

**LONGHORN ARMY
AMMUNITION PLANT
KARNACK, TEXAS**

**ADMINISTRATIVE
RECORD**

Volume 30

2018

Bate Stamp Numbers

00882116 – 00883535

Prepared for

**Department of the Army
Longhorn Army Ammunition Plant**

1976 – 2018

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

VOLUME 30

2018

- A. Title: Letter – Letter to Regulator (TCEQ) – Draft April 2018 Explanation of Significant Differences, LHAAP-35A (58), Shops Area, Group 4, Record of Decision dated September 2010
Author(s): Department of the Army
Recipient: Texas Commission on Environmental Quality
Date: April 5, 2018
Bate Stamp: 00882116 – 00882116
- B. Title: Letter – Letter to Regulator (EPA) – Draft April 2018 Explanation of Significant Differences, LHAAP-35A (58), Shops Area, Group 4, Record of Decision dated September 2010
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: April 5, 2018
Bate Stamp: 00882117 – 00882117
- C. Title: Letter – Letter to Regulator (TCEQ) – April 2018 Draft Final Revision 1, Record of Decision, LHAAP-03, Former Waste Collection Pad, Building 722-P Paint Shop
Author(s): Department of the Army
Recipient: Texas Commission on Environmental Quality
Date: April 5, 2018
Bate Stamp: 00882118 – 00882119
- D. Title: Letter – Letter to Regulator (EPA) – April 2018 Draft Final Revision 1, Record of Decision, LHAAP-03, Former Waste Collection Pad, Building 722-P Paint Shop
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: April 5, 2018
Bate Stamp: 00882120 – 00882121
- E. Title: Report – Draft Final Remedial Action Work Plan, LHAAP-16 Landfill, Final Record of Decision September 2016
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: June 20, 2018
Bate Stamp: 00882122 – 00882260

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

VOLUME 30 (cont'd)

2018

- F. Title: Minutes – Final Minutes, Monthly Manager's Meeting (MMM), May 17, 2018
Author(s): Department of the Army
Recipient: All Parties
Date: June 21, 2018
Bate Stamp: 00882261 – 00882272
- G. Title: Report – Amendment of Class V Injection Well Inventory, Class V No. 5X2600464, Site LHAAP-16/LHAAP-18/24
Author(s): Texas Commission on Environmental Quality
Recipient: Texas Commission on Environmental Quality
Date: June 22, 2018
Bate Stamp: 00882273 – 00882513
- H. Title: Minutes – Final Minutes, Quarterly Restoration Advisory Board (RAB) Meeting, April 19, 2018
Author(s): Department of the Army
Recipient: All Parties
Date: July 21, 2018
Bate Stamp: 00882514 – 00882549
- I. Title: Minutes – Final Minutes, Monthly Manager's Meeting (MMM), June 19, 2018
Author(s): Department of the Army
Recipient: All Parties
Date: July 23, 2018
Bate Stamp: 00882550 – 00882565
- J. Title: Report – Draft Final, Remedial Action Work Plan, LHAAP-16 Landfill
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: July 24, 2018
Bate Stamp: 00882566 – 00882704
- K. Title: Report – Draft Quarterly Evaluation Report 1st Quarter (January-March) 2018 Groundwater Treatment Plant
Author(s): Department of the Army
Recipient: Environmental Protection Agency
Date: July 27, 2018
Bate Stamp: 00882705 – 00883535



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

April 5, 2018

DAIM-ODB-LO

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

Re: Draft April 2018 Explanation of Significant Differences
 LHAAP-35A(58), Shops Area, Group 4, Record of Decision dated September 2010
 Longhorn Army Ammunition Plant, Karnack, Texas

Dear Ms. Palmie,

One hard copy (HC) and compact disc (CD) of the above-referenced document is being transmitted to you for review. Review comments are requested by May 7, 2018.

The document was prepared by Aptim Federal Services, LLC (APTIM) (part of the 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,

A handwritten signature in cursive script that reads "Rose M. Zeiler".

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

Copies furnished:

R. Mayer, USEPA, Region 6, Dallas, TX (letter only)
 P. Bruckwicki, Caddo Lake NWR, TX (1 HC, 1 CD)
 R. Smith, USACE, Tulsa District, OK (letter only)
 A. Williams, USACE, Tulsa District, OK (1 CD)
 N. Smith, USAEC, San Antonio, TX (1 CD)
 K. Nemmers, Bhate, Lakewood, CO (for project files) (1 HC, 1 CD)
 P. Srivastav, APTIM, Houston, TX



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

April 5, 2018

DAIM-ODB-LO

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

Re: Draft April 2018 Explanation of Significant Differences
LHAAP-35A(58), Shops Area, Group 4, Record of Decision dated September 2010
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 Collection Pad, Building 722-P Paint Shop
 Longhorn Army Ammunition Plant, Karnack, Texas

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June 20, 2018

DAIM-ODB-LO

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

Re: Draft Final Remedial Action Work Plan
 LHAAP-16 Landfill
 Final Record of Decision September 2016
 Longhorn Army Ammunition Plant, Karnack, Texas

Dear Mr. Mayer,

Two hard copies (HC) and two compact discs (CDs) for the above-referenced document are being transmitted to you for your records. The document, which addresses LHAAP-16 groundwater, includes revisions based upon your comments on the Draft received on May 23, 2018. 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 Bhate Environmental Associates, Inc. (Bhate) 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.

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 12100 Park 35 Circle, Bldg D
 Austin, TX 78753

Re: Draft Final Remedial Action Work Plan
 LHAAP-16 Landfill
 Final Record of Decision dated September 2016
 Longhorn Army Ammunition Plant, Karnack, Texas

Dear Ms. Palmie,

One hard copy (HC) and one compact disc (CD) for the above-referenced document are being transmitted to you for your records. The document, which addresses LHAAP-16 groundwater, includes revisions based upon your comments on the Draft received on March 19, 2018 and your concurrence to Army responses on May 14, 2018. 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 Bhate Environmental Associates, Inc. (Bhate) 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.

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**Response to Comments on
Draft Remedial Action Work Plan, LHAAP-16 Landfill
Longhorn Army Ammunition Plant, Karnack Texas**

**Document Date: 28 February 2018
Comments Date: 28 March 2018**

**Reviewer: Mr. Richard Mayer, U.S. Environmental Protection Agency
Respondent: Dr. Rose Zeiler, U.S. Army**

1. Respondent Concur (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/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
1	Minor Editorial Comment	Please include the following acronyms in the acronyms section: Bhate, MEGA, MATC, and O&M. Please remove ECP, HASP, MARC, O ₂ and SOP since these are not used in document. Please define in the text the first use of GWTP (page 3-2), ISEB (Figure 4-1), IWWP (page 4-3), mv (page 4-12), OSWER (page 5-1), and ROI (page 4-7).	C	Concur. Text will be revised accordingly.	A	
2	Page 1-5, Section 1.5, 2nd Paragraph	The text references Figure 2-1 in regards to typical depth of water below land surface. However, EPA could not locate well 16WW24 on the figure and there was no measurement collected on well 16WW42. Please include the data to document the depth to the water below land surface. Please modify text and/or figure.	C	Concur. The reference to 16WW24 will be removed from the text. The text and figures included in Appendix A are from the approved Final RD which did not provide the water elevation readings. A reference to the Remedial Design will be added to the text.	A	
3.	Page 4-4, Monitoring Wells	More than 1 hour should be allowed for the bentonite seal to hydrate before the cement grout is used for the remaining annulus.	C	Concur. The Standard Operating Procedure in the Draft Final Installation Wide Work Plan has been revised to include an additional two hours after the final bentonite lift for the bentonite seal to hydrate before grouting begins. Also, see response to TCEQ's Comment 6.	A	

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
4.	Page 4-3, Section 4.3.2	IWWP reference should be updated to draft 2018 or 2017 as shown in references.	C	Concur. The IWWP reference throughout the RAWP and in the reference section will be updated to the Final IWWP published by Bhate in 2018.	A	
5.	Table 4-9	EPA is hesitant to approve the MNA and LTM wells at this time until the pre-remedy sampling and the year 1 and 2 performance monitoring has been implemented.		Noted. The list of MNA and LTM wells in the RAWP are from the EPA and TCEQ approved Final RD, and therefore, the locations were previously approved.	A	The MNA monitoring system may need to be refined in the future per effects of the various treatments being implemented.
6.	Page 4-13, Surface Water Monitoring	Please ensure that the surface water parameters are measured using a field instrument.	C	Concur. Surface water parameters like DO, pH, ORP, temperature and conductivity will be collected using a field instrument. A new table, Table 4-10 has been added which shows the surface water monitoring plan. Also see the response to TCEQ's Comment 9.	A	Section 4.7.8 should include a sentence mentioning that field parameters will be collected in the stream with a multi-parameter meter. <i>Army Response: The following will be inserted in Section 4.7.8, as the 2nd sentence of the 2nd paragraph:</i> "As part of the surface water sample collection activities, field readings (DO, pH, ORP, temperature, and conductivity) will be collected instream with a multi-parameter meter."
7.	Figure 1-3	In the legend there is a symbol for groundwater wells. Are these considered private home/irrigation wells? Some of these are located on Longhorn. Also, the well by the fire station is not a potable water well as the faucets in the firehouse have non-potable water signs on them.	C	Concur. The wells shown on Figure 1-3 are private wells, wells used for public supply and other wells used specifically by oil and gas companies. We received a comment from TCEQ about Figure 1-3, that the water wells shown on this figure may not be useful for remediation purpose. Figure 1-3 is being revised to remove the water wells, see the response to TCEQ's Comment 11.	A	

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
8.	Figures 2-1 & 2-2	Were the extraction wells running when the groundwater elevation levels were taken?		<p>The extraction was operational at the time of the groundwater elevation readings. Section 1.5, 2nd paragraph, 2nd sentence will be revised as follows:</p> <p>“Shallow groundwater elevation contours based on the last comprehensive groundwater elevations collected at the site when extraction was operational in June 2016 are shown on Figure 2-1 of Appendix A.”</p> <p>Section 1.5, 3rd paragraph, 3rd sentence will be revised as follows:</p> <p>“The intermediate groundwater elevation contours based on the last comprehensive groundwater elevations collected at the site when extraction was operational in June 2016 are shown on Figure 2-2 of Appendix A.”</p>	A	
9.	Table 4-1	Not all the proposed wells for this site are included in this table. Please revise accordingly.	C	Concur. Table 4-1 will be revised to include all the proposed wells.	A	
10.	Table 4-3	EPA recommends adding upper deep monitoring well 16WW20.	D	Do not concur. The Pre-Remedy Sampling table is based on the Table 4-11 of the EPA and TCEQ approved Final RD. Well 16WW20 was not included in the approved Final RD for pre-remedy sampling.	A	EPA missed that deep well planned for sampling while reviewing the document.
11.	Table 4-5	Why are the performance parameters different for well 161W04 vs. well 161W03?		The performance parameters are from Table 4-14 of the approved Final RD approved by TCEQ and EPA. Well 161W04 was not selected as a well for quarterly performance monitoring.	A	

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
12.	Table 4-7	EPA recommends adding well 16WW56 as a monitoring well for performance effectiveness of the Bayou Biobarrier.	D	Do not concur. The list of performance monitoring wells in the RAWP is from the approved Final RD. Well 16WW56 was added as a MNA/LTM well in the Final RD. Wells 16RW12 and 16WW40, downgradient of the Bayou Biobarrier, were selected in the approved Final RD to monitor the effectiveness of the injections.	A	
13.	General Comment	The method for analyzing for perchlorate in groundwater should be 6850. Method 314.0 does not require filtering of the groundwater samples to remove microbes (which can biodegrade the perchlorate). Also, this method historically tends to have more false positive and negative analytical results.	C	Concur. We are aware of the limited ability of Method 314.0 to provide accurate and reliable results for perchlorate. Method 6850 will be used for analysis of perchlorate samples. The tables will be revised to include Method 6850. Method 6850 is included in the IWWP, UFP-QAPP.	A	
14.	General Comment	There should be a table for surface water samples monitoring plan such as Table 4-4 as an example to follow.	C	Concur. The RAWP has been revised to include Table 4-10 which shows the surface water monitoring plan and is attached to the TCEQ's RTCs.	A	
15.	Page 4-12, Section 4.7.5	The text indicates that Figure 4-3 shows locations of wells for monitoring, but the figure is for surface water collection locations. Please revise to Figure 4-2.	C	Concur. Text will be revised to reference Figure 4-2.	A	
16.	Page 4-9; Bullets	EPA assumes that some sort of sonde for DO will be used in the collection of DO readings in the Bayou. It is assumed DO changes throughout the day within the bayou naturally (suggest conducting a 24-hour monitoring with a logger during a sunny day and night to see diurnal effects to determine a baseline). What are the criteria for changes in DO in determining if the Injectate has reached the bayou?		A handheld YSI DO meter (or equivalent) will be used to collect readings from the bayou by placing the probe directly into the bayou. Baseline DO levels in the bayou will be collected prior to the injections into the Bayou Biobarrier. At least three baseline readings will be collected throughout a working day prior to injections. Also, see response to Comment 17. The following will be added to Section 4.6.4, page 4-9, lead in paragraph above the bullets:	A	

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
17.	Page 4-2, Item 4	Please identify where the baseline surface water samples will be collected and what constituents/parameters will be analyzed (in regards to potential injection leakage). EPA recommends moving surface water location 16SW02 more towards the left bend in Harrison Bayou based on where TCE was found in shallow groundwater (see Appendix A, Figure 2-6 and well number 16WW40, 1060 µg/L).		<p>“The field readings will be collected using a hand held field instrument and readings will be recorded on field forms. The probe will be placed in the bayou for a direct reading from the bayou. If the carbon source reaches the bayou, the natural organisms will utilize the carbon and will create anaerobic conditions in the water which may impact aquatic life. If any sudden decrease in DO is observed to below baseline readings or a visual change is observed in the water (murkiness) along the bayou bank, injections will be suspended. Additional monitoring and visual observations will be conducted to determine if the decrease is from injection materials or changes in the environmental conditions. If injections are suspended, corrective actions (placement of aerators and/or hay bales) will be implemented if needed. Once DO has stabilized and no visual confirmation of injection materials into the bayou is confirmed, injections will resume.”</p> <p>Pre-remedy surface water samples will be collected from 16SW01, 16SW02, and 16SW03. Samples will be analyzed for VOCs, perchlorate and metals. Additionally, field measurements (DO, ORP, pH, temperature, and conductivity) will also be collected. The surface water sampling plan is included in a new Table 4-10 (an attachment to TCEQ’s RTCs).</p> <p>The location for 16SW02 was established in the EPA and TCEQ approved Final RD.</p> <p>Text in Section 4.2.1, bullet 4 will be revised as follows:</p> <p>“...as indicated in Tables 4-2 and 4-3. Collect pre-remedy surface water samples from three</p>	A	EPA recommended the alternate location because it was close to the location of observed seeps identified in the past at Harrison Bayou.

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
18.	Figure 4-2	Intermediate wells or potentially even deeper wells may need to be drilled on the east side of the bayou due to the intermediate zone contamination currently on the east side of the bayou at monitoring well 16WW41 at 6,650 µg/L of TCE. There is potential for additional migration to the northeast for the intermediate zone.		locations 16SW01, 16SW02, and 16SW03 for VOCs, perchlorate, metals, and field parameters (DO, pH, ORP, conductivity and temperature) as shown in Table 4-10 . Additionally, baseline field readings from the bayou will be collected at locations near the Bayou Biobarrier at least three times during a work day prior to beginning injection into the Bayou Biobarrier.” Noted. EPA made this similar comment during the RD review indicating that a well might be needed at some point in the future. However, at this time, no plans for an intermediate zone well on the east side of the bayou have been made until additional data is collected as part of the implementation and monitoring of the in situ bioremediation. See below for EPA’s comment 17 from the review of the Remedial Design. “EPA agrees with the additional shallow wells proposed by TCEQ shown on revised Figure 4-1. Also, EPA recognizes there may be a need for additional intermediate groundwater monitoring wells in the future, especially in the outer eastern reaches of the plume.”	A	Evaluation of the data obtained during and after the implemented treatments should provide insight for any future actions.
19.	General Comment	When was the last time that the Upper Deep and Lower Deep groundwater monitoring wells have been sampled at the site?		The upper deep and lower deep groundwater monitoring wells were last sampled in May 2013.	A	
20.	General Comment	Please identify the monitoring wells in a Table that are above the MCL for the metal COCs for this site.	C	Concur. The metals information will be added as part of the nature and extent of contamination at the site. A new Table 1-2 (attached) will be added and a new paragraph in Section 1.4 will be added as follows: “Metals have been detected in the shallow, intermediate, upper deep, and deep wells. Table 1-2 summarizes the wells that have had concentrations above the metal cleanup levels	A	Please provide the scheduled or projected dates for the samples on Table 1-2. Army Response: The next five-year review sampling is expected to occur in 2018, and the Army will inform EPA and TCEQ approximately three weeks prior to the commencement of the

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
				<p>indicated in Table 1-1. Table 1-2 includes both the maximum concentration above the cleanup level as well as the most recent date when concentrations were above the cleanup levels. The metals are detected in a few wells and do not indicate widespread metal contamination.”</p> <p>Additionally to address groundwater monitoring, a new section will be added as follows:</p> <p>“Section 4.8 Metals Groundwater Monitoring</p> <p>The selected remedy in the ROD indicates monitoring for metals will be evaluated at the first five year review to determine if any further monitoring for metals is warranted (U.S. Army 2016). Table 1-2 provides a summary of the wells that were sampled for the metals COCs and had detected concentrations above the cleanup levels. As part of the next five year review after remedy implementation, groundwater samples will be collected. All the wells listed on Table 1-2 will be analyzed for thallium. Selected wells listed in Table 1-2 will be analyzed for the remaining metal COCs (chromium, arsenic, nickel and/or manganese) based on the previous results. The sampling will be conducted using low flow sampling as described in Section 3.4 of the IWWP (Bhate 2018). The monitoring results and evaluation will be included in the next five year review report.”</p>		<p>groundwater sampling for metals at LHAAP-16.</p>
21.	General Comment	<p>Tables 3-2, 3-4, 3-6, 3-8, 3-10, and 3-11 refer to SDC-9TM 1x1011. The meaning of 1x1011 in this context is not clear. Please clarify.</p>		<p>The unit for this measurement is <i>Dehalococoides</i> organisms/liter. The units will be added to the tables.</p>		
22.	General Comment	<p>Please add Shaw, 2007 (Table 1-1) reference to the reference section.</p>	C	<p>Concur. Reference as noted on the table will be added to the reference section.</p>		

Notes:

For an additional revision to Section 3.1.2, please see the response to TCEQ's Comment No. 3.

For an additional revision to Section 4.5.2.2, please refer to Army Comment on TCEQ's Comment No. 7.

TCEQ Comments on Draft Remedial Action Work Plan, LHAAP-16

TCEQ Project Manager: April Palmie

Document date: February 28, 2018

Comment date: March 19, 2018

Comment Ref. #	Section, Page Ref.	TCEQ Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
1.	3.1, 3-2	In this sentence, replace "and" with "however" The Final RD specified KB-1 and an equivalent culture, SDC-9TM will be used in place of KB-1.	C	Text will be revised accordingly.		
2.	3.1.1, 3-2	First sentence, remove "(" before direct-push	C	Text will be revised accordingly.		
3.	3.1.2, 3-2	First sentence, remove ")" after EDS-ER	C	Text will be revised accordingly. Additionally the 2 nd and 3 rd sentences of Section 3.1.2 will be replaced with the following: "Before any of the pilot test wells are used for injections, they will be redeveloped prior to use as injection wells for Landfill Biobarrier #2, and no slug tests will be performed."		
4.	4.1.2, 4-1	Notice - TCEQ needs 30-days for UIC coordination	C	Noted.		
5.	4.0 all sections	When relevant, please reference the SOPs (especially sections in 4.3 and 4.4	C	Please refer to Response to comment 6, 7 and 9.		
6.	4.3.3, 4-4	1-hour hydration is not consistent with SOP. Please revise and reference SOP	C	Sentence beginning on the 6 th line of Section 4.3.3 will be replaced as follows: "The bentonite seal will be placed in 1-foot lifts each hydrated for 30 minutes. After placement of the final bentonite lift, the		

Comment Ref. #	Section, Page Ref.	TCEO Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
7.	4.4, 4-4	Reference SOPs	C	<p>bentonite seal will be saturated with potable water and allowed to hydrate for an additional two hours before grouting begins (IWWP, Section 3.2 and SOP A7.3.6)".</p> <p>Several references will be added as follows:</p> <p>Section 4.1.3 first sentence will be revised as follows: " Utility location and clearance for intrusive activities will be conducted (in accordance with Section 3.1 of the IWWP) prior to drilling as follows:"</p> <p>Section 4.3.2 will be revised as follows: "All injection wells will be constructed of 2-inch schedule 40 polyvinyl chloride (PVC) with a 10-foot 0.010 slot PVC screen at the bottom. The wells will be screened over the target intervals as shown in Table 4-1. Injection wells (six) installed in the intermediate groundwater zone will require a minimum of 6-inch diameter Schedule 40 PVC isolation casing to approximately 35 feet. Injection wells will be constructed to the required specification for isolation casing, surface completion, prevention of commingling and confinement of undesirable groundwater to its zone of origin in accordance with Section 3.2 of the IWWP (Bhate, 2018). Please refer to Standard Operating Procedure (SOP) A7-Monitoring Well Installation in Appendix A of the IWWP for additional guidance on well installation."</p>		

Comment Ref. #	Section, Page Ref.	TCEO Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
				<p>Section 4.3.3 will have the following added at the end of the section: "...from the biobarriers for performance monitoring. Wells will be installed in accordance with Section 3.2 of the IWWP (Bhate, 2018). Please refer to Standard Operating Procedure (SOP) A7-Monitoring Well Installation in Appendix A of the IWWP for additional guidance on well installation."</p> <p>Section 4.3.4 will have the following added to the end of the section: "... for injection will be redeveloped. Well development will be conducted in accordance with Section 3.2.2 of the IWWP (Bhate, 2018). Please refer to SOP-A8-Monitoring Well Development for additional guidance on well development."</p> <p>Section 4.4 first paragraph last sentence will be replaced as follows: "Low-flow groundwater sampling will be performed in accordance with Section 3.4 of the IWWP (Bhate, 2018). Procedures for purging and sampling the wells are detailed in SOP A10-Low Stress Groundwater sampling in Appendix A of the IWWP. During the performance monitoring events, surface water samples will be collected concurrently if water is flowing in the creek. Surface water samples will be collected in accordance with Section 3.6 of the IWWP (Bhate, 2018). Please refer to SOP A11 - Surface Water Sampling in Appendix A of</p>		

Comment Ref. #	Section, Page Ref.	TCEQ Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
8.	4.6.2, 4-8	Top of page, in this sentence remove "are" The injection volumes are and amendment mixture quantities (total and per point) are shown on Table 3-4.	C	the IWWP for detailed guidance regarding surface water sampling." Section 4.6 will have the following sentence added: "In situ injection activities will be conducted in accordance with Section 3.10 of the IWWP (Bhate, 2018)." Note Additional Army Change: Additionally, text in Section 4.5.2.2 will be revised to include a top down and/or bottom up approach for injections depending on field conditions and lithology. At LHAAP-58, the amendments were injected successfully using a bottom up approach. Text in Section 4.5.2.2, first paragraph, line 2 will be revised as follows: ". . the entire target interval using a top down or bottom up approach depending on the lithology and field conditions."		
9.	4.7.8 and 4.7.9, 4-13	Reference SOPs	C	Text will be revised accordingly. Section 4.7.8, 2 nd paragraph, 2 nd sentence will be revised as follows: "Surface water samples will be collected in accordance with Section 3.6 of the IWWP (Bhate, 2018). Please refer to SOP A11-Surface Water Sampling in Appendix A of the		

Comment Ref. #	Section, Page Ref.	TCEO Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
10.	5.1.1, 5-2	The second line of evidence sentence should reference TRRP	C	IWWP for detailed guidance regarding surface water sampling." Additionally, a new Table 4-10 will be added to include the surface water monitoring plan and is attached to these response to comments (RTCs). Section 4.7.8, 2 nd paragraph, 3 rd line, will be revised as follows: "... these surface water samples will be analyzed for the COCs as shown in Table 4-10 and concentrations will be compared to clean up levels listed in Table 1-1."		
11.	Figure 1-3	Do the private, public, and installation water wells need to be displayed on this figure? This information is helpful at remedial investigation and remedy selection phases, but not really needed for the remedial action.	C	Figure 1-3 will be revised to remove the water wells shown on the figure.		
12.	Figure 1-4	Western corner of landfill, wells 16WW05 and 06 are mislabeled. Wells 16WW44 and 45 should be added to this figure (and other relevant figures)	C	Figure 1-4 will be revised to show and label wells correctly.		

Comment Ref. #	Section, Page Ref.	TCEQ Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
13.	Figure 3-1	Wells 16WW44 and 45 should be added to this figure (and other relevant figures) These data points are also missing from figure: 16RW07, 16IW04, 16IW09, and 16EW08	C	Figure 3-1 will be revised to show the missing wells.		
14.	Figure 3-3	16IW04 is mislabeled (16IW-4)	C	Figure 3-3 will be revised to correct the mislabeling.		
15.	Figure 4-2	It would be better to have all permanent wells on this figure. Would it be possible to turn on the other wells? The MNA and LTM wells could be shaded/highlighted OR the wells not being used could be faded out. It would also be helpful to have the biobarrier lines drawn for reference (without details)	C	Figure 4-2 has been revised accordingly and is attached to the RTCs.		

Included attachments to the responses:

Table 4-10

Figure 4-2



Draft Final
**Remedial Action Work Plan,
LHAAP-16 Landfill**
Longhorn Army Ammunition Plant
Karnack, Texas



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Acronyms and Abbreviations

APTIM	Aptim Federal Services, LLC
bgs	below ground surface
Bhate	Bhate Environmental, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
cm/sec	centimeters per second
COC	contaminants of concern
CVOC	chlorinated volatile organic compound
DCA	dichloroethane
DCE	dichloroethene
DO	dissolved oxygen
DPT	direct-push technology
EDS-ER™	electron donor solution-extended release
ERS	Environmental Remediation Services
ESD	Explanation of Significant Difference
ESTCP	Environmental Security Technology Certification Program
EVO	emulsified vegetable oil
GPS	global positioning system
GW-Ind	groundwater medium-specific concentration for industrial use
GWTP	groundwater treatment plant
IRA	interim remedial action
ISB	in situ bioremediation
IWWP	Installation-Wide Work Plan
Jacobs	Jacobs Engineering Group, Inc.
LHAAP	Longhorn Army Ammunition Plant
LOE	lines of evidence
LTM	long-term monitoring
LUC	land use controls
MATOC	Multiple Award Task Order Contract
MC	methylene chloride
MEGA	Multiple Environmental Government Acquisition
mg/L	milligrams per liter
MMRP	Military Munitions and Response Program
MNA	monitored natural attenuation
mV	millivolts
O&M	operation and maintenance
OHM	OHM Remediation Services Corporation
ORP	oxidation-reduction potential

Acronyms and Abbreviations *(continued)*

OSWER	Office of Solid Waste and Emergency Response
PoP	period of performance
PVC	polyvinyl chloride
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
ROI	radius of influence
SDC-9™	APTIM's dechlorinating culture
Shaw	Shaw Environmental & Infrastructure, Inc.
SOP	standard operating procedure
TAC	Texas Administrative Code
TCA	trichloroethane
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound
ZVI	zero valent iron

REMEDIAL ACTION WORK PLAN, LHAAP-16 LANDFILL

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 (MEGA) National Small Business Multiple Award Task Order Contract (MATOC) Environmental Remediation Services (ERS) with Military Munitions Response Program (MMRP), Task Order No. W9128BV17F0150 to conduct environmental restoration of LHAAP-16 at Longhorn Army Ammunition Plant (LHAAP). The Bhate Team is comprised of Bhate and Aptim Federal Services, LLC (APTIM). APTIM is conducting the Remedial Action (RA) for LHAAP-16. LHAAP is an inactive, government owned formerly contractor operated and maintained department of Defense facility located central east Texas (**Figure 1-1**). This work plan describes the planned (RA) to address risks associated with contaminated groundwater at the LHAAP-16 landfill. This Remedial Action Work Plan (RAWP) has been developed using the basis and details of the Remedial Design (RD) for LHAAP-16, which was approved by the regulatory agencies in January 2017 (U.S. Army 2017).

1.1 Organization of Work Plan

This work plan is composed of the following sections:

- **Section 1.0:** “Introduction” summarizes the site background, proposed remedy including the contaminants of concern (COCs) and their respective cleanup levels, the nature and extent of contamination and remedial action objectives (RAOs).
- **Section 2.0:** “Land Use Control Plan” describes the proposed scope of work including the implementation activities associated with the land use control (LUC) component of the remedy.
- **Section 3.0:** “In Situ Bioremediation (ISB)” describes the injection activities associated with enhanced in situ bioremediation component of the remedy.
- **Section 4.0:** “Field Preparation and Activities” describes the activities that will be performed prior to the start of fieldwork and the methods that will be followed to complete fieldwork.
- **Section 5.0:** “Remedy Performance Evaluation and Reporting” describes the reports that will be submitted post ISB injections.
- **Section 6.0:** “Schedule” describes the proposed implementation schedule for the RA activities.

- **Section 7.0:** “Operation and Maintenance Procedures” describe the operation and maintenance (O&M) activities and other routine activities that form part of the final remedy.
- **Section 8.0:** “References” provides a list of references cited in the document.

This work plan also includes the following appendices supporting the main text:

- **Appendix A** includes the potentiometric maps and the plume contour maps from the Final RD.
- **Appendix B** includes the sample Annual Land Use Control Compliance Certification and Documentation.
- **Appendix C** includes the Safety Data Sheets for various commercially available emulsified vegetable oil (EVO) products, APTIM’s dechlorinating microbial culture (SDC-9™).
- **Appendix D** includes the procedure provided by the vendor (Redox Tech) to mix the ABC Plus amendment mixture.
- **Appendix E** includes a blank injection log that will be used in the field to track injection volumes, flow rates and pressures.
- **Appendix F** includes the landfill inspection and maintenance checklist.

1.2 Site Description

LHAAP-16 is a capped landfill covering approximately 20 acres in the south-central portion of the former LHAAP (**Figure 1-2**). Harrison Bayou is located along the northeastern edge of the site and flows into Caddo Lake, northeast of the site (**Figure 1-3**). The landfill, which covered approximately 13 acres prior to cap construction, was established in the 1940s for the disposal of solid and industrial wastes, until the 1980s, when disposal activities were terminated.

The U.S. Army and the U.S. Environmental Protection Agency (USEPA) signed a Record of Decision (ROD) and the Texas Water Commission concurred in 1995 approving an interim remedial action (IRA) for LHAAP-16 to mitigate potential risks posed by buried source material at the site. The IRA included the construction of a landfill cap, which is considered a component of the final remedy for the site. Construction of the multilayer cap was completed in 1998. The ROD also specified that the U.S. Army would be required to “perform long-term maintenance of the cap.” LUCs, such as future use restrictions, would also be required.

Previous investigations identified groundwater impacted with chlorinated volatile organic compounds (CVOCs), perchlorate, and metals at LHAAP-16 (U.S. Army 2016). **Figure 1-4** shows the existing groundwater monitoring system and the approximate lateral extent of perchlorate and trichloroethene (TCE) in the Shallow Zone and Intermediate Zone groundwater, based on the last comprehensive groundwater sampling event performed in May 2013 (U.S. Army 2017). The source of this impacted groundwater is the landfill, although the metals were only detected at elevated concentrations sporadically, and do not appear to reflect widespread contamination from the landfill. A groundwater extraction system was voluntarily installed by the U.S. Army in 1996 and 1997 as a treatability study to prevent the groundwater plume from migrating to Harrison Bayou. The extraction system was shut down in August 2012 due to operational issues including damage to the power feed to the system, but operation was restored in November 2012 and the extraction system has been operational since that time.

The Final ROD for LHAAP-16 was issued in September 2016; and documents the final selected remedy for the site; including impacted groundwater (U.S. Army 2016). The Final RD was issued in January 2017; and presents the RD, inspection and maintenance requirements, and LUC requirements, associated with LHAAP-16.

1.3 Planned Remedial Action

The planned RA at LHAAP-16 is comprised of several elements as outlined in the RD (U.S. Army 2017):

- Maintenance of the existing landfill cap to preserve its integrity and minimize or prevent infiltration through the landfill.
- Installation of two biobarriers in the shallow groundwater, one located adjacent to the landfill, and the other located near Harrison Bayou.
- ISB in the most contaminated portion of the shallow and intermediate groundwater zones in conjunction with phased shut down of the existing groundwater extraction system.
- Monitored natural attenuation (MNA) of both the shallow and intermediate groundwater zones to ensure continued degradation of CVOCs, perchlorate and daughter products and that surface water in Harrison Bayou is not adversely affected by groundwater such that it fails to meet surface water standards for CVOCs, perchlorate and daughter products. MNA includes:
 - Evaluation of MNA based on performance objectives after 2 years quarterly monitoring
 - Reapplication of bio-amendments if MNA is found to be ineffective

- Long-term monitoring (LTM) semiannually for 3 years, then annually thereafter until recommended otherwise by the five-year review. LTM will not be initiated until MNA performance monitoring establishes the effectiveness of MNA.
- LUCs to prohibit access to the contaminated groundwater except for environmental monitoring and testing only.
- LUCs to preserve the integrity of the landfill cap, and to restrict intrusive activities (e.g., digging) that would degrade or alter the cap.
- LUCs to restrict land use to nonresidential.
- LUCs to maintain the integrity of any current or future remedial or monitoring systems.

1.4 Nature and Extent of Contamination

The contaminated media at LHAAP-16 includes buried source material (landfill waste under the cap) and the shallow and intermediate groundwater beneath and downgradient of the landfill. The IRA implemented in 1996 through 1998, included placement of a multilayer cap at LHAAP-16 mitigating potential risks posed by buried landfill waste. The cap prevents rainfall from infiltrating and leaching contaminants from principal threat wastes within the landfill. However, groundwater in contact with the buried waste material still provides a mechanism for transportation of COCs away from the landfill (Jacobs 2000). A groundwater extraction system was installed as a treatability study to prevent the groundwater plume from migrating to Harrison Bayou (OHM 1998).

The groundwater COCs for LHAAP-16 identified in the Final ROD (U.S. Army 2016) include CVOCs (TCE; cis-1,2-dichloroethene [DCE]; 1,1-DCE; 1,2-dichloroethane [DCA]; vinyl chloride [VC]; 1,1,2-trichloroethane [TCA], and methylene chloride [MC]), perchlorate, and metals (arsenic, chromium, manganese, nickel and thallium) in the shallow and/or intermediate groundwater. As established in the ROD, groundwater and surface water cleanup levels (U.S. Army 2016) are presented in **Table 1-1**.

The isoconcentration contours for major CVOCs, and perchlorate, in Shallow Zone and Intermediate Zone groundwater based on the last comprehensive round of groundwater sampling conducted in May 2013 are included as in the Final RD (U.S. Army 2017) and are included in **Appendix A (Figures 2-4 through 2-7)** of this work plan. Five metals (arsenic, chromium, manganese, nickel, and thallium) had sporadic elevated detections in 2009 and were retained as COCs in shallow and/or intermediate groundwater in the Final ROD. The detected metals do not appear to be associated with widespread contamination from the landfill.

Data collected from the upper deep groundwater zone from 1998 until 2008 indicate that no COCs were reported at concentrations exceeding their respective cleanup levels (**Table 1-1**). In addition, the data collected from deep groundwater from 1997 until 2004 indicate that no COCs were reported at concentrations exceeding their respective cleanup levels (Shaw 2010).

Metals have been detected in the shallow, intermediate, upper deep, and deep wells. **Table 1-2** summarizes the wells that have had concentrations above the metal cleanup levels indicated in **Table 1-1**. **Table 1-2** includes both the maximum concentration above the cleanup level as well as the most recent date when concentrations were above the cleanup levels. The metals are detected in a few wells and do not indicate widespread metal contamination.

1.5 Geology and Hydrogeology

The surface soil at LHAAP-16 consists of fine sandy loam. The subsurface is composed of medium plastic sandy silt, fine sands, and clay. The clay layers tend to separate the groundwater into shallow, intermediate, upper deep and deep zones.

The shallow groundwater zone varies in thickness from nine to 18 feet below ground surface (bgs). Shallow groundwater elevation contours based on the last comprehensive groundwater elevations collected at the site when extraction was operational in June 2016 are shown on Figure 2-1 of **Appendix A**. Depth to groundwater in the shallow zone is approximately 4 feet to 25 feet bgs (U.S. Army 2017).

An intermediate groundwater zone containing fewer fines than the shallow zone extends from 35 to 62 feet bgs. The intermediate groundwater elevation contours based on the last comprehensive groundwater elevations collected at the site when extraction was operational in June 2016 are shown on Figure 2-2 of **Appendix A**. The upper deep groundwater zone extends from approximately 80 to 151 feet bgs. The lower deep groundwater zone extends below 220 feet bgs (U.S. Army 2017). While flow is primarily horizontal in these zones, vertical interaction between the shallow and intermediate zones is evidenced by pumping test results as well as the presence of contamination in both zones. Such interconnection is consistent with soil layers formed in fluvial depositional environments.

The groundwater flow direction is northeast toward Harrison Bayou in the shallow, intermediate and deep zones, while flow direction is southeast toward Harrison Bayou in the upper deep groundwater zone. Overall, the groundwater flow is toward Caddo Lake. The mean hydraulic conductivity value varies from 1.5×10^{-3} centimeters per second (cm/sec) in the Shallow Zone to 4.2×10^{-4} cm/sec in the Deep Zone (Jacobs 2002). Groundwater flow between the landfill and Harrison Bayou is also influenced by the presence of an extraction well system consisting of four wells in the shallow groundwater zone and four wells in the intermediate groundwater zone.

1.6 Remedial Action Objectives

The RAOs developed for LHAAP-16 and outlined in the LHAAP-16 ROD (U.S. Army 2016) are:

- Protection of human health and the environment by preventing exposure to landfill contents
- Protection of human health and the environment by reducing leaching and migration of landfill hazardous substances into the groundwater
- Protection of human health by preventing human exposure to the contaminated groundwater
- Protection of human health and the environment by preventing COCs and COC-by-products from migrating into Harrison Bayou at levels that cause surface water in Harrison Bayou to exceed surface water criteria
- Return of groundwater to its potential beneficial uses as drinking water, wherever practicable

2.0 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. The following section provides details for the LUC component of the RA.

2.1 Land Use Controls Implementation

The actions required to implement the land use controls (LUCs) for LHAAP-16 are described below. The first of these, the initial notice of LUCs, has been completed. A figure depicting the preliminary LUC boundaries is presented in Figure 3-1 of **Appendix A**. The following actions will be undertaken to implement the LUCs for LHAAP-16:

- Finalize the Boundaries for the LUCs as a part of the RA.
 - Revise the boundaries if necessary. The LUC boundary presented in this RAWP is subject to change, based on COC results from the two proposed wells to be installed on the east side of Harrison Bayou. The final boundaries 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 landfill LUCs (preserve the integrity of the landfill cap, and to restrict intrusive activities (e.g., digging) that would degrade or alter the cap); 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 new data has been completed and revised if necessary.
 - Survey the LUC Boundaries. The boundaries will be finalized after concurrence by USEPA and the Texas Commission on Environmental Quality (TCEQ), and the LUC boundaries 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 Texas Administrative Code (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.

The elements of the LUC Plan for LHAAP-16 included in Section 5.2 and 5.3 of the Final RD will be presented in the Response Action Completion Report (RACR) as the LUC Plan. Implementation of the LUC Plan includes annual inspections which are recorded on the Annual Inspection Form included in **Appendix B**.

2.2 Comprehensive Land Use Control Management Plan

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-16.

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-16. The Comprehensive LUC Management Plan consists of LHAAP RD documents and a survey plat showing the locations where the LUC being implemented at LHAAP is applied. The purpose of this Comprehensive LUC Management Plan is to ensure the site-specific LUC is compiled into one comprehensive document for both pre-transfer use by the installation and for post-transfer use by the transferee. This document has been provided to the USEPA and the TCEQ and is accessible to the public through LHAAP's Administrative Record.

3.0 IN SITU BIOREMEDIATION (PROPOSED REMEDIATION PLAN)

ISB will be conducted at LHAAP-16 to remediate groundwater impacted with volatile organic compounds (VOCs) and perchlorate. The injection locations at LHAAP-16 are shown in **Figure 3-1**. As described in the RD, the following ISB systems will be implemented to treat the VOC and perchlorate impacted groundwater:

- Three Landfill Biobarriers (Landfill Biobarrier #1, Landfill Biobarrier #2, Landfill Biobarrier #3) in the shallow groundwater zone adjacent to the landfill
- One Bayou Biobarrier in the shallow groundwater zone near Harrison Bayou
- A biogrid in the shallow groundwater zone and a biobarrier in the intermediate groundwater zone in the Mid Plume Area

The plume geometry and proposed injections have been developed using the basis and details of the Final RD (U.S. Army 2017). Overall, the implementation of biobarriers and biogrid will involve the injection of an electron donor and a microbial consortium capable of biodegrading primary VOCs and perchlorate.

The primary biodegradation pathway for chlorinated ethenes, such as tetrachloroethene and TCE, is reductive dechlorination, which occurs under highly reducing anaerobic conditions. During reductive dechlorination, chlorinated ethenes are used as respiratory substrates instead of oxygen by the anaerobic microorganisms that reduce these compounds to harmless by-products. Favorable aquifer conditions are established and/or maintained by adding a carbon source, such as EVO, to act as an electron donor. Details of the RA for each of the systems are described in the following sections.

3.1 Landfill Biobarriers

Three landfill biobarriers will be installed to control the migration of VOCs and perchlorate in shallow groundwater immediately downgradient of the landfill. The location of the barriers is designed to fully intercept the plume of chlorinated VOCs and perchlorate from the landfill in the shallow groundwater zone above their respective cleanup levels (**Figures 3-2, 3-3, and 3-4**). The substrate selected was EVO and therefore, replenishment would not be required for 3 to 5 years (U.S. Army 2017). The Safety Data Sheets for various commercial available EVO formulations are included in **Appendix C**. As specified in the RD, the specific formulation of EVO proposed for this project is electron donor solution-extended release (EDS-ER™). An equivalent EVO product will be used if EDS-ER™ becomes unavailable in the market. EDS-ER™ is a water mixable oil formulated with at least 92 percent natural seed

oils. EDS-ER™ is provided by the vendor as a water mixable oil that contains no water, and therefore, will be mixed with water in the field. The product mixes easily with water without using high energy mixers. As specified in the Final RD, a microbial bioaugmentation culture will be used. The Final RD specified KB-1, however, an equivalent culture, SDC-9™ will be used in place of KB-1. The Safety Data Sheet for SDC-9™ is included in **Appendix C**. At the three landfill biobarriers, a conservative tracer (sodium bromide) will be used to evaluate the distribution of the substrate as part of the performance monitoring.

3.1.1 Landfill Biobarrier #1

A biobarrier will be installed by injecting an amendment mixture consisting of EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture, SDC-9™ (APTIM's dechlorinating culture), and sodium bromide into eighteen direct-push technology (DPT) points and one injection well, 16IW09 as shown in **Figure 3-2** and listed on **Table 3-1**. **Table 3-2** shows the volume of amendment scheduled for injection at each injection point/well. The pounds of EVO of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army 2017).

3.1.2 Landfill Biobarrier #2

Existing injection wells installed during the Environmental Security Technology Certification Program (ESTCP) study (Geosyntec 2009) will be used to inject EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™) and sodium bromide to create Landfill Biobarrier #2. Before any of the pilot test wells are used for injections, they will be redeveloped prior to use as injection wells for Landfill Biobarrier #2, and no slug tests will be performed. Injections will be conducted in two phases. Phase 1 will use four existing injection wells for injections while extracting from five existing extraction wells to aid in the distribution of amendment crossgradient. The extracted groundwater during the first phase will accumulate in the onsite tank at LHAAP-16.

Phase 2 will use the extracted groundwater collected in the onsite tank. The extracted groundwater will be mixed with the amendment mixture and injected back into the existing five extraction wells.

The injection locations are shown on **Figure 3-3**. **Table 3-3** specifies the number of locations, and **Table 3-4** shows the planned volume of amendment mixture to be injected at every location. The pounds of EDS-ER™ of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army 2017).

3.1.3 Landfill Biobarrier #3

A biobarrier will be installed by injecting an amendment mixture consisting of EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™), and sodium

bromide into seven DPT points and one injection well, 16IW10, as shown in **Figure 3-4** and listed on **Table 3-5**. **Table 3-6** provides the planned volume of amendment mixture to be injected at each injection point/well. The pounds of EVO of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army 2017).

3.2 Bayou Biobarrier

A biobarrier will be installed by injecting an amendment mixture consisting of ABC Plus which consists of EVO with microscale zero valent iron (ZVI), sodium bromide, and bioaugmentation culture (SDC-9™) into thirteen DPT points and one injection well, 16IW20, as shown in **Figure 3-5**. ABC Plus will consist of 3,500 pounds of EVO and 3,500 pounds of microscale ZVI. As stated in the Final RD, the ABC product will be diluted with water to form a solution of approximately 10% by weight before injection. **Table 3-7** specifies the number of locations (DPT points/injection well) that will be used to inject the amendment mixture, and **Table 3-8** provides the planned volume of amendment mixture to be injected at each injection point. The pounds of EVO and iron of the amendment mixture is the same as provided in Final RD (U.S. Army 2017). The Safety Data Sheet for ABC Plus is included in **Appendix C**.

3.3 Mid-Plume Area ISB

Injections in the Mid-Plume area include injections in the shallow and intermediate groundwater aquifers. As specified in the RD, the specific formulation of EVO proposed for this project is EDS-ER™. The Safety Data Sheets for EDS-ER™ are included in **Appendix C**.

3.3.1 Shallow Groundwater

To treat the VOC and perchlorate impacted groundwater in the shallow groundwater aquifer, a biogrid will be installed by injecting EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™) and sodium bromide (tracer) into forty DPT points as shown in **Figure 3-6** and listed on **Table 3-9**. The Final RD also included fluorescein dye (a tracer) for this area. Only sodium bromide will be used as a tracer to indicate distribution of injected amendment. Analytical results for bromide will be used to indicate its presence. Prior to injections, the shallow zone extraction wells will be shut down. **Table 3-10** specifies the volume of amendment mixture to be injected at each injection point. The pounds of EVO of the amendment mixture are the same as provided in Final RD (U.S. Army 2017).

3.3.2 Intermediate Groundwater

To treat the intermediate groundwater zone, a biobarrier will be installed consisting of EDS-ER™ or an equivalent EVO product, nutrient, bioaugmentation culture (SDC-9™), and sodium bromide (tracer) as shown in **Figure 3-7**. The injection will occur in a phased approach. After the initial injection into the six newly installed injection wells, the four existing extraction wells will be used to recirculate the groundwater between injection wells and the

extraction wells until an increase in bromide is detected in the extraction wells. Extracted groundwater will accumulate in the onsite tank. Once bromide is detected above baseline concentrations, the extraction system will be shut down and amendment mixture will be injected into the extraction wells. **Table 3-11** specifies the volume of amendment mixture to be injected at each injection point along with the amendment mixture quantities. The pounds of EDS-ER™ of the amendment mixture are the same as provided in Final RD (U.S. Army 2017). The Safety Data Sheet for various commercial available EVO formulations is included in **Appendix C**.

3.3.3 Sequencing of Injection Areas

The RD calls for injections in the most contaminated portion of the shallow and intermediate groundwater zones in conjunction with phased shut down of the existing groundwater extraction system. Currently, active extraction is ongoing from both the shallow and intermediate groundwater in the vicinity of the mid-plume injection area. The following is the proposed sequencing of the injections and extraction:

- 1) Continue active extraction from the mid-plume area using the existing onsite tank.
- 2) Inject at Bayou Biobarrier. The Bayou Biobarrier will protect contaminants from migrating to the bayou, and injection will occur at the Bayou Biobarrier before shutting down the extraction at the Mid-Plume area to limit any additional migration to the creek from the shutdown of extraction system. Additionally, this area uses the amendment mixture using EVO and microscale ZVI, while the other areas do not use the ZVI in the mixture. While injections are ongoing at Bayou Barrier, the field technicians will build/install recirculation system for the intermediate groundwater for the Mid-Plume area.
- 3) Shut down extraction from the mid-plume shallow and intermediate groundwater and empty the onsite tank by transferring water to the groundwater treatment plant (GWTP) for treatment.
- 4) Inject into the Mid-Plume. Begin injections into the intermediate groundwater and start recirculation of intermediate groundwater using onsite tank. While recirculating in the intermediate aquifer, inject into the shallow groundwater. During injections in the shallow groundwater, the recirculation of the intermediate groundwater and amendments will be checked. Recirculation will continue in the intermediate aquifer until distribution of amendments has occurred. Once recirculation is successful in the intermediate aquifer, the accumulated water and amendments will be reinjected into the intermediate aquifer.
- 5) Inject at Landfill Biobarrier #1. Injections may begin at Biobarrier #1 while recirculation may be continuing in the Mid-Plume intermediate groundwater.

- 6) Inject at Landfill Biobarrier #2/#3. There are extraction wells at Landfill Biobarrier #2, but they are not currently connected to the existing onsite tank. The initial injections will begin at Landfill Biobarrier #3 while the piping/connections at extraction wells at Landfill Biobarrier #2 are being prepared to be connected to the mixing tank. Once the injections are complete at Biobarrier #3, the injections will be completed at Biobarrier #2. The accumulated water from extraction of the Landfill Biobarrier #2 wells will accumulate in the mixing tank until amendments are added and reinjected into the extraction wells at Landfill Biobarrier #2.

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4.0 FIELD PREPARATION AND ACTIVITIES

This section discusses the field preparation and field methods that will be utilized to complete the scope of work under the RA.

4.1 Pre-Mobilization Activities

4.1.1 Permitting

No permitting is required prior to the commencement of fieldwork.

4.1.2 Notification

TCEQ and USEPA will be notified two weeks in advance of commencement of fieldwork activities.

4.1.3 Utility Clearance

Utility location and clearance for intrusive activities will be conducted (in accordance with Section 3.1 of the Installation-Wide Work Plan [IWWP]) prior to drilling as follows:

The site health and safety officer will:

- Prepare a map indicating the area(s) where intrusive activity is planned to occur.
- Perform the necessary reviews.
- Contact the Texas Excavation Safety System, Inc. utility notification service by calling 811 or 800-892-0123. This notification is to be made a minimum of two working days prior to the initiation of intrusive activity (excluding Saturdays, Sundays, and holidays), but not greater than 14 days.
- Verify that all underground installations have been located, physically marked, and then noted on the map. If needed, a third-party location service will be used.
- Mark all overhead utilities with kilovolts rating on the map.
- Notify the appropriate agencies, contracting officer's representative, and property owners (when applicable). Confirm utility clearance is complete and document.
- A safety meeting shall be held and a job safety analysis shall be completed by all personnel who are involved in the intrusive activities prior to initiating work.

4.2 Site Activities

A RACR will be submitted to document site activities completed to implement the RA. Site activities in chronological order will be as follows

4.2.1 Pre-Injection Activities

1. Install injection and monitoring wells as indicated in **Table 4-1**. Wells will be installed by a licensed Texas driller and oversight provided by an APTIM geologist.
2. Collect soil cuttings from wells in drums and sample for waste characterization.
3. Conduct slug tests for existing pilot test wells that are proposed for injections in the vicinity of Landfill Biobarrier #2, and redevelop wells if necessary.
4. Collect baseline (pre-remedy) readings and samples from existing monitoring wells as indicated in **Tables 4-2** and **4-3**. Collect pre-remedy surface water samples from three locations: 16SW01, 16SW02, and 16SW03 for VOCs, perchlorate, metals, and field parameters (dissolved oxygen [DO], pH, oxidation-reduction potential (ORP), conductivity, and temperature) as shown in **Table 4-10**. Additionally, baseline field readings from the bayou will be collected at locations near the Bayou Biobarrier at least three times during a work day prior to beginning injection into the Bayou Biobarrier. In the event that a release of amendment mixture is suspected to the surface water, a surface water sample will be collected and the results compared to the baseline surface water sample results.
5. Survey the newly installed monitoring and injection wells.
6. Dispose of soil cuttings based on waste characterization analysis.
7. Review soil boring and well completion logs from the well installation event and ones included in the Final RD.
8. Review data from new wells and adjust any amendment quantities if needed if contamination is higher than expected.

4.2.2 Injection Activities

1. Mobilize materials, equipment, mixing tanks, and labor for injections.
2. Set up traffic detouring as needed.
3. Layout of injection arrays and clear DPT injection points. Please refer to **Section 3.3.3** for the sequence of biobarriers.
4. Core concrete/asphalt at injection points, if needed, and adjust any points if obstructions are found.
5. Setup amendment, equipment, and materials onsite including materials for recirculation from Mid-Plume intermediate groundwater and Landfill Biobarrier #2 extraction.

6. Begin preparing amendment solution for injection a day before planned injections. Preparation of amendment solution will be a continual activity.
7. Inject amendments following the sequencing as outlined in **Section 3.3.3** using:
 - DPT rig to push down to required depth and inject amendment through probe rod. No soil cuttings will be generated using DPT, or
 - Injection system to inject amendment into previously installed injection/extraction wells. Recirculate where required.
8. During injections continuously monitor for surfacing near the injection locations; for the Bayou Biobarrier, the creek will also be monitored during injections. Monitor pressure, volume, and flow into each injection point (DPT or well) by observing the gauges on the injection system. Record the injection interval during injections. Record injection information on the injection log in **Appendix E**. During active injection, the system will be continuously monitored by designated personnel.
9. Once injection is complete at a DPT injection point, abandon point.
10. Record DPT injection point locations with global positioning system (GPS).
11. Once injections and recirculation is complete, decontaminate and demobilize equipment, materials, and mixing tank.
12. Restore site and demobilize personnel.

4.2.3 Post Injection Activities

After injections, performance monitoring will be conducted followed by MNA monitoring. Landfill operations and maintenance will be ongoing.

4.3 Drilling and Well Installation

Drilling and well installation will utilize both DPT rigs and hollow stem auger rigs. DPT rigs are used for in situ injections through a probe. The hollow stem auger rigs will be used for the installation of wells. A total of nine injection wells and eighteen monitoring wells will be installed at LHAAP-16 using an auger rig rotary sonic drilling technique as shown in **Table 4-1**. All drilling and well installation activities will be supervised by a Texas-registered geologist.

4.3.1 DPT Drilling

A DPT rig will be used to install the DPT points for the biobarriers. A total of 79 points will be installed using a DPT rig between the landfill and Harrison Bayou. DPT drilling will be conducted in accordance with the procedures presented in the IWWP (Bhate 2018). Each DPT point will be abandoned by filling with grout after injections are completed.

4.3.2 Injection Wells

All injection wells will be constructed of 2-inch schedule 40 polyvinyl chloride (PVC) with a 10-foot 0.010 slot PVC screen at the bottom. The wells will be screened over the target intervals as shown in **Table 4-1**. Injection wells (six) installed in the intermediate groundwater zone will require a minimum of 6-inch diameter Schedule 40 PVC isolation casing to approximately 35 feet. Injection wells will be constructed to the required specification for isolation casing, surface completion, prevention of commingling and confinement of undesirable groundwater to its zone of origin in accordance with Section 3.2 of the IWWP (Bhate 2018). Please refer to Standard Operating Procedure (SOP) A7-Monitoring Well Installation in Appendix A of the IWWP for additional guidance on well installation. Injection wells will be installed using a hollow stem auger rig rotary sonic drilling techniques. The lithology will be logged at the proposed injection and monitoring well location.

4.3.3 Monitoring Wells

Monitoring wells will be constructed of 4-inch inside diameter schedule 40 PVC 0.01 slot well screen with a 4-inch inside diameter riser composed of schedule 40 PVC pipe. A filter pack consisting of 10/20 filter sand will be placed around the screen from the bottom of the borehole to at least 2 feet above the screen. Wells will be pre-developed by bailing and surging to aid in settling the filter pack before placing the bentonite seal. After the filter pack has been placed, a 2- to 5-foot bentonite seal will be introduced into the well above the filter pack. The bentonite seal will be placed in 1-foot lifts each hydrated for 30 minutes. After placement of the final bentonite lift, the bentonite seal will be saturated with potable water and allowed to hydrate for an additional two hours before grouting begins (IWWP, Section 3.2 and SOP A7.3.6). After the bentonite seal has hydrated, the remaining annulus will be grouted using a Type I Portland or American Petroleum Institute Class A cement/bentonite slurry.

The wells will be screened over the target intervals as shown on **Table 4-1**. Monitoring wells will be installed within and downgradient from the biobarriers for performance monitoring. Wells will be installed in accordance with Section 3.2 of the IWWP (Bhate 2018). Please refer to the SOP A7-Monitoring Well Installation in Appendix A of the IWWP for additional guidance on well installation.

4.3.4 Well Development

Each newly installed well will be developed no sooner than 24 hours following well completion. Existing wells that will be used for injection will be redeveloped. Well development will be conducted in accordance with Section 3.2.2 of the IWWP (Bhate 2018). Please refer to SOP-A8-Monitoring Well Development for additional guidance on well development.

4.4 Groundwater and Surface Water Sampling

Areas around the wells will be cleared of vegetation and biohazards to protect the field staff. Wells will be sampled prior to injections for baseline data and post injections. Low-flow groundwater sampling will be performed in accordance with Section 3.4 of the IWWP (Bhate 2018). Procedures for purging and sampling the wells are detailed in SOP A10-Low Stress Groundwater sampling in Appendix A of the IWWP. During the performance monitoring events, surface water samples will be collected concurrently if water is flowing in the creek. Surface water samples will be collected in accordance with Section 3.6 of the IWWP (Bhate 2018). Please refer to SOP A11-Surface Water Sampling in Appendix A of the IWWP for detailed guidance regarding surface water sampling.

Additional details about baseline sampling, performance sampling and surface water sampling is discussed in **Section 4.7** below.

4.5 ISB Injection

Placement of DPT points, injection wells, and existing wells for ISB is shown on **Figures 3-2 to 3-7**. **Tables 3-1 to 3-11** provide the number of injection points, target depths, volumes of each amendment to be prepared, and target volumes to be injected. The calculations to determine the required volumes are based on the calculation sheets provided in the Final RD.

4.5.1 Preparation

4.5.1.1 Location Preparation

Prior to the ISB injection, the site will be cleared of aboveground hazards. A GPS device will be used to locate each injection point. After the third party utility locator service has marked the underground utilities, APTIM will verify that there are no injection points that will impact any utility. If there are points that are affected, APTIM will alter the plan and relocate those points to avoid the utility, while still meeting the injection objectives. The final DPT injection point locations will be recorded with the GPS. Prior to drilling with the DPT at each point, APTIM's standard procedure is to hand dig to 5 feet at each injection point to check for underground obstructions/utilities.

4.5.1.2 Amendment Preparation

The reduction of VOCs and perchlorate will be addressed by using enhancing reductive dechlorination, an anaerobic microbial process. There are various EVO formulations commercially available in the market. EDS-ER™ (or an equivalent EVO product will be used for injections along with APTIM's dechlorinating microbial consortium, SDC-9™. Additionally, the Bayou Barrier will use ABC Plus with microscale ZVI or an equivalent product.

The ISB amendments will be mixed in 20,000-gallon mixing tanks. The tanks will be located at LHAAP-16. If field conditions do not allow for placement of the tanks at LHAAP-16, the 20,000-gallon mixing tanks will be staged at the GWTP. The amendment solution will be mixed prior to the day of injection. The potable water required for mixing will be obtained from the GWTP or from an off-base fire hydrant and transported to the mixing tank in a water truck. If the 20,000-gallon tanks are staged at the GWTP, the amendment mixture will be prepared at the GWTP and transported to the site in water trucks.

Steps required for preparation of ISB (EDS-ER™ and SDC-9™) amendments are as follows:

- Approximately 24 hours prior to injection, the anaerobic solution will be prepared by adding the required volume of EDS-ER™ and dilution water (1:10 mixing ratio), nutrients, and a small volume of SDC-9™ into the mixing tank. The same amendment mixture is used for all injection areas except for the Bayou Barrier where the amendment mixture will include microscale ZVI. The microbes will grow on a small amount of the carbon, and during respiration, they will use the available oxygen in the mixing tank, creating an anaerobic medium. During mixing, a conservative tracer sodium bromide (at target concentration of 500 milligrams per liter [mg/L]) will be added to the solution to evaluate the distribution of amendment during performance monitoring.
- When the solution has become anaerobic, based upon a DO meter reading of less than 1.0 mg/L, the remaining bioaugmentation culture will be added to the mixing tank and recirculated. The procedure differs from the Final RD which called for intermittent injection of anaerobic water and the microbes. Preparing the full volume of anaerobic water for injection and mixing is favorable for the microbes.
- After the anaerobic solution containing each of the amendments has been prepared, the amendments will be injected. The amendment solution will be injected into the subsurface using an injection system, as shown on **Figure 4-1**.
- The injection volume for each point at an injection area along with the associated mass and volume of amendment are provided in **Tables 3-2, 3-4, 3-6, 3-8, 3-10, and 3-12** and are based on 92% EVO oil (EDS-ER™) by weight.

Steps required for preparation of ABC Plus amendment mixture is as follows:

The ABC product will be mixed into a slurry for injection. **Appendix D** provides details regarding the mixing preparation of the ABC Plus product. Additionally, sodium bromide (tracer) will be mixed in with the EVO at the beginning of the mixing process.

4.5.2 In Situ Injections

4.5.2.1 Injection System

An injection system will be used to allow for multiple well/DPT injections at a single time under low pressure (i.e., less than 40 pounds per square inch). The injection system will include volume and pressure gauges so amendment volume can be recorded for each injection location. The total volumes per well, injection pressures and gallon per minute will be tracked on paper and electronically using the Injection Log in **Appendix E**. The injection system will be connected to each well or to the DPT probe with hoses.

4.5.2.2 DPT Injection

For injection into the shallow aquifer, a DPT rig will be used to inject the amendment mixture at 2-foot intervals to cover the entire target interval using a top down or bottom up approach depending on the lithology and field conditions. An injection tool string is advanced to the top of the injection interval and the amendment is pumped through the probe rods. The cycle is repeated to provide coverage across the entire target interval.

4.5.2.3 Injection through Wells

Injection into the intermediate aquifer and Landfill Biobarrier #2 will use newly installed injection wells or existing extraction wells. The injection well screen will be installed over the target interval. The injection well screen interval may be modified during field implementation activities based on field observations including depth to groundwater. For injection using a well, the well will be fitted with an injection connection for attachment of the injection system.

Slug tests will be conducted on the pilot test wells at Landfill Biobarrier #2 to ensure they are in acceptable conditions. If the results indicate they are not, the wells will be redeveloped prior to use as injection wells.

4.5.2.4 Monitoring during Injections

During the ISB injections, possible amendment surfacing (also called daylighting) may occur at the ground surface and will be monitored. Injection pressures will also be monitored since sudden reductions may be an indication of amendment loss into subsurface, possibly from fracturing induced by the injection or from a high-permeability zone. If daylighting on the surface or in nearby drainage features is detected, injection rates will be reduced or injections will be shut down. Bromide will be used as an indicator of distribution of the EVO (carbon). The bromide concentrations will be monitored, and an increase in bromide concentrations above the baseline results will indicate amendment distribution. Samples will be collected and analyzed for bromide to determine if there is an increase in bromide over baseline to evaluate distribution of amendment.

4.6 Injection Areas

In situ injection activities will be conducted in accordance with Section 3.10 of the IWWP (Bhate 2018).

4.6.1 Landfill Biobarrier #1 Amendment Injection

The injection will consist of delivering amendments to the subsurface using a series of eighteen DPT injection points (DPT01 through DPT18) and one injection well (16IW09). The RD proposed that the injection well would also serve as a groundwater monitoring location within the biobarrier. A spacing of 15 feet between injection locations was selected based on the rationale and injection radius of influence (ROI) presented in Section 4.1.2 of the Final ROD.

The target injection intervals are shown on **Table 3-1**. The injection locations are shown on **Figure 3-2**. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-2**.

4.6.2 Landfill Biobarrier #2 Amendment Injection

Existing injection wells and extraction wells installed as part of the ESTCP study (Geosyntec 2009) will be used to deliver the amendments. The injections will be conducted in two phases in the vicinity of Landfill Biobarrier #2. The injection locations are shown on **Figure 3-2**. The screen intervals of the existing wells are included on **Table 3-3**. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-4**.

Phase 1 will involve injecting into injection wells 16IW01, 16IW03, 16IW05, and 16IW07 as groundwater is extracted from extraction wells 16EW11, 16EW12B, 16EW13, 16EW14B, and 16EW15 to enhance distribution of the amendment mixture cross gradient. Pumps and piping are not currently installed and will be temporarily installed for extraction. The extracted groundwater will accumulate into the empty mixing tank. Once the planned amendment volume has been injected, a sample of the extracted groundwater will be collected from each extraction well and tested for bromide. If bromide concentration is more than the baseline concentration, extraction will end. If bromide concentrations are not detected above baseline levels, extraction of groundwater will continue until a higher concentration of bromide is detected in the extraction wells. The extraction wells will be turned off once bromide is detected above baseline concentrations. If additional extraction occurs, it is likely that the accumulated water volume may be more than is needed for the amendment mixture for Phase 2. If this occurs, once the accumulated groundwater is more than 3,500 gallons, the excess water will be reinjected into the injection wells while extraction continues.

During Phase 2 of the injections, the extraction wells will be shutdown. The water accumulated from Phase I of injections will be used to make the amendment mixture for Phase 2. One part of the concentrated EVO solution will be mixed with 10 parts of extracted groundwater and

injected into extraction wells 16EW11, 16EW12B, 16EW13, 16EW14B, and 16EW15. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-4**.

4.6.3 Landfill Biobarrier #3 Amendment Injection

The injection will consist of delivering amendments to the subsurface using series of seven injection points using DPT (DPT19 through DPT25) and one injection well (16IW10). A spacing of 15 feet between injection locations was selected based on the rationale and injection ROI presented in Section 4.1.2 of the Final ROD. The RD proposed that the injection well would also serve as a groundwater monitoring location within the biobarrier.

The injection locations are shown on **Figure 3-4**. The target injection intervals for the DPT locations are shown on **Table 3-5**. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-6** for the injection points and well.

4.6.4 Bayou Biobarrier Amendment Injection

The injection will consist of delivering amendments to the subsurface using a series of thirteen DPT locations (DPT-26 through DPT-35, and DPT-37 through DPT-39) and one injection well (16IW20) to inject the amendment mixture. The injection well will also serve as a groundwater monitoring location within the biobarrier along with 16RW11. The amendment mixture will comprise of a ABC Plus (EVO and microscale ZVI), SDC-9™ and sodium bromide (tracer). A slower rate of injection will be used to reduce chances of surfacing and reaching the creek. 16WW40 and 16WW56 will be used as injection control wells and will be visually monitored hourly during injections to determine if EVO reaches the well. The well should be outside the ROI. However, if EVO reaches the well, then the flow rate and volume will be reduced to ensure that a buffer zone is maintained at the creek and the injection pattern for other points will be modified to move the points away from the creek. Injections will be conducted during weekdays (and not on weekends) in order to facilitate visits by the Army and regulatory personnel for observation.

The field readings will be collected using a hand held field instrument and readings will be recorded on field forms. The probe will be placed in the bayou for a direct reading from the bayou. If the carbon source reaches the bayou, the natural organisms will utilize the carbon and will create anaerobic conditions in the water which may impact aquatic life. If any sudden decrease in DO is observed to below baseline readings or a visual change is observed in the water (murkiness) along the bayou bank, injections will be suspended. Additional monitoring and visual observations will be conducted to determine if the decrease is from injection materials or changes in the environmental conditions. If injections are suspended, corrective actions (placement of aerators and/or hay bales) will be implemented if needed. Once DO has stabilized and no visual confirmation of injection materials into the bayou is confirmed,

injections will resume. During and after the injection, the surface water of Bayou will be monitored for DO. The following monitoring frequency will be conducted along the Bayou:

- Hourly visual and DO inspection along the Bayou during injections within 50 feet of any subsurface drainage feature
- Daily visual and DO inspection during weekdays for one week after injections
- Daily visual and DO inspections during weekend if more than 1 inch of rain is recorded within a week after the injections
- Visual and DO inspections every other day after the first significant rain (3 inches or more within a seven day period) for two weeks

During the injections, parameters will be monitored and recorded by APTIM personnel to ensure consistency. During injections, possible amendment surfacing (also known as daylighting) may occur at the ground surface or in the surface water at the Bayou and will be monitored. If daylighting on the surface or in Bayou is detected, injection rates will be reduced, or injections will be shutdown. If a spill is observed along the Bayou, amendments will be isolated using sand bags and hay bales and the affected materials will be collected and disposed. A solar powered aerator will be available for use, if needed, to aerate and reoxygenate impacted surface water. The target injection intervals are shown on **Table 3-7**. The injection locations are shown on **Figure 3-5**. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-8**.

4.6.5 Mid Plume Area (Shallow Groundwater Zone) Amendment Injection

The extraction wells (16EW01, 16EW02, 16EW03, and 16EW04) will be shut down prior to injections. The injection will consist of delivering amendments to the subsurface using a series of forty DPT locations (DPT-40 through DPT-79). An attempt will be made to inject into alternate points simultaneously to eliminate potential surfacing. The target DPT injection intervals are shown on **Table 3-9**. The injection volume and amendment mixture quantities (total and per point) are shown on **Table 3-10**.

The well locations are shown on **Figure 3-6**.

4.6.6 Mid Plume Area (Intermediate Groundwater Zone) Amendment Injection

Two new injection wells will be installed between pairs of existing extraction wells 16EW05 and 16EW06, 16EW06 and 16EW07, and 16EW07 and 16EW08 for a total of six new injection wells in the intermediate zone to recirculate groundwater between the injection and extraction wells. The proposed well locations are shown on **Figure 3-7**. The existing extraction wells will

be used as injection wells once the recirculation is terminated. The injection volume and amendment mixture quantities (total and per point) are shown on **Table 3-11**.

To distribute the amendments along the linear biobarrier between the injection wells, and to minimize mounding and/or surfacing, a sequence of recirculation will be used as follows:

- Check bromide before injecting and twice a week from active extraction wells. Once an increase in bromide is observed in an individual extraction well, the extraction is shut down from that well.
- Inject all the amendment mixture into each injection well (16IW25 to 16IW30).
- Start extraction at extraction wells 16EW05 and 16EW07 into the onsite tank and recirculate back into injection wells 16IW25, 16IW26, 16IW27, 16IW28, 16IW29, and 16IW30. Continue recirculation for 3 days unless an increase in bromide is observed above baseline levels in 16EW05 and 16EW07, and the extraction would stop.
- After 3 days, switch extraction to extraction wells 16EW06 and 16EW08 to the onsite tank and recirculate back into injection wells 16IW26, 16IW27, 16IW28, 16IW29, and 16IW30. Continue recirculation for 3 days unless an increase in bromide is observed above the baseline levels in 16EW05 and 16EW07, and the extraction would stop.
- After extracting for 3 days at 16EW06 and 16EW08, switch back to 16EW05 and 16EW07. Keep rotating extraction from wells until bromide is above baseline in all extraction wells.
- The extraction wells are estimated to be on for 2 to 3 weeks.
- After extraction has shut down in all extraction wells, the EVO amendment mixture will be injected into the existing extraction wells.

4.7 Performance Monitoring

APTIM will collect performance samples to evaluate the effectiveness of the ISB injections as indicated in **Tables 4-4** through **4-8**.

4.7.1 Baseline Sampling

Baseline samples will be collected prior to the implementation of injections to characterize the CVOC and perchlorate concentrations and geochemical conditions in the Shallow and Intermediate Zone. The wells selected include wells inside and outside of the plumes and wells located upgradient, within and downgradient of the ISB areas. The baseline sampling results will be compared to sample results collected post ISB injections. The wells that will be sampled during the baseline sampling event are included in **Table 4-2** and **4-3**.

4.7.2 Evaluation of Design Effectiveness

Groundwater data will be collected within the first two months of remedy implementation to evaluate effectiveness of injections. Two sets of groundwater samples will be collected before the first quarterly performance monitoring event. The performance monitoring plan for Landfill Biobarrier #1, Landfill Biobarrier #2, Landfill Biobarrier #3, Bayou Biobarrier and Mid-Plume are presented in **Tables 4-4, 4-5, 4-6, 4-7, and 4-8**, respectively.

4.7.3 Performance Monitoring Year 1 and Year 2

Wells included in **Tables 4-4 to 4-8** will be used to monitor the performance of ISB injections in each area. The *Dehalococcoides* are expected to break down the chlorinated ethenes to harmless byproducts like ethene and ethane. This process of biodegradation results in depletion of DO and lowering of ORP. Performance monitoring will be conducted to evaluate change in geochemical conditions, VOCs, and perchlorate concentrations, due to biodegradation reactions. Additionally bromide will also be analyzed to evaluate the distribution of amendments after injections. The performance monitoring plan for Landfill Biobarrier #1, Landfill Biobarrier #2, Landfill Biobarrier #3, Bayou Biobarrier, and Mid-Plume are presented in **Tables 4-4, 4-5, 4-6, 4-7, and 4-8**. These tables also present the rationale for selection of each monitoring location. Any recommendations to reduce the frequency and/ or drop analytical parameters or wells from the sampling list will be made in the Annual Remedial Action Operation (RA-O) Report. Additionally, results will be evaluated to determine if reinjections are needed.

4.7.4 Follow-up Injections in Biobarriers

As specified in the ROD, follow up injections for the biobarriers will be implemented based on the groundwater monitoring results. Though the EVO is specified to last for 3 to 5 years, the decision to reinject will be based on the following criteria:

- Depletion of total organic carbon to below 20 mg/L.
- ORP increase above -50 millivolts (mV).
- Contaminant concentrations in groundwater performance wells for the landfill biobarriers and in surface water for the Bayou Biobarrier remain above cleanup standards.
- If these conditions occur, reinjections will be conducted only in specific areas that meet the above criteria. The wells used to determine the follow-up injection, in the previously injected biobarriers, are indicated as wells for “performance data within the biobarrier” in **Tables 4-4 through 4-7**.

4.7.5 MNA Evaluation

After two years of quarterly performance monitoring, the performance of MNA will be evaluated. The wells selected for performance monitoring for MNA evaluation for shallow and intermediate groundwater plumes are included in **Table 4-9** and in **Figure 4-2**. The analysis for the samples is also included on **Table 4-9**. The performance evaluation for MNA will be based on eight quarters of data combined with historical data to evaluate the effectiveness of biogeochemical reactions in reducing contaminant concentrations. Per the Final ROD (U.S. Army 2016), the evaluation of MNA after two years will be based on the following:

- Plume stability (i.e., plume concentrations are reducing in majority of the performance wells, and the plume is not expanding in area as demonstrated with compliance wells).
- MNA potential based on evaluation of biodegradation screening scores using USEPA guidance.
- MNA process evaluation, based on an attenuation rate calculated with empirical performance monitoring data, and MNA process demonstration based on the presence of daughter products and bacterial culture counts.

4.7.6 Contingency Action for MNA Areas

A contingency remedy will be implemented for MNA areas outside the active remediation areas if the above criteria (stated in **Section 4.7.5**) are not met. A contingency remedy involving the application of bioamendments to address the ineffective aspects of MNA will be conducted. The area and elements of contingency remedy will be selected based on the entire data set available. If the contingency remedy is required, it will be documented in an Explanation of Significant Difference (ESD).

4.7.7 Long-Term Monitoring Year 3 to Next Five Year Review

LTM will be initiated if MNA is found to be effective based on the first two years of performance monitoring. Per the Final ROD, LTM will be implemented at a semiannual frequency for three years, and then annually until the next five-year review. The wells selected and planned analysis is included in **Table 4-9** and will be modified based on the review of first two years of data.

4.7.8 Surface Water Monitoring

Surface water monitoring will be conducted during performance events to ensure that concentrations do not exceed surface water standards for contaminants. The surface water sampling events will be conducted along with the groundwater sampling events for performance monitoring. If surface water samples could not be collected from Harrison Bayou during quarterly sampling events due to a dry event, samples will be collected outside the

routine quarterly sampling events following significant rain events. An attempt will be made to collect four surface water samples every monitoring year.

Surface water samples will be collected at three locations: upgradient, downgradient and immediately adjacent to LHAAP-16 (**Figure 4-3**). As part of the surface water sample collection activities, field readings (DO, pH, ORP, temperature and conductivity) will be collected instream with a multi-parameter meter. Surface water samples will be collected in accordance with Section 3.6 of the IWWP (Bhate 2018). Please refer to SOP A11-Surface Water Sampling in Appendix A of the IWWP for detailed guidance regarding surface water sampling. These surface water samples will be analyzed for the COCs as shown in **Table 4-10** and concentrations will be compared to clean-up levels listed in **Table 1-1**. Surface water conditions will be noted and photos documented during the groundwater sampling event, and when surface water samples are collected.

4.7.9 Remediation Derived Waste Management

Remediation derived waste include the following:

- Drill cuttings from injection and monitoring wells
- Groundwater generated from development of new wells
- Groundwater generated from purging of wells prior to sampling
- Decontamination fluids
- Disposable protective clothing and supplies

Drill cuttings will be placed in 55-gallon drums or high-density polyethylene lined roll off containers. Composite samples will be collected and analyzed for waste characterization prior to proper handling and disposition. All handling of drill cuttings will be performed in accordance with Section 3.8.1 of the IWWP.

Wastewater generated from equipment decontamination, well development, groundwater sampling, or other investigative and remedial activities will be stored in 55-gallon drums and transported to the GWTP at LHAAP-18/24 as specified in Section 3.8.2 of the IWWP.

4.8 Metals Groundwater Monitoring

The selected remedy in the ROD indicates monitoring for metals will be evaluated at the first five year review to determine if any further monitoring for metals is warranted (U.S. Army 2016). **Table 1-2** provides a summary of the wells that were sampled for the metals COCs and had detected concentrations above the cleanup levels. As part of the next five year review after remedy implementation, groundwater samples will be collected. All the wells listed on **Table 1-2** will be analyzed for thallium. Selected wells listed in **Table 1-2** will be analyzed

for the remaining metal COCs (chromium, arsenic, nickel and/or manganese) based on the previous results. The sampling will be conducted using low flow sampling as described in Section 3.4 of the IWWP (Bhate 2018). The monitoring results and evaluation will be included in the next five year review report.

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5.0 REMEDY PERFORMANCE EVALUATION AND REPORTING

A RACR will be submitted to document site activities completed to implement the RA. Performance monitoring results will be included in the Year 1 and Year 2 Annual RA-O Reports. The Year 1 and Year 2 Annual RA-O Reports will include an MNA evaluation of the groundwater COCs for LHAAP-16. After the first two years, if MNA is found to be effective, an Operating Properly and Successfully Report will be prepared. RA-O sampling will continue at a semiannual frequency through the remainder of the period of performance (PoP) and the results will be documented in Annual RA-O Reports.

5.1 Annual RA-O Reports

An Annual RA-O Report will be prepared at the end of each year to present groundwater monitoring results. Wells within the plume areas will be evaluated for MNA performance. 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.

The Annual RA-O Report will also include landfill O&M, annual LUC inspection, and well system O&M.

5.1.1 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 1-1**), 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.

5.2 Contingency Action for MNA Areas

Per the ROD, a contingency remedy would be implemented if the above criteria (**Section 5.1.1**) were not met for the passive MNA areas (i.e., MNA areas outside the active remediation areas). The contingency remedy includes additional injections to enhance MNA. If a contingency remedy is needed, details of additional injections will be documented in an ESD.

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REMEDIAL ACTION WORK PLAN, LHAAP-16 LANDFILL



6.0 SCHEDULE

Table 6-1 shows the estimated duration for each major site activity and timeline. Weather and unknown site conditions could affect this schedule.

REMEDIAL ACTION WORK PLAN, LHAAP-16 LANDFILL

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7.0 OPERATION AND MAINTENANCE PROCEDURES

Some components of the final remedy at LHAAP-16 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 existing landfill cap, which includes signage; and maintenance of the current or future groundwater monitoring system (this would include all wells that serve some purpose, including bioremediation, MNA, background, water levels, and cap performance). Other routine maintenance activities include maintenance and repair of site access features, such as roads, gates, and fencing, as needed. These activities will be conducted annually unless recommended otherwise during a five-year review.

7.1 Maintenance of the Existing Landfill Cap

As discussed previously, a multilayer cap was constructed at LHAAP-16 landfill from 1996 through 1998 as part of an early IRA (under CERCLA) in accordance with the interim ROD signed in 1995. Per the 1995 IRA ROD and 2016 Final ROD, this cap includes the following layers: foundation soil layer, sodium bentonite geocomposite liner, geomembrane, 18-inch fill soil layer, 6-inch top soil, and perimeter berms and drainage swales. Please refer to **Appendix A** for a figure of the Landfill Cap.

Per the selected remedy documented in the 2016 Final ROD, the existing cap will continue to be monitored, maintained, and repaired, as necessary, to preserve its long-term effectiveness. This includes inspection of the landfill cap to check for erosion, settlement, and deep-rooted vegetation, and implementation of necessary repairs. Per the 1995 IRA ROD and 2016 Final ROD, the substantive post-closure requirements at 40 CFR Sections 264.228 (b)(1), (3), and (4); 264.310 (b); and 30 TAC 335.174 are ARARs for landfill cap maintenance and monitoring. The substantive requirements of these post-closure ARARs relevant to LHAAP-16 include the following:

- Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events (e.g. deep-rooted vegetation and burrowing animals).
- Maintain and monitor the ground-water monitoring system.
- Prevent run-on and run-off from eroding or otherwise damaging the final cover.

In order to comply with above requirements, annual inspections will be conducted for the different components of the landfill cap. Inspections will include examining each component of the cap to determine maintenance needs. The area will be checked for proper signage to

ensure that required signs are posted and are legible. If missing or no longer legible, the signs will be replaced.

An RAO Inspection and Maintenance Checklist is presented in **Appendix F**.

7.2 Vegetative Cover Maintenance

Vegetative cover is intended to reduce erosion caused by wind or water. Vegetation will be visually inspected annually, or as needed, following major events including a seismic event greater than a magnitude of 4 on the Richter scale, wildfires, or floods that may affect the integrity of the cover system, for overall health and continuous coverage. Bare spots where the topsoil is exposed, and/or areas of the cap where vegetation is dead or stressed to the point it no longer adequately inhibits erosion will be re-seeded, as appropriate. Unwanted vegetation (e.g., plants with potentially deep root systems such as trees) that has the potential to compromise the integrity of the cap will be removed.

7.3 Erosion and Settlement Inspection and Maintenance

The landfill cap will be inspected annually, for erosion and settlement, or as needed following major events including a seismic event greater than a magnitude of 4 on the Richter scale, wildfires, or floods that may affect the integrity of the cover system. If evidence of significant erosion, settlement, or deterioration, such as gullies, linear crevasses, washouts, rills, or settlement depressions, are observed, the need for cap repair will be evaluated. Settlement can cause cracks, differential displacement, or zones of depression that disrupt the intended flow of storm water over the cover. If repairs are determined to be needed, they will be performed to preserve the integrity of the cap and may include filling and covering the erosion and settlement features with material of similar composition to the existing topsoil. Replacement topsoil will be compacted to restore the cap to the specified grade.

7.4 Drainage System Inspection and Maintenance

The drainage system consisting of graded drainage swales will be visually inspected annually, or as needed, following major events including a seismic event greater than a magnitude of 4 on the Richter scale, wildfires, or floods that may affect the integrity of the cover system, for overgrown vegetation, debris and silt, and erosion of banks and slopes. Areas of the drainage system where vegetation is overgrown to the point that it interferes with drainage off the cover, or where silt and/or debris have accumulated, will be maintained by removing the overgrowth, and/or accumulated sediment/debris from the drainage swale. Also, areas with bank and slope erosion will be restored by removing eroded soil, adding new soil, compacting in 6-inch lifts, and adding vegetation for slope stability. If further stabilization is required, riprap can be placed along the bank slope.

7.5 Maintenance of the Current or Future Groundwater Monitoring System

The groundwater monitoring system is comprised of a network of monitoring wells used to implement ISB, monitor progress of the remedial activities, evaluate the performance of the cap, and determine the magnitude and extent of COCs. This system of wells will be inspected and maintained as part of the annual inspection and maintenance program discussed for the landfill cap. 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 condition will be collected during inspection and maintenance activities. The annual inspection and maintenance activities will be documented in the Annual RA-O reports.

7.6 Maintenance of Site Access Features

LHAAP-16 is accessed by roads and through gates in a perimeter fence. The roads, perimeter fence, and gates will be visually inspected annually, or as needed, to ensure that the roads remain accessible and the perimeter fence and gates are intact and undamaged. Maintenance will be conducted as needed.

Any fence posts that are not securely anchored in the ground and/or metallic parts that are excessively corroded will be repaired or replaced. If evidence of unauthorized entry through, over, or under the fence is observed, these sections of the fence will be reinforced.

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Tables

Table 1-1
Groundwater and Surface Water Cleanup Levels, LHAAP-16

COC	Cleanup Level ($\mu\text{g/L}$)
	MCL
Trichloroethene	5
cis-1,2-dichloroethene	70
1,1-dichloroethene	7
1,2-dichloroethane	5
Vinyl Chloride	2
1,1,2-trichloroethane	5
Methylene Chloride	5
Chromium	100
Arsenic	10
Thallium	2
	TRRP Tier 1 Groundwater Residential PCLs
Nickel	490
Perchlorate	17
Manganese	1,100 ^a

Notes:

^a 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 $\mu\text{g/L}$, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese.

$\mu\text{g/L}$ - micrograms per liter

COC - contaminant of concern

MCL - maximum contaminant level

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

UTL - upper tolerance limit

**Table 1-2
LHAAP-16 Wells with Metal Concentrations above Cleanup Levels**

Cleanup Levels	Maximums					Most Recent Results				
	Arsenic	Chromium	Manganese ^a	Nickel	Thallium	Arsenic	Chromium	Manganese ^a	Nickel	Thallium ^b
	10	100	1100/7820	490	2	10	100	1100/7820	490	2
Shallow Wells										
16WW12	-	1820 (10/97)	-	816 (02/04)	footnote b	-	107 (03/09)	-	-	footnote b
16WW14	-	3090 (10/97)	-	1630 (10/97)	footnote b	-	143 (03/09)	-	-	footnote b
16WW16	-	465 (12/04)	2090 (12/04)	-	footnote b	-	-	2090 (12/04)	-	footnote b
16WW22	-	3860 (12/04)	-	690 (12/04)	footnote b	-	-	-	690 (12/04)	footnote b
16WW24	-	5220 (10/97)	6020 (12/04)	751 (10/97)	17.3 J (03/03)	-	830 (3/09)	6020 (12/04)	-	17.3 J (03/03)
16WW26	11 (10/97)	114 (10/97)	2350 (02/04)	-	11.9 J (12/04)	-	-	2070 (12/04)	-	11.9 J (12/04)
16WW30	-	-	1640 (02/04)	-	19.1 J (03/03)	-	-	1510 (12/04)	-	19.1 J (03/03)
16WW32	-	1260 (12/04)	-	-	footnote b	-	-	-	-	footnote b
16WW34	14 (10/97)	32400 (03/09)	-	1780 (02/04)	footnote b	-	32400 (03/09)	-	985 (12/04)	footnote b
16WW36	-	-	5330 (02/04)	-	6.19 J (3/03)	-	-	5310 (12/04)	-	6.19 J (3/03)
16WW38	-	783 (02/04)	-	976 (02/04)	footnote b	-	671 (03/09)	-	-	footnote b
16WW39	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW40	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW42	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW43	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW44	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW46	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Intermediate Wells										
16WW06	-	-	1770 (02/04)	-	footnote b	-	-	-	-	footnote b
16WW13	-	-	29800 (10/97)	-	11.1 J (03/03)	-	-	3760 (03/09)	-	11.1 J (03/03)
16WW23	-	133 (03/03)	15700 (03/09)	720 (03/03)	40.3 (03/03)	-	-	15700 (03/09)	-	40.3 (03/03)
16WW25	105 (3/09)	-	9300 (02/04)	-	43.7 (03/03)	105 (03/09)	-	7190 (03/09)	-	43.7 (03/03)
16WW27	-	113 (03/03)	4250 (02/04)	-	17.6 J (03/03)	-	-	3550 (02/04)	-	17.6 J (03/03)
16WW28	-	-	1510 (02/04)	-	9.53 J (03/03)	-	-	1380 (12/04)	-	9.53 J (03/03)
16WW29	-	-	1770 (02/04)	-	24.5 (03/03)	-	-	1710 (12/04)	-	13.2 J (12/04)
16WW31	-	122 (12/04)	-	-	footnote b	-	122 (12/04)	-	-	footnote b
16WW33	-	1750 (12/04)	5080 (10/97)	887 (03/03)	footnote b	-	-	1760 (12/04)	-	footnote b
16WW35	123 (03/09)	-	9700 (03/09)	-	90.5 (03/03)	123 (03/09)	-	9700 (03/09)	-	90.5 (03/03)
16WW37	-	251 (10/97)	5700 (10/97)	-	footnote b	-	-	4700 (12/04)	-	footnote b
16WW41	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Upper Deep Wells										
16WW19	-	-	-	-	24.2 (03/03)	-	-	-	-	24.2 (03/03)
16WW20	23 (10/97)	129 (10/97)	-	-	footnote b	-	-	-	-	footnote b
16WW21	-	391 (03/03)	-	-	footnote b	-	-	-	-	footnote b
Lower Deep Wells										
16WW15	20 J (06/95)	-	-	-	14.8 (03/03)	-	-	-	-	14.8 (03/03)
16WW17	-	-	-	-	6.62 J (03/03)	-	-	-	-	6.62 J (03/03)
16WW18	-	-	-	-	6.11 J (03/03)	-	-	-	-	6.11 J (03/03)

Notes:

- All Concentrations in micrograms per liter (µg/L)
- Numbers in parenthesis are month and date of the maximum concentration or most recent sample
- concentration below the Cleanup Levels
- ^a Italic values are above the TCEQ Protective Concentration Limit of 1100 µg/L but below background of 7820 µg/L.
- ^b Thallium was not detected; however, the detection limits were above the cleanup level.
- µg/L - micrograms per liter
- J - estimated value
- NS - not sampled

Table 3-1**Injection Depths and Monitoring Well Screen Intervals – Landfill Biobarrier #1**

Well or DPT ID	Existing/Proposed	Primary Purpose		DPT Injection Depths/ Screen Intervals (feet bgs) ^a
		Substrate Injection	Performance Monitoring	
DPT-01 – DPT-07	Proposed	✓		15 – 21
DPT-08 – DPT-12	Proposed	✓		13 – 18
DPT-13 – DPT-18	Proposed	✓		5 – 18
16IW09	Proposed	✓		13 – 18
16RW01	Proposed		✓	15 – 21
16RW02	Proposed		✓	13 – 18
16RW03	Proposed		✓	13 – 18
16RW04	Proposed		✓	15 – 21
16RW05	Proposed		✓	13 – 18
16WW26	Existing		✓	13 – 18
16WW42	Existing		✓	2 – 12

Notes:

Wells 16WW26 and 16WW42 used to estimate injection depths. Please refer to Appendix C of the Final RD for the well logs.

^a DPT Injection depths and monitoring well screen intervals may be modified based on field observations including depth of clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

DPT - direct-push technology

ID - identification

Table 3-2
ISB Parameters, Landfill Biobarrier #1, LHAAP-16

Landfill Biobarrier #1												
EDS-ER™ Biobarrier Volume Requirements per Well												
Wells	Treatment Thickness	Injection Interval (feet bgs)	Total Feet	EDS-ER™ (pounds)	EDS-ER™ (gallons)	SDC-9™ (gallons)	SDC-9™ (liters)	Sodium bromide (pounds)	Water (gallons)	EDS-ER™ per Well (pounds)	EDS-ER™ per Well (gallons)	Total Volume per Well (gallons)
DPT01-07	6	15-21	42	1411	204	0.44	1.68	8.51	1837	202	29	291.58
DPT08-12	5	13-18	25	840	122	0.26	1.00	5.07	1093	168	24	242.99
DPT 13-18	6	5-18	78	2621	379	0.82	3.12	15.81	3411	437	63	631.76
16W09	5	13-18	5	168	24	0.05	0.20	1.01	219	168	24	242.99
Totals			150		729	1.59	6.00	30.41	6,559			

Biobarrier EDS-ER™ Volume Requirements	
Total EDS-ER required	5,041 pounds
Total EDS-ER required	729 gallons
SDC-9™ 1×10 ¹¹ (DHC/liter)	2 gallons
SDC-9™ 1×10 ¹¹ (DHC/liter)	6 liters
Total water volume	6,559 gallons
EDS-ER™ Requirement	34 pounds/foot
EDS-ER™ Requirement	5 gallons/foot
SDC-9™ requirement 1×10 ¹¹ (DHC/liter)	0.01 gallons/foot
Water Requirement	44 gallons/foot
Sodium bromide	0.20 pounds/foot
Total volume	7,290 gallons
Total volume	49 gallons/foot
Amount of Sodium bromide needed	14 kilos

Notes:

- Refer to Table 3-1 for injection intervals
- bgs - below ground surface
- DHC- dehalococoides
- DPT - direct-push technology
- EDS-ER - Electron Donor Solution-Extended Release
- EVO - emulsified vegetable oil
- ft - feet
- ISB - in situ bioremediation
- SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 3-3
Screen Intervals of Injection/Monitoring Wells – Landfill Biobarrier #2

Well ID	Existing/Proposed	Primary Purpose		Injection/Screen Intervals (feet bgs) ^a
		Substrate Injection	Performance Monitoring	
16EW11	Existing	✓		15.2 – 24.8
16EW12B	Existing	✓		13 – 28
16EW13	Existing	✓		15 – 24.6
16EW14B	Existing	✓		14 – 29
16EW15	Existing	✓		13.9 – 23.5
16IW01	Existing	✓		15 – 25
16IW03	Existing	✓		15 – 25
16IW05	Existing	✓		15 – 25
16IW07	Existing	✓		14 – 24
16PM02	Existing		✓	15.1 – 24.8
16PM03	Existing		✓	15 – 24.5
16PM04	Existing		✓	15.1 – 24.8
16PM14	Existing		✓	15.2 – 24.8
16PM06	Existing		✓	14.9 – 24.6
16PM09	Existing		✓	14.1 – 23.8

Notes:

Wells 16EW11 through 16EW15 used to estimate injection depths. Well logs are included in Appendix C of the Final RD.

^a Injection / monitoring well screen intervals may be modified during field implementation activities based on field observations including depth clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

ID - identification

**Table 3-4
ISB Parameters, Landfill Biobarrier #2, LHAAP-16 (Phase I and Phase 2
Injections)**

Site Parameters	Units	LHAAP-16	
		Phase I	Phase 2
Amendment Volume Requirements			
EDS-ER™	pounds	1797	1,797
EDS-ER™	gallons	260	260
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	2	2
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	0.5	0.5
Water	gallons	2339	2,339
Sodium Bromide	kilo	5	5
Volumes per Point			
EDS-ER™	gallons	65	52
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	0.5	0.4
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	0.13	0.11
Water	gallons	585	468
Injection Parameters			
Injection Spacing	feet	15	15
Target Depth	ft bgs	Refer to Table 3-3 for depths of existing IW & EW	Refer to Table 3-3 for depths of existing IW & EW
Thickness	feet	10	10
Total Volume per Point	gallons	650	520
Injection Rate	gpm	4	4
Injection Pressure (not to exceed)	psi	40	40
Time per Point	hours	2.7	2.2
Simultaneous Points	points	3	3
Hours of Injection per day	hours	8	8
Maximum Volume that can injected per day	gallons	5760	5,760
Points to be Completed (existing IWs and EWs)	points	4	5
Days of Injection	days	0.5	0.5

Notes:

Phase I of injections include injecting amendment into 16IW01, 16IW03, 16IW05 and 16IW07

Phase 2 of injections include injecting amendment into 16EW11, 16EW12B, 16EW13, 16EW14B and 16EW15

DHC - dehalococcoides

EDS-ER™ - Electron donor Substrate - Extended Release

EW - extraction well

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

IW - injection well

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

**Table 3-5
Injection Depths and Monitoring Well Screen Intervals – Landfill Biobarrier #3**

Well or DPT ID	Existing/Proposed	Primary Purpose		DPT Injection Depths/Screen Intervals (feet bgs) ^a
		Substrate Injection	Performance Monitoring	
DPT-19 – DPT-22	Proposed	✓		17 – 27
DPT-23 – DPT-25	Proposed	✓		15 – 25
16IW10	Proposed	✓		15 – 25
16RW06	Proposed		✓	17 – 27
16RW07	Proposed		✓	15 – 25
16RW08	Proposed		✓	15 – 25
16RW09	Proposed		✓	17 – 27
16RW10	Proposed		✓	15 – 25

Notes:

Wells 16WW14 used to estimate injection depths. The well log for 16WW14 is included in Appendix C of the Final RD.

^a DPT Injection depths and monitoring well screen intervals may be modified based on field observations including depth of clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

DPT - direct-push technology

ID - identification

Table 3-6
ISB Parameters, Landfill Biobarrier # 3, LHAAP-16

Site Parameters	Units	LHAAP-16
Amendment Volume Requirements		
EDS-ER™	pounds	2,333
EDS-ER™	gallons	337
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	3
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	1
Water	gallons	3,032
Sodium Bromide Required	kilo	6
Volumes per Point		
EDS-ER™	gallons	42
SDC-9™ 1×10 ¹¹ (DHC/liter)	liters	0.38
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	0.10
Water	gallons	379
Injection Parameters		
Injection Spacing	feet	15
Target Depth	ft bgs	17-27; 15-25
Thickness	feet	10
Total Volume per Point	gallons	421
Injection Rate	gpm	4
Injection Pressure (not to exceed)	psi	40
Time per Point	hours	2
Simultaneous Points	points	3
Hours of Injection per day	hours	8
Maximum volume that can be injected per day	gallons	5,760
Points to be Completed (existing IWs and DPT)	points	8
Days of Injection	days	0.59

Notes:

DHC- dehalococcoides

DPT - direct-push technology

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

IW - injection well

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 3-7
Injection Depths and Monitoring Well Screening Intervals – Bayou Biobarrier

Well or DPT ID	Existing/Proposed	Primary Purpose		DPT Injection Depths/Screen Intervals (feet bgs) ^a
		Substrate Injection	Performance Monitoring	
DPT-26 – DPT-31	Proposed	✓		22 – 32
DPT-32 – DPT-35	Proposed	✓		18 – 28
DPT-37 – DPT-39	Proposed	✓		14 – 24
16IW20	Proposed	✓		14 – 24
16WW22	Existing		✓	21 – 31
16RW11	Proposed		✓	14 – 24
16RW12	Proposed		✓	22 – 32
16WW39	Existing		✓	N/A
16WW12	Existing		✓	14 – 24

Notes:

Wells 16WW12 and 16WW22 used to estimate injection depths. Well logs for 16WW12 and 16WW22 in Appendix C of the Final RD.

^a DPT Injection depths and monitoring well screen intervals may be modified based on field observations including depth of clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

DPT - direct-push technology

ID - identification

N/A - not available

Table 3-8
ISB Parameters, Bayou Biobarrier, LHAAP-16

Site Parameters	Units	LHAAP-16
Amendment Volume Requirements		
ABC Plus (includes both EVO and ZVI) ^a	pounds	7,000
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	5
Volume of product with water	gallons	3,800
Sodium bromide required	kilo	7
Volumes per Point		
Product with water	gallons	271
SDC-9™ 1×10 ¹¹ (DHC/liter)	liters	0.36
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	0.10
Injection Parameters		
Injection Spacing	feet	15
Target Depth	ft bgs	Refer to Table 3-7 for target depths
Thickness	feet	10
Total Volume per Point	gallons	271
Injection Rate	gpm	4
Injection Pressure (not to exceed)	psi	40
Time per Point	hours	2
Simultaneous Points	points	3
Hours of Injection per day	hours	8
Maximum volume that can be injected per day	gallons	5,760
Points to be Completed (proposed 1 IW & 13 DPT)	points	14
Days of Injection	days	0.66

Notes:

^a Includes 3,500 pounds of ABC and 3,500 pounds of ZVI)

ABC is the EVP product supplied by Redox Tech

DHC- dehalococcoides

DPT - direct-push technology

EVO - emulsified vegetable oil

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

IW - injection well

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

ZVI - zero valent iron

Table 3-9
Screen Intervals of Injection/Extraction Wells – Mid-Plume ISB

Well ID	Existing/ Proposed	Purpose		Screen Intervals (feet bgs) ^b
		Substrate Emplacement ^a	Performance Monitoring	
Shallow Groundwater Zone				
DPT-40 – DPT-79	Proposed	✓		14 – 36
16EW01	Existing		✓	31.2 – 36.2
16EW02	Existing		✓	21.5 – 26.5
16EW03	Existing		✓	13 – 18
16EW04	Existing		✓	14 – 19
16WW48	Proposed		✓	25 – 35
16WW39	Existing		✓	N/A
16WW30	Existing		✓	25 – 35
Intermediate Groundwater Zone				
16EW05	Existing	✓	✓	47 – 52
16EW06	Existing	✓	✓	50 – 55
16EW07	Existing	✓	✓	41 – 46
16EW08	Existing	✓	✓	34 – 39
16IW25	Proposed	✓		40 – 55
16IW26	Proposed	✓		40 – 55
16IW27	Proposed	✓		40 – 55
16IW28	Proposed	✓		35 – 50
16IW29	Proposed	✓		35 – 50
16IW30	Proposed	✓		35 – 50
16WW49	Proposed		✓	45 – 55
16WW51	Proposed		✓	35 – 45

Notes:

^a Wells 16EW01 through 16EW04 in the Shallow Zone and wells 16EW05 through 16EW08 in the Intermediate Zone used to estimate injection depths. Well logs are included in Appendix C of the Final RD.

^b Injection/monitoring well screen intervals may be modified during field implementation activities based on field observations including depth clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

DPT - direct-push technology

ID - identification

ISB - in situ bioremediation

N/A - not available

Table 3-10
ISB Parameters, Mid Plume (Shallow Zone), LHAAP-16

Site Parameters	Units	LHAAP-16
Amendment Volume Requirements		
EDS-ER™	pounds	28,414
EDS-ER™	gallons	4,107
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	201
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	53
Water	gallons	36,910
Sodium Bromide Required	kilo	78
Volumes per Point		
EDS-ER™	gallons	103
SDC-9™ 1×10 ¹¹ (DHC/liter)	liters	5
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	1.33
Water	gallons	923
Injection Parameters		
Injection Spacing	feet	15
Target Depth	ft bgs	14-36
Thickness	feet	22
Total Volume per Point	gallons	1,027
Injection Rate	gpm	4
Injection Pressure (not to exceed)	psi	40
Time per Point	hours	5
Simultaneous Points	points	3
Hours of Injection per day	hours	8
Gallons per day	gallons	5,760
Points to be Completed (DPT points)	points	40
Days of Injection	days	7.13

Notes:

DHC- dehalococcoides

DPT - direct-push technology

EDS-ER™ - Electron Donor Substrate - Extended Release

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 3-11
ISB Parameters, Mid Plume (Intermediate Zone), LHAAP-16

Site Parameters	Units	LHAAP-16
Amendment Volume Requirements		
EDS-ER™	pounds	16,565
EDS-ER™	gallons	2,394
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	67
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	18
Water	gallons	21,528
Sodium Bromide Required	kilo	45
Volumes per Point		
Emulsified Vegetable Oil	gallons	239
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	7
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	2
Water	gallons	2,153
Injection Parameters		
Injection Spacing	feet	15
Target Depth	ft bgs	Please refer to Table 3-9 for target depths
Thickness	feet	5 and 15
Total Volume per Point	gallons	2,394
Injection Rate	gpm	4
Injection Pressure (not to exceed)	psi	40
Time per Point	hours	10
Simultaneous Points	points	3
Hours of Injection per day	hours	8
Gallons per day	gallons	5,760
Points to be Completed (4 existing EWs and 6 new IWs)	points	10
Days of Injection	days	4.16

Notes:

DHC- dehalococcoides

DPT - direct-push technology

EW - extraction well

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

IW - injection well

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 4-1
Proposed Injection and Monitoring Wells, LHAAP-16

Well ID	Injections	Performance Monitoring	Screen Intervals	Shallow/ Intermediate Zone
16RW01		✓	15-21	Shallow
16RW02		✓	13-18	Shallow
16RW03		✓	13-18	Shallow
16RW04		✓	15-21	Shallow
16RW05		✓	13-18	Shallow
16IW09	✓		13-18	Shallow
16RW06		✓	17-27	Shallow
16RW07		✓	15-25	Shallow
16RW08		✓	15-25	Shallow
16RW09		✓	17-27	Shallow
16RW10		✓	15-25	Shallow
16IW10	✓	✓	15-25	Shallow
16WW55		✓	17-27	Shallow
16RW11		✓	14-24	Shallow
16RW12		✓	22-32	Shallow
16WW56		✓	22-32	Shallow
16WW57		✓	14-24	Shallow
16WW58		✓	10-20	Shallow
16IW20	✓		14-24	Shallow
16WW48		✓	25-35	Shallow
16IW25	✓		40-55	Intermediate
16IW26	✓		40-55	Intermediate
16IW27	✓		40-55	Intermediate
16IW28	✓		35-50	Intermediate
16IW29	✓		35-50	Intermediate
16IW30	✓		35-50	Intermediate
16WW49		✓	45-55	Intermediate
16WW51		✓	35-45	Intermediate

Table 4-2
Pre-Remedy Sampling Plan in the Shallow Zone, LHAAP-16

Monitoring Locations	ISB Area	Proposed Analyses								
		VOCs ^a (SW8260B)	Perchlorate (6850)	Anions ^b (E300.0)	Dissolved Gases ^c (RSK-175)	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters ^d
16WW26	Downgradient to Landfill Biobarrier #1	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW42	Downgradient to Landfill Biobarrier #1	✓	✓						✓	✓
16WW44	Background	✓	✓							✓
16WW38	Upgradient to Landfill Biobarrier #2	✓	✓							✓
16WW16	Upgradient to Landfill Biobarrier #2	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW36	Downgradient to Landfill Biobarrier #2	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW14	Upgradient to Landfill Biobarrier #3	✓	✓							✓
16WW55	Proposed Well Downgradient to Landfill Biobarrier #3	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW12	Upgradient to Bayou Biobarrier	✓	✓						✓	✓
16WW40	Downgradient to Bayou Biobarrier	✓	✓						✓	✓
16WW22	Upgradient to Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW56	Proposed Well and Downgradient to Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW57	Proposed Well and Across Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW58	Proposed Well and Across Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW30	Downgradient of Mid-Plume	✓	✓						✓	✓
16WW48	Proposed Well and Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW39	Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓
16WW46	Downgradient Outside of Contaminated Area	✓	✓							✓
16WW32	Cross-gradient Outside of Containment Area	✓	✓							✓
16WW34	Cross-gradient Outside of Containment Area	✓	✓							✓
16WW24	Cross-gradient to South of Plume	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW43	Cross-gradient to South of Plume	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 4-2
Pre-Remedy Sampling Plan in the Shallow Zone, LHAAP-16

Monitoring Locations	ISB Area	Proposed Analyses								
		VOCs ^a (SW8260B)	Perchlorate (6850)	Anions ^b (E300.0)	Dissolved Gases ^c (RSK-175)	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters ^d
16WW21	Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓
16EW02	Inside Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes:

This schedule assumes sampling of the extraction wells will be continued annually until the remedy is implemented; therefore, only 16EW02 will be sampled during pre-remedy monitoring.

^a VOCs include TCE; cis-1,2-DCE; 1,1-DCE; 1,2-DCA; 1,1,2-TCA; VC; and methylene chloride.

^b Anions include nitrate and sulfate.

^c Dissolved gasses include ethene, ethane, and methane.

^d Field Parameters include dissolved oxygen, oxidation reduction potential, and pH.

^e Upper deep monitoring well

✓ Indicates that sample will be collected and analyzed for the listed analyte.

DHC - Dehalococcoides (microbial analysis)

TOC - total organic carbon

VOCs - volatile organic compounds

Table 4-3
Pre-Remedy Sampling Plan in the Intermediate Zone, LHAAP-16

Monitoring Locations	ISB Area	Proposed Analyses								
		VOCs ^a (SW8260B)	Perchlorate (6850)	Anions ^b (E300.0)	Dissolved Gases ^c (RSK-175)	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters ^d
16WW45	Background	✓	✓							✓
16WW37	Downgradient of Landfill / Upgradient of Landfill Biobarrier #2	✓	✓							✓
16WW35	Upgradient of Mid-Plume ISB Area / Downgradient of Landfill Biobarrier #2	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW25	Upgradient of Mid-Plume ISB Area / Downgradient of Landfill Biobarrier #1	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW13	Downgradient of Landfill	✓	✓						✓	✓
16WW23	Downgradient of Landfill	✓	✓							✓
16WW27	Downgradient Outside of Contaminated Area	✓	✓							✓
16WW29	Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW41	Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW31	Cross-gradient Outside of Containment Area	✓	✓							✓
16WW33	Cross-gradient Outside of Containment Area	✓	✓							✓
16WW21 ^e	Downgradient of Mid-Plume ISB Area	✓	✓							✓
16WW49	Proposed Well and Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓
16WW51	Proposed Well and Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓
16EW06	Inside Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes:

This schedule assumes sampling of the extraction wells will be continued annually until the remedy is implemented; therefore, only 16EW06 will be sampled during pre-remedy monitoring.

^a VOCs include TCE; cis-1,2-DCE; 1,1-DCE; 1,2-DCA; 1,1,2-TCA; VC; and methylene chloride.

^b Anions include nitrate and sulfate.

^c Dissolved gasses include ethene, ethane, and methane.

^d Field parameters include dissolved oxygen, oxidation reduction potential, and pH.

^e Upper deep monitoring well

✓ Indicates that sample will be collected and analyzed for the listed analyte.

DHC - Dehalococcoides (microbial analysis)

TOC - total organic carbon

VOCs - volatile organic compounds

Table 4-9
MNA and LTM Performance Monitoring Plan - LHAAP-16

Monitoring Locations	Groundwater Zone	Proposed Analyses								
		VOCs ^a (SW8260B)	Perchlorate (6850)	Anions ^b (E300.0)	Dissolved Gases ^c (RSK-175)	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters ^d
16WW44	Shallow	✓	✓							✓
16WW38	Shallow	✓	✓							✓
16WW16	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW14	Shallow	✓	✓							✓
16WW36	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW26	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW42	Shallow	✓	✓							✓
16WW43	Shallow	✓	✓							✓
16WW30	Shallow	✓	✓							✓
16WW40	Shallow	✓	✓							✓
16WW22	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW46	Shallow	✓	✓							✓
16WW32	Shallow	✓	✓							✓
16WW34	Shallow	✓	✓							✓
16WW24	Shallow	✓	✓							✓
16WW48	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW39	Shallow	✓	✓							✓
16WW55	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW56	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW57	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW58	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW37	Intermediate	✓	✓							✓
16WW35	Intermediate	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW13	Intermediate	✓	✓							✓
16WW23	Intermediate	✓	✓							✓
16WW25	Intermediate	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW27	Intermediate	✓	✓							✓
16WW29	Intermediate	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW41	Intermediate	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW31	Intermediate	✓	✓							✓
16WW33	Intermediate	✓	✓							✓
16WW49	Intermediate	✓	✓							✓
16WW51	Intermediate	✓	✓							✓
16WW21	Upper Deep	✓	✓							✓

Notes:

This schedule assumes sampling of the extraction wells will be continued annually until the remedy is implemented; therefore, only 16EW02 will be sampled during baseline monitoring.

^a VOCs include trichloroethene (TCE); cis-1,2-dichloroethene (DCE); 1,1-DCE; 1,2-dichloroethane (DCA); 1,1,2-trichloroethane (TCA); Vinyl Chloride (VC); and methylene chloride.

^b Anions include nitrate and sulfate.

^c Dissolved gasses include ethene, ethane, and methane.

^d Field Parameters include dissolved oxygen, oxidation reduction potential, and pH.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

DHC - Dehalococcoides (microbial analysis)

TOC - total organic carbon

LTM - long-term monitoring

VOCs - volatile organic compounds

Table 4-10
Surface Water Sampling Plan, LHAAP-16

Monitoring Locations	Proposed Analyses			
	VOCs ^a (SW8260B)	Perchlorate (6850)	Metals (6020A/741B)	Field Parameters ^b
16SW01	✓	✓	✓	✓
16SW02	✓	✓	✓	✓
16SW03	✓	✓	✓	✓

Notes:

Surface water samples will be collected from the above locations as part of the pre-remedy sampling event and quarterly performance monitoring events

^a VOCs include trichloroethene (TCE); cis-1,2-dichloroethene (DCE); 1,1-DCE; 1,2-dichloroethane (DCA); 1,1,2-trichloroethane (TCA); Vinyl Chloride (VC); and methylene chloride.

^b Metals include arsenic, chromium, manganese, nickel and thallium.

^c Field Parameters include dissolved oxygen, oxidation reduction potential, conductivity, temperature and pH.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

VOCs - volatile organic compounds

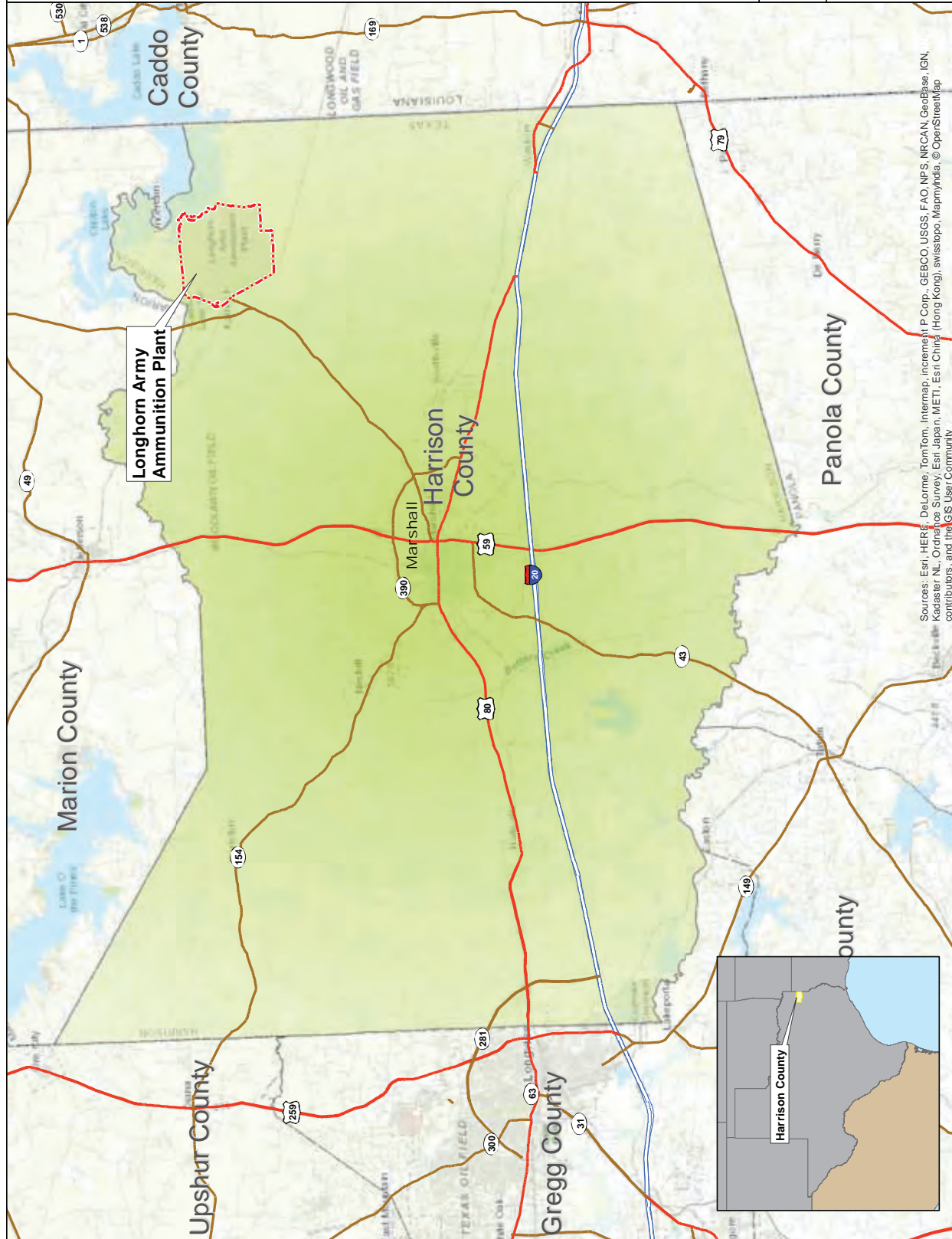
Table 6-1
Schedule for Major Site Activities

Activities	Duration
Submit Injection Information to State	30
Utility Clearance	1
Clear Injection / New Well Locations	3
Install Injection Wells and Monitoring Wells	10
Develop Wells/slug test	4
Baseline Sampling and Gauging	13
Mobilization / Site Set-up for Injections	3
Conduct Injection	25
Demobilization	1
Total No. of days	90

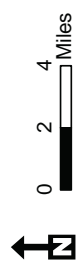
Notes:

Sampling will occur on a quarterly basis for 2 years.

Figures



Longhorn Army Ammunition Plant

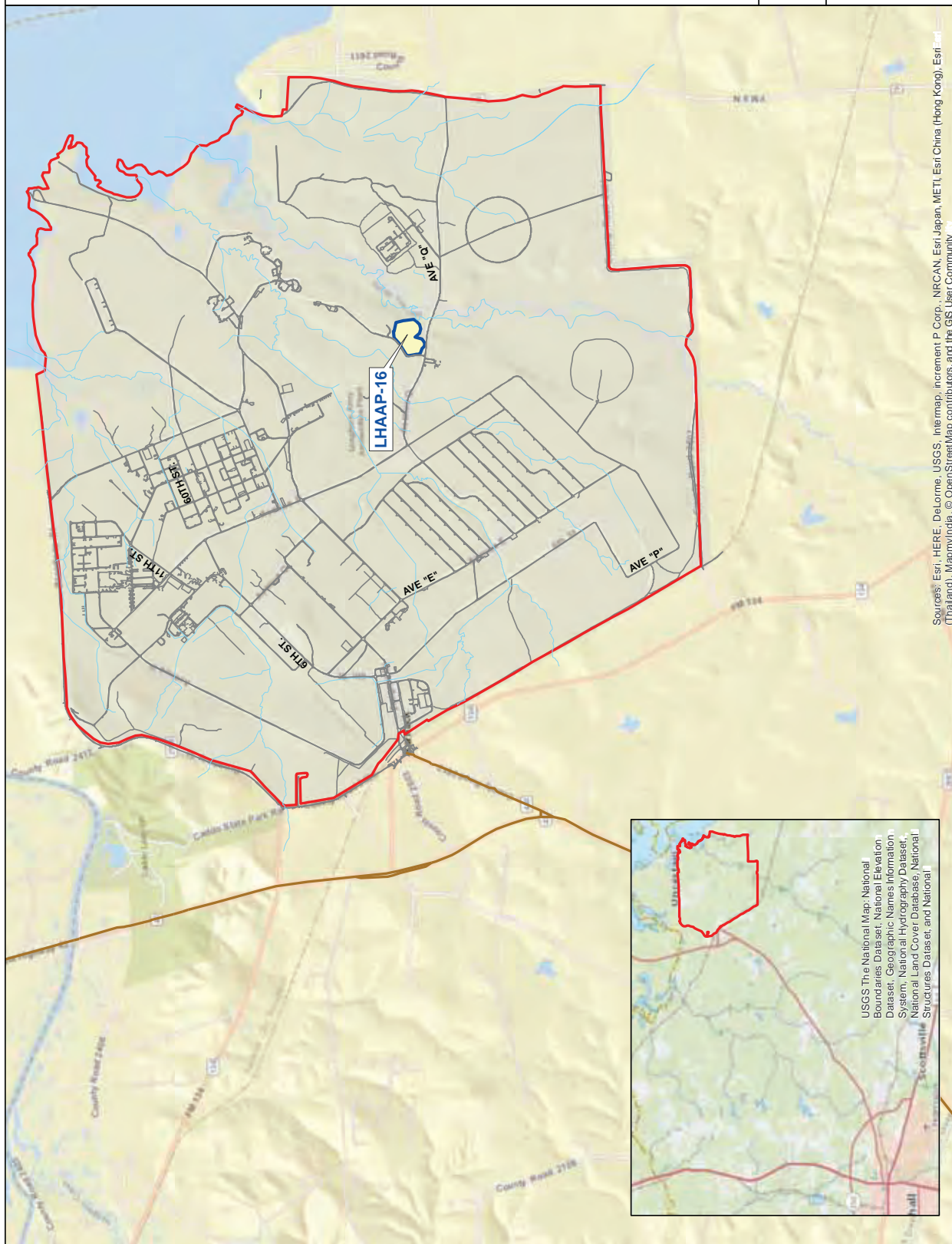


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TULSA, OKLAHOMA

Figure 1-1
LHAAP Location Map
LHAAP-16 RAMP

LONGHORN ARMY AMMUNITION PLANT
MARWACK, TEXAS

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBasis, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



Stream
 Road
 LHAAP Boundary
 LHAAP-16 Site Boundary



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Figure 1-2
 LHAAP Site Location Map
 LHAAP-16 RAWP
 LONGHORN ARMY AMMUNITION PLANT
 MARWACK, TEXAS

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri - (Tailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

USGS The National Map, National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National

- Stream
- Road
- LHAAP Boundary
- LHAAP-16 Site Boundary

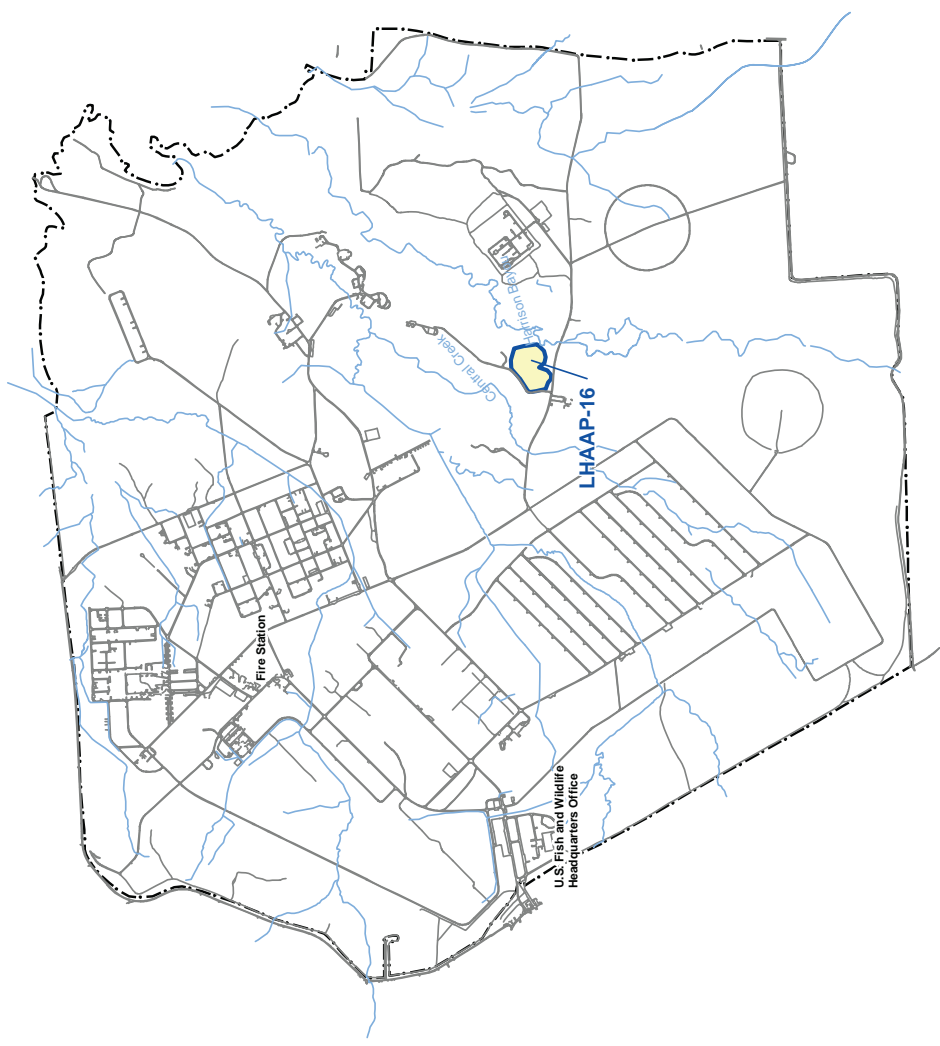


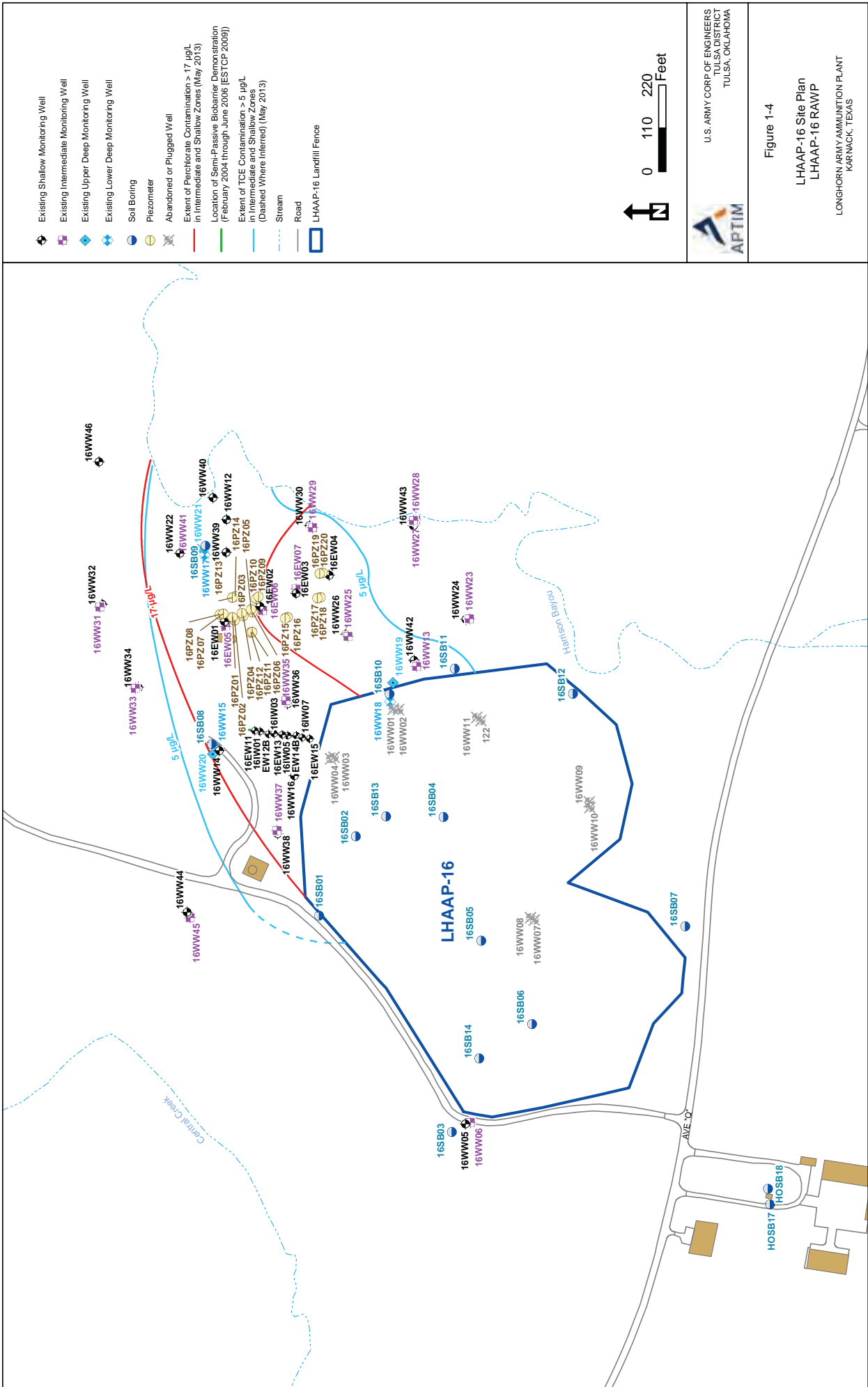
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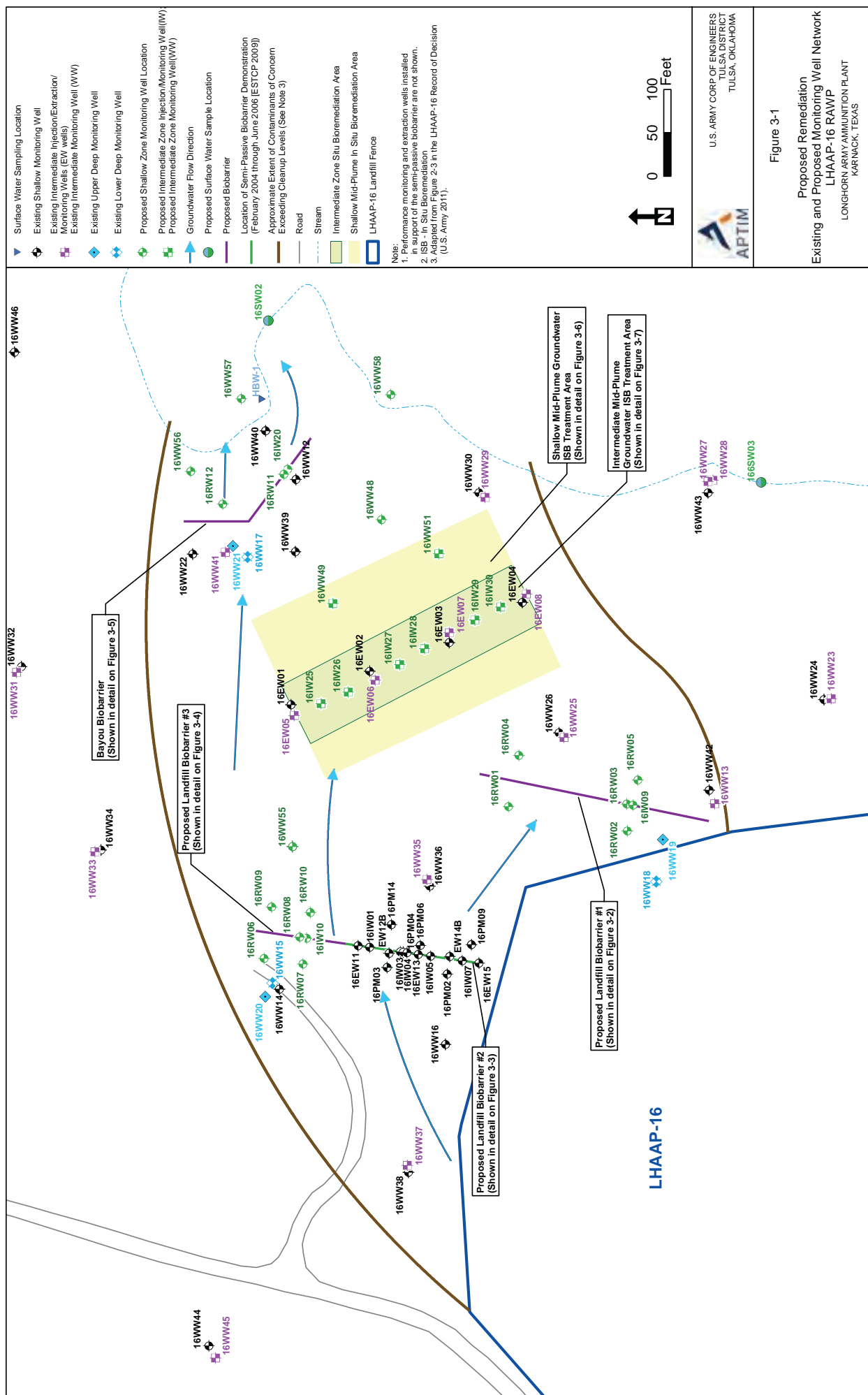
Figure 1-3

Site Vicinity Map
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARTRICK, TEXAS





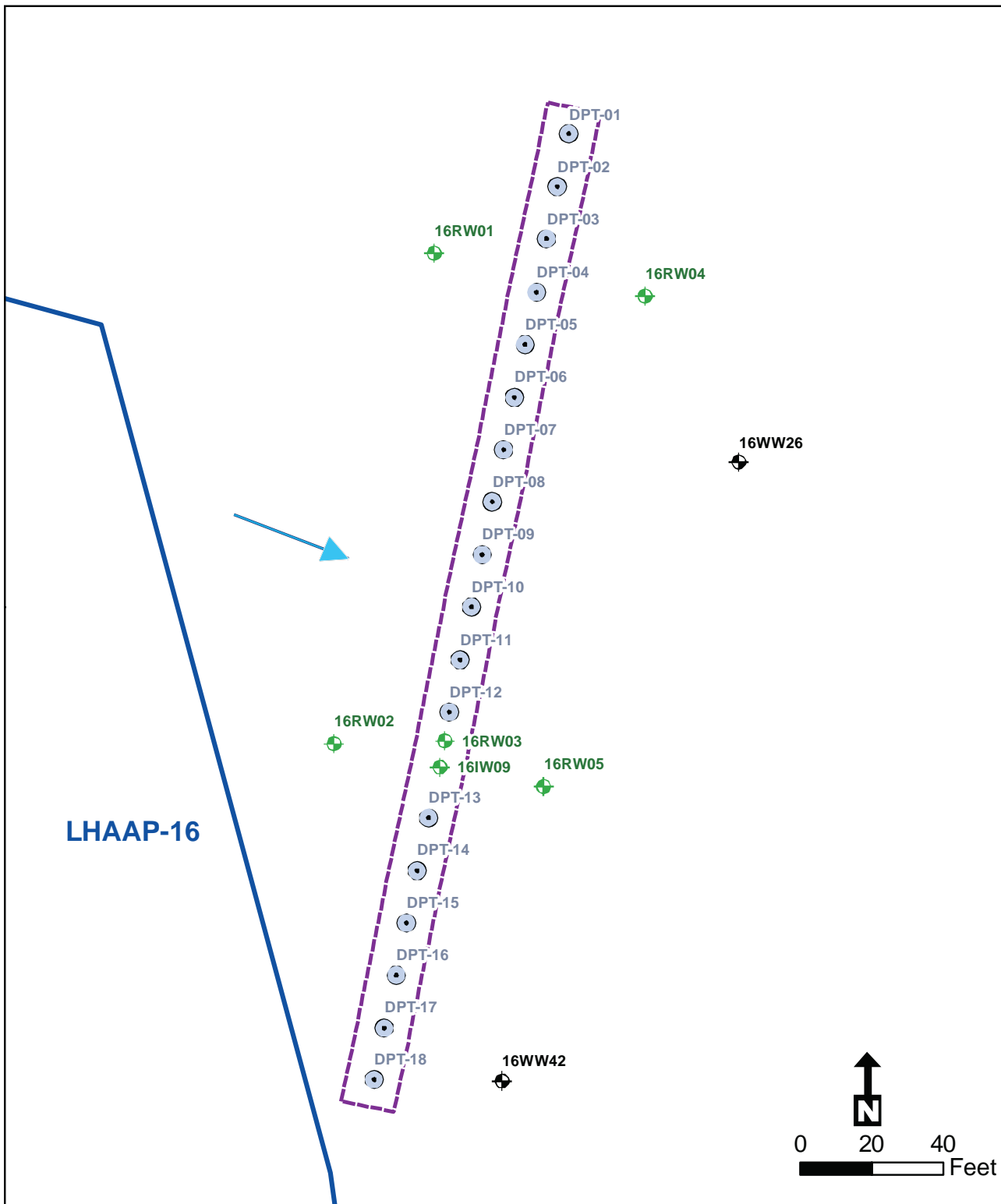


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Figure 3-1

Proposed Remediation
Existing and Proposed Monitoring Well Network
LHAAP-16 RAWP
LONGHORN ARMY AMMUNITION PLANT
KARWICK, TEXAS



- Proposed Well Location
- Existing Well Location
- Proposed Direct Push Injection Point
- Groundwater Flow Direction Without Extraction (Shallow Zone)
- Target In-Situ Reaction Zone Based on Design Radius of Influence
- LHAAP-16 Landfill Fence

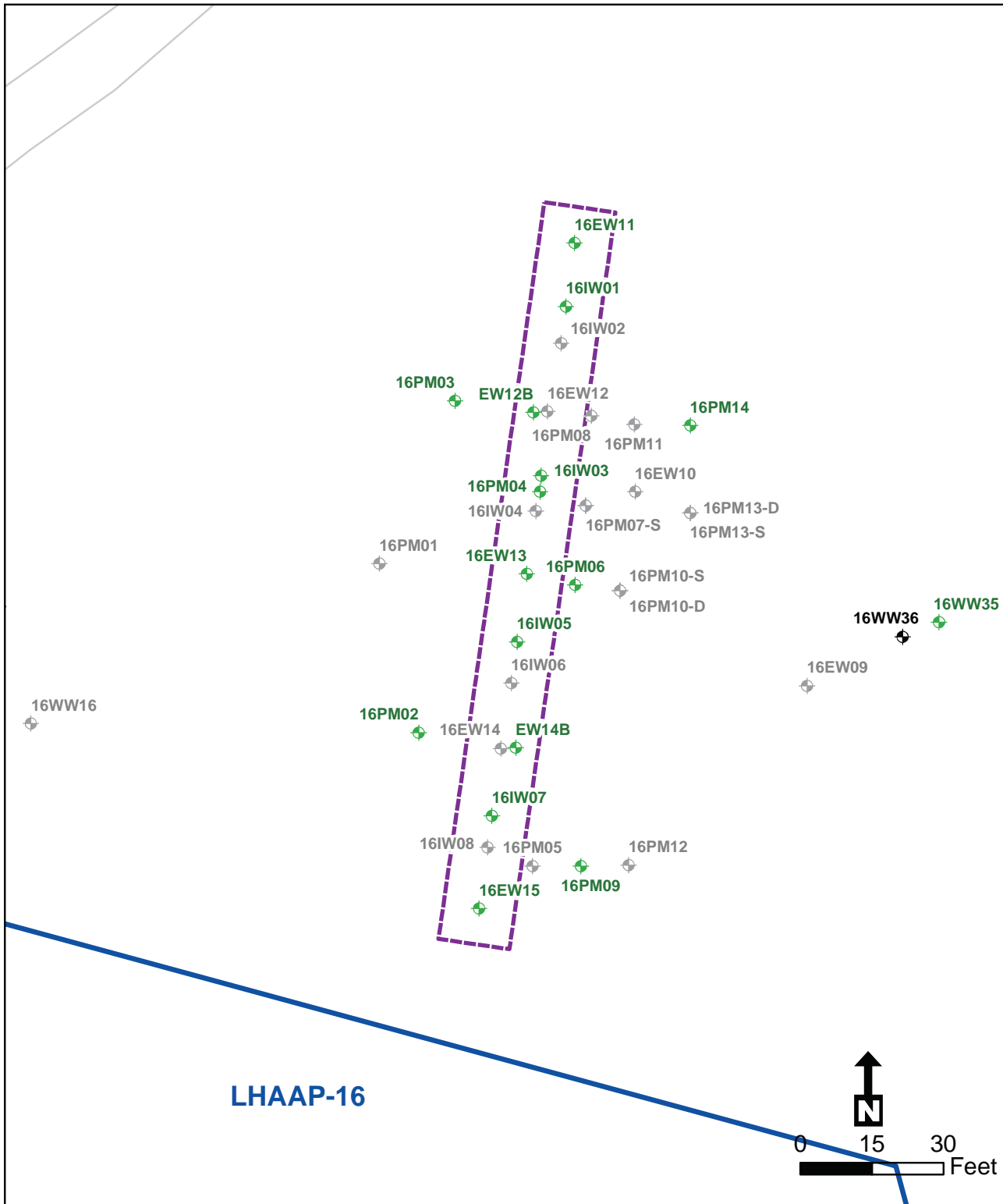







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Figure 3-2
Landfill Biobarrier #1
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Existing Monitored Natural Attenuation Performance Monitoring Well
-  Existing In-Situ Bioremediation Injection/Extraction/Performance Monitoring Well
-  Other Existing Monitoring Well
-  Target In-Situ Reaction Zone Based on Design Radius of Influence
-  LHAAP-16 Landfill Fence



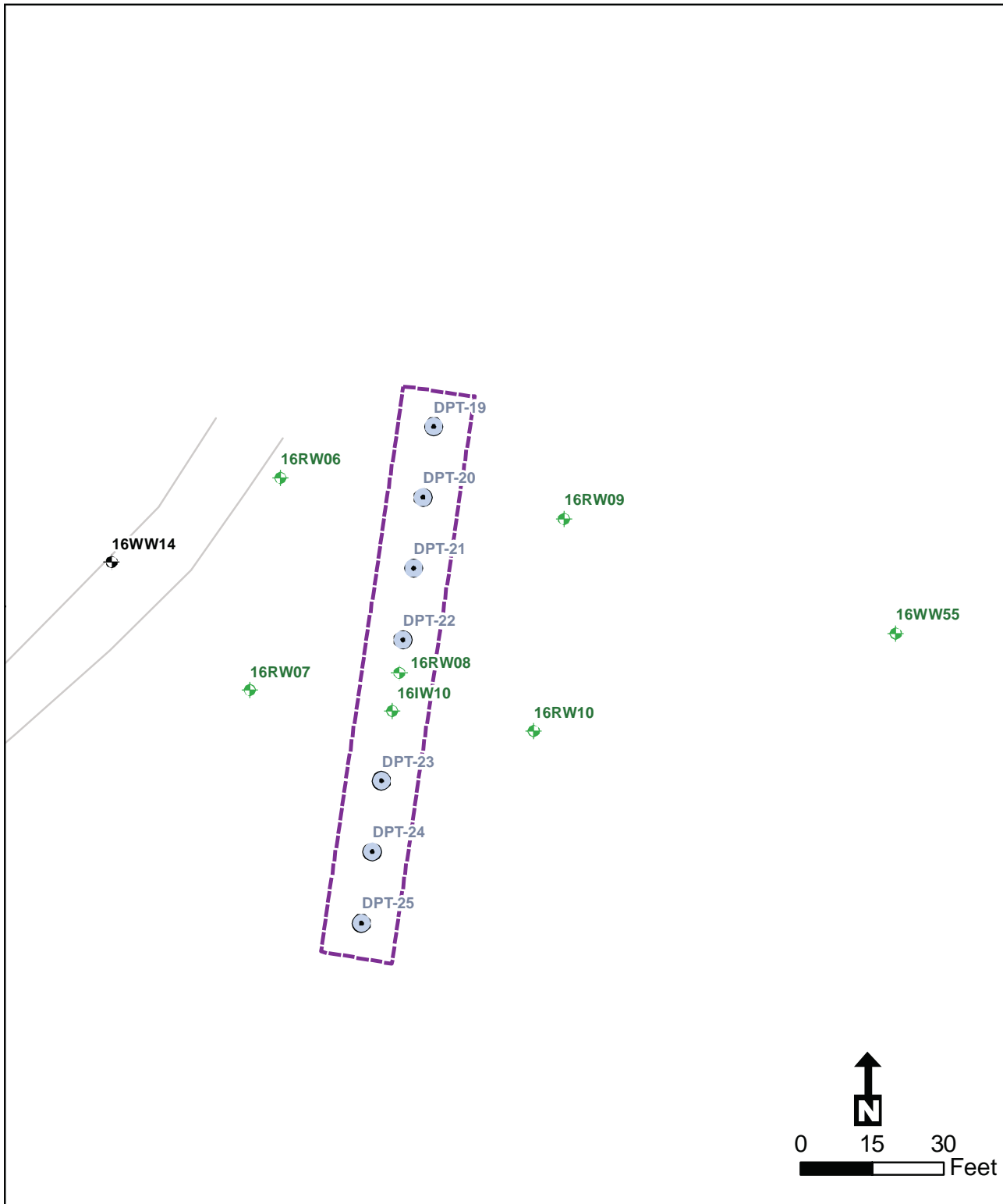
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Figure 3-3

Landfill Biobarrier #2
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 3/26/2018



-  Existing Monitored Natural Attenuation Performance Monitoring Well
-  Proposed Shallow Well Location
-  IW - Injection Well Location
-  RW - Recovery Well Location
-  Proposed Direct Push Injection Point
-  Target In-Situ Reaction Zone Based on Design Radius of Influence



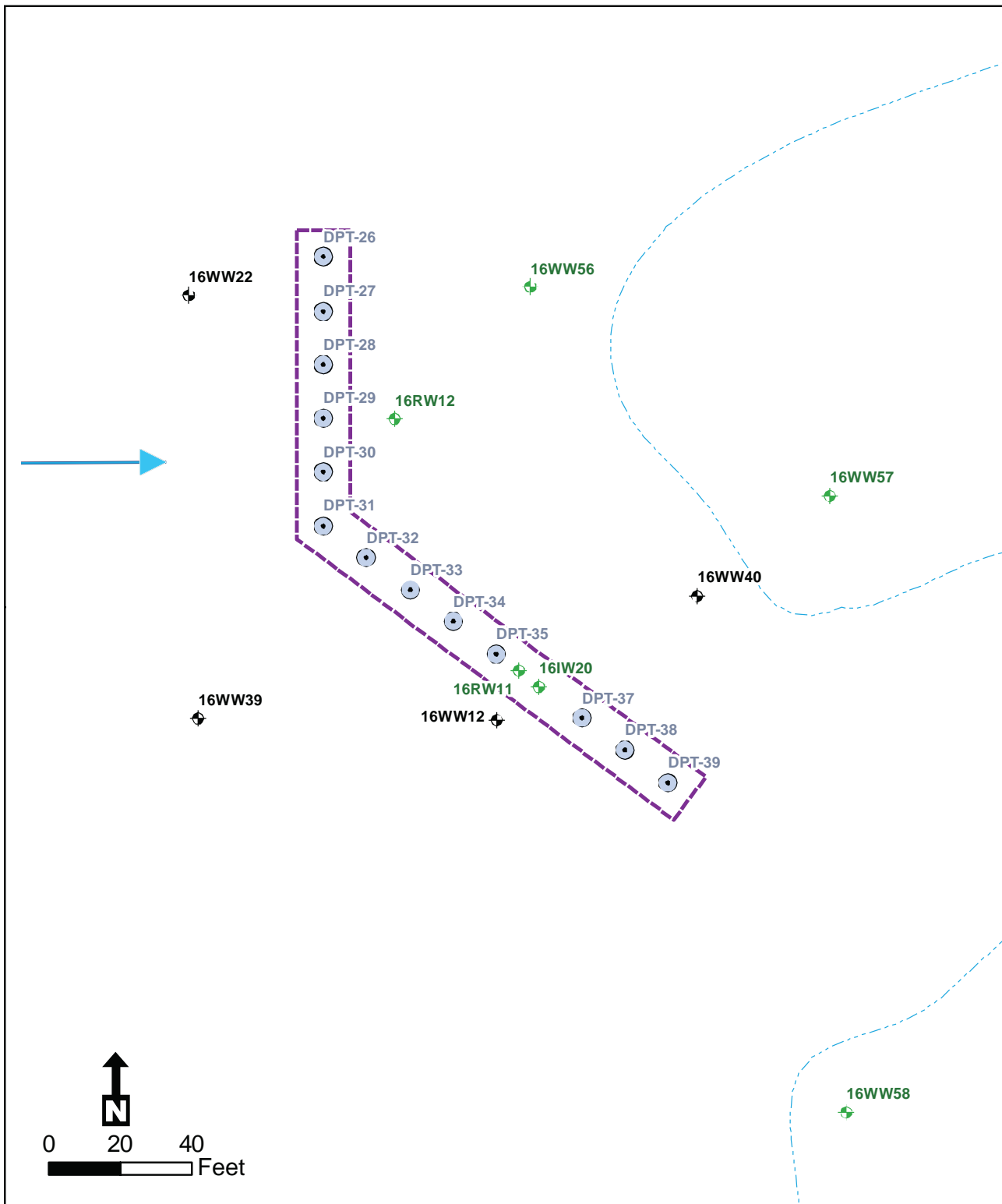
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Figure 3-4

Landfill Biobarrier #3
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Proposed Direct Push Injection Point
-  Existing Monitored Natural Attenuation Performance Monitoring Well
-  Proposed Shallow Well Location
IW = Injection Well
RW = Recovery Well Location
-  Groundwater Flow Direction Without Extraction (Shallow Zone)
-  Target In-Situ Reaction Zone Based on Design Radius of Influence



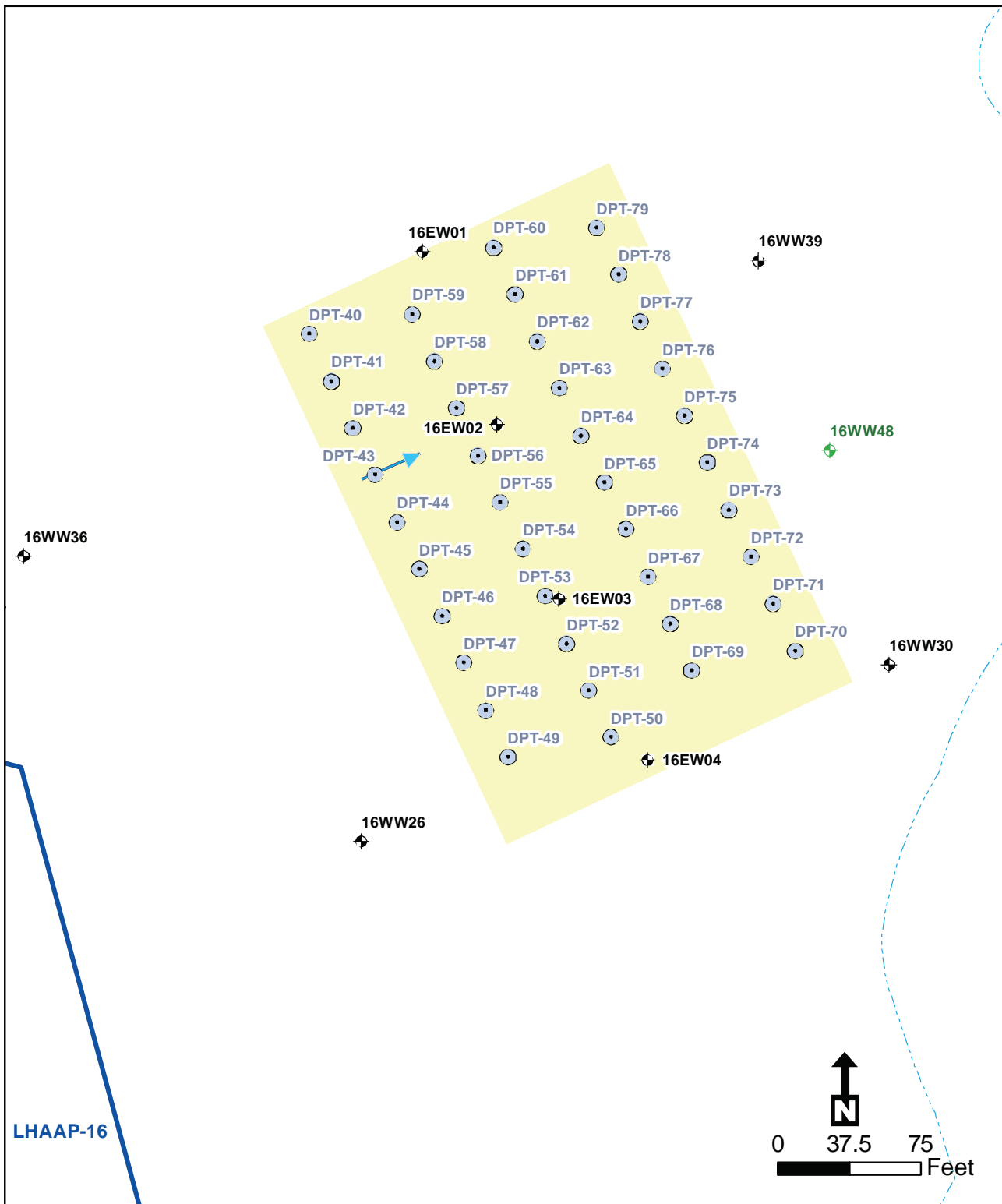
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

Figure 3-5


Bayou Biobarrier
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Existing Shallow Monitoring Well (WW) or Extraction Well (EW) Location
-  Proposed Direct Push Injection Point
-  Proposed Shallow Monitoring Well Location
-  Stream
-  Groundwater Flow Direction Without Extraction (Shallow Zone)
-  Shallow In Situ Bioremediation Area
-  LHAAP-16 Landfill Fence

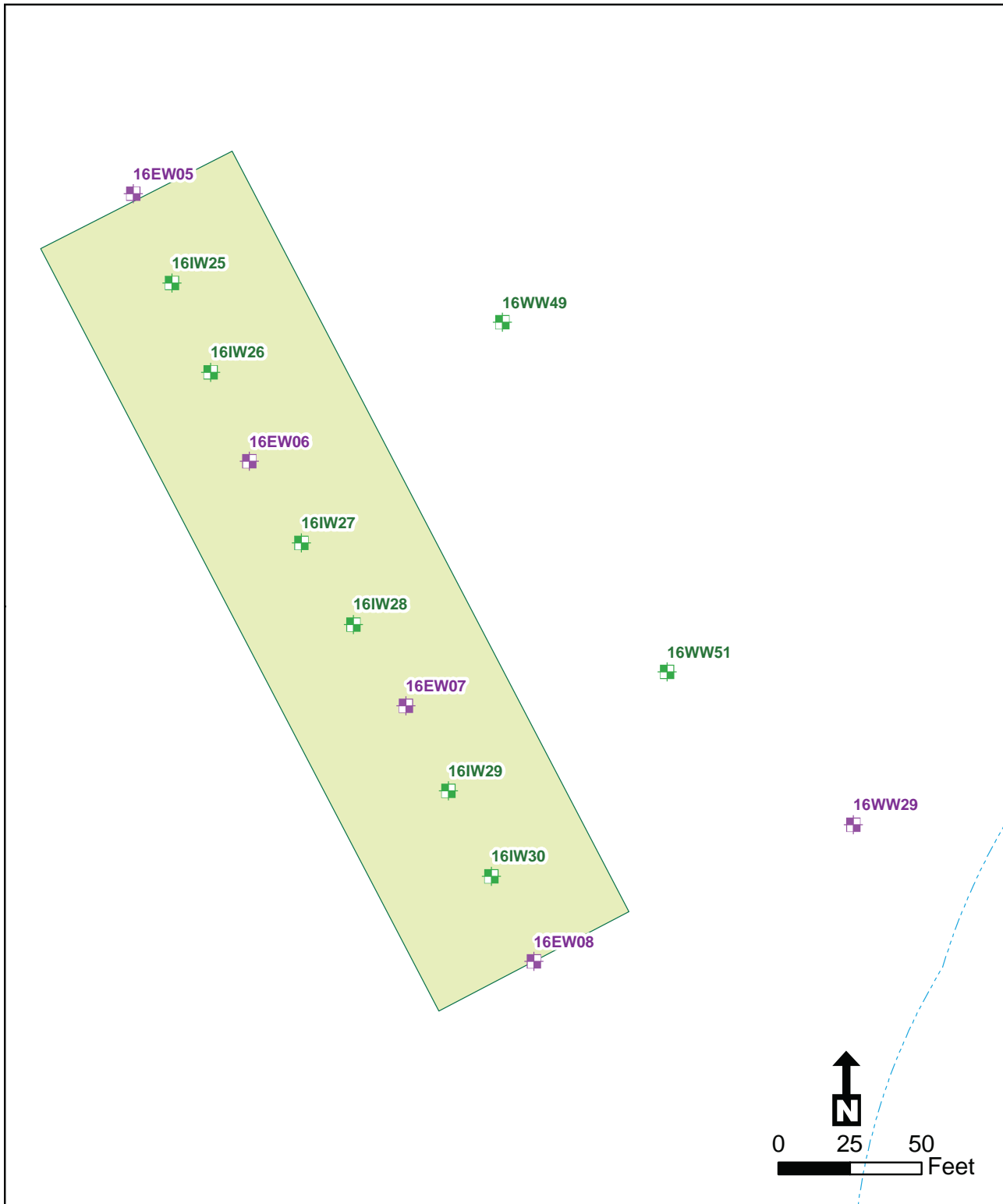






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Figure 3-6
Mid Plume Shallow Groundwater Zone
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Existing Intermediate Injection/Extraction/Monitoring Well (EW)
Existing Intermediate Monitoring Well (WW)
-  Proposed Intermediate Zone Injection/Monitoring Well (IW);
Proposed Intermediate Zone Monitoring Well (WW)
-  Stream
-  Intermediate Zone Situ Bioremediation Area



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Figure 3-7

Mid Plume Intermediate Groundwater Zone
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/22/2018

NOTE:
1. EVO – EMULSIFIED VEGETABLE OIL.

LEGEND:

- | O | BALL VALVE (OPEN)
- | ● | BALL VALVE (CLOSED)
- ◻ ECCENTRIC REDUCER
- ◻ CONCENTRIC REDUCER
- ⊥ CAMLOCK QUICK DISCONNECT
- ⊥ BALL LOCK QUICK DISCONNECT
- ⊥ PNEUMATIC ACTUATOR
- ⊥ SEAL
- ~ FLEXHOSE

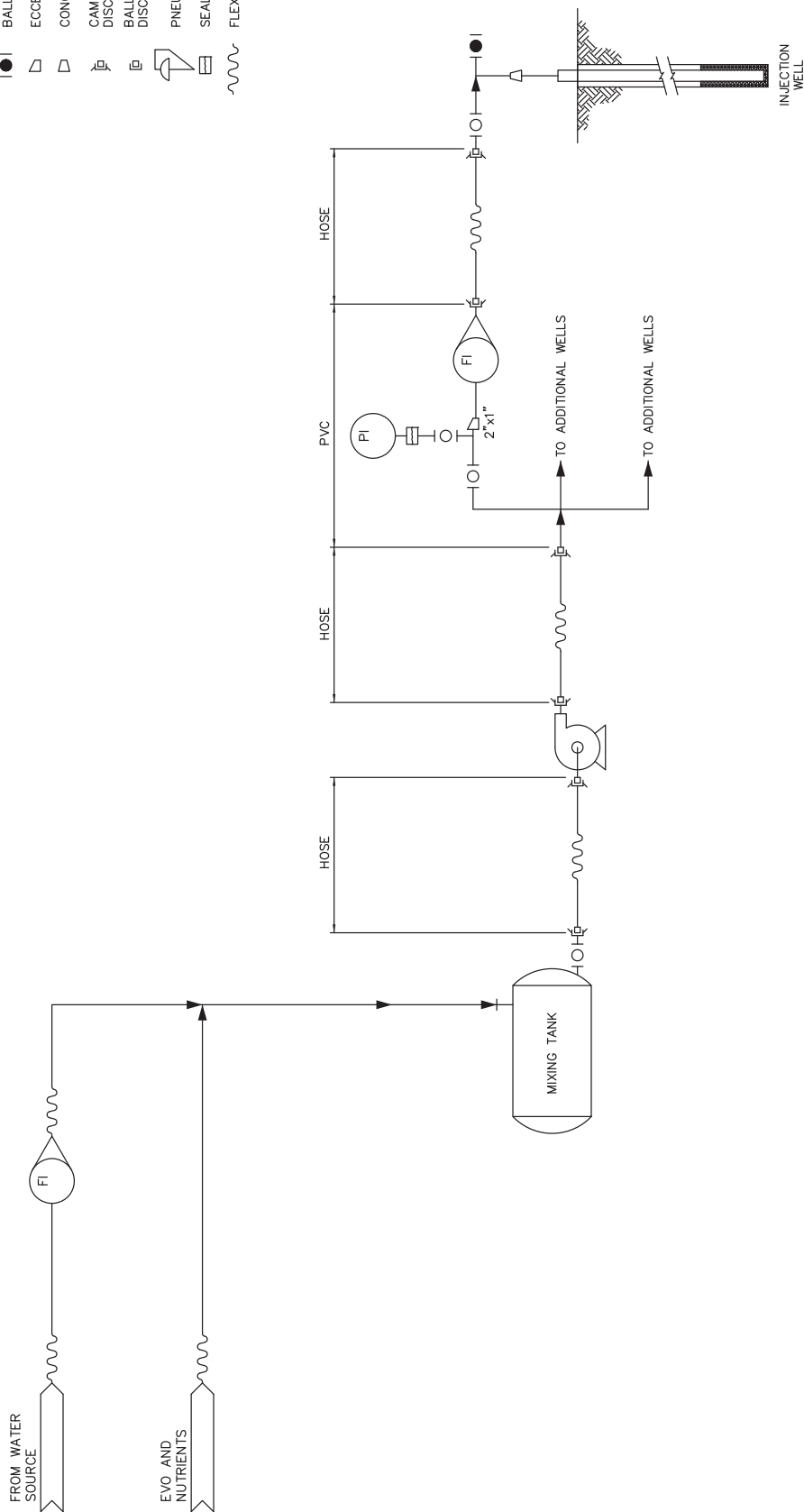
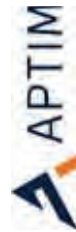
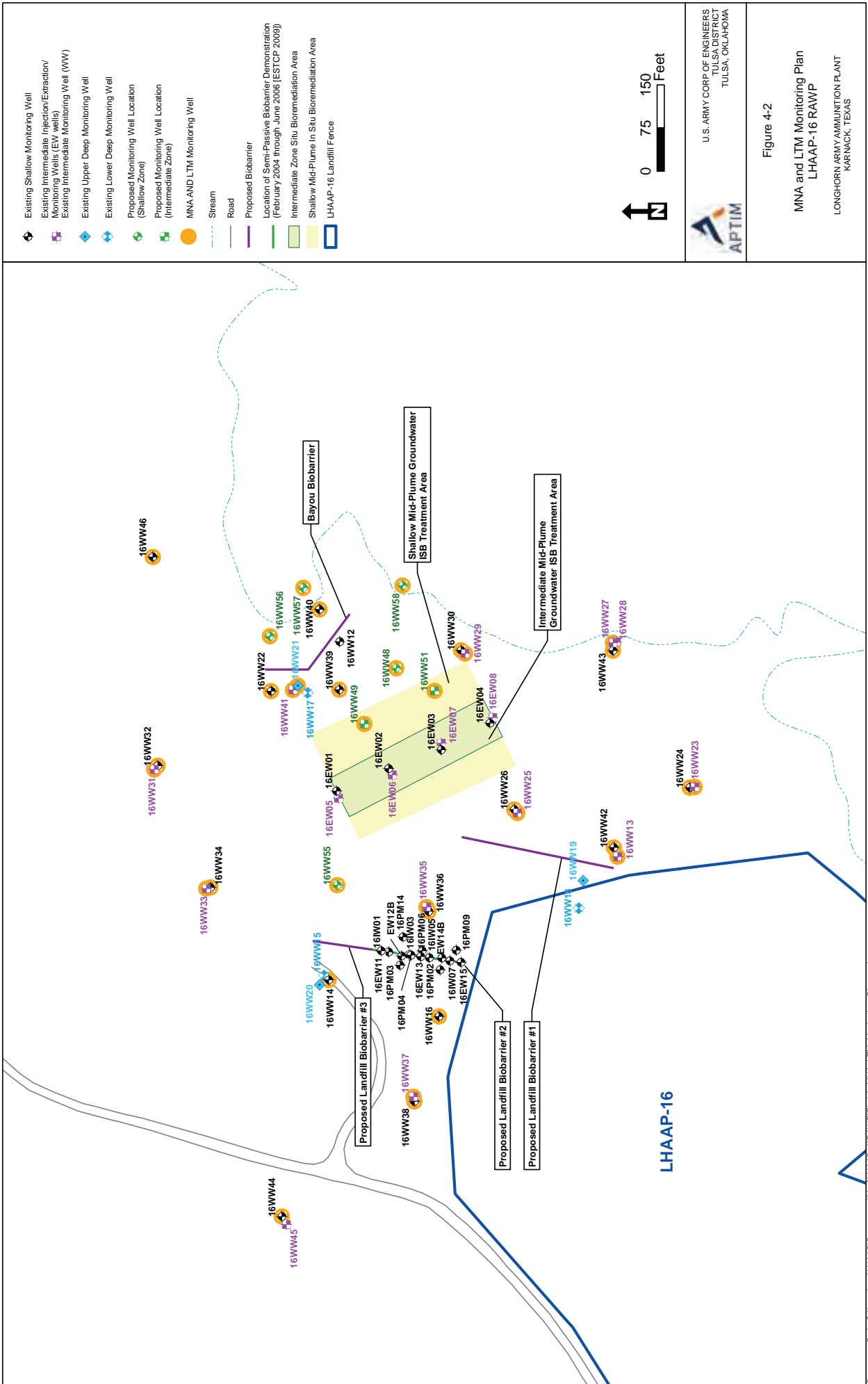


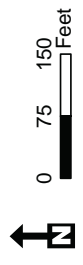
Figure 4-1

ISB Injection System
Hydrogeologic Testing/Pilot Test
Lorington Army Ammunition Plant, Karnack, TX



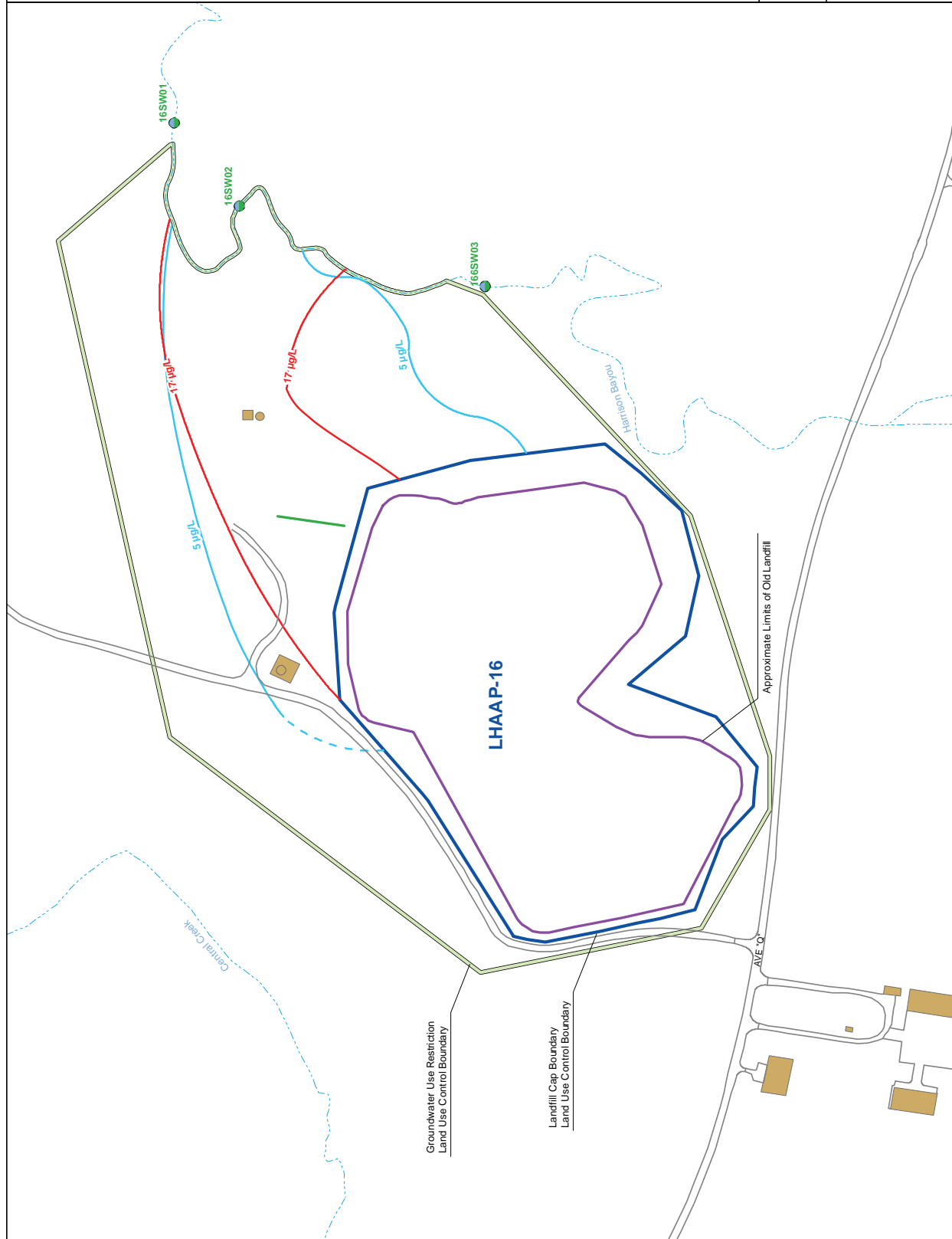


- Existing Shallow Monitoring Well
- Existing Intermediate Injection/Extraction/ Monitoring Wells (EW wells)
- Existing Intermediate Monitoring Well (WW)
- Existing Upper Deep Monitoring Well
- Existing Lower Deep Monitoring Well
- Proposed Monitoring Well Location (Shallow Zone)
- Proposed Monitoring Well Location (Intermediate Zone)
- MNA AND LTM Monitoring Well
- Stream
- Road
- Proposed Biobarrier
- Location of Semi-Passive Biobarrier Demonstration (February 2004 through June 2006 [ESTCP 2009])
- Intermediate Zone Situ Bioremediation Area
- Shallow Mid-Plume In Situ Bioremediation Area
- LHAAP-16 Landfill Fence



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Figure 4-2
MNA and LTM Monitoring Plan
LHAAP-16 RAWP
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS



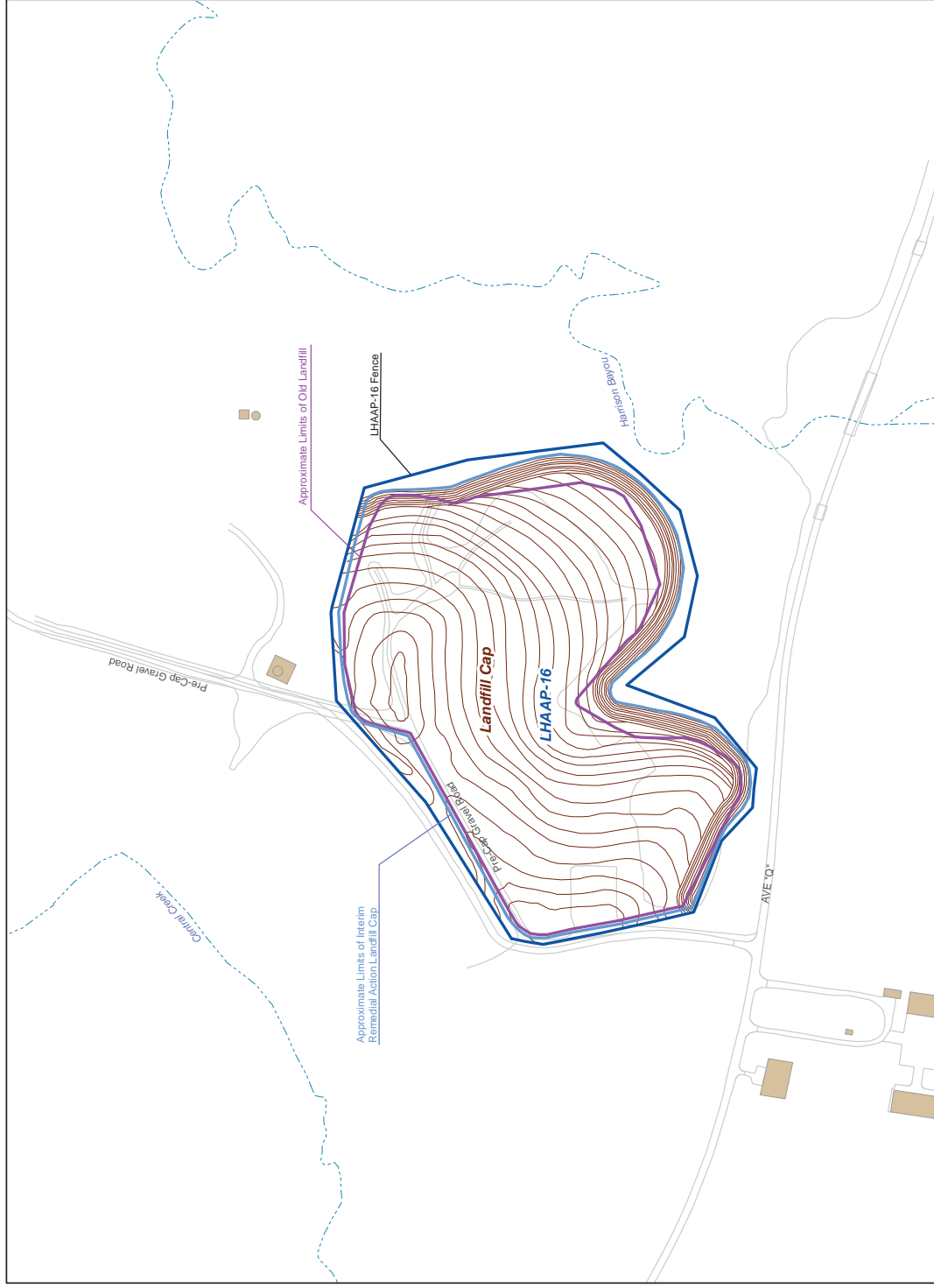
- Proposed Surface Water Sample Location
- Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (May 2013)
- Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)
- Location of Semi-Passive Blotbarrier Demonstration (February 2004 through June 2006 [ESTCP 2009])
- Stream
- Road
- Groundwater Use Restriction Land Use Control Boundary
- LHAAP-16 Landfill Fence

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Figure 4-3
Surface Water Sampling Locations
LHAAP-16 RAWP
LONGHORN ARMY AMMUNITION PLANT
KARWACK, TEXAS

Appendix A

Figures from Final Remedial Design



Legend

- Landfill Cap Contours
- Stream
- Road
- Building
- LHAAP-16 Landfill Fence

Source:
 1. Construction Completion Report, Interim Remedial Action, Landfills 12 and 16 Cap Construction (OHA, 1998).
 2. LHAAP-16 Record of Decision (U.S. Army 2011).

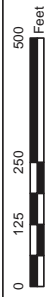
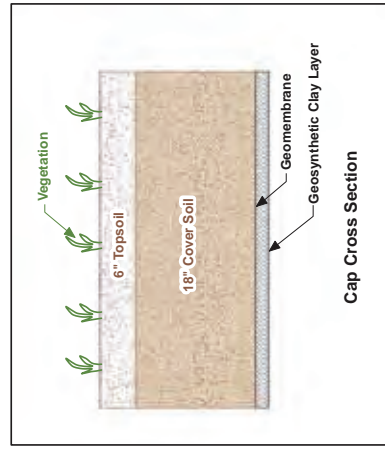
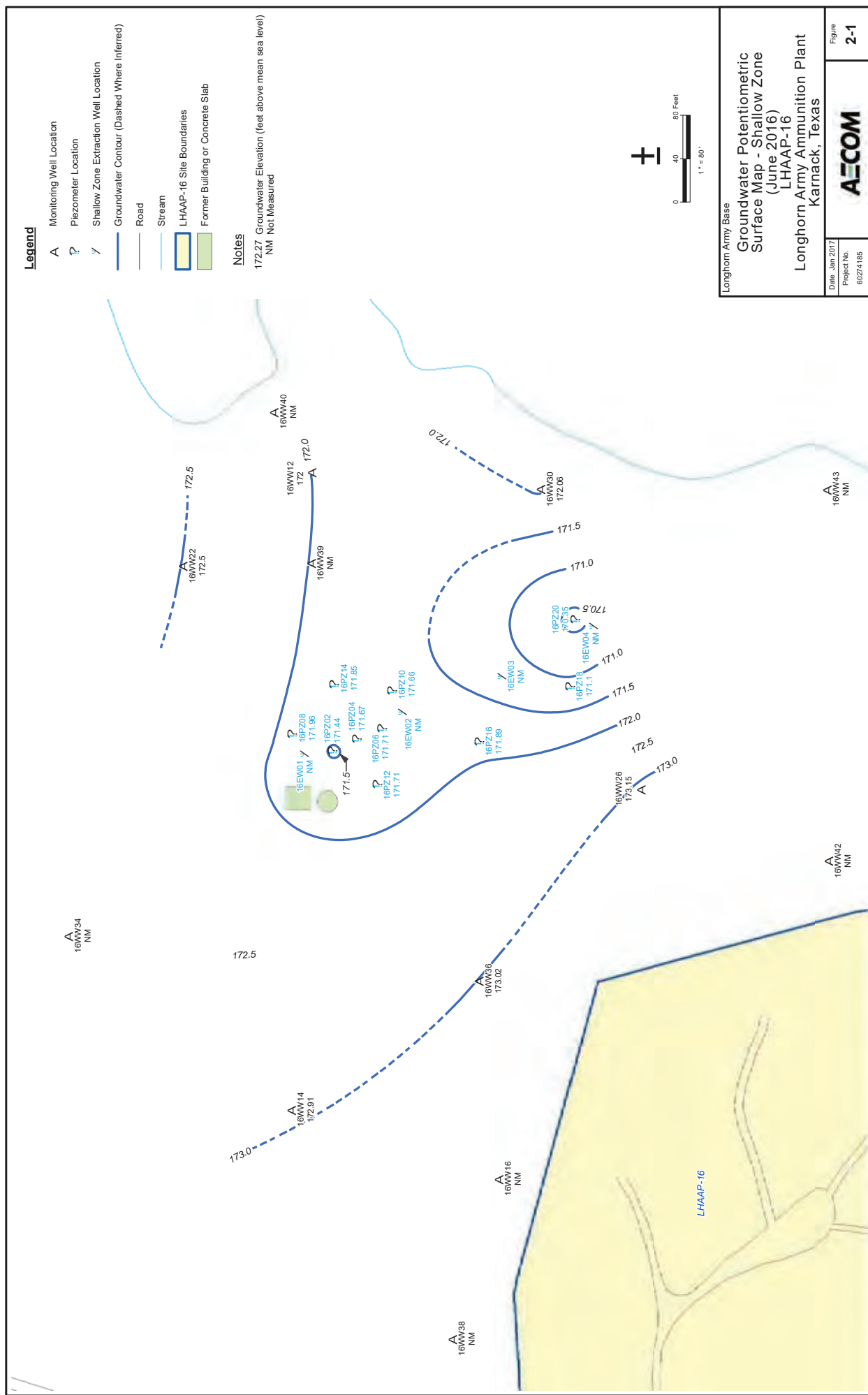


Figure 3-1
 Landfill Cap
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

60256135

January 2017



Legend

- A Monitoring Well Location
- ? Piezometer Location
- / Shallow Zone Extraction Well Location
- Groundwater Contour (Dashed Where Inferred)
- Road
- Stream
- LHAAP-16 Site Boundaries
- Former Building or Concrete Slab

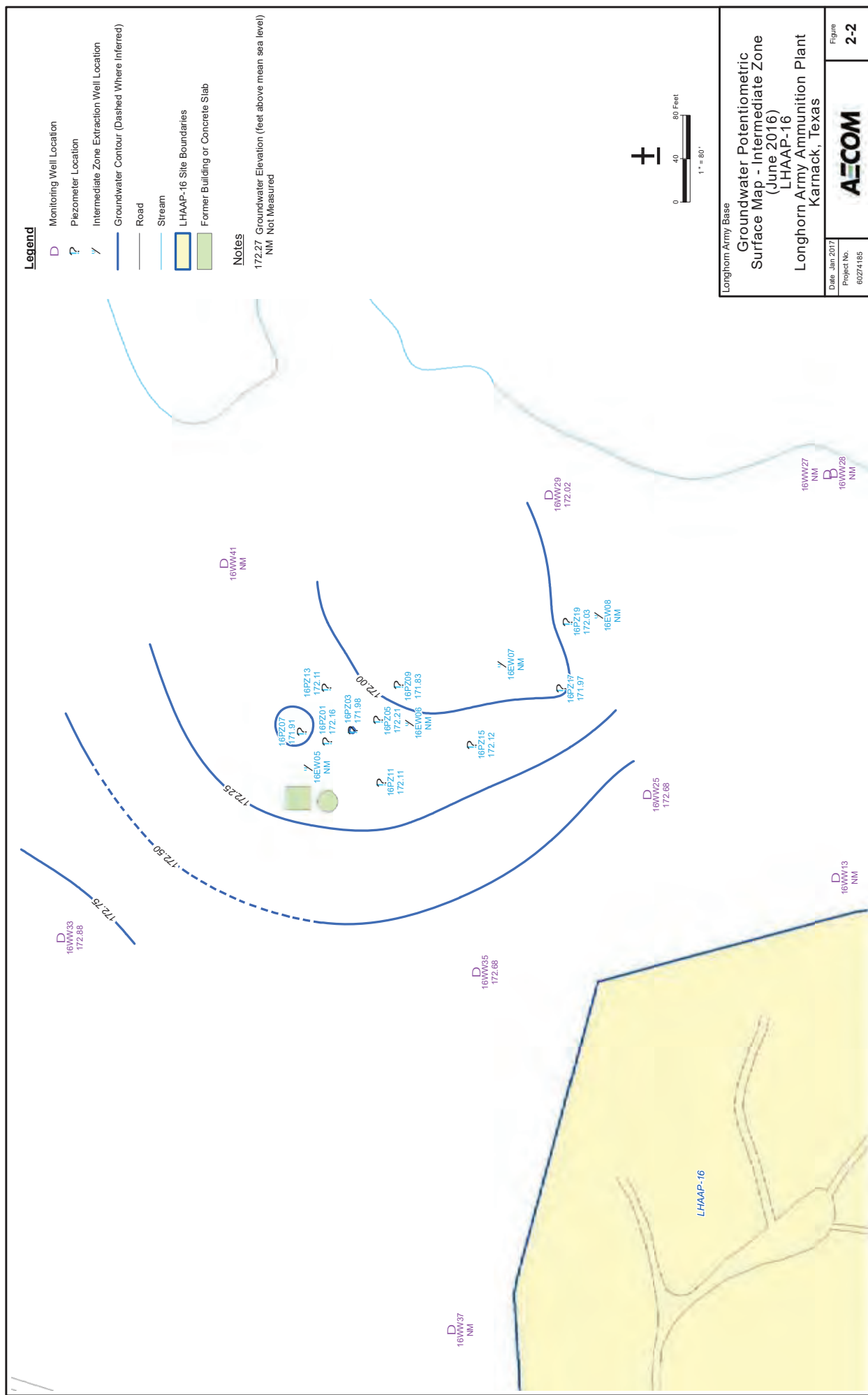
Notes

172.27 Groundwater Elevation (feet above mean sea level)
NM Not Measured

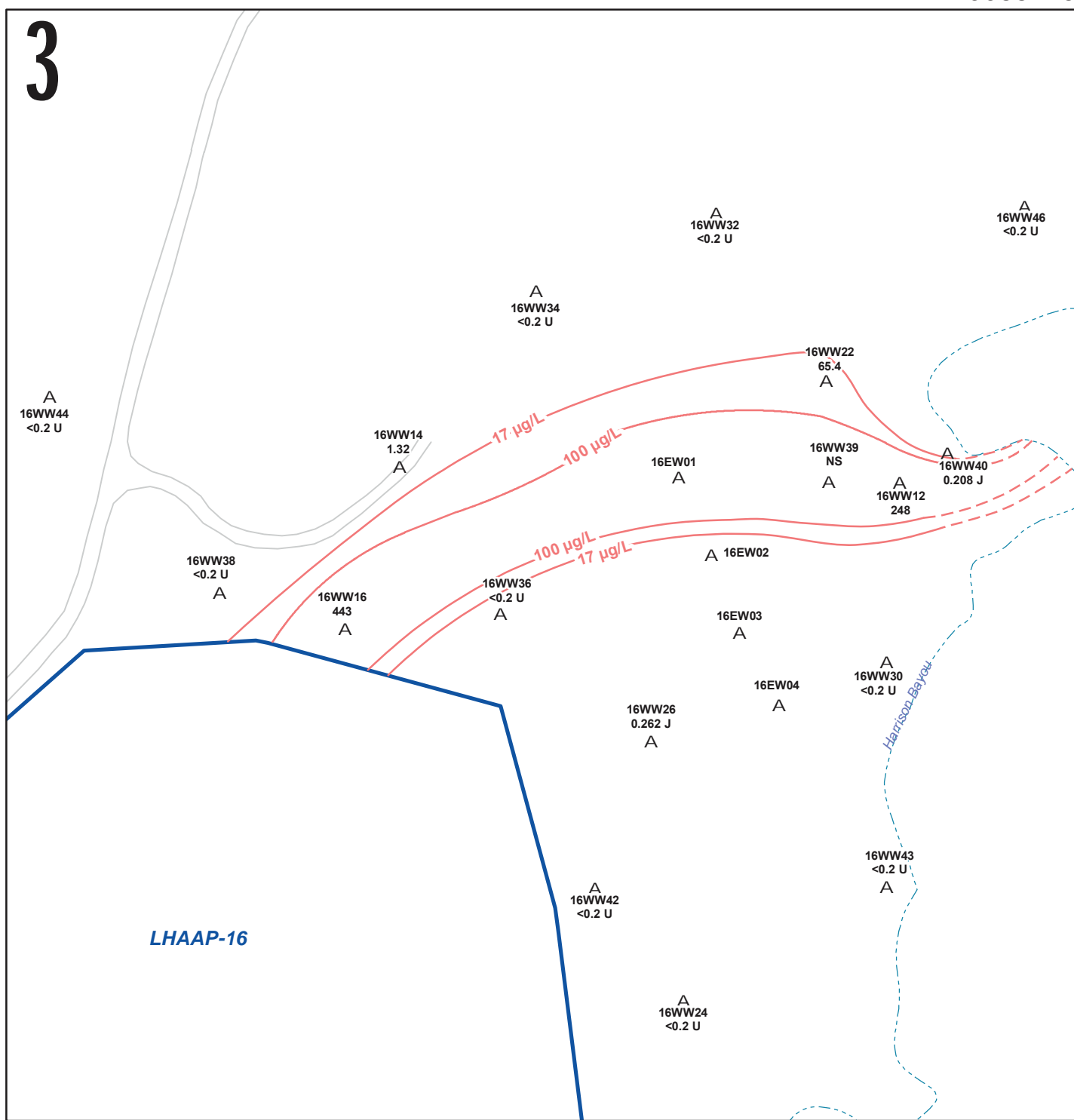
Longhorn Army Base
 Groundwater Potentiometric
 Surface Map - Shallow Zone
 (June 2016)
 LHAAP-16
 Longhorn Army Ammunition Plant
 Karnack, Texas

Date: Jan 2017	Figure
Project No. 60274185	2-1

AECOM



3



Legend

- A Shallow Monitoring Well
- Perchlorate Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

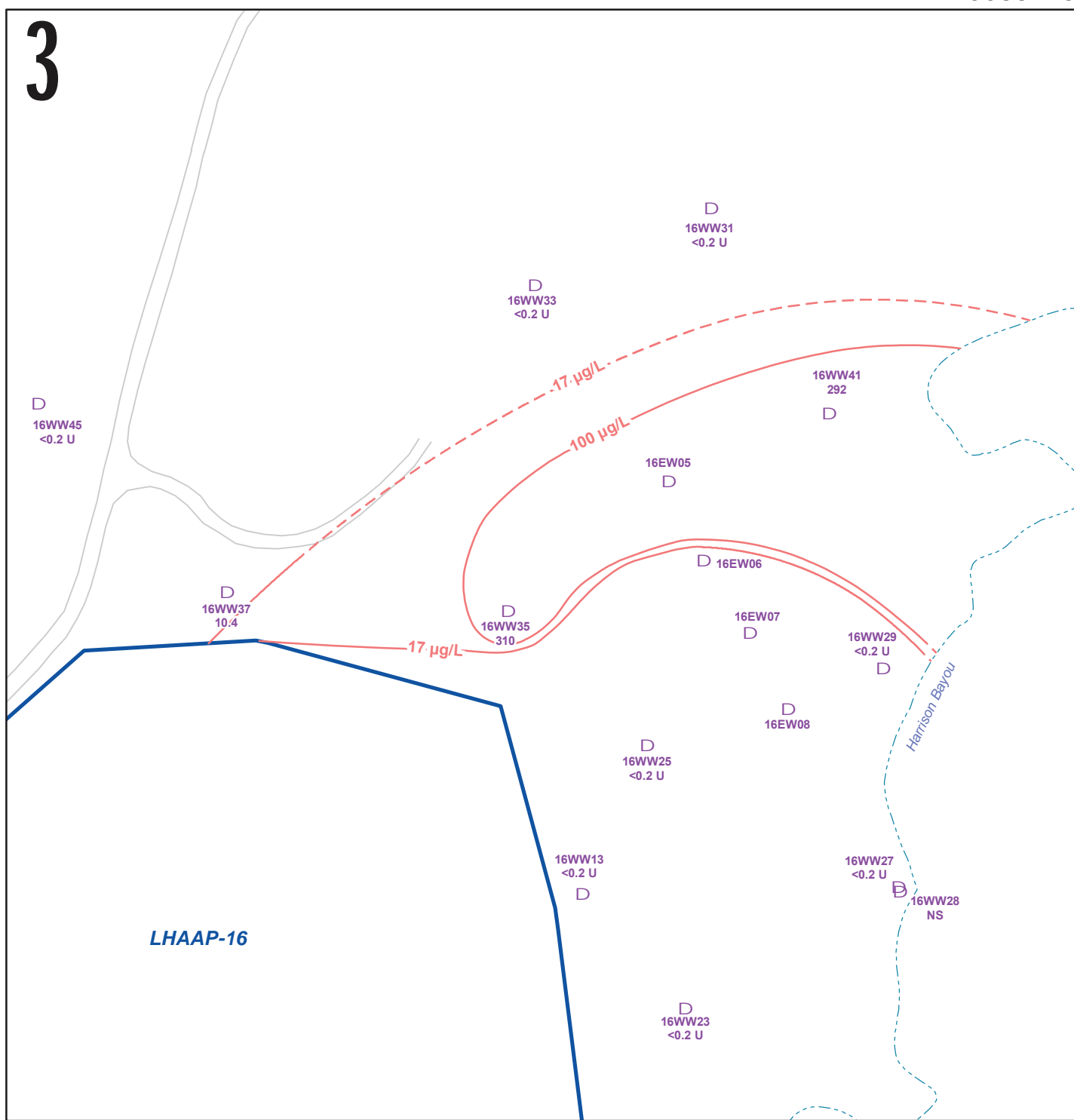
Notes:

Results are in micrograms per liter (µg/L)
 TRRP Residential PCL for Perchlorate = 17 µg/L.
 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.
 NS - Not Sampled



Figure 2-4
 Perchlorate Concentrations in Groundwater
 Shallow Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

3



Legend

- D Intermediate Monitoring Well
- Perchlorate Concentration Contour (Dashed Where Inferred)
- - - Stream
- Road
- LHAAP-16 Landfill Fence

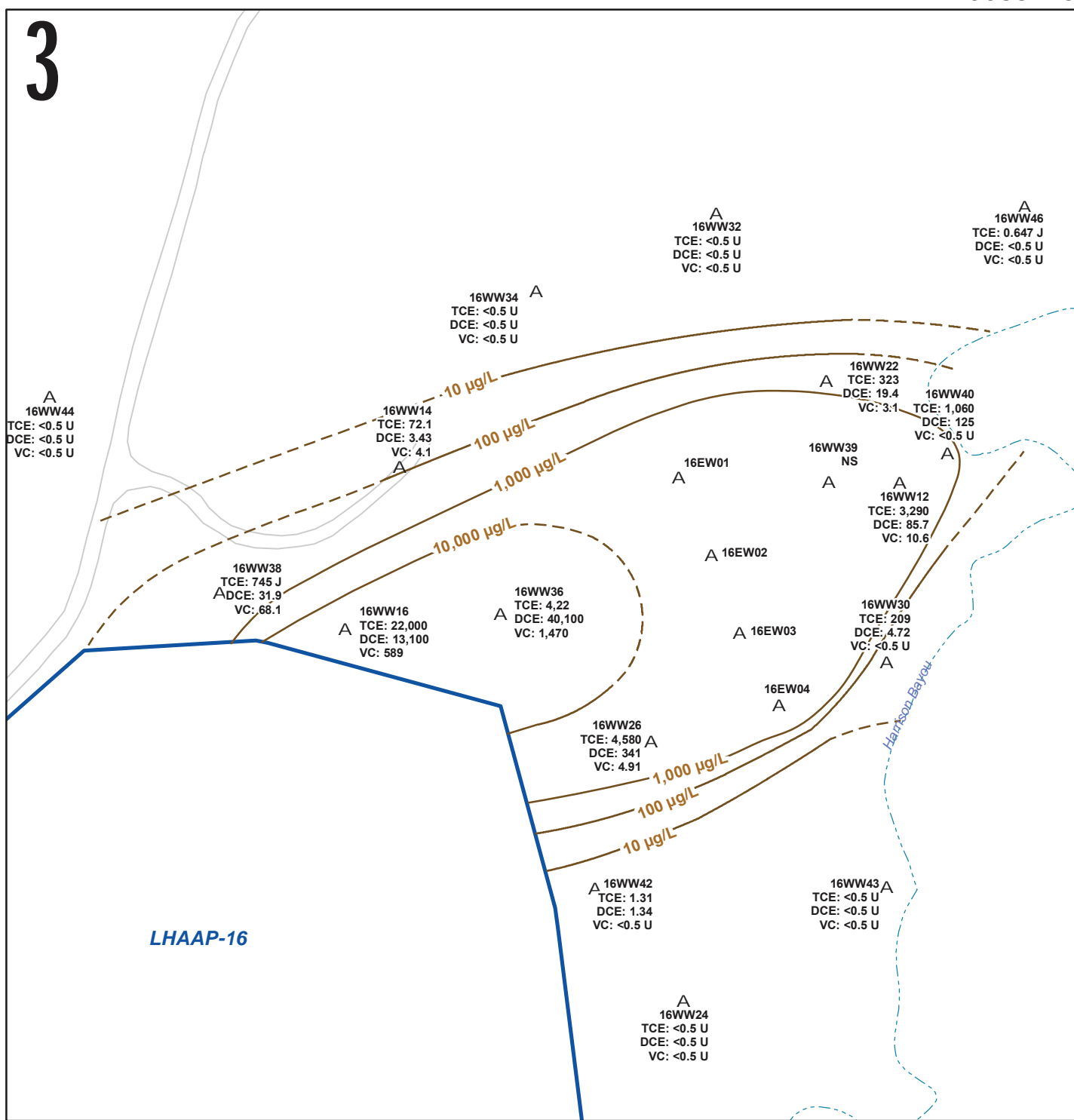
Notes:

Results are in micrograms per liter (µg/L)
 TRRP Residential PCL for Perchlorate = 17 µg/L.
 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.
 NS - Not Sampled



Figure 2-5
 Perchlorate Concentrations in Groundwater
 Intermediate Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

3



LHAAP-16

Legend

- A Shallow Monitoring Well
- TCE Concentration Contour (Dashed Where Inferred)
- - - Stream
- Road
- ▭ LHAAP-16 Landfill Fence

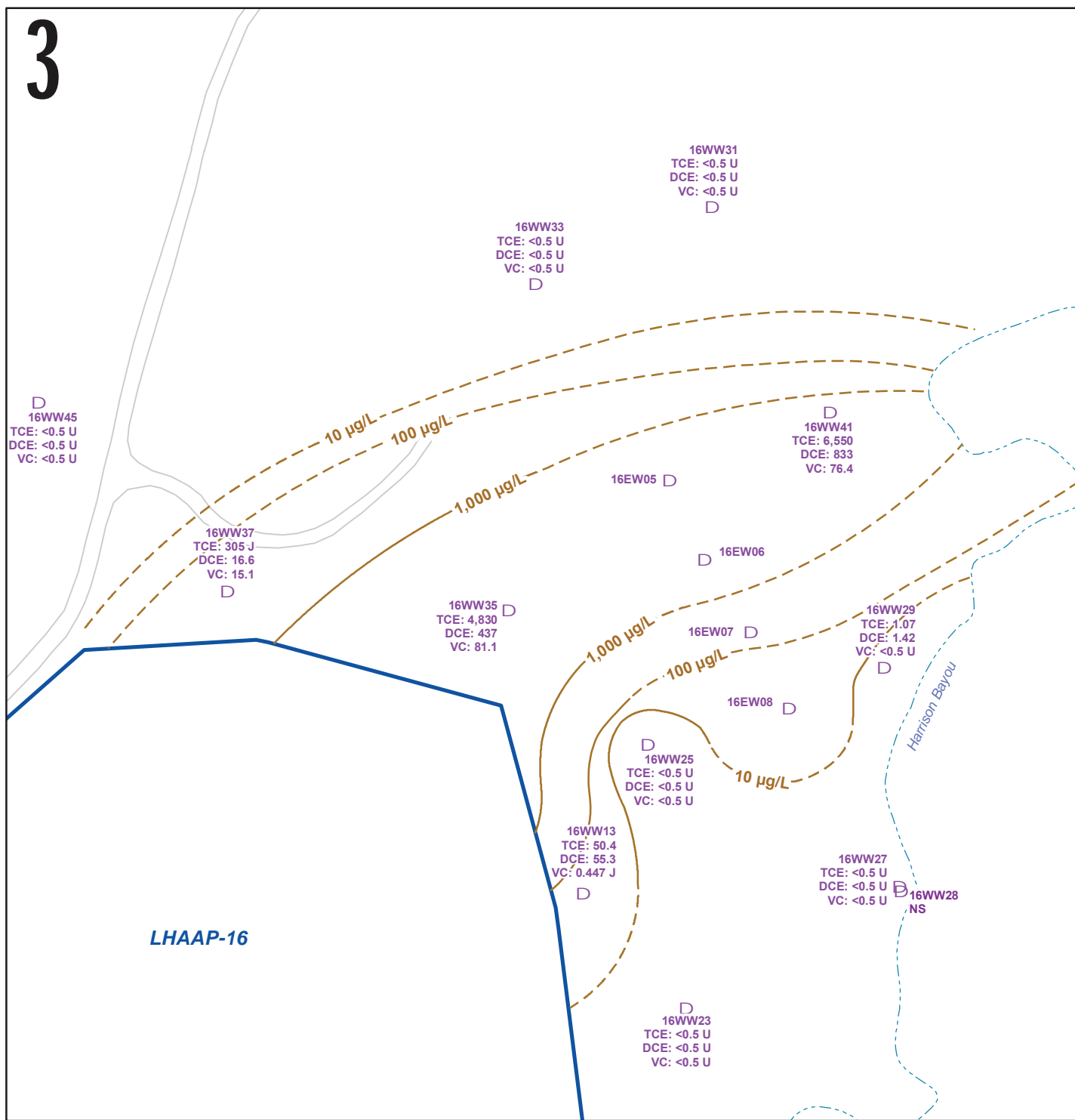
Notes:
 Results are in micrograms per liter (µg/L)
 DCE - cis-1,2-Dichloroethene
 U - Undetected: The analyte was analyzed for, but not detected.
 J - Estimated Value
 NS - Not Sampled
 TCE - Trichloroethene
 VC - Vinyl Chloride
 VOC - Volatile Organic Compound



Figure 2-6
 VOCs in Groundwater
 Shallow Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

Path: L:\AGE\GIS\GISProjects\Longhorn_AA\01_Reports\LHAAP-16\RAW\Fig 2-6 LHAAP-16 VOCs in Shallow Zone May 2013.mxd

3



Legend

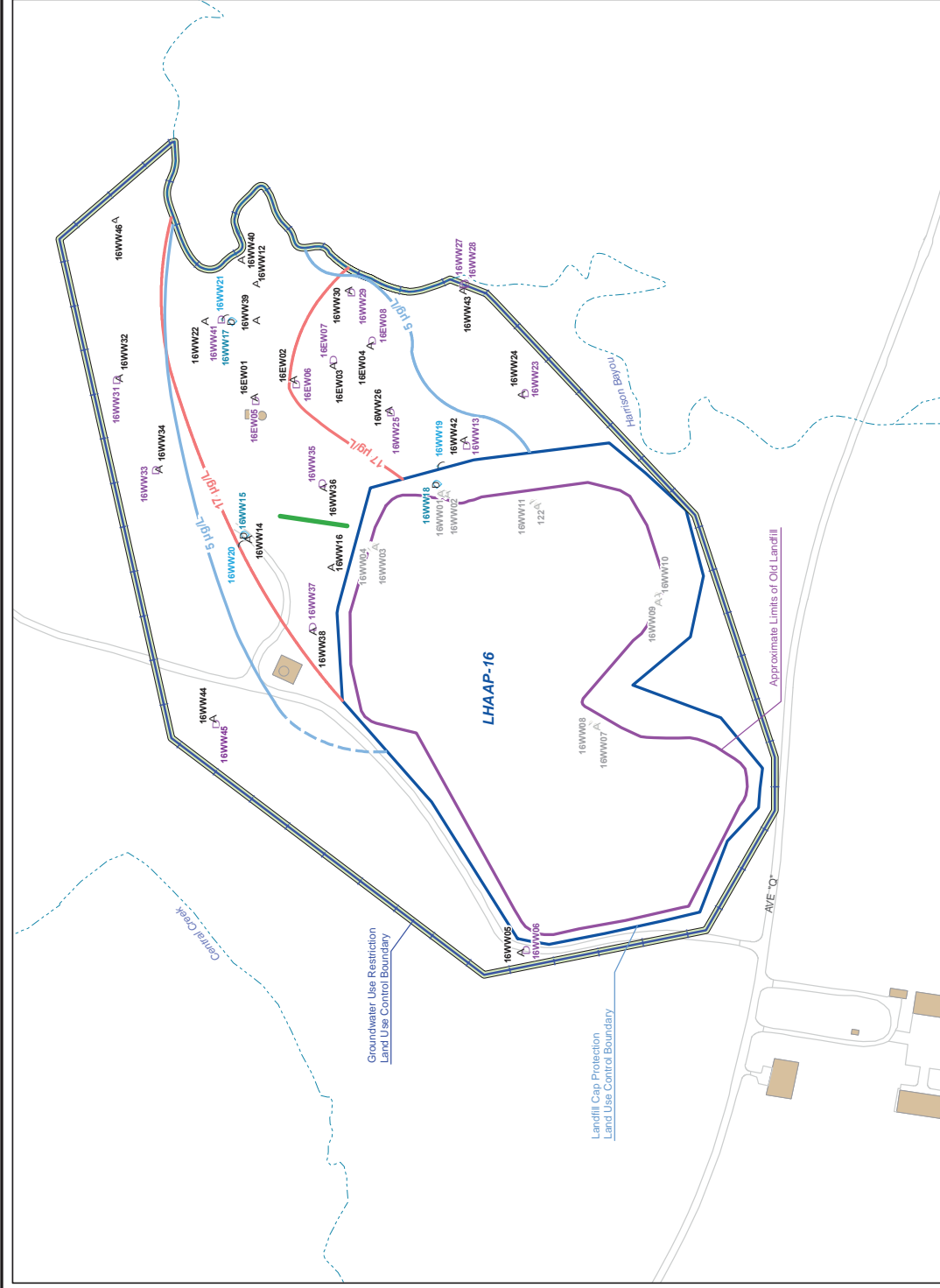
- D Intermediate Monitoring Well
- TCE Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

Notes:

Results are in micrograms per liter (µg/L)
 DCE - cis-1,2-Dichloroethene
 U - Undetected: The analyte was analyzed for, but not detected.
 J - Estimated Value
 NS - Not Sampled
 TCE - Trichloroethene
 VC - Vinyl Chloride
 VOC - Volatile Organic Compound



Figure 2-7
 VOCs in Groundwater
 Intermediate Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas



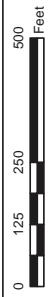
Legend

- A Existing Shallow Monitoring Well
- D Existing Intermediate Monitoring Well
- Existing Upper Deep Monitoring Well
- Existing Lower Deep Monitoring Well
- Abandoned or Plugged Well
- Extent of Perchlorate Contamination > 17 ug/L in Intermediate and Shallow Zones (May 2013)
- Extent of TCE Contamination > 5 ug/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)
- Location of Semi-Passive BioBarrier Demonstration (February 2004 through June 2006 [ESTCP 2009]).
- Road
- Stream
- Remedial and Monitoring System Boundary
- Groundwater Use Restriction Land Use Control Boundary
- LHAAP-16 Landfill Fence



Figure 5-1
 Land Use Control Boundaries
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

160256135



Appendix B

Annual Land Use Control Compliance Inspection Form

Annual Land Use Control Compliance Inspection Form

In accordance with the Remedial Design dated _____ for LHAAP-16 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;
- Landfill integrity - preserve the integrity of the landfill cap and restrict intrusive activities (e.g., digging) that would degrade or alter the cap;
- 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 landfill intrusive activities (e.g., digging) that would degrade or alter the landfill cap; maintenance of vegetative cover and repair of soil subsidence or erosion areas on the cap;
- 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.

Appendix C

Safety Data Sheets



SITEMAP SEARCH FEEDBACK LOGIN REGISTRATION EMPLOYMENT DOWNLOADS

HOME ABOUT PRODUCTS SERVICES LOCATIONS NEWS COST ESTIMATES

search...

Home Products ABC+

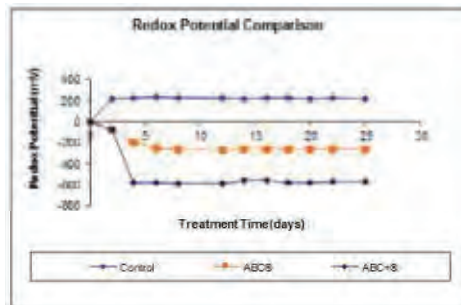
SATURDAY, 18 JUNE 2016

ABC+

ANAEROBIC BIOCHEM PLUS (ABC®+)

ABC+ an enhanced version of our industry proven

Anaerobic Biochem (ABC®) formula, promoting both anaerobic biodegradation and reductive dechlorination of halogenated solvents in groundwater. This product, Anaerobic Biochem Plus (ABC+), is a mixture of our ABC® formula and Zero Valent Iron (ZVI). Formulated and mixed on a site-by-site basis, up to fifty percent (50%) by weight of ZVI can be added. ZVI has been proven and widely accepted as an effective in situ remediation technology of chlorinated solvents such as TCA, PCE, TCE, and daughter products. The degradation process using ZVI is an abiotic reductive dechlorination process occurring on the surface of the granular iron, with the iron acting as an electron donor.



The addition of ZVI to the ABC® mixture provides a number of advantages for enhanced reductive dechlorination (ERD).

The ZVI will provide an immediate reduction. The ABC® will provide short-term and long-term nutrients to anaerobic growth, which also assists to create a reducing environment. ABC® contains soluble lactic acid and a phosphate buffer that provides phosphates, which are a micronutrient for bioremediation, and maintains the pH in a range that is best suited for microbial growth. In addition, the corrosion of iron metal yields ferrous iron and hydrogen, both of which are possible reducing agents. The hydrogen gas produced is also an excellent energy source for a wide variety of anaerobic bacteria.

The ABC® and ZVI are mixed with potable water and emplaced in the subsurface simultaneously. The dilution factor (i.e. water content) can be adjusted to achieve optimal dispersion and distribution based on site-specific parameters such as well spacing, permeability of the formation, and contaminant concentrations. The solution can be emplaced by a variety of techniques, including injection through wells or drill rods (for permeable geologic environments such as sands and fractured rock), hydraulic fracturing (for lower permeable environments such as silt and clay), and through soil blending (for all unconsolidated shallow depth applications less than 20 ft bgs). All of these techniques are part of Redox Tech's service offerings.

Benefits of ABC+ include:

- The presence of ZVI allows for the rapid and complete dechlorination of target compounds. Degradation rates using ZVI are several orders of magnitude greater than under natural conditions. As a consequence, the process does not result in the formation of daughter products other than ethane, ethane, and methane.
- ABC® will last up to 12-24 months in the subsurface environment due to slow releasing compounds, allowing for long-term anaerobic biodegradation
- By creating a reducing environment, ABC+ has the ability to provide long term immobilization of heavy metals (e.g. Ni, Zn, Hg, As)
- Does not require direct contact to act on target constituents.
- Does not divert groundwater flow. ABC is typically mixed at a 15% by weight solution with water. The viscosity of the solution is similar to sugar water and therefore does not measurably influence groundwater flow paths. Due to the relatively low volume of ZVI used, it does not measurably lower the bulk permeability of the formation
- Does not divert groundwater flow. ABC is typically mixed at a 15% by weight solution with water. The viscosity of the solution is similar to sugar water and therefore does not measurably influence groundwater flow paths. Due to the relatively low volume of ZVI used, it does not measurably lower the bulk permeability of the formation
- Patent protection: Redox Tech is licensed under Envirometal Technologies, Inc. (an Adventus Company) who is the current holder of patents pertaining to remediation using ZVI. Therefore, Redox Tech is able to market, sell, and emplace our ABC+ product. There is no patent infringement risk to the client in selecting the ABC+ approach.
- Price advantage. The cost of the ABC+ formula is an extremely competitive approach in relation to other ERD products on the market.

SUB MENU

ABC®

ABC+

ABC-OLÉ

OBC™

OBC+

NUBUFF

ZVI

ANAEROBIC BIOCHEM

Anaerobic Biochem (ABC®), is a patented mixture of lactates, fatty acids, and a phosphate buffer that promotes anaerobic biodegradation of halogenated solvents in groundwater.

Adobe PDF ABC® BROCHURE
Adobe PDF File
[Click here](#)

LATEST NEWS

[Redox Tech Introduces NuBuff](#)

[Redox Tech, LLC Renews](#)

[Comarketing Relationship with](#)

[Carus Corporation](#)

[New Soil Blender Debuts in](#)

[Cambridge, Mass](#)

[ABC® and ABC+ Applied at Over](#)

[350 Sites](#)

[Anaerobic BioChem \(ABC®\), The](#)

["Green" Substrate](#)

- ABC+ produces a significantly lower redox potential of approximately -600 mV

Let Redox Tech help formulate an enhanced anaerobic program for your site today. For more information contact our [Main Office](#).

ADDITIONAL INFO

BROCHURES & PRESENTATIONS

[ABC+ Presentation \(713.91 kB\)](#)

[ABC+ Presentation \(58.6 kB\)](#)

CASE STUDIES

[ABC+ TCA Case Study \(101.76 kB\)](#)

OTHER DOCUMENTS

[ABC versus Emulsified Oils \(55.99 kB\)](#)

[Site Profile for Cost Estimate \(27.11 kB\)](#)

[Florida Remediation Conference \(2.23 MB\)](#)

[Lactate \(webpage\)](#)

¹ABC[®] is protected by US Patent 6,001,252.

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SAFETY DATA SHEET

Anaerobic BioChem (ABC)

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Anaerobic BioChem
GENERAL USE: Bioremediation of halogenated organics and metals

MANUFACTURER:

Redox Tech, LLC
200 Quade Drive
Cary, NC 27513
919-678-0140

EMERGENCY TELEPHONE:

Within USA and Canada: 1-800-424-9300
+1 703-527-3887 (collect calls accepted)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Product is generally recognized as safe. May cause irritation exposure to eyes. Long term contact to skin may cause some drying and minor irritation.

3. COMPOSITION INFORMATION ON INGREDIENTS

Proprietary mixture of fatty acids, glycerol, lactates and dipotassium phosphate.

4. FIRST AID MEASURES

EYES: Immediately flush with water for up to 15 minutes. If irritation persists, seek medical attention.

SKIN: Rinse with water. Irritation is unlikely, but if irritation occurs or persists, seek medical attention.

INGESTION: Generally safe to ingest but not recommended.

INHALATION: No first aid required.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water

FIRE/EXPLOSION HAZARDS: Product is combustible only at temperatures above 600C

FIRE FIGHTING PROCEDURES: Use flooding with plenty of water, carbon dioxide or other inert gasses. Wear full protective clothing and self-contained breathing apparatus. Deluging with water is the best method to control combustion of the product.

ABC

November2014

FLAMMABILITY LIMITS: non-combustible**SENSITIVITY TO IMPACT:** non-sensitive**SENSITIVITY TO STATIC DISCHARGE:** non-sensitive

6. ACCIDENTAL RELEASE MEASURES

Confine and collect spill. Transfer to an approved DOT container and properly dispose. Do not dispose of or rinse material into sewer, stormwater or surface water. Discharge of product to surface water could result in depressed dissolved oxygen levels and subsequent biological impacts.

7. HANDLING AND STORAGE

HANDLING: Protective gloves and safety glasses are recommended.

STORAGE: Keep dry. Use first in, first out storage system. Keep container tightly closed when not in use. Avoid contamination of opened product. Avoid contact with reducing agents.

8. EXPOSURE CONTROLS – PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
ABC	NA	NA	NA

ENGINEERING CONTROLS: None are required

PERSONAL PROTECTIVE EQUIPMENT

EYES and FACE: Safety glasses recommended

RESPIRATOR: none necessary

PROTECTIVE CLOTHING: None necessary

GLOVES: rubber, latex or neoprene recommended but not required

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	none to mild pleasant organic odor
Appearance:	clear to light amber
Auto-ignition Temperature	Non-combustible
Boiling Point	>600 C
Melting Point	NA
Density	1.15 gram/cc
Solubility	infinite
pH	7-9

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID: Do not contact with strong oxidizers

STABILITY: product is stable

POLYMERIZATION: will not occur

INCOMPATIBLE MATERIALS: strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS:

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

A: General Product Information

Acute exposure may cause mild skin and eye irritation.

B: Component Analysis - LD50/LC50

No information available.

B: Component Analysis - TDLo/LDLo

TDLo (Oral-Man) none

Carcinogenicity

A: General Product Information

No information available.

B: Component Carcinogenicity

Product is not listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

Epidemiology

No information available.

Neurotoxicity

No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Discharge to water may cause depressed dissolved oxygen and subsequent ecological stresses

Environmental Fate

No potential for food chain concentration

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Material is not considered hazardous, but consult with local, state and federal agencies prior to disposal to ensure all applicable laws are met.

ABC

November2014

14. TRANSPORT INFORMATION

NOTE: The shipping classification information in this section (Section 14) is meant as a guide to the overall classification of the product. However, transportation classifications may be subject to change with changes in package size. Consult shipper requirements under I.M.O., I.C.A.O. (I.A.T.A.) and 49 CFR to assure regulatory compliance.

US DOT Information

Shipping Name: Not Regulated

Hazard Class: Not Classified

UN/NA #: Not Classified

Packing Group: None

Required Label(s): None

50th Edition International Air Transport Association (IATA):

Not hazardous and not regulated

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

Material is not regulated under IMDG

15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III

SECTION 311 No Hazard for Immediate health Hazard

SECTION 312 No Threshold Quantity

SECTION 313 Not listed

CERCLA NOT REGULATED UNDER CERCLA

TSCA NOT REGULATED UNDER TSCA

CANADA (WHIMS): NOT REGULATED

16. OTHER INFORMATION

HMIS:

Health	1
Flammability	0
Physical Hazard	0
Personal Protection	E

E: Safety Glasses, gloves

Material Safety Data Sheet

Shaw Environmental, Inc.
17 PRINCESS ROAD
LAWRENCEVILLE, N.J. 08648
(609) 895-5340

SECTION 1 - MATERIAL IDENTIFICATION AND INFORMATION

Material Name: DHC microbial consortium (SDC-9) MSDS #: ENV 1033

Date Prepared: 10/06/2003 CAS #: N/A (Not Applicable)

Prepared By: Simon Vainberg Formula #: N/A

Material Description: Non-hazardous, naturally occurring non-altered anaerobic microbes and enzymes in a water-based medium.

SECTION 2 - INGREDIENTS

Components	%	OSHA PEL	ACGIH TLV	OTHER LIMITS
Non-Hazardous Ingredients	100	N/A	N/A	N/A

SECTION 3 - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: 100°C (water) Specific Gravity (H₂O = 1): 0.9 - 1.1

Vapor Pressure @ 25°C: 24 mm Hg (water) Melting Point: 0°C (water)

Vapor Density: N/A Evaporation Rate (H₂O = 1): 0.9 - 1.1

Solubility in Water: Soluble Water Reactive: No

pH: 6.0 - 8.0

Appearance and Odor: Murky, yellow water. Musty odor.

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)
PAGE 2 OF 4
October 6, 2003

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Flammable Limits: N/A

Extinguishing Media: Foam, carbon dioxide, water

Special Fire Fighting Procedures: None

Unusual Fire and Explosion Hazards: None

SECTION 5 - REACTIVITY DATA

Stability: Stable

Conditions to Avoid: None

Incompatibility (Materials to Avoid): Water-reactive materials

Hazardous Decomposition Byproducts: None

SECTION 6 - HEALTH HAZARD DATA

HEALTH EFFECTS

The effects of exposure to this material have not been determined. Safe handling of this material on a long-term basis will avoid any possible effect from repetitive acute exposures. Below are possible health effects based on information from similar materials. Individuals hyper allergic to enzymes or other related proteins should not handle.

Ingestion: Ingestion of large quantities may result in abdominal discomfort including nausea, vomiting, cramps, diarrhea, and fever.

Inhalation: Hypersensitive individuals may experience breathing difficulties after inhalation of aerosols.

Skin Absorption: N/A

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)

PAGE 3 OF 4

October 6, 2003

Skin Contact: May cause skin irritation. Hypersensitive individuals may experience allergic reactions to enzymes.

Eye Contact: May cause eye irritation.

FIRST AID

Ingestion: Get medical attention if allergic symptoms develop (observe for 48 hours). Never give anything by mouth to an unconscious or convulsing person.

Inhalation: Get medical attention if allergic symptoms develop.

Skin Absorption: N/A

Skin Contact: Wash affected area with soap and water. Get medical attention if allergic symptoms develop.

Eye Contact: Flush eyes with plenty of water for at least 15 minutes using an eyewash fountain, if available. Get medical attention if irritation occurs.

NOTE TO PHYSICIANS: All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this material may have occurred.

SECTION 7 - SPILL AND LEAK PROCEDURES

Reportable quantities (in lbs of EPA Hazardous Substances): N/A

Steps to be taken in case of spill or release: No emergency results from spillage. However, spills should be cleaned up promptly. All personnel involved in the cleanup must wear protective clothing and avoid skin contact. Absorb spilled material or vacuum into a container. After clean-up, disinfect all cleaning materials and storage containers that come in contact with the spilled liquid.

Waste Disposal Method: No special disposal methods are required. The material may be sewerred, and is compatible with all known biological treatment methods. To reduce odors and permanently inactivate microorganisms, mix 100 parts (by volume) of DHC consortium with 1 part (by volume) of bleach. Dispose of in accordance with local, state and federal regulations.

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)
PAGE 4 OF 4
October 6, 2003

SECTION 8 - HANDLING AND STORAGE

Hand Protection: Rubber gloves.

Eye Protection: Safety goggles with side splash shields.

Protective Clothing: Use adequate clothing to prevent skin contact.

Respiratory Protection: Surgical mask.

Ventilation: Provide adequate ventilation to remove odors.

Storage & Handling:

Material may be stored for up to 3 weeks at 2-4°C without aeration.

Other Precautions: An eyewash station in the work area is recommended.

While the information and recommendations set forth herein are believed to be accurate as of the date hereof, Shaw Environmental, Inc. MAKES NO WARRANTY WITH RESPECT HERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.



Material Safety Data Sheet

Electron Donor Solution

Section 1: Chemical Product and Company Identification

Product Name: Electron Donor Solution
Extended Release

Catalog Codes: EDS-ER

CAS#: 8001-22-7

TSCA: TSCA 8(b) inventory: Soybean oil

HMIS Code: H F R P: 10 0 A

Trade Name and Synonyms: EDS-ER

Chemical Family: Glyceride Oils

Contact Information:

Tersus Environmental, LLC

109 E. 17th Street, Suite #3880

Cheyenne, WY 82001

Ph: 307.638.2822 • info@tersusenv.com

www.tersusenv.com

For emergency assistance, call: 919.638.7892

Section 2: Composition and Information on Ingredients

COMPONANT	CAS #	OSHA TWA	OSHA STEL	ACGIH TWA	ACGIH STEL
Soybean Oil	8001-22-7	---	10 mg/m ³	---	---
Vegetable Oil Derived Fatty Acid Esters	Confidential	---	---	---	---

HAZARDOUS INGREDIENTS: NONE AS DEFINED UNDER THE U.S. OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200) OR THE CANADIAN HAZARDOUS PRODUCTS ACT S.C. 1987, C.30 (PART 1).

THE PRECISE COMPOSITION OF THIS PRODUCT IS PROPRIETARY INFORMATION. A MORE COMPLETE DISCLOSURE WILL BE PROVIDED TO A PHYSICIAN IN THE EVENT OF A MEDICAL EMERGENCY.

SARA HAZARD: NONE NOTED (SECTION 311/312) TITLE III SECTION 313 - NOT LISTED
All components of this product are listed on the TSCA registry.

Section 3: Physical/Chemical Characteristics

BOILING RANGE: Not applicable VAPOR DENSITY: Exceeds 1.0

SPECIFIC GRAVITY (H₂O=1.0): 0.92 - 0.925 VAPOR PRESSURE: Not applicable

PERCENT VOLATILE BY VOLUME: 0% SOLUBILITY IN WATER: Miscible

EVAPORATION RATE: Not applicable

APPEARANCE AND ODOR: A pale yellow, oily liquid - only a faint odor.

WEIGHT PER GALLON: 7.7 lbs. at 60F.



Material Safety Data Sheet

Section 4: Fire and Explosion Data

FLAMMABILITY CLASSIFICATION: Combustible Liquid - Class IIIB.

FLASHPOINT: Greater than 550 F (288 C).

METHOD USED: Tag Closed Cup.

EXTINGUISHING MEDIA: CO₂, dry chemical, foam, sand.

SPECIAL FIREFIGHTING PROCEDURES: Avoid use of water as it may spread fire by dispersing oil. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Rags soaked with any oil or solvent can present a fire hazard and should always be stored in UL Listed or Factory Mutual approved, covered containers. Improperly stored rags can create conditions that lead to oxidation. Oxidation, under certain conditions can lead to spontaneous combustion.

Section 5: Reactivity Data

STABILITY: Generally stable. Spontaneous combustion can occur. See Unusual Fire and Explosion Procedures, Section IV.

CONDITIONS TO AVOID: High surface area exposure to oxygen can result in polymerization and release of heat.

INCOMPATIBILITY (MATERIALS TO AVOID): Avoid contact with strong oxidizing agents.

HAZARDOUS DECOMPOSITIONS OR BY-PRODUCTS: Decomposition may produce carbon dioxide and carbon monoxide.

HAZARDOUS POLYMERIZATION: Will not occur.

Section 6: Health Hazard Data

THRESHOLD LIMIT VALUE: As a liquid - none. As oil mist - 10 mg/m³ total particulate.

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: Excessive inhalation of oil mist may affect the respiratory system. Oil mist is classified as a nuisance particulate by ACGIH.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: Not classified as a primary skin irritant or corrosive material. Sensitive individuals may experience dermatitis after long exposure of oil on skin.

HEALTH HAZARDS (ACUTE AND CHRONIC): Acute: none observed by inhalation. Chronic: none reported.

EMERGENCY AND FIRST AID PROCEDURES FOR:

SKIN CONTACT: May be removed from skin by washing with soap and warm water.

EYE CONTACT: Immediately flush eyes with plenty of cool water for at least 15 minutes. Do NOT let victim rub eyes.

INHALATION: Immediately remove exposed individual to fresh air source. If victim has stopped breathing give artificial respiration, get medical attention immediately.



Material Safety Data Sheet

Section 7: Precautions for Safe Handling and Use

ENVIRONMENTAL PRECAUTIONS: Where large spills are possible, a comprehensive spill response plan should be developed and implemented.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Wear appropriate respiratory protection and protective clothing as described in section VIII. Depending on quantity of spill: (a) Small spill - add solid adsorbent, shovel into disposable container and wash the area. Clean area with detergent. (b) Large spill - Squeegee or pump into holding container. Clean area with detergent. In the event of an uncontrolled release of this material, the user should determine if this release is reportable under applicable laws and regulations.

WASTE DISPOSAL METHOD: All recovered material should be packaged, labeled, transported, and disposed or reclaimed in accordance with local, state, and federal regulations and good engineering practices.

Section 8: Control Measures

RESPIRATORY PROTECTION: Not normally needed. A qualified health specialist should evaluate whether there is a need for respiratory protection under specific conditions.

VENTILATION: Handle in the presence of adequate ventilation. Intermittent clean air exchanges recommended, but not required.

PROTECTIVE GLOVES: Not normally needed. However, protective clothing is always recommended when handling chemicals.

EYE PROTECTION: Eye protection is always recommended when handling chemicals. Wear safety glasses meeting the specifications established in ANSI Standard Z87.1.

Section 9: Special Precautions

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store away from flame, fire, and excessive heat.

Section 10: Disposal Considerations

General Information: Do not discharge into drains, watercourses or onto the ground. Discharge, treatment, or disposal may be subject to national, state, or local laws. Empty containers may contain product residues.

Disposal Methods: No specific disposal method required.

Container: Since emptied containers retain product residue, follow label warnings even after container is emptied.



Material Safety Data Sheet

Section 11: Transportation Information

DOT Not regulated.
 TDG Not regulated.
 IATA Not regulated.
 IMDG Not regulated.

Section 12: Other Information

Hazard Ratings

	Health Hazard	Fire Hazard	Instability	Special Hazard
NFPA	1	1	0	NONE

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

NFPA Label colored diamond code: Blue - Health; Red - Flammability; Yellow - Instability; White - Special Hazards

	Health Hazard	Flammability	Physical Hazard	Personal Protection
HMIS	1	1	0	--

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

HMIS Label colored bar code: Blue - Health; Red - Flammability; Orange - Physical Hazards; White - Special

Section 13: Disclaimer and/or Comments

We suggest that containers be either professionally reconditioned for re-use by certified firms or properly disposed of by certified firms to help reduce the possibility of an accident. Disposal of containers should be in accordance with applicable federal, state and local laws and regulations. "Empty" drums should not be given to individuals.

The conditions of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Tersus Environmental be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Tersus Environmental has been advised of the possibility of such damages.

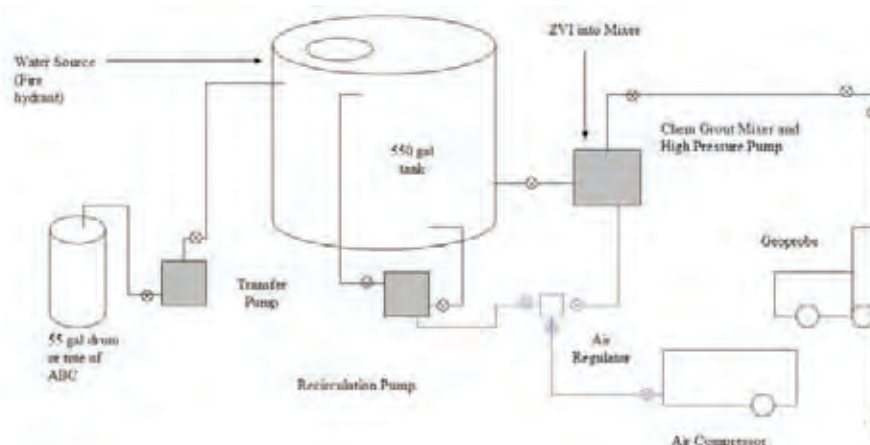
Appendix D

ABC Plus Amendment Preparation Procedure

ABC+ Injections

Anaerobic Biochem ABC[®] is a patented mixture of lactates, fatty acids, and a phosphate buffer. ABC[®] contains soluble lactic acid as well as slow- and long-term releasing components. The phosphate buffer provides phosphates, which are a micronutrient for bioremediation. In addition, the buffer helps to maintain the pH in a range that is best suited for microbial growth. Using a Geoprobe[®] and proprietary injection equipment, Redox Tech is able to inject ABC[®] in most geologic environments, including low-permeability silt and clay. For low permeability environments, Redox Tech utilizes hydraulic fracturing.

In July 2006, the ABC formula was offered with a mixture of ZVI. The new product, marketed as ABC+, provided significant advantages over ABC alone. The ZVI provides an immediate chemical reduction of chlorinated solvents and quickly drives the *in situ* system to reducing conditions. The hydrogen produced from the corrosion of the ZVI also provides nutrients to a wide range of bacteria.



ABC+ injections are initiated by mixing the ABC product in a 550 gallon mixing tank. Complete mixing is achieved by use of a recirculation pump and then it is transferred into an air powered ChemGrout



CG500 high pressure mixing unit. The ABC solution is mixed in the 70 gallon paddle hoppers where guar gum is used to increase the viscosity. Once the viscosity is increased, the ZVI product is introduced where a slurry is formed. The slurry is transferred to the 3 inch positive placement pump and is pumped to the top of the Geoprobe rods and out of the bottom via an expendable tip, to the desired remediation zone.

The ChemGrout CG500 high pressure mixing plant unit has two 70 gallon mixing hoppers so mixing and pumping can be performed simultaneously. The Geoprobe rods are raised to other specified injection intervals to inject the ABC+ slurry to predetermined intervals.



Appendix E

Daily ISB Injection Log

Appendix F

Inspection and Maintenance Checklist

RAO Inspection and Maintenance Checklist

General Information	
Project Name	RAO Inspection and Maintenance, LHAAP-16 Landfill, Longhorn Army Ammunition Plant, Kamack, TX
Contractor	
Inspector's Name	
Inspector's Title	
Inspector's Signature	
Inspector's Contact Number	
Inspection Date	
Type of Inspection	<input type="checkbox"/> Quarterly <input type="checkbox"/> Semiannual <input type="checkbox"/> Annual <input type="checkbox"/> Prior to forecast rain <input type="checkbox"/> After a rain event <input type="checkbox"/> Other -----

Description	Yes	No	N/A	Comments (Attach photos/location sketches)	Corrective Action (Attach photos)
A. CAP Cover Surface					
A.1				Are there any significant cracks present?	
A.2				Is there any evidence of significant/ clearly visible erosion, settlement, or other deterioration?	
A.3.				Are there any damaged areas?	
A.4				Is there any ponded water present?	
A.5				Are the drainage systems in poor condition?	
A.6				Any other relevant observations?	
B. CAP Vegetation and Animal Burrows					
B.1				Are there signs of stressed/ dead vegetation?	
B.2				Are there any significant bare spots?	

Description	Yes	No	N/A	Comments (Attach photos/location sketches)	Corrective Action (Attach photos)
B.3 Are deep-rooted plants present?					
B.4 Are there signs of animal burrows?					
B.5 Any other relevant observations?					
C. Groundwater Monitoring Wells					
C.1 Are the installed groundwater monitoring wells in poor condition?					
C.2 Is the well cleared of vegetation and accessible?					
C.3 Are there any significant cracks present?					
C.4 Are there any damaged areas?					
C.5 Any other relevant observations?					
D. Site Access Features					
D.1 Gate(s) damaged?					
D.2 Litter encountered within the area?					
D.3 Are the gate locks missing?					
D.4 Are signs to prevent unauthorized entry down or missing?					
D.5 Are the access roads in unusable or poor condition?					
D.6 Any other relevant observations?					

Subject: Final Minutes, Monthly Managers' Meeting (MMM),
Longhorn Army Ammunition Plant (LHAAP)

Location of Meeting: Via Conference Call-In 515-603-3155 with Code 1063533#

Date of Meeting: May 17, 2018 – 10:00 AM Central Daylight Time (CDT)

Attendees:

Army BRAC: Rose Zeiler (RMZ)

EPA: Rich Mayer (RM) and Dorelle Harrison

USGS: Kent Becher (KB)

TCEQ: April Palmie (AP)

USACE: Aaron Williams (AW)

AEC: Nick Smith (NS)

Bhate: Kim Nemmers (KN)

APTIM: William (Bill) Foss (BF), Susan Watson (SW) and Praveen Srivastav (PS)

Action Items

Army

- RMZ discussed the LHAAP-18/24 technical memorandum being developed based upon the technical project planning (TPP) meeting and recent data, including the need for a pre-design investigation (PDI) for the east side of the site. The plan is for the performance work statement for the remedial action (RA) and remedial design (RD) to be based on the TPP meeting/strawman and released ahead of the Record of Decision (ROD) to minimize impact to schedule as much as possible. RMZ stated that the RA may be separate from the RD but that was not for certain. RMZ agreed to provide the straw man figure to RM and AP developed during the TPP. RM's primary concern with the draft enforceable schedule was that the documents for LHAAP-18/24 seemed to be far out into the future. RMZ stated that the Army will take another look at the enforceable schedule and then send on to the Regulators.

Bhate Environmental Associates (Bhate)/APTIM

- KN explained that Bhate has prepared a spreadsheet using an evaluation of historical flows and the gauge measurements to establish flow in the creek based upon the height measured in the creek. KN asked if a time could be set for the team to review that spreadsheet together for input at a separate meeting. AP and RM asked that a few dates and times be provided but that a separate meeting was acceptable.
- AP clarified that the maximum discharge is set based upon the groundwater treatment plant process. KN stated that the fluidized bed reactor (FBR) limits the groundwater treatment plant (GWTP) discharge to 50 gallons per minutes.
- KN explained that the chloride and sulfate have fluctuated in the effluent such that this information is still important in determining the allowable flow. AP asked why these chemicals would vary. KN agreed to find out more.

Defense Environmental Restoration Program (DERP) Performance Based Remediation (PBR) Update

KN asked everyone to refer to the Document and Issues Tracking Table dated May 17, 2018.

- **Task 1** (Project Management)
 - Installation Wide Work Plan (IWWP) – Everyone confirmed receipt of the Final IWWP via email on May 16, 2018. KN stated that hard copies with compact discs (CDs) were being delivered today (May 17, 2018).

- **Task 2** (LHAAP-02 Semi-Annual Groundwater Monitoring Report) – KN stated the validated data from the April 2018 sampling event was provided. RM asked why the groundwater was filtered with a 10 micron filter? AP indicated that previous samples were also filtered but the question as to why was not known. KN stated that she would find out the answer. RM asked if the sample nomenclature was correct. KN stated that she would verify but that LHAAP-02 was located within LHAAP-35(A). Note that the April 2018 groundwater samples were determined to not be filtered.
- **Task 3** (LHAAP-03 Record of Decision [ROD] and Explanation of Significant Difference [ESD]) – SW stated that responses to the regulator comments received were being prepared and were due back on June 6, 2018.
- **Task 4** (LHAAP-04 RD/Remedial Action Work Plan [RAWP]) – SW stated that the RD/RAWP is still delayed awaiting contract modification from the Army for additional scope. AW stated that he thinks he can get the modification through upper management and then onto contracting.
- **Task 5** (LHAAP-12 Annual Remedial Action – Operation [RA-O] Report) – SW indicated that the 2017 LHAAP-12 Annual RA-O Report is planned for delivery to the Regulators in June 2018.
- **Task 6** (LHAAP-16 RAWP) – SW stated that the RAWP response to comments were issued to the Regulators and that compliance sampling is still ongoing.
- **Task 7** (LHAAP-17 PDI Report) – SW stated that the PDI Report is under Army review and is due out to the Regulators in mid-July 2018.
- **Task 9** (LHAAP-37) – SW stated that Year 3 RA-O groundwater sampling at LHAAP-37 is being completed in May 2018 with the validated data to be provided during the July 2018 MMM.
- **Task 10** (LHAAP-46) – SW stated that the Year 4 first semi-annual RA-O sampling has been completed. Technical memorandum will be finalized and included as an appendix in the Year 4 RA-O Report. The Year 4 RA-O report will be issued after the August 2018 groundwater sampling event.
- **Task 11** (LHAAP-50 RA-O Reports) – SW Year 3 RA-O Report is being produced for delivery to the Regulators by the end of the month. Note that the report was sent out on May 24, 2018.
- **Task 12** (LHAAP-58 ESD and RA-O Report) – KN stated that the Final ESD was issued with final signatures and TCEQ concurrence letter. The next sampling event is planned for June 2018.
KN stated the Remedial Action Completion Report (RACR) for the injections was being prepared and that the RACR would only include the actual field implementation of the RAWP. KN stated that the June 2018 performance sampling would be presented in the next Annual RA-O Report.
- **Task 13** (LHAAP-67) – SW stated that the next sampling event is being completed in May 2018 with the validated data to be provided in the July 2018 MMM.
- **Tasks 14 and 15** (Military Munitions Response Program [MMRP] Sites' RD) – KN stated that the Final RD was issued in early May with the recordation. RMZ noted that there were also some minor revisions to the text, which KN stated was explained in the cover letter.
- **Task 16 (GWTP)** - KN explained that the 4th Quarter Report 2017 for the GWTP was issued for Regulatory review on May 3, 2018, and the 1st Quarter 2018 Report is being prepared.
- **Task 19: Surface Water**- KN stated that surface water will be collected in June 2018 if there is flow.

- **Administrative Record (AR)** - SW stated that the bate stamping and indices were being prepared and then the CDs will be created. The next AR volumes will then follow since the goal is to update the AR quarterly.

Field Work in April and May 2018

- SW stated groundwater sampling was being completed in May 2018 for LHAAP-37, LHAAP-50 and LHAAP-67. KN added that groundwater sampling at site LHAAP-50 and LHAAP-67 had been completed and that LHAAP-37 was planned for completion next week.
- SW explained that LHAAP-16 had 28 wells planned for installation but only 17 had been installed. The site was too wet for installation of the other wells. SW stated that a different rig may be used to access the areas easier even if they are still wet. The conditions are being monitored to get back in the field and complete the work as soon as reasonably possible.
- SW stated that the new shallow well at Site LHAAP-17 had been installed and sampled. The new monitoring well is next to 17WW11 and 17WW12.
- SW mentioned that the monitoring wells at LHAAP-46 that are typically dry were still dry after the recent rain events.
- KN discussed that LHAAP-18/24 and LHAAP-58 are being sampled in June and stated that these two sites require four weeks to complete the groundwater sampling. KN asked if the LHAAP-18/24 sampling, which is semi-annual, could start at the end of May or if it needed to start June 2, 2018. AP and RM stated that they had no issue starting the sampling as early as May 29, 2018. RM asked if the interception-collection trenches (ICT) wells were sampled semi-annually or annually. KN stated that she knew they were being sampled as part of the June 2018 event but was not sure of the frequency. AW stated that they were sampled annually. AP then clarified that the ICT wells were being sampled in this upcoming June 2018 sampling event to which KN concurred and stated that the ICT wells were being sampled first.
- KN reported that the programmable logic controller (PLC) installation had been completed, with the exception of installation of the panel for LHAAP-16. The panel was not installed awaiting the remedial action implementation for LHAAP-16. The panel will be used at LHAAP-17.
- KN explained that the validated data presented for the GWTP shows that the effluent levels are above the 17 parts per billion (ppb). Currently, the effluent can be discharged to the bayou so there is no issue today. KN stated that the effluent data is collected after the ion exchange vessels. KN then explained that the FBR was not performing as designed because the perchlorate should be treated to very low levels. However, the FBR needs maintenance. KN went on to explain that carbon is being lost out of the FBR, which is not normal and has resulted in the ion exchange vessels no longer working properly. Both the maintenance of the FBR and replacement of the ion exchange vessels are being developed. KN explained that Envirogen, who built the FBR, is being scoped to complete the maintenance evaluation for the FBR. AP stated that we cannot assume that we can discharge to the pond after the ion exchange because perchlorate may not be less than 17 ppb. KN concurred. AP then asked what happens when the FBR is offline. KN stated that she is working to establish a schedule and determine the answer to this question, which can hopefully be answered by early next week. KN stated that moving up the ion exchange vessel replacement is being considered. RM asked if the ion exchange vessels are repairable. KN explained that the ion exchange vessels selected do not allow for replacement of the media so new vessels will be required. KN stated that she is working to order the replacement parts and then subcontract

Envirogen Senior Engineer to come onsite to oversee the maintenance and repair and restart of the FBR.

Review Validated Data –

KN stated that the GWTP and LHAAP-02 validated data was included. AP stated that the correct wells were sampled at LHAAP-02 but that the question regarding why the sample is being filtered was worth asking. Note that the first report prepared for LHAAP-02 included both filtered and unfiltered groundwater samples for analysis.

Schedule Next Managers' Meeting

The June 2018 MMM will be held on June 14, 2018 via conference call at 10:00 AM CDT.

Adjourned at 10:55 AM CDT.

ACRONYM LIST

AEC	United States Army Environmental Command
AP	April Palmie
AR	Administrative Record
AW	Aaron Williams
BF	William (Bill) Foss
Bhate	Bhate Environmental Associates, Inc.
BRAC	Base Realignment and Closure
CD	Compact disc
CDT	Central Daylight Time
DERP	Defense Environmental Restoration Program
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FBR	Fluidized bed reactor
GWTP	Ground Water Treatment Plant
ICT	Interception-Collection Trench
IWWP	Installation Wide Work Plan
KB	Kent Becher
KN	Kim Nemmers
LHAAP	Longhorn Army Ammunition Plant
MMM	Monthly Managers' Meeting
MMRP	Military Munitions Response Program
NS	Nick Smith
PBR	Performance-Based Remediation
PDI	Pre-Design Investigation
PLC	Programmable Logic Controller
PPB	Parts per billion
PS	Praveen Srivastav
RACR	Remedial Action Completion Report
RA	Remedial Action
RA-O	remedial action – operation
RAWP	Remedial Action Work Plan
RD	Remedial Design

ROD	Record of Decision
RM	Rich Mayer
RMZ	Rose M. Zeiler
SW	Susan Watson
TCEQ	Texas Commission on Environmental Quality
TPP	Technical Project Planning
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

LHAAP Validated Data Packages for May 2018 Monthly Manager's Meeting

LHAAP Site	Sampling Event and Analytical Method
GWTP Effluent	<i>Weekly Perchlorate Sampling – April 2018</i> Perchlorate (6850)
GWTP Effluent	<i>Weekly, Bi-Weekly, and Monthly Sampling – April 2018</i> 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	<i>Monthly Sampling – April 2018</i> Metals (6020A) Perchlorate (6850) Hexavalent Chromium (7196A)
LHAAP 02	<i>Semi-Annual Sampling – April 2018</i> Metals (6020A) – Arsenic and Lead

GWTP Bi-Weekly Sampling - April 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24- SP650_040418 4/4/18	LH18/24- SP650_041818 4/18/18
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	< 1.0 U	< 1.0 U
1,1,2-Trichloroethane	µg/L	216.9	< 1.0 U	< 1.0 U
1,1-Dichloroethane	µg/L	14,032	< 1.0 U	< 1.0 U
1,1-Dichloroethene	µg/L	253	< 1.0 U	< 1.0 U
1,2-Dichloroethane	µg/L	181	< 1.0 U	< 1.0 U
1,2-Dichloropropane	µg/L	5	< 1.0 U	< 1.0 U
Acetone	µg/L	2,395	< 2.0 U	3.0
Benzene	µg/L	181	< 1.0 U	< 1.0 U
Carbon tetrachloride	µg/L	181	< 1.0 U	< 1.0 U
Chlorobenzene	µg/L	47,180	< 1.0 U	< 1.0 U
Chloroform	µg/L	3,615	< 1.0 U	< 1.0 U
Ethylbenzene	µg/L	57,025	< 1.0 U	< 1.0 U
m,p-Xylene	µg/L	83.6	< 2.0 U	< 2.0 U
Methylene chloride	µg/L	1,699	< 2.0 U	< 2.0 U
o-Xylene	µg/L	83.6	< 1.0 U	< 1.0 U
Styrene	µg/L	5,987	< 1.0 U	< 1.0 U
Tetrachloroethene	µg/L	180.7	< 1.0 U	< 1.0 U
Toluene	µg/L	4,189	< 1.0 U	< 1.0 U
Trichloroethene	µg/L	181	4.1	4.6
Vinyl chloride	µg/L	72	< 1.0 U	< 1.0 U
Anions (9056)				
Chloride	mg/L	NV	293	387
Sulfate	mg/L	NV	48.1	151

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 - April 2018

Location ID: Sample Date:	Units	LH18/24- SP140_041118 4/11/18
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	< 0.00200 U
Hexavalent Chromium (7196A)		
Hexavalent Chromium	mg/L	< 0.0100 U
Perchlorate (6850)		
Perchlorate	µg/L	6,400

mg/L - milligrams per liter

µg/L - micrograms per liter

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

GWTP Monthly Effluent Sampling - April 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24-SP650- 041118 4/11/18
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	< 1.0 U
1,1,2-Trichloroethane	µg/L	216.9	< 1.0 U
1,1-Dichloroethane	µg/L	14,032	< 1.0 U
1,1-Dichloroethene	µg/L	253	< 1.0 U
1,2-Dichloroethane	µg/L	181	< 1.0 U
1,2-Dichloropropane	µg/L	5	< 1.0 U
Acetone	µg/L	2,395	2.9
Benzene	µg/L	181	< 1.0 U
Carbon tetrachloride	µg/L	181	< 1.0 U
Chlorobenzene	µg/L	47,180	< 1.0 U
Chloroform	µg/L	3,615	< 1.0 U
Ethylbenzene	µg/L	57,025	< 1.0 U
m,p-Xylene	µg/L	83.6	< 2.0 U
Methylene chloride	µg/L	1,699	< 2.0 U
o-Xylene	µg/L	83.6	< 1.0 U
Styrene	µg/L	5,987	< 1.0 U
Tetrachloroethene	µg/L	180.7	< 1.0 U
Toluene	µg/L	4,189	< 1.0 U
Trichloroethene	µg/L	181	4.8
Vinyl chloride	µg/L	72	< 1.0 U
Metals (6020A)			
Barium	mg/L	2	0.124
Lead	mg/L	0.0046	< 0.00200 U
Selenium	mg/L	0.012	< 0.00200 U
Silver	mg/L	0.003	< 0.00200 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	3.6

µg/L - micrograms per liter

mg/L - milligrams per liter

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

GWTP Weekly/Effluent Perchlorate Sampling - April 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24- SP650_040418 4/4/18	LH18/24- SP650_041118 4/11/18	LH18/24-SP650- 041118 4/11/18	LH18/24- SP650_041818 4/18/18	LH18/24- SP650_042518 4/25/18	
Location Description		Collected from a spigot on the discharge of effluent TK-650.						
Perchlorate (6850)			Weekly	Weekly	Monthly EFF	Weekly	Weekly	
Perchlorate	µg/L	589	2.3 J	6.9	12	55	46	

µg/L - micrograms per liter
 J - Estimated value

GWTP Weekly Sampling - April 2018

Location ID: Sample Date:	Units	Maximum Conc	LH18/24- SP650_040418 4/4/18	LH18/24- SP650_041118 4/11/18	LH18/24- SP650_041818 4/18/18	LH18/24- SP650_042518 4/25/18
Location Description						
Ammonia as N (350.3)						
Ammonia as N	mg/L	NV	12	11	28	17
Ortho-Phosphate (365.3)						
Ortho-Phosphate	mg/L	NV	3.74	1.19	2.42	2.24
Organic Carbon (415.1)						
Total Organic Carbon (TOC)	mg/L	NV	40.1	13.4	17.7	44.3

GWTP--Collected from a spigot on the discharge of effluent TK-650. Sampled Weekly.

mg/L - milligrams per liter

NV - No Value

LHAAP-02 April 2018

Location ID: Sample Date:	Units	35AWW13_040418 4/4/18	35AWW13_040418_a 4/4/18
		Parent	Field Duplicate
		Shallow zone, unimpacted downgradient. Field filtered w/10 micron filter.	Shallow zone, unimpacted downgradient. Field filtered w/10 micron filter. Field Duplicate
Metals (6020A)			
Arsenic	mg/L	0.000986 J	0.000895 J
Lead	mg/L	0.00122 J	0.00109 J

mg/L - milligrams per liter

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

Bryan W. Shaw, Ph.D., P.E., *Chairman*
 Toby Baker, *Commissioner*
 Jon Niermann, *Commissioner*
 Stephanie Bergeron Perdue, *Interim Executive Director*



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 22, 2018

Ms. April Palmie
 Texas Commission on Environmental Quality
 Remediation Division/Superfund Section
 12100 Park 35 Circle
 MC136
 Austin, TX 78711

RE: Amendment of Class V Injection Well Inventory
 Class V No. 5X2600464
 CN600696025/RN101264505
 SUP126
 Longhorn Army Ammunition Plant
 Site LHAAP-16/LHAAP-18/24
 State Highway 43
 Karnack, TX

Dear Ms. Palmie:

The Texas Commission on Environmental Quality (TCEQ) Underground Injection Control (UIC) Permits Section staff has completed review of the amendment notification dated April 24, 2018 for the LHAAP-16 site prepared by Bhate Environmental & Infrastructure on behalf of the Department of Army for the above referenced Class V injection well inventory. The amendment meets the requirements of 30 Texas Administrative Code (TAC) §331.10. Our consideration of this proposed amendment included coordination with the TCEQ Remediation Division.

Class V Inventory 5X2600464 is hereby amended as follows for the LHAAP-16 site:

- Addition of EDS-ER™ (An emulsified vegetable oil (EVO) product), SDC-9™ (A microbial dechlorinating culture), ABC Plus (An EVO product with zero valent iron (ZVI)) and microbial nutrients (diammonium phosphate and vitamin B12)
- Addition of 79 direct push technology injection wells, 9 new injection wells and 4 existing extraction wells

The changes to the injection well system are limited to that described by the Class V inventory amendment notification dated April 24, 2018. This amendment revises the requirements and conditions of the Class V inventory notification submitted in 2003 as amended on July 5, 2007 and should be attached thereto. Subsequent changes to the injection well system must meet the requirements of 30 TAC Chapter 331 (Underground Injection Control) and the requirements of the Remediation Division.

Class V inventory 5X2600464 includes injection well systems at the LHAAP-16 and LHAAP-18/24 sites. At the LHAAP-16 site, a total of 15 injection wells were utilized: 8 Injection wells and 7 existing extraction wells for the injection of extracted groundwater amended with sodium lactate. At the LHAAP-18/24 site, two existing infiltration trenches were utilized for the injection of treated groundwater from the on-site treatment plant.

Ms. April Palmie
Page 2
June 22, 2018

If you have any questions or comments regarding this matter please contact me at bryan.smith@tceq.texas.gov or (512) 239-6075. If you will be responding by letter, please include mail code MC233 in the mailing address.

Sincerely,



Bryan Smith, Project Manager
Underground Injection Control Permits Section
Radioactive Materials Division
Texas Commission on Environmental Quality

BSS/krh-d

cc: Ms. Kimberly Nemmers, P.E., Bhate Environmental & Infrastructure



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

April 24, 2018

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: April 2018 Underground Injection Control Substantive Requirements Notification for
 Remedy at LHAAP-16, Longhorn Army Ammunition Plant, Karnack, Texas

Dear Ms. Palmie,

The above-referenced document is being transmitted to you for records. We are presumptively complying with the substantive requirements of 30 Texas Administrative Code (TAC) §331, Subchapters A, C, and H for Class V Injection Wells. Therefore, unless we hear in the negative within 30 calendar days (May 24, 2018), the injections will be implemented at Site LHAAP-16 beginning in May 2018.

The document was prepared by Aptim Federal Services, LLC (APTIM) (part of the Bhate Environmental Associates, Inc. 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)
 R. Smith, USACE, Tulsa District, OK (1 hard copy and 1 CD)
 A. Williams, USACE, Tulsa District, OK (1 CD)
 N. Smith, USAEC, San Antonio, TX (1 CD)
 K. Nemmers, Bhate, Lakewood, CO (1 hard copy and 1 CD))
 P. Srivastav, APTIM, Houston, TX (1 hard copy and 1 CD)



MEMORANDUM FOR RECORD

DATE: April 24, 2018

PROJECT NAME: Remedy for LHAAP-16, Longhorn Army Ammunition Plant, Karnack, Texas

TO: Rose Zeiler Site Manager
Rick Smith Project Manager
Aaron Williams Project Engineer

FROM: Kimberly Nemmers Bhate Project Manager, Cell No. 303-550-9239

SUBJECT: **LHAAP-16 Underground Injection Control Substantive Requirements Notification, Longhorn Army Ammunition Plant, Karnack, TX (Contract No. W9128F-13-D-0012, Task Order No. W912BV17F0150)**

INTRODUCTION

Remedial activities are required under the Record of Decision (ROD) issued for the LHAAP-16 Landfill (U.S. Army 2016). The Remedial Action Work Plan (RAWP) was submitted to Texas Commission on Environmental Quality (TCEQ) for review in March 2018 (U.S. Army 2018). The RAWP was developed using the basis and details of the Remedial Design (RD) for LHAAP-16, which was approved by the regulatory agencies in January 2017 (U.S. Army 2017).

As part of the selected remedy, in situ bioremediation (ISB) will be conducted in the most contaminated portion of the shallow and intermediate groundwater zones. The ISB includes 1) the installation of biobarriers adjacent to the landfill in shallow groundwater (Landfill Biobarriers); 2) biobarrier near Harrison Bayou in shallow groundwater (Bayou Biobarrier); 3) installation of a biogrid and biowall in the shallow and intermediate groundwater (Mid Plume Shallow and Mid Plume Intermediate).

ISB is planned to be conducted at LHAAP-16 in May 2018. The enclosed Class V Injection Well Inventory Form (**Enclosure 1**) and TCEQ Core Data Form (**Enclosure 2**) comply with the substantive requirements for construction, operation, and closure under 30 Texas Administrative Code (TAC) §331, Subchapters, A, C, and H (the Applicable or Relevant and Appropriate Requirements [ARARs] for underground injection control).

SITE HISTORY

LHAAP-16 is a capped landfill covering approximately 20 acres in the south-central portion of the former LHAAP (Class V Injection Well Inventory Form, **Enclosure 1**, Attachment A, Topographic Quadrangle Map). Harrison Bayou is located along the northeastern edge of the site and flows into Caddo Lake, northeast of the site. The landfill, which covered approximately 13 acres prior to cap construction, was established in the 1940s for the disposal of solid and industrial wastes, until the 1980s, when disposal activities were terminated.

The U.S. Army and the U.S. Environmental Protection Agency (USEPA) signed a ROD and the Texas Water Commission concurred in 1995 approving an interim remedial action (IRA) for LHAAP-16 to mitigate

potential risks posed by buried source material at the site. The IRA included the construction of a landfill cap, which is considered a component of the final remedy for the site. Construction of the multilayer cap was completed in 1998. The ROD also specified that the U.S. Army would be required to “perform long-term maintenance of the cap.” Land use controls (LUCs), such as future use restrictions, would also be required.

Previous investigations identified shallow and intermediate groundwater impacted with volatile organic compounds (VOCs), perchlorate, and metals at LHAAP-16 (U.S. Army 2016). The approximate lateral extent of perchlorate (PCE) and trichloroethene (TCE) in the Shallow Zone and Intermediate Zone groundwater is based on the last comprehensive groundwater sampling event performed in May 2013 (Class V Injection Well Inventory Form, **Enclosure 1**, Attachment E, Figures 2-4 through 2-7) (U.S. Army 2017). The source of this impacted groundwater is the landfill, although the metals were only detected at elevated concentrations sporadically, and do not appear to reflect widespread contamination from the landfill. A groundwater extraction system was voluntarily installed by the U.S. Army in 1996 and 1997 as a treatability study to prevent the groundwater plume from migrating to Harrison Bayou.

The Final ROD for LHAAP-16 was issued in September 2016, and documents the final selected remedy for the site including the impacted groundwater (U.S. Army 2016). The Final RD was issued in January 2017 and presents the remedial design, inspection and maintenance requirements, and LUC requirements associated with LHAAP-16.

PLANNED ACTION

The remedy will include ISB at LHAAP-16 to remediate groundwater impacted with VOCs and perchlorate. The implementation of ISB using biobarriers and biogrid applications will involve the injection of an electron donor and a microbial consortium capable of biodegrading primary VOCs and perchlorate. Based on the RAWP, several injectates will be used. The Material Safety Data Sheets for the injectates are included in Class V Injection Well Inventory Form, **Enclosure 1**, Attachment H. The following injectates will be used:

- An emulsified vegetable oil (EVO) product, EDS-ER™ manufactured by Tersus Environmental will be injected in the vicinity of the Landfill Biobarriers (shallow zone east of the landfills) and the Mid Plume Area (shallow and intermediate zone) (Class V Injection Well Inventory Form, **Enclosure 1**, Attachment B, Figures 3-2, 3-3, 3-4, and 3-6). A microbial dechlorinating culture (SDC-9™), a conservative tracer (sodium bromide), and microbial nutrients (diammonium phosphate and Vitamin B12) will be injected into the subsurface in these areas. Additionally, in the Mid Plume (intermediate zone) area, a temporary recirculation system will be installed to get effective distribution of the amendment mixture. After the injectate mixture is injected into the injection wells, the groundwater will be recirculated between the injection wells and extraction wells to achieve sufficient injectate distribution. When sodium bromide (conservative tracer) is detected in the extraction wells (above the baseline concentration), the recirculation system will be shut down. After extraction has shut down in all the extraction wells, additional injectate mixture will be injected into the intermediate zone using the extraction wells.
- An injectate mixture consisting of ABC Plus (EVO with microscale zero valent iron), a conservative tracer (sodium bromide), microbial nutrients (diammonium phosphate and Vitamin B12) and a bioaugmentation culture (SDC-9™) will be injected as a biobarrier near Harrison Bayou (Class V Injection Well Inventory Form, **Enclosure 1**, Attachment B, Figure 3-5). ABC Plus is manufactured by Redox Tech.

Per Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7, the Army is presumptively complying with substantive requirement of construction, operation and closure 30 TAC §331, Subchapters, A, C, and H (ARARs for underground injection control).

Enclosures:

1. Class V Injection Well Inventory Form
2. TCEQ Core Data Form

ENCLOSURE 1

CLASS V INJECTION WELL INVENTORY FORM

**Texas Commission on Environmental Quality
Class V Injection Well
Inventory/Authorization Form**

Submit To:

For TCEQ Use Only

Reg. No. _____

Date Received _____

Date Authorized _____

Section I General Information

Provide the information in items 1 through 8

1. TCEQ Program Area (PST, VCP, IHW, etc.):

2. Agent/Consultant:

3. Owner Operator

4. Name: Longhorn Army Ammunition Plant, Landfill LHAAP-16
 Address (Street, City, County, State, and Zip Code) or location description (if no address is available): Northeast corner of Harrison County, located between State Highway 43 in Karnack, Texas, and the western shore of Caddo Lake

5. Latitude and Longitude (degrees-minutes-seconds) and method of determination (GPS, TOPO, etc.) (Attach a Topographic Quadrangle map which identifies the facility location relative to major streets or roadways as Attachment A.)
 Latitude: 32° 39' 56.718" N; Longitude: 94° 7' 39.068" W. LHAAP-16 Site Map (Figure 1-6 from the RAWP) is also included in **Attachment A**.

6. Type of Well Construction (Vertical Injection, Subsurface Fluid Distribution System, Infiltration Gallery, Temporary Injection Points, etc.) and Number of Injection Wells:
 Existing and new injection wells (IWs), temporary direct-push injection points (new), and existing extraction wells will be used to distribute the injectate mixture into the shallow and intermediate zones.
 In the shallow zone, there will be nine existing IWs, three new IWs, and 79 temporary injection points used to distribute the injectate.
 In the intermediate zone there will be six new IWs installed. The injectate will be recirculated between the IWs and four existing extraction wells in the intermediate zone. After recirculation, the extraction wells will be used for injections.

7. Description regarding purpose of Injection System. Attach a Site Map as Attachment B (Attach the Approved Remediation Plan [if appropriate]):
 LHAAP-16 is a capped landfill covering approximately 20 acres in the south-central portion of LHAAP. The landfill which covered approximately 13 acres prior to the cap construction was established in the 1940s for the disposal of solid and industrial wastes, until the 1980s, when disposal activities were terminated.
 The shallow and/or intermediate groundwater is impacted with the following chemicals of concern (COC): Trichloroethene (TCE); cis-1,2-dichloroethene (DCE); 1,1,-DCE; 1,2-DCA; vinyl chloride (VC); 1,1,2-TCA and methylene chloride (MC), perchlorate and metals (arsenic, chromium, manganese, nickel and thallium). Three Landfill Biobarriers will be installed to control the migration of volatile organic compounds (VOCs) and

perchlorate in shallow groundwater immediately downgradient of the landfill as shown in **Attachment B**, Figures 3-2 through 3-4. One Bayou Biobarrier will be installed in the shallow groundwater zone just upgradient of Harrison Bayou as shown in **Attachment B**, Mid Plume Area, Figure 3-5. A biogrid will be used for distribution of the injectates in the shallow groundwater (**Attachment B**, Figure 3-6) and a biobarrier will be used for distribution of the injectates in the intermediate groundwater (**Attachment B**, Figure 3-7).

To implement ISB, a carbon substrate, emulsified vegetable oil (EVO) with the microbial dechlorinating culture, SDC-9™ and water will be injected into the subsurface. Diammonium phosphate (microbial nutrient), Vitamin B-12 (catalyst), sodium bicarbonate (buffer if needed), and sodium bromide (tracer) will be injected along with the injectate mixture. Additionally, microscale ZVI will be injected along with EVO at the Bayou Biobarrier. The injectate mixture will comprise of a 8 to 10% (by weight) solution of EVO. Injection wells and temporary injection points will be used to inject the injectate mixture.

The Remedial Action Work Plan is in regulatory review and the “proposed remediation plan” from the Remedial Action Work Plan is included in **Attachment B**.

8. Water Well Driller/Installer:
Address (Street, City, State, and Zip Code):

Section II Proposed Down Hole Design

Attach a diagram signed and sealed by a licensed engineer as Attachment C

Name of String	Size	Setting Depth	Sacks Cement/Grout - Slurry Volume - Top of Cement	Hole Size	Weight (lbs/ft) PVC/Steel
9. Casing Shallow well	4"x 4" protective casing	Varies, see Attachment C	Typical well construction diagram is provided in Attachment C.	6 - 8"	Steel protective casing
	8" isolation casing	Varies, see Attachment C	Intermediate wells will have isolation casing installed across the shallow zone. Typical well construction diagram is provided in Attachment C	11"	Isolation casing - Schedule 40 PVC
	4"x 4" protective casing	Varies, see Attachment C	Well will be installed inside the isolation casing	6 - 8"	Steel protective casing
10. Tubing	2" diameter	Varies, see Attachment C	Bentonite pellets will be placed above the sand/filter pack to a minimum thickness of 2 feet to provide an adequate seal. Neat cement or volclay grout will be emplaced via tremie pipe from above the top of the bentonite seal to land surface on both shallow and intermediate wells.	6 - 8"	Blank Schedule 40 PVC
11. Screen	2" diameter, 5- or 10-foot screen length	Attachment C, Table C-1	Lone Star #3 sand filter pack	6 - 8"	Slotted Schedule 40 PVC

Additionally, the injections of the selected solution will be performed via direct-push injection points. The description of the direct-push injection points is provided in Section III below. There will be no permanent casing, tubing, or screens associated with the direct-push injection points.

Section III Proposed Trench System, Subsurface Fluid Distribution System, or Infiltration Gallery

Attach a diagram signed and sealed by a licensed engineer as Attachment D

12. System(s) Dimensions: Approximately 415,000 square feet based on VOC Contour in Shallow groundwater and 400,000 square feet based on VOC Contour in Intermediate groundwater that encompasses the injection footprint and the most contaminated portions of the plumes.

groundwater that encompasses the injection footprint and the most contaminated portions of the plumes.

13. System(s) Construction: The fluid distribution system will consist of a temporary/mobile tanks/containers, hoses, a bulk storage tank, mixing equipment, injection pump, and volume and metering control equipment. Injection points will be advanced using via a CME-45 rig, or similar, with a direct-push technology (DPT) hammer or equivalent when an IWS is not being used. The injectate mixture will be injected using a top-down approach at each proposed direct-push point at approximately 2- to 5-foot intervals in the target treatment area. Under this approach, drilling rods (injection probes) are advanced to the top of the injection interval. Injectate mixture will be pumped down through the DPT drilling rods (acting as a temporary well casing) to the injection interval and injectate will be forced through the ports in the rods to the surrounding formation. The tools are then advanced to the next injection depth and the material is again pumped through the rods. This cycle is repeated to provide coverage across the entire vertical treatment interval. Injection flow rates are expected to range from 2 to 6 gallons per minute and an attempt will be made to keep injection pressures below 40 pounds per square inch (psi).

The fluid distribution will consist of a temporary/mobile tanks/containers, hoses, bulk storage, tank, mixing equipment, injection pump, and volume and metering control equipment. Injection wells will be installed using a hollow stem auger rig rotary sonic drilling techniques. The lithology will be logged at the proposed injection and monitoring well location. All injection wells will be constructed of 2-inch Schedule 40 polyvinyl chloride (PVC) with a 10-foot 0.010 slot PVC screen at the bottom. The new injection wells will be screened over the target intervals as shown in **Attachment C**, Table C-1. The six IWs installed in the intermediate groundwater zone will require a minimum of 6-inch diameter Schedule 40 PVC isolation casing to approximately 35 feet bgs. The injection wells will be completed with a quick connect fitting for attachment of the injection hose. The injectate will flow through the injection rig and through a hose into the injection well where the injectate will flow through the injection well screen into the surrounding formation. The injection flow rates are expected to range from 2 to 6 gallons per minute, and the planned injection pressures are at or below 40 psi.

In the vicinity of the mid plume area (intermediate groundwater), a temporary recirculation system will be installed. Injectate mixture will be injected through the newly installed injection wells and extracted from the existing extraction wells. Once sodium bromide (conservative tracer) is observed in the extraction wells, the system will be turned off. Injectate mixture will then be injected into the extraction wells. Because the system is temporary in nature, no additional diagrams are provided in **Attachment D**.

Section IV Site Hydrogeological and Injection Zone Data

Provide the information in items 14 through 31

14. Name of Contaminated Aquifer: Shallow Aquifer and Intermediate Aquifer
 15. Receiving Formation Name of Injection Zone: Unconsolidated Material

16. Well/Trench Total Depth: Injection point depths are vary from 12 to 55 feet (ft) below ground surface (bgs). (2 to 35 feet bgs [shallow] and 34 to 55 ft bgs [intermediate])
17. Surface Elevation: Approximately 180-200 ft
18. Depth to Ground Water: Ranges from approximately 4 to 25 ft bgs (shallow) and 35 to 65 ft bgs (intermediate)
19. Injection Zone Depth: Injection Zone Depths vary at each biobarrier
 - Landfill Biobarrier #1 (shallow): from 2 to 21 ft bgs
 - Landfill Biobarrier#2 (shallow): 13 to 28 ft bgs
 - Landfill Biobarrier #3 (shallow): 15 to 27 ft bgs
 - Bayou Biobarrier (shallow): 14 to 32 ft bgs
 - Mid Plume Area (Shallow): 14 to 36 ft bgs
 - Mid Plume Area (Intermediate): 34 to 55 ft bgs
20. Injection Zone vertically isolated geologically? Y/N Impervious Strata between Injection Zone and nearest Underground Source of Drinking Water:
 - Name: Intermediate, Upper Deep and Deep Aquifer Zones (clay layers)
 - Thickness:
 - Intermediate Zone: 35 to 62 ft bgs
 - Upper Deep Groundwater: 80 to 151 ft bgs
 - Deep Groundwater: Extends below 220 ft bgs
21. Provide a list of contaminants and the levels (parts per million [ppm]) in contaminated aquifer.
 - Attach as Attachment E: See Figures in **Attachment E** showing recent levels of contamination in parts per billion.
22. Horizontal and Vertical extent of contamination and injection plume
 - Attach as Attachment F: The horizontal extent of contamination shown in **Attachment E**. The contamination is limited to the shallow and intermediate zone. There is no impact to the upper deep or deep zones of the aquifer. A separate Attachment F is not provided.
23. Formation (Injection Zone) Water Chemistry (Background levels) TDS, etc.
 - Attach as Attachment G: Water chemistry data will be provided from the pre-remedy sampling event when available. A separate Attachment G is not provided.
24. Injection Fluid Chemistry in ppm at point of injection
 - Attach as Attachment H: The injection fluid chemistry consists of 8.4 to 10 percent (by weight) solution of EVO (carbon substrate). The EVO product (that will be used in the vicinity of the landfill biobarriers and in the Mid Plume Area), EDS-ER™ will be supplied by Tersus Environmental The EVO product with microscale zero valent iron, ABC Plus will used to implement the Bayou Biobarrier; this product will be provided by Redox Tech. See **Attachment H** for Safety Data Sheets.

Water for the solution will be procured through a 4-inch water line located near the LHAAP Groundwater Treatment Plant. Water analysis data for the water from the 4-inch line is included in **Attachment H**.

25. Lowest Known Depth of Ground Water with < 10,000 ppm TDS: Unknown
26. Maximum injection Rate/Volume/Pressure: Rate: 2 to 10 gallons per minute; Volume: 264 gallons to 2,394 gallons per point; Pressure: 20 to 200 psi (An attempt will be made to keep injection pressures below 40 psi. However, in some cases, depending on the lithology the injection pressure may be higher.
27. Water wells within 1/4 mile radius (attach map as Attachment I): None
28. Injection wells within 1/4 mile radius (attach map as Attachment I): Eight injection wells (16IW01 to 16IW08 near Landfill Biobarrier #2)
29. Monitor wells within 1/4 mile radius (attach driller's logs and map as Attachment I): See **Attachment I**, quarter mile map which indicates approximately 55 monitoring wells within a quarter mile radius from the planned injections.
30. Sampling frequency: Pre-remedy sampling will be conducted prior to the injections followed by quarterly sampling events for eight quarters. The sample results will be included in monitoring reports that will be submitted to TCEQ. Samples will be monitored for VOCs, perchlorate, field parameters, and biogeochemical parameters to monitor the progress of ISB injections.
31. Known hazardous components in injection fluid: There are no hazardous components in the injection fluid.

Section V Site History

Provide the information in items 32 through 35

32. Type of Facility: Former Longhorn Army Ammunition Plant
33. Contamination Dates: 1940s to 1980s
34. Original Contamination (VOCs, TPH, BTEX, etc.) and Concentrations (attach as Attachment J): The original COCs are Trichloroethene (TCE); cis-1,2-dichloroethene (DCE); 1,1,-DCE; 1,2-DCA; vinyl chloride (VC); 1,1,2-TCA and methylene chloride (MC), perchlorate and metals (arsenic, chromium, manganese, nickel and thallium). No separate Attachment J is provided.
35. Previous Remediation: Attach results of any previous remediation as Attachment K. Interim Remedial Action involved construction of a landfill cap. Construction of the multilayer cap was completed in 1998. A groundwater extraction system was voluntarily installed by the U.S. Army in 1996 and 1997 as a treatability study to prevent the groundwater plume from migrating to Harrison Bayou. The extraction system has been operating for approximately 20 years. A separate Attachment K is not provided.

<<NOTE>> Authorization Form should be completed in detail and authorization given by TCEQ before construction, operation, and/or conversion can begin. Attach additional pages as necessary.

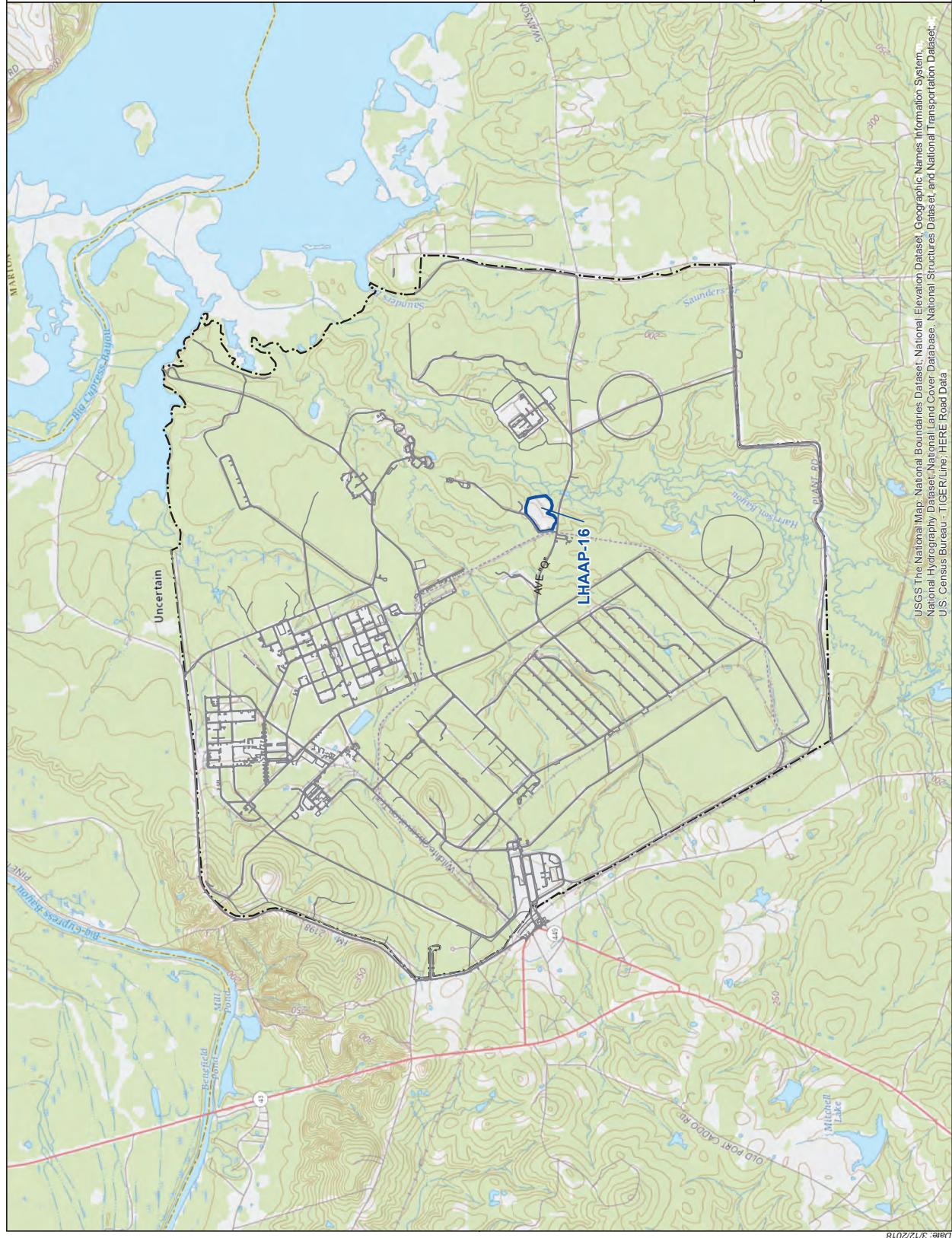
Class V Injection Well Designations

5A07	Heat Pump/AC return (IW used for groundwater to heat and/or cool buildings)
5A19	Industrial Cooling Water Return Flow (IW used to cool industrial process equipment)
5B22	Salt Water Intrusion Barrier (IW used to inject fluids to prevent the intrusion of salt water into an aquifer)
5D02	Storm Water Drainage (IW designed for the disposal of rain water)
5D04	Industrial Stormwater Drainage Wells (IW designed for the disposal of rain water associated with industrial facilities)
5F01	Agricultural Drainage (IW that receive agricultural runoff)
5R21	Aquifer Recharge (IW used to inject fluids to recharge an aquifer)
5S23	Subsidence Control Wells (IW used to control land subsidence caused by ground water withdrawal)
5W09	Untreated Sewage
5W10	Large Capacity Cesspools (Cesspools that are designed for 5,000 gpd or greater)
5W11	Large Capacity Septic systems (Septic systems designed for 5,000 gpd or greater)
5W12	WTTP disposal
5W20	Industrial Process Waste Disposal Wells
5W31	Septic System (Well Disposal method)
5W32	Septic System Drainfield Disposal
5X13	Mine Backfill (IW used to control subsidence, dispose of mining byproducts, and/or fill sections of a mine)
5X25	Experimental Wells (Pilot Test) (IW used to test new technologies or tracer dye studies)
5X26	Aquifer Remediation (IW used to clean up, treat, or prevent contamination of a USDW)
5X27	Other Wells
5X28	Motor Vehicle Waste Disposal Wells (IW used to dispose of waste from a motor vehicle site - These are currently banned)
5X29	Abandoned Drinking Water Wells (waste disposal)

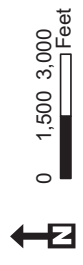
Attachment A

Site Topographic Map & Site Vicinity Map

- **Topographic Quadrangle Map**
- **Figure 1-4, LHAAP-16 Site Plan**



Road
 LHAAP Boundary
 LHAAP-16 Site Boundary



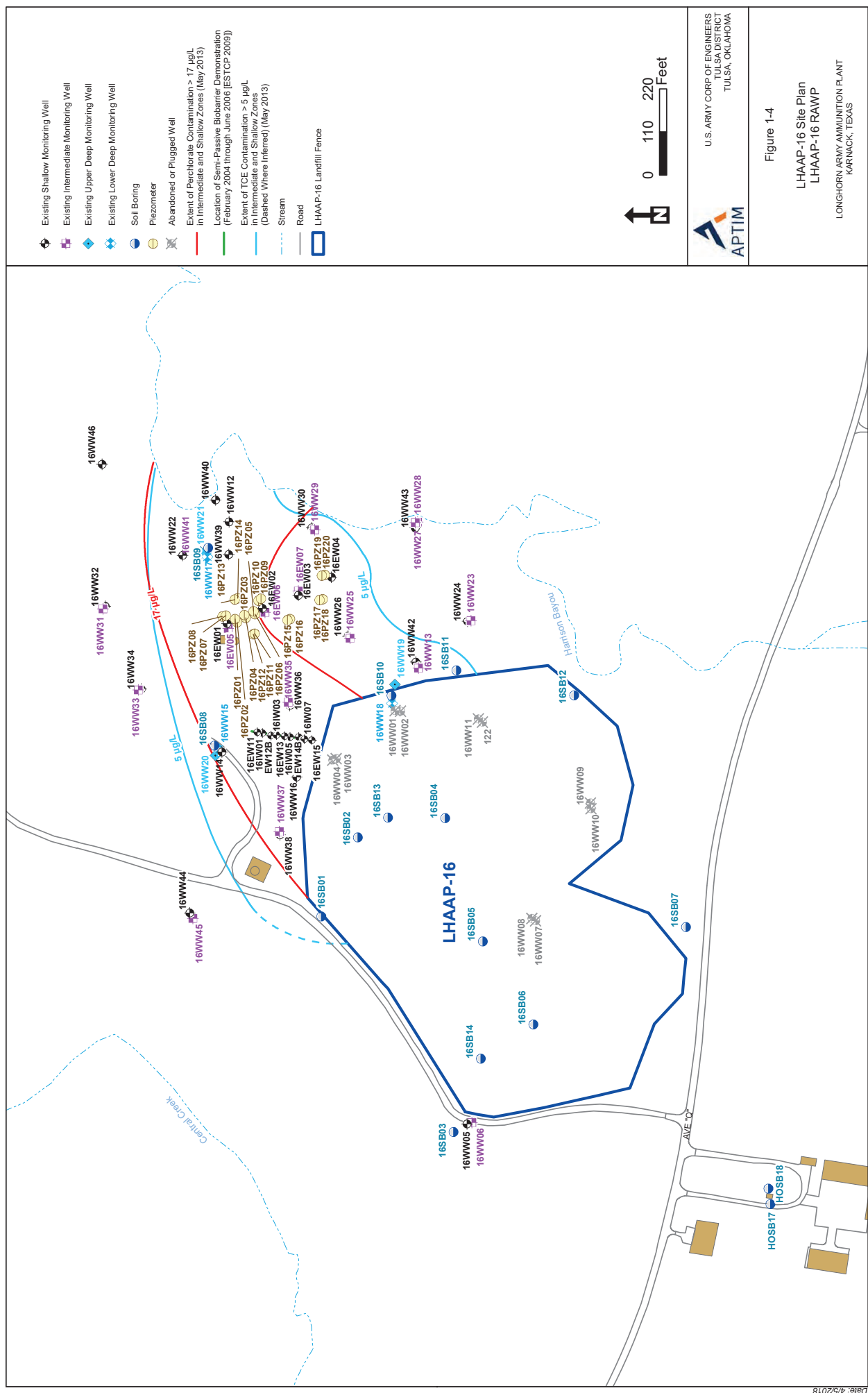
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Attachment A

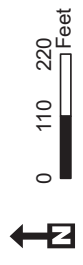
Topographic Quadrangle Map
 LHAAP-16 UIC

LONGHORN ARMY AMMUNITION PLANT
 KARRACK, TEXAS

USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System,
 National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset.
 U.S. Census Bureau - TIGER/Line: HERE Road Data



- Existing Shallow Monitoring Well
- Existing Intermediate Monitoring Well
- Existing Upper Deep Monitoring Well
- Existing Lower Deep Monitoring Well
- Soil Boring
- Piezometer
- Abandoned or Plugged Well
- Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (May 2013)
- Location of Semi-Passive Biobarrier Demonstration (February 2004 through June 2006 (ESTCP 2009))
- Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)
- Stream
- Road
- LHAAP-16 Landfill Fence



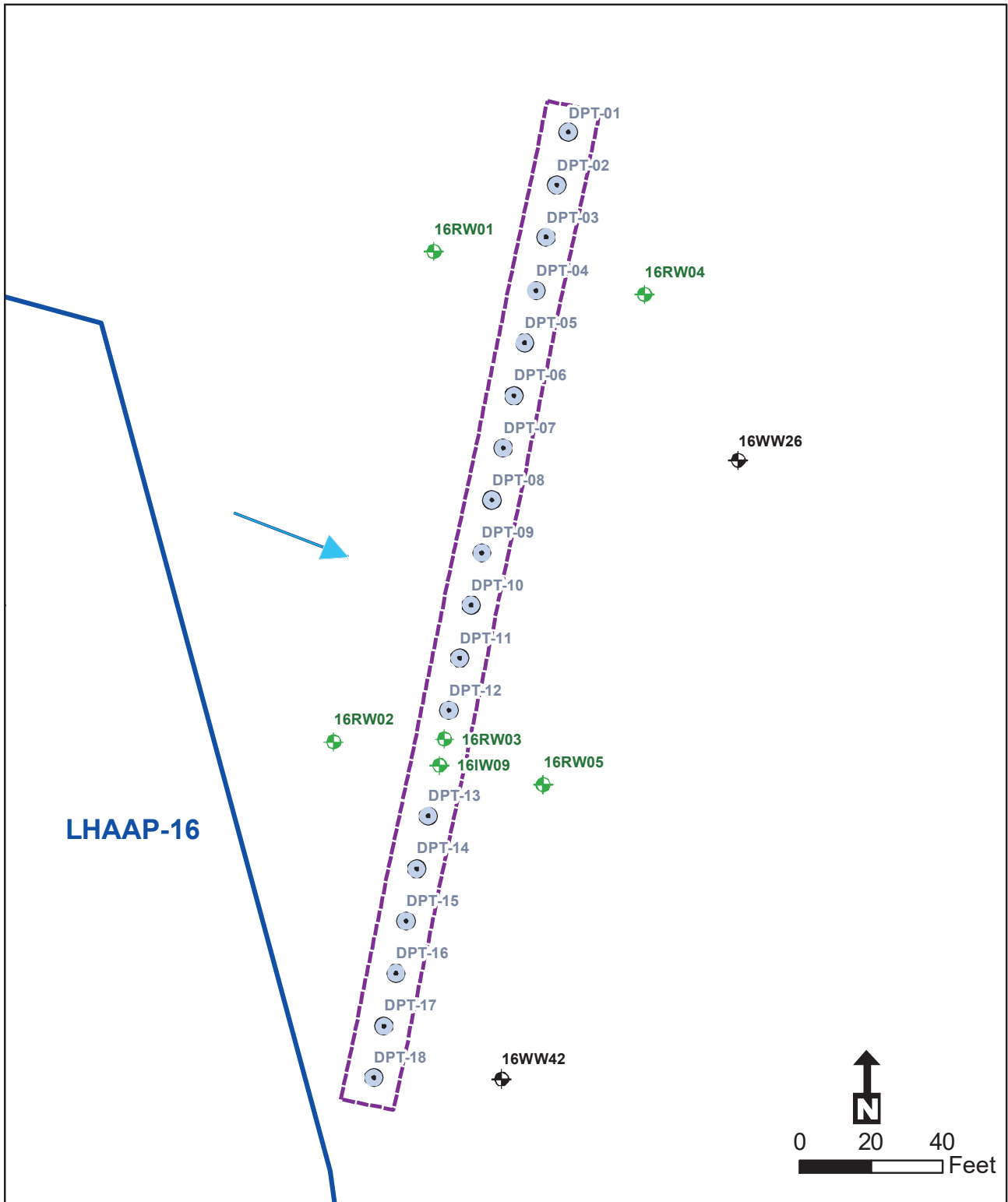

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Figure 1-4
 LHAAP-16 Site Plan
 LHAAP-16 RAWP
 LONGHORN ARMY AMMUNITION PLANT
 KATYACK, TEXAS


Attachment B

Proposed Injection Locations

- **Figure 3-2, Landfill Biobarrier #1, Proposed Remediation, LHAAP-16, RAWP**
- **Figure 3-3, Landfill Biobarrier #2, Proposed Remediation, LHAAP-16, RAWP**
- **Figure 3-4, Landfill Biobarrier #3, Proposed Remediation, LHAAP-16, RAWP**
- **Figure 3-5, Bayou Biobarrier, Proposed Remediation, LHAAP-16, RAWP**
- **Figure 3-6, Mid Plume Shallow Groundwater Zone, Proposed Remediation, LHAAP-16, RAWP**
- **Figure 3-7, Mid Plume Intermediate Groundwater Zone, Proposed Remediation, LHAAP-16, RAWP**
- **Section 3.0 from the LHAAP-16 Draft Remedial Action Work Plan**



-  Proposed Well Location
-  Existing Well Location
-  Proposed Direct Push Injection Point
-  Groundwater Flow Direction Without Extraction (Shallow Zone)
-  Target In-Situ Reaction Zone Based on Design Radius of Influence
-  LHAAP-16 Landfill Fence

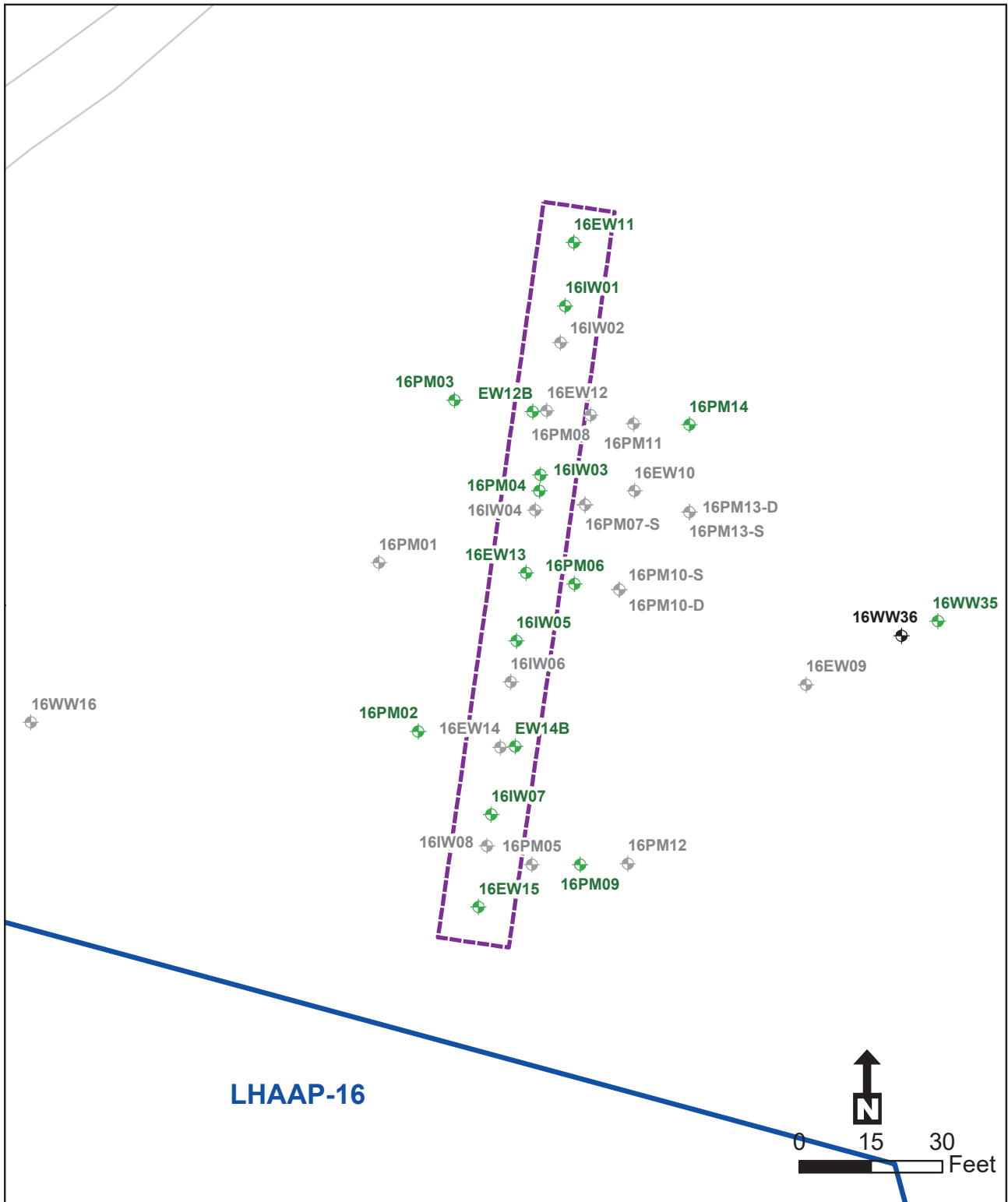


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Figure 3-2
Landfill Biobarrier #1
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



- Existing Monitored Natural Attenuation Performance Monitoring Well
- Existing In-Situ Bioremediation Injection/Extraction/Performance Monitoring Well
- Other Existing Monitoring Well
- Target In-Situ Reaction Zone Based on Design Radius of Influence
- LHAAP-16 Landfill Fence



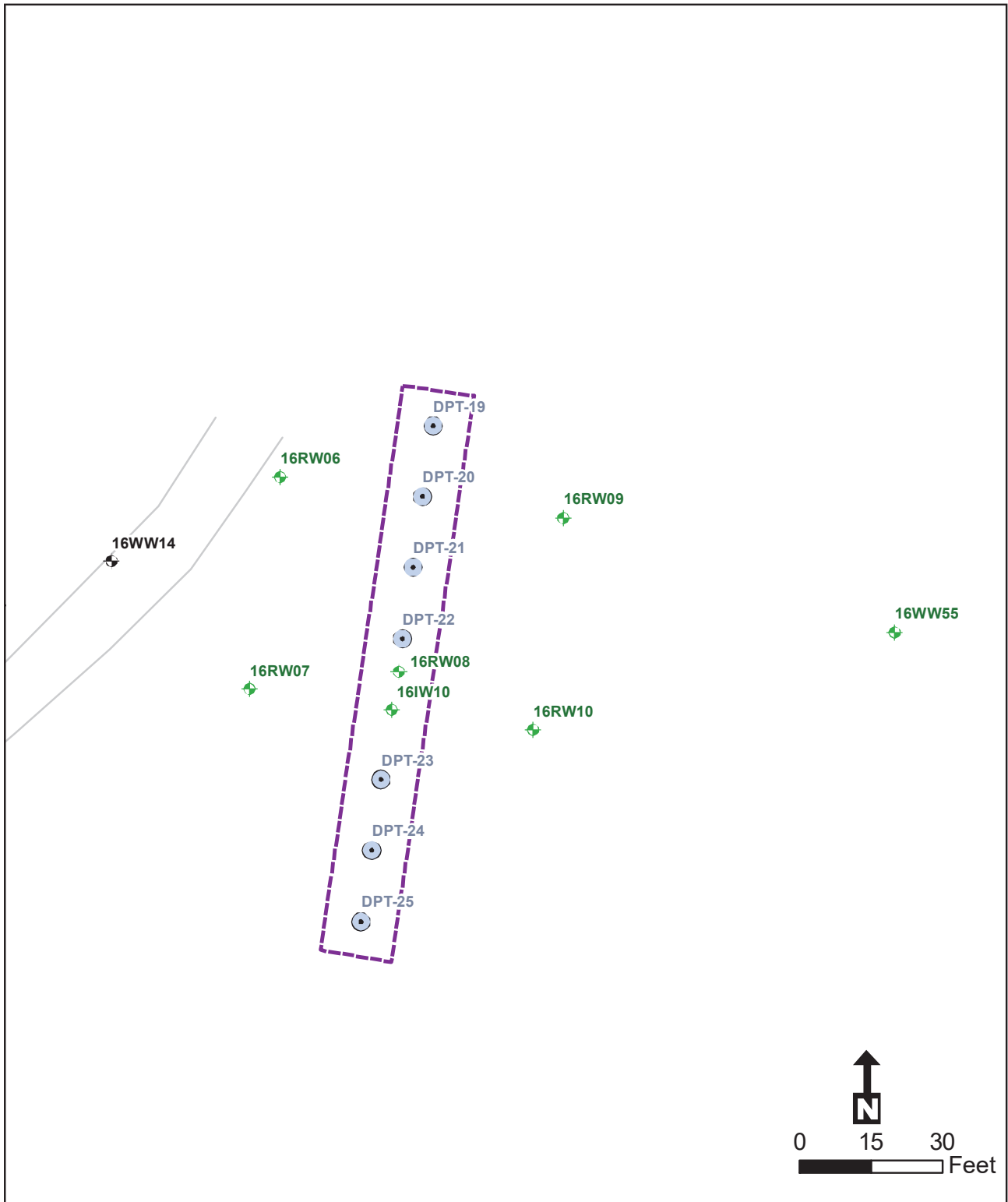
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Figure 3-3

Landfill Biobarrier #2
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 3/26/2018



-  Existing Monitored Natural Attenuation Performance Monitoring Well
-  Proposed Shallow Well Location
-  IW - Injection Well Location
-  RW - Recovery Well Location
-  Proposed Direct Push Injection Point
-  Target In-Situ Reaction Zone Based on Design Radius of Influence



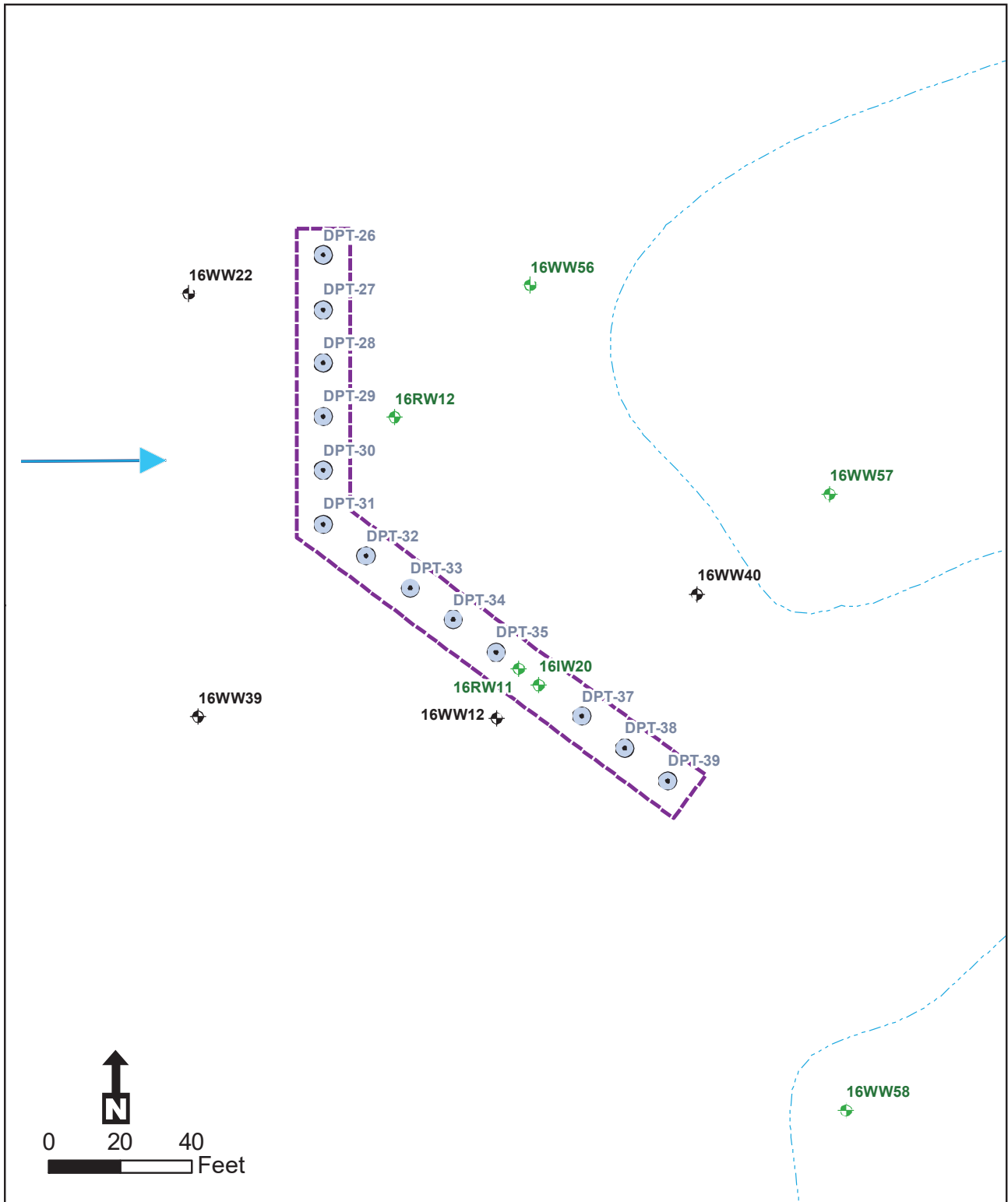
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Figure 3-4

Landfill Biobarrier #3
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Proposed Direct Push Injection Point
-  Existing Monitored Natural Attenuation Performance Monitoring Well
-  Proposed Shallow Well Location
IW = Injection Well
RW = Recovery Well Location
-  Groundwater Flow Direction Without Extraction (Shallow Zone)
-  Target In-Situ Reaction Zone Based on Design Radius of Influence



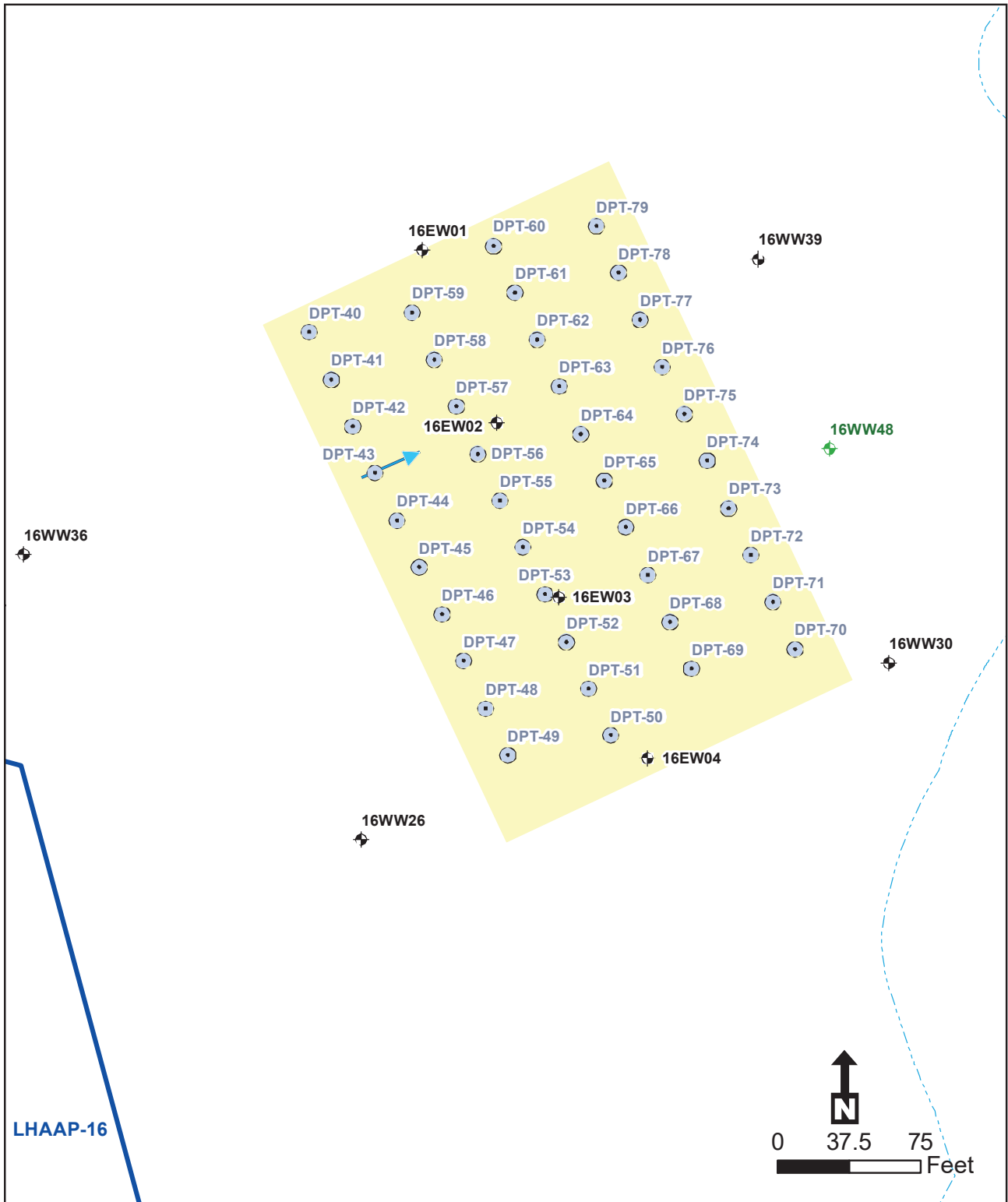
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

Figure 3-5


Bayou Biobarrier
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Existing Shallow Monitoring Well (WW) or Extraction Well (EW) Location
-  Proposed Direct Push Injection Point
-  Proposed Shallow Monitoring Well Location
-  Stream
-  Groundwater Flow Direction Without Extraction (Shallow Zone)
-  Shallow In Situ Bioremediation Area
-  LHAAP-16 Landfill Fence

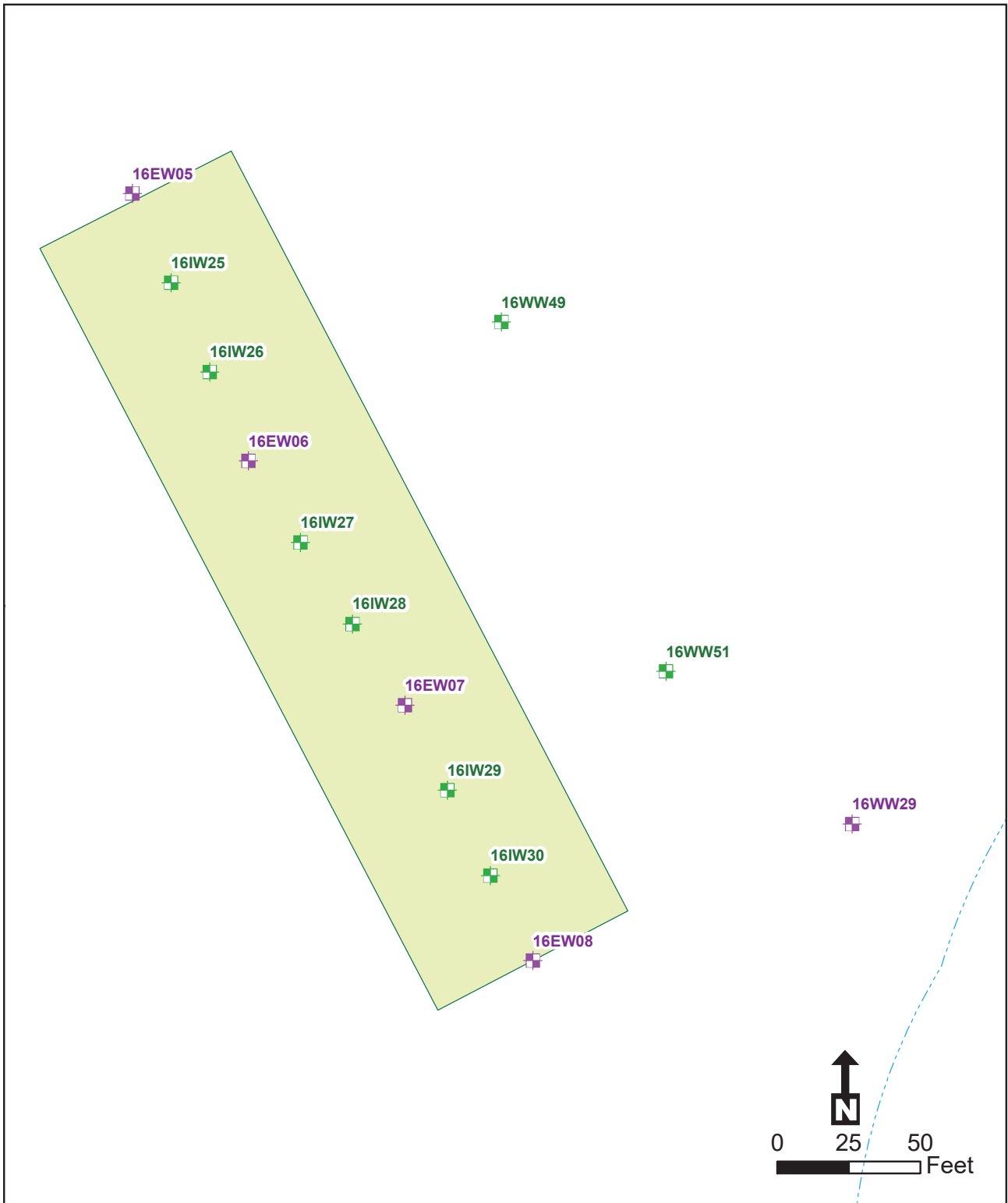






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Figure 3-6
Mid Plume Shallow Groundwater Zone
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Existing Intermediate Injection/Extraction/Monitoring Well (EW)
Existing Intermediate Monitoring Well (WW)
-  Proposed Intermediate Zone Injection/Monitoring Well (IW);
Proposed Intermediate Zone Monitoring Well (WW)
-  Stream
-  Intermediate Zone Situ Bioremediation Area



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Figure 3-7

Mid Plume Intermediate Groundwater Zone
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/22/2018

3.0 IN SITU BIOREMEDIATION (PROPOSED REMEDIATION PLAN)

ISB will be conducted at LHAAP-16 to remediate groundwater impacted with VOCs and perchlorate. The injection locations at LHAAP-16 are shown in **Figure 3-1**. As described in the RD, the following ISB systems will be implemented to treat the VOC and perchlorate impacted groundwater:

- Three Landfill Biobarriers (Landfill Biobarrier #1, Landfill Biobarrier #2, Landfill Biobarrier #3) in the shallow groundwater zone adjacent to the landfill
- One Bayou Biobarrier in the shallow groundwater zone near Harrison Bayou
- A biogrid in the shallow groundwater zone and a biobarrier in the intermediate groundwater zone in the Mid Plume Area

The plume geometry and proposed injections have been developed using the basis and details of the Final RD (U.S. Army, 2017). Overall, the implementation of biobarriers and biogrid will involve the injection of an electron donor and a microbial consortium capable of biodegrading primary VOCs and perchlorate.

The primary biodegradation pathway for chlorinated ethenes, such as tetrachloroethene and TCE, is reductive dechlorination, which occurs under highly reducing anaerobic conditions. During reductive dechlorination, chlorinated ethenes are used as respiratory substrates instead of oxygen by the anaerobic microorganisms that reduce these compounds to harmless by-products. Favorable aquifer conditions are established and/or maintained by adding a carbon source, such as EVO, to act as an electron donor. Details of the RA for each of the systems are described in the following sections.

3.1 Landfill Biobarriers

Three landfill biobarriers will be installed to control the migration of VOCs and perchlorate in shallow groundwater immediately downgradient of the landfill. The location of the barriers is designed to fully intercept the plume of chlorinated VOCs and perchlorate from the landfill in the shallow groundwater zone above their respective cleanup levels (**Figures 3-2, 3-3, and 3-4**). The substrate selected was EVO and therefore, replenishment would not be required for 3 to 5 years (U.S. Army, 2017). The Safety Data Sheets for various commercial available EVO formulations are included in **Appendix C**. As specified in the RD, the specific formulation of EVO proposed for this project is Electron Donor Solution-Extended Release (EDS-ER™). An equivalent EVO product will be used if EDS-ER™ becomes unavailable in the market. EDS-ER™ is a water mixable oil formulated with at least 92 percent natural seed oils. EDS-ER™

is provided by the vendor as a water mixable oil that contains no water, and therefore, will be mixed with water in the field. The product mixes easily with water without using high energy mixers. As specified in the Final RD, a microbial bioaugmentation culture will be used. The Final RD specified KB-1 and an equivalent culture, SDC-9™ will be used in place of KB-1. The Safety Data Sheet for SDC-9™ is included in **Appendix C**. At the three landfill biobarriers, a conservative tracer (sodium bromide) will be used to evaluate the distribution of the substrate as part of the performance monitoring.

3.1.1 Landfill Biobarrier #1

A biobarrier will be installed by injecting an amendment mixture consisting of EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture, SDC-9™ (APTIM's dechlorinating culture) and sodium bromide into eighteen (direct-push technology (DPT) points and one injection well, 16IW09 as shown in **Figure 3-2** and listed on **Table 3-1**. **Table 3-2** shows the volume of amendment scheduled for injection at each injection point/well. The pounds of EVO of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army, 2017).

3.1.2 Landfill Biobarrier #2

Existing injection wells installed during the Environmental Security Technology Certification Program (ESTCP) study (Geosyntec, 2009) will be used to inject EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™) and sodium bromide to create Landfill Biobarrier #2. Before any of the pilot test wells are used for injections, slug tests will be performed to confirm the existing wells are in acceptable condition for injection use. If the results show the injection wells are not in acceptable condition, they will be redeveloped prior to use as injection wells for Landfill Biobarrier #2. Injections will be conducted in two phases. Phase 1 will use four existing injection wells for injections while extracting from five existing extraction wells to aid in the distribution of amendment crossgradient. The extracted groundwater during the first phase will accumulate in the onsite tank at LHAAP-16.

Phase 2 will use the extracted groundwater collected in the onsite tank. The extracted groundwater will be mixed with the amendment mixture and injected back into the existing five extraction wells.

The injection locations are shown on **Figure 3-3**. **Table 3-3** specifies the number of locations, and **Table 3-4** shows the planned volume of amendment mixture to be injected at every location. The pounds of EDS-ER™ of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army, 2017).

3.1.3 Landfill Biobarrier #3

A biobarrier will be installed by injecting an amendment mixture consisting of EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™), and sodium bromide into seven DPT points and one injection well, 16IW10, as shown in **Figure 3-4** and listed on **Table 3-5**. **Table 3-6** provides the planned volume of amendment mixture to be injected at each injection point/well. The pounds of EVO of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army, 2017).

3.2 Bayou Biobarrier

A biobarrier will be installed by injecting an amendment mixture consisting of ABC Plus which consists of EVO with microscale zero valent iron (ZVI), sodium bromide, and bioaugmentation culture (SDC-9™) into thirteen DPT points and one injection well, 16IW20, as shown in **Figure 3-5**. ABC Plus will consist of 3,500 pounds of EVO and 3,500 pounds of microscale ZVI. As stated in the Final RD, the ABC product will be diluted with water to form a solution of approximately 10% by weight before injection. **Table 3-7** specifies the number of locations (DPT points/injection well) that will be used to inject the amendment mixture, and **Table 3-8** provides the planned volume of amendment mixture to be injected at each injection point. The pounds of EVO and iron of the amendment mixture is the same as provided in Final RD (U.S. Army, 2017). The Safety Data Sheet for ABC Plus is included in **Appendix C**.

3.3 Mid-Plume Area ISB

Injections in the Mid-Plume area include injections in the shallow and intermediate groundwater aquifers. As specified in the RD, the specific formulation of EVO proposed for this project is EDS-ER™. The Safety Data Sheets for EDS-ER™ are included in **Appendix C**.

3.3.1 Shallow Groundwater

To treat the VOC and perchlorate impacted groundwater in the shallow groundwater aquifer, a biogrid will be installed by injecting EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™) and sodium bromide (tracer) into forty DPT points as shown in **Figure 3-6** and listed on **Table 3-9**. The Final RD also included fluorescein dye (a tracer) for this area. Only sodium bromide will be used as a tracer to indicate distribution of injected amendment. Analytical results for bromide will be used to indicate its presence. Prior to injections, the shallow zone extraction wells will be shut down. **Table 3-10** specifies the volume of amendment mixture to be injected at each injection point. The pounds of EVO of the amendment mixture are the same as provided in Final RD (U.S. Army, 2017).

3.3.2 Intermediate Groundwater

To treat the intermediate groundwater zone, a biobarrier will be installed consisting of EDS-ER™ or an equivalent EVO product, nutrient, bioaugmentation culture (SDC-9™), and

sodium bromide (tracer) as shown in **Figure 3-7**. The injection will occur in a phased approach. After the initial injection into the six newly installed injection wells, the four existing extraction wells will be used to recirculate the groundwater between injection wells and the extraction wells until an increase in bromide is detected in the extraction wells. Extracted groundwater will accumulate in the onsite tank. Once bromide is detected above baseline concentrations, the extraction system will be shut down and amendment mixture will be injected into the extraction wells. **Table 3-11** specifies the volume of amendment mixture to be injected at each injection point along with the amendment mixture quantities. The pounds of EDS-ER™ of the amendment mixture are the same as provided in Final RD (U.S. Army, 2017). The Safety Data Sheet for various commercial available EVO formulations is included in **Appendix C**.

3.3.3 Sequencing of Injection Areas

The RD calls for injections in the most contaminated portion of the shallow and intermediate groundwater zones in conjunction with phased shut down of the existing groundwater extraction system. Currently, active extraction is ongoing from both the shallow and intermediate groundwater in the vicinity of the mid-plume injection area. The following is the proposed sequencing of the injections and extraction:

- 1) Continue active extraction from the mid-plume area using the existing onsite tank.
- 2) Inject at Bayou Biobarrier. The Bayou Biobarrier will protect contaminants from migrating to the bayou, and injection will occur at the Bayou Biobarrier before shutting down the extraction at the Mid-Plume area to limit any additional migration to the creek from the shutdown of extraction system. Additionally, this area uses the amendment mixture using EVO and microscale ZVI, while the other areas do not use the ZVI in the mixture. While injections are ongoing at Bayou Barrier, the field technicians will build/install recirculation system for the intermediate groundwater for the Mid-Plume area.
- 3) Shut down extraction from the mid-plume shallow and intermediate groundwater and empty the onsite tank by transferring water to the GWTP for treatment.
- 4) Inject into the Mid-Plume. Begin injections into the intermediate groundwater and start recirculation of intermediate groundwater using onsite tank. While recirculating in the intermediate aquifer, inject into the shallow groundwater. During injections in the shallow groundwater, the recirculation of the intermediate groundwater and amendments will be checked. Recirculation will continue in the intermediate aquifer until distribution of amendments has occurred. Once recirculation is successful in the intermediate aquifer, the accumulated water and amendments will be reinjected into the intermediate aquifer.

- 5) Inject at Landfill Biobarrier #1. Injections may begin at Biobarrier #1 while recirculation may be continuing in the Mid-Plume intermediate groundwater.
- 6) Inject at Landfill Biobarrier #2/#3. There are extraction wells at Landfill Biobarrier #2, but they are not currently connected to the existing onsite tank. The initial injections will begin at Landfill Biobarrier #3 while the piping/connections at extraction wells at Landfill Biobarrier #2 are being prepared to be connected to the mixing tank. Once the injections are complete at Biobarrier #3, the injections will be completed at Biobarrier #2. The accumulated water from extraction of the Landfill Biobarrier #2 wells will accumulate in the mixing tank until amendments are added and reinjected into the extraction wells at Landfill Biobarrier #2.

Attachment C

Typical Injection Well Construction Diagram

- **Table C-1**
- **Typical Inject Well Diagram**

**Table C-1
New Injection Wells
LHAAP-16**

Well ID	Screen Interval (feet below ground surface)	Shallow/ Intermediate Zone
16IW09	13-18	Shallow
16IW10	15-25	Shallow
16IW20	14-24	Shallow
16IW25	40-55	Intermediate
16IW26	40-55	Intermediate
16IW27	40-55	Intermediate
16IW28	35-50	Intermediate
16IW29	35-50	Intermediate
16IW30	35-50	Intermediate

LOCKABLE CAP ON CASING
 GROUND SURFACE 0.0
 TOP OF CASING 2.5 FT
 STEEL STICK UP BOX
 CONCRETE WELL PAD 3' x 3' x 6"
 RISER PIPE DIA. 2" PVC
 BOREHOLE DIA. 6"
 ANNULAR SEAL PORTLAND CEMENT/BENTONITE GROUT
 WELL SCREEN SEAL BENTONITE CHIPS (3')
 DEPTH TOP OF FILTER PACK 12.0 FT BGS
 DEPTH TOP OF SCREEN 14.0 FT BGS
 GRADED SAND PACK
 SLOTTED SCREEN DIA. 2" PVC
 SLOT SIZE: 0.010"
 DEPTH BOTTOM OF SCREEN 25.0 FT BGS
 DEPTH BOTTOM OF SUMP/CAP 25.0 FT BGS
 DEPTH BOTTOM OF BOREHOLE 25.5 FT BGS

ELEV. TOP OF CASING _____

ELEV. GROUND SURFACE _____

SCREENED INTERVAL _____

DATE INSTALLED _____

Construction Notes:

Well Casing: _____

Shroud: _____

Filter Pack: _____

Bentonite Seal: _____

Time/Date Placed: _____

Grout _____

Unit Weight: _____

Time/Date Placed: _____

Remarks: _____

TYPICAL SHALLOW INJECTION WELL

ELEV. TOP OF CASING _____

ELEV. GROUND SURFACE _____

SCREENED INTERVAL _____

DATE INSTALLED _____

Construction Notes:

Well Casing: _____

Shroud: _____

Filter Pack: _____

Bentonite Seal: _____

Time/Date Placed: _____

Grout: _____

Unit Weight: _____

Time/Date Placed: _____

Remarks: _____

GROUND SURFACE 0.0 _____

TOP OF CASING 2.5 _____ FT

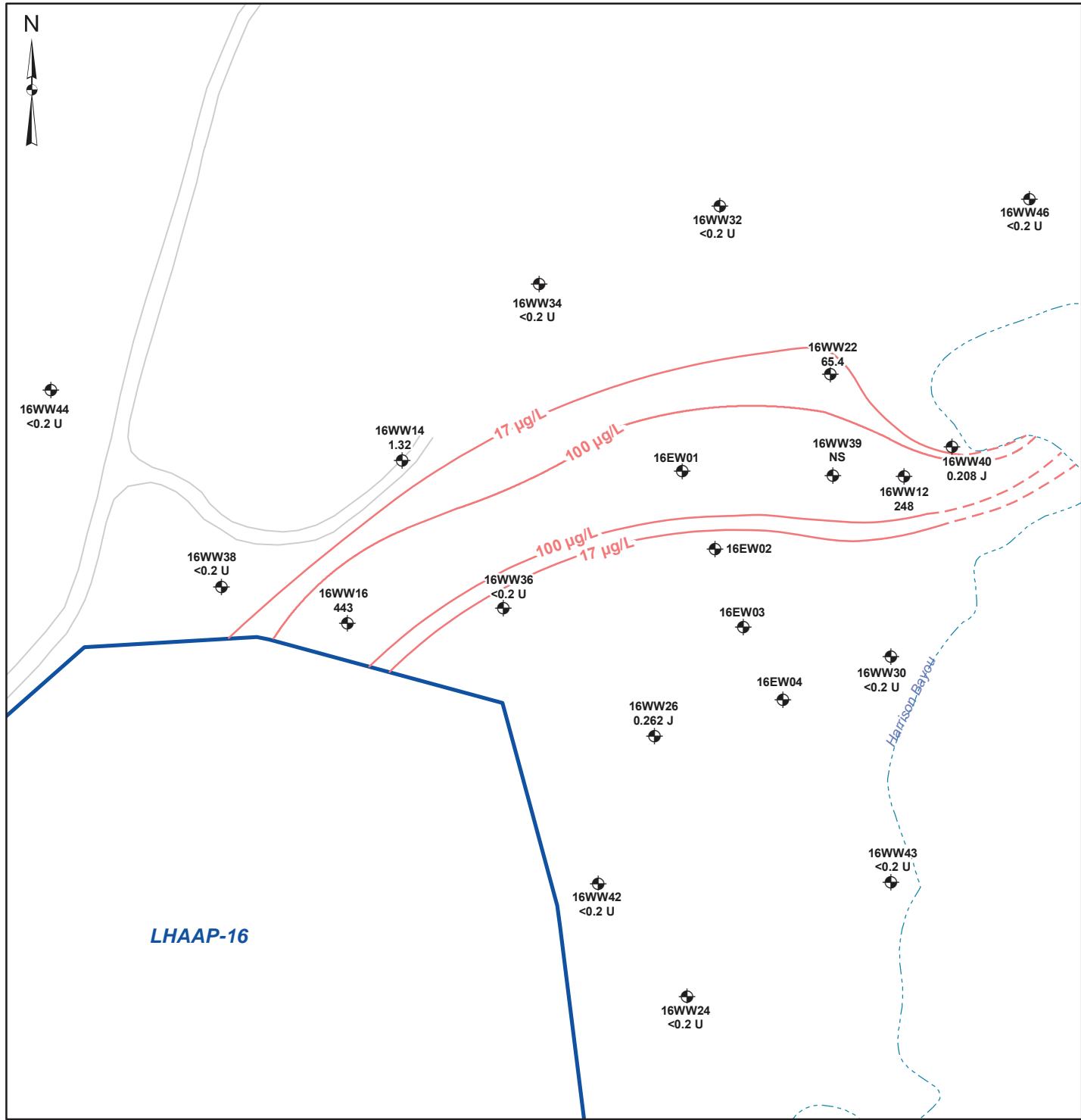
TYPICAL INTERMEDIATE INJECTION WELL

Attachment D
Not Applicable






Attachment E

COC concentrations in Shallow and Intermediate Groundwater

- **Figure 2-4, Perchlorate Concentrations in Groundwater, Shallow Zone – May 2013, LHAAP-16 Remedial Design**
- **Figure 2-5, Perchlorate Concentrations in Groundwater, Intermediate Zone – May 2013, LHAAP-16 Remedial Design**
- **Figure 2-6, VOCs in Groundwater, Shallow Zone – May 2013, LHAAP-16 Remedial Design**
- **Figure 2-7, VOCs in Groundwater Intermediate Zone – May 2013, LHAAP-16 Remedial Design**



Legend

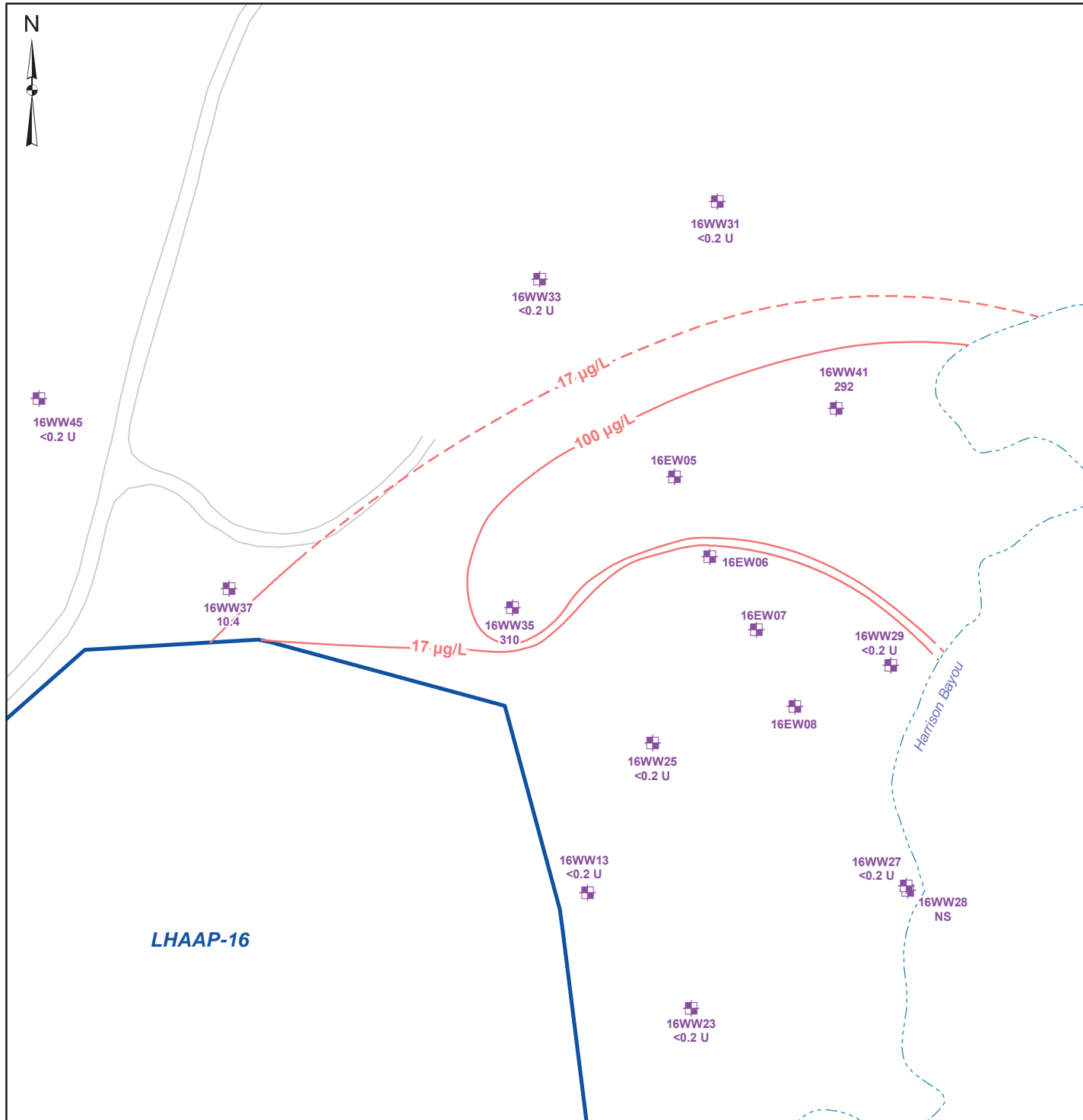
-  Shallow Monitoring Well
-  Perchlorate Concentration Contour (Dashed Where Inferred)
-  Stream
-  Road
-  LHAAP-16 Landfill Fence

Notes:

Results are in micrograms per liter (µg/L)
 TRRP Residential PCL for Perchlorate = 17 µg/L.
 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.
 NS - Not Sampled



Figure 2-4
 Perchlorate Concentrations in Groundwater
 Shallow Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas



Legend

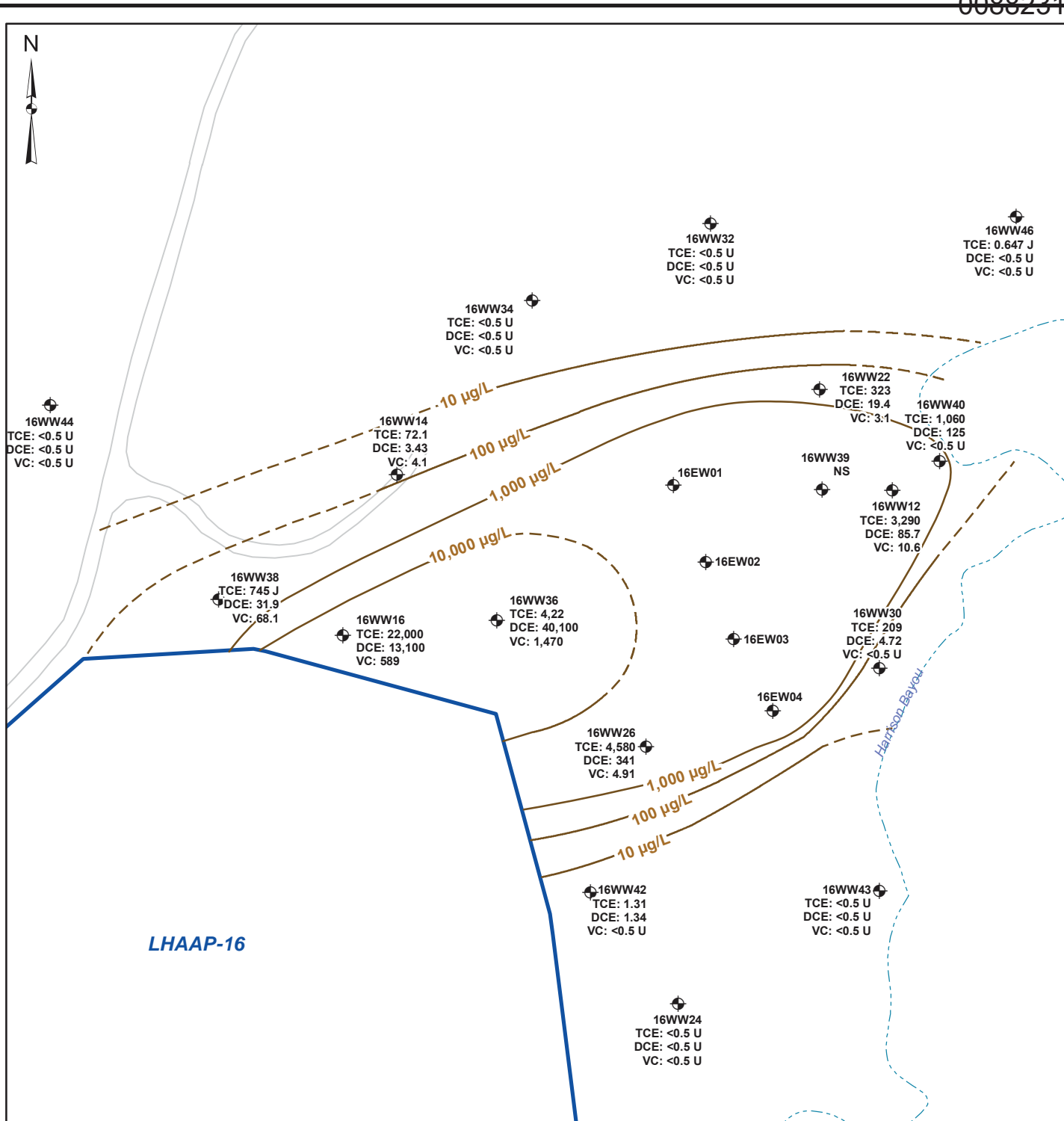
- Intermediate Monitoring Well
- Perchlorate Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

Notes:

Results are in micrograms per liter (µg/L)
 TRRP Residential PCL for Perchlorate = 17 µg/L.
 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.
 NS - Not Sampled



Figure 2-5
 Perchlorate Concentrations in Groundwater
 Intermediate Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas



Legend

- Shallow Monitoring Well
- TCE Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

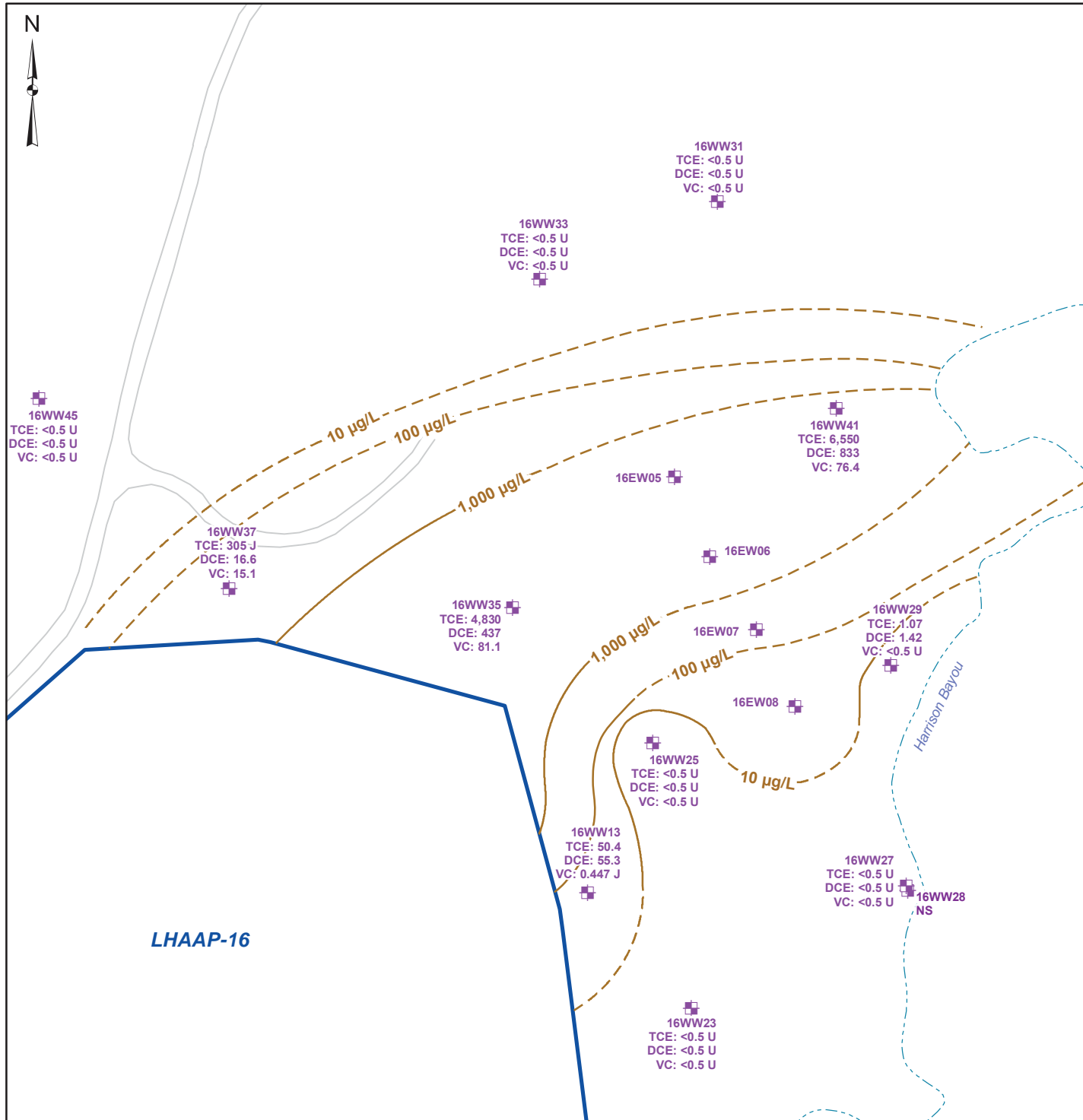
Notes:
 Results are in micrograms per liter (µg/L)
 DCE - cis-1,2-Dichloroethene
 U - Undetected: The analyte was analyzed for, but not detected.
 J - Estimated Value
 NS - Not Sampled
 TCE - Trichloroethene
 VC - Vinyl Chloride
 VOC - Volatile Organic Compound



Path: L:\AGE\GIS\GISProjects\Longhorn_AAP\01_Reports\LHAAP-16\RAW\Fig 2-6 LHAAP-16 VOCs in Shallow Zone May 2013.mxd



Figure 2-6
 VOCs in Groundwater
 Shallow Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas



Legend

- Intermediate Monitoring Well
- TCE Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

Notes:

Results are in micrograms per liter (µg/L)
 DCE - cis-1,2-Dichloroethene
 U - Undetected: The analyte was analyzed for, but not detected.
 J - Estimated Value
 NS - Not Sampled
 TCE - Trichloroethene
 VC - Vinyl Chloride
 VOC - Volatile Organic Compound



Figure 2-7
 VOCs in Groundwater
 Intermediate Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

Attachment F
Not Applicable

Attachment G
Not Applicable

Attachment H

Safety Data Sheets

- **ABC+**
- **Anaerobic Biochem (ABC)**
- **DHC Microbial Consortium (SDC-9™)**
- **Electron Donor Solution (EDS-ER™)**
- **Water Analysis**



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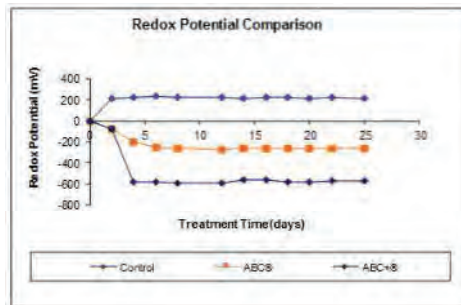
SATURDAY, 18 JUNE 2016

ABC+

ANAEROBIC BIOCHEM PLUS (ABC®+)

ABC+ an enhanced version of our industry proven

Anaerobic Biochem (ABC®) formula, promoting both anaerobic biodegradation and reductive dechlorination of halogenated solvents in groundwater. This product, Anaerobic Biochem Plus (ABC+), is a mixture of our ABC® formula and Zero Valent Iron (ZVI). Formulated and mixed on a site-by-site basis, up to fifty percent (50%) by weight of ZVI can be added. ZVI has been proven and widely accepted as an effective in situ remediation technology of chlorinated solvents such as TCA, PCE, TCE, and daughter products. The degradation process using ZVI is an abiotic reductive dechlorination process occurring on the surface of the granular iron, with the iron acting as an electron donor.



The addition of ZVI to the ABC® mixture provides a number of advantages for enhanced reductive dechlorination (ERD).

The ZVI will provide an immediate reduction. The ABC® will provide short-term and long-term nutrients to anaerobic growth, which also assists to create a reducing environment. ABC® contains soluble lactic acid and a phosphate buffer that provides phosphates, which are a micronutrient for bioremediation, and maintains the pH in a range that is best suited for microbial growth. In addition, the corrosion of iron metal yields ferrous iron and hydrogen, both of which are possible reducing agents. The hydrogen gas produced is also an excellent energy source for a wide variety of anaerobic bacteria.

The ABC® and ZVI are mixed with potable water and emplaced in the subsurface simultaneously. The dilution factor (i.e. water content) can be adjusted to achieve optimal dispersion and distribution based on site-specific parameters such as well spacing, permeability of the formation, and contaminant concentrations. The solution can be emplaced by a variety of techniques, including injection through wells or drill rods (for permeable geologic environments such as sands and fractured rock), hydraulic fracturing (for lower permeable environments such as silt and clay), and through soil blending (for all unconsolidated shallow depth applications less than 20 ft bgs). All of these techniques are part of Redox Tech's service offerings.

Benefits of ABC+ include:

- The presence of ZVI allows for the rapid and complete dechlorination of target compounds. Degradation rates using ZVI are several orders of magnitude greater than under natural conditions. As a consequence, the process does not result in the formation of daughter products other than ethane, ethane, and methane.
- ABC® will last up to 12-24 months in the subsurface environment due to slow releasing compounds, allowing for long-term anaerobic biodegradation
- By creating a reducing environment, ABC+ has the ability to provide long term immobilization of heavy metals (e.g. Ni, Zn, Hg, As)
- Does not require direct contact to act on target constituents.
- Does not divert groundwater flow. ABC is typically mixed at a 15% by weight solution with water. The viscosity of the solution is similar to sugar water and therefore does not measurably influence groundwater flow paths. Due to the relatively low volume of ZVI used, it does not measurably lower the bulk permeability of the formation
- Does not divert groundwater flow. ABC is typically mixed at a 15% by weight solution with water. The viscosity of the solution is similar to sugar water and therefore does not measurably influence groundwater flow paths. Due to the relatively low volume of ZVI used, it does not measurably lower the bulk permeability of the formation
- Patent protection: Redox Tech is licensed under Envirometal Technologies, Inc. (an Adventus Company) who is the current holder of patents pertaining to remediation using ZVI. Therefore, Redox Tech is able to market, sell, and emplace our ABC+ product. There is no patent infringement risk to the client in selecting the ABC+ approach.
- Price advantage. The cost of the ABC+ formula is an extremely competitive approach in relation to other ERD products on the market.

SUB MENU

ABC®

ABC+

ABC-OLÉ

OBC™

OBC+

NUBUFF

ZVI

ANAEROBIC BIOCHEM

Anaerobic Biochem (ABC®), is a patented mixture of lactates, fatty acids, and a phosphate buffer that promotes anaerobic biodegradation of halogenated solvents in groundwater.

 **ABC® BROCHURE**
Adobe PDF File
[Click here](#)

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- ABC+ produces a significantly lower redox potential of approximately -600 mV

Let Redox Tech help formulate an enhanced anaerobic program for your site today. For more information contact our [Main Office](#).

ADDITIONAL INFO

BROCHURES & PRESENTATIONS

[ABC+ Presentation \(713.91 kB\)](#)

[ABC+ Presentation \(58.6 kB\)](#)

CASE STUDIES

[ABC+ TCA Case Study \(101.76 kB\)](#)

OTHER DOCUMENTS

[ABC versus Emulsified Oils \(55.99 kB\)](#)

[Site Profile for Cost Estimate \(27.11 kB\)](#)

[Florida Remediation Conference \(2.23 MB\)](#)

[Lactate \(webpage\)](#)

¹ABC[®] is protected by US Patent 6,001,252.

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SAFETY DATA SHEET

Anaerobic BioChem (ABC)

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Anaerobic BioChem
GENERAL USE: Bioremediation of halogenated organics and metals

MANUFACTURER:

Redox Tech, LLC
200 Quade Drive
Cary, NC 27513
919-678-0140

EMERGENCY TELEPHONE:

Within USA and Canada: 1-800-424-9300
+1 703-527-3887 (collect calls accepted)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Product is generally recognized as safe. May cause irritation exposure to eyes. Long term contact to skin may cause some drying and minor irritation.

3. COMPOSITION INFORMATION ON INGREDIENTS

Proprietary mixture of fatty acids, glycerol, lactates and dipotassium phosphate.

4. FIRST AID MEASURES

EYES: Immediately flush with water for up to 15 minutes. If irritation persists, seek medical attention.

SKIN: Rinse with water. Irritation is unlikely, but if irritation occurs or persists, seek medical attention.

INGESTION: Generally safe to ingest but not recommended.

INHALATION: No first aid required.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water

FIRE/EXPLOSION HAZARDS: Product is combustible only at temperatures above 600C

FIRE FIGHTING PROCEDURES: Use flooding with plenty of water, carbon dioxide or other inert gasses. Wear full protective clothing and self-contained breathing apparatus. Deluging with water is the best method to control combustion of the product.

ABC

November2014

FLAMMABILITY LIMITS: non-combustible**SENSITIVITY TO IMPACT:** non-sensitive**SENSITIVITY TO STATIC DISCHARGE:** non-sensitive

6. ACCIDENTAL RELEASE MEASURES

Confine and collect spill. Transfer to an approved DOT container and properly dispose. Do not dispose of or rinse material into sewer, stormwater or surface water. Discharge of product to surface water could result in depressed dissolved oxygen levels and subsequent biological impacts.

7. HANDLING AND STORAGE

HANDLING: Protective gloves and safety glasses are recommended.

STORAGE: Keep dry. Use first in, first out storage system. Keep container tightly closed when not in use. Avoid contamination of opened product. Avoid contact with reducing agents.

8. EXPOSURE CONTROLS – PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
ABC	NA	NA	NA

ENGINEERING CONTROLS: None are required

PERSONAL PROTECTIVE EQUIPMENT

EYES and FACE: Safety glasses recommended

RESPIRATOR: none necessary

PROTECTIVE CLOTHING: None necessary

GLOVES: rubber, latex or neoprene recommended but not required

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	none to mild pleasant organic odor
Appearance:	clear to light amber
Auto-ignition Temperature	Non-combustible
Boiling Point	>600 C
Melting Point	NA
Density	1.15 gram/cc
Solubility	infinite
pH	7-9

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID: Do not contact with strong oxidizers

STABILITY: product is stable

POLYMERIZATION: will not occur

INCOMPATIBLE MATERIALS: strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS:

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

A: General Product Information

Acute exposure may cause mild skin and eye irritation.

B: Component Analysis - LD50/LC50

No information available.

B: Component Analysis - TDLo/LDLo

TDLo (Oral-Man) none

Carcinogenicity

A: General Product Information

No information available.

B: Component Carcinogenicity

Product is not listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

Epidemiology

No information available.

Neurotoxicity

No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Discharge to water may cause depressed dissolved oxygen and subsequent ecological stresses

Environmental Fate

No potential for food chain concentration

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Material is not considered hazardous, but consult with local, state and federal agencies prior to disposal to ensure all applicable laws are met.

ABC

November2014

14. TRANSPORT INFORMATION

NOTE: The shipping classification information in this section (Section 14) is meant as a guide to the overall classification of the product. However, transportation classifications may be subject to change with changes in package size. Consult shipper requirements under I.M.O., I.C.A.O. (I.A.T.A.) and 49 CFR to assure regulatory compliance.

US DOT Information

Shipping Name: Not Regulated

Hazard Class: Not Classified

UN/NA #: Not Classified

Packing Group: None

Required Label(s): None

50th Edition International Air Transport Association (IATA):

Not hazardous and not regulated

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

Material is not regulated under IMDG

15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III

SECTION 311 No Hazard for Immediate health Hazard

SECTION 312 No Threshold Quantity

SECTION 313 Not listed

CERCLA NOT REGULATED UNDER CERCLA

TSCA NOT REGULATED UNDER TSCA

CANADA (WHIMS): NOT REGULATED

16. OTHER INFORMATION

HMIS:

Health	1
Flammability	0
Physical Hazard	0
Personal Protection	E

E: Safety Glasses, gloves

Material Safety Data Sheet

Shaw Environmental, Inc.
17 PRINCESS ROAD
LAWRENCEVILLE, N.J. 08648
(609) 895-5340

SECTION 1 - MATERIAL IDENTIFICATION AND INFORMATION

Material Name: DHC microbial consortium (SDC-9) MSDS #: ENV 1033

Date Prepared: 10/06/2003 CAS #: N/A (Not Applicable)

Prepared By: Simon Vainberg Formula #: N/A

Material Description: Non-hazardous, naturally occurring non-altered anaerobic microbes and enzymes in a water-based medium.

SECTION 2 - INGREDIENTS

Components	%	OSHA PEL	ACGIH TLV	OTHER LIMITS
Non-Hazardous Ingredients	100	N/A	N/A	N/A

SECTION 3 - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: 100°C (water) Specific Gravity (H₂O = 1): 0.9 - 1.1

Vapor Pressure @ 25°C: 24 mm Hg (water) Melting Point: 0°C (water)

Vapor Density: N/A Evaporation Rate (H₂O = 1): 0.9 - 1.1

Solubility in Water: Soluble Water Reactive: No

pH: 6.0 - 8.0

Appearance and Odor: Murky, yellow water. Musty odor.

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)
PAGE 2 OF 4
October 6, 2003

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Flammable Limits: N/A

Extinguishing Media: Foam, carbon dioxide, water

Special Fire Fighting Procedures: None

Unusual Fire and Explosion Hazards: None

SECTION 5 - REACTIVITY DATA

Stability: Stable

Conditions to Avoid: None

Incompatibility (Materials to Avoid): Water-reactive materials

Hazardous Decomposition Byproducts: None

SECTION 6 - HEALTH HAZARD DATA

HEALTH EFFECTS

The effects of exposure to this material have not been determined. Safe handling of this material on a long-term basis will avoid any possible effect from repetitive acute exposures. Below are possible health effects based on information from similar materials. Individuals hyper allergic to enzymes or other related proteins should not handle.

Ingestion: Ingestion of large quantities may result in abdominal discomfort including nausea, vomiting, cramps, diarrhea, and fever.

Inhalation: Hypersensitive individuals may experience breathing difficulties after inhalation of aerosols.

Skin Absorption: N/A

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)

PAGE 3 OF 4

October 6, 2003

Skin Contact: May cause skin irritation. Hypersensitive individuals may experience allergic reactions to enzymes.

Eye Contact: May cause eye irritation.

FIRST AID

Ingestion: Get medical attention if allergic symptoms develop (observe for 48 hours). Never give anything by mouth to an unconscious or convulsing person.

Inhalation: Get medical attention if allergic symptoms develop.

Skin Absorption: N/A

Skin Contact: Wash affected area with soap and water. Get medical attention if allergic symptoms develop.

Eye Contact: Flush eyes with plenty of water for at least 15 minutes using an eyewash fountain, if available. Get medical attention if irritation occurs.

NOTE TO PHYSICIANS: All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this material may have occurred.

SECTION 7 - SPILL AND LEAK PROCEDURES

Reportable quantities (in lbs of EPA Hazardous Substances): N/A

Steps to be taken in case of spill or release: No emergency results from spillage. However, spills should be cleaned up promptly. All personnel involved in the cleanup must wear protective clothing and avoid skin contact. Absorb spilled material or vacuum into a container. After clean-up, disinfect all cleaning materials and storage containers that come in contact with the spilled liquid.

Waste Disposal Method: No special disposal methods are required. The material may be sewerred, and is compatible with all known biological treatment methods. To reduce odors and permanently inactivate microorganisms, mix 100 parts (by volume) of DHC consortium with 1 part (by volume) of bleach. Dispose of in accordance with local, state and federal regulations.

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)
PAGE 4 OF 4
October 6, 2003

SECTION 8 - HANDLING AND STORAGE

Hand Protection: Rubber gloves.

Eye Protection: Safety goggles with side splash shields.

Protective Clothing: Use adequate clothing to prevent skin contact.

Respiratory Protection: Surgical mask.

Ventilation: Provide adequate ventilation to remove odors.

Storage & Handling:

Material may be stored for up to 3 weeks at 2-4°C without aeration.

Other Precautions: An eyewash station in the work area is recommended.

While the information and recommendations set forth herein are believed to be accurate as of the date hereof, Shaw Environmental, Inc. MAKES NO WARRANTY WITH RESPECT HERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.



Material Safety Data Sheet

Electron Donor Solution

Section 1: Chemical Product and Company Identification

Product Name: Electron Donor Solution
Extended Release

Catalog Codes: EDS-ER

CAS#: 8001-22-7

TSCA: TSCA 8(b) inventory: Soybean oil

HMIS Code: H F R P: 10 0 A

Trade Name and Synonyms: EDS-ER

Chemical Family: Glyceride Oils

Contact Information:

Tersus Environmental, LLC

109 E. 17th Street, Suite #3880

Cheyenne, WY 82001

Ph: 307.638.2822 • info@tersusenv.com

www.tersusenv.com

For emergency assistance, call: 919.638.7892

Section 2: Composition and Information on Ingredients

COMPONANT	CAS #	OSHA TWA	OSHA STEL	ACGIH TWA	ACGIH STEL
Soybean Oil	8001-22-7	---	10 mg/m ³	---	---
Vegetable Oil Derived Fatty Acid Esters	Confidential	---	---	---	---

HAZARDOUS INGREDIENTS: NONE AS DEFINED UNDER THE U.S. OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200) OR THE CANADIAN HAZARDOUS PRODUCTS ACT S.C. 1987, C.30 (PART 1).

THE PRECISE COMPOSITION OF THIS PRODUCT IS PROPRIETARY INFORMATION. A MORE COMPLETE DISCLOSURE WILL BE PROVIDED TO A PHYSICIAN IN THE EVENT OF A MEDICAL EMERGENCY.

SARA HAZARD: NONE NOTED (SECTION 311/312) TITLE III SECTION 313 - NOT LISTED
All components of this product are listed on the TSCA registry.

Section 3: Physical/Chemical Characteristics

BOILING RANGE: Not applicable VAPOR DENSITY: Exceeds 1.0

SPECIFIC GRAVITY (H₂O=1.0): 0.92 - 0.925 VAPOR PRESSURE: Not applicable

PERCENT VOLATILE BY VOLUME: 0% SOLUBILITY IN WATER: Miscible

EVAPORATION RATE: Not applicable

APPEARANCE AND ODOR: A pale yellow, oily liquid - only a faint odor.

WEIGHT PER GALLON: 7.7 lbs. at 60F.



Material Safety Data Sheet

Section 4: Fire and Explosion Data

FLAMMABILITY CLASSIFICATION: Combustible Liquid - Class IIIB.

FLASHPOINT: Greater than 550 F (288 C).

METHOD USED: Tag Closed Cup.

EXTINGUISHING MEDIA: CO₂, dry chemical, foam, sand.

SPECIAL FIREFIGHTING PROCEDURES: Avoid use of water as it may spread fire by dispersing oil. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Rags soaked with any oil or solvent can present a fire hazard and should always be stored in UL Listed or Factory Mutual approved, covered containers. Improperly stored rags can create conditions that lead to oxidation. Oxidation, under certain conditions can lead to spontaneous combustion.

Section 5: Reactivity Data

STABILITY: Generally stable. Spontaneous combustion can occur. See Unusual Fire and Explosion Procedures, Section IV.

CONDITIONS TO AVOID: High surface area exposure to oxygen can result in polymerization and release of heat.

INCOMPATIBILITY (MATERIALS TO AVOID): Avoid contact with strong oxidizing agents.

HAZARDOUS DECOMPOSITIONS OR BY-PRODUCTS: Decomposition may produce carbon dioxide and carbon monoxide.

HAZARDOUS POLYMERIZATION: Will not occur.

Section 6: Health Hazard Data

THRESHOLD LIMIT VALUE: As a liquid - none. As oil mist - 10 mg/m³ total particulate.

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: Excessive inhalation of oil mist may affect the respiratory system. Oil mist is classified as a nuisance particulate by ACGIH.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: Not classified as a primary skin irritant or corrosive material. Sensitive individuals may experience dermatitis after long exposure of oil on skin.

HEALTH HAZARDS (ACUTE AND CHRONIC): Acute: none observed by inhalation. Chronic: none reported.

EMERGENCY AND FIRST AID PROCEDURES FOR:

SKIN CONTACT: May be removed from skin by washing with soap and warm water.

EYE CONTACT: Immediately flush eyes with plenty of cool water for at least 15 minutes. Do NOT let victim rub eyes.

INHALATION: Immediately remove exposed individual to fresh air source. If victim has stopped breathing give artificial respiration, get medical attention immediately.



Material Safety Data Sheet

Section 7: Precautions for Safe Handling and Use

ENVIRONMENTAL PRECAUTIONS: Where large spills are possible, a comprehensive spill response plan should be developed and implemented.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Wear appropriate respiratory protection and protective clothing as described in section VIII. Depending on quantity of spill: (a) Small spill - add solid adsorbent, shovel into disposable container and wash the area. Clean area with detergent. (b) Large spill - Squeegee or pump into holding container. Clean area with detergent. In the event of an uncontrolled release of this material, the user should determine if this release is reportable under applicable laws and regulations.

WASTE DISPOSAL METHOD: All recovered material should be packaged, labeled, transported, and disposed or reclaimed in accordance with local, state, and federal regulations and good engineering practices.

Section 8: Control Measures

RESPIRATORY PROTECTION: Not normally needed. A qualified health specialist should evaluate whether there is a need for respiratory protection under specific conditions.

VENTILATION: Handle in the presence of adequate ventilation. Intermittent clean air exchanges recommended, but not required.

PROTECTIVE GLOVES: Not normally needed. However, protective clothing is always recommended when handling chemicals.

EYE PROTECTION: Eye protection is always recommended when handling chemicals. Wear safety glasses meeting the specifications established in ANSI Standard Z87.1.

Section 9: Special Precautions

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store away from flame, fire, and excessive heat.

Section 10: Disposal Considerations

General Information: Do not discharge into drains, watercourses or onto the ground. Discharge, treatment, or disposal may be subject to national, state, or local laws. Empty containers may contain product residues.

Disposal Methods: No specific disposal method required.

Container: Since emptied containers retain product residue, follow label warnings even after container is emptied.



Material Safety Data Sheet

Section 11: Transportation Information

DOT Not regulated.
 TDG Not regulated.
 IATA Not regulated.
 IMDG Not regulated.

Section 12: Other Information

Hazard Ratings

	Health Hazard	Fire Hazard	Instability	Special Hazard
NFPA	1	1	0	NONE

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

NFPA Label colored diamond code: Blue - Health; Red - Flammability; Yellow - Instability; White - Special Hazards

	Health Hazard	Flammability	Physical Hazard	Personal Protection
HMIS	1	1	0	--

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

HMIS Label colored bar code: Blue - Health; Red - Flammability; Orange - Physical Hazards; White - Special







Section 13: Disclaimer and/or Comments

We suggest that containers be either professionally reconditioned for re-use by certified firms or properly disposed of by certified firms to help reduce the possibility of an accident. Disposal of containers should be in accordance with applicable federal, state and local laws and regulations. "Empty" drums should not be given to individuals.

The conditions of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Tersus Environmental be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Tersus Environmental has been advised of the possibility of such damages.

Status	Contaminant	Results	Units	National Standards	Min. Detection Level
Microbiologicals					
✓	Total Coliform by P/A	Total Coliform and E.coli were ABSENT in this sample.			
Inorganic Analytes - Metals					
✓	Aluminium	ND	mg/L	0.2	EPA Secondary 0.1
✓	Arsenic	ND	mg/L	0.010	EPA Primary 0.005
✓	Barium	ND	mg/L	2	EPA Primary 0.30
✓	Cadmium	ND	mg/L	0.005	EPA Primary 0.002
●	Calcium	17.2	mg/L	--	2.0
✓	Chromium	ND	mg/L	0.1	EPA Primary 0.010
●	Copper	0.064	mg/L	1.3	EPA Action Level 0.004
●	Iron	0.036	mg/L	0.3	EPA Secondary 0.020
✓	Lead	ND	mg/L	0.015	EPA Action Level 0.002
●	Magnesium	7.33	mg/L	--	0.10
✓	Manganese	ND	mg/L	0.05	EPA Secondary 0.004
✓	Mercury	ND	mg/L	0.002	EPA Primary 0.001
✓	Nickel	ND	mg/L	--	0.020
●	Potassium	3.1	mg/L	--	1.0
✓	Selenium	ND	mg/L	0.05	EPA Primary 0.020
●	Silica	25.8	mg/L	--	0.1
✓	Silver	ND	mg/L	0.100	EPA Secondary 0.002
●	Sodium	114	mg/L	--	1
●	Zinc	0.033	mg/L	5	EPA Secondary 0.004
Physical Factors					
●	Alkalinity (Total as CaCO3)	240	mg/L	--	20
●	Hardness	73	mg/L	100	NTL Internal 10
✓	pH	7.1	pH Units	6.5 to 8.5	EPA Secondary
●	Total Dissolved Solids	360	mg/L	500	EPA Secondary 20
●	Turbidity	0.2	NTU	1.0	EPA Action Level 0.1

Status	Contaminant	Results	Units	National Standards	Min. Detection Level
Inorganic Analytes - Other					
	Chloride	32.0	mg/L	250	EPA Secondary 5.0
	Fluoride	ND	mg/L	4.0	EPA Primary 0.5
	Nitrate as N	0.7	mg/L	10	EPA Primary 0.5
	Nitrite as N	ND	mg/L	1	EPA Primary 0.5
	Ortho Phosphate	ND	mg/L	--	2.0
	Sulfate	14.0	mg/L	250	EPA Secondary 5.0

We certify that the analyses performed for this report are accurate, and that the laboratory test were conducted by methods approved by the U.S. Environmental Protection Agency or variations of these EPA methods.

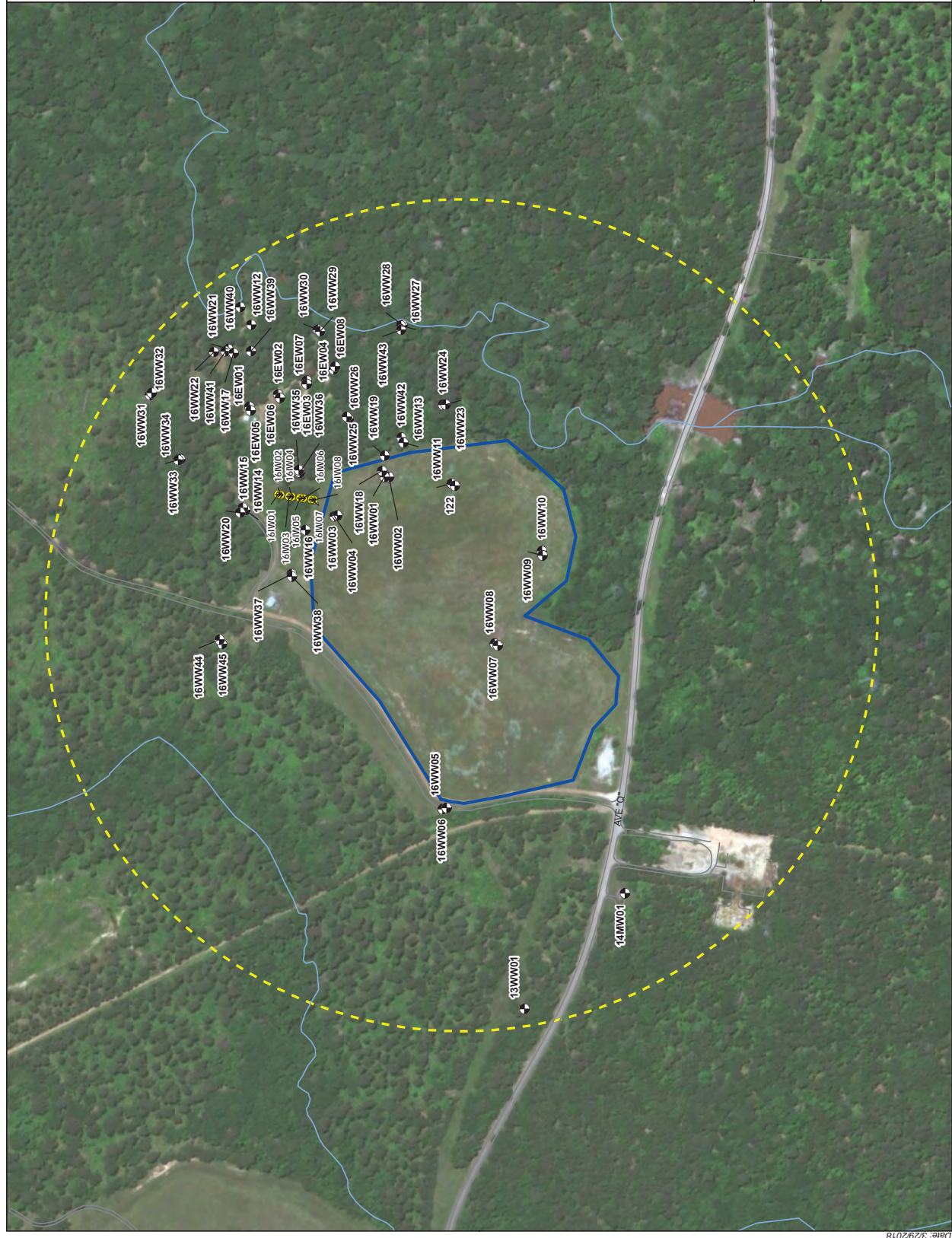
These test results are intended to be used for informational purposes only and may not be used for regulatory compliance.

National Testing Laboratories, Ltd.

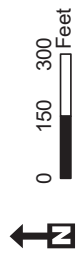
NATIONAL TESTING LABORATORIES, LTD

Attachment I

**Quarter Mile Radius Map
and Boring Logs**



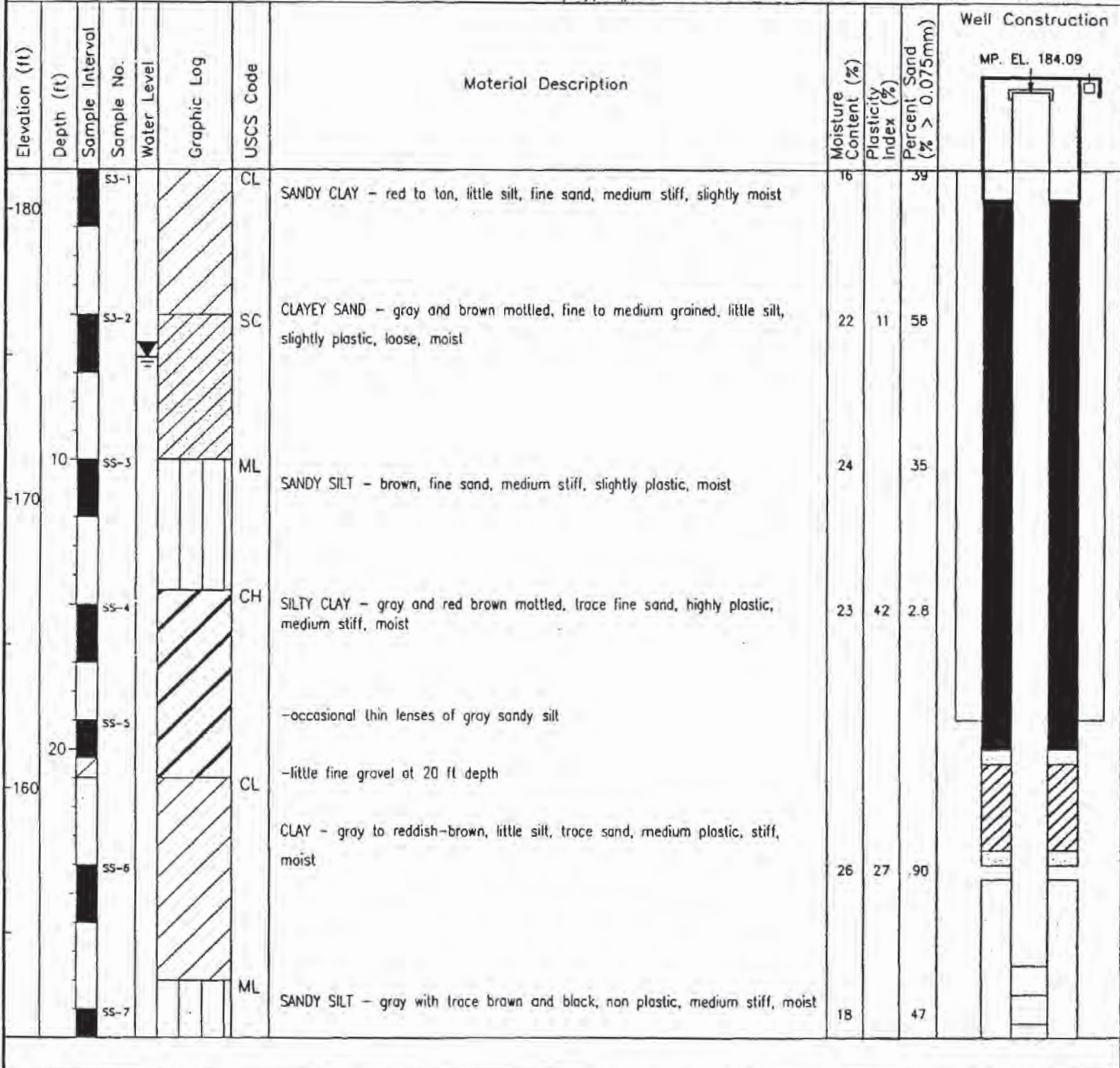
- Monitoring Well Location
- Injection Well Location
- Stream
- Road
- Quarter Mile
- LHAAP-16 Boundary
- LHAAP-16 Site Boundary



U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

Attachment I
Quarter Mile
LHAAP-16 UIC
LONGHORN ARMY AMMUNITION PLANT
KARRACK, TEXAS

Location: Longhorn Army Ammunition Plant		Identification: 16WW02	
Date(s): 05/12/93 - 05/15/93		X Coordinate: 3038134	Y Coordinate: 380300
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 181.37'	Datum: NGVD
Logged By: Schulz\Ratzlaff		Total Depth: 50.00'	Measuring Point: 184.09'
Contractor: Burlington Environmental, Inc.		Completed Depth: 47.50'	Static Water Level: 174.92'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.7' to: 27.50'	
Conductor Casing: type: Carbon Steelze: dia: 12.00" fm: .00' to: 19.00'		Screens: type: Slotted size: .000" dia: 4.00" fm: 27.50' to: 47.50'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 20.00' type: Secondary Sand Filter fm: 20.00' to: 20.50' type: Granular Bentonite Seal fm: 20.50' to: 23.50' type: Secondary Sand Filter fm: 23.50' to: 24.00' type: #20-40 Silica Filter Sand fm: 24.50' to: 48.00'	



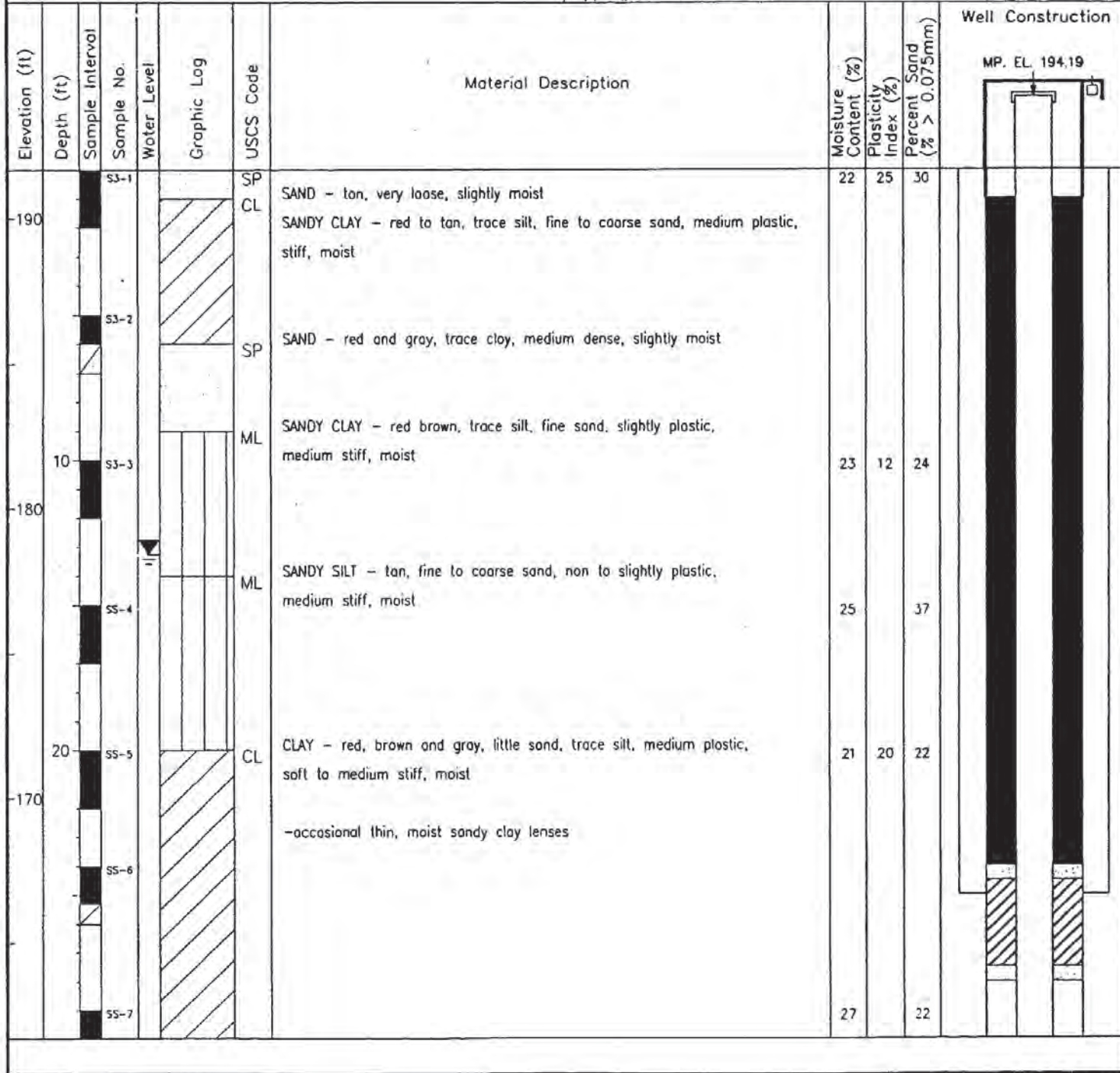
Location: Longhorn Army Ammunition Plant		Identification: 16WW02	
Date(s): 05/12/93 - 05/15/93		X Coordinate: 3038134	Y Coordinate: 380300
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 181.37'	Datum: NGVD
Logged By: Schulz\Ratzlaff		Total Depth: 50.00'	Measuring Point: 184.09'
Contractor: Burlington Environmental, Inc.		Completed Depth: 47.50'	Static Water Level: 174.92'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.7' to: 27.50'	
Conductor Casing: type: Carbon Steel dia: 12.00" fm: .00' to: 19.00'		Screens: type: Slotted size: .000" dia: 4.00" fm: 27.50' to: 47.50'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 20.00' type: Secondary Sand Filter fm: 20.00' to: 20.50' type: Granular Bentonite Seal fm: 20.50' to: 23.50' type: Secondary Sand Filter fm: 23.50' to: 24.00' type: #20-40 Silica Filter Sand fm: 24.50' to: 48.00'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-150						SM	SILTY SAND - dark gray, occasional black grains, fine, non plastic, very loose to loose, moist to saturated				
		SS-8						22		74	
40		SS-9									
-140						CL	SILTY CLAY - dark gray with lighter gray silty partings, little fine to coarse sand, slightly to medium plastic, stiff to very stiff, moist	36	12	8.7	
		SS-10									
		SS-11						24	10		
		SS-12					-thin to medium thick lenses of a silty coarse sand				
50											
-130											

Location: Longhorn Army Ammunition Plant		Identification: 16WW03	
Date(s): 05/04/93 - 05/04/93		X Coordinate: 3038014	Y Coordinate: 380465
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 191.65'	Datum: NGVD
Logged By: D. Schulz		Total Depth: 25.00'	Measuring Point: 193.94'
Contractor: Burlington Environmental, Inc.		Completed Depth: 24.50'	Static Water Level: 193.47'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.3' to: 12.50'	
Conductor Casing: type: N/A size: dia: .00" fm: .00' to: .00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 12.50' to: 24.50'	
Remarks: PID measured in airspace above samples = 5 to 75 ppm from 5 to 19.5 ft depth.		Annular Fill: type: Bentonite Grout fm: .50' to: 6.50' type: Secondary Sand Filter fm: 6.50' to: 7.00' type: Granular Bentonite Seal fm: 7.00' to: 10.00' type: Secondary Sand Filter fm: 10.00' to: 10.50' type: #20-40 Silica Filter Sand fm: 10.50' to: 25.00'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-190			S3-1			CL	CLAY - reddish-brown with gray, trace sand, slightly to medium plastic, very stiff, slightly moist	9	21	12	
			S3-2			SM	SILTY SAND - medium brown and gray, fine, non to slightly plastic, medium dense, slightly moist	9		64	
	10		S3-3			ML	SILT - brown and gray, some fine sand, non plastic, stiff, slightly moist	21	N.P.	25	
-180			SS-4			ML	SANDY SILT - brown and gray, fine sand, non to slightly plastic, medium stiff, slightly moist				
			S3-5			ML	SANDY SILT - gray with some brown, fine to medium sand, non plastic, very moist to saturated	25		45	
	20		SS-6				-occasional thin clay lenses and medium sandy silt lenses				
			SS-7					9		49	
-170			SS-8			CL	SILTY CLAY - brown and gray, trace fine sand, medium plastic, soft, slightly moist to moist				
			SS-8				-grades to clay with thin silty clay lenses at 24 ft depth	24		2.1	

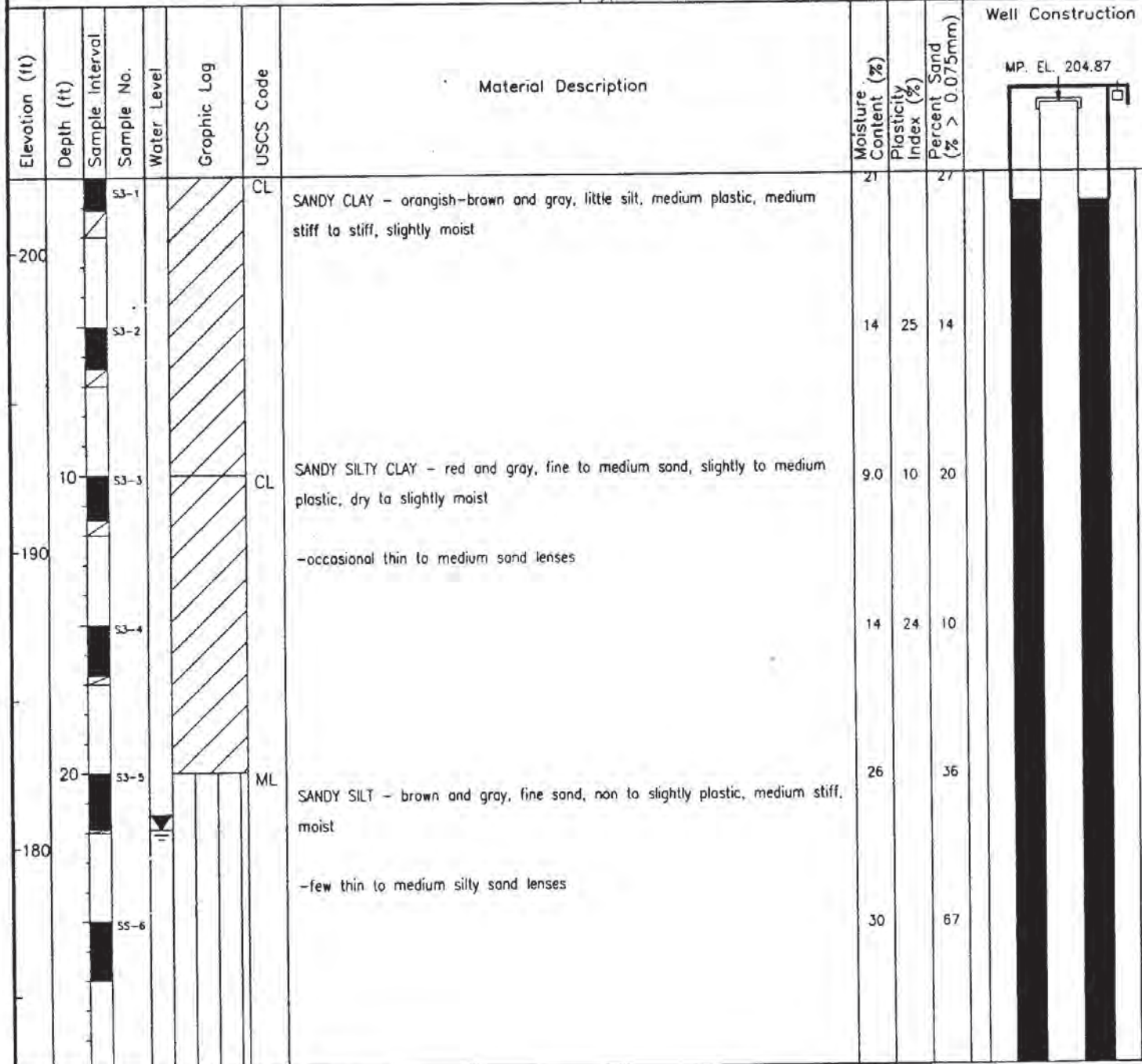
Location: Longhorn Army Ammunition Plant		Identification: 16WW04	
Date(s): 05/12/93 - 05/14/93		X Coordinate: 3038011	Y Coordinate: 380474
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 191.68'	Datum: NGVD
Logged By: Schulz\Ratzlaff		Total Depth: 53.00'	Measuring Point: 194.19'
Contractor: Burlington Environmental, Inc.		Completed Depth: 50.00'	Static Water Level: 194.19'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.5' to: 30.00'	
Conductor Casing: type: Carbon Steel dia: 12.00" fm: .00' to: 25.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 30.00' to: 50.00'	
Remarks: PID in breathing zone = 0ppm from 0-20 ft depth PID measured in airspace above samples = 0 ppm from 25 to 53 ft depth.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 24.00' type: Secondary Sand Filter fm: 24.00' to: 24.50' type: Granular Bentonite Seal fm: 24.50' to: 27.50' type: Secondary Sand Filter fm: 27.50' to: 28.00' type: #20-40 Silica Filter Sand fm: 28.00' to: 51.00'	



Location: Longhorn Army Ammunition Plant		Identification: 16WW04	
Date(s): 05/12/93 - 05/14/93		X Coordinate: 3038011	Y Coordinate: 380474
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 191.68'	Datum: NGVD
Logged By: Schulz\Ratzlaff		Total Depth: 53.00'	Measuring Point: 194.19'
Contractor: Burlington Environmental, Inc.		Completed Depth: 50.00'	Static Water Level: 194.19'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.5' to: 30.00'	
Conductor Casing: type: Carbon Steelize: dia: 12.00" fm: .00' to: 25.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 30.00' to: 50.00'	
Remarks: PID in breathing zone = Oppm from 0-20 ft depth PID measured in airspace above samples = 0 ppm from 25 to 53 ft depth.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 24.00' type: Secondary Sand Filter fm: 24.00' to: 24.50' type: Granular Bentonite Seal fm: 24.50' to: 27.50' type: Secondary Sand Filter fm: 27.50' to: 28.00' type: #20-40 Silica Filter Sand fm: 28.00' to: 51.00'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-160			SS-8			SP	SAND - gray with some reddish brown, fine, trace silt, non to slightly plastic, very loose to loose, moist to saturated -occasional thin clayey sand lenses	26		95	
	40		SS-9								
-150			SS-10			CL SM	SILTY CLAY - dark gray, thin lenses of light gray silty sand, slightly plastic, hard, dry	20		73	
			SS-11				SILTY SAND - light gray, fine, non plastic, clean, dense, saturated	24	23	3	
	50		SS-12			CL	SILTY CLAY - dark gray with light gray silty partings, trace fine sand, medium plastic, hard, moist				
-140			SS-13								

Location: Longhorn Army Ammunition Plant		Identification: 16WW06	
Date(s): 05/06/93 - 05/13/93		X Coordinate: 3037084	Y Coordinate: 380129
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 202.56'	Datum: NGVD
Logged By: Maloney\Schulz		Total Depth: 62.00'	Measuring Point: 204.87'
Contractor: Burlington Environmental, Inc.		Completed Depth: 59.00'	Static Water Level: 204.87'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.3' to: 47.00'	
Conductor Casing: type: Carbon Steelze dia: 12.00" fm: .00' to: 33.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 47.00' to: 59.00'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 39.50' type: Secondary Sand Filter fm: 39.50' to: 40.00' type: Granular Bentonite Seal fm: 40.00' to: 43.00' type: #20-40 Silica Filter Sand fm: 43.00' to: 60.00' type: fm: to:	



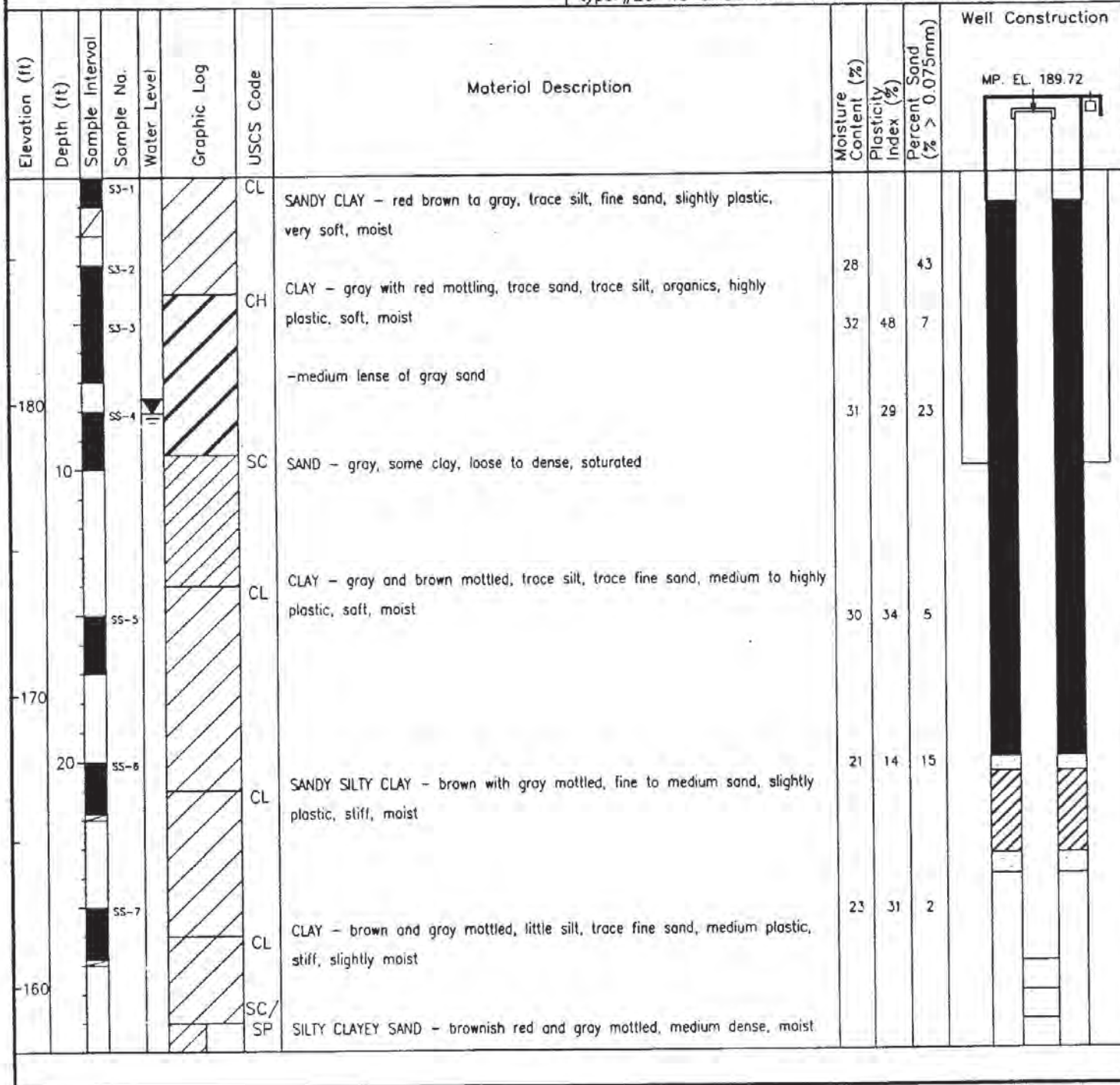
Location: Longhorn Army Ammunition Plant		Identification: 16WW06	
Date(s): 05/06/93 - 05/13/93		X Coordinate: 3037084	Y Coordinate: 380129
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 202.56'	Datum: NGVD
Logged By: Maloney\Schulz		Total Depth: 62.00'	Measuring Point: 204.87'
Contractor: Burlington Environmental, Inc.		Completed Depth: 59.00'	Static Water Level: 204.87'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.3' to: 47.00'	
Conductor Casing: type: Carbon Steelze: dia: 12.00" fm: .00' to: 33.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 47.00' to: 59.00'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 39.50' type: Secondary Sand Filter fm: 39.50' to: 40.00' type: Granular Bentonite Seal fm: 40.00' to: 43.00' type: #20-40 Silica Filter Sand fm: 43.00' to: 60.00' type: fm: to:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-170			SS-7			CH	SILTY CLAY - orangish-brown and gray mottled with hematite stains, trace fine sand, medium to highly plastic, stiff to very stiff, slightly moist	21	46	3	
			SS-8					19	35	8	
	40		SS-9					26		1	
-160			SS-10					24	41		
			SS-11			CL	SANDY CLAY - gray and rust mottled, fine to medium sand, little silt, non to slightly plastic, very stiff, moist				
	50		SS-12				-thin clayey sand lenses throughout	25		35	
-150			SS-13			SM	SAND - brown, little silt, fine to coarse, non plastic, medium dense, saturated	24		85	
						CL	SILTY CLAY - dark gray with light gray silty partings, trace to little fine sand, non to slightly plastic, hard, moist				

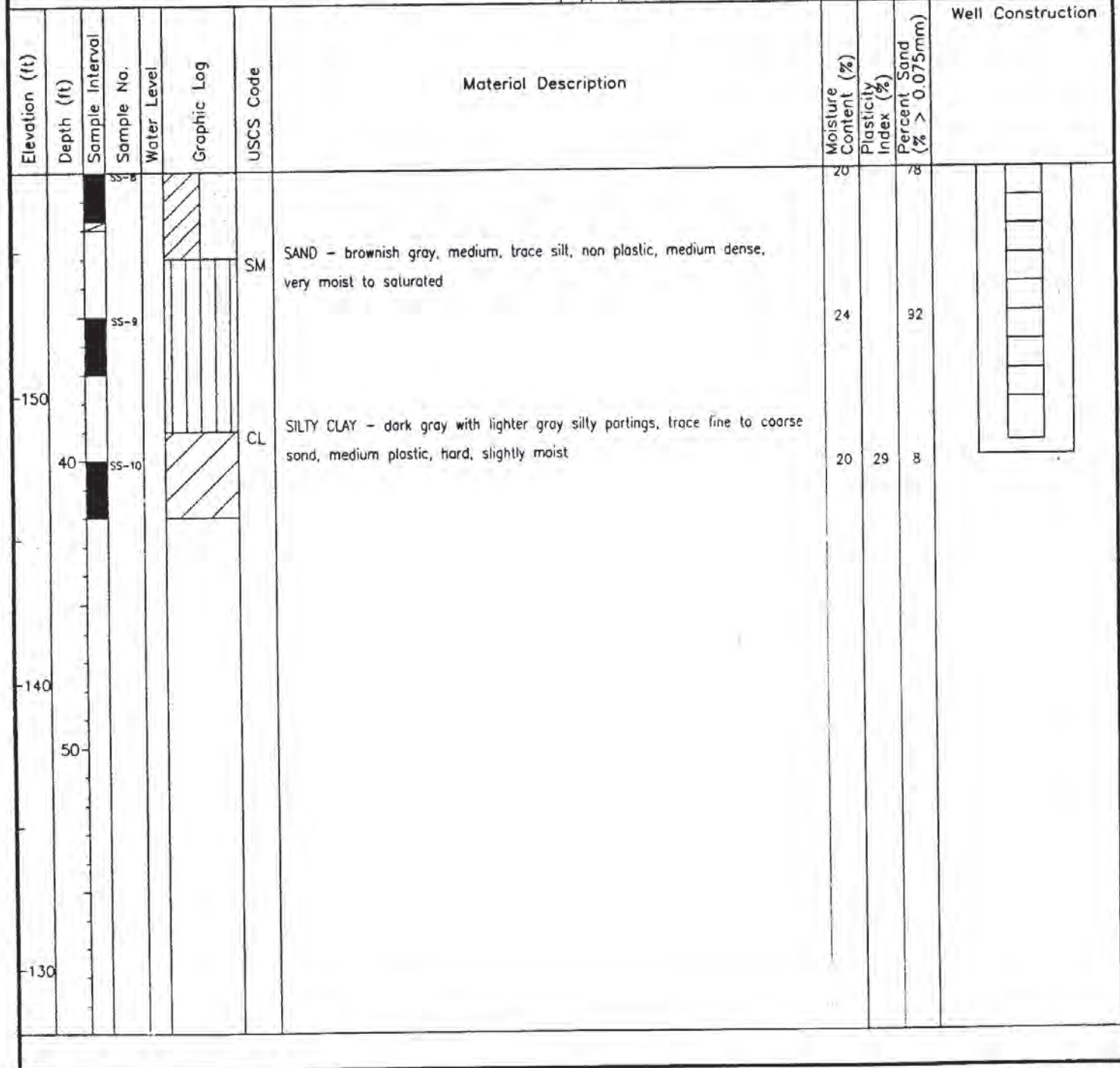
Location: Longhorn Army Ammunition Plant		Identification: 16WW06		00882345	
Date(s): 05/05/93 - 05/13/93		X Coordinate: 3037084	Y Coordinate: 380129		
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 202.56'	Datum: NGVD		
Logged By: Maloney\Schulz		Total Depth: 62.00'	Measuring Point: 204.87'		
Contractor: Burlington Environmental, Inc.		Completed Depth: 59.00'	Static Water Level: 204.87'		
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.3' to: 47.00'			
Conductor Casing: type: Carbon Steelze: dia: 12.00" fm: .00' to: 33.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 47.00' to: 59.00'			
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 39.50' type: Secondary Sand Filter fm: 39.50' to: 40.00' type: Granular Bentonite Seal fm: 40.00' to: 43.00' type: #20-40 Silica Filter Sand fm: 43.00' to: 60.00' type: fm: to:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-140			SS-14					21		11	
-130											
-120											

Location: Longhorn Army Ammunition Plant		Identification: 16WW08	
Date(s): 05/14/93 - 05/19/93		X Coordinate: 3037602	Y Coordinate: 379970
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 187.76'	Datum: NGVD
Logged By: Schulz\Ratzloff		Total Depth: 42.00'	Measuring Point: 189.72'
Contractor: Burlington Environmental, Inc.		Completed Depth: 39.50'	Static Water Level: 189.72'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.0' to: 27.00'	
Conductor Casing: type: Carbon Steelze: dia: 12.00" fm: .00' to: 10.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 27.00' to: 39.50'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 20.00' type: Secondary Sand Filter fm: 20.00' to: 20.50' type: Granular Bentonite Seal fm: 20.50' to: 23.30' type: Secondary Sand Filter fm: 23.30' to: 24.00' type: #20-40 Silica Filter Sand fm: 24.00' to: 40.00'	



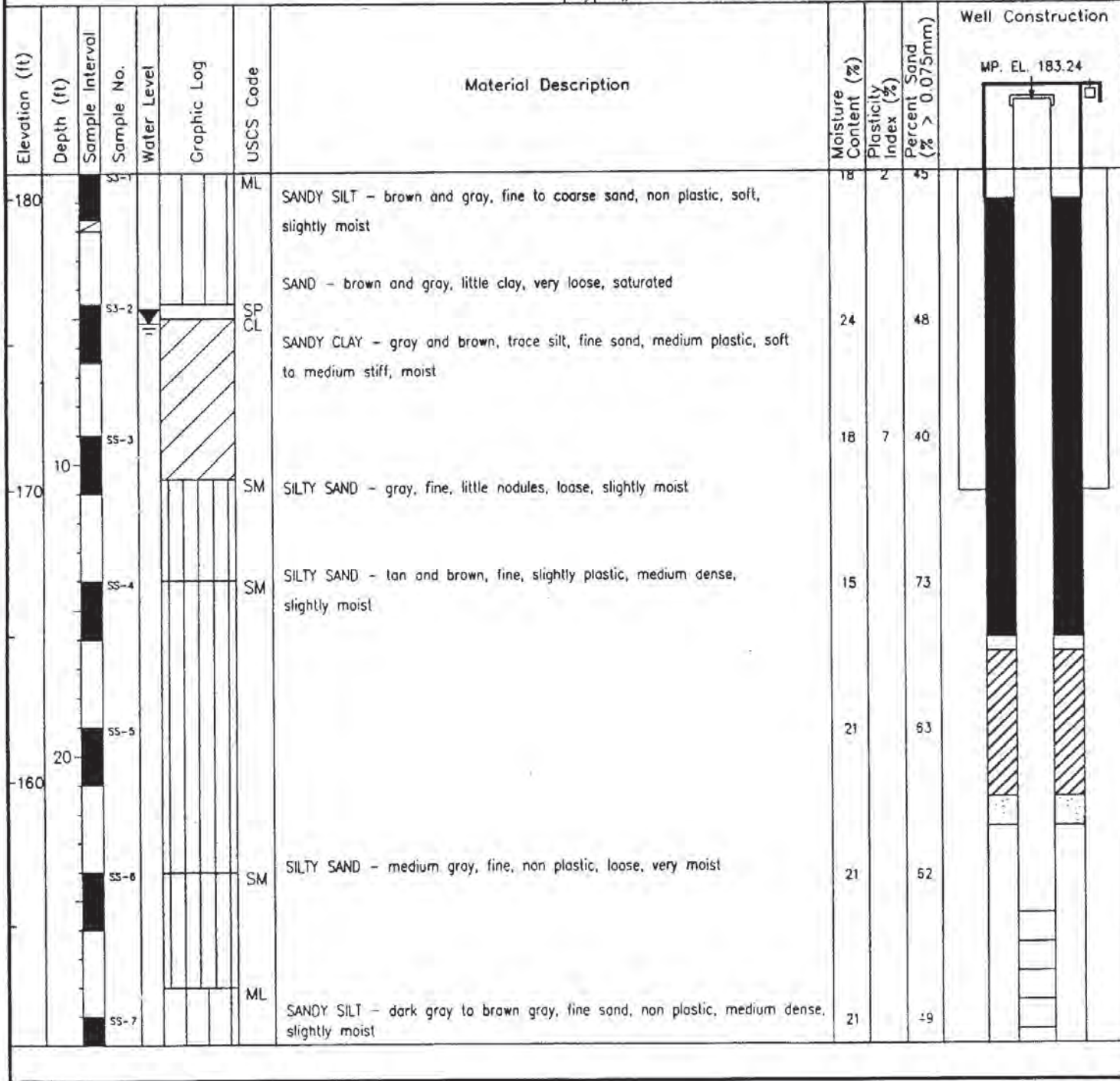
Location: Longhorn Army Ammunition Plant		Identification: 16WW08	
Date(s): 05/14/93 - 05/19/93		X Coordinate: 3037602	Y Coordinate: 379970
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 187.76'	Datum: NGVD
Logged By: Schulz\Ratzlaff		Total Depth: 42.00'	Measuring Point: 189.72'
Contractor: Burlington Environmental, Inc.		Completed Depth: 39.50'	Static Water Level: 189.72'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.0' to: 27.00'	
Conductor Casing: type: Carbon Steelze: dia: 12.00" fm: .00' to: 10.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 27.00' to: 39.50'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 20.00' type: Secondary Sand Filter fm: 20.00' to: 20.50' type: Granular Bentonite Seal fm: 20.50' to: 23.30' type: Secondary Sand Filter fm: 23.30' to: 24.00' type: #20-40 Silica Filter Sand fm: 24.00' to: 40.00'	



Location: Longhorn Army Ammunition Plant		Identification: 16WW09	
Date(s): 05/06/93 - 05/06/93		X Coordinate: 3037883	Y Coordinate: 379816
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 180.87'	Datum: NGVD
Logged By: K. Ratzlaff		Total Depth: 12.00'	Measuring Point: 183.33'
Contractor: Burlington Environmental, Inc.		Completed Depth: 9.00'	Static Water Level: 183.33'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.5' to: 7.00'	
Conductor Casing: type: N/A size: dia: .00" fm: .00' to: .00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 7.00' to: 9.00'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Granular Bentonite Seal fm: 1.00' to: 6.50' type: #20-40 Silica Filter Sand fm: 6.50' to: 9.00' type: fm: to: to: type: fm: to: to:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-180			S3-1			CL	CLAYEY SILT - yellowish brown, trace sand, medium stiff, slightly moist				
			S3-2			ML	SANDY SILT - gray and brown with some yellow, trace to little silt, non plastic, very loose to loose, slightly moist				
			S3-3			ML	SILT - gray, very soft, thin sand lenses, slightly moist				
			S3-4			CL/ML	SILT - tan and gray, some clay, little to some fine sand, thin clay lenses, very soft to soft, saturated				
			S3-5								
-170	10										
-160	20										

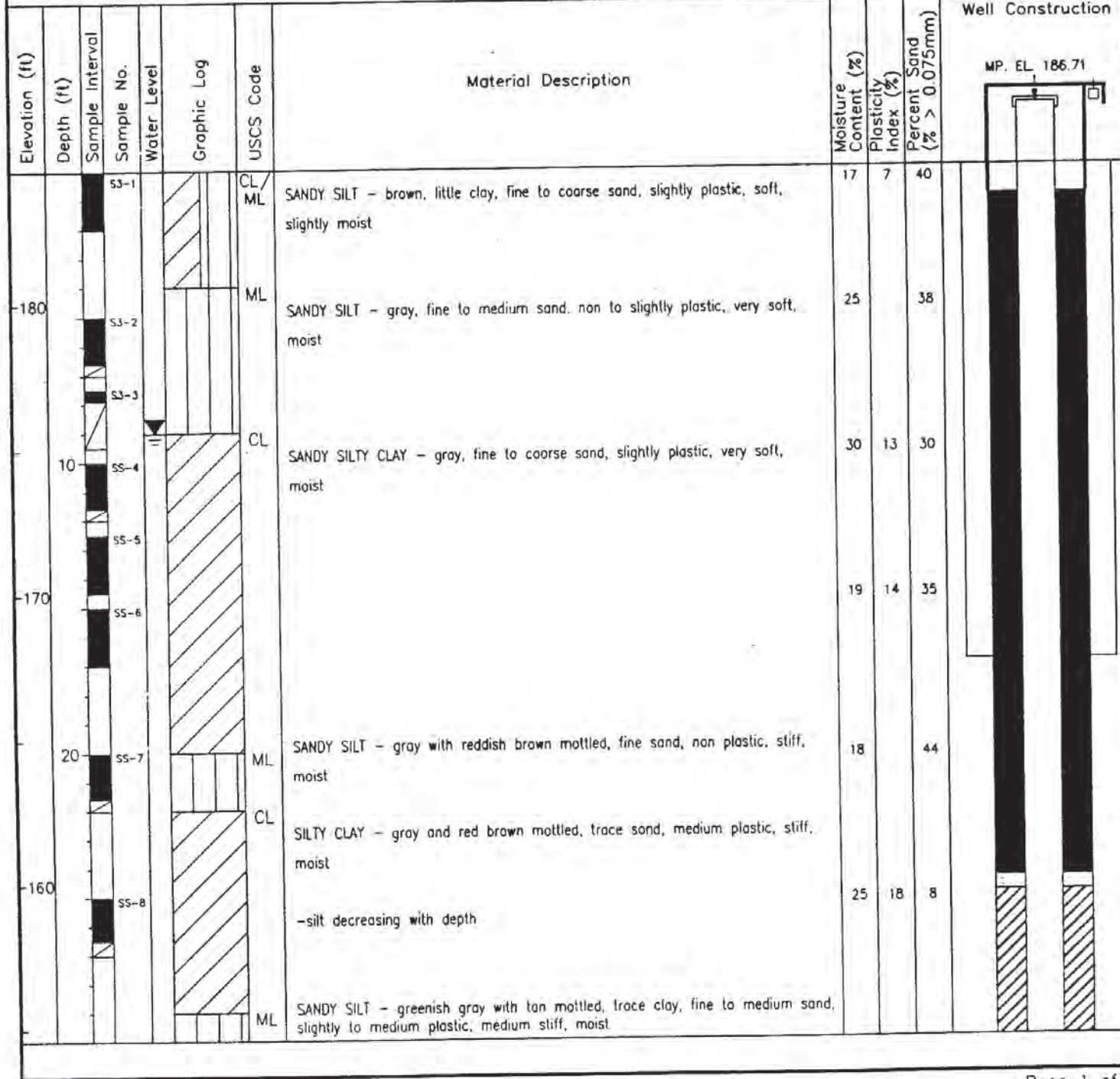
Location: Longhorn Army Ammunition Plant		Identification: 16WW10	
Date(s): 05/14/93 - 05/17/93		X Coordinate: 3037895	Y Coordinate: 379817
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 180.88'	Datum: NGVD
Logged By: Schulz\Ratzlaff		Total Depth: 46.00'	Measuring Point: 183.24'
Contractor: Burlington Environmental, Inc.		Completed Depth: 45.50'	Static Water Level: 183.24'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.4' to: 25.50'	
Conductor Casing: type: Carbon Steelze: dia: 12.00" fm: .00' to: 11.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 25.50' to: 45.50'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 16.00' type: Secondary Sand Filter fm: 16.00' to: 16.50' type: Granular Bentonite Seal fm: 16.50' to: 21.50' type: Secondary Sand Filter fm: 21.50' to: 22.50' type: #20-40 Silica Filter Sand fm: 22.50' to: 46.00'	



Location: Longhorn Army Ammunition Plant		Identification: 16WW10	
Date(s): 05/14/93 - 05/17/93		X Coordinate: 3037895	Y Coordinate: 379817
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 180.88'	Datum: NGVD
Logged By: Schulz\Ratzloff		Total Depth: 46.00'	Measuring Point: 183.24'
Contractor: Burlington Environmental, Inc.		Completed Depth: 45.50'	Static Water Level: 183.24'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.4' to: 25.50'	
Conductor Casing: type: Carbon Steelze: dia: 12.00"fm: .00' to: 11.00'		Screens: type: Slotted size: .010"dia: 4.00" fm: 25.50' to: 45.50'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 16.00' type: Secondary Sand Filter fm: 16.00' to: 16.50' type: Granular Bentonite Seal fm: 16.50' to: 21.50' type: Secondary Sand Filter fm: 21.50' to: 22.50' type: #20-40 Silica Filter Sand fm: 22.50' to: 46.00'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-150						SM	SAND - greenish gray, some silt, fine sand, non plastic, very loose to loose, very moist to saturated	25		76	
		SS-8									
	40		SS-9					22		86	
-140						ML	CLAYEY SILT - dark gray with light gray silty portings, trace sand, non plastic, hard, slightly moist	20	1	9	
			SS-10								
	50										
-130											

Location: Longhorn Army Ammunition Plant		Identification: 16WW11	
Date(s): 05/13/93 - 05/17/93		X Coordinate: 3038112	Y Coordinate: 380101
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 184.59'	Datum: NGVD
Logged By: Schulz\Ratzlaff		Total Depth: 62.00'	Measuring Point: 186.71'
Contractor: Burlington Environmental, Inc.		Completed Depth: 59.00'	Static Water Level: 186.71'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.1' to: 34.00'	
Conductor Casing: type: Carbon Steelze: dia: 12.00" fm: .00' to: 17.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 34.00' to: 59.00'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 24.50' type: Secondary Sand Filter fm: 24.50' to: 25.00' type: Granular Bentonite Seal fm: 25.00' to: 30.00' type: Secondary Sand Filter fm: 30.00' to: 31.00' type: #20-40 Silica Filter Sand fm: 31.00' to: 60.00'	

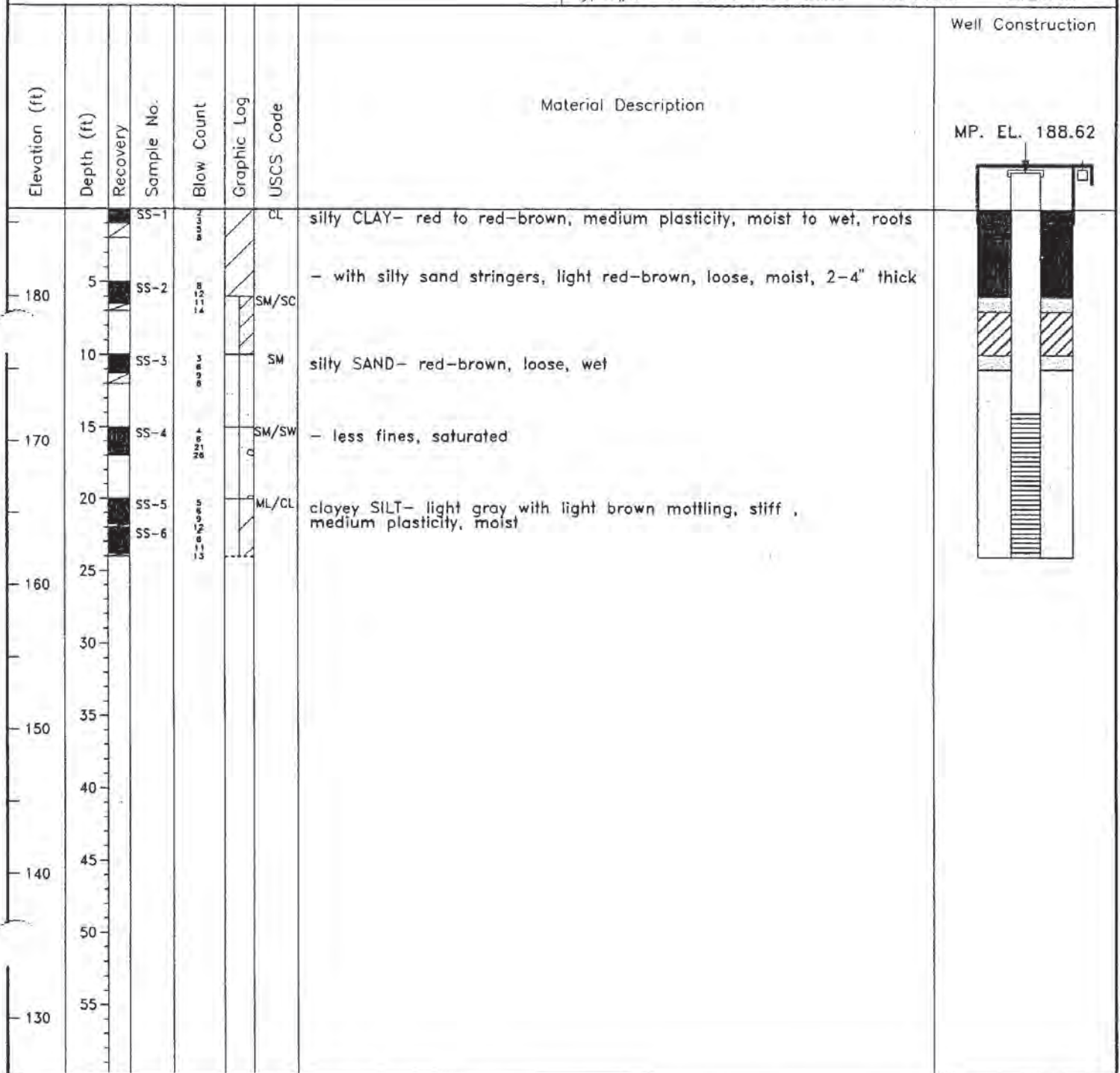


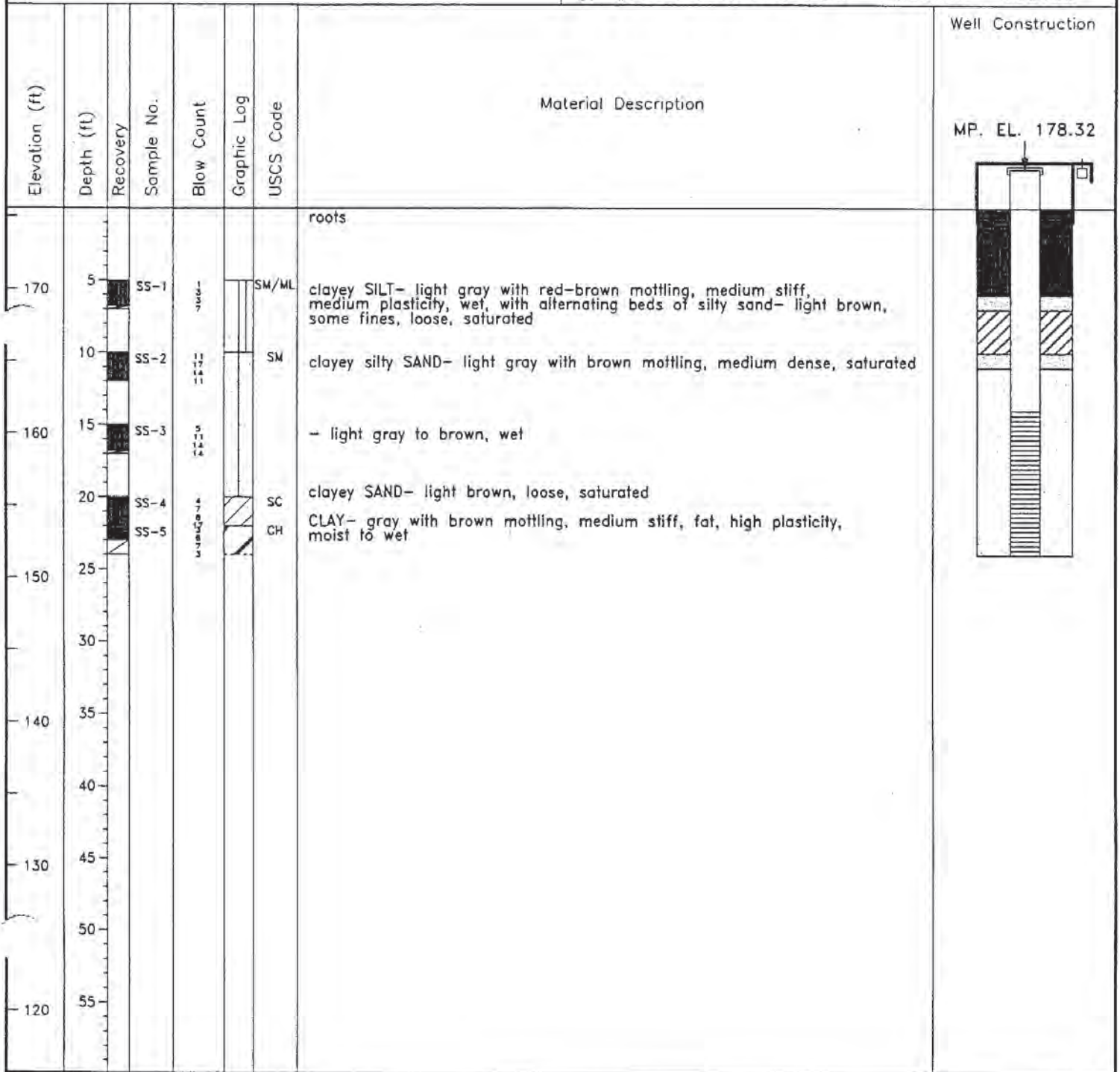
Location: Longhorn Army Ammunition Plant		Identification: 16WW11	
Date(s): 05/13/93 - 05/17/93		X Coordinate: 3038112	Y Coordinate: 380101
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 184.59'	Datum: NGVD
Logged By: Schulz\Ratzloff		Total Depth: 62.00'	Measuring Point: 186.71'
Contractor: Burlington Environmental, Inc.		Completed Depth: 59.00'	Static Water Level: 186.71'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.1' to: 34.00'	
Conductor Casing: type: Carbon Steelze: dia: 12.00" fm: .00' to: 17.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 34.00' to: 59.00'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 24.50' type: Secondary Sand Filter fm: 24.50' to: 25.00' type: Granular Bentonite Seal fm: 25.00' to: 30.00' type: Secondary Sand Filter fm: 30.00' to: 31.00' type: #20-40 Silica Filter Sand fm: 31.00' to: 60.00'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
150			SS-9			SM	SAND - greenish gray, little silt, fine sand, non plastic, very loose, saturated	24		83	
			SS-10				-thin lenses of clayey sandy silt	23		88	
40			SS-11								
140			SS-12			SM	SILTY SAND - gray, fine to medium, non to slightly plastic, very dense, moist	25		74	
			SS-13								
50			SS-14			ML	SANDY SILT - gray, fine to medium sand, medium plastic, hard, slightly moist to moist	27	19	20	
			SS-15			ML	-medium lense of dark gray, stiff clay at 51.5 ft depth				
130							SILT - gray, little to some fine sand, trace clay, non to slightly plastic, very dense, dry to slightly moist				
			SS-16			SM	SILTY SAND - gray, fine grained, non plastic, very dense, slightly moist	22		81	

Location: Longhorn Army Ammunition Plant		Identification: 16WW11	
Date(s): 05/13/93 - 05/17/93		X Coordinate: 3038112	Y Coordinate: 380101
Consulting Firm: Sverdrup Environmental, Inc.		Elevation: 184.59'	Datum: NGVD
Logged By: Schulz\Ratzloff		Total Depth: 62.00'	Measuring Point: 186.71'
Contractor: Burlington Environmental, Inc.		Completed Depth: 59.00'	Static Water Level: 186.71'
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Well Casing: type: PVC dia: 4.00" fm: -2.1' to: 34.00'	
Conductor Casing: type: Carbon Steelze dia: 12.00" fm: .00' to: 17.00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 34.00' to: 59.00'	
Remarks: PID measured in airspace above samples = 0 ppm.		Annular Fill: type: Bentonite Grout fm: 1.00' to: 24.50' type: Secondary Sand Filter fm: 24.50' to: 25.00' type: Granular Bentonite Seal fm: 25.00' to: 30.00' type: Secondary Sand Filter fm: 30.00' to: 31.00' type: #20-40 Silica Filter Sand fm: 31.00' to: 60.00'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-120			55-17					24		75	
-70											
-110											
-80											
-100											





Location: Longhorn Army Ammunition Plant

Elevation: 195.02'

Datum: NGVD

e(s): 05/26/95 - 05/26/95

Total Depth: 29.00'

Measuring Point: 198.65'

Logged By: P. Sazoma

Completed Depth: 29.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

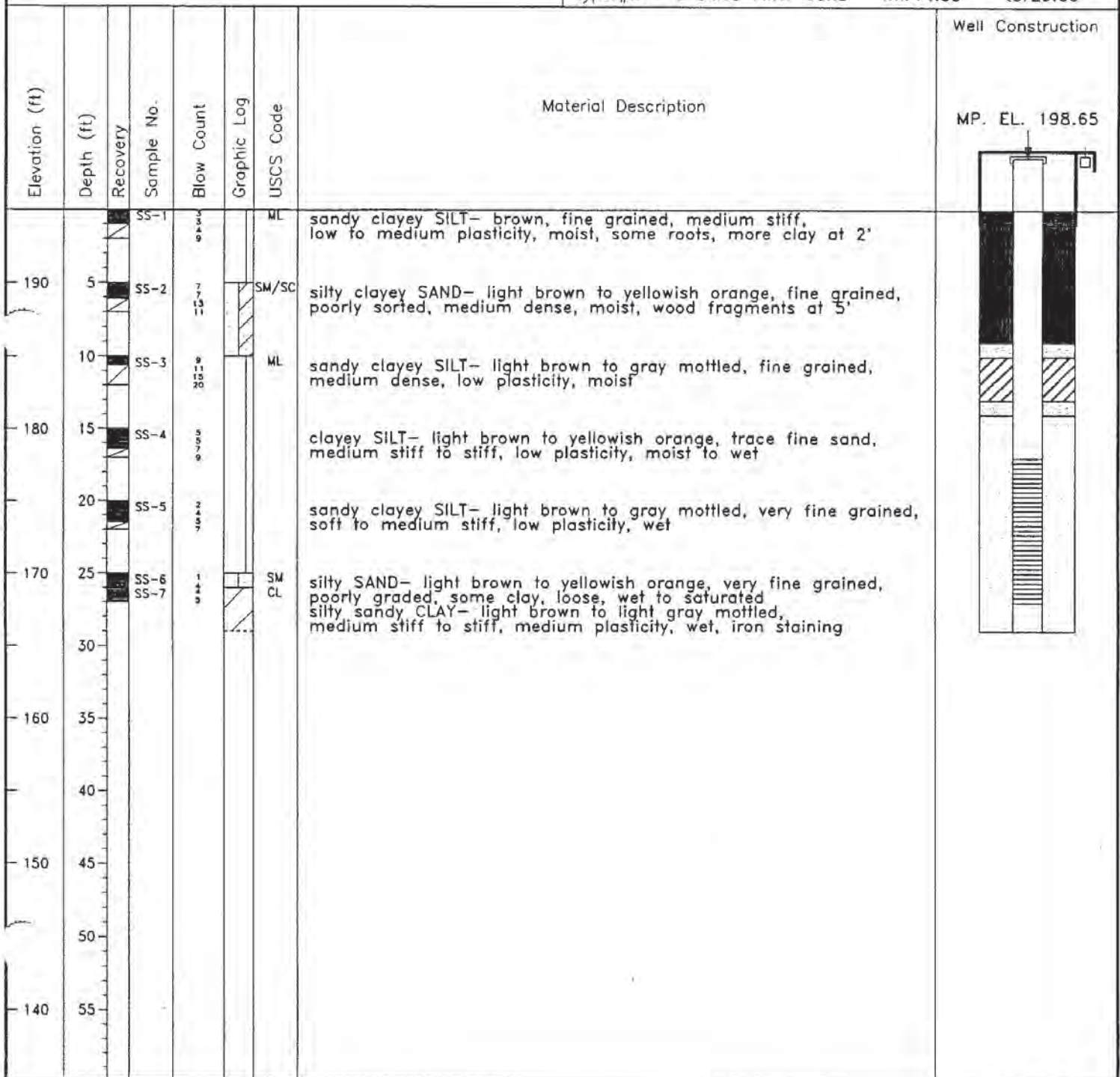
Well Casing: type: SS dia: 4.00in fm: -3.6' to: 17.00'

Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger

Screens:
type: Slotted size: .010in dia: 4.00in fm: 17.00' to: 27.00'

Remarks:
PID measured in airspace above sample = 0 ppm.

Annular Fill:
type: Bentonite/Cement Grout fm: .00' to: 1.00'
type: Bentonite Grout fm: 1.00' to: 9.00'
type: Secondary Sand Filter fm: 9.00' to: 10.00'
type: Granular Bentonite Seal fm: 10.00' to: 13.00'
type: Secondary Sand Filter fm: 13.00' to: 14.00'
type: #20-40 Silica Filter Sand fm: 14.00' to: 29.00'



Sverdrup
ENVIRONMENTAL

Site Id: **16SB08**

X Coordinate: 3313950.20

Y Coordinate: 6953782.95

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

Date(s): 04/18/95 - 04/26/95

Total Depth: 330.00'

Completed Depth: 330.00'

Logged By: S. Brunton

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
190	5		SS-1	10 10		CL	silty CLAY- yellowish brown, gray fine sand inclusions, medium stiff, low plasticity, moist
	10		SS-2	3 21 4		CH	CLAY- yellowish brown, some fine sand, medium stiff, medium plasticity, moist clayey SAND- brown, fine grained, poorly graded, medium dense, wet CLAY- mottled yellowish brown, some fine sand, stiff, medium to high plasticity, dry, some manganese nodules
180	15		SS-3	3 10 13		CL	silty CLAY- yellowish brown, some fine sand, medium stiff, low to medium plasticity, moist
	20		SS-4	51 50 R/3'		SP	
170	25		SS-5	15 30 20		CH	SAND- light gray, fine grained, poorly graded, some fines, medium dense, saturated CLAY- mottled brown, stiff, medium to high plasticity, dry to moist
	30		SS-7	14 10 4			
160	35		SS-8	51 R/1'			
	40		SS-9	50 51 R/1'		CL	sandy CLAY- light gray, stiff, medium plasticity, dry, iron staining
150	45		SS-10	14 14		ER	SAND- greenish gray, fine grained, poorly graded, few fines, medium dense, saturated
			SS-11	99 R/1'			CLAY- dark greenish gray with dark brown laminations, trace silt, very stiff, medium to high plasticity, dry
	50		SS-12	51 R/4'		SP	SAND- light gray, fine grained, poorly graded, trace fines, medium dense, moist to wet
140	55		SS-13	7 51 R/4'		CH	CLAY- dark greenish gray with light gray laminations, silt or fine sand, very stiff, medium to high plasticity, dry - stiff
	60		SS-14	51 28		ER	SAND- greenish gray, fine grained, poorly graded, few fines, medium dense, saturated
			SS-15	51 31 R/3'			CLAY- dark greenish gray with light gray laminations, silt or fine sand, very stiff, medium to high plasticity, dry
			SS-16	99 R/4'			-very dark gray with gray silt laminations, stiff, medium plasticity
130	65		SS-17	60 99		CH/CL	

Sverdrup
ENVIRONMENTAL

Site Id: **16SB08**

X Coordinate: 3313950.20

Y Coordinate: 6953782.95

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

Date(s): 04/18/95 - 04/26/95

Total Depth: 330.00'

Completed Depth: 330.00'

Logged By: S. Brunton

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
			SS-18	70 R/G			
120	75		SS-19	66 R/G			
	80		SS-20	65 R/G		SM	- few silt laminations, medium to high plasticity clayey SAND- gray, fine grained, dense, slight plasticity, moist to wet clayey silty SAND- light greenish gray, fine grained, medium dense, slight plasticity, wet
110	85		SS-21	76 R/G			- less fines, wet to saturated
	90		SS-22	51 ⁴⁰ R/S			- moist to wet
100	95		SS-23	80 R/G			
	100		SS-24	65 R/G			- increased sand content, wet to saturated
90	105		SS-25	58 R/G			- decreased sand content
	110		SS-26	51 ⁴⁰ R/S			- moist to wet
80	115		SS-27	75 R/G			- wet to saturated
	120		SS-28	60 R/G			clayey silty SAND- greenish gray, fine grained, dense, slight plasticity, moist, some fine black organic material
70	125		SS-29	70 R/G			
	130		SS-30	51 ⁵⁰ R/S			- moist to wet
60	135		SS-31	75 R/G			

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

Date(s): 04/18/95 - 04/26/95

Total Depth: 330.00'

Completed Depth: 330.00'

Logged By: S. Brunton

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
			SS-32	8			
50	145		SS-33	30			
	150		SS-34	64 R/5'			- lignite lens at 150.3'
40	155		SS-35	90 R/5'			- increased sand content, wet to saturated
	160		SS-36	50			- black organic laminations
30	165		SS-37	70 R/5'			
	170		SS-38	65 R/5'			
	175		SS-39	60 R/5'			
	180		SS-40	60 R/5'			- decreased sand content
10	185		SS-41	62 R/5'			- moist to wet, black organic laminations
	190		SS-42	61 R/5'			
	195		SS-43	99 R/5'			
	200		SS-44	80 R/5'			- increased sand content, wet to saturated
-10	205		SS-45	70 R/5'			- decreased sand content, moist

Sverdrup
ENVIRONMENTAL

Site Id: **16SB08**

X Coordinate: 3313950.20

Y Coordinate: 6953782.95

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

Date(s): 04/18/95 - 04/26/95

Total Depth: 330.00'

Completed Depth: 330.00'

Logged By: S. Brunton

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
			SS-46				- increased sand content, wet to saturated
-20	215		SS-47	65 R/6'			- decreased sand content
	220		SS-48	65 R/6'			
-30	225		SS-49	51 R/5'			
	230		SS-50	65 R/6'			
-40	235		SS-51	55 R/6'			- moist to wet
	240		SS-52	55 R/6'			
-50	245						
	250		SS-53	60 R/6'			
-60	255						
	260		SS-54	75 R/6'			
-70	265						
	270		SS-55	90 R/6'			
-80	275						

Sverdrup
ENVIRONMENTAL

Site Id: **16SB08**

X Coordinate: 3313950.20

Y Coordinate: 6953782.95

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

Date(s): 04/18/95 - 04/26/95

Total Depth: 330.00'


Completed Depth: 330.00'

Logged By: S. Brunton

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
-90	285		SS-56	55 R/6			
-100	295		SS-57	70 R/6			
-110	305						
-120	310		SS-58	75 R/4		CH	CLAY- dark gray, slightly indurated with light gray silt laminations, very stiff, medium to high plasticity, dry
-130	325						
-140	335						
-150	345						

Sverdrup Environmental, Inc.

13723 Riverport Drive
Maryland Heights, MO 63043BOREHOLE: 16SB08
LOGS: Natrual Gamma
Single Pt. Resistance

PROJECT: LHAAP – Phase 2, Group 2

CLIENT: USACE – Tulsa District

LOCATION: Longhorn Army Ammunition Plant

DATE: 01/31/95 – 06/25/95

COUNTY: Harrison

STATE: Texas

BOREHOLE DATA

DRILLING CONTRACTOR: Burlington Environmental, Inc.

CUSTOMER TD: 330 ft BGS

ELEV: 195.70 ft MSL

DEPTH REF: Ground Surface

LOGGER TD: 330.1 ft BGS

RUN NO.	BIT RECORD			CASING RECORD		
	Bit Size	From	To	Size/Wgt/Thk.	From	To
1	14 inch	0 ft	27 ft	10 in. ID	0 ft	28 ft
2	10 inch	27 ft	62 ft	6 in. ID	0 ft	64 ft
3	6 inch	62 ft	330 ft			

ILL METHOD: Mud Rotary

DATE DRILLED: 4/18–29

TIME SINCE CIRC:

HOLE MEDIUM:

FLUID LEVEL:

MUD TYPE: Bentonite Gel

VISCOSITY:

WEIGHT:

Rm at Deg

GENERAL DATA

LOGGED BY: Steve Brunton

OTHER SERVICES:

WITNESS: Kyle Williams

UNIT/TRUCK: Schramm RotoDrill

LOGGING DATA

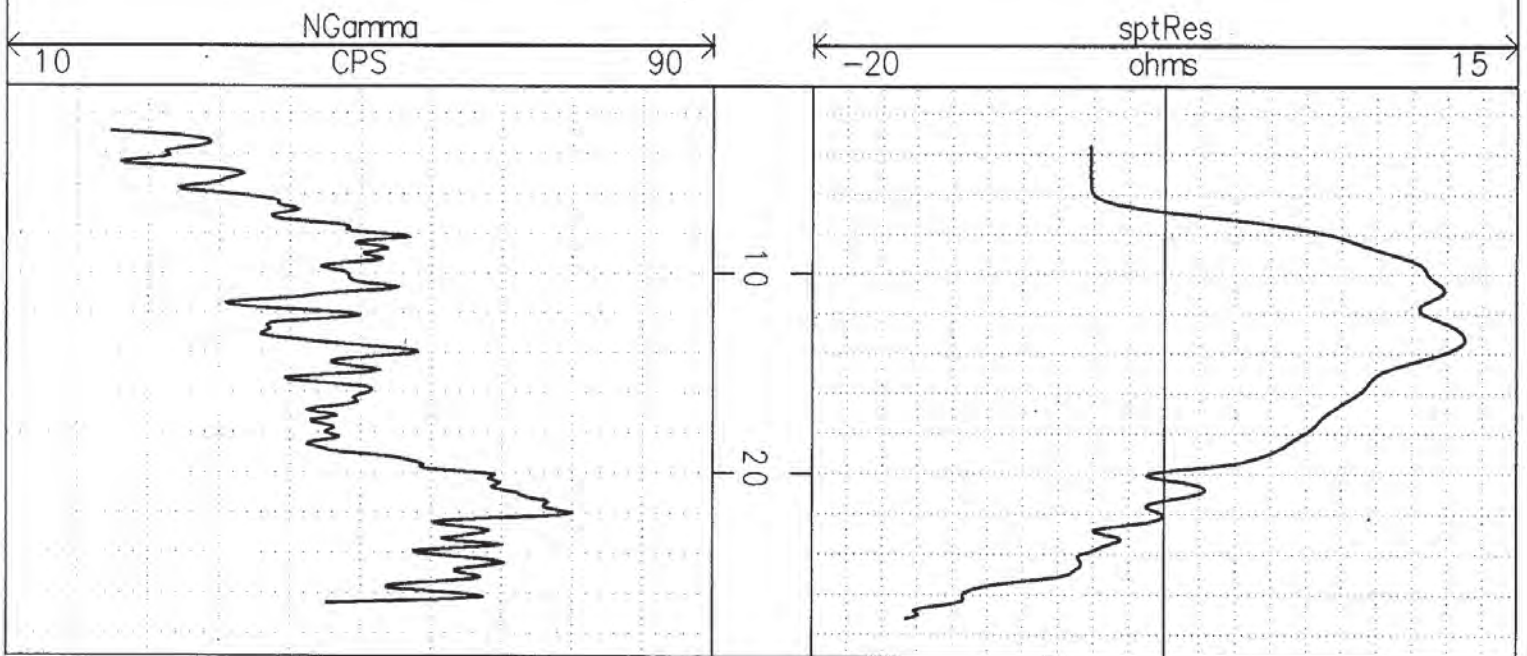
LOG FUNCTION	RUN NO.	EQUIPMENT			LOGGING		DETECTOR TYPE	SOURCE		LOGGED INTERVAL			COMMENTS
		MODEL	PROBE S.N.	UPHOLE S.N.	DIG INT. FEET	SPEED FT/MIN		TYPE	SIZE GBq	FROM	TO	INT. FEET	
4/19/95	1	MGX	2141	176	0.1	1–14	NGAMMA			3.6	27.3	23.8	16SB08_B.GA3
4/19/95	2	MGX	2141	176	0.1	0–16	sptRes			3.6	27.2	23.6	16SB08_B.RA3
4/25/95	3	MGX	2141	176	0.1	0–15	sptRes			3.5	62.1	58.6	16SB08_C.RA0
4/25/95	4	MGX	2141	176	0.1	2–15	NGAMMA			3.6	62.1	58.5	16SB08_C.GA1
4/29/95	5	MGX	2141	176	0.1	5–16	NGAMMA			3.6	330.1	326.5	16SB08_G.GA0
4/29/95	6	MGX	2141	176	0.1	6–13	sptRes			329.8	15.4	314.4	16SB08_C.RA0

DIGITAL FILE NAME(S): 16SB08S.AB2, 16SB08I.AB1, 16SB08D.AB1, 16SB08T.AB1

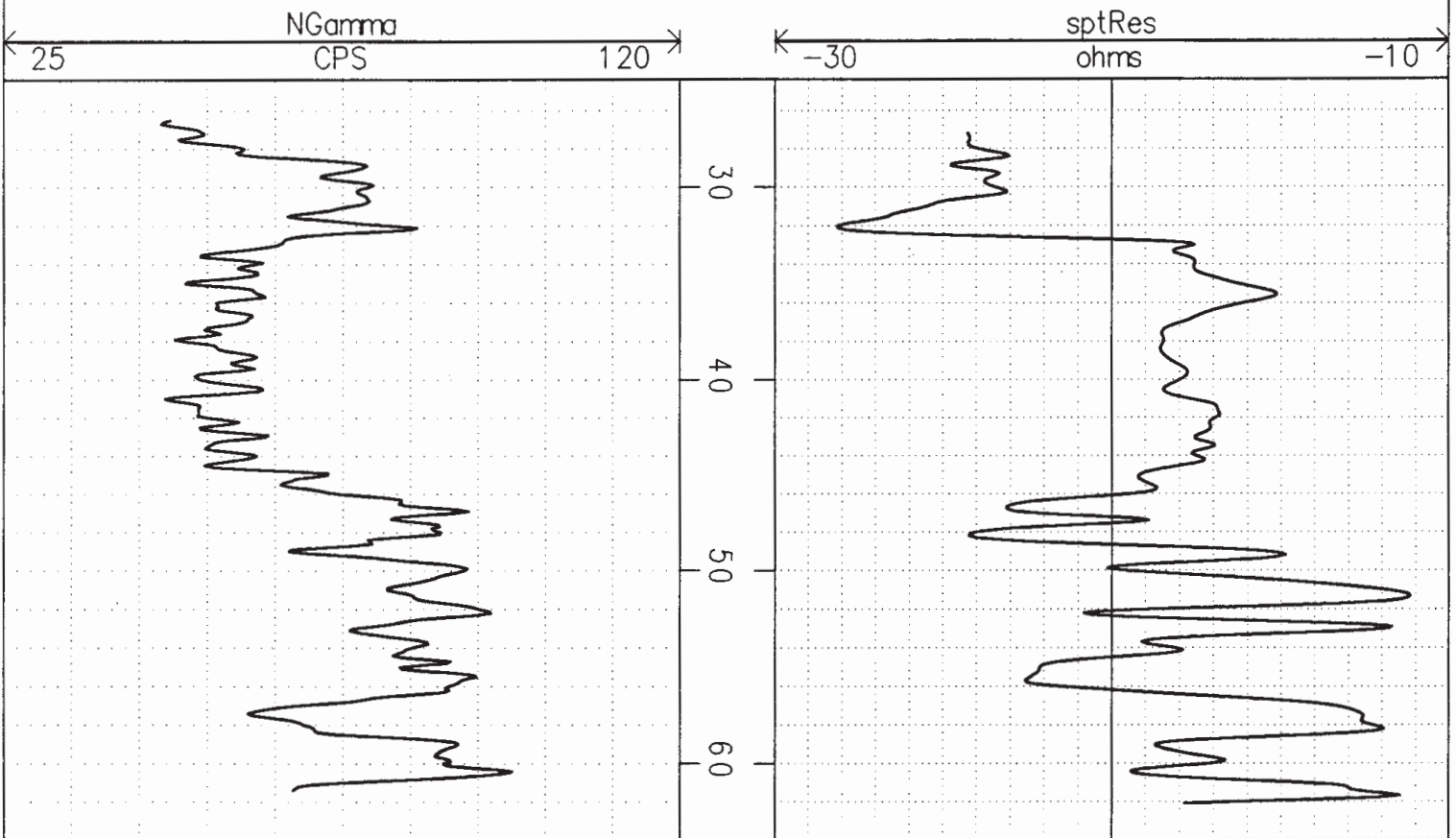
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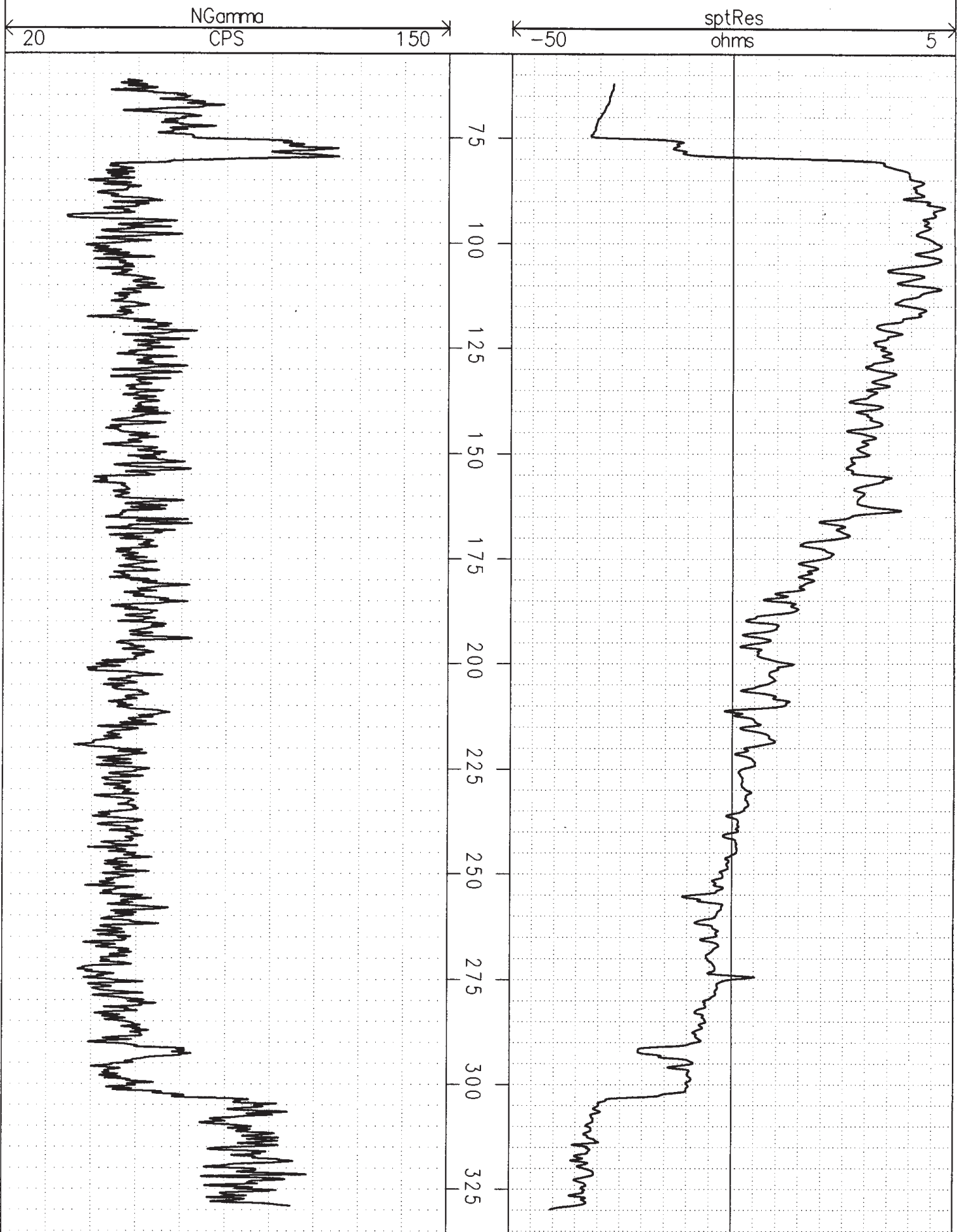
All *.AB1 and *.AB2 files were created from
 filtered and merged data from the original data
 files listed under comments.

16SB08 - SHALLOW

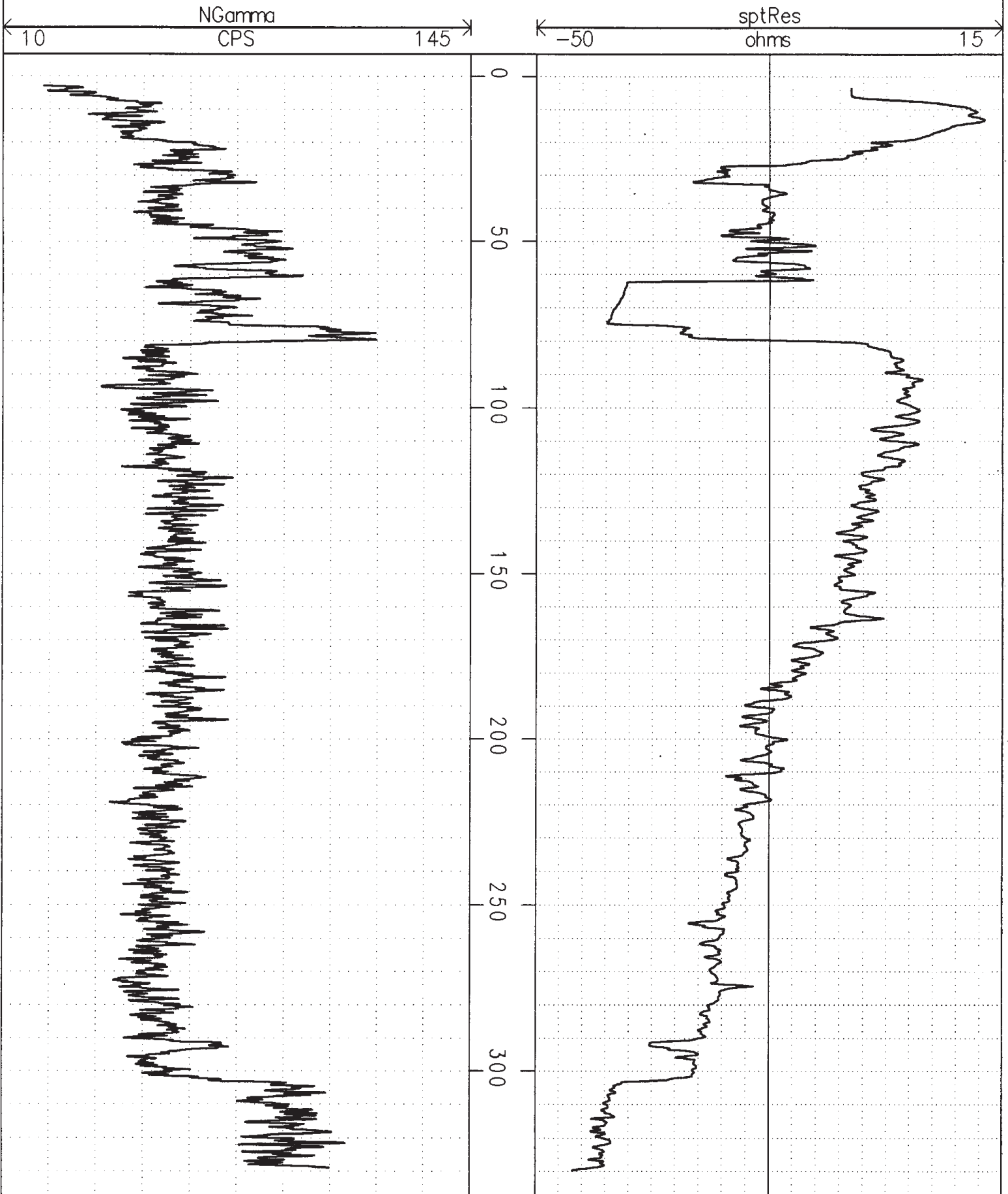


16SB08 - INTERMEDIATE





16SB08 - COMBINED DATA



Sverdrup
ENVIRONMENTAL

Site ID: **16WW15**

X Coordinate: 3313966.10

Y Coordinate: 6953838.40

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

Date(s): 04/27/95 - 05/09/95

Total Depth: 307.00'

Measuring Point: 198.71'

Logged By: S. Brunton

Completed Depth: 307.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

Well Casing: type: SS dia: 4.00in fm: -3.0' to: 297.00'

Drilling Method: Rotary

Screens:
type: Slotted size: .010in dia: 4.00in fm: 297.00'to: 307.00'

Remarks:

Annular Fill:
type: Bentonite/Cement Grout fm: .00' to: 3.00'
type: Bentonite Grout fm: 3.00' to: 286.30'
type: Secondary Sand Filter fm: 286.30' to: 287.00'
type: Granular Bentonite Seal fm: 287.00' to: 291.20'
type: Secondary Sand Filter fm: 291.20' to: 293.00'
type: #20-40 Silica Filter Sand fm: 293.00' to: 307.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-14	28				
			SS-15	51	25			
			SS-16	51	25			
				67	3			
				89	4			
130	65		SS-17	60		CH/CL	SAND- greenish gray, fine grained, poorly graded, few fines, medium dense, saturated CLAY- dark greenish gray with light gray laminations, silt or fine sand, very stiff, medium to high plasticity, dry -very dark gray with gray silt laminations, stiff, medium plasticity	
	70		SS-18	70	R/6			
120	75		SS-19	66	R/6			
	80		SS-20	65	R/6	SM	- few silt laminations, medium to high plasticity clayey SAND- gray, fine grained, dense, slight plasticity, moist to wet clayey silty SAND- light greenish gray, fine grained, medium dense, slight plasticity, wet	
110	85		SS-21	76	R/6		- less fines, wet to saturated	
	90		SS-22	51	40		- moist to wet	
100	95		SS-23	80	R/6			
	100		SS-24	63	R/6		- increased sand content, wet to saturated	
90	105		SS-25	55	R/6		- decreased sand content	
	110		SS-26	51	40		- moist to wet	
80	115		SS-27	75	R/6		- wet to saturated	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-28	80 R/6			clayey silty SAND- greenish gray, fine grained, dense, slight plasticity, moist, some fine black organic material	
70	125		SS-29	70 R/7				
	130		SS-30	51 ²⁰ R/5			- moist to wet	
60	135		SS-31	75 R/6				
	140		SS-32	50				
50	145		SS-33	50				
	150		SS-34	64 R/6			- lignite lens at 150.3'	
40	155		SS-35	90 R/6			- increased sand content, wet to saturated	
	160		SS-36	50			- black organic laminations	
30	165		SS-37	70 R/6				
	170		SS-38	85 R/6				
20	175		SS-39	80 R/6			- decreased sand content	

Sverdrup
ENVIRONMENTAL

Site ID: **16WW15**

X Coordinate: 3313966.10

Y Coordinate: 6953838.40

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

e(s): 04/27/95 - 05/09/95

Total Depth: 307.00'

Measuring Point: 198.71'

Logged By: S. Brunton

Completed Depth: 307.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

Well Casing: type: SS dia: 4.00in fm: -3.0' to: 297.00'

Drilling Method: Rotary

Screens:
type: Slotted size: .010in dia: 4.00in fm: 297.00'to: 307.00'

Remarks:

Annular Fill:
type: Bentonite/Cement Grout fm: .00' to: 3.00'
type: Bentonite Grout fm: 3.00' to: 286.30'
type: Secondary Sand Filter fm: 286.30' to: 287.00'
type: Granular Bentonite Seal fm: 287.00' to: 291.20'
type: Secondary Sand Filter fm: 291.20' to: 293.00'
type: #20-40 Silica Filter Sand fm: 293.00' to: 307.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
	185		SS-40	60 R/6				
10	185		SS-41	62 R/6			- moist to wet, black organic laminations	
	190		SS-42	61 R/6				
0	195		SS-43	99 R/6				
	200		SS-44	80 R/6			- increased sand content, wet to saturated	
-10	205		SS-45	70 R/6			- decreased sand content, moist	
	210		SS-46	7			- increased sand content, wet to saturated	
-20	215		SS-47	65 R/6			- decreased sand content	
	220		SS-48	65 R/6				
-30	225		SS-49	51 ²⁵ R/3 ⁵				
	230		SS-50	65 R/6				
-40	235		SS-51	55 R/6			- moist to wet	

Sverdrup
ENVIRONMENTAL

Site ID: **16WW15**

X Coordinate: 3313966.10

Y Coordinate: 6953838.40

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

e(s): 04/27/95 - 05/09/95

Total Depth: 307.00'

Measuring Point: 198.71'

Logged By: S. Brunton

Completed Depth: 307.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

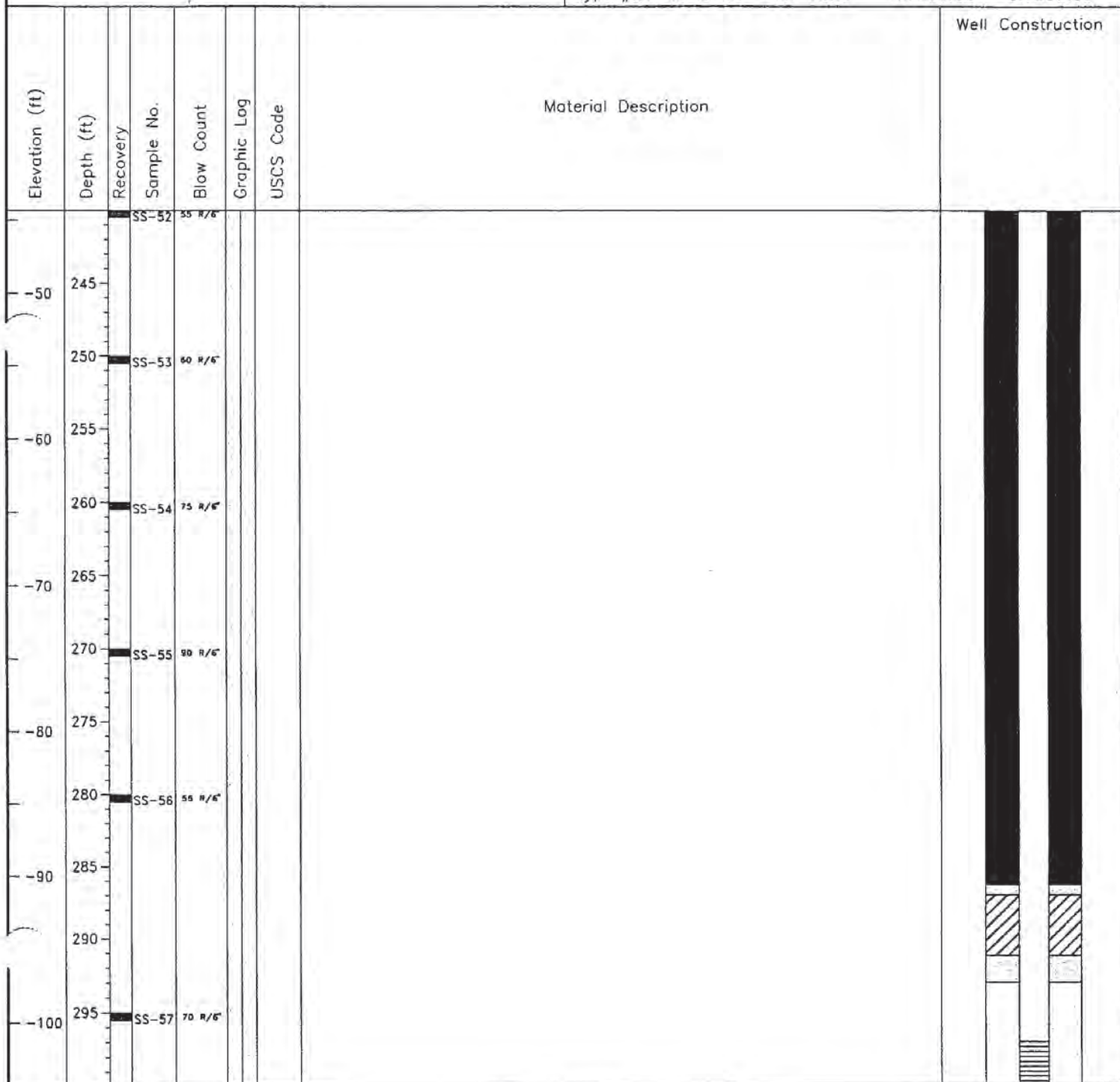
Well Casing: type: SS dia: 4.00in fm: -3.0' to: 297.00'

Drilling Method: Rotary

Screens:
type: Slotted size: .010in dia: 4.00in fm: 297.00'to: 307.00'

Remarks:

Annular Fill:
type: Bentonite/Cement Grout fm: .00' to: 3.00'
type: Bentonite Grout fm: 3.00' to: 286.30'
type: Secondary Sand Filter fm: 286.30' to: 287.00'
type: Granular Bentonite Seal fm: 287.00' to: 291.20'
type: Secondary Sand Filter fm: 291.20' to: 293.00'
type: #20-40 Silica Filter Sand fm: 293.00' to: 307.00'



X Coordinate: 3313966.10

Y Coordinate: 6953838.40

Location: Longhorn Army Ammunition Plant

Elevation: 195.70'

Datum: NGVD

date(s): 04/27/95 - 05/09/95

Total Depth: 307.00'

Measuring Point: 198.71'

Logged By: S. Brunton

Completed Depth: 307.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

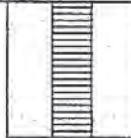
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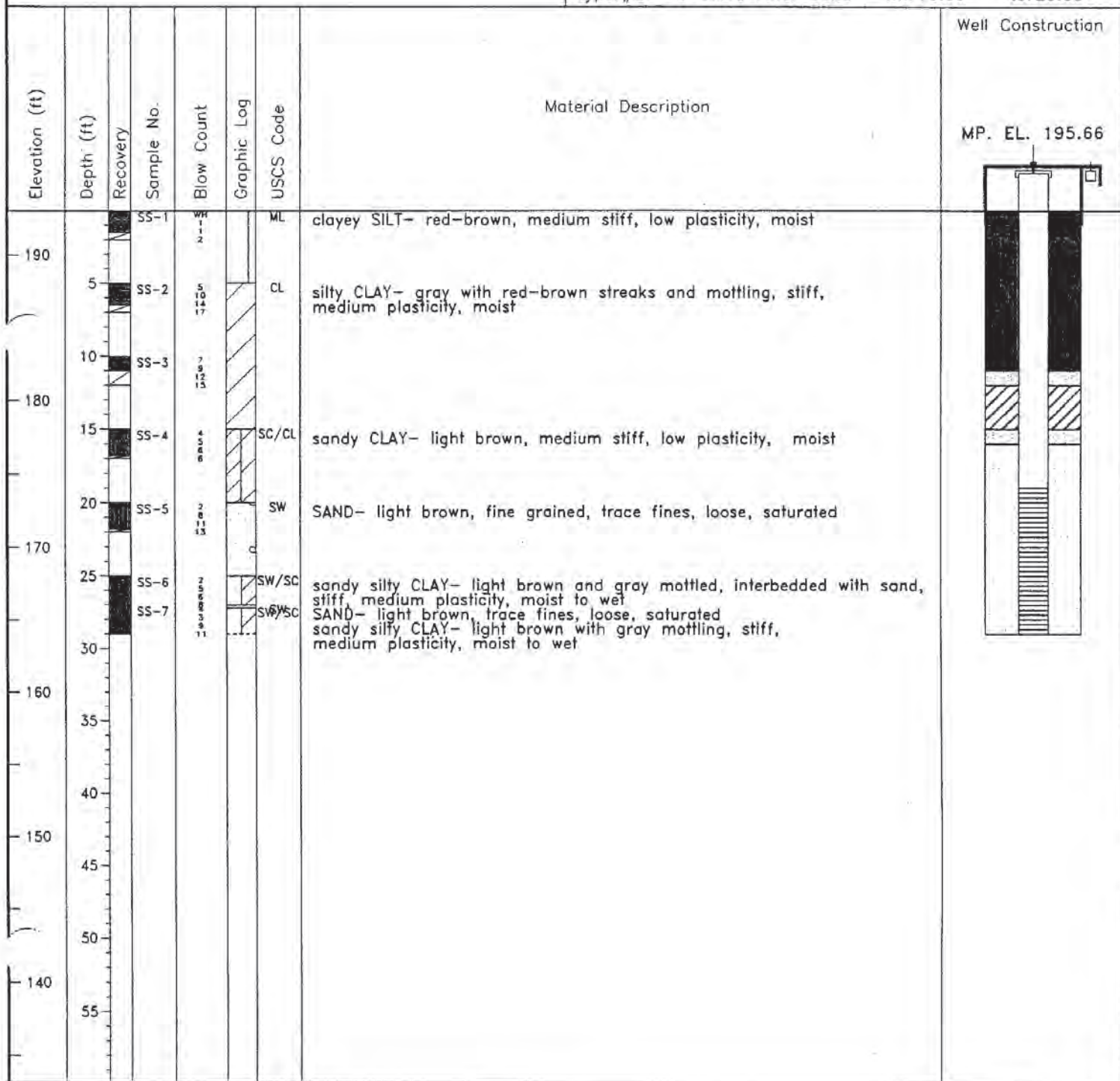
Drilling Method: Rotary

Screens:
type: Slotted size: .010in dia: 4.00in fm: 297.00'to: 307.00'

Remarks:

Annular Fill:
type: Bentonite/Cement Grout fm: .00' to: 3.00'
type: Bentonite Grout fm: 3.00' to: 286.30'
type: Secondary Sand Filter fm: 286.30' to: 287.00'
type: Granular Bentonite Seal fm: 287.00' to: 291.20'
type: Secondary Sand Filter fm: 291.20' to: 293.00'
type: #20-40 Silica Filter Sand fm: 293.00' to: 307.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
-110	305							
	310							
-120	315							
	320							
-130	325							
	330							
-140	335							
	340							
-150	345							
	350							
-160	355							



Location: Longhorn Army Ammunition Plant

Elevation: 195.04'

Datum: NGVD

Date(s): 05/13/95 - 05/22/95

Total Depth: 256.00'

Completed Depth: 256.00'

Logged By: K. Williams

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
190	5		SS-1	5		ML/CL	sandy CLAY- light gray with red mottling grading down to tan with red streaks, stiff, medium plasticity, dry to moist
	10		SS-2	35 38		SM	silty SAND- yellowish orange with red tint, very fine grained, trace fines, loose, dry
180	15		SS-3	7			- yellowish orange, increasing fines, wet
	20		SS-4	8			- saturated
170	25		SS-5	8		SM	CLAY- light gray with red mottling, medium stiff, medium plasticity, wet, approx. 3' silty SAND- yellowish orange, very fine grained, fines, loose, wet
	30		SS-6	5 10 11		CL	silty CLAY- light brown with reddish orange streaks, stiff, medium plasticity, moist to wet
160	35		SS-7	8 8 8			- light gray with light brown streaks, medium stiff, high plasticity, moist
	40		SS-8	6 13 18		SM	SAND- light brown, fine grained, loose, saturated silty SAND- light gray, very fine to fine grained, loose, saturated
150	45		SS-9	10 10 18 18			- medium gray, medium grained, loose, saturated
	50		SS-10	10 27 40 40		CH	silty CLAY- dark gray, soft, high plasticity, moist
140	55		SS-11	17 37 51 R/5'		SC	- increasing sand content
	60		SS-12	10 18 15 6		SM	- with clay laminations, very lean, low plasticity, dry, gray moist sand stringers
130	65		SS-13	18 31 75 R/3'		SW/SM	- tan sand stringers

Sverdrup
ENVIRONMENTAL

Site Id: **16SB09**

X Coordinate: 3314450.90

Y Coordinate: 6953816.72

Location: Longhorn Army Ammunition Plant

Elevation: 195.04'

Datum: NGVD

Date(s): 05/13/95 - 05/22/95

Total Depth: 256.00'

Completed Depth: 256.00'

Logged By: K. Williams

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
			SS-14	15 20 80 R/6"		SM/SW	silty SAND- light gray, subrounded grains, clay, moist
120	75		SS-15	20 27 58 R/3"		SM	- decreasing clay
	80		SS-16	20 27 50 51 R/3"			
110	85		SS-17	10 20 30			
	90		SS-18	20 20 50 51 R/3"			
100	95		SS-19	10 80 R/5"			
	100		SS-20	15 20 45			- increasing clay content
90	105		SS-21	45 51 R/5"			
	110		SS-22	35 50 50			
80	115		SS-23	15 51 R/4"			
	120		SS-24	15 30 50			- small amount of lignite
70	125		SS-25	25 50			
	130		SS-26	20 20 51 R/4"			- light to medium gray, fine grained, moist
60	135		SS-27	25 47 51 R/2"			

Sverdrup
ENVIRONMENTAL

Site Id: **16SB09**

X Coordinate: 3314450.90

Y Coordinate: 6953816.72

Location: Longhorn Army Ammunition Plant

Elevation: 195.04'

Datum: NGVD

Date(s): 05/13/95 - 05/22/95

Total Depth: 256.00'

Completed Depth: 256.00'

Logged By: K. Williams

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
			SS-28	28 51 R/2"			- wet
50	145		SS-29	33 51 R/2"			
	150		SS-30	26 51 R/2"			
40	155		SS-31	25 51 R/1"			
	160		SS-32	23 51 R/2"			
30	165		SS-33	21 51 R/2"			
	170		SS-34	20 51 R/4"			
20	175		SS-35	31 51 R/2"			
	180		SS-36	21 51 R/2"			
10	185		SS-37	35 51 R/2"			
	190		SS-38	21 51 R/2"			- saturated
0	195		SS-39	21 51 R/2"			
	200		SS-40	30 51 R/2"			
-10	205		SS-41	15 51 R/2"			

Sverdrup
ENVIRONMENTAL

Site Id: **16SB09**

X Coordinate: 3314450.90

Y Coordinate: 6953816.72

Location: Longhorn Army Ammunition Plant

Elevation: 195.04'

Datum: NGVD

Date(s): 05/13/95 - 05/22/95

Total Depth: 256.00'

Completed Depth: 256.00'

Logged By: K. Williams

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
			SS-42	23 51 R/2'			
-20	215		SS-43	25 51 R/2'			
	220		SS-44	37 51 R/2'			
-30	225		SS-45	37 99 R/5'		OL	clay SHALE- dark greenish gray, some silt, hard, dry, finely laminated
	230		SS-46	39 50			
-40	235		SS-47	30 51 R/3'			
	240		SS-48	37 51 R/4'			
-50	245		SS-49	40 51 R/3'			
	250		SS-50	39 51 R/5'			
-60	255		SS-51	39 51 R/5'			
	260						
-70	265						
	270						
-80	275						

Sverdrup Environmental, Inc.

13723 Riverport Drive
Maryland Heights, MO 63043BOREHOLE: 16SB09
LOGS: Natrual Gamma
Single Pt. ResistancePROJECT: LHAAP – Phase 2, Group 2
CLIENT: USACE – Tulsa District
LOCATION: Longhorn Army Ammunition PlantDATE: 01/31/95 – 06/25/95
COUNTY: Harrison
STATE: Texas

BOREHOLE DATA

DRILLING CONTRACTOR: Burlington Environmental, Inc.
ELEV: 195.04 ft MSL DEPTH REF: Ground SurfaceCUSTOMER TD: 255 ft BGS
LOGGER TD: 252.3 ft BGS

RUN NO.	BIT RECORD			CASING RECORD		
	Bit Size	From	To	Size/Wgt/Thk.	From	To
1	14 inch	0 ft	30 ft	10 in. ID	0 ft	31 ft
2	10 inch	30 ft	50 ft	6 in. ID	0 ft	51 ft
3	6 inch	50 ft	255 ft			

DRILL METHOD: Mud Rotary

DATE DRILLED: 5/13-18

TIME SINCE CIRC:

HOLE MEDIUM:

FLUID LEVEL:

MUD TYPE: Bentonite Gel

VISCOSITY:

WEIGHT:

Rm at Deg

GENERAL DATA

LOGGED BY: Kyle Williams

OTHER SERVICES:

WITNESS: Steve Brunton

UNIT/TRUCK: Gus Pech Drill Rig

LOGGING DATA

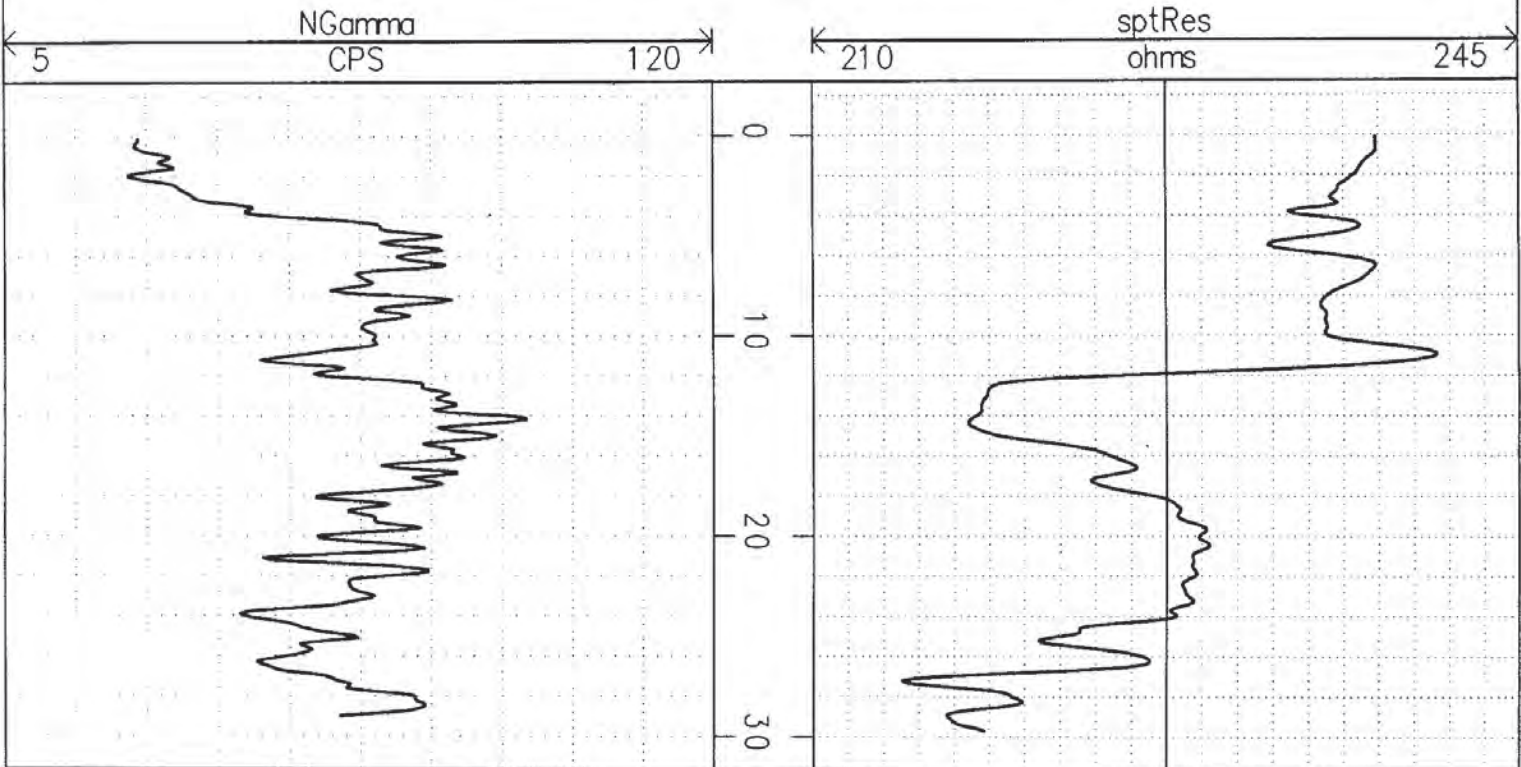
LOG FUNCTION	RUN NO.	EQUIPMENT			LOGGING		DETECTOR TYPE	SOURCE		LOGGED INTERVAL			COMMENTS
		MODEL	PROBE S.N.	UPHOLE S.N.	DIG INT FEET	SPEED FT/MIN		TYPE	SIZE GBq	FROM	TO	INT. FEET	
5/13/95	1	MGX	2141	176	0.1	9-13	NGAMMA			0.1	29.8	29.7	16SB09_A.GA0
5/31/95	2	MGX	2141	176	0.1	6-14	sptRes			+0.6	29.7	30.3	16SB09_A.RA1
5/18/95	3	MGX	2141	176	0.1	0-20	NGAMMA			+0.4	252.3	252.7	16SB09_C.GA0
5/18/95	4	MGX	2141	176	0.1	2-13	sptRes			250.4	45.8	204.6	16SB09_C.RA0

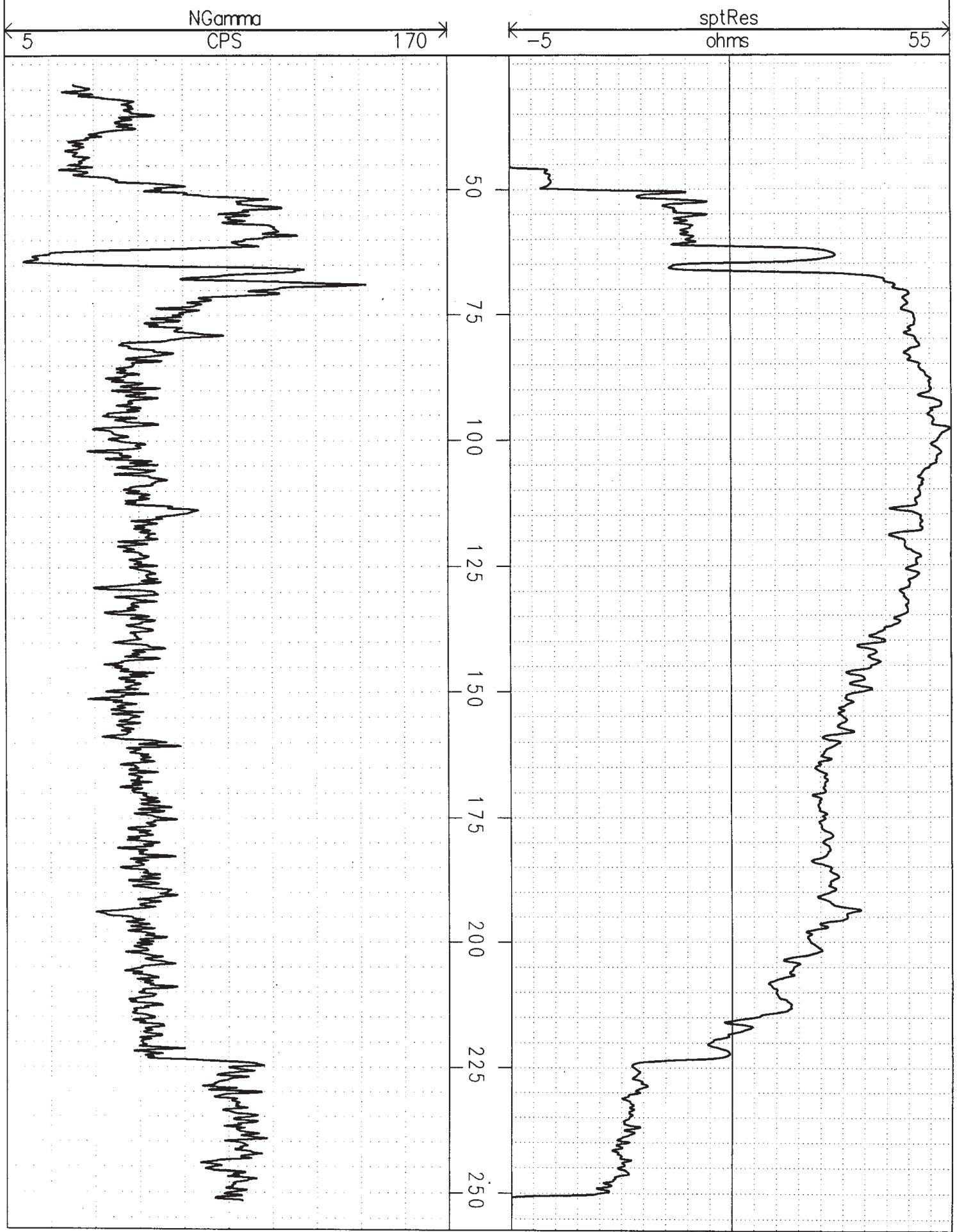
DIGITAL FILE NAME(S): 16SB09S.AB1, 16SB09D.AB2

REMARKS:

All *.AB1 and *.AB2 files were created from
dited and merged data from the original data
files listed under comments.The intermediate portion of the soil boring
was not logged due to a broken wireline/
signal cable.

16SB09 - SHALLOW





Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
190	5	SS-1		5	ML/CL		sandy CLAY- light gray with red mottling grading down to tan with red streaks, stiff, medium plasticity, dry to moist	<p>MP. EL. 197.81</p>
	10	SS-2		5	SM		silty SAND- yellowish orange with red tint, very fine grained, trace fines, loose, dry	
180	15	SS-3		5			- yellowish orange, increasing fines, wet	
	20	SS-4		4			- saturated	
170	25	SS-5		4	SM		CLAY- light gray with red mottling, medium stiff, medium plasticity, wet, approx. 3' silty SAND- yellowish orange, very fine grained, fines, loose, wet	
	30	SS-6		5	CL		silty CLAY- light brown with reddish orange streaks, stiff, medium plasticity, moist to wet	
160	35	SS-7		5			- light gray with light brown streaks, medium stiff, high plasticity, moist	
	40	SS-8		5	SM		SAND- light brown, fine grained, loose, saturated silty SAND- light gray, very fine to fine grained, loose, saturated	
150	45	SS-9		10			- medium gray, medium grained, loose, saturated	
	50	SS-10		10	CH		silty CLAY- dark gray, soft, high plasticity, moist	
140	55	SS-11		17	SC		- increasing sand content	
							- with clay laminations very lean low plasticity dry gray moist	

Sverdrup
ENVIRONMENTAL

Site ID: **16WW17**

X Coordinate: 3314457.60

Y Coordinate: 6953867.30

Location: Longhorn Army Ammunition Plant

Elevation: 195.04'

Datum: NGVD

s): 05/23/95 - 05/26/95

Total Depth: 225.00'

Measuring Point: 197.81'

Logged By: K. Williams

Completed Depth: 225.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

Well Casing: type: SS dia: 4.00in fm: -2.8' to: 215.00'

Drilling Method: Rotary

Screens:
type: Slotted size: .010in dia: 4.00in fm: 215.00'to: 225.00'

Remarks:

Annular Fill:
type: Bentonite/Cement Grout fm: .00' to: 2.00'
type: Bentonite Grout fm: 2.00' to: 207.00'
type: Secondary Sand Filter fm: 207.00' to: 208.00'
type: Granular Bentonite Seal fm: 208.00' to: 211.00'
type: Secondary Sand Filter fm: 211.00' to: 212.00'
type: #20-40 Silica Filter Sand fm: 212.00' to: 225.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-12	10 18 5.8		SM	sand stringers	
130	65		SS-13	18 31 7.5 R/3'		SW/SM	- tan sand stringers	
	70		SS-14	15 25 8.0 R/6'		SM/SW	silty SAND- light gray, subrounded grains, clay, moist	
120	75		SS-15	20 27 5.8 R/3'		SM	- decreasing clay	
	80		SS-16	20 27 5.1 R/3'				
110	85		SS-17	10 31 3.0				
	90		SS-18	20 20 5.1 R/3'				
100	95		SS-19	10 60 R/5'				
	100		SS-20	15 30 4.0			- increasing clay content	
90	105		SS-21	40 51 R/5'				
	110		SS-22	35 30 5.0				
80	115		SS-23	15 51 R/6'				

Sverdrup
ENVIRONMENTAL

Site ID: **16WW17**

Page 3 of 4

X Coordinate: 3314457.60

Y Coordinate: 6953867.30

Location: Longhorn Army Ammunition Plant

Elevation: 195.04'

Datum: NGVD

Start Date: 05/23/95 - 05/26/95

Total Depth: 225.00'

Measuring Point: 197.81'

Logged By: K. Williams

Completed Depth: 225.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

Well Casing: type: SS dia: 4.00in fm: -2.8' to: 215.00'

Drilling Method: Rotary

Screens:
type: Slotted size: .010in dia: 4.00in fm: 215.00'to: 225.00'

Remarks:

Annular Fill:
 type: Bentonite/Cement Grout fm: .00' to: 2.00'
 type: Bentonite Grout fm: 2.00' to: 207.00'
 type: Secondary Sand Filter fm: 207.00' to: 208.00'
 type: Granular Bentonite Seal fm: 208.00' to: 211.00'
 type: Secondary Sand Filter fm: 211.00' to: 212.00'
 type: #20-40 Silica Filter Sand fm: 212.00' to: 225.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
70	125	SS-24	20 25 51 R/2'				- small amount of lignite	
60	130	SS-25	20 25 51 R/2'				- light to medium gray, fine grained, moist	
	135	SS-26	20 25 51 R/2'					
	140	SS-27	20 25 51 R/2'					
	145	SS-28	20 25 51 R/2'				- wet	
50	150	SS-29	20 25 51 R/2'					
	155	SS-30	20 25 51 R/2'					
40	160	SS-31	20 25 51 R/2'					
	165	SS-32	20 25 51 R/2'					
30	170	SS-33	20 25 51 R/2'					
	175	SS-34	20 25 51 R/2'					
20	175	SS-35	20 25 51 R/2'					

Sverdrup ENVIRONMENTAL		Site ID: 16WW17		Page 4 of 4
		X Coordinate: 3314457.60	Y Coordinate: 6953867.30	
Location: Longhorn Army Ammunition Plant		Elevation: 195.04'		Datum: NGVD
(s): 05/23/95 - 05/26/95		Total Depth: 225.00'		Measuring Point: 197.81'
Logged By: K. Williams		Completed Depth: 225.00'		Static Water Level:
Contractor: Burlington Environmental Inc.		Well Casing: type: SS dia: 4.00in fm: -2.8' to: 215.00'		
Drilling Method: Rotary		Screens: type: Slotted size: .010in dia: 4.00in fm: 215.00'to: 225.00'		
Remarks:		Annular Fill: type: Bentonite/Cement Grout fm: .00' to: 2.00' type: Bentonite Grout fm: 2.00' to: 207.00' type: Secondary Sand Filter fm: 207.00' to: 208.00' type: Granular Bentonite Seal fm: 208.00' to: 211.00' type: Secondary Sand Filter fm: 211.00' to: 212.00' type: #20-40 Silica Filter Sand fm: 212.00' to: 225.00'		

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-36	21 51 1/2"				
	185		SS-37	33 51 1/2"				
	190		SS-38	21 51 1/2"			- saturated	
0	195		SS-39	21 51 1/2"				
	200		SS-40	20 51 1/2"				
-10	205		SS-41	15 51 1/2"				
	210		SS-42	15 51 1/2"				
-20	215		SS-43	15 50				
	220		SS-44	27 51 1/2"				
-30	225				OL		CLAY SHALE- dark greenish gray, some silt, hard, dry, finely laminated	
	230							
-40	235							

Sverdrup ENVIRONMENTAL		Site Id: 16SB10		Page 1 of 5
		X Coordinate: 3314046.08	Y Coordinate: 6953337.96	
Location: Longhorn Army Ammunition Plant		Elevation: 180.73'		Datum: NGVD
Date(s): 05/12/95 - 05/16/95		Total Depth: 312.00'		Completed Depth: 312.00'
Logged By: S. Brunton		Remarks:		
Contractor: Burlington Environmental Inc.				
Drilling Method: Rotary				

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
180	5		SS-1	31 48 R/4'		SM	silty SAND- light gray, fine grained, poor to slightly graded, some fines, medium dense, moist, iron staining
170	10		SS-2	25 25 4		SM/SP	-poorly graded, wet
	15		SS-3	11 19 8		SM SC	- moist to wet clayey SAND- yellowish brown mottling, fine grained, poorly graded, medium dense, slight to low plasticity, moist to wet, iron staining -gray
160	20		SS-4	16 23 8		CL/CH	silty CLAY- mottled gray and dark yellowish brown, thin fine sandy silt lenses, stiff, medium to high plasticity, moist, black organics, structures
	25		SS-5				
150	30		SS-6	10 13 15		SM	silty SAND- greenish gray, fine grained, poorly graded, dense, slight plasticity, moist to wet
	35		SS-7	11 25 8		SP	SAND- greenish gray, fine grained, poorly graded, trace fines, medium dense, saturated
140	40		SS-8	7 15 10			- dark greenish gray, medium grained, poorly graded, loose, saturated, lignite lens
	45		SS-9	12 18 30		CH/CL SP	silty CLAY- dark greenish gray, soft, high plasticity, moist to wet clayey SILT- dark greenish gray, soft, low to medium plasticity, wet, flood debris SAND- olive gray, fine to medium grained, poorly graded, loose, wet to saturated, lignite
130	50		SS-10 SS-11	30 51 R/5'		CH SP	CLAY- dark gray, thin silt laminations, very stiff, high plasticity, dry clayey SILT- gray, laminated, slight plasticity, moist SAND- olive gray, fine to medium grained, poorly graded, some fines, saturated
	55		SS-12	30 R/4'		SM	silty SAND- light greenish gray, poorly graded, dense, slight plasticity, moist
	60		SS-13	45 R/4'			
	65		SS-14	75 R/5'			- increased sand content, wet

Location: Longhorn Army Ammunition Plant

Elevation: 180.73'

Datum: NGVD

Date(s): 05/12/95 - 05/16/95

Total Depth: 312.00'

Completed Depth: 312.00'

Logged By: S. Brunton

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
110			SS-15	65 R/6			- light greenish gray, poorly graded, dense, slight plasticity, moist
	75		SS-16	51 ³⁰ R/4			- decreased sand content, moist to wet
100	80		SS-17	60 R/6			- increased sand content, saturated
	85		SS-18	65 R/6			- decreased sand content, moist to wet
90	90		SS-19	60 R/6			- light greenish gray, poorly graded, dense, slight plasticity, moist
	95		SS-20	95 R/6			- increased sand content, saturated
80	100		SS-21	75 R/9			- decreased sand content, moist to wet
	105		SS-22	75 R/7			
70	110		SS-23	70 R/7			
	115		SS-24	70 R/6			
60	120		SS-25	70 R/6			
	125		SS-26	60 R/6			
	130		SS-27	80 R/6			- greenish gray, moist to wet, thin black organic laminations
	135		SS-28	75 R/6			- saturated

Sverdrup
ENVIRONMENTAL

Site Id: **16SB10**

X Coordinate: 3314046.08

Y Coordinate: 6953337.96

Location: Longhorn Army Ammunition Plant

Elevation: 180.73'

Datum: NGVD

Date(s): 05/12/95 - 05/16/95

Total Depth: 312.00'

Completed Depth: 312.00'

Logged By: S. Brunton

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
40			SS-29	90 R/6'			- moist to wet, thin black organic laminations
	145		SS-30	65 R/6'			- increased sand content, wet to saturated
30	150		SS-31	65 R/6'			- moist
	155		SS-32	99 R/6'			- increased sand content, saturated
20	160		SS-33	80 R/6'			- moist
	165		SS-34	99 R/6'			
10	170		SS-35	99 R/6'			
	175		SS-36	80 R/6'			
0	180		SS-37	75 R/5'			
	185		SS-38	70 R/6'			
-10	190		SS-39	52 R/6'			
	195		SS-40	60 R/6'			
20	200		SS-41	99 R/4'			- cemented lenses
	205		SS-42	51 45 R/4'			

Sverdrup
ENVIRONMENTAL

Site Id: **16SB10**

X Coordinate: 3314046.08

Y Coordinate: 6953337.96

Location: Longhorn Army Ammunition Plant

Elevation: 180.73'

Datum: NGVD

Date(s): 05/12/95 - 05/16/95

Total Depth: 312.00'

Completed Depth: 312.00'

Logged By: S. Brunton

Remarks:

Contractor: Burlington Environmental Inc.

Drilling Method: Rotary

Elev. (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description
-30			SS-43	51 R/6'			
	215		SS-44	70 R/6'			
-40	220		SS-45	55 R/6'			
	225		SS-46	60 R/6'			
-50	230		SS-47	75 R/6'			
	235						
-60	240		SS-48	75 R/6'			
	245						
-70	250		SS-49	75 R/6'			
	255						
-80	260		SS-50	65 R/6'			
	265						
-90	270		SS-51	99 R/6'			
	275						

Sverdrup Environmental, Inc.

13723 Riverport Drive
Maryland Heights, MO 63043BOREHOLE: 16SB10
LOGS: Natrual Gamma
Single Pt. Resistance

PROJECT: LHAAP - Phase 2, Group 2

CLIENT: USACE - Tulsa District

LOCATION: Longhorn Army Ammunition Plant

DATE: 01/31/95 - 06/25/95

COUNTY: Harrison

STATE: Texas

BOREHOLE DATA

DRILLING CONTRACTOR: Burlington Environmental, Inc.

ELEV: 180.73 ft MSL

DEPTH REF: Ground Surface

CUSTOMER TD: 310.3 ft BGS

LOGGER TD: 311.5 ft BGS

RUN NO.	BIT RECORD			CASING RECORD		
	Bit Size	From	To	Size/Wgt/Thk.	From	To
1	14 inch	0 ft	20 ft	10 in. ID	0 ft	22 ft
2	10 inch	20 ft	60 ft	6 in. ID	0 ft	60 ft
3	6 inch	60 ft	310 ft			

DRILL METHOD: Mud Rotary

HOLE MEDIUM:

VISCOSITY:

DATE DRILLED: 5/12-16

FLUID LEVEL:

WEIGHT:

TIME SINCE CIRC:

MUD TYPE: Bentonite Gel

Rm at Deg

GENERAL DATA

LOGGED BY: Steve Brunton

WITNESS: Sandy Rudolph

OTHER SERVICES:

UNIT/TRUCK: Schramm RotoDrill

LOGGING DATA

LOG FUNCTION	RUN NO.	EQUIPMENT			LOGGING		DETECTOR TYPE	SOURCE		LOGGED INTERVAL			COMMENTS
		MODEL	PROBE S.N.	UPHOLE S.N.	DIG INT FEET	SPEED FT/MIN		TYPE	SIZE GBq	FROM	TO	INT. FEET	
5/12/95	1	MGX	2141	176	0.1	1-13	NGAMMA			19.1	3.5	15.6	16SB10_A.GA1
5/12/95	2	MGX	2141	176	0.1	7-13	sptRes			19	3.5	15.5	16SB10_A.RA1
5/13/95	3	MGX	2141	176	0.1	1-14	NGAMMA			3.6	59.2	55.6	16SB10_B.GAO
5/13/95	4	MGX	2141	176	0.1	2-14	sptRes			3.6	59	55.4	16SB10_B.RAO
5/16/95	5	MGX	2141	176	0.1	0-16	NGAMMA			3.5	311.5	308	16SB10_D.GAO
5/16/95	6	MGX	2141	176	0.1	0-13	sptRes			305.9	48.5	257.4	16SB10_D.RA1

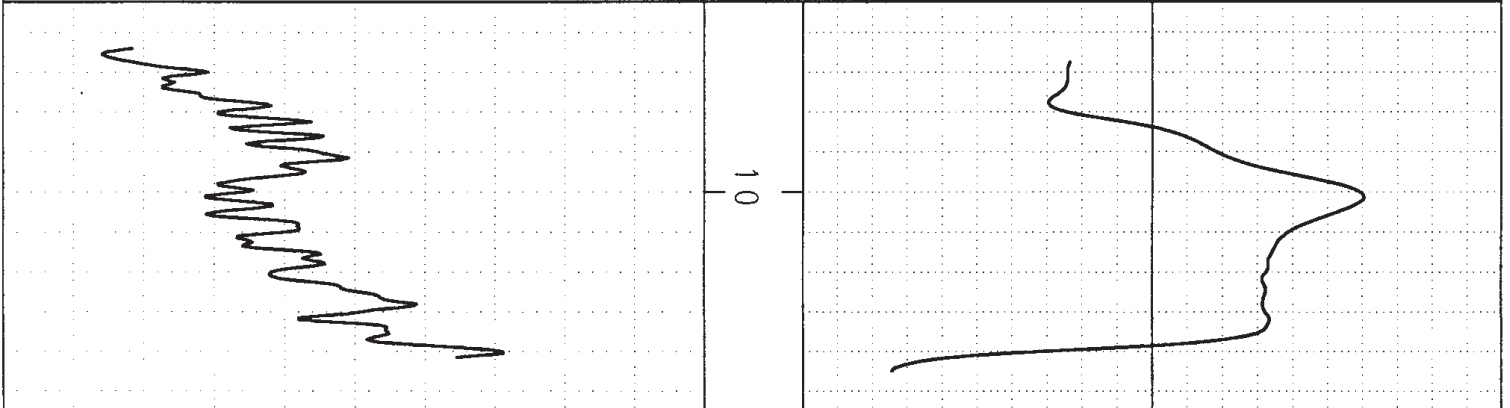
DIGITAL FILE NAME(S): 16SB10S.AB1, 16SB10I.AB1, 16SB10D.AB1, 16SB10T.AB1

REMARKS:

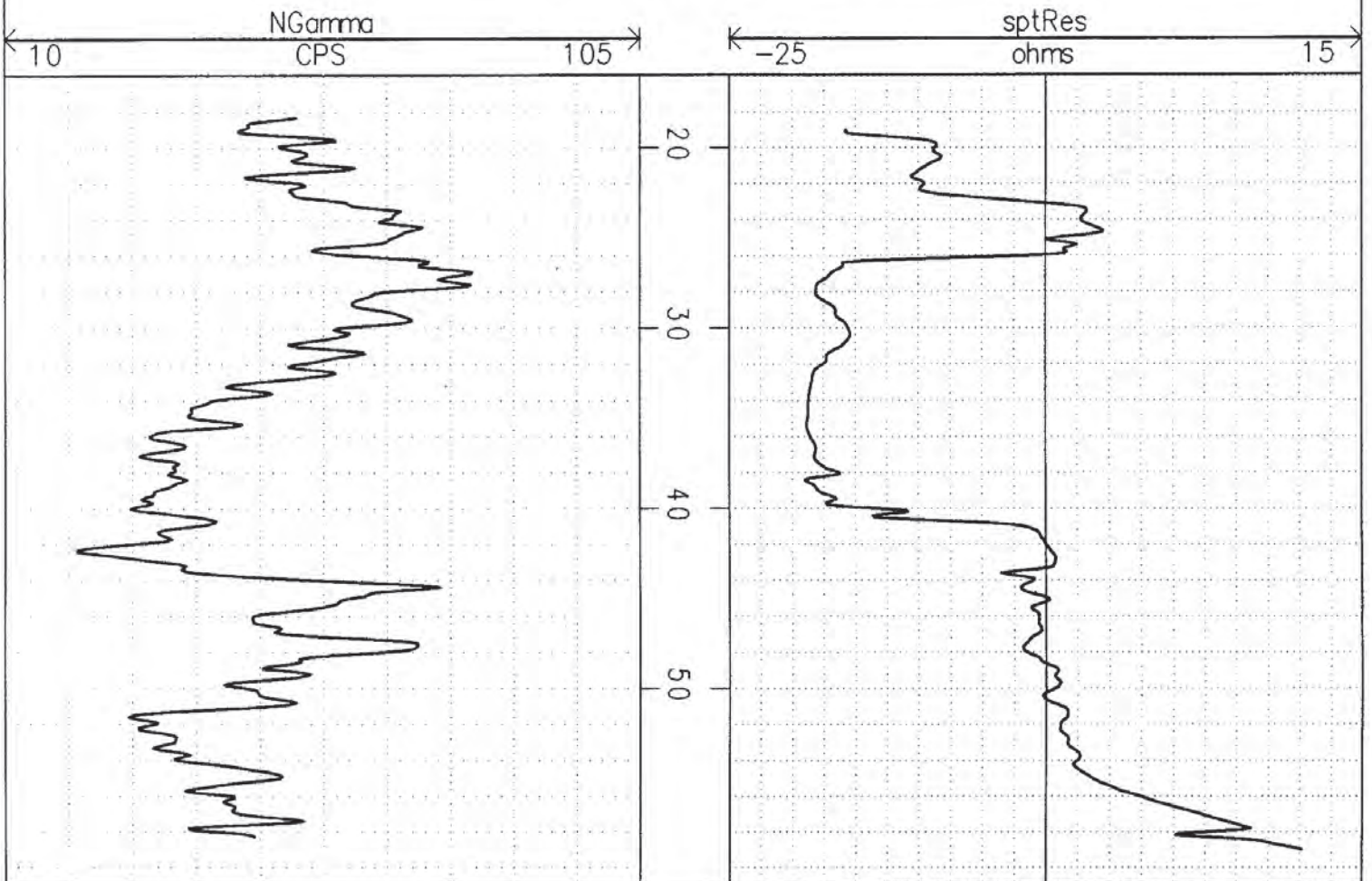
All *.AB1 files were created from edited and merged data from the original data files listed under comments.

16SB10 - SHALLOW

NGamma CPS 15 85 sptRes ohms -30 -10

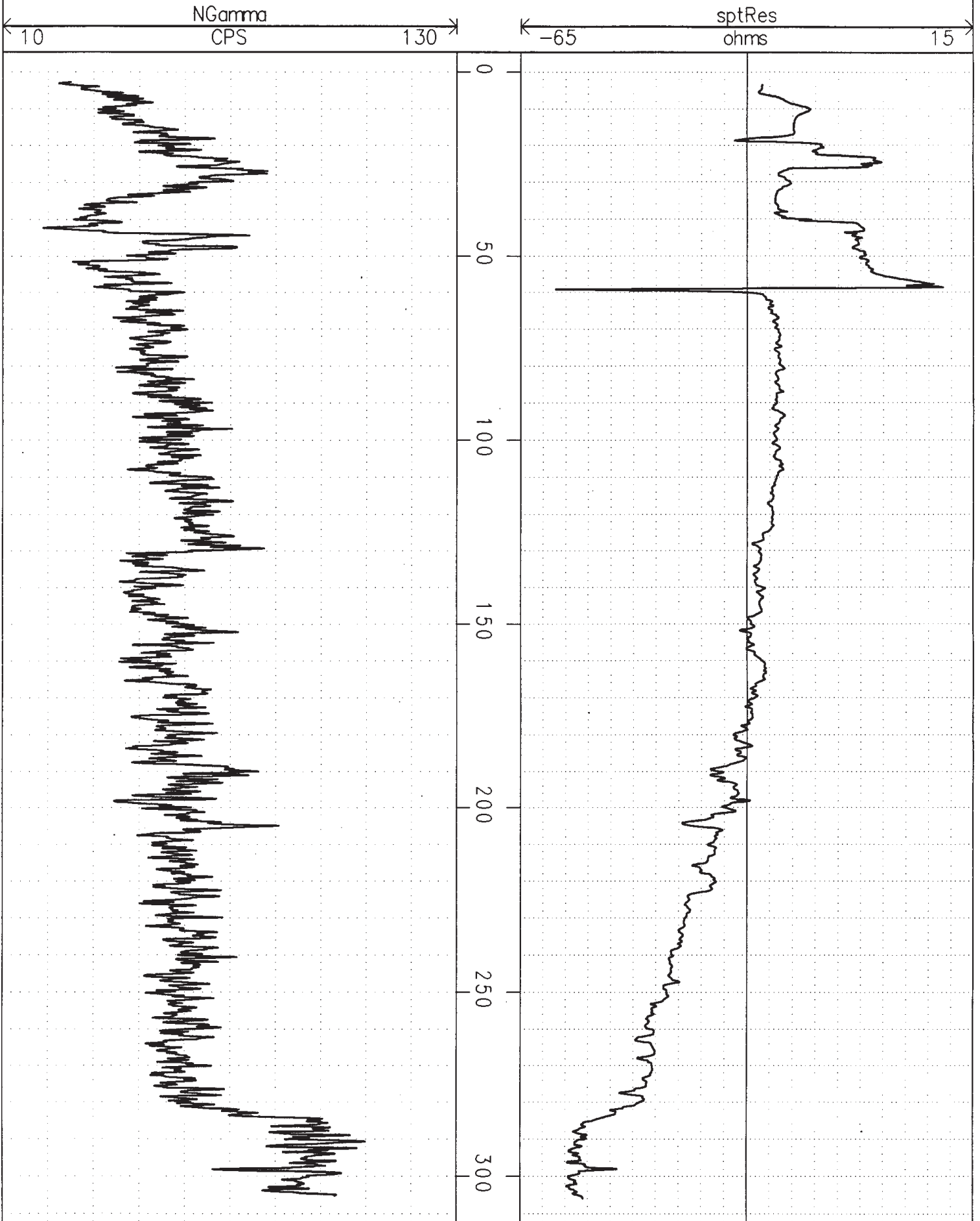


16SB10 - INTERMEDIATE



16SB10 - COMBINED DATA

00882395



Location: Longhorn Army Ammunition Plant

Elevation: 180.73'

Datum: NGVD

(s): 05/18/95 - 05/23/95

Total Depth: 283.00'

Measuring Point: 183.85'

Logged By: S. Brunton

Completed Depth: 283.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

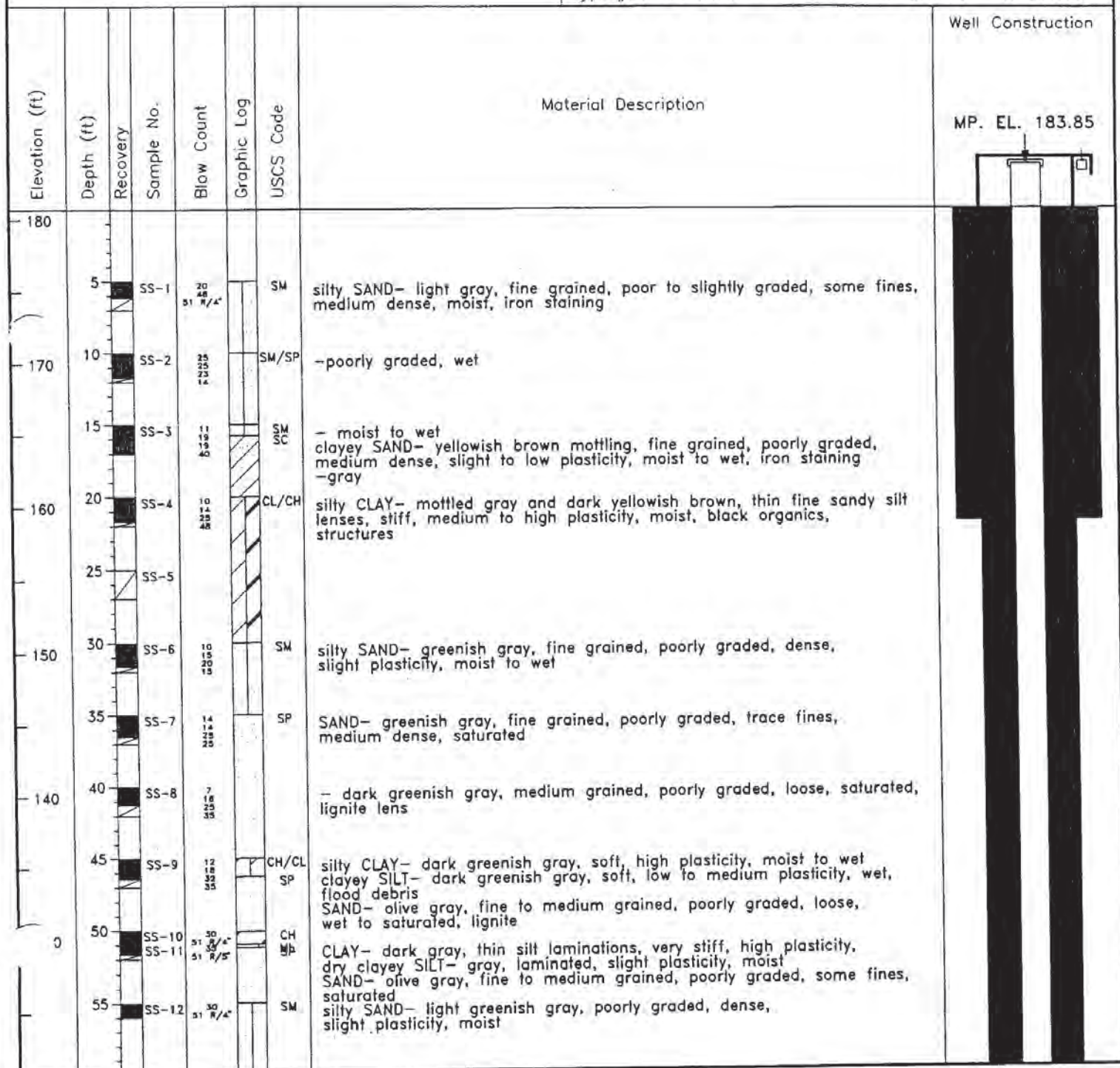
Well Casing: type: SS dia: 4.00in fm: -3.1' to: 272.00'

Drilling Method: Rotary

Screens:
type: Slotted size: .010in dia: 4.00in fm: 272.00'to: 282.00'

Remarks:

Annular Fill:
type: Bentonite/Cement Grout fm: .00' to: 3.00'
type: Bentonite Grout fm: 3.00' to: 261.00'
type: Secondary Sand Filter fm: 261.00' to: 261.60'
type: Granular Bentonite Seal fm: 261.60' to: 265.00'
type: Secondary Sand Filter fm: 265.00' to: 265.70'
type: #20-40 Silica Filter Sand fm: 265.70' to: 283.00'



Location: Longhorn Army Ammunition Plant	Elevation: 180.73'	Datum: NGVD
(s): 05/18/95 - 05/23/95	Total Depth: 283.00'	Measuring Point: 183.85'
Logged By: S. Brunton	Completed Depth: 283.00'	Static Water Level:

Contractor: Burlington Environmental Inc.	Well Casing: type: SS dia: 4.00in fm: -3.1' to: 272.00'
---	---

Drilling Method: Rotary	Screens: type: Slotted size: .010in dia: 4.00in fm: 272.00'to: 282.00'
-------------------------	--

Remarks:	Annular Fill:
	type: Bentonite/Cement Grout fm: .00' to: 3.00'
	type: Bentonite Grout fm: 3.00' to: 261.00'
	type: Secondary Sand Filter fm: 261.00' to: 261.60'
	type: Granular Bentonite Seal fm: 261.60' to: 265.00'
	type: Secondary Sand Filter fm: 265.00' to: 265.70'
	type: #20-40 Silica Filter Sand fm: 265.70' to: 283.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
120			SS-13	51 R/C				
	65		SS-14	75 R/C			- increased sand content, wet	
110	70		SS-15	85 R/C			- light greenish gray, poorly graded, dense, slight plasticity, moist	
	75		SS-16	51 R/C			- decreased sand content, moist to wet	
100	80		SS-17	80 R/C			- increased sand content, saturated	
	85		SS-18	85 R/C			- decreased sand content, moist to wet	
90	90		SS-19	80 R/C			- light greenish gray, poorly graded, dense, slight plasticity, moist	
	95		SS-20	95 R/C			- increased sand content, saturated	
80	100		SS-21	75 R/C			- decreased sand content, moist to wet	
	105		SS-22	75 R/C				
	110		SS-23	70 R/C				
	115		SS-24	70 R/C				

Location: Longhorn Army Ammunition Plant

Elevation: 180.73'

Datum: NGVD

Period(s): 05/18/95 - 05/23/95

Total Depth: 283.00'

Measuring Point: 183.85'

Logged By: S. Brunton

Completed Depth: 283.00'

Static Water Level:

Contractor: Burlington Environmental Inc.

Well Casing: type: SS dia: 4.00in fm: -3.1' to: 272.00'

Drilling Method: Rotary

Screens:
type: Slotted size: .010in dia: 4.00in fm: 272.00'to: 282.00'

Remarks:

Annular Fill:
type: Bentonite/Cement Grout fm: .00' to: 3.00'
type: Bentonite Grout fm: 3.00' to: 261.00'
type: Secondary Sand Filter fm: 261.00' to: 261.60'
type: Granular Bentonite Seal fm: 261.60' to: 265.00'
type: Secondary Sand Filter fm: 265.00' to: 265.70'
type: #20-40 Silica Filter Sand fm: 265.70' to: 283.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
60			SS-25	70 R/G				
	125		SS-26	80 R/G				
50	130		SS-27	80 R/G			- greenish gray, moist to wet, thin black organic laminations	
	135		SS-28	75 R/G			- saturated	
40	140		SS-29	90 R/G			- moist to wet, thin black organic laminations	
	145		SS-30	85 R/G			- increased sand content, wet to saturated	
30	150		SS-31	85 R/G			- moist	
	155		SS-32	99 R/G			- increased sand content, saturated	
20	160		SS-33	80 R/G			- moist	
	165		SS-34	99 R/G				
	170		SS-35	99 R/G				
	175		SS-36	80 R/G				

Sverdrup ENVIRONMENTAL		Site ID: 16WW18		Page 4 of 5
		X Coordinate: 3314083.00	Y Coordinate: 6953395.80	
Location: Longhorn Army Ammunition Plant		Elevation: 180.73'	Datum: NGVD	
Date(s): 05/18/95 - 05/23/95		Total Depth: 283.00'	Measuring Point: 183.85'	
Logged By: S. Brunton		Completed Depth: 283.00'	Static Water Level:	
Contractor: Burlington Environmental Inc.		Well Casing: type: SS dia: 4.00in fm: -3.1' to: 272.00'		
Drilling Method: Rotary		Screens: type: Slotted size: .010in dia: 4.00in fm: 272.00'to: 282.00'		
Remarks:		Annular Fill: type: Bentonite/Cement Grout fm: .00' to: 3.00' type: Bentonite Grout fm: 3.00' to: 261.00' type: Secondary Sand Filter fm: 261.00' to: 261.60' type: Granular Bentonite Seal fm: 261.60' to: 265.00' type: Secondary Sand Filter fm: 265.00' to: 265.70' type: #20-40 Silica Filter Sand fm: 265.70' to: 283.00'		

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
0			SS-37	75 R/6'				
	185		SS-38	70 R/6'				
-10	190		SS-39	52 R/6'				
	195		SS-40	80 R/6'				
-20	200		SS-41	88 R/6'			- cemented lenses	
	205		SS-42	51 ⁴⁵ R/6'				
-30	210		SS-43	51 R/6'				
	215		SS-44	70 R/6'				
-40	220		SS-45	55 R/6'				
	225		SS-46	80 R/6'				
0	230		SS-47	75 R/6'				
	235							

Sverdrup
ENVIRONMENTAL

Site ID: **16WW18** Page 5 of 5

X Coordinate: 3314083.00 Y Coordinate: 6953395.80

Location: Longhorn Army Ammunition Plant Elevation: 180.73' Datum: NGVD

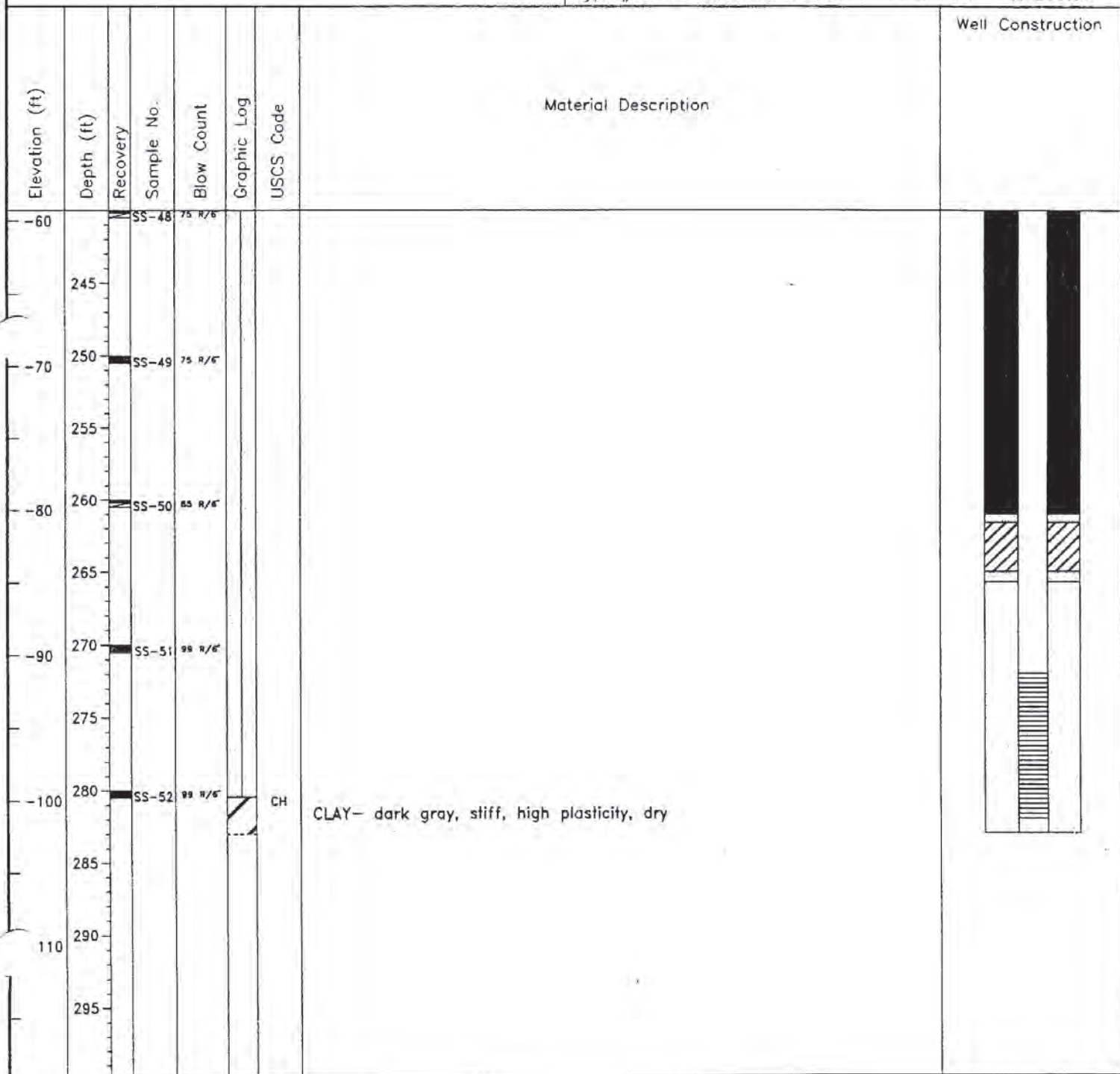
te(s): 05/18/95 - 05/23/95 Total Depth: 283.00' Measuring Point: 183.85'

Logged By: S. Brunton Completed Depth: 283.00' Static Water Level:

Contractor: Burlington Environmental Inc. Well Casing: type: SS dia: 4.00in fm: -3.1' to: 272.00'

Drilling Method: Rotary Screens: type: Slotted size: .010in dia: 4.00in fm: 272.00'to: 282.00'

Remarks: Annular Fill:
 type: Bentonite/Cement Grout fm: .00' to: 3.00'
 type: Bentonite Grout fm: 3.00' to: 261.00'
 type: Secondary Sand Filter fm: 261.00' to: 261.60'
 type: Granular Bentonite Seal fm: 261.60' to: 265.00'
 type: Secondary Sand Filter fm: 265.00' to: 265.70'
 type: #20-40 Silica Filter Sand fm: 265.70' to: 283.00'



X Coordinate: 3314131.54

Y Coordinate: 6953388.57

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 178.57'

Datum: NGVD

Date(s): 06/14/97 - 06/14/97

Total Depth: 96.00'

Measuring Point: 181.87'

Logged By: Dave Cika

Completed Depth: 95.00'

Static Water Level:

Contractor: Philip Environmental

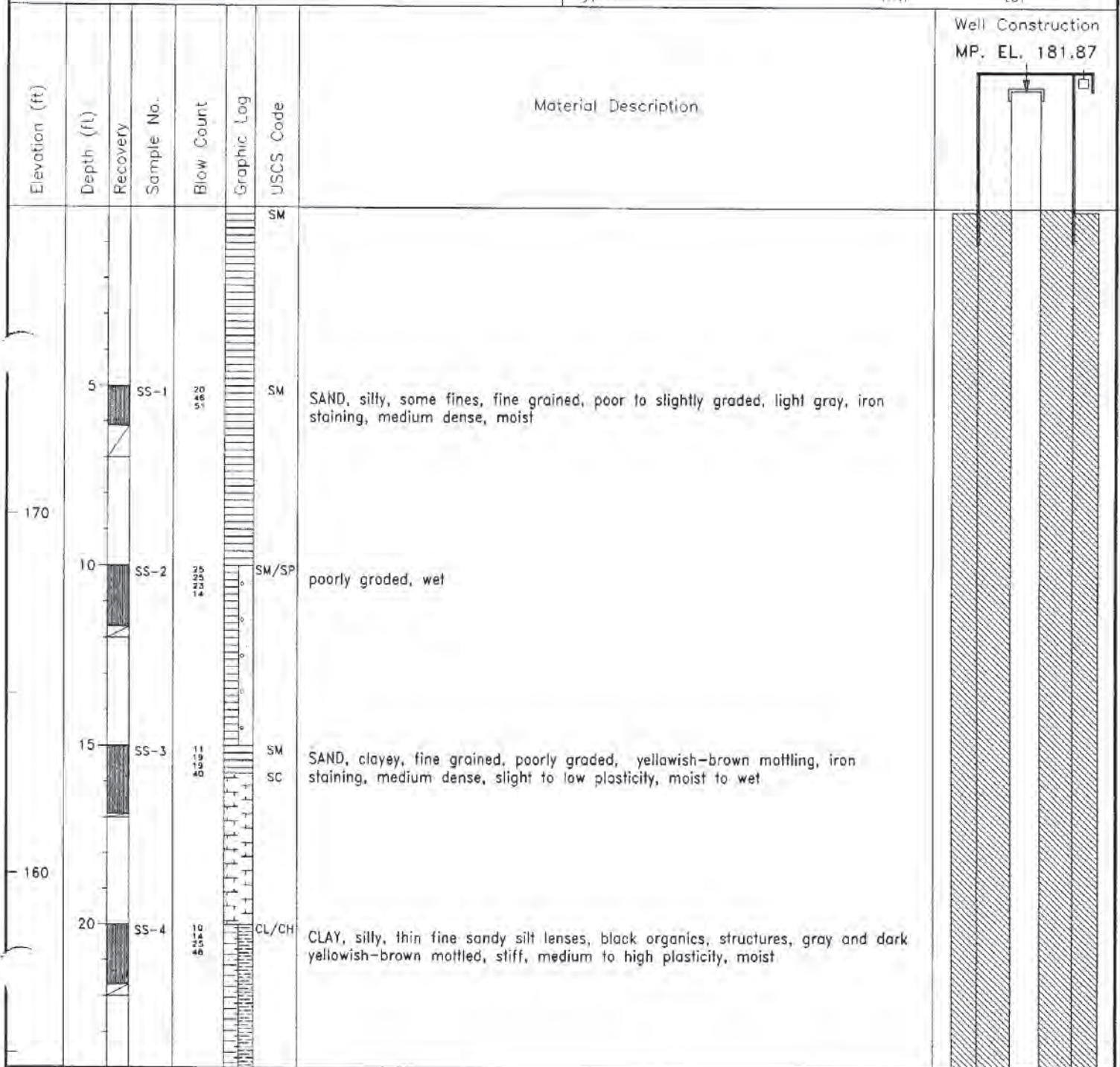
Well Casing: type: SS dia: 4.00in fm: -3.3' to: 85.00'

Drilling Method: Hollow Stem Auger

Screens:
type: Wire-wrap size: 0.010in dia: 4.00in fm: 85.00' to: 95.00'

Remarks:

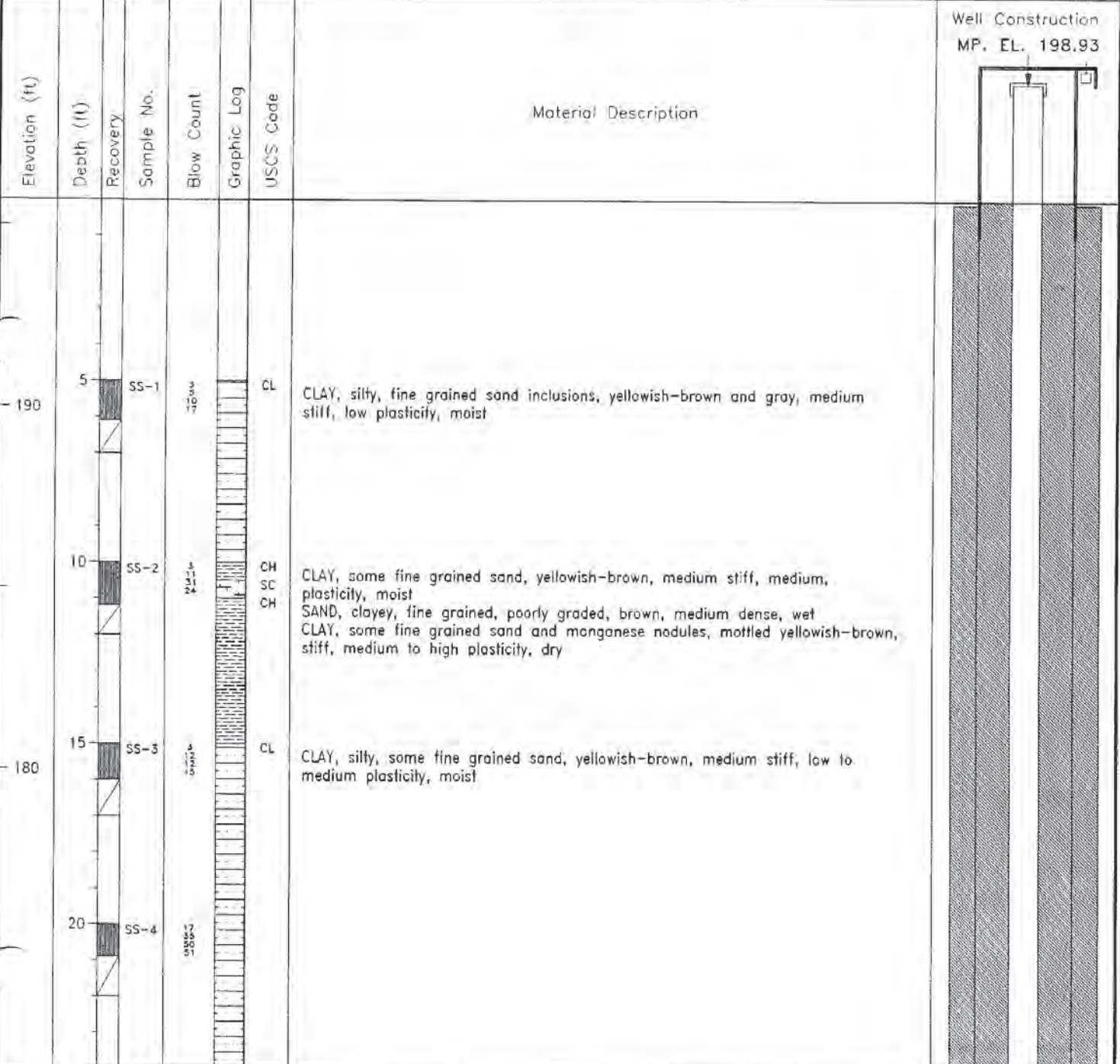
Annular Fill:
type: Bentonite/Cement Grout fm: 0.00' to: 78.00'
type: #20-40 Silica Filter Sand fm: 78.00' to: 79.00'
type: Bentonite Pellets fm: 79.00' to: 82.00'
type: #20-40 Silica Filter Sand fm: 82.00' to: 83.00'
type: Sand Filter fm: 83.00' to: 96.00'
type: fm: to:



Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
150	29		SS-5					
			SS-6	10 16 26 15		SM	SAND, silty, fine grained, poorly graded, greenish-gray, dense, slight plasticity, moist to wet	
	34		SS-7	14 14 25 25		SP	SAND, trace fines, fine grained, poorly graded, greenish-gray, medium dense, saturated	
140	39		SS-8	7 16 23 35			SAND, trace fines, lignite lenses, medium grained, poorly graded, dark greenish-gray, loose, saturated	
	44		SS-9	12 18 32 35		CH/CL SP	CLAY silty, dark greenish-gray, soft, high plasticity, moist to wet SILT, clayey, flood debris, dark greenish-gray, soft, low to medium plasticity, wet	
	49		SS-10	30 51		CH	SAND, lignite, fine to medium grained, poorly graded, olive gray, loose, wet to saturated	
			SS-11	35 51		SP	CLAY, thin silt laminations, dark gray, very stiff, high plasticity, dry SILT, clayey, gray, laminated, slight plasticity, moist SAND, some fines, fine to medium grained, poorly graded, olive gray, saturated	
	54		SS-12	30 51		SM	SAND, silty, poorly graded, light greenish-gray, dense, slight plasticity, moist	
120	59							

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-13	45 51				
	64		SS-14	75			increased sand content, wet	
110	69		SS-15	65			light greenish-gray, poorly graded, dense, slight plasticity, moist	
	74		SS-16	50 51			decreased sand content, moist to wet	
100	79		SS-17	60			increased sand content, saturated	
	84		SS-18	65			decreased sand content, moist to wet	
90	89		SS-19	60			light greenish-gray, poorly graded, dense, slight plasticity, moist	
	94		SS-20	95			increasing sand content, saturated	

Sverdrup ENVIRONMENTAL		Site ID: 16WW20	
		X Coordinate: 3313950.41	Y Coordinate: 6953846.81
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 195.70'	Datum: NGVD
Date(s): 06/02/97 - 06/02/97		Total Depth: 111.00'	Measuring Point: 198.93'
Logged By: Dave Cika		Completed Depth: 110.00'	Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.2' to: 100.00'	
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 100.00' to: 110.00'	
Remarks:		Annular Fill: type: Bentonite/Cement Grout fm: 0.00' to: 94.00' type: #20-40 Silica Filter Sand fm: 94.00' to: 95.00' type: Bentonite Pellets fm: 95.00' to: 97.00' type: #20-40 Silica Filter Sand fm: 97.00' to: 98.00' type: Sand Filter fm: 98.00' to: 111.00' type: fm: to:	



Site Id: 16WW20		Date(s): 06/02/97 - 06/02/97					
Elevation (ft)	Depth (ft)	Recovery Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
170		SS-5	2600		SP	SAND, some fines, fine grained, poorly graded, light gray, medium dense, saturated CLAY, mottled brown, stiff, medium to high plasticity, dry to moist	
		SS-6	140		CH		
	29						
		SS-7					
	34						
160		SS-8	81				
	39						
		SS-9	80		CL	CLAY, sandy, light gray, stiff, medium plasticity, dry, iron staining	
			51				
	44						
150		SS-10	14		SP	SAND, few fines, fine grained, poorly graded, greenish gray, medium dense, saturated CLAY, trace silt, dark gray with dark brown laminations, very stiff, medium to high plasticity, dry	
		SS-11	99		CH		
			45				
	49						
		SS-12	84		SP	SAND, trace fines, fine grained, poorly graded, light gray, medium dense, moist to wet	
			51				
	54						
140		SS-13	7		CH	CLAY, silt or fine grained sand, dark greenish gray with light gray laminations, very stiff, med. to high plasticity, dry	
			20				
			51				
	59						









Site Id: 16WW20

Date(s): 06/02/97 - 06/02/97

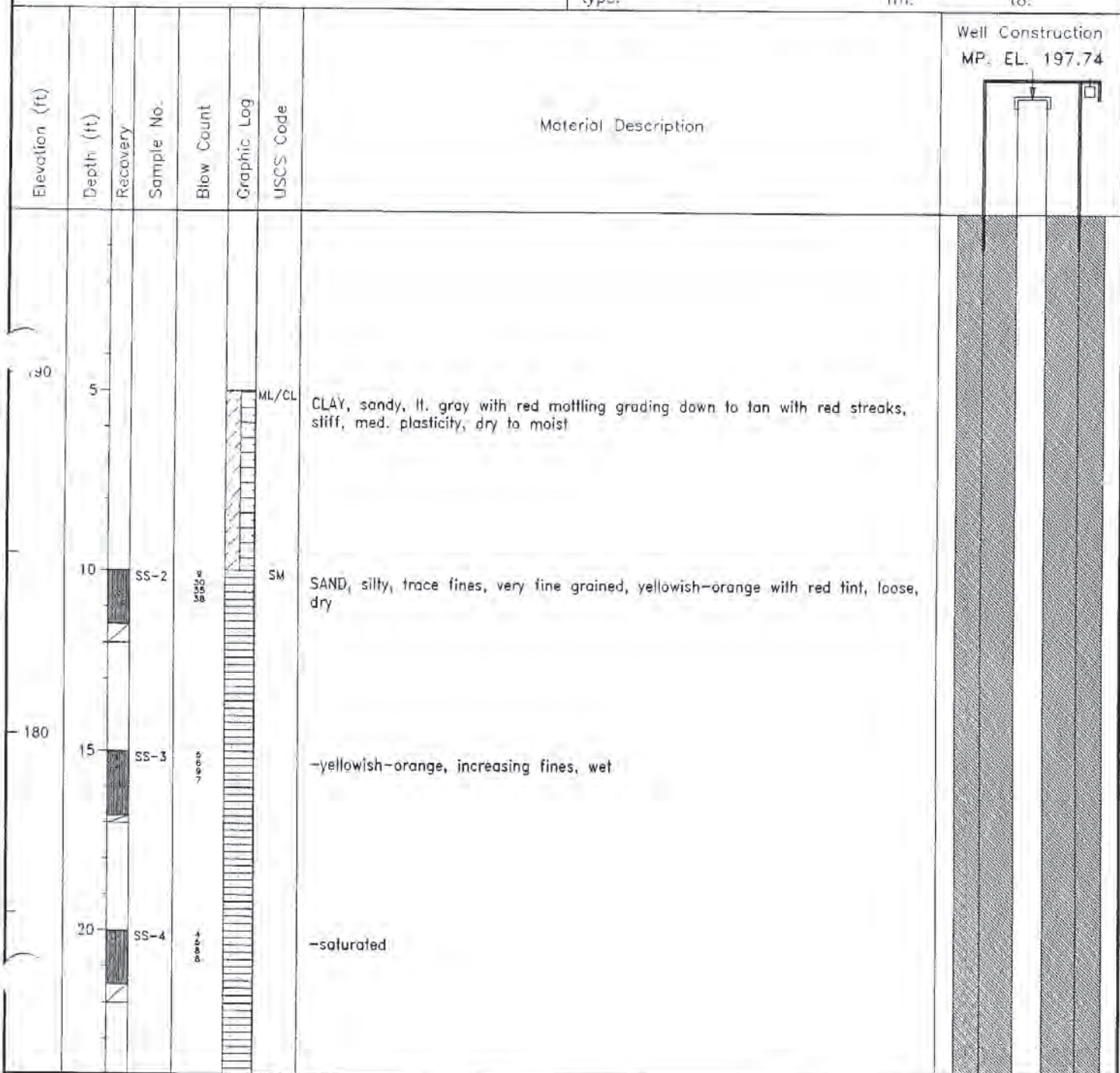
Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-14	28			stiff	
			SS-15	35		SP CH	SAND, few fines, fine grained, poorly graded, greenish gray, medium dense, saturated	
			SS-16	38			CLAY, silt or fine grained sand, dark greenish gray with light gray laminations, very stiff, med. to high plasticity, dry	
130	64		SS-17	50		CH/CL	very dark gray with gray silt laminations, stiff, medium plasticity	
			SS-18	70				
120	69		SS-19	66				
			SS-20	62		SH SH	few silt laminations, medium to high plasticity	
			SS-21	76			SAND, clayey, gray, fine grained, dense, slight plasticity, moist to wet SAND, clayey and silty, fine grained, light greenish gray, medium dense, slight plasticity, wet	
110	84		SS-22	51			less fines, wet to saturated	
			SS-23	80			moist to wet	

Site Id: 16WW20

Date(s): 06/02/97 - 06/02/97

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
	99		SS-24	63			increased sand content, wet to saturated	
	104		SS-25	55			decreased sand content	
	109		SS-26	40 51				
	114							
	119							
	124							
	129							

Sverdrup ENVIRONMENTAL		Site ID: 16WW21	
		X Coordinate: 3314469.65	Y Coordinate: 6953884.40
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 194.52'	Datum: NGVD
Date(s): 06/10/97 - 06/10/97		Total Depth: 101.00'	Measuring Point: 197.74'
Logged By: Dave Cika		Completed Depth: 100.00'	Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.2' to: 90.00'	
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 90.00' to: 100.00'	
Remarks:		Annular Fill: type: Bentonite/Cement Grout fm: 0.00' to: 83.00' type: #20-40 Silica Filter Sand fm: 83.00' to: 84.00' type: Bentonite Pellets fm: 84.00' to: 87.00' type: #20-40 Silica Filter Sand fm: 87.00' to: 88.00' type: Sand Filter fm: 88.00' to: 101.00' type: fm: to:	



Site ID: 16WW21

Date(s): 06/10/97 - 06/10/97

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
170			SS-5	10 13 18		SC	CLAY, lt. gray with red mottling, med. stiff, med. plasticity, wet, approx. 3" silty SAND, fines, yellowish-orange, very fine grained, loose, wet	
29			SS-6	10 13 18		CL	CLAY, silty, lt. brown with reddish-orange streaks, stiff, med. plasticity, moist to wet	
34			SS-7	10 13 18			-lt. gray with lt. brown streaks, med. stiff, high plasticity, moist	
39			SS-8	10 13 18		SM	SAND, fine grained, lt. brown, loose, saturated SAND, silty, lt. gray, very fine to fine grained sand, loose, saturated	
44			SS-9	10 13 18			-med. grained sand, med. gray, loose, saturated	
49			SS-10	10 13 18 20		CH	CLAY, silty, dark gray, soft, high plasticity, moist	
54			SS-11	17 27 34		SC	-increasing sand content	
59								



Site Id: 16WW21

Date(s): 06/10/97 - 06/10/97

Sample No.	Depth (ft)	Recovery	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
SS-12	64	100%	43		SM	-with clay laminations, very lean, low plasticity, dry, gray moist -sand stringers	
SS-13	69	100%	18		SW/SM	-tan sand stringers	
SS-14	74	100%	15		SM/SW	SAND, silty, clayey, subrounded grains, ll. gray, moist	
SS-15	79	100%	20		SM	-decreasing clay	
SS-16	84	100%	20		SM		
SS-17	89	100%	16		SM		
SS-18	94	100%	16		SM		
SS-19	94	100%	16		SM		

Site Id: 16WW21

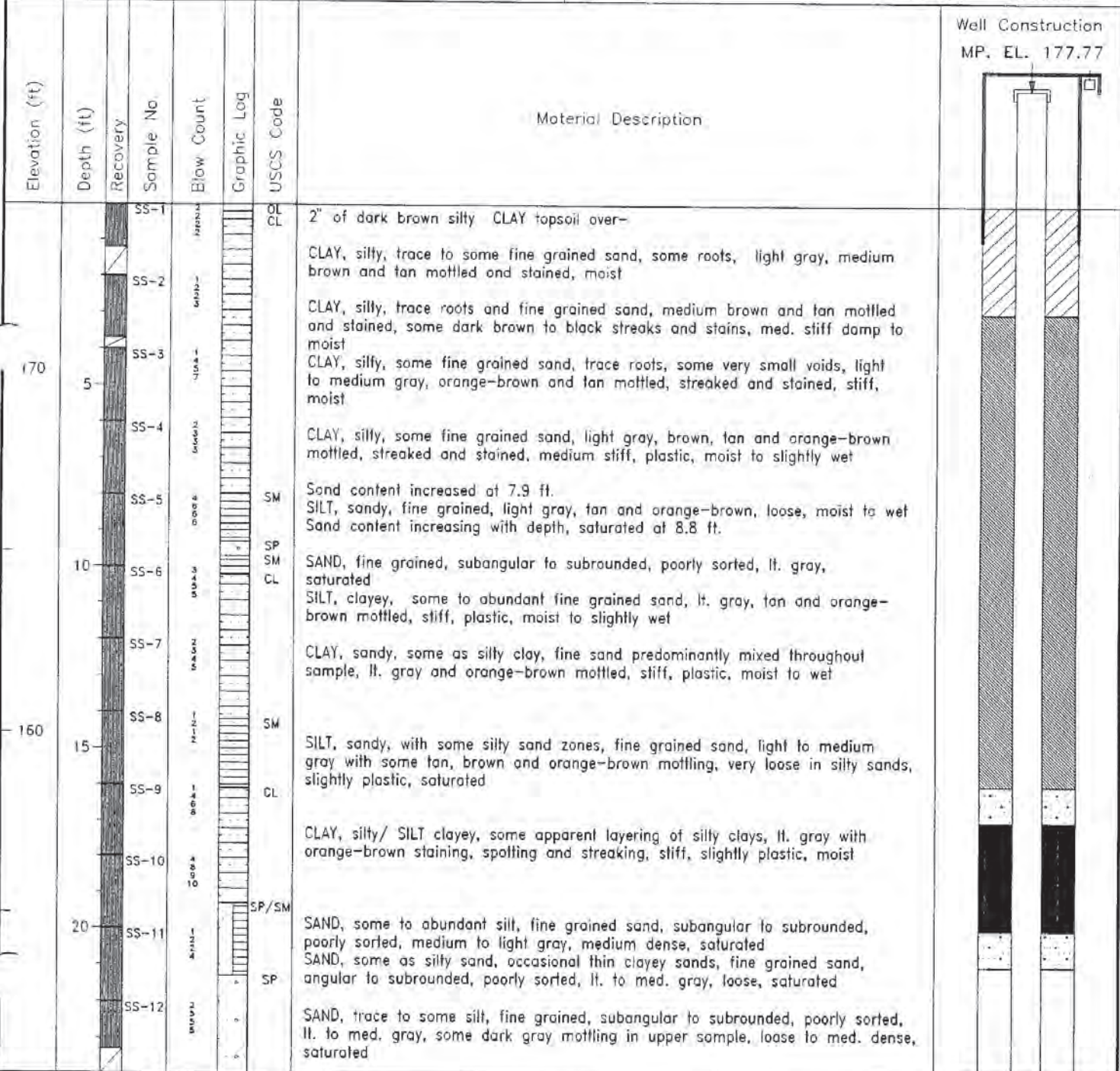
Date(s): 06/10/97 - 06/10/97

Elevation(ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
	99		SS-20	38 48		SM	-increasing clay content	
	104							
	109							
	114							
	119							
	124							
	129							

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-1	4 10		CL	CLAY, silty, trace to some fine grained sand, trace roots, med. to dark orange-brown / reddish brown, very stiff, dry	<p>MP. EL. 199.81</p>
			SS-2	6 13		SM	SAND, silty, fine grained, subangular to subrounded, poorly sorted, orange-brown some lt. brown mottling, med. dense, damp to moist	
	5		SS-3	5 12		SP	SAND, fine grained, subangular to subrounded, fair to poorly sorted, lt. gray, tan and orange-brown mottling, moist	
190			SS-4	9 17		SM	SILT, sandy, fine grained sand, lt. gray, tan, orange-brown and reddish brown, dense, dry	
			SS-5	8 12		CL	SILT, sandy, fine grained sand, some apparent layering of sand, lt. gray and tan mottled with some orange-brown streaking, staining and mottling, dense, dry to slightly damp	
	10		SS-6	10 16		SM	SILT, sandy, fine grained sand, lt. gray and tan mottled with some dark orange-brown streaks, stains and spots, trace black streaks, dense, dry	
			SS-7	8 13		CL	SILT, sandy, fine grained sand, lt. gray and tan mottled with some dark gray to black streaks and stains, dense, dry	
			SS-8	8 11		SM	CLAY, silty, some fine grained sand, tan and orange-brown with some gray mottling, trace to some very thin black streaks, hard, dry	
	15		SS-9	6 12		CL	SAND, silty, and SAND, some apparent layering, lt. gray, tan and lt. orange-brown mottling, dense, nonplastic, dry	
180			SS-10	5 12		SM	CLAY, silty, trace to some fine grained sand, med. gray, brown and orange-brown mottled, streaked and stained, some black streaking and staining, hard, damp to moist	
	20		SS-11	5 12		SM	SAND, silty, fine grained sand, subangular to subrounded, poorly sorted, lt. brown, gray and orange-brown mottled, streaked and stained, dense, damp to moist	
			SS-12	5 12		SP	SILT, sandy, fine grained, subangular to subrounded, poorly sorted, lt. gray, tan, brown and orange-brown mottled, loose, moist becoming wet to saturated at 19.8 ft. while drilling	
						CL	SILT, sandy, fine grained sand, poorly sorted, med. brown, gray and orange-brown, med. dense, wet to saturated	
						SM	SAND, some silt, fine grained, poorly sorted, med. brown and orange-brown mottled, wet to saturated	
						SP	SILT, sandy, some thin slightly clayey layers, fine grained sand, poorly sorted, lt.	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-13	15		CL SP	gray, tan and orange-brown mottled, med. dense, wet to saturated CLAY, silty, some fine sand, med. brown, gray and orange-brown mottled, some rust colored streaks and stains, stiff, plastic, moist to wet (fine sand at 25.2 ft saturated)	
170			SS-14	5		SM/SP	SAND, silty / SAND, interlayered, fine grained, lt. gray, brown and some orange-brown mottled, streaked and layered, wet to saturated	
	29		SS-15	18		SC SP	CLAY, silty, moist at 27.4 SAND, some silt, fine grained generally fairly well sorted, lt. brown, tan and some gray mottled, some orange-brown staining, dense, wet to saturated, solvent odor,	
			SS-16	3		CL	CLAY, silty, trace fine sand, lt. gray and tan mottled, some to abundant orange-brown streaking and staining, stiff, very plastic, damp to moist	
	34							
160								
	39							
	44							
150								
	49							
	54							
40								
	59							

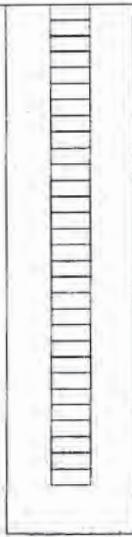
Sverdrup ENVIRONMENTAL		Site ID: 16WW23	
		X Coordinate: 3314293.98	Y Coordinate: 6953194.45
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 174.57'	Datum: NGVD
Date(s): 05/20/97 - 05/20/97		Total Depth: 35.00'	Measuring Point: 177.77'
Logged By: Dave Cika		Completed Depth: 34.00'	Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.2' to: 24.00'	
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 24.00' to: 34.00'	
Remarks:		Annular Fill:	
		type: Cement Grout fm: 0.00' to: 3.00'	
		type: Bentonite/Cement Grout fm: 3.00' to: 16.00'	
		type: #20-40 Silica Filter Sand fm: 16.00' to: 17.00'	
		type: Bentonite Pellets fm: 17.00' to: 20.00'	
		type: #20-40 Silica Filter Sand fm: 20.00' to: 21.00'	
		type: Sand Filter fm: 21.00' to: 35.00'	



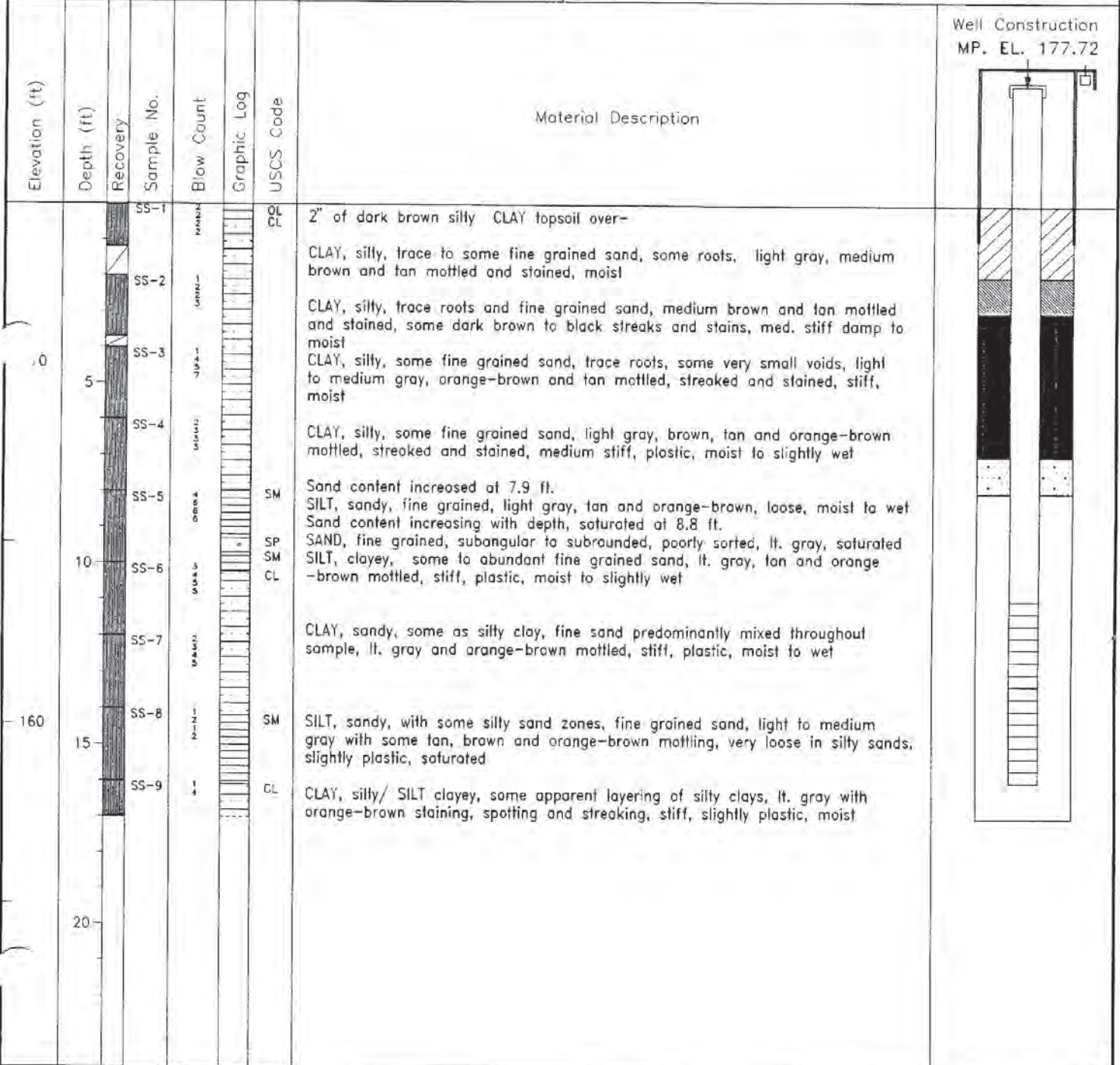
Site Id: 16WW23		Date(s): 05/20/97 - 05/20/97						
Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
150			SS-13	1			SAND, trace silt, fine grained, subangular to subrounded, poorly sorted, med. gray some dark gray in shoe, medium dense, wet/saturated	
			SS-14	1			SAND, fine grained, subangular to subrounded, poorly sorted, medium to dark gray, medium dense, unconsolidated, some stratification, saturated	
	29		SS-15	1			SAND, trace to some silt, fine grained, subangular to subrounded, poorly sorted, lt. to med. gray, some very thin dark gray to black layering, med. dense, saturated	
			SS-16	1		SP	SAND, trace to some silt, fine grained, subangular to subrounded, poorly sorted, med. gray, some dark gray mottling, saturated 1.5 in. silty/sandy clay stringer at 31.3 ft, moist	
			SS-17	1		SM	SILT, sandy, fine grained sand, grades from sand to sandy silt and back into sand, some lignite fragments, medium gray, some dark gray, dense, nonplastic, wet to saturated	
	34		SS-18	3		CL	CLAY silty, with very thin interlayered/laminated sandy silt lenses, medium to dark gray, hard, plastic, damp to moist	
140								
	39							
	44							
130								
	49							
	54							
120								
	59							

type: Cement Grout	fm: 0.00'	to: 3.00'
type: Bentonite/Cement Grout	fm: 3.00'	to: 16.00'
type: #20-40 Silica Filter Sand	fm: 16.00'	to: 17.00'
type: Bentonite Pellets	fm: 17.00'	to: 20.00'
type: #20-40 Silica Filter Sand	fm: 20.00'	to: 21.00'
type: Sand Filter	fm: 21.00'	to: 35.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction MP, EL. 177.77
170	0		SS-1			CE	2' of dark brown silty CLAY topsoil over-	
			SS-2				CLAY, silty, trace to some fine grained sand, some roots, light gray, medium brown and tan mottled and stained, moist	
	5		SS-3				CLAY, silty, trace roots and fine grained sand, medium brown and tan mottled and stained, some dark brown to black streaks and stains, med. stiff damp to moist	
			SS-4				CLAY, silty, some fine grained sand, trace roots, some very small voids, light to medium gray, orange-brown and tan mottled, streaked and stained, stiff, moist	
			SS-5			SM	CLAY, silty, some fine grained sand, light gray, brown, tan and orange-brown mottled, streaked and stained, medium stiff, plastic, moist to slightly wet	
			SS-6			SP SM CL	Sand content increased at 7.9 ft. SILT, sandy, fine grained, light gray, tan and orange-brown, loose, moist to wet Sand content increasing with depth, saturated at 8.8 ft.	
	10		SS-7				SAND, fine grained, subangular to subrounded, poorly sorted, lt. gray, saturated	
			SS-8				SILT, clayey, some to abundant fine grained sand, lt. gray, tan and orange-brown mottled, stiff, plastic, moist to slightly wet	
			SS-9			SM	CLAY, sandy, some as silty clay, fine sand predominantly mixed throughout sample, lt. gray and orange-brown mottled, stiff, plastic, moist to wet	
160	15		SS-10			CL	SILT, sandy, with some silty sand zones, fine grained sand, light to medium gray with some tan, brown and orange-brown mottling, very loose in silty sands, slightly plastic, saturated	
			SS-11			SP/SM	CLAY, silty/ SILT clayey, some apparent layering of silty clays, lt. gray with orange-brown staining, spotting and streaking, stiff, slightly plastic, moist	
	20		SS-12			SP	SAND, some to abundant silt, fine grained sand, subangular to subrounded, poorly sorted, medium to light gray, medium dense, saturated	
							SAND, some as silty sand, occasional thin clayey sands, fine grained sand, angular to subrounded, poorly sorted, lt. to med. gray, loose, saturated	
							SAND, trace to some silt, fine grained, subangular to subrounded, poorly sorted, lt. to med. gray, some dark gray mottling in upper sample, loose to med. dense, saturated	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
150			SS-13	7-7			SAND, trace silt, fine grained, subangular to subrounded, poorly sorted, med. gray some dark gray in shoe, medium dense, wet/saturated	
			SS-14	8-5			SAND, fine grained, subangular to subrounded, poorly sorted, medium to dark gray, medium dense, unconsolidated, some stratification, saturated	
	29		SS-15	8-5			SAND, trace to some silt, fine grained, subangular to subrounded, poorly sorted, lt. to med. gray, some very thin dark gray to black layering, med. dense, saturated	
			SS-16	1				
			SS-17	11 12 22 25		Sp SM SP	SAND, trace to some silt, fine grained, subangular to subrounded, poorly sorted, med. gray, some dark gray mottling, saturated 1.5 in. silty/sandy clay stringer at 31.3 ft, moist	
	34		SS-18	3 15 25 36		CL	SILT, sandy, fine grained sand, grades from sand to sandy silt and back into sand, some lignite fragments, medium gray, some dark gray, dense, nonplastic, wet to saturated	
140							CLAY silty, with very thin interlayered/laminated sandy silt lenses, medium to dark gray, hard, plastic, damp to moist	
	39							
	44							
130								
	49							
	54							
120								
	59							

Sverdrup ENVIRONMENTAL		Site ID: 16WW24
		X Coordinate: 3314292.59 Y Coordinate: 6953202.89
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 174.42' Datum: NGVD
te(s): 05/21/97 - 05/21/97		Total Depth: 17.00' Measuring Point: 177.72'
Logged By: Dave Cika		Completed Depth: 16.00' Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.3' to: 11.00'
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 11.00' to: 16.00'
Remarks:		Annular Fill: type: Cement Grout fm: 0.00' to: 2.00' type: Bentonite/Cement Grout fm: 2.00' to: 3.00' type: Bentonite Pellets fm: 3.00' to: 7.00' type: #20-40 Silica Filler Sand fm: 7.00' to: 8.00' type: Sand Filter fm: 8.00' to: 17.00' type: fm: to:



X Coordinate: 3314249.03

Y Coordinate: 6953502.29

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 185.14'

Datum: NGVD

Date(s): 06/19/97 - 06/19/97

Total Depth: 50.00'

Measuring Point: 188.39'

Logged By: Dave Cika

Completed Depth: 49.00'

Static Water Level:

Contractor: Philip Environmental

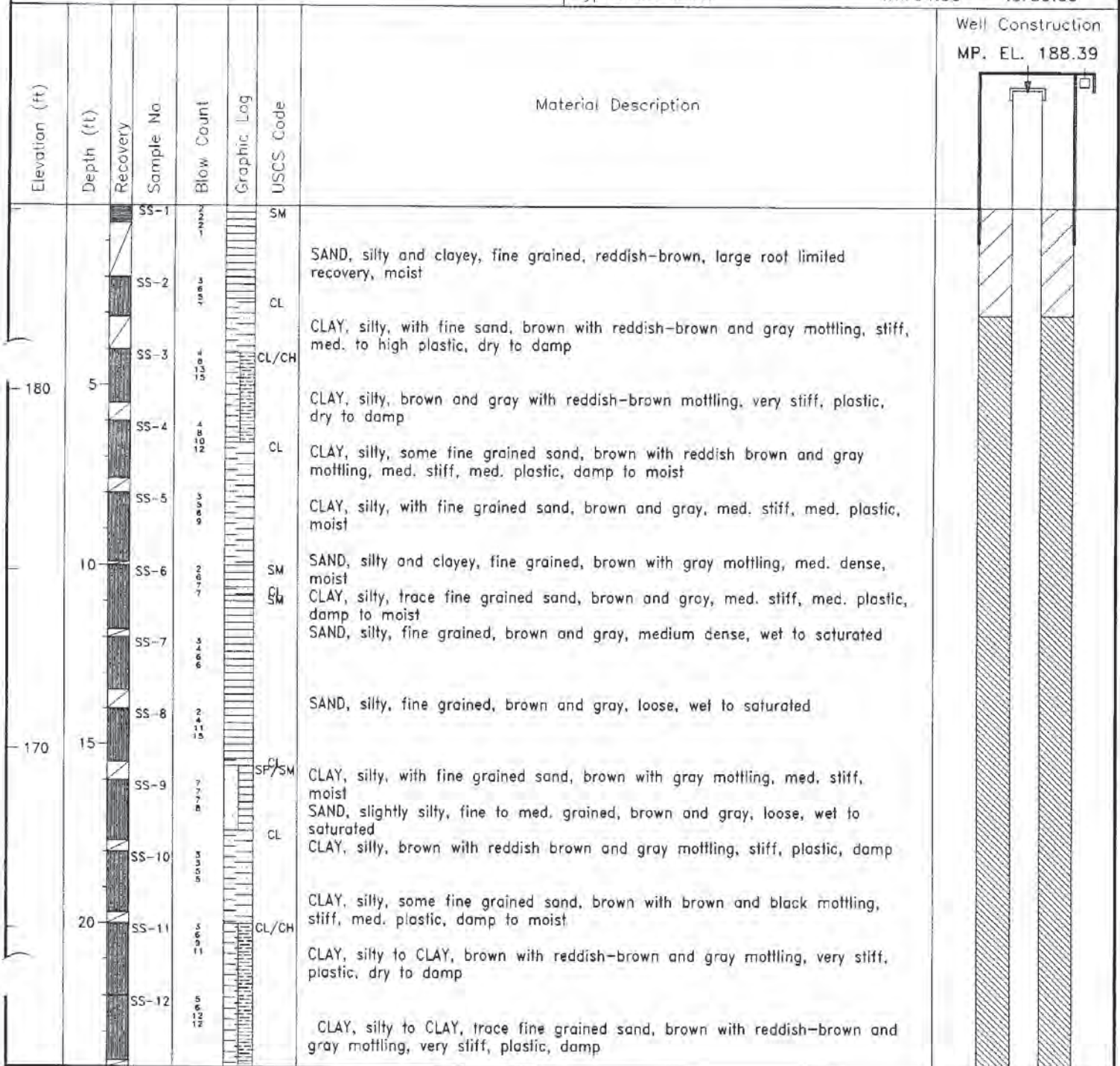
Well Casing: type: SS dia: 4.00in fm: -3.3' to: 39.00'

Drilling Method: Hollow Stem Auger

Screens:
type: Wire-wrap size: 0.010in dia: 4.00in fm: 39.00' to: 49.00'

Remarks:

Annular Fill:
type: Cement Grout fm: 0.00' to: 3.00'
type: Bentonite/Cement Grout fm: 3.00' to: 29.00'
type: #20-40 Silica Filter Sand fm: 29.00' to: 30.00'
type: Bentonite Pellets fm: 30.00' to: 33.00'
type: #20-40 Silica Filter Sand fm: 33.00' to: 34.00'
type: Sand Filter fm: 34.00' to: 50.00'



Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
160			SS-13	10				
			SS-14	10			CLAY, slightly silty, brown with reddish-brown and gray mottling, very stiff, plastic, dry to damp	
29			SS-15	10				
			SS-16	10			CLAY, slightly silty, brown and gray, very stiff, plastic, dry to damp	
			SS-17	10				
34			SS-18	10		CL SM	CLAY, silty, with fine grained sand, gray, stiff, med. plastic, moist	
150			SS-19	10		SP/SM	SAND, silty and clayey, fine grained, gray, loose to med. dense, moist to wet	
			SS-20	10			SAND, silty, fine grained, gray, loose to med. dense, wet to saturated	
39			SS-21	10		SP		
			SS-22	10			SAND, slightly silty, fine grained, gray, loose to med. dense, wet to saturated	
44			SS-23	10				
140			SS-24	10			SAND, slightly silty, fine grained, gray with black mottling, loose to med. dense, wet to saturated	
			SS-25	10		SM/SP SM	SAND, slightly silty, fine grained with lignite fragments, gray with black stains from the lignite, loose, wet to saturated	
49				10		CL/CH	SAND, silty and clayey, fine grained, gray to dark gray, loose, wet to saturated SAND, silty and clayey, fine grained, gray to dark gray, med. dense, wet to saturated CLAY, silty, with thin layers of silt and fine sand, dark gray, very stiff, plastic, damp	
54								
130								
59								

X Coordinate: 3314254.74

Y Coordinate: 6953507.89

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 185.01'

Datum: NGVD

Date(s): 06/24/97 - 06/24/97

Total Depth: 18.50'

Measuring Point: 188.48'

Logged By: Sandra Rudolph

Completed Depth: 17.50'

Static Water Level:

Contractor: Philip Environmental

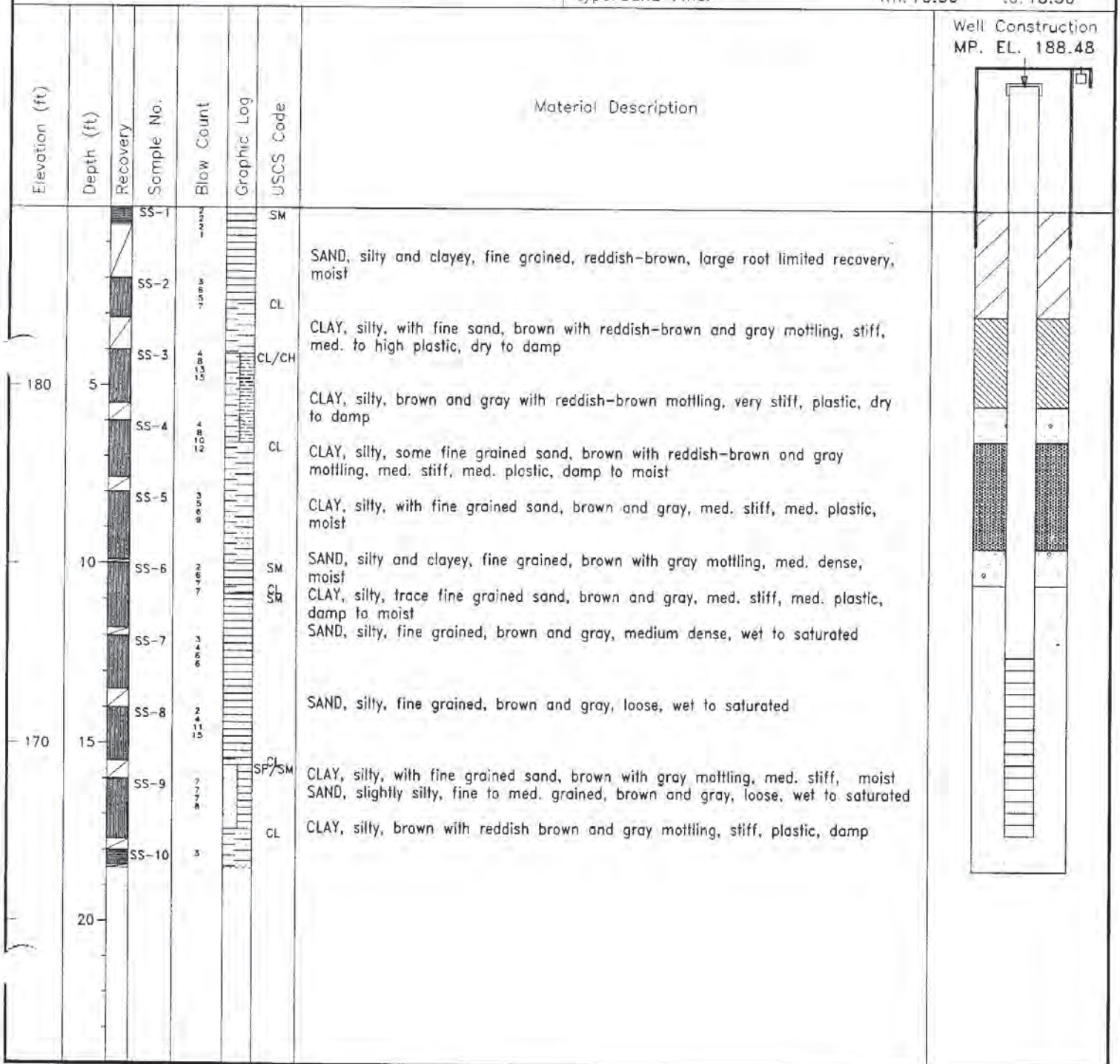
Well Casing: type: SS dia: 4.00in fm: -3.5' to: 12.50'

Drilling Method: Hollow Stem Auger

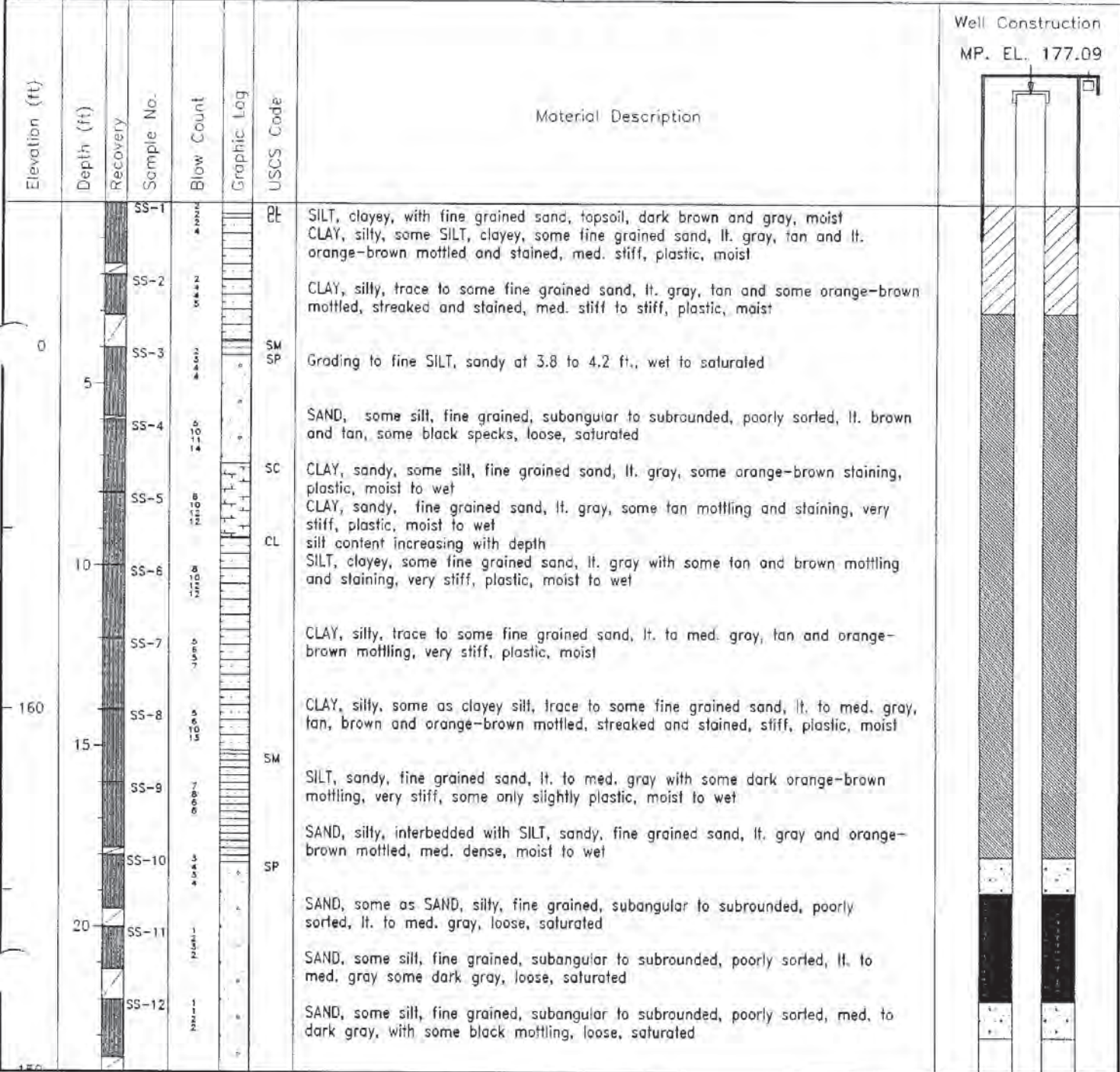
Screens:
type: Wire-wrap size: 0.010in dia; 4.00in fm: 12.50' to: 17.50'

Remarks:

Annular Fill:
type: Cement Grout fm: 0.00' to: 3.00'
type: Bentonite/Cement Grout fm: 3.00' to: 5.50'
type: #20-40 Silica Filter Sand fm: 5.50' to: 6.50'
type: Bentonite Pellets fm: 6.50' to: 9.50'
type: #20-40 Silica Filter Sand fm: 9.50' to: 10.50'
type: Sand Filter fm: 10.50' to: 18.50'

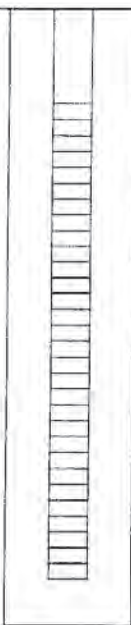


Sverdrup ENVIRONMENTAL		Site ID: 16WW27
Location: LONGHORN ARMY AMMUNITION PLANT		X-Coordinate: 3314543.13 Y-Coordinate: 6953338.10
Date(s): 05/18/97 - 05/18/97		Elevation: 173.99' Datum: NGVD
Logged By: Dave Cika		Total Depth: 50.00' Measuring Point: 177.09'
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.1' to: 26.00'
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 26.00' to: 36.00'
Remarks:		Annular Fill: type: Cement Grout fm: 0.00' to: 3.00' type: Bentonite/Cement Grout fm: 3.00' to: 18.00' type: #20-40 Silica Filter Sand fm: 18.00' to: 19.00' type: Bentonite Pellets fm: 19.00' to: 22.00' type: #20-40 Silica Filter Sand fm: 22.00' to: 23.00' type: Sand Filter fm: 23.00' to: 37.00'



Site Id: 16WW27

Date(s): 05/18/97 - 05/18/97

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-13				SAND, some silt and fine lignite fragments, subangular to subrounded, poorly sorted, dark gray with abundant black specks, very loose, unconsolidated, saturated	
			SS-14				sand content decreasing / silt and clay content increasing from 26.5 - 27.5 ft	
	29		SS-15			CL SP	SILT, clayey, some fine grained sand, lignite fragments in shoe, dark gray, soft, slightly plastic, moist to wet	
			SS-16			SP	CLAY, silty stringer at 28.9 ft to 29.1 ft	
			SS-17				SAND, some silt, trace lignite, fine grained, subangular to subrounded, poorly sorted, med. gray, loose, saturated	
			SS-18				SAND, some silt (abundant from 30.6 ft to 31.3 ft), fine grained, subangular to subrounded, med. gray, med. dense (loose in shoe), saturated	
140	34		SS-19				SAND, trace to some silt, subangular to subrounded, poorly sorted, lt. to predominately med. gray, loose to med. dense, saturated	
			SS-20			CL SP	SAND, some silt and lignite fragments layered in spoon, fine grained, subangular to subrounded, poorly sorted, med. gray, medium dense, saturated	
	39		SS-21			SP	CLAY, silty, with abundant very thin sandy silt layers, horizontally laminated layers, lt. to med. gray, hard, damp to moist	
			SS-22				SAND, fine grained, subangular to subrounded, poorly sorted, med. gray, very dense, saturated	
			SS-23			SM	silt content increasing with depth	
			SS-24				SAND, silty / SILT, sandy, interlayered, fine grained sand, med. gray, very dense, non-plastic, wet to saturated	
130	44		SS-25				SILT, sandy / SAND, silty, thin to very thin interlayered, fine grained sand, med. gray with some dark gray brown very thin layers, very dense, moist to predominantly wet to saturated	
			SS-26				SAND, silty, some sandy silt, fine grained sand, med. gray, very dense, wet to saturated	
			SS-27					
			SS-28					
			SS-29					
			SS-30					
			SS-31					
	49		SS-32				SAND, silty / SILT, sandy, fine grained sand, med. gray, very dense, saturated	
			SS-33					
			SS-34					
			SS-35					
			SS-36					
			SS-37					
			SS-38					
			SS-39					
			SS-40					
			SS-41					
			SS-42					
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			SS-197					
			SS-198					
			SS-199					
			SS-200					

X Coordinate: 3314545.32

Y Coordinate: 6953330.73

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 173.76'

Datum: NGVD

Date(s): 05/19/97 - 05/19/97

Total Depth: 22.00'

Measuring Point: 176.67'

Logged By: Dave Cika

Completed Depth: 21.00'

Static Water Level:

Contractor: Philip Environmental

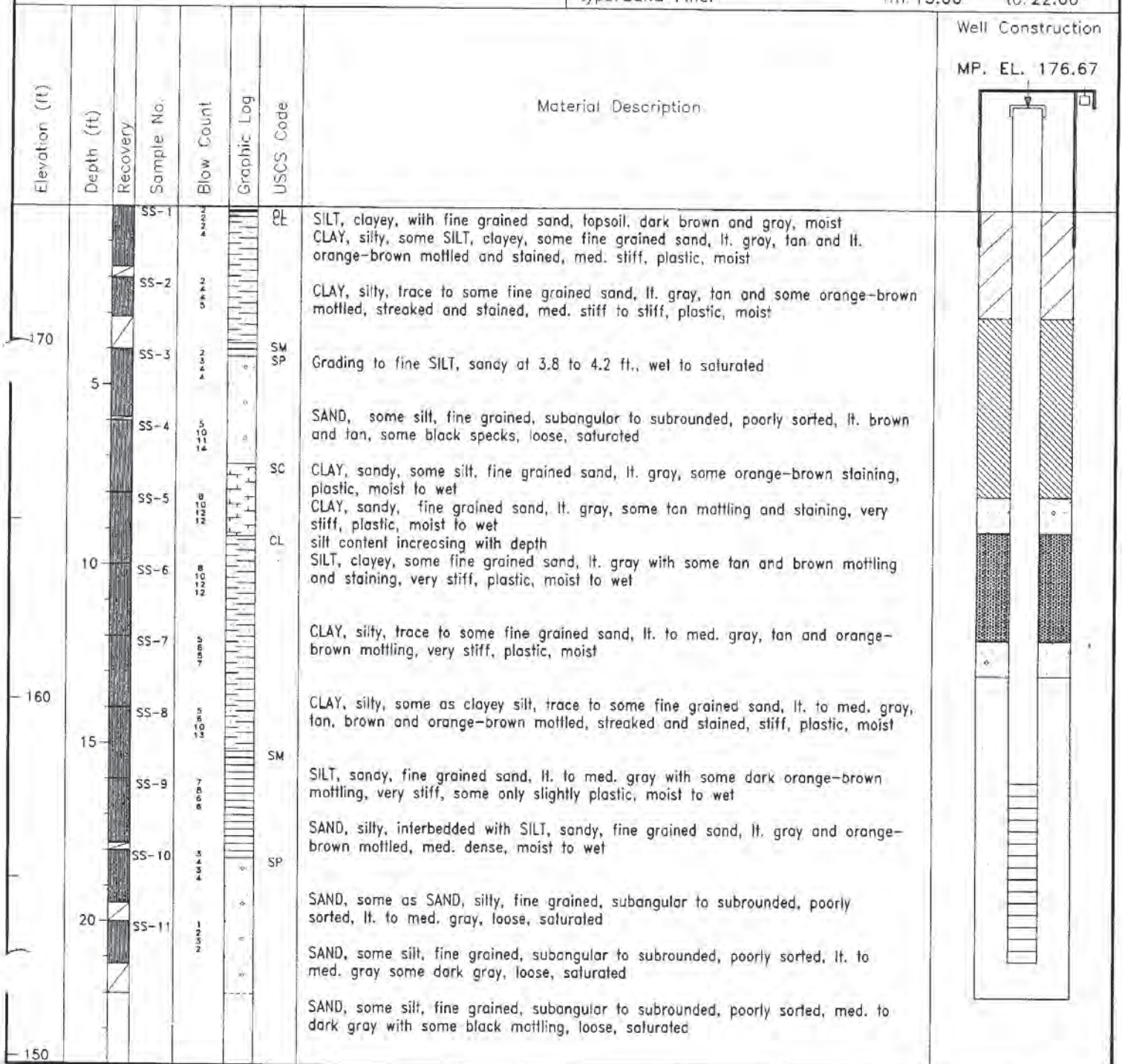
Well Casing: type: SS dia: 4.00in fm: -2.9' to: 16.00'

Drilling Method: Hollow Stem Auger

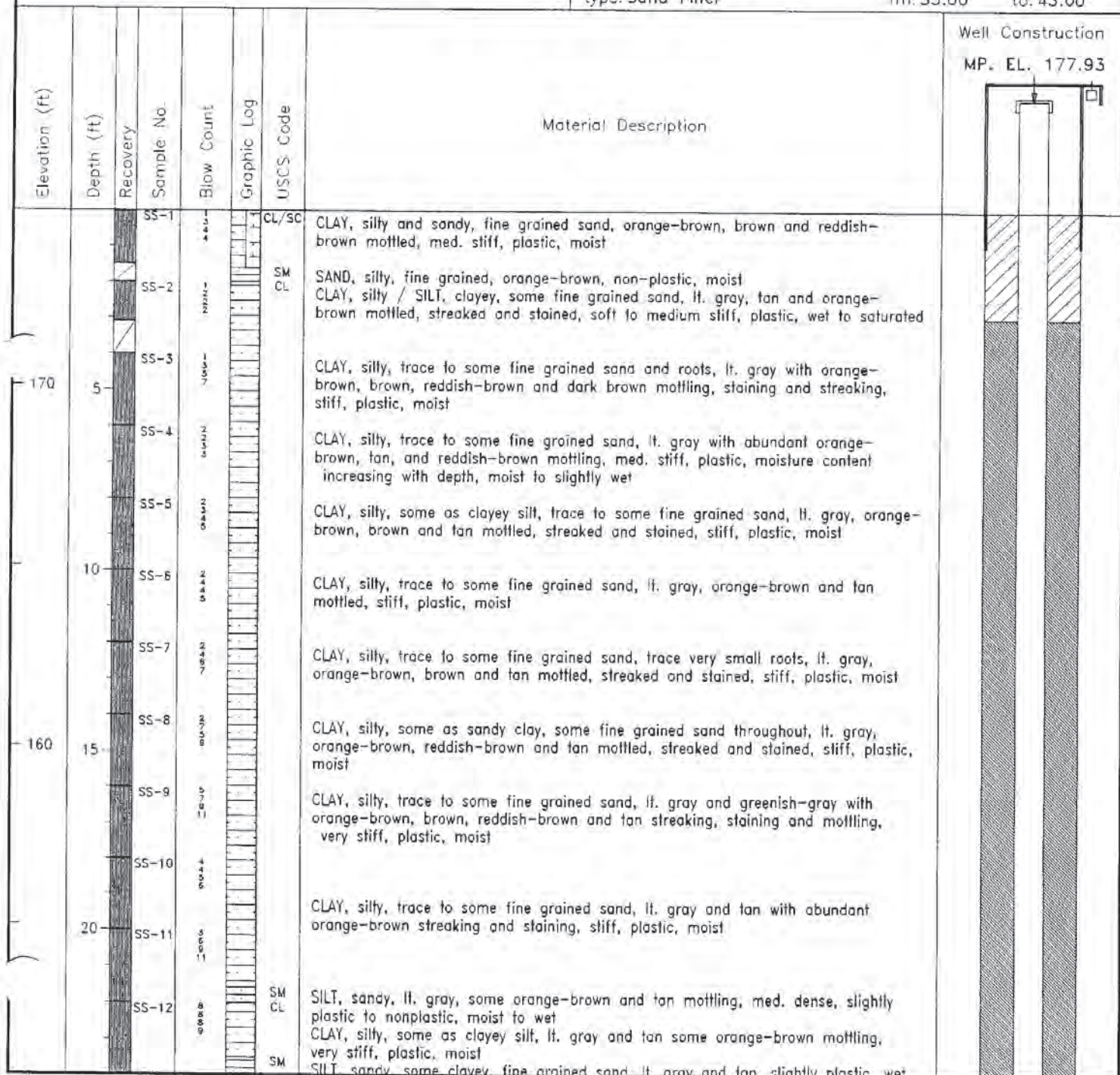
Screens:
type: Wire-wrap size: 0.010in dia: 4.00in fm: 16.00' to: 21.00'

Remarks:

Annular Fill:
type: Cement Grout fm: 0.00' to: 3.00'
type: Bentonite/Cement Grout fm: 3.00' to: 8.00'
type: #20-40 Silica Filter Sand fm: 8.00' to: 9.00'
type: Bentonite Pellets fm: 9.00' to: 12.00'
type: #20-40 Silica Filter Sand fm: 12.00' to: 13.00'
type: Sand Filter fm: 13.00' to: 22.00'



Sverdrup ENVIRONMENTAL		Site ID: 16WW29	
		X Coordinate: 3314526.08	Y Coordinate: 6953593.59
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 174.86'	Datum: NGVD
Date(s): 05/22/97 - 05/22/97		Total Depth: 43.00'	Measuring Point: 177.93'
Logged By: Dave Cika		Completed Depth: 42.00'	Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.1' to: 37.00'	
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 37.00' to: 42.00'	
Remarks:		Annular Fill:	
		type: Cement Grout fm: 0.00' to: 3.00' type: Bentonite/Cement Grout fm: 3.00' to: 29.00' type: #20-40 Silica Filter Sand fm: 29.00' to: 30.00' type: Bentonite Pellets fm: 30.00' to: 34.00' type: #20-40 Silica Filter Sand fm: 34.00' to: 35.00' type: Sand Filter fm: 35.00' to: 43.00'	



Elevation(ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-12			SM CL	SILT, sandy, lt. gray, some orange-brown and tan mottling, med. dense, slightly plastic to nonplastic, moist to wet	
			SS-13			SM	CLAY, silty, some as clayey silt, lt. gray and tan some orange-brown mottling, very stiff, plastic, moist	
150						SP	SILT, sandy, some clayey, fine grained sand, lt. gray and tan, slightly plastic, wet to saturated	
			SS-14			SM SP	SAND, some to abundant silt, fine grained, subangular to subrounded, very poorly sorted, lt. gray, some tan mottling, loose, non-plastic, saturated	
	29		SS-15				SAND, some to abundant silt, fine grained, subangular to subrounded, very poorly sorted, lt. gray to some lt. greenish-gray, very loose sand, saturated	
			SS-16			SC	SAND, clayey, fine grained, subangular to subrounded, very poorly sorted, med. greenish-gray, some rust colored mottling, slightly plastic in shoe, wet (in shoe)	
			SS-17				CLAY, sandy, fine grained sand, very poorly sorted, med. greenish-gray and med. brown mottled, slightly plastic, moist to wet	
	34		SS-18			CL	CLAY, sandy, fine grained sand, med. greenish-gray to lt. gray at 33.6 ft., very stiff, slightly plastic to plastic at 33.8 ft. (and in shoe), moist	
140			SS-19			SP	CLAY, silty, some fine grained sand, lt. to med. gray, some orange-brown mottling, very stiff, plastic, moist	
			SS-20			SP	SAND, trace to some silt, trace lignite fragments, subangular to subrounded, poorly sorted, med. to some as dark gray, medium dense, wet to saturated	
	39		SS-21			SC	SAND, some silt with abundant lignite below 37.4 ft. as seams/layers, fine grained, subangular to subrounded, very poorly sorted, med. gray, med. dense, saturated	
			SS-22			SP	SAND, clayey, with abundant lignite, fine grained, med. to dark gray, saturated	
						CL/CH	SAND, some silt, abundant lignite in very thin seams, fine grained, poorly sorted, med. to dark gray, saturated	
	44						CLAY, silty, some CLAY, with very thin laminated/interlayered lt. gray silt lenses, med. to dark gray, hard, very plastic, damp to moist	
130								
	49							
	54							
120								

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 174.98'

Y Coordinate: 6953600.53

Date(s): 05/28/97 - 05/28/97

Total Depth: 31.00'

Datum: NGVD

Logged By: Dave Cika

Completed Depth: 30.00'

Measuring Point: 178.11'

Contractor: Philip Environmental

Well Casing: type: SS dia: 4.00in fm: -3.1' to: 25.00'

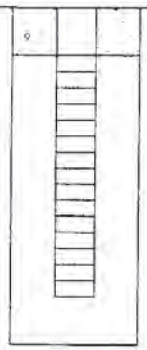
Drilling Method: Hollow Stem Auger

Screens:
type: Wire-wrap size: 0.010in dia: 4.00in fm: 25.00' to: 30.00'

Remarks:

Annular Fill:
type: Cement Grout fm: 0.00' to: 3.00'
type: Bentonite/Cement Grout fm: 3.00' to: 17.00'
type: #20-40 Silica Filter Sand fm: 17.00' to: 18.00'
type: Bentonite Pellets fm: 18.00' to: 21.00'
type: #20-40 Silica Filter Sand fm: 21.00' to: 25.00'
type: Sand Filter fm: 25.00' to: 31.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
170	5		SS-1			CL/SC	CLAY, silty and sandy, fine grained sand, orange-brown, brown and reddish-brown mottled, med. stiff, plastic, moist	
			SS-2			SM CL	SAND, silty, fine grained, orange-brown, non-plastic, moist CLAY, silty / SILT, clayey, some fine grained sand, lt. gray, tan and orange-brown mottled, streaked and stained, soft to medium stiff, plastic, wet to saturated	
			SS-3				CLAY, silty, trace to some fine grained sand and roots, lt. gray with orange-brown, brown, reddish-brown and dark brown mottling, staining and streaking, stiff, plastic, moist	
			SS-4				CLAY, silty, trace to some fine grained sand, lt. gray with abundant orange-brown, tan, and reddish-brown mottling, med. stiff, plastic, moisture content increasing with depth, moist to slightly wet	
			SS-5				CLAY, silty, some as clayey silt, trace to some fine grained sand, lt. gray, orange-brown, brown and tan mottled, streaked and stained, stiff, plastic, moist	
	10		SS-6				CLAY, silty, trace to some fine grained sand, lt. gray, orange-brown and tan mottled, stiff, plastic, moist	
			SS-7				CLAY, silty, trace to some fine grained sand, trace very small roots, lt. gray, orange-brown, brown and tan mottled, streaked and stained, stiff, plastic, moist	
160	15		SS-8				CLAY, silty, some as sandy clay, some fine grained sand throughout, lt. gray, orange-brown, reddish-brown and tan mottled, streaked and stained, stiff, plastic, moist	
			SS-9				CLAY, silty, trace to some fine grained sand, lt. gray and greenish-gray with orange-brown, brown, reddish-brown and tan streaking, staining and mottling, very stiff, plastic, moist	
	20		SS-10				CLAY, silty, trace to some fine grained sand, lt. gray and tan with abundant orange-brown streaking and staining, stiff, plastic, moist	
			SS-11				CLAY, silty, trace to some fine grained sand, lt. gray and tan with abundant orange-brown streaking and staining, stiff, plastic, moist	
			SS-12			SM CL SM	SILT, sandy, lt. gray, some orange-brown and tan mottling, med. dense, slightly plastic to nonplastic, moist to wet CLAY, silty, some as clayey silt, lt. gray and tan some orange-brown mottling, very stiff, plastic, moist SILT, sandy, some clayey, fine grained sand, lt. gray and tan, slightly plastic, wet	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
150			SS-13			SP	to saturated SAND, some to abundant silt, fine grained, subangular to subrounded, very poorly sorted, lt. gray, some tan mottling, loose, non-plastic, saturated	
			SS-14			SM SP	SAND, some to abundant silt, fine grained, subangular to subrounded, very poorly sorted, lt. gray to some lt. greenish-gray, very loose sand, saturated	
29			SS-15				SAND, clayey, fine grained, subangular to subrounded, very poorly sorted, med. greenish-gray, some rust colored mottling, slightly plastic in shoe, wet (in shoe)	
			SS-16			SC	CLAY, sandy, fine grained sand, very poorly sorted, med. greenish-gray and med. brown mottled, slightly plastic, moist to wet	
34								
140								
39								
44								
130								
49								
54								
120								
59								

X Coordinate: 3314323.88

Y Coordinate: 6954133.64

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 199.66'

Datum: NGVD

Date(s): 05/30/97 - 05/30/97

Total Depth: 50.00'

Measuring Point: 202.44'

Logged By: Dave Cika

Completed Depth: 49.00'

Static Water Level:

Contractor: Philip Environmental

Well Casing: type: SS dia: 4.00in fm: -2.8' to: 39.00'

Drilling Method: Hollow Stem Auger

Screens:

type: Wire-wrap size: 0.010in dia: 4.00in fm: 39.00' to: 49.00'

Remarks:

Annular Fill:

type: Cement Grout fm: 0.00' to: 3.00'

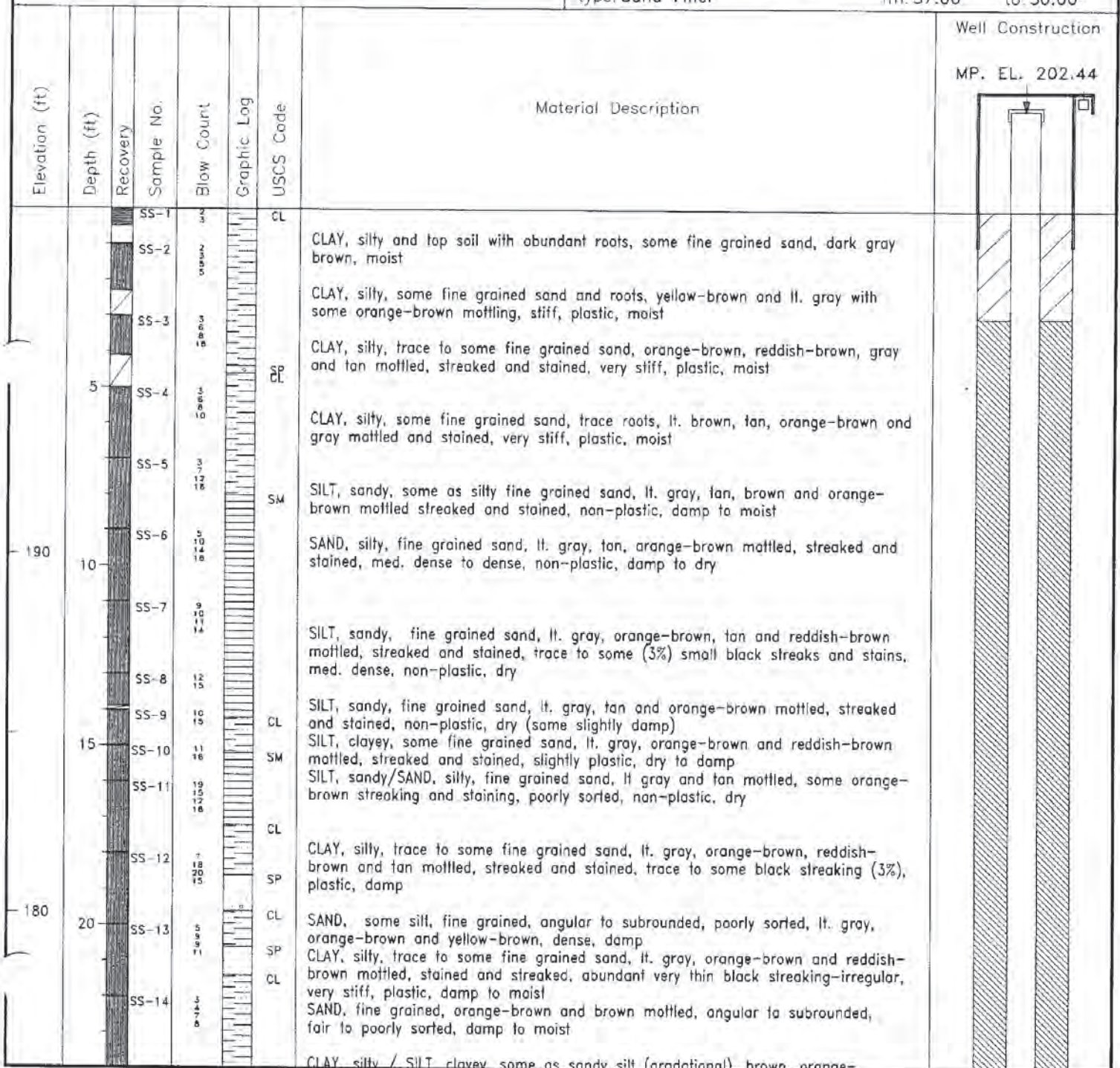
type: Bentonite/Cement Grout fm: 3.00' to: 32.00'

type: #20-40 Silica Filter Sand fm: 32.00' to: 33.00'

type: Bentonite Pellets fm: 33.00' to: 36.00'

type: #20-40 Silica Filter Sand fm: 36.00' to: 37.00'

type: Sand Filter fm: 37.00' to: 50.00'



Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
170		SS-15			SM	brown and gray mottled, micro micaceous, stiff, becoming less plastic with depth, moist to slightly wet	
		SS-16			CL	SAND, silty, some silt to fine grained sand, poorly sorted, med. gray and orange-brown mottled, med. dense sand, non-plastic, moist to wet	
		SS-17			SM	SILT, sandy, fine grained sand, some as 1 in. silty sand lenses, brown, orange-brown and lt. gray mottled, slightly plastic, wet to saturated	
		SS-18			CL SP	SAND, silty/SILT, sandy, some clayey, fine grained sand, orange-brown and lt. gray mottled, slightly plastic, wet and saturated	
		SS-19			CL	SAND, slightly silty, slightly clayey in base of spoon, fine grained, subangular to subrounded, poorly sorted, med. brown to orange-brown mottled, med. dense, wet to saturated	
34		SS-20			SM CL	CLAY, silty, trace to abundant fine grained sand, lt. gray, orange-brown and brown mottled, stiff, plastic, moist. SAND, silty, at 33.4 ft., wet to saturated	
		SS-21			SP	CLAY, silty / CLAY, sandy, some to abundant fine grained sand, lt. gray and orange-brown mottled, very stiff, plastic, moist	
		SS-22				SAND, some silt, fine grained, subangular to subrounded, lt. brown and tan, some orange-brown mottled, med. dense, poorly sorted, wet to saturated	
39		SS-23				SAND, some to abundant silt, subangular to subrounded, poorly sorted, lt. to med. brown and gray, med. dense, wet to saturated	
		SS-24				SAND, some silt, fine grained, subangular to subrounded, poorly sorted, lt. brown and gray mottled, med. dense, wet and saturated	
44		SS-25				SAND, trace to some silt, fine grained, subangular to subrounded, fair to poorly sorted, lt. brown and gray with some slight orange-brown mottling, med. dense, wet to saturated	
		SS-26				SAND, trace to some silt, fine grained, subangular to subrounded, poorly sorted, lt. gray and brown, some yellow-brown mottling, med. dense, wet to saturated	
49		SS-27				SAND, trace silt, fine grained, subangular to subrounded, fairly well sorted, lt. gray brown, very dense, wet to saturated	
54					CL/CH	CLAY/CLAY, silty, trace fine grained sand, with abundant very thin silt layers-laminated and generally uniform, med. to dark gray, very stiff, damp (some lignite above clay and base of sand)	
59							

X Coordinate: 3314330.44

Y Coordinate: 6954128.37

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 199.52'

Datum: NGVD

Date(s): 05/30/97 - 05/30/97

Total Depth: 33.00'

Measuring Point: 202.53'

Logged By: Dave Cika

Completed Depth: 32.00'

Static Water Level:

Contractor: Philip Environmental

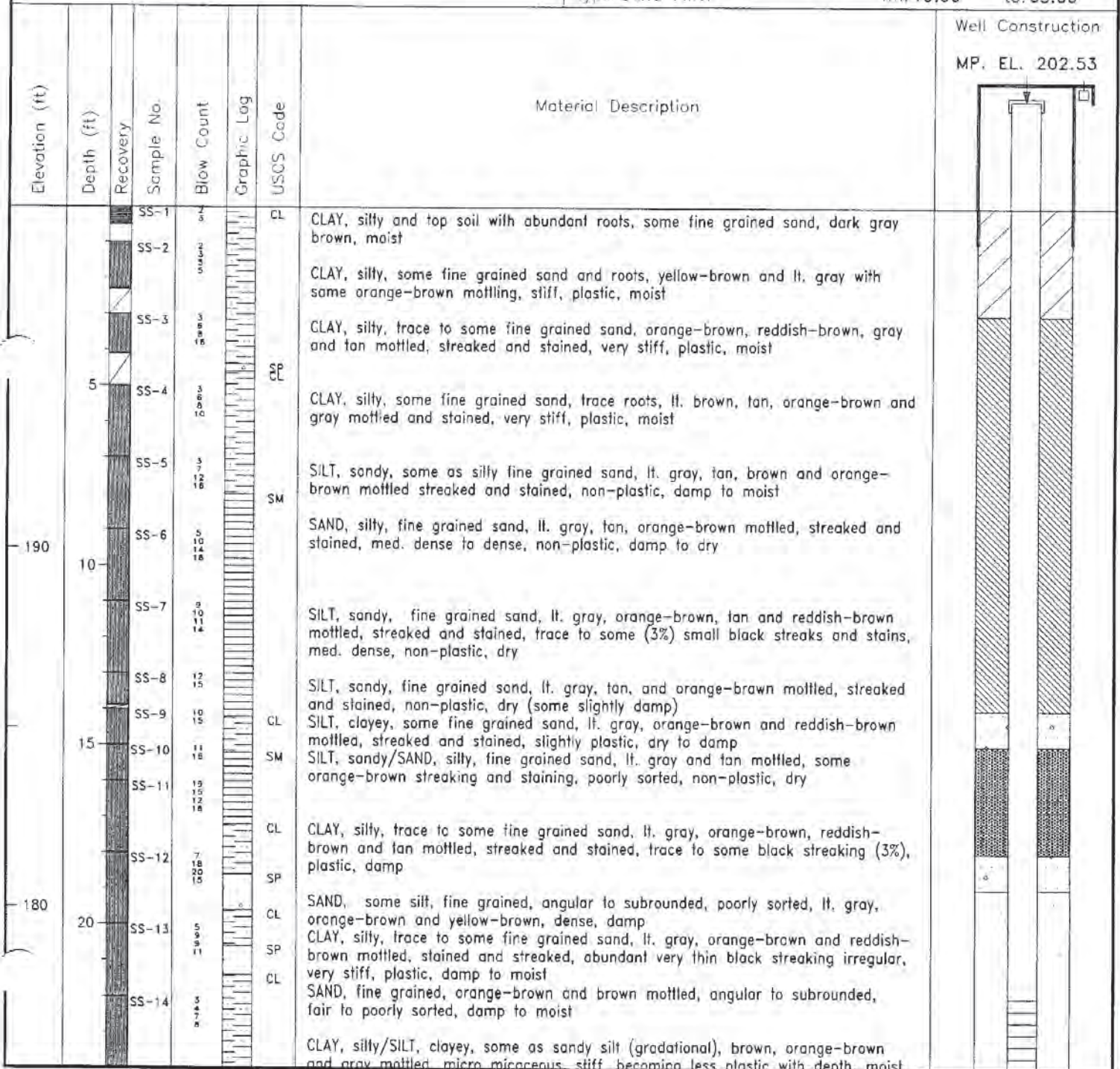
Well Casing: type: SS dia: 4.00in fm: -3.0' to: 22.00'

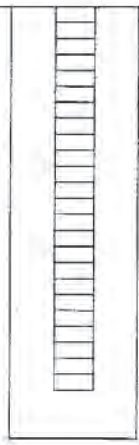
Drilling Method: Hollow Stem Auger

Screens:
type: Wire-wrap size: 0.010india: 4.00in fm: 22.00' to: 32.00'

Remarks:

Annular Fill:
type: Cement Grout fm: 0.00' to: 3.00'
type: Bentonite/Cement Grout fm: 3.00' to: 14.00'
type: #20-40 Silica Filter Sand fm: 14.00' to: 15.00'
type: Bentonite Pellets fm: 15.00' to: 18.00'
type: #20-40 Silica Filter Sand fm: 18.00' to: 19.00'
type: Sand Filter fm: 19.00' to: 33.00'



Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-15			SM	to slightly wet	
			SS-16			CL	SAND, silty, some silt to fine grained sand, poorly sorted, med. gray and orange-brown mottled, med. dense sand, non-plastic, moist to wet	
			SS-17			SM	SILT, sandy, fine grained sand, some as 1 in. silty sand lenses, brown, orange-brown and lt. gray mottled, slightly plastic, wet to saturated	
170	29		SS-18			CL SP	SAND silty / SILT, sandy, some clayey, fine grained sand, orange brown and lt. gray mottled, slightly plastic, wet and saturated	
			SS-19			CL	SAND, slightly silty, slightly clayey in base of spoon, fine grained, subangular to subrounded, poorly sorted, med. brown to orange-brown mottled, med. dense, wet to saturated	
	34						CLAY, silty, trace to abundant fine grained sand, lt. gray, orange-brown and brown mottled, stiff, plastic, moist	
	39							
160								
	44							
	49							
150								
	54							
	59							
140								

Location: LONGHORN ARMY AMMUNITION PLANT

X Coordinate: 3314117.18

Y Coordinate: 6954043.60

Date(s): 06/04/97 - 06/11/97

Elevation: 199.61'

Datum: NGVD

Logged By: Sandra Rudolph

Total Depth: 50.00'

Measuring Point: 202.63'

Contractor: Philip Environmental

Completed Depth: 49.00'

Static Water Level:

Drilling Method: Hollow Stem Auger

Well Casing: type: SS dia: 4.00in fm: -3.0' to: 39.00'

Remarks:

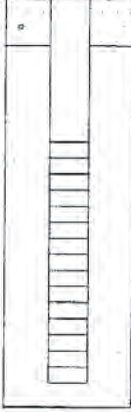
Screens:
type: Wire-wrap size: 0.010in dia: 4.00in fm: 39.00' to: 49.00'

Annular Fill:
type: Cement Grout fm: 0.00' to: 3.00'
type: Bentonite/Cement Grout fm: 3.00' to: 31.00'
type: #20-40 Silica Filter Sand fm: 31.00' to: 32.00'
type: Bentonite Pellets fm: 32.00' to: 36.00'
type: #20-40 Silica Filter Sand fm: 36.00' to: 37.00'
type: Sand Filter fm: 37.00' to: 50.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
199.61	0		SS-1	1		CL	CLAY, silty, grayish-brown mottled, some roots	
	1		SS-2	2		CL	CLAY, silty, grayish-brown with dark orange mottling, stiff, damp and moist	
	2		SS-3	3		CL	CLAY, silty, reddish-brown with gray mottling, very stiff, plastic, damp	
	3		SS-4	4		SM	SAND, silty, fine grained sand, brown, damp to moist	
	4		SS-5	5		CL	CLAY, silty, brownish gray, very stiff, damp	
	5		SS-5	6		SP	SAND, silty, fine grained sand, brown, damp	
	6		SS-5	7		CL	CLAY, silty, brownish gray, very stiff, damp	
	7		SS-5	8		ML	SAND, silt, gray with brown mottling, damp	
	8		SS-5	9		SM	SILT, sandy, lt. gray, dry	
	9		SS-5	10		CL	SAND, silty, brown, dry	
190	10		SS-6	11		SP	CLAY, silty, with fine grained sand, brown, damp	
	11		SS-6	12		ML	SAND, some silt, fine to med. grained, brown, dry	
	12		SS-7	13		CL	SILT, with fine grained sand, gray with brown mottling, stiff, dry	
	13		SS-7	14		CL		
	14		SS-8	15		SP	CLAY, silty, grayish-brown with black reddish-brown mottling, stiff, damp	
	15		SS-8	16		SM	SAND, some silt, fine grained, lt. gray, dry	
	16		SS-9	17		ML	SILT, clayey, trace fine grained sand, brown with reddish-brown and gray mottling	
	17		SS-9	18		CL	CLAY, silty, grayish-brown with reddish-brown mottling, stiff, damp	
	18		SS-9	19		ML		
	19		SS-10	20		SM	SILT, clayey, trace of fine grained sand, brown with reddish-brown and gray mottling	
180	20		SS-10	21		CL	SAND, silty, fine to med. grained, brown, dry to damp	
	21		SS-11	22		SP	CLAY, silty, grayish-brown with reddish-brown and black mottling, stiff, damp	
	22		SS-11	23		ML	SAND, silty, fine grained, grayish-brown, stiff, moist	
	23		SS-11	24		SM	SILT, clayey, grayish-brown with reddish-brown mottling, stiff, moist	
	24		SS-12	25		SM	SAND, silty, fine grained, grayish-brown, dense, wet to saturated	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
170	29		SS-13				SAND, silty, fine grained, seams of sand up to one inch in thickness throughout spoon., grayish-brown, dense, wet to saturated	
			SS-14					
			SS-15			ML SM	SILT, sandy, grayish-brown, soft, moist to saturated	
			SS-16			SP	SAND, silty, fine grained, grayish-brown with reddish-brown staining, wet to saturated	
			SS-17			SC CL	SAND, with silt, brownish-gray, dense, moist to saturated CLAY, sandy, grayish-brown, med. stiff, moist to saturated	
	34		SS-18			SM/SC	CLAY, silty, with fine grained sand, reddish-brown, med. stiff, moist	
			SS-19			SM	SAND, silty and clayey, fine grained, grayish-brown, moist to saturated	
			SS-20				SAND, silty, fine grained, grayish-brown, med. dense, moist to saturated	
160	39		SS-21				SAND, silty, fine grained, gray, med. dense, moist to saturated	
			SS-22				SAND, silty, fine grained, reddish-brown and gray, med. dense, moist to saturated	
	44		SS-23				SAND, silty, fine grained, grayish-brown, med. dense, moist to saturated	
			SS-24			SM/SP	SAND, silty, fine grained, brownish-gray, becoming gray at 45.5 ft., med. dense, moist to saturated	
			SS-25			SC/SM CL/CH	SAND, slightly silty, fine grained, brownish-gray, med. dense, moist to saturated SAND, silty and clayey, fine grained, reddish-brown, med. dense, moist to saturated CLAY, silty / CLAY, dark gray with brown staining, very stiff, plastic, dry to damp	
150	49							
	54							
	59							

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-1			CL	CLAY, silty, grayish-brown mottled, some roots	
			SS-2			CL	CLAY, silty, grayish-brown with dark orange mottling, stiff, damp and moist	
	5		SS-3			CL	CLAY, silty, reddish-brown with gray mottling, very stiff, plastic, damp	
			SS-4			SM	SAND, silty, fine grained sand, brown, damp to moist	
			SS-5			CL	CLAY, silty, brownish gray, very stiff, damp	
			SS-5			SP	SAND, silty, fine grained sand, brown, damp	
			SS-5			CL	CLAY, silty, brownish gray, very stiff, damp	
			SS-5			ML	SAND, silt, gray with brown mottling, damp	
			SS-5			SM	SILT, sandy, lt. gray, dry	
190	10		SS-6			CL	SAND, silty, brown, dry	
			SS-6			SP	CLAY, silty, with fine grained sand, brown, damp	
			SS-6			ML	SAND, some silt, fine to med. grained, brown, dry	
			SS-7			CL	SILT, with fine grained sand, gray with brown mottling, stiff, dry	
			SS-8			CL		
	15		SS-8			SP	CLAY, silty, grayish-brown with black reddish-brown mottling, stiff, damp	
			SS-8			ML	SAND, some silt, fine grained, lt. gray, dry	
			SS-9			ML	SILT, clayey, trace fine grained sand, brown with reddish-brown and gray mottling	
			SS-9			CL	CLAY, silty, grayish-brown with reddish-brown mottling, stiff, damp	
			SS-10			ML		
			SS-10			CL	SILT, clayey, trace of fine grained sand, brown with reddish brown and gray mottling	
			SS-10			ML	CLAY, silty, grayish-brown with reddish-brown mottling, stiff, damp	
			SS-10			SM	SILT, clayey, trace of fine grained sand, brown with reddish brown and gray mottling	
			SS-10			CL	SAND, silty, fine to med. grained, brown, dry to damp	
180	20		SS-11			SP	CLAY, silty, grayish-brown with reddish-brown and black mottling, stiff, damp	
			SS-11			ML	SAND, silty, fine grained, grayish-brown, stiff, moist	
			SS-11			SM	SILT, clayey, grayish-brown with reddish-brown mottling, stiff, moist	
			SS-12			SM	SAND, silty, fine grained, grayish-brown, dense, wet to saturated	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-13	14			SAND, silty, fine grained, seams of sand up to one inch in thickness throughout spoon., grayish-brown, dense, wet to saturated	
			SS-14	3				
			SS-15	2		ML SM	SILT, sandy, grayish-brown, soft, moist to saturated	
170	29		SS-16	9		SP	SAND, silty, fine grained, grayish-brown with reddish-brown staining, wet to saturated	
			SS-17	2		SC	SAND, with silt, brownish-gray, dense, moist to saturated	
						CL	CLAY, sandy, grayish brown, med. stiff, moist to saturated	
	34							
30	39							
	44							
	49							
150	54							
	59							
140								

X Coordinate: 3314077.77

Y Coordinate: 6953657.15

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 187.42'

Datum: NGVD

Date(s): 06/26/97 - 06/26/97

Total Depth: 44.00'

Measuring Point: 190.53'

Logged By: Sandra Rudolph

Completed Depth: 43.50'

Static Water Level:

Contractor: Philip Environmental

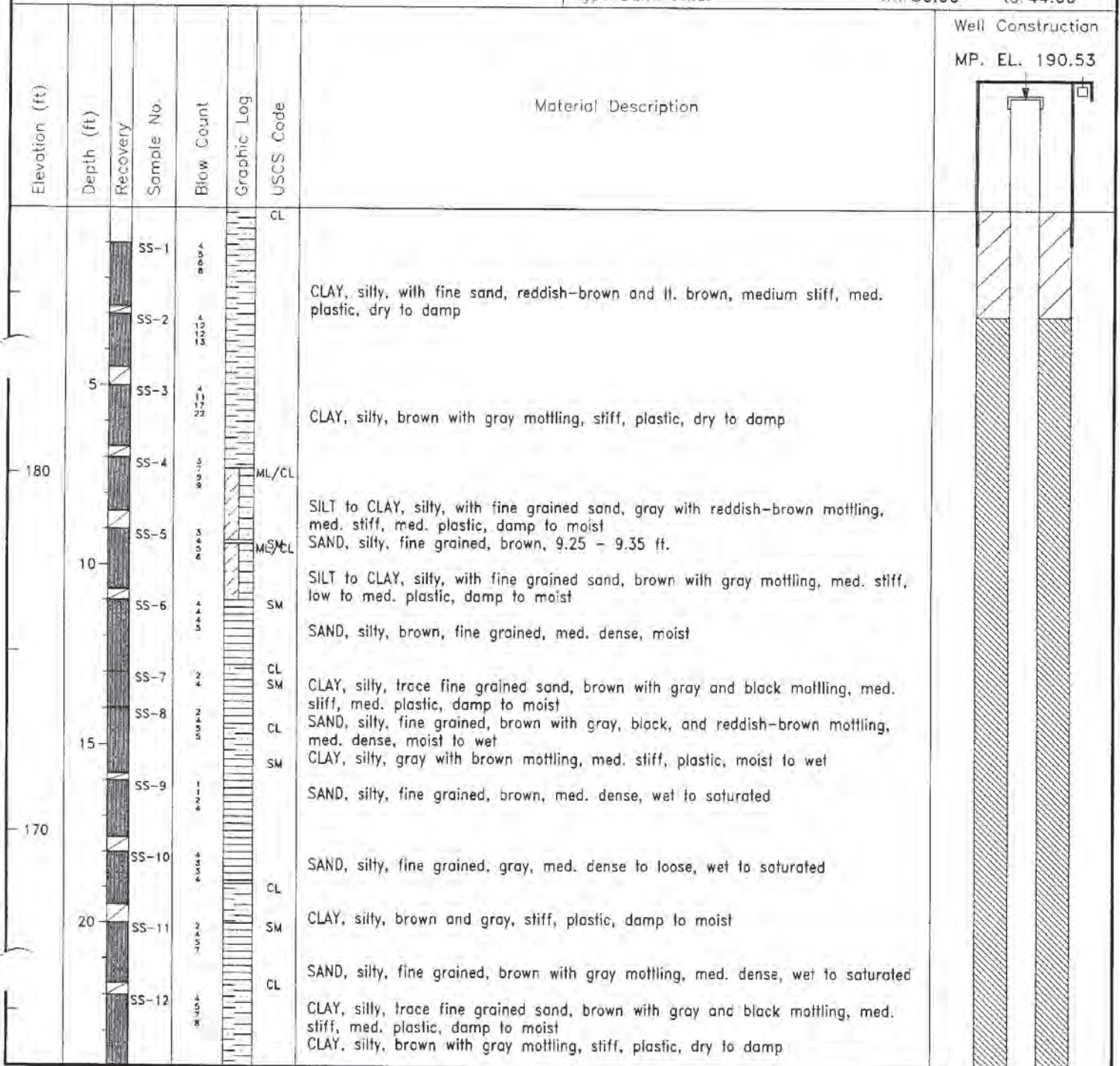
Well Casing: type: SS dia: 4.00in fm: -3.1' to: 33.50'

Drilling Method: Hollow Stem Auger

Screens:
type: Wire-wrap size: 0.010in dia: 4.00in fm: 33.50' to: 43.50'

Remarks:

Annular Fill:
type: Cement Grout fm: 0.00' to: 3.00'
type: Bentonite/Cement Grout fm: 3.00' to: 25.00'
type: #20-40 Silica Filter Sand fm: 25.00' to: 26.00'
type: Bentonite Pellets fm: 26.00' to: 29.00'
type: #20-40 Silica Filter Sand fm: 29.00' to: 30.00'
type: Sand Filter fm: 30.00' to: 44.00'



X Coordinate: 3314085.26

Y Coordinate: 6953660.11

Location: LONGHORN ARMY AMMUNITION PLANT

Elevation: 187.86'

Datum: NGVD

Date(s): 06/27/97 - 06/27/97

Total Depth: 22.00'

Measuring Point: 190.85'

Logged By: Sandra Rudolph

Completed Depth: 21.50'

Static Water Level:

Contractor: Philip Environmental

Well Casing: type: SS dia: 4.00in fm: -3.0' to: 16.50'

Drilling Method: Hollow Stem Auger

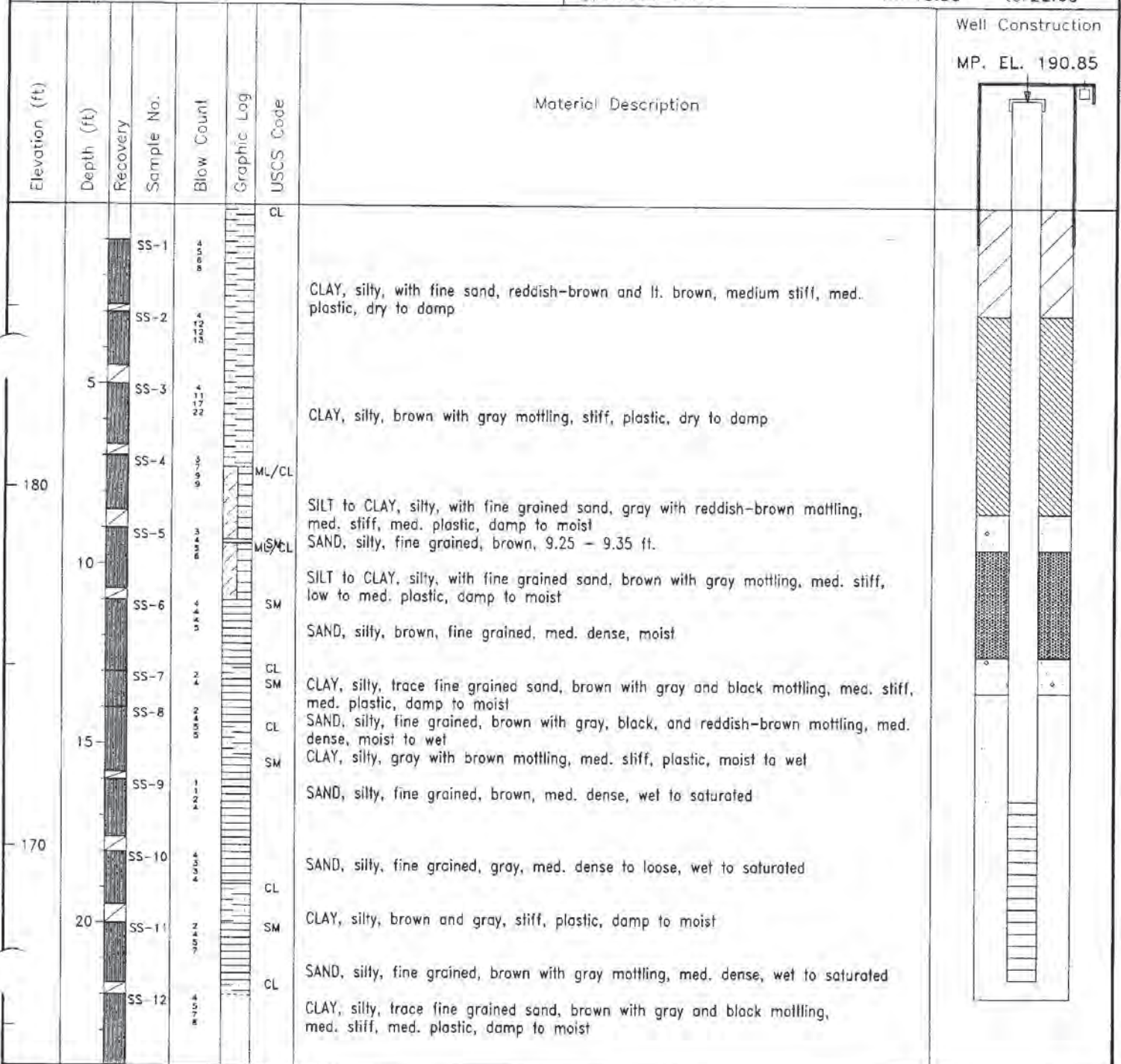
Screens:

type: Wire-wrap size: 0.010india: 4.00in fm: 16.50' to: 21.50'

Remarks:

Annular Fill:

type: Cement Grout	fm: 0.00'	to: 3.00'
type: Bentonite/Cement Grout	fm: 3.00'	to: 8.50'
type: #20-40 Silica Filter Sand	fm: 8.50'	to: 9.50'
type: Bentonite Pellets	fm: 9.50'	to: 12.50'
type: #20-40 Silica Filter Sand	fm: 12.50'	to: 13.50'
type: Sand Filter	fm: 13.50'	to: 22.00'

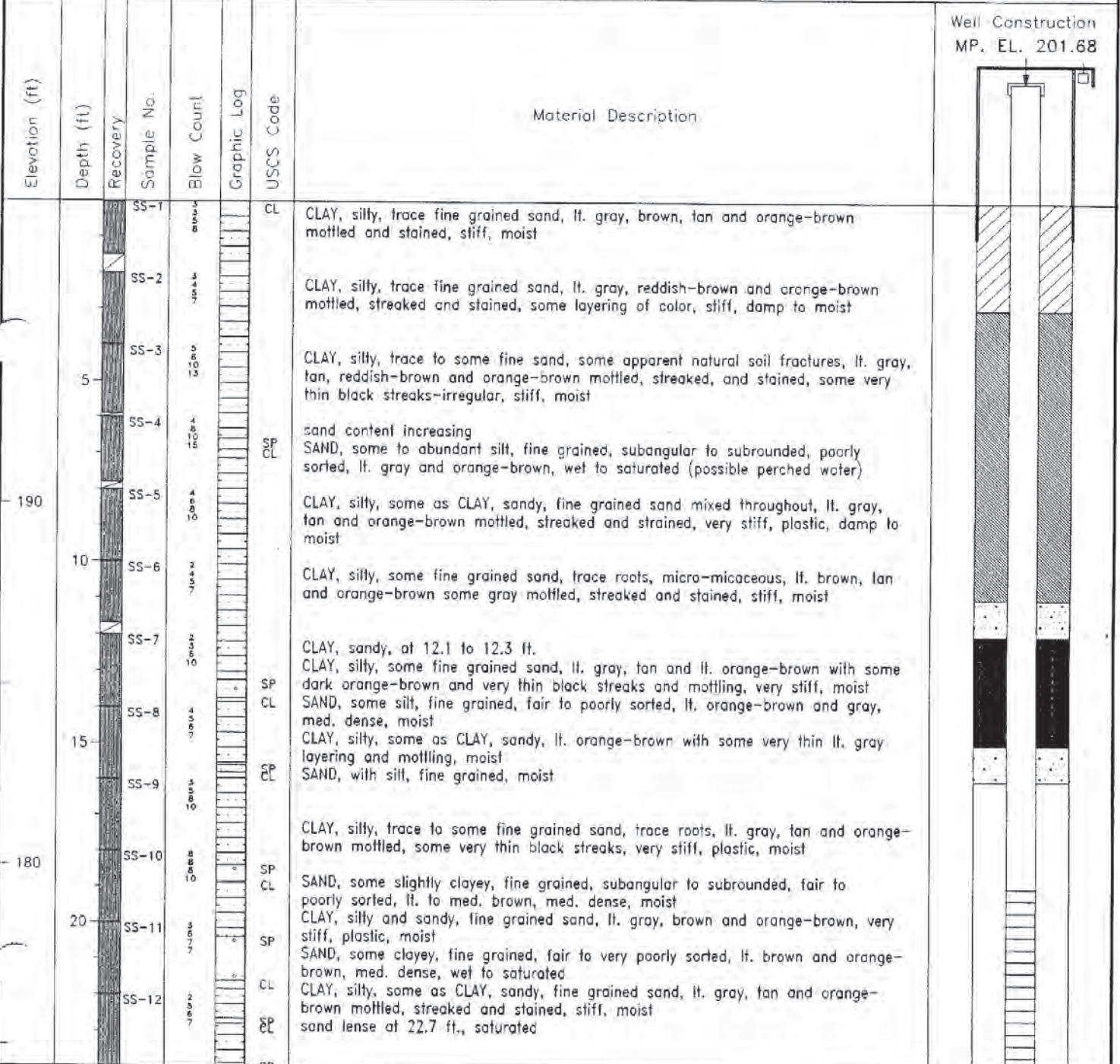


Sverdrup ENVIRONMENTAL		Site ID: 16WW37
		X Coordinate: 3313756.08 Y Coordinate: 6953683.08
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 198.50' Datum: NGVD
Date(s): 06/01/97 - 06/01/97		Total Depth: 46.00' Measuring Point: 201.71'
Logged By: Dave Cika		Completed Depth: 45.50' Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.2' to: 40.50'
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 40.50' to: 45.50'
Remarks:		Annular Fill:
		type: Cement Grout fm: 0.00' to: 3.00' type: Bentonite/Cement Grout fm: 3.00' to: 31.00' type: #20-40 Silica Filter Sand fm: 31.00' to: 32.50' type: Bentonite Pellets fm: 32.50' to: 37.50' type: #20-40 Silica Filter Sand fm: 37.50' to: 38.50' type: Sand Filter fm: 38.50' to: 46.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction MP. EL. 201.71
			SS-1			CL	CLAY, silty, trace fine grained sand, lt. gray, brown, tan and orange-brown mottled and stained, stiff, moist	
			SS-2				CLAY, silty, trace fine grained sand, lt. gray, reddish-brown and orange-brown mottled, streaked and stained, some layering of color, stiff, damp to moist	
			SS-3				CLAY, silty, trace to some fine sand, some apparent natural soil fractures, lt. gray, tan, reddish-brown and orange-brown mottled, streaked, and stained, some very thin black streaks-irregular, stiff, moist	
	5		SS-4			SP CL	sand content increasing SAND, some to abundant silt, fine grained, subangular to subrounded, poorly sorted, lt. gray and orange-brown, wet to saturated (possible perched water)	
190			SS-5				CLAY, silty, some as CLAY, sandy, fine grained sand mixed throughout, lt. gray, tan and orange-brown mottled, streaked and stained, very stiff, plastic, damp to moist	
	10		SS-6				CLAY, silty, some fine grained sand, trace roots, micro-micaceous, lt. brown, tan and orange-brown, some gray mottled, streaked and stained, stiff, moist	
			SS-7				CLAY, sandy, at 12.1 to 12.3 ft. CLAY, silty, some fine grained sand, lt. gray, tan and lt. orange-brown with some dark orange-brown and very thin black streaks and mottling, very stiff, moist	
			SS-8			SP CL	SAND, some silt, fine grained, fair to poorly sorted, lt. orange-brown and gray, med. dense, moist CLAY, silty, some as CLAY, sandy, lt. orange-brown with some very thin lt. gray layering and mottling, moist	
	15		SS-9			SP CL	SAND, with silt, fine grained, moist	
			SS-10			SP CL	CLAY, silty, trace to some fine grained sand, trace roots, lt. gray, tan and orange-brown mottled, some very thin black streaks, very stiff, plastic, moist	
180			SS-11			SP	SAND, some slightly clayey, fine grained, subangular to subrounded, fair to poorly sorted, lt. to med. brown, med. dense, moist CLAY, silty and sandy, fine grained sand, lt. gray, brown and orange-brown, very stiff, plastic, moist	
	20		SS-12			CL SP	SAND, some clayey, fine grained, fair to very poorly sorted, lt. brown and orange-brown, med. dense, wet to saturated CLAY, silty, some as CLAY, sandy, fine grained sand, lt. gray, tan and orange-brown mottled, streaked and stained, stiff, moist sand lense at 22.7 ft., saturated	

Site Id: 16WW37		Date(s): 06/01/97 - 06/01/97						
Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
170	29	SS-13					SAND, some as SILT, sandy and SAND, clayey, fine grained, subangular to subrounded, very poorly sorted, lt. gray sand, lt. orange-brown in silty and clayey zones, medium dense, wet to saturated	
		SS-14					SAND, some as silty and clayey, fine grained, subangular to subrounded, very poorly sorted, lt. brown and tan with some orange-brown streaking and staining, med. dense, wet to saturated	
		SS-15				CL	CLAY, silty, trace to some fine grained sand, lt. gray, tan, brown and orange-brown mottled, streaked and stained, very stiff, plastic, damp to moist	
		SS-16					CLAY, silty, trace fine grained sand and roots, lt. gray, tan, brown and orange-brown mottled, streaked and stained, very stiff, plastic, damp to moist	
		SS-17					CLAY, silty, trace to some fine grained sand, lt. gray, tan, brown and orange-brown mottled, some dark orange-brown very thin streaks, stiff, plastic, moist	
34		SS-18					CLAY, silty, trace to some fine grained sand with sand content increasing with depth, lt. gray and tan with some brown and orange-brown mottling, streaking and staining, stiff, plastic, moist CLAY, sandy at 35.8 ft., moist to slightly wet	
		SS-19					CLAY, silty, some to abundant fine grained sand, lt. to med. gray and orange-brown mottled, med. stiff to stiff, plastic, moist to slightly wet at 37.0 to 37.2 ft.	
160	39	SS-20					CLAY, silty, trace to some fine grained sand, lt. gray, tan, brown and orange-brown mottled with some very thin dark orange-brown streaks-irregular, very stiff, plastic, moist	
		SS-21				SP/SM	SAND and SAND, silty, fine grained sand, poorly sorted, lt. gray sand intermixed with lt. brown/gray silty sand, dense, wet to saturated	
		SS-22				SP/SM	SAND and SAND, silty, fine grained, subangular to subrounded, very poorly sorted, lt. gray and brown/gray, some dark orange mottling, med. dense, wet to saturated	
	44	SS-23				CL/CH	CLAY, silty to CLAY, with very thin lt. gray silt lenses, dark brown/gray to dark gray at 45.2 ft., very stiff, very plastic, damp	
150	49							
	54							
	59							

Sverdrup ENVIRONMENTAL		Site ID: 16WW38	
		X Coordinate: 3313748.10	Y Coordinate: 6953681.68
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 198.38'	Datum: NGVD
Date(s): 06/02/97 - 06/02/97		Total Depth: 30.00'	Measuring Point: 201.68'
Logged By: Dave Cika		Completed Depth: 29.00'	Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.3' to: 19.00'	
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 19.00' to: 29.00'	
Remarks:		Annular Fill:	
		type: Cement Grout fm: 0.00' to: 3.00' type: Bentonite/Cement Grout fm: 3.00' to: 11.00' type: #20-40 Silica Filter Sand fm: 11.00' to: 12.00' type: Bentonite Pellets fm: 12.00' to: 15.00' type: #20-40 Silica Filter Sand fm: 15.00' to: 16.00' type: Sand Filter fm: 16.00' to: 30.00'	



Site Id: 16WW38		Date(s) 06/02/97 - 06/02/97						
Elevation(ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-13				SAND, some as SILT, sandy and SAND, clayey, fine grained, subangular to subrounded, very poorly sorted, lt. gray sand, lt. orange-brown in silty and clayey med. dense, wet to saturated	
			SS-14				SAND, some as silty and clayey, fine grained, subangular to subrounded, very poorly sorted, lt. brown and tan with some orange-brown streaking and staining, med. dense, wet to saturated	
170	29		SS-15			CL	CLAY, silty, trace to some fine grained sand, lt. gray, tan, brown and orange-brown mottled, streaked and stained, very stiff, plastic, damp to moist	
							CLAY, silty, trace fine grained sand and roots, lt. gray, tan, brown and orange-brown mottled, streaked and stained, very stiff, plastic, damp to moist	
	34							
160	39							
	44							
150	49							
	54							
	59							

STATE OF TEXAS WELL REPORT for Tracking #162540

Owner:	Longhorn Army Ammunition Plant	Owner Well #:	16WW41
Address:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Grid #:	35-24-4
Well Location:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Latitude:	32° 40' 04" N
Well County:	Harrison	Longitude:	094° 07' 29" W
Elevation:	No Data	GPS Brand Used:	Garmin e-trex
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **9/30/2008**
 Completed: **11/5/2008**

Diameter of Hole: Diameter: **19 in From Surface To 25 ft**
 Diameter: **10.25 in From 25 ft To 51 ft**

Drilling Method: **Mud Rotary Hollow Stem Auger**

Borehole
 Completion: Gravel Packed From: **38 ft to 51 ft**
 Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 0 ft to 25 ft with 11 cement (#sacks and material)**
 2nd Interval: **From 36 ft to 38 ft with 1 bentonite (#sacks and material)**
 3rd Interval: **From 0 ft to 36 ft with 16 cement (#sacks and material)**
 Method Used: **Tremmie pipe**
 Cemented By: **Driller**
 Distance to Septic Field or other Concentrated Contamination: **No Data**
 Distance to Property Line: **No Data**
 Method of Verification: **No Data**
 Approved by Variance: **No Data**

Surface
 Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
 Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
 Depth of Strata: **No Data**
 Chemical Analysis Made: **No Data**
 Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company **ETTL Engineers & Consultants Inc.**

Information: **1717 E. Erwin
Tyler , TX 75702**

Driller License
Number: **2853**

Licensed Well
Driller Signature: **Thomas Cook**

Registered Driller
Apprentice
Signature: **No Data**

Apprentice
Registration
Number: **No Data**

Comments: **No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #162540) on your written request.

**Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880**

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-46 Not logged
46-47 Clayey sand
47-48 Sandy clay
48-49.5 Clayey sand
49.5-51 Sandy clay

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
12	New	PVC Sch. 40	0 - 25
4	New	PVC Sch. 40	0 - 40
4	New	PVC Sch. 40 - slotted	40 - 50 0.010"

STATE OF TEXAS WELL REPORT for Tracking #162469

Owner:	Longhorn Army Ammunition Plant	Owner Well #:	16WW42
Address:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Grid #:	35-23-9
Well Location:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Latitude:	32° 39' 58" N
Well County:	Harrison	Longitude:	094° 07' 32" W
Elevation:	No Data	GPS Brand Used:	Garmin e-trex
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **11/4/2008**
 Completed: **11/4/2008**

Diameter of Hole: Diameter: **10.25 in From Surface To 12 ft**

Drilling Method: **Hollow Stem Auger**

Borehole
Completion: Gravel Packed From: **1 ft to 12 ft**
 Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 0 ft to 1 ft with 0.5 Bentonite (#sacks and material)**
 2nd Interval: **No Data**
 3rd Interval: **No Data**
 Method Used: **Tremmie pipe**
 Cemented By: **Driller**
 Distance to Septic Field or other Concentrated Contamination: **No Data**
 Distance to Property Line: **No Data**
 Method of Verification: **No Data**
 Approved by Variance: **No Data**

Surface
Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
 Artesian flow: **No Data**

Packers:

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
 Depth of Strata: **No Data**
 Chemical Analysis Made: **No Data**
 Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company
Information: **ETTL Engineers & Consultants Inc.**
 1717 E. Erwin

Tyler, TX 75702

Driller License Number: **54683**

Licensed Well Driller Signature: **Wilburn Ragon, Jr.**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**

Comments: **No Data**

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Please include the report's Tracking number (Tracking #162469) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-3.5 Clayey sand - reddish brown
3.5-11 Poorly graded sand - gray
11-12 Sandy clay

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
4	New	PVC Sch. 40 0 - 2	
4	New	PVC Sch. 40 - slotted 2 - 12 0.010"	

STATE OF TEXAS WELL REPORT for Tracking #162470

Owner:	Longhorn Army Ammunition Plant	Owner Well #:	16WW43
Address:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Grid #:	35-24-7
Well Location:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Latitude:	32° 39' 58" N
Well County:	Harrison	Longitude:	094° 07' 28" W
Elevation:	No Data	GPS Brand Used:	Garmin e-trex
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **11/4/2008**
 Completed: **11/4/2008**

Diameter of Hole: Diameter: **10.25 in From Surface To 12 ft**

Drilling Method: **Hollow Stem Auger**

Borehole
Completion: Gravel Packed From: **1 ft to 12 ft**
 Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 0 ft to 1 ft with 0.5 Bentonite (#sacks and material)**
 2nd Interval: **No Data**
 3rd Interval: **No Data**
 Method Used: **Tremmie pipe**
 Cemented By: **Driller**
 Distance to Septic Field or other Concentrated Contamination: **No Data**
 Distance to Property Line: **No Data**
 Method of Verification: **No Data**
 Approved by Variance: **No Data**

Surface
Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
 Artesian flow: **No Data**

Packers:

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
 Depth of Strata: **No Data**
 Chemical Analysis Made: **No Data**
 Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company
Information: **ETTL Engineers & Consultants Inc.**
 1717 E. Erwin

Tyler , TX 75702
 Driller License Number: **54683**
 Licensed Well Driller Signature: **Wilburn Ragon, Jr.**
 Registered Driller Apprentice Signature: **No Data**
 Apprentice Registration Number: **No Data**
 Comments: **No Data**

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Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-11 Silty sand - brown
11-12 Clay

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
4	New	PVC Sch. 40 0 - 2	
4	New	PVC Sch. 40 - slotted 2 - 12 0.010"	

STATE OF TEXAS WELL REPORT for Tracking #162476

Owner:	Longhorn Army Ammunition Plant	Owner Well #:	16WW44
Address:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Grid #:	35-23-6
Well Location:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Latitude:	32° 40' 04" N
Well County:	Harrison	Longitude:	094° 07' 40" W
Elevation:	No Data	GPS Brand Used:	Garmin e-trex
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **11/5/2008**
 Completed: **11/6/2008**

Diameter of Hole: Diameter: **10.25 in From Surface To 30 ft**

Drilling Method: **Hollow Stem Auger**

Borehole
Completion: Gravel Packed From: **18 ft to 30 ft**
 Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 16 ft to 18 ft with 1 Bentonite (#sacks and material)**
 2nd Interval: **From 0 ft to 16 ft with 7 Cement (#sacks and material)**
 3rd Interval: **No Data**
 Method Used: **Tremmie Pipe**
 Cemented By: **Driller**
 Distance to Septic Field or other Concentrated Contamination: **No Data**
 Distance to Property Line: **No Data**
 Method of Verification: **No Data**
 Approved by Variance: **No Data**

Surface
Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
 Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
 Depth of Strata: **No Data**
 Chemical Analysis Made: **No Data**
 Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company
Information: **ETTL Engineers & Consultants Inc.**
 1717 E. Erwin

Tyler , TX 75702

Driller License Number: **2126**

Licensed Well Driller Signature: **H. Douglas Hinds**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**

Comments: **No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #162476) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description

0-5 Sandy clay - brown

5-6 Clayey sand - brown

6-7 Sandy clay - brown

7-8 Clayey sand - tan

8-9 Sandy clay - brown

9-18 Clayey sand - brown

18-20 Clayey sand - gray

20-27 Sandy clay - brown

27-29 Clayey sand

29-30 Sandy clay

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
4	New	PVC Sch. 40	0 - 20
4	New	PVC Sch. 40 - slotted	20 - 30 0.010"

STATE OF TEXAS WELL REPORT for Tracking #162486

Owner:	Longhorn Army Ammunition Plant	Owner Well #:	16WW45
Address:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Grid #:	35-23-6
Well Location:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Latitude:	32° 40' 04" N
Well County:	Harrison	Longitude:	094° 07' 40" W
Elevation:	No Data	GPS Brand Used:	Garmin e-trex
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **11/4/2008**
 Completed: **11/12/2008**

Diameter of Hole: Diameter: **19 in From Surface To 30 ft**
 Diameter: **10.25 in From 30 ft To 51 ft**

Drilling Method: **Mud Rotary Hollow Stem Auger**

Borehole
 Completion: Gravel Packed From: **38 ft to 51 ft**
 Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 0 ft to 30 ft with 12 cement (#sacks and material)**
 2nd Interval: **From 36 ft to 38 ft with 1 bentonite (#sacks and material)**
 3rd Interval: **From 0 ft to 36 ft with 16 cement (#sacks and material)**
 Method Used: **Tremmie pipe**
 Cemented By: **Driller**
 Distance to Septic Field or other Concentrated Contamination: **No Data**
 Distance to Property Line: **No Data**
 Method of Verification: **No Data**
 Approved by Variance: **No Data**

Surface
 Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
 Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
 Depth of Strata: **No Data**
 Chemical Analysis Made: **No Data**
 Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company **ETTL Engineers & Consultants Inc.**

Information: **1717 E. Erwin
Tyler , TX 75702**

Driller License
Number: **2853**

Licensed Well
Driller Signature: **Thomas Cook**

Registered Driller
Apprentice
Signature: **No Data**

Apprentice
Registration
Number: **No Data**

Comments: **No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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P.O. Box 12157
Austin, TX 78711
(512) 463-7880**

DESC. & COLOR OF FORMATION MATERIAL

CASING, BLANK PIPE & WELL SCREEN DATA

From (ft) To (ft) Description	Dia. New/Used Type Setting From/To
0-5 Sandy lean clay	12 New PVC Sch. 40 0 - 30
5-6 Clayey sand	4 New PVC Sch. 40 0 - 40
6-7 Sandy lean clay	4 New PVC Sch. 40 - slotted 40 - 50 0.010"
7-8 Clayey sand	
8-9 Sandy lean clay - brown	
9-20 Clayey sand - brown & gray	
20-27 Poorly graded sand - gray	
30-32.5 Sandy lean clay	
32.5-34 Clayey sand	
34-34.5 Lignite	
34.5-36.5 Clayey sand	
36.5-37.5 Sandy lean clay	
37.5-49 Clayey sand - brownish gray	
49-51 Sandy lean clay	

STATE OF TEXAS WELL REPORT for Tracking #162483

Owner:	Longhorn Army Ammunition Plant	Owner Well #:	16WW46
Address:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Grid #:	35-24-4
Well Location:	Hwy 143 @ Spur 449, LHAAP Karnack , TX 75661	Latitude:	32° 40' 06" N
Well County:	Harrison	Longitude:	094° 07' 27" W
Elevation:	No Data	GPS Brand Used:	Garmin e-trex
<hr/>			
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **11/6/2008**
 Completed: **11/6/2008**

Diameter of Hole: Diameter: **10.25 in From Surface To 21 ft**

Drilling Method: **Hollow Stem Auger**

Borehole
Completion: Gravel Packed From: **8 ft to 21 ft**
 Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **From 6 ft to 8 ft with 1 bentonite (#sacks and material)**
 2nd Interval: **From 0 ft to 6 ft with 4 cement (#sacks and material)**
 3rd Interval: **No Data**
 Method Used: **Tremmie pipe**
 Cemented By: **Driller**
 Distance to Septic Field or other Concentrated Contamination: **No Data**
 Distance to Property Line: **No Data**
 Method of Verification: **No Data**
 Approved by Variance: **No Data**

Surface
Completion: **Surface Sleeve Installed**

Water Level: Static level: **No Data**
 Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
 Depth of Strata: **No Data**
 Chemical Analysis Made: **No Data**
 Did the driller knowingly penetrate any strata which contained undesirable constituents: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company
Information: **ETTL Engineers & Consultants Inc.**
 1717 E. Erwin

Tyler , TX 75702

Driller License Number: **2853**

Licensed Well Driller Signature: **Thomas Cook**

Registered Driller Apprentice Signature: **No Data**

Apprentice Registration Number: **No Data**

Comments: **No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Please include the report's Tracking number (Tracking #162483) on your written request.

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Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description

0-7.5 No recovery

7.5-9 Sandy clay

9-12.5 Clayey sand

12.5-14.5 Sandy clay

14.5-16 Clayey sand

16-17 Sandy clay

17-18 Clayey sand

18-21 Sandy clay

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
4	New	PVC Sch. 40	0 - 10
4	New	PVC Sch. 40 - slotted	10 - 20 0.010"



Borehole No. 16PM01

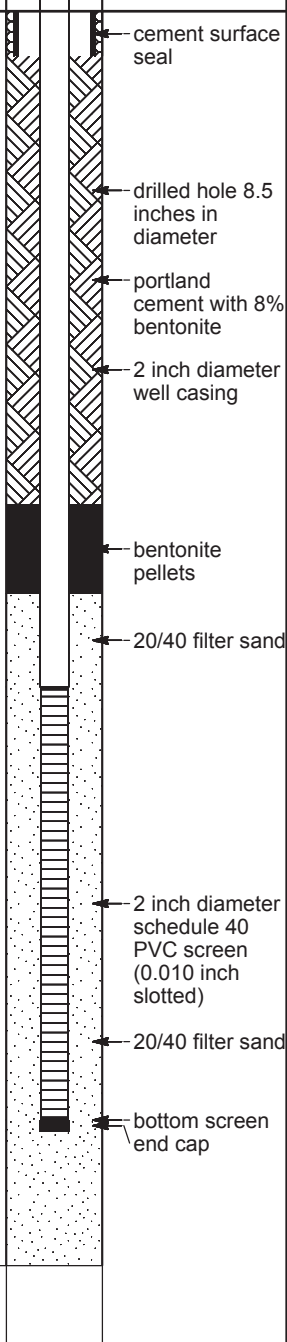
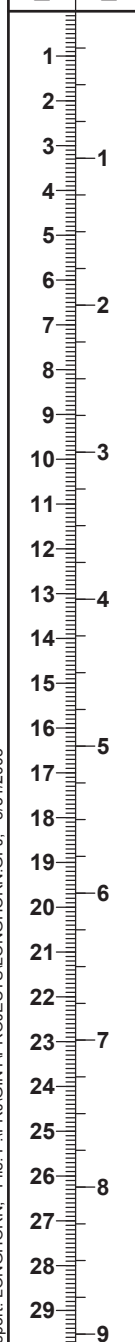
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,672.6 E 3,313,969.2
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	187.5	
									Top PVC Casing	190.5	
1									cement surface seal		
2											
3											
4	1								drilled hole 8.5 inches in diameter		
5									portland cement with 8% bentonite		
6	2								2 inch diameter well casing		
7											
8											
9											
10	3										
11											
12									bentonite pellets		
13	4								20/40 filter sand		
14											
15											
16	5										
17											
18											
19											
20	6								2 inch diameter schedule 40 PVC screen (0.010 inch slotted)		
21											
22											
23	7								20/40 filter sand		
24											
25											
26	8								bottom screen end cap		
27											
28											
29	9										
				Borehole depth 28.0 ft (28.0 m)							

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005

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8-Mar-2005





Borehole No. 16PM02

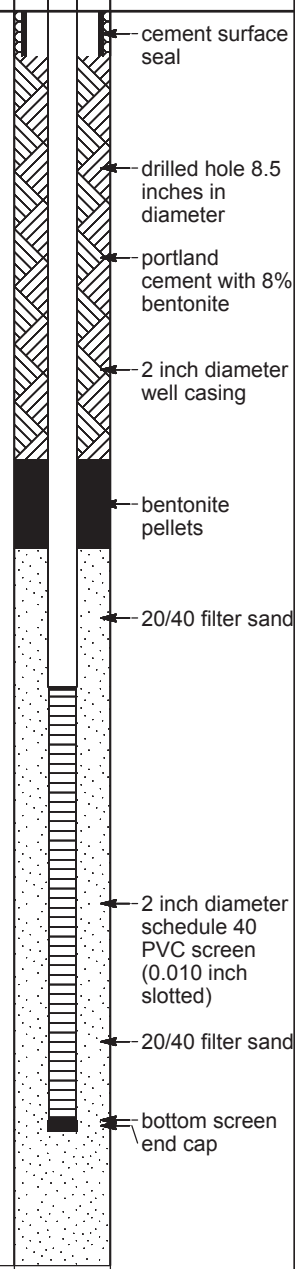
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,637.4 E 3,313,977.1
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID			
				no samples recovered						Ground Surface	188.0
										Top PVC Casing	191.1
1											
2											
3											
4	1										
5											
6											
7	2										
8											
9											
10	3										
11											
12											
13	4										
14											
15											
16	5										
17											
18											
19											
20	6										
21											
22											
23	7										
24											
25											
26	8										
27											
28											
29	9										
				Borehole depth 28.0 ft (28.0 m)							

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005

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8-Mar-2005





Borehole No. 16PM03

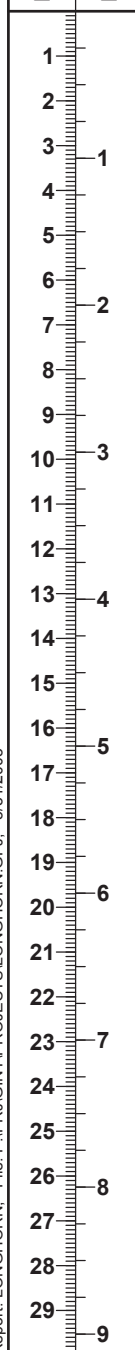
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,706.8 E 3,313,985.1
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	187.5	
									Top PVC Casing	190.4	
1									cement surface seal		
2											
3											
4	1								drilled hole 8.5 inches in diameter		
5									portland cement with 8% bentonite		
6									2 inch diameter well casing		
7	2										
8											
9											
10	3										
11									bentonite pellets		
12											
13	4								20/40 filter sand		
14											
15											
16	5										
17											
18											
19											
20	6								2 inch diameter schedule 40 PVC screen (0.010 inch slotted)		
21											
22											
23	7								20/40 filter sand		
24											
25									bottom screen end cap		
26	8			Borehole depth 25.0 ft (25.0 m)							
27											
28											
29	9										

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005

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8-Mar-2005





Borehole No. 16PM04

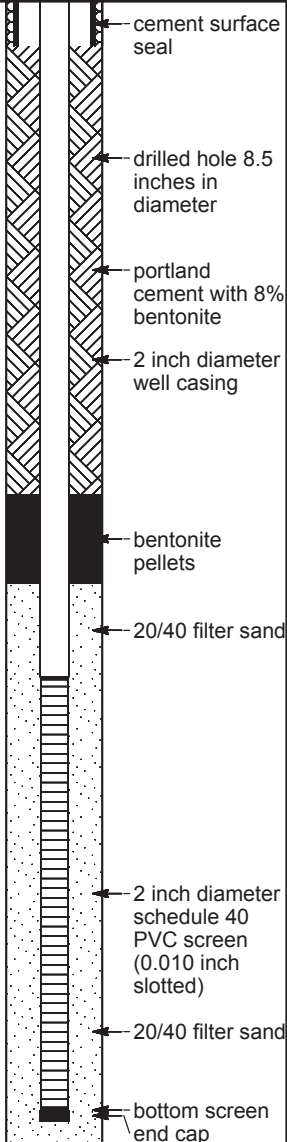
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,687.7 E 3,314,002.8
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 23 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	187.0	
1									Top PVC Casing	190.4	
2											
3											
4	1										
5											
6											
7	2										
8											
9											
10											
11	3										
12											
13											
14	4										
15											
16											
17	5										
18											
19											
20	6										
21											
22											
23	7										
24											
25											
26	8										
27											
28											
29	9										
				Borehole depth 28.0 ft (28.0 m)							

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8-Mar-2005





Borehole No. 16PM06

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,668.3 E 3,314,010.1
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					186.4	Ground Surface	
									189.6	Top PVC Casing	
1										cement surface seal	
2											
3											
4	1									drilled hole 8.5 inches in diameter	
5											
6	2									portland cement with 8% bentonite	
7										2 inch diameter well casing	
8											
9											
10	3										
11											
12										bentonite pellets	
13	4									20/40 filter sand	
14											
15		8-Mar-2005									
16	5										
17											
18											
19											
20	6									2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
21											
22											
23	7									20/40 filter sand	
24											
25										bottom screen end cap	
26	8										
27											
28											
29	9										
				Borehole depth 28.0 ft (28.0 m)							

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



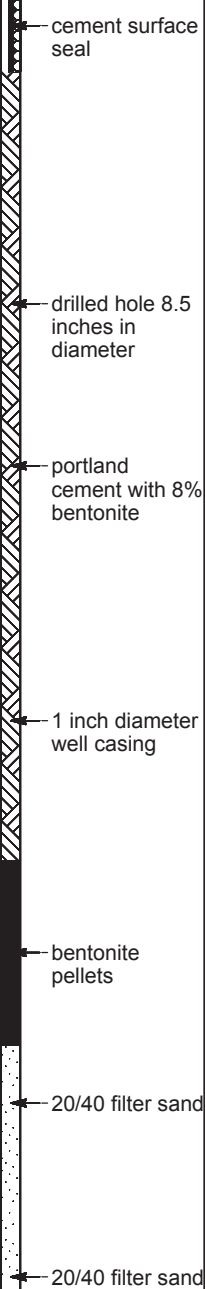
Borehole No. 16PM07D

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,683.1 E 3,314,012.4
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 23 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID			
				no samples recovered						Ground Surface	187.2
										Top PVC Casing	190.4
1											
2											
3	1			silt, some clay, trace sand, fine, stiff, mottled red-brown and grey, dry to moist							
4											
5				mottled brown and black							
6					MLCS	93	NA	SS-1			
7	2										
8											
9											
10	3			silty sand, fine to medium, loose, mottled brown grey, dry to moist	SM						
11				clayey sand, fine to medium, stiff, mottled brown and grey, moist							
12				clay lenses	SC	100	NA	SS-2			
13	4			silty sand, trace clay, fine to medium, loose, grey, moist to wet							
14				medium to coarse, very loose, brown grey, very wet	SM						

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005





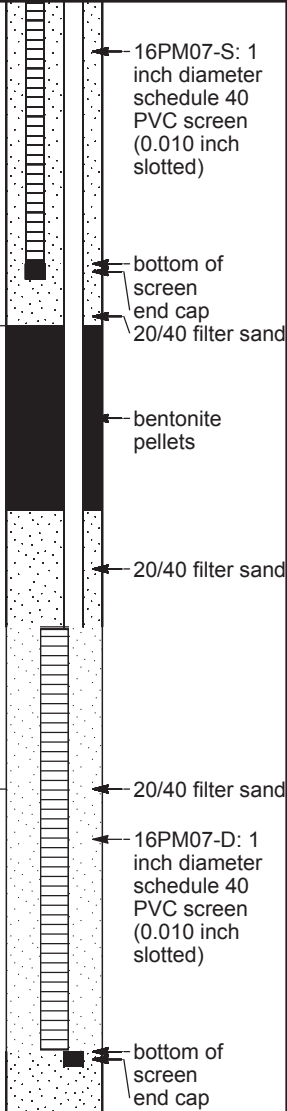
Borehole No. 16PM07D

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,683.1 E 3,314,012.4
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 23 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments			
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID			
									Ground Surface	187.2		
									Top PVC Casing	190.4		
15				clay lens (15' - 15'2")	SM							
		8-Mar-2005		sandy clay, fine to medium, very stiff, brown and grey, moist to wet	CLS	78	NA	SS-3				
16	5			silty clay, fine, very stiff, mottled grey and brown, moist								
17					CLM							
18				sandy clay, some silt, medium, loose, brown and grey, moist to wet								
19					CLMS							
20	6			clay, trace silt, fine, very stiff, mottled grey and brown, moist								
21					CL	97	NA	SS-4				
22												
23	7			sandy clay silty sand, some clay, medium to coarse, loose, grey, wet brown, clay lenses								
24												
25					SM CLS							
26	8					92	NA	SS-5				
27				clayey sand, some silt, medium, loose, mottled brown and grey, moist								
28					SC SM							
				Borehole depth 28.0 ft (28.0 m)								

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005





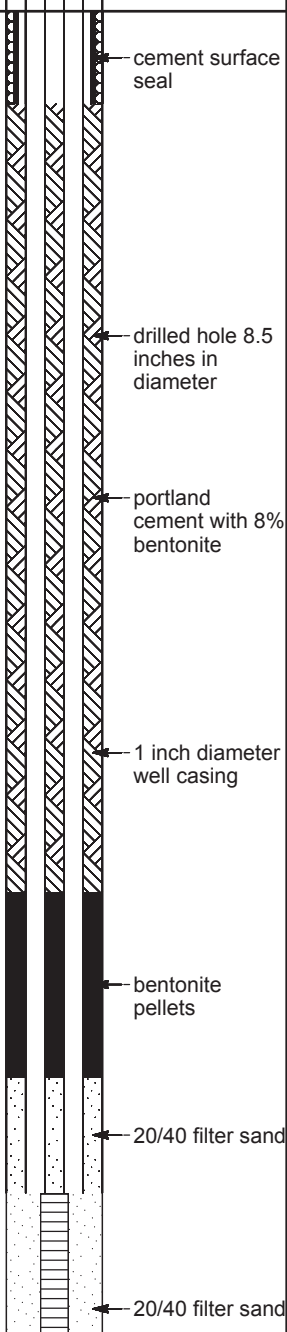
Borehole No. 16PM07S

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,673.1 E 3,314,012.4
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 23 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID			
				no samples recovered						Ground Surface	187.2
										Top PVC Casing	190.4
1											
2											
3	1			silt, some clay, trace sand, fine, stiff, mottled red-brown and grey, dry to moist							
4											
5				mottled brown and black							
6					MLCS						
7	2										
8											
9				silty sand, fine to medium, loose, mottled brown grey, dry to moist	SM						
10	3			clayey sand, fine to medium, stiff, mottled brown and grey, moist							
11				clay lenses	SC						
12											
13	4			silty sand, trace clay, fine to medium, loose, grey, moist to wet							
14				medium to coarse, very loose, brown grey, very wet	SM						

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005





Borehole No. 16PM07S

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,673.1 E 3,314,012.4
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 23 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
									Ground Surface	187.2
									Top PVC Casing	190.4
15				clay lens (15' - 15'2")	SM					
16	5	8-Mar-2005		sandy clay, fine to medium, very stiff, brown and grey, moist to wet	CLS				16PM07-S: 1 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
17				silty clay, fine, very stiff, mottled grey and brown, moist	CLM				bottom of screen end cap	
18				sandy clay, some silt, medium, loose, brown and grey, moist to wet	CLMS				20/40 filter sand	
19				clay, trace silt, fine, very stiff, mottled grey and brown, moist	CL				bentonite pellets	
20	6									
21									20/40 filter sand	
22										
23	7			sandy clay silty sand, some clay, medium to coarse, loose, grey, wet brown, clay lenses	SM CLS				20/40 filter sand	
24									16PM07-D: 1 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
25										
26	8								bottom of screen end cap	
27				clayey sand, some silt, medium, loose, mottled brown and grey, moist	SC SM					
28				Borehole depth 28.0 ft (28.0 m)						

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



Borehole No. 16PM09

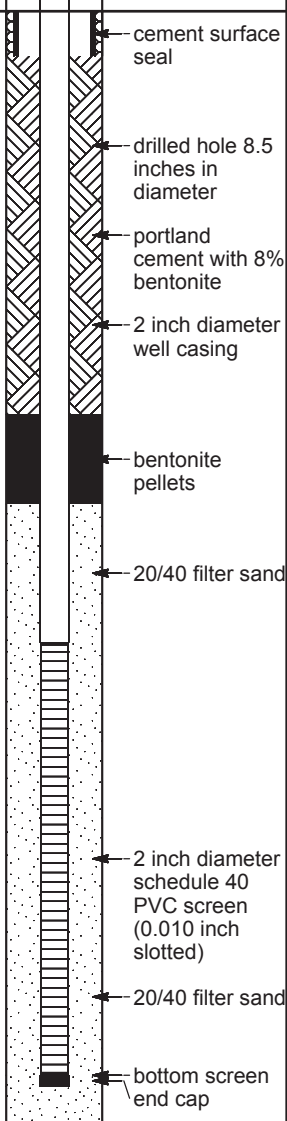
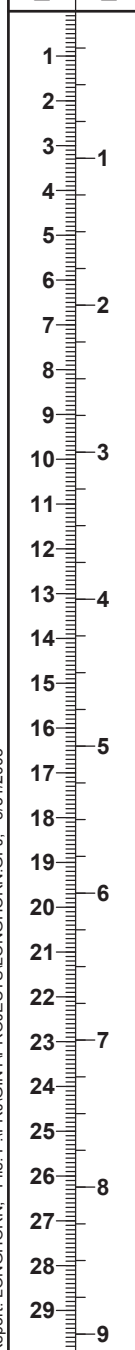
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,609.7 E 3,314,011.0
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	185.5	
1									Top PVC Casing	188.3	
2									cement surface seal		
3									drilled hole 8.5 inches in diameter		
4	1								portland cement with 8% bentonite		
5									2 inch diameter well casing		
6	2								bentonite pellets		
7									20/40 filter sand		
8											
9	3										
10											
11											
12											
13	4										
14											
15											
16	5										
17											
18											
19											
20	6										
21											
22											
23	7										
24											
25											
26	8										
27											
28											
29	9										
				Borehole depth 25.0 ft (25.0 m)							

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005

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8-Mar-2005





Borehole No. 16PM10

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,667.1 E 3,314,019.6
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID	
				no samples recovered					
1									
2									
3									
1				silt, some clay, trace sand, fine, firm, mottled brown, grey, black and red, dry to moist, roots	MLCS				
4									
5				silty clay, firm, brown grey red, moist silty sand (4'3.5" - 4'7")					
				silty sand, some clay (5'2" - 5'4")	CLM				
6									
2				clayey silt, fine, stiff, brown and grey, moist					
7					MLC				
8									
9				silty clay, fine, firm, mottled brown grey red, moist to wet					
10									
3				more clay (10'5" - 12'2")	CLM				
11									
12									
13				silty sand, medium to coarse, loose, brown and grey, moist to wet					
4					SM				
14									

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Borehole No. 16PM10

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,667.1 E 3,314,019.6
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID	
16	5			sandy clay layer (15'2" - 15'9")	SM				
17				sandy clay layer (16'5" - 17'1")					
18				oxidized sand, red (17'1" - 17'5")					
18				clay, some sand surround core, medium to coarse, very stiff, brown red, moist	CL				
19				silty sand, medium, very loose, grey, wet	SM				
19				some clay (18'8" - 18'10")					
20	6			silty clay, fine, firm, mottled brown, grey and red, dry to moist					
21				more silt (20'2" - 20'11")	CLM				
22									
23	7			clayey silt, some sand, fine to medium, brown and grey	MLC				
24				silty sand, medium, well sorted, very loose, brown and grey, very wet					
25									
26	8				SM				
27									
28				Borehole depth 28.0 ft (28.0 m)					
29	9								

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Borehole No. 16PM10D

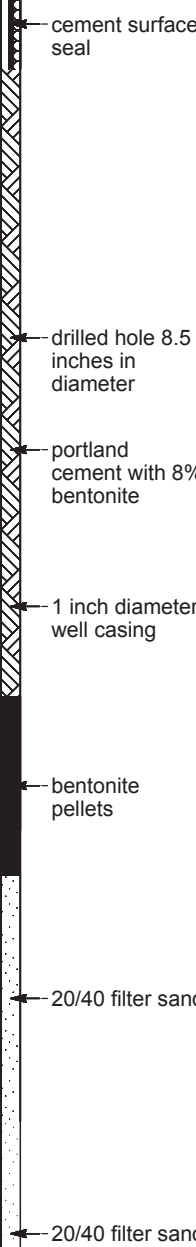
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,667.1 E 3,314,019.6
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	186.3	
1											
2											
3											
4	1			silt, some clay, trace sand, fine, firm, mottled brown, grey, black and red, dry to moist, roots	MLCS						
5				silty clay, firm, brown grey red, moist silty sand (4'3.5" - 4'7") silty sand, some clay (5'2" - 5'4")	CLM	85	NA	SS-1			
6											
7	2			clayey silt, fine, stiff, brown and grey, moist	MLC						
8											
9				silty clay, fine, firm, mottled brown grey red, moist to wet							
10	3										
11				more clay (10'5" - 12'2")	CLM	98	NA	SS-2			
12											
13	4			silty sand, medium to coarse, loose, brown and grey, moist to wet							
14					SM						

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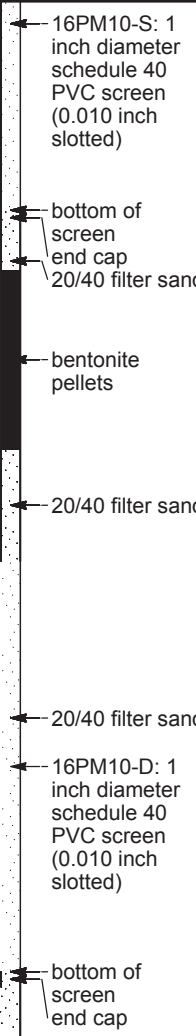
Borehole No. 16PM10D

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,667.1 E 3,314,019.6
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
									Ground Surface	186.3
									Top PVC Casing	189.6
16	5			sandy clay layer (15'2" - 15'9")	SM	93	NA	SS-3		
17				sandy clay layer (16'5" - 17'1")						
18				oxidized sand, red (17'1" - 17'5") clay, some sand surround core, medium to coarse, very stiff, brown red, moist	CL					
19				some clay (18'8" - 18'10") silty sand, medium, very loose, grey, wet	SM					
20	6			some clay (18'8" - 18'10") silty clay, fine, firm, mottled brown, grey and red, dry to moist						
21				more silt (20'2" - 20'11")	CLM	100	NA	SS-4		
22										
23	7			clayey silt, some sand, fine to medium, brown and grey silty sand, medium, well sorted, very loose, brown and grey, very wet	MLC					
24										
25										
26	8				SM	80	NA	SS-5		
27										
28				Borehole depth 28.0 ft (28.0 m)						
29	9									

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Borehole No. 16PM10S

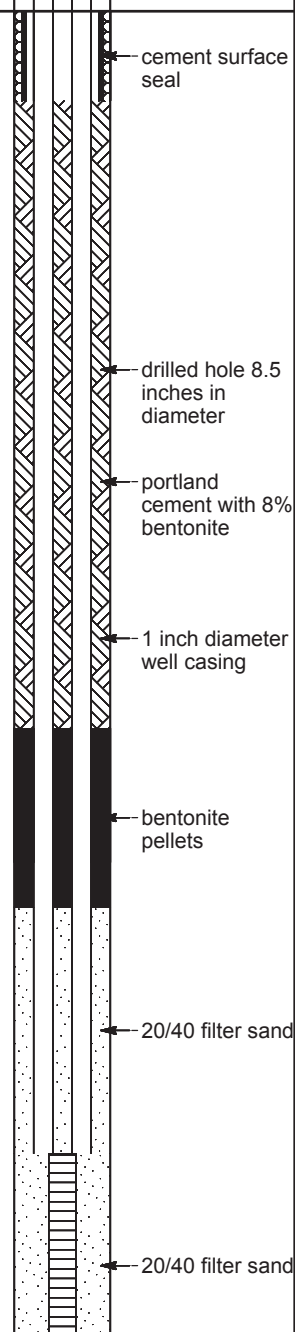
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,657.1 E 3,314,019.6
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
				no samples recovered					Ground Surface 186.3	
1									Top PVC Casing 189.6	
2										
3										
4	1			silt, some clay, trace sand, fine, firm, mottled brown, grey, black and red, dry to moist, roots	MLCS					
5				silty clay, firm, brown grey red, moist silty sand (4'3.5" - 4'7") silty sand, some clay (5'2" - 5'4")	CLM					
6										
7	2			clayey silt, fine, stiff, brown and grey, moist	MLC					
8										
9				silty clay, fine, firm, mottled brown grey red, moist to wet						
10	3			more clay (10'5" - 12'2")	CLM					
11										
12										
13	4			silty sand, medium to coarse, loose, brown and grey, moist to wet	SM					
14										

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Borehole No. 16PM10S

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,657.1 E 3,314,019.6
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
									Ground Surface	186.3	
									Top PVC Casing	189.6	
16	5			sandy clay layer (15'2" - 15'9")	SM				16PM10-S: 1 inch diameter schedule 40 PVC screen (0.010 inch slotted)		
17				sandy clay layer (16'5" - 17'1")							
18				oxidized sand, red (17'1" - 17'5") clay, some sand surround core, medium to coarse, very stiff, brown red, moist	CL				bottom of screen		
19				some clay (18'8" - 18'10") silty sand, medium, very loose, grey, wet	SM				end cap		
20	6			some clay (18'8" - 18'10") silty clay, fine, firm, mottled brown, grey and red, dry to moist					20/40 filter sand		
21				more silt (20'2" - 20'11")	CLM				bentonite pellets		
22									20/40 filter sand		
23	7			clayey silt, some sand, fine to medium, brown and grey	MLC				20/40 filter sand		
24				silty sand, medium, well sorted, very loose, brown and grey, very wet					16PM10-D: 1 inch diameter schedule 40 PVC screen (0.010 inch slotted)		
25					SM						
26	8								bottom of screen		
27									end cap		
28				Borehole depth 28.0 ft (28.0 m)							
29	9										

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



Borehole No. 16PM11

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,701.7 E 3,314,023.7
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	187.9	
									Top PVC Casing	190.9	
1									cement surface seal		
2											
3											
4	1								drilled hole 8.5 inches in diameter		
5									portland cement with 8% bentonite		
6									2 inch diameter well casing		
7	2										
8											
9											
10	3										
11									bentonite pellets		
12											
13	4								20/40 filter sand		
14											
15											
16	5		▼ 8-Mar-2005								
17											
18											
19											
20	6								2 inch diameter schedule 40 PVC screen (0.010 inch slotted)		
21											
22											
23	7								20/40 filter sand		
24											
25											
26	8								bottom screen end cap		
27											
28											
29	9										
				Borehole depth 28.0 ft (28.0 m)							

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



Borehole No. 16PM12

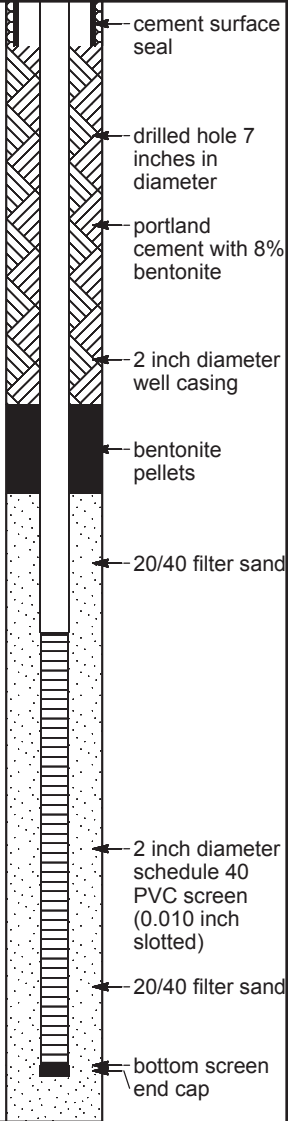
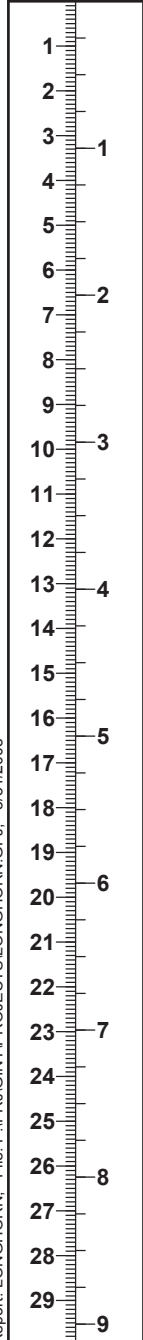
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,609.9 E 3,314,021.1
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	185.2	
1									Top PVC Casing	188.1	
2									cement surface seal		
3									drilled hole 7 inches in diameter		
4	1								portland cement with 8% bentonite		
5									2 inch diameter well casing		
6	2								bentonite pellets		
7									20/40 filter sand		
8											
9											
10	3										
11											
12											
13	4										
14											
15											
16	5										
17											
18											
19											
20	6										
21											
22											
23	7										
24											
25											
26	8										
27											
28											
29	9										
				Borehole depth 25.0 ft (25.0 m)							

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005

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8-Mar-2005





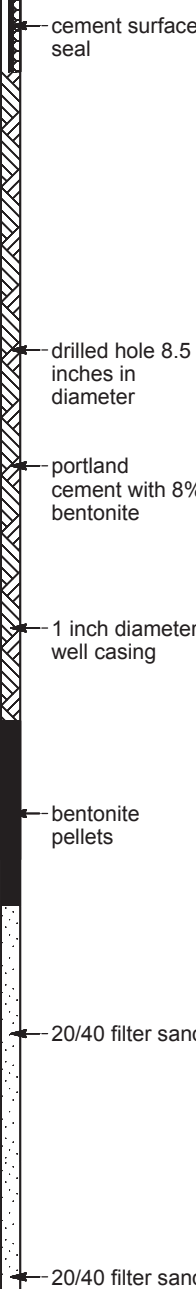
Borehole No. 16PM13D

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,683.2 E 3,314,034.5
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	186.9
				no samples recovered						Ground Surface	186.9
1										Top PVC Casing	189.8
2											
3				no samples recovered							
4				no samples recovered							
5				no samples recovered							
6				no samples recovered							
7				no samples recovered							
8				no samples recovered							
9				no samples recovered							
10				no samples recovered							
11				no samples recovered							
12				no samples recovered							
13				no samples recovered							
14				no samples recovered							

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Borehole No. 16PM13D

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,683.2 E 3,314,034.5
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
		8-Mar-2005		clayey sand (14'6" - 14'10")	SM				Ground Surface	186.9
15				sand, some silt and clay, medium to coarse, very loose, brown and red, moist	SPMC	60	NA	SS-3	16PM13-S: 1 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
16	5			sandy silt, medium, very loose, brown grey, wet					bottom of screen end cap	
17					SM				20/40 filter sand	
18									bentonite pellets	
19				clayey sand, medium, mottled brown and grey, moist to wet clay lens (19'6" - 19'10")	SC					
20	6			silty clay, trace sand, fine very stiff, mottled brown grey, moist		100	NA	SS-4	20/40 filter sand	
21					CLM					
22										
23	7			clayey silt, fine to medium, firm, mottled brown grey, moist, black grains	MLC				20/40 filter sand	
24				silty sand, very loose, brown grey, wet					16PM13-D: 1 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
25				some clay (24'2" - 24'4") change in colour to mottled red brown grey (24'4")						
26	8				SM	73	NA	SS-5	bottom of screen end cap	
27										
28				Borehole depth 28.0 ft (28.0 m)						

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



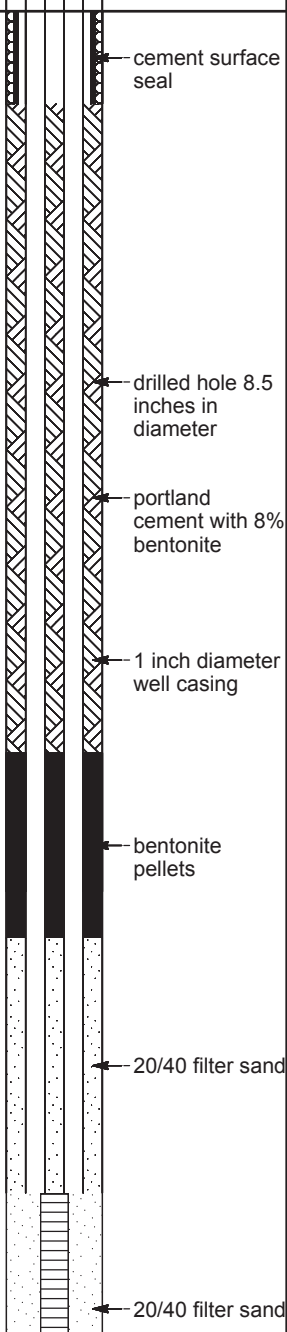
Borehole No. 16PM13S

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,673.2 E 3,314,034.5
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	186.9	
1									Top PVC Casing	189.8	
1				no samples recovered							
2											
3											
3				1	1						
4				1	1						
5				1	1						
6				1	1						
7				2	2						
8				2	2						
9				2	2						
10				3	3						
11				3	3						
12				3	3						
13				4	4						
14				4	4						

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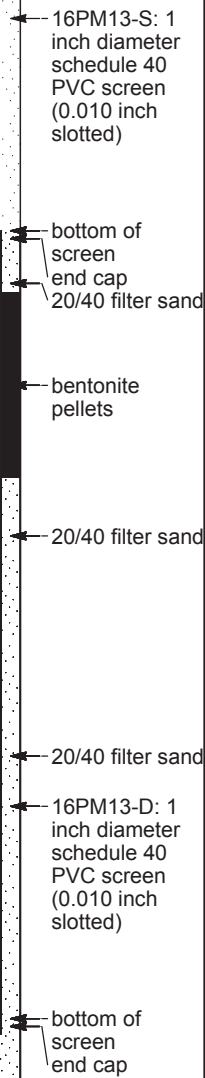
Borehole No. 16PM13S

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,673.2 E 3,314,034.5
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Unified Soil Classification	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level				Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
										186.9	
										189.8	
15		8-Mar-2005		clayey sand (14'6" - 14'10")	SM						
16				sand, some silt and clay, medium to coarse, very loose, brown and red, moist	SPMC						
17	5			sandy silt, medium, very loose, brown grey, wet							
18					SM						
19											
20	6			clayey sand, medium, mottled brown and grey, moist to wet clay lens (19'6" - 19'10")	SC						
21				silty clay, trace sand, fine very stiff, mottled brown grey, moist							
22					CLM						
23	7			clayey silt, fine to medium, firm, mottled brown grey, moist, black grains	MLC						
24				silty sand, very loose, brown grey, wet							
25				some clay (24'2" - 24'4") change in colour to mottled red brown grey (24'4")							
26	8				SM						
27											
28											
				Borehole depth 28.0 ft (28.0 m)							

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005





Borehole No. 16PM14

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,701.6 E 3,314,034.4
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 June 2003	Borehole Diameter: 8.5 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	188.2	
									Top PVC Casing	191.2	
1									cement surface seal		
2											
3											
4	1								drilled hole 8.5 inches in diameter		
5									portland cement with 8% bentonite		
6	2								2 inch diameter well casing		
7											
8											
9											
10	3										
11									bentonite pellets		
12											
13	4								20/40 filter sand		
14											
15											
16	5										
17											
18											
19											
20	6								2 inch diameter schedule 40 PVC screen (0.010 inch slotted)		
21											
22											
23	7								20/40 filter sand		
24											
25											
26	8								bottom screen end cap		
27											
28											
29	9										
				Borehole depth 28.0 ft (28.0 m)							

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▼
8-Mar-2005



Borehole No. 16EW09

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,647.1 E 3,314,058.7
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 March 2003	Borehole Diameter: 10.25 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	187.4
1				no samples recovered						Ground Surface	187.4
2										Top PVC Casing	190.4
3	1			no samples recovered							
4				no samples recovered							
5				no samples recovered							
6	2			no samples recovered							
7				no samples recovered							
8				no samples recovered							
9				no samples recovered							
10	3			no samples recovered							
11				no samples recovered							
12				no samples recovered							
13	4			no samples recovered							
14				no samples recovered							
15				no samples recovered							
16				no samples recovered							
17	5			no samples recovered							
18				no samples recovered							
19				no samples recovered							
6				no samples recovered							

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cement surface seal
 drilled hole 10.25 inches in diameter
 portland cement with 8% bentonite
 4 inch diameter well casing
 bentonite pellets
 20/40 filter sand



Borehole No. 16EW09

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,647.1 E 3,314,058.7
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 March 2003	Borehole Diameter: 10.25 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments		
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID		
					SC SM	100	NA	SS-4		Ground Surface 187.4	
21				silty clay, very stiff, brown, some pockets of grey	CL					Top PVC Casing 190.4	
22											
23	7			clayey sand, firm, light brown, wet	SC					4 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
24										20/40 filter sand	
25				silty sand, trace clay, loose, brown-grey, wet	SM	83	NA	SS-5			
26	8									bottom of screen end cap	
27				clayey sand, firm, mottled brown and grey, moist	SC						
28				Borehole depth 28.0 ft (28.0 m)							
29											
30	9										
31											
32											
33	10										
34											
35											
36	11										
37											
38											
39	12									NA - not available	

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Borehole No. 16EW10

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,687.9 E 3,314,023.0
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 March 2003	Borehole Diameter: 10.25 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	
				no samples recovered					Ground Surface	187.7	
1									Top PVC Casing	190.5	
2											
3	1			silty clay, mottled reddish brown and grey, moist							
4											
5				some sand	CL	100	NA	SS-1			
6											
7	2			silty sand, trace clay, loose, brown-grey, dry to moist	SM						
8				silty clay, fine to medium grained, stiff, mottled brown and grey, wet	CL						
9											
10	3			silty sand, fine to medium grained, loose, light brown, wet		55	NA	SS-2			
11											
12											
13	4			trace clay, fine grained, very wet							
14											
15					SM						
16						77	NA	SS-3			
17	5			some clay							
18				fine to medium grained, wet							
19											
6				some clay, brown-grey							

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cement surface seal
 drilled hole 10.25 inches in diameter
 portland cement with 8% bentonite
 4 inch diameter well casing
 bentonite pellets
 20/40 filter sand



Borehole No. 16EW10

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,687.9 E 3,314,023.0
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 25 March 2003	Borehole Diameter: 10.25 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	187.7
21					SM	100	NA	SS-4			
22				silty clay, stiff, brown-grey, wet	CL						
23	7			silty sand, trace clay, fine to medium grained, light brown, loose, very wet							
24											
25						83	NA	SS-5			
26	8										
27				no clay, loose							
28					SM						
29											
30	9										
31											
32						10	NA	SS-6			
33	10			Borehole depth 33.0 ft (33.0 m)							
34											
35											
36	11										
37											
38											
39	12										NA - not available

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4 inch diameter schedule 40 PVC screen (0.010 inch slotted)
 20/40 filter sand
 bottom of screen end cap



Borehole No. 16EW11

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,739.9 E 3,314,010.7
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 26 March 2003	Borehole Diameter: 10.25 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
				no samples recovered					Ground Surface	190.4
1									Top PVC Casing	193.4
2										
3	1			silty clay, stiff, mottled brown and grey, moist	CL					
4										
5				silty sand with trace clay, fine grained, loose, light brown, moist	SM	92	NA	SS-1		
6	2			silty clay with trace sand, stiff, light brown with some grey pockets, moist						
7				some sand, mottled brown and grey	CL					
8				no sand, firm						
9										
10	3			silty sand, trace clay, firm, brown-grey, moist	SM					
11				some clay						
12				clayey silt, trace sand, stiff, brown-grey, moist	CL	100	NA	SS-2		
13	4			silty sand, fine to medium grained, brown, loose, moist	SM					
14				clayey sand, some silt, fine grained, firm, brown, moist and wet	SC					
15				silty sand, fine to medium grained, loose, dark brown, moist	SM					
16	5			silty clay, stiff, light brown, moist	CL					
17										
18				silty sand, fine grained, loose, light brown, wet						
19				very wet						
20	6			very loose, very wet	SM					

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cement surface seal
 drilled hole 10.75 inches in diameter
 4 inch diameter well casing
 portland cement with 8% bentonite
 bentonite pellets
 20/40 filter sand



Borehole No. 16EW11

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,739.9 E 3,314,010.7
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 26 March 2003	Borehole Diameter: 10.25 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
									Ground Surface	190.4
									Top PVC Casing	193.4
21				silty clay, hard, light brown, wet	CL	100	NA	SS-4		
22				clayey sand, some silt, compact, light brown with small pockets of grey, wet	SC					← 20/40 filter sand
23	7			silty sand, trace clay, fine grained, loose, brown, very wet	SM					
24				silty clay, hard, mottled brown and grey, moist to wet	CL	100	NA	SS-5		← 4 inch diameter schedule 40 PVC screen (0.010 inch slotted)
25				clayey sand with some silt, loose, light brown, wet	SC					
26	8			silty sand, trace clay, loose, light brown-grey, wet						← bottom screen
27				brown	SM	100	NA	SS-6	← end cap	
28										
29	9									
30										
31										
32										
33	10			Borehole depth 33.0 ft (33.0 m)						
34										
35										
36	11									
37										
38										
39	12									
										NA - not available

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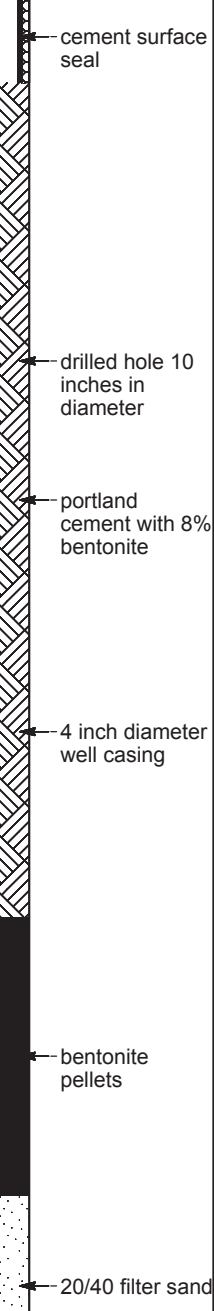
Borehole No. 16EW12

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,704.4 E 3,314,004.6
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 23 June 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
				clayey silt, firm, brown, moist, roots	MLC				Ground Surface	187.2
1				dark brown, dry to moist	MLC	100	NA	SS-1		
2				sandy silt, medium, compact, brown red grey, dry to moist						
3					SM					
4										
5				clayey silt, mottled light brown and grey, dry to moist	MLC	98	NA	SS-2		
6				silty clay, fine, very stiff, light brown grey, moist	CLM					
7				clay, very stiff, mottled brown and grey, moist	CL					
8				clay, some sand, fine to medium, firm, mottled light brown and grey, moist to wet						
9					CLS					
10				silt, some clay, very loose, brown, moist						
11					MLC	93	NA	SS-3		
12				silty clay, some sand, firm, light brown, dry to moist	CLMS					
13				silt, some clay, very loose, grey, wet						
14					MLC					

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Borehole No. 16EW12B

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,704.4 E 3,314,001.6
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 8 December 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		
1				no samples recovered					Ground Surface
2									Top PVC Casing
3									→ cement surface seal
4	1			sandy silt, trace clay, fine to medium grained, compact, light brown-red, dry to moist, oxidized					→ drilled hole 10 inches in diameter
5									→ 4 inch diameter well casing
6				some clay, fine grained, light brown-grey	SM	100	NA	SS-1	→ portland cement with 8% bentonite
7	2								
8				silty sand, trace clay, loose, brown, dry to moist					
9				sandy clay, some silt, stiff, brown-grey, moist to wet					→ bentonite pellets (1/2 inch)
10	3			higher clay content (10'2" - 10'6")	CL	100	NA	SS-2	
11									
12				silty sand, some clay, medium to coarse grained, loose, light brown-grey, moist to wet					→ 12/20 filter sand
13	4			higher clay content (12'5" - 12'8")					
14				sample taken (12'10" - 13') very loose, light brown, wet	SM				
15				sample taken (13'10" - 15'1")					
				some clay, compact, light brown-grey, moist to wet		83	NA	SS-3	

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Borehole No. 16EW12B

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,704.4 E 3,314,001.6
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 8 December 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		
16			[Diagonal hatching pattern]	higher clay content (15'11" - 16'3") silty clay, some sand, stiff, light brown-grey, moist	SM			[Well diagram showing screen and casing]	Ground Surface Top PVC Casing
17	5			higher clay content, very stiff (16'10" - 17'9")	CLMS				
18			[Diagonal hatching pattern]	sandy clay, moist to wet (18'5" - 19'2")	CL	100	NA	SS-4	4 inch diameter PVC Vee-Wire Wrap Screen (0.010 inch slotted)
19				silty clay, some sand, very stiff, light brown, red-brown, some grey, moist					
20	6		[Dotted pattern]	silty sand, some clay, medium grained, loose, brown-grey, moist	SM	88	NA	SS-5	12/20 filter sand
21				compact, moist to wet wet (23' - 23'7") some clay (23'9" - 24'2")					
22			[Dotted pattern]	sample taken (27'1.5" - 27'5")				bottom screen end cap	
23	7			no samples recovered					
24			[Dotted pattern]					formation collapse	
25	8								
26			[Dotted pattern]						
27									
28			[Dotted pattern]						
29	9								
30				Borehole depth 30.0 ft (30.0 m)					
31									

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Borehole No. 16EW13

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,670.3 E 3,314,000.2
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
				no samples recovered					Ground Surface	186.6
									Top PVC Casing	189.9
1										
2										
3										
4				clayey silt, trace sand, fine to medium, stiff, mottled brown, grey and red, moist, roots	MLCS					
5				silty sand, medium, very loose, brown and grey, moist to wet	SM					
6				silty clay, some sand, trace gravel, stiff, mottled brown, grey and red, moist	CL MLSG	60	NA	SS-1		
7										
8										
9				clayey sand, some silt, loose, mottled brown, grey and red, moist, some clay lenses	SC SM					
10										
11				clayey silt, mottled brown, grey and red, moist	MLC	100	NA	SS-2		
12				silty sand, medium to coarse, loose, brown, moist to wet silty clay lens (12')						
13				silty clay lens (12'10" - 13') grey, some roots	SM					
14				clay lens (13'8" - 13'10")						

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cement surface seal
 drilled hole 10 inches in diameter
 portland cement with 8% bentonite
 4 inch diameter well casing
 bentonite pellets
 20/40 filter sand



Borehole No. 16EW13

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,670.3 E 3,314,000.2
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
		8-Mar-2005			SM				Ground Surface	186.6
15				clayey silt, some sand, medium, firm, mottled brown grey red, moist	MLCS	95	NA	SS-3		
16	5			silty sand (15'8" - 16')	CL MLS					
17				silty clay, some sand, fine to medium, stiff, mottled brown, grey and red, moist	CLM					
18				clay, some silt, fine, very stiff, brown and grey, moist	MLS					
19				silty clay, fine to medium (17'5" - 17'9")	CLM	82	NA	SS-4		
20	6			sandy silt, some clay, fine to medium, loose mottled brown grey, wet					4 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
21				silty clay, some sand, fine to medium, very stiff, mottled brown grey, moist					20/40 filter sand	
22				sandy clay (21'6" - 21'10")	SM	78	NA	SS-5		
23	7			silty sand, trace clay, medium to coarse, very loose, mottled brown grey red, wet, roots					bottom screen end cap	
24										
25										
26	8									
27				green tint					Slough	
28				Borehole depth 28.0 ft (28.0 m)						

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Borehole No. 16EW14

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,634.2 E 3,313,994.3
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
				no samples recovered					Ground Surface	186.8
1									Top PVC Casing	189.8
2										
3	1			silt, some clay, firm, dark brown, moist to wet, lots of roots causing poor recovery	MLC	72	NA	SS-1		
4										
5										
6	2									
7										
8										
9				silty clay, stiff, mottled brown and grey	CLM					
10	3			sand, some clay, fine to medium, loose, brown, moist	SC	37	NA	SS-2		
11										
12										
13	4			silty sand, fine to medium, well sorted, very loose, brown and grey, very wet causing poor recovery	SM					
14				some clay						

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Borehole No. 16EW14

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,634.2 E 3,313,994.3
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 24 June 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		Ground Surface	186.8
16	5				SM	27	NA	SS-3			
17											
18				silty clay, very stiff, light brown, wet							
19											
20	6										
21					CLM	63	NA	SS-4	4 inch diameter schedule 40 PVC screen (0.010 inch slotted)		
22									20/40 filter sand		
23	7										
24				no samples recovered							
25						0	NA	SS-5	bottom screen end cap		
26	8			Borehole depth 26.0 ft (26.0 m)							
27											
28											
29	9										



Borehole No. 16EW14B

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,633.2 E 3,313,997.3
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 8 December 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		
1				no samples recovered					Ground Surface
2									Top PVC Casing
3				no sample recovered, pushed a root causing poor recovery					→ cement surface seal
4									→ drilled hole 10 inches in diameter
5						40	NA	SS-1	→ portland cement with 8% bentonite
6				silty clay, soft, grey-black, moist					→ 4 inch diameter well casing
7					CLM				
8				silty sand, some roots, medium grained, very loose, brown-grey, moist to wet					
9					SM				
10						55	NA	SS-2	→ bentonite pellets (1/2 inch)
11				clay, some silt, very stiff, grey-black mottled, dry to moist					
12					CL				
13				clayey sand, medium grained, loose, brown-grey mottled, dry to moist, some roots					→ 12/20 filter sand
14					SC				
15				clay, some silt, stiff, brown-grey mottled, moist		98	NA	SS-3	
					CL				

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Borehole No. 16EW14B

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,633.2 E 3,313,997.3
Geologist: N. Barros	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 8 December 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		
5					CL				Ground Surface Top PVC Casing ← 4 inch diameter PVC Vee-Wire Wrap Screen (0.010 inch slotted) ← 12/20 filter sand ← bottom screen ← end cap ← formation collapse
17				sandy clay, firm, brown-grey mottled, moist to wet	CLS				
18				clay, trace silt, stiff, brown-grey mottled, dry to moist, some roots					
19									
20	6				CL	100	NA	SS-4	
21									
22				clayey sand, some roots, compact, brown-grey, moist	SC				
23	7			silty sand, medium to coarse grained, loose, brown-grey, wet causing poor recovery					
24									
25					SM	50	NA	SS-5	
26	8								
27									
28				no samples recovered					
29									
30	9			Borehole depth 30.0 ft (30.0 m)					
31									

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



Borehole No. 16EW15

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,600.9 E 3,313,989.6
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 23 June 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
				no samples recovered					Ground Surface	186.8
1									Top PVC Casing	189.8
2										
3				1						
4										
5										
6					CLM	100	NA	SS-1		
7				2						
8					SM					
9					SM					
10				3						
11					ML	97	NA	SS-2		
12					SC					
13				4						
14					SM					

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005

8-Mar-2005



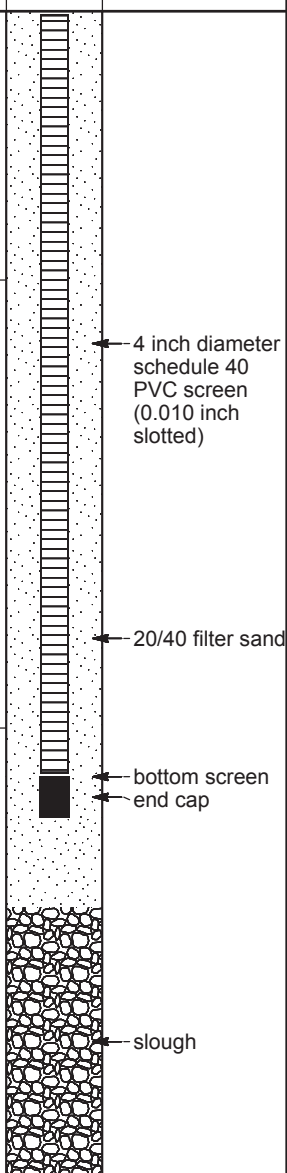
Borehole No. 16EW15

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates: N 6,953,600.9 E 3,313,989.6
Geologist: D. Bertrand	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 23 June 2003	Borehole Diameter: 10 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples			Well Configuration	Elevations (ft amsl) and Comments	
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)		Soil Sample ID	
									Ground Surface	186.8
									Top PVC Casing	189.8
16	5			sandy silt, fine, loose, mottled brown grey, moist to wet	MLS	100	NA	SS-3		
17				silty clay, very stiff, mottled brown and grey, moist to wet	CLM					
18				silty sand, trace clay, fine, loose, mottled brown grey, moist to wet	SM					
19				silty clay, very stiff, mottled brown grey, moist to wet						
20	6			silty sand, loose, brown, wet, small pockets of grey	SM					
21				sandy silt, trace clay, brown grey, wet, small pockets of grey	MLS					
22				silty sand, some clay, loose, brown, wet	SPMC					
23	7			silty clay, fine, v. stiff, mottled brown grey, moist						
24										
25										
26	8									
27										
28										
29	9									
				Borehole depth 28.0 ft (28.0 m)						

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005





Borehole No. 16IW01

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates:
Geologist: B. Corrigan	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 2 September 2003	Borehole Diameter: 8 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
1									Ground Surface	
2									Top PVC Casing	
3										
4		1							drilled hole 8 inches in diameter	
5									portland cement with 8% bentonite	
6		2							2 inch diameter well casing	
7										
8										
9										
10		3								
11										
12									bentonite pellets	
13		4							20/40 filter sand	
14										
15										
16		5								
17										
18										
19										
20		6							2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
21										
22									20/40 filter sand	
23		7								
24										
25									bottom screen end cap	
26		8								
27										
28										
29		9								



Borehole No. 16IW02

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates:
Geologist: B. Corrigan	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 2 September 2003	Borehole Diameter: 8 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
1									Ground Surface	
2									Top PVC Casing	
3										
4									drilled hole 8 inches in diameter	
5									portland cement with 8% bentonite	
6									2 inch diameter well casing	
7										
8										
9										
10										
11										
12									bentonite pellets	
13									20/40 filter sand	
14										
15										
16										
17										
18										
19										
20									2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
21										
22									20/40 filter sand	
23										
24										
25									bottom screen end cap	
26										
27										
28										
29										

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



Borehole No. 16IW03

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates:
Geologist: B. Corrigan	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 2 September 2003	Borehole Diameter: 8 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
1									Ground Surface	
2									Top PVC Casing	
3										
4		1							drilled hole 8 inches in diameter	
5									portland cement with 8% bentonite	
6		2							2 inch diameter well casing	
7										
8										
9										
10		3								
11										
12									bentonite pellets	
13		4							20/40 filter sand	
14										
15										
16		5								
17										
18										
19										
20		6							2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
21										
22									20/40 filter sand	
23		7								
24										
25									bottom screen end cap	
26		8								
27										
28										
29		9								



Borehole No. 16IW04

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates:
Geologist: B. Corrigan	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 3 September 2003	Borehole Diameter: 8 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
1									Ground Surface	
2									Top PVC Casing	
3										
4									drilled hole 8 inches in diameter	
5									portland cement with 8% bentonite	
6									2 inch diameter well casing	
7										
8										
9										
10										
11										
12									bentonite pellets	
13									20/40 filter sand	
14										
15										
16										
17										
18										
19										
20									2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
21									20/40 filter sand	
22										
23										
24										
25									bottom screen end cap	
26										
27										
28										
29										



Borehole No. 16IW05

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates:
Geologist: B. Corrigan	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 2 September 2003	Borehole Diameter: 8 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
1									Ground Surface	
2									Top PVC Casing	
3										
4									drilled hole 8 inches in diameter	
5									portland cement with 8% bentonite	
6									2 inch diameter well casing	
7										
8										
9										
10										
11										
12									bentonite pellets	
13									20/40 filter sand	
14										
15										
16										
17										
18										
19										
20									2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
21									20/40 filter sand	
22										
23										
24										
25									bottom screen end cap	
26										
27										
28										
29										

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



Borehole No. 16IW06

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates:
Geologist: B. Corrigan	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 2 September 2003	Borehole Diameter: 8 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
1									Ground Surface	
2									Top PVC Casing	
3										
4									drilled hole 8 inches in diameter	
5									portland cement with 8% bentonite	
6									2 inch diameter well casing	
7										
8										
9										
10										
11										
12									bentonite pellets	
13									20/40 filter sand	
14										
15										
16										
17										
18										
19										
20									2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
21										
22									20/40 filter sand	
23										
24										
25									bottom screen end cap	
26										
27										
28										
29										

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



Borehole No. 16IW07

Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates:
Geologist: B. Corrigan	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 3 September 2003	Borehole Diameter: 8 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
1									Ground Surface	
2									Top PVC Casing	
3										
4	1								drilled hole 8 inches in diameter	
5									portland cement with 8% bentonite	
6									2 inch diameter well casing	
7	2									
8										
9										
10	3									
11									bentonite pellets	
12									20/40 filter sand	
13	4									
14										
15										
16	5									
17										
18										
19									2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
20	6									
21										
22										
23	7								20/40 filter sand	
24									bottom screen end cap	
25										
26	8									
27										
28										
29	9									

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005



Borehole No. 16IW08

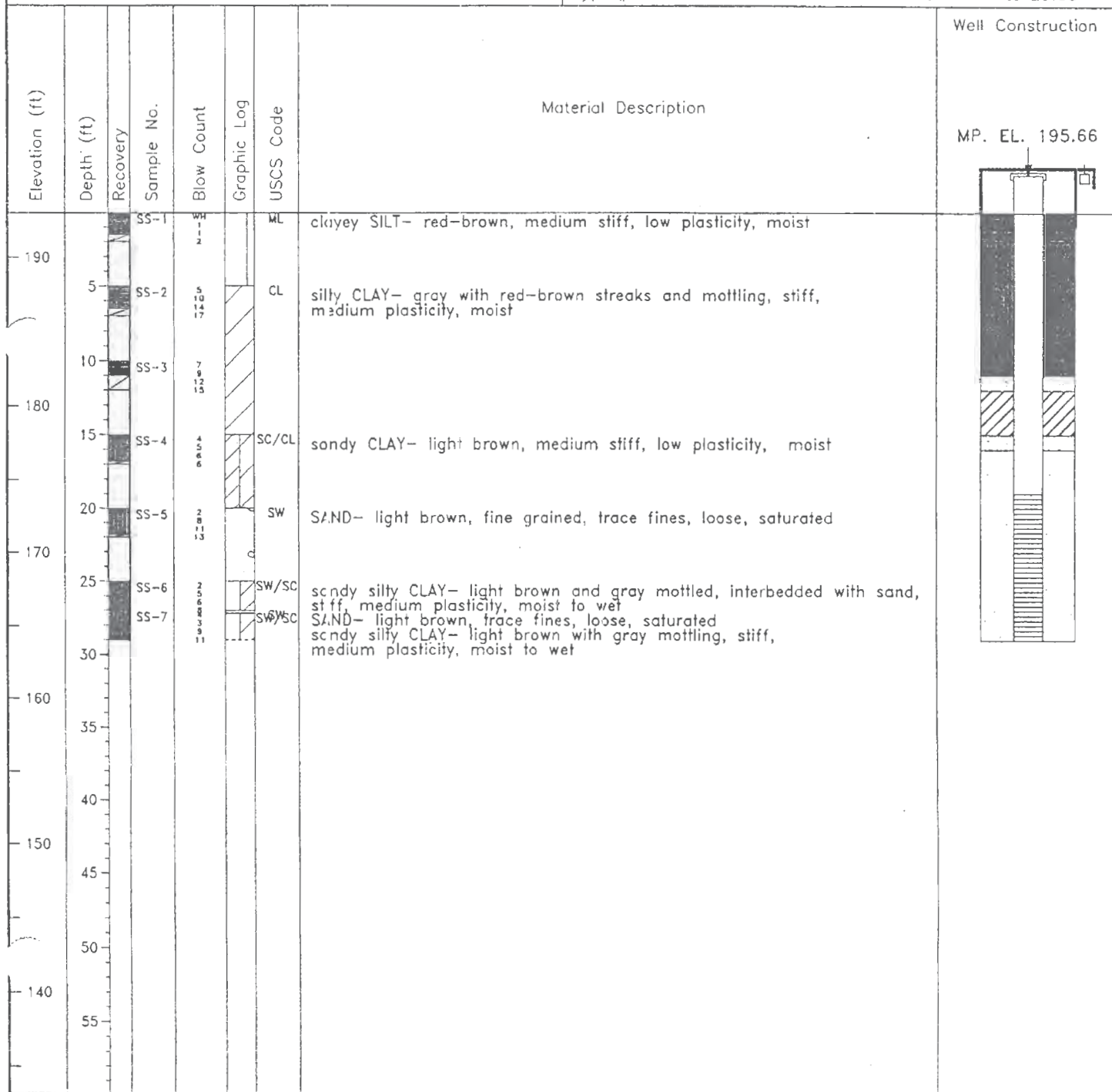
Borehole Log

Project No.: TR0136	Location: Site 16 Landfill
Client: Longhorn Army Ammunition Plant	Coordinates:
Geologist: B. Corrigan	Drilling Method: Hollow Stem Augers
Drilling Company: E TTL Drilling Services	Well Material: 4 inch PVC Vee-Wire Wrap
Completion Date: 3 September 2003	Borehole Diameter: 8 inches
	Site Datum: Site 16 Landfill Benchmark

Depth			Stratigraphy	Lithologic Description	Geologic Samples				Well Configuration	Elevations (ft amsl) and Comments
Depth, feet	Depth, metres	Water Level			Unified Soil Classification	Recovery, %	PID (ppmv)	Soil Sample ID		
1									Ground Surface	
2									Top PVC Casing	
3										
4	1								drilled hole 8 inches in diameter	
5									portland cement with 8% bentonite	
6									2 inch diameter well casing	
7	2									
8										
9										
10	3								bentonite pellets	
11										
12									20/40 filter sand	
13	4									
14										
15										
16	5									
17										
18										
19									2 inch diameter schedule 40 PVC screen (0.010 inch slotted)	
20	6									
21										
22										
23	7								20/40 filter sand	
24									bottom screen end cap	
25										
26	8									
27										
28										
29	9									

Report: LONGHORN; File: P:\PRJ\GINT\PROJECTS\LONGHORN.GPJ; 5/31/2005

Sverdrup ENVIRONMENTAL		Site ID: 16WW16	Page 1 of 1
		X Coordinate: 3313895.70	Y Coordinate: 6953639.30
Location: Longhorn Army Ammunition Plant		Elevation: 193.04'	Datum: NGVD
e(s): 04/14/95 - 04/14/95		Total Depth: 29.00'	Measuring Point: 195.66'
Logged By: K. Williams		Completed Depth: 29.00'	Static Water Level:
Contractor: Burlington Environmental Inc.		Well Casing: type: SS dia: 4.00in fm: -2.6' to: 19.00'	
Drilling Method: 6-1/4 in. I.D. Hollow Stem Auger		Screens: type: Slotted size: .010in dia: 4.00in fm: 19.00' to: 29.00'	
Remarks:		Annular Fill: type: Bentonite/Cement Grout fm: .00' to: 2.00' type: Bentonite Grout fm: 2.00' to: 11.00' type: Secondary Sand Filter fm: 11.00' to: 12.00' type: Granular Bentonite Seal fm: 12.00' to: 15.00' type: Secondary Sand Filter fm: 15.00' to: 16.00' type: #20-40 Silica Filter Sand fm: 16.00' to: 29.00'	

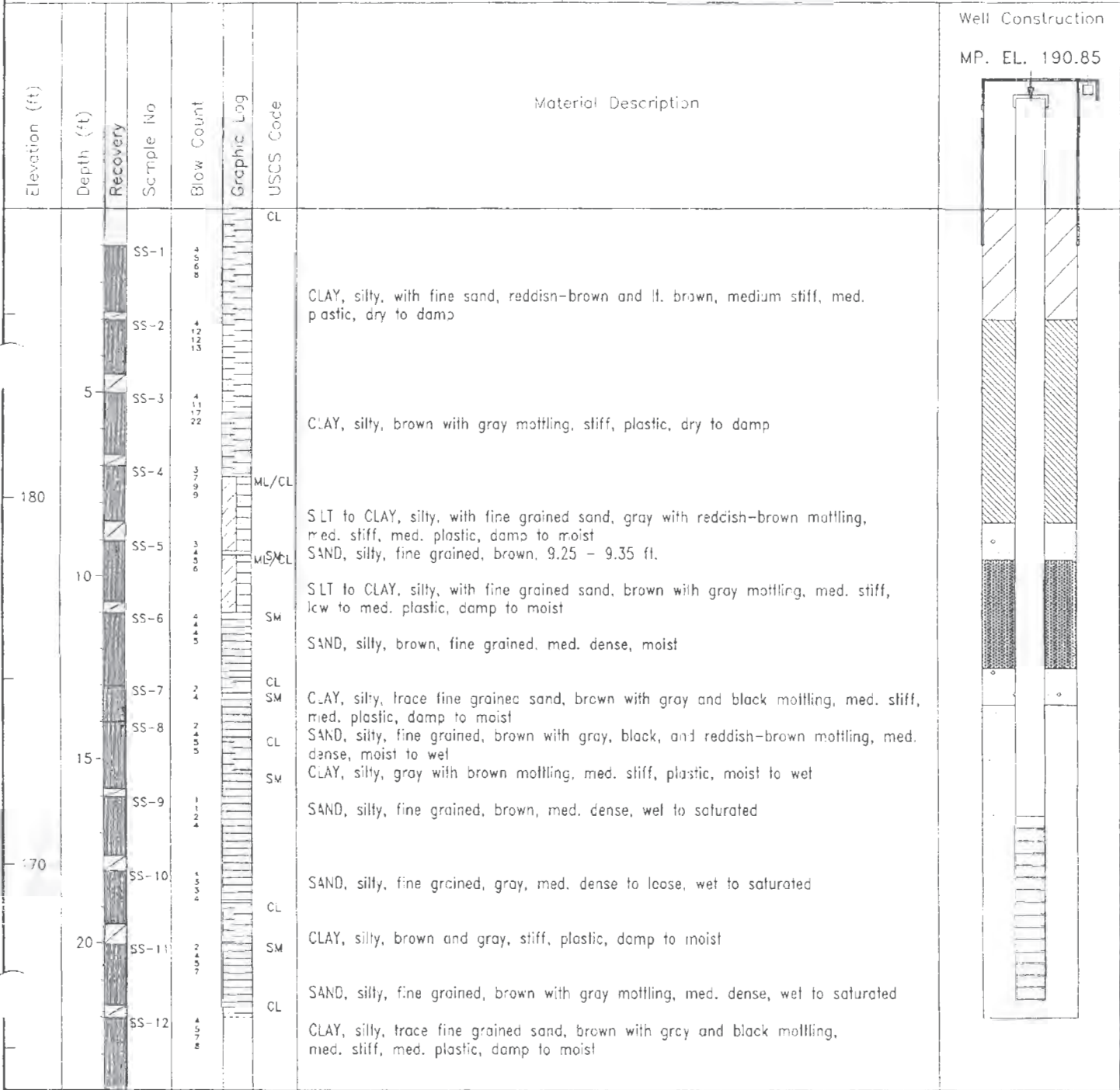


Sverdrup ENVIRONMENTAL		Site ID: 16WW35	
		X Coordinate: 3314077.77	Y Coordinate: 6953657.15
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 187.42'	Datum: NGVD
Date(s): 06/26/97 - 06/26/97		Total Depth: 44.00'	Measuring Point: 190.53'
Logged By: Sandra Rudolph		Completed Depth: 43.50'	Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.1' to: 33.50'	
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 33.50' to: 43.50'	
Remarks:		Annular Fill:	
		type: Cement Grout fm: 0.00' to: 3.00' type: Bentonite/Cement Grout fm: 3.00' to: 25.00' type: #20-40 Silica Filter Sand fm: 25.00' to: 26.00' type: Bentonite Pellets fm: 26.00' to: 29.00' type: #20-40 Silica Filter Sand fm: 29.00' to: 30.00' type: Sand Filter fm: 30.00' to: 44.00'	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
						CL		MP. EL. 190.53
			SS-1	8		CL	CLAY, silty, with fine sand, reddish-brown and lt. brown, medium stiff, med. plastic, dry to damp	
			SS-2	12		CL		
	5		SS-3	4		CL	CLAY, silty, brown with gray mottling, stiff, plastic, dry to damp	
180			SS-4	3		ML/CL		
			SS-5	3		MS/CL	SILT to CLAY, silty, with fine grained sand, gray with reddish-brown mottling, med. stiff, med. plastic, damp to moist SAND, silty, fine grained, brown, 9.25 - 9.35 ft.	
10			SS-6	4		SM	SILT to CLAY, silty, with fine grained sand, brown with gray mottling, med. stiff, low to med. plastic, damp to moist	
			SS-7	2		CL	SAND, silty, brown, fine grained, med. dense, moist	
			SS-8	2		SM	CLAY, silty, trace fine grained sand, brown with gray and black mottling, med. stiff, med. plastic, damp to moist	
15			SS-9	2		CL	SAND, silty, fine grained, brown with gray, black, and reddish-brown mottling, med. dense, moist to wet	
			SS-10	2		SM	CLAY, silty, gray with brown mottling, med. stiff, plastic, moist to wet	
170			SS-11	2		CL	SAND, silty, fine grained, brown, med. dense, wet to saturated	
			SS-12	2		CL	SAND, silty, fine grained, gray, med. dense to loose, wet to saturated	
	20		SS-11	2		SM	CLAY, silty, brown and gray, stiff, plastic, damp to moist	
			SS-12	2		CL	SAND, silty, fine grained, brown with gray mottling, med. dense, wet to saturated	
						CL	CLAY, silty, trace fine grained sand, brown with gray and black mottling, med. stiff, med. plastic, damp to moist	
						CL	CLAY, silty, brown with gray mottling, stiff, plastic, dry to damp	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Graphic Log	USCS Code	Material Description	Well Construction
			SS-13	1		ML	SILT, clayey, with fine grained sand, brown and gray, med. stiff, low plastic, moist to saturated	
160			SS-14	2		CL	CLAY, silty, trace fine grained sand, gray with reddish-brown mottling, med. stiff to stiff, plastic, moist	
	29		SS-15	2		ML	SILT, clayey, with fine grained sand, gray with brown mottling, med. stiff, med. plastic, moist to wet	
			SS-16	1		CL/SM	CLAY, silty, gray with brown mottling, stiff, plastic, moist	
			SS-17	2			SILT, clayey and SAND, fine grained, gray with brown mottling, soft, med. plastic, moist to saturated	
	34		SS-18	1		SM/SP	SILT, clayey and SAND, fine grained with angular gravel at 33.6 to 33.8 ft., reddish-brown with gray mottling, wet SILT, sandy, fine grained, gray with black mottling, wet	
			SS-19	1		SP	SAND, silty, fine grained, gray and brown, loose to med. dense, wet to saturated	
150			SS-20	4 8 16 22			SAND, slightly silty, fine grained, gray, loose to med. dense, wet to saturated	
	39		SS-21	12 24 46 80			SAND, slightly silty, fine grained, gray with brown mottling, med. dense to dense, wet to saturated	
			SS-22	14 24 23 24			SAND, slightly clayey and silty, fine grained, brown and gray, med. dense to dense, wet to saturated	
	44					CL/CH	SAND, slightly silty, fine grained, gray, dense, wet to saturated CLAY, silty, with thin layers of lt gray silt, dark gray, very stiff, plastic, dry	
	49							
	54							
0								
	59							

Sverdrup ENVIRONMENTAL		Site ID: 16WW36	
		X Coordinate: 3314085.26	Y Coordinate: 6953660.11
Location: LONGHORN ARMY AMMUNITION PLANT		Elevation: 187.86'	Datum: NGVD
Date(s): 06/27/97 - 06/27/97		Total Depth: 22.00'	Measuring Point: 190.85'
Logged By: Sandra Rudolph		Completed Depth: 21.50'	Static Water Level:
Contractor: Philip Environmental		Well Casing: type: SS dia: 4.00in fm: -3.0' to: 16.50'	
Drilling Method: Hollow Stem Auger		Screens: type: Wire-wrap size: 0.010in dia: 4.00in fm: 16.50' to: 21.50'	
Remarks:		Annular Fill:	
		type: Cement Grout fm: 0.00' to: 3.00' type: Bentonite/Cement Grout fm: 3.00' to: 8.50' type: #20-40 Silica Filter Sand fm: 8.50' to: 9.50' type: Bentonite Pellets fm: 9.50' to: 12.50' type: #20-40 Silica Filter Sand fm: 12.50' to: 13.50' type: Sand Filter fm: 13.50' to: 22.00'	



ENCLOSURE 2

TCEQ CORE DATA FORM



TCEQ Core Data Form

TCEQ Use Only

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission (If other is checked please describe in space provided.)		
<input type="checkbox"/> New Permit, Registration or Authorization (Core Data Form should be submitted with the program application.)		
<input type="checkbox"/> Renewal (Core Data Form should be submitted with the renewal form)	<input type="checkbox"/> Other _____	
2. Customer Reference Number (if issued)	Follow this link to search for CN or RN numbers in Central Registry**	3. Regulated Entity Reference Number (if issued)
CN _____		RN _____

SECTION II: Customer Information

4. General Customer Information	5. Effective Date for Customer Information Updates (mm/dd/yyyy)		_____	
<input type="checkbox"/> New Customer <input type="checkbox"/> Update to Customer Information <input type="checkbox"/> Change in Regulated Entity Ownership <input type="checkbox"/> Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)				
<i>The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).</i>				
6. Customer Legal Name (If an individual, print last name first: e.g.: Doe, John)			If new Customer, enter previous Customer below:	
U.S. Department of Army			_____	
7. TX SOS/CPA Filing Number	8. TX State Tax ID (11 digits)	9. Federal Tax ID (9 digits)	10. DUNS Number (if applicable)	
_____	_____	_____	_____	
11. Type of Customer:	<input type="checkbox"/> Corporation	<input type="checkbox"/> Individual	Partnership: <input type="checkbox"/> General <input type="checkbox"/> Limited	
Government: <input type="checkbox"/> City <input type="checkbox"/> County <input checked="" type="checkbox"/> Federal <input type="checkbox"/> State <input type="checkbox"/> Other	<input type="checkbox"/> Sole Proprietorship	<input type="checkbox"/> Other: _____		
12. Number of Employees		13. Independently Owned and Operated?		
<input checked="" type="checkbox"/> 0-20 <input type="checkbox"/> 21-100 <input type="checkbox"/> 101-250 <input type="checkbox"/> 251-500 <input type="checkbox"/> 501 and higher		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
14. Customer Role (Proposed or Actual) - as it relates to the Regulated Entity listed on this form. Please check one of the following:				
<input type="checkbox"/> Owner <input type="checkbox"/> Operator <input checked="" type="checkbox"/> Owner & Operator <input type="checkbox"/> Occupational Licensee <input type="checkbox"/> Responsible Party <input type="checkbox"/> Voluntary Cleanup Applicant <input type="checkbox"/> Other: _____				
15. Mailing Address:	_____			

City	_____	State	_____	ZIP
_____	_____	_____	_____	ZIP + 4
16. Country Mailing Information (if outside USA)			17. E-Mail Address (if applicable)	
_____			_____	
18. Telephone Number	19. Extension or Code		20. Fax Number (if applicable)	
() -	-		() -	

SECTION III: Regulated Entity Information

21. General Regulated Entity Information (If "New Regulated Entity" is selected below this form should be accompanied by a permit application)	
<input type="checkbox"/> New Regulated Entity <input type="checkbox"/> Update to Regulated Entity Name <input type="checkbox"/> Update to Regulated Entity Information	
<i>The Regulated Entity Name submitted may be updated in order to meet TCEQ Agency Data Standards (removal of organizational endings such as Inc, LP, or LLC).</i>	
22. Regulated Entity Name (Enter name of the site where the regulated action is taking place.)	
LHAAP-16 Landfill, Longhorn Army Ammunition Plant	

23. Street Address of the Regulated Entity: (No PO Boxes)							
	City		State		ZIP		ZIP + 4
24. County							

Enter Physical Location Description if no street address is provided.

25. Description to Physical Location:	LHAAP is located in the northeast corner of Harrison County between SH43 and the western shore of Caddo Lake								
26. Nearest City	Karnack			State	TX		Nearest ZIP Code	75661	
27. Latitude (N) In Decimal:	32.6665		28. Longitude (W) In Decimal:	94.1265					
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds				
32	39	59.4	94	07	35.4				
29. Primary SIC Code (4 digits)	30. Secondary SIC Code (4 digits)		31. Primary NAICS Code (5 or 6 digits)		32. Secondary NAICS Code (5 or 6 digits)				

33. What is the Primary Business of this entity? (Do not repeat the SIC or NAICS description.)

Inactive Government-Owned Industrial Facility

34. Mailing Address:							
	City		State		ZIP		ZIP + 4
35. E-Mail Address:							
36. Telephone Number		37. Extension or Code		38. Fax Number (if applicable)			
() -				() -			

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form. See the Core Data Form instructions for additional guidance.

<input type="checkbox"/> Dam Safety	<input type="checkbox"/> Districts	<input type="checkbox"/> Edwards Aquifer	<input type="checkbox"/> Emissions Inventory Air	<input type="checkbox"/> Industrial Hazardous Waste
<input type="checkbox"/> Municipal Solid Waste	<input type="checkbox"/> New Source Review Air	<input type="checkbox"/> OSSF	<input type="checkbox"/> Petroleum Storage Tank	<input type="checkbox"/> PWS
<input type="checkbox"/> Sludge	<input type="checkbox"/> Storm Water	<input type="checkbox"/> Title V Air	<input type="checkbox"/> Tires	<input type="checkbox"/> Used Oil
<input type="checkbox"/> Voluntary Cleanup	<input type="checkbox"/> Waste Water	<input type="checkbox"/> Wastewater Agriculture	<input type="checkbox"/> Water Rights	<input checked="" type="checkbox"/> Other:

SECTION IV: Preparer Information

40. Name:				41. Title:		
42. Telephone Number	43. Ext./Code	44. Fax Number	45. E-Mail Address			
() -		() -				

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:			Job Title:		
Name (In Print):			Phone:	() -	
Signature:			Date:		



**Subject: Final Minutes, Quarterly Restoration Advisory Board (RAB) Meeting
Longhorn Army Ammunition Plant (LHAAP)**

Location of Meeting: Karnack Community Center, Karnack, Texas

Date of Meeting: April 19, 2018, 4:00 – 5:00 PM Central Daylight Time (CDT)

Meeting Participants:

Army BRAC:	Rose M. Zeiler
USACE:	Aaron Williams and Rick Smith
USAEC:	Andrew Maly
Bhate:	Kim Nemmers and Dustin McNeil
APTIM:	William (Bill) Foss
USEPA Region 6:	Rich Mayer, Dorelle Harrison
TCEQ:	April Palmie
USGS:	Kent Becher
RAB:	Present: Paul Fortune, Carol Fortune, Judy VanDeventer, Tom Walker, Charles Dixon, and Richard Le Tourneau Absent: Ken Burkhalter; Lee Guice; Ted Kurz; Terry Britt; James Lambright; John Pollard, Jr.; and Nigel R. Shivers
Public:	Laura-Ashley Overdyke, Katherine Edmonds, Robert Lanier, Sharon Metting, and Carl Dunn

An agenda for the RAB meeting, a color copy of the Bhate Environmental Associates, Inc. (Bhate) slide presentation, and handouts (see list at end of meeting minutes) were provided for meeting attendees.

Welcome and Introduction

Mr. Paul Fortune, RAB Co-Chair, called the meeting to order. Mr. Fortune noted new persons were at the RAB Meeting. Mr. Andrew Maly stated that he is with the United States Army Environmental Command (USAEC). Mr. Robert Lanier stated that he is a nearby home owner. Sharon Metting was also a noted as a new attendee.

Open Items

Ms. Rose Zeiler stated that the RAB Members were sent the minutes from the January 2018 meeting. Ms. Judy VanDeventer motioned for approval to which Mr. Paul Fortune seconded. Ms. Zeiler also noted that there were new people attending and that the use of technical terms may not be familiar to those people or even existing RAB Members. Ms. Zeiler suggested that a brief hydrogeology refresher be held at the next meeting, which was agreed to by others at the meeting.

Ms. Kim Nemmers mentioned that handouts were available and encouraged those that had not picked up these handouts to do so. Ms. Nemmers discussed the agenda as outlined and explained the abbreviations slide. Ms. Nemmers explained that the RAB Member form was available as a handout and encouraged those that might be interested in joining to take one. Mr. Fortune stated that public participation was encouraged.



Ms. Nemmers presented the website address for the LHAAP and stated that the site includes the final documents prepared and brief information about the sites. The feedback from the public has been positive for the website.

Ms. Nemmers explained the sites remaining to be remediated at LHAAP, and which sites are included under the Bhate project. Bhate is the prime contractor for all of the sites that are under a Record of Decision (ROD). Ms. Katherine Edmonds asked if there were any environmental experts at the RAB, to which Ms. Nemmers introduced Ms. April Palmie with the Texas Commission on Environmental Quality (TCEQ) and Mr. Rich Mayer with the United States Environmental Protection Agency (USEPA). Ms. Nemmers then explained that the sites to be discussed at the RAB would be those under the Bhate contract.

Defense Environmental Restoration

Overview of Sites

Ms. Nemmers discussed the documents being prepared and the field work that has been completed over the prior 3 months to move the sites forward. Ms. Nemmers explained that, under the new contract, a new work plan to cover all the work including health and safety and standard operating procedures (e.g. how to install a well) was prepared and is being finalized.

Ms. Nemmers explained two decision documents are being prepared to address LHAAP-03 soil and groundwater separately. Because the groundwater under Site 3 is indistinguishable from the groundwater plume under LHAAP-58, it will be addressed under the Site 58 remedy, which requires an explanation of significant difference (ESD). The LHAAP-03 ROD is being revised and will address only the contaminated soils at LHAAP-03. LHAAP-03 is located within LHAAP-58.

Ms. Nemmers explained that a lot of groundwater monitoring is performed to evaluate how the contamination is attenuating or how the remedies are performing. So, there are several documents being prepared to present that information for sites.

A Pre-Design Investigation, which has been discussed at previous meetings, was completed at Site LHAAP-17 to assess the soil impacts based upon more recent screening criteria to develop the design for that site. The LHAAP-17 pre-design investigation was completed with the exception of soil samples that were in a wet area.

A Groundwater Treatment Plant (GWTP) Report is also being prepared which will include surface water and Site LHAAP-18/24, which feeds groundwater to the GWTP.

Ms. Edmonds asked what the mercury level is at LHAAP. Ms. Zeiler asked if the reference was to levels of mercury in Caddo Lake. Ms. Edmonds stated that mercury was dumped into the lake. Ms. Zeiler stated that she was unaware of dumping, but that there was quite a bit of sediment testing conducted at Caddo Lake and the tributaries to identify hot spots, including along LHAAP. The results were that there was some mercury in sediment but at levels lower than other areas in the lake. Reports were that the mercury was related to power plants. Ms. Laura-Ashley Overdyke, CLI Executive Director, stated that there are fish mercury warnings. Mr. Kent Becher of the United States Geological Survey (USGS) explained that the source of mercury in the lake is airborne from coal-burning power plants all over east Texas and not LHAAP. Mr. Robert Lanier said he just wanted to know if he could eat the fish. Ms. Overdyke said the restrictions are still



in effect but that the mercury levels in the fish are going down and are expected to go down more based upon fish tissue sampling. Ms. Overdyke stated that it might help new attendees in the future to explain the purpose of the RAB meeting at the start of the meeting. Ms. Overdyke explained that the purpose of the meeting is to discuss the LHAAP cleanup with the RAB.

Mr. Lanier asked where the soil removed goes when it is excavated during a cleanup of a site and who governs and watches it. Ms. Zeiler explained that waste is governed by the Resource Conservation and Recovery Act (RCRA) and has to be disposed of at the proper facility. Ms. Zeiler stated that the Army and contractor watch to make sure the waste is classified and disposed of properly and that information is then reviewed by the TCEQ and USEPA. Ms. VanDeventer stated that she can attest that the disposal of soils is being watched based upon her many years on the RAB. Ms. VanDeventer explained that it is the RAB's role to ask questions and make sure that they get answered. Mr. Fortune said the question was a valid question and encouraged people that are interested to join the RAB to get the information out to the community.

Ms. Nemmers continued to discuss LHAAP completed field work by explaining that groundwater sampling is conducted as either remedial action-operations (RA-O) or performance sampling when listed. Groundwater monitoring means that water is collected from existing wells and that water is sent to offsite analytical laboratories for analysis. The groundwater data is then pulled into monitoring reports.

Repairs (i.e. soil placed where depressions were observed) were completed at LHAAP-19 landfill but will need to be repaired again (i.e. more soil placed and seeding completed) when things dry up more.

Ms. Nemmers explained that reports and work plans are used in the environmental industry to document activities. So, you will see that field work is followed by reports to document the work completed. The ROD and ESD for LHAAP-03 is being worked on to finalize these documents. The Pre-Design Investigation Report for LHAAP-17 will document the soil and groundwater results to support the design. A report is being prepared to document the remediation recently completed for LHAAP-58.

The 3 month look-ahead includes more sampling. Ms. Nemmers explained that, in addition, new monitoring wells and injection wells are being installed at LHAAP-16. The monitoring wells will further define the extent of groundwater contamination. The injection wells will be used to treat the groundwater contamination. Also, another shallow well is planned at LHAAP-17 to ensure that the groundwater contamination is fully defined.

LHAAP-58

Ms. Nemmers then discussed remediation at LHAAP-58, which primarily has chlorinated solvent contamination. The site has a decision document which means the remedy was selected. For LHAAP-58, the remedy selected was monitored natural attenuation which is essentially naturally occurring microbes in the groundwater that are able to use the contamination as a food source. After 2 years of monitoring, it was determined that more help was needed for the bacteria. The Eastern Plume was treated previously. In the past month, the Western Plume was also treated. During the baseline groundwater sampling, the bacteria needed to degrade the chlorinated



compounds were found to be naturally occurring. However, we added more bacteria during the treatment as well as a carbon substrate, which in this case was vegetable oil. Ms. Nemmers explained that the entire process implemented was to keep the bacteria happy in their new environment so that they will grow. The groundwater is monitored to ensure that the conditions are good for the bacteria, which are relatively new to the environmental cleanup industry.

Ms. Nemmers showed a map where the new monitoring wells were installed and stated that the downgradient monitoring well had fully defined the plume as no impacts were detected during the baseline groundwater sampling. Two mobilizations were completed for the treatment of the groundwater. The first injection was used to condition the aquifer to decrease the oxidation-reduction potential because the aquifer already had low dissolved oxygen. Prior to injection of the bacteria, monitoring was completed that confirmed the aquifer conditions were good. Ms. Nemmers then showed photos of the field work and explained how the injections are actually completed in the field. Ms. Nemmers explained that the drill rig is used to push tooling to the point we want to inject and then pulled up to the point we stop injecting. For LHAAP-58, the depth that the direct push was completed to was 30 feet below the ground and was pulled up to 20 feet below ground. This process is called bottoms up approach to an injection. Ms. Nemmers explained that quantities of all of the injections are measured. Emulsified vegetable oil (EVO) was selected as the substrate, which was then diluted prior to injecting. The water used to dilute the EVO was deoxygenated, which means that all of the oxygen is pulled out of the water. Mr. Rich Mayer asked what was used to deoxygenate the water. Ms. Nemmers stated that sodium sulfite was used, which takes 20 minutes to 2 hours to deoxygenate the water. Ms. Nemmers stated that when the bacteria was added, KB-1 Primer[®] was used by the company that provided the bacteria. The reason for using the KB-1 Primer[®] is that too much sodium sulfite can kill off the bacteria but the KB-1 primer limits sodium sulfite and has amino acids to scavenge the reduction potential. Ms. Nemmers explained that everything we do is to keep the bacteria happy.

Mr. Fortune asked if this was a similar approach to the Chem Lab. Ms. Zeiler stated that it was but the bioremediation was aerobic at the Chem Lab. So, the approach is similar but that oxygen was needed for the process.

Ms. Zeiler pointed out that each circle in the rows on the slide represented an injection point. Each point has the same process Ms. Nemmers discussed.

Mr. Fortune asked if the process was new. Ms. Nemmers explained that it is commonly used in the industry but was not introduced until about 10 years ago. The bacteria was found accidentally in wastewater treatment. Ms. Nemmers explained that the treatment does not require direct contact initially with the contamination as the bacteria will eventually treat the chlorinated solvents as they grow and move.

LHAAP-16

Mr. Bill Foss explained that there is contamination in two different aquifer zones at Site 16. Near Harrison Bayou, the shallow aquifer zone is about 5 feet below ground surface to 25 feet below ground surface when you get farther into the site. There is also an intermediate aquifer zone, which is 35 to 60 feet below ground surface. LHAAP-16 has chlorinated solvents, perchlorate,



and some metals present in the groundwater. Mr. Foss explained that a remedial design was approved in 2017 for in-situ bioremediation, similar to that presented for LHAAP-58. Currently, there is an extraction system operating for treatment of the groundwater.

Mr. Foss explained that a bromide tracer will be injected with the bioremediation solution at Site 16 to determine when the injections reach the extraction wells. Once the injections reach the extraction wells, they will be shut down and additional solution will be injected into the extraction wells. The current status is that the Remedial Design is approved and the Remedial Action Work Plan is prepared and is under review. The Remedial Design included the well locations so those are being installed in the field currently. No injections will be completed until the Remedial Action Work Plan is approved by the regulators and all of the wells are installed. The May/June date could be pushed out. Ms. Edmonds asked if the TCEQ and USEPA are involved. Mr. Foss confirmed that they will be reviewing everything.

Mr. Foss explained that the approach will use bacteria to treat the contamination. Ms. Overdyke asked about the injections focusing on the areas with the highest levels of contamination and questioned whether thought had been given to areas closest to the Bayou. Mr. Foss stated that a bio-barrier is being installed near the Bayou to address this concern. Shallow and intermediate zones are being treated. While the entire site is not being treated, Mr. Foss explained that the focus is to treat the hottest contamination and also to prevent impacts from entering the Bayou.

Ms. Edmonds asked if there was 2,4,6-trinitrotoluene (TNT) present at LHAAP-16. Mr. Foss stated that TNT was not a contaminant of concern. Ms. Zeiler stated that generally an investigation into the landfill contents is not performed, but releases from the landfill are assessed. No release of TNT has been identified. Mr. Mayer explained that investigation of a landfill can be dangerous since you don't know what is within the landfill itself. Ms. April Palmie stated that monitoring wells are present along the perimeter of the landfill to monitor groundwater. Both temporary and permanent wells are being installed with a total of 28 wells. The work started on Tuesday, April 17, and will take 2.5 to 3 weeks to be completed.

Groundwater Treatment Plant

Ms. Nemmers then discussed the GWTP slides and handouts provided. January 2018 was cold with freezing conditions which resulted in a decrease in the discharge. Also, Ms. Nemmers explained that dry weather eliminates our ability to discharge to the Bayou because there is not flow. So, treated water is discharged to the pond. However, February and March 2018 have an increase in the discharge volume because treated groundwater was discharged from both the GWTP and the pond to the Bayou.

Surface Water Sampling

Ms. Nemmers explained that surface water samples were collected as recently as March 2018, which is included in the graph. The bottom line is that the March 2018 results were non-detect. Any variations in the graphed line are due to the detection limits by the offsite analytical laboratory.



RAB Tour

Ms. Nemmers explained the different travel options for the tour. Ms. Nemmers presented the tour route and that handouts would be provided for each site when stopped. Ms. Overdyke asked if the tour would stop at each site, which Ms. Nemmers confirmed.

Next RAB Meeting Schedule and Closing Remarks

Ms. Zeiler then discussed the next meeting. The next RAB meeting will be held on **July 19, 2018**, with a **meeting starting at 6:00 pm CDT** at the Karnack Community Center, based upon input during the meeting. Mr. Lanier asked why this work is being done. Ms. Zeiler explained that the Army has the liability to clean up the site under the law. Ms. Zeiler also explained that leaving the sites as they are poses an unacceptable risk. Mr. Lanier asked if this risk was not known when the sites were active to which Ms. Zeiler confirmed that was the case. Mr. Lanier inquired whether work is being done to prevent the contamination from entering the lake, which Ms. Zeiler confirmed it was.

Ms. Zeiler explained that there is another contractor, HDR, who is working on Sites LHAAP-18/24, -29, and -47, the sites without final RODs. For LHAAP-29, the old TNT production lines, the proposed plan and ROD are being revised. The plan is to have the proposed plan out to the public in September 2018 for review and comment. LHAAP-18/24 had screening sampling completed to gather more data, which helped in completion of the Feasibility Study. Now the proposed plan for LHAAP-18/24 is being prepared and refined. The Proposed Plan is where the remedy is selected. LHAAP-47 has a draft final ROD but Army felt that new data had to be collected because the existing data was old and there were too many dry wells. A Pre-Design Investigation is being conducted to collect the new data. LHAAP-47 has a final Proposed Plan, which should not need to change.

Ms. Zeiler discussed the transfer of property under Environmental Condition of Property (ECP) VII which includes the two Military Munitions Response Program (MMRP) ranges (80 acres a piece), demolition debris landfill (about 13 acres), and the pistol range (about 1 acre). The ECP VII is under Army review and will then be sent to the United States Fish and Wildlife Service (USFWS) for review. EPA will also be asked to review, as will TCEQ. Mr. Fortune asked approximately how many acres are left. Ms. Zeiler stated that there were a little over 1,000 acres with most of that tied up in the production areas, including the GWTP and the sites that feed into that treatment plant. The transfer of the four sites will bring the transferred acreage up to approximately 85-percent of the LHAAP footprint. She also added that additional surface water rights will be transferred to USFWS.

Mr. Lanier asked where the funds come from and who controls the funds. Mr. Andrew Maly then discussed the funding approved by Congress and given to the USAEC to control and allocate. Mr. Maly explained the Environmental Restoration Account. Mr. Maly stated it is centrally funded but the recent continuing resolutions has caused issues with funding. Ms. Zeiler stated that LHAAP has not been impacted by funding issues.

Adjourn

Ms. VanDeventer motioned to adjourn. Mr. Tom Walker seconded the motion. Meeting adjourned at 5:01 pm CDT.



April 2018 Meeting Attachments and Handouts:

- Meeting Agenda
- Color Copy of Bhate Presentation Slides
- Groundwater Treatment Plant (GWTP) – Processed Groundwater Volumes Handout



LONGHORN ARMY AMMUNITION PLANT
RESTORATION ADVISORY BOARD

Karnack, Texas
(479) 635-0110

AGENDA

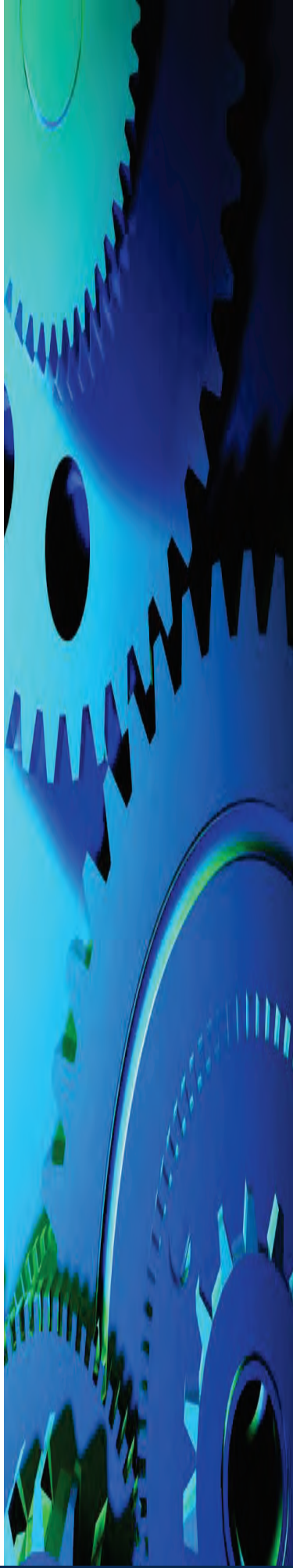
DATE: Thursday, April 19, 2018
TIME: 4:00 – 5:00 PM
PLACE: Karnack Community Center, Karnack, Texas

- 04:00** **Welcome and Introduction**
- 04:05** **Open Items {RMZ}**
- RAB Administrative Issues
 - Minutes (January 2018 RAB Meeting)
 - Ongoing Outreach/Website
- 04:15** **Defense Environmental Restoration Program (DERP) Update {Bhate}**
- Documents and Field Work Completed in 1st Quarter 2018
 - Three Month Lookahead
 - LHAAP-58 Contingent Remedy Implementation
 - LHAAP-16 Remedial Action
 - Groundwater Treatment Plant (GWTP) Update
 - Overview of Tour that will follow the RAB
- 04:45** **Environmental Restoration Issues {RMZ}**
- Update on LHAAP Sites -18/24, -29 and -47
- 04:50** **Next RAB Meeting Schedule and Closing Remarks {RMZ}**
- 05:00** **Tour of LHAAP (Participants to drive their own vehicles or carpool)**



Longhorn Army Ammunition Plant Quarterly Restoration Advisory Board Meeting

Karnack Community Center
April 19, 2018
4:00 PM CDT



Agenda

- 04:00 Welcome and Introduction
- 04:05 Open Items
 - RAB Administrative Issues
 - Minutes (January 2018 RAB Meeting)
 - Ongoing Outreach/Website
- 04:15 Defense Environmental Restoration Program (DERP) Update {Bhate}
 - Documents and Field Work Completed
 - Three Month Look Ahead
 - LHAAP-58 Contingent Remedy Implementation
 - LHAAP-16 Remedial Action
 - Groundwater Treatment Plant (GWTP) Update
 - Overview of Tour that will follow the RAB
- 04:45 Environmental Restoration Issues
 - Update on LHAAP Sites -18/24, -29, and -47
- 04:50 Next RAB Meeting Schedule and Closing Remarks
- 05:00 Tour of LHAAP (Participants to drive their own vehicles or carpool)

Abbreviations and Acronyms

µg/L	micrograms per liter
DERP	Defense Environmental Restoration Program
DF	Draft Final
EISB	Enhanced in-situ bioremediation
ERD	Enhanced reductive dechlorination
ESD	Explanation of Significant Difference
EW	extraction well
ft bgs	feet below ground surface
GWTP	groundwater treatment plant
ISB	In-situ bioremediation
IW	injection well
LHAAP	Longhorn Army Ammunition Plant
MNA	monitored natural attenuation
MW	monitoring well

RAB	Restoration Advisory Board
RA-O	Remedial Action - Operation
RACR	Remedial Action Completion Report
RAWP	Remedial Action Work Plan
RD	Remedial Design
ROD	Record of Decision
RTC	response to comment

Restoration Advisory Board Meeting

RAB Administrative Issues

RAB Membership

RAB Tour



Restoration Advisory Board Meeting

Minutes from Past RAB Meetings

Discussion of January 2018 RAB Meeting minutes/motion to accept



The Army Wants You to be Informed

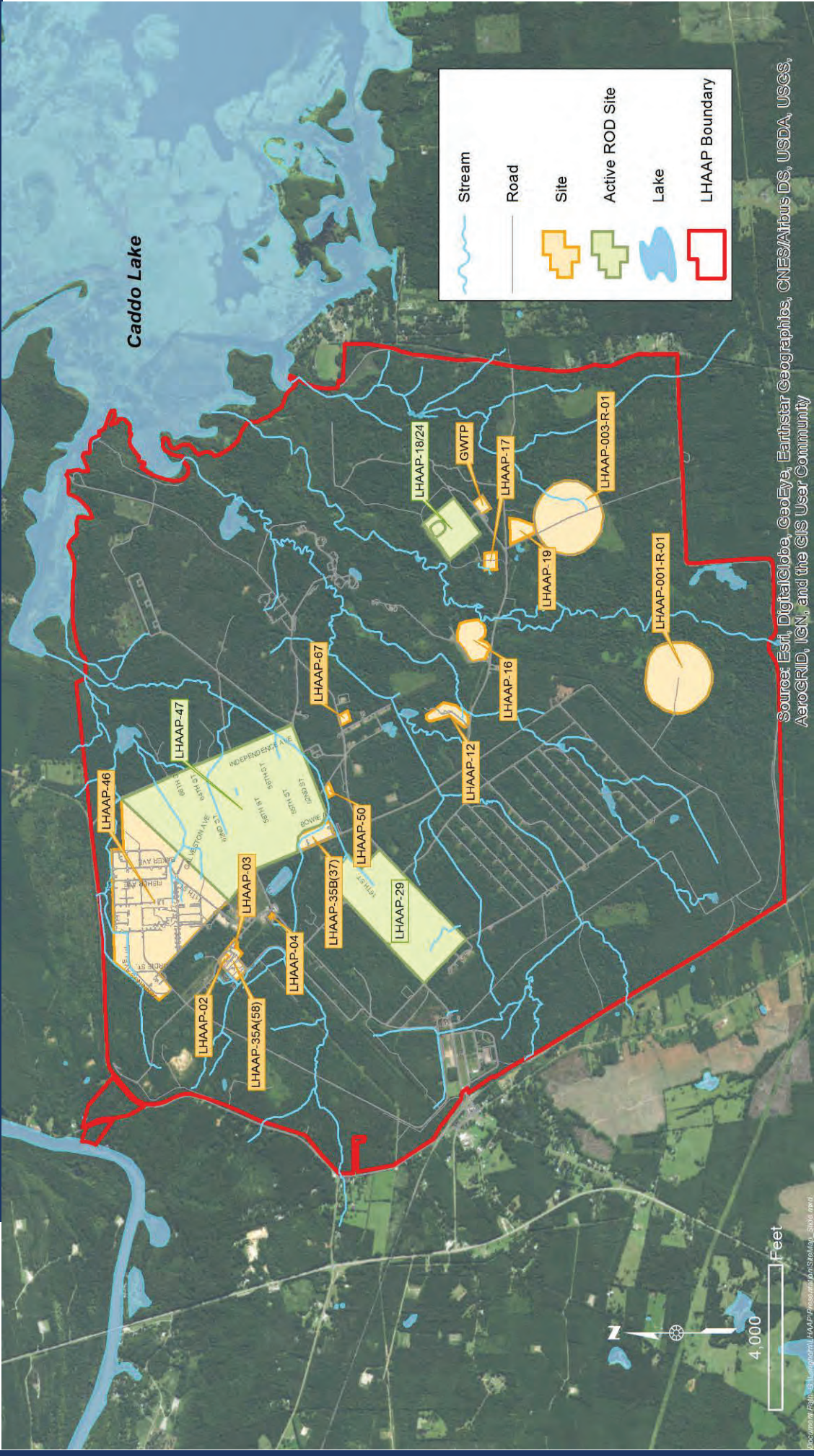
- The Army is committed to protecting human health and the environment; key to that commitment is engaging the community and increasing public participation in environmental restoration at LHAAP
- You are encouraged to:
 - Attend RAB Meetings and/or become a member of the RAB
 - Visit the Longhorn environmental website at www.longhornaap.com
 - Make suggestions for improving communication – the Army welcomes and appreciates community feedback

Outreach

- Website Address: <http://www.longhornaap.com/>
- Website will be updated to indicate the upcoming field events at each site including groundwater sampling, monitoring well installations, soil sampling, or remediation activities

Restoration Advisory Board Meeting

Site Map



Restoration Advisory Board Meeting

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Documents in Process

Site	Document
Basewide	Installation Wide Work Plan
LHAAP-03	Response to Comment (RTC) – Draft Final (DF) Record of Decision (ROD)
LHAAP-03/58	Explanation of Significant Difference (ESD) to address groundwater under LHAAP-03
LHAAP-12	Annual Remedial Action – Operation (RA-O) Report
LHAAP-16	Remedial Action Work Plan (RAWP)
LHAAP-17	Pre-Design Investigation (PDI) Report
LHAAP-50	Year 3 RA-O Report
LHAAP-58	ESD, Year 3 RA-O Report
GWTP, LHAAP-18/24 and Surface Water	Quarterly Evaluation Report Fourth Quarter (October – December) 2017

Completed Field Work

Site	Activity
LHAAP-04	Installed new wells (Dec 2017) and sampled all wells (Jan 2018)
LHAAP-12	RA-O Sampling – December 2017
LHAAP-16	Compliance groundwater sampling – February 2018
LHAAP-17	PDI – Sampled Existing Groundwater Wells (Nov 2017), installed shallow well (Dec 2017) and piezometers, initiated soil sampling (Jan 2018)
LHAAP-19	Repairs to landfill cap
LHAAP-37	RA-O Sampling – February 2018
LHAAP-46	RA-O Sampling – February 2018
LHAAP-58	Baseline Groundwater Sampling and Enhanced Reductive Dechlorination (ERD) Injections
LHAAP-67	RA-O Sampling – December 2017
Surface Water	Surface Water Sampling – March 2018

Restoration Advisory Board Meeting

3 Month Look Ahead - Documents

Site	Document
LHAAP-03	RTC – DF ROD
LHAAP-03/58	ESD
LHAAP-12	Annual RA-O Report for 2017 (Year 3)
LHAAP-16	RAWP
LHAAP-17	PDI Report
LHAAP-50	Year 3 RA-O Report
LHAAP-58	Remedial Action Completion Report (RACR)
GWTP, LHAAP-18/24, LHAAP-16, Surface Water	Quarterly Evaluation Reports: Fourth Quarter (October –December) 2017 and First Quarter (January – March) 2018

3 Month Look Ahead - Field Work

Site	Activity
LHAAP-02	Groundwater Sampling - April 2018
LHAAP-16	Monitoring well and injection well installation, pre-remedy groundwater sampling, in-situ bioremediation (ISB) injections – April to June 2018
LHAAP-17	PDI – If site conditions dry up - complete soil sampling; install additional shallow well and complete additional groundwater sampling
LHAAP-18/24	RA-O Sampling
LHAAP-37	RA-O Sampling – May 2018
LHAAP-50	RA-O Sampling – May 2018
LHAAP-58	RA-O Sampling
LHAAP-67	RA-O Sampling – May 2018
Surface Water	Collect Surface Water samples

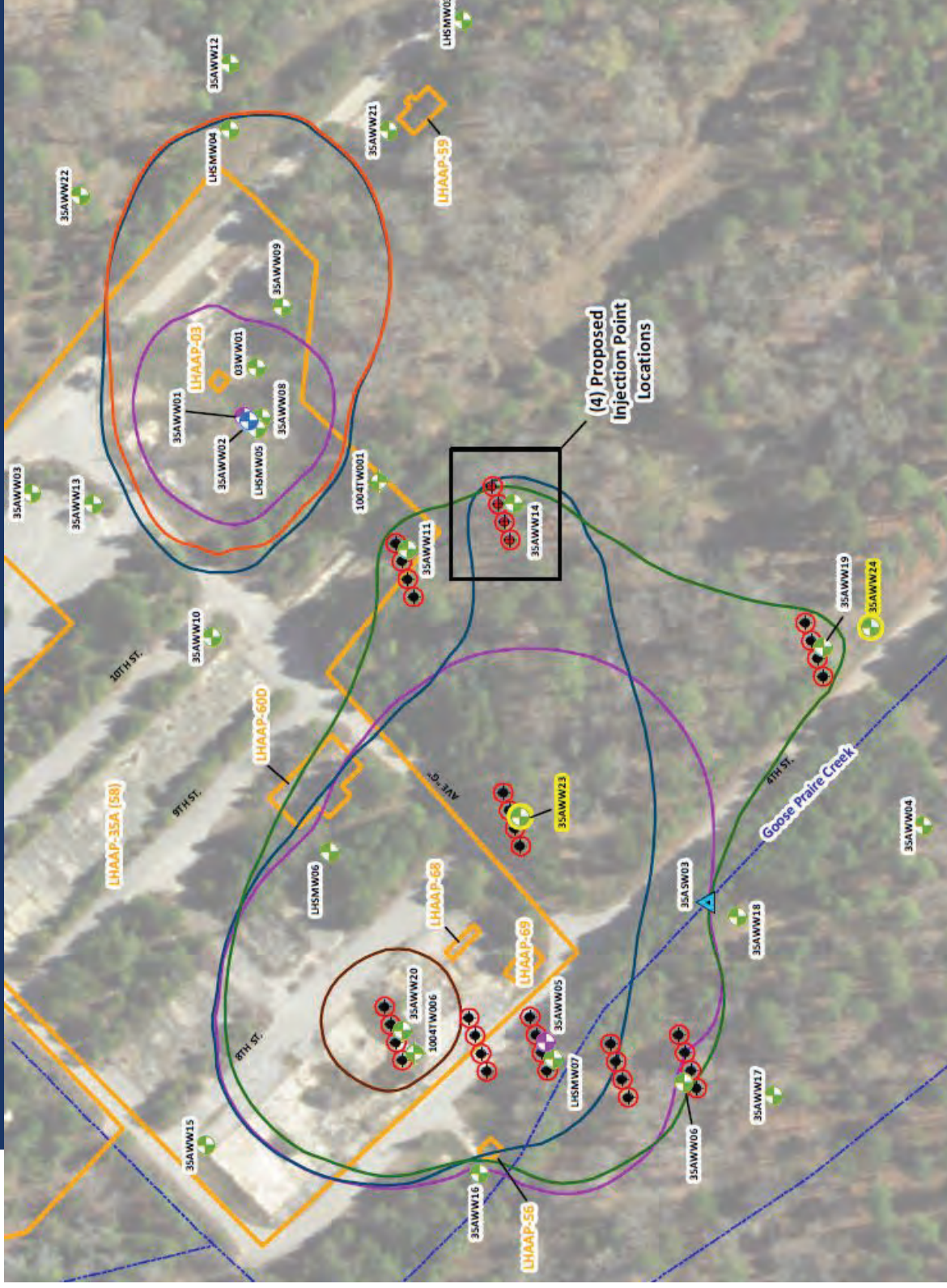
Restoration Advisory Board Meeting

LHAAP-58: Shops Area, Group 3

- Shallow zone groundwater is impacted with volatile organic compounds (VOCs)
- Groundwater plume has two distinct areas: eastern plume and western plume
- Soil poses no unacceptable threat to human health or the environment
- 2018 Contingency Remedy Implemented – Western Plume
 - Monitored natural attenuation (MNA) remedy for the western plume, as presented in the ROD, calls for an evaluation of the remedy after 2 years
 - ROD provides for implementation of a contingency remedy to enhance MNA if MNA is found to be ineffective
 - RA-O implementation was completed between October 2013 and October 2015 and the 2nd year RA-O report was finalized in May 2016
 - After 2 years of MNA, the 2nd year RA-O report concluded that MNA is ineffective and implementation of a contingency remedy is appropriate
 - Contingency Remedy is enhanced in-situ bioremediation (EISB) for the western plume

Restoration Advisory Board Meeting

LHAAP-58: Contingent Remedial Action



Restoration Advisory Board Meeting

LHAAP-58: Contingent Remedial Action



Restoration Advisory Board Meeting

LHAAP-58: Current Status

- Completed Contingent Remedy
 - Emulsified Vegetable Oil
 - Bacteria added for bioaugmentation
- Semi-Annual RA-O sampling planned for June 2018

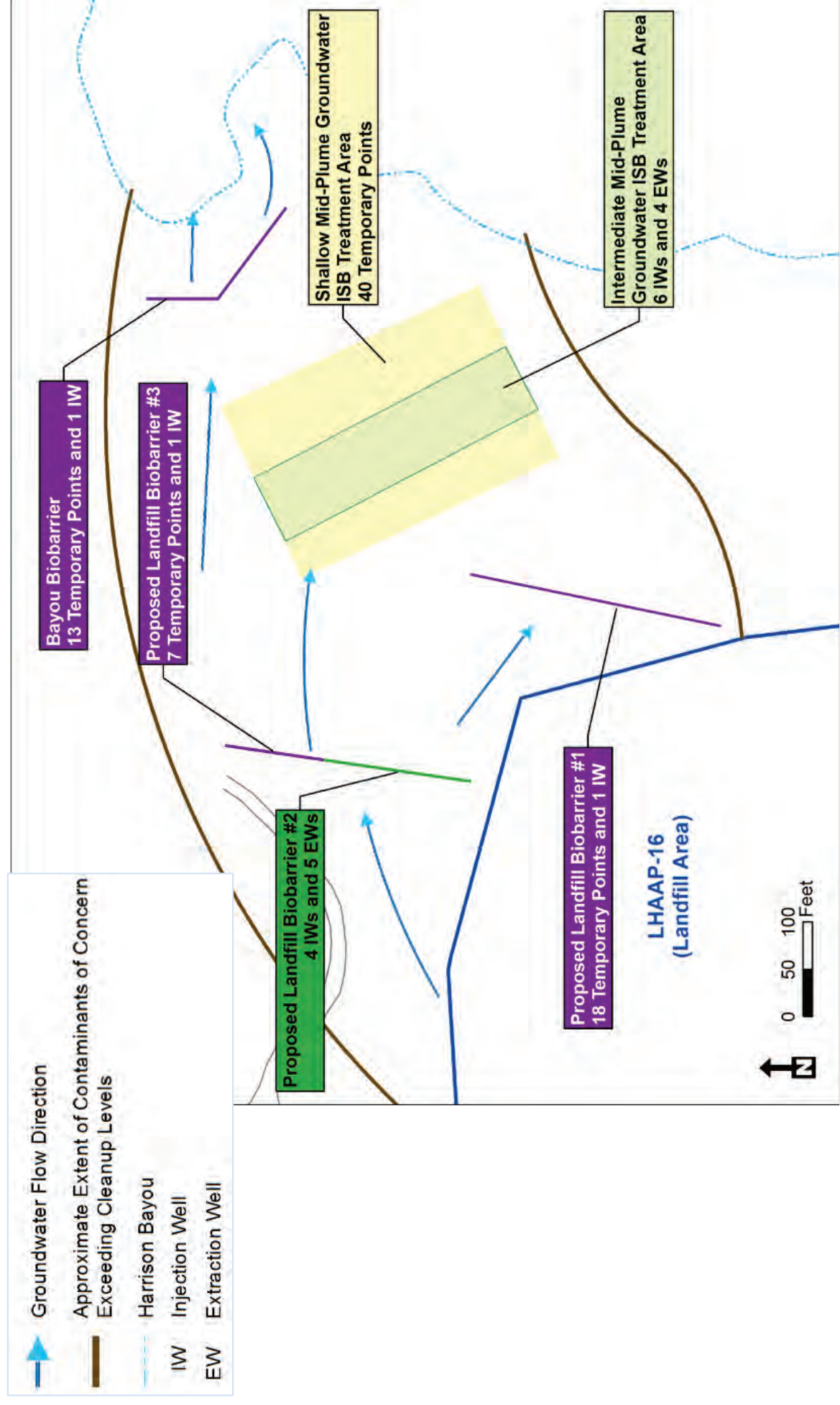


LHAAP-16: Remedial Action

- Site conditions
 - LHAAP-16 is a capped landfill approximately 20 acres
 - Groundwater plumes are present in shallow zone (4 feet below ground surface [ft bgs] near Harrison Bayou to 25 ft bgs near landfill) and intermediate zone (35 to 62 ft bgs)
 - Contaminants include chlorinated volatile organic compounds, perchlorate, and metals
 - Groundwater flow is towards Harrison Bayou
- Status
 - Remedial Design (RD) approved in January 2017 for ISB
 - RAWP is in comment resolution phase with the regulators
 - Installation of additional monitoring wells and injection wells – April - May 2018
 - Begin injections – May/June 2018
- ISB
 - ISB injections and phased shutdown of existing extraction system
 - Performance monitoring will be conducted for 2 years post injections
 - The ISB is focused on areas of the highest concentrations and is expected to reduce concentrations to allow the remaining plume areas to naturally attenuate after injections
 - After performance monitoring, it will be determined if MNA is a viable remedy for the remaining plume

Restoration Advisory Board Meeting

LHAAP-16 Remedial Action



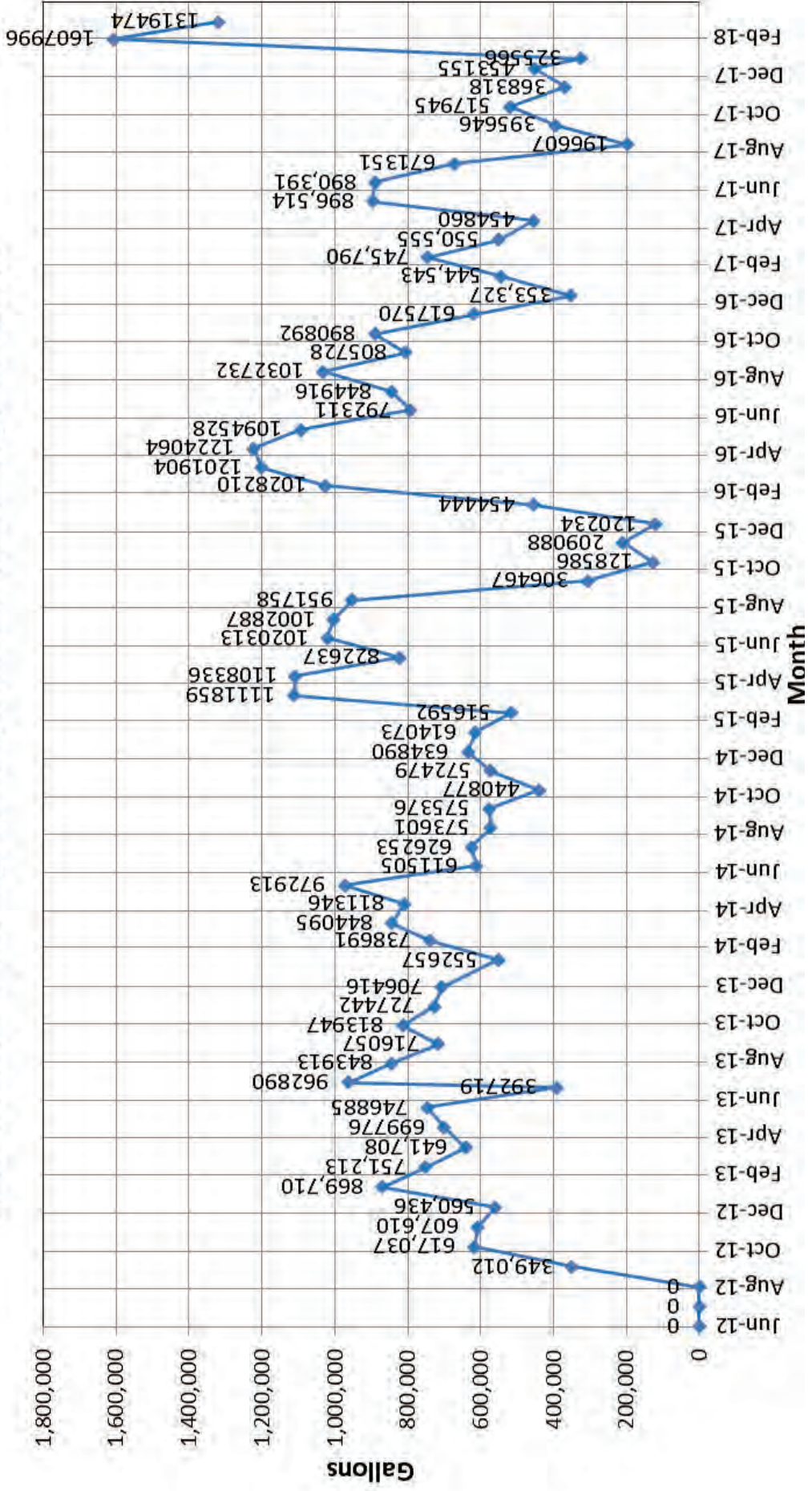
LHAAP-16: ISB Remedial Action

- ISB (Contd)
 - Injection of carbon sources (emulsified vegetable oil) and bacteria for biougmentation to enhance aquifer conditions for reductive dechlorination to reduce volatile organic and perchlorate concentrations
 - Injection mixture will consist of water, emulsified vegetable oil, bacteria, nutrients, and a tracer
 - Additionally, iron will be added to the injection mixture at the Bayou Biobarrier
 - Some locations use temporary injection points that use direct push technology
 - Other locations use injection wells (existing or new) and extraction wells (existing)
 - Where there are extraction wells, the extraction system will be used to help distribute the injected material by using the tracer. Once distributed, the extraction will be turned off and the extraction wells will be used for injections.

Restoration Advisory Board Meeting

GWTP Update

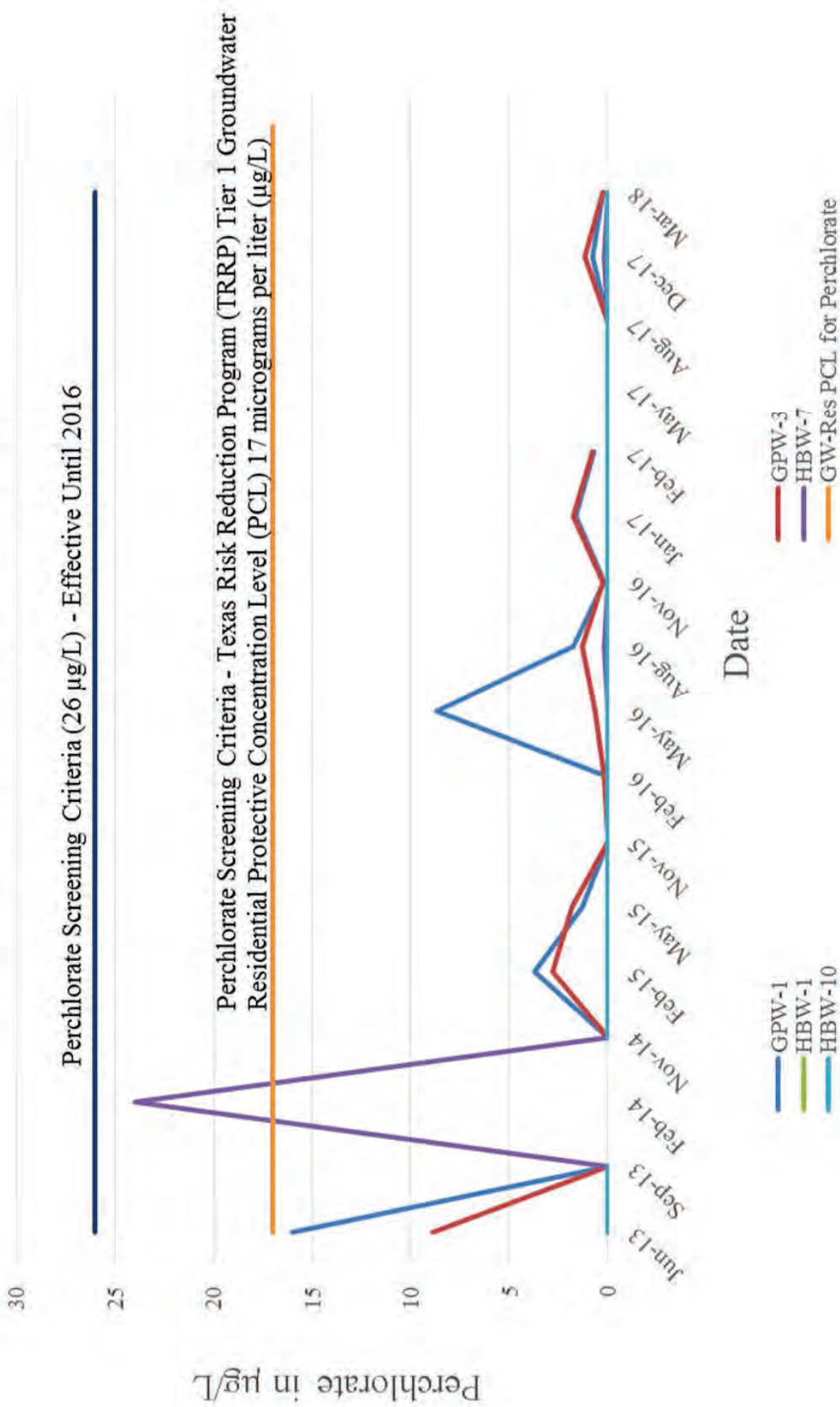
Water Treated and Discharge Monthly from June 2012 through March 2018



Restoration Advisory Board Meeting

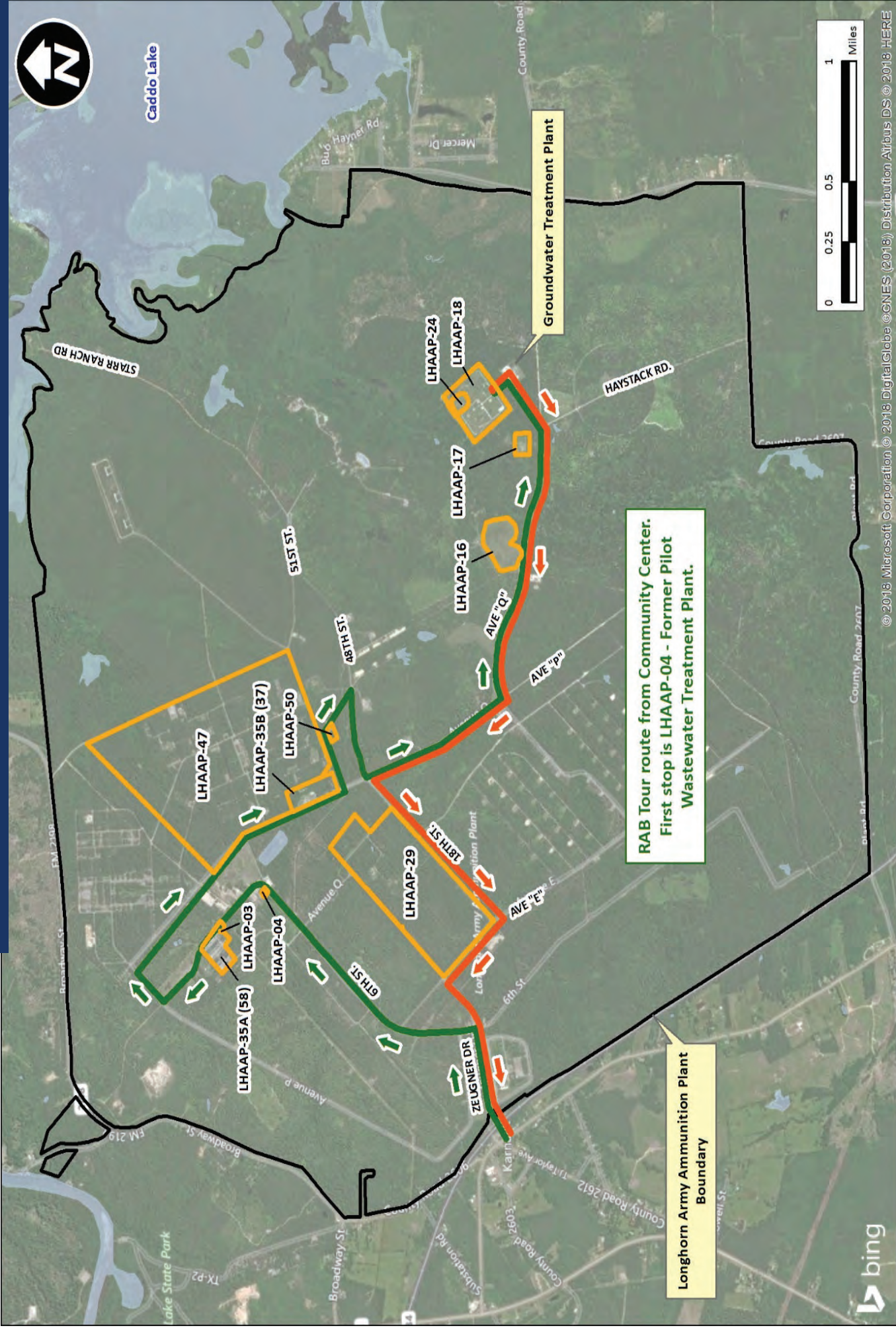
Surface Water Sample Results

Surface Water Samples - Perchlorate



Restoration Advisory Board Meeting

RAB Site Tour



RAB Tour route from Community Center.
 First stop is LHAAP-04 - Former Pilot
 Wastewater Treatment Plant.

Longhorn Army Ammunition Plant
 Boundary

Groundwater Treatment Plant



Restoration Advisory Board Meeting

Next RAB Meeting Schedule & Closing Remarks

- Schedule July 2018 RAB Meeting
- Other Issues/Remarks
- LHAAP Tour



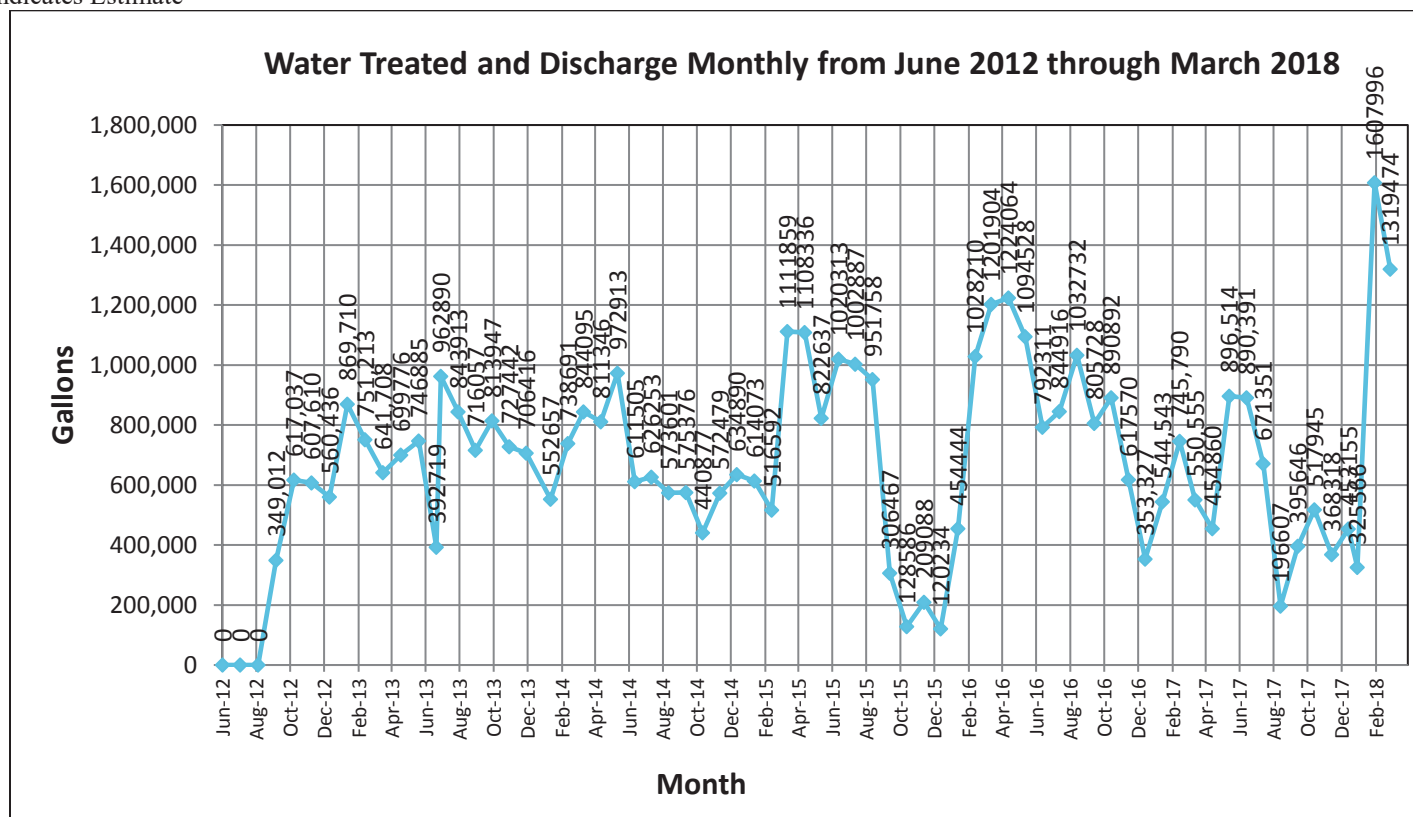
Groundwater Treatment Plant - Processed Groundwater Volumes

The amount of groundwater treated is determined by measuring the number of gallons of processed water.

Processed Water Data (in gallons)

Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
1,041,491	848,356	804,822	792,148	665,883	818,872	791,306	568,812	776,904	748,377	690,052	617,199
Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09
655,059	619,274	726,118	552,299	598,144	433,800	488,807	526,958	387,644	0	414,853	735,716
Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10
808,322	636,306	727,492	391,898	695,343	802,656	894,731	962,121	1,257,977	1,314,924	1,041,495	1,136,547
Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
956,567	705,805	849,712	811,679	668,281	1,090,348	817,325	900,338	916,552	784,369	652,524	733,456
Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12
748,102	658,250	684,903	865,453	725,000*	730,000*	980,000*	630,000*	0	0	0	349,012
Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13
617,037	607,610	560,436	869,710	751,213	641,708	699,776	746,885	392,719	962,890	843,913	716,057
Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14
813,974	727,442	706,416	552,657	738,691	844,095	811,346	972,913	611,505	626,253	573,601	575,376
Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15
440,877	572,479	634,890	614,073	516,592	1,111,859	1,108,336	822,637	1,020,313	1,002,887	951,758	306,467
Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
128,586	209,088	120,234	454,444	1,028,210	1,201,904	1,224,064	1,094,528	792,311	844,916	1,032,732	805,728
Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
890,892	617,570	353,327	544,543	745,790	550,555	454,860	896,514	890,391	528,538	195,198	961,324
Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18						
517,945	368,318	453,155	325,566	1,607,996	1,319,474						

*Indicates Estimate



Water Discharge Location and Volume (Gallons)

Month	Harrison Bayou	LHAAP-18/24 Sprinklers	INF Pond	INF Pond to Harrison Bayou	Contract Hauled Off-Site
Dec-16	0	236,688	0	0	0
Jan-17	0	0	0	0	0
Feb-17	0	0	0	0	14,355
Mar-17	127,242	0	0	0	14,400
Apr-17	113,038	0	236,821	0	0
May-17	205,665	0	534,155	0	0
Jun-17	467,830	0	294,550	490,574	0
Jul-17	0	0	528,538	0	0
Aug-17	0	0	195,197	0	0
Sep-17	0	0	309,980	651,434	0
Oct-17	0	0	517,945	0	0
Nov-17	0	0	368,318	0	0
Dec-17	0	0	453,155	560,350	0
Jan-18	325,566	0	253,177	325,566	0
Feb-18	1,607,996	0	62,017	1,430,634	0
Mar-18	1,319,474	0	0	870,816	0

Harrison Bayou and Goose Prairie Creek – Perchlorate Data

Surface water samples are collected quarterly from each location in Harrison Bayou and Goose Prairie Creek, unless the sampling location is dry.

Surface Water Sample Data (in micrograms per liter)

Quarter	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st
Creek Sample ID	Jul 1999	Sep 1999	Feb 2000	Apr 2000	Aug 2000	Dec 2000	Feb 2001	Apr 2001	July 2001	Oct 2001	Jan 2002
GPW-1	<1.0U	-	4	<4.0 U	<4.0 U	<4.0 U	-	2.65	<4.0 U	<4.0 U	<4.0 U
GPW-3	<1.0U	<4.0 U	17	8	<4.0 U	<4.0 U	-	2.28	<4.0 U	<4.0 U	<4.0 U
HBW-1	-	<80.0 U	310	23	-	-	<4.0 U	-	<4.0 U	<4.0 U	<4.0 U
HBW-7	-	<8.0 U	370	110	-	-	<4.0 U	-	<4.0 U	<4.0 U	<4.0 U
HBW-10	-	<8.0 U	905	650	<4.0 U	-	<4.0 U	-	<4.0 U	-	-

Quarter	2 nd	3 rd	4 th	1 st	2 nd	3 rd	3 rd	4 th	2 nd	3 rd	4 th
Creek Sample ID	June 2002	Sept 2002	Dec 2002	Feb 2003	June 2003	Aug 2003	July 2004	Dec 2006	May 2007	Aug 2007	Dec 2007
GPW-1	<4.0 U	<4.0 U	18.3	18.6	59.9	-	2.25	-	<1.0 U	<1.0 U	10.7
GPW-3	<4.0 U	<4.0 U	5.49	12.6	14.7	-	2.2	-	<1.0 U	<1.0 U	7.48
HBW-1	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	99.3	<0.2U	<1.0 U	<1.0 U	122	<1.0 U
HBW-7	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	<4.0 U	<0.2U	<1.0 U	<1.0 U	1.02	<1.0 U
HBW-10	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	-	<0.2U	<1.0 U	<1.0 U	<1.0 U	<1.0 U

Quarter	1 st	2 nd	3 rd	4 th	2 nd	3 rd	3 rd	3 rd	4 th	1 st	2 nd
Creek Sample ID	Mar 2008	Jun 2008	Sep 2008	Dec 2008	May 2009	Jul 2009	Aug 2009	Sep 2009	Dec 2009	Mar 2010	Jun 2010
GPW-1	27	<0.5U	<0.5U	<0.22U	16	<4U	NS	<1.2U	3.7	1.3J	<0.6U
GPW-3	21.9	9.42	1.1	<0.22U	8.9	<4U	NS	<0.6U	2.8	1.8J	<0.6U
HBW-1	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	NS	<1.5U	<0.275U	1.5U	<0.6U
HBW-7	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	24	<1.2U	<0.275U	1.5U	<0.6U
HBW-10	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	NS	<1.5U	<0.275U	1.2U	<0.6U

Quarter	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st
Creek Sample ID	Sep 2010	Dec 2010	Mar 2011	Jun 2011	Sep 2011	Dec 2011	Mar 2012	Jun 2012	Not Applicable	Jan & Feb 2013	Mar 2013
GPW-1	dry	<0.1U	8.7	dry	dry	1.76	0.163J	dry	NS	1.65	0.735
GPW-3	dry	0.199J	0.673	dry	dry	1.31	0.261	dry	NS	1.74	0.754
HBW-1	dry	<0.1U	<0.2U	dry	dry	<0.1U	0.1U	dry	NS	<0.2U	<0.2U
HBW-7	dry	<0.1U	<0.2U	dry	dry	0.171J	0.1U	dry	NS	<0.2U	<0.2U
HBW-10	dry	<0.1U	<0.2U	dry	dry	<0.1U	0.1U	dry	NS	<0.2U	<0.2U

Quarter	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th
Creek Sample ID	Jun 2013	Sept 2013	Dec 2013	Feb 2014	May 2014	Aug 2014	Nov 2014	Feb 2015	May 2015	Aug 2015	Nov 2015
GPW-1	dry	<0.2 U	dry	0.766	dry	dry	0.244 J	0.311 J	0.156J	dry	0.142 J
GPW-3	dry	<0.2 U	dry	1.15	dry	dry	0.276 J	0.344 J	dry	dry	0.311 J
HBW-1	<0.2U	<0.2 U	dry	<0.2 U	dry	dry	<0.2 U	<0.2 U	dry	dry	<0.2 U
HBW-7	<0.2U	<0.2 U	dry	0.201 J	dry	dry	<0.2 U	0.124 J	dry	dry	<0.2 U
HBW-10	<0.2U	<0.2 U	dry	<0.2 U	dry	dry	<0.2 U	<0.2 U	dry	dry	<0.2 U

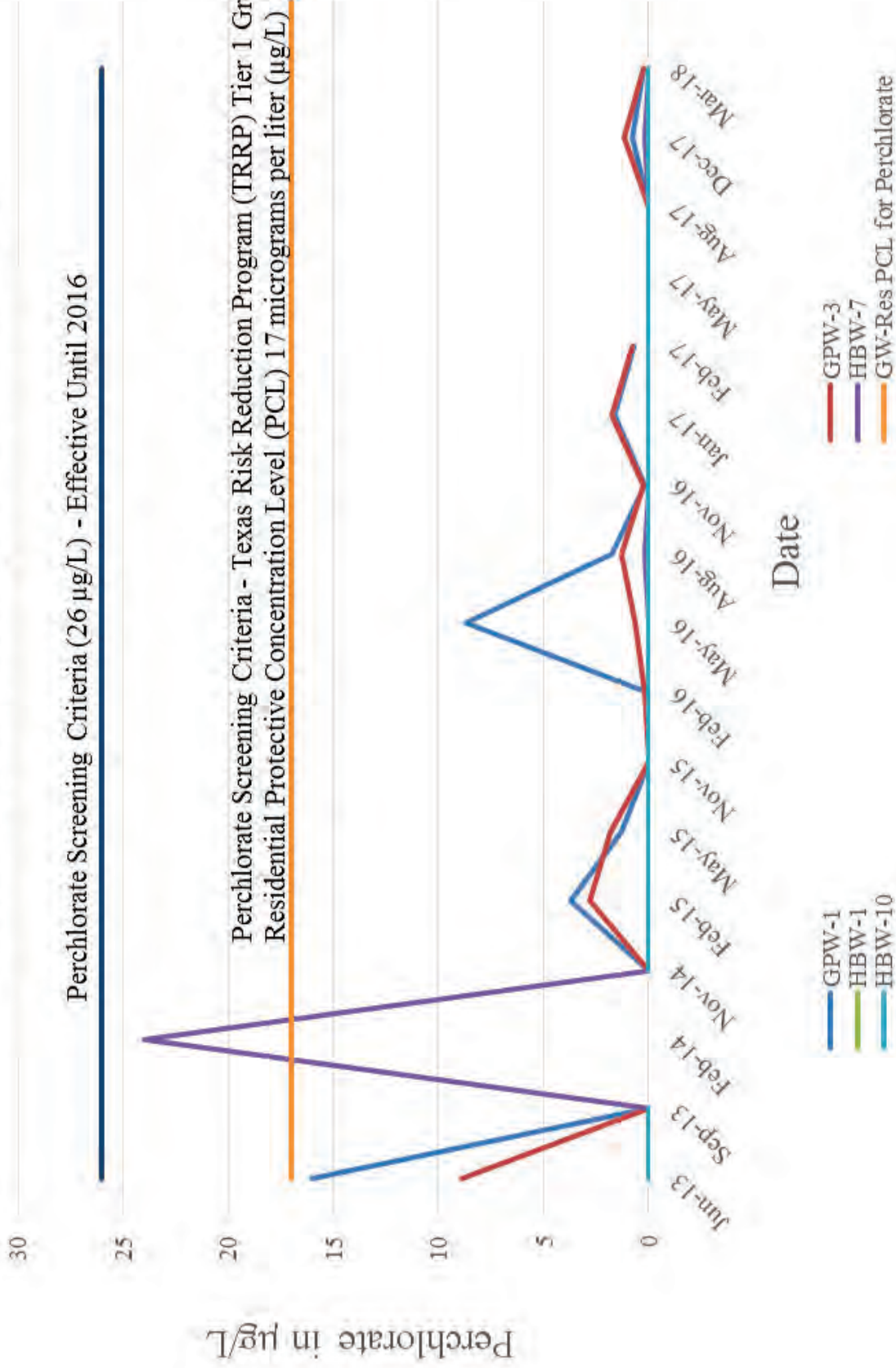
Quarter	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st
Creek Sample ID	Feb 2016	May 2016	Aug 2016	Nov 2016	Feb 2017	May 2017	Aug 2017	Dec 2017	March 2018
GPW-1	0.447	6.59	<0.2 U	0.301 J	<1 U	0.263	dry	<4.0 U	<4.0 U
GPW-3	0.474	0.457	0.141	0.563	<1 U	0.274	dry	<4.0 U	<4.0 U
HBW-1	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<1 U	<0.2 U	<0.2 U	1.1 J	<4.0 U
HBW-7	<0.2 U	<0.2 U	<0.2 U	0.318 J	<1 U	0.155	<0.2 U	<4.0 U	<4.0 U
HBW-10	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<1 U	<0.2 U	0.111J	<4.0 U	<4.0 U

NS – not sampled U – non-detect J – Estimated Dry – no surface water

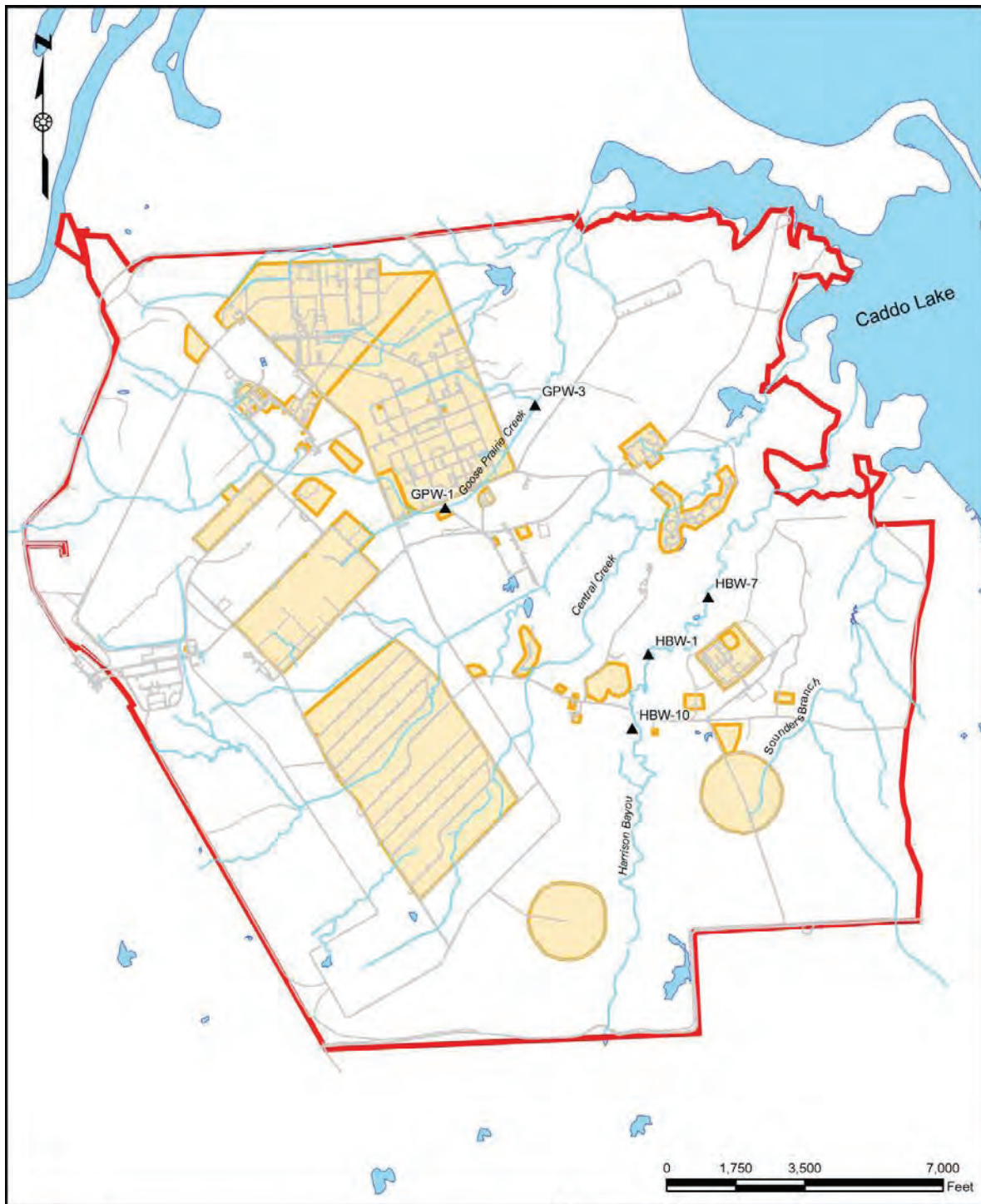
Surface Water Samples - Perchlorate

Perchlorate Screening Criteria (26 µg/L) - Effective Until 2016

Perchlorate Screening Criteria - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL) 17 micrograms per liter (µg/L)



Longhorn Army Ammunition Plant Creek Sampling Locations



<p>Legend</p> <ul style="list-style-type: none">▲ Surface Water Sampling Location— Stream— Road■ Site■ Lake	<p>U.S. ARMY CORPS OF ENGINEERS TULSA DISTRICT TULSA, OKLAHOMA</p>
<p>SURFACE WATER SAMPLING LOCATION</p> <p>LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS</p>	

Subject: Final Minutes, Monthly Managers' Meeting (MMM),
Longhorn Army Ammunition Plant (LHAAP)

Location of Meeting: Via Conference Call-In 515-603-3155 with Code 1063533#

Date of Meeting: June 19, 2018 – 1:00 PM Central Daylight Time (CDT)

Attendees:

Army BRAC: Rose Zeiler (RMZ)
 EPA: Rich Mayer (RM)
 TCEQ: April Palmie (AP)
 USFWS: Paul Bruckwicki (PB)
 USACE: Aaron Williams (AW)
 AEC: Nick Smith (NS)
 Bhate: Frank Gardner (FG)
 APTIM: Susan Watson (SW)

Action Items

Army/United States Environmental Protection Agency (EPA) / Texas Commission on Environmental Quality (TCEQ)

- Status of the enforceable schedule was discussed. RMZ indicated that RM had previously commented that the 120-day time for documents (including the Record of Decision [ROD]) from Draft through Final appeared long. RMZ indicated that the 120-day review time allowed for the initial 30-day Draft regulatory review, 30-day Army response period, 30-day Draft Final regulatory review, and then an additional 30-day period to address any additional comments and issue the Final document. RM and AP indicated that they had no changes on the schedule. RMZ will move forward with the enforceable schedule.

United States Fish and Wildlife Service (USFWS)

- RMZ confirmed that PB would forward copies of the annual inspections and certification documents for the last five years in support of the five-year review. PB indicated that he would scan in and send all 5 years.

Bhate Environmental Associates (Bhate)/APTIM

- FG confirmed that the revised page for standard operating procedures (SOP) and the flow calculation spreadsheet for evaluating discharge to the bayou had been sent. AP and RM indicated they received and will be reviewing the SOP and spreadsheet.
- FG explained the chloride and sulfate fluctuations appear to be tied to the fluidized bed reactor (FBR) and the breakdown of the perchlorate. The new programmable logic controller (PLC) system being brought online should help minimize the fluctuations of acetic acid and these fluctuations of chloride and sulfate in the breakdown of the perchlorate. Maintenance of the FBR will be conducted this month and will include removing the carbon, installing new parts, replacing the carbon, and adding new carbon. A 2000-gallon cone bottom tank will be used for the transfer of carbon using the vendor developed SOP. RM asked how long the system would be down and if it would take a while for the bugs to adjust. FG explained the system should be down about a week. The bugs will be kept wet the whole time, and it is anticipated that the bugs will adjust quickly after the system has been brought back online.

Defense Environmental Restoration Program (DERP) Performance Based Remediation (PBR) Update

SW asked everyone to refer to the Document and Issues Tracking Table dated June 14, 2018.

- **Task 1** (Project Management)
 - Monthly Managers Meeting (MMM) - FG stated that the Draft meeting minutes were sent on June 13, 2018.
 - Restoration Advisory Board (RAB) – FG stated that the notices had been sent for the upcoming RAB meeting in July. The Draft Final Minutes for the RAB were provided to the Regulators on May 18, 2018.
- **Task 2** (LHAAP-02 Semi-Annual Groundwater Monitoring Report) – FG stated the Draft Technical Memorandum was under Army Review and that this deliverable is ahead of schedule.
- **Task 3** (LHAAP-03 ROD and Explanation of Significant Difference [ESD]) – SW stated that the Final ROD and DF ESD had been sent out on June 4, 2018. RM indicated that EPA planned to concur with the ROD. However, RM indicated that the EPA was drafting a statement regarding Texas Risk Reduction Program (TRRP) versus TCEQ’s Risk Reduction Standards (RRS) and that the Army should ensure that the selected cleanup level is protective. AP indicated that TCEQ also intended to provide concurrence letter for the ROD. Both RM and AP indicated that they had received the LHAAP-58 ESD.
- **Task 4** (LHAAP-04 Remedial Design [RD]/Remedial Action Work Plan [RAWP]) – SW stated that the RD/RAWP is still delayed awaiting contract modification from the Army for the scope for additional wells to define the perchlorate plume.
- **Task 5** (LHAAP-12 Annual Remedial Action – Operation [RA-O] Report) – SW indicated that the 2017 LHAAP-12 Annual RA-O Report is currently under Army review and is scheduled to be sent to the Regulators on June 30, 2018.
- **Task 6** (LHAAP-16 RAWP) – SW stated that the Draft Final Remedial Action Work Plan (RAWP) would be issued to the Regulators on June 22, 2018.
- **Task 7** (LHAAP-17 Pre-Design Investigation [PDI] Report) – SW stated that the PDI Report is under Army review and is due out to the Regulators in mid-July 2018. Information on the new shallow well will be included in the PDI Report and had been sent to the Regulators prior to this MMM. The data confirms that the shallow perchlorate plume is bounded. AP asked if the trichloroethene (TCE) detection was from LHAAP-17 or LHAAP-18/24 and suggested that the western corner of LHAAP-18/24 data be included in the LHAAP-17 PDI. RMZ indicated that the Army had this same comment. SW stated that the LHAAP-18/24 data would be included in the LHAAP-17 PDI Report and that the full TCE plume would be presented in the PDI Report.
- **Task 9** (LHAAP-37) – SW stated that Year 1 Quarter 3 RA-O groundwater sampling at LHAAP-37 was completed.
- **Task 11** (LHAAP-50 RA-O Report) – SW stated that the Year 3 RA-O Report is in Regulatory review. The validated data for the May 2018 RA-O sampling was provided in this MMM.
- **Task 12** (LHAAP-58) – FG stated the Remedial Action Completion Report (RACR) for the injections was under Army review.
- **Task 13** (LHAAP-67) – SW stated that the validated data was provided in this June 2018 MMM.
- **Task 16** (GWTP) – FG indicated that the EPA comments received on May 23, 2018 are being incorporated in Section 7 of the 1st Quarter 2018 Report, which is in Army review.

- **Task 19** (Surface Water) – FG stated that surface water sampling for June 2018 was complete.
- **Administrative Record (AR)** - SW stated that there were several older documents being pulled into the AR that were missing some pieces of information. The information has been provided, and the bate stamping and indices are being prepared.

Field Work in July and August 2018

- FG stated that the June 2018 groundwater sampling at LHAAP-18/24 would be completed this week. However, the June 2018 LHAAP-58 groundwater sampling will not be completed until July because of the maintenance work being performed on the FBR this month.
- SW stated that the LHAAP-46 semiannual sampling will be conducted in August 2018.

Other Site Updates

- LHAAP-47 – RMZ indicated that the field work (including 11 soil borings, 6 shallow groundwater and 6 intermediate groundwater direct push points [DPTs]) is complete. AW indicated that some of the areas were dry. According to the Work Plan, the Army and Regulators need to discuss and agree on the locations of three shallow and two intermediate monitoring wells. RMZ indicated a call should be held this week so the drilling of the wells can be conducted before the contractor demobilizes. RMZ will send figures and results of the DPTs for discussion on the call. RM and AP indicated they had availability for the call.
- LHAAP-29 – RMZ indicated that the Proposed Plan (PP) was almost ready to be sent to Army Legal along with a summary of the prior version.
- LHAAP 18/24 – RMZ indicated that the PP is being developed and is about 50% complete.
- Four Sites (Two Military Munitions Response Program (MMRP), Demolition Debris Landfill, and Pistol Range) – RMZ wanted to confirm that the EPA and TCEQ had received proper notification of the Environmental Condition of Property (ECP) that will be submitted. AP and RM indicated that sufficient notification had been provided.

Schedule Next Managers' Meeting

The July 2018 MMM will be held on July 19, 2018 at LHAAP at 10:00 AM CDT.

Adjourned at 1:45 PM CDT.

ACRONYM LIST

AEC	United States Army Environmental Command
AP	April Palmie
AR	Administrative Record
AW	Aaron Williams
Bhate	Bhate Environmental Associates, Inc.
BRAC	Base Realignment and Closure
CDT	Central Daylight Time
DERP	Defense Environmental Restoration Program
ECP	Environmental Condition of Property
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FBR	Fluidized bed reactor

FG	Frank Gardner
GWTP	Ground Water Treatment Plant
LHAAP	Longhorn Army Ammunition Plant
MMM	Monthly Managers' Meeting
MMRP	Military Munitions Response Program
NS	Nick Smith
PB	Paul Bruckwicki
PBR	Performance-Based Remediation
PDI	Pre-Design Investigation
PLC	Programmable Logic Controller
PP	Proposed Plan
RACR	Remedial Action Completion Report
RA	Remedial Action
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
RRS	Risk Reduction Standards
SOP	standard operating procedure
SW	Susan Watson
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
TRRP	Texas Risk Reduction Program
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

LHAAP Validated Data Packages for June 2018 Monthly Manager's Meeting

LHAAP Area	Analytic Method
LHAAP-17	<p><i>Sampling of Newly Installed Well 17WW20 - May 2018</i></p> <p>Perchlorate (6850) VOCs (SW8260)</p>
LHAAP-50	<p><i>Semiannual MNA Groundwater Sampling - May 2018</i></p> <p>Perchlorate (6850) VOCs (SW8260)</p>
LHAAP-67	<p><i>Semiannual MNA Groundwater Sampling - May 2018</i></p> <p>VOCs (SW8260)</p>
GWTP Effluent	<p><i>Weekly Perchlorate Sampling – May 2018</i></p> <p>Perchlorate (6850)</p>
GWTP Effluent	<p><i>Weekly, Bi-Weekly, and Monthly Sampling – May 2018</i></p> <p>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)</p>
GWTP Influent	<p><i>Monthly Sampling – May 2018</i></p> <p>Metals (6020A) Perchlorate (6850) Hexavalent Chromium (7196A)</p>

LHAAP-17 Sampling of Newly Installed Well 17WWW20 - May 2018

		Location Code		17WWW20
		Sample ID		17WWW20-180508
		Sample Date		5/8/2018
		Location Description		
Parameter	Units	MCL/PCL	Result	Val Qual
Perchlorate				
Perchlorate	µg/L	17	< 2	U
VOCs				
1,1-Dichloroethene	µg/L	7	< 0.5	U
1,2-Dichloroethane	µg/L	5	< 0.5	U
cis-1,2-Dichloroethene	µg/L	70	< 0.5	U
Trichloroethene	µg/L	5	1.6	
Vinyl Chloride	µg/L	2	< 0.5	U

Notes:

Some samples may have been diluted due to the concentration(s) of one or more analytes exceeding the upper limit of the calibration curve.

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

µg/L - micrograms per liter

MCL - maximum contaminant limit

MNA - monitored natural attenuation

PCL - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (for Perchlorate only).

Val Qual - validation qualifier

VOC - volatile organic compound

LHAAP-50 Semiannual MNA Groundwater Sampling - May 2018

Parameter	Units	MCL/PCL	Location Code		50WW05		50WW06		50WW08		50WW09		50WW10		50WW11	
			Sample ID	Sample Date	Sample ID	Sample Date	Sample ID	Sample Date	Sample ID	Sample Date	Sample ID	Sample Date	Sample ID	Sample Date	Sample ID	Sample Date
Location Description			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	< 2	U	220	U	140	U	2.7	J	2.8	J	< 2	U	1000	U
VOCs																
1,1-Dichloroethene	µg/L	7	1.9		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	1.7	U
1,2-Dichloroethane	µg/L	5	1.5		< 0.5	U	1.6	U	< 0.5	U	< 0.5	U	< 0.5	U	2	U
Cis-1,2-Dichloroethene	µg/L	70	44		< 0.5	U	1.5	U	2.4	U	2.2	U	< 0.5	U	11	U
Tetrachloroethene	µg/L	5	< 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	170		14		130		83		74		< 0.5	U	280	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/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.
 µg/L - micrograms per liter
 MCL - maximum contaminant limit
 MNA - monitored natural attenuation
 PCL - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (for Perchlorate only)
 Val Qual - validation qualifier
 VOC - volatile organic compound

LHAAP-50 Semiannual MNA Groundwater Sampling - May 2018

Parameter	Location Code		50WW12		50WW13		50WW14		50WW15		50WW16		50WW17		50WW18		
	Units	MCL/PCL	Sample ID	Sample Date	Location Description	Result	Val Qual	Sample ID	Sample Date	Location Description	Result	Val Qual	Sample ID	Sample Date	Location Description	Result	Val Qual
Perchlorate			50WW12-180508	5/8/2018	Site 50 - ENE, upper shallow, outside site boundary.	91000	U	50WW14-180509	5/9/2018	Site 50 - E, lower shallow, outside site boundary, along S. Crockett Ave.	< 2	U	50WW16-180509	5/9/2018	Site 50 - NE, upper shallow, outside site boundary, along Goose Prairie Creek.	< 2	U
Perchlorate	µg/L	17				89000											
VOCS																	
1,1-Dichloroethene	µg/L	7				1.1											
1,2-Dichloroethane	µg/L	5				0.95											
cis-1,2-Dichloroethene	µg/L	70				< 0.5											
Tetrachloroethene	µg/L	5				< 0.5											
Trichloroethene	µg/L	5				79											
Vinyl chloride	µg/L	2				< 0.5											

Notes:

Blue highlighted/bold results indicate 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.

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

MCL - maximum contaminant limit

MNA - monitored natural attenuation

PCL - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (for Perchlorate only).

Val Qual - validation qualifier

VOC - volatile organic compound

LHAAP-50 Semiannual MNA Groundwater Sampling - May 2018

Parameter	Units	Location Code		50WWZ1		50WWZ2		50WWZ3		50WWZ4		50WWZ7																			
		MCL/PCL	Result	Val Qual	MCL/PCL	Result	Val Qual	MCL/PCL	Result	Val Qual	MCL/PCL	Result	Val Qual																		
<table border="1"> <thead> <tr> <th>Sample ID</th> <th>Sample Date</th> <th>Location Description</th> </tr> </thead> <tbody> <tr> <td>50WWZ1-180507</td> <td>5/7/2018</td> <td>Site 50 - E, upper shallow, outside site boundary, east side of S. Crockett Ave.</td> </tr> <tr> <td>50WWZ2-180509</td> <td>5/9/2018</td> <td>Site 50 - SE, upper shallow, outside site boundary.</td> </tr> <tr> <td>50WWZ3-180515</td> <td>5/15/2018</td> <td>Site 50 - E, upper shallow, outside site boundary.</td> </tr> <tr> <td>50WWZ4-180507</td> <td>5/7/2018</td> <td>Site 50 - ENE, upper shallow, outside site boundary.</td> </tr> <tr> <td>50WWZ7-180507</td> <td>5/7/2018</td> <td>Site 50 - N, upper shallow, outside site boundary, east of S. Crockett Ave.</td> </tr> </tbody> </table>														Sample ID	Sample Date	Location Description	50WWZ1-180507	5/7/2018	Site 50 - E, upper shallow, outside site boundary, east side of S. Crockett Ave.	50WWZ2-180509	5/9/2018	Site 50 - SE, upper shallow, outside site boundary.	50WWZ3-180515	5/15/2018	Site 50 - E, upper shallow, outside site boundary.	50WWZ4-180507	5/7/2018	Site 50 - ENE, upper shallow, outside site boundary.	50WWZ7-180507	5/7/2018	Site 50 - N, upper shallow, outside site boundary, east of S. Crockett Ave.
Sample ID	Sample Date	Location Description																													
50WWZ1-180507	5/7/2018	Site 50 - E, upper shallow, outside site boundary, east side of S. Crockett Ave.																													
50WWZ2-180509	5/9/2018	Site 50 - SE, upper shallow, outside site boundary.																													
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50WWZ4-180507	5/7/2018	Site 50 - ENE, upper shallow, outside site boundary.																													
50WWZ7-180507	5/7/2018	Site 50 - N, upper shallow, outside site boundary, east of S. Crockett Ave.																													
Perchlorate																															
Perchlorate	µg/L	17	<2	U	1.1	J	<2	U	<2	U	<2	U	<2																		
VOCS																															
1,1-Dichloroethene	µg/L	7	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5																		
1,2-Dichloroethane	µg/L	5	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5																		
cis-1,2-Dichloroethene	µg/L	70	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5																		
Tetrachloroethene	µg/L	5	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5																		
Trichloroethene	µg/L	5	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5																		
Vinyl chloride	µg/L	2	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5																		

Notes:

Blue highlighted/bold results indicate 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.
 J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.
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 µg/L - micrograms per liter
 MCL - maximum contaminant limit
 MMA - monitored natural attenuation
 PCL - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (for Perchlorate only).
 Val Qual - validation qualifier
 VOC - volatile organic compound

LHAAP-67 Semiannual MNA Groundwater Sampling - May 2018

Parameter	Location Code		67WW01		67WW02		67WW05		67WW07		67WW08		67WW09		67WW09A	
	Sample ID	Sample Date	67WW01-180503	67WW02-180503	67WW02-180503FD	67WW05-180503	67WW07-180503	67WW08-180501	67WW09-180502	67WW09A-180503	Location Description	Units	MC/LPCL	Result	Val	Qual
	Location Description	Site 67-Central, within site boundary	Site 67-NW, within site boundary	Site 67-NW, within site boundary	Site 67-WW, 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						
VOCs																
1,1,1-Trichloroethane	200	5/3/2018	<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	5	5/3/2018	1.2	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
1,1-Dichloroethane	7	5/3/2018	450	U	190	U	<0.5	U	<0.5	U	300	U	<0.5	U	<0.5	U
1,2-Dichloroethane	5	5/3/2018	22	U	1.9	U	<0.5	U	<0.5	U	11	U	<0.5	U	<0.5	U
cis-1,2-Dichloroethane	70	5/3/2018	0.95	J	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
Trichloroethane	5	5/3/2018	1.7	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U	<0.5	U
Vinyl chloride	2	5/3/2018	1.4	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 MC/LPCL.
 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.
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 µg/L - micrograms per liter
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 MNA - monitored natural attenuation
 PCL - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (for Perchlorate only)
 Val Qual - validation qualifier
 VOC - volatile organic compound

LHAAP-67 Semiannual MNA Groundwater Sampling - May 2018

Parameter	Location Code		67WW10		67WW11		67WW12		67WW13		67WW14		67WW15		67WW161	
	Sample ID	Sample Date	67WW10-180503	67WW11-180502	67WW12-180503	67WW13-180501	67WW13-180501FD	67WW14-180502	67WW15-180502	67WW161-180503	67WW14-180502	67WW15-180502	67WW161-180503	67WW14-180502	67WW15-180502	67WW161-180503
	Location Description	Units	5/3/2018	5/2/2018	5/3/2018	5/1/2018	5/1/2018	5/2/2018	5/2/2018	5/2/2018	5/2/2018	5/2/2018	5/2/2018	5/2/2018	5/2/2018	5/2/2018
VOCs																
1,1,1-Trichloroethane	µg/L	200	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2-Trichloroethane	µg/L	5	<0.5	<0.5	<0.5	4.8	4.7	<0.5	5.6	<0.5	5.6	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	µg/L	7	<0.5	5.5	<0.5	160	170	<0.5	380	<0.5	380	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	µg/L	5	<0.5	<0.5	<0.5	27	28	<0.5	26	<0.5	26	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethane	µg/L	70	<0.5	<0.5	<0.5	0.99	1	<0.5	1.3	<0.5	1.3	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	µg/L	5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl chloride	µg/L	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Notes:
Blue highlighted bold results indicate concentrations above the MCL/PCL.
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 µg/L - micrograms per liter
 MCL - maximum contaminant limit
 MNA - monitored natural attenuation
 PCL - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (for Perchlorate only)
 Val Qual - validation qualifier
 VOC - volatile organic compound

GWTP Weekly/Effluent Perchlorate Sampling - May 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24- SP650_050318 5/3/18	LH18/24- SP650_051718 5/17/18	LH18/24- SP650_052418 5/24/18	LH18/24- SP650_052418 5/24/18	LH18/24- SP650_053018_ Before IX 5/30/18	LH18/24- SP650_053018_ After IX 5/30/18
Location Description			Collected from a spigot on the discharge of effluent TK-650.					
			Weekly	Weekly	Weekly	Weekly	Monthly EFF	
Perchlorate (6850)								
Perchlorate	µg/L	589	4.9	< 2.0 U	23	34	18	2.2 J
			Collected before ion exchange			Collected after ion exchange		

µg/L - micrograms per liter

J - Estimated value

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

GWTP Weekly Sampling - May 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24- SP650_050318 5/3/18	LH18/24- SP650_051718 5/17/18	LH18/24- SP650_052418 5/24/18	LH18/24- SP650_053018 5/30/18
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	22	49	15	18
Ortho-Phosphate (365.3)						
Ortho-Phosphate	mg/L	NV	3.78	4.3	2.4	3
Organic Carbon (415.1)						
Total Organic Carbon (TOC)	mg/L	NV	87.6	233	19.2	150

mg/L - milligrams per liter

NV - No Value

GWTP Bi-Weekly Sampling - May 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24- SP650_050318 5/3/18	LH18/24- SP650_051718 5/17/18	LH18/24- SPA650_0530218 5/30/18
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	< 2.5 U
1,1,2-Trichloroethane	µg/L	216.9	< 0.5 U	< 0.5 U	< 2.5 U
1,1-Dichloroethane	µg/L	14,032	< 0.5 U	< 0.5 U	< 2.5 U
1,1-Dichloroethene	µg/L	253	< 0.5 U	< 0.5 U	< 2.5 U
1,2-Dichloroethane	µg/L	181	< 0.5 U	< 0.5 U	< 2.5 U
1,2-Dichloropropane	µg/L	5	< 0.5 U	< 0.5 U	< 2.5 U
Acetone	µg/L	2,395	11	21	35
Benzene	µg/L	181	< 0.5 U	< 0.5 U	< 2.5 U
Carbon tetrachloride	µg/L	181	< 0.5 U	< 0.5 U	< 2.5 U
Chlorobenzene	µg/L	47,180	< 0.5 U	< 0.5 U	< 2.5 U
Chloroform	µg/L	3,615	< 0.5 U	< 0.5 U	< 2.5 U
Ethylbenzene	µg/L	57,025	< 0.5 U	< 0.5 U	< 2.5 U
m,p-Xylene	µg/L	83.6	< 1.0 U	< 1.0 U	< 5.0 U
Methylene chloride	µg/L	1,699	< 1.0 U	< 1.0 U	< 5.0 U
o-Xylene	µg/L	83.6	< 0.5 U	< 0.5 U	< 2.5 U
Styrene	µg/L	5,987	< 0.5 U	< 0.5 U	< 2.5 U
Tetrachloroethene	µg/L	180.7	< 0.5 U	< 0.5 U	< 2.5 U
Toluene	µg/L	4,189	0.32 J	0.44 J	< 2.5 U
Trichloroethene	µg/L	181	2.3	2.1	< 2.5 U
Vinyl chloride	µg/L	72	< 0.5 U	< 0.5 U	< 2.5 U
Anions (9056)					
Chloride	mg/L	NV	429	492	634
Sulfate	mg/L	NV	116	153	87.9

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

GWTP Monthly Effluent Sampling - May 2018

Location ID: Sample Date:	Units	Daily Maximum Conc	LH18/24- SP650_052418 5/24/18
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	< 2.5 U
1,1,2-Trichloroethane	µg/L	216.9	< 2.5 U
1,1-Dichloroethane	µg/L	14,032	< 2.5 U
1,1-Dichloroethene	µg/L	253	< 2.5 U
1,2-Dichloroethane	µg/L	181	< 2.5 U
1,2-Dichloropropane	µg/L	5	< 2.5 U
Acetone	µg/L	2,395	< 5.0 U
Benzene	µg/L	181	< 2.5 U
Carbon tetrachloride	µg/L	181	< 2.5 U
Chlorobenzene	µg/L	47,180	< 2.5 U
Chloroform	µg/L	3,615	< 2.5 U
Ethylbenzene	µg/L	57,025	< 2.5 U
m,p-Xylene	µg/L	83.6	< 5.0 U
Methylene chloride	µg/L	1,699	< 5.0 U
o-Xylene	µg/L	83.6	< 2.5 U
Styrene	µg/L	5,987	< 2.5 U
Tetrachloroethene	µg/L	180.7	< 2.5 U
Toluene	µg/L	4,189	< 2.5 U
Trichloroethene	µg/L	181	< 2.5 U
Vinyl chloride	µg/L	72	< 2.5 U
Metals (6020A)			
Barium	mg/L	2	0.186
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	11

µg/L - micrograms per liter

mg/L - milligrams per liter

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

GWTP Monthly Influent Sampling - May 2018

Location ID: Sample Date:	Units	LH18/24- SP140_052418 5/24/18
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	12,000

mg/L - milligrams per liter

µg/L - micrograms per liter

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



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

June 20, 2018

DAIM-ODB-LO

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

Re: Draft Final Remedial Action Work Plan
 LHAAP-16 Landfill
 Final Record of Decision September 2016
 Longhorn Army Ammunition Plant, Karnack, Texas

Dear Mr. Mayer,

Two hard copies (HC) and two compact discs (CDs) for the above-referenced document are being transmitted to you for your records. The document, which addresses LHAAP-16 groundwater, includes revisions based upon your comments on the Draft received on May 23, 2018. 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 Bhate Environmental Associates, Inc. (Bhate) 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 (letter)
- P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy and 1 CD)
- A. Williams, USACE, Tulsa District, OK (1CD)
- N. Smith, USAEC, San Antonio, TX (1CD)

K. Nemmers, Bhate, Lakewood, CO (1 hard copy and 1 CD for project files)
P. Srivastav, APTIM, Houston, TX (1 hard copy and 1 CD for project files)



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

June 20, 2018

DAIM-ODB-LO

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

Re: Draft Final Remedial Action Work Plan
LHAAP-16 Landfill
Final Record of Decision dated September 2016
Longhorn Army Ammunition Plant, Karnack, Texas

Dear Ms. Palmie,

One hard copy (HC) and one compact disc (CD) for the above-referenced document are being transmitted to you for your records. The document, which addresses LHAAP-16 groundwater, includes revisions based upon your comments on the Draft received on March 19, 2018 and your concurrence to Army responses on May 14, 2018. 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 Bhate Environmental Associates, Inc. (Bhate) 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,

A handwritten signature in cursive script that reads "Rose M. Zeiler".

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

Copies furnished (letter only):
R. Mayer, USEPA, Region 6, Dallas, TX
P. Bruckwicki, Caddo Lake NWR, TX
A. Williams, USACE, Tulsa District, OK
N. Smith, USAEC, San Antonio, TX

K. Nemmers, Bhate, Lakewood, CO (for project files)
P. Srivastav, APTIM, Houston, TX (for project files)

**Response to Comments on
Draft Remedial Action Work Plan, LHAAP-16 Landfill
Longhorn Army Ammunition Plant, Karnack Texas**

**Document Date: 28 February 2018
Comments Date: 28 March 2018**

**Reviewer: Mr. Richard Mayer, U.S. Environmental Protection Agency
Respondent: Dr. Rose Zeiler, U.S. Army**

1. Respondent Concur (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/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
1	Minor Editorial Comment	Please include the following acronyms in the acronyms section: Bhate, MEGA, MATC, and O&M. Please remove ECP, HASP, MARC, O ₂ and SOP since these are not used in document. Please define in the text the first use of GWTP (page 3-2), ISEB (Figure 4-1), IWWP (page 4-3), mv (page 4-12), OSWER (page 5-1), and ROI (page 4-7).	C	Concur. Text will be revised accordingly.	A	
2	Page 1-5, Section 1.5, 2nd Paragraph	The text references Figure 2-1 in regards to typical depth of water below land surface. However, EPA could not locate well 16WW24 on the figure and there was no measurement collected on well 16WW42. Please include the data to document the depth to the water below land surface. Please modify text and/or figure.	C	Concur. The reference to 16WW24 will be removed from the text. The text and figures included in Appendix A are from the approved Final RD which did not provide the water elevation readings. A reference to the Remedial Design will be added to the text.	A	
3.	Page 4-4, Monitoring Wells	More than 1 hour should be allowed for the bentonite seal to hydrate before the cement grout is used for the remaining annulus.	C	Concur. The Standard Operating Procedure in the Draft Final Installation Wide Work Plan has been revised to include an additional two hours after the final bentonite lift for the bentonite seal to hydrate before grouting begins. Also, see response to TCEQ's Comment 6.	A	

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
4.	Page 4-3, Section 4.3.2	IWWP reference should be updated to draft 2018 or 2017 as shown in references.	C	Concur. The IWWP reference throughout the RAWP and in the reference section will be updated to the Final IWWP published by Bhate in 2018.	A	
5.	Table 4-9	EPA is hesitant to approve the MNA and LTM wells at this time until the pre-remedy sampling and the year 1 and 2 performance monitoring has been implemented.		Noted. The list of MNA and LTM wells in the RAWP are from the EPA and TCEQ approved Final RD, and therefore, the locations were previously approved.	A	The MNA monitoring system may need to be refined in the future per effects of the various treatments being implemented.
6.	Page 4-13, Surface Water Monitoring	Please ensure that the surface water parameters are measured using a field instrument.	C	Concur. Surface water parameters like DO, pH, ORP, temperature and conductivity will be collected using a field instrument. A new table, Table 4-10 has been added which shows the surface water monitoring plan. Also see the response to TCEQ's Comment 9.	A	Section 4.7.8 should include a sentence mentioning that field parameters will be collected in the stream with a multi-parameter meter. <i>Army Response: The following will be inserted in Section 4.7.8, as the 2nd sentence of the 2nd paragraph:</i> "As part of the surface water sample collection activities, field readings (DO, pH, ORP, temperature, and conductivity) will be collected instream with a multi-parameter meter."
7.	Figure 1-3	In the legend there is a symbol for groundwater wells. Are these considered private home/irrigation wells? Some of these are located on Longhorn. Also, the well by the fire station is not a potable water well as the faucets in the firehouse have non-potable water signs on them.	C	Concur. The wells shown on Figure 1-3 are private wells, wells used for public supply and other wells used specifically by oil and gas companies. We received a comment from TCEQ about Figure 1-3, that the water wells shown on this figure may not be useful for remediation purpose. Figure 1-3 is being revised to remove the water wells, see the response to TCEQ's Comment 11.	A	

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
8.	Figures 2-1 & 2-2	Were the extraction wells running when the groundwater elevation levels were taken?		<p>The extraction was operational at the time of the groundwater elevation readings. Section 1.5, 2nd paragraph, 2nd sentence will be revised as follows:</p> <p>“Shallow groundwater elevation contours based on the last comprehensive groundwater elevations collected at the site when extraction was operational in June 2016 are shown on Figure 2-1 of Appendix A.”</p> <p>Section 1.5, 3rd paragraph, 3rd sentence will be revised as follows:</p> <p>“The intermediate groundwater elevation contours based on the last comprehensive groundwater elevations collected at the site when extraction was operational in June 2016 are shown on Figure 2-2 of Appendix A.”</p>	A	
9.	Table 4-1	Not all the proposed wells for this site are included in this table. Please revise accordingly.	C	Concur. Table 4-1 will be revised to include all the proposed wells.	A	
10.	Table 4-3	EPA recommends adding upper deep monitoring well 16WW20.	D	Do not concur. The Pre-Remedy Sampling table is based on the Table 4-11 of the EPA and TCEQ approved Final RD. Well 16WW20 was not included in the approved Final RD for pre-remedy sampling.	A	EPA missed that deep well planned for sampling while reviewing the document.
11.	Table 4-5	Why are the performance parameters different for well 161W04 vs. well 161W03?		The performance parameters are from Table 4-14 of the approved Final RD approved by TCEQ and EPA. Well 161W04 was not selected as a well for quarterly performance monitoring.	A	

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
12.	Table 4-7	EPA recommends adding well 16WW56 as a monitoring well for performance effectiveness of the Bayou Biobarrier.	D	Do not concur. The list of performance monitoring wells in the RAWP is from the approved Final RD. Well 16WW56 was added as a MNA/LTM well in the Final RD. Wells 16RW12 and 16WW40, downgradient of the Bayou Biobarrier, were selected in the approved Final RD to monitor the effectiveness of the injections.	A	
13.	General Comment	The method for analyzing for perchlorate in groundwater should be 6850. Method 314.0 does not require filtering of the groundwater samples to remove microbes (which can biodegrade the perchlorate). Also, this method historically tends to have more false positive and negative analytical results.	C	Concur. We are aware of the limited ability of Method 314.0 to provide accurate and reliable results for perchlorate. Method 6850 will be used for analysis of perchlorate samples. The tables will be revised to include Method 6850. Method 6850 is included in the IWWP, UFP-QAPP.	A	
14.	General Comment	There should be a table for surface water samples monitoring plan such as Table 4-4 as an example to follow.	C	Concur. The RAWP has been revised to include Table 4-10 which shows the surface water monitoring plan and is attached to the TCEQ's RTCs.	A	
15.	Page 4-12, Section 4.7.5	The text indicates that Figure 4-3 shows locations of wells for monitoring, but the figure is for surface water collection locations. Please revise to Figure 4-2.	C	Concur. Text will be revised to reference Figure 4-2.	A	
16.	Page 4-9; Bullets	EPA assumes that some sort of sonde for DO will be used in the collection of DO readings in the Bayou. It is assumed DO changes throughout the day within the bayou naturally (suggest conducting a 24-hour monitoring with a logger during a sunny day and night to see diurnal effects to determine a baseline). What are the criteria for changes in DO in determining if the Injectate has reached the bayou?		A handheld YSI DO meter (or equivalent) will be used to collect readings from the bayou by placing the probe directly into the bayou. Baseline DO levels in the bayou will be collected prior to the injections into the Bayou Biobarrier. At least three baseline readings will be collected throughout a working day prior to injections. Also, see response to Comment 17. The following will be added to Section 4.6.4, page 4-9, lead in paragraph above the bullets:	A	

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
17.	Page 4-2, Item 4	Please identify where the baseline surface water samples will be collected and what constituents/parameters will be analyzed (in regards to potential injection leakage). EPA recommends moving surface water location 16SW02 more towards the left bend in Harrison Bayou based on where TCE was found in shallow groundwater (see Appendix A, Figure 2-6 and well number 16WW40, 1060 µg/L).		<p>“The field readings will be collected using a handheld field instrument and readings will be recorded on field forms. The probe will be placed in the bayou for a direct reading from the bayou. If the carbon source reaches the bayou, the natural organisms will utilize the carbon and will create anaerobic conditions in the water which may impact aquatic life. If any sudden decrease in DO is observed to below baseline readings or a visual change is observed in the water (murkiness) along the bayou bank, injections will be suspended. Additional monitoring and visual observations will be conducted to determine if the decrease is from injection materials or changes in the environmental conditions. If injections are suspended, corrective actions (placement of aerators and/or hay bales) will be implemented if needed. Once DO has stabilized and no visual confirmation of injection materials into the bayou is confirmed, injections will resume.”</p> <p>Pre-remedy surface water samples will be collected from 16SW01, 16SW02, and 16SW03. Samples will be analyzed for VOCs, perchlorate and metals. Additionally, field measurements (DO, ORP, pH, temperature, and conductivity) will also be collected. The surface water sampling plan is included in a new Table 4-10 (an attachment to TCEQ’s RTCs).</p> <p>The location for 16SW02 was established in the EPA and TCEQ approved Final RD.</p> <p>Text in Section 4.2.1, bullet 4 will be revised as follows:</p> <p>“...as indicated in Tables 4-2 and 4-3. Collect pre-remedy surface water samples from three</p>	A	EPA recommended the alternate location because it was close to the location of observed seeps identified in the past at Harrison Bayou.

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
18.	Figure 4-2	Intermediate wells or potentially even deeper wells may need to be drilled on the east side of the bayou due to the intermediate zone contamination currently on the east side of the bayou at monitoring well 16WW41 at 6,650 µg/L of TCE. There is potential for additional migration to the northeast for the intermediate zone.		locations 16SW01, 16SW02, and 16SW03 for VOCs, perchlorate, metals, and field parameters (DO, pH, ORP, conductivity and temperature) as shown in Table 4-10 . Additionally, baseline field readings from the bayou will be collected at locations near the Bayou Biobarrier at least three times during a work day prior to beginning injection into the Bayou Biobarrier.” Noted. EPA made this similar comment during the RD review indicating that a well might be needed at some point in the future. However, at this time, no plans for an intermediate zone well on the east side of the bayou have been made until additional data is collected as part of the implementation and monitoring of the in situ bioremediation. See below for EPA’s comment 17 from the review of the Remedial Design. “EPA agrees with the additional shallow wells proposed by TCEQ shown on revised Figure 4-1. Also, EPA recognizes there may be a need for additional intermediate groundwater monitoring wells in the future, especially in the outer eastern reaches of the plume.”	A	Evaluation of the data obtained during and after the implemented treatments should provide insight for any future actions.
19.	General Comment	When was the last time that the Upper Deep and Lower Deep groundwater monitoring wells have been sampled at the site?		The upper deep and lower deep groundwater monitoring wells were last sampled in May 2013.	A	
20.	General Comment	Please identify the monitoring wells in a Table that are above the MCL for the metal COCs for this site.	C	Concur. The metals information will be added as part of the nature and extent of contamination at the site. A new Table 1-2 (attached) will be added and a new paragraph in Section 1.4 will be added as follows: “Metals have been detected in the shallow, intermediate, upper deep, and deep wells. Table 1-2 summarizes the wells that have had concentrations above the metal cleanup levels	A	Please provide the scheduled or projected dates for the samples on Table 1-2. Army Response: The next five-year review sampling is expected to occur in 2018, and the Army will inform EPA and TCEQ approximately three weeks prior to the commencement of the

Comment No.	Section/Page/ Paragraph	Comment	C, D, E, or X ¹	Response	A or D ²	Comment
				<p>indicated in Table 1-1. Table 1-2 includes both the maximum concentration above the cleanup level as well as the most recent date when concentrations were above the cleanup levels. The metals are detected in a few wells and do not indicate widespread metal contamination.”</p> <p>Additionally to address groundwater monitoring, a new section will be added as follows:</p> <p>“Section 4.8 Metals Groundwater Monitoring</p> <p>The selected remedy in the ROD indicates monitoring for metals will be evaluated at the first five year review to determine if any further monitoring for metals is warranted (U.S. Army 2016). Table 1-2 provides a summary of the wells that were sampled for the metals COCs and had detected concentrations above the cleanup levels. As part of the next five year review after remedy implementation, groundwater samples will be collected. All the wells listed on Table 1-2 will be analyzed for thallium. Selected wells listed in Table 1-2 will be analyzed for the remaining metal COCs (chromium, arsenic, nickel and/or manganese) based on the previous results. The sampling will be conducted using low flow sampling as described in Section 3.4 of the IWWP (Bhate 2018). The monitoring results and evaluation will be included in the next five year review report.”</p>		<p>groundwater sampling for metals at LHAAP-16.</p>
21.	General Comment	<p>Tables 3-2, 3-4, 3-6, 3-8, 3-10, and 3-11 refer to SDC-9TM 1x1011. The meaning of 1x1011 in this context is not clear. Please clarify.</p>		<p>The unit for this measurement is <i>Dehalococoides</i> organisms/liter. The units will be added to the tables.</p>		
22.	General Comment	<p>Please add Shaw, 2007 (Table 1-1) reference to the reference section.</p>	C	<p>Concur. Reference as noted on the table will be added to the reference section.</p>		

Notes:

For an additional revision to Section 3.1.2, please see the response to TCEQ's Comment No. 3.

For an additional revision to Section 4.5.2.2, please refer to Army Comment on TCEQ's Comment No. 7.

TCEQ Comments on Draft Remedial Action Work Plan, LHAAP-16

TCEQ Project Manager: April Palmie

Document date: February 28, 2018

Comment date: March 19, 2018

Comment Ref. #	Section, Page Ref.	TCEQ Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
1.	3.1, 3-2	In this sentence, replace "and" with "however" The Final RD specified KB-1 and an equivalent culture, SDC-9TM will be used in place of KB-1.	C	Text will be revised accordingly.		
2.	3.1.1, 3-2	First sentence, remove "(before direct-push	C	Text will be revised accordingly.		
3.	3.1.2, 3-2	First sentence, remove ")" after EDS-ER	C	Text will be revised accordingly. Additionally the 2 nd and 3 rd sentences of Section 3.1.2 will be replaced with the following: "Before any of the pilot test wells are used for injections, they will be redeveloped prior to use as injection wells for Landfill Biobarrier #2, and no slug tests will be performed."		
4.	4.1.2, 4-1	Notice - TCEQ needs 30-days for UIC coordination	C	Noted.		
5.	4.0 all sections	When relevant, please reference the SOPs (especially sections in 4.3 and 4.4	C	Please refer to Response to comment 6, 7 and 9.		
6.	4.3.3, 4-4	1-hour hydration is not consistent with SOP. Please revise and reference SOP	C	Sentence beginning on the 6 th line of Section 4.3.3 will be replaced as follows: "The bentonite seal will be placed in 1-foot lifts each hydrated for 30 minutes. After placement of the final bentonite lift, the		

Comment Ref. #	Section, Page Ref.	TCEO Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
7.	4.4, 4-4	Reference SOPs	C	<p>bentonite seal will be saturated with potable water and allowed to hydrate for an additional two hours before grouting begins (IWWP, Section 3.2 and SOP A7.3.6)".</p> <p>Several references will be added as follows:</p> <p>Section 4.1.3 first sentence will be revised as follows: " Utility location and clearance for intrusive activities will be conducted (in accordance with Section 3.1 of the IWWP) prior to drilling as follows:"</p> <p>Section 4.3.2 will be revised as follows: "All injection wells will be constructed of 2-inch schedule 40 polyvinyl chloride (PVC) with a 10-foot 0.010 slot PVC screen at the bottom. The wells will be screened over the target intervals as shown in Table 4-1. Injection wells (six) installed in the intermediate groundwater zone will require a minimum of 6-inch diameter Schedule 40 PVC isolation casing to approximately 35 feet. Injection wells will be constructed to the required specification for isolation casing, surface completion, prevention of commingling and confinement of undesirable groundwater to its zone of origin in accordance with Section 3.2 of the IWWP (Bhate, 2018). Please refer to Standard Operating Procedure (SOP) A7-Monitoring Well Installation in Appendix A of the IWWP for additional guidance on well installation."</p>		

Comment Ref. #	Section, Page Ref.	TCEO Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
				<p>Section 4.3.3 will have the following added at the end of the section: "...from the biobarriers for performance monitoring. Wells will be installed in accordance with Section 3.2 of the IWWP (Bhate, 2018). Please refer to Standard Operating Procedure (SOP) A7-Monitoring Well Installation in Appendix A of the IWWP for additional guidance on well installation."</p> <p>Section 4.3.4 will have the following added to the end of the section: "... for injection will be redeveloped. Well development will be conducted in accordance with Section 3.2.2 of the IWWP (Bhate, 2018). Please refer to SOP-A8-Monitoring Well Development for additional guidance on well development."</p> <p>Section 4.4 first paragraph last sentence will be replaced as follows: "Low-flow groundwater sampling will be performed in accordance with Section 3.4 of the IWWP (Bhate, 2018). Procedures for purging and sampling the wells are detailed in SOP A10-Low Stress Groundwater sampling in Appendix A of the IWWP. During the performance monitoring events, surface water samples will be collected concurrently if water is flowing in the creek. Surface water samples will be collected in accordance with Section 3.6 of the IWWP (Bhate, 2018). Please refer to SOP A11 - Surface Water Sampling in Appendix A of</p>		

Comment Ref. #	Section, Page Ref.	TCEO Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
				<p>the IWWP for detailed guidance regarding surface water sampling."</p> <p>Section 4.6 will have the following sentence added: "In situ injection activities will be conducted in accordance with Section 3.10 of the IWWP (Bhate, 2018)."</p> <p>Note Additional Army Change: Additionally, text in Section 4.5.2.2 will be revised to include a top down and/or bottom up approach for injections depending on field conditions and lithology. At LHAAP-58, the amendments were injected successfully using a bottom up approach. Text in Section 4.5.2.2, first paragraph, line 2 will be revised as follows: ". . the entire target interval using a top down or bottom up approach depending on the lithology and field conditions."</p>		
8.	4.6.2, 4-8	<p>Top of page, in this sentence remove "are"</p> <p>The injection volumes are and amendment mixture quantities (total and per point) are shown on Table 3-4.</p>	C	Text will be revised accordingly.		
9.	4.7.8 and 4.7.9, 4-13	Reference SOPs	C	Section 4.7.8, 2 nd paragraph, 2 nd sentence will be revised as follows: "Surface water samples will be collected in accordance with Section 3.6 of the IWWP (Bhate, 2018). Please refer to SOP A11-Surface Water Sampling in Appendix A of the		

Comment Ref. #	Section, Page Ref.	TCEO Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
10.	5.1.1, 5-2	The second line of evidence sentence should reference TRRP	C	IWWP for detailed guidance regarding surface water sampling." Additionally, a new Table 4-10 will be added to include the surface water monitoring plan and is attached to these response to comments (RTCs). Section 4.7.8, 2 nd paragraph, 3 rd line, will be revised as follows: "... these surface water samples will be analyzed for the COCs as shown in Table 4-10 and concentrations will be compared to clean up levels listed in Table 1-1."		
11.	Figure 1-3	Do the private, public, and installation water wells need to be displayed on this figure? This information is helpful at remedial investigation and remedy selection phases, but not really needed for the remedial action.	C	Figure 1-3 will be revised to remove the water wells shown on the figure.		
12.	Figure 1-4	Western corner of landfill, wells 16WW05 and 06 are mislabeled. Wells 16WW44 and 45 should be added to this figure (and other relevant figures)	C	Figure 1-4 will be revised to show and label wells correctly.		

Comment Ref. #	Section, Page Ref.	TCEQ Comment	C, D, E, or X ¹	Response	A or D ²	Army Comment
13.	Figure 3-1	Wells 16WW44 and 45 should be added to this figure (and other relevant figures) These data points are also missing from figure: 16RW07, 16IW04, 16IW09, and 16EW08	C	Figure 3-1 will be revised to show the missing wells.		
14.	Figure 3-3	16IW04 is mislabeled (16IW-4)	C	Figure 3-3 will be revised to correct the mislabeling.		
15.	Figure 4-2	It would be better to have all permanent wells on this figure. Would it be possible to turn on the other wells? The MNA and LTM wells could be shaded/highlighted OR the wells not being used could be faded out. It would also be helpful to have the biobarrier lines drawn for reference (without details)	C	Figure 4-2 has been revised accordingly and is attached to the RTCs.		

Included attachments to the responses:

Table 4-10

Figure 4-2



Draft Final
**Remedial Action Work Plan,
LHAAP-16 Landfill**
Longhorn Army Ammunition Plant
Karnack, Texas



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Acronyms and Abbreviations

APTIM	Aptim Federal Services, LLC
bgs	below ground surface
Bhate	Bhate Environmental, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
cm/sec	centimeters per second
COC	contaminants of concern
CVOC	chlorinated volatile organic compound
DCA	dichloroethane
DCE	dichloroethene
DO	dissolved oxygen
DPT	direct-push technology
EDS-ER™	electron donor solution-extended release
ERS	Environmental Remediation Services
ESD	Explanation of Significant Difference
ESTCP	Environmental Security Technology Certification Program
EVO	emulsified vegetable oil
GPS	global positioning system
GW-Ind	groundwater medium-specific concentration for industrial use
GWTP	groundwater treatment plant
IRA	interim remedial action
ISB	in situ bioremediation
IWWP	Installation-Wide Work Plan
Jacobs	Jacobs Engineering Group, Inc.
LHAAP	Longhorn Army Ammunition Plant
LOE	lines of evidence
LTM	long-term monitoring
LUC	land use controls
MATOC	Multiple Award Task Order Contract
MC	methylene chloride
MEGA	Multiple Environmental Government Acquisition
mg/L	milligrams per liter
MMRP	Military Munitions and Response Program
MNA	monitored natural attenuation
mV	millivolts
O&M	operation and maintenance
OHM	OHM Remediation Services Corporation
ORP	oxidation-reduction potential

Acronyms and Abbreviations *(continued)*

OSWER	Office of Solid Waste and Emergency Response
PoP	period of performance
PVC	polyvinyl chloride
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
ROI	radius of influence
SDC-9™	APTIM's dechlorinating culture
Shaw	Shaw Environmental & Infrastructure, Inc.
SOP	standard operating procedure
TAC	Texas Administrative Code
TCA	trichloroethane
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound
ZVI	zero valent iron

REMEDIAL ACTION WORK PLAN, LHAAP-16 LANDFILL

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 (MEGA) National Small Business Multiple Award Task Order Contract (MATOC) Environmental Remediation Services (ERS) with Military Munitions Response Program (MMRP), Task Order No. W9128BV17F0150 to conduct environmental restoration of LHAAP-16 at Longhorn Army Ammunition Plant (LHAAP). The Bhate Team is comprised of Bhate and Aptim Federal Services, LLC (APTIM). APTIM is conducting the Remedial Action (RA) for LHAAP-16. LHAAP is an inactive, government owned formerly contractor operated and maintained department of Defense facility located central east Texas (**Figure 1-1**). This work plan describes the planned (RA) to address risks associated with contaminated groundwater at the LHAAP-16 landfill. This Remedial Action Work Plan (RAWP) has been developed using the basis and details of the Remedial Design (RD) for LHAAP-16, which was approved by the regulatory agencies in January 2017 (U.S. Army 2017).

1.1 Organization of Work Plan

This work plan is composed of the following sections:

- **Section 1.0:** “Introduction” summarizes the site background, proposed remedy including the contaminants of concern (COCs) and their respective cleanup levels, the nature and extent of contamination and remedial action objectives (RAOs).
- **Section 2.0:** “Land Use Control Plan” describes the proposed scope of work including the implementation activities associated with the land use control (LUC) component of the remedy.
- **Section 3.0:** “In Situ Bioremediation (ISB)” describes the injection activities associated with enhanced in situ bioremediation component of the remedy.
- **Section 4.0:** “Field Preparation and Activities” describes the activities that will be performed prior to the start of fieldwork and the methods that will be followed to complete fieldwork.
- **Section 5.0:** “Remedy Performance Evaluation and Reporting” describes the reports that will be submitted post ISB injections.
- **Section 6.0:** “Schedule” describes the proposed implementation schedule for the RA activities.

- **Section 7.0:** “Operation and Maintenance Procedures” describe the operation and maintenance (O&M) activities and other routine activities that form part of the final remedy.
- **Section 8.0:** “References” provides a list of references cited in the document.

This work plan also includes the following appendices supporting the main text:

- **Appendix A** includes the potentiometric maps and the plume contour maps from the Final RD.
- **Appendix B** includes the sample Annual Land Use Control Compliance Certification and Documentation.
- **Appendix C** includes the Safety Data Sheets for various commercially available emulsified vegetable oil (EVO) products, APTIM’s dechlorinating microbial culture (SDC-9™).
- **Appendix D** includes the procedure provided by the vendor (Redox Tech) to mix the ABC Plus amendment mixture.
- **Appendix E** includes a blank injection log that will be used in the field to track injection volumes, flow rates and pressures.
- **Appendix F** includes the landfill inspection and maintenance checklist.

1.2 Site Description

LHAAP-16 is a capped landfill covering approximately 20 acres in the south-central portion of the former LHAAP (**Figure 1-2**). Harrison Bayou is located along the northeastern edge of the site and flows into Caddo Lake, northeast of the site (**Figure 1-3**). The landfill, which covered approximately 13 acres prior to cap construction, was established in the 1940s for the disposal of solid and industrial wastes, until the 1980s, when disposal activities were terminated.

The U.S. Army and the U.S. Environmental Protection Agency (USEPA) signed a Record of Decision (ROD) and the Texas Water Commission concurred in 1995 approving an interim remedial action (IRA) for LHAAP-16 to mitigate potential risks posed by buried source material at the site. The IRA included the construction of a landfill cap, which is considered a component of the final remedy for the site. Construction of the multilayer cap was completed in 1998. The ROD also specified that the U.S. Army would be required to “perform long-term maintenance of the cap.” LUCs, such as future use restrictions, would also be required.

Previous investigations identified groundwater impacted with chlorinated volatile organic compounds (CVOCs), perchlorate, and metals at LHAAP-16 (U.S. Army 2016). **Figure 1-4** shows the existing groundwater monitoring system and the approximate lateral extent of perchlorate and trichloroethene (TCE) in the Shallow Zone and Intermediate Zone groundwater, based on the last comprehensive groundwater sampling event performed in May 2013 (U.S. Army 2017). The source of this impacted groundwater is the landfill, although the metals were only detected at elevated concentrations sporadically, and do not appear to reflect widespread contamination from the landfill. A groundwater extraction system was voluntarily installed by the U.S. Army in 1996 and 1997 as a treatability study to prevent the groundwater plume from migrating to Harrison Bayou. The extraction system was shut down in August 2012 due to operational issues including damage to the power feed to the system, but operation was restored in November 2012 and the extraction system has been operational since that time.

The Final ROD for LHAAP-16 was issued in September 2016; and documents the final selected remedy for the site; including impacted groundwater (U.S. Army 2016). The Final RD was issued in January 2017; and presents the RD, inspection and maintenance requirements, and LUC requirements, associated with LHAAP-16.

1.3 Planned Remedial Action

The planned RA at LHAAP-16 is comprised of several elements as outlined in the RD (U.S. Army 2017):

- Maintenance of the existing landfill cap to preserve its integrity and minimize or prevent infiltration through the landfill.
- Installation of two biobarriers in the shallow groundwater, one located adjacent to the landfill, and the other located near Harrison Bayou.
- ISB in the most contaminated portion of the shallow and intermediate groundwater zones in conjunction with phased shut down of the existing groundwater extraction system.
- Monitored natural attenuation (MNA) of both the shallow and intermediate groundwater zones to ensure continued degradation of CVOCs, perchlorate and daughter products and that surface water in Harrison Bayou is not adversely affected by groundwater such that it fails to meet surface water standards for CVOCs, perchlorate and daughter products. MNA includes:
 - Evaluation of MNA based on performance objectives after 2 years quarterly monitoring
 - Reapplication of bio-amendments if MNA is found to be ineffective

- Long-term monitoring (LTM) semiannually for 3 years, then annually thereafter until recommended otherwise by the five-year review. LTM will not be initiated until MNA performance monitoring establishes the effectiveness of MNA.
- LUCs to prohibit access to the contaminated groundwater except for environmental monitoring and testing only.
- LUCs to preserve the integrity of the landfill cap, and to restrict intrusive activities (e.g., digging) that would degrade or alter the cap.
- LUCs to restrict land use to nonresidential.
- LUCs to maintain the integrity of any current or future remedial or monitoring systems.

1.4 Nature and Extent of Contamination

The contaminated media at LHAAP-16 includes buried source material (landfill waste under the cap) and the shallow and intermediate groundwater beneath and downgradient of the landfill. The IRA implemented in 1996 through 1998, included placement of a multilayer cap at LHAAP-16 mitigating potential risks posed by buried landfill waste. The cap prevents rainfall from infiltrating and leaching contaminants from principal threat wastes within the landfill. However, groundwater in contact with the buried waste material still provides a mechanism for transportation of COCs away from the landfill (Jacobs 2000). A groundwater extraction system was installed as a treatability study to prevent the groundwater plume from migrating to Harrison Bayou (OHM 1998).

The groundwater COCs for LHAAP-16 identified in the Final ROD (U.S. Army 2016) include CVOCs (TCE; cis-1,2-dichloroethene [DCE]; 1,1-DCE; 1,2-dichloroethane [DCA]; vinyl chloride [VC]; 1,1,2-trichloroethane [TCA], and methylene chloride [MC]), perchlorate, and metals (arsenic, chromium, manganese, nickel and thallium) in the shallow and/or intermediate groundwater. As established in the ROD, groundwater and surface water cleanup levels (U.S. Army 2016) are presented in **Table 1-1**.

The isoconcentration contours for major CVOCs, and perchlorate, in Shallow Zone and Intermediate Zone groundwater based on the last comprehensive round of groundwater sampling conducted in May 2013 are included as in the Final RD (U.S. Army 2017) and are included in **Appendix A (Figures 2-4 through 2-7)** of this work plan. Five metals (arsenic, chromium, manganese, nickel, and thallium) had sporadic elevated detections in 2009 and were retained as COCs in shallow and/or intermediate groundwater in the Final ROD. The detected metals do not appear to be associated with widespread contamination from the landfill.

Data collected from the upper deep groundwater zone from 1998 until 2008 indicate that no COCs were reported at concentrations exceeding their respective cleanup levels (**Table 1-1**). In addition, the data collected from deep groundwater from 1997 until 2004 indicate that no COCs were reported at concentrations exceeding their respective cleanup levels (Shaw 2010).

Metals have been detected in the shallow, intermediate, upper deep, and deep wells. **Table 1-2** summarizes the wells that have had concentrations above the metal cleanup levels indicated in **Table 1-1**. **Table 1-2** includes both the maximum concentration above the cleanup level as well as the most recent date when concentrations were above the cleanup levels. The metals are detected in a few wells and do not indicate widespread metal contamination.

1.5 Geology and Hydrogeology

The surface soil at LHAAP-16 consists of fine sandy loam. The subsurface is composed of medium plastic sandy silt, fine sands, and clay. The clay layers tend to separate the groundwater into shallow, intermediate, upper deep and deep zones.

The shallow groundwater zone varies in thickness from nine to 18 feet below ground surface (bgs). Shallow groundwater elevation contours based on the last comprehensive groundwater elevations collected at the site when extraction was operational in June 2016 are shown on Figure 2-1 of **Appendix A**. Depth to groundwater in the shallow zone is approximately 4 feet to 25 feet bgs (U.S. Army 2017).

An intermediate groundwater zone containing fewer fines than the shallow zone extends from 35 to 62 feet bgs. The intermediate groundwater elevation contours based on the last comprehensive groundwater elevations collected at the site when extraction was operational in June 2016 are shown on Figure 2-2 of **Appendix A**. The upper deep groundwater zone extends from approximately 80 to 151 feet bgs. The lower deep groundwater zone extends below 220 feet bgs (U.S. Army 2017). While flow is primarily horizontal in these zones, vertical interaction between the shallow and intermediate zones is evidenced by pumping test results as well as the presence of contamination in both zones. Such interconnection is consistent with soil layers formed in fluvial depositional environments.

The groundwater flow direction is northeast toward Harrison Bayou in the shallow, intermediate and deep zones, while flow direction is southeast toward Harrison Bayou in the upper deep groundwater zone. Overall, the groundwater flow is toward Caddo Lake. The mean hydraulic conductivity value varies from 1.5×10^{-3} centimeters per second (cm/sec) in the Shallow Zone to 4.2×10^{-4} cm/sec in the Deep Zone (Jacobs 2002). Groundwater flow between the landfill and Harrison Bayou is also influenced by the presence of an extraction well system consisting of four wells in the shallow groundwater zone and four wells in the intermediate groundwater zone.

1.6 Remedial Action Objectives

The RAOs developed for LHAAP-16 and outlined in the LHAAP-16 ROD (U.S. Army 2016) are:

- Protection of human health and the environment by preventing exposure to landfill contents
- Protection of human health and the environment by reducing leaching and migration of landfill hazardous substances into the groundwater
- Protection of human health by preventing human exposure to the contaminated groundwater
- Protection of human health and the environment by preventing COCs and COC-by-products from migrating into Harrison Bayou at levels that cause surface water in Harrison Bayou to exceed surface water criteria
- Return of groundwater to its potential beneficial uses as drinking water, wherever practicable

2.0 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. The following section provides details for the LUC component of the RA.

2.1 Land Use Controls Implementation

The actions required to implement the land use controls (LUCs) for LHAAP-16 are described below. The first of these, the initial notice of LUCs, has been completed. A figure depicting the preliminary LUC boundaries is presented in Figure 3-1 of **Appendix A**. The following actions will be undertaken to implement the LUCs for LHAAP-16:

- Finalize the Boundaries for the LUCs as a part of the RA.
 - Revise the boundaries if necessary. The LUC boundary presented in this RAWP is subject to change, based on COC results from the two proposed wells to be installed on the east side of Harrison Bayou. The final boundaries 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 landfill LUCs (preserve the integrity of the landfill cap, and to restrict intrusive activities (e.g., digging) that would degrade or alter the cap); 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 new data has been completed and revised if necessary.
 - Survey the LUC Boundaries. The boundaries will be finalized after concurrence by USEPA and the Texas Commission on Environmental Quality (TCEQ), and the LUC boundaries 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 Texas Administrative Code (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.

The elements of the LUC Plan for LHAAP-16 included in Section 5.2 and 5.3 of the Final RD will be presented in the Response Action Completion Report (RACR) as the LUC Plan. Implementation of the LUC Plan includes annual inspections which are recorded on the Annual Inspection Form included in **Appendix B**.

2.2 Comprehensive Land Use Control Management Plan

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-16.

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-16. The Comprehensive LUC Management Plan consists of LHAAP RD documents and a survey plat showing the locations where the LUC being implemented at LHAAP is applied. The purpose of this Comprehensive LUC Management Plan is to ensure the site-specific LUC is compiled into one comprehensive document for both pre-transfer use by the installation and for post-transfer use by the transferee. This document has been provided to the USEPA and the TCEQ and is accessible to the public through LHAAP's Administrative Record.

3.0 IN SITU BIOREMEDIATION (PROPOSED REMEDIATION PLAN)

ISB will be conducted at LHAAP-16 to remediate groundwater impacted with volatile organic compounds (VOCs) and perchlorate. The injection locations at LHAAP-16 are shown in **Figure 3-1**. As described in the RD, the following ISB systems will be implemented to treat the VOC and perchlorate impacted groundwater:

- Three Landfill Biobarriers (Landfill Biobarrier #1, Landfill Biobarrier #2, Landfill Biobarrier #3) in the shallow groundwater zone adjacent to the landfill
- One Bayou Biobarrier in the shallow groundwater zone near Harrison Bayou
- A biogrid in the shallow groundwater zone and a biobarrier in the intermediate groundwater zone in the Mid Plume Area

The plume geometry and proposed injections have been developed using the basis and details of the Final RD (U.S. Army 2017). Overall, the implementation of biobarriers and biogrid will involve the injection of an electron donor and a microbial consortium capable of biodegrading primary VOCs and perchlorate.

The primary biodegradation pathway for chlorinated ethenes, such as tetrachloroethene and TCE, is reductive dechlorination, which occurs under highly reducing anaerobic conditions. During reductive dechlorination, chlorinated ethenes are used as respiratory substrates instead of oxygen by the anaerobic microorganisms that reduce these compounds to harmless by-products. Favorable aquifer conditions are established and/or maintained by adding a carbon source, such as EVO, to act as an electron donor. Details of the RA for each of the systems are described in the following sections.

3.1 Landfill Biobarriers

Three landfill biobarriers will be installed to control the migration of VOCs and perchlorate in shallow groundwater immediately downgradient of the landfill. The location of the barriers is designed to fully intercept the plume of chlorinated VOCs and perchlorate from the landfill in the shallow groundwater zone above their respective cleanup levels (**Figures 3-2, 3-3, and 3-4**). The substrate selected was EVO and therefore, replenishment would not be required for 3 to 5 years (U.S. Army 2017). The Safety Data Sheets for various commercial available EVO formulations are included in **Appendix C**. As specified in the RD, the specific formulation of EVO proposed for this project is electron donor solution-extended release (EDS-ER™). An equivalent EVO product will be used if EDS-ER™ becomes unavailable in the market. EDS-ER™ is a water mixable oil formulated with at least 92 percent natural seed

oils. EDS-ER™ is provided by the vendor as a water mixable oil that contains no water, and therefore, will be mixed with water in the field. The product mixes easily with water without using high energy mixers. As specified in the Final RD, a microbial bioaugmentation culture will be used. The Final RD specified KB-1, however, an equivalent culture, SDC-9™ will be used in place of KB-1. The Safety Data Sheet for SDC-9™ is included in **Appendix C**. At the three landfill biobarriers, a conservative tracer (sodium bromide) will be used to evaluate the distribution of the substrate as part of the performance monitoring.

3.1.1 Landfill Biobarrier #1

A biobarrier will be installed by injecting an amendment mixture consisting of EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture, SDC-9™ (APTIM's dechlorinating culture), and sodium bromide into eighteen direct-push technology (DPT) points and one injection well, 16IW09 as shown in **Figure 3-2** and listed on **Table 3-1**. **Table 3-2** shows the volume of amendment scheduled for injection at each injection point/well. The pounds of EVO of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army 2017).

3.1.2 Landfill Biobarrier #2

Existing injection wells installed during the Environmental Security Technology Certification Program (ESTCP) study (Geosyntec 2009) will be used to inject EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™) and sodium bromide to create Landfill Biobarrier #2. Before any of the pilot test wells are used for injections, they will be redeveloped prior to use as injection wells for Landfill Biobarrier #2, and no slug tests will be performed. Injections will be conducted in two phases. Phase 1 will use four existing injection wells for injections while extracting from five existing extraction wells to aid in the distribution of amendment crossgradient. The extracted groundwater during the first phase will accumulate in the onsite tank at LHAAP-16.

Phase 2 will use the extracted groundwater collected in the onsite tank. The extracted groundwater will be mixed with the amendment mixture and injected back into the existing five extraction wells.

The injection locations are shown on **Figure 3-3**. **Table 3-3** specifies the number of locations, and **Table 3-4** shows the planned volume of amendment mixture to be injected at every location. The pounds of EDS-ER™ of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army 2017).

3.1.3 Landfill Biobarrier #3

A biobarrier will be installed by injecting an amendment mixture consisting of EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™), and sodium

bromide into seven DPT points and one injection well, 16IW10, as shown in **Figure 3-4** and listed on **Table 3-5**. **Table 3-6** provides the planned volume of amendment mixture to be injected at each injection point/well. The pounds of EVO of the amendment mixture are the same as the calculation sheets provided in Final RD (U.S. Army 2017).

3.2 Bayou Biobarrier

A biobarrier will be installed by injecting an amendment mixture consisting of ABC Plus which consists of EVO with microscale zero valent iron (ZVI), sodium bromide, and bioaugmentation culture (SDC-9™) into thirteen DPT points and one injection well, 16IW20, as shown in **Figure 3-5**. ABC Plus will consist of 3,500 pounds of EVO and 3,500 pounds of microscale ZVI. As stated in the Final RD, the ABC product will be diluted with water to form a solution of approximately 10% by weight before injection. **Table 3-7** specifies the number of locations (DPT points/injection well) that will be used to inject the amendment mixture, and **Table 3-8** provides the planned volume of amendment mixture to be injected at each injection point. The pounds of EVO and iron of the amendment mixture is the same as provided in Final RD (U.S. Army 2017). The Safety Data Sheet for ABC Plus is included in **Appendix C**.

3.3 Mid-Plume Area ISB

Injections in the Mid-Plume area include injections in the shallow and intermediate groundwater aquifers. As specified in the RD, the specific formulation of EVO proposed for this project is EDS-ER™. The Safety Data Sheets for EDS-ER™ are included in **Appendix C**.

3.3.1 Shallow Groundwater

To treat the VOC and perchlorate impacted groundwater in the shallow groundwater aquifer, a biogrid will be installed by injecting EDS-ER™ or an equivalent EVO product, nutrients, bioaugmentation culture (SDC-9™) and sodium bromide (tracer) into forty DPT points as shown in **Figure 3-6** and listed on **Table 3-9**. The Final RD also included fluorescein dye (a tracer) for this area. Only sodium bromide will be used as a tracer to indicate distribution of injected amendment. Analytical results for bromide will be used to indicate its presence. Prior to injections, the shallow zone extraction wells will be shut down. **Table 3-10** specifies the volume of amendment mixture to be injected at each injection point. The pounds of EVO of the amendment mixture are the same as provided in Final RD (U.S. Army 2017).

3.3.2 Intermediate Groundwater

To treat the intermediate groundwater zone, a biobarrier will be installed consisting of EDS-ER™ or an equivalent EVO product, nutrient, bioaugmentation culture (SDC-9™), and sodium bromide (tracer) as shown in **Figure 3-7**. The injection will occur in a phased approach. After the initial injection into the six newly installed injection wells, the four existing extraction wells will be used to recirculate the groundwater between injection wells and the

extraction wells until an increase in bromide is detected in the extraction wells. Extracted groundwater will accumulate in the onsite tank. Once bromide is detected above baseline concentrations, the extraction system will be shut down and amendment mixture will be injected into the extraction wells. **Table 3-11** specifies the volume of amendment mixture to be injected at each injection point along with the amendment mixture quantities. The pounds of EDS-ER™ of the amendment mixture are the same as provided in Final RD (U.S. Army 2017). The Safety Data Sheet for various commercial available EVO formulations is included in **Appendix C**.

3.3.3 Sequencing of Injection Areas

The RD calls for injections in the most contaminated portion of the shallow and intermediate groundwater zones in conjunction with phased shut down of the existing groundwater extraction system. Currently, active extraction is ongoing from both the shallow and intermediate groundwater in the vicinity of the mid-plume injection area. The following is the proposed sequencing of the injections and extraction:

- 1) Continue active extraction from the mid-plume area using the existing onsite tank.
- 2) Inject at Bayou Biobarrier. The Bayou Biobarrier will protect contaminants from migrating to the bayou, and injection will occur at the Bayou Biobarrier before shutting down the extraction at the Mid-Plume area to limit any additional migration to the creek from the shutdown of extraction system. Additionally, this area uses the amendment mixture using EVO and microscale ZVI, while the other areas do not use the ZVI in the mixture. While injections are ongoing at Bayou Barrier, the field technicians will build/install recirculation system for the intermediate groundwater for the Mid-Plume area.
- 3) Shut down extraction from the mid-plume shallow and intermediate groundwater and empty the onsite tank by transferring water to the groundwater treatment plant (GWTP) for treatment.
- 4) Inject into the Mid-Plume. Begin injections into the intermediate groundwater and start recirculation of intermediate groundwater using onsite tank. While recirculating in the intermediate aquifer, inject into the shallow groundwater. During injections in the shallow groundwater, the recirculation of the intermediate groundwater and amendments will be checked. Recirculation will continue in the intermediate aquifer until distribution of amendments has occurred. Once recirculation is successful in the intermediate aquifer, the accumulated water and amendments will be reinjected into the intermediate aquifer.
- 5) Inject at Landfill Biobarrier #1. Injections may begin at Biobarrier #1 while recirculation may be continuing in the Mid-Plume intermediate groundwater.

- 6) Inject at Landfill Biobarrier #2/#3. There are extraction wells at Landfill Biobarrier #2, but they are not currently connected to the existing onsite tank. The initial injections will begin at Landfill Biobarrier #3 while the piping/connections at extraction wells at Landfill Biobarrier #2 are being prepared to be connected to the mixing tank. Once the injections are complete at Biobarrier #3, the injections will be completed at Biobarrier #2. The accumulated water from extraction of the Landfill Biobarrier #2 wells will accumulate in the mixing tank until amendments are added and reinjected into the extraction wells at Landfill Biobarrier #2.

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4.0 FIELD PREPARATION AND ACTIVITIES

This section discusses the field preparation and field methods that will be utilized to complete the scope of work under the RA.

4.1 Pre-Mobilization Activities

4.1.1 Permitting

No permitting is required prior to the commencement of fieldwork.

4.1.2 Notification

TCEQ and USEPA will be notified two weeks in advance of commencement of fieldwork activities.

4.1.3 Utility Clearance

Utility location and clearance for intrusive activities will be conducted (in accordance with Section 3.1 of the Installation-Wide Work Plan [IWWP]) prior to drilling as follows:

The site health and safety officer will:

- Prepare a map indicating the area(s) where intrusive activity is planned to occur.
- Perform the necessary reviews.
- Contact the Texas Excavation Safety System, Inc. utility notification service by calling 811 or 800-892-0123. This notification is to be made a minimum of two working days prior to the initiation of intrusive activity (excluding Saturdays, Sundays, and holidays), but not greater than 14 days.
- Verify that all underground installations have been located, physically marked, and then noted on the map. If needed, a third-party location service will be used.
- Mark all overhead utilities with kilovolts rating on the map.
- Notify the appropriate agencies, contracting officer's representative, and property owners (when applicable). Confirm utility clearance is complete and document.
- A safety meeting shall be held and a job safety analysis shall be completed by all personnel who are involved in the intrusive activities prior to initiating work.

4.2 Site Activities

A RACR will be submitted to document site activities completed to implement the RA. Site activities in chronological order will be as follows

4.2.1 Pre-Injection Activities

1. Install injection and monitoring wells as indicated in **Table 4-1**. Wells will be installed by a licensed Texas driller and oversight provided by an APTIM geologist.
2. Collect soil cuttings from wells in drums and sample for waste characterization.
3. Conduct slug tests for existing pilot test wells that are proposed for injections in the vicinity of Landfill Biobarrier #2, and redevelop wells if necessary.
4. Collect baseline (pre-remedy) readings and samples from existing monitoring wells as indicated in **Tables 4-2** and **4-3**. Collect pre-remedy surface water samples from three locations: 16SW01, 16SW02, and 16SW03 for VOCs, perchlorate, metals, and field parameters (dissolved oxygen [DO], pH, oxidation-reduction potential (ORP), conductivity, and temperature) as shown in **Table 4-10**. Additionally, baseline field readings from the bayou will be collected at locations near the Bayou Biobarrier at least three times during a work day prior to beginning injection into the Bayou Biobarrier. In the event that a release of amendment mixture is suspected to the surface water, a surface water sample will be collected and the results compared to the baseline surface water sample results.
5. Survey the newly installed monitoring and injection wells.
6. Dispose of soil cuttings based on waste characterization analysis.
7. Review soil boring and well completion logs from the well installation event and ones included in the Final RD.
8. Review data from new wells and adjust any amendment quantities if needed if contamination is higher than expected.

4.2.2 Injection Activities

1. Mobilize materials, equipment, mixing tanks, and labor for injections.
2. Set up traffic detouring as needed.
3. Layout of injection arrays and clear DPT injection points. Please refer to **Section 3.3.3** for the sequence of biobarriers.
4. Core concrete/asphalt at injection points, if needed, and adjust any points if obstructions are found.
5. Setup amendment, equipment, and materials onsite including materials for recirculation from Mid-Plume intermediate groundwater and Landfill Biobarrier #2 extraction.

6. Begin preparing amendment solution for injection a day before planned injections. Preparation of amendment solution will be a continual activity.
7. Inject amendments following the sequencing as outlined in **Section 3.3.3** using:
 - DPT rig to push down to required depth and inject amendment through probe rod. No soil cuttings will be generated using DPT, or
 - Injection system to inject amendment into previously installed injection/extraction wells. Recirculate where required.
8. During injections continuously monitor for surfacing near the injection locations; for the Bayou Biobarrier, the creek will also be monitored during injections. Monitor pressure, volume, and flow into each injection point (DPT or well) by observing the gauges on the injection system. Record the injection interval during injections. Record injection information on the injection log in **Appendix E**. During active injection, the system will be continuously monitored by designated personnel.
9. Once injection is complete at a DPT injection point, abandon point.
10. Record DPT injection point locations with global positioning system (GPS).
11. Once injections and recirculation is complete, decontaminate and demobilize equipment, materials, and mixing tank.
12. Restore site and demobilize personnel.

4.2.3 Post Injection Activities

After injections, performance monitoring will be conducted followed by MNA monitoring. Landfill operations and maintenance will be ongoing.

4.3 Drilling and Well Installation

Drilling and well installation will utilize both DPT rigs and hollow stem auger rigs. DPT rigs are used for in situ injections through a probe. The hollow stem auger rigs will be used for the installation of wells. A total of nine injection wells and eighteen monitoring wells will be installed at LHAAP-16 using an auger rig rotary sonic drilling technique as shown in **Table 4-1**. All drilling and well installation activities will be supervised by a Texas-registered geologist.

4.3.1 DPT Drilling

A DPT rig will be used to install the DPT points for the biobarriers. A total of 79 points will be installed using a DPT rig between the landfill and Harrison Bayou. DPT drilling will be conducted in accordance with the procedures presented in the IWWP (Bhate 2018). Each DPT point will be abandoned by filling with grout after injections are completed.

4.3.2 Injection Wells

All injection wells will be constructed of 2-inch schedule 40 polyvinyl chloride (PVC) with a 10-foot 0.010 slot PVC screen at the bottom. The wells will be screened over the target intervals as shown in **Table 4-1**. Injection wells (six) installed in the intermediate groundwater zone will require a minimum of 6-inch diameter Schedule 40 PVC isolation casing to approximately 35 feet. Injection wells will be constructed to the required specification for isolation casing, surface completion, prevention of commingling and confinement of undesirable groundwater to its zone of origin in accordance with Section 3.2 of the IWWP (Bhate 2018). Please refer to Standard Operating Procedure (SOP) A7-Monitoring Well Installation in Appendix A of the IWWP for additional guidance on well installation. Injection wells will be installed using a hollow stem auger rig rotary sonic drilling techniques. The lithology will be logged at the proposed injection and monitoring well location.

4.3.3 Monitoring Wells

Monitoring wells will be constructed of 4-inch inside diameter schedule 40 PVC 0.01 slot well screen with a 4-inch inside diameter riser composed of schedule 40 PVC pipe. A filter pack consisting of 10/20 filter sand will be placed around the screen from the bottom of the borehole to at least 2 feet above the screen. Wells will be pre-developed by bailing and surging to aid in settling the filter pack before placing the bentonite seal. After the filter pack has been placed, a 2- to 5-foot bentonite seal will be introduced into the well above the filter pack. The bentonite seal will be placed in 1-foot lifts each hydrated for 30 minutes. After placement of the final bentonite lift, the bentonite seal will be saturated with potable water and allowed to hydrate for an additional two hours before grouting begins (IWWP, Section 3.2 and SOP A7.3.6). After the bentonite seal has hydrated, the remaining annulus will be grouted using a Type I Portland or American Petroleum Institute Class A cement/bentonite slurry.

The wells will be screened over the target intervals as shown on **Table 4-1**. Monitoring wells will be installed within and downgradient from the biobarriers for performance monitoring. Wells will be installed in accordance with Section 3.2 of the IWWP (Bhate 2018). Please refer to the SOP A7-Monitoring Well Installation in Appendix A of the IWWP for additional guidance on well installation.

4.3.4 Well Development

Each newly installed well will be developed no sooner than 24 hours following well completion. Existing wells that will be used for injection will be redeveloped. Well development will be conducted in accordance with Section 3.2.2 of the IWWP (Bhate 2018). Please refer to SOP-A8-Monitoring Well Development for additional guidance on well development.

4.4 Groundwater and Surface Water Sampling

Areas around the wells will be cleared of vegetation and biohazards to protect the field staff. Wells will be sampled prior to injections for baseline data and post injections. Low-flow groundwater sampling will be performed in accordance with Section 3.4 of the IWWP (Bhate 2018). Procedures for purging and sampling the wells are detailed in SOP A10-Low Stress Groundwater sampling in Appendix A of the IWWP. During the performance monitoring events, surface water samples will be collected concurrently if water is flowing in the creek. Surface water samples will be collected in accordance with Section 3.6 of the IWWP (Bhate 2018). Please refer to SOP A11-Surface Water Sampling in Appendix A of the IWWP for detailed guidance regarding surface water sampling.

Additional details about baseline sampling, performance sampling and surface water sampling is discussed in **Section 4.7** below.

4.5 ISB Injection

Placement of DPT points, injection wells, and existing wells for ISB is shown on **Figures 3-2 to 3-7**. **Tables 3-1 to 3-11** provide the number of injection points, target depths, volumes of each amendment to be prepared, and target volumes to be injected. The calculations to determine the required volumes are based on the calculation sheets provided in the Final RD.

4.5.1 Preparation

4.5.1.1 Location Preparation

Prior to the ISB injection, the site will be cleared of aboveground hazards. A GPS device will be used to locate each injection point. After the third party utility locator service has marked the underground utilities, APTIM will verify that there are no injection points that will impact any utility. If there are points that are affected, APTIM will alter the plan and relocate those points to avoid the utility, while still meeting the injection objectives. The final DPT injection point locations will be recorded with the GPS. Prior to drilling with the DPT at each point, APTIM's standard procedure is to hand dig to 5 feet at each injection point to check for underground obstructions/utilities.

4.5.1.2 Amendment Preparation

The reduction of VOCs and perchlorate will be addressed by using enhancing reductive dechlorination, an anaerobic microbial process. There are various EVO formulations commercially available in the market. EDS-ER™ (or an equivalent EVO product will be used for injections along with APTIM's dechlorinating microbial consortium, SDC-9™. Additionally, the Bayou Barrier will use ABC Plus with microscale ZVI or an equivalent product.

The ISB amendments will be mixed in 20,000-gallon mixing tanks. The tanks will be located at LHAAP-16. If field conditions do not allow for placement of the tanks at LHAAP-16, the 20,000-gallon mixing tanks will be staged at the GWTP. The amendment solution will be mixed prior to the day of injection. The potable water required for mixing will be obtained from the GWTP or from an off-base fire hydrant and transported to the mixing tank in a water truck. If the 20,000-gallon tanks are staged at the GWTP, the amendment mixture will be prepared at the GWTP and transported to the site in water trucks.

Steps required for preparation of ISB (EDS-ER™ and SDC-9™) amendments are as follows:

- Approximately 24 hours prior to injection, the anaerobic solution will be prepared by adding the required volume of EDS-ER™ and dilution water (1:10 mixing ratio), nutrients, and a small volume of SDC-9™ into the mixing tank. The same amendment mixture is used for all injection areas except for the Bayou Barrier where the amendment mixture will include microscale ZVI. The microbes will grow on a small amount of the carbon, and during respiration, they will use the available oxygen in the mixing tank, creating an anaerobic medium. During mixing, a conservative tracer sodium bromide (at target concentration of 500 milligrams per liter [mg/L]) will be added to the solution to evaluate the distribution of amendment during performance monitoring.
- When the solution has become anaerobic, based upon a DO meter reading of less than 1.0 mg/L, the remaining bioaugmentation culture will be added to the mixing tank and recirculated. The procedure differs from the Final RD which called for intermittent injection of anaerobic water and the microbes. Preparing the full volume of anaerobic water for injection and mixing is favorable for the microbes.
- After the anaerobic solution containing each of the amendments has been prepared, the amendments will be injected. The amendment solution will be injected into the subsurface using an injection system, as shown on **Figure 4-1**.
- The injection volume for each point at an injection area along with the associated mass and volume of amendment are provided in **Tables 3-2, 3-4, 3-6, 3-8, 3-10, and 3-12** and are based on 92% EVO oil (EDS-ER™) by weight.

Steps required for preparation of ABC Plus amendment mixture is as follows:

The ABC product will be mixed into a slurry for injection. **Appendix D** provides details regarding the mixing preparation of the ABC Plus product. Additionally, sodium bromide (tracer) will be mixed in with the EVO at the beginning of the mixing process.

4.5.2 In Situ Injections

4.5.2.1 Injection System

An injection system will be used to allow for multiple well/DPT injections at a single time under low pressure (i.e., less than 40 pounds per square inch). The injection system will include volume and pressure gauges so amendment volume can be recorded for each injection location. The total volumes per well, injection pressures and gallon per minute will be tracked on paper and electronically using the Injection Log in **Appendix E**. The injection system will be connected to each well or to the DPT probe with hoses.

4.5.2.2 DPT Injection

For injection into the shallow aquifer, a DPT rig will be used to inject the amendment mixture at 2-foot intervals to cover the entire target interval using a top down or bottom up approach depending on the lithology and field conditions. An injection tool string is advanced to the top of the injection interval and the amendment is pumped through the probe rods. The cycle is repeated to provide coverage across the entire target interval.

4.5.2.3 Injection through Wells

Injection into the intermediate aquifer and Landfill Biobarrier #2 will use newly installed injection wells or existing extraction wells. The injection well screen will be installed over the target interval. The injection well screen interval may be modified during field implementation activities based on field observations including depth to groundwater. For injection using a well, the well will be fitted with an injection connection for attachment of the injection system.

Slug tests will be conducted on the pilot test wells at Landfill Biobarrier #2 to ensure they are in acceptable conditions. If the results indicate they are not, the wells will be redeveloped prior to use as injection wells.

4.5.2.4 Monitoring during Injections

During the ISB injections, possible amendment surfacing (also called daylighting) may occur at the ground surface and will be monitored. Injection pressures will also be monitored since sudden reductions may be an indication of amendment loss into subsurface, possibly from fracturing induced by the injection or from a high-permeability zone. If daylighting on the surface or in nearby drainage features is detected, injection rates will be reduced or injections will be shut down. Bromide will be used as an indicator of distribution of the EVO (carbon). The bromide concentrations will be monitored, and an increase in bromide concentrations above the baseline results will indicate amendment distribution. Samples will be collected and analyzed for bromide to determine if there is an increase in bromide over baseline to evaluate distribution of amendment.

4.6 Injection Areas

In situ injection activities will be conducted in accordance with Section 3.10 of the IWWP (Bhate 2018).

4.6.1 Landfill Biobarrier #1 Amendment Injection

The injection will consist of delivering amendments to the subsurface using a series of eighteen DPT injection points (DPT01 through DPT18) and one injection well (16IW09). The RD proposed that the injection well would also serve as a groundwater monitoring location within the biobarrier. A spacing of 15 feet between injection locations was selected based on the rationale and injection radius of influence (ROI) presented in Section 4.1.2 of the Final ROD.

The target injection intervals are shown on **Table 3-1**. The injection locations are shown on **Figure 3-2**. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-2**.

4.6.2 Landfill Biobarrier #2 Amendment Injection

Existing injection wells and extraction wells installed as part of the ESTCP study (Geosyntec 2009) will be used to deliver the amendments. The injections will be conducted in two phases in the vicinity of Landfill Biobarrier #2. The injection locations are shown on **Figure 3-2**. The screen intervals of the existing wells are included on **Table 3-3**. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-4**.

Phase 1 will involve injecting into injection wells 16IW01, 16IW03, 16IW05, and 16IW07 as groundwater is extracted from extraction wells 16EW11, 16EW12B, 16EW13, 16EW14B, and 16EW15 to enhance distribution of the amendment mixture cross gradient. Pumps and piping are not currently installed and will be temporarily installed for extraction. The extracted groundwater will accumulate into the empty mixing tank. Once the planned amendment volume has been injected, a sample of the extracted groundwater will be collected from each extraction well and tested for bromide. If bromide concentration is more than the baseline concentration, extraction will end. If bromide concentrations are not detected above baseline levels, extraction of groundwater will continue until a higher concentration of bromide is detected in the extraction wells. The extraction wells will be turned off once bromide is detected above baseline concentrations. If additional extraction occurs, it is likely that the accumulated water volume may be more than is needed for the amendment mixture for Phase 2. If this occurs, once the accumulated groundwater is more than 3,500 gallons, the excess water will be reinjected into the injection wells while extraction continues.

During Phase 2 of the injections, the extraction wells will be shutdown. The water accumulated from Phase I of injections will be used to make the amendment mixture for Phase 2. One part of the concentrated EVO solution will be mixed with 10 parts of extracted groundwater and

injected into extraction wells 16EW11, 16EW12B, 16EW13, 16EW14B, and 16EW15. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-4**.

4.6.3 Landfill Biobarrier #3 Amendment Injection

The injection will consist of delivering amendments to the subsurface using series of seven injection points using DPT (DPT19 through DPT25) and one injection well (16IW10). A spacing of 15 feet between injection locations was selected based on the rationale and injection ROI presented in Section 4.1.2 of the Final ROD. The RD proposed that the injection well would also serve as a groundwater monitoring location within the biobarrier.

The injection locations are shown on **Figure 3-4**. The target injection intervals for the DPT locations are shown on **Table 3-5**. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-6** for the injection points and well.

4.6.4 Bayou Biobarrier Amendment Injection

The injection will consist of delivering amendments to the subsurface using a series of thirteen DPT locations (DPT-26 through DPT-35, and DPT-37 through DPT-39) and one injection well (16IW20) to inject the amendment mixture. The injection well will also serve as a groundwater monitoring location within the biobarrier along with 16RW11. The amendment mixture will comprise of a ABC Plus (EVO and microscale ZVI), SDC-9™ and sodium bromide (tracer). A slower rate of injection will be used to reduce chances of surfacing and reaching the creek. 16WW40 and 16WW56 will be used as injection control wells and will be visually monitored hourly during injections to determine if EVO reaches the well. The well should be outside the ROI. However, if EVO reaches the well, then the flow rate and volume will be reduced to ensure that a buffer zone is maintained at the creek and the injection pattern for other points will be modified to move the points away from the creek. Injections will be conducted during weekdays (and not on weekends) in order to facilitate visits by the Army and regulatory personnel for observation.

The field readings will be collected using a hand held field instrument and readings will be recorded on field forms. The probe will be placed in the bayou for a direct reading from the bayou. If the carbon source reaches the bayou, the natural organisms will utilize the carbon and will create anaerobic conditions in the water which may impact aquatic life. If any sudden decrease in DO is observed to below baseline readings or a visual change is observed in the water (murkiness) along the bayou bank, injections will be suspended. Additional monitoring and visual observations will be conducted to determine if the decrease is from injection materials or changes in the environmental conditions. If injections are suspended, corrective actions (placement of aerators and/or hay bales) will be implemented if needed. Once DO has stabilized and no visual confirmation of injection materials into the bayou is confirmed,

injections will resume. During and after the injection, the surface water of Bayou will be monitored for DO. The following monitoring frequency will be conducted along the Bayou:

- Hourly visual and DO inspection along the Bayou during injections within 50 feet of any subsurface drainage feature
- Daily visual and DO inspection during weekdays for one week after injections
- Daily visual and DO inspections during weekend if more than 1 inch of rain is recorded within a week after the injections
- Visual and DO inspections every other day after the first significant rain (3 inches or more within a seven day period) for two weeks

During the injections, parameters will be monitored and recorded by APTIM personnel to ensure consistency. During injections, possible amendment surfacing (also known as daylighting) may occur at the ground surface or in the surface water at the Bayou and will be monitored. If daylighting on the surface or in Bayou is detected, injection rates will be reduced, or injections will be shutdown. If a spill is observed along the Bayou, amendments will be isolated using sand bags and hay bales and the affected materials will be collected and disposed. A solar powered aerator will be available for use, if needed, to aerate and reoxygenate impacted surface water. The target injection intervals are shown on **Table 3-7**. The injection locations are shown on **Figure 3-5**. The injection volumes and amendment mixture quantities (total and per point) are shown on **Table 3-8**.

4.6.5 Mid Plume Area (Shallow Groundwater Zone) Amendment Injection

The extraction wells (16EW01, 16EW02, 16EW03, and 16EW04) will be shut down prior to injections. The injection will consist of delivering amendments to the subsurface using a series of forty DPT locations (DPT-40 through DPT-79). An attempt will be made to inject into alternate points simultaneously to eliminate potential surfacing. The target DPT injection intervals are shown on **Table 3-9**. The injection volume and amendment mixture quantities (total and per point) are shown on **Table 3-10**.

The well locations are shown on **Figure 3-6**.

4.6.6 Mid Plume Area (Intermediate Groundwater Zone) Amendment Injection

Two new injection wells will be installed between pairs of existing extraction wells 16EW05 and 16EW06, 16EW06 and 16EW07, and 16EW07 and 16EW08 for a total of six new injection wells in the intermediate zone to recirculate groundwater between the injection and extraction wells. The proposed well locations are shown on **Figure 3-7**. The existing extraction wells will

be used as injection wells once the recirculation is terminated. The injection volume and amendment mixture quantities (total and per point) are shown on **Table 3-11**.

To distribute the amendments along the linear biobarrier between the injection wells, and to minimize mounding and/or surfacing, a sequence of recirculation will be used as follows:

- Check bromide before injecting and twice a week from active extraction wells. Once an increase in bromide is observed in an individual extraction well, the extraction is shut down from that well.
- Inject all the amendment mixture into each injection well (16IW25 to 16IW30).
- Start extraction at extraction wells 16EW05 and 16EW07 into the onsite tank and recirculate back into injection wells 16IW25, 16IW26, 16IW27, 16IW28, 16IW29, and 16IW30. Continue recirculation for 3 days unless an increase in bromide is observed above baseline levels in 16EW05 and 16EW07, and the extraction would stop.
- After 3 days, switch extraction to extraction wells 16EW06 and 16EW08 to the onsite tank and recirculate back into injection wells 16IW26, 16IW27, 16IW28, 16IW29, and 16IW30. Continue recirculation for 3 days unless an increase in bromide is observed above the baseline levels in 16EW05 and 16EW07, and the extraction would stop.
- After extracting for 3 days at 16EW06 and 16EW08, switch back to 16EW05 and 16EW07. Keep rotating extraction from wells until bromide is above baseline in all extraction wells.
- The extraction wells are estimated to be on for 2 to 3 weeks.
- After extraction has shut down in all extraction wells, the EVO amendment mixture will be injected into the existing extraction wells.

4.7 Performance Monitoring

APTIM will collect performance samples to evaluate the effectiveness of the ISB injections as indicated in **Tables 4-4** through **4-8**.

4.7.1 Baseline Sampling

Baseline samples will be collected prior to the implementation of injections to characterize the CVOC and perchlorate concentrations and geochemical conditions in the Shallow and Intermediate Zone. The wells selected include wells inside and outside of the plumes and wells located upgradient, within and downgradient of the ISB areas. The baseline sampling results will be compared to sample results collected post ISB injections. The wells that will be sampled during the baseline sampling event are included in **Table 4-2** and **4-3**.

4.7.2 Evaluation of Design Effectiveness

Groundwater data will be collected within the first two months of remedy implementation to evaluate effectiveness of injections. Two sets of groundwater samples will be collected before the first quarterly performance monitoring event. The performance monitoring plan for Landfill Biobarrier #1, Landfill Biobarrier #2, Landfill Biobarrier #3, Bayou Biobarrier and Mid-Plume are presented in **Tables 4-4, 4-5, 4-6, 4-7, and 4-8**, respectively.

4.7.3 Performance Monitoring Year 1 and Year 2

Wells included in **Tables 4-4 to 4-8** will be used to monitor the performance of ISB injections in each area. The *Dehalococcoides* are expected to break down the chlorinated ethenes to harmless byproducts like ethene and ethane. This process of biodegradation results in depletion of DO and lowering of ORP. Performance monitoring will be conducted to evaluate change in geochemical conditions, VOCs, and perchlorate concentrations, due to biodegradation reactions. Additionally bromide will also be analyzed to evaluate the distribution of amendments after injections. The performance monitoring plan for Landfill Biobarrier #1, Landfill Biobarrier #2, Landfill Biobarrier #3, Bayou Biobarrier, and Mid-Plume are presented in **Tables 4-4, 4-5, 4-6, 4-7, and 4-8**. These tables also present the rationale for selection of each monitoring location. Any recommendations to reduce the frequency and/ or drop analytical parameters or wells from the sampling list will be made in the Annual Remedial Action Operation (RA-O) Report. Additionally, results will be evaluated to determine if reinjections are needed.

4.7.4 Follow-up Injections in Biobarriers

As specified in the ROD, follow up injections for the biobarriers will be implemented based on the groundwater monitoring results. Though the EVO is specified to last for 3 to 5 years, the decision to reinject will be based on the following criteria:

- Depletion of total organic carbon to below 20 mg/L.
- ORP increase above -50 millivolts (mV).
- Contaminant concentrations in groundwater performance wells for the landfill biobarriers and in surface water for the Bayou Biobarrier remain above cleanup standards.
- If these conditions occur, reinjections will be conducted only in specific areas that meet the above criteria. The wells used to determine the follow-up injection, in the previously injected biobarriers, are indicated as wells for “performance data within the biobarrier” in **Tables 4-4 through 4-7**.

4.7.5 MNA Evaluation

After two years of quarterly performance monitoring, the performance of MNA will be evaluated. The wells selected for performance monitoring for MNA evaluation for shallow and intermediate groundwater plumes are included in **Table 4-9** and in **Figure 4-2**. The analysis for the samples is also included on **Table 4-9**. The performance evaluation for MNA will be based on eight quarters of data combined with historical data to evaluate the effectiveness of biogeochemical reactions in reducing contaminant concentrations. Per the Final ROD (U.S. Army 2016), the evaluation of MNA after two years will be based on the following:

- Plume stability (i.e., plume concentrations are reducing in majority of the performance wells, and the plume is not expanding in area as demonstrated with compliance wells).
- MNA potential based on evaluation of biodegradation screening scores using USEPA guidance.
- MNA process evaluation, based on an attenuation rate calculated with empirical performance monitoring data, and MNA process demonstration based on the presence of daughter products and bacterial culture counts.

4.7.6 Contingency Action for MNA Areas

A contingency remedy will be implemented for MNA areas outside the active remediation areas if the above criteria (stated in **Section 4.7.5**) are not met. A contingency remedy involving the application of bioamendments to address the ineffective aspects of MNA will be conducted. The area and elements of contingency remedy will be selected based on the entire data set available. If the contingency remedy is required, it will be documented in an Explanation of Significant Difference (ESD).

4.7.7 Long-Term Monitoring Year 3 to Next Five Year Review

LTM will be initiated if MNA is found to be effective based on the first two years of performance monitoring. Per the Final ROD, LTM will be implemented at a semiannual frequency for three years, and then annually until the next five-year review. The wells selected and planned analysis is included in **Table 4-9** and will be modified based on the review of first two years of data.

4.7.8 Surface Water Monitoring

Surface water monitoring will be conducted during performance events to ensure that concentrations do not exceed surface water standards for contaminants. The surface water sampling events will be conducted along with the groundwater sampling events for performance monitoring. If surface water samples could not be collected from Harrison Bayou during quarterly sampling events due to a dry event, samples will be collected outside the

routine quarterly sampling events following significant rain events. An attempt will be made to collect four surface water samples every monitoring year.

Surface water samples will be collected at three locations: upgradient, downgradient and immediately adjacent to LHAAP-16 (**Figure 4-3**). As part of the surface water sample collection activities, field readings (DO, pH, ORP, temperature and conductivity) will be collected instream with a multi-parameter meter. Surface water samples will be collected in accordance with Section 3.6 of the IWWP (Bhate 2018). Please refer to SOP A11-Surface Water Sampling in Appendix A of the IWWP for detailed guidance regarding surface water sampling. These surface water samples will be analyzed for the COCs as shown in **Table 4-10** and concentrations will be compared to clean-up levels listed in **Table 1-1**. Surface water conditions will be noted and photos documented during the groundwater sampling event, and when surface water samples are collected.

4.7.9 Remediation Derived Waste Management

Remediation derived waste include the following:

- Drill cuttings from injection and monitoring wells
- Groundwater generated from development of new wells
- Groundwater generated from purging of wells prior to sampling
- Decontamination fluids
- Disposable protective clothing and supplies

Drill cuttings will be placed in 55-gallon drums or high-density polyethylene lined roll off containers. Composite samples will be collected and analyzed for waste characterization prior to proper handling and disposition. All handling of drill cuttings will be performed in accordance with Section 3.8.1 of the IWWP.

Wastewater generated from equipment decontamination, well development, groundwater sampling, or other investigative and remedial activities will be stored in 55-gallon drums and transported to the GWTP at LHAAP-18/24 as specified in Section 3.8.2 of the IWWP.

4.8 Metals Groundwater Monitoring

The selected remedy in the ROD indicates monitoring for metals will be evaluated at the first five year review to determine if any further monitoring for metals is warranted (U.S. Army 2016). **Table 1-2** provides a summary of the wells that were sampled for the metals COCs and had detected concentrations above the cleanup levels. As part of the next five year review after remedy implementation, groundwater samples will be collected. All the wells listed on **Table 1-2** will be analyzed for thallium. Selected wells listed in **Table 1-2** will be analyzed

for the remaining metal COCs (chromium, arsenic, nickel and/or manganese) based on the previous results. The sampling will be conducted using low flow sampling as described in Section 3.4 of the IWWP (Bhate 2018). The monitoring results and evaluation will be included in the next five year review report.

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5.0 REMEDY PERFORMANCE EVALUATION AND REPORTING

A RACR will be submitted to document site activities completed to implement the RA. Performance monitoring results will be included in the Year 1 and Year 2 Annual RA-O Reports. The Year 1 and Year 2 Annual RA-O Reports will include an MNA evaluation of the groundwater COCs for LHAAP-16. After the first two years, if MNA is found to be effective, an Operating Properly and Successfully Report will be prepared. RA-O sampling will continue at a semiannual frequency through the remainder of the period of performance (PoP) and the results will be documented in Annual RA-O Reports.

5.1 Annual RA-O Reports

An Annual RA-O Report will be prepared at the end of each year to present groundwater monitoring results. Wells within the plume areas will be evaluated for MNA performance. 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.

The Annual RA-O Report will also include landfill O&M, annual LUC inspection, and well system O&M.

5.1.1 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 1-1**), 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.

5.2 Contingency Action for MNA Areas

Per the ROD, a contingency remedy would be implemented if the above criteria (**Section 5.1.1**) were not met for the passive MNA areas (i.e., MNA areas outside the active remediation areas). The contingency remedy includes additional injections to enhance MNA. If a contingency remedy is needed, details of additional injections will be documented in an ESD.

6.0 SCHEDULE

Table 6-1 shows the estimated duration for each major site activity and timeline. Weather and unknown site conditions could affect this schedule.

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7.0 OPERATION AND MAINTENANCE PROCEDURES

Some components of the final remedy at LHAAP-16 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 existing landfill cap, which includes signage; and maintenance of the current or future groundwater monitoring system (this would include all wells that serve some purpose, including bioremediation, MNA, background, water levels, and cap performance). Other routine maintenance activities include maintenance and repair of site access features, such as roads, gates, and fencing, as needed. These activities will be conducted annually unless recommended otherwise during a five-year review.

7.1 Maintenance of the Existing Landfill Cap

As discussed previously, a multilayer cap was constructed at LHAAP-16 landfill from 1996 through 1998 as part of an early IRA (under CERCLA) in accordance with the interim ROD signed in 1995. Per the 1995 IRA ROD and 2016 Final ROD, this cap includes the following layers: foundation soil layer, sodium bentonite geocomposite liner, geomembrane, 18-inch fill soil layer, 6-inch top soil, and perimeter berms and drainage swales. Please refer to **Appendix A** for a figure of the Landfill Cap.

Per the selected remedy documented in the 2016 Final ROD, the existing cap will continue to be monitored, maintained, and repaired, as necessary, to preserve its long-term effectiveness. This includes inspection of the landfill cap to check for erosion, settlement, and deep-rooted vegetation, and implementation of necessary repairs. Per the 1995 IRA ROD and 2016 Final ROD, the substantive post-closure requirements at 40 CFR Sections 264.228 (b)(1), (3), and (4); 264.310 (b); and 30 TAC 335.174 are ARARs for landfill cap maintenance and monitoring. The substantive requirements of these post-closure ARARs relevant to LHAAP-16 include the following:

- Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events (e.g. deep-rooted vegetation and burrowing animals).
- Maintain and monitor the ground-water monitoring system.
- Prevent run-on and run-off from eroding or otherwise damaging the final cover.

In order to comply with above requirements, annual inspections will be conducted for the different components of the landfill cap. Inspections will include examining each component of the cap to determine maintenance needs. The area will be checked for proper signage to

ensure that required signs are posted and are legible. If missing or no longer legible, the signs will be replaced.

An RAO Inspection and Maintenance Checklist is presented in **Appendix F**.

7.2 Vegetative Cover Maintenance

Vegetative cover is intended to reduce erosion caused by wind or water. Vegetation will be visually inspected annually, or as needed, following major events including a seismic event greater than a magnitude of 4 on the Richter scale, wildfires, or floods that may affect the integrity of the cover system, for overall health and continuous coverage. Bare spots where the topsoil is exposed, and/or areas of the cap where vegetation is dead or stressed to the point it no longer adequately inhibits erosion will be re-seeded, as appropriate. Unwanted vegetation (e.g., plants with potentially deep root systems such as trees) that has the potential to compromise the integrity of the cap will be removed.

7.3 Erosion and Settlement Inspection and Maintenance

The landfill cap will be inspected annually, for erosion and settlement, or as needed following major events including a seismic event greater than a magnitude of 4 on the Richter scale, wildfires, or floods that may affect the integrity of the cover system. If evidence of significant erosion, settlement, or deterioration, such as gullies, linear crevasses, washouts, rills, or settlement depressions, are observed, the need for cap repair will be evaluated. Settlement can cause cracks, differential displacement, or zones of depression that disrupt the intended flow of storm water over the cover. If repairs are determined to be needed, they will be performed to preserve the integrity of the cap and may include filling and covering the erosion and settlement features with material of similar composition to the existing topsoil. Replacement topsoil will be compacted to restore the cap to the specified grade.

7.4 Drainage System Inspection and Maintenance

The drainage system consisting of graded drainage swales will be visually inspected annually, or as needed, following major events including a seismic event greater than a magnitude of 4 on the Richter scale, wildfires, or floods that may affect the integrity of the cover system, for overgrown vegetation, debris and silt, and erosion of banks and slopes. Areas of the drainage system where vegetation is overgrown to the point that it interferes with drainage off the cover, or where silt and/or debris have accumulated, will be maintained by removing the overgrowth, and/or accumulated sediment/debris from the drainage swale. Also, areas with bank and slope erosion will be restored by removing eroded soil, adding new soil, compacting in 6-inch lifts, and adding vegetation for slope stability. If further stabilization is required, riprap can be placed along the bank slope.

7.5 Maintenance of the Current or Future Groundwater Monitoring System

The groundwater monitoring system is comprised of a network of monitoring wells used to implement ISB, monitor progress of the remedial activities, evaluate the performance of the cap, and determine the magnitude and extent of COCs. This system of wells will be inspected and maintained as part of the annual inspection and maintenance program discussed for the landfill cap. 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 condition will be collected during inspection and maintenance activities. The annual inspection and maintenance activities will be documented in the Annual RA-O reports.

7.6 Maintenance of Site Access Features

LHAAP-16 is accessed by roads and through gates in a perimeter fence. The roads, perimeter fence, and gates will be visually inspected annually, or as needed, to ensure that the roads remain accessible and the perimeter fence and gates are intact and undamaged. Maintenance will be conducted as needed.

Any fence posts that are not securely anchored in the ground and/or metallic parts that are excessively corroded will be repaired or replaced. If evidence of unauthorized entry through, over, or under the fence is observed, these sections of the fence will be reinforced.

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Tables

Table 1-1
Groundwater and Surface Water Cleanup Levels, LHAAP-16

COC	Cleanup Level ($\mu\text{g/L}$)
	MCL
Trichloroethene	5
cis-1,2-dichloroethene	70
1,1-dichloroethene	7
1,2-dichloroethane	5
Vinyl Chloride	2
1,1,2-trichloroethane	5
Methylene Chloride	5
Chromium	100
Arsenic	10
Thallium	2
	TRRP Tier 1 Groundwater Residential PCLs
Nickel	490
Perchlorate	17
Manganese	1,100 ^a

Notes:

^a 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 $\mu\text{g/L}$, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese.

$\mu\text{g/L}$ - micrograms per liter

COC - contaminant of concern

MCL - maximum contaminant level

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

UTL - upper tolerance limit

**Table 1-2
LHAAP-16 Wells with Metal Concentrations above Cleanup Levels**

Cleanup Levels	Maximums					Most Recent Results				
	Arsenic	Chromium	Manganese ^a	Nickel	Thallium	Arsenic	Chromium	Manganese ^a	Nickel	Thallium ^b
10	10	100	1100/7820	490	2	10	100	1100/7820	490	2
Shallow Wells										
16WW12	-	1820 (10/97)	-	816 (02/04)	footnote b	-	107 (03/09)	-	-	footnote b
16WW14	-	3090 (10/97)	-	1630 (10/97)	footnote b	-	143 (03/09)	-	-	footnote b
16WW16	-	465 (12/04)	2090 (12/04)	-	footnote b	-	-	2090 (12/04)	-	footnote b
16WW22	-	3860 (12/04)	-	690 (12/04)	footnote b	-	-	-	690 (12/04)	footnote b
16WW24	-	5220 (10/97)	6020 (12/04)	751 (10/97)	17.3 J (03/03)	-	830 (3/09)	6020 (12/04)	-	17.3 J (03/03)
16WW26	11 (10/97)	114 (10/97)	2350 (02/04)	-	11.9 J (12/04)	-	-	2070 (12/04)	-	11.9 J (12/04)
16WW30	-	-	1640 (02/04)	-	19.1 J (03/03)	-	-	1510 (12/04)	-	19.1 J (03/03)
16WW32	-	1260 (12/04)	-	-	footnote b	-	-	-	-	footnote b
16WW34	14 (10/97)	32400 (03/09)	-	1780 (02/04)	footnote b	-	32400 (03/09)	-	985 (12/04)	footnote b
16WW36	-	-	5330 (02/04)	-	6.19 J (3/03)	-	-	5310 (12/04)	-	6.19 J (3/03)
16WW38	-	783 (02/04)	-	976 (02/04)	footnote b	-	671 (03/09)	-	-	footnote b
16WW39	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW40	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW42	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW43	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW44	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
16WW46	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Intermediate Wells										
16WW06	-	-	1770 (02/04)	-	footnote b	-	-	-	-	footnote b
16WW13	-	29800 (10/97)	-	-	11.1 J (03/03)	-	-	3760 (03/09)	-	11.1 J (03/03)
16WW23	-	133 (03/03)	15700 (03/09)	720 (03/03)	40.3 (03/03)	-	-	15700 (03/09)	-	40.3 (03/03)
16WW25	105 (3/09)	-	9300 (02/04)	-	43.7 (03/03)	105 (03/09)	-	7190 (03/09)	-	43.7 (03/03)
16WW27	-	113 (03/03)	4250 (02/04)	-	17.6 J (03/03)	-	-	3550 (02/04)	-	17.6 J (03/03)
16WW28	-	-	1510 (02/04)	-	9.53 J (03/03)	-	-	1380 (12/04)	-	9.53 J (03/03)
16WW29	-	-	1770 (02/04)	-	24.5 (03/03)	-	-	1710 (12/04)	-	13.2 J (12/04)
16WW31	-	122 (12/04)	-	-	footnote b	-	122 (12/04)	-	-	footnote b
16WW33	-	1750 (12/04)	5080 (10/97)	887 (03/03)	footnote b	-	-	1760 (12/04)	-	footnote b
16WW35	123 (03/09)	-	9700 (03/09)	-	90.5 (03/03)	123 (03/09)	-	9700 (03/09)	-	90.5 (03/03)
16WW37	-	251 (10/97)	5700 (10/97)	-	footnote b	-	-	4700 (12/04)	-	footnote b
16WW41	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Upper Deep Wells										
16WW19	-	-	-	-	24.2 (03/03)	-	-	-	-	24.2 (03/03)
16WW20	23 (10/97)	129 (10/97)	-	-	footnote b	-	-	-	-	footnote b
16WW21	-	391 (03/03)	-	-	footnote b	-	-	-	-	footnote b
Lower Deep Wells										
16WW15	20 J (06/95)	-	-	-	14.8 (03/03)	-	-	-	-	14.8 (03/03)
16WW17	-	-	-	-	6.62 J (03/03)	-	-	-	-	6.62 J (03/03)
16WW18	-	-	-	-	6.11 J (03/03)	-	-	-	-	6.11 J (03/03)

Notes:

- All Concentrations in micrograms per liter (µg/L)
- Numbers in parenthesis are month and date of the maximum concentration or most recent sample
- concentration below the Cleanup Levels
- ^a Italic values are above the TCEQ Protective Concentration Limit of 1100 µg/L but below background of 7820 µg/L.
- ^b Thallium was not detected; however, the detection limits were above the cleanup level.
- µg/L - micrograms per liter
- J - estimated value
- NS - not sampled

Table 3-1
Injection Depths and Monitoring Well Screen Intervals – Landfill Biobarrier #1

Well or DPT ID	Existing/Proposed	Primary Purpose		DPT Injection Depths/ Screen Intervals (feet bgs) ^a
		Substrate Injection	Performance Monitoring	
DPT-01 – DPT-07	Proposed	✓		15 – 21
DPT-08 – DPT-12	Proposed	✓		13 – 18
DPT-13 – DPT-18	Proposed	✓		5 – 18
16IW09	Proposed	✓		13 – 18
16RW01	Proposed		✓	15 – 21
16RW02	Proposed		✓	13 – 18
16RW03	Proposed		✓	13 – 18
16RW04	Proposed		✓	15 – 21
16RW05	Proposed		✓	13 – 18
16WW26	Existing		✓	13 – 18
16WW42	Existing		✓	2 – 12

Notes:

Wells 16WW26 and 16WW42 used to estimate injection depths. Please refer to Appendix C of the Final RD for the well logs.

^a DPT Injection depths and monitoring well screen intervals may be modified based on field observations including depth of clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

DPT - direct-push technology

ID - identification

Table 3-2
ISB Parameters, Landfill Biobarrier #1, LHAAP-16

Landfill Biobarrier #1												
EDS-ER™ Biobarrier Volume Requirements per Well												
Wells	Treatment Thickness	Injection Interval (feet bgs)	Total Feet	EDS-ER™ (pounds)	EDS-ER™ (gallons)	SDC-9™ (gallons)	SDC-9™ (liters)	Sodium bromide (pounds)	Water (gallons)	EDS-ER™ per Well (pounds)	EDS-ER™ per Well (gallons)	Total Volume per Well (gallons)
DPT 01-07	6	15-21	42	1411	204	0.44	1.68	8.51	1837	202	29	291.58
DPT 08-12	5	13-18	25	840	122	0.26	1.00	5.07	1093	168	24	242.99
DPT 13-18	13	5-18	78	2621	379	0.82	3.12	15.81	3411	437	63	631.76
16W09	5	13-18	5	168	24	0.05	0.20	1.01	219	168	24	242.99
Totals			150		729	1.59	6.00	30.41	6,559			

Biobarrier EDS-ER™ Volume Requirements	
Total EDS-ER required	5,041 pounds
Total EDS-ER required	729 gallons
SDC-9™ 1×10 ¹¹ (DHC/liter)	2 gallons
SDC-9™ 1×10 ¹¹ (DHC/liter)	6 liters
Total water volume	6,559 gallons
EDS-ER™ Requirement	34 pounds/foot
EDS-ER™ Requirement	5 gallons/foot
SDC-9™ requirement 1×10 ¹¹ (DHC/liter)	0.01 gallons/foot
Water Requirement	44 gallons/foot
Sodium bromide	0.20 pounds/foot
Total volume	7,290 gallons
Total volume	49 gallons/foot
Amount of Sodium bromide needed	14 kilos

Notes:
 Refer to Table 3-1 for injection intervals
 bgs - below ground surface
 DHC- dehalococoides
 DPT - direct-push technology
 EDS-ER - Electron Donor Solution-Extended Release
 EVO - emulsified vegetable oil
 ft - feet
 ISB - in situ bioremediation
 SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 3-3
Screen Intervals of Injection/Monitoring Wells – Landfill Biobarrier #2

Well ID	Existing/Proposed	Primary Purpose		Injection/Screen Intervals (feet bgs) ^a
		Substrate Injection	Performance Monitoring	
16EW11	Existing	✓		15.2 – 24.8
16EW12B	Existing	✓		13 – 28
16EW13	Existing	✓		15 – 24.6
16EW14B	Existing	✓		14 – 29
16EW15	Existing	✓		13.9 – 23.5
16IW01	Existing	✓		15 – 25
16IW03	Existing	✓		15 – 25
16IW05	Existing	✓		15 – 25
16IW07	Existing	✓		14 – 24
16PM02	Existing		✓	15.1 – 24.8
16PM03	Existing		✓	15 – 24.5
16PM04	Existing		✓	15.1 – 24.8
16PM14	Existing		✓	15.2 – 24.8
16PM06	Existing		✓	14.9 – 24.6
16PM09	Existing		✓	14.1 – 23.8

Notes:

Wells 16EW11 through 16EW15 used to estimate injection depths. Well logs are included in Appendix C of the Final RD.

^a Injection / monitoring well screen intervals may be modified during field implementation activities based on field observations including depth clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

ID - identification

Table 3-4
ISB Parameters, Landfill Biobarrier #2, LHAAP-16 (Phase I and Phase 2
Injections)

Site Parameters	Units	LHAAP-16	
		Phase I	Phase 2
Amendment Volume Requirements			
EDS-ER™	pounds	1797	1,797
EDS-ER™	gallons	260	260
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	2	2
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	0.5	0.5
Water	gallons	2339	2,339
Sodium Bromide	kilo	5	5
Volumes per Point			
EDS-ER™	gallons	65	52
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	0.5	0.4
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	0.13	0.11
Water	gallons	585	468
Injection Parameters			
Injection Spacing	feet	15	15
Target Depth	ft bgs	Refer to Table 3-3 for depths of existing IW & EW	Refer to Table 3-3 for depths of existing IW & EW
Thickness	feet	10	10
Total Volume per Point	gallons	650	520
Injection Rate	gpm	4	4
Injection Pressure (not to exceed)	psi	40	40
Time per Point	hours	2.7	2.2
Simultaneous Points	points	3	3
Hours of Injection per day	hours	8	8
Maximum Volume that can injected per day	gallons	5760	5,760
Points to be Completed (existing IWs and EWs)	points	4	5
Days of Injection	days	0.5	0.5

Notes:

Phase I of injections include injecting amendment into 16IW01, 16IW03, 16IW05 and 16IW07

Phase 2 of injections include injecting amendment into 16EW11, 16EW12B, 16EW13, 16EW14B and 16EW15

DHC - dehalococcoides

EDS-ER™ - Electron donor Substrate - Extended Release

EW - extraction well

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

IW - injection well

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 3-5
Injection Depths and Monitoring Well Screen Intervals – Landfill Biobarrier #3

Well or DPT ID	Existing/Proposed	Primary Purpose		DPT Injection Depths/Screen Intervals (feet bgs) ^a
		Substrate Injection	Performance Monitoring	
DPT-19 – DPT-22	Proposed	✓		17 – 27
DPT-23 – DPT-25	Proposed	✓		15 – 25
16IW10	Proposed	✓		15 – 25
16RW06	Proposed		✓	17 – 27
16RW07	Proposed		✓	15 – 25
16RW08	Proposed		✓	15 – 25
16RW09	Proposed		✓	17 – 27
16RW10	Proposed		✓	15 – 25

Notes:

Wells 16WW14 used to estimate injection depths. The well log for 16WW14 is included in Appendix C of the Final RD.

^a DPT Injection depths and monitoring well screen intervals may be modified based on field observations including depth of clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

DPT - direct-push technology

ID - identification

Table 3-6
ISB Parameters, Landfill Biobarrier # 3, LHAAP-16

Site Parameters	Units	LHAAP-16
Amendment Volume Requirements		
EDS-ER™	pounds	2,333
EDS-ER™	gallons	337
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	3
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	1
Water	gallons	3,032
Sodium Bromide Required	kilo	6
Volumes per Point		
EDS-ER™	gallons	42
SDC-9™ 1×10 ¹¹ (DHC/liter)	liters	0.38
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	0.10
Water	gallons	379
Injection Parameters		
Injection Spacing	feet	15
Target Depth	ft bgs	17-27; 15-25
Thickness	feet	10
Total Volume per Point	gallons	421
Injection Rate	gpm	4
Injection Pressure (not to exceed)	psi	40
Time per Point	hours	2
Simultaneous Points	points	3
Hours of Injection per day	hours	8
Maximum volume that can be injected per day	gallons	5,760
Points to be Completed (existing IWs and DPT)	points	8
Days of Injection	days	0.59

Notes:

DHC- dehalococcoides

DPT - direct-push technology

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

IW - injection well

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 3-7
Injection Depths and Monitoring Well Screening Intervals – Bayou Biobarrier

Well or DPT ID	Existing/Proposed	Primary Purpose		DPT Injection Depths/Screen Intervals (feet bgs) ^a
		Substrate Injection	Performance Monitoring	
DPT-26 – DPT-31	Proposed	✓		22 – 32
DPT-32 – DPT-35	Proposed	✓		18 – 28
DPT-37 – DPT-39	Proposed	✓		14 – 24
16IW20	Proposed	✓		14 – 24
16WW22	Existing		✓	21 – 31
16RW11	Proposed		✓	14 – 24
16RW12	Proposed		✓	22 – 32
16WW39	Existing		✓	N/A
16WW12	Existing		✓	14 – 24

Notes:

Wells 16WW12 and 16WW22 used to estimate injection depths. Well logs for 16WW12 and 16WW22 in Appendix C of the Final RD.

^a DPT Injection depths and monitoring well screen intervals may be modified based on field observations including depth of clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

DPT - direct-push technology

ID - identification

N/A - not available

Table 3-8
ISB Parameters, Bayou Biobarrier, LHAAP-16

Site Parameters	Units	LHAAP-16
Amendment Volume Requirements		
ABC Plus (includes both EVO and ZVI) ^a	pounds	7,000
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	5
Volume of product with water	gallons	3,800
Sodium bromide required	kilo	7
Volumes per Point		
Product with water	gallons	271
SDC-9™ 1×10 ¹¹ (DHC/liter)	liters	0.36
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	0.10
Injection Parameters		
Injection Spacing	feet	15
Target Depth	ft bgs	Refer to Table 3-7 for target depths
Thickness	feet	10
Total Volume per Point	gallons	271
Injection Rate	gpm	4
Injection Pressure (not to exceed)	psi	40
Time per Point	hours	2
Simultaneous Points	points	3
Hours of Injection per day	hours	8
Maximum volume that can be injected per day	gallons	5,760
Points to be Completed (proposed 1 IW & 13 DPT)	points	14
Days of Injection	days	0.66

Notes:

^a Includes 3,500 pounds of ABC and 3,500 pounds of ZVI)

ABC is the EVP product supplied by Redox Tech

DHC- dehalococcoides

DPT - direct-push technology

EVO - emulsified vegetable oil

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

IW - injection well

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

ZVI - zero valent iron

Table 3-9
Screen Intervals of Injection/Extraction Wells – Mid-Plume ISB

Well ID	Existing/ Proposed	Purpose		Screen Intervals (feet bgs) ^b
		Substrate Emplacement ^a	Performance Monitoring	
Shallow Groundwater Zone				
DPT-40 – DPT-79	Proposed	✓		14 – 36
16EW01	Existing		✓	31.2 – 36.2
16EW02	Existing		✓	21.5 – 26.5
16EW03	Existing		✓	13 – 18
16EW04	Existing		✓	14 – 19
16WW48	Proposed		✓	25 – 35
16WW39	Existing		✓	N/A
16WW30	Existing		✓	25 – 35
Intermediate Groundwater Zone				
16EW05	Existing	✓	✓	47 – 52
16EW06	Existing	✓	✓	50 – 55
16EW07	Existing	✓	✓	41 – 46
16EW08	Existing	✓	✓	34 – 39
16IW25	Proposed	✓		40 – 55
16IW26	Proposed	✓		40 – 55
16IW27	Proposed	✓		40 – 55
16IW28	Proposed	✓		35 – 50
16IW29	Proposed	✓		35 – 50
16IW30	Proposed	✓		35 – 50
16WW49	Proposed		✓	45 – 55
16WW51	Proposed		✓	35 – 45

Notes:

^a Wells 16EW01 through 16EW04 in the Shallow Zone and wells 16EW05 through 16EW08 in the Intermediate Zone used to estimate injection depths. Well logs are included in Appendix C of the Final RD.

^b Injection/monitoring well screen intervals may be modified during field implementation activities based on field observations including depth clay layer separating shallow and intermediate groundwater zones and depth to groundwater.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

bgs - below ground surface

DPT - direct-push technology

ID - identification

ISB - in situ bioremediation

N/A - not available

Table 3-10
ISB Parameters, Mid Plume (Shallow Zone), LHAAP-16

Site Parameters	Units	LHAAP-16
Amendment Volume Requirements		
EDS-ER TM	pounds	28,414
EDS-ER TM	gallons	4,107
SDC-9 TM 1×10 ¹¹ (DHC/liter)	Liters	201
SDC-9 TM 1×10 ¹¹ (DHC/liter)	gallons	53
Water	gallons	36,910
Sodium Bromide Required	kilo	78
Volumes per Point		
EDS-ER TM	gallons	103
SDC-9 TM 1×10 ¹¹ (DHC/liter)	liters	5
SDC-9 TM 1×10 ¹¹ (DHC/liter)	gallons	1.33
Water	gallons	923
Injection Parameters		
Injection Spacing	feet	15
Target Depth	ft bgs	14-36
Thickness	feet	22
Total Volume per Point	gallons	1,027
Injection Rate	gpm	4
Injection Pressure (not to exceed)	psi	40
Time per Point	hours	5
Simultaneous Points	points	3
Hours of Injection per day	hours	8
Gallons per day	gallons	5,760
Points to be Completed (DPT points)	points	40
Days of Injection	days	7.13

Notes:

DHC- dehalococoides

DPT - direct-push technology

EDS-ERTM - Electron Donor Substrate - Extended Release

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

psi - pounds per square inch

SDC-9TM - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 3-11
ISB Parameters, Mid Plume (Intermediate Zone), LHAAP-16

Site Parameters	Units	LHAAP-16
Amendment Volume Requirements		
EDS-ER™	pounds	16,565
EDS-ER™	gallons	2,394
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	67
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	18
Water	gallons	21,528
Sodium Bromide Required	kilo	45
Volumes per Point		
Emulsified Vegetable Oil	gallons	239
SDC-9™ 1×10 ¹¹ (DHC/liter)	Liters	7
SDC-9™ 1×10 ¹¹ (DHC/liter)	gallons	2
Water	gallons	2,153
Injection Parameters		
Injection Spacing	feet	15
Target Depth	ft bgs	Please refer to Table 3-9 for target depths
Thickness	feet	5 and 15
Total Volume per Point	gallons	2,394
Injection Rate	gpm	4
Injection Pressure (not to exceed)	psi	40
Time per Point	hours	10
Simultaneous Points	points	3
Hours of Injection per day	hours	8
Gallons per day	gallons	5,760
Points to be Completed (4 existing EWs and 6 new IWs)	points	10
Days of Injection	days	4.16

Notes:

DHC- dehalococcoides

DPT - direct-push technology

EW - extraction well

ft bgs - feet below ground surface

gpm - gallons per minute

ISB - in situ bioremediation

IW - injection well

psi - pounds per square inch

SDC-9™ - APTIM's (Aptim Federal Services, LLC) dechlorinating culture

Table 4-1
Proposed Injection and Monitoring Wells, LHAAP-16

Well ID	Injections	Performance Monitoring	Screen Intervals	Shallow/ Intermediate Zone
16RW01		✓	15-21	Shallow
16RW02		✓	13-18	Shallow
16RW03		✓	13-18	Shallow
16RW04		✓	15-21	Shallow
16RW05		✓	13-18	Shallow
16IW09	✓		13-18	Shallow
16RW06		✓	17-27	Shallow
16RW07		✓	15-25	Shallow
16RW08		✓	15-25	Shallow
16RW09		✓	17-27	Shallow
16RW10		✓	15-25	Shallow
16IW10	✓	✓	15-25	Shallow
16WW55		✓	17-27	Shallow
16RW11		✓	14-24	Shallow
16RW12		✓	22-32	Shallow
16WW56		✓	22-32	Shallow
16WW57		✓	14-24	Shallow
16WW58		✓	10-20	Shallow
16IW20	✓		14-24	Shallow
16WW48		✓	25-35	Shallow
16IW25	✓		40-55	Intermediate
16IW26	✓		40-55	Intermediate
16IW27	✓		40-55	Intermediate
16IW28	✓		35-50	Intermediate
16IW29	✓		35-50	Intermediate
16IW30	✓		35-50	Intermediate
16WW49		✓	45-55	Intermediate
16WW51		✓	35-45	Intermediate

Table 4-2
Pre-Remedy Sampling Plan in the Shallow Zone, LHAAP-16

Monitoring Locations	ISB Area	Proposed Analyses								
		VOCs ^a (SW8260B)	Perchlorate (6850)	Anions ^b (E300.0)	Dissolved Gases ^c (RSK-175)	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters ^d
16WW26	Downgradient to Landfill Biobarrier #1	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW42	Downgradient to Landfill Biobarrier #1	✓	✓						✓	✓
16WW44	Background	✓	✓							✓
16WW38	Upgradient to Landfill Biobarrier #2	✓	✓							✓
16WW16	Upgradient to Landfill Biobarrier #2	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW36	Downgradient to Landfill Biobarrier #2	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW14	Upgradient to Landfill Biobarrier #3	✓	✓							✓
16WW55	Proposed Well Downgradient to Landfill Biobarrier #3	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW12	Upgradient to Bayou Biobarrier	✓	✓						✓	✓
16WW40	Downgradient to Bayou Biobarrier	✓	✓						✓	✓
16WW22	Upgradient to Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW56	Proposed Well and Downgradient to Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW57	Proposed Well and Across Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW58	Proposed Well and Across Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW30	Downgradient of Mid-Plume	✓	✓						✓	✓
16WW48	Proposed Well and Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW39	Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓
16WW46	Downgradient Outside of Contaminated Area	✓	✓							✓
16WW32	Cross-gradient Outside of Containment Area	✓	✓							✓
16WW34	Cross-gradient Outside of Containment Area	✓	✓							✓
16WW24	Cross-gradient to South of Plume	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW43	Cross-gradient to South of Plume	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 4-2
Pre-Remedy Sampling Plan in the Shallow Zone, LHAAP-16

Monitoring Locations	ISB Area	Proposed Analyses								
		VOCs ^a (SW8260B)	Perchlorate (6850)	Anions ^b (E300.0)	Dissolved Gases ^c (RSK-175)	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters ^d
16WW21	Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓
16EW02	Inside Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes:

This schedule assumes sampling of the extraction wells will be continued annually until the remedy is implemented; therefore, only 16EW02 will be sampled during pre-remedy monitoring.

^a VOCs include TCE; cis-1,2-DCE; 1,1-DCE; 1,2-DCA; 1,1,2-TCA; VC; and methylene chloride.

^b Anions include nitrate and sulfate.

^c Dissolved gasses include ethene, ethane, and methane.

^d Field Parameters include dissolved oxygen, oxidation reduction potential, and pH.

^e Upper deep monitoring well

✓ Indicates that sample will be collected and analyzed for the listed analyte.

DHC - Dehalococoides (microbial analysis)

TOC - total organic carbon

VOCs - volatile organic compounds

Table 4-3
Pre-Remedy Sampling Plan in the Intermediate Zone, LHAAP-16

Monitoring Locations	ISB Area	Proposed Analyses								
		VOCs ^a (SW8260B)	Perchlorate (6850)	Anions ^b (E300.0)	Dissolved Gases ^c (RSK-175)	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters ^d
16WW45	Background	✓	✓							✓
16WW37	Downgradient of Landfill / Upgradient of Landfill Biobarrier #2	✓	✓							✓
16WW35	Upgradient of Mid-Plume ISB Area / Downgradient of Landfill Biobarrier #2	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW25	Upgradient of Mid-Plume ISB Area / Downgradient of Landfill Biobarrier #1	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW13	Downgradient of Landfill	✓	✓						✓	✓
16WW23	Downgradient of Landfill	✓	✓							✓
16WW27	Downgradient Outside of Contaminated Area	✓	✓							✓
16WW29	Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW41	Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW31	Cross-gradient Outside of Containment Area	✓	✓							✓
16WW33	Cross-gradient Outside of Containment Area	✓	✓							✓
16WW21 ^e	Downgradient of Mid-Plume ISB Area	✓	✓							✓
16WW49	Proposed Well and Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓
16WW51	Proposed Well and Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓
16EW06	Inside Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes:

This schedule assumes sampling of the extraction wells will be continued annually until the remedy is implemented; therefore, only 16EW06 will be sampled during pre-remedy monitoring.

^a VOCs include TCE; cis-1,2-DCE; 1,1-DCE; 1,2-DCA; 1,1,2-TCA; VC; and methylene chloride.

^b Anions include nitrate and sulfate.

^c Dissolved gasses include ethene, ethane, and methane.

^d Field parameters include dissolved oxygen, oxidation reduction potential, and pH.

^e Upper deep monitoring well

✓ Indicates that sample will be collected and analyzed for the listed analyte.

DHC - Dehalococcoides (microbial analysis)

TOC - total organic carbon

VOCs - volatile organic compounds

Table 4-9
MNA and LTM Performance Monitoring Plan - LHAAP-16

Monitoring Locations	Groundwater Zone	Proposed Analyses								
		VOCs ^a (SW8260B)	Perchlorate (6850)	Anions ^b (E300.0)	Dissolved Gases ^c (RSK-175)	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters ^d
16WW44	Shallow	✓	✓							✓
16WW38	Shallow	✓	✓							✓
16WW16	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW14	Shallow	✓	✓							✓
16WW36	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW26	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW42	Shallow	✓	✓							✓
16WW43	Shallow	✓	✓							✓
16WW30	Shallow	✓	✓							✓
16WW40	Shallow	✓	✓							✓
16WW22	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW46	Shallow	✓	✓							✓
16WW32	Shallow	✓	✓							✓
16WW34	Shallow	✓	✓							✓
16WW24	Shallow	✓	✓							✓
16WW48	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW39	Shallow	✓	✓							✓
16WW55	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW56	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW57	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW58	Shallow	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW37	Intermediate	✓	✓							✓
16WW35	Intermediate	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW13	Intermediate	✓	✓							✓
16WW23	Intermediate	✓	✓							✓
16WW25	Intermediate	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW27	Intermediate	✓	✓							✓
16WW29	Intermediate	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW41	Intermediate	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW31	Intermediate	✓	✓							✓
16WW33	Intermediate	✓	✓							✓
16WW49	Intermediate	✓	✓							✓
16WW51	Intermediate	✓	✓							✓
16WW21	Upper Deep	✓	✓							✓

Notes:

This schedule assumes sampling of the extraction wells will be continued annually until the remedy is implemented; therefore, only 16EW02 will be sampled during baseline monitoring.

^a VOCs include trichloroethene (TCE); cis-1,2-dichloroethene (DCE); 1,1-DCE; 1,2-dichloroethane (DCA); 1,1,2-trichloroethane (TCA); Vinyl Chloride (VC); and methylene chloride.

^b Anions include nitrate and sulfate.

^c Dissolved gasses include ethene, ethane, and methane.

^d Field Parameters include dissolved oxygen, oxidation reduction potential, and pH.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

DHC - Dehalococcoides (microbial analysis)

TOC - total organic carbon

LTM - long-term monitoring

VOCs - volatile organic compounds

Table 4-10
Surface Water Sampling Plan, LHAAP-16

Monitoring Locations	Proposed Analyses			
	VOCs ^a (SW8260B)	Perchlorate (6850)	Metals (6020A/741B)	Field Parameters ^b
16SW01	✓	✓	✓	✓
16SW02	✓	✓	✓	✓
16SW03	✓	✓	✓	✓

Notes:

Surface water samples will be collected from the above locations as part of the pre-remedy sampling event and quarterly performance monitoring events

^a VOCs include trichloroethene (TCE); cis-1,2-dichloroethene (DCE); 1,1-DCE; 1,2-dichloroethane (DCA); 1,1,2-trichloroethane (TCA); Vinyl Chloride (VC); and methylene chloride.

^b Metals include arsenic, chromium, manganese, nickel and thallium.

^c Field Parameters include dissolved oxygen, oxidation reduction potential, conductivity, temperature and pH.

✓ Indicates that sample will be collected and analyzed for the listed analyte.

VOCs - volatile organic compounds

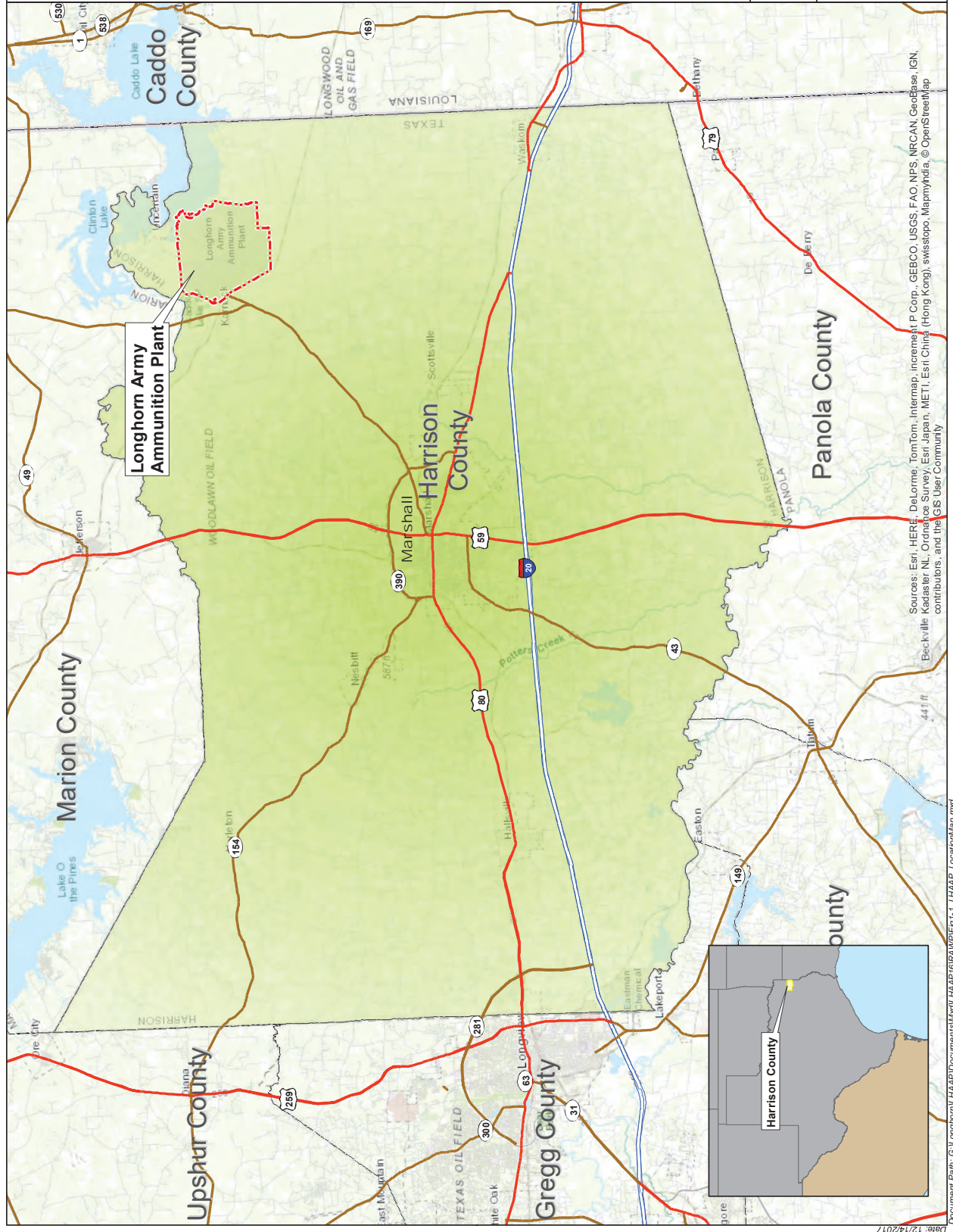
Table 6-1
Schedule for Major Site Activities

Activities	Duration
Submit Injection Information to State	30
Utility Clearance	1
Clear Injection / New Well Locations	3
Install Injection Wells and Monitoring Wells	10
Develop Wells/slug test	4
Baseline Sampling and Gauging	13
Mobilization / Site Set-up for Injections	3
Conduct Injection	25
Demobilization	1
Total No. of days	90

Notes:

Sampling will occur on a quarterly basis for 2 years.

Figures



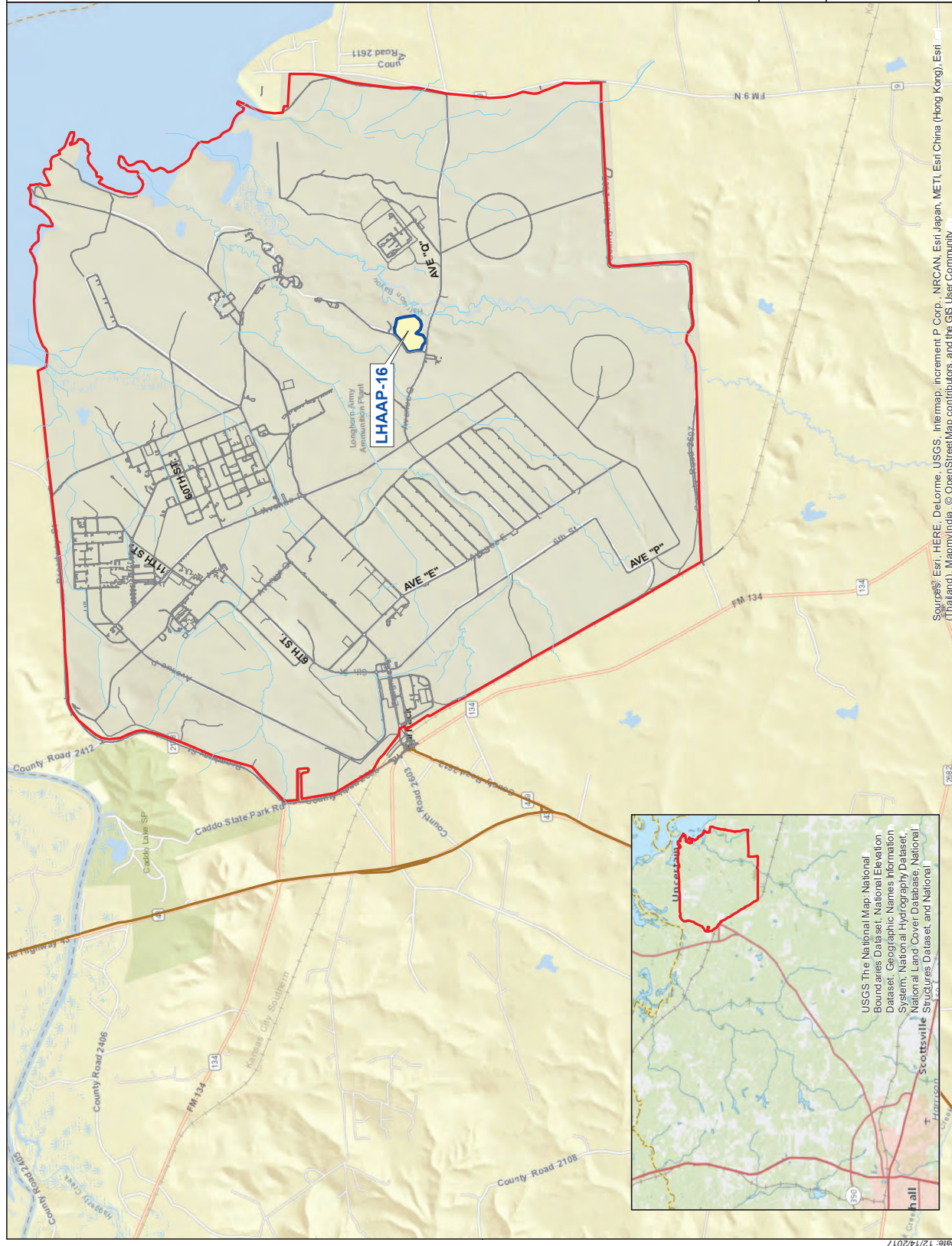
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TULSA DISTRICT
TULSA, OKLAHOMA

APTIM

Figure 1-1
LHAAP Location Map
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
MARWACK, TEXAS

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBCas, IGN, Beckwith, Kauder, NLS, OpenStreetMap, Esri, Japan, METI, Esri China (Hong Kong), Swisstopo, Mapbox, © OpenStreetMap contributors, and the GIS User Community



Stream
 Road
 LHAAP Boundary
 LHAAP-16 Site Boundary

0 1,500 3,000 Feet



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Figure 1-2

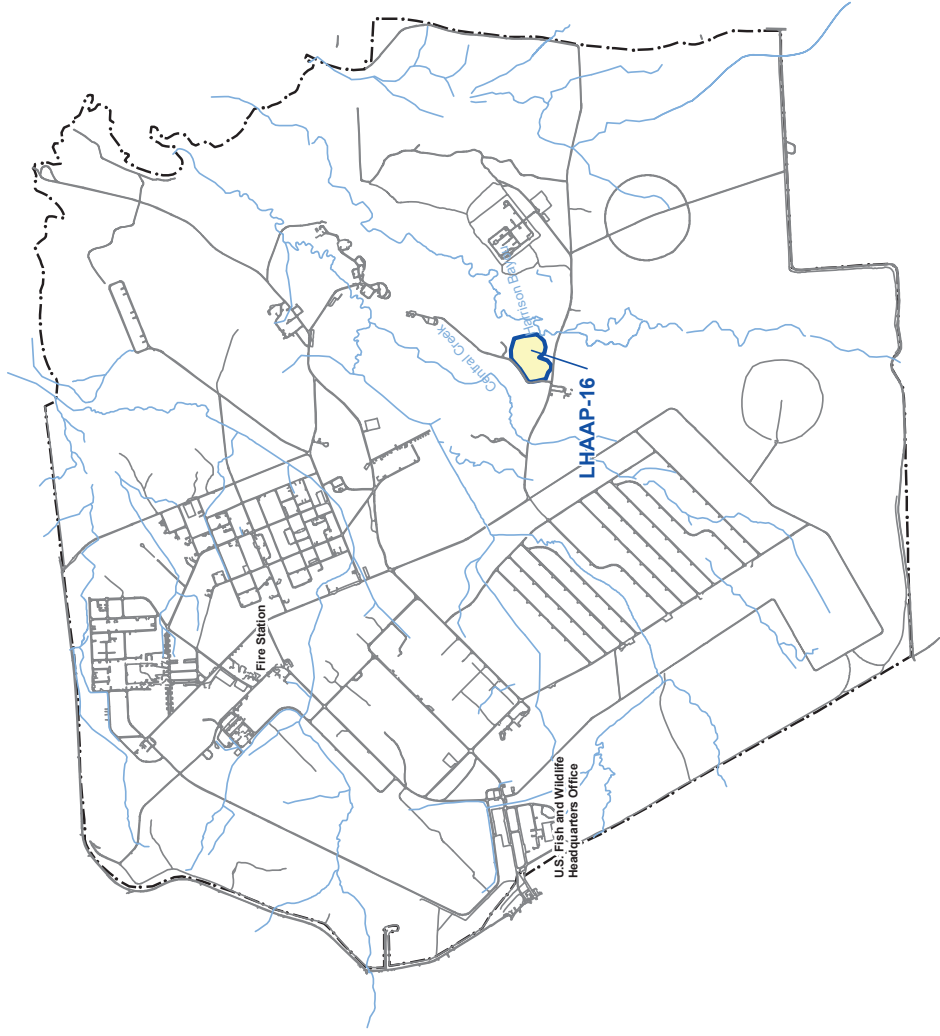
LHAAP Site Location Map
 LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
 MARWACK, TEXAS

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapbox, Swisstopo, Mapbox, OpenStreetMap contributors, and the GIS User Community

USGS The National Map, National Boundaries Data set, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National

-  Stream
-  Road
-  LHAAP Boundary
-  LHAAP-16 Site Boundary

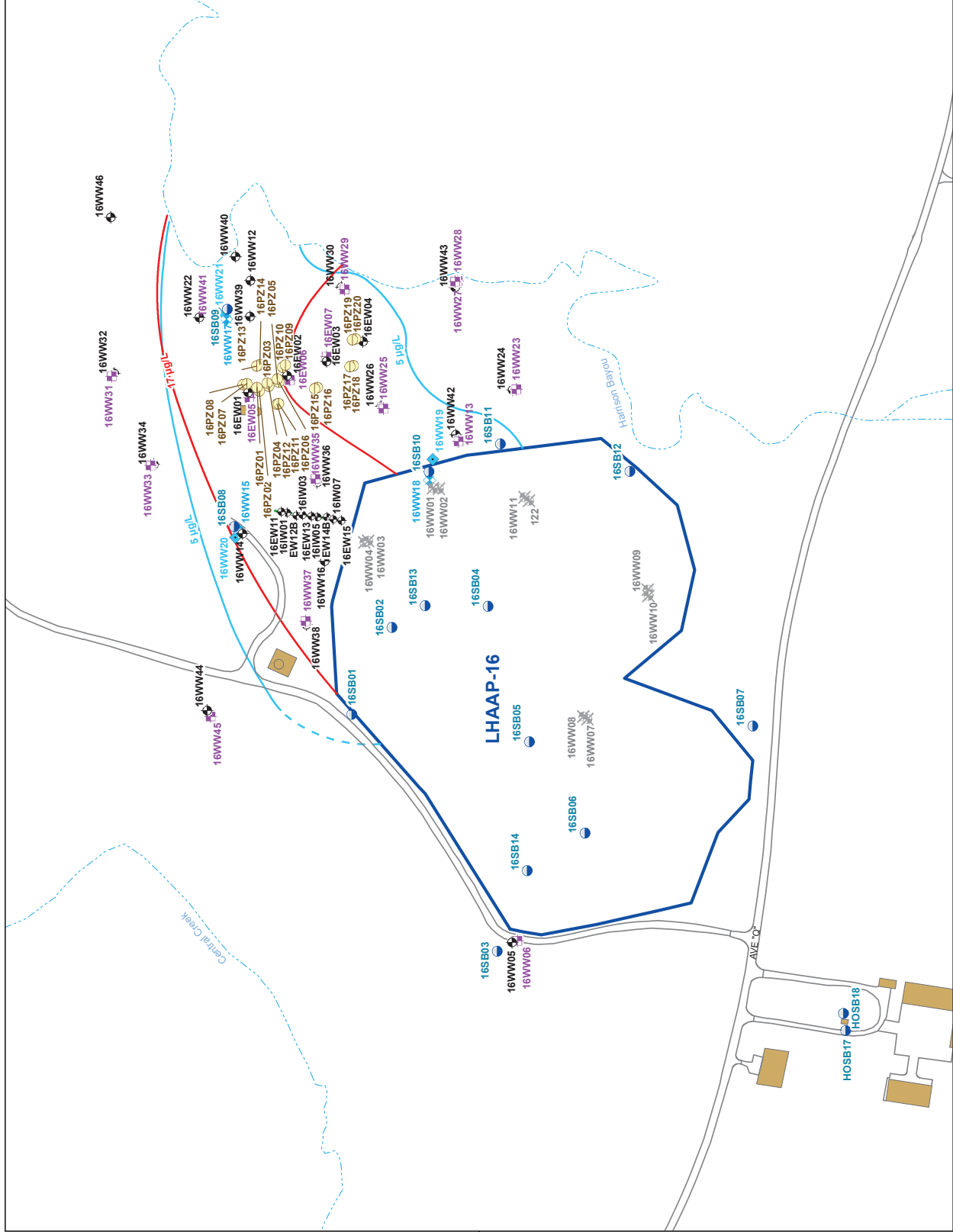


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Figure 1-3

Site Vicinity Map
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARWICK, TEXAS

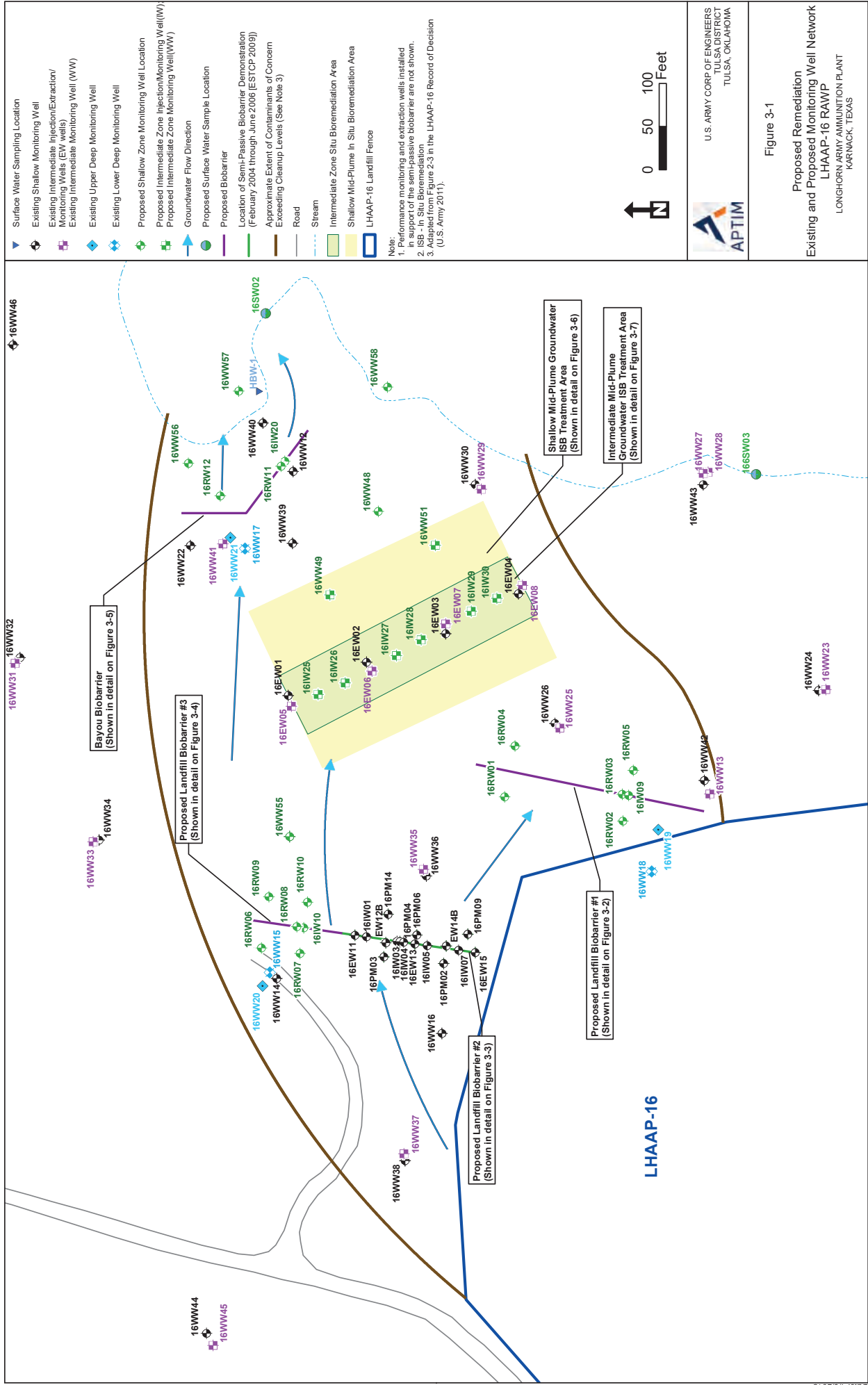


- Existing Shallow Monitoring Well
- Existing Intermediate Monitoring Well
- Existing Upper Deep Monitoring Well
- Existing Lower Deep Monitoring Well
- Soil Boring
- Piezometer
- Abandoned or Plugged Well
- Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (May 2013)
- Location of Semi-Passive Biobarrier Demonstration (February 2004 through June 2006 (ESTCP 2009))
- Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)
- Stream
- Road
- LHAAP-16 Landfill Fence



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Figure 1-4
LHAAP-16 Site Plan
LHAAP-16 RAWP
LONGHORN ARMY AMMUNITION PLANT
KARWICK, TEXAS

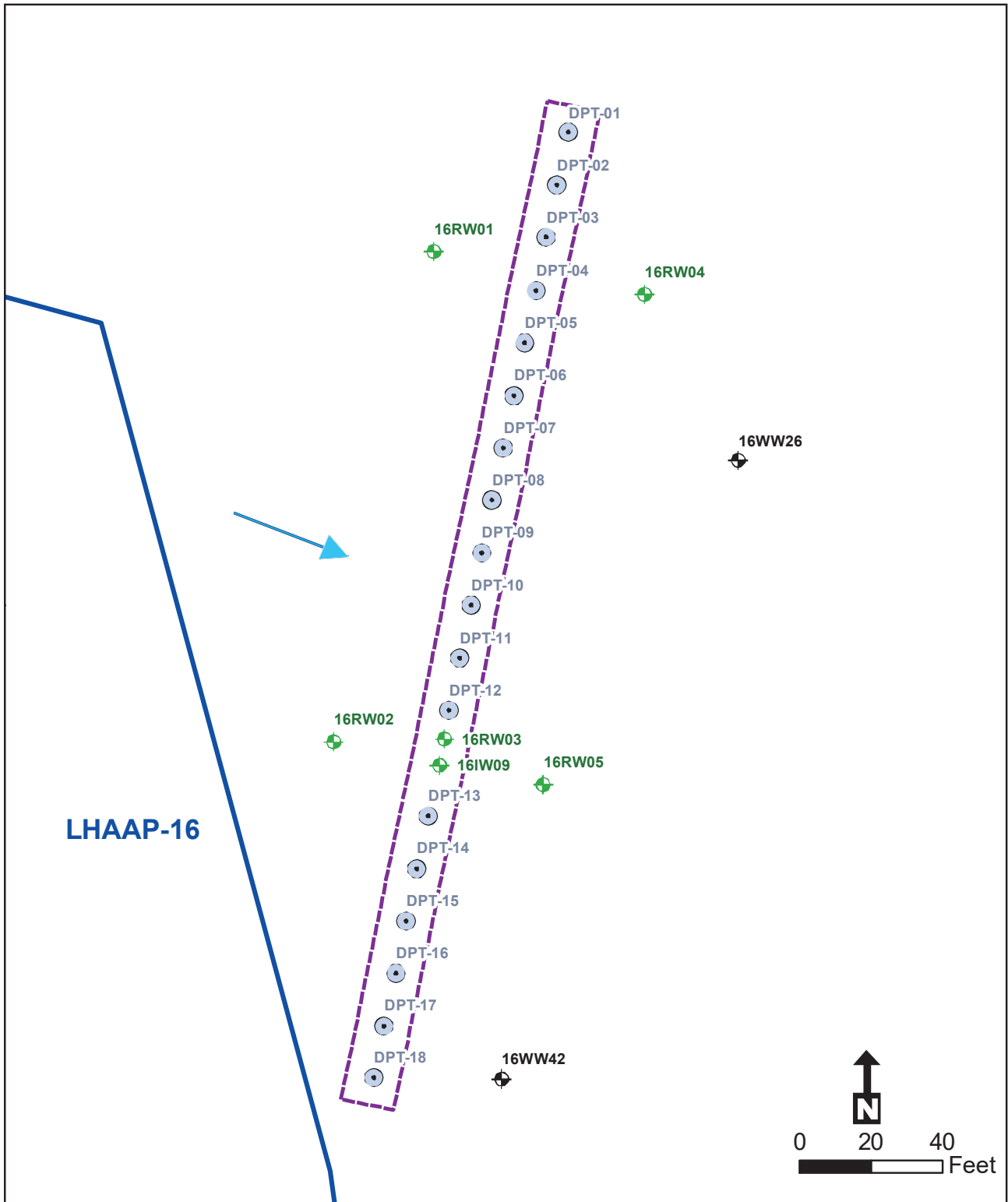


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Figure 3-1

Proposed Remediation and Proposed Monitoring Well Network
 LHAAP-16 RAWP
 LONGHORN ARMY AMMUNITION PLANT
 KATY, TEXAS



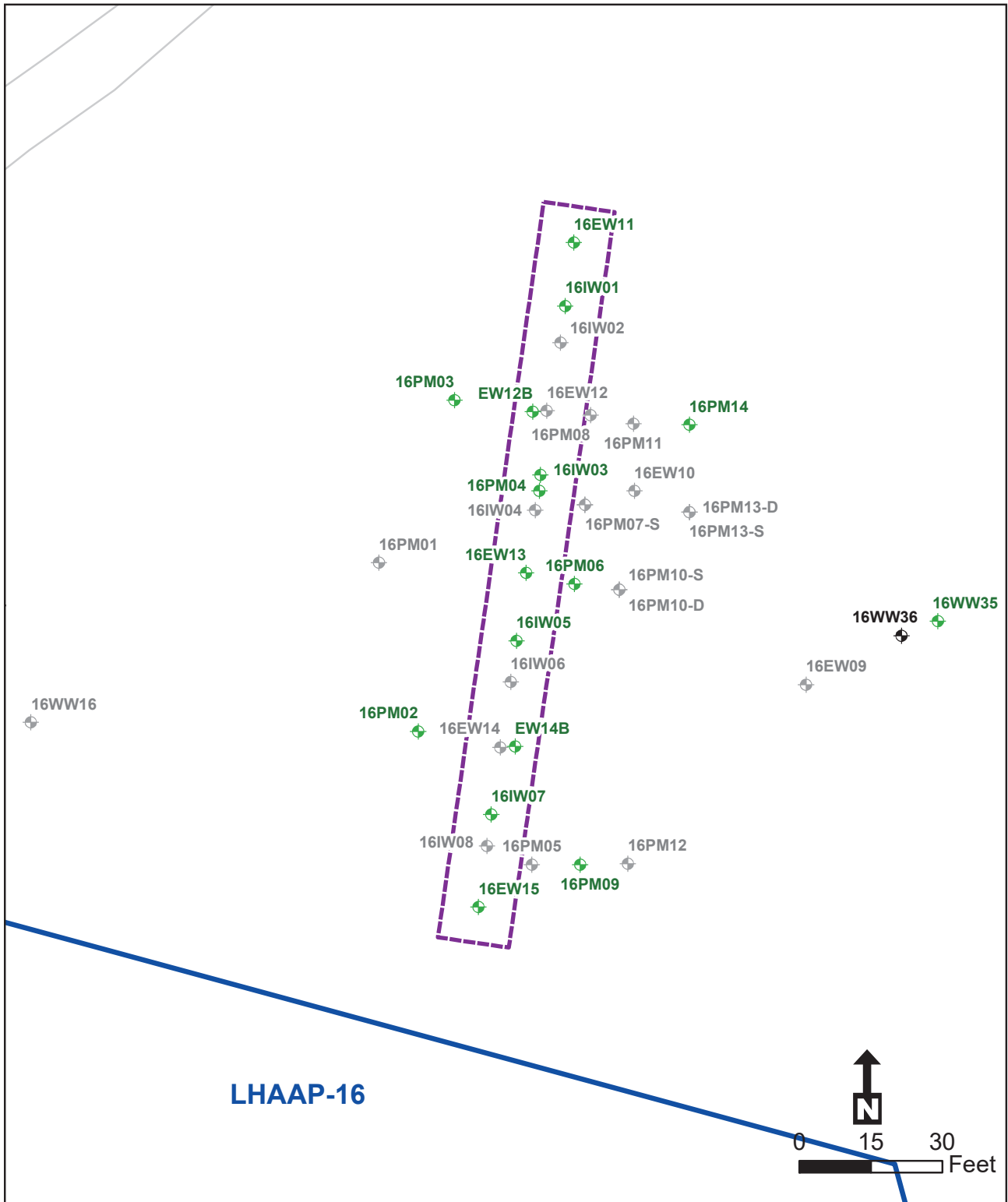
- Proposed Well Location
- Existing Well Location
- Proposed Direct Push Injection Point
- Groundwater Flow Direction Without Extraction (Shallow Zone)
- Target In-Situ Reaction Zone Based on Design Radius of Influence
- LHAAP-16 Landfill Fence



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Figure 3-2
Landfill Biobarrier #1
Proposed Remediation
LHAAP-16 RAWP
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



- Existing Monitored Natural Attenuation Performance Monitoring Well
- Existing In-Situ Bioremediation Injection/Extraction/Performance Monitoring Well
- Other Existing Monitoring Well
- Target In-Situ Reaction Zone Based on Design Radius of Influence
- LHAAP-16 Landfill Fence



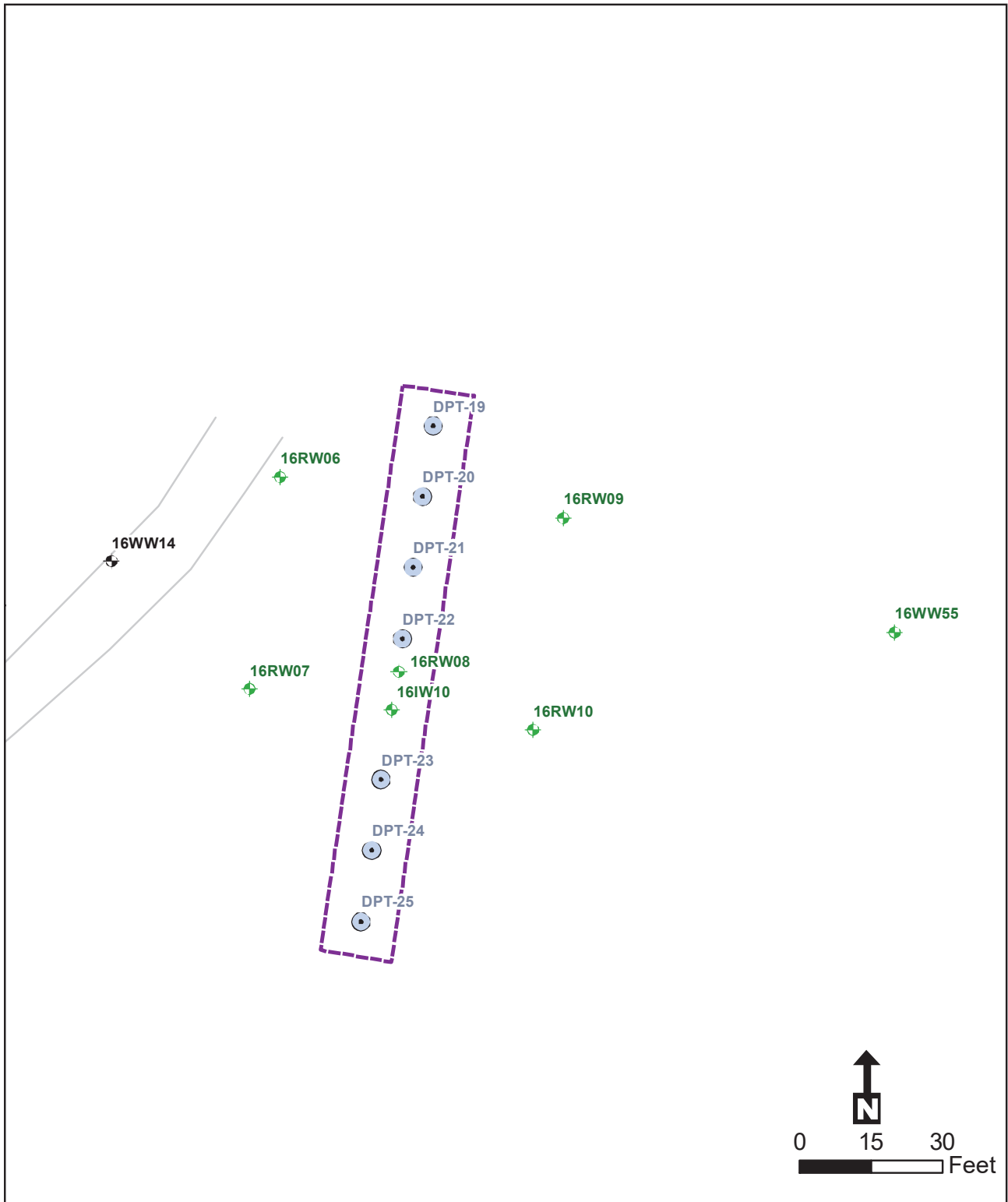
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Figure 3-3

Landfill Biobarrier #2
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 3/26/2018



-  Existing Monitored Natural Attenuation Performance Monitoring Well
-  Proposed Shallow Well Location
-  IW - Injection Well Location
-  RW - Recovery Well Location
-  Proposed Direct Push Injection Point
-  Target In-Situ Reaction Zone Based on Design Radius of Influence



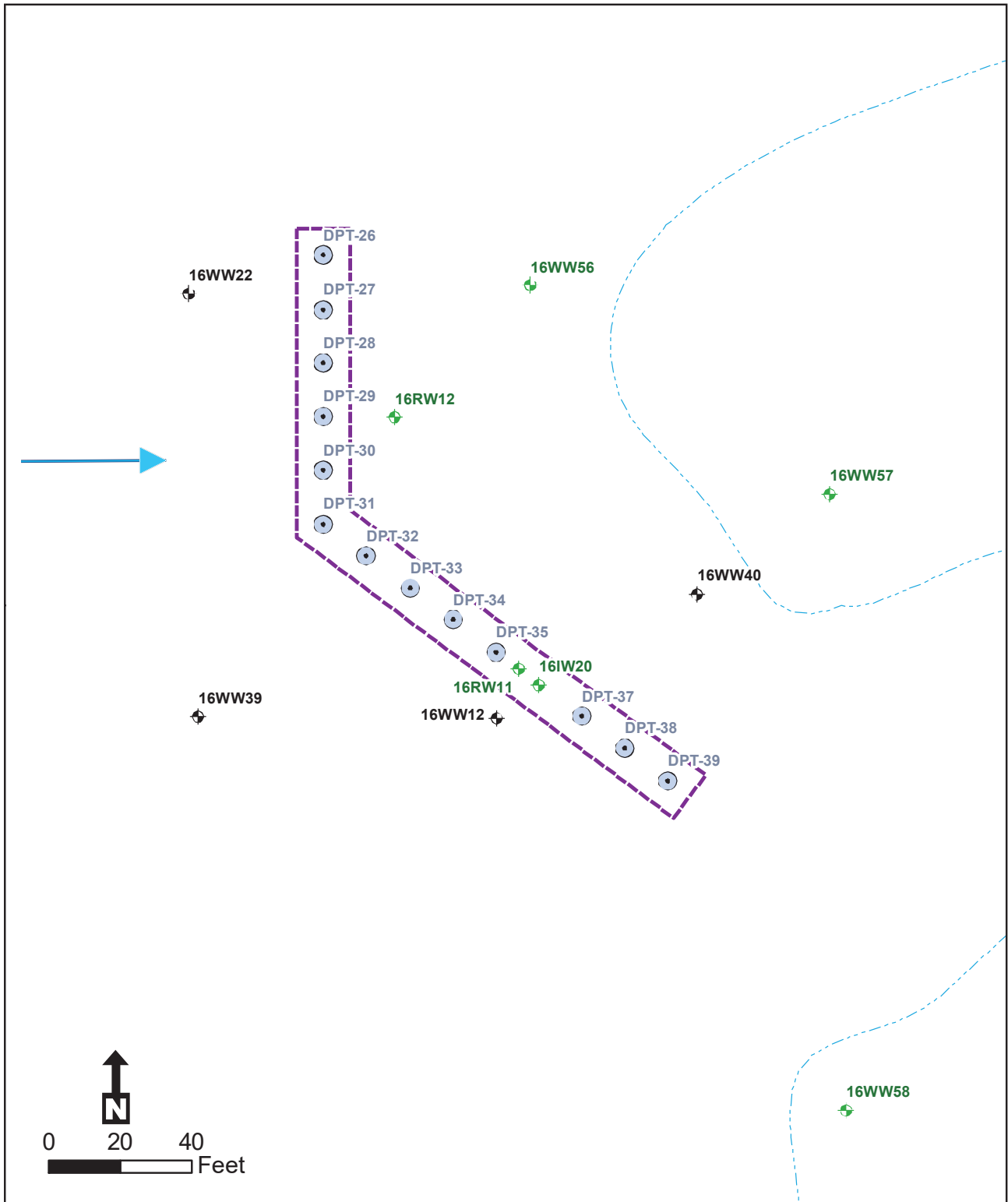
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Figure 3-4

Landfill Biobarrier #3
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Proposed Direct Push Injection Point
-  Existing Monitored Natural Attenuation Performance Monitoring Well
-  Proposed Shallow Well Location
IW = Injection Well
RW = Recovery Well Location
-  Groundwater Flow Direction Without Extraction (Shallow Zone)
-  Target In-Situ Reaction Zone Based on Design Radius of Influence



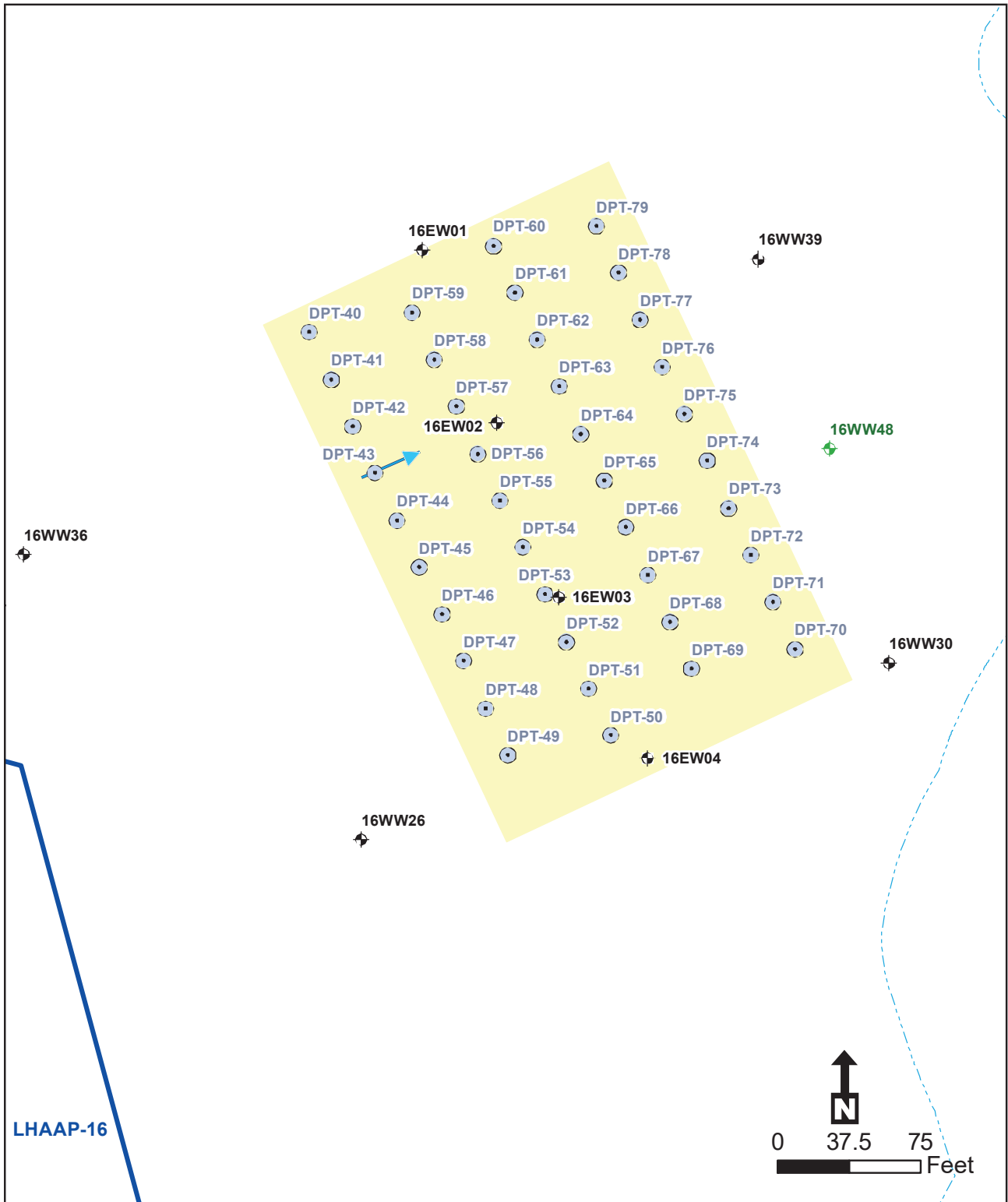
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

Figure 3-5


Bayou Biobarrier
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Existing Shallow Monitoring Well (WW) or Extraction Well (EW) Location
-  Proposed Direct Push Injection Point
-  Proposed Shallow Monitoring Well Location
-  Stream
-  Groundwater Flow Direction Without Extraction (Shallow Zone)
-  Shallow In Situ Bioremediation Area
-  LHAAP-16 Landfill Fence

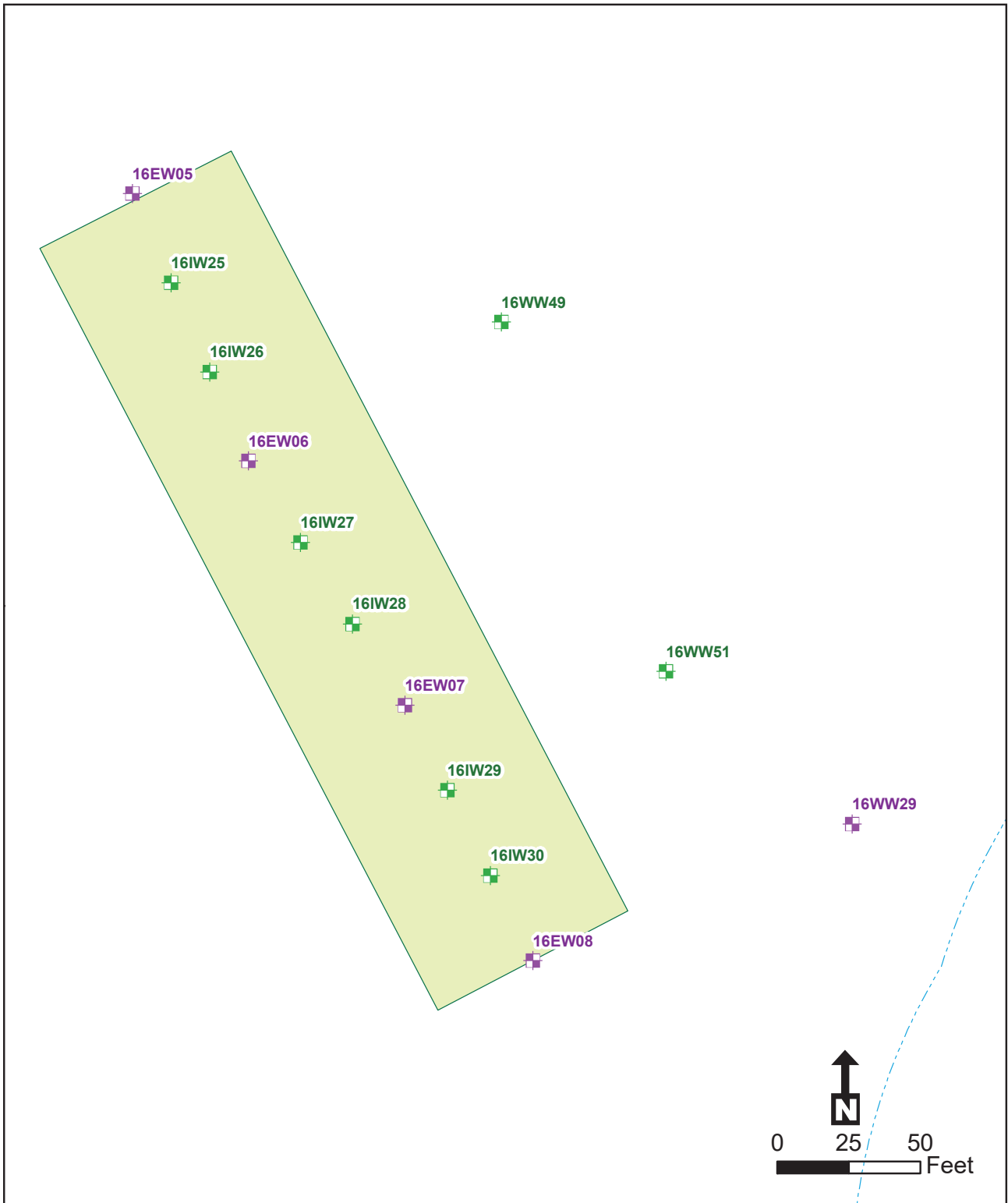






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Figure 3-6
Mid Plume Shallow Groundwater Zone
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 12/14/2017



-  Existing Intermediate Injection/Extraction/Monitoring Well (EW)
Existing Intermediate Monitoring Well (WW)
-  Proposed Intermediate Zone Injection/Monitoring Well (IW);
Proposed Intermediate Zone Monitoring Well (WW)
-  Stream
-  Intermediate Zone Situ Bioremediation Area



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Figure 3-7
Mid Plume Intermediate Groundwater Zone
Proposed Remediation
LHAAP-16 RAWP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 2/22/2018

NOTE:
1. EVO – EMULSIFIED VEGETABLE OIL.

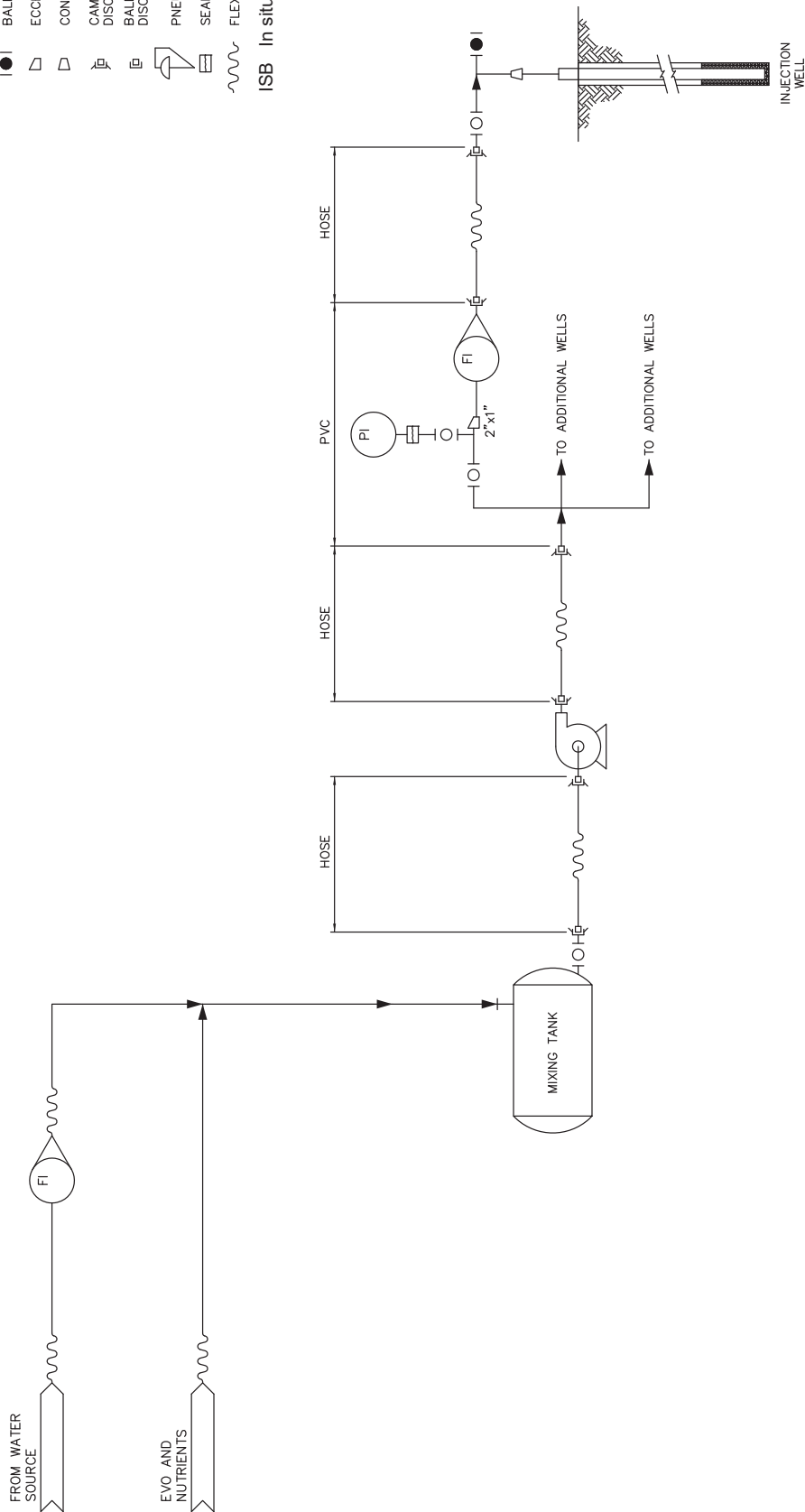
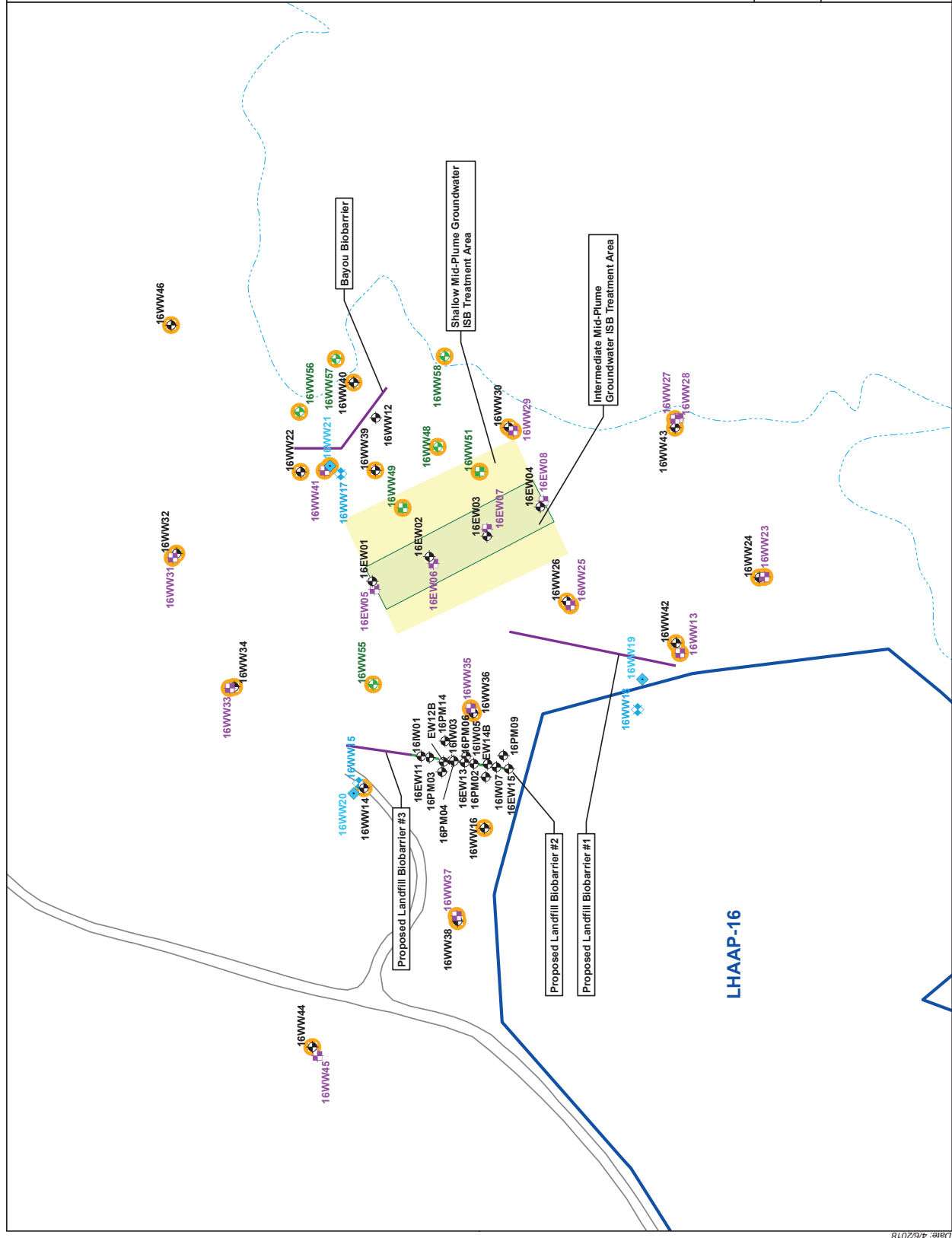


Figure 4-1

ISB Injection System
Hydrogeologic Testing/Pilot Test
Lorington Army Ammunition Plant, Karnack, TX

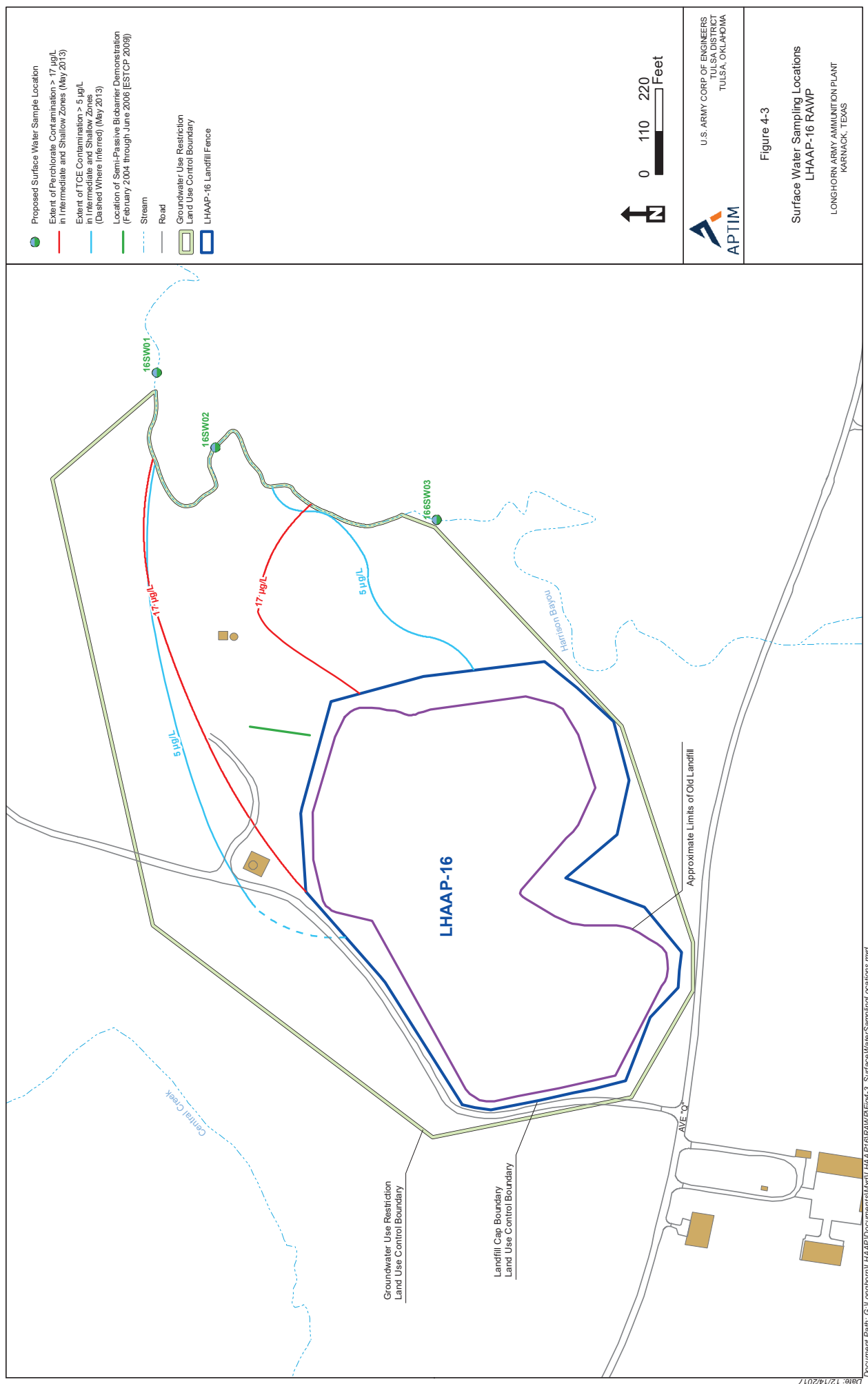




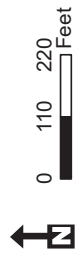


 U.S. ARMY CORP OF ENGINEERS
 TULSA DISTRICT
 TULSA, OKLAHOMA

Figure 4-2
MNA and LTM Monitoring Plan
LHAAP-16 RAWP
 LONGHORN ARMY AMMUNITION PLANT
 KARRACK, TEXAS



- Proposed Surface Water Sample Location
- Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (May 2013)
- Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)
- Location of Semi-Passive Blotbarrier Demonstration (February 2004 through June 2006 [ESTCP 2009])
- Stream
- Road
- Groundwater Use Restriction Land Use Control Boundary
- LHAAP-16 Landfill Fence



U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

APTIM

Figure 4-3
Surface Water Sampling Locations
LHAAP-16 RAWP
LONGHORN ARMY AMMUNITION PLANT
KARWACK, TEXAS

Appendix A

Figures from Final Remedial Design

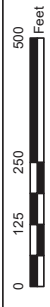
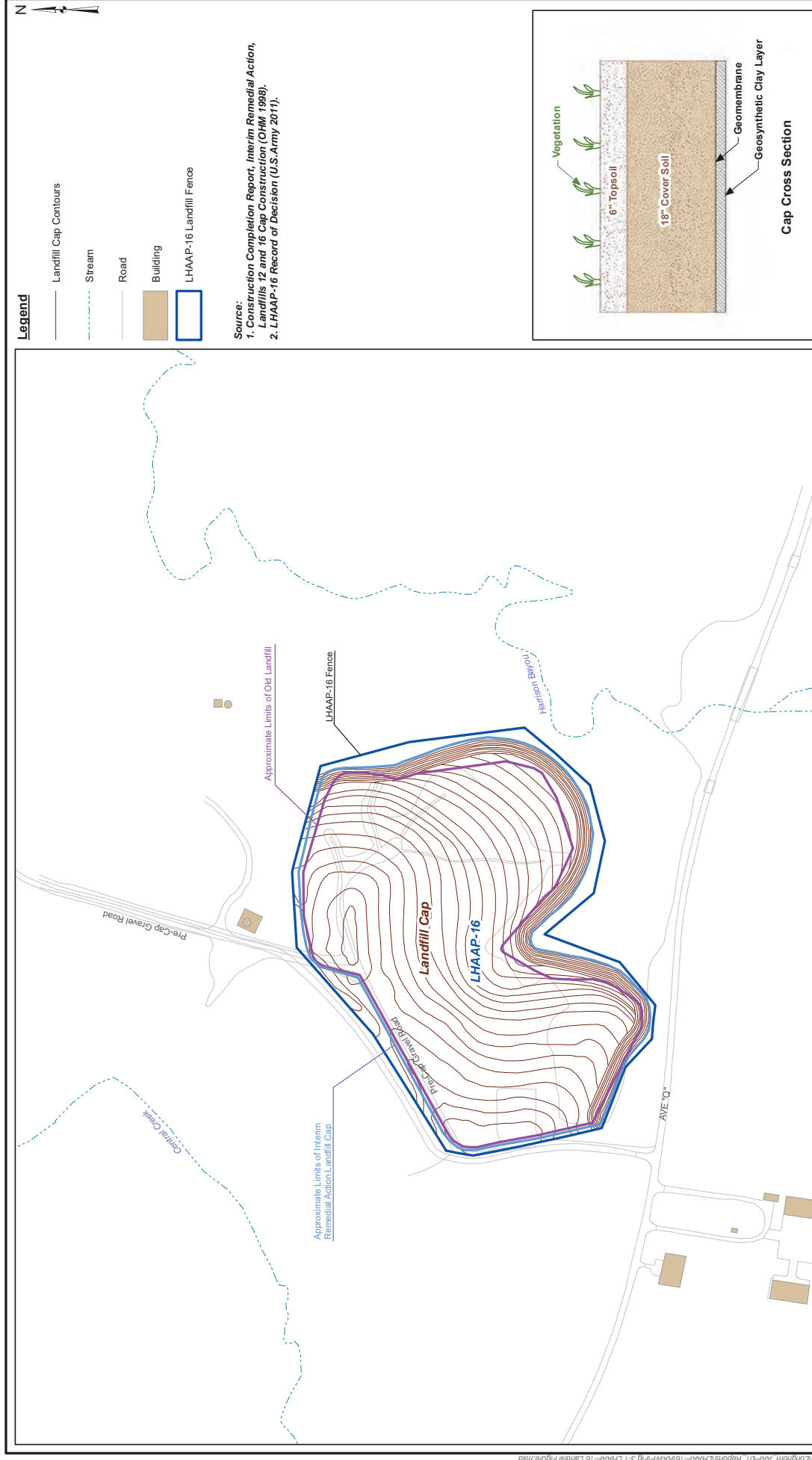
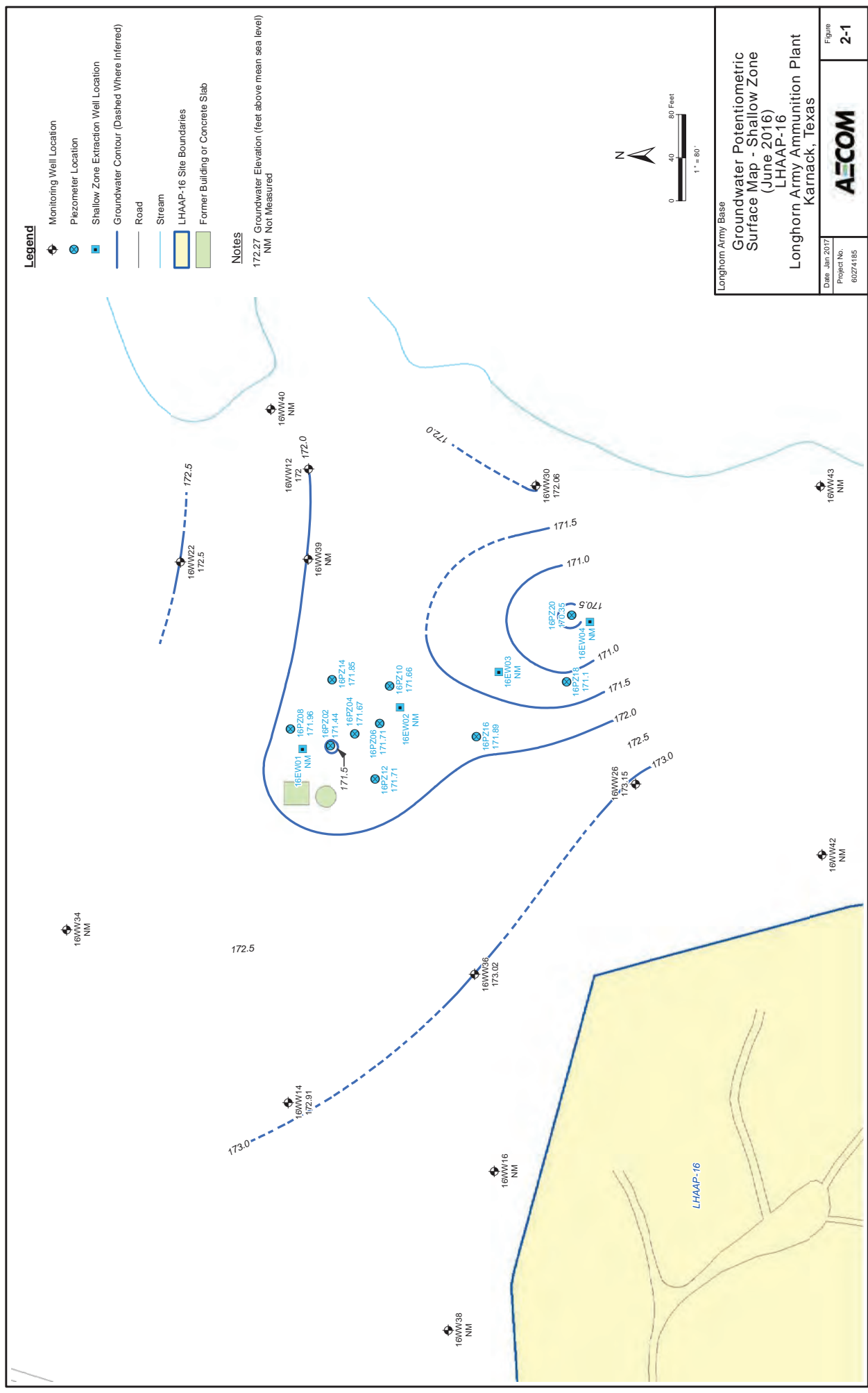


Figure 3-1
 Landfill Cap
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

60256135

January 2017

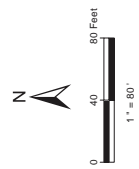


Legend

- Monitoring Well Location
- Piezometer Location
- Shallow Zone Extraction Well Location
- Groundwater Contour (Dashed Where Inferred)
- Road
- Stream
- LHAAP-16 Site Boundaries
- Former Building or Concrete Slab

Notes

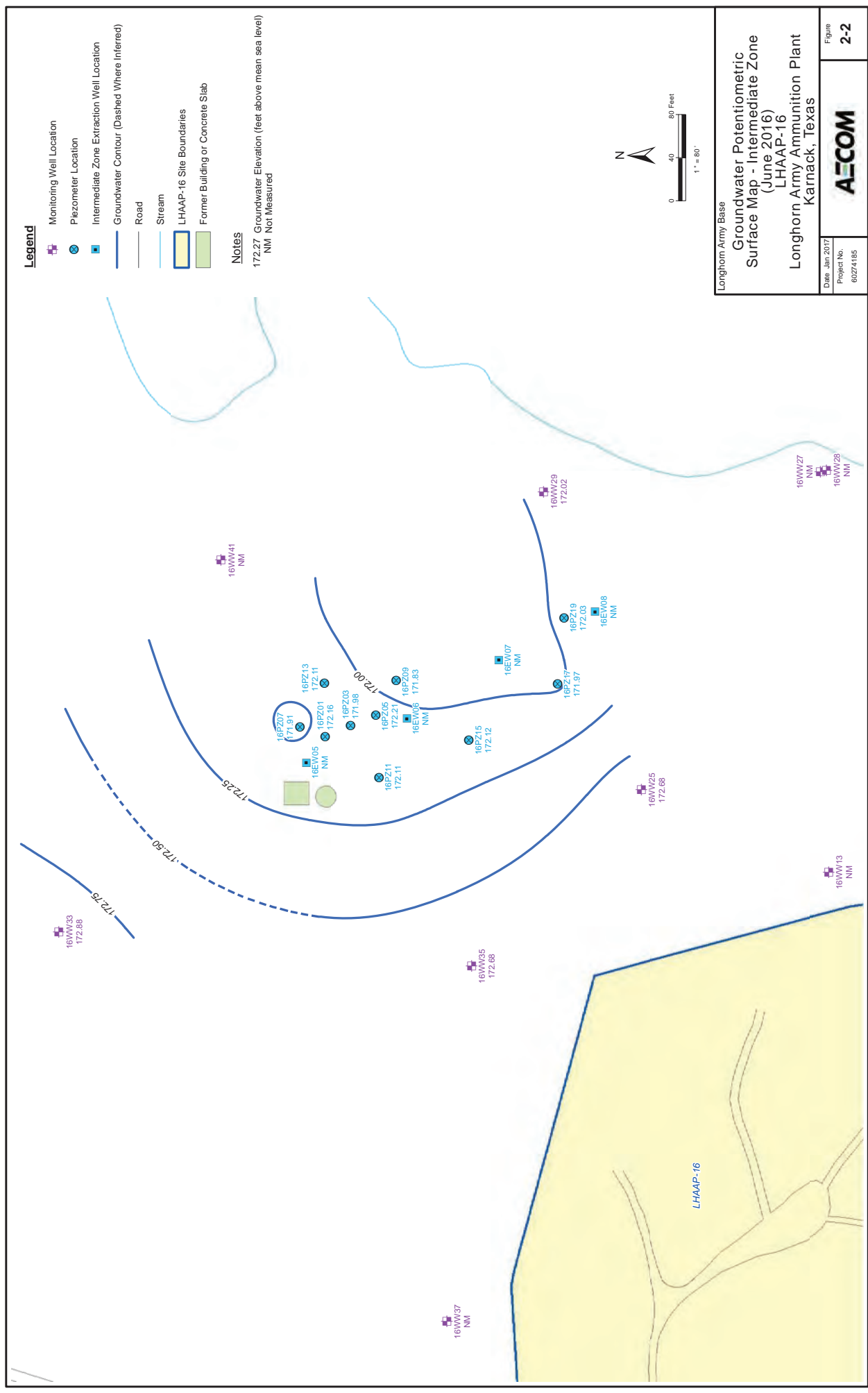
172.27 Groundwater Elevation (feet above mean sea level)
 NM Not Measured

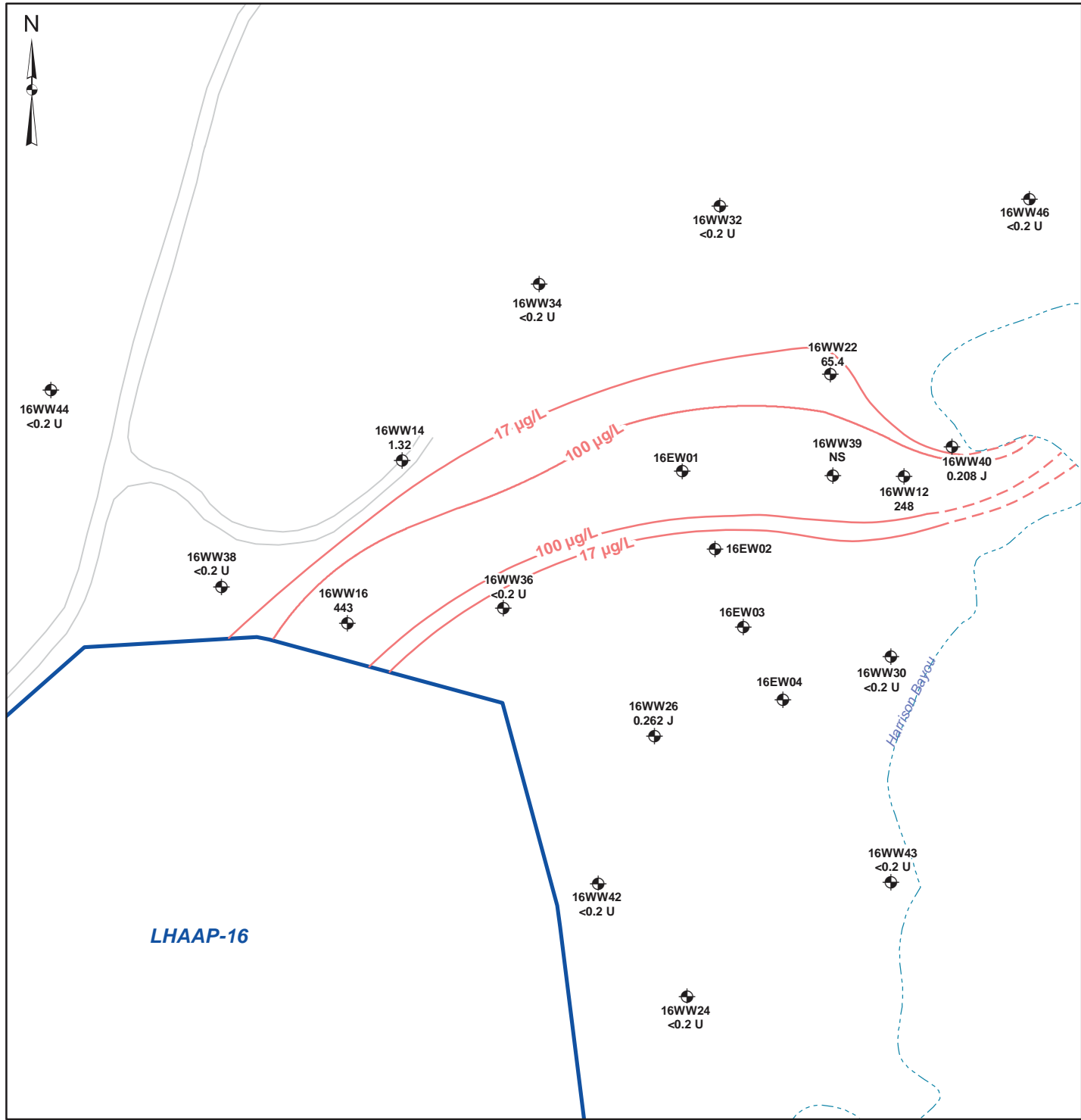


Longhorn Army Base
 Groundwater Potentiometric
 Surface Map - Shallow Zone
 (June 2016)
 LHAAP-16
 Longhorn Army Ammunition Plant
 Karnack, Texas

Date: Jan 2017	Figure
Project No. 60274185	2-1

AECOM





Legend

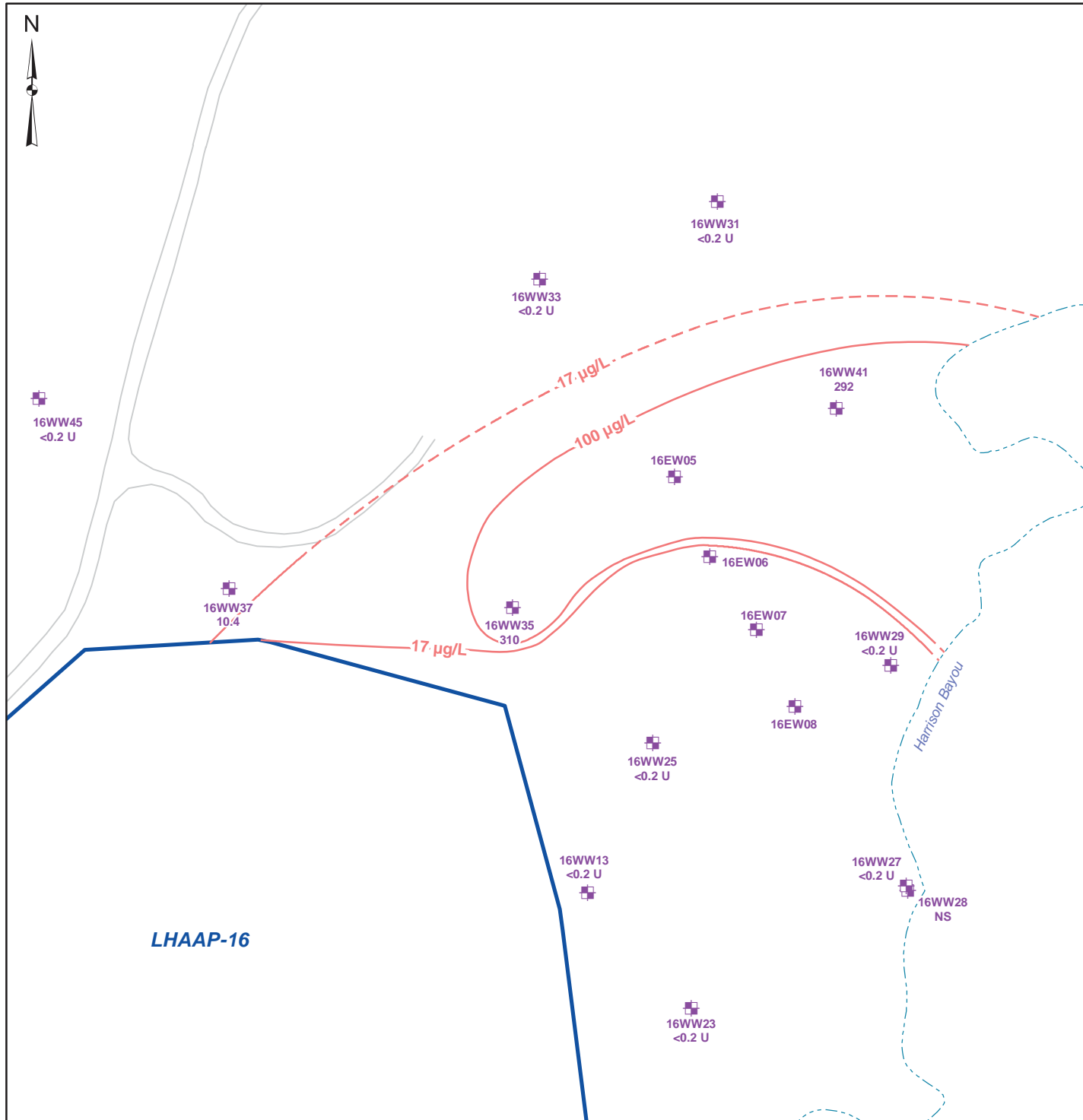
- Shallow Monitoring Well
- Perchlorate Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

Notes:

Results are in micrograms per liter (µg/L)
 TRRP Residential PCL for Perchlorate = 17 µg/L.
 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.
 NS - Not Sampled



Figure 2-4
 Perchlorate Concentrations in Groundwater
 Shallow Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas



Path: L:\AGE\GIS\AUS_GIS\GIS_P\Projects\Longhorn_AAP\01_Reports\LHAAP-16\RAW\Fig 2-5 LHAAP-16 Perchlorate in Intermediate Zone May 2013.mxd

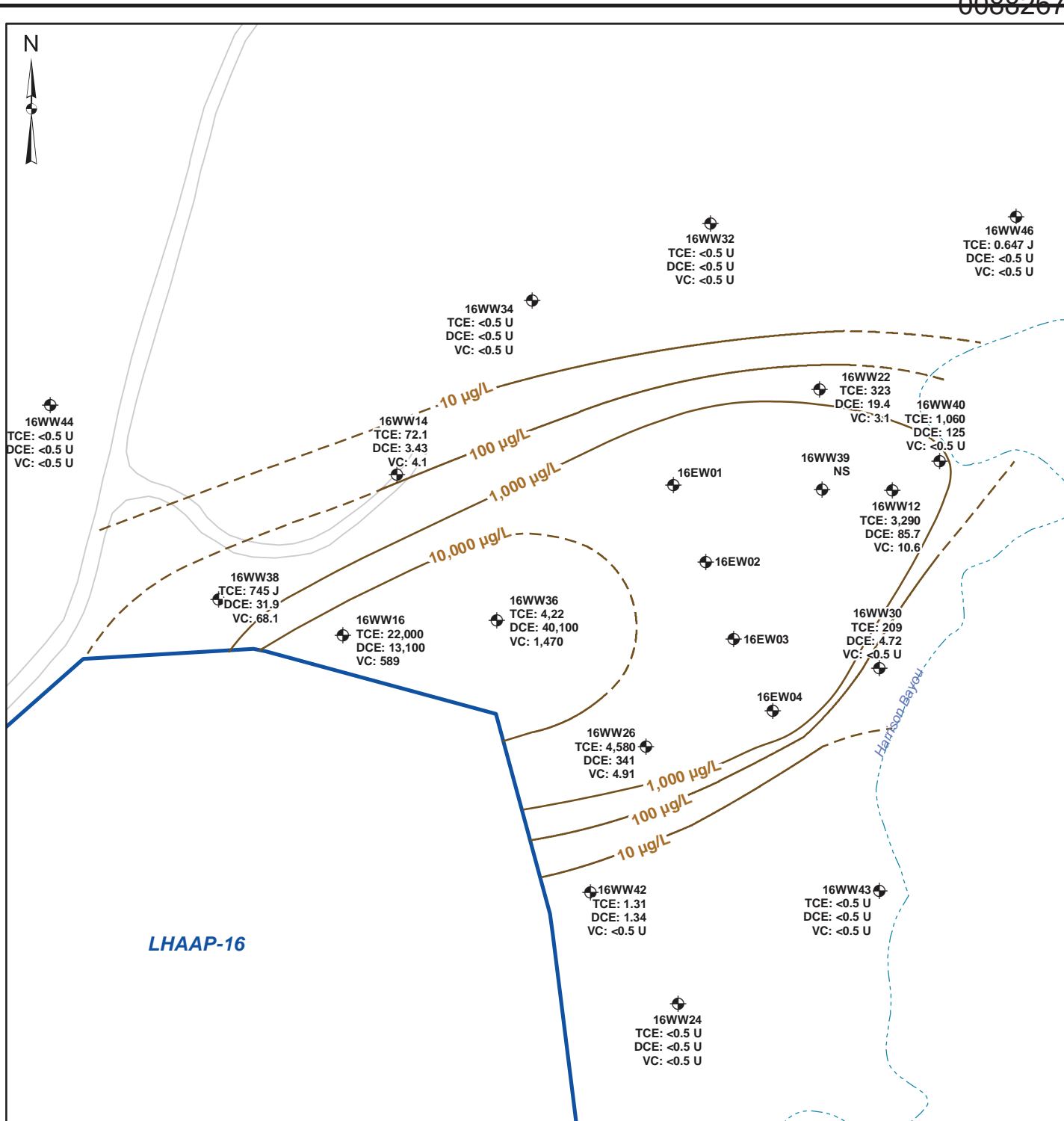
Legend

- Intermediate Monitoring Well
- Perchlorate Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

Notes:
 Results are in micrograms per liter (µg/L)
 TRRP Residential PCL for Perchlorate = 17 µg/L.
 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.
 NS - Not Sampled



Figure 2-5
 Perchlorate Concentrations in Groundwater
 Intermediate Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas



Legend

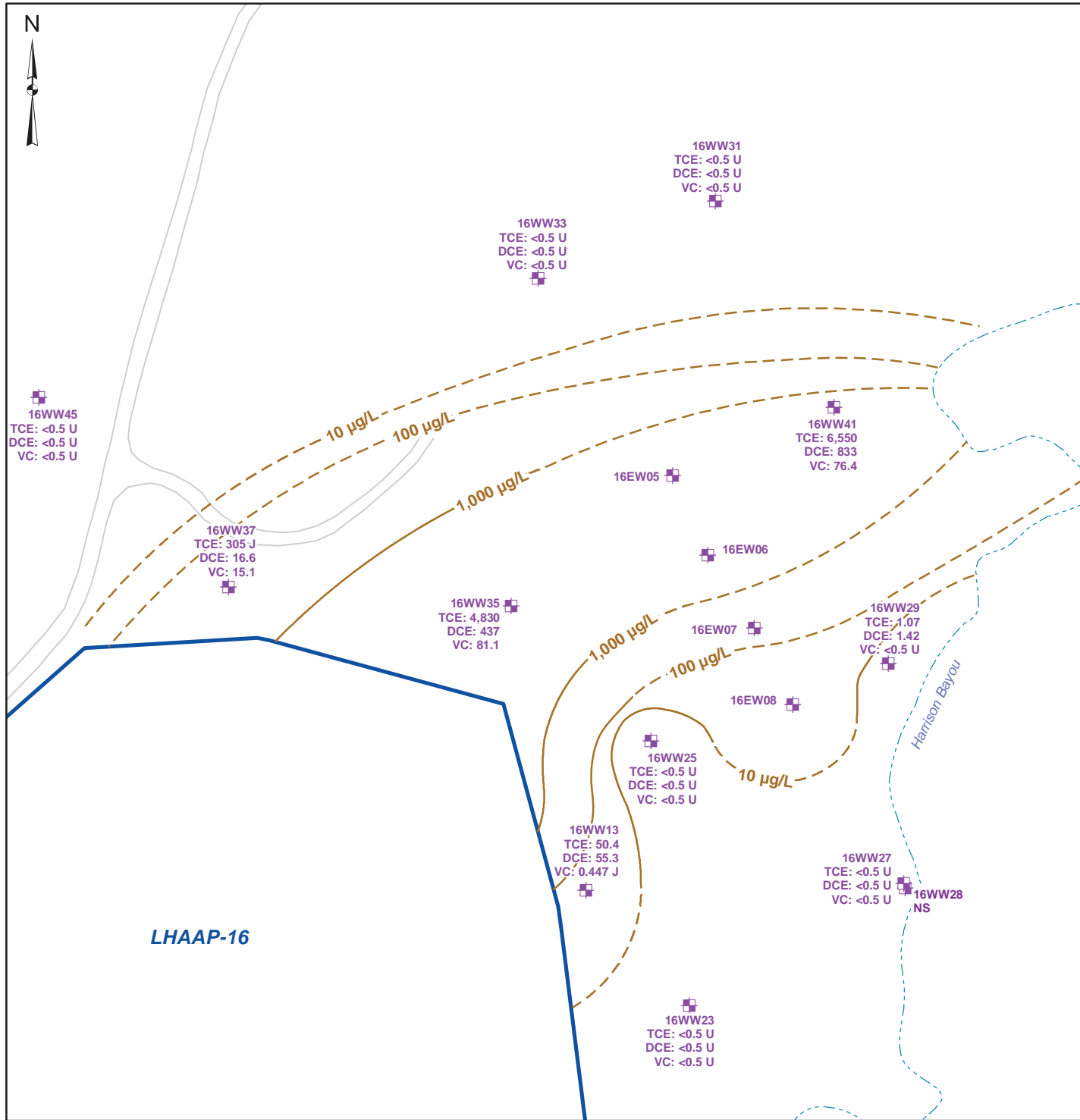
- Shallow Monitoring Well
- TCE Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

Notes:
 Results are in micrograms per liter (µg/L)
 DCE - cis-1,2-Dichloroethene
 U - Undetected: The analyte was analyzed for, but not detected.
 J - Estimated Value
 NS - Not Sampled
 TCE - Trichloroethene
 VC - Vinyl Chloride
 VOC - Volatile Organic Compound



Figure 2-6
 VOCs in Groundwater
 Shallow Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

Path: L:\AGE\GIS\GIS\Projects\Longhorn_AAP\01_Reports\LHAAP-16\RAW\Fig 2-7 LHAAP-16 VOCs in Intermediate Zone May 2013.mxd



Legend

- Intermediate Monitoring Well
- TCE Concentration Contour (Dashed Where Inferred)
- Stream
- Road
- LHAAP-16 Landfill Fence

Notes:

Results are in micrograms per liter (µg/L)
 DCE - cis-1,2-Dichloroethene
 U - Undetected: The analyte was analyzed for, but not detected.
 J - Estimated Value
 NS - Not Sampled
 TCE - Trichloroethene
 VC - Vinyl Chloride
 VOC - Volatile Organic Compound



Figure 2-7
 VOCs in Groundwater
 Intermediate Zone - May 2013
 LHAAP-16 Remedial Design
 Longhorn Army Ammunition Plant
 Karnack, Texas

Appendix B

Annual Land Use Control Compliance Inspection Form

Annual Land Use Control Compliance Inspection Form

In accordance with the Remedial Design dated _____ for LHAAP-16 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;
- Landfill integrity - preserve the integrity of the landfill cap and restrict intrusive activities (e.g., digging) that would degrade or alter the cap;
- 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 landfill intrusive activities (e.g., digging) that would degrade or alter the landfill cap; maintenance of vegetative cover and repair of soil subsidence or erosion areas on the cap;
- 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.

Appendix C

Safety Data Sheets

REDOX TECH, LLC



Providing Innovative In Situ Soil & Groundwater Treatment

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Home Products ABC+

SATURDAY, 18 JUNE 2016

ABC+

ANAEROBIC BIOCHEM PLUS (ABC[®]+))

ABC+ an enhanced version of our industry proven

Anaerobic Biochem (ABC[®]) formula, promoting both anaerobic biodegradation and reductive dechlorination of halogenated solvents in groundwater. This product, Anaerobic Biochem Plus (ABC+), is a mixture of our ABC[®] formula and Zero Valent Iron (ZVI). Formulated and mixed on a site-by-site basis, up to fifty percent (50%) by weight of ZVI can be added. ZVI has been proven and widely accepted as an effective in situ remediation technology of chlorinated solvents such as TCA, PCE, TCE, and daughter products. The degradation process using ZVI is an abiotic reductive dechlorination process occurring on the surface of the granular iron, with the iron acting as an electron donor.

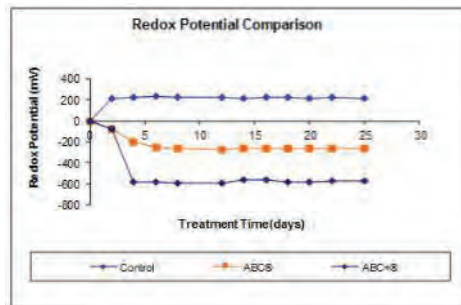
The addition of ZVI to the ABC[®] mixture provides a number of advantages for enhanced reductive dechlorination (ERD).

The ZVI will provide an immediate reduction. The ABC[®] will provide short-term and long-term nutrients to anaerobic growth, which also assists to create a reducing environment. ABC[®] contains soluble lactic acid and a phosphate buffer that provides phosphates, which are a micronutrient for bioremediation, and maintains the pH in a range that is best suited for microbial growth. In addition, the corrosion of iron metal yields ferrous iron and hydrogen, both of which are possible reducing agents. The hydrogen gas produced is also an excellent energy source for a wide variety of anaerobic bacteria.

The ABC[®] and ZVI are mixed with potable water and emplaced in the subsurface simultaneously. The dilution factor (i.e. water content) can be adjusted to achieve optimal dispersion and distribution based on site-specific parameters such as well spacing, permeability of the formation, and contaminant concentrations. The solution can be emplaced by a variety of techniques, including injection through wells or drill rods (for permeable geologic environments such as sands and fractured rock), hydraulic fracturing (for lower permeable environments such as silt and clay), and through soil blending (for all unconsolidated shallow depth applications less than 20 ft bgs). All of these techniques are part of Redox Tech's service offerings.

Benefits of ABC+ include:

- The presence of ZVI allows for the rapid and complete dechlorination of target compounds. Degradation rates using ZVI are several orders of magnitude greater than under natural conditions. As a consequence, the process does not result in the formation of daughter products other than ethane, ethane, and methane.
- ABC[®] will last up to 12-24 months in the subsurface environment due to slow releasing compounds, allowing for long-term anaerobic biodegradation
- By creating a reducing environment, ABC+ has the ability to provide long term immobilization of heavy metals (e.g. Ni, Zn, Hg, As)
- Does not require direct contact to act on target constituents.
- Does not divert groundwater flow. ABC is typically mixed at a 15% by weight solution with water. The viscosity of the solution is similar to sugar water and therefore does not measurably influence groundwater flow paths. Due to the relatively low volume of ZVI used, it does not measurably lower the bulk permeability of the formation
- Does not divert groundwater flow. ABC is typically mixed at a 15% by weight solution with water. The viscosity of the solution is similar to sugar water and therefore does not measurably influence groundwater flow paths. Due to the relatively low volume of ZVI used, it does not measurably lower the bulk permeability of the formation
- Patent protection: Redox Tech is licensed under Envirometal Technologies, Inc. (an Adventus Company) who is the current holder of patents pertaining to remediation using ZVI. Therefore, Redox Tech is able to market, sell, and emplace our ABC+ product. There is no patent infringement risk to the client in selecting the ABC+ approach.
- Price advantage. The cost of the ABC+ formula is an extremely competitive approach in relation to other ERD products on the market.



SUB MENU

ABC[®]

ABC+

ABC-OLÉ

OBC[™]

OBC+

NUBUFF

ZVI

ANAEROBIC BIOCHEM

Anaerobic Biochem (ABC[®]), is a patented mixture of lactates, fatty acids, and a phosphate buffer that promotes anaerobic biodegradation of halogenated solvents in groundwater.

Adobe PDF ABC[®] BROCHURE
Adobe PDF File
[Click here](#)

LATEST NEWS

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[Carus Corporation](#)

[New Soil Blender Debuts in](#)

[Cambridge, Mass](#)

[ABC[®] and ABC+ Applied at Over](#)

[350 Sites](#)

[Anaerobic BioChem \(ABC[®]\), The](#)

["Green" Substrate](#)

- ABC+ produces a significantly lower redox potential of approximately -600 mV

Let Redox Tech help formulate an enhanced anaerobic program for your site today. For more information contact our [Main Office](#).

ADDITIONAL INFO

BROCHURES & PRESENTATIONS

[ABC+ Presentation \(713.91 kB\)](#)

[ABC+ Presentation \(58.6 kB\)](#)

CASE STUDIES

[ABC+ TCA Case Study \(101.76 kB\)](#)

OTHER DOCUMENTS

[ABC versus Emulsified Oils \(55.99 kB\)](#)

[Site Profile for Cost Estimate \(27.11 kB\)](#)

[Florida Remediation Conference \(2.23 MB\)](#)

[Lactate \(webpage\)](#)

¹ABC[®] is protected by US Patent 6,001,252.

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SAFETY DATA SHEET

Anaerobic BioChem (ABC)

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Anaerobic BioChem
GENERAL USE: Bioremediation of halogenated organics and metals

MANUFACTURER:

Redox Tech, LLC
200 Quade Drive
Cary, NC 27513
919-678-0140

EMERGENCY TELEPHONE:

Within USA and Canada: 1-800-424-9300
+1 703-527-3887 (collect calls accepted)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Product is generally recognized as safe. May cause irritation exposure to eyes. Long term contact to skin may cause some drying and minor irritation.

3. COMPOSITION INFORMATION ON INGREDIENTS

Proprietary mixture of fatty acids, glycerol, lactates and dipotassium phosphate.

4. FIRST AID MEASURES

EYES: Immediately flush with water for up to 15 minutes. If irritation persists, seek medical attention.

SKIN: Rinse with water. Irritation is unlikely, but if irritation occurs or persists, seek medical attention.

INGESTION: Generally safe to ingest but not recommended.

INHALATION: No first aid required.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water

FIRE/EXPLOSION HAZARDS: Product is combustible only at temperatures above 600C

FIRE FIGHTING PROCEDURES: Use flooding with plenty of water, carbon dioxide or other inert gasses. Wear full protective clothing and self-contained breathing apparatus. Deluging with water is the best method to control combustion of the product.

ABC

November2014

FLAMMABILITY LIMITS: non-combustible**SENSITIVITY TO IMPACT:** non-sensitive**SENSITIVITY TO STATIC DISCHARGE:** non-sensitive

6. ACCIDENTAL RELEASE MEASURES

Confine and collect spill. Transfer to an approved DOT container and properly dispose. Do not dispose of or rinse material into sewer, stormwater or surface water. Discharge of product to surface water could result in depressed dissolved oxygen levels and subsequent biological impacts.

7. HANDLING AND STORAGE

HANDLING: Protective gloves and safety glasses are recommended.

STORAGE: Keep dry. Use first in, first out storage system. Keep container tightly closed when not in use. Avoid contamination of opened product. Avoid contact with reducing agents.

8. EXPOSURE CONTROLS – PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
ABC	NA	NA	NA

ENGINEERING CONTROLS: None are required

PERSONAL PROTECTIVE EQUIPMENT

EYES and FACE: Safety glasses recommended

RESPIRATOR: none necessary

PROTECTIVE CLOTHING: None necessary

GLOVES: rubber, latex or neoprene recommended but not required

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	none to mild pleasant organic odor
Appearance:	clear to light amber
Auto-ignition Temperature	Non-combustible
Boiling Point	>600 C
Melting Point	NA
Density	1.15 gram/cc
Solubility	infinite
pH	7-9

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID: Do not contact with strong oxidizers

STABILITY: product is stable

POLYMERIZATION: will not occur

INCOMPATIBLE MATERIALS: strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS:

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

A: General Product Information

Acute exposure may cause mild skin and eye irritation.

B: Component Analysis - LD50/LC50

No information available.

B: Component Analysis - TDLo/LDLo

TDLo (Oral-Man) none

Carcinogenicity

A: General Product Information

No information available.

B: Component Carcinogenicity

Product is not listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

Epidemiology

No information available.

Neurotoxicity

No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Discharge to water may cause depressed dissolved oxygen and subsequent ecological stresses

Environmental Fate

No potential for food chain concentration

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Material is not considered hazardous, but consult with local, state and federal agencies prior to disposal to ensure all applicable laws are met.

14. TRANSPORT INFORMATION

NOTE: The shipping classification information in this section (Section 14) is meant as a guide to the overall classification of the product. However, transportation classifications may be subject to change with changes in package size. Consult shipper requirements under I.M.O., I.C.A.O. (I.A.T.A.) and 49 CFR to assure regulatory compliance.

US DOT Information

Shipping Name: Not Regulated

Hazard Class: Not Classified

UN/NA #: Not Classified

Packing Group: None

Required Label(s): None

50th Edition International Air Transport Association (IATA):

Not hazardous and not regulated

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

Material is not regulated under IMDG

15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III

SECTION 311 No Hazard for Immediate health Hazard

SECTION 312 No Threshold Quantity

SECTION 313 Not listed

CERCLA NOT REGULATED UNDER CERCLA

TSCA NOT REGULATED UNDER TSCA

CANADA (WHIMS): NOT REGULATED

16. OTHER INFORMATION

HMIS:

Health	1
Flammability	0
Physical Hazard	0
Personal Protection	E

E: Safety Glasses, gloves

Material Safety Data Sheet

Shaw Environmental, Inc.
17 PRINCESS ROAD
LAWRENCEVILLE, N.J. 08648
(609) 895-5340

SECTION 1 - MATERIAL IDENTIFICATION AND INFORMATION

Material Name: DHC microbial consortium (SDC-9) MSDS #: ENV 1033

Date Prepared: 10/06/2003 CAS #: N/A (Not Applicable)

Prepared By: Simon Vainberg Formula #: N/A

Material Description: Non-hazardous, naturally occurring non-altered anaerobic microbes and enzymes in a water-based medium.

SECTION 2 - INGREDIENTS

Components	%	OSHA PEL	ACGIH TLV	OTHER LIMITS
Non-Hazardous Ingredients	100	N/A	N/A	N/A

SECTION 3 - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point: 100°C (water) Specific Gravity (H₂O = 1): 0.9 - 1.1

Vapor Pressure @ 25°C: 24 mm Hg (water) Melting Point: 0°C (water)

Vapor Density: N/A Evaporation Rate (H₂O = 1): 0.9 - 1.1

Solubility in Water: Soluble Water Reactive: No

pH: 6.0 - 8.0

Appearance and Odor: Murky, yellow water. Musty odor.

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)
PAGE 2 OF 4
October 6, 2003

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Flammable Limits: N/A

Extinguishing Media: Foam, carbon dioxide, water

Special Fire Fighting Procedures: None

Unusual Fire and Explosion Hazards: None

SECTION 5 - REACTIVITY DATA

Stability: Stable

Conditions to Avoid: None

Incompatibility (Materials to Avoid): Water-reactive materials

Hazardous Decomposition Byproducts: None

SECTION 6 - HEALTH HAZARD DATA

HEALTH EFFECTS

The effects of exposure to this material have not been determined. Safe handling of this material on a long-term basis will avoid any possible effect from repetitive acute exposures. Below are possible health effects based on information from similar materials. Individuals hyper allergic to enzymes or other related proteins should not handle.

Ingestion: Ingestion of large quantities may result in abdominal discomfort including nausea, vomiting, cramps, diarrhea, and fever.

Inhalation: Hypersensitive individuals may experience breathing difficulties after inhalation of aerosols.

Skin Absorption: N/A

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)

PAGE 3 OF 4

October 6, 2003

Skin Contact: May cause skin irritation. Hypersensitive individuals may experience allergic reactions to enzymes.

Eye Contact: May cause eye irritation.

FIRST AID

Ingestion: Get medical attention if allergic symptoms develop (observe for 48 hours). Never give anything by mouth to an unconscious or convulsing person.

Inhalation: Get medical attention if allergic symptoms develop.

Skin Absorption: N/A

Skin Contact: Wash affected area with soap and water. Get medical attention if allergic symptoms develop.

Eye Contact: Flush eyes with plenty of water for at least 15 minutes using an eyewash fountain, if available. Get medical attention if irritation occurs.

NOTE TO PHYSICIANS: All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this material may have occurred.

SECTION 7 - SPILL AND LEAK PROCEDURES

Reportable quantities (in lbs of EPA Hazardous Substances): N/A

Steps to be taken in case of spill or release: No emergency results from spillage. However, spills should be cleaned up promptly. All personnel involved in the cleanup must wear protective clothing and avoid skin contact. Absorb spilled material or vacuum into a container. After clean-up, disinfect all cleaning materials and storage containers that come in contact with the spilled liquid.

Waste Disposal Method: No special disposal methods are required. The material may be sewerred, and is compatible with all known biological treatment methods. To reduce odors and permanently inactivate microorganisms, mix 100 parts (by volume) of DHC consortium with 1 part (by volume) of bleach. Dispose of in accordance with local, state and federal regulations.

MATERIAL SAFETY DATA SHEET FOR DHC consortium (SDC-9)
PAGE 4 OF 4
October 6, 2003

SECTION 8 - HANDLING AND STORAGE

Hand Protection: Rubber gloves.

Eye Protection: Safety goggles with side splash shields.

Protective Clothing: Use adequate clothing to prevent skin contact.

Respiratory Protection: Surgical mask.

Ventilation: Provide adequate ventilation to remove odors.

Storage & Handling:

Material may be stored for up to 3 weeks at 2-4°C without aeration.

Other Precautions: An eyewash station in the work area is recommended.

While the information and recommendations set forth herein are believed to be accurate as of the date hereof, Shaw Environmental, Inc. MAKES NO WARRANTY WITH RESPECT HERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.



Material Safety Data Sheet

Electron Donor Solution

Section 1: Chemical Product and Company Identification

Product Name: Electron Donor Solution
Extended Release

Catalog Codes: EDS-ER

CAS#: 8001-22-7

TSCA: TSCA 8(b) inventory: Soybean oil

HMIS Code: H F R P: 10 0 A

Trade Name and Synonyms: EDS-ER

Chemical Family: Glyceride Oils

Contact Information:

Tersus Environmental, LLC

109 E. 17th Street, Suite #3880

Cheyenne, WY 82001

Ph: 307.638.2822 • info@tersusenv.com

www.tersusenv.com

For emergency assistance, call: 919.638.7892

Section 2: Composition and Information on Ingredients

COMPONANT	CAS #	OSHA TWA	OSHA STEL	ACGIH TWA	ACGIH STEL
Soybean Oil	8001-22-7	---	10 mg/m ³	---	---
Vegetable Oil Derived Fatty Acid Esters	Confidential	---	---	---	---

HAZARDOUS INGREDIENTS: NONE AS DEFINED UNDER THE U.S. OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200) OR THE CANADIAN HAZARDOUS PRODUCTS ACT S.C. 1987, C.30 (PART 1).

THE PRECISE COMPOSITION OF THIS PRODUCT IS PROPRIETARY INFORMATION. A MORE COMPLETE DISCLOSURE WILL BE PROVIDED TO A PHYSICIAN IN THE EVENT OF A MEDICAL EMERGENCY.

SARA HAZARD: NONE NOTED (SECTION 311/312) TITLE III SECTION 313 - NOT LISTED
All components of this product are listed on the TSCA registry.

Section 3: Physical/Chemical Characteristics

BOILING RANGE: Not applicable VAPOR DENSITY: Exceeds 1.0

SPECIFIC GRAVITY (H₂O=1.0): 0.92 - 0.925 VAPOR PRESSURE: Not applicable

PERCENT VOLATILE BY VOLUME: 0% SOLUBILITY IN WATER: Miscible

EVAPORATION RATE: Not applicable

APPEARANCE AND ODOR: A pale yellow, oily liquid - only a faint odor.

WEIGHT PER GALLON: 7.7 lbs. at 60F.



Material Safety Data Sheet

Section 4: Fire and Explosion Data

FLAMMABILITY CLASSIFICATION: Combustible Liquid - Class IIIB.

FLASHPOINT: Greater than 550 F (288 C).

METHOD USED: Tag Closed Cup.

EXTINGUISHING MEDIA: CO₂, dry chemical, foam, sand.

SPECIAL FIREFIGHTING PROCEDURES: Avoid use of water as it may spread fire by dispersing oil. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Rags soaked with any oil or solvent can present a fire hazard and should always be stored in UL Listed or Factory Mutual approved, covered containers. Improperly stored rags can create conditions that lead to oxidation. Oxidation, under certain conditions can lead to spontaneous combustion.

Section 5: Reactivity Data

STABILITY: Generally stable. Spontaneous combustion can occur. See Unusual Fire and Explosion Procedures, Section IV.

CONDITIONS TO AVOID: High surface area exposure to oxygen can result in polymerization and release of heat.

INCOMPATIBILITY (MATERIALS TO AVOID): Avoid contact with strong oxidizing agents.

HAZARDOUS DECOMPOSITIONS OR BY-PRODUCTS: Decomposition may produce carbon dioxide and carbon monoxide.

HAZARDOUS POLYMERIZATION: Will not occur.

Section 6: Health Hazard Data

THRESHOLD LIMIT VALUE: As a liquid - none. As oil mist - 10 mg/m³ total particulate.

INHALATION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: Excessive inhalation of oil mist may affect the respiratory system. Oil mist is classified as a nuisance particulate by ACGIH.

SKIN ABSORPTION HEALTH RISKS AND SYMPTOMS OF EXPOSURE: Not classified as a primary skin irritant or corrosive material. Sensitive individuals may experience dermatitis after long exposure of oil on skin.

HEALTH HAZARDS (ACUTE AND CHRONIC): Acute: none observed by inhalation. Chronic: none reported.

EMERGENCY AND FIRST AID PROCEDURES FOR:

SKIN CONTACT: May be removed from skin by washing with soap and warm water.

EYE CONTACT: Immediately flush eyes with plenty of cool water for at least 15 minutes. Do NOT let victim rub eyes.

INHALATION: Immediately remove exposed individual to fresh air source. If victim has stopped breathing give artificial respiration, get medical attention immediately.



Material Safety Data Sheet

Section 7: Precautions for Safe Handling and Use

ENVIRONMENTAL PRECAUTIONS: Where large spills are possible, a comprehensive spill response plan should be developed and implemented.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Wear appropriate respiratory protection and protective clothing as described in section VIII. Depending on quantity of spill: (a) Small spill - add solid adsorbent, shovel into disposable container and wash the area. Clean area with detergent. (b) Large spill - Squeegee or pump into holding container. Clean area with detergent. In the event of an uncontrolled release of this material, the user should determine if this release is reportable under applicable laws and regulations.

WASTE DISPOSAL METHOD: All recovered material should be packaged, labeled, transported, and disposed or reclaimed in accordance with local, state, and federal regulations and good engineering practices.

Section 8: Control Measures

RESPIRATORY PROTECTION: Not normally needed. A qualified health specialist should evaluate whether there is a need for respiratory protection under specific conditions.

VENTILATION: Handle in the presence of adequate ventilation. Intermittent clean air exchanges recommended, but not required.

PROTECTIVE GLOVES: Not normally needed. However, protective clothing is always recommended when handling chemicals.

EYE PROTECTION: Eye protection is always recommended when handling chemicals. Wear safety glasses meeting the specifications established in ANSI Standard Z87.1.

Section 9: Special Precautions

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Store away from flame, fire, and excessive heat.

Section 10: Disposal Considerations

General Information: Do not discharge into drains, watercourses or onto the ground. Discharge, treatment, or disposal may be subject to national, state, or local laws. Empty containers may contain product residues.

Disposal Methods: No specific disposal method required.

Container: Since emptied containers retain product residue, follow label warnings even after container is emptied.



Material Safety Data Sheet

Section 11: Transportation Information

DOT Not regulated.
 TDG Not regulated.
 IATA Not regulated.
 IMDG Not regulated.

Section 12: Other Information

Hazard Ratings

	Health Hazard	Fire Hazard	Instability	Special Hazard
NFPA	1	1	0	NONE

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

NFPA Label colored diamond code: Blue - Health; Red - Flammability; Yellow - Instability; White - Special Hazards

	Health Hazard	Flammability	Physical Hazard	Personal Protection
HMIS	1	1	0	--

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

HMIS Label colored bar code: Blue - Health; Red - Flammability; Orange - Physical Hazards; White - Special

Section 13: Disclaimer and/or Comments

We suggest that containers be either professionally reconditioned for re-use by certified firms or properly disposed of by certified firms to help reduce the possibility of an accident. Disposal of containers should be in accordance with applicable federal, state and local laws and regulations. "Empty" drums should not be given to individuals.

The conditions of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Tersus Environmental be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Tersus Environmental has been advised of the possibility of such damages.

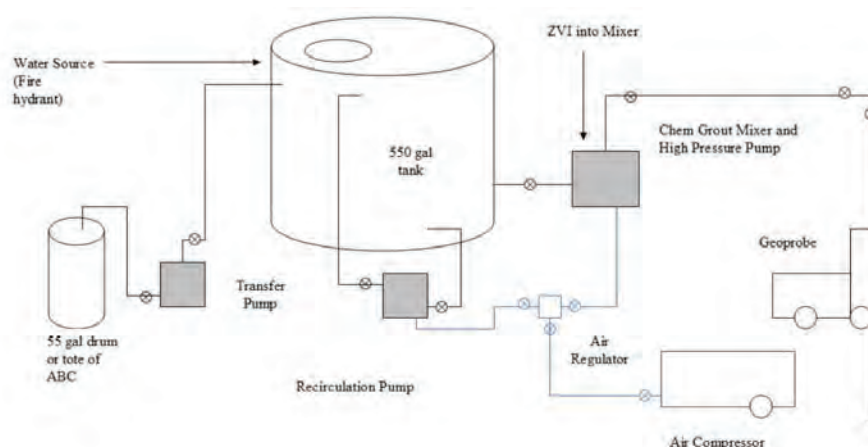
Appendix D

ABC Plus Amendment Preparation Procedure

ABC+ Injections

Anaerobic Biochem ABC[®] is a patented mixture of lactates, fatty acids, and a phosphate buffer. ABC[®] contains soluble lactic acid as well as slow- and long-term releasing components. The phosphate buffer provides phosphates, which are a micronutrient for bioremediation. In addition, the buffer helps to maintain the pH in a range that is best suited for microbial growth. Using a Geoprobe[®] and proprietary injection equipment, Redox Tech is able to inject ABC[®] in most geologic environments, including low-permeability silt and clay. For low permeability environments, Redox Tech utilizes hydraulic fracturing.

In July 2006, the ABC formula was offered with a mixture of ZVI. The new product, marketed as ABC+, provided significant advantages over ABC alone. The ZVI provides an immediate chemical reduction of chlorinated solvents and quickly drives the *in situ* system to reducing conditions. The hydrogen produced from the corrosion of the ZVI also provides nutrients to a wide range of bacteria.



ABC+ injections are initiated by mixing the ABC product in a 550 gallon mixing tank. Complete mixing is achieved by use of a recirculation pump and then it is transferred into an air powered ChemGrout



CG500 high pressure mixing unit. The ABC solution is mixed in the 70 gallon paddle hoppers where guar gum is used to increase the viscosity. Once the viscosity is increased, the ZVI product is introduced where a slurry is formed. The slurry is transferred to the 3 inch positive placement pump and is pumped to the top of the Geoprobe rods and out of the bottom via an expendable tip, to the desired remediation zone.

The ChemGrout CG500 high pressure mixing plant unit has two 70 gallon mixing hoppers so mixing and pumping can be performed simultaneously. The Geoprobe rods are raised to other specified injection intervals to inject the ABC+ slurry to predetermined intervals.



Appendix E

Daily ISB Injection Log

Appendix F

Inspection and Maintenance Checklist

RAO Inspection and Maintenance Checklist

General Information	
Project Name	RAO Inspection and Maintenance, LHAAP-16 Landfill, Longhorn Army Ammunition Plant, Kamack, TX
Contractor	
Inspector's Name	
Inspector's Title	
Inspector's Signature	
Inspector's Contact Number	
Inspection Date	
Type of Inspection	<input type="checkbox"/> Quarterly <input type="checkbox"/> Semiannual <input type="checkbox"/> Annual <input type="checkbox"/> Prior to forecast rain <input type="checkbox"/> After a rain event <input type="checkbox"/> Other -----

Description	Yes	No	N/A	Comments (Attach photos/location sketches)	Corrective Action (Attach photos)
A. CAP Cover Surface					
A.1				Are there any significant cracks present?	
A.2				Is there any evidence of significant/ clearly visible erosion, settlement, or other deterioration?	
A.3.				Are there any damaged areas?	
A.4				Is there any ponded water present?	
A.5				Are the drainage systems in poor condition?	
A.6				Any other relevant observations?	
B. CAP Vegetation and Animal Burrows					
B.1				Are there signs of stressed/ dead vegetation?	
B.2				Are there any significant bare spots?	

Description	Yes	No	N/A	Comments (Attach photos/location sketches)	Corrective Action (Attach photos)
B.3					
B.4					
B.5					
C. Groundwater Monitoring Wells					
C.1					
C.2					
C.3					
C.4					
C.5					
D. Site Access Features					
D.1					
D.2					
D.3					
D.4					
D.5					
D.6					



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

July 27, 2018

DAIM-ODB-LO

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

Re: Draft Quarterly Evaluation Report 1st Quarter (January-March) 2018 Groundwater
Treatment Plant Longhorn Army Ammunition Plant, Karnack, Texas, July 2018

Dear Mr. Mayer,

The above-referenced document is being transmitted to you for your review. Review comments are requested by August 27, 2018.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) 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,

A handwritten signature in cursive script that reads "Rose M. Zeiler".

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

Copies furnished:

A. Palmie, TCEQ, Austin, TX
P. Bruckwicki, Caddo Lake NWR, TX
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

July 27, 2018

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 Quarterly Evaluation Report 1st Quarter (January - March) 2018 Groundwater
Treatment Plant Longhorn Army Ammunition Plant, Karnack, Texas, July 2018

Dear Ms. Palmie,

The above-referenced document is being transmitted to you for your review. Review comments are requested by August 27, 2018.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) 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,

A handwritten signature in cursive script that reads "Rose M. Zeiler".

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

Copies furnished:

R. Mayer, USEPA Region 6, Dallas, TX
P. Bruckwicki, Caddo Lake NWR, TX
A. Williams, USACE, Tulsa District, OK
N. Smith, USAEC, San Antonio, TX
K. Nemmers, Bhate, Lakewood, CO (for project files)

DRAFT
QUARTERLY EVALUATION REPORT
1ST QUARTER (JANUARY - MARCH) 2018
GROUNDWATER TREATMENT PLANT
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

JULY 2018

Prepared For:



U.S. Army Corps of Engineers
Tulsa District

Contract No. W9128F-13-D-0012
Task Order No. W912BV17F0150
Bhate Project No. NWO1312.0150.016.0001.03

Prepared By:



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LONGHORN ARMY AMMUNITION PLANT

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- Appendix A ICT Layout and GWTP Process Flow Diagram
 Appendix B Groundwater Elevation Contour Maps
 Appendix C GWTP Water Sampling Laboratory Analytical Results for the 1st Quarter 2018
 (Provided on CD Only)
 Appendix D Laboratory Analytical Results for LHAAP-16 (Provided on CD Only)
 Appendix E Quality Control Summary Report
 Appendix F Air Monitoring Data – 1st Quarter 2018 (Provided on CD Only)
 Attachment 1: Air Monitoring Calculations
 Attachment 2: PID Readings and Calibration Logs
 Attachment 3: Air Analytical Laboratory Report
 Appendix G Protocol for Discharging GWTP Effluent

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ACRONYMS AND ABBREVIATIONS

AED	Automated external defibrillator
AMCV	Air Monitoring Comparison Value
amsl	Above mean sea level
bgs	Below ground surface
Bhate	Bhate Environmental Associates, Inc.
CD	Compact disc
COD	Chemical oxygen demand
CPR	Cardiopulmonary resuscitation
DCE	Dichloroethene
ESD	Explanation of Significant Difference
ESL	Effects Screening Level
FBR	Fluidized bed reactor
ft	Feet or foot
GAC	Granular activated carbon
gpd	Gallons per day
gph	Gallons per hour
gpm	Gallons per minute
GWTP	Groundwater Treatment Plant
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	Hydrochloric acid
HDPE	High density polyethylene
ICT	Interception-collection trench
IRA	Interim Remedial Action
J	Estimated concentration
lbs/hr	Pounds per hour
LHAAP	Longhorn Army Ammunition Plant
MCL	Maximum Contaminant Level
µg/L	Micrograms per liter
Mg(OH) ₂	Magnesium hydroxide
MSC	Medium Specific Concentration

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mV	Millivolts
NA	Not applicable
NaOH	Sodium hydroxide
No.	Number
ORP	Oxidation-reduction potential
PCL	Protective Concentration Level
PID	Photoionization detector
ppmv	Parts per million by volume
psi	Pounds per square inch
PVC	Polyvinyl chloride
ROD	Record of Decision
TAC	Texas Administrative Code
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
tpy	Tons per year
TRRP	Texas Risk Reduction Program
UEP	Unlined Evaporation Pond
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

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EXECUTIVE SUMMARY

The operation of the Groundwater Treatment Plant (GWTP) is part of the Interim Remedial Action (IRA) at Burning Ground Number (No.) 3, also referred to as Longhorn Army Ammunition Plant (LHAAP)-18/24. A historical pilot test for nearby landfill LHAAP-16 resulted in the installation of eight extraction wells which also contribute groundwater to the GWTP. Groundwater extraction, treatment, and monitoring activities consist of:

- Continuous extraction of groundwater from multiple interception-collection trenches (ICTs) and extraction wells at both LHAAP-18/24 and LHAAP-16;
- Treatment of extracted groundwater for heavy metals, chlorinated compounds, and perchlorate using precipitation, air stripping, and biological methods, respectively;
- Evaluation of the hydraulic effectiveness of the extraction system by groundwater monitoring;
- Monitoring of treated groundwater to ensure compliance with the discharge limits; and
- Discharge of treated water to Harrison Bayou, or to a holding pond (INF Pond), or the treated water may be released as irrigation water on LHAAP-18/24.

The location of the extraction wells and ICTs are shown on **Figure A-1** in **Appendix A**. The process flow diagram of the GWTP is shown on **Figure A-2** in **Appendix A**.

Figure ES-1 depicts the monthly total volume of groundwater that was extracted from the ICTs and extraction wells at LHAAP-18/24 and LHAAP-16 between September 2012 and March 2018.

The GWTP was not operational during June, July, and August 2012. This was related to meltdown of the scrubber system, associated with the catalytic oxidizer, due to system overheating. Overheating occurred when the blower became inoperable after the bearing on the scrubber blower unit was shattered and damaged the blower. This occurred around 1:00 PM on May 21, 2012.

After developing an interim air monitoring plan and obtaining concurrence from the Texas Commission on Environmental Quality (TCEQ) and the United States Environmental Protection Agency (USEPA) to operate the GWTP without use of air abatement equipment, a pilot run of the GWTP was conducted on September 6, 2012. In that first pilot run, 85,170 gallons of water that had been stored in the influent equalization tank (TK-140) were treated. The treated water was re-circulated through the fluidized bed reactor (FBR) to revive the FBR after 3 months of dormancy. Treated groundwater and air samples were collected and analyzed respectively for perchlorate, metals, and Volatile Organic Compounds (VOCs); and VOCs only. On September 19, 2012, a second pilot run was performed at the GWTP and 107,264 gallons of water were treated. Based on the successful re-start of the GWTP, continuous groundwater extraction began again on September 24, 2012. While groundwater extraction occurs on a continuous basis, operation

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of the GWTP occurs intermittently due to the low volume of water available for treatment with respect to the design capacity of the GWTP. During the 3rd quarter of 2012, groundwater extraction occurred only from LHAAP-18/24. Groundwater extraction from LHAAP-16 was not performed due to equipment failure. However, extraction from LHAAP-16 began in October 2012 and the extraction volumes increased steadily throughout the 4th quarter of 2012, as pumping equipment was gradually repaired/replaced. The GWTP operated under normal conditions until September 2015.

On September 14, 2015, at 11:15 AM, the blower on the air stripper (BL-340) malfunctioned during routine operation. The wiring on the blower was repaired and the blower operated for less than 2 hours on September 17, 2015, when the blower malfunctioned again. It was determined that the blower needed to be replaced, and groundwater extraction and operation of the GWTP ceased beginning September 18, 2015, as the influent equalization tank (TK-140) became full. Beginning on October 2, 2015, it was determined that the GWTP could operate without the blower at a reduced extraction rate. The operation of the GWTP allowed extraction of groundwater from ICTs 12E, 13A, 13B, and 13C (13C was changed to ICT 13E on October 12, 2015), which were considered critical ICTs to prevent migration of contaminants to Harrison Bayou. Groundwater extraction was switched frequently between ICTs 12E, 13A, 13B, and 13E to ICTs 14B, 14C, and 14D beginning on December 14, 2015.

On December 12, 2016, flange bolts at TK-380 failed and allowed hydrochloric acid (HCl) to drain into the sump. The containment area was washed down and the sump contents were transferred into the equalization tank (TK-140). Because of the acid release, extraction of groundwater from the ICTs was halted, and the GWTP was put into recycle mode (effluent sent back as influent) until the acid was neutralized and perchlorate, metals, and VOCs were below discharge criteria on March 17, 2017.

On August 12, 2017, severe storms caused a power outage at LHAAP-18/24. When electrical service was restored, the main transformer failed due to a manufacturing defect. A portable emergency generator was brought on-site on August 21, 2017, to allow the FBR to operate in full recycle mode. After a replacement transformer was installed on September 12, 2017, extraction began from ICT-13B, 13C, 13D, 13E, 13F, 7, and EW01 and the FBR was put into normal operation. Beginning on September 21, 2017, groundwater was extracted from all of the ICTs.

As shown on **Figure ES-1**, the total extracted groundwater volume from LHAAP-18/24 during the 1st quarter of 2018 was within normal range. The extracted groundwater volume was measured on a monthly basis as the sum of the ICTs flow meter totalizers' differences between the beginning and end of each month. Extraction volumes were somewhat depressed due to drought conditions. Extraction quantities in LHAAP-18/24 ranged between 378,955 gallons in January 2018 and 729,615 gallons in March 2018. The decreased volume extracted in January 2018 was due to freezing conditions. The increase in extracted groundwater from LHAAP-18/24 was a direct result of maintenance of pumps that allowed additional ICTs and wells to come online that had lower production rates in January and/or February.

GWTP QUARTERLY EVALUATION REPORT – 1ST QUARTER 2018 LONGHORN ARMY AMMUNITION PLANT

Extraction from LHAAP-16 was slightly less than the extraction presented in the 4th Quarter 2017. In February 2018, only 11,092 gallons was extracted from LHAAP-16 due to repairs on the pulley within the air compressor motor. Groundwater extraction from LHAAP-16 was 21,240 gallons in January 2018; 11,092 gallons in February 2018; and 28,615 gallons in March 2018. The total extracted from LHAAP-16 from January through March 2018 was 60,947 gallons. Approximately 1,672,185 gallons of groundwater were extracted from LHAAP-18/24 and LHAAP 16 during the 1st quarter of 2018 compared to approximately 1,713,492 gallons extracted during the 4th quarter of 2017.

No treated water was returned to ICTs 6 and 9 during the 1st quarter of 2018 because this practice was discontinued after system restart in September 2012. The treated water quantities returned to LHAAP-18/24 through the injection system each month since January 2008 are shown on **Figure ES-2**.

The typical discharged flowrate from the GWTP was calculated as 10 to 14 gallons per minute (gpm) during the 1st quarter of 2018. Water discharge from the INF Pond varied from a flow rate of 18 gpm to 184 gpm. Approximately 626,247 gallons of groundwater was discharged from the GWTP to the Harrison Bayou, and 2,627,016 gallons was discharged from the INF Pond to the Harrison Bayou (see **Figure ES-3** below).

Grab perchlorate samples from the GWTP influent were collected on January 31, February 14, and March 14, 2018, and the following concentrations were reported: 7,800 micrograms per liter ($\mu\text{g/L}$), 16,000 $\mu\text{g/L}$, and 7,000 $\mu\text{g/L}$, respectively. The average perchlorate concentration in the GWTP influent during the quarter was 10,267 $\mu\text{g/L}$. No perchlorate concentrations in any effluent (TK-650) samples exceeded daily maximum effluent limits of 589 $\mu\text{g/L}$, respectively, during the quarter. However, the effluent from March 21, 2018, was detected at 500 $\mu\text{g/L}$ of perchlorate, which was collected after the FBR. Prior to this sample being collected, a drum of hydrated granular activated carbon (GAC) was added to the FBR which increased the oxidation-reduction potential (ORP) slightly. Therefore, the ion exchange vessels were brought online on March 26, 2018. The effluent sample was then collected after the ion exchange on March 28, 2018, and was non-detect for perchlorate.

As shown in **Table ES-1**, no treated water was discharged directly from the GWTP to Harrison Bayou in January 2018, but 325,566 gallons of treated water was discharged from the INF Pond during this time. In February 2018, a total of 178,589 gallons was discharged directly to the Harrison Bayou, and 1,430,634 gallons were discharged from the INF Pond to the Harrison Bayou. Approximately 448,651 gallons of treated water was discharged directly to Harrison Bayou in March 2018, and approximately 870,816 gallons was discharged to Harrison Bayou from the INF pond.

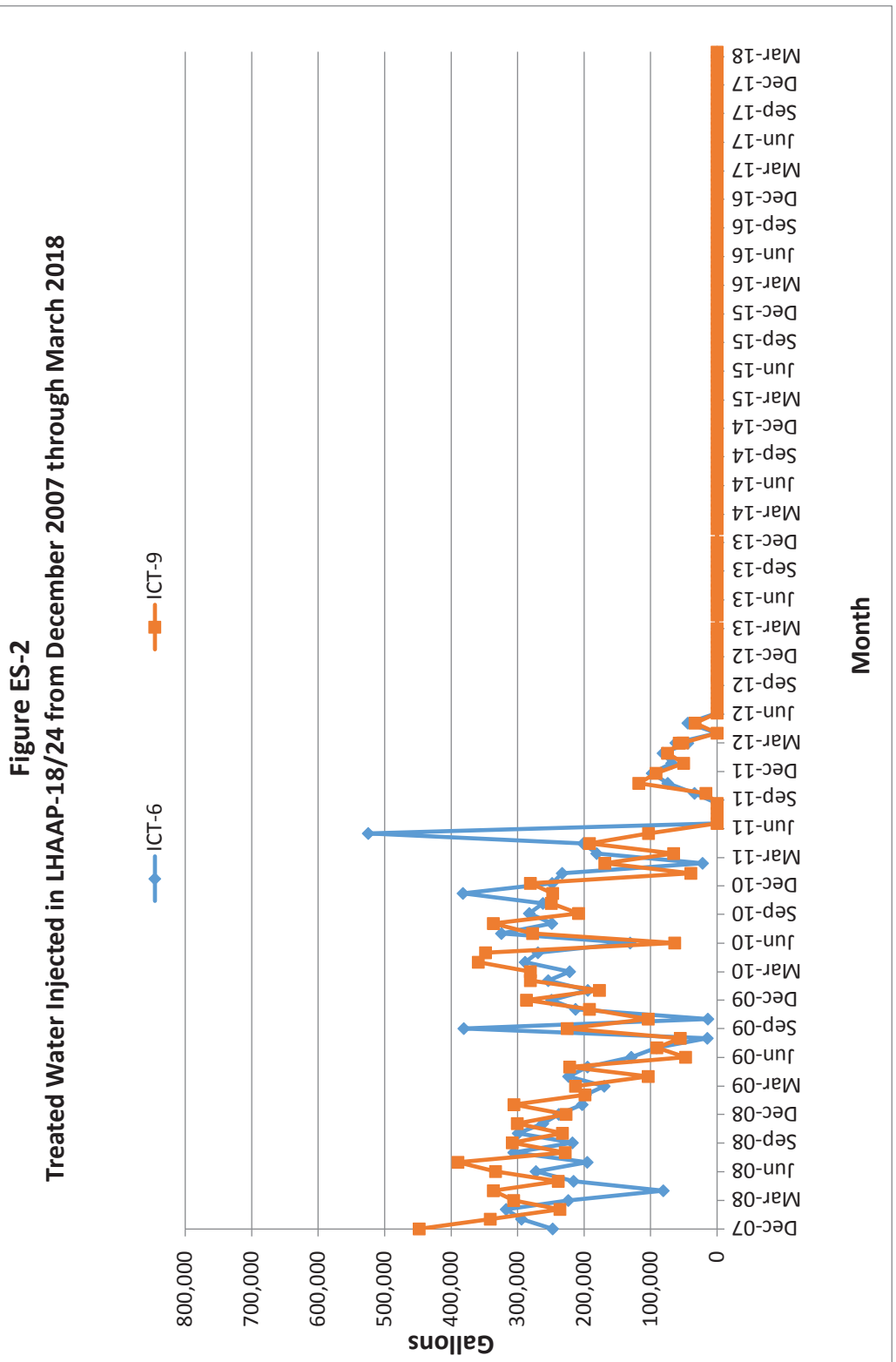
The groundwater volume extracted for treatment at the GWTP ranged from a low of approximately 400,195 gallons in January 2018 to a high of approximately 758,230 gallons in March 2018. The total water extracted for treatment by the GWTP for the 1st quarter of 2018

GWTP QUARTERLY EVALUATION REPORT – 1ST QUARTER 2018

LONGHORN ARMY AMMUNITION PLANT

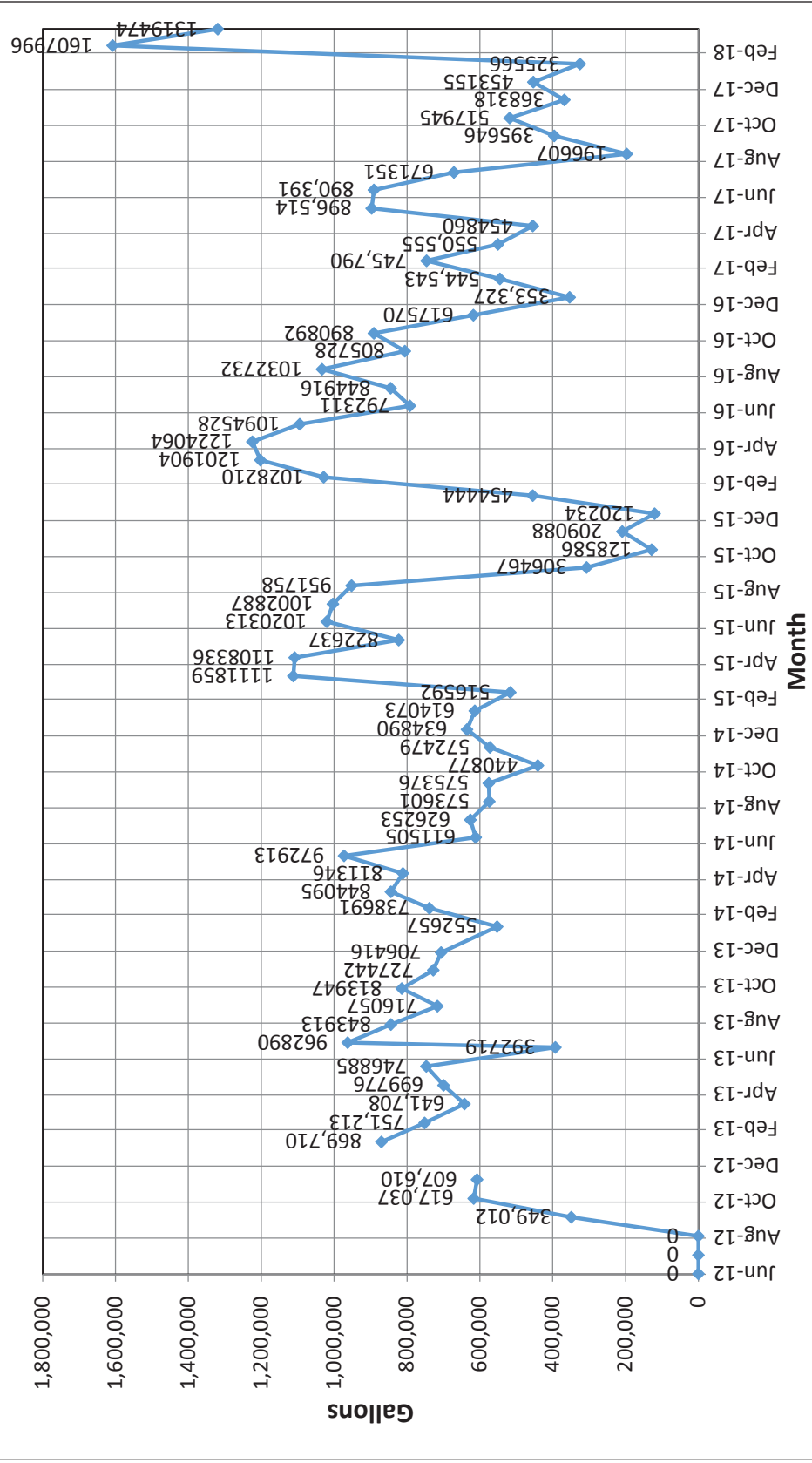
was approximately 1,672,185 gallons. The 3 month average was approximately 557,395 gallons per month. The water quantities treated each month since June 2012 are shown on **Figure ES-3**. The total volume of water extracted from LHAAP-18/24 and LHAAP-16 in the 1st quarter 2018 (1,672,185 gallons) is higher than the volume of water discharged to the INF Pond (941,658 gallons). The reason for the difference is the change in volume stored in the GWTP, the amount of water lost with the removed metals precipitation sludge, and the amount of evaporative water lost in the air stripper (which is included in the volume processed, but not in the volume discharged).

GWTP QUARTERLY EVALUATION REPORT –1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT



GWTP QUARTERLY EVALUATION REPORT – 1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

Figure ES-3
Water Treated and Discharged Monthly from June 2012 through March 2018



GWTP QUARTERLY EVALUATION REPORT –1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

Table ES-1: Discharge Information to Harrison Bayou During 1st Quarter 2018

Date	Harrison Bayou Flow (gpm)	Maximum Rate Allowed (gpm)	Released Flow Rate From GWTP To Harrison Bayou (gpm)	Volume Release to Harrison Bayou from GWTP (Gallons)	Released Flow Rate From INF Pond To Harrison Bayou (gpm)	Volume Released to Harrison Bayou from INF Pond (Gallons)	Combined Total Flow Rate Released To Harrison Bayou (gpm)	Combined Total Volume Released To Harrison Bayou (Gallons)
01/01/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/02/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/03/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/04/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/05/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/06/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/07/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/08/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/09/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/10/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/11/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/12/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/13/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/14/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/15/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/16/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/17/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/18/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/19/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/20/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/21/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/22/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0

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Date	Harrison Bayou Flow (gpm)	Maximum Rate Allowed (gpm)	Released Flow Rate From GWTP To Harrison Bayou (gpm)	Volume Release to Harrison Bayou from GWTP (Gallons)	Released Flow Rate From INF Pond To Harrison Bayou (gpm)	Volume Released to Harrison Bayou from INF Pond (Gallons)	Combined Total Flow Rate Released To Harrison Bayou (gpm)	Combined Total Volume Released To Harrison Bayou (Gallons)
01/23/2018	682	199	0.0	0.0	0.0	0.0	0.0	0.0
01/24/2018	631	184	0.0	0.0	106	153,900	106	153,900
01/25/2018	315	92	0.0	0.0	64	92,928	64	92,928
01/26/2018	226	66	0.0	0.0	51	78,738	51	78,738
01/27/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/28/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/29/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/30/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/31/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/01/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/02/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/03/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/04/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/05/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/06/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/07/2018	32,018.00	5,857.00	10	4,021	0.0	0.0	10	4,021
02/08/2018	FLOOD STAGE	MAXIMUM	10	15,678	152	219,096	162	234,774
02/09/2018	18,544.0	3,392.0	10	8,820	154	222,308	164	231,128
02/10/2018	7,631.0	1,395.0	10	4,780	145	208,780	155	213,560
02/11/2018	5,309.0	971.0	10	5,313	134	193,694	144	199,007
02/12/2018	2,925.0	535.0	10	7,899	148	213,675	158	221,574
02/13/2018	2,051.0	527.0	10	7,611	126	182,478	136	190,089
02/14/2018	2,536.0	652.0	10	8,248	72	104,838	82	113,086
02/15/2018	19,322.0	4,968.0	10	8,044	40	58,996	50	67,040

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Date	Harrison Bayou Flow (gpm)	Maximum Rate Allowed (gpm)	Released Flow Rate From GWTP To Harrison Bayou (gpm)	Volume Release to Harrison Bayou from GWTP (Gallons)	Released Flow Rate From INF Pond To Harrison Bayou (gpm)	Volume Released to Harrison Bayou from INF Pond (Gallons)	Combined Total Flow Rate Released To Harrison Bayou (gpm)	Combined Total Volume Released To Harrison Bayou (Gallons)
02/16/2018	18,950.0	4,873.0	10	6,395	18	26,769	28	33,164
02/17/2018	9,161.0	2,355.0	10	5,227	0	0	10	5,227
02/18/2018	8,697.0	2,236.0	10	6,814	0	0	10	6,814
02/19/2018	6,575.0	1,690.0	10	6,872	0	0	10	6,872
02/20/2018	4,753.0	1,222.0	10	8,172	0	0	10	8,172
02/21/2018	11,363.0	2,922.0	10	9,428	0	0	10	9,428
02/22/2018	No Release	N/A	0.0	0	0	0	0	0
02/23/2018	No Release	N/A	0.0	0	0	0	0	0
02/24/2018	FLOOD STAGE	MAXIMUM	In Recycle	0	0	0	0	0
02/25/2018	FLOOD STAGE	MAXIMUM	10	14,185	0	0	10	14,185
02/26/2018	FLOOD STAGE	MAXIMUM	10	19,690	0	0	10	19,690
02/27/2018	FLOOD STAGE	MAXIMUM	10	14,238	0	0	10	14,238
02/28/2018	FLOOD STAGE	MAXIMUM	12	17,154	0	0	12	17,154
03/01/2018	FLOOD STAGE	MAXIMUM	12	16,638	0	0	12	16,638
03/02/2018	FLOOD STAGE	MAXIMUM	12	11,233	0	0	12	11,233
03/03/2018	FLOOD STAGE	MAXIMUM	12	18,882	0	0	12	18,882
03/04/2018	FLOOD STAGE	MAXIMUM	12	14,826	0	0	12	14,826
03/05/2018	FLOOD STAGE	MAXIMUM	12	24,161	0	0	12	24,161
03/06/2018	20,897	6,106	10	12,869	0	0	10	12,869
03/07/2018	15,464	4,518	10	13,411	0	0	10	13,411
03/08/2018	10,842	3,168	10	13,427	0	0	10	13,427
03/09/2018	6,098	1,782	10	10,021	0	0	10	10,021
03/10/2018	5,210	1,522	10	13,287	0	0	10	13,287
03/11/2018	7,943	2,321	10	9,748	0	0	10	9,748

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Date	Harrison Bayou Flow (gpm)	Maximum Rate Allowed (gpm)	Released Flow Rate From GWTP To Harrison Bayou (gpm)	Volume Release to Harrison Bayou from GWTP (Gallons)	Released Flow Rate From INF Pond To Harrison Bayou (gpm)	Volume Released to Harrison Bayou from INF Pond (Gallons)	Combined Total Flow Rate Released To Harrison Bayou (gpm)	Combined Total Volume Released To Harrison Bayou (Gallons)
03/12/2018	FLOOD STAGE	MAXIMUM	12	23,029	0	0	12	23,029
03/13/2018	FLOOD STAGE	MAXIMUM	12	16,576	0	0	12	16,576
03/14/2018	17,332	6,723	12	14,784	0	0	12	14,784
03/15/2018	11,797	4,576	10	15,051	148	213,150	158	228,201
03/16/2018	7,332	2,844	10	10,064	130	187,284	140	197,348
03/17/2018	6,861	2,661	10	12,716	115	165,680	125	178,396
03/18/2018	6,293	2,441	10	12,288	87	125,020	97	137,308
03/19/2018	5,526	2,144	10	15,407	80	116,128	90	131,535
03/20/2018	4,040	1,567	None-In Recycle	0	44	63,554	44	63,554
03/21/2018	4,787	1,857	10	14,026	0	0	10	14,026
03/22/2018	3,888	1,508	10	14,722	0	0	10	14,722
03/23/2018	2,911	1,129	10	10,141	0	0	10	10,141
03/24/2018	2,242	869	10	10,034	0	0	10	10,034
03/25/2018	1,820	706	10	13,813	0	0	10	13,813
03/26/2018	1,279	496	14	22,102	0	0	14	22,102
03/27/2018	1,131	378	12	17,615	0	0	12	17,615
03/28/2018	FLOOD STAGE	MAXIMUM	12	19,195	0	0	12	19,195
03/29/2018	FLOOD STAGE	MAXIMUM	12	17,572	0	0	12	17,572
03/30/2018	FLOOD STAGE	MAXIMUM	12	15,082	0	0	12	15,082
03/31/2018	FLOOD STAGE	MAXIMUM	14	15,931	0	0	14	15,931
Totals				627,240		2,627,016		3,254,256

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1 EVALUATION OF GROUNDWATER TREATMENT PLANT

The Groundwater Treatment Plant (GWTP) was constructed as part of the Interim Remedial Action (IRA) at Burning Ground Number (No.) 3, also referred to as Longhorn Army Ammunition Plant (LHAAP)-18/24, to treat groundwater extracted from interception-collection trenches (ICTs) and extraction wells. **Figure A-1** located in **Appendix A** presents the layout of the ICTs and extraction wells at LHAAP-18/24. The groundwater contamination at LHAAP-18/24 likely resulted from infiltration from an Unlined Evaporation Pond (UEP) that was used to store manufacturing wastewater, and from burning trenches and other industrial processes used to flash pyrotechnic, propellant, and explosive waste streams. The groundwater at LHAAP-18/24 is contaminated mainly with chlorinated ethenes and perchlorate, with lesser concentrations of 1,4-dioxane.

The GWTP also receives flow from eight extraction wells installed at LHAAP-16 as part of a historical treatability study. The extraction wells were installed in 1996 and 1997. The wells are located between the landfill at LHAAP-16 and Harrison Bayou. The groundwater at LHAAP-16 is also contaminated mainly with chlorinated ethenes and perchlorate.

1.1 Treatment Configuration

The process flow diagram for the GWTP is presented in **Appendix A, Figure A-2**. The GWTP was not operational between May 24, 2012, and September 6, 2012, due to malfunction of the scrubber unit associated with the catalytic oxidizer. Since September 6, 2012, the GWTP has operated without air abatement equipment. Although major repairs were conducted on the GWTP (e.g., replacement of level alarms, repair of the hydrochloric acid [HCl] tank, replacement of TK-650, replacement of malfunctioning valves and flow meters, replacement of metering pumps, repair or replacement of various system pumps, rust removal and repainting of various tanks, and replacement and repair of various extraction pumps, motors, and level switches), the GWTP treatment configuration has remained unchanged.

Malfunction of the blower on the air stripper (BL-340) on September 14, 2015, and on September 17, 2015, disrupted continuous extraction and routine operations of the GWTP, which lasted through January 7, 2016. Prior to this occurrence, the GWTP performed as designed and the GWTP was operated on an as needed basis (i.e., semi-continuous operational basis). During the 4th quarter of 2015, groundwater was extracted from a limited number of ICTs (ICTs 12E, 13A, 13B, 13C, and/or 13E, or ICTs 14B, 14C, and 14D). Operation of the GWTP occurred on a batch basis through the fluidized bed reactor (FBR). After replacement of the blower, attempts were made to restore continuous operations to the FBR but remained predominantly on a batch basis throughout January 2016.

In December 2016, a HCl spill caused plant operations to shut down until the issue could be properly addressed. The FBR performance was challenged by the increased chlorides in the

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neutralized wastewater, but performance gradually returned to normal in the 1st quarter of 2017. Groundwater extraction was gradually increased to full rates during the 2nd quarter of 2017.

On August 12, 2017, severe storms caused a power outage at LHAAP-18/24. When electrical service was restored, the main transformer failed due to a manufacturing defect. A portable emergency generator was brought on-site on August 21, 2017, to allow the FBR to operate in full recycle mode. After a replacement transformer was installed on September 12, 2017, extraction began from ICT-13B, 13C, 13D, 13E, 13F, 7, and EW01 and the FBR was put into normal operation. Beginning on September 21, 2017, groundwater was extracted from all of the ICTs.

Flow rates for the treatment processes for metals and Volatile Organic Compounds (VOCs) ranged between 170 and 210 gallons per minute (gpm) with an average of approximately 185 gpm for the operating hours (i.e., this flow rate does not represent continuous flows). The GWTP operated for 107 hours during the quarter. The treatment configuration of the plant at these rates (with minor variations) is as follows:

GWTP Metals Precipitation Operating Parameters

Pretreatment Settings	Tank 200-A Mg(OH) ₂ Mixing	Tank 200-B NaOH Mixing	Tank 200-C Polymer Mixing	Tank 300 feed line to Air Stripper
pH Adjustment	9.0	10.5	NA	5.0 to meet ≤ 8.0 release from stripper
Feed Pump Settings	Speed 100% Stroke 100% 10 gph Mg(OH) ₂	Speed 100% Stroke 100% 9.0 gph NaOH	Speed 90% Stroke 100% 40 gph water	Speed 80% Stroke 80% 10 gph HCl
Notes: gph - gallons per hour, NaOH - sodium hydroxide, Mg(OH) ₂ - magnesium hydroxide, NA - not applicable				

GWTP Air Compressors Operating Parameters

Air Compressors	K-700A	K-700B	K-701
Air Pressure Settings	88 psi	88 psi	105 psi
Note: psi - pounds per square inch			

GWTP Stripper Operating Parameters

Stripper Tower	
pH Setting	7.4
Inlet Pressure Gauge	Not operational
Stripper Pressure Gauge	Not operational
Air Flow Rate	Not operational

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GWTP Fluidized Bed Reactor Operating Parameters

Fluidized Bed Reactor	
Carbon Bed Height	12 feet & 8 to 11 inches
Recycle Flow Rate	200 gpm
pH	7.1 to 7.4
Recycle oxidation-reduction potential (ORP)	-430 mV to -452 mV
Note: mV - millivolts	

The operating parameters for the GWTP FBR are presented in **Table 2**. During January 2018, freezing conditions affected the FBR slightly, however extracted groundwater was further treated via the ion exchange vessels. Effluent, sampled on January 31, 2018, had perchlorate detected above 17 micrograms per liter ($\mu\text{g/L}$). After further evaluation, it was determined that the two ion exchange resin vessels were not in series as understood. The two ion exchange vessels are in parallel such that the effluent sample collected for offsite analysis was the water discharged to the INF pond and no additional treatment by a second or lag ion exchange vessel occurred (as would occur in series or lead/lag configuration). Further discussion of perchlorate sampling conducted during the quarter is provided in Section 2.4.1.

1.2 Work Performed at the GWTP

Work performed at the GWTP during the 1st quarter of 2018 is described in the following subsections.

1.2.1 Major Maintenance

The major maintenance items that were completed at the GWTP during this quarterly reporting period are:

- January 23, 2018: BLOC Electrical was on site to repair a programmable logic controller problem on the FBR.
- February 8, 2018: Tri-State Electrical was on site to repair an electrical problem with the TK-200C mixer motor and ICT 14D and started installing electrical wiring for new air compressors.
- February 9, 2018: Tri-State Electrical was on site to finish electrical wiring for the new air compressors.
- February 13, 2018: Ingersoll-Rand was on site for startup of the new air compressors.

1.2.2 Routine Maintenance

The following routine maintenance items were completed at the GWTP during this quarterly

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reporting period:

- Performed housekeeping in GWTP office
- Performed housekeeping in Army trailer
- Performed housekeeping around GWTP and containment area
- Performed housekeeping in GWTP Shop
- Repaired broken 3-inch and 2 ½-inch polyvinyl chloride (PVC) piping and fittings on FBR
- Repaired broken 1-inch PVC water addition line to polymer feed tank
- Repaired broken 1-inch potable water line in GWTP
- Installed new Digi Pulse Flow Monitor on P-104 (acetic acid feed pump)
- Repaired broken 2-inch PVC piping and fittings in pipe rack between the clarifier and decant tanks
- Installed new 6-inch butterfly valve and discharge location in Harrison Bayou
- Rebuilt Grundfos pumps
- Repaired polymer feed pump
- Repaired the Honda trash pump
- Replaced suction tubing on P-103
- Collected the quarterly air samples
- Repaired leaking fittings and piping on two safety showers in GWTP

1.2.2.1 Safety

The GWTP Operators, Mr. Scott Beesinger and Mr. Kennie Moore, completed their Hazardous Waste Operations and Emergency Response (HAZWOPER) 8 hour Annual Refresher training on April 2, 2018. In addition, both GWTP Operators completed First Aid/cardiopulmonary resuscitation (CPR) and automated external defibrillator (AED) training on March 13, 2018.

1.2.2.2 Lubrication

No lubrication maintenance was conducted during the reporting period.

1.2.2.3 Air Compressors

- January 24, 2018: Received two new 15 horsepower air compressors with the air dryer for the compressors received on January 30, 2018.
- Compressors were installed from January 29 through February 2, 2018, with start up on February 6, 2018.

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1.2.2.4 Belt Press and Waste Disposal

No belt press or waste disposal was conducted during the reporting period.

1.2.2.5 Sand Filter

No maintenance or repairs were conducted on the sand filter during the reporting period.

1.2.2.6 Well Field at LHAAP-18/24

- Collected monthly flowmeter readings
- Collected monthly water levels
- Installed new flow meter on ICT 13C
- Cleaned level probes on ICT 14C
- Cleaned level probes in ICT 13C and lowered high level probe
- Replaced broken 1-inch union on ICT 13B
- Replaced two broken 1-inch elbows on ICT 14A and lowered the high level probe
- Replaced broken 1-inch tee on ICT 14B and lowered the high level probe
- Installed new flow meter on ICT 14D
- Replaced broken 1-inch tee on ICT 8 and cleaned level probes
- Cleaned level probes on ICT 14D
- Replaced low level probe on ICT 14C
- Cleaned level probes on ICT 13B
- Installed new electric motor on ICT 13A
- Replaced a leaking 1-inch union on ICT 13A
- Replaced level probes on 13B and lowered high level probe on 14E.
- Cleaned and adjusted level probes on ICT 13C
- Replaced a broken 1-inch elbow and flow meter on ICT 12B
- Installed rebuilt pump in ICT 2

1.2.2.7 Miscellaneous Activities

- On March 26, 2018, Ark-La-Tex Electric was on site to replace a broken power pole.
- On March 27, 2018, Texas Drum Co. was on site to remove 150 empty acetic acid drums on behalf of the chemical supplier for reuse.

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1.2.3 Routine Maintenance at LHAAP-16

- Checked site daily
- Collected monthly water levels
- Repaired pulley on air compressor motor
- Collected annual extraction well samples

1.2.4 Routine Maintenance (Potable Water Wells)

- Flushed potable water lines
- Added chlorine tablets to potable water well # 1

1.3 Filter Cake Operations and Management

No filter cake operations took place during this reporting period.

1.4 Fluidized Bed Reactor Operations

Freezing conditions effected the performance of the FBR in mid-January. However, the FBR and ion exchange were in operation during January 2018. Effluent sampled on January 31, 2018, had perchlorate detected above 17 µg/L (Appendix G). Effluent analytical results were non-detect for perchlorate the week before and after that effluent sample was collected. Effluent had been treated for perchlorate by both the FBR and ion exchange vessels during the time of this exceedance.

Following the freezing conditions, further evaluation of the FBR was completed. The carbon within the FBR column was determined to be low. Hydrated granular activated carbon (GAC) was added slowly over February and March 2018. This addition of GAC will continue into April 2018. Then, the performance of the FBR will be assessed to determine if additional activities are necessary to further improve the FBR performance. The ion exchange vessels were brought online to further treat perchlorate following the addition of GAC. The use of the ion exchange vessels was a conservative measure implemented due to variations in the FBR performance immediately following the placement of the GAC within the column. Within the 1st Quarter 2018, approximately 200 pounds of GAC were added to the FBR. During the quarter, the ORP ranged between -352 and -520 mV, and the pH ranged between 6.7 and 7.4 standard units. The lowest ORP was observed the week following the freezing conditions at the GWTP (January 23 through 26, 2018), but was within normal range the following week. This time period is also when the lowest pH was observed. The average perchlorate concentration in the GWTP influent during the 1st quarter of 2018 was 10,267 µg/L.

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Table 2. Enhanced Fluidized Bed Reactor Operating Parameters – 1st Quarter 2018

Date	pH (Acceptable Range: 7.1-7.4)	ORP (Acceptable Level:<-430 mV)	Temperature (Degrees Fahrenheit)
1/2/2018	7.0	-500	44
1/3/2018	6.9	-490	45
1/4/2018	6.8	-480	47
1/5/2018	6.8	-480	44
1/6/2018	6.8	-479	47
1/8/2018	6.9	-490	53
1/9/2018	6.9	-500	53
1/10/2018	6.9	-507	53
1/11/2018	6.9	-516	55
1/12/2018	6.9	-516	50
1/15/2018	7.0	-520	51
1/16/2018	6.9	-510	48
1/23/2018	6.7	-352	51
1/24/2018	6.7	-362	52
1/25/2018	6.7	-376	53
1/26/2018	6.7	-381	53
1/29/2018	7.0	-413	55
1/30/2018	7.1	-430	55
1/31/2018	7.3	-460	56
2/1/2018	7.3	-507	58
2/2/2018	7.3	-507	58
2/5/2018	7.3	-425	58
2/6/2018	7.3	-448	57
2/7/2018	7.3	-473	56
2/8/2018	7.3	-483	56
2/9/2018	7.3	-494	55
2/10/2018	7.3	-491	54
2/11/2018	7.3	-493	54
2/12/2018	7.4	-480	53
2/13/2018	7.3	-489	52
2/14/2018	7.3	-480	52
2/15/2018	7.3	-494	56
2/16/2018	7.3	-489	57
2/17/2018	7.3	-489	56
2/18/2018	7.3	-484	56
2/19/2018	7.3	-485	58
2/20/2018	7.3	-482	65
2/21/2018	7.2	-486	63
2/22/2018	7.2	-497	62

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Date	pH (Acceptable Range: 7.1-7.4)	ORP (Acceptable Level:<-430 mV)	Temperature (Degrees Fahrenheit)
2/23/2018	7.2	-504	62
2/24/2018	7.2	-504	64
2/25/2018	7.2	-503	63
2/26/2018	7.3	-507	65
2/27/2018	7.2	-507	64
2/28/2018	7.2	-513	67
3/1/2018	7.3	-480	66
3/2/2018	7.3	-504	64
3/3/2018	7.3	-510	64
3/4/2018	7.3	-511	63
3/5/2018	7.3	-512	67
3/6/2018	7.3	-508	66
3/7/2018	7.2	-504	65
3/8/2018	7.2	-503	65
3/9/2018	7.2	-504	63
3/10/2018	7.2	-507	65
3/11/2018	7.2	-500	64
3/12/2018	7.1	-507	64
3/13/2018	7.0	-500	64
3/14/2018	7.0	-494	63
3/15/2018	7.0	-493	64
3/16/2018	7.0	-490	64
3/17/2018	7.0	-495	66
3/18/2018	7.0	-498	66
3/19/2018	7.0	-477	71
3/20/2018	7.1	-480	67
3/21/2018	7.1	-494	66
3/22/2018	7.2	-502	67
3/23/2018	7.2	-507	65
3/24/2018	7.3	-506	69
3/25/2018	7.3	-508	68
3/26/2018	7.2	-500	69
3/27/2018	7.3	-516	71
3/28/2018	7.3	-518	70
3/29/2018	7.3	-518	70
3/30/2018	7.3	-479	69
3/31/2018	7.2	-492	69

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1.5 Process Chemical Usage at GWTP

Approximate chemical consumption and the quantity delivered during the 1st quarter of 2018 are shown in **Table 3**.

Table 3. Process Chemicals Delivered and Used

Chemical	Usage 1 st Quarter 2018	Quantity Delivered 1 st Quarter 2018
Hydrochloric acid	635 gallons	0
Sodium hydroxide (35%)	950 gallons	42,000 pounds of 35% Sodium Hydroxide
Acetic acid (50%)	15 drums = 825 gallons	0
Phosphoric acid (75%)	39.4 liters	0
Magnesium hydroxide	265 gallons	0
Urea	280.8 pounds	500 pounds
Polymer (magnafloc 110-L)	6.6 liters	0

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2 EVALUATION OF LHAAP-18/24 ICT EFFECTIVENESS

The ICT system at Burning Ground No. 3 is composed of 14 sections ranging in length from 100 feet (ft) to 1,300 ft. A total of approximately 5,000 linear ft of trench was installed within and around three sides of Burning Ground No. 3. The trench sections extend approximately 22 ft to 45 ft below ground surface (bgs). Most, but not all of the trenches are as deep as the confining clay layer of the shallow groundwater zone. High density polyethylene (HDPE) liners were installed in ICTs 12 and 13, located on the western and northern boundaries of LHAAP-18/24, respectively. The locations of the liners are shown on **Figure A-1** in **Appendix A**. **Table A-1** in **Appendix A** presents the depths of the ICTs.

2.1 Sampling Activities

Water levels from 95 monitoring wells and 11 piezometers (piezometer 12 was damaged and plugged and abandoned in May 2013) are measured monthly to generate potentiometric surface maps that assist in monitoring the effectiveness of the groundwater extraction system on plume containment. The groundwater contours are generated using the water levels from the shallow zone and Wilcox Formation wells. The water level data are presented in **Table 4**. No reinjection of treated groundwater or reapplication to LHAAP-18/24 grounds via the existing irrigation system occurred during the 1st quarter of 2018. Potentiometric surface maps are presented in **Appendix B** and groundwater elevations from the 1st quarter of 2018 are discussed in Section 2.2. No groundwater sampling was completed at LHAAP-18/24 in the 1st quarter of 2018.

2.2 Performance of Plume Capture

The intent of the ICTs is to control groundwater gradients, prevent off-site migration of contaminated groundwater, extract the most highly contaminated groundwater, and reduce the mass of contaminants in groundwater. Liners were installed in the ICTs on the northern (ICT 13) and western (ICT 12) site boundaries to limit migration of contaminated water from the site towards Harrison Bayou. At the same time, the liners reduce or prevent removal of contaminated groundwater that is outside the containment zone, between the site and Harrison Bayou. The ICTs are installed within the shallow subsurface at the site and capture primarily shallow groundwater (e.g., < 40 ft bgs).

In 2007 and 2008, in consultation with the Texas Commission on Environmental Quality (TCEQ) and the USEPA, the Army ceased operations of ICTs 1, 3, 5, 10, and 12A for groundwater extraction (note that extraction from ICT 12A was resumed after pump replacement in December 2012). Two other ICTs (ICT 6 and ICT 9) were changed from extraction ICTs to re-injection ICTs. Groundwater extraction from well EW-1 located in the northeast central portion of the site began in October 2008 and well 18WW17 located to the northeast of the ICT containment area began in January 2008. **Table B-1** in **Appendix B** presents a summary of extraction equipment replacement since 2011, as dictated by poor extraction performance (malfunctioning pumps,

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poor pump positioning with respect to groundwater, non-operational level probes, scale build up, etc.). Further discussion of extraction performance of various ICTs and extraction wells is presented in Section 2.3.

Potentiometric surface maps of the shallow zone groundwater in the vicinity of LHAAP-18/24, based on groundwater elevations measured on January 31, February 28, and March 29, 2018, are shown on **Figures B-1, B-2, and B-3 in Appendix B**, respectively.

The potentiometric surface maps of the shallow zone were contoured using the Kriging geostatistical interpolation method included in the Golden Software Surfer® data analysis software. The HDPE liners in the ICTs, where present, were interpreted as groundwater flow barriers. The potentiometric surface maps for January through March 2018 continue to reflect high groundwater elevations in the northern/northwestern portion of the site with groundwater flow occurring radially from groundwater highs at monitoring well 18CPTMW04 (171.10 ft above mean sea level [amsl] in January 2018), monitoring well 18CPTMW04 (171.48 ft amsl in February 2018), and monitoring well AWD-1 (172.00 ft amsl in March 2018) inside the ICT containment area.

The elevated potentiometric surface contours within the ICTs compared to the lower potentiometric surface contours on the outside of the ICTs is likely due to a no flow boundary condition caused by the ICT liners and groundwater extraction along the ICTs. From the groundwater highs at monitoring wells 18CPTMW04 and AWD-1, groundwater flows radially towards the surrounding ICTs which include ICT 13 to the north and northwest, and ICT 12 to the west and southwest. East of the groundwater mound and in the northeastern third of the site, groundwater flow is primarily towards ICT 14 along the northeast site boundary.

Groundwater extraction rates from the ICTs were 378,955 gallons in January 2018; 502,668 gallons in February 2018; and 729,615 gallons in March 2018. Rainfall amounts recorded at the GWTP were 2.17 inches in January 2018, 12.67 inches in February 2018, and 7.14 inches in March 2018. This amount of rainfall resulted in over 164,000 gallons of additional water treated and discharged but not metered with the influent totals.

During the reporting period, approximately 3.25-million gallons of treated groundwater was discharged to Harrison Bayou from either the GWTP or the INF Pond. Treated water discharged to the Harrison Bayou was all from the INF pond in January 2018 because the butterfly valve used to discharge treated water from the GWTP was ceased up. Due to rusting and age of the valve, a replacement valve was installed on January 26, 2018. Starting February 7, 2018, treated water discharged to the Harrison Bayou came from both the INF Pond and the GWTP directly. No treated groundwater from the GWTP was returned to LHAAP-18/24 via the sprinkler system. Overall groundwater levels increased throughout the 1st quarter of 2018 with an average shallow zone groundwater elevation rise of 0.68 ft.

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Groundwater levels in Wilcox Formation wells (generally > 40 to 50 ft bgs) were measured during the 1st quarter of 2018 groundwater gauging events. Wilcox Formation wells correspond generally to those wells previously identified as “Intermediate” and “Deep” wells. “Intermediate” wells are designated as Upper Wilcox Formation wells and “Deep” wells are designated as Lower Wilcox Formation wells. Generally, groundwater in the Upper and Lower Wilcox Formation wells are in hydraulic communication and so can be treated as a single hydrogeologic unit. Therefore, the groundwater elevations in Upper Wilcox wells were used to construct the potentiometric surface maps for the Wilcox Formation. **Figures B-4, B-5, and B-6** in **Appendix B** show the locations of the Wilcox Formation monitoring wells and the potentiometric surface of the Wilcox Formation, based on static water levels measured during the January, February, and March 2018 gauging events, respectively. Groundwater in the Wilcox Formation generally flows in a northerly direction, towards Caddo Lake and there is a downward vertical gradient between the overlying shallow zone and the Wilcox Formation. However, a groundwater high in the Wilcox Formation occurs in the area of MW-14.

2.3 Quantity of Water Extracted from LHAAP-18/24

The average daily extraction rates from the ICTs were 12,224 gallons per day (gpd) in January 2018, approximately 17,952 gpd in February 2018, and approximately 23,536 gpd in March 2018. The increase in average daily extraction rates is due to maintenance repairs on the pumps and discharge lines starting in February 2018 following a freezing period that caused damage to some of these components in January 2018.

The volume of groundwater removed from LHAAP-18/24 during the 1st Quarter 2018 measured approximately 1,672,185 gallons, based on total flow measured at from the extraction wells and ICT wells, and as presented on **Figure 2-1**. LHAAP-16 contributed 60,947 gallons to the GWTP. Together, approximately 1,672,185 gallons was extracted from both LHAAP-16 and LHAAP-18/24. **Figure 2-1** shows the historical trends of extracted volumes by quarter.

In contrast to the approximate total extracted volume based on total flow measured at the GWTP, the total estimated volume discharged to the INF pond and/or Harrison Bayou following treatment by the GWTP was 241,613 gallons in January 2018; 228,643 in February 2018; and 432,020 gallons in March 2018 for a total of 902,276 gallons discharged in 1st Quarter 2018. However, this volume does not account for water present in the decant tank at the end of March or the influent that was not treated after the GWTP last ran on March 27, 2018. The difference between the influent and effluent volumes is approximately 46%. However, considering the over 300,000 gallons of water within the treatment plant as of March 31, 2018, this percent difference is closer to 25% variation, which is contributable to variations in the flow meter recordings. New gauges will be installed in May 2018 as part of a programmable logic controller update to the GWTP that should improve the information collected from the GWTP.

As indicated by **Table 5**, 23 of 27 ICTs and wells produced water during the 1st quarter of 2018.

2.4 Groundwater Treatment Plant Sampling and Analysis

As part of the GWTP operations, samples from various water streams are required to be collected and analyzed for the parameters cited in the Interim Record of Decision (ROD) and the TCEQ letter dated January 8, 2002 (see Administrative Record Volume 1 of 4 in 2002, Document A). Besides the ROD sampling requirement, additional sample analyses are typically performed on the influent and effluent samples to monitor the effectiveness of the perchlorate treatment (FBR and/or ion exchange vessels) process. Sections 2.4.1 through 2.4.4 present the results of analyses conducted during the 1st quarter 2018. The complete laboratory results are provided on a compact disc (CD) (**Appendix C**).

2.4.1 Perchlorate Sampling

Table 6 presents the biweekly effluent perchlorate results for the 1st quarter of 2018. Note- the requirement is biweekly however for most of the 1st quarter 2018 weekly effluent perchlorate sampling was conducted/reported. In January 2018, effluent was discharged to the INF Pond. One date of sampling (January 31, 2018) exceeded 17 µg/L (Appendix G). This sampling date included both the weekly effluent sampling and the monthly effluent sampling. The results from both samples were comparable with the monthly sample having perchlorate detected at 66 µg/L and the weekly sample having perchlorate detected at 51 µg/L. The effluent samples collected the week prior and week after were non-detect for perchlorate. After further evaluation, it was determined that the two ion exchange resin vessels were not in series (lead/lag) but rather in parallel. The sample port is after the groundwater is treated by the ion exchange vessels in the current configuration instead of between the lead and lag vessels as presented in the protocol for discharge (**Appendix G**).

Due to the elevated detection of perchlorate in treated effluent discharged to the INF Pond, water was collected from the discharge point into the INF pond (inlet) and the discharge point from the INF pond to the Harrison Bayou (outlet) on March 7, 2018. The inlet and outlet results from the INF Pond were 1.8 J (estimated concentration) µg/L and 1.9 J µg/L respectively, which is below the contract required detection limit. Given the low level detections and similar levels of perchlorate at the inlet and outlet of the pond, the effluent discharged in late January 2018 did not affect the pond perchlorate levels.

Based upon continued discharge to the Harrison Bayou, the ion exchange vessels were bypassed starting on February 21, 2018, per the discharge protocol. Therefore, effluent samples were collected after the FBR on February 28, 2018, and each of the four weeks in March 2018.

However, the perchlorate detected in the effluent increased from 73 µg/L on February 22, 2018, to 130 µg/L on March 14, 2018. Based upon the FBR not treating the perchlorate to less than 17µg/L, additional GAC was added to the FBR column slowly over the remainder of the quarter and into April 2018. Perchlorate was detected at 500 µg/L in the effluent following the FBR treatment on March 21, 2018, after a full drum of GAC was added. Based upon a change in the

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FBR parameters, the ion exchange vessels were brought back online on March 26, 2018, and have remained in place to ensure the discharge is at or below criteria. The effluent sample collected on March 28, 2018, was non-detect for perchlorate following treatment by both the FBR and ion exchange vessels. The FBR performance will continue to be evaluated and optimized to eliminate or minimize the use of the ion exchange vessels.

All perchlorate concentrations in the effluent (TK-650) were lower than the daily maximum concentration discharge limit to Harrison Bayou of 589 µg/L. Treated groundwater from the GWTP was discharged to Harrison Bayou during the current quarter when effluent perchlorate concentrations were less than the daily maximum concentration of 589 µg/L, and adequate flow in the bayou was observed.

Three grab samples from the influent to the GWTP (TK-140) were collected. The perchlorate concentrations in these samples ranged from 7,000 to 16,000 µg/L.

2.4.2 VOC Sampling

Tables 7 through 9 present the effluent VOC results for January, February, and March 2018. Sampling of the effluent for VOCs was conducted on a biweekly basis beginning on January 10, 2018. The results, where applicable, were below the discharge limits. The tables also provide monthly influent concentrations for VOCs and perchlorate.

2.4.3 Monthly Metals Sampling

As per the Final Installation-Wide Work Plan (AECOM, July 2014), the monthly metals sampling is reported in **Tables 7 through 9**. None of the metals exceeded the effluent discharge limits.

2.4.4 Quarterly Sampling

Sampling of the effluent for VOCs, anions, chemical oxygen demand (COD), oil and grease, perchlorate, and metals was conducted during this quarter and the results were below the discharge limits. **Table 10** presents the analytical results for the 1st quarter 2018.

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Table 4: Groundwater Elevations at LHAAP-18/24 Piezometers, Monitoring Wells, and Surface Water
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PIEZOMETER LEVELS

Piezometers	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
BGPZ-1	01/31/2018	184.99	12.60	172.39
BGPZ-2	01/31/2018	184.39	17.21	167.18
BGPZ-3	01/31/2018	180.35	13.50	166.85
BGPZ-4	01/31/2018	177.77	11.44	166.33
BGPZ-5	01/31/2018	180.76	13.79	166.97
BGPZ-6	01/31/2018	197.82	29.40	168.42
BGPZ-7	01/31/2018	195.96	28.40	167.56
BGPZ-8	01/31/2018	197.08	30.18	166.90
BGPZ-9	01/31/2018	196.45	27.84	168.61
BGPZ-10	01/31/2018	197.00	27.75	169.25
BGPZ-11	01/31/2018	196.99	27.78	169.21
BGPZ-12	01/31/2018	188.17	NA	Plugged

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
AWD-1	01/31/2018	182.27	11.21	171.06
AWD-2	01/31/2018	186.78	16.25	170.53
AWD-3	01/31/2018	200.13	29.08	171.05
AWD-4	01/31/2018	193.89	25.44	168.45
MW-1	01/31/2018	199.22	28.35	170.87
MW-2	01/31/2018	196.73	27.80	168.93
MW-3	01/31/2018	196.54	28.20	168.34
MW-4	01/31/2018	197.27	27.71	169.56
MW-5	01/31/2018	194.97	27.00	167.97
MW-6	01/31/2018	192.18	24.29	167.89
MW-7	01/31/2018	188.47	20.22	168.25
MW-8	01/31/2018	187.13	18.90	168.23
MW-9	01/31/2018	184.73	15.81	168.92
MW-10	01/31/2018	178.12	10.59	167.53
MW-11	01/31/2018	184.65	17.52	167.13
MW-12	01/31/2018	178.33	10.85	167.48
MW-13	01/31/2018	176.72	9.15	167.57
MW-14	01/31/2018	186.19	15.03	171.16
MW-16	01/31/2018	178.59	11.43	167.16
MW-17	01/31/2018	179.03	11.39	167.64
MW-18	01/31/2018	178.58	10.42	168.16
MW-19	01/31/2018	178.60	10.37	168.23
MW-20	01/31/2018	186.64	12.66	173.98
MW-21	01/31/2018	198.70	31.95	166.75
MW-22	01/31/2018	197.51	28.04	169.47
MW-23	01/31/2018	198.79	28.40	170.39
101	01/31/2018	197.53	12.25	185.28
102	01/31/2018	193.94	23.47	170.47
109	01/31/2018	197.02	29.19	167.83
120	01/31/2018	184.19	13.97	170.22

Table 4: Groundwater Elevations at LHAAP-18/24 Piezometers, Monitoring Wells, and Surface Water
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MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
123	01/31/2018	186.21	15.32	170.89
125	01/31/2018	196.28	26.84	169.44
126	01/31/2018	199.37	30.03	169.34
129	01/31/2018	197.24	27.24	170.00
130	01/31/2018	177.73	9.10	168.63
C-01	01/31/2018	193.89	25.11	168.78
C-02	01/31/2018	175.95	8.09	167.86
C-03	01/31/2018	196.34	28.50	167.84
C-04	01/31/2018	194.64	27.13	167.51
C-04A	01/31/2018	194.61	27.41	167.20
C-05	01/31/2018	180.74	15.29	165.45
C-06	01/31/2018	192.22	27.43	164.79
C-07	01/31/2018	196.80	28.76	168.04
C-08	01/31/2018	193.10	24.54	168.56
C-09	01/31/2018	202.35	33.51	168.84
C-10	01/31/2018	201.86	32.67	169.19
17WW08	01/31/2018	179.72	11.55	168.17
18WW01	01/31/2018	201.31	31.74	169.57
18WW02	01/31/2018	179.30	11.10	168.20
18WW03	01/31/2018	195.59	27.75	167.84
18WW04	01/31/2018	183.74	18.72	165.02
18WW05	01/31/2018	189.59	25.31	164.28
18WW06	01/31/2018	179.70	12.20	167.50
18WW07	01/31/2018	183.67	8.65	175.02
18WW08	01/31/2018	177.77	12.69	165.08
18WW09	01/31/2018	177.51	10.57	166.94
18WW10	01/31/2018	182.26	15.38	166.88
18WW11	01/31/2018	182.29	15.19	167.10
18WW14	01/31/2018	186.47	18.91	167.56
18WW15	01/31/2018	186.24	18.62	167.62
18WW16	01/31/2018	201.88	32.25	169.63
18WW18	01/31/2018	196.82	29.17	167.65
18WW19	01/31/2018	179.56	13.58	165.98
18WW20	01/31/2018	180.42	14.41	166.01
18WW21	01/31/2018	195.20	28.09	167.11
18WW22	01/31/2018	195.37	27.95	167.42
18WW24	01/31/2018	176.40	9.81	166.59
18WW25	01/31/2018	175.15	9.42	165.73
18CPTMW01SW	01/31/2018	198.20	29.40	168.80
18CPTMW01DW	01/31/2018	197.92	29.31	168.61
18CPTMW03SW	01/31/2018	198.53	30.72	167.81
18CPTMW04	01/31/2018	196.60	25.50	171.10
18CPTMW04SW	01/31/2018	196.42	28.74	167.68
18CPTMW06	01/31/2018	198.12	30.29	167.83
18CPTMW07	01/31/2018	197.32	29.47	167.85
18CPTMW08SW	01/31/2018	196.38	28.70	167.68
18CPTMW08DW	01/31/2018	196.59	29.17	167.42
18CPTMW10SW	01/31/2018	186.98	19.22	167.76
18CPTMW10DW	01/31/2018	187.38	19.90	167.48

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MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
18CPTMW12SW	01/31/2018	190.90	22.95	167.95
18CPTMW12DW	01/31/2018	190.25	22.33	167.92
18CPTMW14	01/31/2018	196.69	27.60	169.09
18CPTMW15	01/31/2018	179.79	12.98	166.81
18CPTMW16	01/31/2018	175.37	9.21	166.16
18CPTMW18	01/31/2018	194.53	27.84	166.69
18CPTMW19	01/31/2018	193.59	25.30	168.29
18CPTMW19SW	01/31/2018	193.29	25.96	167.33
18CPTMW22SW	01/31/2018	187.79	19.87	167.92
18CPTMW22R	01/31/2018	187.23	12.81	174.42
18CPTMW22DW	01/31/2018	188.00	19.70	168.30
18CPTMW23	01/31/2018	177.47	10.62	166.85
18CPTMW23SW	01/31/2018	177.43	10.03	167.40
18CPTMW24	01/31/2018	194.89	26.90	167.99
18CPTMW26	01/31/2018	182.60	16.90	165.70
18CPTMW26SW	01/31/2018	182.00	13.75	168.25

SURFACE WATER LEVELS

Harrison Bayou	Date	Reference Elevation (feet amsl)	Staff Reading (water depth) (feet)	Surface Water Elevation (feet amsl)
1824HBSW7	01/31/2018	167.92	0.75	168.67

PIEZOMETER LEVELS

Piezometers	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
BGPZ-1	02/28/2018	184.99	10.85	174.14
BGPZ-2	02/28/2018	184.39	16.60	167.79
BGPZ-3	02/28/2018	180.35	12.63	167.72
BGPZ-4	02/28/2018	177.77	10.56	167.21
BGPZ-5	02/28/2018	180.76	12.93	167.83
BGPZ-6	02/28/2018	197.82	28.97	168.85
BGPZ-7	02/28/2018	195.96	27.88	168.08
BGPZ-8	02/28/2018	197.08	29.57	167.51
BGPZ-9	02/28/2018	196.45	27.33	169.12
BGPZ-10	02/28/2018	197.00	27.29	169.71
BGPZ-11	02/28/2018	196.99	27.44	169.55
BGPZ-12	02/28/2018	188.17	NA	Plugged

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
AWD-1	02/28/2018	182.27	10.69	171.58
AWD-2	02/28/2018	186.78	15.90	170.88
AWD-3	02/28/2018	200.13	28.67	171.46
AWD-4	02/28/2018	193.89	25.10	168.79
MW-1	02/28/2018	199.22	27.95	171.27
MW-2	02/28/2018	196.73	27.39	169.34

Table 4: Groundwater Elevations at LHAAP-18/24 Piezometers, Monitoring Wells, and Surface Water
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MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
MW-3	02/28/2018	196.54	27.63	168.91
MW-4	02/28/2018	197.27	27.30	169.97
MW-5	02/28/2018	194.97	26.57	168.40
MW-6	02/28/2018	192.18	23.89	168.29
MW-7	02/28/2018	188.47	19.80	168.67
MW-8	02/28/2018	187.13	18.33	168.80
MW-9	02/28/2018	184.73	15.37	169.36
MW-10	02/28/2018	178.12	10.08	168.04
MW-11	02/28/2018	184.65	17.11	167.54
MW-12	02/28/2018	178.33	9.77	168.56
MW-13	02/28/2018	176.72	8.07	168.65
MW-14	02/28/2018	186.19	14.69	171.50
MW-16	02/28/2018	178.59	10.55	168.04
MW-17	02/28/2018	179.03	10.85	168.18
MW-18	02/28/2018	178.58	9.93	168.65
MW-19	02/28/2018	178.60	9.75	168.85
MW-20	02/28/2018	186.64	11.89	174.75
MW-21	02/28/2018	198.70	31.47	167.23
MW-22	02/28/2018	197.51	27.40	170.11
MW-23	02/28/2018	198.79	27.83	170.96
101	02/28/2018	197.53	11.05	186.48
102	02/28/2018	193.94	23.00	170.94
109	02/28/2018	197.02	28.79	168.23
120	02/28/2018	184.19	13.61	170.58
123	02/28/2018	186.21	14.76	171.45
125	02/28/2018	196.28	26.49	169.79
126	02/28/2018	199.37	29.60	169.77
129	02/28/2018	197.24	26.91	170.33
130	02/28/2018	177.73	8.00	169.73
C-01	02/28/2018	193.89	24.66	169.23
C-02	02/28/2018	175.95	7.02	168.93
C-03	02/28/2018	196.34	28.09	168.25
C-04	02/28/2018	194.64	26.83	167.81
C-04A	02/28/2018	194.61	27.04	167.57
C-05	02/28/2018	180.74	14.51	166.23
C-06	02/28/2018	192.22	26.96	165.26
C-07	02/28/2018	196.80	28.42	168.38
C-08	02/28/2018	193.10	24.17	168.93
C-09	02/28/2018	202.35	33.15	169.20
C-10	02/28/2018	201.86	32.30	169.56
17WW08	02/28/2018	179.72	10.69	169.03
18WW01	02/28/2018	201.31	31.49	169.82
18WW02	02/28/2018	179.30	10.45	168.85
18WW03	02/28/2018	195.59	27.40	168.19
18WW04	02/28/2018	183.74	18.29	165.45
18WW05	02/28/2018	189.59	24.89	164.70
18WW06	02/28/2018	179.70	11.53	168.17
18WW07	02/28/2018	183.67	7.12	176.55

Table 4: Groundwater Elevations at LHAAP-18/24 Piezometers, Monitoring Wells, and Surface Water
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
18WW08	02/28/2018	177.77	11.37	166.40
18WW09	02/28/2018	177.51	9.43	168.08
18WW10	02/28/2018	182.26	14.44	167.82
18WW11	02/28/2018	182.29	14.20	168.09
18WW14	02/28/2018	186.47	18.49	167.98
18WW15	02/28/2018	186.24	18.22	168.02
18WW16	02/28/2018	201.88	31.84	170.04
18WW18	02/28/2018	196.82	28.48	168.34
18WW19	02/28/2018	179.56	12.67	166.89
18WW20	02/28/2018	180.42	13.50	166.92
18WW21	02/28/2018	195.20	27.31	167.89
18WW22	02/28/2018	195.37	27.30	168.07
18WW24	02/28/2018	176.40	7.95	168.45
18WW25	02/28/2018	175.15	7.51	167.64
18CPTMW01SW	02/28/2018	198.20	28.93	169.27
18CPTMW01DW	02/28/2018	197.92	28.85	169.07
18CPTMW03SW	02/28/2018	198.53	30.35	168.18
18CPTMW04	02/28/2018	196.60	25.12	171.48
18CPTMW04SW	02/28/2018	196.42	28.29	168.13
18CPTMW06	02/28/2018	198.12	29.70	168.42
18CPTMW07	02/28/2018	197.32	28.94	168.38
18CPTMW08SW	02/28/2018	196.38	28.27	168.11
18CPTMW08DW	02/28/2018	196.59	28.69	167.90
18CPTMW10SW	02/28/2018	186.98	18.81	168.17
18CPTMW10DW	02/28/2018	187.38	19.55	167.83
18CPTMW12SW	02/28/2018	190.90	22.59	168.31
18CPTMW12DW	02/28/2018	190.25	21.96	168.29
18CPTMW14	02/28/2018	196.69	27.08	169.61
18CPTMW15	02/28/2018	179.79	11.93	167.86
18CPTMW16	02/28/2018	175.37	7.10	168.27
18CPTMW18	02/28/2018	194.53	27.40	167.13
18CPTMW19	02/28/2018	193.59	24.95	168.64
18CPTMW19SW	02/28/2018	193.29	25.62	167.67
18CPTMW22SW	02/28/2018	187.79	19.39	168.40
18CPTMW22R	02/28/2018	187.23	12.09	175.14
18CPTMW22DW	02/28/2018	188.00	19.30	168.70
18CPTMW23	02/28/2018	177.47	9.57	167.90
18CPTMW23SW	02/28/2018	177.43	8.96	168.47
18CPTMW24	02/28/2018	194.89	26.23	168.66
18CPTMW26	02/28/2018	182.60	16.69	165.91
18CPTMW26SW	02/28/2018	182.00	12.90	169.10

SURFACE WATER LEVELS

Harrison Bayou	Date	Reference Elevation (feet amsl)	Staff Reading (water depth) (feet)	Surface Water Elevation (feet amsl)
1824HBSW7	02/28/2018	167.92	6.15	174.07

Table 4: Groundwater Elevations at LHAAP-18/24 Piezometers, Monitoring Wells, and Surface Water
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

PIEZOMETER LEVELS

Piezometers	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
BGPZ-1	03/29/2018	184.99	8.92	176.07
BGPZ-2	03/29/2018	184.39	16.16	168.23
BGPZ-3	03/29/2018	180.35	11.95	168.40
BGPZ-4	03/29/2018	177.77	9.69	168.08
BGPZ-5	03/29/2018	180.76	12.10	168.66
BGPZ-6	03/29/2018	197.82	28.50	169.32
BGPZ-7	03/29/2018	195.96	27.43	168.53
BGPZ-8	03/29/2018	197.08	29.12	167.96
BGPZ-9	03/29/2018	196.45	26.94	169.51
BGPZ-10	03/29/2018	197.00	26.90	170.10
BGPZ-11	03/29/2018	196.99	27.00	169.99
BGPZ-12	03/29/2018	188.17	NA	Plugged

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
AWD-1	03/29/2018	182.27	10.27	172.00
AWD-2	03/29/2018	186.78	15.43	171.35
AWD-3	03/29/2018	200.13	28.20	171.93
AWD-4	03/29/2018	193.89	24.73	169.16
MW-1	03/29/2018	199.22	27.51	171.71
MW-2	03/29/2018	196.73	27.00	169.73
MW-3	03/29/2018	196.54	27.25	169.29
MW-4	03/29/2018	197.27	26.92	170.35
MW-5	03/29/2018	194.97	26.19	168.78
MW-6	03/29/2018	192.18	23.44	168.74
MW-7	03/29/2018	188.47	19.36	169.11
MW-8	03/29/2018	187.13	17.90	169.23
MW-9	03/29/2018	184.73	14.95	169.78
MW-10	03/29/2018	178.12	9.61	168.51
MW-11	03/29/2018	184.65	16.77	167.88
MW-12	03/29/2018	178.33	9.23	169.10
MW-13	03/29/2018	176.72	7.59	169.13
MW-14	03/29/2018	186.19	14.21	171.98
MW-16	03/29/2018	178.59	9.89	168.70
MW-17	03/29/2018	179.03	10.34	168.69
MW-18	03/29/2018	178.58	9.40	169.18
MW-19	03/29/2018	178.60	9.22	169.38
MW-20	03/29/2018	186.64	11.48	175.16
MW-21	03/29/2018	198.70	30.97	167.73
MW-22	03/29/2018	197.51	26.98	170.53
MW-23	03/29/2018	198.79	27.40	171.39
101	03/29/2018	197.53	10.33	187.20
102	03/29/2018	193.94	22.56	171.38
109	03/29/2018	197.02	28.35	168.67
120	03/29/2018	184.19	13.15	171.04
123	03/29/2018	186.21	14.26	171.95

Table 4: Groundwater Elevations at LHAAP-18/24 Piezometers, Monitoring Wells, and Surface Water
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
125	03/29/2018	196.28	26.00	170.28
126	03/29/2018	199.37	29.17	170.20
129	03/29/2018	197.24	26.45	170.79
130	03/29/2018	177.73	7.31	170.42
C-01	03/29/2018	193.89	24.20	169.69
C-02	03/29/2018	175.95	6.55	169.40
C-03	03/29/2018	196.34	27.67	168.67
C-04	03/29/2018	194.64	26.41	168.23
C-04A	03/29/2018	194.61	26.60	168.01
C-05	03/29/2018	180.74	13.91	166.83
C-06	03/29/2018	192.22	26.45	165.77
C-07	03/29/2018	196.80	28.03	168.77
C-08	03/29/2018	193.10	23.63	169.47
C-09	03/29/2018	202.35	32.71	169.64
C-10	03/29/2018	201.86	31.95	169.91
17WW08	03/29/2018	179.72	9.89	169.83
18WW01	03/29/2018	201.31	31.05	170.26
18WW02	03/29/2018	179.30	9.93	169.37
18WW03	03/29/2018	195.59	27.04	168.55
18WW04	03/29/2018	183.74	17.85	165.89
18WW05	03/29/2018	189.59	24.49	165.10
18WW06	03/29/2018	179.70	10.93	168.77
18WW07	03/29/2018	183.67	6.59	177.08
18WW08	03/29/2018	177.77	10.82	166.95
18WW09	03/29/2018	177.51	8.89	168.62
18WW10	03/29/2018	182.26	13.84	168.42
18WW11	03/29/2018	182.29	13.60	168.69
18WW14	03/29/2018	186.47	18.02	168.45
18WW15	03/29/2018	186.24	17.80	168.44
18WW16	03/29/2018	201.88	31.45	170.43
18WW18	03/29/2018	196.82	27.94	168.88
18WW19	03/29/2018	179.56	12.05	167.51
18WW20	03/29/2018	180.42	13.00	167.42
18WW21	03/29/2018	195.20	26.87	168.33
18WW22	03/29/2018	195.37	26.92	168.45
18WW24	03/29/2018	176.40	6.49	169.91
18WW25	03/29/2018	175.15	6.13	169.02
18CPTMW01SW	03/29/2018	198.20	28.50	169.70
18CPTMW01DW	03/29/2018	197.92	28.43	169.49
18CPTMW03SW	03/29/2018	198.53	29.95	168.58
18CPTMW04	03/29/2018	196.60	24.81	171.79
18CPTMW04SW	03/29/2018	196.42	27.92	168.50
18CPTMW06	03/29/2018	198.12	29.25	168.87
18CPTMW07	03/29/2018	197.32	28.49	168.83
18CPTMW08SW	03/29/2018	196.38	27.75	168.63
18CPTMW08DW	03/29/2018	196.59	28.26	168.33
18CPTMW10SW	03/29/2018	186.98	18.37	168.61
18CPTMW10DW	03/29/2018	187.38	19.09	168.29

Table 4: Groundwater Elevations at LHAAP-18/24 Piezometers, Monitoring Wells, and Surface Water
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
18CPTMW12SW	03/29/2018	190.90	22.27	168.63
18CPTMW12DW	03/29/2018	190.25	21.55	168.70
18CPTMW14	03/29/2018	196.69	26.67	170.02
18CPTMW15	03/29/2018	179.79	11.31	168.48
18CPTMW16	03/29/2018	175.37	5.96	169.41
18CPTMW18	03/29/2018	194.53	27.03	167.50
18CPTMW19	03/29/2018	193.59	24.57	169.02
18CPTMW19SW	03/29/2018	193.29	25.26	168.03
18CPTMW22SW	03/29/2018	187.79	18.92	168.87
18CPTMW22R	03/29/2018	187.23	11.65	175.58
18CPTMW22DW	03/29/2018	188.00	18.89	169.11
18CPTMW23	03/29/2018	177.47	8.75	168.72
18CPTMW23SW	03/29/2018	177.43	8.15	169.28
18CPTMW24	03/29/2018	194.89	25.89	169.00
18CPTMW26	03/29/2018	182.60	16.31	166.29
18CPTMW26SW	03/29/2018	182.00	12.53	169.47

SURFACE WATER LEVELS

Harrison Bayou	Date	Reference Elevation (feet amsl)	Staff Reading (water depth) (feet)	Surface Water Elevation (feet amsl)
1824HBSW7	03/29/2018	167.92	5.95	173.87

Notes:

amsl - above mean sea level

Table 5: Monthly Groundwater Extraction Quantities
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

ICT or Well Number	January 2018 (gallons)	February 2018 (gallons)	March 2018 (gallons)	Total
1	0	0	0	0
2	67,535	0	13,225	80,760
3	0	0	0	0
4	35,319	47,160	74,106	156,585
5	0	0	0	0
EW-1	41	1,166	1,890	3,097
7	1,706	9,573	12,531	23,810
8	51,303	36,480	104,780	192,563
18WW17	3,780	6,649	10,130	20,559
10	0	0	0	0
11	86,887	80,753	79,907	247,547
12A	6,127	7,890	9,400	23,417
12B	1,130	0	0	1,130
12C	8,332	12,547	18,933	39,812
12D	21,640	29,975	43,229	94,844
12E	8,830	18,172	22,469	49,471
13A	124	0	16,683	16,807
13B	15,090	34,365	59,917	109,372
13C	1,779	47,319	95,989	145,087
13D	8,186	23,364	33,913	65,463
13E	367	0	389	756
13F	0	2,380	64	2,444
14A	0	463	0	463
14B	4,793	29,249	31,151	65,193
14C	27,910	33,507	100,829	162,246
14D	26,477	77,903	23	104,403
14E	1,599	3,753	57	5,409
Total LHAAP-18/24	378,955	502,668	729,615	1,611,238
LHAAP-16	21,240	11,092	28,615	
Total LHAAP-16	21,240	11,092	28,615	60,947
TOTAL	400,195	513,760	758,230	1,672,185

Table 6: Weekly Perchlorate Sample Results
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

Sample Identification	Date Sampled	Sample Location	TRRP PCL for discharge to INF Pond	Effluent Limitation for Discharge to Harrison Bayou (µg/L)		Discharge Point	Reporting Limit	Influent		Effluent		Does Concentration Meet Discharge Limit? (Yes/No)
				Daily Average Concentration	Daily Maximum Concentration			Result (µg/L)	Limit	Result (µg/L)	DVQ	
LH18/24-SP650_011018	1/10/2018	TK-650	17	278	589	INF Pond	4	NA	NA	2.3	J	Yes
LH18/24-SP650_012518	1/25/2018	TK-650	17	278	589	INF Pond	4	NA	NA	< 4.0	U	Yes
LH18/24-SP650_013118 (Monthly)	1/31/2018	TK-650	17	278	589	INF Pond	4	NA	NA	66		No
LH18/24-SP140_013118 (Monthly)	1/31/2018	TK-140	17	NA	NA	INF Pond	NA	7,800	NA	NA		NA
LH18/24-SP650_013118	1/31/2018	TK-650	17	278	589	INF Pond	4	NA	NA	51		No
LH18/24-SP650_020718	2/7/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	< 4.0	UJ	Yes
LH18/24-SP650_021418 (Monthly)	2/14/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	< 4.0	U	Yes
LH18/24-SP140_021418 (Monthly)	2/14/2018	TK-140	17	NA	NA	Harrison Bayou	NA	16,000	NA	NA		NA
LH18/24-SP650_021418	2/14/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	< 4.0	U	Yes
LH18/24-SP650_022118_BIX	2/21/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	81		Yes
LH18/24-SP650_022118_AIX	2/21/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	< 4.0	U	Yes
LH18/24-SP650_022818	2/28/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	73.0		Yes
LH18/24-SP650_030718	3/7/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	57		Yes
LH18/24-SP650_031418	3/14/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	130		Yes
LH18/24-SP650_031418 (Monthly)	3/14/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	130		Yes
LH18/24-SP140_031418 (Monthly)	3/14/2018	TK-140	17	NA	NA	Harrison Bayou	NA	7,000	NA	NA		NA
LH18/24-SP650_032118	3/21/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	500		Yes
LH18/24-SP650_032818	3/28/2018	TK-650	17	278	589	Harrison Bayou	4	NA	NA	< 4.0	U	Yes

Notes:

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

SP140 samples are influent samples

µg/L - micrograms per liter

DVQ - data validation qualifier

ID - identification

J - Estimated concentration

NA - not applicable or not analyzed

U - non detect

UJ - considered an artifact of blank contamination

Table 7: Bi-Weekly GWTP Analytical Sampling Results for January 2018
 1st Quarter 2018 Groundwater Treatment Plant Report
 Longhorn Army Ammunition Plant

Sample Location Sample Identification Lab Package Sample Date Sample Type	Effluent Limitation for Discharge (µg/L) per Table 2 of ROD		EFFLUENT - Biweekly		EFFLUENT - Biweekly		EFFLUENT - Monthly		EFFLUENT - Monthly		Does Concentration Meet Effluent Discharge Limits? (Yes/No)	
	Daily Average Concentration µg/L	Daily Maximum Concentration µg/L	Reporting Limit µg/L	Result µg/L	DVQ	Result µg/L	DVQ	Result µg/L	DVQ	Result µg/L		DVQ
	µg/L	µg/L	µg/L	µg/L		µg/L		µg/L		µg/L		
VOLATILES												
1,1,1-Trichloroethane	3,417	7,230	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
1,1,2-Trichloroethane	102.5	216.9	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
1,1-Dichloroethane	6,633	14,032	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
1,1-Dichloroethane	119	253	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
1,2-Dichloroethane	85	181	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
1,2-Dichloropropane	NA	NA	1	<2.0	U	<1.0	U	<1.0	U	NA	Yes	
Acetone	1,132	2,395	2	<1.0	U	<2.0	U	<1.0	U	NA	Yes	
Benzene	85	181	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Carbon Tetrachloride	85	181	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Chlorobenzene	22,300	47,180	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Chloroform	1,708	3,615	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Ethylbenzene	26,954	57,025	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
m,p-Xylenes	39.5	83.6	2	<2.0	U	<2.0	U	<2.0	U	NA	Yes	
Methylene Chloride	803	1,699	2	<5.0	U	<2.0	U	<2.0	U	NA	Yes	
o-Xylene	39.5	83.6	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Styrene	2,829	5,987	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Tetrachloroethene	85.4	180.7	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Toluene	1,980	4,189	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Trichloroethene	85	181	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
Vinyl Chloride	34	72	1	<1.0	U	<1.0	U	<1.0	U	NA	Yes	
ANIONS												
Chloride	NA	NA	10	546		618		NA		NA	NA	
Sulfate	NA	NA	10	47.8		81.9		NA		NA	NA	
PERCHLORATE												
Perchlorate	17*	17*	4	NA		NA		µg/L		66	No**	
METALS												
Hexavalent Chromium	0.058	0.124	0.010	NA		NA		mg/L		mg/L	Yes	
Barium	1	2	0.004	NA		NA		<0.0100		<0.0100	U	
Lead	0.0022	0.0046	0.002	NA		NA		0.295		NA	Yes	
Selenium	0.0057	0.0120	0.002	NA		NA		<0.00200		<0.00200	U	
Silver	0.0014	0.0030	0.002	NA		NA		<0.00200		<0.00200	U	
SEMI-VOLATILES												
1,4-Dioxane**	NA	134.2	1	NA		NA		µg/L		8.3	Yes	

Notes:
 µg/L - micrograms per liter
 mg/L - milligrams per liter
 DVQ - data validation qualifier
 NA - not applicable or not analyzed
 GWTP - Groundwater Treatment Plant
 ROD - Record of Decision
 Grab samples are compared to the daily maximum and composite samples to the daily average.
 U - not detected; J - estimated concentration
 * Due to discharging only to the INF Pond, the maximum perchlorate discharge concentration allowed is 17 µg/L, which is the Texas Risk Reduction Program Tier 1 Groundwater Residential Protective Concentration Level (PCL).
 **Influent sample not compared to discharge limits
 *** Calculated Effluent Limit

Table 8: Bi-Weekly GWTP Analytical Sampling Results for February 2018
 1st Quarter 2018 Groundwater Treatment Plant Report
 Longhorn Army Ammunition Plant

Sample Location	Sample Identification		Sample Date		Sample Type		Effluent Limitation for Discharge (µg/L)		EFFLUENT - Biweekly		EFFLUENT - Monthly		EFFLUENT - Biweekly		Does Concentration Meet Effluent Discharge Limits? (Yes/No)
	Lab Package	Sample Date	Sample Date	Sample Type	Result	DVQ	Result	DVQ	Result	DVQ	Result	DVQ	Result	DVQ	
	Sample Identification	Sample Date	Sample Date	Sample Type	Daily Average Concentration	Daily Maximum Concentration	Detection Limit	DVQ	Result	DVQ	Result	DVQ	Result	DVQ	
VOLATILES					µg/L	µg/L	µg/L		µg/L		µg/L		µg/L		
1,1,1-Trichloroethane		3,417	7,230	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
1,1,2-Trichloroethane		102.5	216.9	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
1,1-Dichloroethane		6,633	14,032	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
1,1-Dichloroethane		119	253	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
1,2-Dichloroethane		85	181	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
1,2-Dichloropropane		NA	NA	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Acetone		1,132	2,395	2	<2.0	U	<2.0	U	<2.0	U	NA	<2.0	U	<2.0	Yes
Benzene		85	181	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Carbon Tetrachloride		85	181	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Chlorobenzene		22,300	47,180	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Chloroform		1,708	3,615	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Ethylbenzene		26,954	57,025	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
m,p-Xylenes		39.5	83.6	2	<2.0	U	<2.0	U	<2.0	U	NA	<2.0	U	<2.0	Yes
Methylene Chloride		803	1,699	2	<2.0	U	<2.0	U	<2.0	U	NA	<2.0	U	<2.0	Yes
o-Xylene		39.5	83.6	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Styrene		2,829	5,987	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Tetrachloroethene		85.4	180.7	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Toluene		1,980	4,189	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Trichloroethene		85	181	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
Vinyl Chloride		34	72	1	<1.0	U	<1.0	U	<1.0	U	NA	<1.0	U	<1.0	Yes
ANIONS					mg/L	mg/L	mg/L		mg/L		mg/L		mg/L		
Chloride		NA	NA	10	603	NA	NA	NA	603	NA	NA	NA	582	NA	NA
Sulfate		NA	NA	10	83.3	NA	NA	NA	83.3	NA	NA	NA	55.9	NA	NA
PERCHLORATE					µg/L	µg/L	µg/L		µg/L		µg/L		µg/L		
Perchlorate		278	589	4	NA	NA	<4.0	U	<4.0	U	16,000	<4.0	NA	NA	Yes*
METALS					mg/L	mg/L	mg/L		mg/L		mg/L		mg/L		
Hexavalent Chromium		0.058	0.124	0.010	NA	NA	<0.0100	U	<0.0100	U	<0.0100	<0.0100	U	<0.0100	Yes
Barium		1	2	0.004	NA	NA	0.205	NA	0.205	NA	NA	NA	NA	NA	Yes
Lead		0.0022	0.0046	0.002	NA	NA	<0.00200	U	<0.00200	U	NA	NA	NA	NA	Yes
Selenium		0.0057	0.0120	0.002	NA	NA	<0.00200	U	<0.00200	U	0.00130	<0.00200	J	NA	Yes
Silver		0.0014	0.0030	0.002	NA	NA	<0.00200	U	<0.00200	U	<0.00200	<0.00200	U	NA	Yes
SEMI-VOLATILES					µg/L	µg/L	µg/L		µg/L		µg/L		µg/L		
1,4-Dioxane**		NA	134.2	1	NA	NA	5.3	NA	5.3	NA	NA	NA	NA	NA	Yes

Notes:
 µg/L - micrograms per liter
 mg/L - milligrams per liter
 DVQ - data validation qualifier
 GWTP - Groundwater Treatment Plant
 U - non detect; J - estimated concentration
 Grab samples are compared to the daily maximum and composite samples to the daily average.
 *Influent sample not compared to discharge limits
 ** Calculated Effluent Limit

Table 9: Bi-Weekly Analytical GWTP Sampling Results for March 2018
 1st Quarter 2018 Groundwater Treatment Plant Report
 Longhorn Army Ammunition Plant

Sample Location	Sample Identification		Sample Date		Sample Type		Effluent Limitation for Discharge (µg/L) per Table 2 of ROD		EFFLUENT - Biweekly		EFFLUENT - Monthly		EFFLUENT - Biweekly		Does Concentration Meet Effluent Discharge Limits? (Yes/No)	
	Lab Package	Sample Date	Sample Date	Sample Type	Result	DVQ	Result	DVQ	Result	DVQ	Result	DVQ	Result	DVQ		
	Sample Date	Sample Type	Result	DVQ	Result	DVQ	Result	DVQ	Result	DVQ	Result	DVQ	Result	DVQ		
VOLATILES																
1,1,1-Trichloroethane	µg/L	3,417	µg/L	7,230	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
1,1,2-Trichloroethane	µg/L	102.5	µg/L	216.9	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
1,1-Dichloroethane	µg/L	6,633	µg/L	14,032	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
1,1-Dichloroethene	µg/L	119	µg/L	253	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
1,2-Dichloroethane	µg/L	85	µg/L	181	1	0.72	J	0.64	J	NA	U	NA	U	<1.0	U	Yes
1,2-Dichloropropane	µg/L	NA	µg/L	NA	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
Acetone	µg/L	1,132	µg/L	2,395	2	<2.0	U	<2.0	U	NA	U	NA	U	<2.0	U	Yes
Benzene	µg/L	85	µg/L	181	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
Carbon Tetrachloride	µg/L	85	µg/L	181	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
Chlorobenzene	µg/L	22,300	µg/L	47,180	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
Chloroform	µg/L	1,708	µg/L	3,615	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
Ethylbenzene	µg/L	26,954	µg/L	57,025	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
m,p-Xylenes	µg/L	39.5	µg/L	83.6	2	<2.0	U	<2.0	U	NA	U	NA	U	<2.0	U	Yes
Methylene Chloride	µg/L	803	µg/L	1,699	2	<2.0	U	<2.0	U	NA	U	NA	U	<2.0	U	Yes
o-Xylene	µg/L	39.5	µg/L	83.6	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
Styrene	µg/L	2,829	µg/L	5,987	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
Tetrachloroethene	µg/L	85.4	µg/L	180.7	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
Toluene	µg/L	1,980	µg/L	4,189	1	<1.0	U	<1.0	U	NA	U	NA	U	0.81	J	Yes
Trichloroethene	µg/L	85	µg/L	181	1	3.2	U	2.7	U	NA	U	NA	U	2.0	U	Yes
Vinyl Chloride	µg/L	34	µg/L	72	1	<1.0	U	<1.0	U	NA	U	NA	U	<1.0	U	Yes
ANIONS																
Chloride	mg/L	NA	mg/L	NA	10	345	NA	NA	NA	NA	NA	NA	NA	312	NA	NA
Sulfate	µg/L	NA	µg/L	NA	10	113	NA	NA	NA	NA	NA	NA	NA	119	NA	NA
PERCHLORATE																
Perchlorate	µg/L	278	µg/L	589	4	NA	NA	130	NA	7,000	NA	NA	NA	NA	Yes*	
METALS																
Hexavalent Chromium	mg/L	0.058	mg/L	0.124	0.010	NA	NA	<0.0100	U	<0.0100	U	<0.0100	U	NA	Yes	
Barium	µg/L	1	µg/L	2	0.004	NA	NA	0.171	NA	NA	NA	NA	NA	NA	Yes	
Lead	µg/L	0.0022	µg/L	0.0046	0.002	NA	NA	<0.00200	U	NA	NA	NA	NA	NA	Yes	
Selenium	µg/L	0.0057	µg/L	0.0120	0.002	NA	NA	<0.00200	U	<0.00200	U	<0.00200	U	NA	Yes	
Silver	µg/L	0.0014	µg/L	0.0030	0.002	NA	NA	<0.00200	U	<0.00200	U	<0.00200	U	NA	Yes	
SEMI-VOLATILES																
1,4-Dioxane**	µg/L	NA	µg/L	134.2	1	NA	NA	7.6	NA	NA	NA	NA	NA	NA	Yes	

Notes:
 µg/L - micrograms per liter
 DVQ - data validation qualifier
 GWTP - Groundwater Treatment Plant
 J - estimated concentration
 mg/L - milligrams per liter
 U - Non detect
 NA - not applicable
 Grab samples are compared to the daily maximum and composite samples to the daily average
 *Influent sample not compared to discharge limits
 ** Calculated Effluent Limit

**Table 10: Quarterly GWTP Analytical Sampling Results
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant**

	Sample Location				EFFLUENT*		INFLUENT		Does Concentration Meet Discharge Limits? (Yes/No)
	Sample Identification				LH18/24-SP650_022818		LH18/24-SP140_022818		
	Lab Package				HS18030055		HS18030054		
Sample Date				28-Feb-18		28-Feb-18			
Sample Type				GRAB		GRAB			
*Effluent Limitation for Discharge (µg/L)									
per Table 2 of ROD									
	Daily Average Concentration µg/L	Daily Maximum Concentration µg/L	Reporting Limit µg/L	Result µg/L	DVQ	Result µg/L	DVQ	Result µg/L	DVQ
VOLATILES									
1,1,1-Trichloroethane	3,417	7,230	1	< 1.0	U	< 10	U	< 10	Yes
1,1,2-Trichloroethane	102.5	216.9	1	< 1.0	U	< 10	U	< 10	Yes
1,1-Dichloroethane	6.633	14,032	1	< 1.0	U	< 10	U	< 10	Yes
1,1-Dichloroethene	119	253	1	< 1.0	U	< 1.0	U	< 1.0	Yes
1,2-Dichloroethane	85	181	1	0.76	J	32		32	Yes
1,2-Dichloropropane	NA	NA	1	< 1.0	U	< 10	U	< 10	Yes
Acetone	1,132	2,395	2	< 2.0	U	< 20	U	< 20	Yes
Benzene	85	181	1	< 1.0	U	< 10	U	< 10	Yes
Carbon Tetrachloride	85	181	1	< 1.0	U	< 10	U	< 10	Yes
Chlorobenzene	22,300	47,180	1	< 1.0	U	< 10	U	< 10	Yes
Chloroform	1,708	3,615	1	< 1.0	U	< 10	U	< 10	Yes
Ethylbenzene	26,954	57,025	1	< 1.0	U	< 10	U	< 10	Yes
m,p-Xylenes	39.5	83.6	2	< 2.0	U	< 20	U	< 20	Yes
Methylene Chloride	803	1,699	2	< 2.0	U	27		27	Yes
o-Xylene	39.5	83.6	1	< 1.0	U	< 10	U	< 10	Yes
Styrene	2,829	5,987	1	< 1.0	U	< 10	U	< 10	Yes
Tetrachloroethene	85.4	180.7	1	< 1.0	U	< 10	U	< 10	Yes
Toluene	1,980	4,189	1	< 1.0	U	< 10	U	< 10	Yes
Trichloroethene	85	181	1	2.4		7,200		7,200	Yes
Vinyl Chloride	34	72	1	< 1.0	U	51		51	Yes
ANIONS									
Chloride	NA	NA	10	mg/L		mg/L		mg/L	NA
Sulfate	NA	NA	10	mg/L		mg/L		mg/L	NA
PERCHLORATE									
Perchlorate	278	589	4	µg/L		µg/L		µg/L	Yes
METALS									
Aluminum	0.777	1.644	0.0100	mg/L		mg/L		mg/L	Yes
Antimony	NA	NA	0.00200	mg/L		mg/L		mg/L	NA
Arsenic	0.365	0.772	0.00200	mg/L		mg/L		mg/L	Yes

**Table 10: Quarterly GWTP Analytical Sampling Results
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant**

	Sample Location				EFFLUENT*		INFLUENT		Does Concentration Meet Discharge Limits? (Yes/No)
	Sample Identification				LH18/24-SP650_022818		LH18/24-SP140_022818		
	Lab Package				HS18030055		HS18030054		
Sample Date				28-Feb-18		28-Feb-18			
Sample Type				GRAB		GRAB			
*Effluent Limitation for Discharge (µg/L)									
per Table 2 of ROD									
	Daily Average Concentration	Daily Maximum Concentration	Reporting Limit	Result	DVQ	Result	DVQ		
Barium	1	2	0.00400	0.155		0.104		Yes	
Beryllium	NA	NA	0.00200	< 0.00200	U	< 0.00200	U	NA	
Cadmium	0.0016	0.0034	0.00200	< 0.00200	U	< 0.00200	U	Yes	
Calcium	NA	NA	0.500	15.3		140		NA	
Chromium	0.355	0.752	0.00400	0.00669		0.00189	J	Yes	
Cobalt	5.433	11.495	0.00500	0.00266	J	0.00502		Yes	
Iron	1.132	2.395	0.200	0.140	J	0.479		Yes	
Lead	0.0022	0.0046	0.00200	< 0.00200	U	0.000854	J	Yes	
Magnesium	NA	NA	0.200	28.3		106		NA	
Manganese	7.323	15.494	0.00500	0.0579		0.199		Yes	
Nickel	0.087	0.184	0.00200	0.0121		0.00727		Yes	
Potassium	NA	NA	0.200	1.93		1.64		NA	
Selenium	0.0057	0.012	0.00200	0.00149	J	0.00283		Yes	
Silver	0.0014	0.003	0.00200	< 0.00200	U	< 0.00200	U	Yes	
Sodium	NA	NA	1.00	483		720		NA	
Thallium	NA	NA	0.00200	< 0.00200	U	< 0.00200	U	NA	
Vanadium	1.698	3.592	0.00500	< 0.00500	U	< 0.00500	U	Yes	
Zinc	0.146	0.31	0.00400	0.0357		0.0503		Yes	
Mercury	NA	NA	0.000200	< 0.000200	U	< 0.000200	U	NA	
1,4-Dioxane	µg/L	µg/L	µg/L	µg/L		µg/L			
1,4-Dioxane	NA	134.2	1	13		7.1		Yes	
Chemical Oxygen Demand	mg/L	mg/L	mg/L	mg/L		mg/L			
Oil and Grease	NA	200	75	86		24.0		Yes	
	NA	15	2	3.54		<2.0	U	Yes	

Notes:
 µg/L - micrograms per liter GWTP - Groundwater Treatment Plant NA - not applicable
 DVQ - data validation qualifier J - Estimated concentration mg/L - milligrams per liter ROD - Record of Decision
 Grab samples are compared to the daily maximum and composite samples to the daily average U - non detect
 UB - considered non detect due to blank contamination
 * only Effluent sample is compared to discharge limits

3 EVALUATION OF LHAAP-16 EXTRACTION SYSTEM

3.1 Quantity of Groundwater Extracted From LHAAP-16

Groundwater was extracted from LHAAP-16 during January (21,240 gallons), February (11,092 gallons) and March (28,615 gallons) 2018. The volume of extracted groundwater from LHAAP-16 is shown in **Table 11** and on **Figure ES-1**. These flows are based on the sum of individual flow meter readings. The extracted volume decreased in February 2018 due to repairs required on the pump.

3.2 Groundwater Elevation

The groundwater elevations in the piezometers and monitoring wells at LHAAP-16 for January, February and March 2018 are presented in **Table 11**. The potentiometric surface maps for the shallow and Upper Wilcox (intermediate) groundwater zones at LHAAP-16 for January, February and March 2018 are presented on **Figures B-7** through **B-12** in **Appendix B**. Based on the potentiometric surface maps, the general groundwater flow direction in the shallow and intermediate zone is southeast.

3.3 Groundwater Sampling Activities

On February 7, 2018, a total of eight monitoring wells were sampled at Site LHAAP-16 for VOCs and perchlorate. The analytical results are presented in **Table 12** and the laboratory analytical report is presented in **Appendix D**. Parameters exceeding their respective United States Environmental Protection Agency (USEPA) Maximum Contaminant Level (MCL) or Texas Risk Reduction Program (TRRP) Groundwater Industrial Medium Specific Concentration (MSC) are 1,1-dichloroethene (DCE); 1,2-dichloroethane; cis-1,2-DCE; trichloroethene (TCE); and vinyl chloride. Perchlorate was compared to the TRRP Protective Concentration Level (PCL) of 17 µg/L, which was exceeded at LHAAP-16. Two monitoring wells had perchlorate above the PCL with a detection of 130 µg/L in both 16EW01 and 16EW05. All eight of the monitoring wells sampled had exceedances of the MCL for TCE with the highest detection of TCE present in 16EW02 (19,000 µg/L) and 16EW03 (24,000 µg/L). These two wells also had elevated detections of cis-1,2-DCE and vinyl chloride, indicating that monitored natural attenuation is occurring in addition to the extraction and treatment of the LHAAP-16 groundwater. **Figure 3-1** depicts the groundwater sampling results on the LHAAP-16 map. No isoconcentration map was prepared due to the limited number of monitoring wells sampled.

GWTP QUARTERLY EVALUATION REPORT –1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

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Table 11: Groundwater Elevations at LHAAP-16 Piezometers and Monitoring Wells
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

PIEZOMETER LEVELS

Piezometers	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
16PZ-1	01/31/2018	199.44	28.40	171.04
16PZ-2	01/31/2018	199.75	28.81	170.94
16PZ-3	01/31/2018	198.61	27.49	171.12
16PZ-4	01/31/2018	198.81	27.92	170.89
16PZ-5	01/31/2018	198.31	27.64	170.67
16PZ-6	01/31/2018	198.61	27.91	170.70
16PZ-7	01/31/2018	200.10	28.75	171.35
16PZ-8	01/31/2018	199.93	29.03	170.90
16PZ-9	01/31/2018	196.49	26.60	169.89
16PZ-10	01/31/2018	196.65	26.22	170.43
16PZ-11	01/31/2018	198.88	27.85	171.03
16PZ-12	01/31/2018	199.00	28.24	170.76
16PZ-13	01/31/2018	196.58	25.55	171.03
16PZ-14	01/31/2018	196.09	25.42	170.67
16PZ-15	01/31/2018	191.93	21.40	170.53
16PZ-16	01/31/2018	190.79	20.39	170.40
16PZ-17	01/31/2018	186.67	17.91	168.76
16PZ-18	01/31/2018	185.99	16.32	169.67
16PZ-19	01/31/2018	183.98	15.93	168.05
16PZ-20	01/31/2018	183.12	13.68	169.44

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
16WW12	01/31/2018	188.81	19.11	169.70
16WW14	01/31/2018	198.87	26.54	172.33
16WW22	01/31/2018	200.13	29.33	170.80
16WW25	01/31/2018	188.77	20.15	168.62
16WW26	01/31/2018	188.83	19.08	169.75
16WW29	01/31/2018	178.24	9.79	168.45
16WW30	01/31/2018	178.47	10.20	168.27
16WW31	01/31/2018	202.78	31.32	171.46
16WW33	01/31/2018	203.09	31.23	171.86
16WW35	01/31/2018	191.23	19.60	171.63
16WW36	01/31/2018	190.94	19.10	171.84

Table 11: Groundwater Elevations at LHAAP-16 Piezometers and Monitoring Wells
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

PIEZOMETER LEVELS

Piezometers	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
16PZ-1	02/28/2018	199.44	28.08	171.36
16PZ-2	02/28/2018	199.75	28.47	171.28
16PZ-3	02/28/2018	198.61	27.15	171.46
16PZ-4	02/28/2018	198.81	27.59	171.22
16PZ-5	02/28/2018	198.31	27.28	171.03
16PZ-6	02/28/2018	198.61	27.55	171.06
16PZ-7	02/28/2018	200.10	28.41	171.69
16PZ-8	02/28/2018	199.93	28.70	171.23
16PZ-9	02/28/2018	196.49	26.20	170.29
16PZ-10	02/28/2018	196.65	25.81	170.84
16PZ-11	02/28/2018	198.88	27.47	171.41
16PZ-12	02/28/2018	199.00	27.82	171.18
16PZ-13	02/28/2018	196.58	25.19	171.39
16PZ-14	02/28/2018	196.09	25.13	170.96
16PZ-15	02/28/2018	191.93	21.01	170.92
16PZ-16	02/28/2018	190.79	19.95	170.84
16PZ-17	02/28/2018	186.67	17.42	169.25
16PZ-18	02/28/2018	185.99	15.89	170.10
16PZ-19	02/28/2018	183.98	14.97	169.01
16PZ-20	02/28/2018	183.12	12.73	170.39

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
16WW12	02/28/2018	188.81	16.96	171.85
16WW14	02/28/2018	198.87	26.22	172.65
16WW22	02/28/2018	200.13	28.31	171.82
16WW25	02/28/2018	188.77	19.40	169.37
16WW26	02/28/2018	188.83	18.31	170.52
16WW29	02/28/2018	178.24	7.98	170.26
16WW30	02/28/2018	178.47	8.23	170.24
16WW31	02/28/2018	202.78	30.92	171.86
16WW33	02/28/2018	203.09	30.85	172.24
16WW35	02/28/2018	191.23	19.17	172.06
16WW36	02/28/2018	190.94	18.77	172.17

Table 11: Groundwater Elevations at LHAAP-16 Piezometers and Monitoring Wells
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

PIEZOMETER LEVELS

Piezometers	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
16PZ-1	03/29/2018	199.44	27.60	171.84
16PZ-2	03/29/2018	199.75	27.95	171.80
16PZ-3	03/29/2018	198.61	26.72	171.89
16PZ-4	03/29/2018	198.81	27.12	171.69
16PZ-5	03/29/2018	198.31	27.81	170.50
16PZ-6	03/29/2018	198.61	27.10	171.51
16PZ-7	03/29/2018	200.10	28.00	172.10
16PZ-8	03/29/2018	199.93	28.30	171.63
16PZ-9	03/29/2018	196.49	25.74	170.75
16PZ-10	03/29/2018	196.65	25.37	171.28
16PZ-11	03/29/2018	198.88	27.02	171.86
16PZ-12	03/29/2018	199.00	27.33	171.67
16PZ-13	03/29/2018	196.58	24.75	171.83
16PZ-14	03/29/2018	196.09	24.69	171.40
16PZ-15	03/29/2018	191.93	20.55	171.38
16PZ-16	03/29/2018	190.79	19.47	171.32
16PZ-17	03/29/2018	186.67	16.98	169.69
16PZ-18	03/29/2018	185.99	15.37	170.62
16PZ-19	03/29/2018	183.98	14.50	169.48
16PZ-20	03/29/2018	183.12	12.25	170.87

MONITORING WELL LEVELS

Monitoring Wells	Date	Reference Elevation (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
16WW12	03/29/2018	188.81	16.35	172.46
16WW14	03/29/2018	198.87	25.75	173.12
16WW22	03/29/2018	200.13	27.83	172.30
16WW25	03/29/2018	188.77	18.97	169.80
16WW26	03/29/2018	188.83	17.90	170.93
16WW29	03/29/2018	178.24	7.05	171.19
16WW30	03/29/2018	178.47	7.29	171.18
16WW31	03/29/2018	202.78	30.51	172.27
16WW33	03/29/2018	203.09	30.47	172.62
16WW35	03/29/2018	191.23	18.65	172.58
16WW36	03/29/2018	190.94	18.30	172.64

Notes:

amsl - above mean sea level

Table 12: LHAAP-16 Annual Sampling Results
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

Location ID: Sample Date:	Units	MCL/PCL/ MSC	16EW01_ 020718	16EW02_ 020718	16EW03_ 020718	16EW04_ 020718	16EW05_ 020718	16EW05_ 020718_a	16EW06_ 020718	16EW07_ 020718	16EW08_ 020718
Lab Package: HS18020534											
Location Description			Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – NE middle region Sampled Annually	Site 16 – ENE, middle region Sampled Annually	Site 16 – NE middle region Sampled Annually	Site 16 – NE middle region Sampled Annually Duplicate.	Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – ENE, middle region Sampled Annually
Perchlorate (6850)											
Perchlorate	µg/L	1.7*	130	5.0	< 4.0 U	< 4.0 U	130	110	< 4.0 U	< 4.0 U	< 4.0 U
Volatile Organic Compounds (8260C)											
1,1,1,2-Tetrachloroethane	µg/L	110	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1,1-Trichloroethane	µg/L	200	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1,2,2-Tetrachloroethane	µg/L	14	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1,2-Trichloroethane	µg/L	5	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1-Dichloroethane	µg/L	10,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1-Dichloroethene	µg/L	7	11	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,1-Dichloropropene	µg/L	2.9	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2,3-Trichlorobenzene	µg/L	310	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2,3-Trichloropropane	µg/L	0.041	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2,4-Trichlorobenzene	µg/L	70	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2,4-Trimethylbenzene	µg/L	5,100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2-Dibromo-3-chloropropane	µg/L	0.2	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2-Dibromoethane	µg/L	0.05	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2-Dichlorobenzene	µg/L	600	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,2-Dichloroethane	µg/L	5	15	< 50 U	< 50 U	< 1.0 U	< 1.0 U	1.2	1.9	< 1.0 U	< 1.0 U
1,2-Dichloropropane	µg/L	5	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,3,5-Trimethylbenzene	µg/L	5,100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,3-Dichlorobenzene	µg/L	3,100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,3-Dichloropropane	µg/L	29	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
1,4-Dichlorobenzene	µg/L	75	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
2,2-Dichloropropane	µg/L	42	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
2-Butanone	µg/L	61,000	< 2.0 U	< 100 U	< 100 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
2-Chlorotoluene	µg/L	2,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U

Table 12: LHAAP-16 Annual Sampling Results
 1st Quarter 2018 Groundwater Treatment Plant Report
 Longhorn Army Ammunition Plant

Location ID: Sample Date:	Units	MCL/PCL/ MSC	16EW01_ 020718	16EW02_ 020718	16EW03_ 020718	16EW04_ 020718	16EW05_ 020718	16EW05_ 020718_a	16EW06_ 020718	16EW07_ 020718	16EW08_ 020718
Lab Package: HS18020534											
Location Description			Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – ENE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually Duplicate.	Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – ENE, middle region Sampled Annually
2-Hexanone	µg/L	6,100	< 2.0 U	< 100 U	< 100 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
4-Chlorotoluene	µg/L	2,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
4-Isopropyltoluene	µg/L	10,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
4-Methyl-2-pentanone	µg/L	8,200	< 2.0 U	< 100 U	< 100 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
Acetone	µg/L	92,000	< 2.0 U	< 100 U	< 100 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
Benzene	µg/L	5	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromobenzene	µg/L	2,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromochloromethane	µg/L	4,100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromodichloromethane	µg/L	4.6	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromoform	µg/L	36	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Bromomethane	µg/L	140	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Carbon disulfide	µg/L	10,000	< 2.0 U	< 100 U	< 100 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
Carbon tetrachloride	µg/L	5	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Chlorobenzene	µg/L	100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Chloroethane	µg/L	41,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Chloroform	µg/L	1,000	0.79 J	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	0.60 J	< 1.0 U	< 1.0 U
Chloromethane	µg/L	220	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
cis-1,2-Dichloroethene	µg/L	70	3,100	7,400	7,400	47	76 J	190 J	570	230	150
cis-1,3-Dichloropropene	µg/L	5.3	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Dibromochloromethane	µg/L	34	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Dibromomethane	µg/L	380	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Dichlorodifluoromethane	µg/L	20,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Ethylbenzene	µg/L	700	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Hexachlorobutadiene	µg/L	20	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Isopropylbenzene	µg/L	10,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
m,p-Xylene	µg/L	10,000**	< 2.0 U	< 100 U	< 100 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U

Table 12: LHAAP-16 Annual Sampling Results
1st Quarter 2018 Groundwater Treatment Plant Report
Longhorn Army Ammunition Plant

Location ID: Sample Date:	Units	MCL/PCL/ MSC	16EW01_ 020718	16EW02_ 020718	16EW03_ 020718	16EW04_ 020718	16EW05_ 020718	16EW05_ 020718_a	16EW06_ 020718	16EW07_ 020718	16EW08_ 020718
Lab Package: HS18020534											
Location Description			Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – ENE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually Duplicate.	Site 16 – NE, middle region Sampled Annually	Site 16 – NE, middle region Sampled Annually	Site 16 – ENE, middle region Sampled Annually
Methylene chloride	µg/L	5	< 2.0 U	< 100 U	< 100 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U
Naphthalene	µg/L	2,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
n-Butylbenzene	µg/L	4,100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
n-Propylbenzene	µg/L	4,100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
o-Xylene	µg/L	10,000**	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
sec-Butylbenzene	µg/L	4,100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Styrene	µg/L	100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
tert-Butylbenzene	µg/L	4,100	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Tetrachloroethene	µg/L	5	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Toluene	µg/L	1,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
trans-1,2-Dichloroethene	µg/L	100	5.0	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
trans-1,3-Dichloropropene	µg/L	29	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Trichloroethene	µg/L	5	3,600	19,000	24,000	67	100 J	280 J	660	130	460
Trichlorofluoromethane	µg/L	31,000	< 1.0 U	< 50 U	< 50 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Vinyl chloride	µg/L	2	31	320	79	< 1.0 U	40 J	110 J	2.4	1.3	1.3

Notes:

Blue Highlighting Indicates concentrations above the MCL/PCL/MSC

MCL/PCL/MSC - Maximum Contaminant Limit/Protective Concentration Level/Medium-Specific Concentration

µg/L - micrograms per liter

J - estimated value between the limit of quantitation and the detection limit and/or estimated due to quality control discrepancies

UJ - estimated non-detect due to quality control discrepancies

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

*PCL – Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level

** Value is for total xylenes

-a - duplicate sample

GWTP QUARTERLY EVALUATION REPORT – 1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

4 QUALITY CONTROL

This report summarizes the data for samples collected during January, February, and March 2018. The samples were reviewed and validated in accordance with the guidelines in the *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA, January 2017); *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (USEPA, January 2017); and the quality control criteria specified in the *Basewide Uniform Federal Policy - Quality Assurance Project Plan Longhorn Army Ammunition Plant* (Bhate, May 2018).

The purpose of the sampling program is to evaluate the effectiveness of the groundwater pump and treat system, assess water quality within the capture zone, and assure compliance with the effluent discharge requirements of the Interim ROD. Quality control and quality assurance problems noted in the case narratives received from the laboratory are minor and do not affect the usability of the data for compliance at the GWTP. No sample results from the 1st quarter of 2018 were rejected due to quality control problems.

ALS Environmental analyzed the compliance samples collected from the GWTP. Independent data verification and validation was performed by the Bhate Environmental Associates, Inc. (Bhate) project chemist as described in the Quality Control Summary Report in **Appendix E**. The laboratory reports for the 1st quarter of 2018 are included in **Appendix C** on a CD and the laboratory results for sampling conducted at LHAAP-16 are included in **Appendix D** on CD. Air monitoring data is presented in **Appendix F** on CD.

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LONGHORN ARMY AMMUNITION PLANT

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5 TREATED GROUNDWATER DISCHARGED

Reinjection of groundwater in ICT 6 and ICT 9 was discontinued as of July 15, 2012. The last injection occurred on May 24, 2012, immediately prior to the scrubber system malfunction which caused GWTP operation to cease temporarily.

Treated groundwater that met the perchlorate discharge criteria was discharged to Harrison Bayou or the INF Pond in accordance with the Protocol for Discharging GWTP Effluent (**Appendix G**). **Table 13** summarizes flow rates from the INF Pond to the Harrison Bayou, the maximum flow rate allowed by chloride and sulfate concentrations, and the approximated flow rate discharged for February and March 2018. No treated groundwater was discharged to Harrison Bayou in January 2018 from the GWTP directly. Only water from the INF Pond was discharged to the Harrison Bayou in January 2018 because the valve for discharge from the GWTP could not be opened due to rusting. This valve was replaced on January 30, 2018. No treated groundwater was discharged to the INF Pond in March 2018 due to the continuous flow of the Harrison Bayou.

GWTP QUARTERLY EVALUATION REPORT –1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

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Table 13: Treated Groundwater Discharged to Harrison Bayou - October 2017 through December 2017

Date	Harrison Bayou Flow (gpm)	Maximum Rate Allowed (gpm)	Released Flow Rate From GWTP To Harrison Bayou (gpm)	Volume Release to Harrison Bayou from GWTP (Gallons)	Released Flow Rate From INF Pond To Harrison Bayou (gpm)	Volume Released to INF Pond from Harrison Bayou (Gallons)	Combined Total Flow Rate Released To Harrison Bayou (gpm)	Combined Total Volume Released To Harrison Bayou (Gallons)
01/01/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/02/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/03/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/04/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/05/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/06/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/07/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/08/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/09/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/10/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/11/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/12/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/13/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/14/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/15/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/16/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/17/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/18/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/19/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/20/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/21/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/22/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/23/2018	682	199	0.0	0.0	0.0	0.0	0.0	0.0
01/24/2018	631	184	0.0	0.0	106	153,900	106	153,900
01/25/2018	315	92	0.0	0.0	64	92,928	64	92,928
01/26/2018	226	66	0.0	0.0	51	78,738	51	78,738
01/27/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/28/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/29/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/30/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
01/31/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0

Table 13: Treated Groundwater Discharged to Harrison Bayou - October 2017 through December 2017

Date	Harrison Bayou Flow (gpm)	Maximum Rate Allowed (gpm)	Released Flow Rate From GWTP To Harrison Bayou (gpm)	Volume Release to Harrison Bayou from GWTP (Gallons)	Released Flow Rate From INF Pond To Harrison Bayou (gpm)	Volume Released to INF Pond (Gallons)	Combined Total Flow Rate Released To Harrison Bayou (gpm)	Combined Total Volume Released To Harrison Bayou (Gallons)
02/01/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/02/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/03/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/04/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/05/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/06/2018	No Release	N/A	0.0	0.0	0.0	0.0	0.0	0.0
02/07/2018	32,018.00	5,857.00	10	4,021	0.0	0.0	10	4,021
02/08/2018	FLOOD STAGE	MAXIMUM	10	15,678	152	219,096	162	234,774
02/09/2018	18,544.0	3,392.0	10	8,820	154	222,308	164	231,128
02/10/2018	7,631.0	1,395.0	10	4,780	145	208,780	155	213,560
02/11/2018	5,309.0	971.0	10	5,313	134	193,694	144	199,007
02/12/2018	2,925.0	535.0	10	7,899	148	213,675	158	221,574
02/13/2018	2,051.0	527.0	10	7,611	126	182,478	136	190,089
02/14/2018	2,536.0	652.0	10	8,248	72	104,838	82	113,086
02/15/2018	19,322.0	4,968.0	10	8,044	40	58,996	50	67,040
02/16/2018	18,950.0	4,873.0	10	6,395	18	26,769	28	33,164
02/17/2018	9,161.0	2,355.0	10	5,227	0	0	10	5,227
02/18/2018	8,697.0	2,236.0	10	6,814	0	0	10	6,814
02/19/2018	6,575.0	1,690.0	10	6,872	0	0	10	6,872
02/20/2018	4,753.0	1,222.0	10	8,172	0	0	10	8,172
02/21/2018	11,363.0	2,922.0	10	9,428	0	0	10	9,428
02/22/2018	No Release	N/A	0.0	0	0	0	0	0
02/23/2018	No Release	N/A	0.0	0	0	0	0	0
02/24/2018	FLOOD STAGE	MAXIMUM	In Recycle	0	0	0	0	0
02/25/2018	FLOOD STAGE	MAXIMUM	10	14,185	0	0	10	14,185
02/26/2018	FLOOD STAGE	MAXIMUM	10	19,690	0	0	10	19,690
02/27/2018	FLOOD STAGE	MAXIMUM	10	14,238	0	0	10	14,238
02/28/2018	FLOOD STAGE	MAXIMUM	12	17,154	0	0	12	17,154
03/01/2018	FLOOD STAGE	MAXIMUM	12	16,638	0	0	12	16,638
03/02/2018	FLOOD STAGE	MAXIMUM	12	11,233	0	0	12	11,233

Table 13: Treated Groundwater Discharged to Harrison Bayou - October 2017 through December 2017

Date	Harrison Bayou Flow (gpm)	Maximum Rate Allowed (gpm)	Released Flow Rate From GWTP To Harrison Bayou (gpm)	Volume Release to Harrison Bayou from GWTP (Gallons)	Released Flow Rate From INF Pond To Harrison Bayou (gpm)	Volume Released to INF Pond (Gallons)	Combined Total Flow Rate Released To Harrison Bayou (gpm)	Combined Total Volume Released To Harrison Bayou (Gallons)
03/03/2018	FLOOD STAGE	MAXIMUM	12	18,882	0	0	12	18,882
03/04/2018	FLOOD STAGE	MAXIMUM	12	14,826	0	0	12	14,826
03/05/2018	FLOOD STAGE	MAXIMUM	12	24,161	0	0	12	24,161
03/06/2018	20,897	6,106	10	12,869	0	0	10	12,869
03/07/2018	15,464	4,518	10	13,411	0	0	10	13,411
03/08/2018	10,842	3,168	10	13,427	0	0	10	13,427
03/09/2018	6,098	1,782	10	10,021	0	0	10	10,021
03/10/2018	5,210	1,522	10	13,287	0	0	10	13,287
03/11/2018	7,943	2,321	10	9,748	0	0	10	9,748
03/12/2018	FLOOD STAGE	MAXIMUM	12	23,029	0	0	12	23,029
03/13/2018	FLOOD STAGE	MAXIMUM	12	16,576	0	0	12	16,576
03/14/2018	17,332	6,723	12	14,784	0	0	12	14,784
03/15/2018	11,797	4,576	10	15,051	148	213,150	158	228,201
03/16/2018	7,332	2,844	10	10,064	130	187,284	140	197,348
03/17/2018	6,861	2,661	10	12,716	115	165,680	125	178,396
03/18/2018	6,293	2,441	10	12,288	87	125,020	97	137,308
03/19/2018	5,526	2,144	10	15,407	80	116,128	90	131,535
03/20/2018	4,040	1,567	None-In Recycle	0	44	63,554	44	63,554
03/21/2018	4,787	1,857	10	14,026	0	0	10	14,026
03/22/2018	3,888	1,508	10	14,722	0	0	10	14,722
03/23/2018	2,911	1,129	10	10,141	0	0	10	10,141
03/24/2018	2,242	869	10	10,034	0	0	10	10,034
03/25/2018	1,820	706	10	13,813	0	0	10	13,813
03/26/2018	1,279	496	14	22,102	0	0	14	22,102
03/27/2018	1,131	378	12	17,615	0	0	12	17,615
03/28/2018	FLOOD STAGE	MAXIMUM	12	19,195	0	0	12	19,195
03/29/2018	FLOOD STAGE	MAXIMUM	12	17,572	0	0	12	17,572
03/30/2018	FLOOD STAGE	MAXIMUM	12	15,082	0	0	12	15,082
03/31/2018	FLOOD STAGE	MAXIMUM	14	15,931	0	0	14	15,931
Totals				627,240		2,627,016		3,254,256

Notes:

gpm - gallons per minute

N/A - not applicable

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6 AIR MONITORING

6.1 Summary of Air Monitoring Approach

Operation of the GWTP without air abatement was approved by the TCEQ and USEPA conditioned on collection of air monitoring data to determine the effect of GWTP operation on ambient air quality with respect to potential human health exposure risk. An Interim Air Monitoring Plan was developed by AECOM in August 2012 and used to implement the air monitoring program. The air monitoring program included sampling emission concentrations from the air stripper, ambient air at the GWTP, and ambient air downwind of the GWTP. Collection of air data occurred on a weekly basis between September 2012 and September 2013, on a monthly basis between September 2013 and September 2014, and on a quarterly basis since that time. The sampling program includes use of Summa canisters and a photoionization detector (PID) to measure vapor phase concentrations. The air stripper emission sample is collected as a grab sample, while the ambient air samples are collected as composite samples. The GWTP sample is collected over 8 hours to represent a work day and the downwind sample is collected over 24 hours to represent potential exposure to an off-site receptor¹. The downwind sample is collected at the closest downwind property boundary, based on prevailing wind direction.

PID data (after system calibration) are collected each time the GWTP is operated and serve as a real-time indicator of ambient air conditions at and downwind of the GWTP. Correlations between definitive analytical air data and PID measurements were established and a means to calculate contaminant concentration from PID measurements was developed. A PID threshold of 0.4 parts per million by volume (ppmv) in ambient air was established, such that Summa canister measurements would occur when the PID threshold is exceeded.

The Summa canister samples are analyzed for VOCs using USEPA Method TO-15. The PID measurements are collected after instrument calibration. The air sampling results are summarized and reported to the USEPA and TCEQ in the GWTP quarterly reports; however, the air results are reviewed immediately upon receipt for the potential presence of any exceedances of ambient air concentrations. **Appendix F** (Tables 1 through 4) includes a summary of analytical results and PID readings, calculations of emission rates from the emission point, comparison of ambient air concentrations with TCEQ Air Monitoring Comparison Values (AMCVs) or the short-term Effects Screening Levels (ESLs) for chemicals with no published AMCVs, and a compilation of PID results and calibration records. The air monitoring results to date indicate that all ambient

¹ Off-site receptor - Any recreational area, residence, commercial/industrial facility, or other normally occupied structures not used solely by the owner or operator of the facilities or the owner of the site upon which the facilities are located. Measurements of distances to determine compliance with this distance restriction must be taken toward structures that are in use as of the date that a notification is filed with the commission.

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air concentrations are lower than the AMCVs or ESLs. The stripper stack sample concentrations are used to calculate emission rates in pounds per hour (lbs/hr) and tons per year (tpy). The calculated emission rates in lbs/hr are then compared to the allowable emission rates per 30 Texas Administrative Code (TAC) §106.533(f)(1). The emission rates have been lower than the allowable emission rates to the conservatively-selected off-site receptor. The calculated emission rate in tpy is compared to the allowable limit of 5 tpy per chemical. All emission rates have been lower than the allowable emission rates.

The air monitoring results from the first few months of operation between September and November 2012 were compiled and submitted in a separate report (December 2012) (along with validated data) to TCEQ to demonstrate compliance with Texas Permit by Rule emission standards. Approval of the analytical results and concurrence that the site will continue to meet Title 30 TAC §106.533 without the use of air abatement using a catalytic oxidation system was obtained from the TCEQ via email on February 22, 2013.

On February 18, 2013, AECOM presented analysis of the approach applicable to obtaining a variance for operating the GWTP without air abatement equipment to the TCEQ and USEPA. The analysis indicated that the use of an Explanation of Significant Difference (ESD) was the appropriate approach for the site. Approval of use of an ESD was obtained from the USEPA via email on March 21, 2013. The ESD was developed, reviewed, and accepted by USEPA and TCEQ. The ESD was signed by the designated parties on April 3, 2014, and concurrence from the TCEQ was obtained in a letter dated April 16, 2014.

6.2 Air Monitoring Results for the 1st Quarter of 2018

During the 1st quarter of 2018, air sampling was completed on March 5, 2018. A summary of the air sampling results is presented in **Appendix F (Tables 1 through 3)**. All results met the criteria described in Section 6.1.

6.2.1 Summa Canister Monitoring Results

One sampling event was conducted on March 5, 2018, for presentation during the 1st Quarter 2018 reporting period using Summa canisters. The samples were collected and analyzed as described in Section 6.1 and per the approved air monitoring plan dated August 2012. The analytical results were then compiled in spreadsheets where calculations were completed and comparisons to applicable criteria were made as described in Section 6.1.

6.2.1.1 Ambient Air Results

Dichlorodifluoromethane, ethanol, trichlorofluoromethane, trichlorotrifluoroethane, alpha-pinene, toluene, and ethyl acetate were detected in March 2018 in ambient air downwind of the GWTP.

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Compounds originating at the GWTP would be expected to have lower concentrations in the downwind sampling location than at the GWTP sampling location. Likewise, compounds like n-hexane, dichlorodifluoromethane, and trichlorofluoromethane with similar concentrations in both GWTP ambient air and downwind ambient air are suspected to be present in the ambient (background) air.

All ambient air results during the quarter met the ambient air criteria, as presented in **Table 1** within **Appendix F**.

6.2.1.2 Air Stripper Effluent Results

The VOCs present in groundwater that are removed via the air stripper include 1,1-DCE; 1,2-dichloroethane; cis-1,2-DCE; methylene chloride; TCE; vinyl chloride; and trichlorotrifluoroethane. The highest reported concentrations are for TCE; methylene chloride; cis-1,2-DCE; and trichlorotrifluoroethane. These compounds are frequently reported in groundwater at the site, with the exception of trichlorotrifluoroethane which is not typically a groundwater analyte at LHAAP. Trichlorotrifluoroethane, however, appears to be present in groundwater as indicated by limited analysis conducted in December 2013, where it was detected in several wells, and from historical accounts. Many of the chemicals that are reported in ambient air are not detected in the air stripper effluent. This is likely because the reporting limit for the air stripper effluent is higher than the reporting limit for the ambient air samples or the source for some of these chemicals are extraneous to groundwater.

All air stripper effluent concentrations were below the emission criteria, as presented in **Table 2** within **Appendix F**.

6.2.2 PID Results

Along with collection of Summa canister air samples, PID measurements from the same sources/areas are collected and recorded. These simultaneous measurements allowed establishing a correlation between PID readings and VOC concentrations in the Summa canister air samples. Conversion from PID to compound concentrations was established by TCEQ in 30 TAC §106.533(h). The TCEQ equation allows use of a PID to determine individual compound concentrations if the distribution of chemicals in the ambient air is known or assumed. This allows the use of a PID as a tool to measure VOC concentrations and convert the PID results to estimates of compound concentrations. All ambient air PID measurements during this quarter at the GWTP were reported at 0.0 parts per million. The results of the PID readings collected during GWTP operations are presented in **Table 3** within **Appendix F**.

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7 COMMENTS AND RESPONSES

The following comments were received from the USEPA on 23 May 2018, for the 3rd Quarter 2017 Report. A response follows each comment.

Comment 1: Page 1-6, Section 1.4: The text indicates that [orthophosphate] ortho-P and [ammonia-nitrogen] Ammonia-N were higher than usual, but then returned to normal after recycling. What are considered normal values for these parameters? Is there a relationship between high ortho-P and Ammonia-N values vs. the FBR not treating perchlorate concentrations to acceptable levels? Please explain. Is there a need to have a table showing the perchlorate concentrations vs. the levels of ortho-P and Ammonia-N concentrations?

Response to Comment 1: Ammonia-N and ortho-P are soluble nutrients used by the microbes in the metabolic process within the FBR. Effluent samples at the reactor outlet are analyzed to verify that trace amounts of these are present, which indicates that there is enough to sustain the biomass. If there is bypassing or short circuiting in the reactor and perchlorate is not being fully degraded, elevated levels of these nutrients may be present at the FBR outlet. **Table 14** following this section presents the nutrient results for the first quarter of 2018 and will be included in future reports. The elevated levels of soluble nutrients noted in third quarter of 2017 were not detected in the first quarter 2018 despite elevated levels of perchlorate in some of the weekly samples. The table also notes which samples were collected after the FBR versus the ion exchange vessels.

Comment 2: ICT 13D: EPA did notice a 2-foot water change in the area around ICT13D from August to September 2017. The pump and water level indicator were replaced and additional volumes of groundwater was pumped. EPA believes that if there is no irrigation water being sprinkled onsite and the pumps are working properly, there will be a decrease in the groundwater mound in the NW corner over time.

Response to Comment 2: Concur. In early August 2017, the high level probe was lowered in ICT 13D by approximately 4 feet due to the low level of water being produced from this extraction ICT. The observed change in water elevation is believed to be associated with the change in the pump placement.

Comment 3: Is there a meter measuring the gpm going out of the INF pond into Harrison Bayou? EPA has not seen it when visiting the INF pond. Table ES-1 indicates the number of gallons released on certain dates. The September 6 release was at maximum allowed in regards to discharge into Harrison Bayou. Is the flow of the Harrison Bayou greater at the INF pond discharge point vs. the discharge point for the GWTP?

Response to Comment 3: A digital inline flow meter is located on the northeast corner of the INF pond to measure outfall at the base of the dike near the handrails. On

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September 6, 2017, no effluent was released from the GWTP to Harrison Bayou; however, water from the INF pond was discharged to the Harrison Bayou. The maximum flow rate allowed was 48 gpm. The total released was 69,120 gallons, which equates to 48 gpm over the 24 hour period.

The following comments were received from the USEPA on 23 May 2018, for the 4th Quarter 2017 Report. Responses follow each comment.

Comment 1: Page Xii. Table ES-1, Last release date (12/16/17): The gallons per minute released from the INF pond seem to exceed the maximum release rate. Please explain. In addition, the effluent release is based on the flow to the bayou, chloride/sulfate concentrations, and volume. In cases where the water is stored in the INF pond and then released later, how is the proper release calculated? Is it the average of concentrations over time released to the INF? Are chloride and sulfate collected from the INF prior to release? Please clarify. Also, table 5-1 information contradicts some of the information in table ES-1.

Response to Comment 1: Table 5-1 within this report contains the correct information. Table ES-1 is incorrect. There was no water released from the GWTP or the INF pond on 12/16/17. Chloride and sulfate is analyzed from the GWTP effluent and the INF pond discharge waters, when discharging from both locations. These readings are then entered into the calculation spreadsheet, and whichever one is the lowest allowable flow rate is used as the maximum allowable discharge rate for both the GWTP and INF pond combined.

Comment 2: Tables 2-2: On some of the monitoring well results the tables have an “a” designation and there is no indication of what it means. EPA assumes they are duplicative sample results. Please clarify.

Response to comment 2: The “a” designations does mean a duplicative sample result, which will be added to the notes at the bottom of the appropriate tables within this document and in future documents.

Comment 3: Shallow Zone Potentiometric Maps for Site 18/24: Why are there high water levels in monitoring well 18WW07 during this quarter?

Response to comment 3: The water level for 18WW07 was not used in development of the potentiometric maps. It is believed that the screen has collapsed in this well because the total depth is shallower than from the original total depth according to the drilling log.

Comment 4: Concentration Isoleths for 18/24: From the previous temporary well that was installed in the SW corner, concentrations of perchlorate were approximately 120,000 ppb. This map seems misleading in respect to the perchlorate concentrations in this corner.

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Response to Comment 4: Noted. This comment was addressed in the Final Revised Feasibility Study with follow-on response to EPA comment #58.

Comment 5: Site 16 Intermediate Zone Potentiometric Maps: There is a noticeable bend in the contours about 3/4 up from left to right. This has not been identified before in previous maps. It appears there is a preferential flow path (potential paleochannel).

Response to Comment 5: These contours are created using the Surfer software. It would appear that this bend is based upon the limited groundwater level data. The additional well installation at Site 16 will be used in the near future to better assess the groundwater flow and potential preferential flow pathway(s). The potentiometric maps presented in **Appendix B** contain contours developed using the Surfer software, which was then smoothed out in the final presentation given the limited number of wells evaluated.

Comment 6: General Comment: EPA noticed that the amount of water being pumped out of ICTs increased to over 600,000 gallons this quarter. The replacement of the pumps and the water level sensors obviously has helped. The volume of water pumped out of ICT 14D greatly increased also. Why did ICT 13C decrease so much in November and December? Are there mechanical problems?

Response to Comment 6: The decrease at ICT 13C was due to both the flow meter and pump not working properly. Both of these issues were resolved at the end of January 2018.

Comment 7: General Comment: Monitoring well 18CPTMW08DW needs to be analyzed for VOCs. While the well has been analyzed for perchlorate on a consistent basis, EPA does not recall the last time the well was sampled for VOCs. The other deep wells have been sampled for VOCs on a regular basis.

Response to Comment 7: VOCs will be added to the June 2018 groundwater sampling event for well 18CPTMW08DW.

Comment 7: General Comment: EPA recommends further evaluation (possibly [passive diffusion bags] PDBs or changing the pump location) on monitoring well 18WW08 to determine why there is great variability in the contaminant concentrations per sampling events. Are the contaminants located in the lower vertical screen interval?

Response to Comment 7: Recommendation is noted.

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The following comments were received from the TCEQ on May 31, 2018, for the 4th Quarter 2017 Report. Responses follow each comment.

Comment 1: Section 2.4.1: This section should include a note that perchlorate is sampled biweekly. The last sentence should be revised to indicate all discharge was from the INF pond. The requirements for discharge to INF should be referenced.

Response to Comment 1: Section 2.4.1 will note that effluent sampling is completed biweekly. The discharge protocol will be noted in quarterly reports going forward, including within Section 2.4.1 of this report.

Comment 2: Table 5-1: When discharge is from INF pond, data should be included for “Harrison Bayou Flow” and “Maximum Rate Allowed” columns.

Response to Comment 2: Concur. Table 5-1 incorrectly reports a released flow rate from the INF Pond to the Harrison Bayou from December 2, 2017, through December 7, 2017. No release occurred to the Harrison Bayou until December 21, 2017.

Comment 1: Figure A-2: Add ion exchange vessels or a note.

Response to Comment 4: Concur. The following note will be added to Figure A-2: *Ion exchange resin vessels may be put online prior to the TK-650 sampling spigot for further treatment of perchlorate following the FBR.*

Comment 4: Appendix G: The binder is missing Appendix G Attachments 1 and 2. These should be part of the printed document. They are also not included on the separate pdf for Appendix G, which only has the lab package. The air data package is very small. Next time please just include it with the full document pdf. It makes sense to pull out the GW data packages, but not the air package. Also, the pages in the appendix are not in the right order, pdf page 177 should go before pdf page 142; these both belong in Attachment 1.

Response to Comment 4: The complete PDF includes Attachments 1 and 2 within Appendix G. Only the laboratory data is separate from the full PDF, as noted in the Table of Contents. Going forward, the laboratory reports containing the quarterly air samples will be included in full within the printed document and PDF. In addition the tables containing the Emissions Stack Air Data and the Ambient Air Data will be placed within *Attachment 1: Air Monitoring Calculations.*

Table 14
 Weekly Effluent Nutrient and Organic Carbon Sample Results
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Sample Identification	*LH18/24-SP650_011018 HS18010395	*LH18/24-SP650_012518 HS18011091 & H18011089	*LH18/24-SP650_013118 HS18020023	*LH18/24-SP650_020718 HS18020424	*LH18/24-SP650-021418 HS18020815	*LH18/24-SP650_022118 HS1805310 & HS18021137	LH18/24-SP650_022818 HS18030029	LH18/24-SP650_030718 HS18030369	LH18/24-SP650_031418 HS18030720	LH18/24-SP650_032118 HS18031052	*LH18/24-SP650_032818 HS18031414
Location Description											
Units	GWTP--Collected from a spigot on the discharge of effluent TK-650. Sampled Weekly.										
Perchlorate (6850)	Daily Maximum Concentration										
Perchlorate (weekly)	µg/L	ND	51	ND	ND	ND	73	57	130	500	ND
Ammonia as N (350.3)	See Table 2-3										
Ammonia as N	mg/L	16	18	8.7	8.4	10	11	10	16	14	14
Ortho-Phosphate (365.3)											
Ortho-Phosphate	mg/L	2.5	3.23	1.73	3.02	2.83	2.12	3.16	2.37	3.5	1.79
Organic Carbon (415.1)											
Total Organic Carbon (TOC)	mg/L	28.6	15.4	36.2	24.4	23.3	28.2	31.2	24.3	25.5	21.4

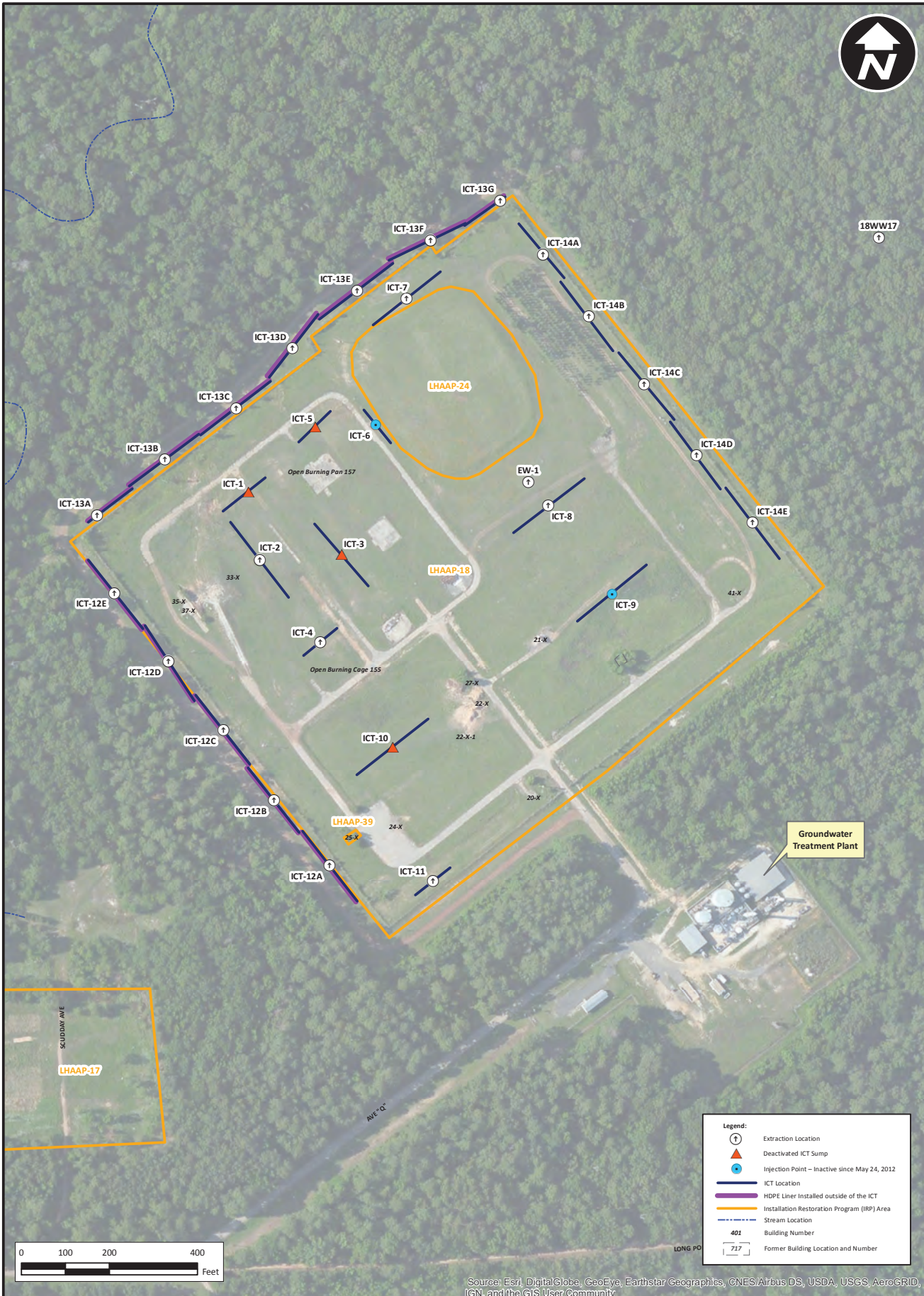
Notes:
 µg/L - micrograms per liter
 mg/L - milligrams per liter
 NV - No value
 GWTP - Groundwater Treatment Plant
 ND - Not Detected
 J - estimated concentration
 * Sample analyzed after the ion exchange vessel

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APPENDIX A
ICT LAYOUT AND GWTP PROCESS FLOW DIAGRAM

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



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Groundwater Treatment Plant
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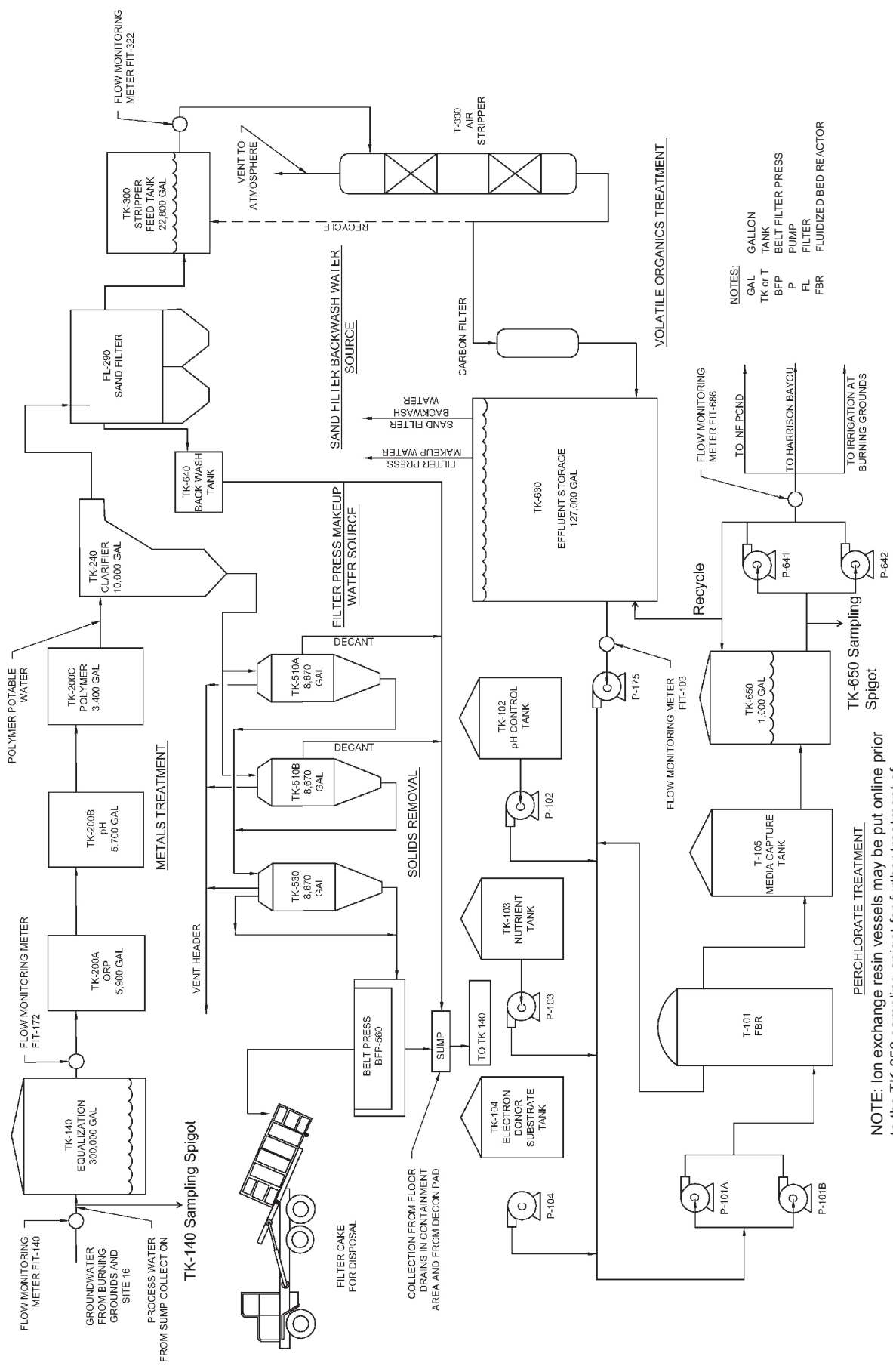
PROJECT NO:	SCALE:	DATE:	DRAWN BY:
NWO1312.0150	As Shown	3/12/2018	MRM

ICT Layout Map

Figure A-1

PROJECT NO:	NW01312.0150
SCALE:	Not to Scale
DATE:	3/12/2018
DRAWN BY:	MRM

Quarterly Evaluation Report 4th Quarter (October - December) 2017
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Longhorn Army Ammunition Plant, Karnack, Texas



- NOTES:
- GAL GALLON
 - TK or T TANK
 - BFP BELT FILTER PRESS
 - P PUMP
 - FL FILTER
 - FBR FLUIDIZED BED REACTOR

NOTE: Ion exchange resin vessels may be put online prior to the TK-650 sampling spigot for further treatment of perchlorate following the FBR.

Table A-1: ICTs Completion Depths

ICT	TOC Elevation	Total Depth	Sump Elevation	Comment
1	186.07	22.5	163.57	Taken out of service in 2007.
2	185.02	29.5	155.52	
3	192.27	37.75	154.52	Taken out of service in 2007.
4	193.51	37.5	156.01	
5	192.67	35	157.67	Taken out of service in 2007.
6	197.30	40.75	156.55	Converted to infiltration in 2007. Ceased reinjection in July 2012.
7	198.03	32.33	165.7	
8	198.97	44.5	154.47	
9	197.64	45.5	152.14	Converted to infiltration in 2007. Ceased reinjection in July 2012.
10	198.07	45.42	152.65	Taken out of service in 2007.
11	198.01	43.33	154.68	
12A	189.06	31.5	157.56	Taken out of service in 2007. Reinstituted in December 2012.
12B	191.97	36.25	155.72	
12C	193.90	34.33	159.57	
12D	185.64	33.75	151.89	
12E	183.38	32.25	151.13	
13A	182.59	28.17	154.42	
13B	184.72	29.58	155.14	
13C	186.13	28.17	157.96	
13D	186.72	26.17	160.55	
13E	191.79	27.08	164.71	
13F	197.81	32.33	165.48	
13G	197.03	27.25	169.78	Taken out of service in 2008.
14A	196.8	43.00	153.8	
14B	197.61	43.42	154.19	
14C	197.86	41.33	156.53	
14D	198.47	44.25	154.22	
14E	198.47	43.08	155.39	

Note(s):

ICT - interception-collection trench

TOC - top of casing, measuring point for groundwater elevations

Elevations are reported as feet above mean sea level.

Total depths are reported as feet below TOC.

Sump elevation calculated by subtracting total depth from TOC elevation.

ICTs were installed in 1998.

ICT 12A was replaced on December 5, 2012, and extraction has resumed.

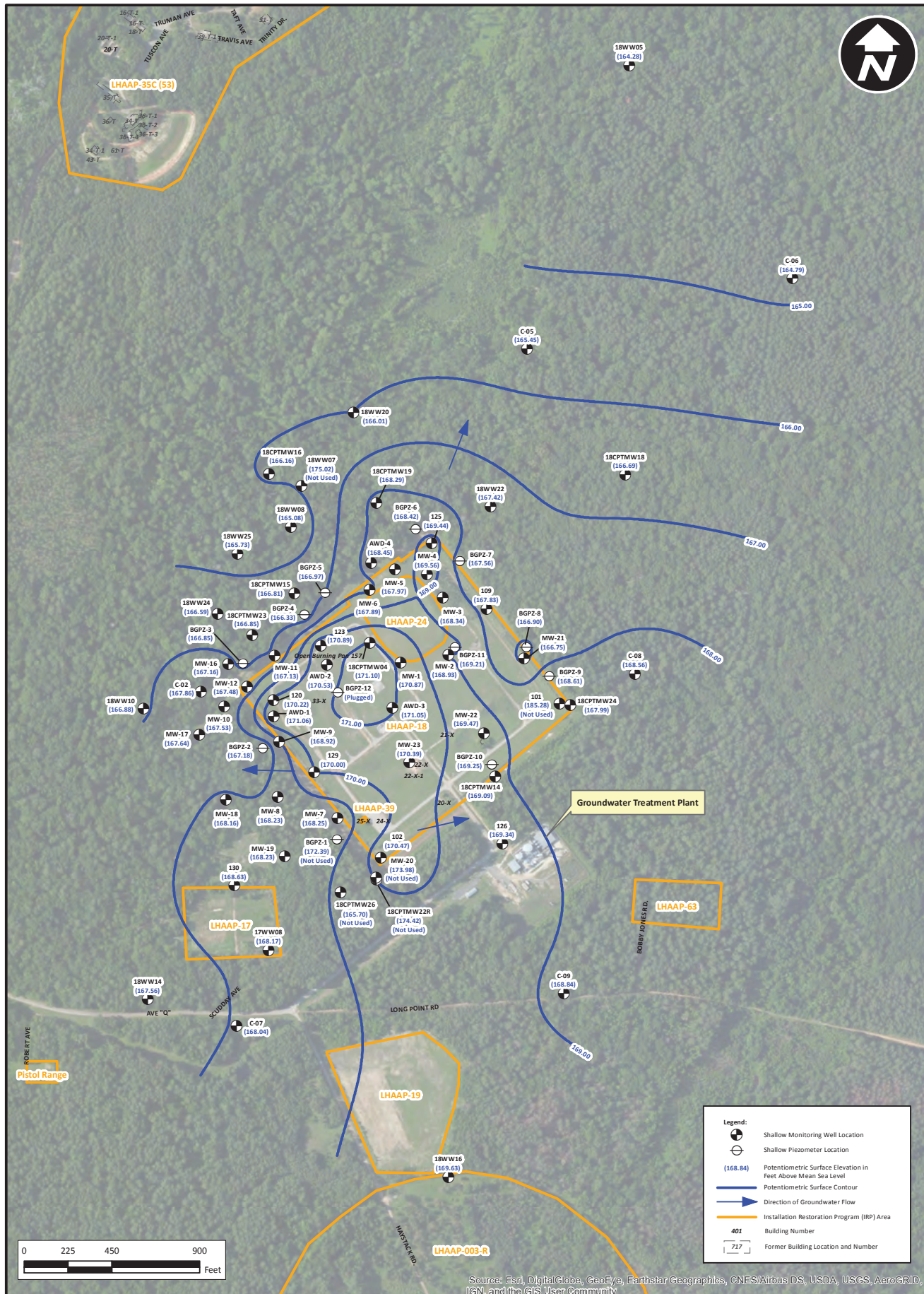
TOC Elevations and total depth measured in October 2003, 4th Quarter 2003, Groundwater Treatment Plant Report.

GWTP QUARTERLY EVALUATION REPORT – 1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

APPENDIX B
GROUNDWATER ELEVATION CONTOUR MAPS

GWTP QUARTERLY EVALUATION REPORT –1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

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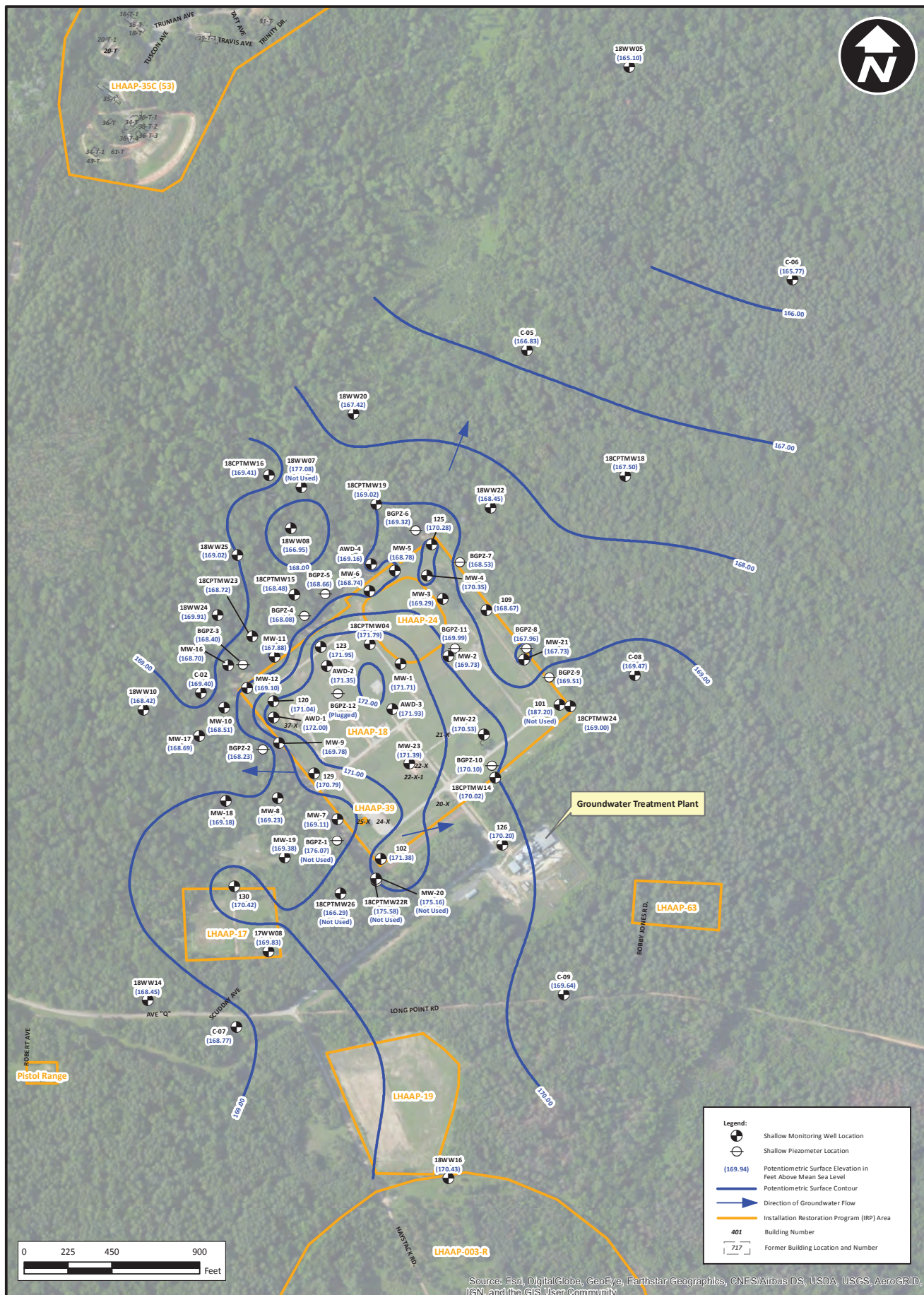


Quarterly Evaluation Report 1st Quarter (January – March) 2018
 Groundwater Treatment Plant
 Longhorn Army Ammunition Plant, Karnack, Texas

PROJECT NO:	SCALE:	DATE:	DRAWN BY:
NWO1312.0150	As Shown	4/24/2018	MRR

Groundwater Potentiometric Surface Map
 Shallow Zone (January 2018) LHAAP-18/24

Figure B-1



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

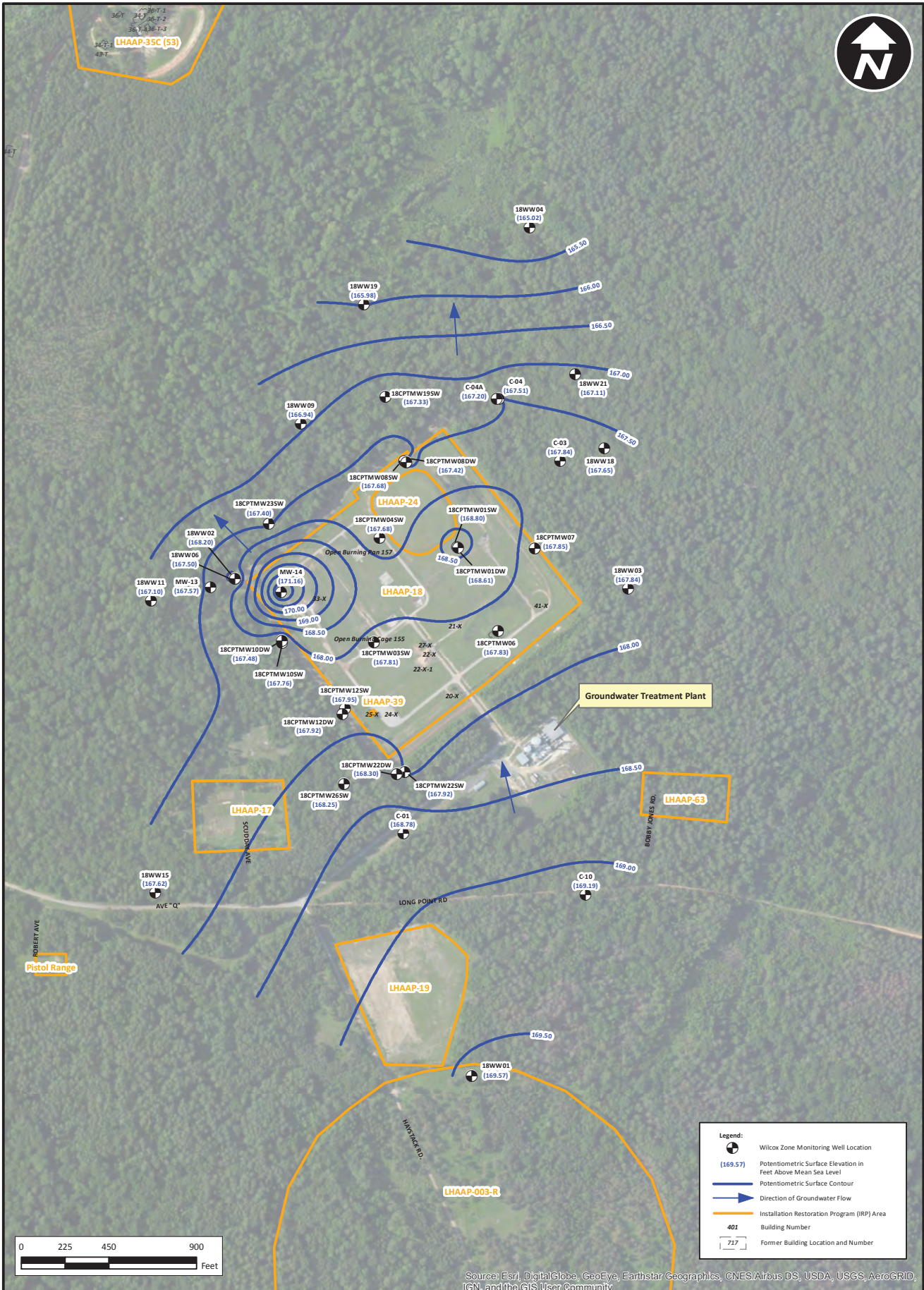


Quarterly Evaluation Report 1st Quarter (January – March) 2018
Groundwater Treatment Plant
Longhorn Army Ammunition Plant, Karnack, Texas

Groundwater Potentiometric Surface Map
Shallow Zone (March 2018) LHAAP-18/24

PROJECT NO.	SCALE:	DATE:	DRAWN BY:
NWO1312.0150	As Shown	5/22/2018	MRM

Figure B-3

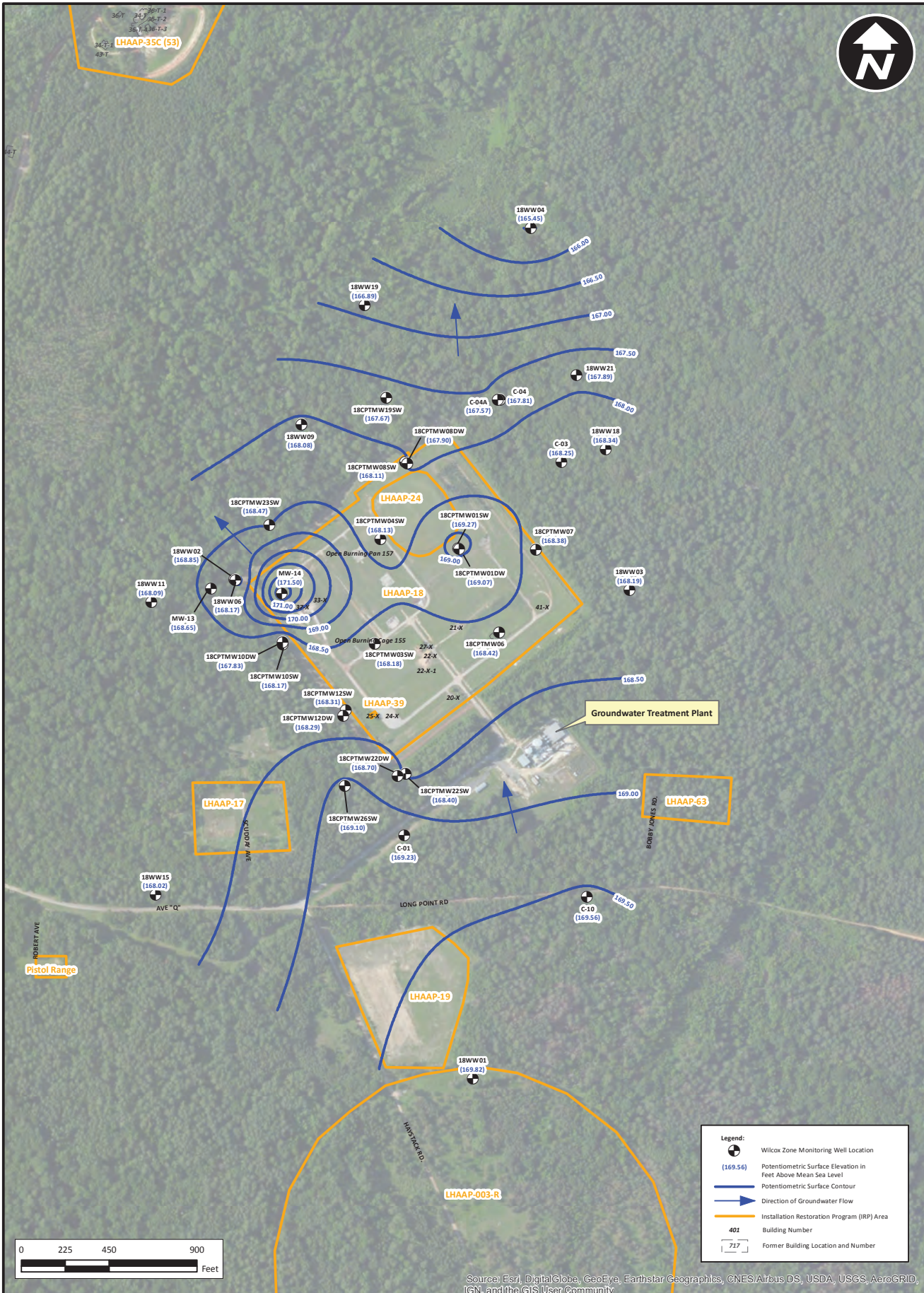


Quarterly Evaluation Report 1st Quarter (January – March) 2018
 Groundwater Treatment Plant
 Longhorn Army Ammunition Plant, Karnack, Texas

Groundwater Potentiometric Surface Map
 Wilcox Zone (January 2018) LHAAP-18/24

PROJECT NO:	SCALE:	DATE:	DRAWN BY:
NWO1312.0150	As Shown	4/25/2018	MRM

Figure B-4



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

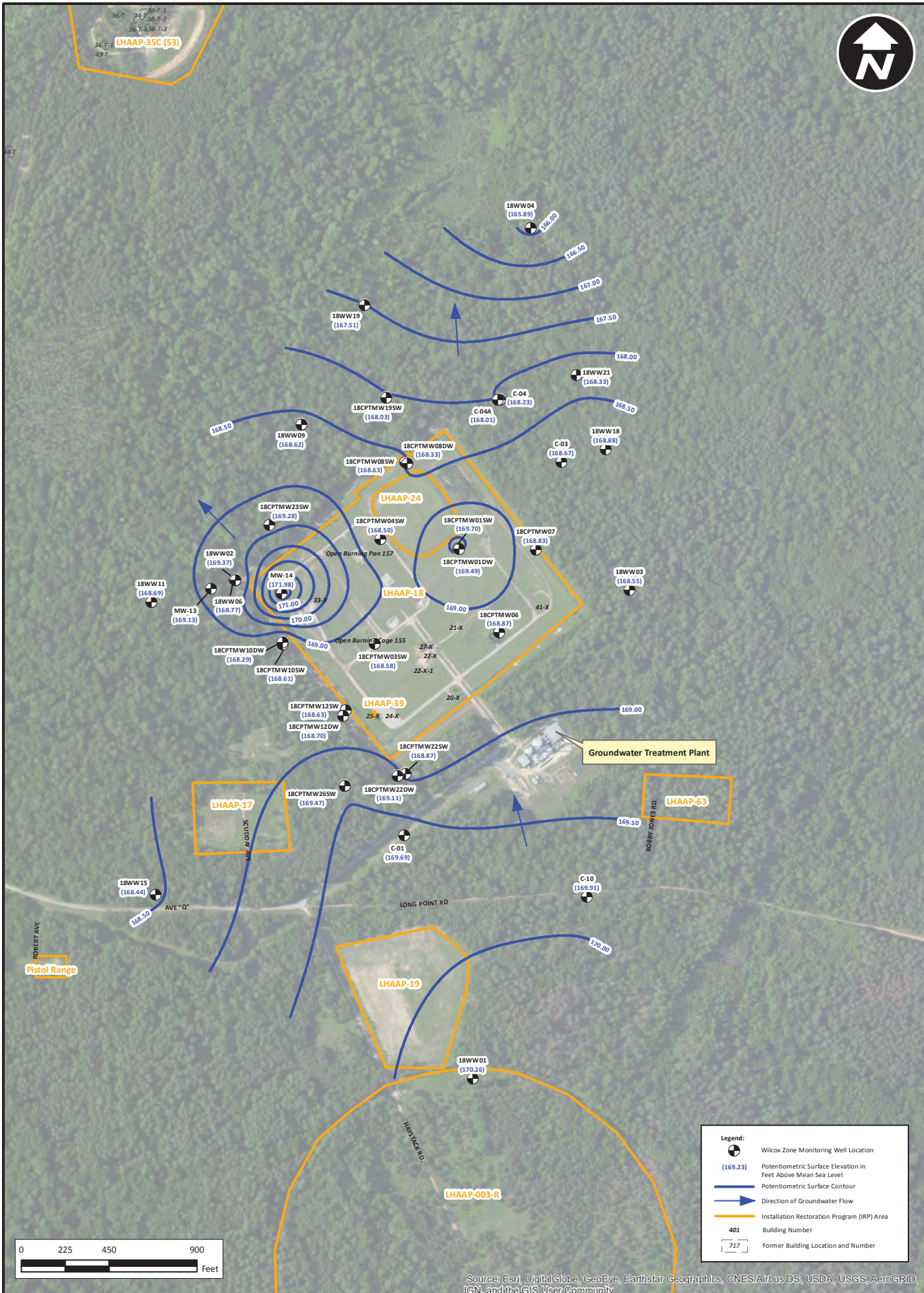


Quarterly Evaluation Report 1st Quarter (January – March) 2018
 Groundwater Treatment Plant
 Longhorn Army Ammunition Plant, Karnack, Texas

Groundwater Potentiometric Surface Map
 Wilcox Zone (February 2018) LHAAP-18/24

PROJECT NO:	SCALE:	DATE:	DRAWN BY:
NWO1312.0150	As Shown	4/25/2018	MRM

Figure B-5



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



Quarterly Evaluation Report 1st Quarter (January – March) 2018
Groundwater Treatment Plant
Longhorn Army Ammunition Plant, Karnack, Texas

Groundwater Potentiometric Surface Map
Wilcox Zone (March 2018) LHAAP-18/24

PROJECT NO.	SCALE	DATE	DRAWN BY
NWO1312.0150	As Shown	4/25/2018	MRM

Figure B-6

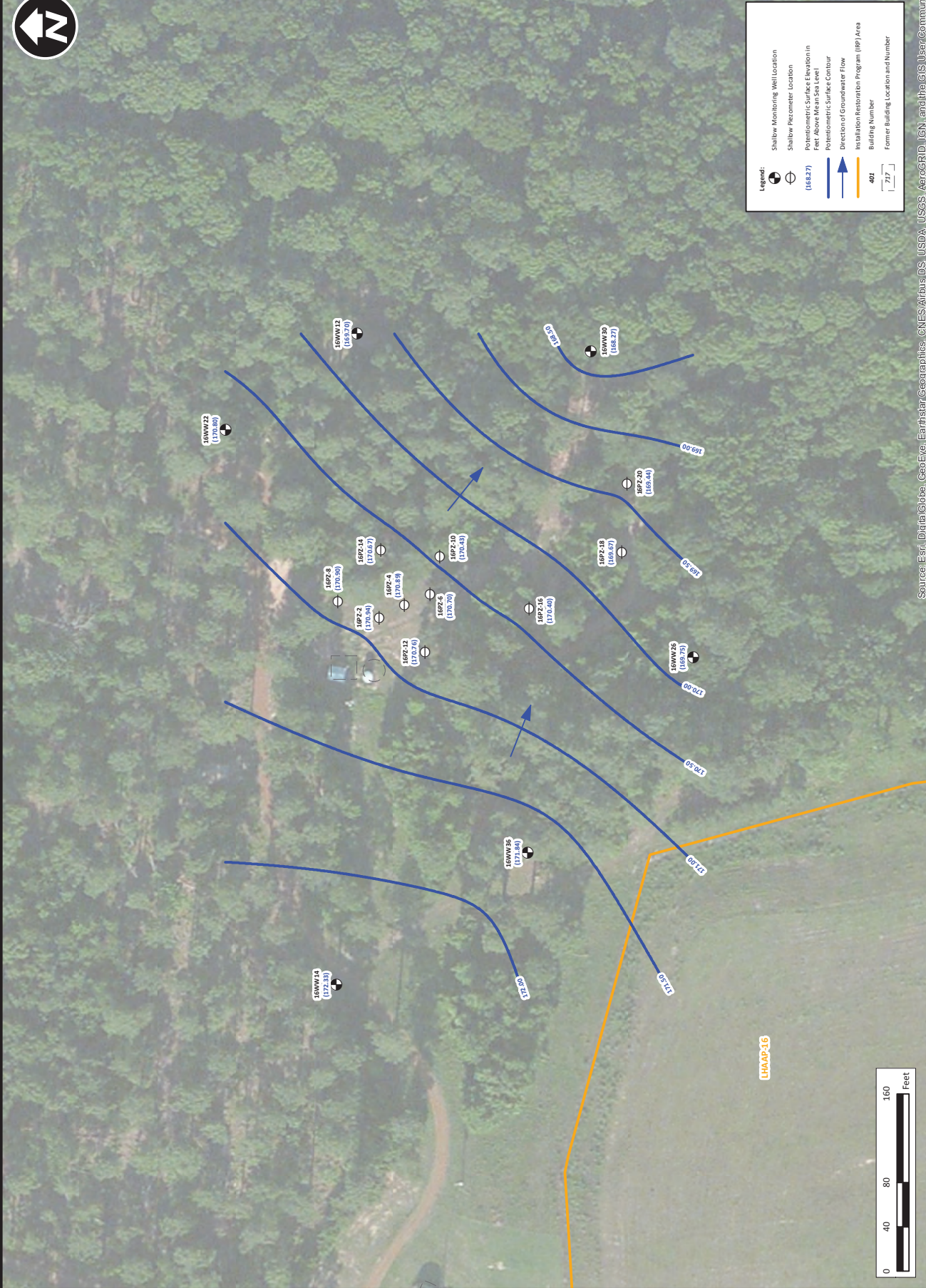
Figure B-7

Groundwater Potentiometric Surface Map
 Shallow Zone (January 2018) LHAAP-16



Legend:

- Shallow Monitoring Well Location
- Shallow Piezometer Location
- Potentiometric Surface Elevation in Feet Above Mean Sea Level (168.27)
- Potentiometric Surface Contour
- Direction of Groundwater Flow
- Installation Restoration Program (IRP) Area
- Building Number
- Former Building Location and Number



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

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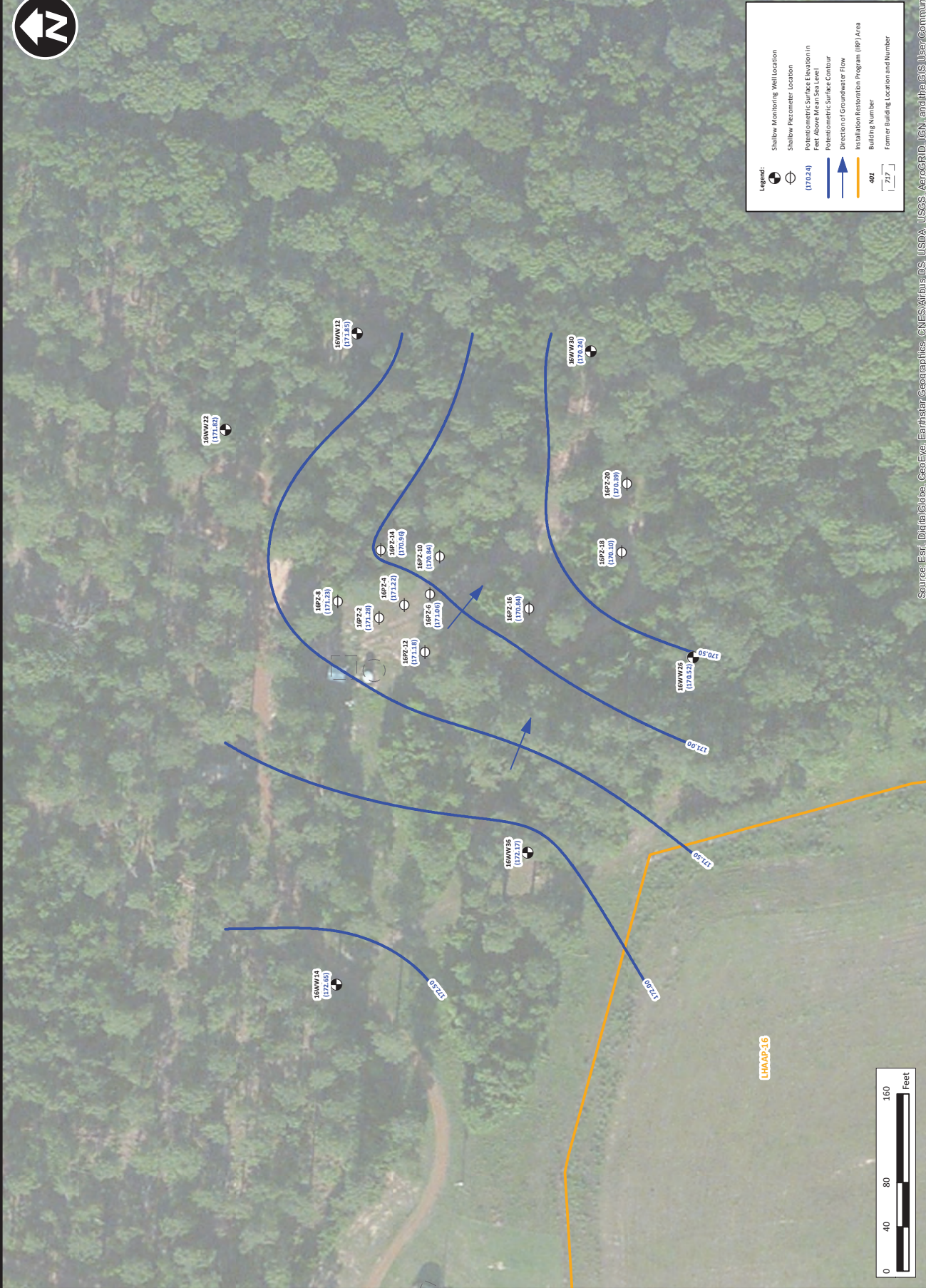
Figure B-8

Groundwater Potentiometric Surface Map
Shallow Zone (February 2018) LHAP-16



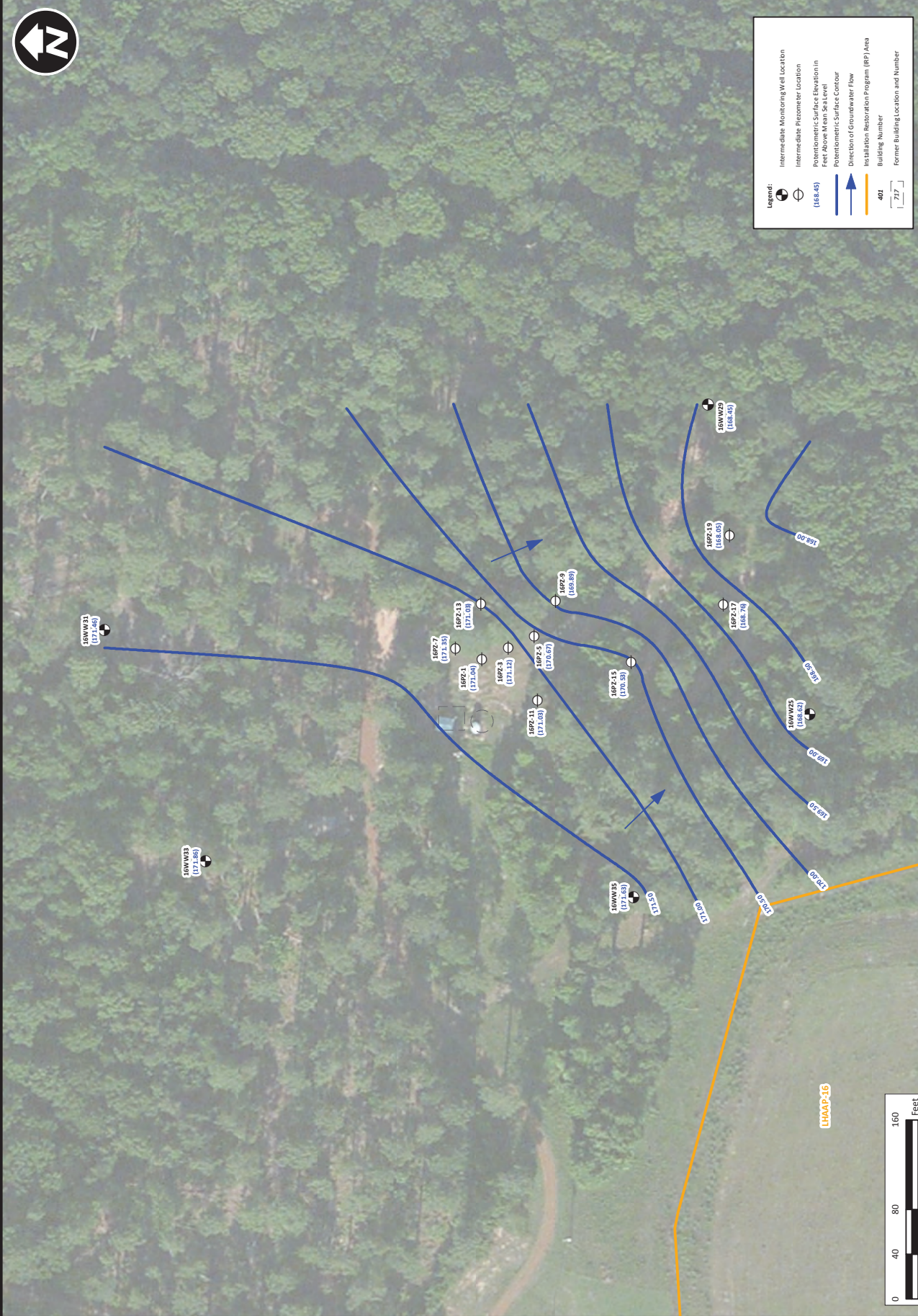
Legend:

- Shallow Monitoring Well Location
- Shallow Piezometer Location
- Potentiometric Surface Elevation in Feet Above Mean Sea Level (170.24)
- Potentiometric Surface Contour
- Direction of Groundwater Flow
- Installation Restoration Program (IRP) Area
- Building Number
- Former Building Location and Number



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

0672882799



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

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GWTP QUARTERLY EVALUATION REPORT – 1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

APPENDIX C
GWTP WATER SAMPLING LABORATORY ANALYTICAL RESULTS FOR THE 1ST
QUARTER 2018
(PROVIDED ON CD ONLY)

GWTP QUARTERLY EVALUATION REPORT –1ST QUARTER 2018
LONGHORN ARMY AMMUNITION PLANT

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

January 26, 2018

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

Work Order: **HS18010396**

Laboratory Results for: **Groundwater Treatment Plant Bi-Weekly Samples**

Dear Marcia,

ALS Environmental received 2 sample(s) on Jan 11, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
Work Order: HS18010396

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18010396-01	LH18/24-SP650_011018	Water		10-Jan-2018 14:00	11-Jan-2018 08:27	<input type="checkbox"/>
HS18010396-02	Trip Blank	Water	ALS- 110717-46	10-Jan-2018 00:00	11-Jan-2018 08:27	<input type="checkbox"/>

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
Work Order: HS18010396

CASE NARRATIVE

GCMS Volatiles by Method SW8260**Batch ID: R309266****Sample ID: HS18010704-15MS**

- MS and MSD are for an unrelated sample

WetChemistry by Method SW9056**Batch ID: R309426**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
 Project: Groundwater Treatment Plant Bi-Weekly Samples
 Sample ID: LH18/24-SP650_011018
 Collection Date: 10-Jan-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18010396
 Lab ID:HS18010396-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	20-Jan-2018 13:05	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	20-Jan-2018 13:05	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	20-Jan-2018 13:05	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	20-Jan-2018 13:05	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	20-Jan-2018 13:05	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
 Project: Groundwater Treatment Plant Bi-Weekly Samples
 Sample ID: LH18/24-SP650_011018
 Collection Date: 10-Jan-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18010396
 Lab ID:HS18010396-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
cis-1,2-Dichloroethene	3.6		0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	20-Jan-2018 13:05	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	20-Jan-2018 13:05	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 13:05	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>93.0</i>			0	<i>81-118</i>	%REC	<i>1</i>	<i>20-Jan-2018 13:05</i>	
<i>Surr: 4-Bromofluorobenzene</i>	<i>98.2</i>			0	<i>85-114</i>	%REC	<i>1</i>	<i>20-Jan-2018 13:05</i>	
<i>Surr: Dibromofluoromethane</i>	<i>104</i>			0	<i>80-119</i>	%REC	<i>1</i>	<i>20-Jan-2018 13:05</i>	
<i>Surr: Toluene-d8</i>	<i>91.3</i>			0	<i>89-112</i>	%REC	<i>1</i>	<i>20-Jan-2018 13:05</i>	
ANIONS BY SW9056A		Method:SW9056							Analyst: KMU
Chloride	546		2.00	2.50	5.00	mg/L	10	19-Jan-2018 15:57	
Sulfate	47.8		2.00	2.50	5.00	mg/L	10	19-Jan-2018 15:57	

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
 Project: Groundwater Treatment Plant Bi-Weekly Samples
 Sample ID: Trip Blank
 Collection Date: 10-Jan-2018 00:00

ANALYTICAL REPORT
 WorkOrder:HS18010396
 Lab ID:HS18010396-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	20-Jan-2018 12:40	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	20-Jan-2018 12:40	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	20-Jan-2018 12:40	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	20-Jan-2018 12:40	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	20-Jan-2018 12:40	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
 Project: Groundwater Treatment Plant Bi-Weekly Samples
 Sample ID: Trip Blank
 Collection Date: 10-Jan-2018 00:00

ANALYTICAL REPORT
 WorkOrder:HS18010396
 Lab ID:HS18010396-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
cis-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	20-Jan-2018 12:40	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	20-Jan-2018 12:40	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	20-Jan-2018 12:40	
Surr: 1,2-Dichloroethane-d4	92.4			0	81-118	%REC	1	20-Jan-2018 12:40	
Surr: 4-Bromofluorobenzene	97.8			0	85-114	%REC	1	20-Jan-2018 12:40	
Surr: Dibromofluoromethane	102			0	80-119	%REC	1	20-Jan-2018 12:40	
Surr: Toluene-d8	93.9			0	89-112	%REC	1	20-Jan-2018 12:40	

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R309266		Test Name : VOLATILES ORGANICS BY METHOD 8260C		Matrix: Water		
HS18010396-01	LH18/24-SP650_011018	10 Jan 2018 14:00			20 Jan 2018 13:05	1
HS18010396-02	Trip Blank	10 Jan 2018 00:00			20 Jan 2018 12:40	1
Batch ID R309426		Test Name : ANIONS BY SW9056A		Matrix: Water		
HS18010396-01	LH18/24-SP650_011018	10 Jan 2018 14:00			19 Jan 2018 15:57	10

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180120	Units: ug/L			Analysis Date: 20-Jan-2018 12:16					
Client ID:	Run ID: VOA2_309266	SeqNo: 4399283	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	0.50	1.0								U
1,1,1-Trichloroethane	0.50	1.0								U
1,1,2,2-Tetrachloroethane	0.50	1.0								U
1,1,2-Trichloroethane	0.50	1.0								U
1,1-Dichloroethane	0.50	1.0								U
1,1-Dichloroethene	0.50	1.0								U
1,1-Dichloropropene	0.50	1.0								U
1,2,3-Trichlorobenzene	0.50	1.0								U
1,2,3-Trichloropropane	0.50	1.0								U
1,2,4-Trichlorobenzene	0.50	1.0								U
1,2,4-Trimethylbenzene	0.50	1.0								U
1,2-Dibromo-3-chloropropane	0.50	1.0								U
1,2-Dibromoethane	0.50	1.0								U
1,2-Dichlorobenzene	0.50	1.0								U
1,2-Dichloroethane	0.50	1.0								U
1,2-Dichloropropane	0.50	1.0								U
1,3,5-Trimethylbenzene	0.50	1.0								U
1,3-Dichlorobenzene	0.50	1.0								U
1,3-Dichloropropane	0.50	1.0								U
1,4-Dichlorobenzene	0.50	1.0								U
2,2-Dichloropropane	0.50	1.0								U
2-Butanone	1.0	2.0								U
2-Chlorotoluene	0.50	1.0								U
2-Hexanone	1.0	2.0								U
4-Chlorotoluene	0.50	1.0								U
4-Isopropyltoluene	0.50	1.0								U
4-Methyl-2-pentanone	1.0	2.0								U
Acetone	1.0	2.0								U
Benzene	0.50	1.0								U
Bromobenzene	0.50	1.0								U
Bromochloromethane	0.50	1.0								U
Bromodichloromethane	0.50	1.0								U
Bromoform	0.50	1.0								U
Bromomethane	0.50	1.0								U

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180120	Units: ug/L			Analysis Date: 20-Jan-2018 12:16					
Client ID:	Run ID: VOA2_309266	SeqNo: 4399283	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	1.0	2.0								U
Carbon tetrachloride	0.50	1.0								U
Chlorobenzene	0.50	1.0								U
Chloroethane	0.50	1.0								U
Chloroform	0.50	1.0								U
Chloromethane	0.50	1.0								U
cis-1,2-Dichloroethene	0.50	1.0								U
cis-1,3-Dichloropropene	0.50	1.0								U
Dibromochloromethane	0.50	1.0								U
Dibromomethane	0.50	1.0								U
Dichlorodifluoromethane	0.50	1.0								U
Ethylbenzene	0.50	1.0								U
Hexachlorobutadiene	0.50	1.0								U
Isopropylbenzene	0.50	1.0								U
m,p-Xylene	1.0	2.0								U
Methylene chloride	1.0	2.0								U
Naphthalene	0.50	1.0								U
n-Butylbenzene	0.50	1.0								U
n-Propylbenzene	0.50	1.0								U
o-Xylene	0.50	1.0								U
sec-Butylbenzene	0.50	1.0								U
Styrene	0.50	1.0								U
tert-Butylbenzene	0.50	1.0								U
Tetrachloroethene	0.50	1.0								U
Toluene	0.50	1.0								U
trans-1,2-Dichloroethene	0.50	1.0								U
trans-1,3-Dichloropropene	0.50	1.0								U
Trichloroethene	0.50	1.0								U
Trichlorofluoromethane	0.50	1.0								U
Vinyl chloride	0.50	1.0								U
Surr: 1,2-Dichloroethane-d4	46.47	1.0	50	0	92.9	81 - 118				
Surr: 4-Bromofluorobenzene	48.47	1.0	50	0	96.9	85 - 114				
Surr: Dibromofluoromethane	51.71	1.0	50	0	103	80 - 119				
Surr: Toluene-d8	46.1	1.0	50	0	92.2	89 - 112				

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180120	Units: ug/L			Analysis Date: 20-Jan-2018 11:26					
Client ID:	Run ID: VOA2_309266	SeqNo: 4399281	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	47.82	1.0	50	0	95.6	78 - 124				
1,1,1-Trichloroethane	50.26	1.0	50	0	101	74 - 131				
1,1,2,2-Tetrachloroethane	42.74	1.0	50	0	85.5	71 - 121				
1,1,2-Trichloroethane	45.88	1.0	50	0	91.8	80 - 119				
1,1-Dichloroethane	48.39	1.0	50	0	96.8	77 - 125				
1,1-Dichloroethene	53.31	1.0	50	0	107	71 - 131				
1,1-Dichloropropene	52.91	1.0	50	0	106	79 - 125				
1,2,3-Trichlorobenzene	52.81	1.0	50	0	106	69 - 129				
1,2,3-Trichloropropane	43.26	1.0	50	0	86.5	73 - 122				
1,2,4-Trichlorobenzene	52.53	1.0	50	0	105	69 - 130				
1,2,4-Trimethylbenzene	40.76	1.0	50	0	81.5	76 - 124				
1,2-Dibromo-3-chloropropane	45.44	1.0	50	0	90.9	62 - 128				
1,2-Dibromoethane	49.63	1.0	50	0	99.3	77 - 121				
1,2-Dichlorobenzene	42.87	1.0	50	0	85.7	80 - 119				
1,2-Dichloroethane	51.46	1.0	50	0	103	73 - 128				
1,2-Dichloropropane	47	1.0	50	0	94.0	78 - 122				
1,3,5-Trimethylbenzene	41.48	1.0	50	0	83.0	75 - 124				
1,3-Dichlorobenzene	42.37	1.0	50	0	84.7	80 - 119				
1,3-Dichloropropane	45.29	1.0	50	0	90.6	80 - 119				
1,4-Dichlorobenzene	42.3	1.0	50	0	84.6	79 - 118				
2,2-Dichloropropane	51.64	1.0	50	0	103	60 - 139				
2-Butanone	98.17	2.0	100	0	98.2	56 - 143				
2-Chlorotoluene	39.89	1.0	50	0	79.8	79 - 122				
2-Hexanone	90.34	2.0	100	0	90.3	57 - 139				
4-Chlorotoluene	39.98	1.0	50	0	80.0	78 - 122				
4-Isopropyltoluene	43.44	1.0	50	0	86.9	77 - 127				
4-Methyl-2-pentanone	89.02	2.0	100	0	89.0	67 - 130				
Acetone	102.6	2.0	100	0	103	39 - 160				
Benzene	48.67	1.0	50	0	97.3	79 - 120				
Bromobenzene	41.28	1.0	50	0	82.6	80 - 120				
Bromochloromethane	51.04	1.0	50	0	102	78 - 123				
Bromodichloromethane	49.58	1.0	50	0	99.2	79 - 125				
Bromoform	51.65	1.0	50	0	103	66 - 130				
Bromomethane	54.41	1.0	50	0	109	53 - 141				

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180120	Units: ug/L			Analysis Date: 20-Jan-2018 11:26					
Client ID:	Run ID: VOA2_309266	SeqNo: 4399281	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	99.91	2.0	100	0	99.9	64 - 133				
Carbon tetrachloride	43.55	1.0	50	0	87.1	72 - 136				
Chlorobenzene	45.63	1.0	50	0	91.3	80 - 120				
Chloroethane	47.9	1.0	50	0	95.8	82 - 118				
Chloroform	48.92	1.0	50	0	97.8	79 - 124				
Chloromethane	48.21	1.0	50	0	96.4	50 - 139				
cis-1,2-Dichloroethene	50.17	1.0	50	0	100	78 - 123				
cis-1,3-Dichloropropene	53.28	1.0	50	0	107	75 - 124				
Dibromochloromethane	48.54	1.0	50	0	97.1	74 - 126				
Dibromomethane	52.3	1.0	50	0	105	79 - 123				
Dichlorodifluoromethane	48.5	1.0	50	0	97.0	32 - 152				
Ethylbenzene	45.29	1.0	50	0	90.6	79 - 121				
Hexachlorobutadiene	48.74	1.0	50	0	97.5	66 - 134				
Isopropylbenzene	46.7	1.0	50	0	93.4	72 - 131				
m,p-Xylene	90.53	2.0	100	0	90.5	80 - 121				
Methylene chloride	46.49	2.0	50	0	93.0	74 - 124				
Naphthalene	49.97	1.0	50	0	99.9	61 - 128				
n-Butylbenzene	44.74	1.0	50	0	89.5	75 - 128				
n-Propylbenzene	41.51	1.0	50	0	83.0	76 - 126				
o-Xylene	46.25	1.0	50	0	92.5	78 - 122				
sec-Butylbenzene	43.88	1.0	50	0	87.8	77 - 126				
Styrene	46.62	1.0	50	0	93.2	78 - 128				
tert-Butylbenzene	42.36	1.0	50	0	84.7	78 - 124				
Tetrachloroethene	51.93	1.0	50	0	104	74 - 129				
Toluene	44.7	1.0	50	0	89.4	80 - 121				
trans-1,2-Dichloroethene	54.34	1.0	50	0	109	75 - 124				
trans-1,3-Dichloropropene	54.56	1.0	50	0	109	73 - 127				
Trichloroethene	52.44	1.0	50	0	105	79 - 123				
Trichlorofluoromethane	54.62	1.0	50	0	109	65 - 141				
Vinyl chloride	49	1.0	50	0	98.0	58 - 137				
Surr: 1,2-Dichloroethane-d4	47.38	1.0	50	0	94.8	81 - 118				
Surr: 4-Bromofluorobenzene	49.62	1.0	50	0	99.2	85 - 114				
Surr: Dibromofluoromethane	49.38	1.0	50	0	98.8	80 - 119				
Surr: Toluene-d8	45.06	1.0	50	0	90.1	89 - 112				

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18010704-15MS	Units: ug/L			Analysis Date: 20-Jan-2018 15:09					
Client ID:	Run ID: VOA2_309266	SeqNo: 4399290	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	46.39	1.0	50	0	92.8	78 - 124				
1,1,1-Trichloroethane	51.16	1.0	50	0	102	74 - 131				
1,1,2,2-Tetrachloroethane	45.77	1.0	50	0	91.5	71 - 121				
1,1,2-Trichloroethane	44.47	1.0	50	0	88.9	80 - 119				
1,1-Dichloroethane	48.75	1.0	50	0	97.5	77 - 125				
1,1-Dichloroethene	54.17	1.0	50	0	108	71 - 131				
1,1-Dichloropropene	53.89	1.0	50	0	108	79 - 125				
1,2,3-Trichlorobenzene	50.05	1.0	50	0	100	69 - 129				
1,2,3-Trichloropropane	41.45	1.0	50	0	82.9	73 - 122				
1,2,4-Trichlorobenzene	49.28	1.0	50	0	98.6	69 - 130				
1,2,4-Trimethylbenzene	39.5	1.0	50	0	79.0	76 - 124				
1,2-Dibromo-3-chloropropane	46.41	1.0	50	0	92.8	62 - 128				
1,2-Dibromoethane	47.61	1.0	50	0	95.2	77 - 121				
1,2-Dichlorobenzene	41.18	1.0	50	0	82.4	80 - 119				
1,2-Dichloroethane	49.41	1.0	50	0	98.8	73 - 128				
1,2-Dichloropropane	45.68	1.0	50	0	91.4	78 - 122				
1,3,5-Trimethylbenzene	38.48	1.0	50	0	77.0	75 - 124				
1,3-Dichlorobenzene	40.63	1.0	50	0	81.3	80 - 119				
1,3-Dichloropropane	44.17	1.0	50	0	88.3	80 - 119				
1,4-Dichlorobenzene	40.53	1.0	50	0	81.1	79 - 118				
2,2-Dichloropropane	48.96	1.0	50	0	97.9	60 - 139				
2-Butanone	98.35	2.0	100	0	98.3	56 - 143				
2-Chlorotoluene	39.22	1.0	50	0	78.4	79 - 122				S
2-Hexanone	92.52	2.0	100	0	92.5	57 - 139				
4-Chlorotoluene	39.45	1.0	50	0	78.9	78 - 122				
4-Isopropyltoluene	42.4	1.0	50	0	84.8	77 - 127				
4-Methyl-2-pentanone	91.62	2.0	100	0	91.6	67 - 130				
Acetone	108.5	2.0	100	0	108	39 - 160				
Benzene	47.55	1.0	50	0	95.1	79 - 120				
Bromobenzene	40.22	1.0	50	0	80.4	80 - 120				
Bromochloromethane	50.22	1.0	50	0	100	78 - 123				
Bromodichloromethane	48.4	1.0	50	0	96.8	79 - 125				
Bromoform	51.29	1.0	50	0	103	66 - 130				
Bromomethane	46.96	1.0	50	0	93.9	53 - 141				

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18010704-15MS	Units: ug/L			Analysis Date: 20-Jan-2018 15:09					
Client ID:	Run ID: VOA2_309266	SeqNo: 4399290	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	105.8	2.0	100	0	106	64 - 133				
Carbon tetrachloride	44.1	1.0	50	0	88.2	72 - 136				
Chlorobenzene	44.61	1.0	50	0	89.2	80 - 120				
Chloroethane	47.52	1.0	50	0	95.0	82 - 118				
Chloroform	47.57	1.0	50	0	95.1	79 - 124				
Chloromethane	42.55	1.0	50	0	85.1	50 - 139				
cis-1,2-Dichloroethene	49.31	1.0	50	0	98.6	78 - 123				
cis-1,3-Dichloropropene	50.3	1.0	50	0	101	75 - 124				
Dibromochloromethane	47.15	1.0	50	0	94.3	74 - 126				
Dibromomethane	49.8	1.0	50	0	99.6	79 - 123				
Dichlorodifluoromethane	51.1	1.0	50	0	102	32 - 152				
Ethylbenzene	44.41	1.0	50	0	88.8	79 - 121				
Hexachlorobutadiene	45.61	1.0	50	0	91.2	66 - 134				
Isopropylbenzene	46.63	1.0	50	0	93.3	72 - 131				
m,p-Xylene	89.47	2.0	100	0	89.5	80 - 121				
Methylene chloride	45.48	2.0	50	0	91.0	74 - 124				
Naphthalene	48.91	1.0	50	0	97.8	61 - 128				
n-Butylbenzene	43.94	1.0	50	0	87.9	75 - 128				
n-Propylbenzene	40.85	1.0	50	0	81.7	76 - 126				
o-Xylene	45.33	1.0	50	0	90.7	78 - 122				
sec-Butylbenzene	42.97	1.0	50	0	85.9	77 - 126				
Styrene	1.349	1.0	50	0	2.70	78 - 128				S
tert-Butylbenzene	41.61	1.0	50	0	83.2	78 - 124				
Tetrachloroethene	51.03	1.0	50	0	102	74 - 129				
Toluene	43.99	1.0	50	0	88.0	80 - 121				
trans-1,2-Dichloroethene	55.12	1.0	50	0	110	75 - 124				
trans-1,3-Dichloropropene	50.38	1.0	50	0	101	73 - 127				
Trichloroethene	50.15	1.0	50	0	100	79 - 123				
Trichlorofluoromethane	56.28	1.0	50	0	113	65 - 141				
Vinyl chloride	51.83	1.0	50	0	104	58 - 137				
Surr: 1,2-Dichloroethane-d4	47.85	1.0	50	0	95.7	81 - 118				
Surr: 4-Bromofluorobenzene	49.47	1.0	50	0	98.9	85 - 114				
Surr: Dibromofluoromethane	49.71	1.0	50	0	99.4	80 - 119				
Surr: Toluene-d8	45.21	1.0	50	0	90.4	89 - 112				

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266		Instrument: VOA2		Method: SW8260						
MSD	Sample ID: HS18010704-15MSD	Units: ug/L			Analysis Date: 20-Jan-2018 15:33					
Client ID:	Run ID: VOA2_309266	SeqNo: 4399291	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	47.42	1.0	50	0	94.8	78 - 124	46.39	2.2	20	
1,1,1-Trichloroethane	54.03	1.0	50	0	108	74 - 131	51.16	5.44	20	
1,1,2,2-Tetrachloroethane	46.63	1.0	50	0	93.3	71 - 121	45.77	1.86	20	
1,1,2-Trichloroethane	45.21	1.0	50	0	90.4	80 - 119	44.47	1.64	20	
1,1-Dichloroethane	50.39	1.0	50	0	101	77 - 125	48.75	3.31	20	
1,1-Dichloroethene	57.42	1.0	50	0	115	71 - 131	54.17	5.83	20	
1,1-Dichloropropene	54.91	1.0	50	0	110	79 - 125	53.89	1.88	20	
1,2,3-Trichlorobenzene	52.52	1.0	50	0	105	69 - 129	50.05	4.81	20	
1,2,3-Trichloropropane	43.11	1.0	50	0	86.2	73 - 122	41.45	3.93	20	
1,2,4-Trichlorobenzene	51.67	1.0	50	0	103	69 - 130	49.28	4.74	20	
1,2,4-Trimethylbenzene	40.6	1.0	50	0	81.2	76 - 124	39.5	2.74	20	
1,2-Dibromo-3-chloropropane	47.55	1.0	50	0	95.1	62 - 128	46.41	2.42	20	
1,2-Dibromoethane	48.2	1.0	50	0	96.4	77 - 121	47.61	1.23	20	
1,2-Dichlorobenzene	42.24	1.0	50	0	84.5	80 - 119	41.18	2.53	20	
1,2-Dichloroethane	50.78	1.0	50	0	102	73 - 128	49.41	2.74	20	
1,2-Dichloropropane	48.25	1.0	50	0	96.5	78 - 122	45.68	5.47	20	
1,3,5-Trimethylbenzene	38.5	1.0	50	0	77.0	75 - 124	38.48	0.0609	20	
1,3-Dichlorobenzene	42.03	1.0	50	0	84.1	80 - 119	40.63	3.39	20	
1,3-Dichloropropane	44.51	1.0	50	0	89.0	80 - 119	44.17	0.772	20	
1,4-Dichlorobenzene	42.17	1.0	50	0	84.3	79 - 118	40.53	3.96	20	
2,2-Dichloropropane	51.21	1.0	50	0	102	60 - 139	48.96	4.49	20	
2-Butanone	105.6	2.0	100	0	106	56 - 143	98.35	7.15	20	
2-Chlorotoluene	39.99	1.0	50	0	80.0	79 - 122	39.22	1.93	20	
2-Hexanone	98.11	2.0	100	0	98.1	57 - 139	92.52	5.86	20	
4-Chlorotoluene	40.52	1.0	50	0	81.0	78 - 122	39.45	2.68	20	
4-Isopropyltoluene	43.69	1.0	50	0	87.4	77 - 127	42.4	2.98	20	
4-Methyl-2-pentanone	94.99	2.0	100	0	95.0	67 - 130	91.62	3.61	20	
Acetone	113.9	2.0	100	0	114	39 - 160	108.5	4.83	20	
Benzene	50.01	1.0	50	0	100	79 - 120	47.55	5.05	20	
Bromobenzene	41.09	1.0	50	0	82.2	80 - 120	40.22	2.13	20	
Bromochloromethane	53.36	1.0	50	0	107	78 - 123	50.22	6.04	20	
Bromodichloromethane	49.77	1.0	50	0	99.5	79 - 125	48.4	2.8	20	
Bromoform	51.74	1.0	50	0	103	66 - 130	51.29	0.858	20	
Bromomethane	49.65	1.0	50	0	99.3	53 - 141	46.96	5.56	20	

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266		Instrument: VOA2			Method: SW8260					
MSD	Sample ID: HS18010704-15MSD	Units: ug/L			Analysis Date: 20-Jan-2018 15:33					
Client ID:	Run ID: VOA2_309266	SeqNo: 4399291			PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	111.5	2.0	100	0	111	64 - 133	105.8	5.23	20	
Carbon tetrachloride	45.86	1.0	50	0	91.7	72 - 136	44.1	3.9	20	
Chlorobenzene	45.2	1.0	50	0	90.4	80 - 120	44.61	1.32	20	
Chloroethane	50.19	1.0	50	0	100	82 - 118	47.52	5.47	20	
Chloroform	50.44	1.0	50	0	101	79 - 124	47.57	5.85	20	
Chloromethane	44.04	1.0	50	0	88.1	50 - 139	42.55	3.45	20	
cis-1,2-Dichloroethene	52.19	1.0	50	0	104	78 - 123	49.31	5.67	20	
cis-1,3-Dichloropropene	53.09	1.0	50	0	106	75 - 124	50.3	5.38	20	
Dibromochloromethane	48.09	1.0	50	0	96.2	74 - 126	47.15	1.97	20	
Dibromomethane	51.9	1.0	50	0	104	79 - 123	49.8	4.13	20	
Dichlorodifluoromethane	48.89	1.0	50	0	97.8	32 - 152	51.1	4.43	20	
Ethylbenzene	46.03	1.0	50	0	92.1	79 - 121	44.41	3.57	20	
Hexachlorobutadiene	47.19	1.0	50	0	94.4	66 - 134	45.61	3.39	20	
Isopropylbenzene	47.33	1.0	50	0	94.7	72 - 131	46.63	1.5	20	
m,p-Xylene	91.64	2.0	100	0	91.6	80 - 121	89.47	2.4	20	
Methylene chloride	48.41	2.0	50	0	96.8	74 - 124	45.48	6.23	20	
Naphthalene	51.02	1.0	50	0	102	61 - 128	48.91	4.23	20	
n-Butylbenzene	45.06	1.0	50	0	90.1	75 - 128	43.94	2.52	20	
n-Propylbenzene	41.76	1.0	50	0	83.5	76 - 126	40.85	2.19	20	
o-Xylene	46.37	1.0	50	0	92.7	78 - 122	45.33	2.28	20	
sec-Butylbenzene	43.48	1.0	50	0	87.0	77 - 126	42.97	1.2	20	
Styrene	1.393	1.0	50	0	2.79	78 - 128	1.349	3.19	20	S
tert-Butylbenzene	43.18	1.0	50	0	86.4	78 - 124	41.61	3.7	20	
Tetrachloroethene	52.02	1.0	50	0	104	74 - 129	51.03	1.91	20	
Toluene	45.15	1.0	50	0	90.3	80 - 121	43.99	2.6	20	
trans-1,2-Dichloroethene	57.9	1.0	50	0	116	75 - 124	55.12	4.93	20	
trans-1,3-Dichloropropene	53.22	1.0	50	0	106	73 - 127	50.38	5.47	20	
Trichloroethene	51.92	1.0	50	0	104	79 - 123	50.15	3.48	20	
Trichlorofluoromethane	59.34	1.0	50	0	119	65 - 141	56.28	5.29	20	
Vinyl chloride	53.83	1.0	50	0	108	58 - 137	51.83	3.79	20	
Surr: 1,2-Dichloroethane-d4	48.07	1.0	50	0	96.1	81 - 118	47.85	0.463	20	
Surr: 4-Bromofluorobenzene	49.8	1.0	50	0	99.6	85 - 114	49.47	0.655	20	
Surr: Dibromofluoromethane	50.1	1.0	50	0	100	80 - 119	49.71	0.777	20	
Surr: Toluene-d8	44.66	1.0	50	0	89.3	89 - 112	45.21	1.21	20	

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

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309266	Instrument: VOA2	Method: SW8260
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The following samples were analyzed in this batch:

HS18010396-01	HS18010396-02
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Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

QC BATCH REPORT

Batch ID: R309426		Instrument: ICS2100			Method: SW9056					
MBLK	Sample ID: WBLKW1-011918	Units: mg/L			Analysis Date: 19-Jan-2018 13:57					
Client ID:	Run ID: ICS2100_309426	SeqNo: 4402640			PrepDate:			DF: 1		
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	0.21	0.500								J
Sulfate	0.250	0.500								U
LCS	Sample ID: WLCSW1-011918	Units: mg/L			Analysis Date: 19-Jan-2018 14:11					
Client ID:	Run ID: ICS2100_309426	SeqNo: 4402641			PrepDate:			DF: 1		
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	21	0.500	20	0	105	80 - 120				
Sulfate	21.31	0.500	20	0	107	80 - 120				
LCSD	Sample ID: WLCSDW1-011918	Units: mg/L			Analysis Date: 19-Jan-2018 14:26					
Client ID:	Run ID: ICS2100_309426	SeqNo: 4402642			PrepDate:			DF: 1		
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	21.08	0.500	20	0	105	80 - 120	21	0.394	20	
Sulfate	21.26	0.500	20	0	106	80 - 120	21.31	0.207	20	
MS	Sample ID: HS18010396-01MS	Units: mg/L			Analysis Date: 19-Jan-2018 16:12					
Client ID: LH18/24-SP650_011018	Run ID: ICS2100_309426	SeqNo: 4402646			PrepDate:			DF: 10		
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	634.9	5.00	100	545.6	89.4	80 - 120				O
Sulfate	151.5	5.00	100	47.8	104	80 - 120				
MSD	Sample ID: HS18010396-01MSD	Units: mg/L			Analysis Date: 19-Jan-2018 17:08					
Client ID: LH18/24-SP650_011018	Run ID: ICS2100_309426	SeqNo: 4402647			PrepDate:			DF: 10		
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	640.6	5.00	100	545.6	95.0	80 - 120	634.9	0.886	20	O
Sulfate	155.7	5.00	100	47.8	108	80 - 120	151.5	2.74	20	
The following samples were analyzed in this batch: HS18010396-01										

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

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
WorkOrder: HS18010396

**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 Quantitation Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

Unit Reported	Description
mg/L	Milligrams per Liter

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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

ALS Group USA, Corp

Date: 26-Jan-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Bi-Weekly Samples
Work Order: HS18010396

SAMPLE TRACKING

Lab Samp ID	Client Sample ID	Action	Date	Person	New Location
HS18010396-01	LH18/24-SP650_011018	Login	1/11/2018 12:03:48 PM	CL	WET245
HS18010396-01	LH18/24-SP650_011018	Login	1/11/2018 12:03:48 PM	CL	VOA152
HS18010396-02	Trip Blank	Login	1/11/2018 12:03:48 PM	CL	VOA152

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18010396

Date/Time Received: 11-Jan-2018 08:27
 Received by: NDR

Checklist completed by: Cesar A. Lira 11-Jan-2018
 eSignature Date

Reviewed by: RJ Modashia 11-Jan-2018
 eSignature 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): 3.1C/3.4C UC/C IR30
 Cooler(s)/Kit(s): 43046
 Date/Time sample(s) sent to storage: 1/11/2018 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:

FedEx
0723 7376 9751 2816

THU - 11 JAN 10:30A
PRIORITY OVERNIGHT

AB SGRA

77099
IX-US
IAH



TID 162785 18MM10 56EA 546CL/8049/ACDVA



ALS
10450 Stenciliff Rd., Suite 210
Houston, Texas 77089
Tel. +1 281 530 5656
Fax. +1 281 530 5887

CUSTODY SEAL		Seal Broken B:
Date: 11/10/18	Time: 14:30	
Name: SCOTT STALEY		
Company: SNAPP		Date:



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

WorkOrder: HS18011091

Longhorn GW Treatment Plant Weekly Samples

Bhate Environmental Associates, Inc.

Marcia Olive
445 Union Blvd Ste 129
Lakewood CO 80228

01-Feb-2018





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

February 01, 2018

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

Work Order: **HS18011091**

Laboratory Results for: **Longhorn GW Treatment Plant Weekly Samples**

Dear Marcia,

ALS Environmental received 1 sample(s) on Jan 26, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager



ALS Group USA, Corp

Date: 01-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18011091

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18011091-01	LH18/24-SP650_012518	Water		25-Jan-2018 14:00	26-Jan-2018 09:10	<input type="checkbox"/>



ALS Group USA, Corp

Date: 01-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18011091

CASE NARRATIVE**Work Order Comments**

- The analyses for Perchlorate was subcontracted to ALS Environmental in Salt Lake City, Utah Final report attached.
-



ALS Group USA, Corp

Date: 01-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Weekly Samples
 Sample ID: LH18/24-SP650_012518
 Collection Date: 25-Jan-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18011091
 Lab ID:HS18011091-01
 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	01-Feb-2018 16:08

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



ALS Group USA, Corp

Date: 01-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011091

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R310039	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850) Matrix: Water					
HS18011091-01	LH18/24-SP650_012518	25 Jan 2018 14:00			01 Feb 2018 16:08	1



Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011091

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018



Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18011091

Date/Time Received: **26-Jan-2018 09:10**
 Received by: **RPG**

Checklist completed by: Jared R. Makan 26-Jan-2018 Reviewed by: RJ Modashia 29-Jan-2018
 eSignature Date eSignature 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): 0.2c/0.6c UC/C IR30
 Cooler(s)/Kit(s): Blue
 Date/Time sample(s) sent to storage: 01/26/2018 11:45

- 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:





IAH TX-US 77099

AB SGRA

FRI - 26 JAN 10:30A PRIORITY OVERNIGHT

TRK# 7376 9751 2805 FedEx

RETURNS MON-SAT PRIORITY OVERNIGHT


TRK# 7376 9751 2805

STODY SEAM	Time: 17:00
Seal Broken By: JM	Date: 1/26/18

CU	Date: 1/25/18
Name: Scott	Company: SMC

ALS

10450 Springh Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 630 6656
Fax. +1 281 630 6887






Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1802951

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2042 (207799)

General Set Information: There was one field sample in this Work Order. The sample was 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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: NA

Method QC data: The method blank (LMB 585673) was less than 1/2 the CRDL. The recovery for the LCS (585674) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1802951001 (Client ID: LH18/24-SP650_012518). 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): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)

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 01FEBD02/03/06/13.

Thomas Bosch February 01, 2018
Analyst Date





ANALYTICAL REPORT

Report Date: February 01, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1802951**

Project ID: HS18011091 012518

Purchase Order: HS18011091

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP650_012518	1802951001	01/25/18	01/27/18	





ANALYTICAL REPORT

Workorder: 34-1802951

Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP650_012518	Sampling Site: NA	Collected: 01/25/2018				
Lab ID: 1802951001	Media: 125 mL Nalgene	Received: 01/27/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2042 (HBN: 207799) Analyzed: 02/01/2018 10:05	Instrument ID: LCMS04 Percent Solid: NA 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 02/01/2018 12:57	/S/ Stephen Brose 02/01/2018 13:54

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123Phone: (801) 266-7700
Email: als.lt.lab@ALSGlobal.com
Web: www.alssl.com



ANALYTICAL REPORT

Workorder: 34-1802951

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
Washington	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	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.aiclasscorp.com





ANALYTICAL REPORT

Workorder: 34-1802951

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

00882847

Analysis Information

Workorder: 1802951

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2042 (HBN: 207799)
Analyzed By: Thomas Bosch

Blank

LMB: 585673 Analyzed: 02/01/2018 09:30 Units: ug/L			
Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 585674 Analyzed: 02/01/2018 09:45 Dilution: 1 Units: ug/L				
Analyte	Result	Target	% Rec	QC Limits
Perchlorate	5.43	5.00	109	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1802951001 Analyzed: 02/01/2018 10:05 Dilution: 1 Units: ug/L			MS: 585675 Analyzed: 02/01/2018 10:22 Dilution: 1 Units: ug/L			MSD: 585676 Analyzed: 02/01/2018 10:37 Dilution: 1 Units: ug/L			
Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	ND	5.05	5	101	78.8 123.8	5.13	103	1.56	0.0 20.0

Continuing Calibration Verification

CCV: 585670 Analyzed: 02/01/2018 08:43 Units: ug/L Criteria: ± 15%				CCV: 585677 Analyzed: 02/01/2018 11:35 Units: ug/L Criteria: ± 15%		
Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	26.1	25.0	104	25.2	25.0	101

Interference Check Sample

ICSA: 585672 Analyzed: 02/01/2018 09:15 Units: ug/L Criteria: ± 30%			
Analyte	Result	Target	% Rec.
Perchlorate	0.995	1.00	99.5

Limit of Detection Verification

LODV: 585671 Analyzed: 02/01/2018 09:01 Units: ug/L Criteria: ± 50%				LODV: 585678 Analyzed: 02/01/2018 11:50 Units: ug/L Criteria: ± 50%		
Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	0.967	1.00	96.7	0.981	1.00	98.1





Quality Control Sample Batch Report

00882848

Analysis Information

Workorder: 1802951

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2042 (HBN: 207799)

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 02/01/2018 12:57	/S/ Stephen Brose 02/01/2018 13:54

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



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Subcontract Chain of Custody

COC ID: 8446

1802951

SUBCONTRACT TO:

ALS Laboratory Group
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Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18011091
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18011091-01	LH18/24-SP650_012518	Water	25 Jan 2018 14:00
SUB_Perch-6850			29 Jan 2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: J. Winnings
Received By: Meredith Orland
Cooler ID(s): 8199

Date/Time: 1/26/18 18:00
Date/Time: 1/26/18 11:05
Temperature(s): 5





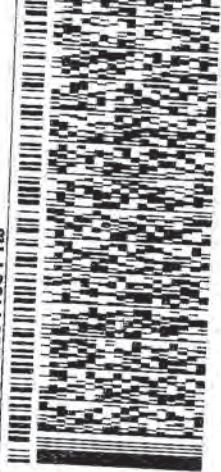
ORIGIN ID:SGRA (281) 530-5656
 SHIPPING DEPT
 ALS LABORATORY GROUP
 10450 STANCLIFF RD
 SUITE 210
 HOUSTON, TX 77089
 UNITED STATES US

SHIP DATE: 26JAN18
 ACTWGT: 11.05 LB MAN
 CAD: 300130/CAFE3108
 DIMS: 14x11x10 IN
 BILL SENDER

TO **PAUL POPE**
ALS ENVIRONMENTAL
960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123

(801) 266-7700
 REF: HS18011091 RJ



SATURDAY 12:00P
PRIORITY OVERNIGHT

TRK# 7376 9752 0402
 0201

XO BTFA

84123
 UT-US SLC



00882851





Batch Worklist



Batch: ELMS/2042
 Rule: EPA 6850, DoD QSM Water
 Workorder: 1802951 [ENV_LVL4]

Created: 2/1/2018 08:11
 Analyst: T. Bosch

Instrument: WP
 Status: WP

HBN: 207799



Pos	Lab ID	Sample ID	Prep Initial	Prep Final	Dust Weight	Type	Mix	Container	Procedure	Mgr	Expire Date	Due Date	Run Date
1	585670	CCV for HBN 207799 [ELMS/2042]				CCV	3		E685041C3Q	5311		2/9/2018	
2	585671	LODV for HBN 207799 [ELMS/2042]				LODV	3		E6850.D3Q	5311		2/9/2018	
3	585672	ICS for HBN 207799 [ELMS/2042]				ICS	3		E6850.D3Q	5311		2/9/2018	
4	585673	LMB for HBN 207799 [ELMS/2042]				LMB	3		E6850Q413Q	5311		2/9/2018	
5	585674	LCS for HBN 207799 [ELMS/2042]				LCS	3		E6850Q413Q	5311		2/9/2018	
6	1802951001	LH18/24-SP650_012518				SAMPLE	3	1802951001-A	E6850Q41.3	5480	2/22/2018	2/9/2018	
7	585675	LH18/24-SP650...(1802951001MS)				MS	3		E6850Q413Q	5311		2/9/2018	
8	585676	LH18/24-SP65...(1802951001MSD)				MSD	3		E6850Q413Q	5311		2/9/2018	
9	585677	CCV for HBN 207799 [ELMS/2042]				CCV	3		E685041C3Q	5311		2/9/2018	
10	585678	LODV for HBN 207799 [ELMS/2042]				LODV	3		E6850.D3Q	5311		2/9/2018	



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation



ALS Work Order #'s & Sample #'s: 1802951 (001)

ELMS Batch/HBN ID: 2042 (207799)

Prep Date: 02/01/2018 Analysis Date: 02/01/2018 Analyst: T. Bosch

Analyte: **Perchlorate** Matrix: **Water** Method: **6850**

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\01FEB18D.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-DOD.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 585674; Target = 5.0µg/L. ASTM type II water was used for LMB 585673.

MS/MSD: MS/MSD was performed on sample 1802951001 (Client ID: LH18/24-SP650_012518). 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\2018\JAN\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 01FEBD02/03/06/13.
- 5) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\207799-DOD-ALS-HSTN-LCMS4 or through \\ALSLTWS013\DATA\REVIEW\HBN#





STANDARD REPORT

Working Standard - CLO4 WRK

CLO4 WRK			Description - 6850 WKG Std 100.ug/L		
Standard: 36735		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 WRK		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 INT		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17		Lab Lot: CLO4 QC WRK 100.ug/L		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/2017		Lab Lot: CLO4 QC INT 10.ug/mL		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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



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/NCCL 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.





Certificate of Analysis



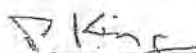
ISO Guide 34 Reference Material

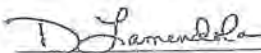
Product Number: ICC-013
Lot Number: CP-0860

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 (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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, Inorganic QC Manager



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:
ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 data.

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data



Batch Report: C:\HPCHEM\1\DATA\01FEB18D\01FEB18S.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		
*	585670	CCV@25	Vial 71	1	Control	1	9.49446e5	9.030	26.08531
*	585671	LODV@1.	Vial 72	1	Control	2	3.69034e4	9.281	9.67120e-1
*	585672	ICS@1.	Vial 73	1	Control	3	2.80283e4	8.885	9.94808e-1
*	585673	LMB	Vial 74	1	Control	4	0.00000	0.000	0.00000
*	585674	LCS@5.	Vial 75	1	Control	5	1.72028e5	9.115	5.42774
*	1802951001		Vial 76	1	Sample	6	1.29491e4	8.846	5.11196e-1
*	585675	29511MS	Vial 77	1	Sample	7	1.54165e5	8.883	5.05035
*	585676	29511SD	Vial 78	1	Sample	8	1.66168e5	8.903	5.12985
*	585677	CCV@25	Vial 71	1	Control	12	9.12457e5	9.243	25.15332
*	585678	LODV@1.	Vial 72	1	Control	13	3.64326e4	9.361	9.80672e-1

#*	Sample Location	Inj	SampleType	Run	CLO4-85 Area	CLO4-85 RT	CLO4-85 Amount		
*	585670	CCV@25	Vial 71	1	Control	1	3.02060e5	9.046	26.29311
*	585671	LODV@1.	Vial 72	1	Control	2	1.42564e4	9.336	9.28027e-1
*	585672	ICS@1.	Vial 73	1	Control	3	1.05033e4	8.892	9.26522e-1
*	585673	LMB	Vial 74	1	Control	4	0.00000	0.000	0.00000
*	585674	LCS@5.	Vial 75	1	Control	5	5.98631e4	9.131	5.67168
*	1802951001		Vial 76	1	Sample	6	5352.28125	8.872	4.20504e-1
*	585675	29511MS	Vial 77	1	Sample	7	5.17634e4	8.909	5.07164
*	585676	29511SD	Vial 78	1	Sample	8	5.83634e4	8.916	5.39699
*	585677	CCV@25	Vial 71	1	Control	12	2.93139e5	9.265	25.55392
*	585678	LODV@1.	Vial 72	1	Control	13	1.32623e4	9.383	8.78256e-1

#*	Sample Location	Inj	SampleType	Run	CLO4-89-ISTD Area	CLO4-89-ISTD RT	CLO4-89-ISTD Amount		
*	585670	CCV@25	Vial 71	1	Control	1	1.48413e5	9.047	5.00000
*	585671	LODV@1.	Vial 72	1	Control	2	1.80740e5	9.309	5.00000
*	585672	ICS@1.	Vial 73	1	Control	3	1.33336e5	8.900	5.00000
*	585673	LMB	Vial 74	1	Control	4	1.69518e5	9.212	5.00000
*	585674	LCS@5.	Vial 75	1	Control	5	1.43604e5	9.134	5.00000
*	1802951001		Vial 76	1	Sample	6	1.23105e5	8.883	5.00000
*	585675	29511MS	Vial 77	1	Sample	7	1.38627e5	8.904	5.00000
*	585676	29511SD	Vial 78	1	Sample	8	1.47033e5	8.921	5.00000
*	585677	CCV@25	Vial 71	1	Control	12	1.48570e5	9.267	5.00000
*	585678	LODV@1.	Vial 72	1	Control	13	1.75893e5	9.387	5.00000

*** End of Report ***

Sequence: C:\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\01FEB18D,S

Sequence Table:

Method and Injection Info Part:

Line	Location	SampleName	Method	Inj	SampleType	InjVolume	DataFile
1	Vial 71	585670	CCV@25	CLO4-DOD	1	Ctrl Samp	
2	Vial 72	585671	LODV@1.	CLO4-DOD	1	Ctrl Samp	
3	Vial 73	585672	ICS@1.	CLO4-DOD	1	Ctrl Samp	
4	Vial 74	585673	LMB	CLO4-DOD	1	Ctrl Samp	
5	Vial 75	585674	LCS@5.	CLO4-DOD	1	Ctrl Samp	
6	Vial 76	1802951001		CLO4-DOD	1	Sample	
7	Vial 77	585675	29511MS	CLO4-DOD	1	Sample	
8	Vial 78	585676	29511SD	CLO4-DOD	1	Sample	
9	Vial 81	1802477001		CLO4-DOD	1	Sample	
10	Vial 82	XXXXXX	24776MS	CLO4-DOD	1	Sample	
11	Vial 83	XXXXXX	24776SD	CLO4-DOD	1	Sample	
12	Vial 71	585677	CCV@25	CLO4-DOD	1	Ctrl Samp	
13	Vial 72	585678	LODV@1.	CLO4-DOD	1	Ctrl Samp	

Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD01.D

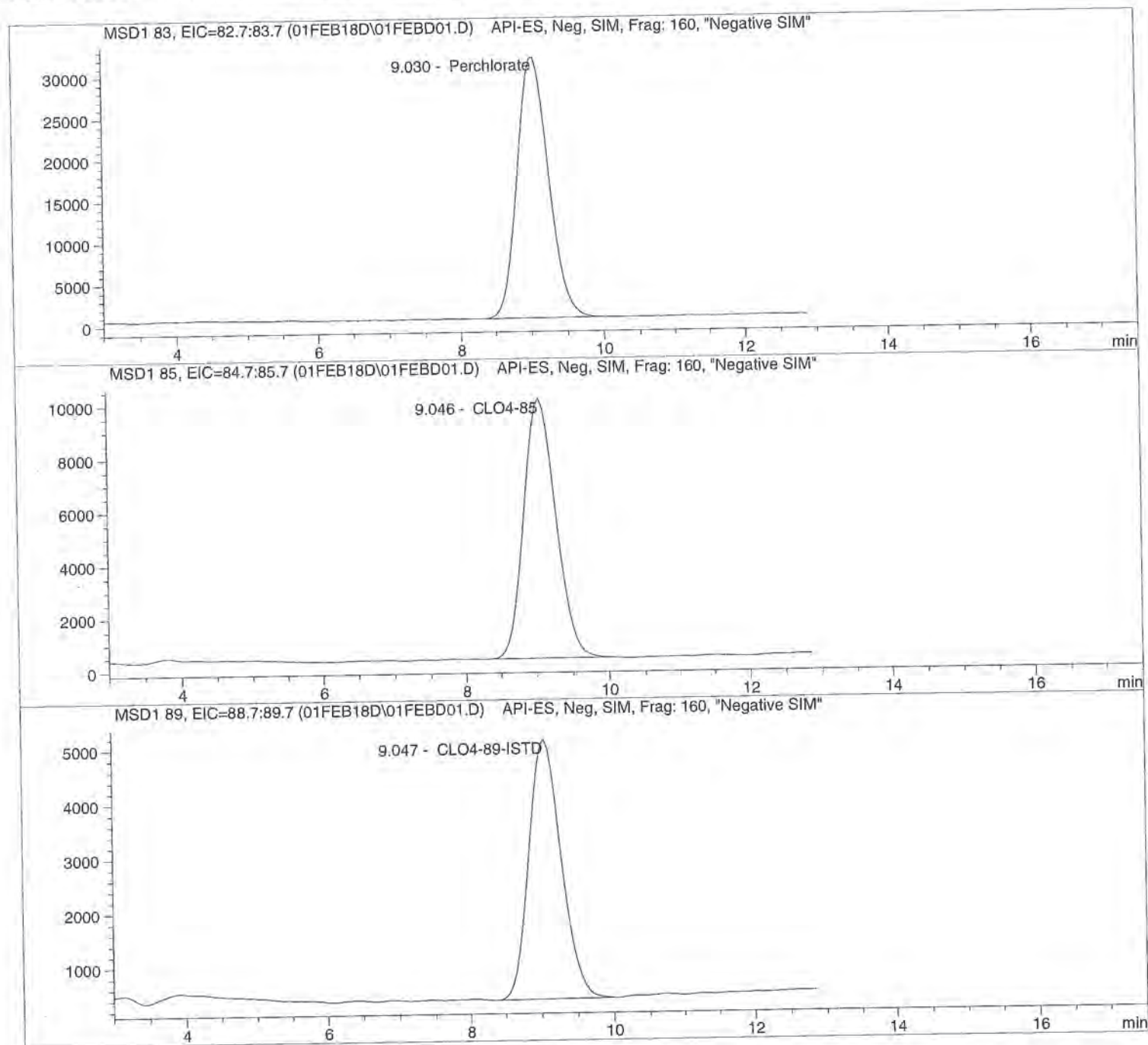
Sample Name: 585670 CCV@25

Injection Date: 2/01/2018 08:43:40
Sample Name: 585670 CCV@25
Acq Operator: TNB

Seq Line: 1
Location: Vial 71
Inj. No.: 1
Inj. Vol.: 25 μ l

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD01.D Sample Name: 585670 CCV@25

```

=====
Injection Date: 2/01/2018 08:43:40      Seq Line: 1
Sample Name: 585670 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: 1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
Sample Information
=====

```

```

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.030	PBA	949445.8	26.0853	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.046	PBA	302060.5	26.2931	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.047	PBA	148413.2	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

```

Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD02.D

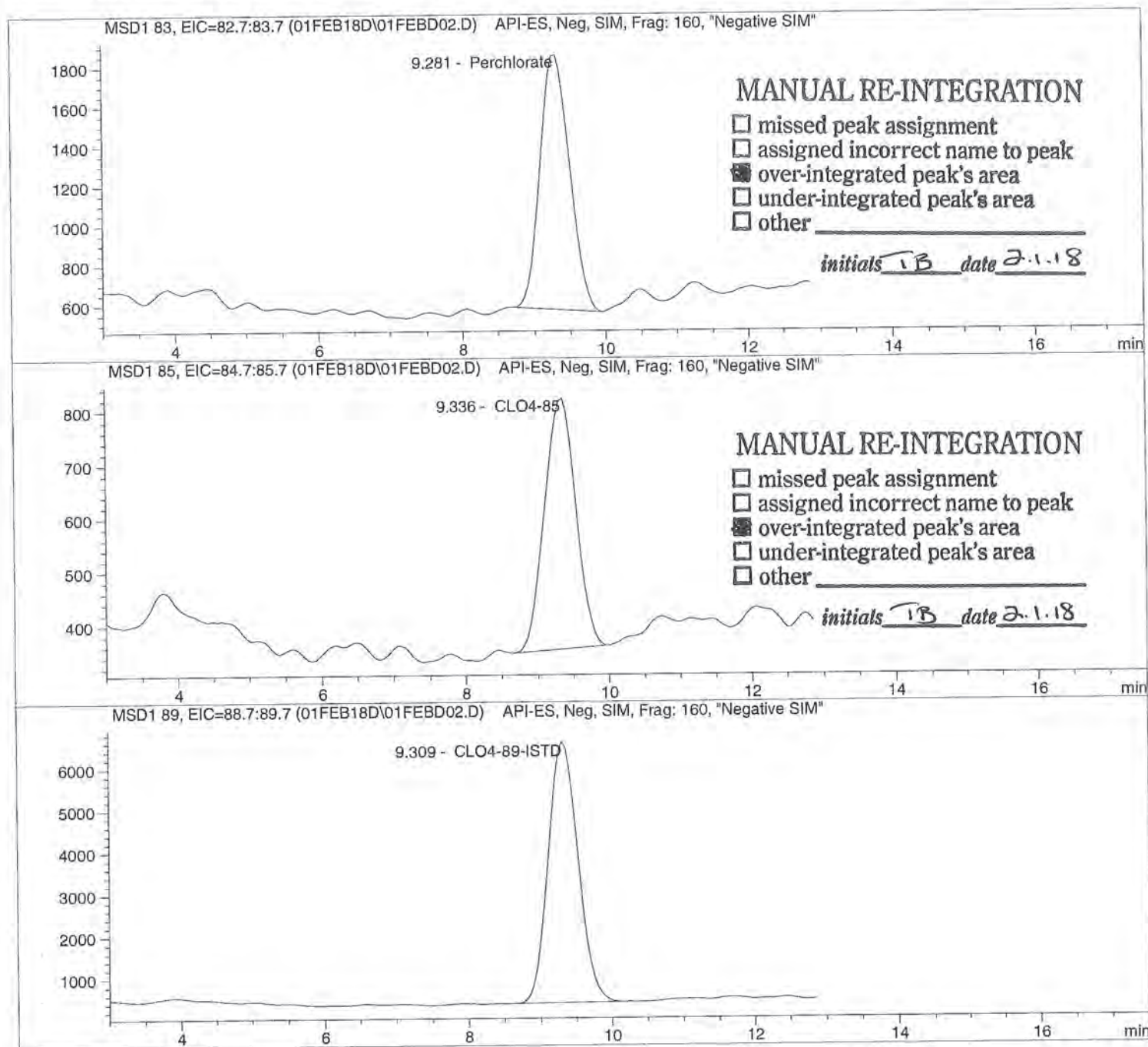
Sample Name: 585671 LODV@1.

Injection Date: 2/01/2018 09:01:12
 Sample Name: 585671 LODV@1.
 Acq Operator: TNB

Seq Line: 2
 Location: Vial 72
 Inj. No.: 1
 Inj. Vol.: 25 μ l

Acq. Method: CLO4-DOD.M
 Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
 Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD02.D Sample Name: 585671 LODV@1.

```

=====
Injection Date: 2/01/2018 09:01:12      Seq Line:          2
Sample Name:    585671  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:   1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
Sample Information
=====

```

```

Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.281	MM	36903.4	0.9671	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.336	MM	14256.4	0.9280	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.309	PBA	180739.6	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

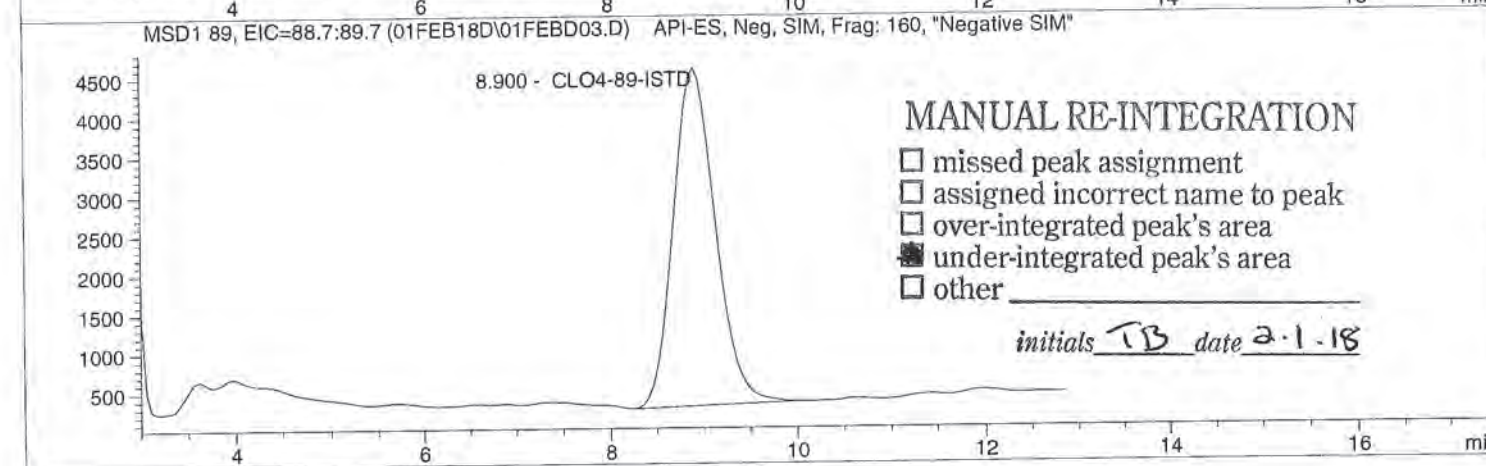
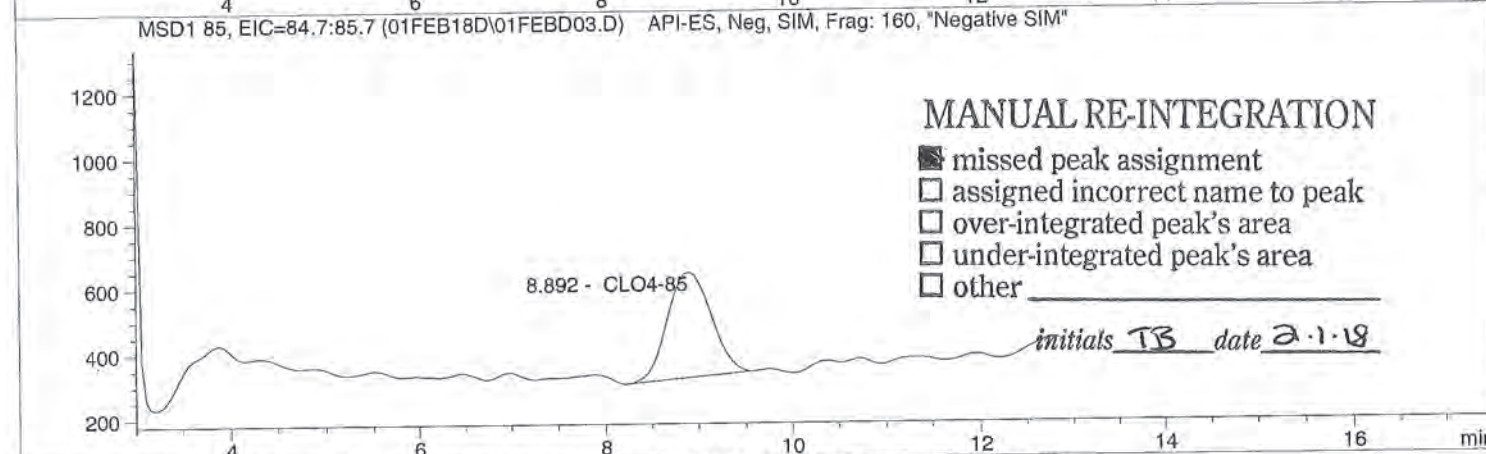
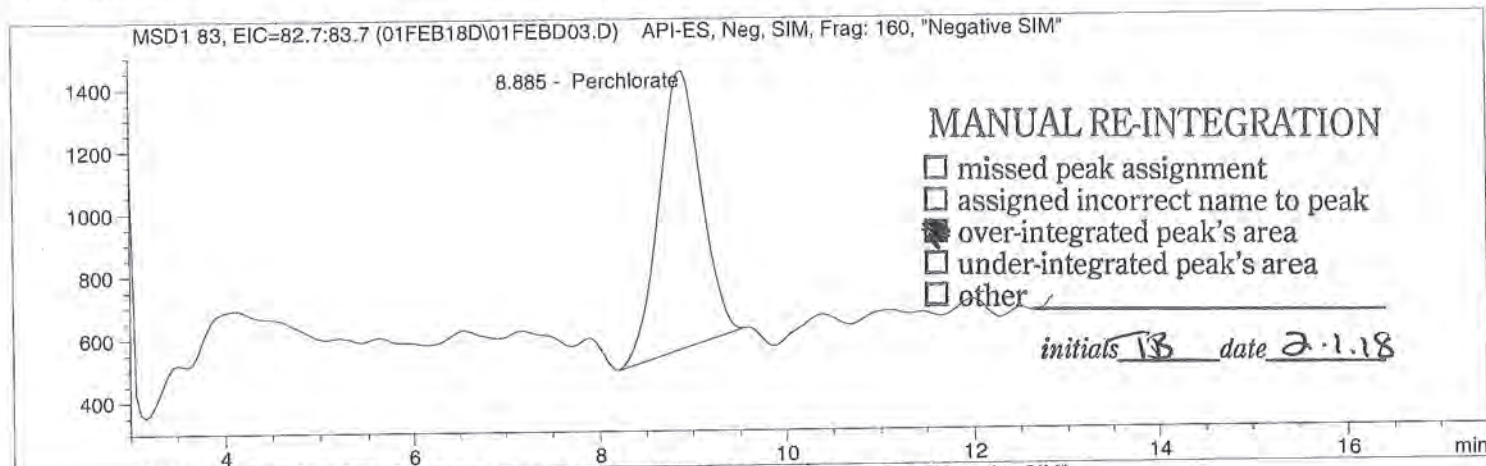
```

Injection Date: 2/01/2018 09:15:50
Sample Name: 585672 ICS@1.
Acq Operator: TNB

Seq Line: 3
Location: Vial 73
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD03.D

Sample Name: 585672 ICS@1.

```

=====
Injection Date: 2/01/2018 09:15:50      Seq Line: 3
Sample Name: 585672 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: 1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
Sample Information
=====

```

```

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.885	MM	28028.3	0.9948	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.892	MM	10503.3	0.9265	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.900	MM	133336.4	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

```


Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD04.D

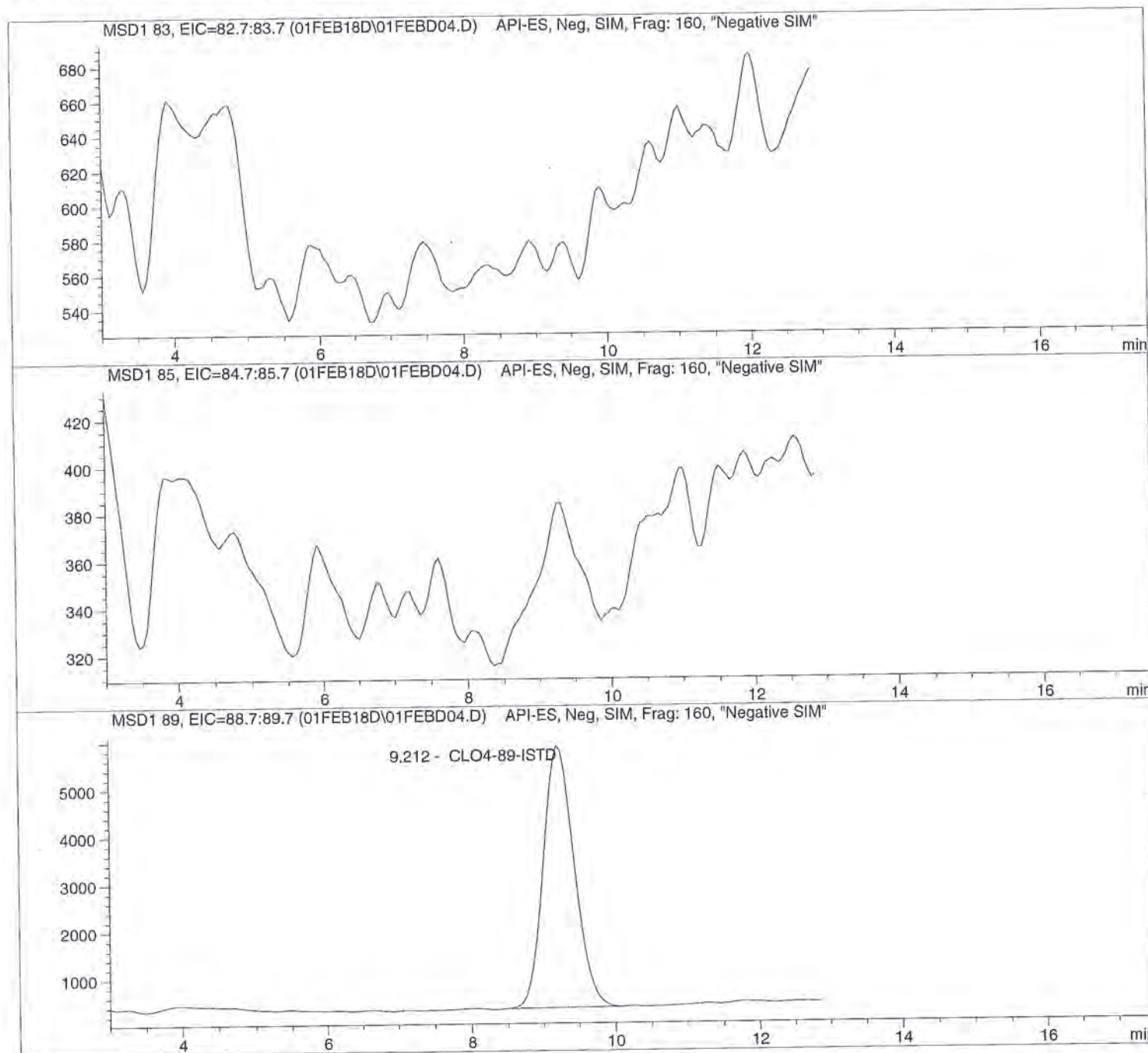
Sample Name: 585673 LMB

Injection Date: 2/01/2018 09:30:34
Sample Name: 585673 LMB
Acq Operator: TNB

Seq Line: 4
Location: Vial 74
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD04.D Sample Name: 585673 LMB

```

=====
Injection Date: 2/01/2018 09:30:34      Seq Line: 4
Sample Name: 585673 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: 1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
Sample Information
=====

```

```

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018, 08:59:33 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
9.212	BBA	169518.4	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

```

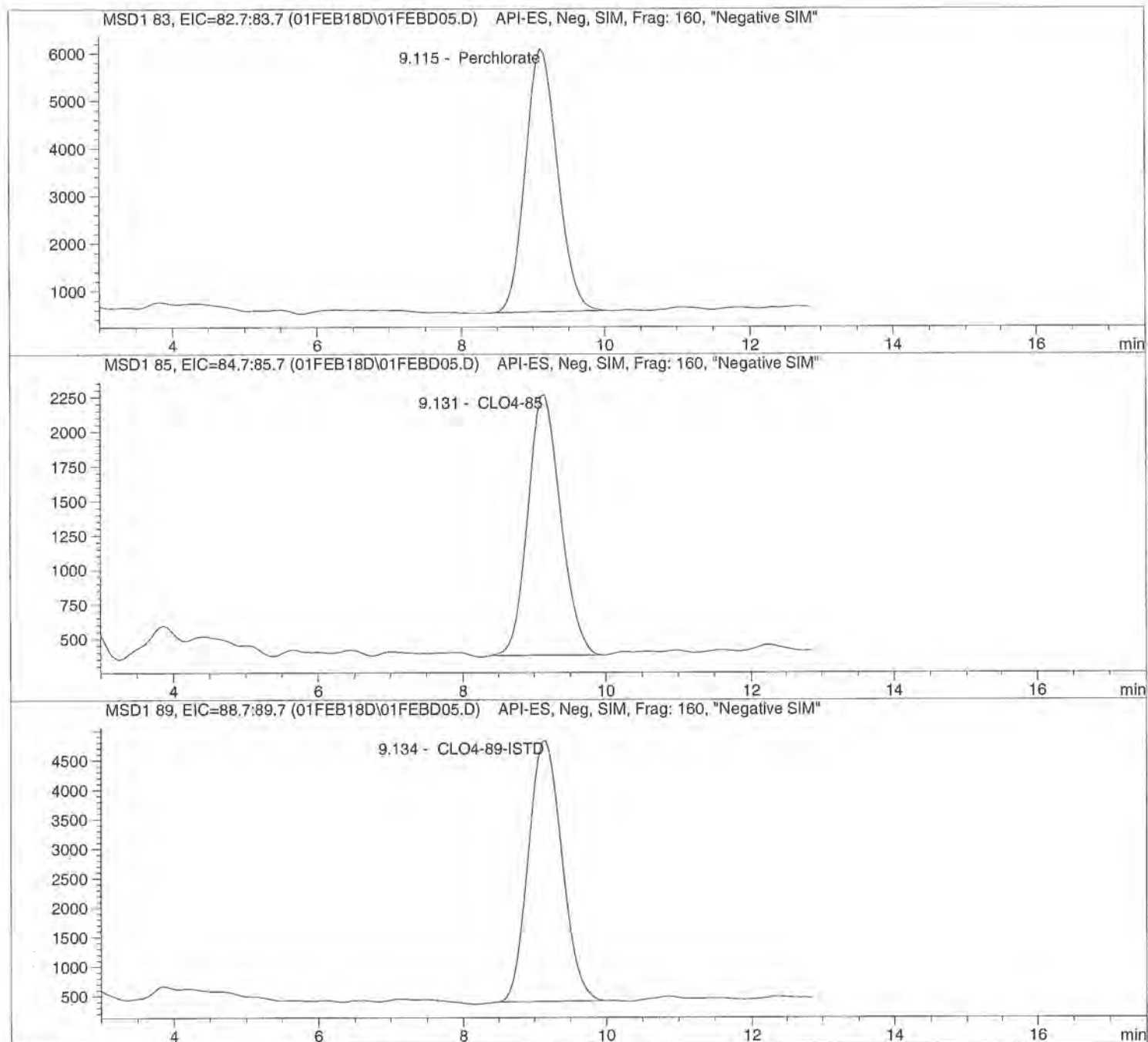


Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD05.D Sample Name: 585674 LCS05.

Injection Date: 2/01/2018 09:45:12 Seq Line: 5
Sample Name: 585674 LCS05. Location: Vial 75
Acq Operator: TNB Inj. No.: 1
Inj. Vol.: 25 μ l

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD05.D Sample Name: 585674 LCS05.

```

=====
Injection Date: 2/01/2018 09:45:12      Seq Line:          5
Sample Name:    585674  LCS05.           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:   1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
Sample Information
=====

```

```

Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.115	PBA	172028.5	5.4277	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.131	PBA	59863.1	5.6717	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.134	PBA	143604.4	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

```

Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD06.D

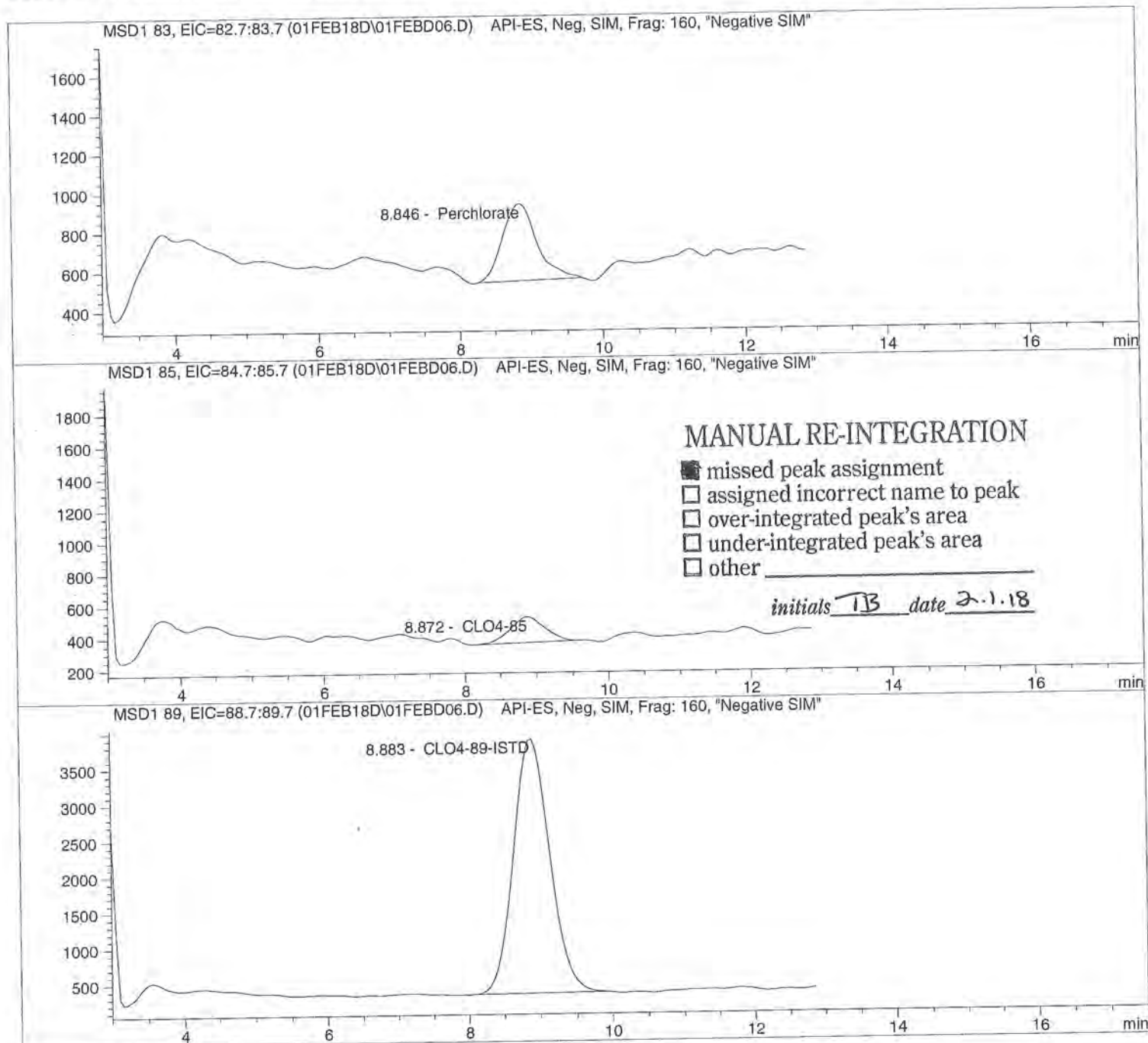
Sample Name: 1802951001

Injection Date: 2/01/2018 10:05:34
 Sample Name: 1802951001
 Acq Operator: TNB

Seq Line: 6
 Location: Vial 76
 Inj. No.: 1
 Inj. Vol.: 25 μ l

Acq. Method: CLO4-DOD.M
 Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
 Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



```
=====
Injection Date:  2/01/2018  10:05:34      Seq Line:      6
Sample Name:    1802951001                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:   1/19/2018  12:46:10
=====
```

Perchlorate analysis

Sample Information

```
Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.846	PBA	12949.1	0.5112	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.872	MM	5352.3	0.4205	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.883	PBA	123105.3	5.0000	CLO4-89-ISTD

*** End of Report ***



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD07.D

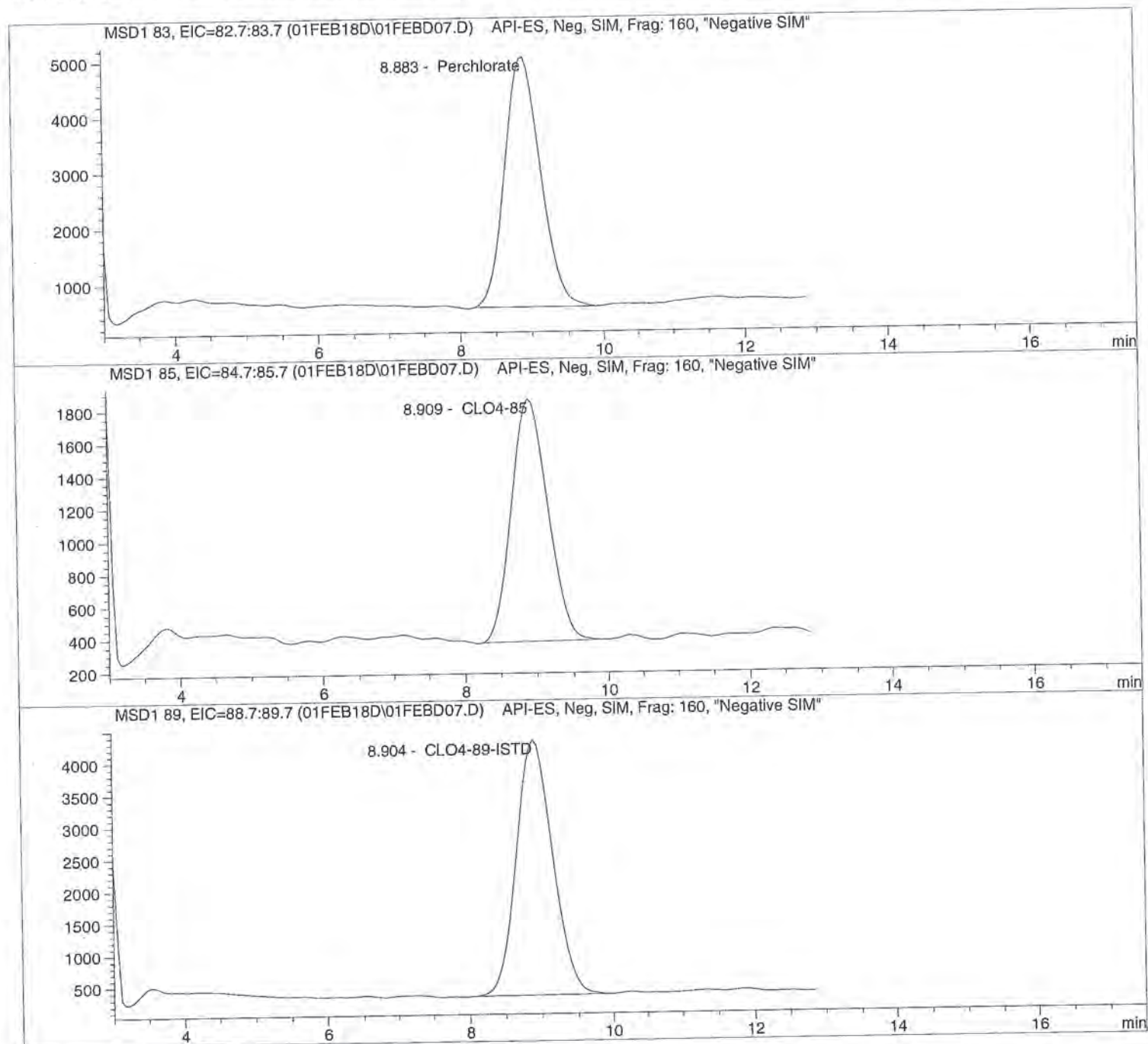
Sample Name: 585675 29511MS

Injection Date: 2/01/2018 10:22:32
Sample Name: 585675 29511MS
Acq Operator: TNB

Seq Line: 7
Location: Vial 77
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD07.D Sample Name: 585675 29511MS

```

=====
Injection Date: 2/01/2018 10:22:32      Seq Line:          7
Sample Name:    585675 29511MS          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:   1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
Sample Information
=====

```

```

Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.883	PBA	154165.2	5.0504	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.909	PBA	51763.4	5.0716	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.904	PBA	138627.2	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

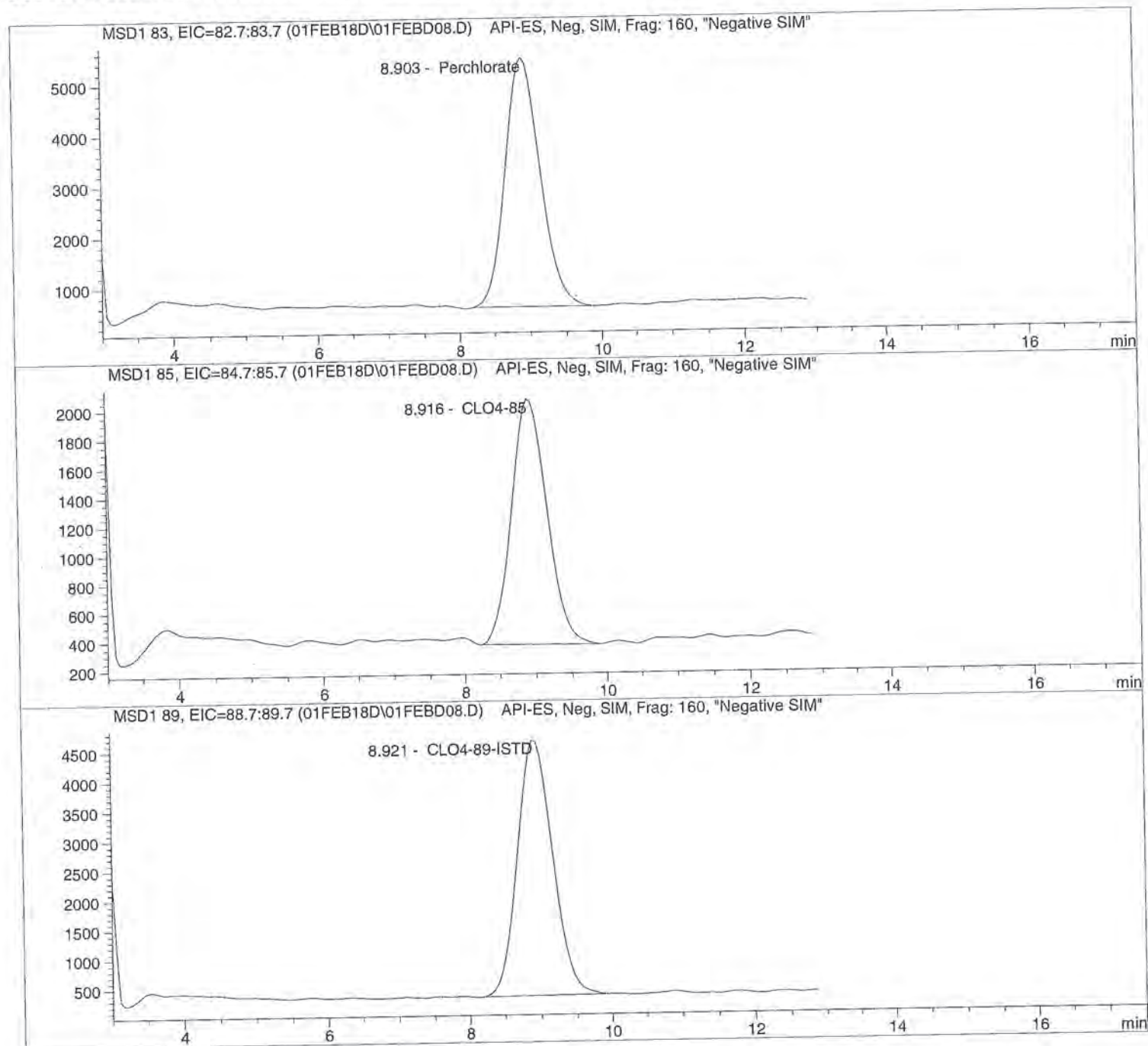
```

Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD08.D Sample Name: 585676 29511SD

=====
Injection Date: 2/01/2018 10:37:12 Seq Line: 8
Sample Name: 585676 29511SD 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: 1/19/2018 12:46:10

Perchlorate analysis



Injection Date: 2/01/2018 10:37:12 Seq Line: 8
Sample Name: 585676 29511SD 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: 1/19/2018 12:46:10

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.903	PBA	166168.3	5.1298	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.916	PBA	58363.4	5.3970	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.921	PBA	147033.3	5.0000	CLO4-89-ISTD

*** End of Report ***



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD12.D

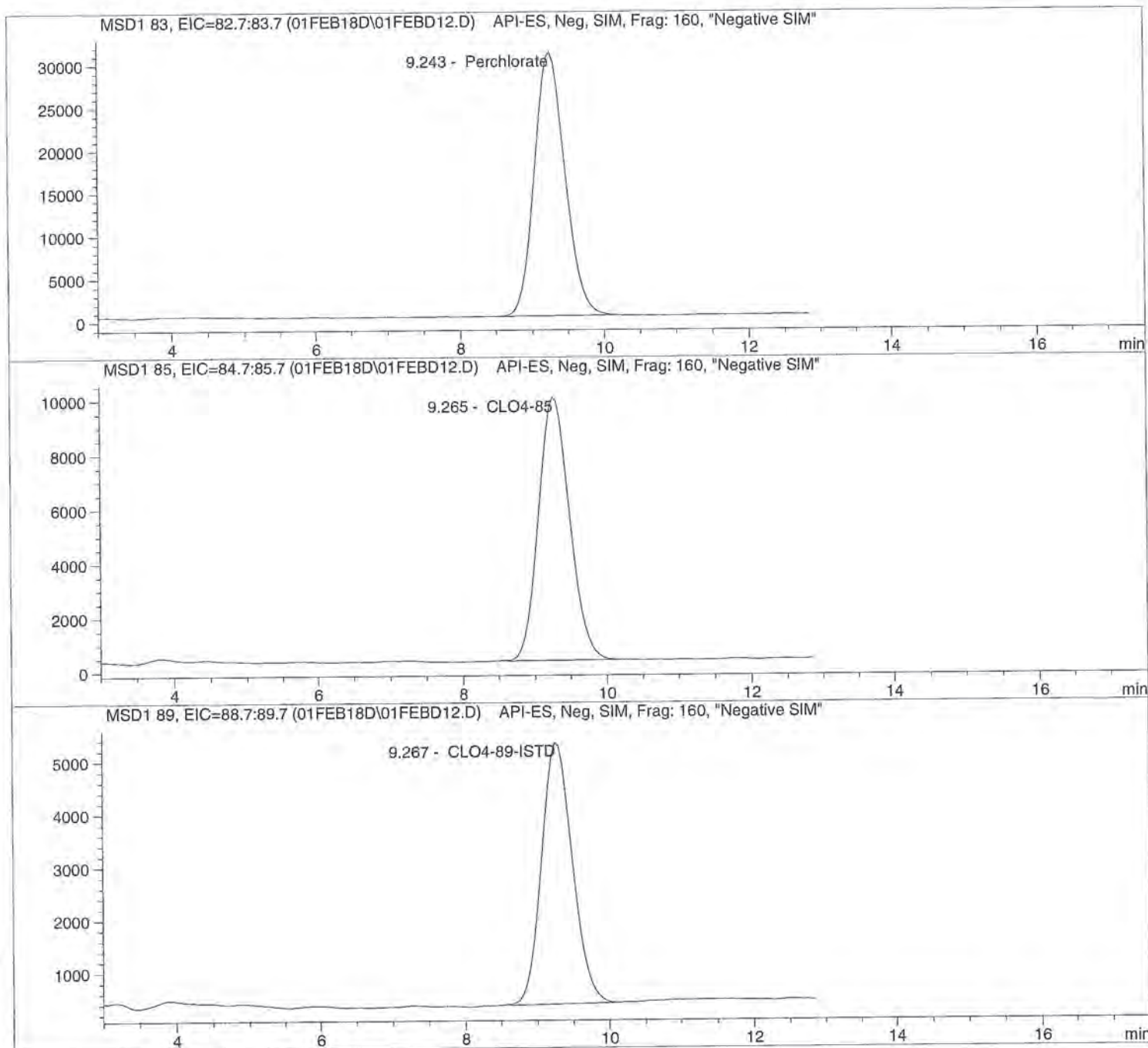
Sample Name: 585677 CCV@25

Injection Date: 2/01/2018 11:35:43
Sample Name: 585677 CCV@25
Acq Operator: TNB

Seq Line: 12
Location: Vial 71
Inj. No.: 1
Inj. Vol.: 25 μ l

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD12.D Sample Name: 585677 CCV@25

```

=====
Injection Date: 2/01/2018 11:35:43      Seq Line: 12
Sample Name: 585677 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: 1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
Sample Information
=====

```

```

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018, 08:59:33 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
9.243	BBA	912456.6	25.1533	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.265	BBA	293138.7	25.5539	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.267	BBA	148570.3	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

```



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD13.D

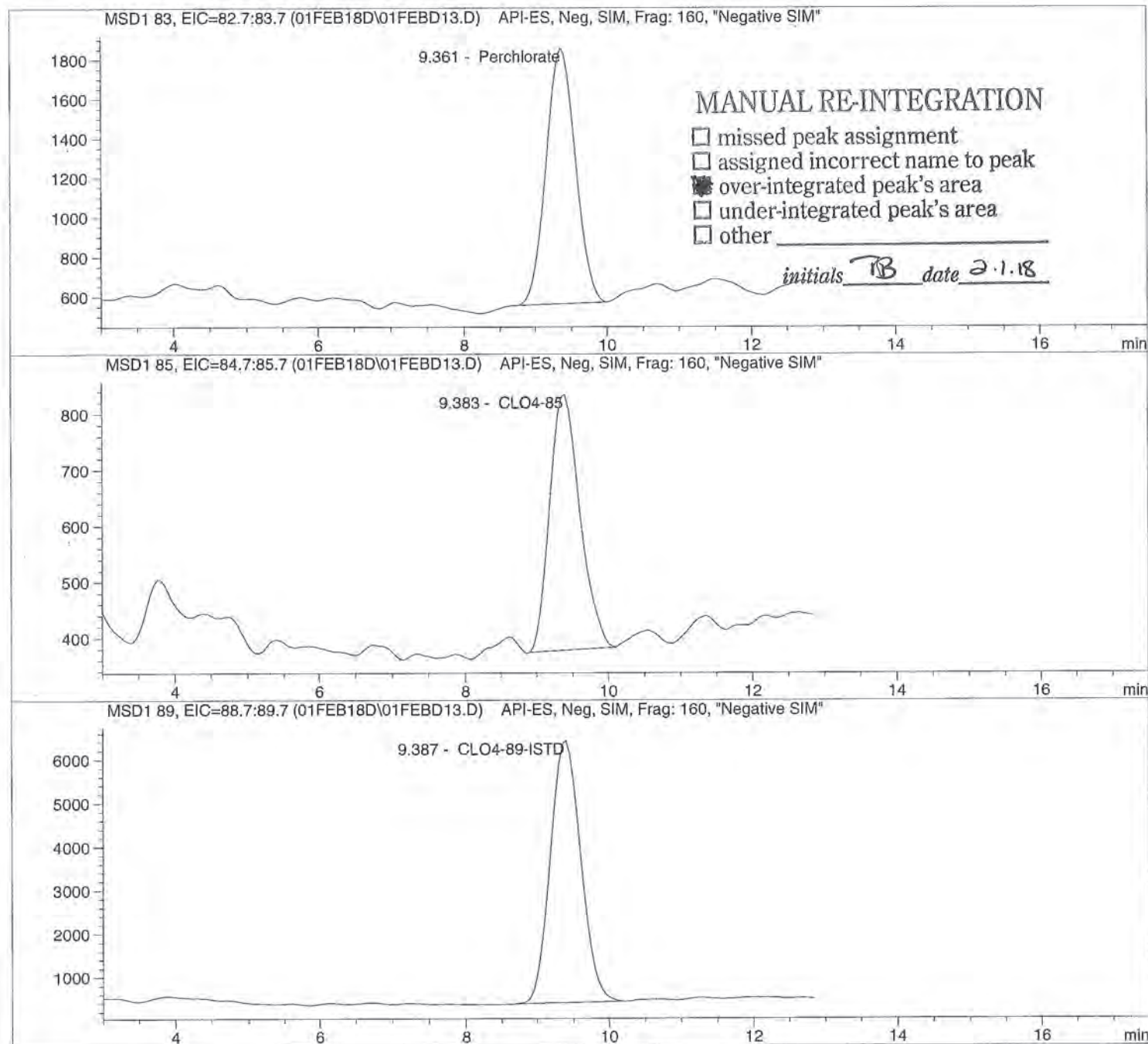
Sample Name: 585678 LODV@1.

Injection Date: 2/01/2018 11:50:19
 Sample Name: 585678 LODV@1.
 Acq Operator: TNB

Seq Line: 13
 Location: Vial 72
 Inj. No.: 1
 Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
 Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
 Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD13.D Sample Name: 585678 LODV@1.

```

=====
Injection Date: 2/01/2018 11:50:19      Seq Line:          13
Sample Name:   585678  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:  1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
                          Sample Information
=====

```

```

Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.361	MM	36432.6	0.9807	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.383	PBA	13262.3	0.8783	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.387	BBA	175892.6	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

```



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

Raw Data

Initial Calibration



Method 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 AreaRel. 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 missingCurve 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
#

#	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]	Lvl Sig	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		



Method 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

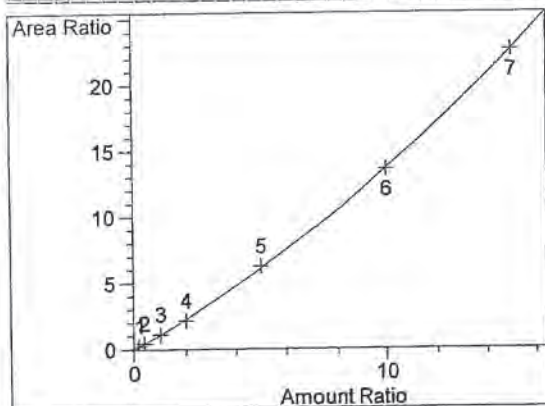
Compound: CLO4-89-ISTD

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

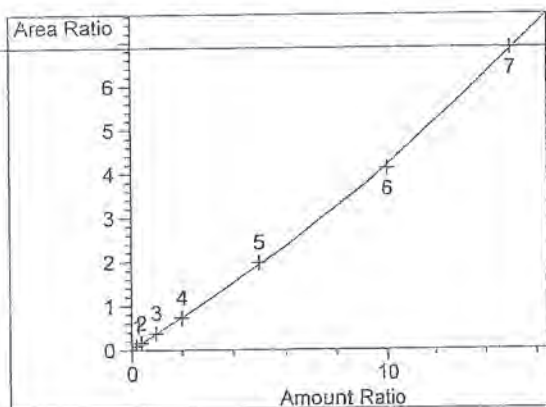
 Calibration Curves



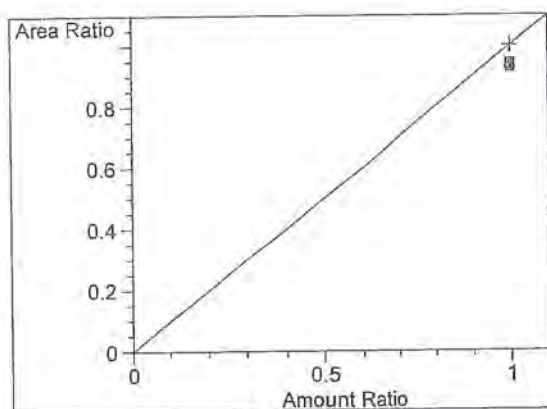
Perchlorate at exp. RT: 12.090
 MSD1 83, EIC=82.7:83.7
 Correlation: 0.99991
 Residual Std. Dev.: 0.08487
 Formula: $y = ax^2 + bx + c$
 a: 2.87739e-2
 b: 1.07712
 c: -5.23718e-3
 x: Amount Ratio
 y: Area Ratio

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

Method 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

atch 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 /1

Acq Operator: TNB

Inj. No.: 1

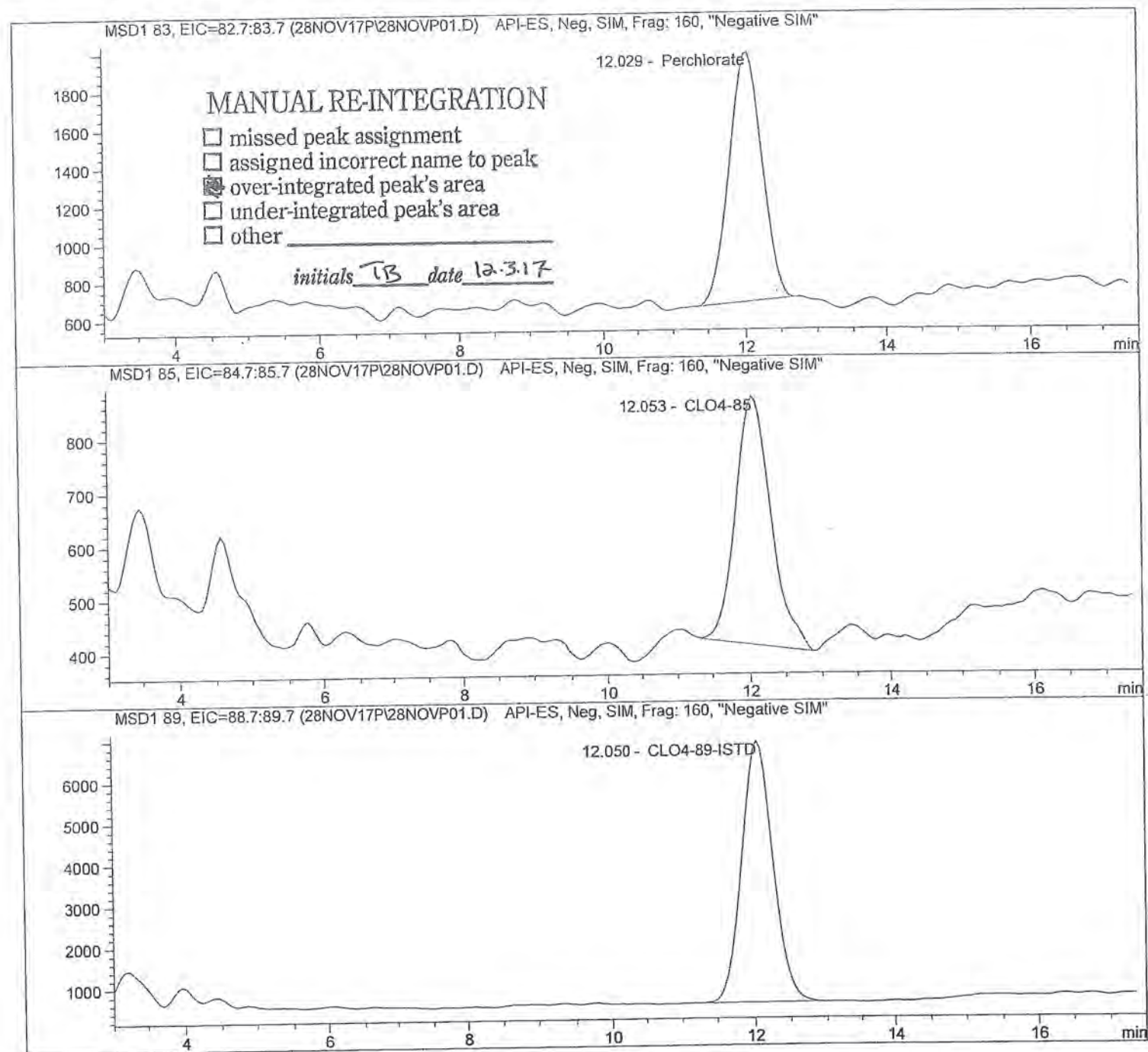
Inj. Vol.: 25 µl

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

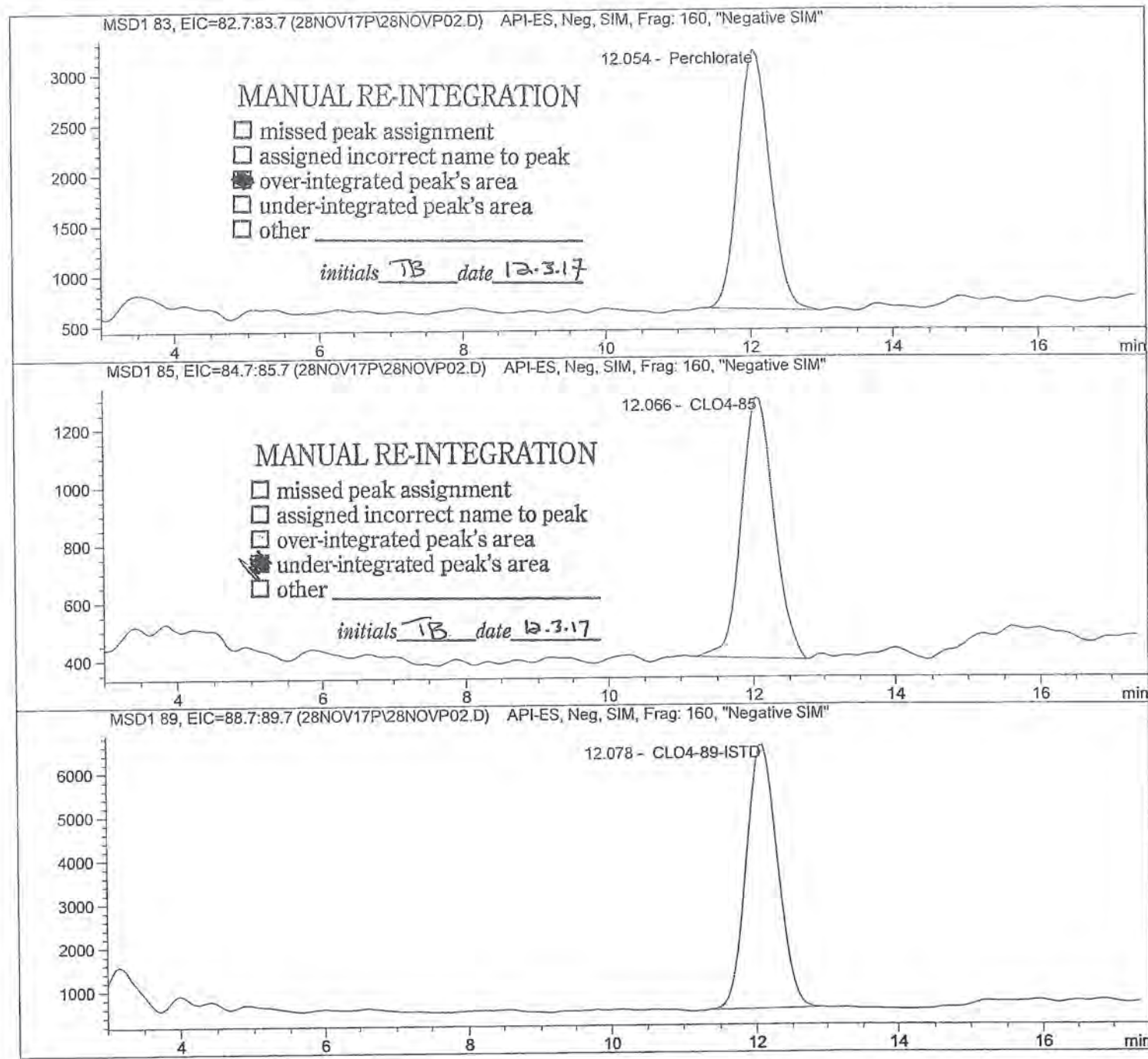
Inj. Vol.: 25 µl

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

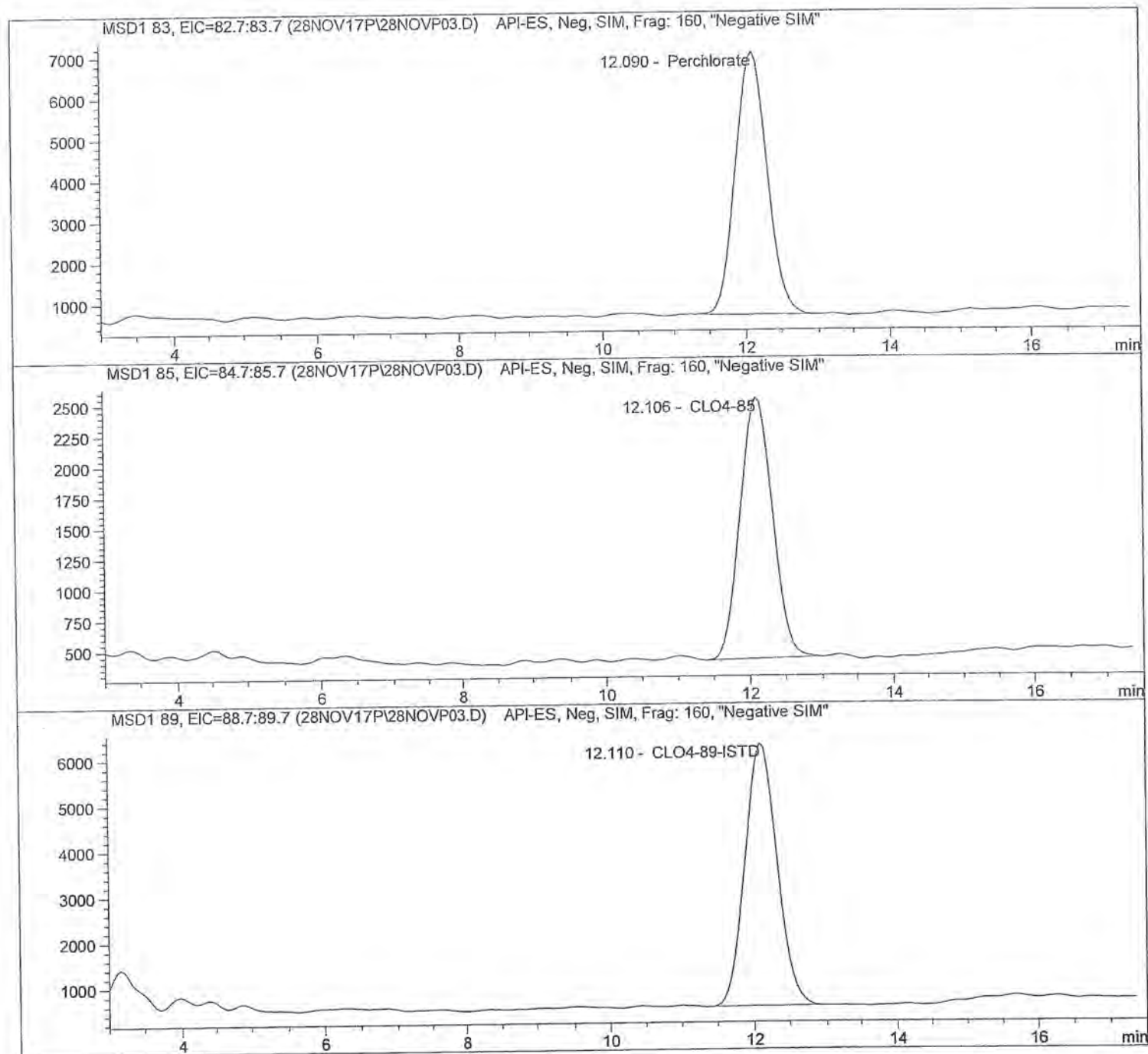
Inj. Vol.: 25 µl

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

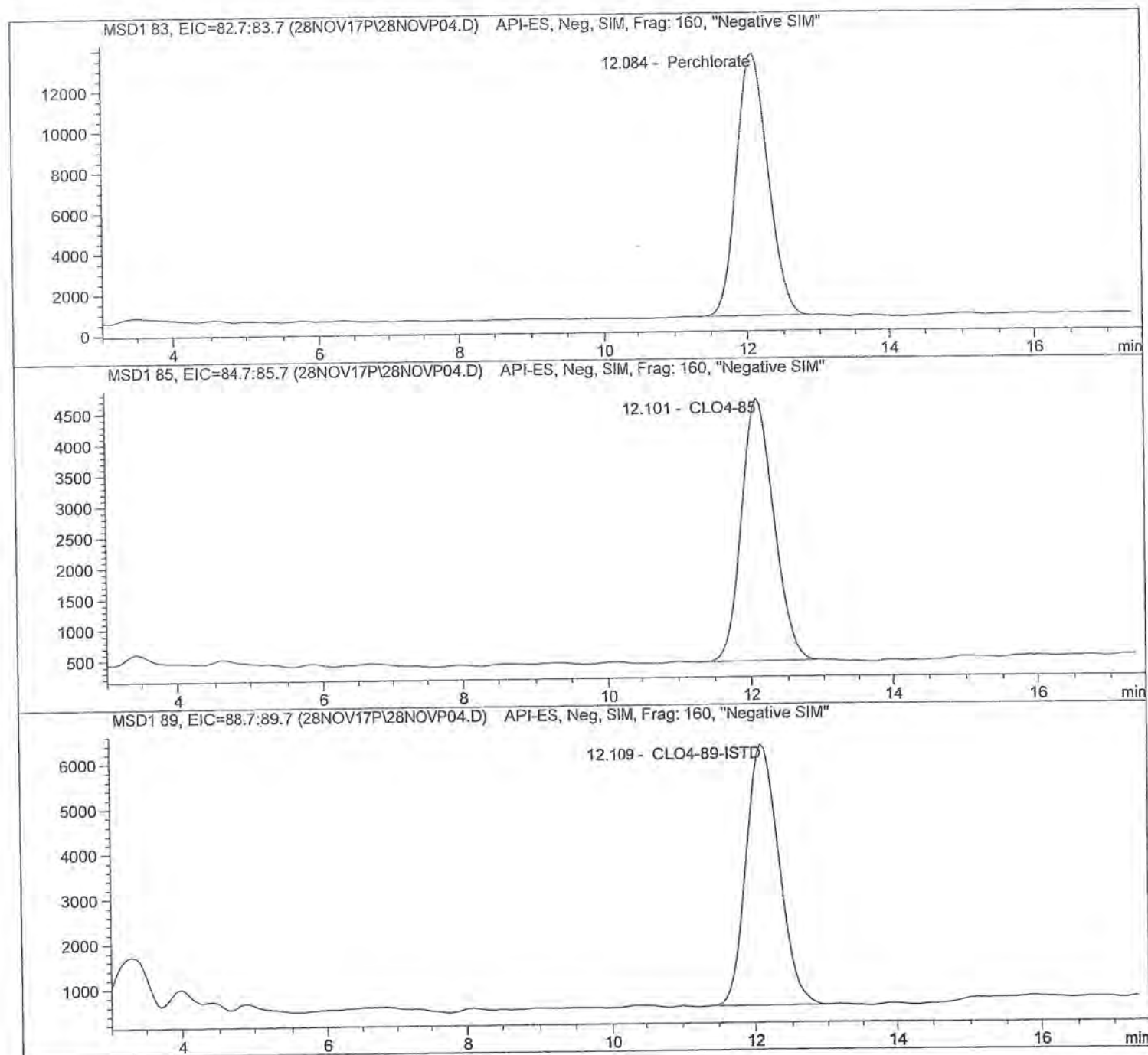
Inj. Vol.: 25 µl

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

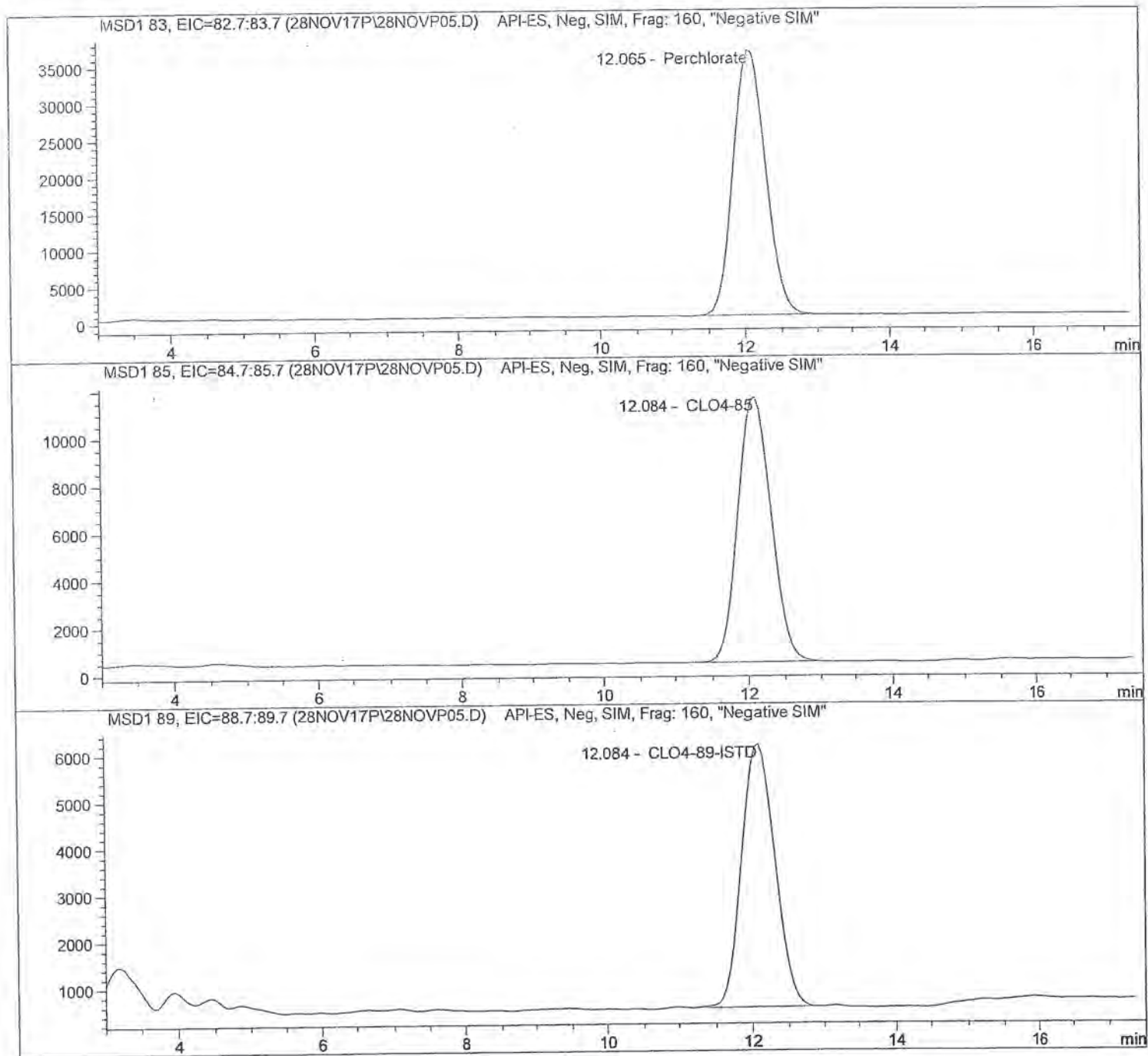
Inj. Vol.: 25 µl

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

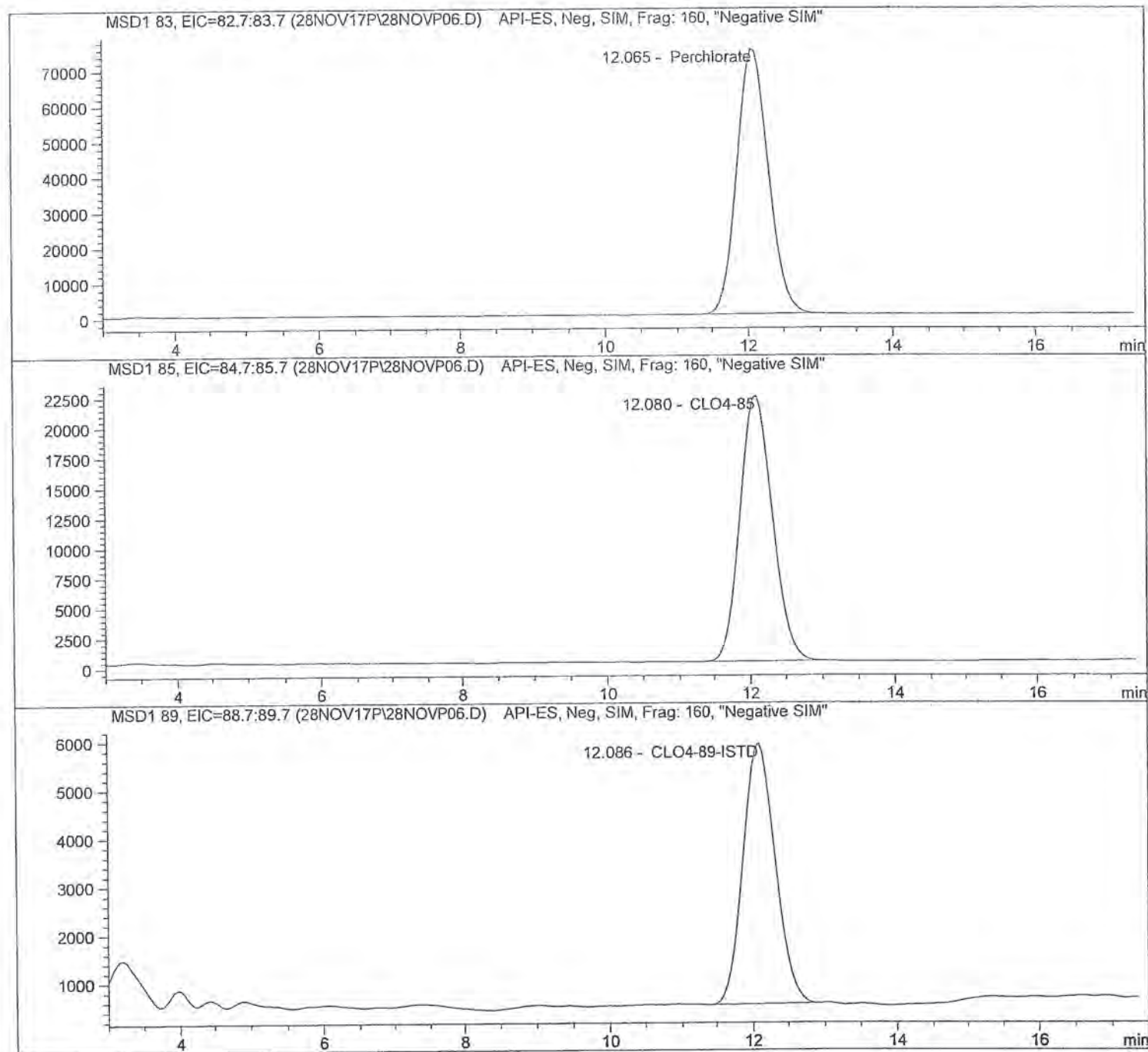
Inj. Vol.: 25 µl

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

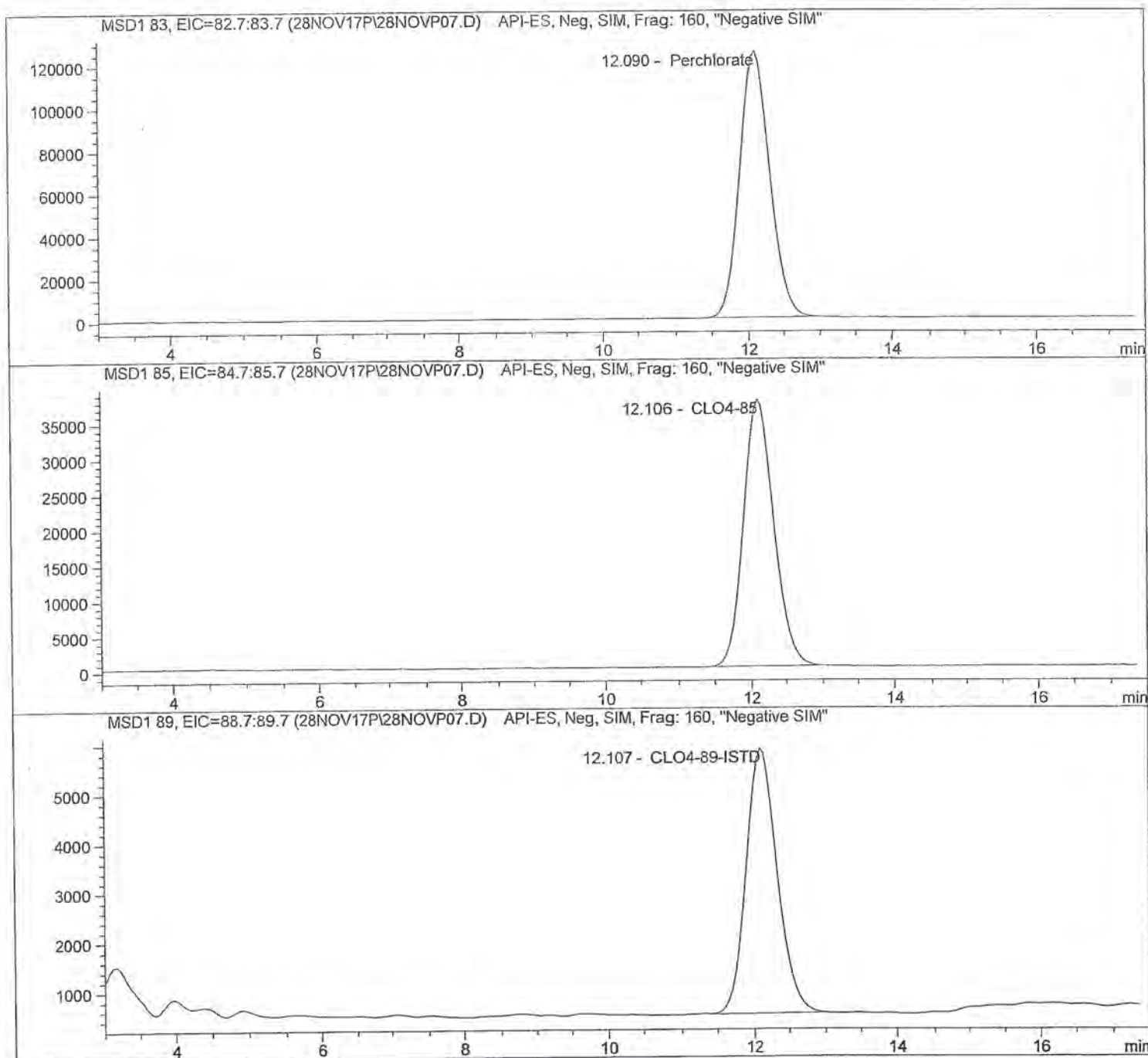
Inj. Vol.: 25 µl

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 ***



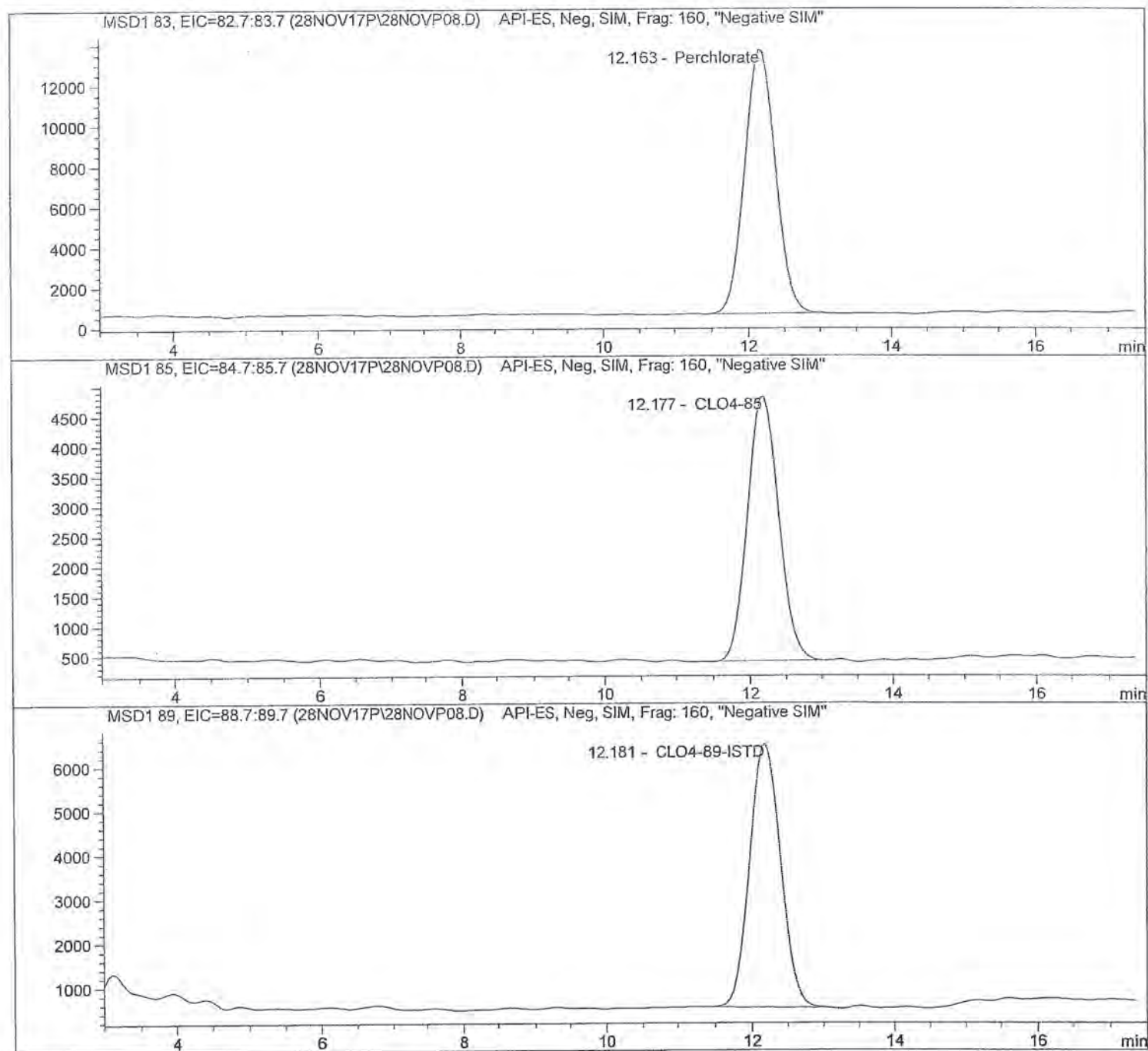
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP08.D

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

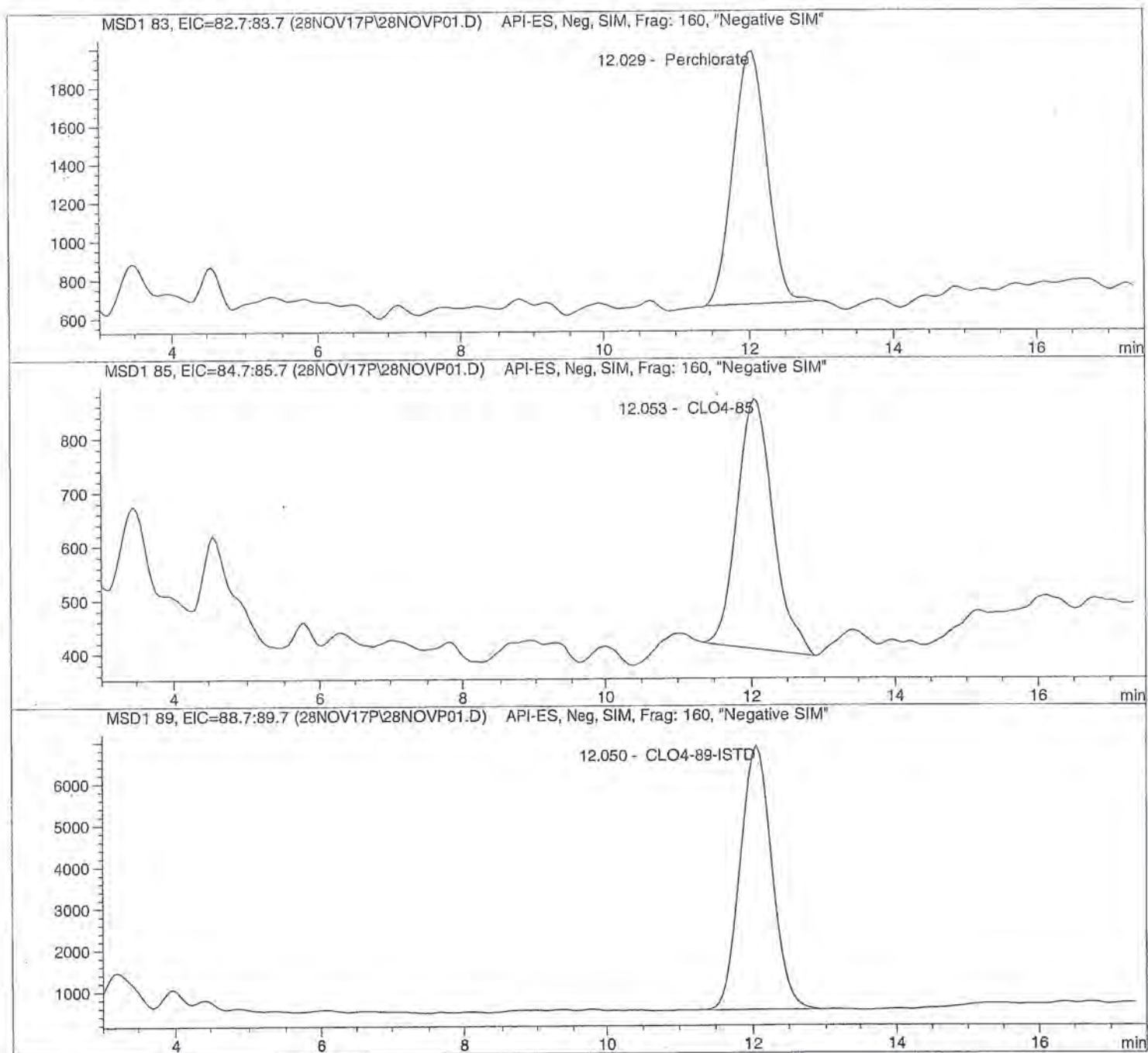
Inj. Vol.: 25 µl

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

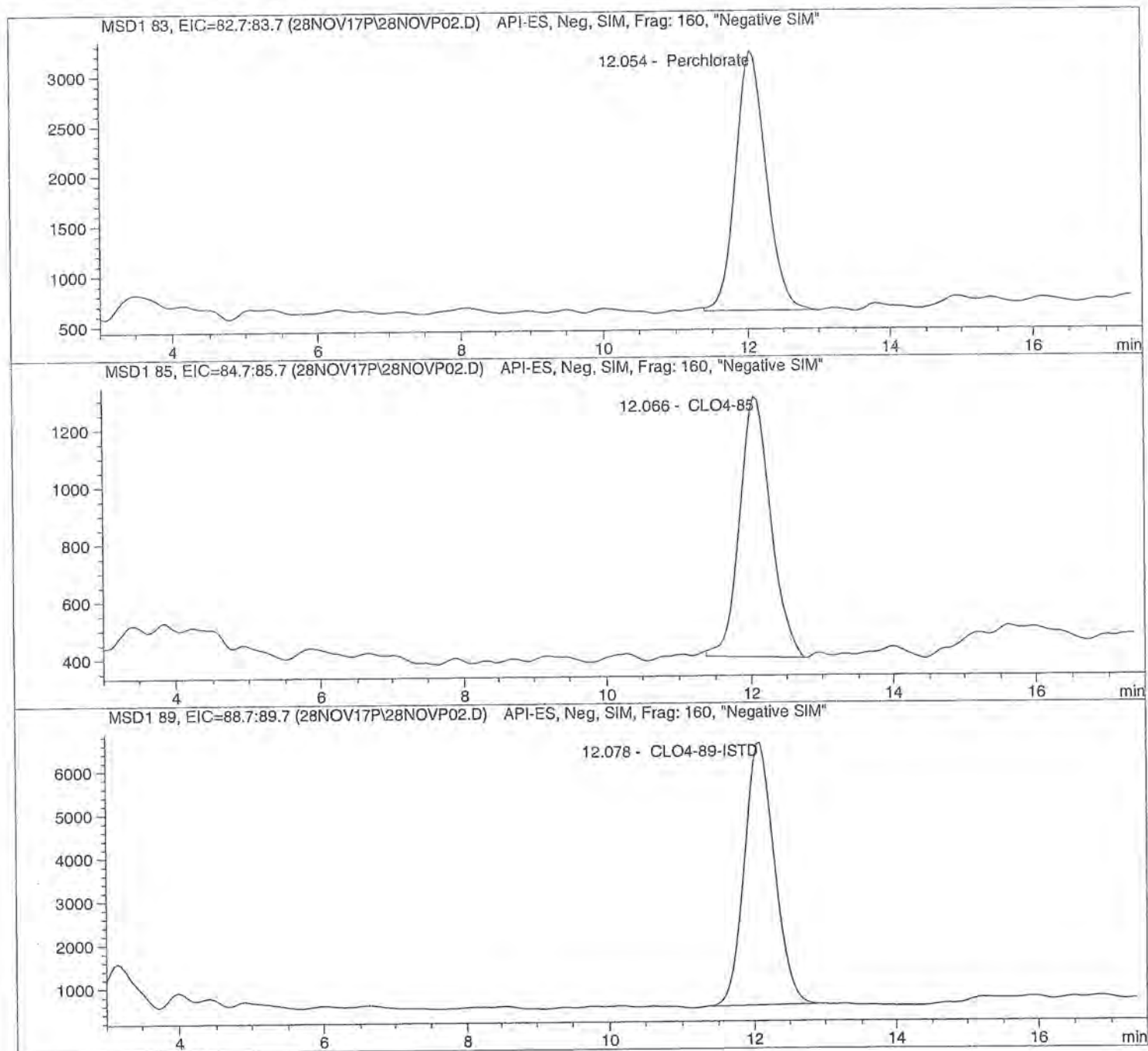
Inj. Vol.: 25 µl

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\01FEB18D\01FEBD02.D

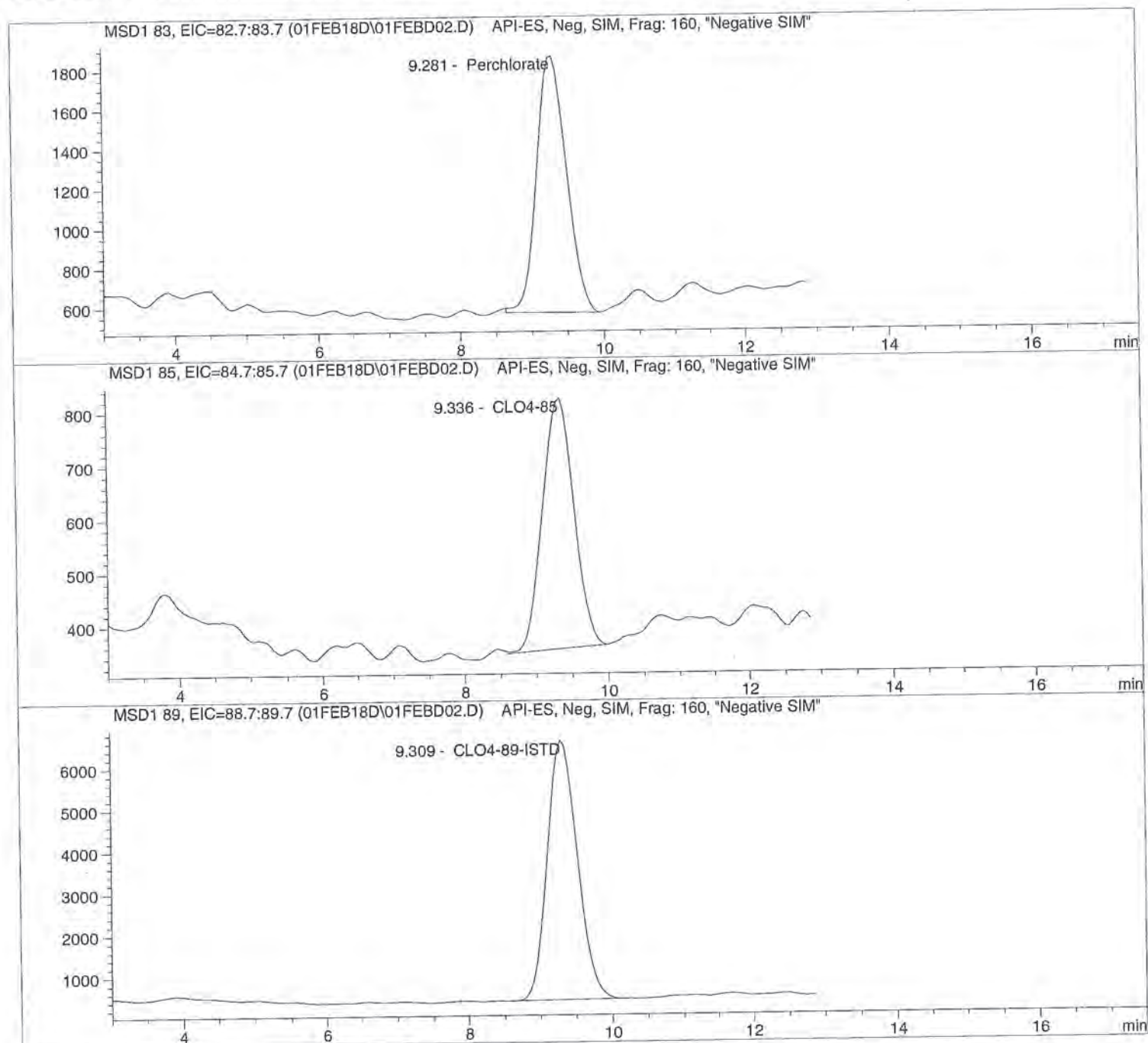
Sample Name: 585671 LODV@1.

Injection Date: 2/01/2018 09:01:12
Sample Name: 585671 LODV@1.
Acq Operator: TNB

Seq Line: 2
Location: Vial 72
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD02.D Sample Name: 585671 LODV@1.

Injection Date: 2/01/2018 09:01:12 Seq Line: 2
 Sample Name: 585671 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: 1/19/2018 12:46:10

Perchlorate analysis

Sample Information

Sorted By: Signal
 Calib. Data Modified: Thu, 18. Jan. 2018, 08:59:33 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
9.281	BBA	37788.4	0.9896	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.336	BBA	14370.0	0.9370	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.309	PBA	180739.6	5.0000	CLO4-89-ISTD

*** End of Report ***

Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD03.D

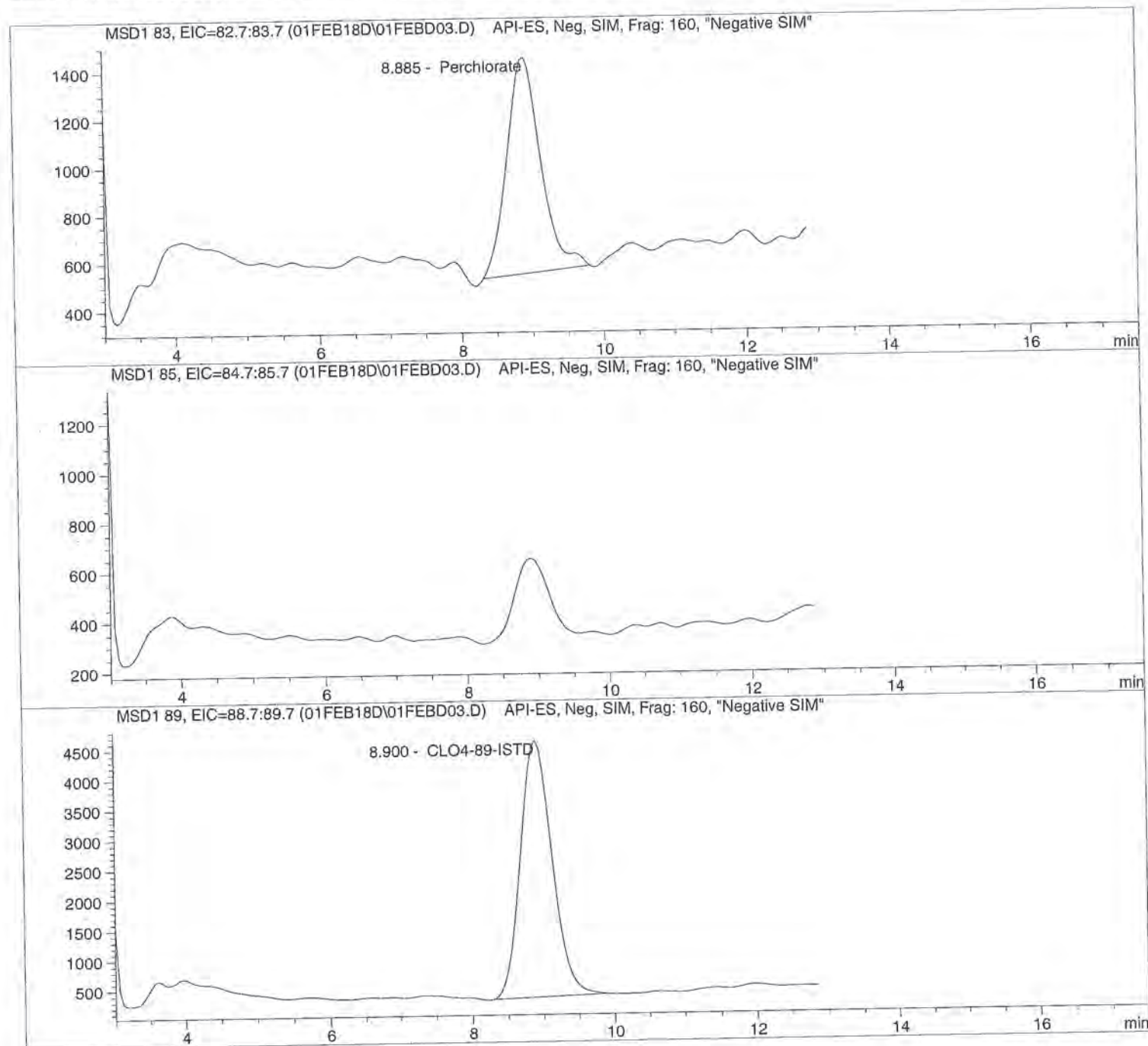
Sample Name: 585672 ICS@1.

Injection Date: 2/01/2018 09:15:50
Sample Name: 585672 ICS@1.
Acq Operator: TNB

Seq Line: 3
Location: Vial 73
Inj. No.: 1
Inj. Vol.: 25 μ l

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD03.D Sample Name: 585672 ICS@1.

=====
Injection Date: 2/01/2018 09:15:50 Seq Line: 3
Sample Name: 585672 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: 1/19/2018 12:46:10

Perchlorate analysis

=====
Sample Information
=====

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.885	PBA	29957.8	1.0712	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
8.900	PBA	132056.4	5.0000	CLO4-89-ISTD

=====
*** End of Report ***

Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD06.D

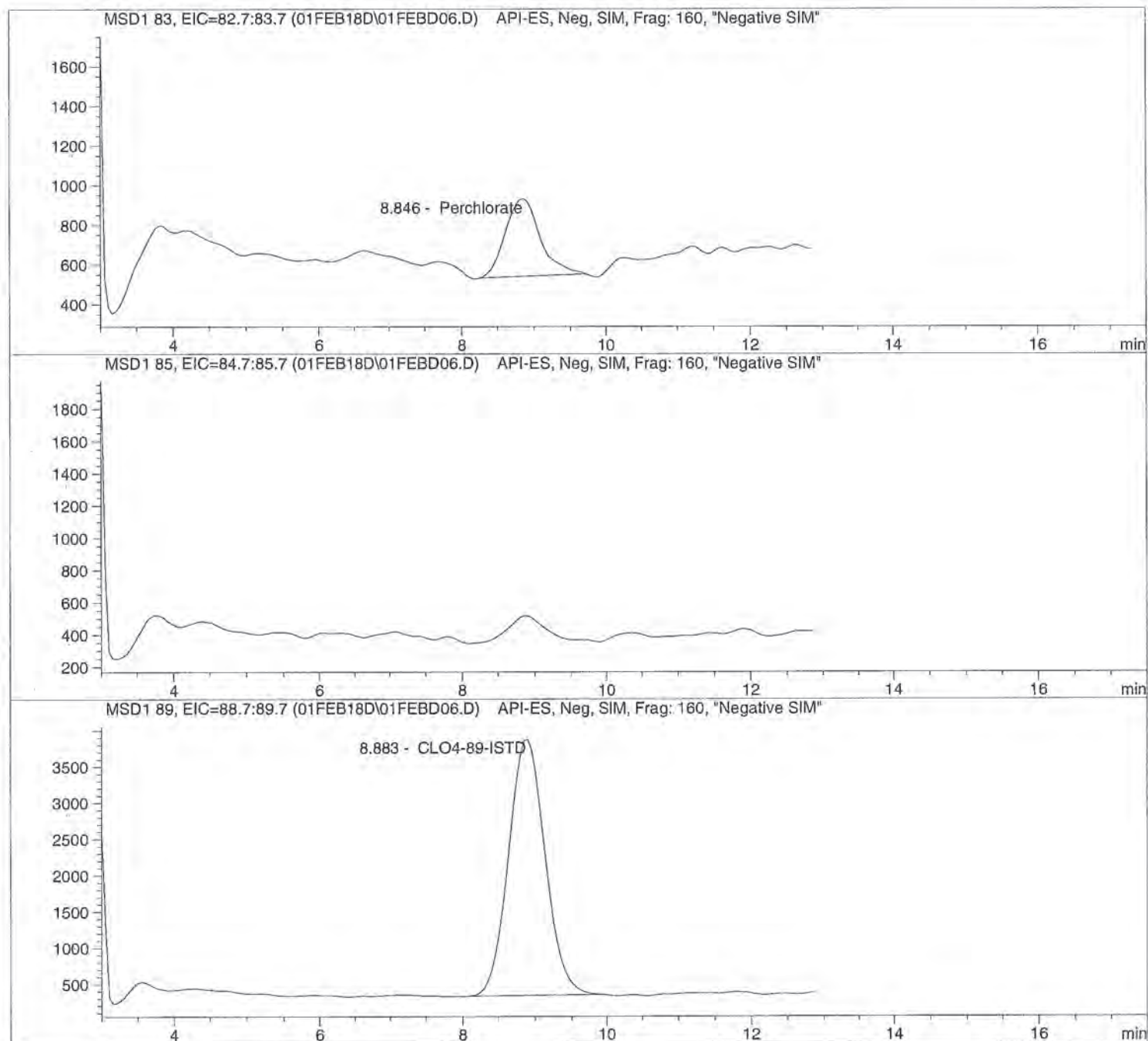
Sample Name: 1802951001

Injection Date: 2/01/2018 10:05:34
Sample Name: 1802951001
Acq Operator: TNB

Seq Line: 6
Location: Vial 76
Inj. No.: 1
Inj. Vol.: 25 μ l

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD06.D Sample Name: 1802951001

```

=====
Injection Date: 2/01/2018 10:05:34      Seq Line: 6
Sample Name: 1802951001                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: 1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
Sample Information
=====

```

```

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.846	PBA	12949.1	0.5112	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
8.883	PBA	123105.3	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

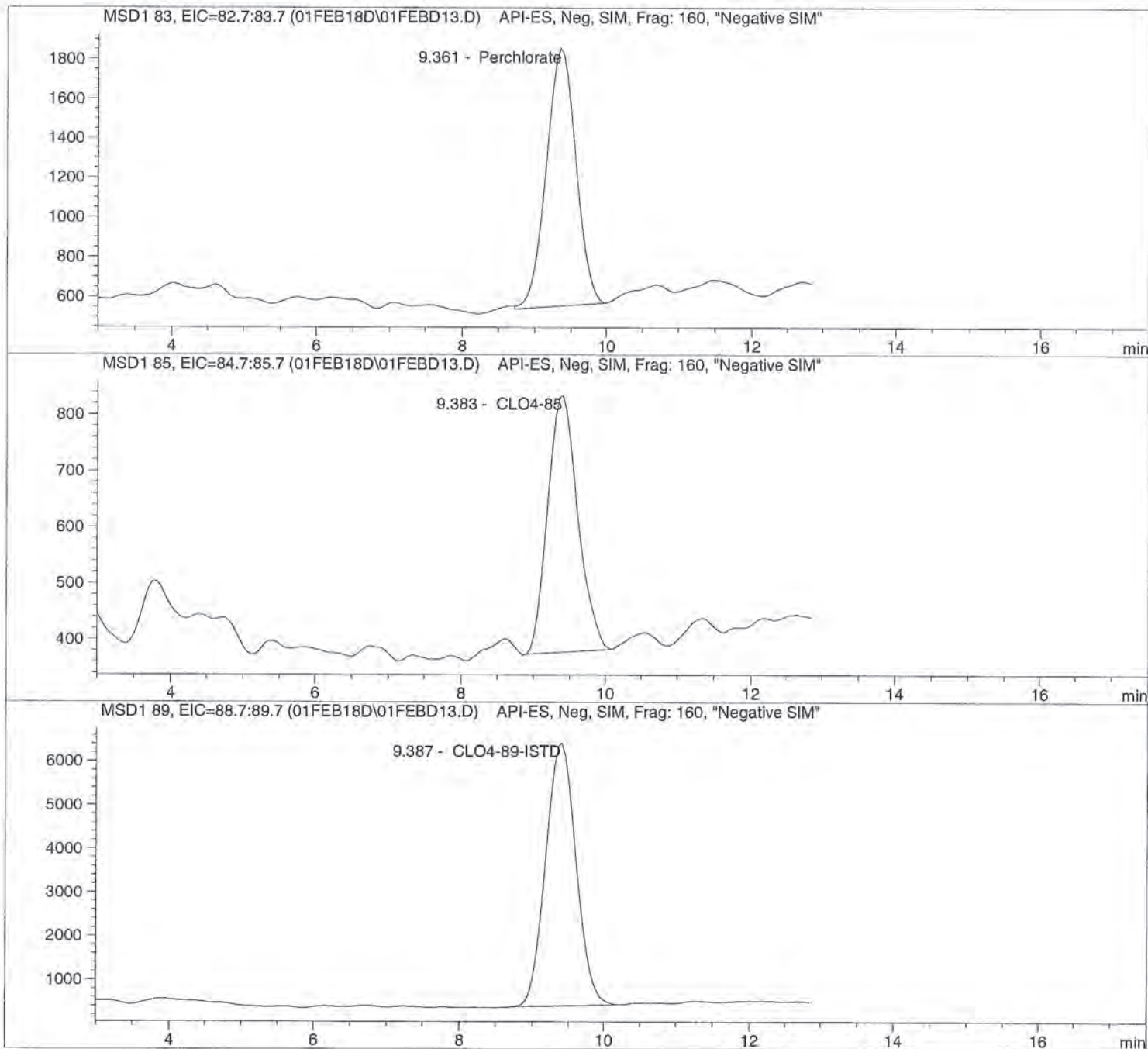
```

Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD13.D Sample Name: 585678 LODV@1.

Injection Date: 2/01/2018 11:50:19 Seq Line: 13
Sample Name: 585678 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: 1/19/2018 12:46:10

Perchlorate analysis



Data file: C:\HPCHEM\1\DATA\01FEB18D\01FEBD13.D Sample Name: 585678 LODV@1.

```

=====
Injection Date:  2/01/2018  11:50:19      Seq Line:           13
Sample Name:    585678  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:   1/19/2018  12:46:10
=====

```

Perchlorate analysis

```

=====
                          Sample Information
=====

```

```

Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.361	BBA	37035.3	0.9964	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.383	PBA	13262.3	0.8783	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.387	BBA	175892.6	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

```



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February 02, 2018

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

Work Order: **HS18010395**

Laboratory Results for: **Groundwater Treatment Plant Weekly Samples**

Dear Marcia,

ALS Environmental received 1 sample(s) on Jan 11, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 02-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
Work Order: HS18010395

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18010395-01	LH18/24-SP650_011018	Water		10-Jan-2018 14:00	11-Jan-2018 08:27	<input type="checkbox"/>

ALS Group USA, Corp

Date: 02-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
Work Order: HS18010395

CASE NARRATIVE**Work Order Comments**

- The analysis for Perchlorate was subcontracted to ALS Salt Lake City, UT. Final report attached.
-

WetChemistry by Method E415.1**Batch ID: R309274**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E365.3**Batch ID: R308975**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E350.3**Batch ID: R308901**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 02-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Groundwater Treatment Plant Weekly Samples
 Sample ID: LH18/24-SP650_011018
 Collection Date: 10-Jan-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18010395
 Lab ID:HS18010395-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
AMMONIA AS N BY E350.3(ISE)								Analyst: SAP
Nitrogen, Ammonia (As N)	16		0.20	0.10	0.20	mg/L	1	12-Jan-2018 14:10
ORTHO PHOSPHATE (PO4) AS P BY E365.3								Analyst: MZD
Phosphorus, Total Orthophosphate (As P)	2.50		0.0500	0.125	0.125	mg/L	5	12-Jan-2018 12:38
TOTAL ORGANIC CARBON BY E415.1								Analyst: KMU
Organic Carbon, Total	28.6		0.500	0.500	1.00	mg/L	1	20-Jan-2018 18:55
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)								Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	01-Feb-2018 16:08

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

ALS Group USA, Corp

Date: 02-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18010395

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R308901	Test Name : AMMONIA AS N BY E350.3(ISE)		Matrix: Water			
HS18010395-01	LH18/24-SP650_011018	10 Jan 2018 14:00			12 Jan 2018 14:10	1
Batch ID R308975	Test Name : ORTHO PHOSPHATE (PO4) AS P BY E365.3		Matrix: Water			
HS18010395-01	LH18/24-SP650_011018	10 Jan 2018 14:00			12 Jan 2018 12:38	5
Batch ID R309274	Test Name : TOTAL ORGANIC CARBON BY E415.1		Matrix: Water			
HS18010395-01	LH18/24-SP650_011018	10 Jan 2018 14:00			20 Jan 2018 18:55	1
Batch ID R310039	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18010395-01	LH18/24-SP650_011018	10 Jan 2018 14:00			01 Feb 2018 16:08	1

ALS Group USA, Corp

Date: 02-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18010395

QC BATCH REPORT

Batch ID: R308901		Instrument: WetChem_HS		Method: E350.3	
MBLK	Sample ID: MBLK-R308901	Units: mg/L		Analysis Date: 12-Jan-2018 14:10	
Client ID:	Run ID: WetChem_HS_308901	SeqNo: 4391146	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	0.10	0.20			U
LCS	Sample ID: LCS-R308901	Units: mg/L		Analysis Date: 12-Jan-2018 14:10	
Client ID:	Run ID: WetChem_HS_308901	SeqNo: 4391145	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	10.25	0.20	10	0	102 80 - 120
MS	Sample ID: HS18010186-01MS	Units: mg/L		Analysis Date: 12-Jan-2018 14:10	
Client ID:	Run ID: WetChem_HS_308901	SeqNo: 4391250	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	10.09	0.20	10	0.03627	101 80 - 120
MSD	Sample ID: HS18010186-01MSD	Units: mg/L		Analysis Date: 12-Jan-2018 14:10	
Client ID:	Run ID: WetChem_HS_308901	SeqNo: 4391251	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	9.961	0.20	10	0.03627	99.2 80 - 120 10.09 1.29 20

The following samples were analyzed in this batch: HS18010395-01

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

ALS Group USA, Corp

Date: 02-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18010395

QC BATCH REPORT

Batch ID: R308975		Instrument: UV-2450		Method: E365.3						
MBLK	Sample ID: MBLK-308975	Units: mg/L		Analysis Date: 12-Jan-2018 12:38						
Client ID:	Run ID: UV-2450_308975	SeqNo: 4393504	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.0250	0.0250								U
LCS	Sample ID: LCS-308975	Units: mg/L		Analysis Date: 12-Jan-2018 12:38						
Client ID:	Run ID: UV-2450_308975	SeqNo: 4393505	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.241	0.0250	0.25	0	96.4	80 - 120				
MS	Sample ID: HS18010395-01MS	Units: mg/L		Analysis Date: 12-Jan-2018 12:38						
Client ID: LH18/24-SP650_011018	Run ID: UV-2450_308975	SeqNo: 4394485	PrepDate:	DF: 5						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	3.57	0.125	1.25	2.495	86.0	80 - 120				
MSD	Sample ID: HS18010395-01MSD	Units: mg/L		Analysis Date: 12-Jan-2018 12:38						
Client ID: LH18/24-SP650_011018	Run ID: UV-2450_308975	SeqNo: 4394486	PrepDate:	DF: 5						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	3.545	0.125	1.25	2.495	84.0	80 - 120	3.57	0.703	20	

The following samples were analyzed in this batch: HS18010395-01

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

ALS Group USA, Corp

Date: 02-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18010395

QC BATCH REPORT

Batch ID: R309274		Instrument: TOC_02		Method: E415.1						
MBLK	Sample ID: WBLKW1-012018	Units: mg/L		Analysis Date: 20-Jan-2018 16:51						
Client ID:	Run ID: TOC_02_309274	SeqNo: 4399412		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	0.500	1.00							U	
LCS	Sample ID: WLCSW1-012018	Units: mg/L		Analysis Date: 20-Jan-2018 17:06						
Client ID:	Run ID: TOC_02_309274	SeqNo: 4399413		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	9.769	1.00	10	0	97.7	80 - 120				
LCSD	Sample ID: WLCSDW1-012018	Units: mg/L		Analysis Date: 20-Jan-2018 17:21						
Client ID:	Run ID: TOC_02_309274	SeqNo: 4399414		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	9.76	1.00	10	0	97.6	80 - 120	9.769	0.0922	20	
MS	Sample ID: HS18010395-01MS	Units: mg/L		Analysis Date: 20-Jan-2018 19:10						
Client ID: LH18/24-SP650_011018	Run ID: TOC_02_309274	SeqNo: 4399416		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	38.74	1.00	10	28.56	102	80 - 120				

The following samples were analyzed in this batch: HS18010395-01

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

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18010395

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
Work Order: HS18010395

SAMPLE TRACKING

Lab Samp ID	Client Sample ID	Action	Date	Person	New Location
HS18010395-01	LH18/24-SP650_011018	Login	1/11/2018 12:03:33 PM	CL	Sub
HS18010395-01	LH18/24-SP650_011018	Login	1/11/2018 12:03:33 PM	CL	WET245
HS18010395-01	LH18/24-SP650_011018	Login	1/11/2018 12:03:33 PM	CL	WET245
HS18010395-01	LH18/24-SP650_011018	Login	1/11/2018 12:03:33 PM	CL	WET245

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18010395

Date/Time Received: **11-Jan-2018 08:27**
 Received by: **RPG**

Checklist completed by: Cesar A. Lira 11-Jan-2018 Reviewed by: RJ Modashia 11-Jan-2018
 eSignature Date eSignature 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): 3.1C/3.5C UC/C IR30
 Cooler(s)/Kit(s): 43046
 Date/Time sample(s) sent to storage: 1/11/2018 12:10

- 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:

CHAIN OF CUSTODY

Name Of Lab Shipping To: AES 10450 Stanciff Rd. Suite 210 Houston, TX 77099 (281) 530-5656 AITN: SONIA WEST Page 1 of 1

Project: BHATE
 LONGHORN ARMY AMMN. PLANT (LHAAP)
 GROUNDWATER TREATMENT PLANT (GWTP)
 KARNACK, TEXAS

Project No.:
 NWO1312.0150.0
 16.0001

Job:
**GROUNDWATER TREATMENT PLANT
 WEEKLY SAMPLES**

Prepared By:
 Scott Beesinger

P.O. Number

Field Sample I.D.	Sample Matrix	Date / Time	MS / MSD	NO. OF CONTAINERS	ANALYSES			Remarks (Preservatives, etc.)	Lab I.D.#
					AMMONIA-N	ORTHO-PHOSPHATE	PERCHLORATE		
LH18/24-SP650_011018	Water	01/10/18 / 14:00		2	X	X		H2SO4	
LH18/24-SP650_011018	Water	01/10/18 / 14:00		2	X	X		NONE	

HS18010395
 Bhate Environmental Associates, Inc.
 Groundwater Treatment Plant Weekly Samples



Additional Remarks: Standard TAT on all parameters

Relinquished By: *[Signature]* Date: 01/10/18 Time: 14:30
Received By: _____ Date: _____ Time: _____
Relinquished By: _____ Date: _____ Time: _____
Received By: _____ Date: _____ Time: _____

For Lab Use Only

Received At Lab By: *[Signature]* Date: 1/11/17 Time: 0800
Opened By: _____ Date: _____ Time: _____
Seal No.: _____
Temp of Container: 31
Condition: 100% OK
 100% OK
 OK + D.Y.

THU - 11 JAN 10:30A
PRIORITY OVERNIGHT

922-1376 9751 2816

77099
TX-US
IAH

AB SGRA



F.P. 10/2/05 10:00:10 060X 516C1/8019/020A



ALS
10450 Stanciliff Rd., Suite 210
Houston, Texas 77039
Tel. +1 281 530 4756
Fax. +1 281 530 4887

CUSTODY SEAL		Seal Broken 0/1
Date: 11/01/05	Time: 14:30	Date:
Name: Scott F. Stancil	Company: ALS	



Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1801949; 1802229

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2040 (207523)

General Set Information: There were three 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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: NA

Method QC data: The method blank (LMB 585118) was less than 1/2 the CRDL. The recovery for the LCS (585119) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on samples 1801949002/03 (Client ID: 17WW19-011518). 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): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)

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 29JAND02/04/11/13/14.

Thomas Bosch January 29, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: February 01, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1802229**

Project ID: 8357 011018

Purchase Order: 8357

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP650_011018	1802229001	01/10/18	01/22/18	8357



ANALYTICAL REPORT

Workorder: 34-1802229

Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP650_011018	Sampling Site: 8357	Collected: 01/10/2018				
Lab ID: 1802229001	Media: 125 mL Nalgene	Received: 01/22/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2040 (HBN: 207523) Analyzed: 01/29/2018 11:12	Instrument ID: LCMS04 Percent Solid: NA Report Basis: Wet				
Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	2.3	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 01/29/2018 16:56	/S/ Stephen Brose 02/01/2018 09:10

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123Phone: (801) 266-7700
Email: als@alst.com
Web: www.alst.com



ANALYTICAL REPORT

Workorder: 34-1802229

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
Washington	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.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1802229

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

00882948

Analysis Information

Workorder: 1802229

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2040 (HBN: 207523)
Analyzed By: Thomas Bosch

Blank

LMB: 585118
Analyzed: 01/29/2018 09:43
Units: ug/L

Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 585119
Analyzed: 01/29/2018 09:57
Dilution: 1
Units: ug/L

Analyte	Result	Target	% Rec	QC Limits
Perchlorate	5.20	5.00	104	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1801949001
Analyzed: 01/29/2018 10:13
Dilution: 1
Units: ug/L

MS: 1801949002
Analyzed: 01/29/2018 10:28
Dilution: 1
Units: ug/L

MSD: 1801949003
Analyzed: 01/29/2018 10:42
Dilution: 1
Units: ug/L

Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	ND	4.4	5	88.0	78.8 123.8	4.37	87.4	0.707	0.0 20.0

Continuing Calibration Verification

CCV: 585115
Analyzed: 01/29/2018 09:12
Units: ug/L
Criteria: ± 15%

CCV: 585120
Analyzed: 01/29/2018 11:58
Units: ug/L
Criteria: ± 15%

Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	26.5	25.0	106	21.5	25.0	85.9

Interference Check Sample

ICSA: 585117
Analyzed: 01/29/2018 09:28
Units: ug/L
Criteria: ± 30%

Analyte	Result	Target	% Rec.
Perchlorate	0.971	1.00	97.1

Limit of Detection Verification

LODV: 585116
Analyzed: 01/29/2018 08:53
Units: ug/L
Criteria: ± 50%

LODV: 585121
Analyzed: 01/29/2018 11:41
Units: ug/L
Criteria: ± 50%

Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	1.23	1.00	123	1.29	1.00	129



Quality Control Sample Batch Report

00882949

Analysis Information

Workorder: 1802229

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2040 (HBN: 207523)

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 01/29/2018 16:56	/S/ Stephen Brose 02/01/2018 09:08

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

1802229 00882950
~~1802229~~

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: 8357

SUBCONTRACT TO:

ALS Laboratory Group
3352 128th Ave.
Holland, MI 494249263

Phone: +1 616 399 6070

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: HS18010395
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18010395-01	LH18/24-SP650_011018	Water	10 Jan 2018 14:00
SUB_Perch-6850			25 Jan 2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: [Signature] Date/Time: Jan 12, 2018 1800

Received By: [Signature] Date/Time: 1-17-18 1230

Cooler ID(s): SP2 Temperature(s): 5.0

rec: [Signature] 01-22-18 10:00



10450 Stancliff Rd, Ste 210
Houston, TX 77099
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www.alsglobal.com

Subcontract Chain of Custody

COC ID: 8418

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18010395
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18010395-01	LH18/24-SP650_011018	Water	10 Jan 2018 14:00
SUB_Perch-6850			25 Jan 2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

DOD IV (DOD Data Package)

QC Level: DOD IV (DoD Data Package)

Relinquished By: _____

Date/Time: _____

Received By: _____

Date/Time: _____

Cooler ID(s): _____

Temperature(s): _____

Ref:
Dep:

Date: 18Jan18
Wgt: 6.00 LBS
DV:

SHIPPING: 30.76
SPECIAL: 1.85
HANDLING: 0.00
TOTAL: 32.61

Svs: STANDARD OVERNIGHT
TRK: 7261 2424 3810

ORIGIN ID:GRRR (616) 399-6070
SAMPLE RECEIVING
ALS ENVIRONMENTAL
3352 128TH AVENUE

HOLLAND, MI 494249263
UNITED STATES US

SHIP DATE: 18JAN18
ACTWGT: 6.00 LB
CAD: 0122071/CAFE3108

BILL SENDER

TO **SAMPLE RECEIVING**
ALS - SALT LAKE CITY
960 W. LEVOY DR.

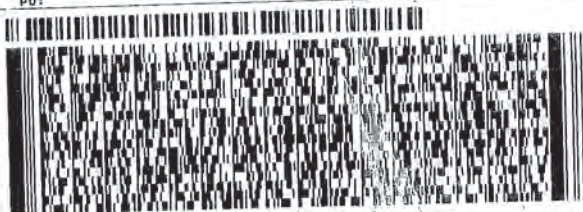
SALT LAKE CITY UT 84123

(800) 356-9135

INV:
PO:

REF:

DEPT:



FedEx
Express



FRI - 19 JAN 3:00P
STANDARD OVERNIGHT

TRK# 7261 2424 3810
0201

XH BTFA

84123
UT-US SLC



2
15:00
B
3810
01:22

ALS-SALT LAKE CITY-RELATED INFORMATION REPORT (CRIR)

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

Client Name: <u>ALS Houston</u>		Project/Task/Site: _____							
Date/Time of Receipt: <u>01-22-18 10:00</u>		Number of Coolers Received: <u>1</u>							
Condition of Coolers: <u>Acceptable</u> /Unacceptable		Temperature Control: Present/ <u>Not Included</u>							
Cooler Custody Seals: Present/ <u>Absent</u> /NA		Location Temp Taken: Control/ <u>Between Samples</u>							
Container Custody Seals: Present/ <u>Absent</u> /NA		Are all temperatures within project specific guidelines? Yes/No/ <u>NA</u>							
Ice Present: <u>Yes</u> /No/NA		VOA Headspace Present? Yes/No/ <u>NA</u>							
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 <u>8186</u>	<u>10</u> °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: <u>Jamita Jussel</u>		Signature		<u>Tamir Vaitassel</u>		Printed Name		<u>01-22-18</u>	Date

CLIENT-RELATED INFORMATION

- | | | | |
|--|---|--|---|
| <input type="checkbox"/> Missing Cooler | <input type="checkbox"/> Missing Samples/Bottles | <input type="checkbox"/> Incorrect Preservation | <input type="checkbox"/> Insufficient Sample Volume |
| <input type="checkbox"/> Cooler Conditions | <input type="checkbox"/> Broken/Leaking Samples | <input type="checkbox"/> pH Criteria Not Met | <input type="checkbox"/> Chain of Custody Problems |
| <input type="checkbox"/> Missing Paperwork | <input type="checkbox"/> Incorrect Bottle Type | <input type="checkbox"/> Residual Chlorine Present | <input type="checkbox"/> Other: |
| <input type="checkbox"/> Missing/Incorrect Bottle Labels | <input type="checkbox"/> Cooler Temperatures Out of Range | <input type="checkbox"/> Head Space in Bottles | |

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

temp out of range!

Client Notified? YES NO

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

ALS Project Manager: _____ Returned to Sample Receipt by: _____ Date: _____
Printed Name Signature



Batch Worklist

HBN: 207523



Created: 1/26/2018 12:56

Instrument: W/P

Analyst: T. Bosch

Rule: EPA 6850, DoD QSM Water

Workorder: 1801949 [ENV_LVL4]

Workorder: 1802229 [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	585115	CCV for HBN 207523 [ELMS/2040]				CCV	3		E685041C3Q	5311		2/2/2018	
2	585116	LODV for HBN 207523 [ELMS/2040]				LODV	3		E6850..D3Q	5311		2/2/2018	
3	585117	ICS for HBN 207523 [ELMS/2040]				ICS	3		E6850..D3Q	5311		2/2/2018	
4	585118	LMB for HBN 207523 [ELMS/2040]				LMB	3		E6850Q413Q	5311		2/2/2018	
5	585119	LCS for HBN 207523 [ELMS/2040]				LCS	3		E6850Q413Q	5311		2/2/2018	
6	1801949001	17WW19-011518				SAMPLE	3	1801949001-A	E6850Q41.3	5480	2/12/2018	2/2/2018	
7	1801949002	17WW19-011518MS				MS	3	1801949002-A	E6850Q413Q	5480		2/2/2018	
8	1801949003	17WW19-011518MSD				MSD	3	1801949003-A	E6850Q413Q	5480		2/2/2018	
9	1801949004	17WW19-011518-FD				SAMPLE	3	1801949004-A	E6850Q41.3	5480	2/12/2018	2/2/2018	
10	1802229001	LH18/24-SP650_011018				SAMPLE	3	1802229001-A	E6850Q41.3	5480	2/7/2018	2/5/2018	
11	585120	CCV for HBN 207523 [ELMS/2040]				CCV	3		E685041C3Q	5311		2/2/2018	
12	585121	LODV for HBN 207523 [ELMS/2040]				LODV	3		E6850..D3Q	5311		2/2/2018	

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ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #()'s: 1801949 (001-04); 1802229 (001)
 ELMS Batch/HBN ID: 2040 (207523)
 Prep Date: 01/29/2018 Analysis Date: 01/29/2018 Analyst: T. Bosch
 Analyte: **Perchlorate** Matrix: **Water** Method: **6850**
 Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\JAN\29JAN18D.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-DOD.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 585119; Target = 5.0µg/L. ASTM type II water was used for LMB 585118.

MS/MSD: MS/MSD was performed on samples 1801949002/03 (Client ID: 17WW19-011518). 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: \\ALSITWS013\LCMS\LCMS04\2018\JAN\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 29JAND02/04/11/13/14.
- 5) Notebook: \\alsitws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\207523-DOD-ALS-HSTN-LCMS4 or through \\ALSITWS013\DATAREVIEW\HBN#



STANDARD REPORT

Working Standard - CLO4 WRK

CLO4 WRK		Description - 6850 WKG Std 100.ug/L			
Standard: 36735		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 WRK		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 INT		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17		Lab Lot: CLO4 QC WRK 100.ug/L		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/2017		Lab Lot: CLO4 QC INT 10.ug/mL		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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



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.





Certificate of Analysis



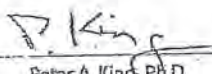
ISO Guide 34 Reference Material

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. Larnendola
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 (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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. 822-275672-11

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:
ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data

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		
*	585116	LODV@1.	Vial 72	1	Control	2	3.99335e4	9.238	1.23322
*	585115	CCV@25	Vial 71	1	Control	3	8.69918e5	9.242	26.45203
*	585117	ICS@1.	Vial 73	1	Control	4	2.41610e4	8.944	9.70817e-1
*	585118	LMB	Vial 74	1	Control	5	0.00000	0.000	0.00000
*	585119	LCS@5.	Vial 75	1	Control	6	1.55581e5	9.046	5.20404
*	1801949001		Vial 76	1	Sample	7	0.00000	0.000	0.00000
*	1801949002	MS	Vial 77	1	Sample	8	1.40255e5	9.045	4.40206
*	1801949003	MSD	Vial 78	1	Sample	9	1.50985e5	9.037	4.37111
*	1801949004	FD	Vial 79	1	Sample	10	0.00000	0.000	0.00000
*	1802229001		Vial 80	1	Sample	11	6.37274e4	8.975	2.27213
*	585121	LODV@1.	Vial 72	1	Control	13	4.64507e4	9.408	1.29303
*	585120	CCV@25	Vial 71	1	Control	14	7.64537e5	9.269	21.47601

#*	Sample Location	Inj	SampleType	Run	CLO4-85 Area	CLO4-85 RT	CLO4-85 Amount		
*	585116	LODV@1.	Vial 72	1	Control	2	1.60003e4	9.259	1.30186
*	585115	CCV@25	Vial 71	1	Control	3	2.91664e5	9.259	27.98484
*	585117	ICS@1.	Vial 73	1	Control	4	7613.24951	8.950	7.23463e-1
*	585118	LMB	Vial 74	1	Control	5	0.00000	0.000	0.00000
*	585119	LCS@5.	Vial 75	1	Control	6	5.18019e4	9.053	5.18929
*	1801949001		Vial 76	1	Sample	7	0.00000	0.000	0.00000
*	1801949002	MS	Vial 77	1	Sample	8	4.80214e4	9.073	4.47697
*	1801949003	MSD	Vial 78	1	Sample	9	5.31868e4	9.059	4.57538
*	1801949004	FD	Vial 79	1	Sample	10	0.00000	0.000	0.00000
*	1802229001		Vial 80	1	Sample	11	2.56524e4	8.990	2.61089
*	585121	LODV@1.	Vial 72	1	Control	13	1.71864e4	9.420	1.25602
*	585120	CCV@25	Vial 71	1	Control	14	2.53308e5	9.285	22.34917

#*	Sample Location	Inj	SampleType	Run	CLO4-89-ISTD Area	CLO4-89-ISTD RT	CLO4-89-ISTD Amount		
*	585116	LODV@1.	Vial 72	1	Control	2	1.52315e5	9.267	5.00000
*	585115	CCV@25	Vial 71	1	Control	3	1.33865e5	9.261	5.00000
*	585117	ICS@1.	Vial 73	1	Control	4	1.17867e5	8.943	5.00000
*	585118	LMB	Vial 74	1	Control	5	1.54956e5	9.159	5.00000
*	585119	LCS@5.	Vial 75	1	Control	6	1.35641e5	9.068	5.00000
*	1801949001		Vial 76	1	Sample	7	1.33078e5	9.067	5.00000
*	1801949002	MS	Vial 77	1	Sample	8	1.45286e5	9.070	5.00000
*	1801949003	MSD	Vial 78	1	Sample	9	1.57539e5	9.057	5.00000
*	1801949004	FD	Vial 79	1	Sample	10	1.37008e5	9.069	5.00000
*	1802229001		Vial 80	1	Sample	11	1.30009e5	8.989	5.00000
*	585121	LODV@1.	Vial 72	1	Control	13	1.68767e5	9.425	5.00000
*	585120	CCV@25	Vial 71	1	Control	14	1.48395e5	9.285	5.00000

*** End of Report ***

Sequence Table:

Method and Injection Info Part:

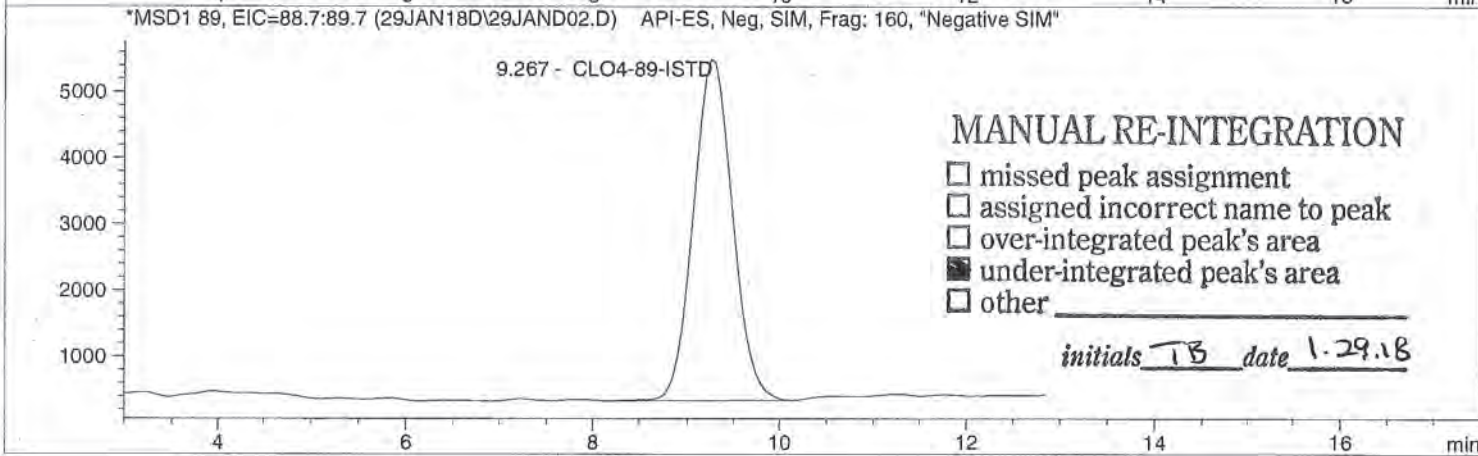
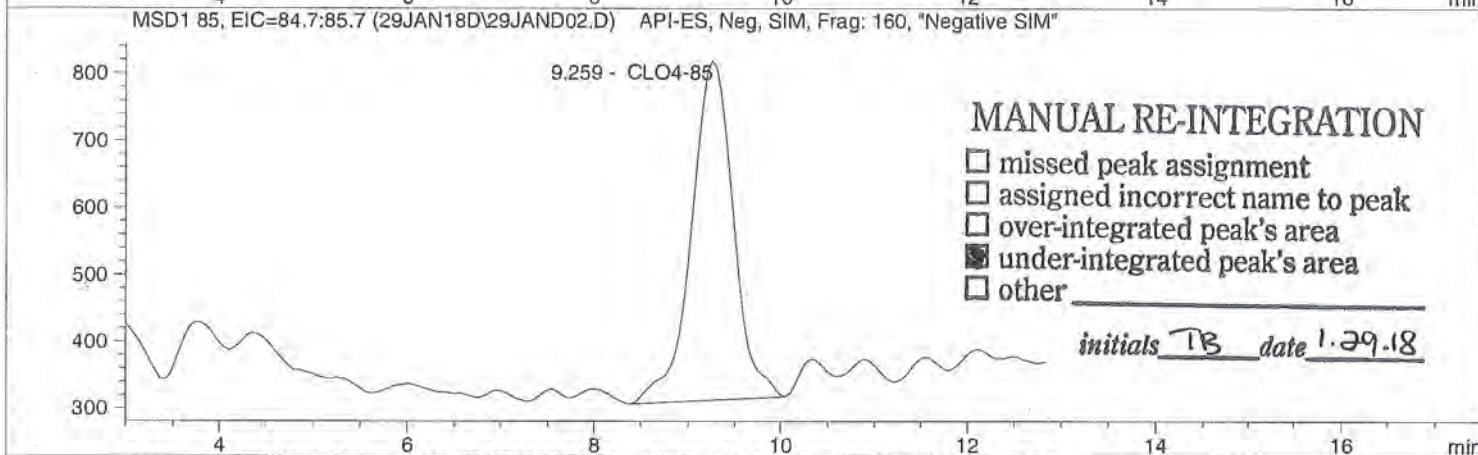
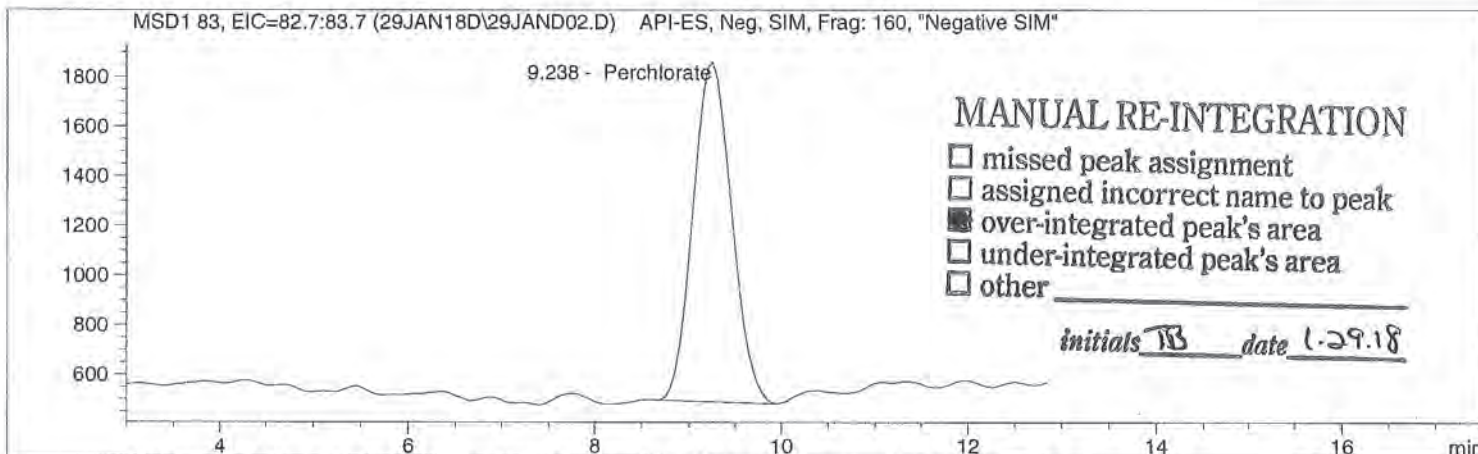
Line	Location	SampleName	Method	Inj	SampleType	InjVolume	DataFile
1	Vial 71	585115	CCV@25	CLO4-DOD	1	Ctrl Samp	
2	Vial 72	585116	LODV@1.	CLO4-DOD	1	Ctrl Samp	
3	Vial 71	585115	CCV@25	CLO4-DOD	1	Ctrl Samp	
4	Vial 73	585117	ICS@1.	CLO4-DOD	1	Ctrl Samp	
5	Vial 74	585118	LMB	CLO4-DOD	1	Ctrl Samp	
6	Vial 75	585119	LCS@5.	CLO4-DOD	1	Ctrl Samp	
7	Vial 76	1801949001		CLO4-DOD	1	Sample	
8	Vial 77	1801949002	MS	CLO4-DOD	1	Sample	
9	Vial 78	1801949003	MSD	CLO4-DOD	1	Sample	
10	Vial 79	1801949004	FD	CLO4-DOD	1	Sample	
11	Vial 80	1802229001		CLO4-DOD	1	Sample	
12	Vial 71	585120	CCV@25	CLO4-DOD	1	Ctrl Samp	
13	Vial 72	585121	LODV@1.	CLO4-DOD	1	Ctrl Samp	
14	Vial 71	585120	CCV@25	CLO4-DOD	1	Ctrl Samp	

Injection Date: 1/29/2018 08:53:03
Sample Name: 585116 LODV@1.
Acq Operator: TNB

Seq Line: 2
Location: Vial 72
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



```
=====
Injection Date: 1/29/2018 08:53:03      Seq Line:      2
Sample Name:    585116  LODV01.          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:   1/19/2018 12:46:10
=====
```

Perchlorate analysis

===== Sample Information =====

```
Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.238	MM	39933.5	1.2332	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.259	MM	16000.3	1.3019	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.267	MM	152314.7	5.0000	CLO4-89-ISTD

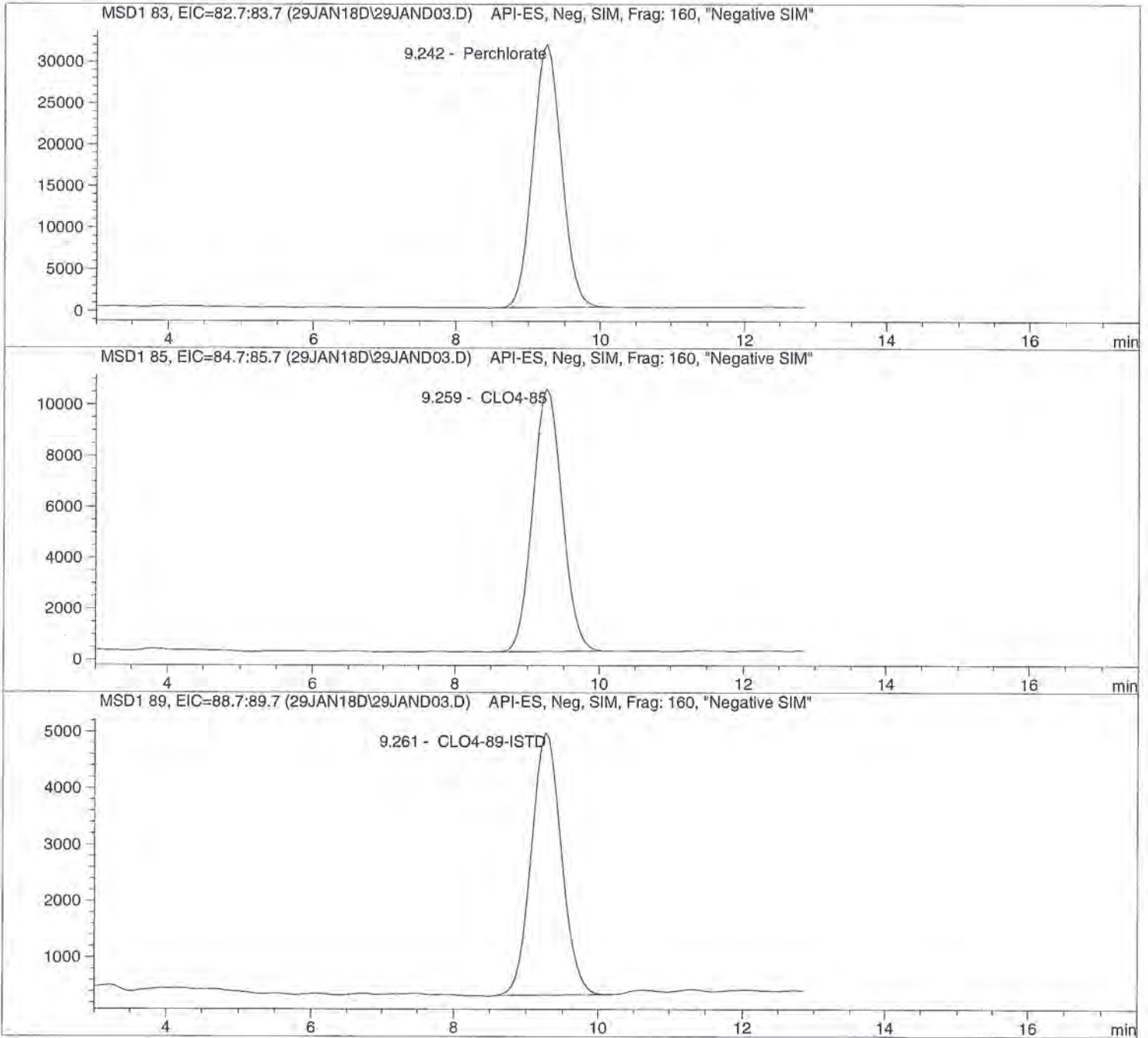
=====
*** End of Report ***
=====

Injection Date: 1/29/2018 09:12:03
Sample Name: 585115 CCV@25
Acq Operator: TNB

Seq Line: 3
Location: Vial 71
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



```
=====
Injection Date: 1/29/2018 09:12:03      Seq Line:      3
Sample Name:    585115  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:   1/19/2018 12:46:10
=====
```

Perchlorate analysis

===== Sample Information =====

```
Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.242	PBA	869917.6	26.4520	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.259	PBA	291664.1	27.9848	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.261	PBA	133864.6	5.0000	CLO4-89-ISTD

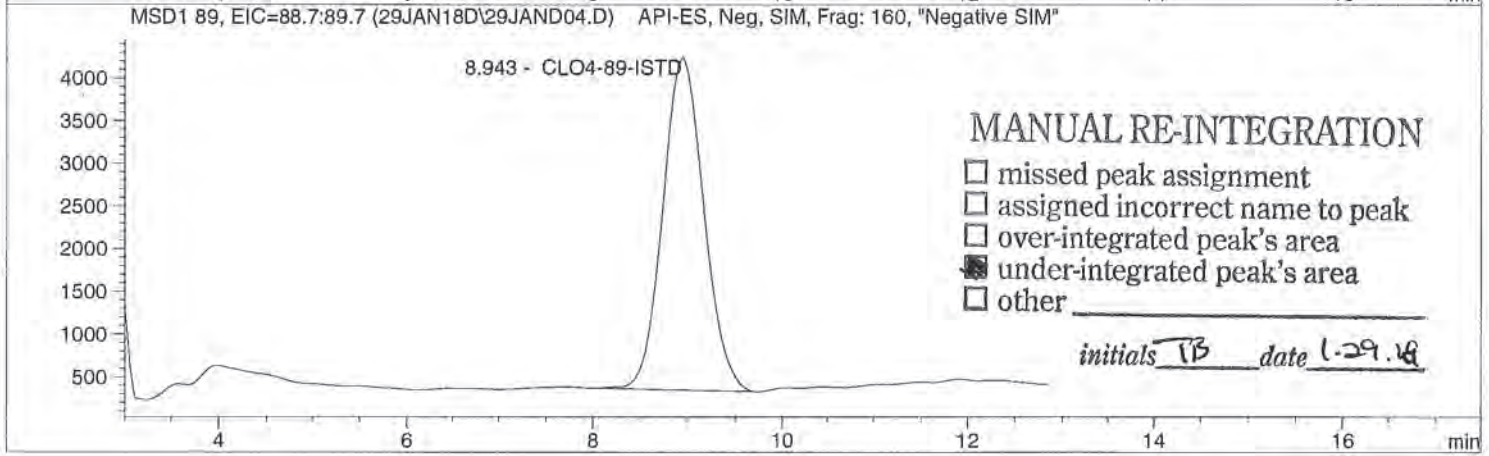
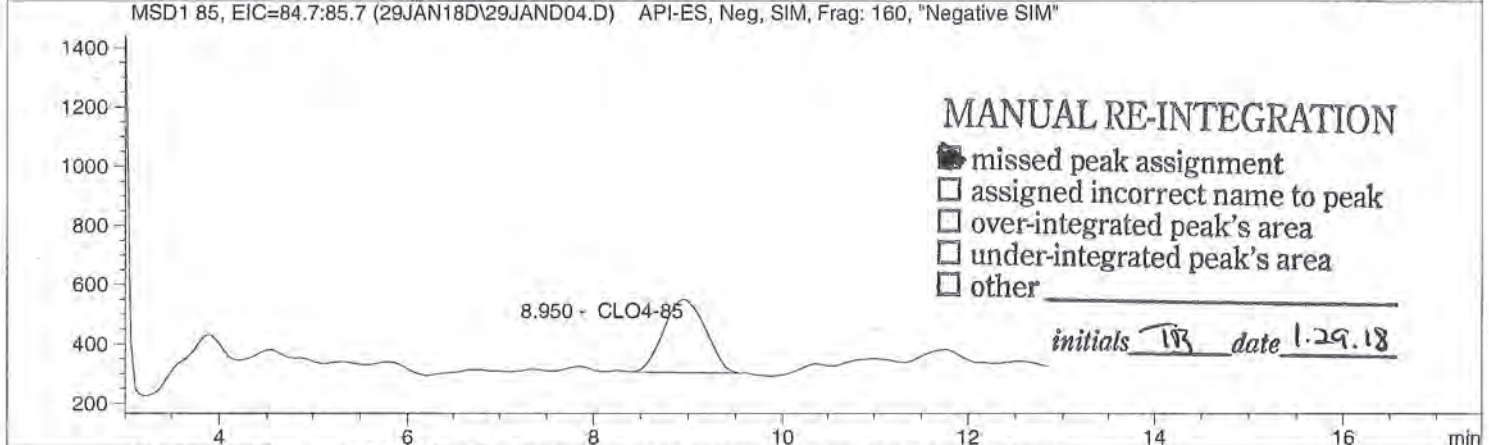
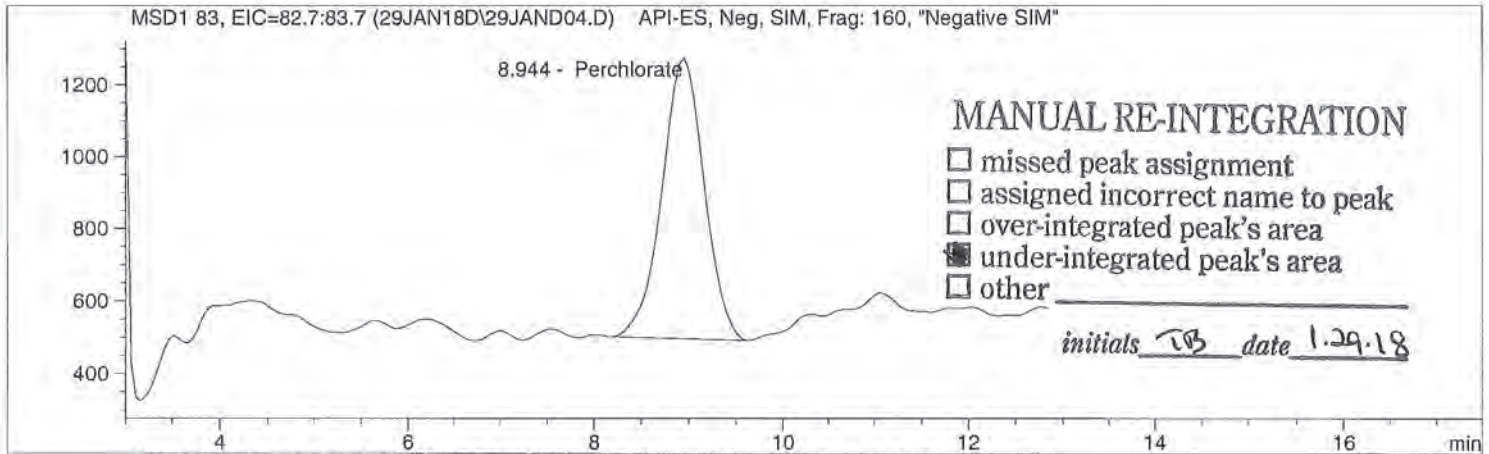
=====
*** End of Report ***

Injection Date: 1/29/2018 09:28:16
Sample Name: 585117 ICS@1.
Acq Operator: TNB

Seq Line: 4
Location: Vial 73
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Injection Date: 1/29/2018 09:28:16 Seq Line: 4
Sample Name: 585117 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: 1/19/2018 12:46:10

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.944	MM	24161.0	0.9708	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.950	MM	7613.2	0.7235	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.943	MM	117867.3	5.0000	CLO4-89-ISTD

*** End of Report ***


```
=====
Injection Date: 1/29/2018 09:43:00      Seq Line:          5
Sample Name:    585118 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:   1/19/2018 12:46:10
=====
```

Perchlorate analysis

===== Sample Information =====

```
Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.159	PBA	154955.5	5.0000	CLO4-89-ISTD

=====
*** End of Report ***


```
=====
Injection Date: 1/29/2018 10:13:23      Seq Line: 7
Sample Name: 1801949001                 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: 1/19/2018 12:46:10
=====
```

Perchlorate analysis

```
=====
Sample Information
=====
```

```
Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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

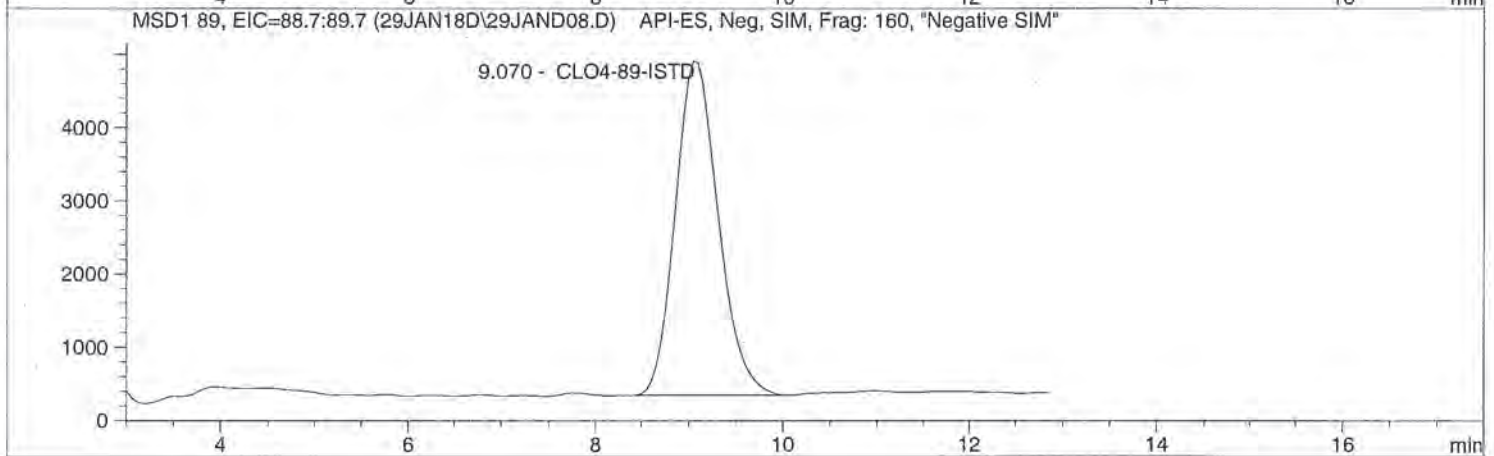
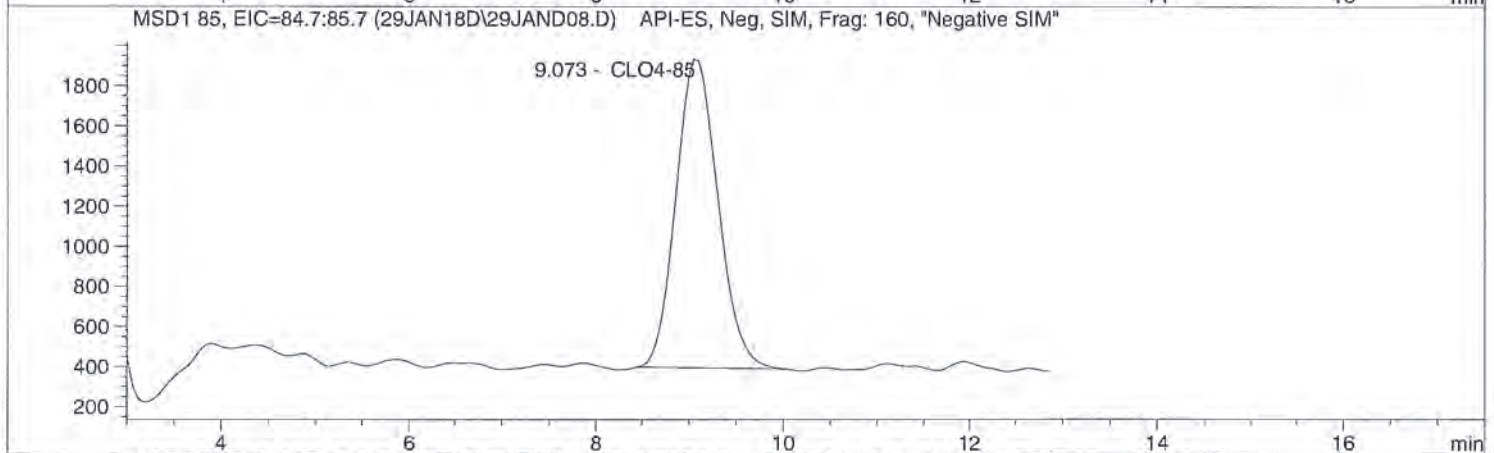
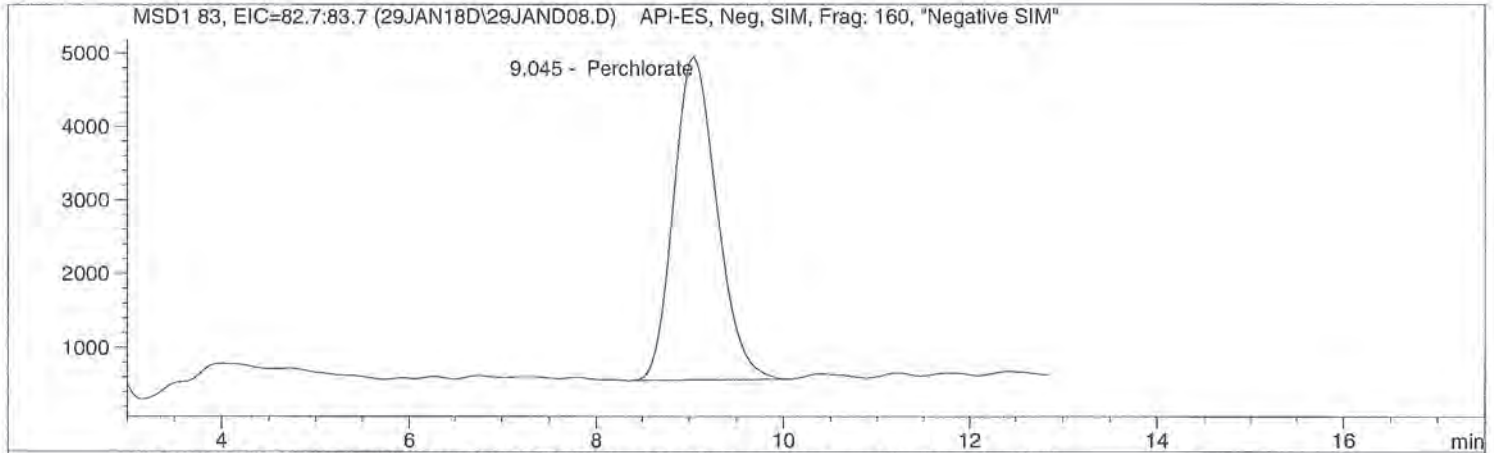
RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.067	BBA	133077.6	5.0000	CLO4-89-ISTD

```
=====
*** End of Report ***
=====
```


=====
Injection Date: 1/29/2018 10:28:03 Seq Line: 8
Sample Name: 1801949002 MS 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: 1/19/2018 12:46:10

Perchlorate analysis
=====



Injection Date: 1/29/2018 10:28:03 Seq Line: 8
Sample Name: 1801949002 MS 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: 1/19/2018 12:46:10

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.045	PBA	140255.5	4.4021	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.073	BBA	48021.4	4.4770	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.070	PBA	145286.1	5.0000	CLO4-89-ISTD

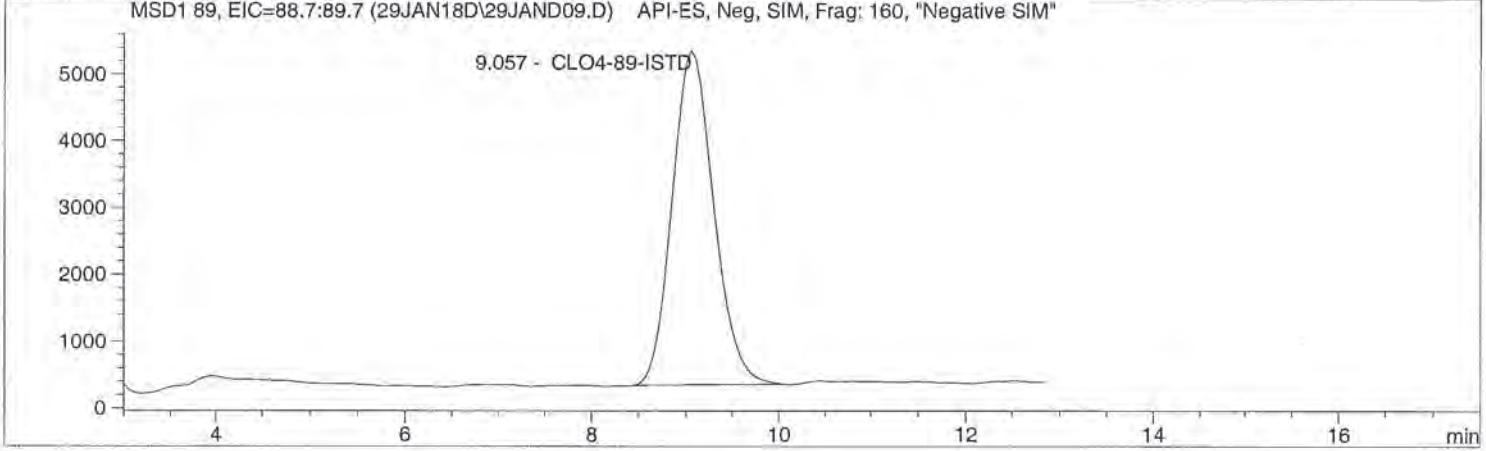
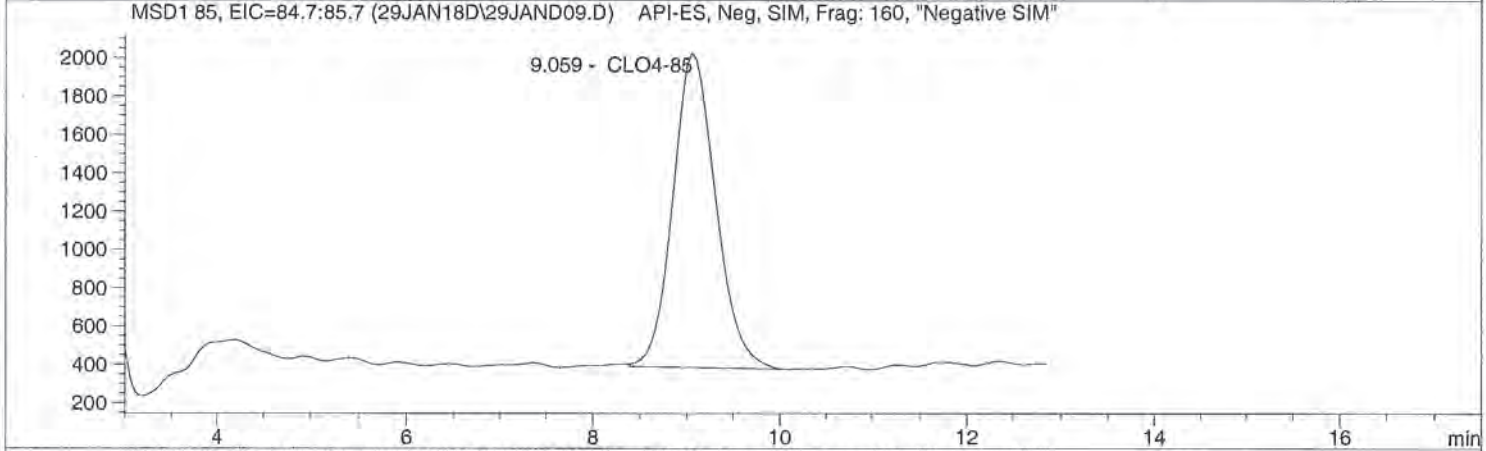
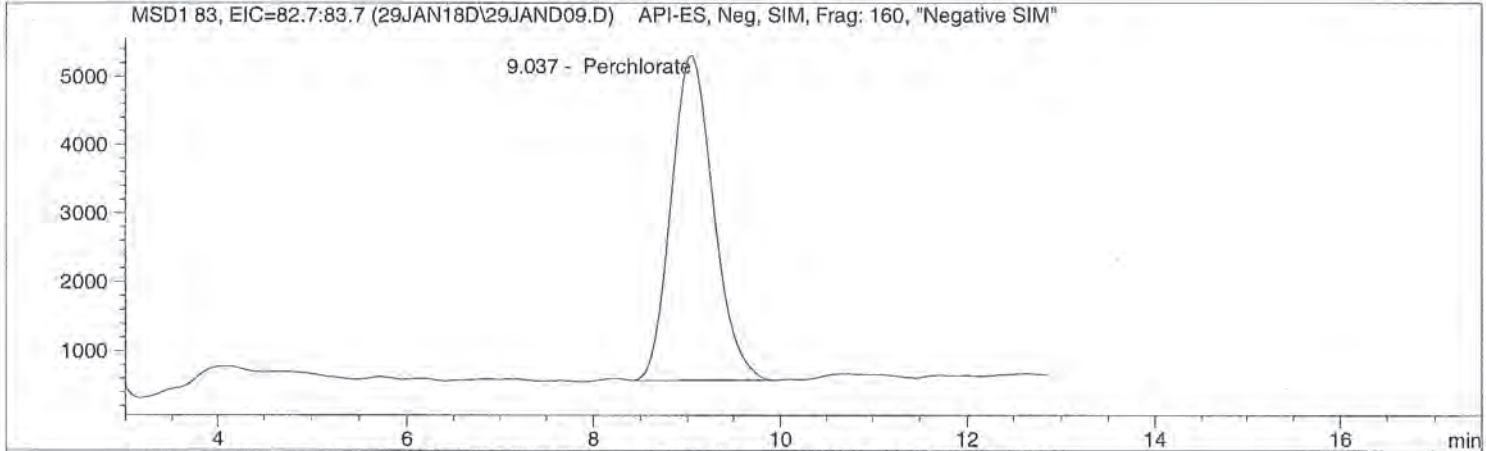
*** End of Report ***

Injection Date: 1/29/2018 10:42:43
Sample Name: 1801949003 MSD
Acq Operator: TNB

Seq Line: 9
Location: Vial 78
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis




```
=====
Injection Date: 1/29/2018 10:42:43      Seq Line:          9
Sample Name:    1801949003  MSD          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:   1/19/2018 12:46:10
=====
```

Perchlorate analysis

===== Sample Information =====

```
Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.037	PBA	150984.7	4.3711	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.059	BBA	53186.8	4.5754	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

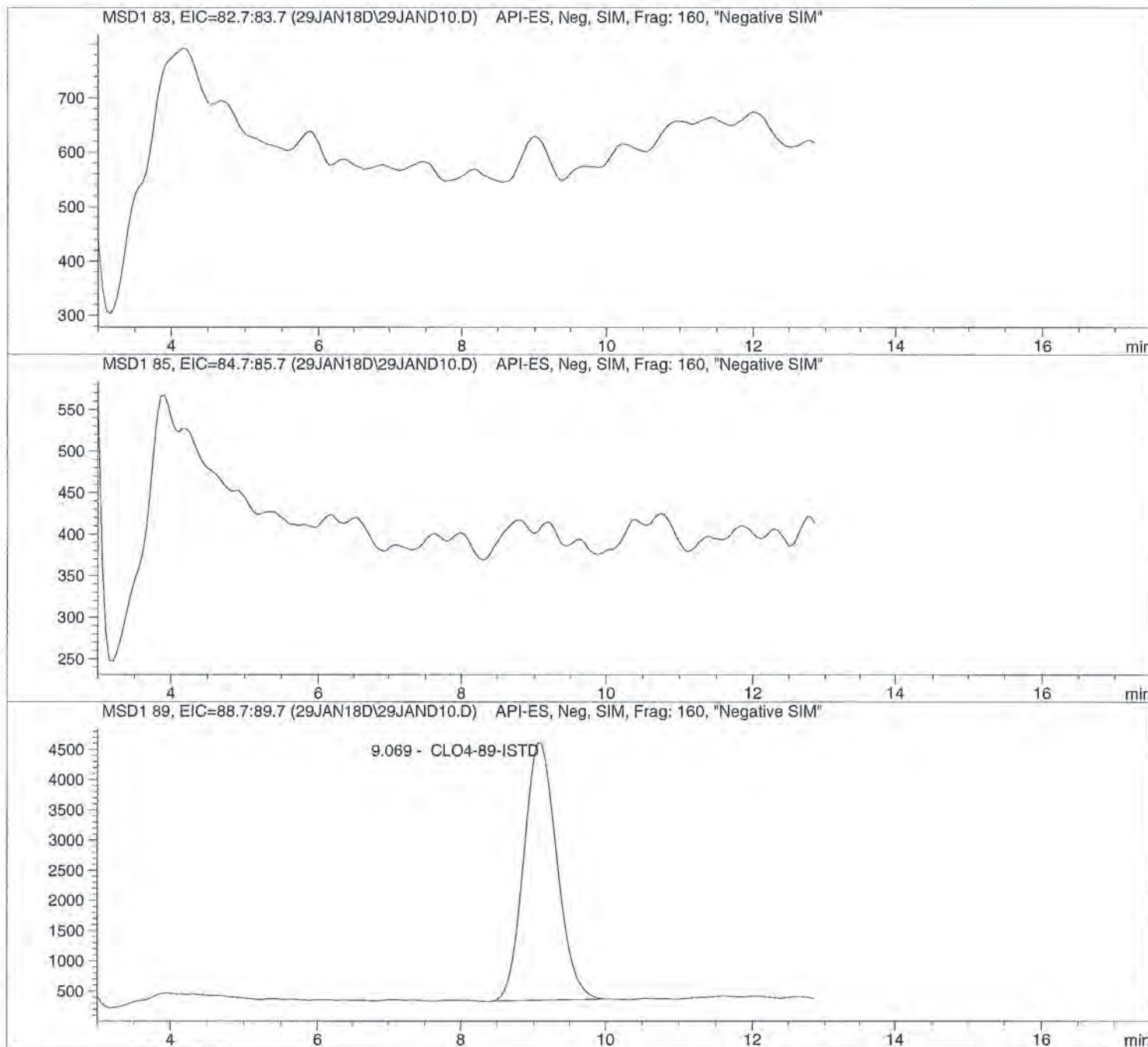
RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.057	PBA	157539.1	5.0000	CLO4-89-ISTD

=====
*** End of Report ***

Injection Date: 1/29/2018 10:57:23 Seq Line: 10
Sample Name: 1801949004 FD 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: 1/19/2018 12:46:10

Perchlorate analysis




```
=====
Injection Date: 1/29/2018 10:57:23      Seq Line: 10
Sample Name: 1801949004 FD              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: 1/19/2018 12:46:10
=====
```

Perchlorate analysis

===== Sample Information =====

```
Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.069	PBA	137008.2	5.0000	CLO4-89-ISTD

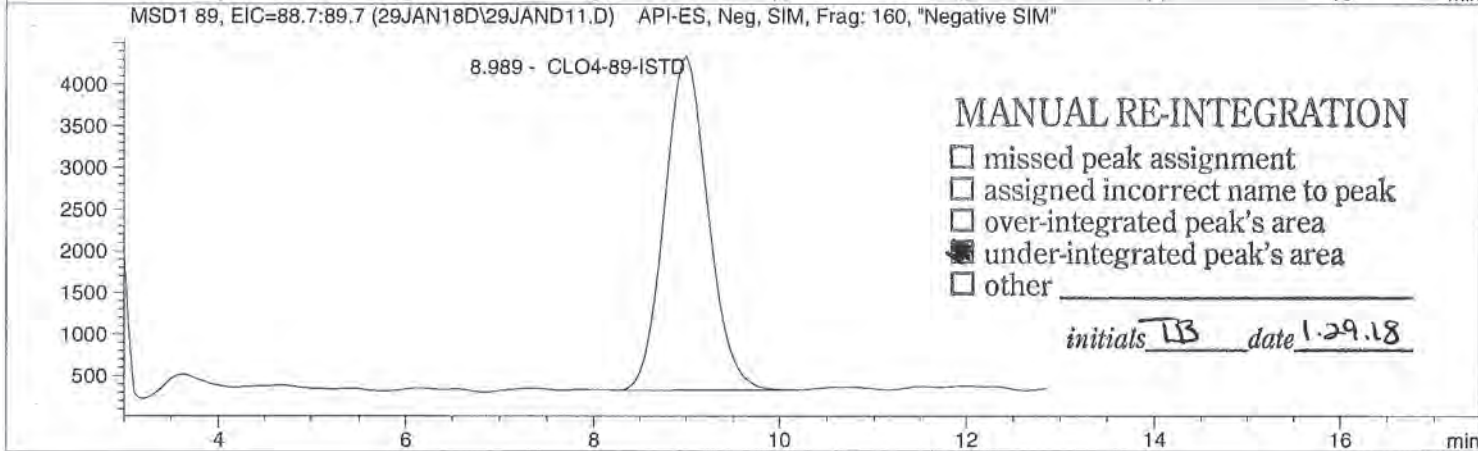
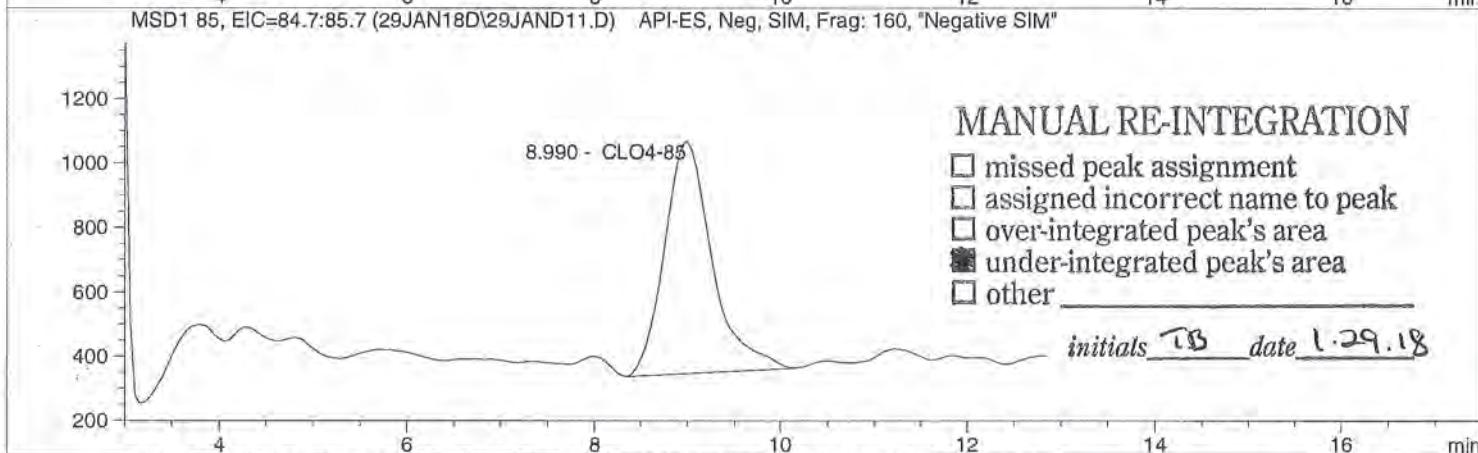
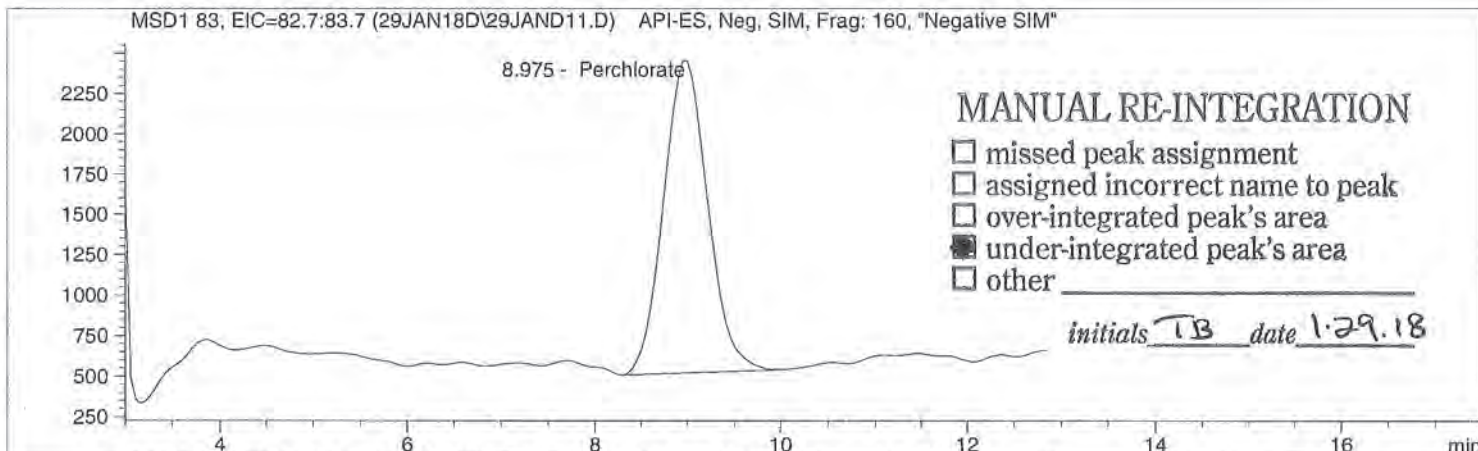
=====
*** End of Report ***

Injection Date: 1/29/2018 11:12:05
Sample Name: 1802229001
Acq Operator: TNB

Seq Line: 11
Location: Vial 80
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis




```
=====
Injection Date: 1/29/2018 11:12:05      Seq Line: 11
Sample Name: 1802229001                 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: 1/19/2018 12:46:10
=====
```

Perchlorate analysis

```
=====
Sample Information
=====
```

```
Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.975	MM	63727.4	2.2721	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.990	MM	25652.4	2.6109	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.989	MM	130009.1	5.0000	CLO4-89-ISTD

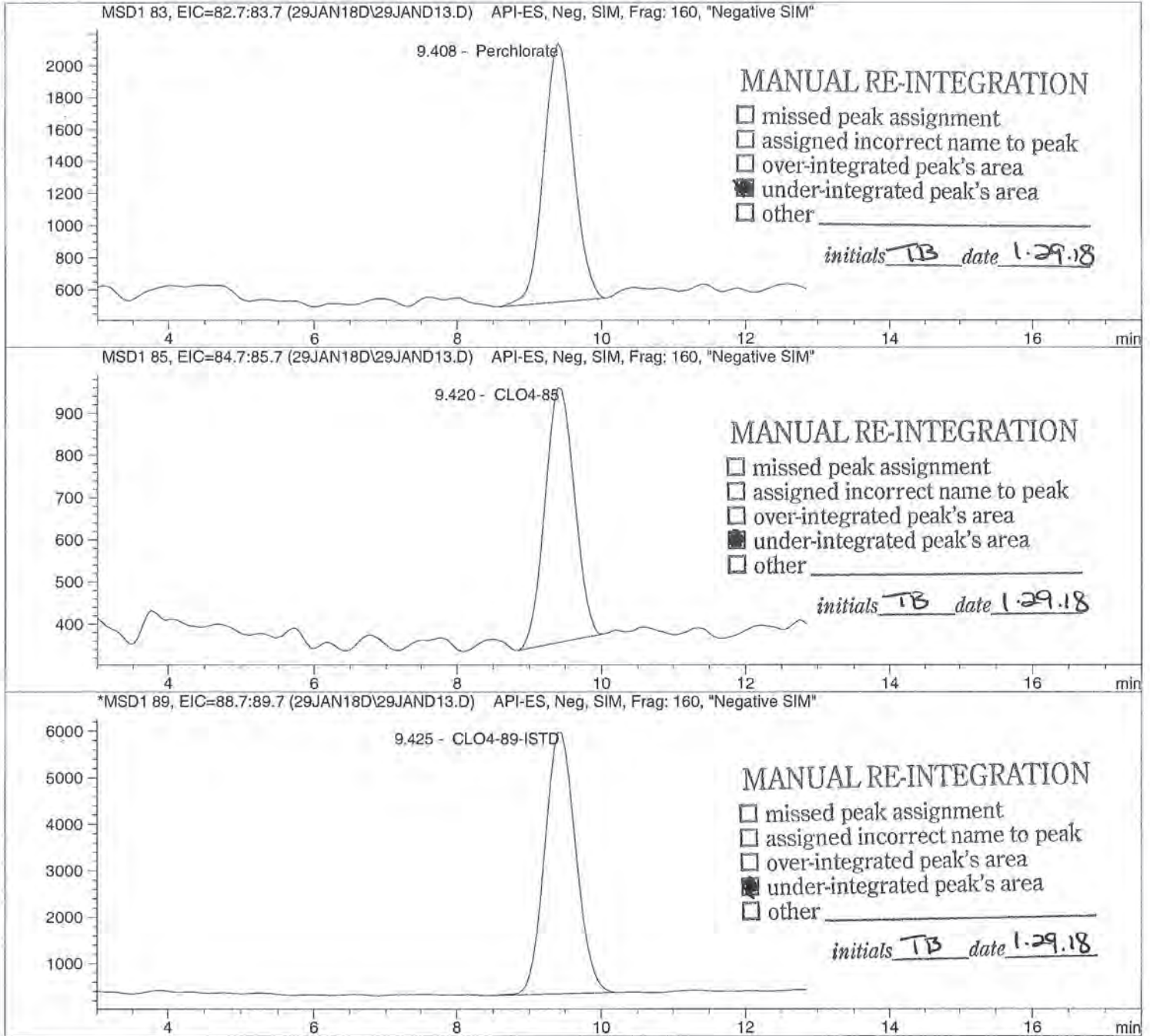
```
=====
*** End of Report ***
=====
```

Injection Date: 1/29/2018 11:41:26
Sample Name: 585121 LODV@1.
Acq Operator: TNB

Seq Line: 13
Location: Vial 72
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



Injection Date: 1/29/2018 11:41:26 Seq Line: 13
Sample Name: 585121 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: 1/19/2018 12:46:10

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.408	MM	46450.7	1.2930	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.420	MM	17186.4	1.2560	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.425	MM	168767.0	5.0000	CLO4-89-ISTD

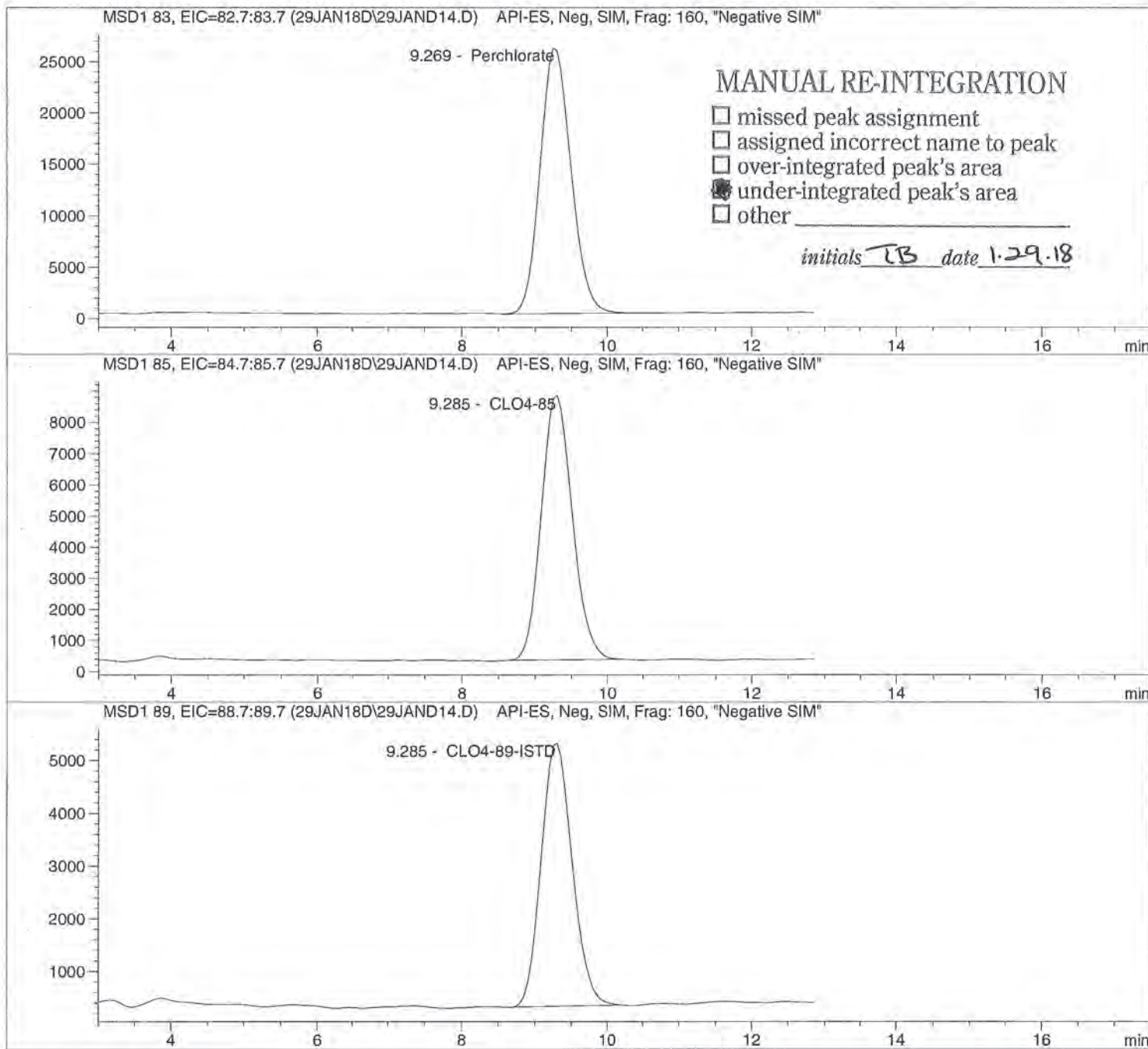
*** End of Report ***

Injection Date: 1/29/2018 11:58:26
Sample Name: 585120 CCV@25
Acq Operator: TNB

Seq Line: 14
Location: Vial 71
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



```
=====
Injection Date: 1/29/2018 11:58:26      Seq Line:      14
Sample Name:    585120  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:   1/19/2018 12:46:10
=====
```

Perchlorate analysis

===== Sample Information =====

```
Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.269	MM	764537.1	21.4760	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.285	PBA	253307.9	22.3492	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.285	PBA	148394.9	5.0000	CLO4-89-ISTD

=====
*** End of Report ***
=====



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Raw Data

Initial Calibration

 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

#

#	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	Lvl	Amount	Area	Amt/Area	Ref Grp Name	
[min]	Sig					
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

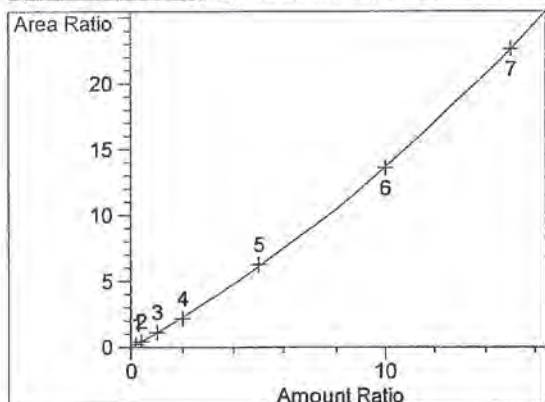
Compound: CLO4-89-ISTD

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

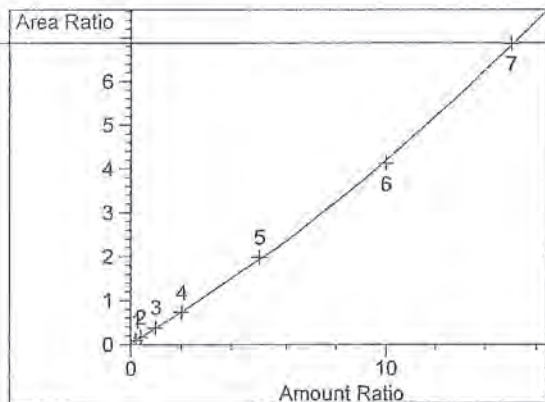
x: Amount Ratio

y: Area Ratio

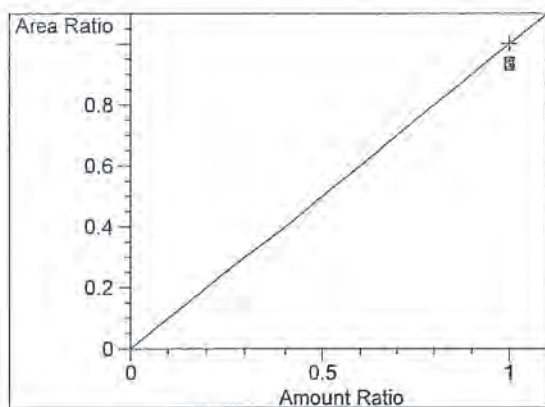
Calibration Level Weights:

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
 MSDI 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
 MSDI 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 ***

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		

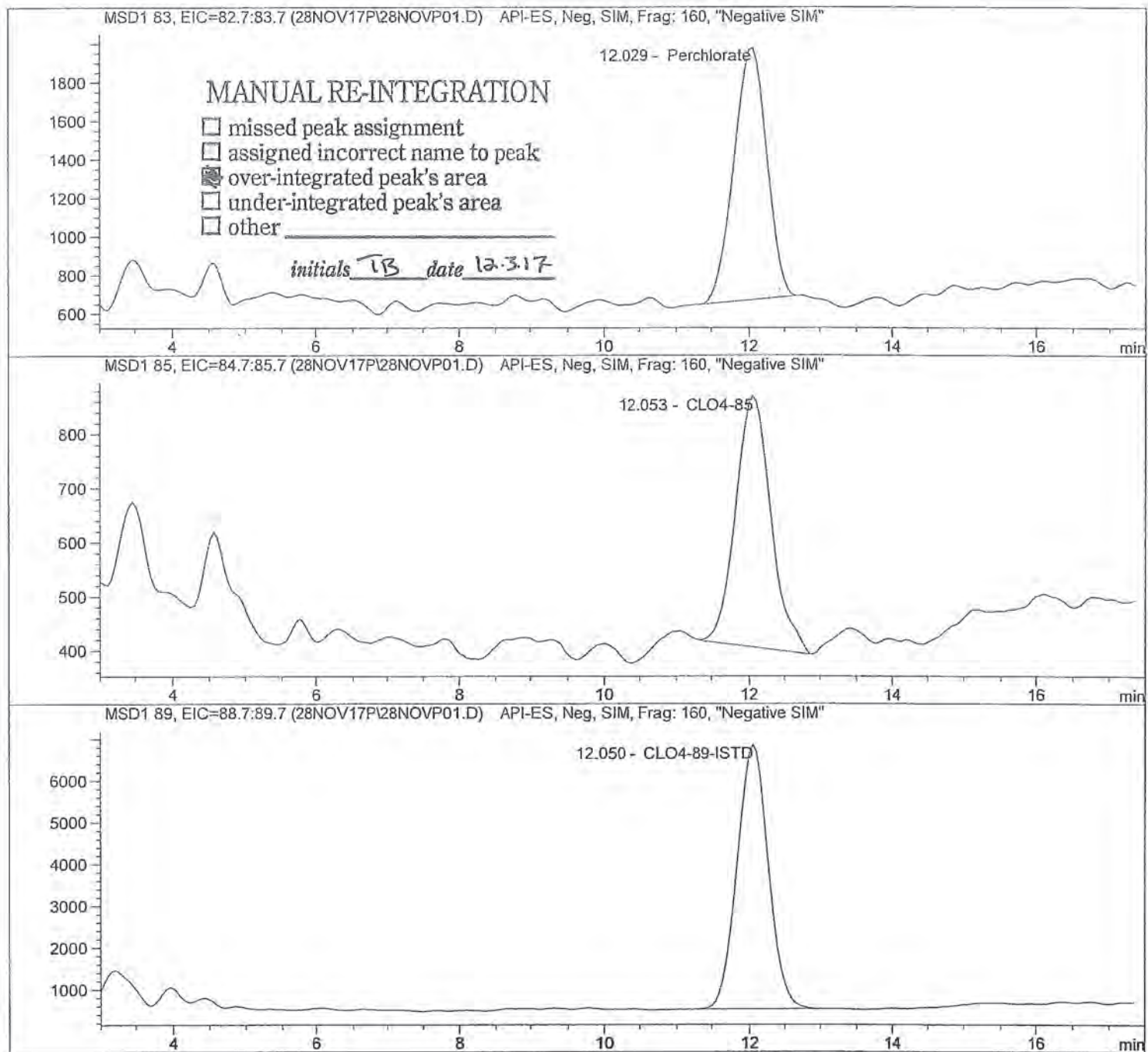
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP01.D

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

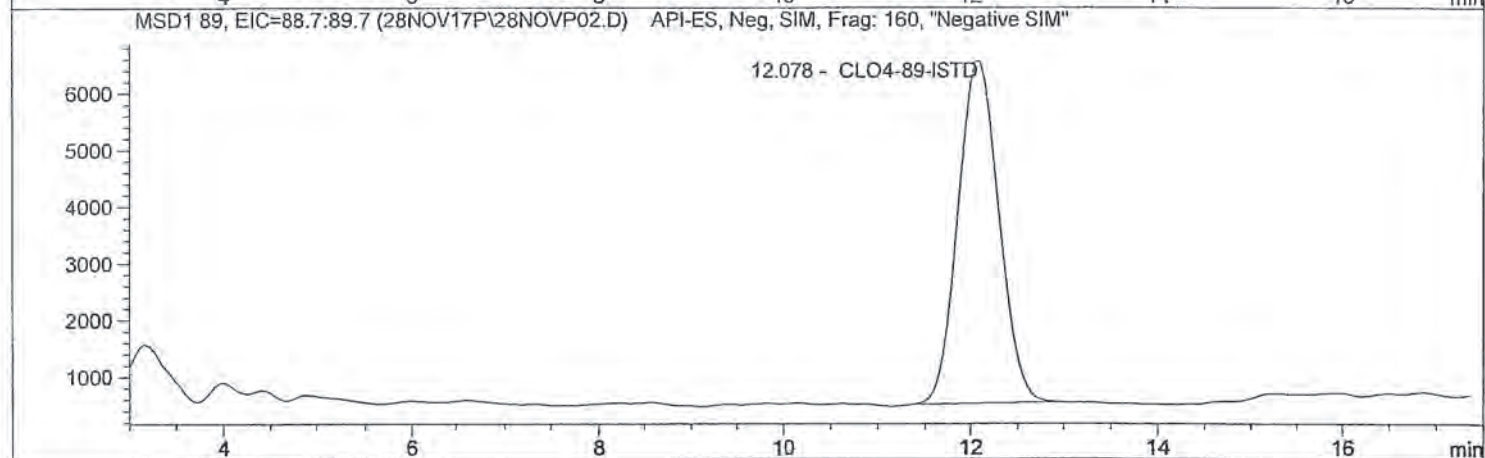
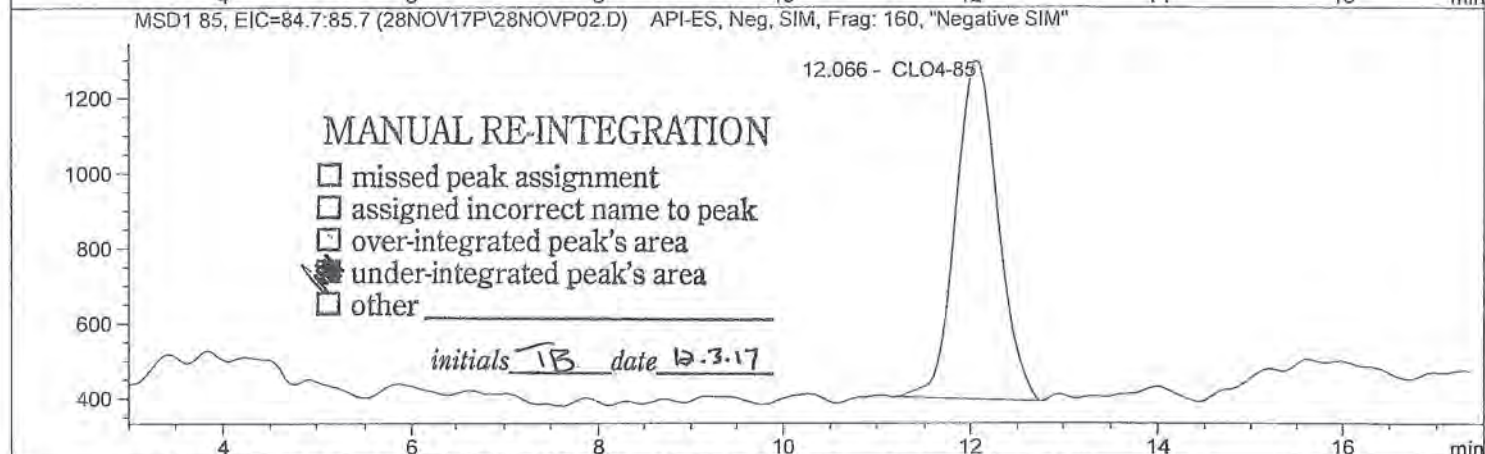
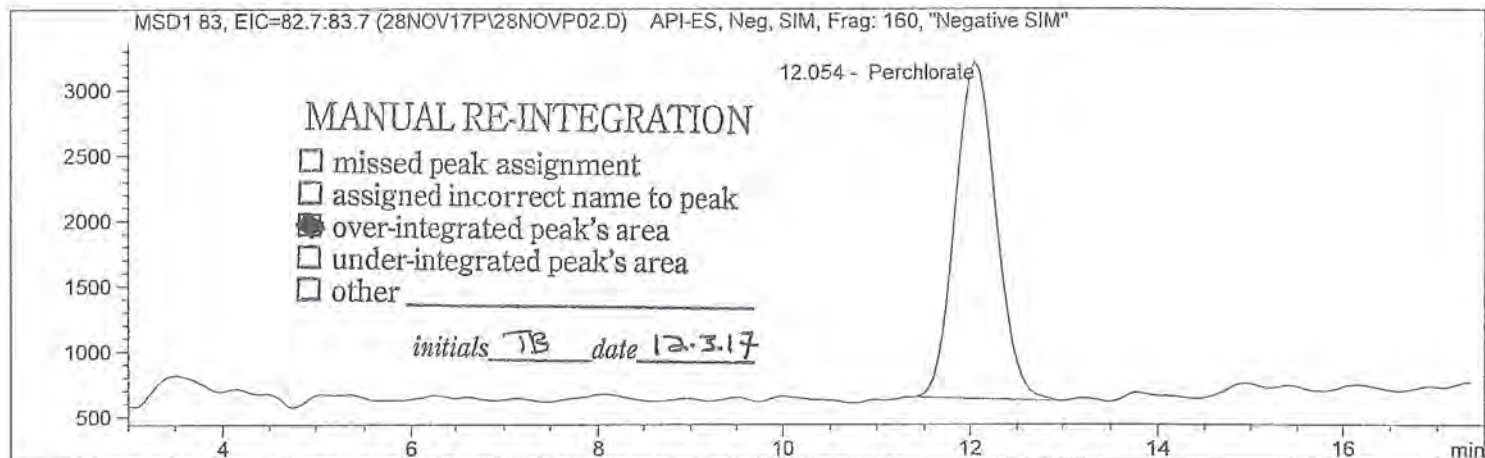
Inj. Vol.: 25 µl

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 ***

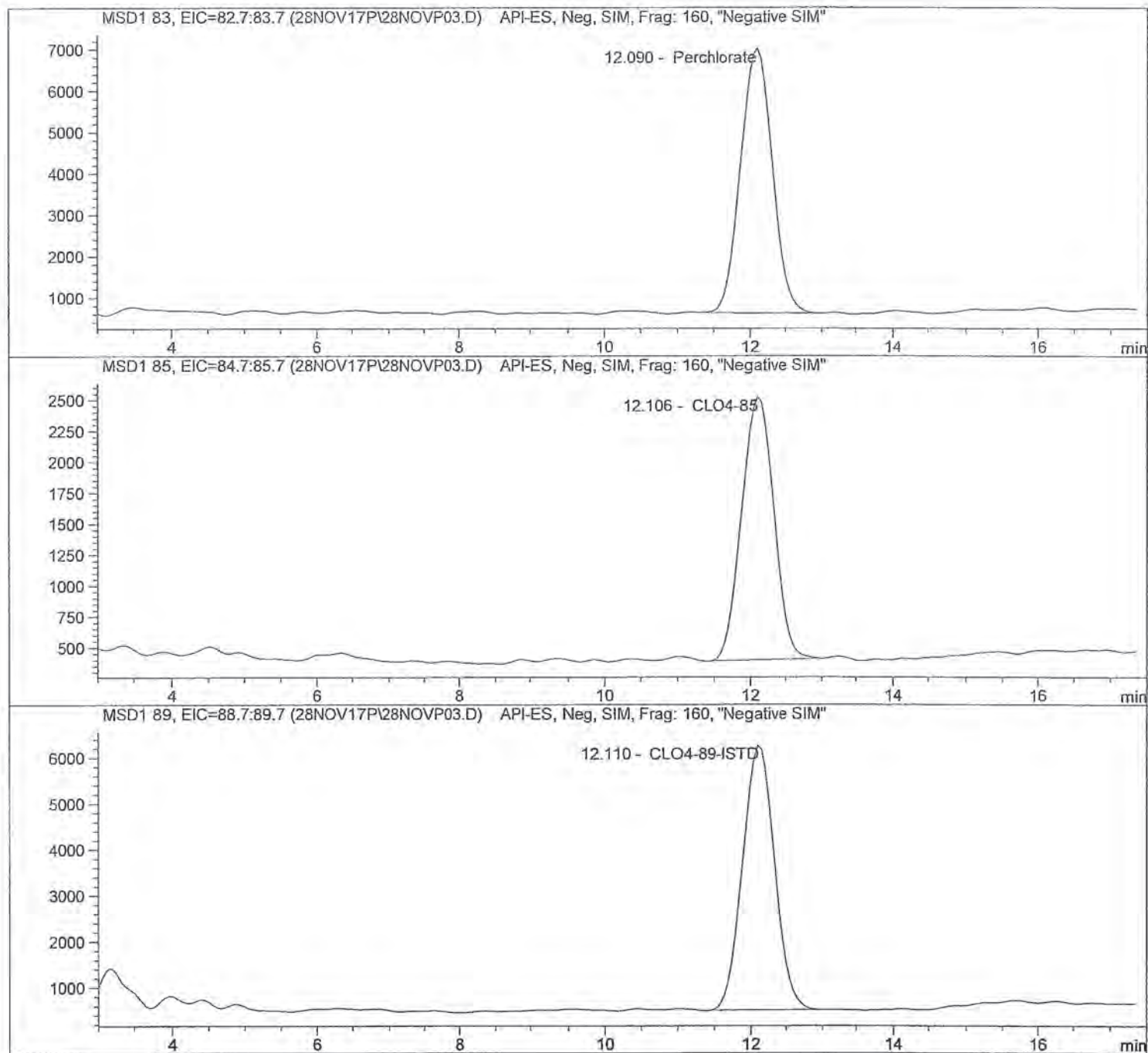
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP03.D

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 ***
=====

```

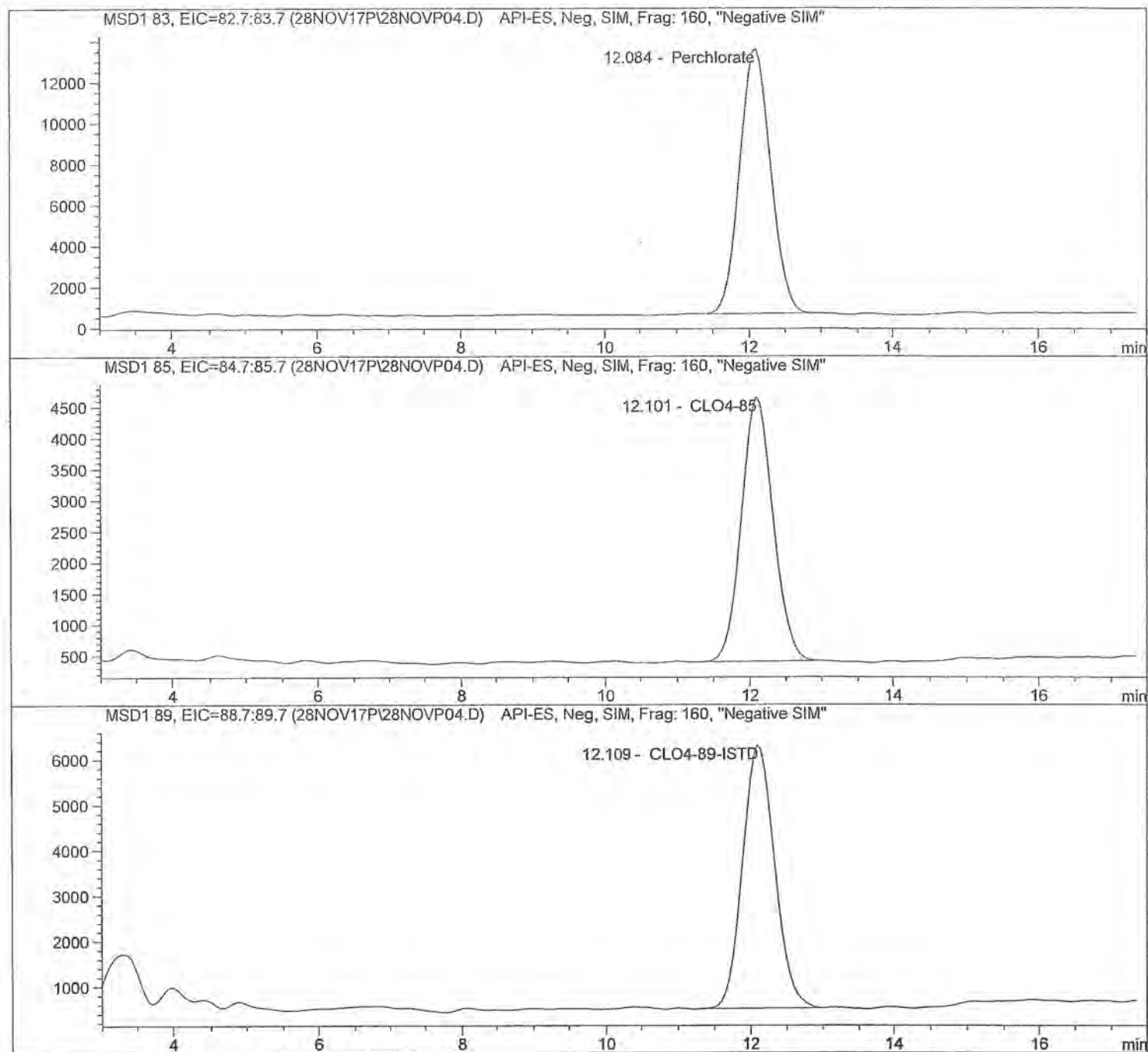
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP04.D

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 ***

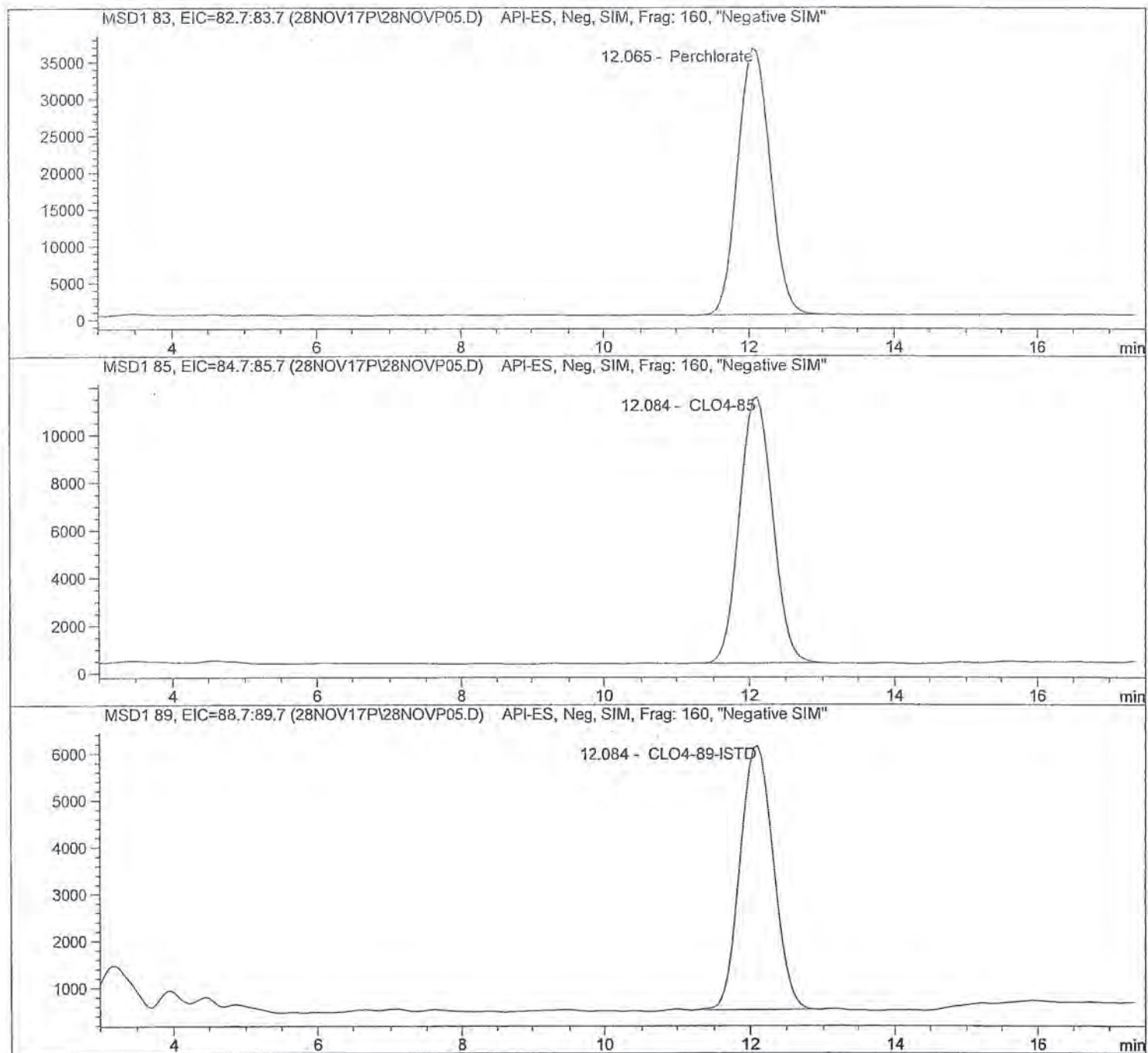
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP05.D

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 ***

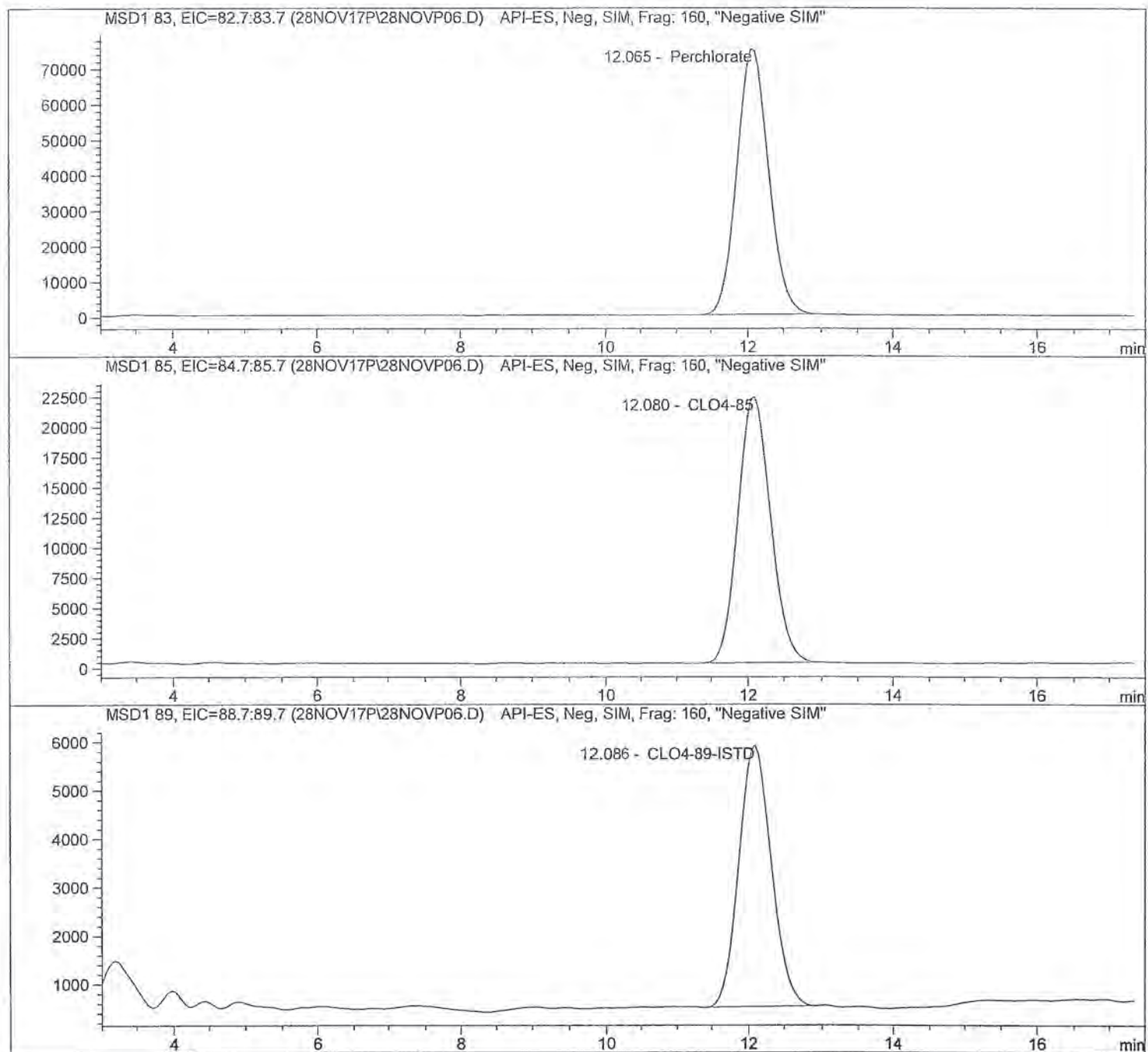
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP06.D

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 ***

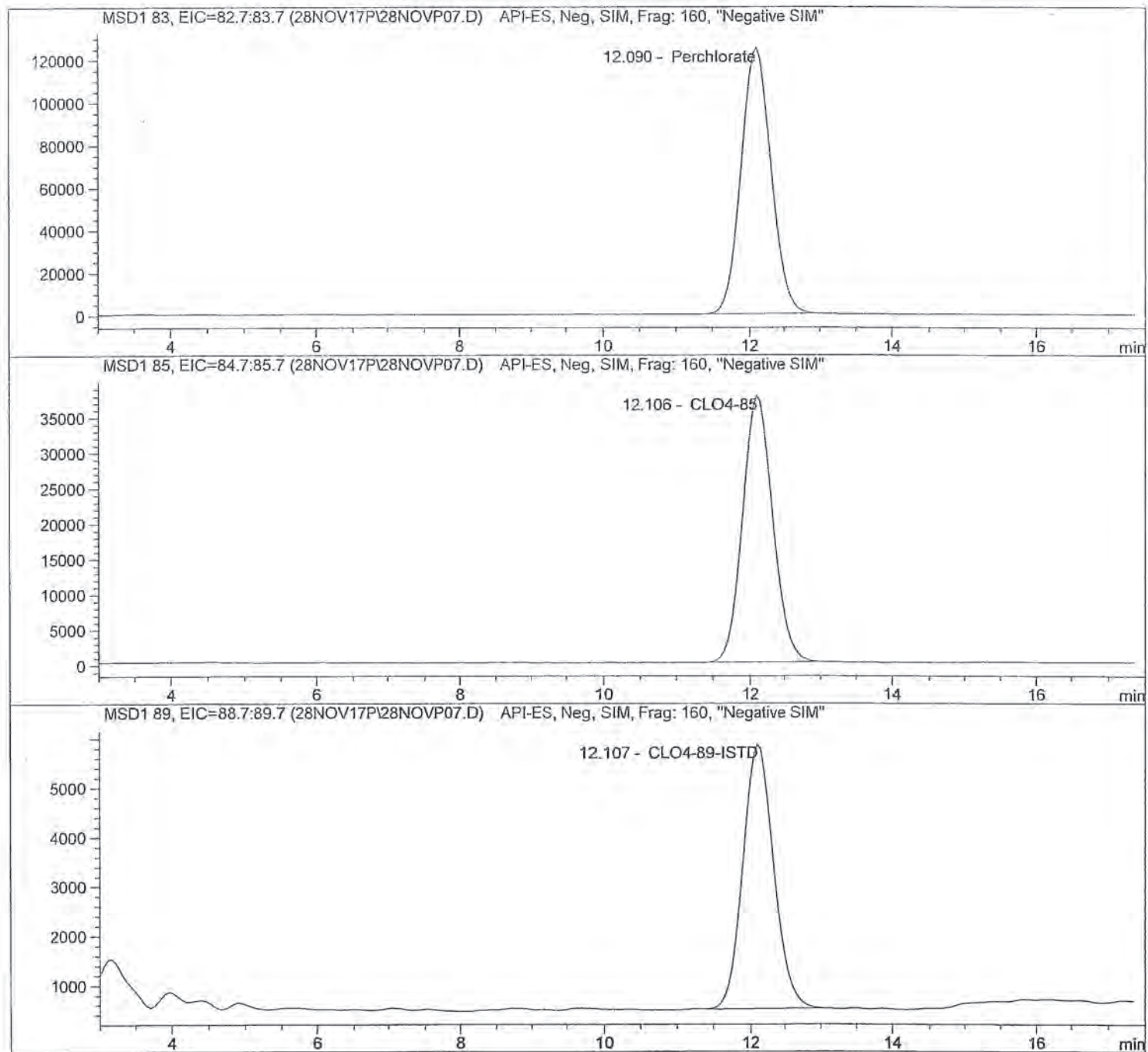
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP07.D

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 ***

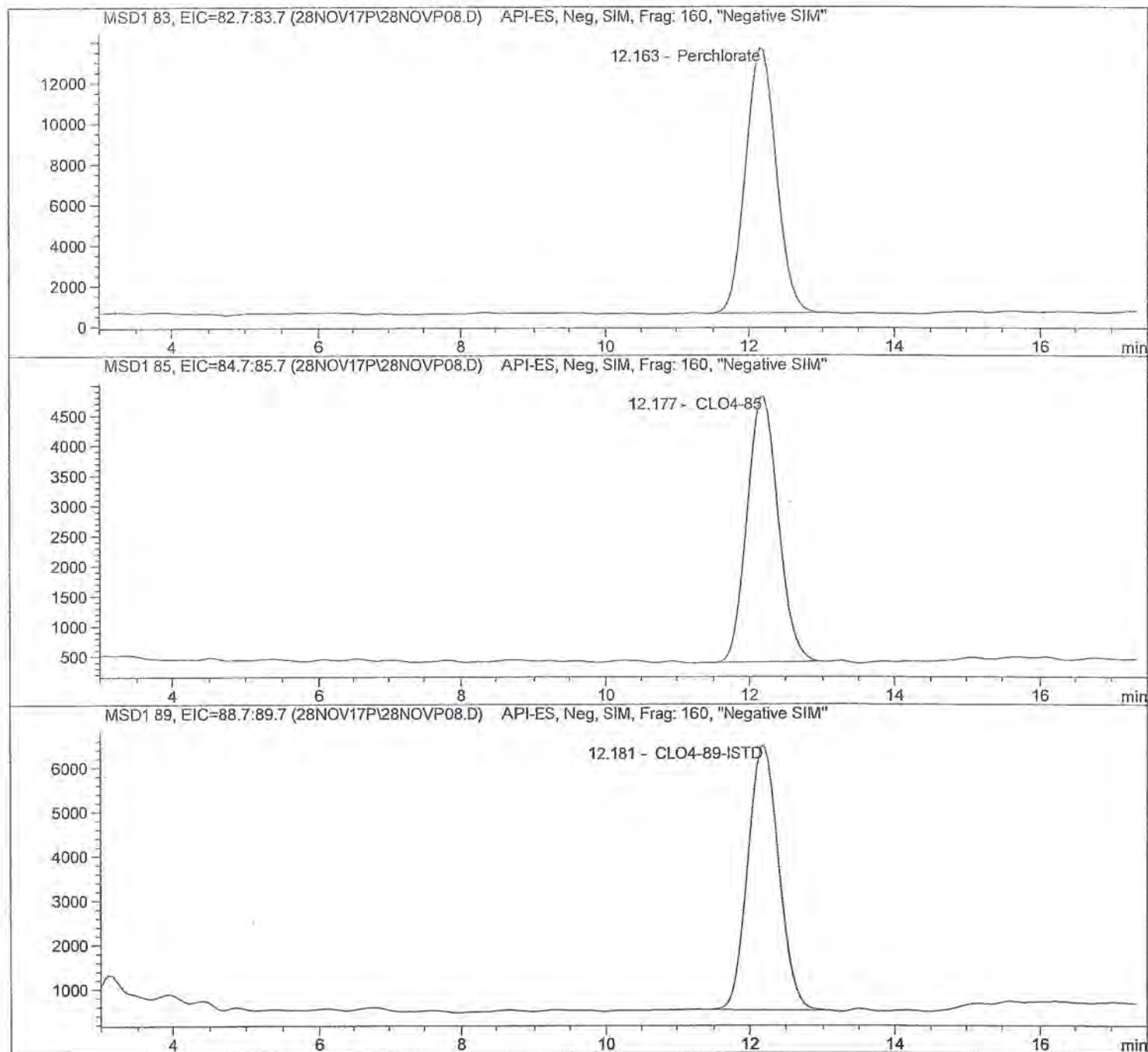
Data file: C:\HPCHEM\1\DATA\28NOV17P\28NOVP08.D

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

```

=====
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

```

=====
                          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

```

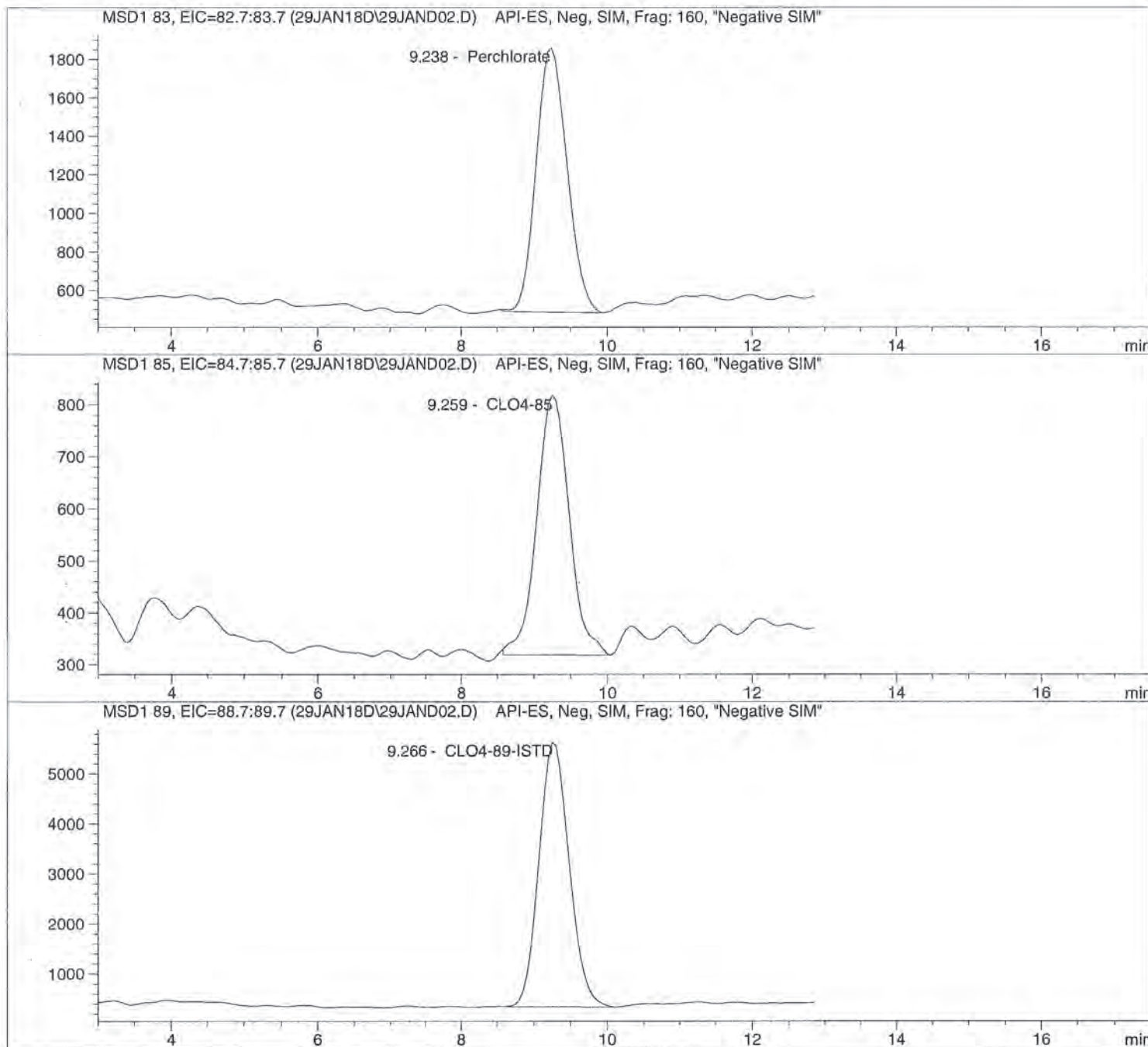
=====
*** End of Report ***

```

Injection Date: 1/29/2018 08:53:03 Seq Line: 2
Sample Name: 585116 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: 1/19/2018 12:46:10

Perchlorate analysis



Injection Date: 1/29/2018 08:53:03 Seq Line: 2
Sample Name: 585116 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: 1/19/2018 12:46:10

Perchlorate analysis

Sample Information

Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018, 08:59:33 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
9.238	BBA	40297.0	1.2488	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.259	BBA	15415.6	1.2527	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

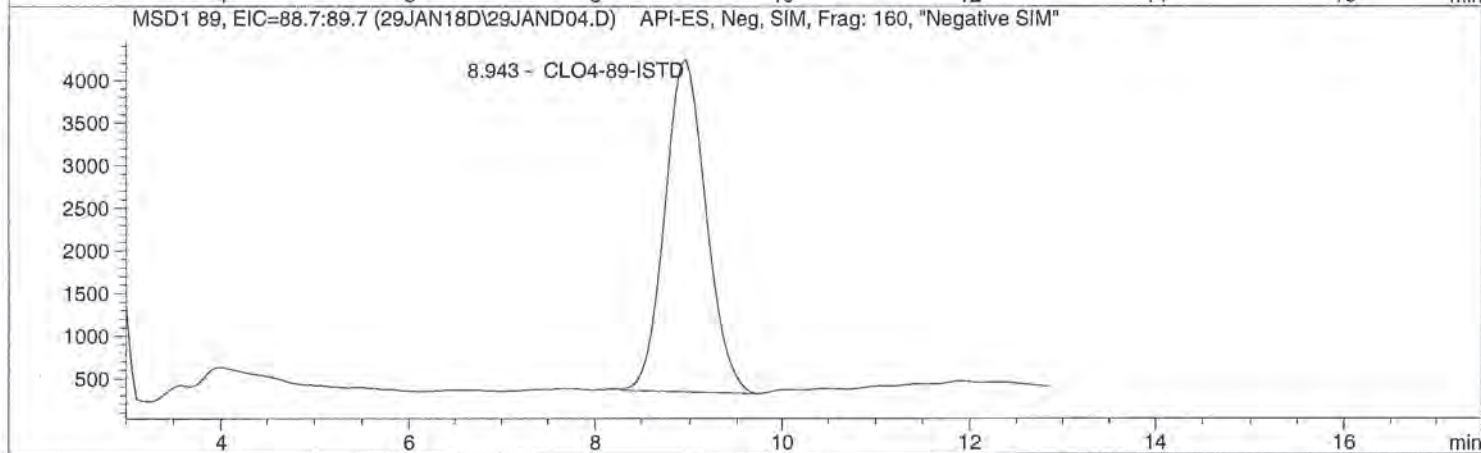
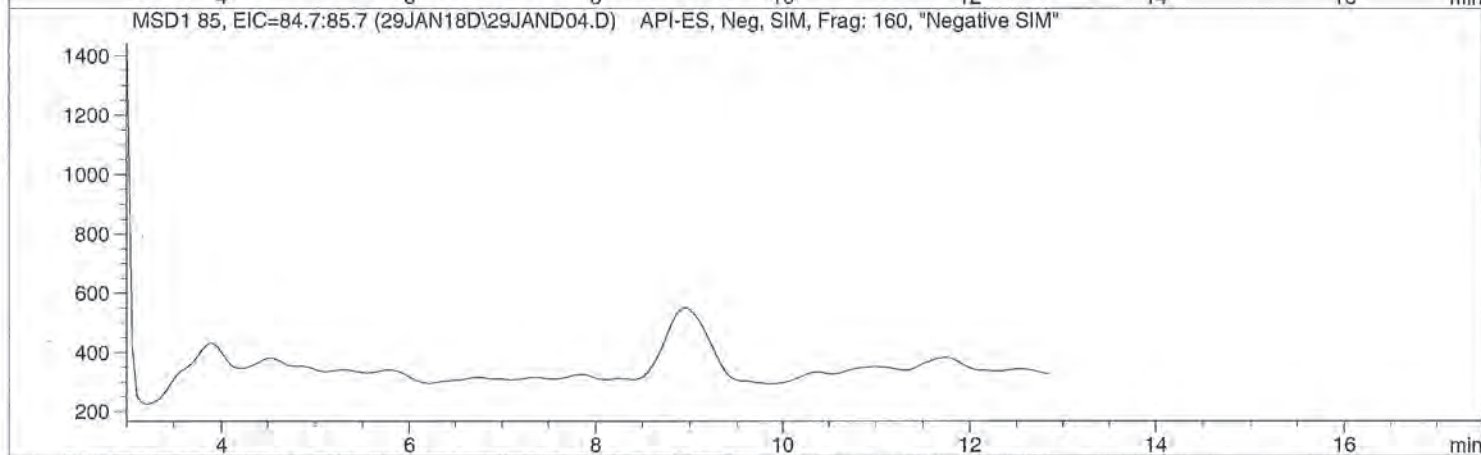
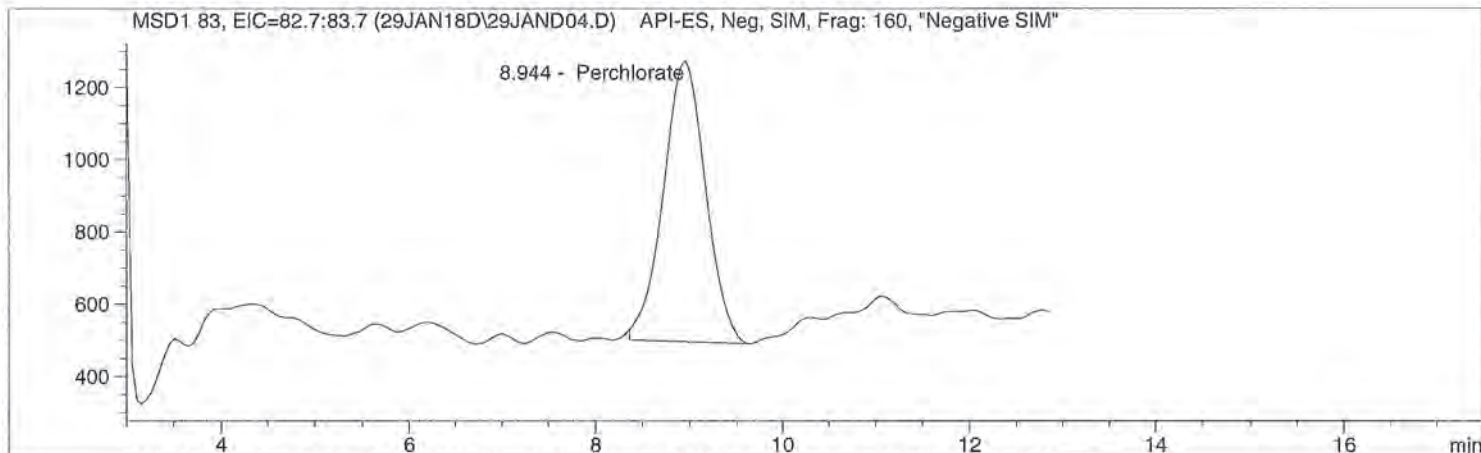
RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.266	BBA	151728.9	5.0000	CLO4-89-ISTD

*** End of Report ***

Injection Date: 1/29/2018 09:28:16 Seq Line: 4
Sample Name: 585117 ICS01. 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: 1/19/2018 12:46:10

Perchlorate analysis



```
=====
Injection Date: 1/29/2018 09:28:16      Seq Line: 4
Sample Name: 585117 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: 1/19/2018 12:46:10
=====
```

Perchlorate analysis

===== Sample Information =====

```
Sorted By: Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
8.944	BBA	24012.3	0.9667	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

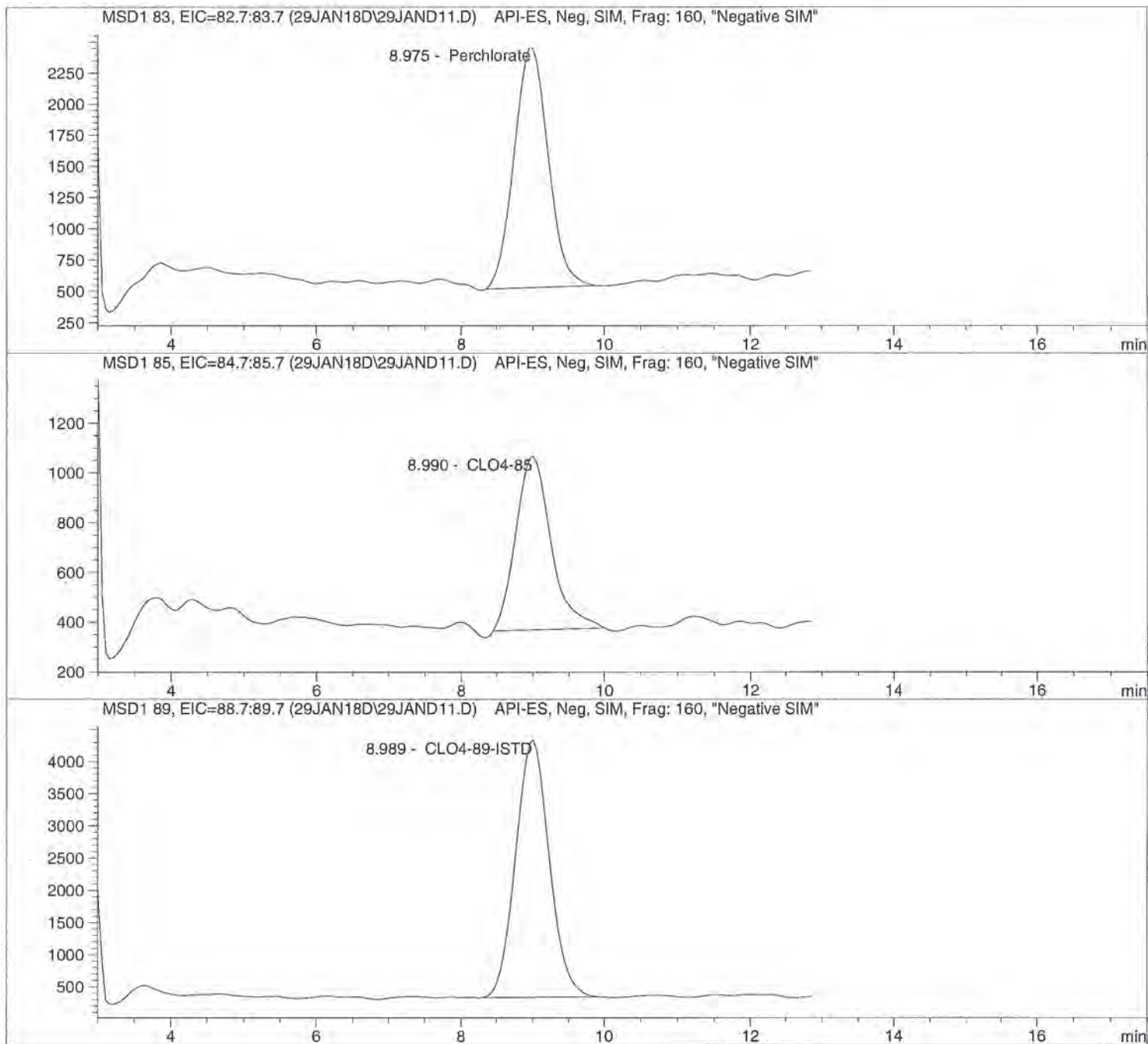
RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.943	BBA	117654.0	5.0000	CLO4-89-ISTD

=====
*** End of Report ***

Injection Date: 1/29/2018 11:12:05 Seq Line: 11
Sample Name: 1802229001 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: 1/19/2018 12:46:10

Perchlorate analysis



```
=====
Injection Date: 1/29/2018 11:12:05      Seq Line:      11
Sample Name:    1802229001              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:   1/19/2018 12:46:10
=====
```

Perchlorate analysis

Sample Information

```
Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018, 08:59:33 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
8.975	PBA	62983.1	2.2594	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.990	PBA	23650.9	2.4089	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
8.989	PBA	129228.9	5.0000	CLO4-89-ISTD

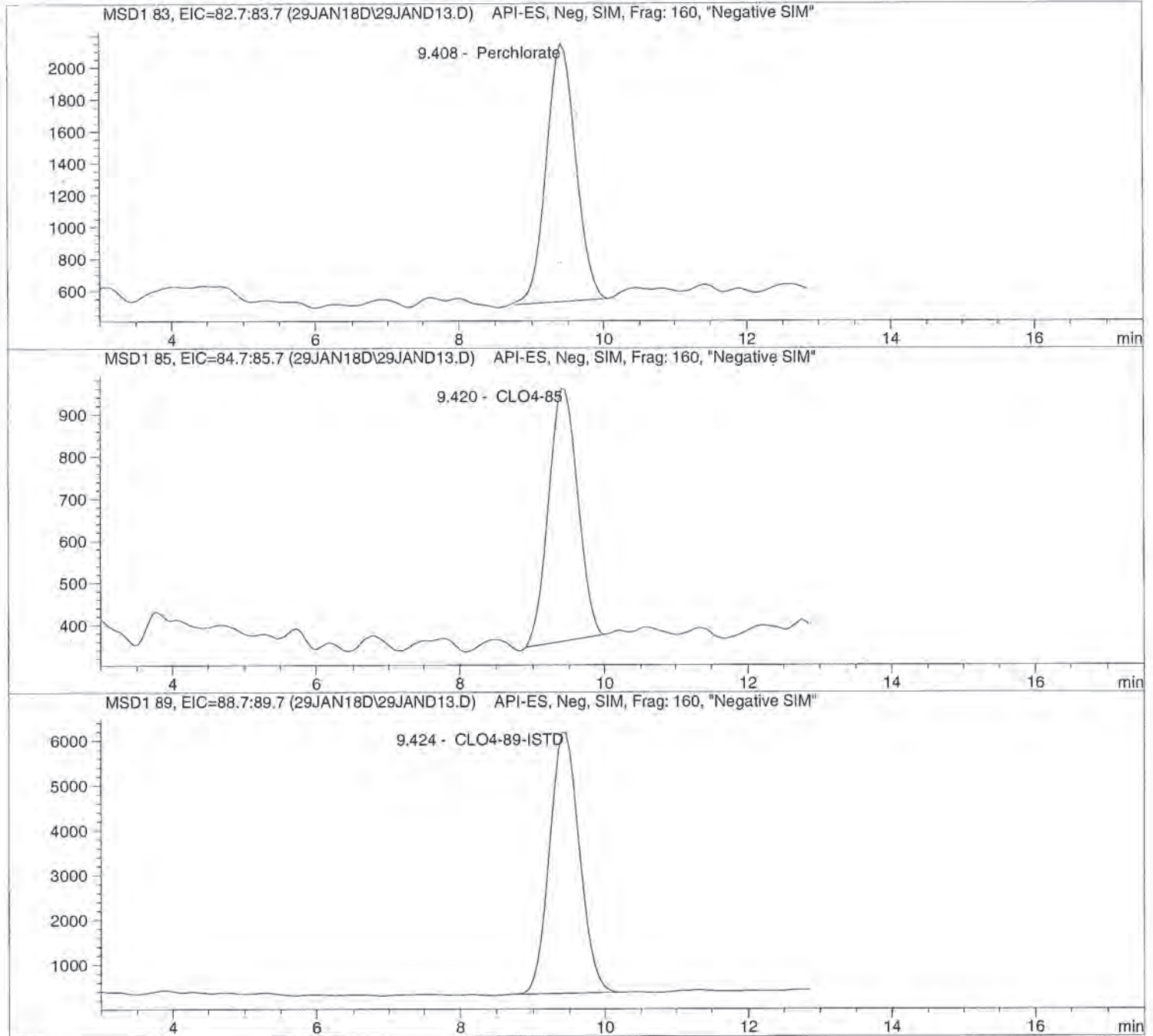
*** End of Report ***

Injection Date: 1/29/2018 11:41:26
Sample Name: 585121 LODV@1.
Acq Operator: TNB

Seq Line: 13
Location: Vial 72
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis



```

=====
Injection Date: 1/29/2018 11:41:26      Seq Line:          13
Sample Name:   585121  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:  1/19/2018 12:46:10
=====

```

Perchlorate analysis

```

=====
                          Sample Information
=====

```

```

Sorted By:      Signal
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.408	PBA	45913.5	1.2838	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.420	PBA	16973.3	1.2442	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.424	BBA	168040.2	5.0000	CLO4-89-ISTD

```

=====
*** End of Report ***
=====

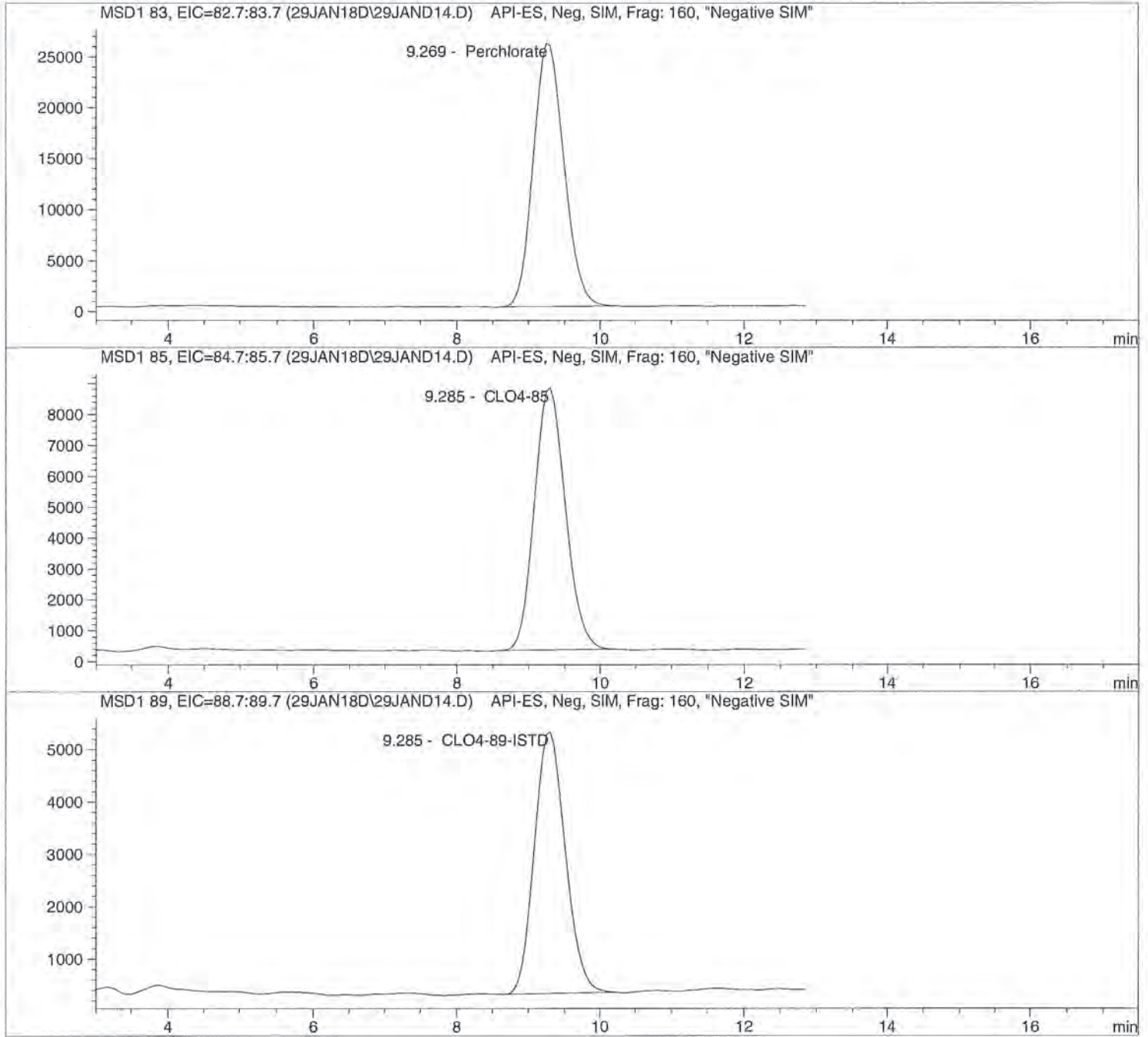
```

Injection Date: 1/29/2018 11:58:26
Sample Name: 585120 CCV@25
Acq Operator: TNB

Seq Line: 14
Location: Vial 71
Inj. No.: 1
Inj. Vol.: 25 µl

Acq. Method: CLO4-DOD.M
Analysis Method: C:\HPCHEM\1\METHODS\CLO4-DPR.M
Last Changed: 1/19/2018 12:46:10

Perchlorate analysis




```
=====  
Injection Date: 1/29/2018 11:58:26      Seq Line: 14  
Sample Name: 585120 CCV025             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: 1/19/2018 12:46:10  
=====
```

Perchlorate analysis

=====
Sample Information
=====

```
Sorted By: Signal  
Calib. Data Modified: Thu, 18. Jan. 2018,08:59:33 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
9.269	PBA	761722.6	21.4044	Perchlorate

Signal2: MSD1 85, EIC=84.7:85.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.285	PBA	253307.9	22.3492	CLO4-85

Signal3: MSD1 89, EIC=88.7:89.7

RT [min]	Type	Area	Amount [ug/sample]	Compound Name
9.285	PBA	148394.9	5.0000	CLO4-89-ISTD

=====
*** End of Report ***
=====



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

February 09, 2018

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

Work Order: **HS18011089**

Laboratory Results for: **Longhorn GW Treatment Plant Weekly Samples**

Dear Marcia,

ALS Environmental received 1 sample(s) on Jan 26, 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,

A handwritten signature in black ink, appearing to read 'Dayna Fisher', enclosed in a circular scribble.

Generated By: Dayna.Fisher
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18011089

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18011089-01	LH18/24-SP650-012518	Water		25-Jan-2018 14:00	26-Jan-2018 09:10	<input type="checkbox"/>

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18011089

CASE NARRATIVE

WetChemistry by Method E350.3**Batch ID: R310365**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E415.1**Batch ID: R310295**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E365.3**Batch ID: R309918**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Weekly Samples
 Sample ID: LH18/24-SP650-012518
 Collection Date: 25-Jan-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18011089
 Lab ID:HS18011089-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
AMMONIA AS N BY E350.3(ISE)								Analyst: SAP
Nitrogen, Ammonia (As N)	18		0.20	0.10	0.20	mg/L	1	06-Feb-2018 15:30
ORTHO PHOSPHATE (PO4) AS P BY E365.3								Analyst: MZD
Phosphorus, Total Orthophosphate (As P)	3.23		0.100	0.250	0.250	mg/L	10	26-Jan-2018 18:00
TOTAL ORGANIC CARBON BY E415.1								Analyst: KMU
Organic Carbon, Total	15.4		0.500	0.500	1.00	mg/L	1	06-Feb-2018 19:10

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011089

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R309918					Test Name : ORTHO PHOSPHATE (PO4) AS P BY E365.3	Matrix: Water
HS18011089-01	LH18/24-SP650-012518	25 Jan 2018 14:00				26 Jan 2018 18:00 10
Batch ID R310295					Test Name : TOTAL ORGANIC CARBON BY E415.1	Matrix: Water
HS18011089-01	LH18/24-SP650-012518	25 Jan 2018 14:00				06 Feb 2018 19:10 1
Batch ID R310365					Test Name : AMMONIA AS N BY E350.3(ISE)	Matrix: Water
HS18011089-01	LH18/24-SP650-012518	25 Jan 2018 14:00				06 Feb 2018 15:30 1

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011089

QC BATCH REPORT

Batch ID: R309918		Instrument: UV-2450		Method: E365.3						
MBLK	Sample ID: MBLK-309918	Units: mg/L			Analysis Date: 26-Jan-2018 18:00					
Client ID:	Run ID: UV-2450_309918	SeqNo: 4414128		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	0.0250	0.0250							U	
LCS	Sample ID: LCS-309918	Units: mg/L			Analysis Date: 26-Jan-2018 18:00					
Client ID:	Run ID: UV-2450_309918	SeqNo: 4414129		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	0.231	0.0250	0.25	0	92.4	85 - 115				
LCSD	Sample ID: LCSD-309918	Units: mg/L			Analysis Date: 26-Jan-2018 18:00					
Client ID:	Run ID: UV-2450_309918	SeqNo: 4414130		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	0.232	0.0250	0.25	0	92.8	85 - 115	0.231	0.432	20	
MS	Sample ID: HS18011089-01MS	Units: mg/L			Analysis Date: 26-Jan-2018 18:00					
Client ID: LH18/24-SP650-012518	Run ID: UV-2450_309918	SeqNo: 4414132		PrepDate:			DF: 10			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	5.32	0.250	2.5	3.23	83.6	80 - 120				
MSD	Sample ID: HS18011089-01MSD	Units: mg/L			Analysis Date: 26-Jan-2018 18:00					
Client ID: LH18/24-SP650-012518	Run ID: UV-2450_309918	SeqNo: 4414133		PrepDate:			DF: 10			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	5.4	0.250	2.5	3.23	86.8	80 - 120	5.32	1.49	20	

The following samples were analyzed in this batch: HS18011089-01

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011089

QC BATCH REPORT

Batch ID:	R310295	Instrument:	TOC_02	Method:	E415.1					
MBLK	Sample ID: WBLKW1-020618	Units: mg/L	Analysis Date: 06-Feb-2018 17:35							
Client ID:	Run ID: TOC_02_310295	SeqNo: 4422552	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Organic Carbon, Total	0.500	1.00								U
LCS	Sample ID: WLCSW1-020618	Units: mg/L	Analysis Date: 06-Feb-2018 17:49							
Client ID:	Run ID: TOC_02_310295	SeqNo: 4422553	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Organic Carbon, Total	9.983	1.00	10	0	99.8	80 - 120				
LCSD	Sample ID: WLCSDW1-020618	Units: mg/L	Analysis Date: 06-Feb-2018 18:02							
Client ID:	Run ID: TOC_02_310295	SeqNo: 4422554	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Organic Carbon, Total	9.984	1.00	10	0	99.8	80 - 120	9.983	0.01	20	
MS	Sample ID: HS18020023-01MS	Units: mg/L	Analysis Date: 06-Feb-2018 19:37							
Client ID:	Run ID: TOC_02_310295	SeqNo: 4422558	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Organic Carbon, Total	45.96	1.00	10	36.23	97.3	80 - 120				

The following samples were analyzed in this batch: HS18011089-01

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011089

QC BATCH REPORT

Batch ID: R310365		Instrument: WetChem_HS		Method: E350.3	
MBLK	Sample ID: MBLK-R310365	Units: mg/L		Analysis Date: 06-Feb-2018 15:30	
Client ID:	Run ID: WetChem_HS_310365	SeqNo: 4424098	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD Limit Qual
Nitrogen, Ammonia (As N)	0.10	0.20			U
LCS	Sample ID: LCS-R310365	Units: mg/L		Analysis Date: 06-Feb-2018 15:30	
Client ID:	Run ID: WetChem_HS_310365	SeqNo: 4424097	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD Limit Qual
Nitrogen, Ammonia (As N)	10.14	0.20	10	0	101 80 - 120
MS	Sample ID: HS18011125-01MS	Units: mg/L		Analysis Date: 06-Feb-2018 15:30	
Client ID:	Run ID: WetChem_HS_310365	SeqNo: 4424134	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD Limit Qual
Nitrogen, Ammonia (As N)	10.27	0.20	10	0.04705	102 80 - 120
MSD	Sample ID: HS18011125-01MSD	Units: mg/L		Analysis Date: 06-Feb-2018 15:30	
Client ID:	Run ID: WetChem_HS_310365	SeqNo: 4424135	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD Limit Qual
Nitrogen, Ammonia (As N)	10.11	0.20	10	0.04705	101 80 - 120 10.27 1.57 20

The following samples were analyzed in this batch: HS18011089-01

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011089

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18011089

Date/Time Received: **26-Jan-2018 09:10**
 Received by: **RPG**

Checklist completed by: Jared R. Makan 26-Jan-2018
 eSignature Date

Reviewed by: RJ Modashia 26-Jan-2018
 eSignature Date

Matrices: **Water**

Carrier name: **FedEx**

- 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): 0.2c/0.6c UC/C IR30

Cooler(s)/Kit(s): Blue

Date/Time sample(s) sent to storage: 01/26/2018 11:30

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:

00883048

 <p>ALS 10450 Stantcliff Rd., Suite 210 Houston, Texas 77089 Tel. +1 281 530 5656 Fax. +1 281 530 5697</p>	<p>CU Date: 1/25/18 Name: SEP Company: BKT</p>	<p>STUDY SEAL Time: 1430 Name: BEL, M.C.H. Date: 1/26/18</p>
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RETURNS MON - SAT
PRIORITY OVERNIGHT

TRK# 7376 9751 2805
0221

FedEx
0221 7376 9751 2805

FRI - 26 JAN 10:30A
PRIORITY OVERNIGHT

AB SGRA

77099
TX-US
IAH



F10 152709 26JAN10 08:01 5662VFN020 18000



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

February 09, 2018

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

Work Order: **HS18011092**

Laboratory Results for: **Longhorn GW Treatment Plant Weekly Samples**

Dear Marcia,

ALS Environmental received 2 sample(s) on Jan 26, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18011092

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18011092-01	LH18/24-SP650_012518	Water		25-Jan-2018 14:00	26-Jan-2018 09:10	<input type="checkbox"/>
HS18011092-02	Trip Blank	Water	ALS 112117-38	25-Jan-2018 00:00	26-Jan-2018 09:10	<input type="checkbox"/>

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18011092

CASE NARRATIVE

GCMS Volatiles by Method SW8260**Batch ID: R309794****Sample ID: CCV**

- Dichlorodifluoromethane exceeded %D limits on CCV. Samples ND.

WetChemistry by Method SW9056**Batch ID: R310530**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Weekly Samples
 Sample ID: LH18/24-SP650_012518
 Collection Date: 25-Jan-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18011092
 Lab ID:HS18011092-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	30-Jan-2018 07:50	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	30-Jan-2018 07:50	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	30-Jan-2018 07:50	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	30-Jan-2018 07:50	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	30-Jan-2018 07:50	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Weekly Samples
 Sample ID: LH18/24-SP650_012518
 Collection Date: 25-Jan-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18011092
 Lab ID:HS18011092-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260						Analyst: AKP	
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
cis-1,2-Dichloroethene	4.0		0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	30-Jan-2018 07:50	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	30-Jan-2018 07:50	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Naphthalene	5.9		0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 07:50	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>97.6</i>			0	<i>81-118</i>	%REC	1	30-Jan-2018 07:50	
<i>Surr: 4-Bromofluorobenzene</i>	<i>98.3</i>			0	<i>85-114</i>	%REC	1	30-Jan-2018 07:50	
<i>Surr: Dibromofluoromethane</i>	<i>108</i>			0	<i>80-119</i>	%REC	1	30-Jan-2018 07:50	
<i>Surr: Toluene-d8</i>	<i>91.5</i>			0	<i>89-112</i>	%REC	1	30-Jan-2018 07:50	
ANIONS BY SW9056A		Method:SW9056						Analyst: KMU	
Chloride	618		2.00	2.50	5.00	mg/L	10	07-Feb-2018 14:02	
Sulfate	81.9		0.200	0.250	0.500	mg/L	1	07-Feb-2018 13:47	

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Weekly Samples
 Sample ID: Trip Blank
 Collection Date: 25-Jan-2018 00:00

ANALYTICAL REPORT
 WorkOrder:HS18011092
 Lab ID:HS18011092-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	30-Jan-2018 00:52	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	30-Jan-2018 00:52	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	30-Jan-2018 00:52	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	30-Jan-2018 00:52	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	30-Jan-2018 00:52	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Weekly Samples
 Sample ID: Trip Blank
 Collection Date: 25-Jan-2018 00:00

ANALYTICAL REPORT
 WorkOrder:HS18011092
 Lab ID:HS18011092-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
cis-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	30-Jan-2018 00:52	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	30-Jan-2018 00:52	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	30-Jan-2018 00:52	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>92.7</i>			0	<i>81-118</i>	<i>%REC</i>	<i>1</i>	<i>30-Jan-2018 00:52</i>	
<i>Surr: 4-Bromofluorobenzene</i>	<i>97.4</i>			0	<i>85-114</i>	<i>%REC</i>	<i>1</i>	<i>30-Jan-2018 00:52</i>	
<i>Surr: Dibromofluoromethane</i>	<i>103</i>			0	<i>80-119</i>	<i>%REC</i>	<i>1</i>	<i>30-Jan-2018 00:52</i>	
<i>Surr: Toluene-d8</i>	<i>92.6</i>			0	<i>89-112</i>	<i>%REC</i>	<i>1</i>	<i>30-Jan-2018 00:52</i>	

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R309794	Test Name : VOLATILES ORGANICS BY METHOD 8260C			Matrix: Water		
HS18011092-01	LH18/24-SP650_012518	25 Jan 2018 14:00			30 Jan 2018 07:50	1
HS18011092-02	Trip Blank	25 Jan 2018 00:00			30 Jan 2018 00:52	1
Batch ID R310530	Test Name : ANIONS BY SW9056A			Matrix: Water		
HS18011092-01	LH18/24-SP650_012518	25 Jan 2018 14:00			07 Feb 2018 14:02	10
HS18011092-01	LH18/24-SP650_012518	25 Jan 2018 14:00			07 Feb 2018 13:47	1

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180129	Units: ug/L			Analysis Date: 29-Jan-2018 23:39					
Client ID:	Run ID: VOA2_309794	SeqNo: 4411356	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	0.50	1.0								U
1,1,1-Trichloroethane	0.50	1.0								U
1,1,2,2-Tetrachloroethane	0.50	1.0								U
1,1,2-Trichloroethane	0.50	1.0								U
1,1-Dichloroethane	0.50	1.0								U
1,1-Dichloroethene	0.50	1.0								U
1,1-Dichloropropene	0.50	1.0								U
1,2,3-Trichlorobenzene	0.50	1.0								U
1,2,3-Trichloropropane	0.50	1.0								U
1,2,4-Trichlorobenzene	0.50	1.0								U
1,2,4-Trimethylbenzene	0.50	1.0								U
1,2-Dibromo-3-chloropropane	0.50	1.0								U
1,2-Dibromoethane	0.50	1.0								U
1,2-Dichlorobenzene	0.50	1.0								U
1,2-Dichloroethane	0.50	1.0								U
1,2-Dichloropropane	0.50	1.0								U
1,3,5-Trimethylbenzene	0.50	1.0								U
1,3-Dichlorobenzene	0.50	1.0								U
1,3-Dichloropropane	0.50	1.0								U
1,4-Dichlorobenzene	0.50	1.0								U
2,2-Dichloropropane	0.50	1.0								U
2-Butanone	1.0	2.0								U
2-Chlorotoluene	0.50	1.0								U
2-Hexanone	1.0	2.0								U
4-Chlorotoluene	0.50	1.0								U
4-Isopropyltoluene	0.50	1.0								U
4-Methyl-2-pentanone	1.0	2.0								U
Acetone	1.0	2.0								U
Benzene	0.50	1.0								U
Bromobenzene	0.50	1.0								U
Bromochloromethane	0.50	1.0								U
Bromodichloromethane	0.50	1.0								U
Bromoform	0.50	1.0								U
Bromomethane	0.50	1.0								U

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180129	Units: ug/L			Analysis Date: 29-Jan-2018 23:39					
Client ID:	Run ID: VOA2_309794	SeqNo: 4411356	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	1.0	2.0								U
Carbon tetrachloride	0.50	1.0								U
Chlorobenzene	0.50	1.0								U
Chloroethane	0.50	1.0								U
Chloroform	0.50	1.0								U
Chloromethane	0.50	1.0								U
cis-1,2-Dichloroethene	0.50	1.0								U
cis-1,3-Dichloropropene	0.50	1.0								U
Dibromochloromethane	0.50	1.0								U
Dibromomethane	0.50	1.0								U
Dichlorodifluoromethane	0.50	1.0								U
Ethylbenzene	0.50	1.0								U
Hexachlorobutadiene	0.50	1.0								U
Isopropylbenzene	0.50	1.0								U
m,p-Xylene	1.0	2.0								U
Methylene chloride	1.0	2.0								U
Naphthalene	0.50	1.0								U
n-Butylbenzene	0.50	1.0								U
n-Propylbenzene	0.50	1.0								U
o-Xylene	0.50	1.0								U
sec-Butylbenzene	0.50	1.0								U
Styrene	0.50	1.0								U
tert-Butylbenzene	0.50	1.0								U
Tetrachloroethene	0.50	1.0								U
Toluene	0.50	1.0								U
trans-1,2-Dichloroethene	0.50	1.0								U
trans-1,3-Dichloropropene	0.50	1.0								U
Trichloroethene	0.50	1.0								U
Trichlorofluoromethane	0.50	1.0								U
Vinyl chloride	0.50	1.0								U
Surr: 1,2-Dichloroethane-d4	46.19	1.0	50	0	92.4	81 - 118				
Surr: 4-Bromofluorobenzene	48.87	1.0	50	0	97.7	85 - 114				
Surr: Dibromofluoromethane	52.74	1.0	50	0	105	80 - 119				
Surr: Toluene-d8	46.34	1.0	50	0	92.7	89 - 112				

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180129	Units: ug/L			Analysis Date: 29-Jan-2018 22:50					
Client ID:	Run ID: VOA2_309794	SeqNo: 4411355	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	48.9	1.0	50	0	97.8	78 - 124				
1,1,1-Trichloroethane	53.94	1.0	50	0	108	74 - 131				
1,1,2,2-Tetrachloroethane	40.8	1.0	50	0	81.6	71 - 121				
1,1,2-Trichloroethane	46.52	1.0	50	0	93.0	80 - 119				
1,1-Dichloroethane	51.65	1.0	50	0	103	77 - 125				
1,1-Dichloroethene	57.23	1.0	50	0	114	71 - 131				
1,1-Dichloropropene	54.72	1.0	50	0	109	79 - 125				
1,2,3-Trichlorobenzene	50.97	1.0	50	0	102	69 - 129				
1,2,3-Trichloropropane	41.47	1.0	50	0	82.9	73 - 122				
1,2,4-Trichlorobenzene	51.09	1.0	50	0	102	69 - 130				
1,2,4-Trimethylbenzene	42.3	1.0	50	0	84.6	76 - 124				
1,2-Dibromo-3-chloropropane	41.57	1.0	50	0	83.1	62 - 128				
1,2-Dibromoethane	48.84	1.0	50	0	97.7	77 - 121				
1,2-Dichlorobenzene	44.06	1.0	50	0	88.1	80 - 119				
1,2-Dichloroethane	55.16	1.0	50	0	110	73 - 128				
1,2-Dichloropropane	49.77	1.0	50	0	99.5	78 - 122				
1,3,5-Trimethylbenzene	43.01	1.0	50	0	86.0	75 - 124				
1,3-Dichlorobenzene	43.68	1.0	50	0	87.4	80 - 119				
1,3-Dichloropropane	45.47	1.0	50	0	90.9	80 - 119				
1,4-Dichlorobenzene	43.62	1.0	50	0	87.2	79 - 118				
2,2-Dichloropropane	52.22	1.0	50	0	104	60 - 139				
2-Butanone	95.19	2.0	100	0	95.2	56 - 143				
2-Chlorotoluene	41.39	1.0	50	0	82.8	79 - 122				
2-Hexanone	85.18	2.0	100	0	85.2	57 - 139				
4-Chlorotoluene	42.13	1.0	50	0	84.3	78 - 122				
4-Isopropyltoluene	45.01	1.0	50	0	90.0	77 - 127				
4-Methyl-2-pentanone	87.07	2.0	100	0	87.1	67 - 130				
Acetone	99.32	2.0	100	0	99.3	39 - 160				
Benzene	50.34	1.0	50	0	101	79 - 120				
Bromobenzene	43.34	1.0	50	0	86.7	80 - 120				
Bromochloromethane	54.92	1.0	50	0	110	78 - 123				
Bromodichloromethane	51.47	1.0	50	0	103	79 - 125				
Bromoform	50.73	1.0	50	0	101	66 - 130				
Bromomethane	61.35	1.0	50	0	123	53 - 141				

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180129	Units: ug/L			Analysis Date: 29-Jan-2018 22:50					
Client ID:	Run ID: VOA2_309794	SeqNo: 4411355	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	107	2.0	100	0	107	64 - 133				
Carbon tetrachloride	45.38	1.0	50	0	90.8	72 - 136				
Chlorobenzene	46.57	1.0	50	0	93.1	80 - 120				
Chloroethane	43.07	1.0	50	0	86.1	82 - 118				
Chloroform	51.42	1.0	50	0	103	79 - 124				
Chloromethane	58.15	1.0	50	0	116	50 - 139				
cis-1,2-Dichloroethene	52.58	1.0	50	0	105	78 - 123				
cis-1,3-Dichloropropene	54.85	1.0	50	0	110	75 - 124				
Dibromochloromethane	50.6	1.0	50	0	101	74 - 126				
Dibromomethane	52.47	1.0	50	0	105	79 - 123				
Dichlorodifluoromethane	62.51	1.0	50	0	125	32 - 152				
Ethylbenzene	46.33	1.0	50	0	92.7	79 - 121				
Hexachlorobutadiene	50.15	1.0	50	0	100	66 - 134				
Isopropylbenzene	48.71	1.0	50	0	97.4	72 - 131				
m,p-Xylene	92.66	2.0	100	0	92.7	80 - 121				
Methylene chloride	49.45	2.0	50	0	98.9	74 - 124				
Naphthalene	47.73	1.0	50	0	95.5	61 - 128				
n-Butylbenzene	46.15	1.0	50	0	92.3	75 - 128				
n-Propylbenzene	43.47	1.0	50	0	86.9	76 - 126				
o-Xylene	47.28	1.0	50	0	94.6	78 - 122				
sec-Butylbenzene	45.54	1.0	50	0	91.1	77 - 126				
Styrene	47.95	1.0	50	0	95.9	78 - 128				
tert-Butylbenzene	44.4	1.0	50	0	88.8	78 - 124				
Tetrachloroethene	53.81	1.0	50	0	108	74 - 129				
Toluene	46.7	1.0	50	0	93.4	80 - 121				
trans-1,2-Dichloroethene	57.21	1.0	50	0	114	75 - 124				
trans-1,3-Dichloropropene	55.08	1.0	50	0	110	73 - 127				
Trichloroethene	55.05	1.0	50	0	110	79 - 123				
Trichlorofluoromethane	53.34	1.0	50	0	107	65 - 141				
Vinyl chloride	56.41	1.0	50	0	113	58 - 137				
Surr: 1,2-Dichloroethane-d4	47.41	1.0	50	0	94.8	81 - 118				
Surr: 4-Bromofluorobenzene	49.73	1.0	50	0	99.5	85 - 114				
Surr: Dibromofluoromethane	50.38	1.0	50	0	101	80 - 119				
Surr: Toluene-d8	45.48	1.0	50	0	91.0	89 - 112				

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18010987-01MS	Units: ug/L			Analysis Date: 30-Jan-2018 02:55					
Client ID:	Run ID: VOA2_309794	SeqNo: 4411022	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	48.27	1.0	50	0	96.5	78 - 124				
1,1,1-Trichloroethane	55.1	1.0	50	0	110	74 - 131				
1,1,2,2-Tetrachloroethane	42.06	1.0	50	0	84.1	71 - 121				
1,1,2-Trichloroethane	44.9	1.0	50	0	89.8	80 - 119				
1,1-Dichloroethane	52.11	1.0	50	0	104	77 - 125				
1,1-Dichloroethene	58.64	1.0	50	0	117	71 - 131				
1,1-Dichloropropene	55.46	1.0	50	0	111	79 - 125				
1,2,3-Trichlorobenzene	45.62	1.0	50	0	91.2	69 - 129				
1,2,3-Trichloropropane	39.74	1.0	50	0	79.5	73 - 122				
1,2,4-Trichlorobenzene	47.6	1.0	50	0	95.2	69 - 130				
1,2,4-Trimethylbenzene	40.71	1.0	50	0	81.4	76 - 124				
1,2-Dibromo-3-chloropropane	38.79	1.0	50	0	77.6	62 - 128				
1,2-Dibromoethane	46.17	1.0	50	0	92.3	77 - 121				
1,2-Dichlorobenzene	41.43	1.0	50	0	82.9	80 - 119				
1,2-Dichloroethane	52.34	1.0	50	0	105	73 - 128				
1,2-Dichloropropane	49.5	1.0	50	0	99.0	78 - 122				
1,3,5-Trimethylbenzene	41.63	1.0	50	0	83.3	75 - 124				
1,3-Dichlorobenzene	42.06	1.0	50	0	84.1	80 - 119				
1,3-Dichloropropane	43.51	1.0	50	0	87.0	80 - 119				
1,4-Dichlorobenzene	41.06	1.0	50	0	82.1	79 - 118				
2,2-Dichloropropane	48.94	1.0	50	0	97.9	60 - 139				
2-Butanone	89.74	2.0	100	0	89.7	56 - 143				
2-Chlorotoluene	41.02	1.0	50	0	82.0	79 - 122				
2-Hexanone	80.68	2.0	100	0	80.7	57 - 139				
4-Chlorotoluene	40.53	1.0	50	0	81.1	78 - 122				
4-Isopropyltoluene	42.82	1.0	50	0	85.6	77 - 127				
4-Methyl-2-pentanone	83.23	2.0	100	0	83.2	67 - 130				
Acetone	95.45	2.0	100	0	95.4	39 - 160				
Benzene	50.21	1.0	50	0	100	79 - 120				
Bromobenzene	40.97	1.0	50	0	81.9	80 - 120				
Bromochloromethane	53.68	1.0	50	0	107	78 - 123				
Bromodichloromethane	50.64	1.0	50	0	101	79 - 125				
Bromoform	47.71	1.0	50	0	95.4	66 - 130				
Bromomethane	54.3	1.0	50	0	109	53 - 141				

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18010987-01MS	Units: ug/L			Analysis Date: 30-Jan-2018 02:55					
Client ID:	Run ID: VOA2_309794	SeqNo: 4411022	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	107.3	2.0	100	0	107	64 - 133				
Carbon tetrachloride	48.45	1.0	50	0	96.9	72 - 136				
Chlorobenzene	45.59	1.0	50	0	91.2	80 - 120				
Chloroethane	43.44	1.0	50	0	86.9	82 - 118				
Chloroform	50.58	1.0	50	0	101	79 - 124				
Chloromethane	51.37	1.0	50	0	103	50 - 139				
cis-1,2-Dichloroethene	52.98	1.0	50	0	106	78 - 123				
cis-1,3-Dichloropropene	52.84	1.0	50	0	106	75 - 124				
Dibromochloromethane	47.75	1.0	50	0	95.5	74 - 126				
Dibromomethane	49.95	1.0	50	0	99.9	79 - 123				
Dichlorodifluoromethane	40.12	1.0	50	0	80.2	32 - 152				
Ethylbenzene	46.83	1.0	50	0	93.7	79 - 121				
Hexachlorobutadiene	44.85	1.0	50	0	89.7	66 - 134				
Isopropylbenzene	47.78	1.0	50	0	95.6	72 - 131				
m,p-Xylene	91.74	2.0	100	0	91.7	80 - 121				
Methylene chloride	47.73	2.0	50	0	95.5	74 - 124				
Naphthalene	42.02	1.0	50	0	84.0	61 - 128				
n-Butylbenzene	43.75	1.0	50	0	87.5	75 - 128				
n-Propylbenzene	42.4	1.0	50	0	84.8	76 - 126				
o-Xylene	46.57	1.0	50	0	93.1	78 - 122				
sec-Butylbenzene	44.31	1.0	50	0	88.6	77 - 126				
Styrene	46.24	1.0	50	0	92.5	78 - 128				
tert-Butylbenzene	43.97	1.0	50	0	87.9	78 - 124				
Tetrachloroethene	51.53	1.0	50	0	103	74 - 129				
Toluene	46.32	1.0	50	0	92.6	80 - 121				
trans-1,2-Dichloroethene	57.84	1.0	50	0	116	75 - 124				
trans-1,3-Dichloropropene	51.23	1.0	50	0	102	73 - 127				
Trichloroethene	50.67	1.0	50	0	101	79 - 123				
Trichlorofluoromethane	48.91	1.0	50	0	97.8	65 - 141				
Vinyl chloride	53.06	1.0	50	0	106	58 - 137				
Surr: 1,2-Dichloroethane-d4	47.86	1.0	50	0	95.7	81 - 118				
Surr: 4-Bromofluorobenzene	50.04	1.0	50	0	100	85 - 114				
Surr: Dibromofluoromethane	50.8	1.0	50	0	102	80 - 119				
Surr: Toluene-d8	45.1	1.0	50	0	90.2	89 - 112				

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794		Instrument: VOA2		Method: SW8260						
MSD	Sample ID: HS18010987-01MSD	Units: ug/L			Analysis Date: 30-Jan-2018 03:20					
Client ID:	Run ID: VOA2_309794	SeqNo: 4411023		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	46.66	1.0	50	0	93.3	78 - 124	48.27	3.38	20	
1,1,1-Trichloroethane	53.24	1.0	50	0	106	74 - 131	55.1	3.43	20	
1,1,2,2-Tetrachloroethane	43.02	1.0	50	0	86.0	71 - 121	42.06	2.26	20	
1,1,2-Trichloroethane	43.86	1.0	50	0	87.7	80 - 119	44.9	2.34	20	
1,1-Dichloroethane	49.89	1.0	50	0	99.8	77 - 125	52.11	4.36	20	
1,1-Dichloroethene	55.95	1.0	50	0	112	71 - 131	58.64	4.69	20	
1,1-Dichloropropene	53.15	1.0	50	0	106	79 - 125	55.46	4.25	20	
1,2,3-Trichlorobenzene	46.65	1.0	50	0	93.3	69 - 129	45.62	2.23	20	
1,2,3-Trichloropropane	39.51	1.0	50	0	79.0	73 - 122	39.74	0.587	20	
1,2,4-Trichlorobenzene	48.57	1.0	50	0	97.1	69 - 130	47.6	2.02	20	
1,2,4-Trimethylbenzene	39.87	1.0	50	0	79.7	76 - 124	40.71	2.08	20	
1,2-Dibromo-3-chloropropane	40.69	1.0	50	0	81.4	62 - 128	38.79	4.79	20	
1,2-Dibromoethane	46.18	1.0	50	0	92.4	77 - 121	46.17	0.0212	20	
1,2-Dichlorobenzene	42.19	1.0	50	0	84.4	80 - 119	41.43	1.81	20	
1,2-Dichloroethane	51.45	1.0	50	0	103	73 - 128	52.34	1.71	20	
1,2-Dichloropropane	48.4	1.0	50	0	96.8	78 - 122	49.5	2.25	20	
1,3,5-Trimethylbenzene	41.21	1.0	50	0	82.4	75 - 124	41.63	1.01	20	
1,3-Dichlorobenzene	41.86	1.0	50	0	83.7	80 - 119	42.06	0.473	20	
1,3-Dichloropropane	43.67	1.0	50	0	87.3	80 - 119	43.51	0.365	20	
1,4-Dichlorobenzene	41.04	1.0	50	0	82.1	79 - 118	41.06	0.0605	20	
2,2-Dichloropropane	47.26	1.0	50	0	94.5	60 - 139	48.94	3.49	20	
2-Butanone	89.47	2.0	100	0	89.5	56 - 143	89.74	0.306	20	
2-Chlorotoluene	40.57	1.0	50	0	81.1	79 - 122	41.02	1.11	20	
2-Hexanone	81.61	2.0	100	0	81.6	57 - 139	80.68	1.16	20	
4-Chlorotoluene	40.42	1.0	50	0	80.8	78 - 122	40.53	0.272	20	
4-Isopropyltoluene	43.12	1.0	50	0	86.2	77 - 127	42.82	0.697	20	
4-Methyl-2-pentanone	83.15	2.0	100	0	83.2	67 - 130	83.23	0.0978	20	
Acetone	92.75	2.0	100	0	92.8	39 - 160	95.45	2.86	20	
Benzene	49.52	1.0	50	0	99.0	79 - 120	50.21	1.39	20	
Bromobenzene	41.37	1.0	50	0	82.7	80 - 120	40.97	0.958	20	
Bromochloromethane	52.02	1.0	50	0	104	78 - 123	53.68	3.15	20	
Bromodichloromethane	49.84	1.0	50	0	99.7	79 - 125	50.64	1.59	20	
Bromoform	47.99	1.0	50	0	96.0	66 - 130	47.71	0.581	20	
Bromomethane	52.2	1.0	50	0	104	53 - 141	54.3	3.93	20	

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794		Instrument: VOA2		Method: SW8260						
MSD	Sample ID: HS18010987-01MSD	Units: ug/L			Analysis Date: 30-Jan-2018 03:20					
Client ID:	Run ID: VOA2_309794	SeqNo: 4411023		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	102.3	2.0	100	0	102	64 - 133	107.3	4.84	20	
Carbon tetrachloride	45.75	1.0	50	0	91.5	72 - 136	48.45	5.73	20	
Chlorobenzene	44.64	1.0	50	0	89.3	80 - 120	45.59	2.11	20	
Chloroethane	42.33	1.0	50	0	84.7	82 - 118	43.44	2.58	20	
Chloroform	48.71	1.0	50	0	97.4	79 - 124	50.58	3.76	20	
Chloromethane	48.08	1.0	50	0	96.2	50 - 139	51.37	6.63	20	
cis-1,2-Dichloroethene	50.16	1.0	50	0	100	78 - 123	52.98	5.46	20	
cis-1,3-Dichloropropene	51.46	1.0	50	0	103	75 - 124	52.84	2.64	20	
Dibromochloromethane	47.23	1.0	50	0	94.5	74 - 126	47.75	1.11	20	
Dibromomethane	50.03	1.0	50	0	100	79 - 123	49.95	0.16	20	
Dichlorodifluoromethane	37.49	1.0	50	0	75.0	32 - 152	40.12	6.76	20	
Ethylbenzene	45	1.0	50	0	90.0	79 - 121	46.83	3.98	20	
Hexachlorobutadiene	45.97	1.0	50	0	91.9	66 - 134	44.85	2.47	20	
Isopropylbenzene	46.75	1.0	50	0	93.5	72 - 131	47.78	2.2	20	
m,p-Xylene	89.32	2.0	100	0	89.3	80 - 121	91.74	2.67	20	
Methylene chloride	47.69	2.0	50	0	95.4	74 - 124	47.73	0.0761	20	
Naphthalene	44.5	1.0	50	0	89.0	61 - 128	42.02	5.75	20	
n-Butylbenzene	44.17	1.0	50	0	88.3	75 - 128	43.75	0.937	20	
n-Propylbenzene	41.86	1.0	50	0	83.7	76 - 126	42.4	1.28	20	
o-Xylene	45.39	1.0	50	0	90.8	78 - 122	46.57	2.58	20	
sec-Butylbenzene	43.67	1.0	50	0	87.3	77 - 126	44.31	1.46	20	
Styrene	45.94	1.0	50	0	91.9	78 - 128	46.24	0.638	20	
tert-Butylbenzene	43.12	1.0	50	0	86.2	78 - 124	43.97	1.97	20	
Tetrachloroethene	50.23	1.0	50	0	100	74 - 129	51.53	2.55	20	
Toluene	44.71	1.0	50	0	89.4	80 - 121	46.32	3.54	20	
trans-1,2-Dichloroethene	54.73	1.0	50	0	109	75 - 124	57.84	5.52	20	
trans-1,3-Dichloropropene	50.98	1.0	50	0	102	73 - 127	51.23	0.497	20	
Trichloroethene	49.81	1.0	50	0	99.6	79 - 123	50.67	1.71	20	
Trichlorofluoromethane	49.32	1.0	50	0	98.6	65 - 141	48.91	0.842	20	
Vinyl chloride	50.56	1.0	50	0	101	58 - 137	53.06	4.82	20	
Surr: 1,2-Dichloroethane-d4	47.68	1.0	50	0	95.4	81 - 118	47.86	0.375	20	
Surr: 4-Bromofluorobenzene	48.81	1.0	50	0	97.6	85 - 114	50.04	2.49	20	
Surr: Dibromofluoromethane	49.86	1.0	50	0	99.7	80 - 119	50.8	1.86	20	
Surr: Toluene-d8	44.96	1.0	50	0	89.9	89 - 112	45.1	0.328	20	

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R309794	Instrument: VOA2	Method: SW8260
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The following samples were analyzed in this batch:

HS18011092-01	HS18011092-02
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Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

QC BATCH REPORT

Batch ID: R310530		Instrument: ICS2100		Method: SW9056						
MBLK	Sample ID: WBLKW1-020618	Units: mg/L			Analysis Date: 06-Feb-2018 17:58					
Client ID:	Run ID: ICS2100_310530	SeqNo: 4427931		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	0.250	0.500							U	
Sulfate	0.250	0.500							U	
LCS	Sample ID: WLCSW1-020618	Units: mg/L			Analysis Date: 06-Feb-2018 18:13					
Client ID:	Run ID: ICS2100_310530	SeqNo: 4427932		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	20.44	0.500	20	0	102	80 - 120				
Sulfate	20.5	0.500	20	0	103	80 - 120				
LCSD	Sample ID: WLCSDW1-020618	Units: mg/L			Analysis Date: 06-Feb-2018 18:27					
Client ID:	Run ID: ICS2100_310530	SeqNo: 4427933		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	20.45	0.500	20	0	102	80 - 120	20.44	0.0636	20	
Sulfate	21.1	0.500	20	0	106	80 - 120	20.5	2.87	20	
MS	Sample ID: HS18020278-02MS	Units: mg/L			Analysis Date: 06-Feb-2018 19:11					
Client ID:	Run ID: ICS2100_310530	SeqNo: 4427936		PrepDate:			DF: 10			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	416.5	5.00	100	322.3	94.2	80 - 120				
Sulfate	198	5.00	100	96.54	101	80 - 120				
MSD	Sample ID: HS18020278-02MSD	Units: mg/L			Analysis Date: 06-Feb-2018 19:25					
Client ID:	Run ID: ICS2100_310530	SeqNo: 4427937		PrepDate:			DF: 10			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	420.2	5.00	100	322.3	97.9	80 - 120	416.5	0.871	20	
Sulfate	199.4	5.00	100	96.54	103	80 - 120	198	0.745	20	
The following samples were analyzed in this batch: HS18011092-01										

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

ALS Group USA, Corp

Date: 09-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18011092

**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 Quantitation Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

Unit Reported	Description
mg/L	Milligrams per Liter

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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18011092

Date/Time Received: **26-Jan-2018 09:10**
 Received by: **RPG**

Checklist completed by: Jared R. Makan 26-Jan-2018
 eSignature Date

Reviewed by: RJ Modashia 26-Jan-2018
 eSignature 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): 0.2c/0.6c UC/C IR30

Cooler(s)/Kit(s): Blue

Date/Time sample(s) sent to storage: 01/26/2018 11:55

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:

 <p>ALS 10450 Springdale Rd., Suite 210 Houston, Tx. 77059 Tel. +1 281 530 5656 Fax. +1 281 530 6887</p>	<p>CU</p> <p>Date: 1/26/18 Name: SGA Company: SGA</p>	<p>STUDY SEAL</p> <p>Time: 11:00 Date: 1/26/18</p>	<p>Seal Broken By: -JM Date: 1/26/18</p>
	<p>Time: 11:00 Date: 1/26/18</p>		

RETURNS MON - SAT
PRIORITY OVERNIGHT

TRK# 7376 9751 2805
[0221]

FRI - 26 JAN 10:30A
PRIORITY OVERNIGHT

FEDEX
[0221] 7376 9751 2805

AB SGRA

77099
TX-US
IAH



FLD 162/05 20JAN18 6564 546178467AKSBA



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

February 16, 2018

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

Work Order: **HS18020016**

Laboratory Results for: **Longhorn GW Treatment Plant**

Dear Marcia,

ALS Environmental received 2 sample(s) on Feb 01, 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,

A handwritten signature in black ink, appearing to read 'Raj. P. Modashia', enclosed in a circular scribble.

Generated By: Dayna.Fisher
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18020016

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18020016-01	LH18/24-SP650_013118	Water		31-Jan-2018 14:00	01-Feb-2018 08:40	<input type="checkbox"/>
HS18020016-02	Trip Blank	Water	ALS 112117-03	31-Jan-2018 00:00	01-Feb-2018 08:40	<input type="checkbox"/>

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18020016

CASE NARRATIVE

Work Order Comments

- The analyses for Perchlorate was subcontracted to ALS Environmental in Salt Lake City, Utah Final report attached.

GCMS Semivolatiles by Method SW8270SIM**Batch ID: 124925****Sample ID: LH18/24-SP650_013118 (HS18020016-01)**

- The surrogate recoveries could not be determined due to dilution below the calibration range.

Sample ID: LCSD-124925

- The RPD between the LCS and LCSD was outside of the control limit for surrogate 2-Fluorobiphenyl.

GCMS Volatiles by Method SW8260**Batch ID: R310216**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

Sample ID: HS18011112-03MS

- MS and MSD are for an unrelated sample

Metals by Method SW6020**Batch ID: 124980**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method SW7196**Batch ID: R310277**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650_013118
 Collection Date: 31-Jan-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18020016
 Lab ID:HS18020016-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	05-Feb-2018 21:48	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	05-Feb-2018 21:48	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	05-Feb-2018 21:48	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	05-Feb-2018 21:48	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	05-Feb-2018 21:48	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650_013118
 Collection Date: 31-Jan-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18020016
 Lab ID:HS18020016-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260						Analyst: AKP	
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
cis-1,2-Dichloroethene	3.9		0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	05-Feb-2018 21:48	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	05-Feb-2018 21:48	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 21:48	
Surr: 1,2-Dichloroethane-d4	104			0	81-118	%REC	1	05-Feb-2018 21:48	
Surr: 4-Bromofluorobenzene	108			0	85-114	%REC	1	05-Feb-2018 21:48	
Surr: Dibromofluoromethane	96.0			0	80-119	%REC	1	05-Feb-2018 21:48	
Surr: Toluene-d8	101			0	89-112	%REC	1	05-Feb-2018 21:48	
SEMIVOLATILES SIM		Method:SW8270SIM						Prep:SW3510 / 02-Feb-2018 Analyst: ACN	
1,4-Dioxane	8.3		1.0	1.0	1.0	ug/L	100	06-Feb-2018 19:07	
Surr: 2-Fluorobiphenyl	0	S		0	40-140	%REC	100	06-Feb-2018 19:07	
Surr: 4-Terphenyl-d14	0	S		0	40-140	%REC	100	06-Feb-2018 19:07	
Surr: Nitrobenzene-d5	0	S		0	40-140	%REC	100	06-Feb-2018 19:07	

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650_013118
 Collection Date: 31-Jan-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18020016
 Lab ID:HS18020016-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
ICP-MS METALS BY SW6020A		Method:SW6020			Prep:SW3010A / 05-Feb-2018		Analyst: JDE	
Barium	0.295		0.00190	0.00250	0.00400	mg/L	1	06-Feb-2018 13:52
Lead	0.00100	U	0.000600	0.00100	0.00200	mg/L	1	06-Feb-2018 16:17
Selenium	0.00200	U	0.00110	0.00200	0.00200	mg/L	1	06-Feb-2018 13:52
Silver	0.00100	U	0.000200	0.00100	0.00200	mg/L	1	06-Feb-2018 13:52
HEXAVALENT CHROMIUM BY SW7196A		Method:SW7196			Prep:SW7196		Analyst: JHD	
Chromium, Hexavalent	0.00600	U	0.00600	0.00600	0.0100	mg/L	1	01-Feb-2018 13:26
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Method:NA					Analyst: SUB	
Subcontract Analysis	See Attached		0	0		NA	1	16-Feb-2018 13:58

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: Trip Blank
 Collection Date: 31-Jan-2018 00:00

ANALYTICAL REPORT
 WorkOrder:HS18020016
 Lab ID:HS18020016-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	05-Feb-2018 17:19	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	05-Feb-2018 17:19	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	05-Feb-2018 17:19	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	05-Feb-2018 17:19	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	05-Feb-2018 17:19	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: Trip Blank
 Collection Date: 31-Jan-2018 00:00

ANALYTICAL REPORT

WorkOrder:HS18020016
 Lab ID:HS18020016-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD		Method:SW8260							Analyst: AKP
8260C									
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
cis-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	05-Feb-2018 17:19	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	05-Feb-2018 17:19	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	05-Feb-2018 17:19	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>103</i>			0	<i>81-118</i>	<i>%REC</i>	<i>1</i>	<i>05-Feb-2018 17:19</i>	
<i>Surr: 4-Bromofluorobenzene</i>	<i>104</i>			0	<i>85-114</i>	<i>%REC</i>	<i>1</i>	<i>05-Feb-2018 17:19</i>	
<i>Surr: Dibromofluoromethane</i>	<i>98.6</i>			0	<i>80-119</i>	<i>%REC</i>	<i>1</i>	<i>05-Feb-2018 17:19</i>	
<i>Surr: Toluene-d8</i>	<i>101</i>			0	<i>89-112</i>	<i>%REC</i>	<i>1</i>	<i>05-Feb-2018 17:19</i>	

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

WEIGHT LOG

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

Batch ID: 124925 **Method:** SEMIVOLATILES SIM **Prep:** 3510_B_SIM

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18020016-01	1	990	1 (mL)	0.00101

Batch ID: 124980 **Method:** ICP-MS METALS BY SW6020A **Prep:** 3010A

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18020016-01	1	10	10 (mL)	1

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID 124925	Test Name : SEMIVOLATILES SIM		Matrix: Water			
HS18020016-01	LH18/24-SP650_013118	31 Jan 2018 14:00		02 Feb 2018 09:23	06 Feb 2018 19:07	100
Batch ID 124980	Test Name : ICP-MS METALS BY SW6020A		Matrix: Water			
HS18020016-01	LH18/24-SP650_013118	31 Jan 2018 14:00		05 Feb 2018 13:15	06 Feb 2018 16:17	1
HS18020016-01	LH18/24-SP650_013118	31 Jan 2018 14:00		05 Feb 2018 13:15	06 Feb 2018 13:52	1
Batch ID R310216	Test Name : VOLATILES ORGANICS BY METHOD 8260C		Matrix: Water			
HS18020016-01	LH18/24-SP650_013118	31 Jan 2018 14:00			05 Feb 2018 21:48	1
HS18020016-02	Trip Blank	31 Jan 2018 00:00			05 Feb 2018 17:19	1
Batch ID R310277	Test Name : HEXAVALENT CHROMIUM BY SW7196A		Matrix: Water			
HS18020016-01	LH18/24-SP650_013118	31 Jan 2018 14:00			01 Feb 2018 13:26	1
Batch ID R310951	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18020016-01	LH18/24-SP650_013118	31 Jan 2018 14:00			16 Feb 2018 13:58	1

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: 124980		Instrument: ICPMS05		Method: SW6020						
MBLK	Sample ID: MBLK-124980	Units: mg/L			Analysis Date: 06-Feb-2018 13:26					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421584	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual	
Barium	0.00250	0.00400							U	
Selenium	0.00200	0.00200							U	
Silver	0.00100	0.00200							U	
MBLK	Sample ID: MBLK-124980	Units: mg/L			Analysis Date: 06-Feb-2018 16:03					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421895	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual	
Lead	0.00100	0.00200							U	
LCS	Sample ID: LCS-124980	Units: mg/L			Analysis Date: 06-Feb-2018 13:28					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421585	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual	
Barium	0.04715	0.00400	0.05	0	94.3	80 - 120				
Selenium	0.04387	0.00200	0.05	0	87.7	80 - 120				
Silver	0.0449	0.00200	0.05	0	89.8	80 - 120				
LCS	Sample ID: LCS-124980	Units: mg/L			Analysis Date: 06-Feb-2018 16:05					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421896	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual	
Lead	0.05122	0.00200	0.05	0	102	80 - 120				
MS	Sample ID: HS18011346-02MS	Units: mg/L			Analysis Date: 06-Feb-2018 13:34					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421588	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual	
Barium	0.1166	0.00400	0.05	0.07012	92.9	80 - 120				
Selenium	0.0509	0.00200	0.05	0.002272	97.2	80 - 120				
Silver	0.04283	0.00200	0.05	0.000191	85.3	80 - 120				

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID:	124980	Instrument:	ICPMS05	Method:	SW6020					
MS	Sample ID: HS18011346-02MS	Units: mg/L	Analysis Date: 06-Feb-2018 16:11							
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421899	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Lead	0.04657	0.00200	0.05	0.00013	92.9	80 - 120				
MSD	Sample ID: HS18011346-02MSD	Units: mg/L	Analysis Date: 06-Feb-2018 13:36							
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421589	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	0.1206	0.00400	0.05	0.07012	101	80 - 120	0.1166	3.43	20	
Selenium	0.05809	0.00200	0.05	0.002272	112	80 - 120	0.0509	13.2	20	
Silver	0.04443	0.00200	0.05	0.000191	88.5	80 - 120	0.04283	3.68	20	
MSD	Sample ID: HS18011346-02MSD	Units: mg/L	Analysis Date: 06-Feb-2018 16:13							
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421900	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Lead	0.04811	0.00200	0.05	0.00013	96.0	80 - 120	0.04657	3.26	20	
PDS	Sample ID: HS18011346-02PDS	Units: mg/L	Analysis Date: 06-Feb-2018 13:38							
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421590	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	0.1638	0.00400	0.1	0.07012	93.7	75 - 125				
Selenium	0.1013	0.00200	0.1	0.002272	99.0	75 - 125				
Silver	0.09041	0.00200	0.1	0.000191	90.2	75 - 125				
PDS	Sample ID: HS18011346-02PDS	Units: mg/L	Analysis Date: 06-Feb-2018 16:15							
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421901	PrepDate: 05-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Lead	0.09288	0.00200	0.1	0.00013	92.8	75 - 125				

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: 124980		Instrument: ICPMS05		Method: SW6020						
SD	Sample ID: HS18011346-02SD	Units: mg/L		Analysis Date: 06-Feb-2018 13:32						
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421587	PrepDate: 05-Feb-2018	DF: 5						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Barium	0.07508	0.0200					0.07012	7.08	10	
Selenium	0.0100	0.0100					0.002272	0	10	U
Silver	0.00500	0.0100					0.000191	0	10	U
SD	Sample ID: HS18011346-02SD	Units: mg/L		Analysis Date: 06-Feb-2018 16:09						
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421898	PrepDate: 05-Feb-2018	DF: 5						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Lead	0.00500	0.0100					0.00013	0	10	U

The following samples were analyzed in this batch: HS18020016-01

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: 124925		Instrument: SV-5		Method: SW8270SIM						
MBLK	Sample ID: MBLK-124925	Units: ug/L			Analysis Date: 06-Feb-2018 15:59					
Client ID:	Run ID: SV-5_310297	SeqNo: 4422596		PrepDate: 02-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,4-Dioxane	0.010	0.010								U
Surr: 2-Fluorobiphenyl	0.09567	0	0.08	0	120	40 - 140				
Surr: 4-Terphenyl-d14	0.04347	0	0.08	0	54.3	40 - 140				
Surr: Nitrobenzene-d5	0.0649	0	0.08	0	81.1	40 - 140				
LCS	Sample ID: LCS-124925	Units: ug/L			Analysis Date: 06-Feb-2018 16:19					
Client ID:	Run ID: SV-5_310297	SeqNo: 4422597		PrepDate: 02-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,4-Dioxane	0.05524	0.010	0.08	0	69.1	40 - 140				
Surr: 2-Fluorobiphenyl	0.1089	0	0.08	0	136	40 - 140				
Surr: 4-Terphenyl-d14	0.09114	0	0.08	0	114	40 - 140				
Surr: Nitrobenzene-d5	0.05903	0	0.08	0	73.8	40 - 140				
LCSD	Sample ID: LCSD-124925	Units: ug/L			Analysis Date: 06-Feb-2018 16:40					
Client ID:	Run ID: SV-5_310297	SeqNo: 4422598		PrepDate: 02-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,4-Dioxane	0.06664	0.010	0.08	0	83.3	40 - 140	0.05524	18.7	20	
Surr: 2-Fluorobiphenyl	0.07773	0	0.08	0	97.2	40 - 140	0.1089	33.4	20	R
Surr: 4-Terphenyl-d14	0.09527	0	0.08	0	119	40 - 140	0.09114	4.43	20	
Surr: Nitrobenzene-d5	0.05846	0	0.08	0	73.1	40 - 140	0.05903	0.96	20	

The following samples were analyzed in this batch: HS18020016-01

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310216		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180203	Units: ug/L			Analysis Date: 05-Feb-2018 14:28					
Client ID:	Run ID: VOA2_310216	SeqNo: 4420839	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	0.50	1.0								U
1,1,1-Trichloroethane	0.50	1.0								U
1,1,2,2-Tetrachloroethane	0.50	1.0								U
1,1,2-Trichloroethane	0.50	1.0								U
1,1-Dichloroethane	0.50	1.0								U
1,1-Dichloroethene	0.50	1.0								U
1,1-Dichloropropene	0.50	1.0								U
1,2,3-Trichlorobenzene	0.50	1.0								U
1,2,3-Trichloropropane	0.50	1.0								U
1,2,4-Trichlorobenzene	0.50	1.0								U
1,2,4-Trimethylbenzene	0.50	1.0								U
1,2-Dibromo-3-chloropropane	0.50	1.0								U
1,2-Dibromoethane	0.50	1.0								U
1,2-Dichlorobenzene	0.50	1.0								U
1,2-Dichloroethane	0.50	1.0								U
1,2-Dichloropropane	0.50	1.0								U
1,3,5-Trimethylbenzene	0.50	1.0								U
1,3-Dichlorobenzene	0.50	1.0								U
1,3-Dichloropropane	0.50	1.0								U
1,4-Dichlorobenzene	0.50	1.0								U
2,2-Dichloropropane	0.50	1.0								U
2-Butanone	1.0	2.0								U
2-Chlorotoluene	0.50	1.0								U
2-Hexanone	1.0	2.0								U
4-Chlorotoluene	0.50	1.0								U
4-Isopropyltoluene	0.50	1.0								U
4-Methyl-2-pentanone	1.0	2.0								U
Acetone	1.0	2.0								U
Benzene	0.50	1.0								U
Bromobenzene	0.50	1.0								U
Bromochloromethane	0.50	1.0								U
Bromodichloromethane	0.50	1.0								U
Bromoform	0.50	1.0								U
Bromomethane	0.50	1.0								U

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310216		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180203	Units: ug/L			Analysis Date: 05-Feb-2018 14:28					
Client ID:	Run ID: VOA2_310216	SeqNo: 4420839	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	1.0	2.0								U
Carbon tetrachloride	0.50	1.0								U
Chlorobenzene	0.50	1.0								U
Chloroethane	0.50	1.0								U
Chloroform	0.50	1.0								U
Chloromethane	0.50	1.0								U
cis-1,2-Dichloroethene	0.50	1.0								U
cis-1,3-Dichloropropene	0.50	1.0								U
Dibromochloromethane	0.50	1.0								U
Dibromomethane	0.50	1.0								U
Dichlorodifluoromethane	0.50	1.0								U
Ethylbenzene	0.50	1.0								U
Hexachlorobutadiene	0.50	1.0								U
Isopropylbenzene	0.50	1.0								U
m,p-Xylene	1.0	2.0								U
Methylene chloride	1.0	2.0								U
Naphthalene	0.50	1.0								U
n-Butylbenzene	0.50	1.0								U
n-Propylbenzene	0.50	1.0								U
o-Xylene	0.50	1.0								U
sec-Butylbenzene	0.50	1.0								U
Styrene	0.50	1.0								U
tert-Butylbenzene	0.50	1.0								U
Tetrachloroethene	0.50	1.0								U
Toluene	0.50	1.0								U
trans-1,2-Dichloroethene	0.50	1.0								U
trans-1,3-Dichloropropene	0.50	1.0								U
Trichloroethene	0.50	1.0								U
Trichlorofluoromethane	0.50	1.0								U
Vinyl chloride	0.50	1.0								U
Surr: 1,2-Dichloroethane-d4	51.26	1.0	50	0	103	81 - 118				
Surr: 4-Bromofluorobenzene	52.39	1.0	50	0	105	85 - 114				
Surr: Dibromofluoromethane	48.78	1.0	50	0	97.6	80 - 119				
Surr: Toluene-d8	50.46	1.0	50	0	101	89 - 112				

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310216		Instrument: VOA2			Method: SW8260					
LCS	Sample ID: VLCSW-180203	Units: ug/L			Analysis Date: 05-Feb-2018 13:39					
Client ID:	Run ID: VOA2_310216	SeqNo: 4420879			PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	52.05	1.0	50	0	104	78 - 124				
1,1,1-Trichloroethane	62.41	1.0	50	0	125	74 - 131				
1,1,2,2-Tetrachloroethane	43.91	1.0	50	0	87.8	71 - 121				
1,1,2-Trichloroethane	47.02	1.0	50	0	94.0	80 - 119				
1,1-Dichloroethane	53.25	1.0	50	0	107	77 - 125				
1,1-Dichloroethene	54.15	1.0	50	0	108	71 - 131				
1,1-Dichloropropene	59.77	1.0	50	0	120	79 - 125				
1,2,3-Trichlorobenzene	47.43	1.0	50	0	94.9	69 - 129				
1,2,3-Trichloropropane	49.7	1.0	50	0	99.4	73 - 122				
1,2,4-Trichlorobenzene	53.66	1.0	50	0	107	69 - 130				
1,2,4-Trimethylbenzene	45.24	1.0	50	0	90.5	76 - 124				
1,2-Dibromo-3-chloropropane	52.6	1.0	50	0	105	62 - 128				
1,2-Dibromoethane	50.59	1.0	50	0	101	77 - 121				
1,2-Dichlorobenzene	44.34	1.0	50	0	88.7	80 - 119				
1,2-Dichloroethane	58.29	1.0	50	0	117	73 - 128				
1,2-Dichloropropane	49.49	1.0	50	0	99.0	78 - 122				
1,3,5-Trimethylbenzene	45.99	1.0	50	0	92.0	75 - 124				
1,3-Dichlorobenzene	44.82	1.0	50	0	89.6	80 - 119				
1,3-Dichloropropane	49.85	1.0	50	0	99.7	80 - 119				
1,4-Dichlorobenzene	44.09	1.0	50	0	88.2	79 - 118				
2,2-Dichloropropane	63.41	1.0	50	0	127	60 - 139				
2-Butanone	113.9	2.0	100	0	114	56 - 143				
2-Chlorotoluene	44.88	1.0	50	0	89.8	79 - 122				
2-Hexanone	116.9	2.0	100	0	117	57 - 139				
4-Chlorotoluene	45.44	1.0	50	0	90.9	78 - 122				
4-Isopropyltoluene	47.75	1.0	50	0	95.5	77 - 127				
4-Methyl-2-pentanone	108.7	2.0	100	0	109	67 - 130				
Acetone	124.9	2.0	100	0	125	39 - 160				
Benzene	49.63	1.0	50	0	99.3	79 - 120				
Bromobenzene	43.39	1.0	50	0	86.8	80 - 120				
Bromochloromethane	53.08	1.0	50	0	106	78 - 123				
Bromodichloromethane	59	1.0	50	0	118	79 - 125				
Bromoform	60.42	1.0	50	0	121	66 - 130				
Bromomethane	57.32	1.0	50	0	115	53 - 141				

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310216		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180203	Units: ug/L			Analysis Date: 05-Feb-2018 13:39					
Client ID:	Run ID: VOA2_310216	SeqNo: 4420879	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	102.1	2.0	100	0	102	64 - 133				
Carbon tetrachloride	63.3	1.0	50	0	127	72 - 136				
Chlorobenzene	47.79	1.0	50	0	95.6	80 - 120				
Chloroethane	54.01	1.0	50	0	108	82 - 118				
Chloroform	53.6	1.0	50	0	107	79 - 124				
Chloromethane	50.48	1.0	50	0	101	50 - 139				
cis-1,2-Dichloroethene	50.62	1.0	50	0	101	78 - 123				
cis-1,3-Dichloropropene	56.33	1.0	50	0	113	75 - 124				
Dibromochloromethane	55.01	1.0	50	0	110	74 - 126				
Dibromomethane	55.29	1.0	50	0	111	79 - 123				
Dichlorodifluoromethane	63.74	1.0	50	0	127	32 - 152				
Ethylbenzene	48.16	1.0	50	0	96.3	79 - 121				
Hexachlorobutadiene	50.4	1.0	50	0	101	66 - 134				
Isopropylbenzene	51.98	1.0	50	0	104	72 - 131				
m,p-Xylene	94.9	2.0	100	0	94.9	80 - 121				
Methylene chloride	50.49	2.0	50	0	101	74 - 124				
Naphthalene	48.71	1.0	50	0	97.4	61 - 128				
n-Butylbenzene	49.1	1.0	50	0	98.2	75 - 128				
n-Propylbenzene	46.4	1.0	50	0	92.8	76 - 126				
o-Xylene	47.54	1.0	50	0	95.1	78 - 122				
sec-Butylbenzene	47.96	1.0	50	0	95.9	77 - 126				
Styrene	49.32	1.0	50	0	98.6	78 - 128				
tert-Butylbenzene	46.47	1.0	50	0	92.9	78 - 124				
Tetrachloroethene	48.24	1.0	50	0	96.5	74 - 129				
Toluene	47.47	1.0	50	0	94.9	80 - 121				
trans-1,2-Dichloroethene	50.78	1.0	50	0	102	75 - 124				
trans-1,3-Dichloropropene	59.87	1.0	50	0	120	73 - 127				
Trichloroethene	52.79	1.0	50	0	106	79 - 123				
Trichlorofluoromethane	64.62	1.0	50	0	129	65 - 141				
Vinyl chloride	54.52	1.0	50	0	109	58 - 137				
Surr: 1,2-Dichloroethane-d4	54.18	1.0	50	0	108	81 - 118				
Surr: 4-Bromofluorobenzene	53.5	1.0	50	0	107	85 - 114				
Surr: Dibromofluoromethane	45.94	1.0	50	0	91.9	80 - 119				
Surr: Toluene-d8	48.88	1.0	50	0	97.8	89 - 112				

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310216		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18011112-03MS	Units: ug/L			Analysis Date: 05-Feb-2018 18:08					
Client ID:	Run ID: VOA2_310216	SeqNo: 4420848	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	48.89	1.0	50	0	97.8	78 - 124				
1,1,1-Trichloroethane	60.98	1.0	50	0	122	74 - 131				
1,1,2,2-Tetrachloroethane	41.34	1.0	50	0	82.7	71 - 121				
1,1,2-Trichloroethane	44.95	1.0	50	0	89.9	80 - 119				
1,1-Dichloroethane	52.1	1.0	50	0	104	77 - 125				
1,1-Dichloroethene	54.54	1.0	50	0	109	71 - 131				
1,1-Dichloropropene	57.14	1.0	50	0	114	79 - 125				
1,2,3-Trichlorobenzene	42.46	1.0	50	0	84.9	69 - 129				
1,2,3-Trichloropropane	46.25	1.0	50	0	92.5	73 - 122				
1,2,4-Trichlorobenzene	47.22	1.0	50	0	94.4	69 - 130				
1,2,4-Trimethylbenzene	41.56	1.0	50	0	83.1	76 - 124				
1,2-Dibromo-3-chloropropane	48.49	1.0	50	0	97.0	62 - 128				
1,2-Dibromoethane	46.91	1.0	50	0	93.8	77 - 121				
1,2-Dichlorobenzene	40.69	1.0	50	0	81.4	80 - 119				
1,2-Dichloroethane	54.84	1.0	50	0	110	73 - 128				
1,2-Dichloropropane	47.8	1.0	50	0	95.6	78 - 122				
1,3,5-Trimethylbenzene	42.89	1.0	50	0	85.8	75 - 124				
1,3-Dichlorobenzene	41.18	1.0	50	0	82.4	80 - 119				
1,3-Dichloropropane	47.32	1.0	50	0	94.6	80 - 119				
1,4-Dichlorobenzene	39.86	1.0	50	0	79.7	79 - 118				
2,2-Dichloropropane	59.27	1.0	50	0	119	60 - 139				
2-Butanone	105.5	2.0	100	0	106	56 - 143				
2-Chlorotoluene	41.9	1.0	50	0	83.8	79 - 122				
2-Hexanone	107.7	2.0	100	0	108	57 - 139				
4-Chlorotoluene	41.68	1.0	50	0	83.4	78 - 122				
4-Isopropyltoluene	43.42	1.0	50	0	86.8	77 - 127				
4-Methyl-2-pentanone	105	2.0	100	0	105	67 - 130				
Acetone	116.9	2.0	100	0	117	39 - 160				
Benzene	47.9	1.0	50	0	95.8	79 - 120				
Bromobenzene	40.88	1.0	50	0	81.8	80 - 120				
Bromochloromethane	50.9	1.0	50	0	102	78 - 123				
Bromodichloromethane	54.75	1.0	50	0	109	79 - 125				
Bromoform	56.98	1.0	50	0	114	66 - 130				
Bromomethane	54.75	1.0	50	0	110	53 - 141				

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310216		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18011112-03MS	Units: ug/L			Analysis Date: 05-Feb-2018 18:08					
Client ID:	Run ID: VOA2_310216	SeqNo: 4420848	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	105	2.0	100	0	105	64 - 133				
Carbon tetrachloride	61.76	1.0	50	0	124	72 - 136				
Chlorobenzene	45.51	1.0	50	0	91.0	80 - 120				
Chloroethane	50.7	1.0	50	0	101	82 - 118				
Chloroform	54.13	1.0	50	1.786	105	79 - 124				
Chloromethane	44.15	1.0	50	0	88.3	50 - 139				
cis-1,2-Dichloroethene	50.03	1.0	50	0	100	78 - 123				
cis-1,3-Dichloropropene	51.92	1.0	50	0	104	75 - 124				
Dibromochloromethane	52.34	1.0	50	0	105	74 - 126				
Dibromomethane	51.95	1.0	50	0	104	79 - 123				
Dichlorodifluoromethane	57.42	1.0	50	0	115	32 - 152				
Ethylbenzene	46.32	1.0	50	0	92.6	79 - 121				
Hexachlorobutadiene	43.66	1.0	50	0	87.3	66 - 134				
Isopropylbenzene	49.65	1.0	50	0	99.3	72 - 131				
m,p-Xylene	91.42	2.0	100	0	91.4	80 - 121				
Methylene chloride	50.19	2.0	50	0	100	74 - 124				
Naphthalene	42.99	1.0	50	0	86.0	61 - 128				
n-Butylbenzene	44.34	1.0	50	0	88.7	75 - 128				
n-Propylbenzene	43.3	1.0	50	0	86.6	76 - 126				
o-Xylene	45.59	1.0	50	0	91.2	78 - 122				
sec-Butylbenzene	44.6	1.0	50	0	89.2	77 - 126				
Styrene	12.76	1.0	50	0	25.5	78 - 128				S
tert-Butylbenzene	43.86	1.0	50	0	87.7	78 - 124				
Tetrachloroethene	47.91	1.0	50	0	95.8	74 - 129				
Toluene	45.7	1.0	50	0	91.4	80 - 121				
trans-1,2-Dichloroethene	49.74	1.0	50	0	99.5	75 - 124				
trans-1,3-Dichloropropene	55.02	1.0	50	0	110	73 - 127				
Trichloroethene	50.56	1.0	50	0	101	79 - 123				
Trichlorofluoromethane	62.46	1.0	50	0	125	65 - 141				
Vinyl chloride	55.95	1.0	50	0	112	58 - 137				
Surr: 1,2-Dichloroethane-d4	52.71	1.0	50	0	105	81 - 118				
Surr: 4-Bromofluorobenzene	53.91	1.0	50	0	108	85 - 114				
Surr: Dibromofluoromethane	45.36	1.0	50	0	90.7	80 - 119				
Surr: Toluene-d8	49.55	1.0	50	0	99.1	89 - 112				

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310216		Instrument: VOA2			Method: SW8260					
MSD	Sample ID: HS18011112-03MSD	Units: ug/L			Analysis Date: 05-Feb-2018 18:33					
Client ID:	Run ID: VOA2_310216	SeqNo: 4420849		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	50.5	1.0	50	0	101	78 - 124	48.89	3.25	20	
1,1,1-Trichloroethane	61.98	1.0	50	0	124	74 - 131	60.98	1.63	20	
1,1,2,2-Tetrachloroethane	42.32	1.0	50	0	84.6	71 - 121	41.34	2.36	20	
1,1,2-Trichloroethane	46.28	1.0	50	0	92.6	80 - 119	44.95	2.91	20	
1,1-Dichloroethane	54.47	1.0	50	0	109	77 - 125	52.1	4.44	20	
1,1-Dichloroethene	54.2	1.0	50	0	108	71 - 131	54.54	0.62	20	
1,1-Dichloropropene	62.06	1.0	50	0	124	79 - 125	57.14	8.25	20	
1,2,3-Trichlorobenzene	46.8	1.0	50	0	93.6	69 - 129	42.46	9.72	20	
1,2,3-Trichloropropane	48.93	1.0	50	0	97.9	73 - 122	46.25	5.63	20	
1,2,4-Trichlorobenzene	52.74	1.0	50	0	105	69 - 130	47.22	11	20	
1,2,4-Trimethylbenzene	44.37	1.0	50	0	88.7	76 - 124	41.56	6.54	20	
1,2-Dibromo-3-chloropropane	50.09	1.0	50	0	100	62 - 128	48.49	3.24	20	
1,2-Dibromoethane	49	1.0	50	0	98.0	77 - 121	46.91	4.36	20	
1,2-Dichlorobenzene	42.68	1.0	50	0	85.4	80 - 119	40.69	4.8	20	
1,2-Dichloroethane	55.17	1.0	50	0	110	73 - 128	54.84	0.597	20	
1,2-Dichloropropane	48.83	1.0	50	0	97.7	78 - 122	47.8	2.14	20	
1,3,5-Trimethylbenzene	45.24	1.0	50	0	90.5	75 - 124	42.89	5.33	20	
1,3-Dichlorobenzene	43.76	1.0	50	0	87.5	80 - 119	41.18	6.07	20	
1,3-Dichloropropane	48.43	1.0	50	0	96.9	80 - 119	47.32	2.3	20	
1,4-Dichlorobenzene	42.34	1.0	50	0	84.7	79 - 118	39.86	6.03	20	
2,2-Dichloropropane	61.94	1.0	50	0	124	60 - 139	59.27	4.4	20	
2-Butanone	105.6	2.0	100	0	106	56 - 143	105.5	0.0398	20	
2-Chlorotoluene	44.59	1.0	50	0	89.2	79 - 122	41.9	6.22	20	
2-Hexanone	110.9	2.0	100	0	111	57 - 139	107.7	2.9	20	
4-Chlorotoluene	44.93	1.0	50	0	89.9	78 - 122	41.68	7.51	20	
4-Isopropyltoluene	46.19	1.0	50	0	92.4	77 - 127	43.42	6.19	20	
4-Methyl-2-pentanone	106.2	2.0	100	0	106	67 - 130	105	1.21	20	
Acetone	109.1	2.0	100	0	109	39 - 160	116.9	6.88	20	
Benzene	50.51	1.0	50	0	101	79 - 120	47.9	5.3	20	
Bromobenzene	42.69	1.0	50	0	85.4	80 - 120	40.88	4.33	20	
Bromochloromethane	52.35	1.0	50	0	105	78 - 123	50.9	2.82	20	
Bromodichloromethane	57.29	1.0	50	0	115	79 - 125	54.75	4.53	20	
Bromoform	57.13	1.0	50	0	114	66 - 130	56.98	0.264	20	
Bromomethane	54.46	1.0	50	0	109	53 - 141	54.75	0.537	20	

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310216		Instrument: VOA2		Method: SW8260						
MSD	Sample ID: HS18011112-03MSD	Units: ug/L			Analysis Date: 05-Feb-2018 18:33					
Client ID:	Run ID: VOA2_310216	SeqNo: 4420849	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	106.4	2.0	100	0	106	64 - 133	105	1.32	20	
Carbon tetrachloride	62.28	1.0	50	0	125	72 - 136	61.76	0.831	20	
Chlorobenzene	46.95	1.0	50	0	93.9	80 - 120	45.51	3.11	20	
Chloroethane	54.05	1.0	50	0	108	82 - 118	50.7	6.4	20	
Chloroform	54.81	1.0	50	1.786	106	79 - 124	54.13	1.25	20	
Chloromethane	45.76	1.0	50	0	91.5	50 - 139	44.15	3.59	20	
cis-1,2-Dichloroethene	51.02	1.0	50	0	102	78 - 123	50.03	1.96	20	
cis-1,3-Dichloropropene	54.28	1.0	50	0	109	75 - 124	51.92	4.43	20	
Dibromochloromethane	52.87	1.0	50	0	106	74 - 126	52.34	1.01	20	
Dibromomethane	53.08	1.0	50	0	106	79 - 123	51.95	2.16	20	
Dichlorodifluoromethane	59.88	1.0	50	0	120	32 - 152	57.42	4.2	20	
Ethylbenzene	47.99	1.0	50	0	96.0	79 - 121	46.32	3.56	20	
Hexachlorobutadiene	46.61	1.0	50	0	93.2	66 - 134	43.66	6.54	20	
Isopropylbenzene	51.29	1.0	50	0	103	72 - 131	49.65	3.24	20	
m,p-Xylene	93.96	2.0	100	0	94.0	80 - 121	91.42	2.74	20	
Methylene chloride	50.41	2.0	50	0	101	74 - 124	50.19	0.448	20	
Naphthalene	47.3	1.0	50	0	94.6	61 - 128	42.99	9.55	20	
n-Butylbenzene	47.01	1.0	50	0	94.0	75 - 128	44.34	5.86	20	
n-Propylbenzene	46.06	1.0	50	0	92.1	76 - 126	43.3	6.17	20	
o-Xylene	46.9	1.0	50	0	93.8	78 - 122	45.59	2.84	20	
sec-Butylbenzene	47.99	1.0	50	0	96.0	77 - 126	44.6	7.34	20	
Styrene	2.33	1.0	50	0	4.66	78 - 128	12.76	138	20	SR
tert-Butylbenzene	46.46	1.0	50	0	92.9	78 - 124	43.86	5.75	20	
Tetrachloroethene	48.33	1.0	50	0	96.7	74 - 129	47.91	0.868	20	
Toluene	46.7	1.0	50	0	93.4	80 - 121	45.7	2.17	20	
trans-1,2-Dichloroethene	52.12	1.0	50	0	104	75 - 124	49.74	4.67	20	
trans-1,3-Dichloropropene	57.54	1.0	50	0	115	73 - 127	55.02	4.48	20	
Trichloroethene	52.61	1.0	50	0	105	79 - 123	50.56	3.99	20	
Trichlorofluoromethane	65.47	1.0	50	0	131	65 - 141	62.46	4.7	20	
Vinyl chloride	56.32	1.0	50	0	113	58 - 137	55.95	0.658	20	
Surr: 1,2-Dichloroethane-d4	52.9	1.0	50	0	106	81 - 118	52.71	0.354	20	
Surr: 4-Bromofluorobenzene	53.44	1.0	50	0	107	85 - 114	53.91	0.882	20	
Surr: Dibromofluoromethane	45.95	1.0	50	0	91.9	80 - 119	45.36	1.29	20	
Surr: Toluene-d8	49.22	1.0	50	0	98.4	89 - 112	49.55	0.665	20	

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT**Batch ID:** R310216**Instrument:** VOA2**Method:** SW8260

The following samples were analyzed in this batch: HS18020016-01 HS18020016-02

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

QC BATCH REPORT

Batch ID: R310277		Instrument: UV-2450		Method: SW7196						
MBLK	Sample ID: MBLK-310277	Units: mg/L			Analysis Date: 01-Feb-2018 09:50					
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422021		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.00600	0.0100							U	
LCS	Sample ID: LCS-310277	Units: mg/L			Analysis Date: 01-Feb-2018 09:50					
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422022		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.252	0.0100	0.25	0	101	80 - 120				
LCSD	Sample ID: LCSD-310277	Units: mg/L			Analysis Date: 01-Feb-2018 09:50					
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422023		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.243	0.0100	0.25	0	97.2	80 - 120	0.252	3.64	20	
MS	Sample ID: HS18011362-03MS	Units: mg/L			Analysis Date: 01-Feb-2018 09:50					
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422025		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.281	0.0100	0.25	0.003	111	75 - 125				
MSD	Sample ID: HS18011362-03MSD	Units: mg/L			Analysis Date: 01-Feb-2018 09:50					
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422026		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.277	0.0100	0.25	0.003	110	75 - 125	0.281	1.43	20	

The following samples were analyzed in this batch: HS18020016-01

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020016

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18020016

Date/Time Received: **01-Feb-2018 08:40**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 1-Feb-2018
 eSignature Date

Reviewed by: _____
 eSignature 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): 1.8c/1.2c UC/C IR25

Cooler(s)/Kit(s): Blue

Date/Time sample(s) sent to storage: 02/01/2018 12:00

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:

Client Contacted: _____ Date Contacted: _____ Person Contacted: _____

Contacted By: _____ Regarding: _____

Comments: _____

Corrective Action: _____

Name Of Lab Shipping To: ALS, 10450 Stanciff Rd., Suite 210 Houston, TX 77099 (281) 530-5656 ATTN: SONIA WEST

CHAIN OF CUSTODY

Project: BHATE
 LONGHORN ARMY AMMIN. PLANT (LHAAP)
 GROUNDWATER TREATMENT PLANT (GWTP)
 KARNACK, TEXAS

Analyses

Field Sample I.D.	Sample Matrix	Date / Time	MS / MSD	No. OF CONTAINERS	VOLATILES	SILVER, SELENIUM, LEAD, BARIUM	HEXAVALENT CHROMIUM	1, 4 - DIOXANE	PERCHLORATE	Remarks (Preservatives, etc.)	Lab I.D.#
LH18/24-SP650_013118	Water	01/31/18 / 14:00		3	X					HCL	
LH18/24-SP650_013118	Water	01/31/18 / 14:00		3		X	X	X		NONE	
LH18/24-SP650_013118	Water	01/31/18 / 14:00		1		X				HNO3	
Trip Blank	Water	01/31/18		2	X					HCL	

Job:
 GROUNDWATER TREATMENT PLANT
 MONTHLY EFFLUENT SAMPLES

Prepared By:
 Scott Beesinger

P.O. Number

STANDARD TURN AROUND TIME

Relinquished By:	Date	Time	Received By:	Date	Time	Relinquished By:	Date	Time	Received By:	Date	Time
<i>Scott Beesinger</i>	01/31/18	14:30	<i>SW</i>	2/1/18	08:49						

Received At Lab By: _____ **Date:** _____ **Time:** _____ **Alhibit No.:** _____

For Lab Use Only:
Opened By: _____ **Date:** _____ **Time:** _____ **Temp of Container:** _____ **Seal No.:** _____ **Condition:** _____

Remarks: Cooler - Blue 1225
 Temp 1.8 CF-0.0

HS18020016

Bhate Environmental Associates, inc.
 Longhorn GW Treatment Plant



00883100

RETURNS MON - SAT
THU - 01 FEB 10:30A
PRIORITY OVERNIGHT 99

7376 9751 2700

7376 9751 2790

AB SGRA



10 102705 314416 650A 546CL1220/8CT



10450 Stencil Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5687

CUSTODY SEAL	
Date: 1/31/98	Time: 7:30
Name: Scott Beatty	Company: SHATE
Seal Broken By: JKL	
Date: 2/1/98	



Case Narrative

Method: 6850

Analysis: Perchlorate

Analysis SOP: LC-MS-CLO4

ALS WO ID(s): 1803622; 1803625; 1803629;
1804064; 1804362

Client: ALS Laboratories (Houston, TX)

Matrix: Water

ELMS Batch (HBN): 2046 (208525)

General Set Information: There were thirteen 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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

Method QC data: The method blank (LMB 587237) was less than 1/2 the CRDL. The recovery for the LCS (587238) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1803622001 (Client ID: LH18/24-SP650_013118). The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The relative percent difference (RPD) was within the performance limits.



Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)

B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for field samples 1804362003/04/07. No positive results were reported for these samples. 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 13FEBD02/03/14/15/17.

Thomas Bosch February 15, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: February 16, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1803629**

Project ID: HS18020016 013118

Purchase Order: HS18020016

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP650_013118	1803629001	01/31/18	02/02/18	



ANALYTICAL REPORT

Workorder: 34-1803629

Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP650_013118	Sampling Site: NA	Collected: 01/31/2018				
Lab ID: 1803629001	Media: 125 mL Nalgene	Received: 02/02/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2046 (HBN: 208525) Analyzed: 02/13/2018 10:42	Instrument ID: LCMS04 Percent Solid: NA Report Basis: Wet				
Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	66	1.0	2.0	4.0	1	

Comments

Quality Control: EPA 6850, DoD QSM - (HBN: 208525)

Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

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 02/15/2018 10:45	/S/ Stephen Brose 02/16/2018 09:27

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: als@alst.com
Web: www.alst.com



ANALYTICAL REPORT

Workorder: 34-1803629

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	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.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1803629

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

00883107

Analysis Information

Workorder: 1803629

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2046 (HBN: 208525)
Analyzed By: Thomas Bosch

Blank

LMB: 587237 Analyzed: 02/13/2018 09:12 Units: ug/L			
Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 587238 Analyzed: 02/13/2018 09:27 Dilution: 1 Units: ug/L				
Analyte	Result	Target	% Rec	QC Limits
Perchlorate	4.48	5.00	89.6	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1803622001 Analyzed: 02/13/2018 09:43 Dilution: 1 Units: ug/L		MS: 587239 Analyzed: 02/13/2018 09:58 Dilution: 1 Units: ug/L			MSD: 587240 Analyzed: 02/13/2018 10:13 Dilution: 1 Units: ug/L				
Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	51.0	53.9	5	▲ 60.3	78.8 123.8	53.6	▲ 53.7	0.622	0.0 20.0

Continuing Calibration Verification

CCV: 587234 Analyzed: 02/13/2018 08:27 Units: ug/L Criteria: ± 15%			CCV: 587241 Analyzed: 02/13/2018 12:12 Units: ug/L Criteria: ± 15%			CCV: 587243 Analyzed: 02/13/2018 14:10 Units: ug/L Criteria: ± 15%			
Analyte	Result	Target	% Rec.	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	23.1	25.0	92.4	22.9	25.0	91.8	23.8	25.0	95.4

Interference Check Sample

ICSA: 587236 Analyzed: 02/13/2018 08:58 Units: ug/L Criteria: ± 30%			
Analyte	Result	Target	% Rec.
Perchlorate	0.940	1.00	94.0

Limit of Detection Verification

LODV: 587235 Analyzed: 02/13/2018 08:43 Units: ug/L Criteria: ± 50%			LODV: 587242 Analyzed: 02/13/2018 12:26 Units: ug/L Criteria: ± 50%			LODV: 587244 Analyzed: 02/13/2018 14:25 Units: ug/L Criteria: ± 50%			
Analyte	Result	Target	% Rec.	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	0.780	1.00	78.0	0.960	1.00	96.0	0.974	1.00	97.4



Quality Control Sample Batch Report

00883108

Analysis Information

Workorder: 1803629		
Limits: Client SOW/Contract Specified	Preparation: NA	Analysis: EPA 6850
Basis: DoD QSM	Batch: NA	Batch: ELMS/2046 (HBN: 208525)
	Prepared By: NA	Analyzed By: Thomas Bosch

Comments

Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch 02/15/2018 10:46	/S/ Stephen Brose 02/16/2018 09:27

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



1803629

18698/#2

10450 Stancliff Rd, Ste 210
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Subcontract Chain of Custody

COC ID: 8495

1803629

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18020016
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18020016-01	LH18/24-SP650_013118	Water	31 Jan 2018 14:00
SUB_Perch-6850			15 Feb 2018

Comments: Please analyze for the analysis listed above. Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: J. Winnings
Received By: Jumoke Lawal
Cooler ID(s): _____

Date/Time: 2/1/18 18:00
Date/Time: 2-2-18 10:08
Temperature(s): _____

ALS-SALT LAKE CITY-RELATED INFORMATION REPORT (CRIR)

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

1803029

Client Name: ALS Houston Project/Task/Site: _____
 Date/Time of Receipt: 2-2-18 10:08 Number of Coolers Received: 1

Condition of Coolers: Acceptable / Unacceptable
 Cooler Custody Seals: Present / Absent / NA
 Container Custody Seals: Present / Absent / NA
 Ice Present: Yes / No / NA
 Temperature Control: Present / Not Included
 Location Temp Taken: Control / Between Samples
 Are all temperatures within project specific guidelines? Yes / No / 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 <u>8214</u>	<u>4</u> °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: Jessica Davies Signature Jessica Davies Printed Name 2-2-18 Date

CLIENT-RELATED INFORMATION

- | | | | |
|--|---|--|---|
| <input type="checkbox"/> Missing Cooler | <input type="checkbox"/> Missing Samples/Bottles | <input type="checkbox"/> Incorrect Preservation | <input type="checkbox"/> Insufficient Sample Volume |
| <input type="checkbox"/> Cooler Conditions | <input type="checkbox"/> Broken/Leaking Samples | <input type="checkbox"/> pH Criteria Not Met | <input type="checkbox"/> Chain of Custody Problems |
| <input type="checkbox"/> Missing Paperwork | <input type="checkbox"/> Incorrect Bottle Type | <input type="checkbox"/> Residual Chlorine Present | <input type="checkbox"/> Other: |
| <input type="checkbox"/> Missing/Incorrect Bottle Labels | <input type="checkbox"/> Cooler Temperatures Out of Range | <input type="checkbox"/> Head Space in Bottles | |

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

Client Notified? Yes No

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

ALS Project Manager: _____ Returned to Sample Receipt by: _____ Date: _____
Printed Name Signature



ORIGIN ID: 5GRA (281) 530-5656
SHIPPING DEPT
ALS LABORATORY GROUP
10450 STANCLIFF RD
SUITE 210
HOUSTON, TX 77099
UNITED STATES US

SHIP DATE: 01FEB18
ACTWT: 6.95 LB
CAD: 300130/CAFE3108
DIMS: 14x11x10 IN
BILL SENDER

TO **PAUL POPE**
ALS ENVIRONMENTAL
960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123

(801) 266-7700
REF: HS18020016/020/023 RJ



FRI - 02 FEB 3:00
STANDARD OVERNIGHT

TRK# **7376 9752 1968**
0201

AX BTFA

8412
UT-US **SLI**



00883112

Batch Worklist



Batch: ELMS/ 2046

Rule: EPA 6850, DoD QSM Water

Created: 2/13/2018 08:15

Analyst: T. Bosch

Instrument:

Status: WP

HBN: 208525



- Workorder: 1803622 [ENV_LVL4]
- Workorder: 1803625 [ENV_LVL4]
- Workorder: 1803629 [ENV_LVL4]
- Workorder: 1804064 [ENV_LVL4]
- Workorder: 1804362 [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	587234	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
2	587235	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	
3	587236	ICS for HBN 208525 [ELMS/2046]				ICS	3		E6850.D3Q	5311		2/16/2018	
4	587237	LMB for HBN 208525 [ELMS/2046]				LMB	3		E6850Q413Q	5311		2/16/2018	
5	587238	LCS for HBN 208525 [ELMS/2046]				LCS	3		E6850Q413Q	5311		2/16/2018	
6	1803622001	LH18/24-SP650_013118				SAMPLE	3	1803622001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
7	587239	LH18/24-SP650...(1803622001MS)				MS	3		E6850Q413Q	5311		2/16/2018	
8	587240	LH18/24-SP65...(1803622001MSD)				MSD	3		E6850Q413Q	5311		2/16/2018	
9	1803625001	LH18/24-SPI40_013118				SAMPLE	3	1803625001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
10	1803629001	LH18/24-SP650_013118				SAMPLE	3	1803629001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
11	1804064001	LH18/24-SP650_020718				SAMPLE	3	1804064001-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
12	1804362001	16EW01_020718				SAMPLE	3	1804362001-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
13	1804362002	16EW02_020718				SAMPLE	3	1804362002-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
14	1804362003	16EW03_020718				SAMPLE	3	1804362003-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
15	1804362004	16EW04_020718				SAMPLE	3	1804362004-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
16	1804362005	16EW05_020718				SAMPLE	3	1804362005-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
17	1804362006	16EW05_020718-a				SAMPLE	3	1804362006-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
18	587241	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
19	587242	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	
20	1804362007	16EW06_020718				SAMPLE	3	1804362007-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
21	1804362008	16EW07_020718				SAMPLE	3	1804362008-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
22	1804362009	16EW08_020718				SAMPLE	3	1804362009-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
23	587243	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
24	587244	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #()'s: 1803622 (001); 1803625 (001); 1803629 (001); 1804064 (001); 1804362 (001-09)

ELMS Batch/HBN ID: 2046 (208525)

Prep Date: 02/13/2018 Analysis Date: 02/13/2018 Analyst: T. Bosch

Analyte: **Perchlorate** Matrix: **Water** Method: **6850**

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\13FEB18D.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 D1735)/0.1% glacial acetic acid (JT-Baker Lot 04802).
Eluent B1: 95% ACN (B&J Lot D1735)/ 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-DOD.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	0.80
4.0	0.80
5.0	0.25
10.0	0.25
10.5	0.80
13.0	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 587238; Target = 5.0µg/L. ASTM type II water was used for LMB 587237.

MS/MSD: MS/MSD was performed on sample 1803622001 (Client ID: LH18/24-SP650_013118). 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. Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.
- 2) All QC, Blank, CCV, and MS/MSD results were within method parameters, except for the following. The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The ion ratio of m/z 83 to 85 often fails at levels near the reported Detection Limit (DL). The 83/85 ion ratio failed for field samples 1804362003/04/07. No positive results were reported for these samples.
- 3) Sample data can be viewed at two directories within the ALS system: \\ALSLTWS013\LCMS\LCMS04\2018\FEB\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 13FEBD02/03/14/15/17.
- 5) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\208525-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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 WRK		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 INT		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 10 mL	
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17	Lab Lot: CLO4 QC WRK 100.ug/L	Usable: Yes	
Part ID:			

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 Infrmdt Std-OC 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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/2017		Lab Lot: CLO4 QC INT 10.ug/mL		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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



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/NCCL 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.





Certificate of Analysis



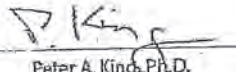
ISO Guide 34 Reference Material

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. Larnendola
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 (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:

ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



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

February 16, 2018

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

Work Order: **HS18020020**

Laboratory Results for: **Longhorn GW Treatment Plant**

Dear Marcia,

ALS Environmental received 1 sample(s) on Feb 01, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18020020

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18020020-01	LH18/24-SP140_013118	Water		31-Jan-2018 14:00	01-Feb-2018 08:40	<input type="checkbox"/>

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18020020

CASE NARRATIVE**Work Order Comments**

- The analyses for Perchlorate was subcontracted to ALS Environmental in Salt Lake City, Utah Final report attached.
-

Metals by Method SW6020**Batch ID: 124980**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method SW7196**Batch ID: R310277**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP140_013118
 Collection Date: 31-Jan-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18020020
 Lab ID:HS18020020-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
ICP-MS METALS BY SW6020A		Method:SW6020				Prep:SW3010A / 05-Feb-2018		Analyst: JDE
Selenium	0.00120	J	0.00110	0.00200	0.00200	mg/L	1	06-Feb-2018 13:54
Silver	0.00100	U	0.000200	0.00100	0.00200	mg/L	1	06-Feb-2018 13:54
HEXAVALENT CHROMIUM BY SW7196A		Method:SW7196				Prep:SW7196		Analyst: JHD
Chromium, Hexavalent	0.00600	U	0.00600	0.00600	0.0100	mg/L	1	01-Feb-2018 13:25
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Method:NA						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	16-Feb-2018 13:58

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

WEIGHT LOG

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020020

Batch ID: 124980 **Method:** ICP-MS METALS BY SW6020A **Prep:** 3010A

SampleID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18020020-01	1	10	10 (mL)	1

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020020

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID 124980	Test Name : ICP-MS METALS BY SW6020A		Matrix: Water			
HS18020020-01	LH18/24-SP140_013118	31 Jan 2018 14:00		05 Feb 2018 13:15	06 Feb 2018 13:54	1
Batch ID R310277	Test Name : HEXAVALENT CHROMIUM BY SW7196A		Matrix: Water			
HS18020020-01	LH18/24-SP140_013118	31 Jan 2018 14:00			01 Feb 2018 13:25	1
Batch ID R310951	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18020020-01	LH18/24-SP140_013118	31 Jan 2018 14:00			16 Feb 2018 13:58	1

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020020

QC BATCH REPORT

Batch ID: 124980		Instrument: ICPMS05		Method: SW6020					
MBLK	Sample ID: MBLK-124980	Units: mg/L		Analysis Date: 06-Feb-2018 13:26					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421584	PrepDate: 05-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.00200	0.00200							U
Silver	0.00100	0.00200							U
LCS	Sample ID: LCS-124980	Units: mg/L		Analysis Date: 06-Feb-2018 13:28					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421585	PrepDate: 05-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.04387	0.00200	0.05	0	87.7	80 - 120			
Silver	0.0449	0.00200	0.05	0	89.8	80 - 120			
MS	Sample ID: HS18011346-02MS	Units: mg/L		Analysis Date: 06-Feb-2018 13:34					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421588	PrepDate: 05-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.0509	0.00200	0.05	0.002272	97.2	80 - 120			
Silver	0.04283	0.00200	0.05	0.000191	85.3	80 - 120			
MSD	Sample ID: HS18011346-02MSD	Units: mg/L		Analysis Date: 06-Feb-2018 13:36					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421589	PrepDate: 05-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.05809	0.00200	0.05	0.002272	112	80 - 120	0.0509	13.2	20
Silver	0.04443	0.00200	0.05	0.000191	88.5	80 - 120	0.04283	3.68	20
PDS	Sample ID: HS18011346-02PDS	Units: mg/L		Analysis Date: 06-Feb-2018 13:38					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421590	PrepDate: 05-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.1013	0.00200	0.1	0.002272	99.0	75 - 125			
Silver	0.09041	0.00200	0.1	0.000191	90.2	75 - 125			

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020020

QC BATCH REPORT

Batch ID: 124980		Instrument: ICPMS05		Method: SW6020						
SD	Sample ID: HS18011346-02SD	Units: mg/L			Analysis Date: 06-Feb-2018 13:32					
Client ID:	Run ID: ICPMS05_310230	SeqNo: 4421587	PrepDate: 05-Feb-2018	DF: 5						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	Limit	Qual
Selenium	0.0100	0.0100					0.002272	0	10	U
Silver	0.00500	0.0100					0.000191	0	10	U

The following samples were analyzed in this batch: HS18020020-01

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020020

QC BATCH REPORT

Batch ID: R310277		Instrument: UV-2450		Method: SW7196						
MBLK	Sample ID: MBLK-310277	Units: mg/L		Analysis Date: 01-Feb-2018 09:50						
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422021		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.00600	0.0100							U	
LCS	Sample ID: LCS-310277	Units: mg/L		Analysis Date: 01-Feb-2018 09:50						
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422022		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.252	0.0100	0.25	0	101	80 - 120				
LCSD	Sample ID: LCSD-310277	Units: mg/L		Analysis Date: 01-Feb-2018 09:50						
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422023		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.243	0.0100	0.25	0	97.2	80 - 120	0.252	3.64	20	
MS	Sample ID: HS18011362-03MS	Units: mg/L		Analysis Date: 01-Feb-2018 09:50						
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422025		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.281	0.0100	0.25	0.003	111	75 - 125				
MSD	Sample ID: HS18011362-03MSD	Units: mg/L		Analysis Date: 01-Feb-2018 09:50						
Client ID:	Run ID: UV-2450_310277	SeqNo: 4422026		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chromium, Hexavalent	0.277	0.0100	0.25	0.003	110	75 - 125	0.281	1.43	20	

The following samples were analyzed in this batch: HS18020020-01

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020020

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Client: Bhate Environmental Associates, Inc.**Project:** Longhorn GW Treatment Plant**Work Order:** HS18020020**SAMPLE TRACKING**

Lab Samp ID	Client Sample ID	Action	Date	Person	New Location
HS18020020-01	LH18/24-SP140_013118	Login	2/1/2018 11:58:18 AM	JRM	WET067
HS18020020-01	LH18/24-SP140_013118	Login	2/1/2018 11:58:18 AM	JRM	WET067
HS18020020-01	LH18/24-SP140_013118	Login	2/1/2018 11:58:18 AM	JRM	WET067
HS18020020-01	LH18/24-SP140_013118	Login	2/1/2018 11:58:18 AM	JRM	MET054
HS18020020-01	LH18/24-SP140_013118	Login	2/1/2018 11:58:18 AM	JRM	VOA093

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18020020

Date/Time Received: **01-Feb-2018 08:40**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 1-Feb-2018
 eSignature Date

Reviewed by: RJ Modashia 2-Feb-2018
 eSignature 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): 1.8c/1.2c UC/C IR25

Cooler(s)/Kit(s): Blue

Date/Time sample(s) sent to storage: 02/01/2018 12:00

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:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

CHAIN OF CUSTODY

Name Of Lab Shipping To: ALS 10450 Staneliff Rd., Suite 210 Houston, TX. 77099 (281) 530-5656 ATTN: SONIA WEST Page 1 of 1

Project: BHATE LONGHORN ARMY AMMIN. PLANT (LHAAP) GROUNDWATER TREATMENT PLANT (GWTP) KARNACK, TEXAS		Project No.: NWO1312.0150.0 16.0001	
Job: GROUNDWATER TREATMENT PLANT MONTHLY INFLUENT SAMPLES			
Prepared By: Scott Beesinger		P.O. Number	
Field Sample I.D. LH18/24-SP140_013118 LH18/24-SP140_013118		Sample Matrix Date / Time Water 01/31/18 / 14:00 Water 01/31/18 / 14:00	
MS / MSD No. OF CONTAINERS		Analyses	
1 X		SILVER & SELENIUM HEXAVALENT CHROMIUM PERCHLORATE	
2 X X		REMARKS (Preservatives, etc.) HNO3 NONE	
Lab I.D.#		Date Time	

STANDARD TURN AROUND TIME

Additional Remarks:	
Relinquished By: <i>Scott Beesinger</i>	Received By: <i>SM</i>
Date: 01/31/18 Time: 14:30	Date: 2/1/18 Time: 08:40
Relinquished By:	Received By:
Date:	Date:
Time:	Time:

Received At Lab By:		For Lab Use Only	
Date:	Time:	Date:	Time:
Airbill No.:	Temp of Container:	Seal No.:	Condition:
Remarks: Cooler - Blue 11225 Temp 1.8 CF-06		HS18020020	

Bhate Environmental Associates, Inc.
 Longhorn GW Treatment Plant



RETURNS MON - SAT
THU - 01 FEB 10:30A
PRIORITY OVERNIGHT 99

7376 9751 2700

7376 9751 2790

AB SGRA



FD - 162/05 31JAN00 00CA 54651/1220/011

77099
IAH



10450 Stencil Rd., Suite 210
Houston, Texas 77089
Tel. +1 281 530 5656
Fax. +1 281 530 5687

JUSTODY SIA:	
Serial	77099
Name	SGRA
Company	IAH
Serial Broken Dr.	77099
Date	2/1/18



Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1803622; 1803625; 1803629;
1804064; 1804362

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2046 (208525)

General Set Information: There were thirteen 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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

Method QC data: The method blank (LMB 587237) was less than 1/2 the CRDL. The recovery for the LCS (587238) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1803622001 (Client ID: LH18/24-SP650_013118). The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The relative percent difference (RPD) was within the performance limits.



Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)

B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for field samples 1804362003/04/07. No positive results were reported for these samples. 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 13FEBD02/03/14/15/17.

Thomas Bosch February 15, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: February 16, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1803625**

Project ID: HS18020020 013118

Purchase Order: HS18020020

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP140_013118	1803625001	01/31/18	02/02/18	



ANALYTICAL REPORT

Workorder: 34-1803625

Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP140_013118	Sampling Site: NA	Collected: 01/31/2018				
Lab ID: 1803625001	Media: 125 mL Nalgene	Received: 02/02/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2046 (HBN: 208525) Analyzed: 02/13/2018 10:28	Instrument ID: LCMS04 Percent Solid: NA Report Basis: Wet				
Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	7800	1000	2000	4000	1000	

Comments

Quality Control: EPA 6850, DoD QSM - (HBN: 208525)

Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

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 02/15/2018 10:45	/S/ Stephen Brose 02/16/2018 09:27

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: als@alst.com
Web: www.alssl.com



ANALYTICAL REPORT

Workorder: 34-1803625

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
Washington	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.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1803625

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

00883151

Analysis Information

Workorder: 1803625

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2046 (HBN: 208525)
Analyzed By: Thomas Bosch

Blank

LMB: 587237 Analyzed: 02/13/2018 09:12 Units: ug/L			
Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 587238 Analyzed: 02/13/2018 09:27 Dilution: 1 Units: ug/L				
Analyte	Result	Target	% Rec	QC Limits
Perchlorate	4.48	5.00	89.6	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1803622001 Analyzed: 02/13/2018 09:43 Dilution: 1 Units: ug/L		MS: 587239 Analyzed: 02/13/2018 09:58 Dilution: 1 Units: ug/L			MSD: 587240 Analyzed: 02/13/2018 10:13 Dilution: 1 Units: ug/L				
Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	51.0	53.9	5	▲ 60.3	78.8 123.8	53.6	▲ 53.7	0.622	0.0 20.0

Continuing Calibration Verification

CCV: 587234 Analyzed: 02/13/2018 08:27 Units: ug/L Criteria: ± 15%			CCV: 587241 Analyzed: 02/13/2018 12:12 Units: ug/L Criteria: ± 15%			CCV: 587243 Analyzed: 02/13/2018 14:10 Units: ug/L Criteria: ± 15%			
Analyte	Result	Target	% Rec.	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	23.1	25.0	92.4	22.9	25.0	91.8	23.8	25.0	95.4

Interference Check Sample

ICSA: 587236 Analyzed: 02/13/2018 08:58 Units: ug/L Criteria: ± 30%			
Analyte	Result	Target	% Rec.
Perchlorate	0.940	1.00	94.0

Limit of Detection Verification

LODV: 587235 Analyzed: 02/13/2018 08:43 Units: ug/L Criteria: ± 50%			LODV: 587242 Analyzed: 02/13/2018 12:26 Units: ug/L Criteria: ± 50%			LODV: 587244 Analyzed: 02/13/2018 14:25 Units: ug/L Criteria: ± 50%			
Analyte	Result	Target	% Rec.	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	0.780	1.00	78.0	0.960	1.00	96.0	0.974	1.00	97.4



Quality Control Sample Batch Report

00883152

Analysis Information

Workorder: 1803625

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2046 (HBN: 208525)

Prepared By: NA

Analyzed By: Thomas Bosch

Comments

Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch 02/15/2018 10:46	/S/ Stephen Brose 02/16/2018 09:27

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

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Subcontract Chain of Custody

COC ID: 8494

1803625

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18020020
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18020020-01	LH18/24-SP140_013118	Water	31 Jan 2018 14:00
SUB_Perch-6850			15 Feb 2018

Comments: Please analyze for the analysis listed above. Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: J. M. Lawal
Received By: Jumoke Damis
Cooler ID(s): _____

Date/Time: 2/1/18 18:00
Date/Time: 2-2-18 10:08
Temperature(s): _____

ALS-SALT LAKE CITY-RELATED INFORMATION REPORT (CRIR)

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

Client Name: <u>ALS Houston</u>		Project/Task/Site: <u>1803el5</u>						
Date/Time of Receipt: <u>2-2-18 10:08</u>		Number of Coolers Received: <u>1</u>						
Condition of Coolers: <u>Acceptable</u> / Unacceptable		Temperature Control: <u>Present</u> / Not Included						
Cooler Custody Seals: <u>Present</u> / Absent / NA		Location Temp Taken: Control / <u>Between Samples</u>						
Container Custody Seals: <u>Intact</u> / Broken / NA		Are all temperatures within project specific guidelines? <u>Yes</u> / No / NA						
Ice Present: <u>Yes</u> / No / NA		VOA Headspace Present? Yes / No / <u>NA</u>						
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 <u>8214</u>	<u>4</u> °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: <u>Jessica Davies</u>		<u>Jessica Davies</u>		<u>2-2-18</u>				

CLIENT-RELATED INFORMATION

- | | | | |
|--|---|--|---|
| <input type="checkbox"/> Missing Cooler | <input type="checkbox"/> Missing Samples/Bottles | <input type="checkbox"/> Incorrect Preservation | <input type="checkbox"/> Insufficient Sample Volume |
| <input type="checkbox"/> Cooler Conditions | <input type="checkbox"/> Broken/Leaking Samples | <input type="checkbox"/> pH Criteria Not Met | <input type="checkbox"/> Chain of Custody Problems |
| <input type="checkbox"/> Missing Paperwork | <input type="checkbox"/> Incorrect Bottle Type | <input type="checkbox"/> Residual Chlorine Present | <input type="checkbox"/> Other: |
| <input type="checkbox"/> Missing/Incorrect Bottle Labels | <input type="checkbox"/> Cooler Temperatures Out of Range | <input type="checkbox"/> Head Space in Bottles | |

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

Client Notified? YES NO

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

ALS Project Manager: _____ Returned to Sample Receipt by: _____ Date: _____



ORIGIN ID: 56RA (281) 530-5656
SHIPPING DEPT
ALS LABORATORY GROUP
10450 STANCLIFF RD
SUITE 210
HOUSTON, TX 77099
UNITED STATES US

SHIP DATE: 01FEB18
ACTWT: 8.95 LB
CAD: 300130/CAFE3108
DIMS: 14x11x10 IN
BILL SENDER

TO **PAUL POPE**
ALS ENVIRONMENTAL
960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123

(801) 266-7700
REF: HS18020016/020/023 RJ



FRI - 02 FEB 3:00P
STANDARD OVERNIGHT

TRK# **7376 9752 1968**

AX BTFA

84123
UT-US **SLC**



00883156



Batch Worklist

HBN: 208525



Instrument: WP
Status: WP

Created: 2/13/2018 08:15
Analyst: T. Bosch

Batch: ELMS/ 2046
Rule: EPA 6850, DoD QSM Water
Workorder: 1803622 [ENV_LVL4]
Workorder: 1803625 [ENV_LVL4]
Workorder: 1803629 [ENV_LVL4]
Workorder: 1804064 [ENV_LVL4]
Workorder: 1804362 [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	587234	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
2	587235	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	
3	587236	ICS for HBN 208525 [ELMS/2046]				ICS	3		E6850.D3Q	5311		2/16/2018	
4	587237	LMB for HBN 208525 [ELMS/2046]				LMB	3		E6850Q413Q	5311		2/16/2018	
5	587238	LCS for HBN 208525 [ELMS/2046]				LCS	3		E6850Q413Q	5311		2/16/2018	
6	1803622001	LH18/24-SP650_013118				SAMPLE	3	1803622001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
7	587239	LH18/24-SP650...(1803622001MS)				MS	3		E6850Q413Q	5311		2/16/2018	
8	587240	LH18/24-SP65...(1803622001MSD)				MSD	3		E6850Q413Q	5311		2/16/2018	
9	1803625001	LH18/24-SPI40_013118				SAMPLE	3	1803625001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
10	1803629001	LH18/24-SP650_013118				SAMPLE	3	1803629001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
11	1804064001	LH18/24-SP650_020718				SAMPLE	3	1804064001-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
12	1804362001	16EW01_020718				SAMPLE	3	1804362001-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
13	1804362002	16EW02_020718				SAMPLE	3	1804362002-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
14	1804362003	16EW03_020718				SAMPLE	3	1804362003-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
15	1804362004	16EW04_020718				SAMPLE	3	1804362004-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
16	1804362005	16EW05_020718				SAMPLE	3	1804362005-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
17	1804362006	16EW05_020718-a				SAMPLE	3	1804362006-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
18	587241	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
19	587242	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	
20	1804362007	16EW06_020718				SAMPLE	3	1804362007-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
21	1804362008	16EW07_020718				SAMPLE	3	1804362008-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
22	1804362009	16EW08_020718				SAMPLE	3	1804362009-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
23	587243	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
24	587244	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #()'s: 1803622 (001); 1803625 (001); 1803629 (001); 1804064 (001); 1804362 (001-09)

ELMS Batch/HBN ID: 2046 (208525)

Prep Date: 02/13/2018 Analysis Date: 02/13/2018 Analyst: T. Bosch

Analyte: **Perchlorate** Matrix: **Water** Method: **6850**

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\13FEB18D.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 D1735)/0.1% glacial acetic acid (JT-Baker Lot 04802).
Eluent B1: 95% ACN (B&J Lot D1735)/ 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-DOD.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	0.80
4.0	0.80
5.0	0.25
10.0	0.25
10.5	0.80
13.0	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 587238; Target = 5.0µg/L. ASTM type II water was used for LMB 587237.

MS/MSD: MS/MSD was performed on sample 1803622001 (Client ID: LH18/24-SP650_013118). 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. Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.
- 2) All QC, Blank, CCV, and MS/MSD results were within method parameters, except for the following. The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The ion ratio of m/z 83 to 85 often fails at levels near the reported Detection Limit (DL). The 83/85 ion ratio failed for field samples 1804362003/04/07. No positive results were reported for these samples.
- 3) Sample data can be viewed at two directories within the ALS system: \\ALSLTWS013\LCMS\LCMS04\2018\FEB\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 13FEBD02/03/14/15/17.
- 5) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\208525-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	Created By: T. Bosch	Amount: 10 mL			
MFG: ALS/SLC	Create Date: 05/10/2017	Expires: 05/10/2018			
MFG Lot: TNB: 05/10/17	Lab Lot: CLO4 WRK	Usable: Yes			
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 INT		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 10 mL	
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17	Lab Lot: CLO4 QC WRK 100.ug/L	Usable: Yes	
Part ID:			

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 Infrmdt Std-OC 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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/2017		Lab Lot: CLO4 QC INT 10.ug/mL		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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



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/NCCL 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.





Certificate of Analysis



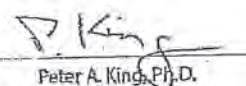
ISO Guide 34 Reference Material

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. Larnendola
Director of QA/RA



125 Market Street
New Haven, CT 06513
USA



AccuStandard[®] Inc.

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www.AccuStandard.com

CERTIFICATE OF ANALYSIS

AccuTrace™ Reference Standard

Catalog No: IC-PER-10X-1
Description: Perchlorate Standard
Element: Perchlorate (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:

ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



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

February 16, 2018

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

Work Order: **HS18020023**

Laboratory Results for: **Longhorn GW Treatment Plant**

Dear Marcia,

ALS Environmental received 1 sample(s) on Feb 01, 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,

A handwritten signature in black ink, appearing to read 'Raj. P. Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18020023

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18020023-01	LH18/24-SP650_013118	Water		31-Jan-2018 14:00	01-Feb-2018 08:40	<input type="checkbox"/>

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.**CASE NARRATIVE****Project:** Longhorn GW Treatment Plant**Work Order:** HS18020023

Work Order Comments

- The analyses for Perchlorate was subcontracted to ALS Environmental in Salt Lake City, Utah Final report attached.

WetChemistry by Method E350.3**Batch ID: R310365**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method E415.1**Batch ID: R310295**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method E365.3**Batch ID: R310121**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650_013118
 Collection Date: 31-Jan-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18020023
 Lab ID:HS18020023-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
AMMONIA AS N BY E350.3(ISE)								Analyst: SAP
Nitrogen, Ammonia (As N)	8.7		0.20	0.10	0.20	mg/L	1	06-Feb-2018 15:30
ORTHO PHOSPHATE (PO4) AS P BY E365.3								Analyst: MZD
Phosphorus, Total Orthophosphate (As P)	1.73		0.100	0.250	0.250	mg/L	10	01-Feb-2018 17:00
TOTAL ORGANIC CARBON BY E415.1								Analyst: KMU
Organic Carbon, Total	36.2		0.500	0.500	1.00	mg/L	1	06-Feb-2018 19:23
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)								Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	16-Feb-2018 13:58

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020023

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R310121	Test Name : ORTHO PHOSPHATE (PO4) AS P BY E365.3		Matrix: Water			
HS18020023-01	LH18/24-SP650_013118	31 Jan 2018 14:00			01 Feb 2018 17:00	10
Batch ID R310295	Test Name : TOTAL ORGANIC CARBON BY E415.1		Matrix: Water			
HS18020023-01	LH18/24-SP650_013118	31 Jan 2018 14:00			06 Feb 2018 19:23	1
Batch ID R310365	Test Name : AMMONIA AS N BY E350.3(ISE)		Matrix: Water			
HS18020023-01	LH18/24-SP650_013118	31 Jan 2018 14:00			06 Feb 2018 15:30	1
Batch ID R310951	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18020023-01	LH18/24-SP650_013118	31 Jan 2018 14:00			16 Feb 2018 13:58	1

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020023

QC BATCH REPORT

Batch ID:	R310121	Instrument:	UV-2450	Method:	E365.3					
MBLK	Sample ID: MBLK-310121	Units: mg/L	Analysis Date: 01-Feb-2018 17:00							
Client ID:	Run ID: UV-2450_310121	SeqNo: 4418135	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.0250	0.0250								U
LCS	Sample ID: LCS-310121	Units: mg/L	Analysis Date: 01-Feb-2018 17:00							
Client ID:	Run ID: UV-2450_310121	SeqNo: 4418136	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.22	0.0250	0.25	0	88.0	85 - 115				
LCSD	Sample ID: LCSD-310121	Units: mg/L	Analysis Date: 01-Feb-2018 17:00							
Client ID:	Run ID: UV-2450_310121	SeqNo: 4418137	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.216	0.0250	0.25	0	86.4	85 - 115	0.22	1.83	20	
MS	Sample ID: HS18020042-02MS	Units: mg/L	Analysis Date: 01-Feb-2018 17:00							
Client ID:	Run ID: UV-2450_310121	SeqNo: 4421351	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.229	0.0250	0.25	0	91.6	80 - 120				
MSD	Sample ID: HS18020042-02MSD	Units: mg/L	Analysis Date: 01-Feb-2018 17:00							
Client ID:	Run ID: UV-2450_310121	SeqNo: 4421352	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.234	0.0250	0.25	0	93.6	80 - 120	0.229	2.16	20	

The following samples were analyzed in this batch: HS18020023-01

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020023

QC BATCH REPORT

Batch ID: R310295		Instrument: TOC_02		Method: E415.1						
MBLK	Sample ID: WBLKW1-020618	Units: mg/L		Analysis Date: 06-Feb-2018 17:35						
Client ID:	Run ID: TOC_02_310295	SeqNo: 4422552		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	0.500	1.00							U	
LCS	Sample ID: WLCSW1-020618	Units: mg/L		Analysis Date: 06-Feb-2018 17:49						
Client ID:	Run ID: TOC_02_310295	SeqNo: 4422553		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	9.983	1.00	10	0	99.8	80 - 120				
LCSD	Sample ID: WLCSDW1-020618	Units: mg/L		Analysis Date: 06-Feb-2018 18:02						
Client ID:	Run ID: TOC_02_310295	SeqNo: 4422554		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	9.984	1.00	10	0	99.8	80 - 120	9.983	0.01	20	
MS	Sample ID: HS18020023-01MS	Units: mg/L		Analysis Date: 06-Feb-2018 19:37						
Client ID: LH18/24-SP650_013118	Run ID: TOC_02_310295	SeqNo: 4422558		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	45.96	1.00	10	36.23	97.3	80 - 120				

The following samples were analyzed in this batch: HS18020023-01

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

ALS Group USA, Corp

Date: 16-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020023

QC BATCH REPORT

Batch ID:	R310365	Instrument:	WetChem_HS	Method:	E350.3					
MBLK	Sample ID: MBLK-R310365	Units: mg/L	Analysis Date: 06-Feb-2018 15:30							
Client ID:	Run ID: WetChem_HS_310365	SeqNo: 4424098	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Ammonia (As N)	0.10	0.20								U
LCS	Sample ID: LCS-R310365	Units: mg/L	Analysis Date: 06-Feb-2018 15:30							
Client ID:	Run ID: WetChem_HS_310365	SeqNo: 4424097	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Ammonia (As N)	10.14	0.20	10	0	101	80 - 120				
MS	Sample ID: HS18011125-01MS	Units: mg/L	Analysis Date: 06-Feb-2018 15:30							
Client ID:	Run ID: WetChem_HS_310365	SeqNo: 4424134	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Ammonia (As N)	10.27	0.20	10	0.04705	102	80 - 120				
MSD	Sample ID: HS18011125-01MSD	Units: mg/L	Analysis Date: 06-Feb-2018 15:30							
Client ID:	Run ID: WetChem_HS_310365	SeqNo: 4424135	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Nitrogen, Ammonia (As N)	10.11	0.20	10	0.04705	101	80 - 120	10.27	1.57	20	

The following samples were analyzed in this batch: HS18020023-01

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020023

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Client: Bhate Environmental Associates, Inc.**Project:** Longhorn GW Treatment Plant**Work Order:** HS18020023**SAMPLE TRACKING**

Lab Samp ID	Client Sample ID	Action	Date	Person	New Location
HS18020023-01	LH18/24-SP650_013118	Login	2/1/2018 12:20:06 PM	JRM	WET067
HS18020023-01	LH18/24-SP650_013118	Login	2/1/2018 12:20:06 PM	JRM	WET067
HS18020023-01	LH18/24-SP650_013118	Login	2/1/2018 12:20:06 PM	JRM	MET054

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18020023

Date/Time Received: **01-Feb-2018 08:40**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 1-Feb-2018
 eSignature Date

Reviewed by: RJ Modashia 2-Feb-2018
 eSignature 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): 1.8c/1.2c UC/C IR25

Cooler(s)/Kit(s): Blue

Date/Time sample(s) sent to storage: 02/01/2018 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:

RETURNS MON - SAT
THU - 01 FEB 10:30A
PRIORITY OVERNIGHT 99

TRK# 7376 9751 2700

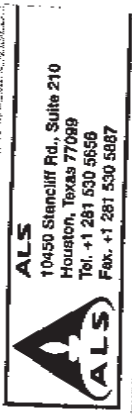
FedEx
TRK# 7376 9751 2700

AB SGRA

77099
TX-US
IAH



1D - 162706 31JMM10 6664 646511220801



10450 Stanchiff Rd., Suite 210
Houston, Texas 77059
Tel. +1 281 530 5659
Fax. +1 281 530 5687

CUSTODY SEAL

Owner: WILLIAMS
Name: WILLIAMS
Company: WILLIAMS
Title: 1430
Date: 1/1/18

Seal Broken By: JM

Date: 1/1/18



Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1803622; 1803625; 1803629;
1804064; 1804362

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2046 (208525)

General Set Information: There were thirteen 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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

Method QC data: The method blank (LMB 587237) was less than 1/2 the CRDL. The recovery for the LCS (587238) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1803622001 (Client ID: LH18/24-SP650_013118). The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The relative percent difference (RPD) was within the performance limits.



Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)
B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for field samples 1804362003/04/07. No positive results were reported for these samples. 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 13FEBD02/03/14/15/17.

Thomas Bosch February 15, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: February 16, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1803622**

Project ID: HS18020023 013118

Purchase Order: HS18020023

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP650_013118	1803622001	01/31/18	02/02/18	



ANALYTICAL REPORT

Workorder: 34-1803622

Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP650_013118	Sampling Site: NA	Collected: 01/31/2018				
Lab ID: 1803622001	Media: 125 mL Nalgene	Received: 02/02/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2046 (HBN: 208525) Analyzed: 02/13/2018 09:43	Instrument ID: LCMS04 Percent Solid: NA Report Basis: Wet				
Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	51	1.0	2.0	4.0	1	

Comments

Quality Control: EPA 6850, DoD QSM - (HBN: 208525)

Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

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 02/15/2018 10:45	/S/ Stephen Brose 02/16/2018 09:27

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: als@alst.com
Web: www.alst.com



ANALYTICAL REPORT

Workorder: 34-1803622

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
Washington	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.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1803622

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

00883194

Analysis Information

Workorder: 1803622

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2046 (HBN: 208525)
Analyzed By: Thomas Bosch

Blank

LMB: 587237 Analyzed: 02/13/2018 09:12 Units: ug/L			
Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 587238 Analyzed: 02/13/2018 09:27 Dilution: 1 Units: ug/L				
Analyte	Result	Target	% Rec	QC Limits
Perchlorate	4.48	5.00	89.6	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1803622001 Analyzed: 02/13/2018 09:43 Dilution: 1 Units: ug/L		MS: 587239 Analyzed: 02/13/2018 09:58 Dilution: 1 Units: ug/L			MSD: 587240 Analyzed: 02/13/2018 10:13 Dilution: 1 Units: ug/L				
Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	51.0	53.9	5	▲ 60.3	78.8 123.8	53.6	▲ 53.7	0.622	0.0 20.0

Continuing Calibration Verification

CCV: 587234 Analyzed: 02/13/2018 08:27 Units: ug/L Criteria: ± 15%			CCV: 587241 Analyzed: 02/13/2018 12:12 Units: ug/L Criteria: ± 15%			CCV: 587243 Analyzed: 02/13/2018 14:10 Units: ug/L Criteria: ± 15%			
Analyte	Result	Target	% Rec.	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	23.1	25.0	92.4	22.9	25.0	91.8	23.8	25.0	95.4

Interference Check Sample

ICSA: 587236 Analyzed: 02/13/2018 08:58 Units: ug/L Criteria: ± 30%			
Analyte	Result	Target	% Rec.
Perchlorate	0.940	1.00	94.0

Limit of Detection Verification

LODV: 587235 Analyzed: 02/13/2018 08:43 Units: ug/L Criteria: ± 50%			LODV: 587242 Analyzed: 02/13/2018 12:26 Units: ug/L Criteria: ± 50%			LODV: 587244 Analyzed: 02/13/2018 14:25 Units: ug/L Criteria: ± 50%			
Analyte	Result	Target	% Rec.	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	0.780	1.00	78.0	0.960	1.00	96.0	0.974	1.00	97.4



Quality Control Sample Batch Report

00883195

Analysis Information

Workorder: 1803622

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2046 (HBN: 208525)

Prepared By: NA

Analyzed By: Thomas Bosch

Comments

Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch 02/15/2018 10:46	/S/ Stephen Brose 02/16/2018 09:27

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



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Subcontract Chain of Custody

COC ID: 8493

1803622

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18020023
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18020023-01	LH18/24-SP650_013118	Water	31 Jan 2018 14:00
SUB_Perch-6850			15 Feb 2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: J. Winnings
Received By: Jumoke Lawal
Cooler ID(s): _____

Date/Time: 2/1/18 18:00
Date/Time: 2-2-18 10-08
Temperature(s): _____

ALS-SALT LAKE CITY-RELATED INFORMATION REPORT (CRIR)

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

Client Name: <u>ALS Houston</u>		Project/Task/Site: <u>1803622</u>						
Date/Time of Receipt: <u>2-2-18 10:08</u>		Number of Coolers Received: <u>1</u>						
Condition of Coolers:	Acceptable /Unacceptable	Temperature Control:	Present /Not Included					
Cooler Custody Seals:	Present /Absent/NA	Location Temp Taken:	Control/ <u>Between Samples</u>					
Container Custody Seals:	Intact /Broken/NA	Are all temperatures within project specific guidelines?	<u>Yes</u> /No/NA					
Ice Present:	<u>Yes</u> /No/NA	VOA Headspace Present?	Yes/No/ <u>NA</u>					
	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	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 <u>8214</u>	<u>4</u> °C	4	°C	7	C18	°C
	2	C18	°C	5	°C	8	C18	°C
	3	C18	°C	6	°C	9	C18	°C
Taken By: <u>Jessica Davies</u>		<u>Jessica Davies</u>		<u>2-2-18</u>				
		<small>Signature</small>		<small>Printed Name</small>		<small>Date</small>		

CLIENT-RELATED INFORMATION

- | | | | |
|--|---|--|---|
| <input type="checkbox"/> Missing Cooler | <input type="checkbox"/> Missing Samples/Bottles | <input type="checkbox"/> Incorrect Preservation | <input type="checkbox"/> Insufficient Sample Volume |
| <input type="checkbox"/> Cooler Conditions | <input type="checkbox"/> Broken/Leaking Samples | <input type="checkbox"/> pH Criteria Not Met | <input type="checkbox"/> Chain of Custody Problems |
| <input type="checkbox"/> Missing Paperwork | <input type="checkbox"/> Incorrect Bottle Type | <input type="checkbox"/> Residual Chlorine Present | <input type="checkbox"/> Other: |
| <input type="checkbox"/> Missing/Incorrect Bottle Labels | <input type="checkbox"/> Cooler Temperatures Out of Range | <input type="checkbox"/> Head Space in Bottles | |

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

Client Notified? YES NO

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

ALS Project Manager: _____ Returned to Sample Receipt by: _____ Date: _____

Printed Name Signature Date



ORIGIN ID: 56RA (281) 530-5656
 SHIPPING DEPT
 ALS LABORATORY GROUP
 10450 STANCLIFF RD
 SUITE 210
 HOUSTON, TX 77099
 UNITED STATES US

SHIP DATE: 01FEB18
 ACTWGT: 6.95 LB
 CAD: 300130/CAFE3108
 DIMS: 14x11x10 IN
 BILL SENDER

TO PAUL POPE
 ALS ENVIRONMENTAL
 960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123

(801) 266-7700
 REF: HS18020016/020/023 RJ



FRI - 02 FEB 3:00P
 STANDARD OVERNIGHT

TRK# 7376 9752 1968

0201

AX BTFA

84123
 UT-US SLC



00883199



Batch Worklist

HBN: 208525



Instrument: WP
Status: WP

Created: 2/13/2018 08:15
Analyst: T. Bosch

Batch: ELMS/ 2046
Rule: EPA 6850, DoD QSM Water
Workorder: 1803622 [ENV_LVL4]
Workorder: 1803625 [ENV_LVL4]
Workorder: 1803629 [ENV_LVL4]
Workorder: 1804064 [ENV_LVL4]
Workorder: 1804362 [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	587234	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
2	587235	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	
3	587236	ICS for HBN 208525 [ELMS/2046]				ICS	3		E6850.D3Q	5311		2/16/2018	
4	587237	LMB for HBN 208525 [ELMS/2046]				LMB	3		E6850Q413Q	5311		2/16/2018	
5	587238	LCS for HBN 208525 [ELMS/2046]				LCS	3		E6850Q413Q	5311		2/16/2018	
6	1803622001	LH18/24-SP650_013118				SAMPLE	3	1803622001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
7	587239	LH18/24-SP650...(1803622001MS)				MS	3		E6850Q413Q	5311		2/16/2018	
8	587240	LH18/24-SP65...(1803622001MSD)				MSD	3		E6850Q413Q	5311		2/16/2018	
9	1803625001	LH18/24-SP140_013118				SAMPLE	3	1803625001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
10	1803629001	LH18/24-SP650_013118				SAMPLE	3	1803629001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
11	1804064001	LH18/24-SP650_020718				SAMPLE	3	1804064001-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
12	1804362001	16EW01_020718				SAMPLE	3	1804362001-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
13	1804362002	16EW02_020718				SAMPLE	3	1804362002-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
14	1804362003	16EW03_020718				SAMPLE	3	1804362003-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
15	1804362004	16EW04_020718				SAMPLE	3	1804362004-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
16	1804362005	16EW05_020718				SAMPLE	3	1804362005-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
17	1804362006	16EW05_020718-a				SAMPLE	3	1804362006-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
18	587241	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
19	587242	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	
20	1804362007	16EW06_020718				SAMPLE	3	1804362007-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
21	1804362008	16EW07_020718				SAMPLE	3	1804362008-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
22	1804362009	16EW08_020718				SAMPLE	3	1804362009-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
23	587243	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
24	587244	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #()'s: 1803622 (001); 1803625 (001); 1803629 (001); 1804064 (001); 1804362 (001-09)

ELMS Batch/HBN ID: 2046 (208525)

Prep Date: 02/13/2018 Analysis Date: 02/13/2018 Analyst: T. Bosch

Analyte: **Perchlorate** Matrix: **Water** Method: **6850**

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\13FEB18D.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 D1735)/0.1% glacial acetic acid (JT-Baker Lot 04802).
Eluent B1: 95% ACN (B&J Lot D1735)/ 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-DOD.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	0.80
4.0	0.80
5.0	0.25
10.0	0.25
10.5	0.80
13.0	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 587238; Target = 5.0µg/L. ASTM type II water was used for LMB 587237.

MS/MSD: MS/MSD was performed on sample 1803622001 (Client ID: LH18/24-SP650_013118). 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. Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.
- 2) All QC, Blank, CCV, and MS/MSD results were within method parameters, except for the following. The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The ion ratio of m/z 83 to 85 often fails at levels near the reported Detection Limit (DL). The 83/85 ion ratio failed for field samples 1804362003/04/07. No positive results were reported for these samples.
- 3) Sample data can be viewed at two directories within the ALS system: \\ALSLTWS013\LCMS\LCMS04\2018\FEB\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 13FEBD02/03/14/15/17.
- 5) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\208525-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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 WRK		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 INT		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 10 mL	
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17	Lab Lot: CLO4 QC WRK 100.ug/L	Usable: Yes	
Part ID:			

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-OC 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	Created By: T. Bosch	Amount: 10 mL			
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018			
MFG Lot: TNB: 05/11/2017	Lab Lot: CLO4 QC INT 10.ug/mL	Usable: Yes			
Part ID:					
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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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



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/NC SL 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.





Certificate of Analysis



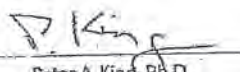
ISO Guide 34 Reference Material

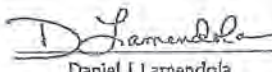
Product Number: ICC-013
Lot Number: CP-0860

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. Larnendola
Director of QA/RA



125 Market Street
New Haven, CT 06513
USA



AccuStandard® Inc.

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www.AccuStandard.com

CERTIFICATE OF ANALYSIS

AccuTrace™ Reference Standard

Catalog No: IC-PER-10X-1
Description: Perchlorate Standard
Element: Perchlorate (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:

ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



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

February 22, 2018

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

Work Order: **HS18020424**

Laboratory Results for: **Groundwater Treatment Plant Weekly Samples**

Dear Marcia,

ALS Environmental received 1 sample(s) on Feb 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,

A handwritten signature in black ink, appearing to read 'Raj. P. Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
Work Order: HS18020424

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18020424-01	LH18/24-SP650_020718	Water		07-Feb-2018 14:00	08-Feb-2018 08:40	<input type="checkbox"/>

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
Work Order: HS18020424

CASE NARRATIVE

Work Order Comments

- The analyses for Perchlorate was subcontracted to ALS Environmental in Salt Lake City, Utah Final report attached.
-

WetChemistry by Method E415.1**Batch ID: R311394**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E350.3**Batch ID: R311075**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E365.3**Batch ID: R310501**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Groundwater Treatment Plant Weekly Samples
 Sample ID: LH18/24-SP650_020718
 Collection Date: 07-Feb-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18020424
 Lab ID:HS18020424-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
AMMONIA AS N BY E350.3(ISE)								Analyst: SAP
Nitrogen, Ammonia (As N)	8.4		0.20	0.10	0.20	mg/L	1	16-Feb-2018 11:00
ORTHO PHOSPHATE (PO4) AS P BY E365.3								Analyst: MZD
Phosphorus, Total Orthophosphate (As P)	3.02		0.100	0.250	0.250	mg/L	10	08-Feb-2018 16:00
TOTAL ORGANIC CARBON BY E415.1								Analyst: KMU
Organic Carbon, Total	24.4		0.500	0.500	1.00	mg/L	1	22-Feb-2018 07:49
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)								Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	16-Feb-2018 13:58

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18020424

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R310501	Test Name : ORTHO PHOSPHATE (PO4) AS P BY E365.3		Matrix: Water			
HS18020424-01	LH18/24-SP650_020718	07 Feb 2018 14:00			08 Feb 2018 16:00	10
Batch ID R310951	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18020424-01	LH18/24-SP650_020718	07 Feb 2018 14:00			16 Feb 2018 13:58	1
Batch ID R311075	Test Name : AMMONIA AS N BY E350.3(ISE)		Matrix: Water			
HS18020424-01	LH18/24-SP650_020718	07 Feb 2018 14:00			16 Feb 2018 11:00	1
Batch ID R311394	Test Name : TOTAL ORGANIC CARBON BY E415.1		Matrix: Water			
HS18020424-01	LH18/24-SP650_020718	07 Feb 2018 14:00			22 Feb 2018 07:49	1

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18020424

QC BATCH REPORT

Batch ID: R310501		Instrument: UV-2450		Method: E365.3						
MBLK	Sample ID: MBLK-310501	Units: mg/L		Analysis Date: 08-Feb-2018 16:00						
Client ID:	Run ID: UV-2450_310501	SeqNo: 4427304	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.0250	0.0250								U
LCS	Sample ID: LCS-310501	Units: mg/L		Analysis Date: 08-Feb-2018 16:00						
Client ID:	Run ID: UV-2450_310501	SeqNo: 4427305	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.236	0.0250	0.25	0	94.4	85 - 115				
MS	Sample ID: HS18020424-01MS	Units: mg/L		Analysis Date: 08-Feb-2018 16:00						
Client ID: LH18/24-SP650_020718	Run ID: UV-2450_310501	SeqNo: 4427307	PrepDate:	DF: 10						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	5.31	0.250	2.5	3.02	91.6	80 - 120				
MSD	Sample ID: HS18020424-01MSD	Units: mg/L		Analysis Date: 08-Feb-2018 16:00						
Client ID: LH18/24-SP650_020718	Run ID: UV-2450_310501	SeqNo: 4427308	PrepDate:	DF: 10						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	5.46	0.250	2.5	3.02	97.6	80 - 120	5.31	2.79	20	

The following samples were analyzed in this batch: HS18020424-01

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18020424

QC BATCH REPORT

Batch ID: R311075		Instrument: WetChem_HS		Method: E350.3	
MBLK	Sample ID: MBLK-R311075	Units: mg/L		Analysis Date: 16-Feb-2018 11:00	
Client ID:	Run ID: WetChem_HS_311075	SeqNo: 4441543	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	0.10	0.20			U
LCS	Sample ID: LCS-R311075	Units: mg/L		Analysis Date: 16-Feb-2018 11:00	
Client ID:	Run ID: WetChem_HS_311075	SeqNo: 4441542	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	10.35	0.20	10	0	104 80 - 120
MS	Sample ID: HS18020503-01MS	Units: mg/L		Analysis Date: 16-Feb-2018 11:00	
Client ID:	Run ID: WetChem_HS_311075	SeqNo: 4441548	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (as N)	10.31	0.20	10	0.03082	103 80 - 120
MSD	Sample ID: HS18020503-01MSD	Units: mg/L		Analysis Date: 16-Feb-2018 11:00	
Client ID:	Run ID: WetChem_HS_311075	SeqNo: 4441547	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (as N)	10.46	0.20	10	0.03082	104 80 - 120 10.31 1.44 20

The following samples were analyzed in this batch: HS18020424-01

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18020424

QC BATCH REPORT

Batch ID: R311394		Instrument: TOC_02		Method: E415.1						
MBLK	Sample ID: WBLKW4-022118	Units: mg/L		Analysis Date: 22-Feb-2018 07:14						
Client ID:	Run ID: TOC_02_311394	SeqNo: 4448464		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	0.500	1.00							U	
LCS	Sample ID: WLCSW4-022118	Units: mg/L		Analysis Date: 22-Feb-2018 07:27						
Client ID:	Run ID: TOC_02_311394	SeqNo: 4448465		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	10.23	1.00	10	0	102	80 - 120				
LCSD	Sample ID: WLCSDW4-022118	Units: mg/L		Analysis Date: 22-Feb-2018 07:38						
Client ID:	Run ID: TOC_02_311394	SeqNo: 4448466		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	10.3	1.00	10	0	103	80 - 120	10.23	0.682	20	
MS	Sample ID: HS18020424-01MS	Units: mg/L		Analysis Date: 22-Feb-2018 08:01						
Client ID: LH18/24-SP650_020718	Run ID: TOC_02_311394	SeqNo: 4448468		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	35.44	1.00	10	24.45	110	80 - 120				

The following samples were analyzed in this batch: HS18020424-01

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

Client: Bhate Environmental Associates, Inc.
Project: Groundwater Treatment Plant Weekly Samples
WorkOrder: HS18020424

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18020424

Date/Time Received: **08-Feb-2018 08:40**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 8-Feb-2018
 eSignature Date

Reviewed by: RJ Modashia 9-Feb-2018
 eSignature 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): 1.5c/1.9c UC/C IR30
 Cooler(s)/Kit(s): 24662
 Date/Time sample(s) sent to storage: 02/08/2018 14:10

- 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:

ALS
 10450 Stanciliff Rd., Suite 210
 Houston, Texas 77099
 Tel. +1 281 530 5656
 Fax. +1 281 530 5887

CUSTODY SEAL

Date: 2/7/08 Time: 11:30
 Name: Scott R. Bland Company: S. H. H. H.

Seal Broken By: _____
 Date: _____

FedEx
 TRACKING 7376 9752 1821

THU - 08 FEB 10:30A
 PRIORITY OVERNIGHT

AB SGRA

77099
 TX-US
 IAH



FTD 5898257 87FF8B18 656A 546C17A2207ACFA



Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1803622; 1803625; 1803629;
1804064; 1804362

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2046 (208525)

General Set Information: There were thirteen 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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

Method QC data: The method blank (LMB 587237) was less than 1/2 the CRDL. The recovery for the LCS (587238) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1803622001 (Client ID: LH18/24-SP650_013118). The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The relative percent difference (RPD) was within the performance limits.



Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)
B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for field samples 1804362003/04/07. No positive results were reported for these samples. 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 13FEBD02/03/14/15/17.

Thomas Bosch February 15, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: February 16, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1804064**

Project ID: HS18020424 020718

Purchase Order: HS18020424

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP650_020718	1804064001	02/07/18	02/09/18	



ANALYTICAL REPORT

Workorder: **34-1804064**Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP650_020718	Sampling Site: NA	Collected: 02/07/2018				
Lab ID: 1804064001	Media: 125 mL Nalgene	Received: 02/09/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2046 (HBN: 208525) Analyzed: 02/13/2018 10:58	Instrument ID: LCMS04 Percent Solid: NA 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

Comments

Quality Control: EPA 6850, DoD QSM - (HBN: 208525)

Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

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 02/15/2018 10:45	/S/ Stephen Brose 02/16/2018 09:27

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: 34-1804064

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	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.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1804064

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

00883236

Analysis Information

Workorder: 1804064

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2046 (HBN: 208525)
Analyzed By: Thomas Bosch

Blank

LMB: 587237 Analyzed: 02/13/2018 09:12 Units: ug/L			
Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 587238 Analyzed: 02/13/2018 09:27 Dilution: 1 Units: ug/L				
Analyte	Result	Target	% Rec	QC Limits
Perchlorate	4.48	5.00	89.6	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1803622001 Analyzed: 02/13/2018 09:43 Dilution: 1 Units: ug/L		MS: 587239 Analyzed: 02/13/2018 09:58 Dilution: 1 Units: ug/L			MSD: 587240 Analyzed: 02/13/2018 10:13 Dilution: 1 Units: ug/L				
Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	51.0	53.9	5	▲ 60.3	78.8 123.8	53.6	▲ 53.7	0.622	0.0 20.0

Continuing Calibration Verification

CCV: 587234 Analyzed: 02/13/2018 08:27 Units: ug/L Criteria: ± 15%				CCV: 587241 Analyzed: 02/13/2018 12:12 Units: ug/L Criteria: ± 15%			CCV: 587243 Analyzed: 02/13/2018 14:10 Units: ug/L Criteria: ± 15%			
Analyte	Result	Target	% Rec.	Result	Target	% Rec.	Result	Target	% Rec.	
Perchlorate	23.1	25.0	92.4	22.9	25.0	91.8	23.8	25.0	95.4	

Interference Check Sample

ICSA: 587236 Analyzed: 02/13/2018 08:58 Units: ug/L Criteria: ± 30%			
Analyte	Result	Target	% Rec.
Perchlorate	0.940	1.00	94.0

Limit of Detection Verification

LODV: 587235 Analyzed: 02/13/2018 08:43 Units: ug/L Criteria: ± 50%				LODV: 587242 Analyzed: 02/13/2018 12:26 Units: ug/L Criteria: ± 50%			LODV: 587244 Analyzed: 02/13/2018 14:25 Units: ug/L Criteria: ± 50%			
Analyte	Result	Target	% Rec.	Result	Target	% Rec.	Result	Target	% Rec.	
Perchlorate	0.780	1.00	78.0	0.960	1.00	96.0	0.974	1.00	97.4	



Quality Control Sample Batch Report

00883237

Analysis Information

Workorder: 1804064

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2046 (HBN: 208525)

Prepared By: NA

Analyzed By: Thomas Bosch

Comments

Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.

The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch 02/15/2018 10:46	/S/ Stephen Brose 02/16/2018 09:27

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: 8566

1804064

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18020424
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18020424-01	LH18/24-SP650_020718	Water	07 Feb 2018 14:00
SUB_Perch-6850			22 Feb 2018

Comments: Please analyze for the analysis listed above. Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: [Signature]
Received By: [Signature]
Cooler ID(s): _____

Date/Time: 2/8/18 18:00
Date/Time: 02-09-18 9:35
Temperature(s): _____

ALS-SALT LAKE CITY-RELATED INFORMATION REPORT (CRIR)

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

Client Name: <u>WLS Houston</u>		Project/Task/Site: <u>1804064</u>							
Date/Time of Receipt: <u>08-09-18 9:35</u>		Number of Coolers Received: <u>1</u>							
Condition of Coolers: <u>Acceptable</u> /Unacceptable		Temperature Control: Present/Not <u>Included</u>							
Cooler Custody Seals: <u>Present</u> /Absent/NA		Location Temp Taken: Control/ <u>Between Samples</u>							
Container Custody Seals: <u>Present</u> /Absent/NA		Are all temperatures within project specific guidelines? Yes/No/ <u>NA</u>							
Ice Present: <u>Yes</u> /No/NA		VOA Headspace Present? Yes/No/ <u>NA</u>							
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 8037	9 °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: <u>[Signature]</u>		Signature		<u>Tamara Antasell</u>		Printed Name		<u>08-09-18</u>	Date

CLIENT-RELATED INFORMATION

- | | | | |
|--|---|--|---|
| <input type="checkbox"/> Missing Cooler | <input type="checkbox"/> Missing Samples/Bottles | <input type="checkbox"/> Incorrect Preservation | <input type="checkbox"/> Insufficient Sample Volume |
| <input type="checkbox"/> Cooler Conditions | <input type="checkbox"/> Broken/Leaking Samples | <input type="checkbox"/> pH Criteria Not Met | <input type="checkbox"/> Chain of Custody Problems |
| <input type="checkbox"/> Missing Paperwork | <input type="checkbox"/> Incorrect Bottle Type | <input type="checkbox"/> Residual Chlorine Present | <input type="checkbox"/> Other: |
| <input type="checkbox"/> Missing/Incorrect Bottle Labels | <input type="checkbox"/> Cooler Temperatures Out of Range | <input type="checkbox"/> Head Space in Bottles | |

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

Client Notified? YES NO

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

ALS Project Manager: _____ Returned to Sample Receipt by: _____ Date: _____
Printed Name Signature



SHIP DATE: 08FEB18

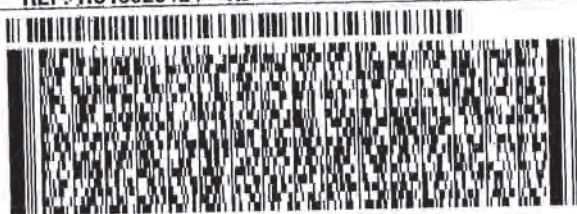
ORIGIN ID:SGRA (281) 530-5656
SHIPPING DEPT
ALS LABORATORY GROUP
10450 STANCLIFF RD
SUITE 210
HOUSTON, TX 77099
UNITED STATES US

SHIP DATE: 08FEB18
ACTWGT: 9.15 LB
CAD: 300130/CAFE3108
DIMS: 14x11x10 IN
BILL SENDER

TO **KEVIN GRIFFITHS**
ALS ENVIRONMENTAL
960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123

(801) 266-7700
REF: HS18020424 - RJ



FedEx
Express



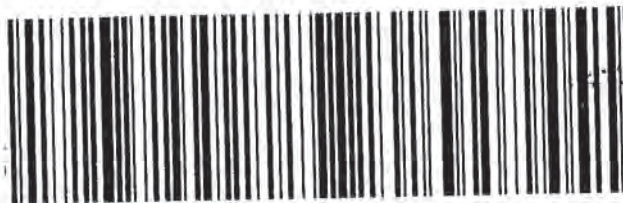
J17710181090011 BY

TRK# 7376 9752 3581
0201

FRI - 09 FEB 3:00P
STANDARD OVERNIGHT

AX BTFA

84123
UT-US SLC





Batch Worklist

HBN: 208525



Instrument: WP
Status: WP

Created: 2/13/2018 08:15
Analyst: T. Bosch

Batch: ELMS/ 2046
Rule: EPA 6850, DoD QSM Water
Workorder: 1803622 [ENV_LVL4]
Workorder: 1803625 [ENV_LVL4]
Workorder: 1803629 [ENV_LVL4]
Workorder: 1804064 [ENV_LVL4]
Workorder: 1804362 [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	587234	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
2	587235	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	
3	587236	ICS for HBN 208525 [ELMS/2046]				ICS	3		E6850.D3Q	5311		2/16/2018	
4	587237	LMB for HBN 208525 [ELMS/2046]				LMB	3		E6850Q413Q	5311		2/16/2018	
5	587238	LCS for HBN 208525 [ELMS/2046]				LCS	3		E6850Q413Q	5311		2/16/2018	
6	1803622001	LH18/24-SP650_013118				SAMPLE	3	1803622001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
7	587239	LH18/24-SP650...(1803622001MS)				MS	3		E6850Q413Q	5311		2/16/2018	
8	587240	LH18/24-SP65...(1803622001MSD)				MSD	3		E6850Q413Q	5311		2/16/2018	
9	1803625001	LH18/24-SP140_013118				SAMPLE	3	1803625001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
10	1803629001	LH18/24-SP650_013118				SAMPLE	3	1803629001-A	E6850Q41.3	5480	2/28/2018	2/16/2018	
11	1804064001	LH18/24-SP650_020718				SAMPLE	3	1804064001-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
12	1804362001	16EW01_020718				SAMPLE	3	1804362001-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
13	1804362002	16EW02_020718				SAMPLE	3	1804362002-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
14	1804362003	16EW03_020718				SAMPLE	3	1804362003-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
15	1804362004	16EW04_020718				SAMPLE	3	1804362004-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
16	1804362005	16EW05_020718				SAMPLE	3	1804362005-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
17	1804362006	16EW05_020718-a				SAMPLE	3	1804362006-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
18	587241	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
19	587242	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	
20	1804362007	16EW06_020718				SAMPLE	3	1804362007-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
21	1804362008	16EW07_020718				SAMPLE	3	1804362008-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
22	1804362009	16EW08_020718				SAMPLE	3	1804362009-A	E6850Q41.3	5480	3/7/2018	2/22/2018	
23	587243	CCV for HBN 208525 [ELMS/2046]				CCV	3		E685041C3Q	5311		2/16/2018	
24	587244	LODY for HBN 208525 [ELMS/2046]				LODY	3		E6850.D3Q	5311		2/16/2018	



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #()'s: 1803622 (001); 1803625 (001); 1803629 (001); 1804064 (001); 1804362 (001-09)

ELMS Batch/HBN ID: 2046 (208525)

Prep Date: 02/13/2018 Analysis Date: 02/13/2018 Analyst: T. Bosch

Analyte: **Perchlorate** Matrix: **Water** Method: **6850**

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\13FEB18D.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 D1735)/0.1% glacial acetic acid (JT-Baker Lot 04802).
Eluent B1: 95% ACN (B&J Lot D1735)/ 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-DOD.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	0.80
4.0	0.80
5.0	0.25
10.0	0.25
10.5	0.80
13.0	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 587238; Target = 5.0µg/L. ASTM type II water was used for LMB 587237.

MS/MSD: MS/MSD was performed on sample 1803622001 (Client ID: LH18/24-SP650_013118). 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. Sample 1803625001 was analyzed and reported at a 1:1,000 dilution. Samples 1804362001/05/06 were analyzed and reported at 1:10 dilutions. The reporting limits have been adjusted accordingly.
- 2) All QC, Blank, CCV, and MS/MSD results were within method parameters, except for the following. The Matrix Spike and duplicate (MS/MSD – 587239/40) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The ion ratio of m/z 83 to 85 often fails at levels near the reported Detection Limit (DL). The 83/85 ion ratio failed for field samples 1804362003/04/07. No positive results were reported for these samples.
- 3) Sample data can be viewed at two directories within the ALS system: \\ALSLTWS013\LCMS\LCMS04\2018\FEB\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 13FEBD02/03/14/15/17.
- 5) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\208525-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	Created By: T. Bosch	Amount: 10 mL			
MFG: ALS/SLC	Create Date: 05/10/2017	Expires: 05/10/2018			
MFG Lot: TNB: 05/10/17	Lab Lot: CLO4 WRK	Usable: Yes			
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 INT		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 10 mL	
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17	Lab Lot: CLO4 QC WRK 100.ug/L	Usable: Yes	
Part ID:			

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-OC 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	Created By: T. Bosch	Amount: 10 mL			
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018			
MFG Lot: TNB: 05/11/2017	Lab Lot: CLO4 QC INT 10.ug/mL	Usable: Yes			
Part ID:					
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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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



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/NCCL 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.





Certificate of Analysis



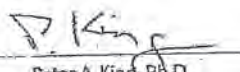
ISO Guide 34 Reference Material

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. Larnendola
Director of QA/RA



125 Market Street
New Haven, CT 06513
USA



AccuStandard® Inc.

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www.AccuStandard.com

CERTIFICATE OF ANALYSIS

AccuTrace™ Reference Standard

Catalog No: IC-PER-10X-1
Description: Perchlorate Standard
Element: Perchlorate (ClO₄)
SRM: Ind. Std.
Lot: 216095148

Matrix: Water

Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:

ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



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

February 22, 2018

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

Work Order: **HS18020529**

Laboratory Results for: **Longhorn GW Treatment Plant**

Dear Marcia,

ALS Environmental received 2 sample(s) on Feb 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18020529

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18020529-01	LH18/24-SP650_020718	Water		07-Feb-2018 14:00	08-Feb-2018 08:40	<input type="checkbox"/>
HS18020529-02	Trip Blank ALS-012618-45	Water		07-Feb-2018 00:00	08-Feb-2018 08:40	<input type="checkbox"/>

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18020529

CASE NARRATIVE

GCMS Volatiles by Method SW8260**Batch ID: R311205****Sample ID: HS18020448-02MS**

- MS and MSD are for an unrelated sample

WetChemistry by Method SW9056**Batch ID: R311368**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650_020718
 Collection Date: 07-Feb-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18020529
 Lab ID:HS18020529-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	20-Feb-2018 17:52	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	20-Feb-2018 17:52	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	20-Feb-2018 17:52	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	20-Feb-2018 17:52	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	20-Feb-2018 17:52	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650_020718
 Collection Date: 07-Feb-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18020529
 Lab ID:HS18020529-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
cis-1,2-Dichloroethene	2.9		0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	20-Feb-2018 17:52	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	20-Feb-2018 17:52	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 17:52	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>87.7</i>			0	<i>81-118</i>	%REC	1	20-Feb-2018 17:52	
<i>Surr: 4-Bromofluorobenzene</i>	<i>99.3</i>			0	<i>85-114</i>	%REC	1	20-Feb-2018 17:52	
<i>Surr: Dibromofluoromethane</i>	<i>87.0</i>			0	<i>80-119</i>	%REC	1	20-Feb-2018 17:52	
<i>Surr: Toluene-d8</i>	<i>107</i>			0	<i>89-112</i>	%REC	1	20-Feb-2018 17:52	
ANIONS BY SW9056A		Method:SW9056							Analyst: KMU
Chloride	603		2.00	2.50	5.00	mg/L	10	21-Feb-2018 21:11	
Sulfate	83.3		2.00	2.50	5.00	mg/L	10	21-Feb-2018 21:11	

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: Trip Blank ALS-012618-45
 Collection Date: 07-Feb-2018 00:00

ANALYTICAL REPORT

WorkOrder:HS18020529
 Lab ID:HS18020529-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260						
								Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 11:31
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	20-Feb-2018 11:31
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	20-Feb-2018 11:31
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 11:31
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	20-Feb-2018 11:31
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	20-Feb-2018 11:31
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	20-Feb-2018 11:31
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: Trip Blank ALS-012618-45
 Collection Date: 07-Feb-2018 00:00

ANALYTICAL REPORT

WorkOrder:HS18020529
 Lab ID:HS18020529-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
VOLATILES ORGANICS BY METHOD		Method:SW8260						
8260C								Analyst: AKP
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
cis-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	20-Feb-2018 11:31
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	20-Feb-2018 11:31
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	20-Feb-2018 11:31
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	20-Feb-2018 11:31
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	20-Feb-2018 11:31
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>87.6</i>			0	<i>81-118</i>	<i>%REC</i>	<i>1</i>	<i>20-Feb-2018 11:31</i>
<i>Surr: 4-Bromofluorobenzene</i>	<i>99.5</i>			0	<i>85-114</i>	<i>%REC</i>	<i>1</i>	<i>20-Feb-2018 11:31</i>
<i>Surr: Dibromofluoromethane</i>	<i>85.8</i>			0	<i>80-119</i>	<i>%REC</i>	<i>1</i>	<i>20-Feb-2018 11:31</i>
<i>Surr: Toluene-d8</i>	<i>108</i>			0	<i>89-112</i>	<i>%REC</i>	<i>1</i>	<i>20-Feb-2018 11:31</i>

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R311205	Test Name : VOLATILES ORGANICS BY METHOD 8260C			Matrix: Water		
HS18020529-01	LH18/24-SP650_020718	07 Feb 2018 14:00			20 Feb 2018 17:52	1
HS18020529-02	Trip Blank ALS-012618-45	07 Feb 2018 00:00			20 Feb 2018 11:31	1
Batch ID R311368	Test Name : ANIONS BY SW9056A			Matrix: Water		
HS18020529-01	LH18/24-SP650_020718	07 Feb 2018 14:00			21 Feb 2018 21:11	10

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180220	Units: ug/L			Analysis Date: 20-Feb-2018 10:41					
Client ID:	Run ID: VOA2_311205	SeqNo: 4444472	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	0.50	1.0								U
1,1,1-Trichloroethane	0.50	1.0								U
1,1,2,2-Tetrachloroethane	0.50	1.0								U
1,1,2-Trichloroethane	0.50	1.0								U
1,1-Dichloroethane	0.50	1.0								U
1,1-Dichloroethene	0.50	1.0								U
1,1-Dichloropropene	0.50	1.0								U
1,2,3-Trichlorobenzene	0.50	1.0								U
1,2,3-Trichloropropane	0.50	1.0								U
1,2,4-Trichlorobenzene	0.50	1.0								U
1,2,4-Trimethylbenzene	0.50	1.0								U
1,2-Dibromo-3-chloropropane	0.50	1.0								U
1,2-Dibromoethane	0.50	1.0								U
1,2-Dichlorobenzene	0.50	1.0								U
1,2-Dichloroethane	0.50	1.0								U
1,2-Dichloropropane	0.50	1.0								U
1,3,5-Trimethylbenzene	0.50	1.0								U
1,3-Dichlorobenzene	0.50	1.0								U
1,3-Dichloropropane	0.50	1.0								U
1,4-Dichlorobenzene	0.50	1.0								U
2,2-Dichloropropane	0.50	1.0								U
2-Butanone	1.0	2.0								U
2-Chlorotoluene	0.50	1.0								U
2-Hexanone	1.0	2.0								U
4-Chlorotoluene	0.50	1.0								U
4-Isopropyltoluene	0.50	1.0								U
4-Methyl-2-pentanone	1.0	2.0								U
Acetone	1.0	2.0								U
Benzene	0.50	1.0								U
Bromobenzene	0.50	1.0								U
Bromochloromethane	0.50	1.0								U
Bromodichloromethane	0.50	1.0								U
Bromoform	0.50	1.0								U
Bromomethane	0.50	1.0								U

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180220	Units: ug/L			Analysis Date: 20-Feb-2018 10:41					
Client ID:	Run ID: VOA2_311205	SeqNo: 4444472	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	1.0	2.0								U
Carbon tetrachloride	0.50	1.0								U
Chlorobenzene	0.50	1.0								U
Chloroethane	0.50	1.0								U
Chloroform	0.50	1.0								U
Chloromethane	0.50	1.0								U
cis-1,2-Dichloroethene	0.50	1.0								U
cis-1,3-Dichloropropene	0.50	1.0								U
Dibromochloromethane	0.50	1.0								U
Dibromomethane	0.50	1.0								U
Dichlorodifluoromethane	0.50	1.0								U
Ethylbenzene	0.50	1.0								U
Hexachlorobutadiene	0.50	1.0								U
Isopropylbenzene	0.50	1.0								U
m,p-Xylene	1.0	2.0								U
Methylene chloride	1.0	2.0								U
Naphthalene	0.50	1.0								U
n-Butylbenzene	0.50	1.0								U
n-Propylbenzene	0.50	1.0								U
o-Xylene	0.50	1.0								U
sec-Butylbenzene	0.50	1.0								U
Styrene	0.50	1.0								U
tert-Butylbenzene	0.50	1.0								U
Tetrachloroethene	0.50	1.0								U
Toluene	0.50	1.0								U
trans-1,2-Dichloroethene	0.50	1.0								U
trans-1,3-Dichloropropene	0.50	1.0								U
Trichloroethene	0.50	1.0								U
Trichlorofluoromethane	0.50	1.0								U
Vinyl chloride	0.50	1.0								U
Surr: 1,2-Dichloroethane-d4	43.61	1.0	50	0	87.2	81 - 118				
Surr: 4-Bromofluorobenzene	49.03	1.0	50	0	98.1	85 - 114				
Surr: Dibromofluoromethane	43.63	1.0	50	0	87.3	80 - 119				
Surr: Toluene-d8	54.02	1.0	50	0	108	89 - 112				

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205		Instrument: VOA2		Method: SW8260						
LCS		Sample ID: VLCSW-180220		Units: ug/L		Analysis Date: 20-Feb-2018 09:53				
Client ID:		Run ID: VOA2_311205		SeqNo: 4444470		PrepDate:		DF: 1		
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
1,1,1,2-Tetrachloroethane	44.22	1.0	50	0	88.4	78 - 124				
1,1,1-Trichloroethane	47.5	1.0	50	0	95.0	74 - 131				
1,1,2,2-Tetrachloroethane	42.82	1.0	50	0	85.6	71 - 121				
1,1,2-Trichloroethane	44.77	1.0	50	0	89.5	80 - 119				
1,1-Dichloroethane	43.89	1.0	50	0	87.8	77 - 125				
1,1-Dichloroethene	47.54	1.0	50	0	95.1	71 - 131				
1,1-Dichloropropene	48.8	1.0	50	0	97.6	79 - 125				
1,2,3-Trichlorobenzene	46.94	1.0	50	0	93.9	69 - 129				
1,2,3-Trichloropropane	43.14	1.0	50	0	86.3	73 - 122				
1,2,4-Trichlorobenzene	46.2	1.0	50	0	92.4	69 - 130				
1,2,4-Trimethylbenzene	47.5	1.0	50	0	95.0	76 - 124				
1,2-Dibromo-3-chloropropane	45.36	1.0	50	0	90.7	62 - 128				
1,2-Dibromoethane	46.38	1.0	50	0	92.8	77 - 121				
1,2-Dichlorobenzene	41.76	1.0	50	0	83.5	80 - 119				
1,2-Dichloroethane	45.71	1.0	50	0	91.4	73 - 128				
1,2-Dichloropropane	45.48	1.0	50	0	91.0	78 - 122				
1,3,5-Trimethylbenzene	48.22	1.0	50	0	96.4	75 - 124				
1,3-Dichlorobenzene	42.41	1.0	50	0	84.8	80 - 119				
1,3-Dichloropropane	43.23	1.0	50	0	86.5	80 - 119				
1,4-Dichlorobenzene	41.93	1.0	50	0	83.9	79 - 118				
2,2-Dichloropropane	47.37	1.0	50	0	94.7	60 - 139				
2-Butanone	98.43	2.0	100	0	98.4	56 - 143				
2-Chlorotoluene	47.25	1.0	50	0	94.5	79 - 122				
2-Hexanone	95.64	2.0	100	0	95.6	57 - 139				
4-Chlorotoluene	47.75	1.0	50	0	95.5	78 - 122				
4-Isopropyltoluene	42.91	1.0	50	0	85.8	77 - 127				
4-Methyl-2-pentanone	87.87	2.0	100	0	87.9	67 - 130				
Acetone	96.05	2.0	100	0	96.0	39 - 160				
Benzene	45.45	1.0	50	0	90.9	79 - 120				
Bromobenzene	40.99	1.0	50	0	82.0	80 - 120				
Bromochloromethane	47.88	1.0	50	0	95.8	78 - 123				
Bromodichloromethane	47.17	1.0	50	0	94.3	79 - 125				
Bromoform	49.55	1.0	50	0	99.1	66 - 130				
Bromomethane	49.43	1.0	50	0	98.9	53 - 141				

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180220	Units: ug/L			Analysis Date: 20-Feb-2018 09:53					
Client ID:	Run ID: VOA2_311205	SeqNo: 4444470		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	92.16	2.0	100	0	92.2	64 - 133				
Carbon tetrachloride	45.74	1.0	50	0	91.5	72 - 136				
Chlorobenzene	43.6	1.0	50	0	87.2	80 - 120				
Chloroethane	42.63	1.0	50	0	85.3	82 - 118				
Chloroform	43.04	1.0	50	0	86.1	79 - 124				
Chloromethane	48.03	1.0	50	0	96.1	50 - 139				
cis-1,2-Dichloroethene	46.23	1.0	50	0	92.5	78 - 123				
cis-1,3-Dichloropropene	49.25	1.0	50	0	98.5	75 - 124				
Dibromochloromethane	46.72	1.0	50	0	93.4	74 - 126				
Dibromomethane	51.14	1.0	50	0	102	79 - 123				
Dichlorodifluoromethane	46.7	1.0	50	0	93.4	32 - 152				
Ethylbenzene	49.4	1.0	50	0	98.8	79 - 121				
Hexachlorobutadiene	47.09	1.0	50	0	94.2	66 - 134				
Isopropylbenzene	45.49	1.0	50	0	91.0	72 - 131				
m,p-Xylene	87.31	2.0	100	0	87.3	80 - 121				
Methylene chloride	43.5	2.0	50	0	87.0	74 - 124				
Naphthalene	49.67	1.0	50	0	99.3	61 - 128				
n-Butylbenzene	45.19	1.0	50	0	90.4	75 - 128				
n-Propylbenzene	42.51	1.0	50	0	85.0	76 - 126				
o-Xylene	44.33	1.0	50	0	88.7	78 - 122				
sec-Butylbenzene	44.33	1.0	50	0	88.7	77 - 126				
Styrene	44.73	1.0	50	0	89.5	78 - 128				
tert-Butylbenzene	42.11	1.0	50	0	84.2	78 - 124				
Tetrachloroethene	45.91	1.0	50	0	91.8	74 - 129				
Toluene	42.51	1.0	50	0	85.0	80 - 121				
trans-1,2-Dichloroethene	47.93	1.0	50	0	95.9	75 - 124				
trans-1,3-Dichloropropene	51.02	1.0	50	0	102	73 - 127				
Trichloroethene	48.18	1.0	50	0	96.4	79 - 123				
Trichlorofluoromethane	46.83	1.0	50	0	93.7	65 - 141				
Vinyl chloride	45.66	1.0	50	0	91.3	58 - 137				
Surr: 1,2-Dichloroethane-d4	43.81	1.0	50	0	87.6	81 - 118				
Surr: 4-Bromofluorobenzene	50.26	1.0	50	0	101	85 - 114				
Surr: Dibromofluoromethane	40.68	1.0	50	0	81.4	80 - 119				
Surr: Toluene-d8	51.63	1.0	50	0	103	89 - 112				

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18020448-02MS	Units: ug/L			Analysis Date: 20-Feb-2018 18:17					
Client ID:	Run ID: VOA2_311205	SeqNo: 4444490	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	27.39	1.0	50	0	54.8	78 - 124				S
1,1,1-Trichloroethane	27.26	1.0	50	0	54.5	74 - 131				S
1,1,2,2-Tetrachloroethane	32.54	1.0	50	0	65.1	71 - 121				S
1,1,2-Trichloroethane	28.77	1.0	50	0	57.5	80 - 119				S
1,1-Dichloroethane	25.36	1.0	50	0	50.7	77 - 125				S
1,1-Dichloroethene	25.49	1.0	50	0	51.0	71 - 131				S
1,1-Dichloropropene	28.42	1.0	50	0	56.8	79 - 125				S
1,2,3-Trichlorobenzene	24.67	1.0	50	0	49.3	69 - 129				S
1,2,3-Trichloropropane	34.54	1.0	50	0	69.1	73 - 122				S
1,2,4-Trichlorobenzene	22.7	1.0	50	0	45.4	69 - 130				S
1,2,4-Trimethylbenzene	26.64	1.0	50	0	53.3	76 - 124				S
1,2-Dibromo-3-chloropropane	40.23	1.0	50	0	80.5	62 - 128				S
1,2-Dibromoethane	31.96	1.0	50	0	63.9	77 - 121				S
1,2-Dichlorobenzene	24.44	1.0	50	0	48.9	80 - 119				S
1,2-Dichloroethane	27.31	1.0	50	0	54.6	73 - 128				S
1,2-Dichloropropane	26.57	1.0	50	0	53.1	78 - 122				S
1,3,5-Trimethylbenzene	26.83	1.0	50	0	53.7	75 - 124				S
1,3-Dichlorobenzene	24.23	1.0	50	0	48.5	80 - 119				S
1,3-Dichloropropane	27.84	1.0	50	0	55.7	80 - 119				S
1,4-Dichlorobenzene	23.65	1.0	50	0	47.3	79 - 118				S
2,2-Dichloropropane	26.75	1.0	50	0	53.5	60 - 139				S
2-Butanone	85.26	2.0	100	0	85.3	56 - 143				S
2-Chlorotoluene	26.95	1.0	50	0	53.9	79 - 122				S
2-Hexanone	88.38	2.0	100	0	88.4	57 - 139				S
4-Chlorotoluene	26.68	1.0	50	0	53.4	78 - 122				S
4-Isopropyltoluene	23.09	1.0	50	0	46.2	77 - 127				S
4-Methyl-2-pentanone	79.17	2.0	100	0	79.2	67 - 130				S
Acetone	102.3	2.0	100	20.47	81.9	39 - 160				S
Benzene	27.13	1.0	50	0.6473	53.0	79 - 120				S
Bromobenzene	24.04	1.0	50	0	48.1	80 - 120				S
Bromochloromethane	27.98	1.0	50	0	56.0	78 - 123				S
Bromodichloromethane	27.58	1.0	50	0	55.2	79 - 125				S
Bromoform	34.11	1.0	50	0	68.2	66 - 130				S
Bromomethane	19.75	1.0	50	0	39.5	53 - 141				S

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18020448-02MS	Units: ug/L			Analysis Date: 20-Feb-2018 18:17					
Client ID:	Run ID: VOA2_311205	SeqNo: 4444490	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	53.76	2.0	100	0	53.8	64 - 133				S
Carbon tetrachloride	28.18	1.0	50	0	56.4	72 - 136				S
Chlorobenzene	25.58	1.0	50	0	51.2	80 - 120				S
Chloroethane	161.5	1.0	50	0	323	82 - 118				S
Chloroform	24.88	1.0	50	0	49.8	79 - 124				S
Chloromethane	26.79	1.0	50	0	53.6	50 - 139				
cis-1,2-Dichloroethene	26.85	1.0	50	0	53.7	78 - 123				S
cis-1,3-Dichloropropene	28.69	1.0	50	0	57.4	75 - 124				S
Dibromochloromethane	28.52	1.0	50	0	57.0	74 - 126				S
Dibromomethane	30.71	1.0	50	0	61.4	79 - 123				S
Dichlorodifluoromethane	18.47	1.0	50	0	36.9	32 - 152				
Ethylbenzene	28.1	1.0	50	0	56.2	79 - 121				S
Hexachlorobutadiene	19.03	1.0	50	0	38.1	66 - 134				S
Isopropylbenzene	26.38	1.0	50	0	52.8	72 - 131				S
m,p-Xylene	51.98	2.0	100	0	52.0	80 - 121				S
Methylene chloride	24.84	2.0	50	0	49.7	74 - 124				S
Naphthalene	38.12	1.0	50	0	76.2	61 - 128				
n-Butylbenzene	22.4	1.0	50	0	44.8	75 - 128				S
n-Propylbenzene	24.2	1.0	50	0	48.4	76 - 126				S
o-Xylene	26.29	1.0	50	0	52.6	78 - 122				S
sec-Butylbenzene	24.16	1.0	50	0	48.3	77 - 126				S
Styrene	26.18	1.0	50	0	52.4	78 - 128				S
tert-Butylbenzene	23.97	1.0	50	0	47.9	78 - 124				S
Tetrachloroethene	26.52	1.0	50	0	53.0	74 - 129				S
Toluene	25.78	1.0	50	0	51.6	80 - 121				S
trans-1,2-Dichloroethene	26.82	1.0	50	0	53.6	75 - 124				S
trans-1,3-Dichloropropene	29.92	1.0	50	0	59.8	73 - 127				S
Trichloroethene	28.08	1.0	50	0	56.2	79 - 123				S
Trichlorofluoromethane	25.26	1.0	50	0	50.5	65 - 141				S
Vinyl chloride	24.75	1.0	50	0	49.5	58 - 137				S
Surr: 1,2-Dichloroethane-d4	45.73	1.0	50	0	91.5	81 - 118				
Surr: 4-Bromofluorobenzene	50.04	1.0	50	0	100	85 - 114				
Surr: Dibromofluoromethane	42.37	1.0	50	0	84.7	80 - 119				
Surr: Toluene-d8	53.21	1.0	50	0	106	89 - 112				

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205		Instrument: VOA2			Method: SW8260						
MSD	Sample ID: HS18020448-02MSD	Units: ug/L			Analysis Date: 20-Feb-2018 18:41						
Client ID:	Run ID: VOA2_311205	SeqNo: 4444491		PrepDate:		DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual	
1,1,1,2-Tetrachloroethane	31.36	1.0	50	0	62.7	78 - 124	27.39	13.5	20	S	
1,1,1-Trichloroethane	30.07	1.0	50	0	60.1	74 - 131	27.26	9.81	20	S	
1,1,2,2-Tetrachloroethane	36.82	1.0	50	0	73.6	71 - 121	32.54	12.4	20		
1,1,2-Trichloroethane	33.16	1.0	50	0	66.3	80 - 119	28.77	14.2	20	S	
1,1-Dichloroethane	29.44	1.0	50	0	58.9	77 - 125	25.36	14.9	20	S	
1,1-Dichloroethene	28.16	1.0	50	0	56.3	71 - 131	25.49	9.94	20	S	
1,1-Dichloropropene	29.18	1.0	50	0	58.4	79 - 125	28.42	2.61	20	S	
1,2,3-Trichlorobenzene	30.68	1.0	50	0	61.4	69 - 129	24.67	21.7	20	SR	
1,2,3-Trichloropropane	37.83	1.0	50	0	75.7	73 - 122	34.54	9.1	20		
1,2,4-Trichlorobenzene	27.82	1.0	50	0	55.6	69 - 130	22.7	20.2	20	SR	
1,2,4-Trimethylbenzene	30.76	1.0	50	0	61.5	76 - 124	26.64	14.4	20	S	
1,2-Dibromo-3-chloropropane	45.88	1.0	50	0	91.8	62 - 128	40.23	13.1	20		
1,2-Dibromoethane	35.35	1.0	50	0	70.7	77 - 121	31.96	10.1	20	S	
1,2-Dichlorobenzene	28.4	1.0	50	0	56.8	80 - 119	24.44	15	20	S	
1,2-Dichloroethane	31.25	1.0	50	0	62.5	73 - 128	27.31	13.5	20	S	
1,2-Dichloropropane	30.38	1.0	50	0	60.8	78 - 122	26.57	13.4	20	S	
1,3,5-Trimethylbenzene	30.17	1.0	50	0	60.3	75 - 124	26.83	11.7	20	S	
1,3-Dichlorobenzene	28.02	1.0	50	0	56.0	80 - 119	24.23	14.5	20	S	
1,3-Dichloropropane	33.09	1.0	50	0	66.2	80 - 119	27.84	17.2	20	S	
1,4-Dichlorobenzene	27.31	1.0	50	0	54.6	79 - 118	23.65	14.4	20	S	
2,2-Dichloropropane	28.96	1.0	50	0	57.9	60 - 139	26.75	7.91	20	S	
2-Butanone	91.77	2.0	100	0	91.8	56 - 143	85.26	7.35	20		
2-Chlorotoluene	30.63	1.0	50	0	61.3	79 - 122	26.95	12.8	20	S	
2-Hexanone	95.94	2.0	100	0	95.9	57 - 139	88.38	8.21	20		
4-Chlorotoluene	31.29	1.0	50	0	62.6	78 - 122	26.68	15.9	20	S	
4-Isopropyltoluene	26.02	1.0	50	0	52.0	77 - 127	23.09	11.9	20	S	
4-Methyl-2-pentanone	87.44	2.0	100	0	87.4	67 - 130	79.17	9.92	20		
Acetone	113	2.0	100	20.47	92.5	39 - 160	102.3	9.85	20		
Benzene	30.44	1.0	50	0.6473	59.6	79 - 120	27.13	11.5	20	S	
Bromobenzene	28.1	1.0	50	0	56.2	80 - 120	24.04	15.6	20	S	
Bromochloromethane	32.64	1.0	50	0	65.3	78 - 123	27.98	15.4	20	S	
Bromodichloromethane	32.04	1.0	50	0	64.1	79 - 125	27.58	15	20	S	
Bromoform	39.48	1.0	50	0	79.0	66 - 130	34.11	14.6	20		
Bromomethane	25.36	1.0	50	0	50.7	53 - 141	19.75	24.9	20	SR	

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205		Instrument: VOA2		Method: SW8260							
MSD	Sample ID: HS18020448-02MSD	Units: ug/L			Analysis Date: 20-Feb-2018 18:41						
Client ID:	Run ID: VOA2_311205	SeqNo: 4444491		PrepDate:		DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual	
Carbon disulfide	58.94	2.0	100	0	58.9	64 - 133	53.76	9.19	20	S	
Carbon tetrachloride	28.51	1.0	50	0	57.0	72 - 136	28.18	1.19	20	S	
Chlorobenzene	29.93	1.0	50	0	59.9	80 - 120	25.58	15.7	20	S	
Chloroethane	94.74	1.0	50	0	189	82 - 118	161.5	52.1	20	SR	
Chloroform	28.91	1.0	50	0	57.8	79 - 124	24.88	15	20	S	
Chloromethane	21.87	1.0	50	0	43.7	50 - 139	26.79	20.2	20	SR	
cis-1,2-Dichloroethene	31.52	1.0	50	0	63.0	78 - 123	26.85	16	20	S	
cis-1,3-Dichloropropene	32.31	1.0	50	0	64.6	75 - 124	28.69	11.9	20	S	
Dibromochloromethane	33.83	1.0	50	0	67.7	74 - 126	28.52	17	20	S	
Dibromomethane	35.44	1.0	50	0	70.9	79 - 123	30.71	14.3	20	S	
Dichlorodifluoromethane	19.2	1.0	50	0	38.4	32 - 152	18.47	3.91	20		
Ethylbenzene	31.84	1.0	50	0	63.7	79 - 121	28.1	12.5	20	S	
Hexachlorobutadiene	23.09	1.0	50	0	46.2	66 - 134	19.03	19.2	20	S	
Isopropylbenzene	29.09	1.0	50	0	58.2	72 - 131	26.38	9.76	20	S	
m,p-Xylene	58.72	2.0	100	0	58.7	80 - 121	51.98	12.2	20	S	
Methylene chloride	28.31	2.0	50	0	56.6	74 - 124	24.84	13	20	S	
Naphthalene	45.23	1.0	50	0	90.5	61 - 128	38.12	17.1	20		
n-Butylbenzene	25.6	1.0	50	0	51.2	75 - 128	22.4	13.3	20	S	
n-Propylbenzene	26.67	1.0	50	0	53.3	76 - 126	24.2	9.7	20	S	
o-Xylene	29.82	1.0	50	0	59.6	78 - 122	26.29	12.6	20	S	
sec-Butylbenzene	26.56	1.0	50	0	53.1	77 - 126	24.16	9.47	20	S	
Styrene	30.47	1.0	50	0	60.9	78 - 128	26.18	15.2	20	S	
tert-Butylbenzene	26.5	1.0	50	0	53.0	78 - 124	23.97	9.99	20	S	
Tetrachloroethene	28.44	1.0	50	0	56.9	74 - 129	26.52	7	20	S	
Toluene	29.25	1.0	50	0	58.5	80 - 121	25.78	12.6	20	S	
trans-1,2-Dichloroethene	30.51	1.0	50	0	61.0	75 - 124	26.82	12.9	20	S	
trans-1,3-Dichloropropene	35.05	1.0	50	0	70.1	73 - 127	29.92	15.8	20	S	
Trichloroethene	31.51	1.0	50	0	63.0	79 - 123	28.08	11.5	20	S	
Trichlorofluoromethane	25.46	1.0	50	0	50.9	65 - 141	25.26	0.8	20	S	
Vinyl chloride	26.39	1.0	50	0	52.8	58 - 137	24.75	6.4	20	S	
Surr: 1,2-Dichloroethane-d4	46.82	1.0	50	0	93.6	81 - 118	45.73	2.36	20		
Surr: 4-Bromofluorobenzene	49.27	1.0	50	0	98.5	85 - 114	50.04	1.55	20		
Surr: Dibromofluoromethane	42.66	1.0	50	0	85.3	80 - 119	42.37	0.679	20		
Surr: Toluene-d8	53.29	1.0	50	0	107	89 - 112	53.21	0.165	20		

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311205	Instrument: VOA2	Method: SW8260
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The following samples were analyzed in this batch:

HS18020529-01	HS18020529-02
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Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

QC BATCH REPORT

Batch ID: R311368		Instrument: ICS2100		Method: SW9056						
MBLK	Sample ID: WBLKW1-022118	Units: mg/L			Analysis Date: 21-Feb-2018 12:19					
Client ID:	Run ID: ICS2100_311368	SeqNo: 4448028		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	0.250	0.500							U	
Sulfate	0.250	0.500							U	
LCS	Sample ID: WLCSW1-022118	Units: mg/L			Analysis Date: 21-Feb-2018 12:33					
Client ID:	Run ID: ICS2100_311368	SeqNo: 4448029		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	20.43	0.500	20	0	102	80 - 120				
Sulfate	20.62	0.500	20	0	103	80 - 120				
LCSD	Sample ID: WLCSDW1-022118	Units: mg/L			Analysis Date: 21-Feb-2018 12:48					
Client ID:	Run ID: ICS2100_311368	SeqNo: 4448030		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	20.51	0.500	20	0	103	80 - 120	20.43	0.425	20	
Sulfate	20.73	0.500	20	0	104	80 - 120	20.62	0.517	20	
MS	Sample ID: HS18021075-01MS	Units: mg/L			Analysis Date: 21-Feb-2018 22:10					
Client ID:	Run ID: ICS2100_311368	SeqNo: 4448039		PrepDate:			DF: 20			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	475.3	10.0	200	279.5	97.9	80 - 120				
Sulfate	750.8	10.0	200	561.8	94.5	80 - 120				
MSD	Sample ID: HS18021075-01MSD	Units: mg/L			Analysis Date: 21-Feb-2018 22:24					
Client ID:	Run ID: ICS2100_311368	SeqNo: 4448040		PrepDate:			DF: 20			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	467	10.0	200	279.5	93.7	80 - 120	475.3	1.76	20	
Sulfate	741.9	10.0	200	561.8	90.1	80 - 120	750.8	1.19	20	

The following samples were analyzed in this batch: HS18020529-01

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

ALS Group USA, Corp

Date: 22-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18020529

**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 Quantitation Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

Unit Reported	Description
mg/L	Milligrams per Liter

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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18020529

Date/Time Received: **08-Feb-2018 08:40**
 Received by: **JRM**

Checklist completed by: Raegen Giga 9-Feb-2018 Reviewed by: RJ Modashia 12-Feb-2018
 eSignature Date eSignature 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): 1.5c/1.9c uc/c IR 30
 Cooler(s)/Kit(s): 24662
 Date/Time sample(s) sent to storage: 02/08/2018 18:00 prior to sample login

- 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:



ALS
 10450 Standliff Rd., Suite 210
 Houston, Texas 77099
 Tel. +1 281 530 5656
 Fax. +1 281 530 5807

CUSTODY SEAL		Seal Broken By:
Date: <u>2/7/13</u>	Time: <u>11:30</u>	Date:
Name: <u>STANLIFF</u>	Company: <u>ALS</u>	

THU - 08 FEB 10:30A
PRIORITY OVERNIGHT
7376 9752 1821

AB SGRA
77099
 TX-US
IAH



FTD 5898257 87FE918 665A 546CL1/1220/RC9A



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

February 27, 2018

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

Work Order: **HS18020787**

Laboratory Results for: **Longhorn GW Treatment Plant Monthly Ehhluent Samples**

Dear Marcia,

ALS Environmental received 2 sample(s) on Feb 15, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
Work Order: HS18020787

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18020787-01	LH18/24-SP650-021418	Water		14-Feb-2018 14:00	15-Feb-2018 09:00	<input type="checkbox"/>
HS18020787-02	Trip Blank	Water	ALS 111417-86	15-Feb-2018 00:00	15-Feb-2018 09:00	<input type="checkbox"/>

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
Work Order:

CASE NARRATIVE

Work Order Comments

- The analysis for Perchlorate was subcontracted to ALS Salt Lake City, UT. Final report attached.
-

GCMS Semivolatiles by Method SW8270SIM**Batch ID: 125445**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

GCMS Volatiles by Method SW8260**Batch ID: R311411****Sample ID: HS18020820-02MS**

- MS and MSD are for an unrelated sample
-

Metals by Method SW6020**Batch ID: 125507**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method SW7196**Batch ID: R311220**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
 Sample ID: LH18/24-SP650-021418
 Collection Date: 14-Feb-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18020787
 Lab ID:HS18020787-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	22-Feb-2018 15:02	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	22-Feb-2018 15:02	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	22-Feb-2018 15:02	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	22-Feb-2018 15:02	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	22-Feb-2018 15:02	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
 Sample ID: LH18/24-SP650-021418
 Collection Date: 14-Feb-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18020787
 Lab ID:HS18020787-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260						Analyst: AKP	
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
cis-1,2-Dichloroethene	2.7		0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	22-Feb-2018 15:02	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	22-Feb-2018 15:02	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 15:02	
<i>Surr: 1,2-Dichloroethane-d4</i>	89.2			0	81-118	%REC	1	22-Feb-2018 15:02	
<i>Surr: 4-Bromofluorobenzene</i>	99.2			0	85-114	%REC	1	22-Feb-2018 15:02	
<i>Surr: Dibromofluoromethane</i>	85.9			0	80-119	%REC	1	22-Feb-2018 15:02	
<i>Surr: Toluene-d8</i>	107			0	89-112	%REC	1	22-Feb-2018 15:02	
SEMIVOLATILES SIM		Method:SW8270SIM						Prep:SW3510 / 20-Feb-2018 Analyst: ACN	
1,4-Dioxane	5.3		0.20	0.20	0.20	ug/L	20	22-Feb-2018 14:47	
<i>Surr: 2-Fluorobiphenyl</i>	133			0	40-140	%REC	20	22-Feb-2018 14:47	
<i>Surr: 4-Terphenyl-d14</i>	100.0			0	40-140	%REC	20	22-Feb-2018 14:47	
<i>Surr: Nitrobenzene-d5</i>	51.0			0	40-140	%REC	20	22-Feb-2018 14:47	

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
 Sample ID: LH18/24-SP650-021418
 Collection Date: 14-Feb-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18020787
 Lab ID:HS18020787-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
ICP-MS METALS BY SW6020A		Method:SW6020				Prep:SW3010A / 21-Feb-2018		Analyst: JCJ
Barium	0.205		0.00190	0.00250	0.00400	mg/L	1	26-Feb-2018 13:32
Lead	0.00100	U	0.000600	0.00100	0.00200	mg/L	1	26-Feb-2018 13:32
Selenium	0.00200	U	0.00110	0.00200	0.00200	mg/L	1	26-Feb-2018 13:32
Silver	0.00100	U	0.000200	0.00100	0.00200	mg/L	1	26-Feb-2018 13:32
HEXAVALENT CHROMIUM BY SW7196A		Method:SW7196				Prep:SW7196		Analyst: JHD
Chromium, Hexavalent	0.00600	U	0.00600	0.00600	0.0100	mg/L	1	15-Feb-2018 13:45
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Method:NA						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	23-Feb-2018 15:46

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
 Sample ID: Trip Blank
 Collection Date: 15-Feb-2018 00:00

ANALYTICAL REPORT
 WorkOrder:HS18020787
 Lab ID:HS18020787-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	22-Feb-2018 13:48	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	22-Feb-2018 13:48	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	22-Feb-2018 13:48	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	22-Feb-2018 13:48	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	22-Feb-2018 13:48	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
 Sample ID: Trip Blank
 Collection Date: 15-Feb-2018 00:00

ANALYTICAL REPORT
 WorkOrder:HS18020787
 Lab ID:HS18020787-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD		Method:SW8260							Analyst: AKP
8260C									
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
cis-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	22-Feb-2018 13:48	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	22-Feb-2018 13:48	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	22-Feb-2018 13:48	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>85.8</i>			0	<i>81-118</i>	<i>%REC</i>	<i>1</i>	<i>22-Feb-2018 13:48</i>	
<i>Surr: 4-Bromofluorobenzene</i>	<i>96.8</i>			0	<i>85-114</i>	<i>%REC</i>	<i>1</i>	<i>22-Feb-2018 13:48</i>	
<i>Surr: Dibromofluoromethane</i>	<i>86.5</i>			0	<i>80-119</i>	<i>%REC</i>	<i>1</i>	<i>22-Feb-2018 13:48</i>	
<i>Surr: Toluene-d8</i>	<i>109</i>			0	<i>89-112</i>	<i>%REC</i>	<i>1</i>	<i>22-Feb-2018 13:48</i>	

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

WEIGHT LOG

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

Batch ID: 125445 **Method:** SEMIVOLATILES SIM **Prep:** 3510_B_SIM

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18020787-01	1	980	1 (mL)	0.00102

Batch ID: 125507 **Method:** ICP-MS METALS BY SW6020A **Prep:** 3010A

SampID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18020787-01	1	10	10 (mL)	1

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID 125445	Test Name : SEMIVOLATILES SIM		Matrix: Water			
HS18020787-01	LH18/24-SP650-021418	14 Feb 2018 14:00		20 Feb 2018 11:19	22 Feb 2018 14:47	20
Batch ID 125507	Test Name : ICP-MS METALS BY SW6020A		Matrix: Water			
HS18020787-01	LH18/24-SP650-021418	14 Feb 2018 14:00		21 Feb 2018 14:23	26 Feb 2018 13:32	1
Batch ID R311220	Test Name : HEXAVALENT CHROMIUM BY SW7196A		Matrix: Water			
HS18020787-01	LH18/24-SP650-021418	14 Feb 2018 14:00			15 Feb 2018 13:45	1
Batch ID R311411	Test Name : VOLATILES ORGANICS BY METHOD 8260C		Matrix: Water			
HS18020787-01	LH18/24-SP650-021418	14 Feb 2018 14:00			22 Feb 2018 15:02	1
HS18020787-02	Trip Blank	15 Feb 2018 00:00			22 Feb 2018 13:48	1
Batch ID R311458	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18020787-01	LH18/24-SP650-021418	14 Feb 2018 14:00			23 Feb 2018 15:46	1

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: 125507		Instrument: ICPMS04		Method: SW6020						
MBLK	Sample ID: MBLK-125507	Units: mg/L		Analysis Date: 26-Feb-2018 13:28						
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451733		PrepDate: 21-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Barium	0.00250	0.00400							U	
Lead	0.00100	0.00200							U	
Selenium	0.00200	0.00200							U	
Silver	0.00100	0.00200							U	
LCS	Sample ID: LCS-125507	Units: mg/L		Analysis Date: 26-Feb-2018 13:30						
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451734		PrepDate: 21-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Barium	0.05059	0.00400	0.05	0	101	80 - 120				
Lead	0.04655	0.00200	0.05	0	93.1	80 - 120				
Selenium	0.05046	0.00200	0.05	0	101	80 - 120				
Silver	0.04804	0.00200	0.05	0	96.1	80 - 120				
MS	Sample ID: HS18020829-02MS	Units: mg/L		Analysis Date: 26-Feb-2018 13:41						
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451739		PrepDate: 21-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Barium	0.1405	0.00400	0.05	0.0957	89.5	80 - 120				
Lead	0.04529	0.00200	0.05	0.000013	90.5	80 - 120				
Selenium	0.0473	0.00200	0.05	-0.000831	96.3	80 - 120				
Silver	0.04618	0.00200	0.05	0.000013	92.3	80 - 120				
MSD	Sample ID: HS18020829-02MSD	Units: mg/L		Analysis Date: 26-Feb-2018 13:48						
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451767		PrepDate: 21-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Barium	0.1416	0.00400	0.05	0.0957	91.8	80 - 120	0.1405	0.796	20	
Lead	0.04437	0.00200	0.05	0	88.7	80 - 120	0.04529	2.04	20	
Selenium	0.0494	0.00200	0.05	0	98.8	80 - 120	0.0473	4.34	20	
Silver	0.04606	0.00200	0.05	0	92.1	80 - 120	0.04618	0.262	20	

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: 125507		Instrument: ICPMS04		Method: SW6020						
PDS	Sample ID: HS18020829-02PDS	Units: mg/L		Analysis Date: 26-Feb-2018 13:50						
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451768	PrepDate: 21-Feb-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	0.1999	0.00400	0.1	0.0957	104	75 - 125				
Lead	0.09731	0.00200	0.1	0	97.3	75 - 125				
Selenium	0.1004	0.00200	0.1	0	100	75 - 125				
Silver	0.09696	0.00200	0.1	0	97.0	75 - 125				
SD	Sample ID: HS18020829-02SD	Units: mg/L		Analysis Date: 26-Feb-2018 13:39						
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451738	PrepDate: 21-Feb-2018	DF: 5						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	RPD Limit	Qual
Barium	0.09569	0.0200					0.0957	0.0094	10	
Lead	0.00500	0.0100					0.000013	0	10	U
Selenium	0.0100	0.0100					-0.000831	0	10	U
Silver	0.00500	0.0100					0.000013	0	10	U
The following samples were analyzed in this batch: HS18020787-01										

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: 125445		Instrument: SV-5		Method: SW8270SIM						
MBLK	Sample ID: MBLK-125445	Units: ug/L		Analysis Date: 22-Feb-2018 12:17						
Client ID:	Run ID: SV-5_311381	SeqNo: 4448271		PrepDate: 20-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

1,4-Dioxane	0.010	0.010								U
Surr: 2-Fluorobiphenyl	0.09936	0	0.08	0	124	40 - 140				
Surr: 4-Terphenyl-d14	0.06559	0	0.08	0	82.0	40 - 140				
Surr: Nitrobenzene-d5	0.05669	0	0.08	0	70.9	40 - 140				

LCS	Sample ID: LCS-125445	Units: ug/L		Analysis Date: 22-Feb-2018 12:38						
Client ID:	Run ID: SV-5_311381	SeqNo: 4448272		PrepDate: 20-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

1,4-Dioxane	0.07968	0.010	0.08	0	99.6	40 - 140				
Surr: 2-Fluorobiphenyl	0.1057	0	0.08	0	132	40 - 140				
Surr: 4-Terphenyl-d14	0.07504	0	0.08	0	93.8	40 - 140				
Surr: Nitrobenzene-d5	0.05911	0	0.08	0	73.9	40 - 140				

LCSD	Sample ID: LCSD-125445	Units: ug/L		Analysis Date: 22-Feb-2018 12:58						
Client ID:	Run ID: SV-5_311381	SeqNo: 4448273		PrepDate: 20-Feb-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual

1,4-Dioxane	0.08015	0.010	0.08	0	100	40 - 140	0.07968	0.592	20	
Surr: 2-Fluorobiphenyl	0.1087	0	0.08	0	136	40 - 140	0.1057	2.84	20	
Surr: 4-Terphenyl-d14	0.07476	0	0.08	0	93.4	40 - 140	0.07504	0.372	20	
Surr: Nitrobenzene-d5	0.05978	0	0.08	0	74.7	40 - 140	0.05911	1.12	20	

The following samples were analyzed in this batch: HS18020787-01

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180222	Units: ug/L			Analysis Date: 22-Feb-2018 13:23					
Client ID:	Run ID: VOA2_311411	SeqNo: 4449132	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	0.50	1.0								U
1,1,1-Trichloroethane	0.50	1.0								U
1,1,2,2-Tetrachloroethane	0.50	1.0								U
1,1,2-Trichloroethane	0.50	1.0								U
1,1-Dichloroethane	0.50	1.0								U
1,1-Dichloroethene	0.50	1.0								U
1,1-Dichloropropene	0.50	1.0								U
1,2,3-Trichlorobenzene	0.50	1.0								U
1,2,3-Trichloropropane	0.50	1.0								U
1,2,4-Trichlorobenzene	0.50	1.0								U
1,2,4-Trimethylbenzene	0.50	1.0								U
1,2-Dibromo-3-chloropropane	0.50	1.0								U
1,2-Dibromoethane	0.50	1.0								U
1,2-Dichlorobenzene	0.50	1.0								U
1,2-Dichloroethane	0.50	1.0								U
1,2-Dichloropropane	0.50	1.0								U
1,3,5-Trimethylbenzene	0.50	1.0								U
1,3-Dichlorobenzene	0.50	1.0								U
1,3-Dichloropropane	0.50	1.0								U
1,4-Dichlorobenzene	0.50	1.0								U
2,2-Dichloropropane	0.50	1.0								U
2-Butanone	1.0	2.0								U
2-Chlorotoluene	0.50	1.0								U
2-Hexanone	1.0	2.0								U
4-Chlorotoluene	0.50	1.0								U
4-Isopropyltoluene	0.50	1.0								U
4-Methyl-2-pentanone	1.0	2.0								U
Acetone	1.0	2.0								U
Benzene	0.50	1.0								U
Bromobenzene	0.50	1.0								U
Bromochloromethane	0.50	1.0								U
Bromodichloromethane	0.50	1.0								U
Bromoform	0.50	1.0								U
Bromomethane	0.50	1.0								U

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180222	Units: ug/L			Analysis Date: 22-Feb-2018 13:23					
Client ID:	Run ID: VOA2_311411	SeqNo: 4449132	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	1.0	2.0								U
Carbon tetrachloride	0.50	1.0								U
Chlorobenzene	0.50	1.0								U
Chloroethane	0.50	1.0								U
Chloroform	0.50	1.0								U
Chloromethane	0.50	1.0								U
cis-1,2-Dichloroethene	0.50	1.0								U
cis-1,3-Dichloropropene	0.50	1.0								U
Dibromochloromethane	0.50	1.0								U
Dibromomethane	0.50	1.0								U
Dichlorodifluoromethane	0.50	1.0								U
Ethylbenzene	0.50	1.0								U
Hexachlorobutadiene	0.50	1.0								U
Isopropylbenzene	0.50	1.0								U
m,p-Xylene	1.0	2.0								U
Methylene chloride	1.0	2.0								U
Naphthalene	0.50	1.0								U
n-Butylbenzene	0.50	1.0								U
n-Propylbenzene	0.50	1.0								U
o-Xylene	0.50	1.0								U
sec-Butylbenzene	0.50	1.0								U
Styrene	0.50	1.0								U
tert-Butylbenzene	0.50	1.0								U
Tetrachloroethene	0.50	1.0								U
Toluene	0.50	1.0								U
trans-1,2-Dichloroethene	0.50	1.0								U
trans-1,3-Dichloropropene	0.50	1.0								U
Trichloroethene	0.50	1.0								U
Trichlorofluoromethane	0.50	1.0								U
Vinyl chloride	0.50	1.0								U
Surr: 1,2-Dichloroethane-d4	42.51	1.0	50	0	85.0	81 - 118				
Surr: 4-Bromofluorobenzene	49.53	1.0	50	0	99.1	85 - 114				
Surr: Dibromofluoromethane	43.06	1.0	50	0	86.1	80 - 119				
Surr: Toluene-d8	53.93	1.0	50	0	108	89 - 112				

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180222	Units: ug/L			Analysis Date: 22-Feb-2018 12:34					
Client ID:	Run ID: VOA2_311411	SeqNo: 4449130		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	44.86	1.0	50	0	89.7	78 - 124				
1,1,1-Trichloroethane	47.14	1.0	50	0	94.3	74 - 131				
1,1,2,2-Tetrachloroethane	43.36	1.0	50	0	86.7	71 - 121				
1,1,2-Trichloroethane	45.89	1.0	50	0	91.8	80 - 119				
1,1-Dichloroethane	45.07	1.0	50	0	90.1	77 - 125				
1,1-Dichloroethene	48.33	1.0	50	0	96.7	71 - 131				
1,1-Dichloropropene	50.07	1.0	50	0	100	79 - 125				
1,2,3-Trichlorobenzene	47.12	1.0	50	0	94.2	69 - 129				
1,2,3-Trichloropropane	44.97	1.0	50	0	89.9	73 - 122				
1,2,4-Trichlorobenzene	45.94	1.0	50	0	91.9	69 - 130				
1,2,4-Trimethylbenzene	46.12	1.0	50	0	92.2	76 - 124				
1,2-Dibromo-3-chloropropane	48.02	1.0	50	0	96.0	62 - 128				
1,2-Dibromoethane	48.41	1.0	50	0	96.8	77 - 121				
1,2-Dichlorobenzene	41.27	1.0	50	0	82.5	80 - 119				
1,2-Dichloroethane	45.36	1.0	50	0	90.7	73 - 128				
1,2-Dichloropropane	44.97	1.0	50	0	89.9	78 - 122				
1,3,5-Trimethylbenzene	46.8	1.0	50	0	93.6	75 - 124				
1,3-Dichlorobenzene	41.98	1.0	50	0	84.0	80 - 119				
1,3-Dichloropropane	44.55	1.0	50	0	89.1	80 - 119				
1,4-Dichlorobenzene	41.07	1.0	50	0	82.1	79 - 118				
2,2-Dichloropropane	46.98	1.0	50	0	94.0	60 - 139				
2-Butanone	108.7	2.0	100	0	109	56 - 143				
2-Chlorotoluene	46.4	1.0	50	0	92.8	79 - 122				
2-Hexanone	103.9	2.0	100	0	104	57 - 139				
4-Chlorotoluene	46.54	1.0	50	0	93.1	78 - 122				
4-Isopropyltoluene	41.45	1.0	50	0	82.9	77 - 127				
4-Methyl-2-pentanone	95.89	2.0	100	0	95.9	67 - 130				
Acetone	100.5	2.0	100	0	100	39 - 160				
Benzene	45.35	1.0	50	0	90.7	79 - 120				
Bromobenzene	40.71	1.0	50	0	81.4	80 - 120				
Bromochloromethane	49.54	1.0	50	0	99.1	78 - 123				
Bromodichloromethane	47.26	1.0	50	0	94.5	79 - 125				
Bromoform	50.53	1.0	50	0	101	66 - 130				
Bromomethane	48.48	1.0	50	0	97.0	53 - 141				

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180222	Units: ug/L			Analysis Date: 22-Feb-2018 12:34					
Client ID:	Run ID: VOA2_311411	SeqNo: 4449130		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	93.4	2.0	100	0	93.4	64 - 133				
Carbon tetrachloride	45.83	1.0	50	0	91.7	72 - 136				
Chlorobenzene	44.11	1.0	50	0	88.2	80 - 120				
Chloroethane	41.99	1.0	50	0	84.0	82 - 118				
Chloroform	43.44	1.0	50	0	86.9	79 - 124				
Chloromethane	47	1.0	50	0	94.0	50 - 139				
cis-1,2-Dichloroethene	47.53	1.0	50	0	95.1	78 - 123				
cis-1,3-Dichloropropene	49.24	1.0	50	0	98.5	75 - 124				
Dibromochloromethane	47.82	1.0	50	0	95.6	74 - 126				
Dibromomethane	50.02	1.0	50	0	100	79 - 123				
Dichlorodifluoromethane	45.26	1.0	50	0	90.5	32 - 152				
Ethylbenzene	50.35	1.0	50	0	101	79 - 121				
Hexachlorobutadiene	43.37	1.0	50	0	86.7	66 - 134				
Isopropylbenzene	45.24	1.0	50	0	90.5	72 - 131				
m,p-Xylene	88.7	2.0	100	0	88.7	80 - 121				
Methylene chloride	43.61	2.0	50	0	87.2	74 - 124				
Naphthalene	51.48	1.0	50	0	103	61 - 128				
n-Butylbenzene	42.92	1.0	50	0	85.8	75 - 128				
n-Propylbenzene	41.34	1.0	50	0	82.7	76 - 126				
o-Xylene	45.09	1.0	50	0	90.2	78 - 122				
sec-Butylbenzene	43.67	1.0	50	0	87.3	77 - 126				
Styrene	45.14	1.0	50	0	90.3	78 - 128				
tert-Butylbenzene	41.74	1.0	50	0	83.5	78 - 124				
Tetrachloroethene	46.26	1.0	50	0	92.5	74 - 129				
Toluene	43.23	1.0	50	0	86.5	80 - 121				
trans-1,2-Dichloroethene	48.51	1.0	50	0	97.0	75 - 124				
trans-1,3-Dichloropropene	50.85	1.0	50	0	102	73 - 127				
Trichloroethene	48.68	1.0	50	0	97.4	79 - 123				
Trichlorofluoromethane	44.54	1.0	50	0	89.1	65 - 141				
Vinyl chloride	46.79	1.0	50	0	93.6	58 - 137				
Surr: 1,2-Dichloroethane-d4	44.58	1.0	50	0	89.2	81 - 118				
Surr: 4-Bromofluorobenzene	50.45	1.0	50	0	101	85 - 114				
Surr: Dibromofluoromethane	41.8	1.0	50	0	83.6	80 - 119				
Surr: Toluene-d8	51.66	1.0	50	0	103	89 - 112				

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18020820-02MS	Units: ug/L			Analysis Date: 22-Feb-2018 15:27					
Client ID:	Run ID: VOA2_311411	SeqNo: 4449192	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	44.17	1.0	50	0	88.3	78 - 124				
1,1,1-Trichloroethane	47.68	1.0	50	0	95.4	74 - 131				
1,1,2,2-Tetrachloroethane	42.98	1.0	50	0	86.0	71 - 121				
1,1,2-Trichloroethane	44.07	1.0	50	0	88.1	80 - 119				
1,1-Dichloroethane	43.43	1.0	50	0	86.9	77 - 125				
1,1-Dichloroethene	48.06	1.0	50	0	96.1	71 - 131				
1,1-Dichloropropene	49.85	1.0	50	0	99.7	79 - 125				
1,2,3-Trichlorobenzene	45.04	1.0	50	0	90.1	69 - 129				
1,2,3-Trichloropropane	43.68	1.0	50	0	87.4	73 - 122				
1,2,4-Trichlorobenzene	44.66	1.0	50	0	89.3	69 - 130				
1,2,4-Trimethylbenzene	46	1.0	50	0	92.0	76 - 124				
1,2-Dibromo-3-chloropropane	50.04	1.0	50	0	100	62 - 128				
1,2-Dibromoethane	46.46	1.0	50	0	92.9	77 - 121				
1,2-Dichlorobenzene	39.79	1.0	50	0	79.6	80 - 119				S
1,2-Dichloroethane	43.46	1.0	50	0	86.9	73 - 128				
1,2-Dichloropropane	43.56	1.0	50	0	87.1	78 - 122				
1,3,5-Trimethylbenzene	46.86	1.0	50	0	93.7	75 - 124				
1,3-Dichlorobenzene	41.15	1.0	50	0	82.3	80 - 119				
1,3-Dichloropropane	42.94	1.0	50	0	85.9	80 - 119				
1,4-Dichlorobenzene	39.67	1.0	50	0	79.3	79 - 118				
2,2-Dichloropropane	45.81	1.0	50	0	91.6	60 - 139				
2-Butanone	108.1	2.0	100	0	108	56 - 143				
2-Chlorotoluene	45.47	1.0	50	0	90.9	79 - 122				
2-Hexanone	108.4	2.0	100	0	108	57 - 139				
4-Chlorotoluene	45.26	1.0	50	0	90.5	78 - 122				
4-Isopropyltoluene	42.04	1.0	50	0	84.1	77 - 127				
4-Methyl-2-pentanone	98.5	2.0	100	0	98.5	67 - 130				
Acetone	106.2	2.0	100	0	106	39 - 160				
Benzene	44.58	1.0	50	0	89.2	79 - 120				
Bromobenzene	38.81	1.0	50	0	77.6	80 - 120				S
Bromochloromethane	46.4	1.0	50	0	92.8	78 - 123				
Bromodichloromethane	45.2	1.0	50	0	90.4	79 - 125				
Bromoform	50.04	1.0	50	0	100	66 - 130				
Bromomethane	35.27	1.0	50	0	70.5	53 - 141				

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18020820-02MS	Units: ug/L			Analysis Date: 22-Feb-2018 15:27					
Client ID:	Run ID: VOA2_311411	SeqNo: 4449192	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	94.72	2.0	100	0	94.7	64 - 133				
Carbon tetrachloride	49.3	1.0	50	0	98.6	72 - 136				
Chlorobenzene	43.35	1.0	50	0	86.7	80 - 120				
Chloroethane	41.46	1.0	50	0	82.9	82 - 118				
Chloroform	41.77	1.0	50	0	83.5	79 - 124				
Chloromethane	44.16	1.0	50	0	88.3	50 - 139				
cis-1,2-Dichloroethene	45.94	1.0	50	0	91.9	78 - 123				
cis-1,3-Dichloropropene	46.41	1.0	50	0	92.8	75 - 124				
Dibromochloromethane	46.88	1.0	50	0	93.8	74 - 126				
Dibromomethane	47.57	1.0	50	0	95.1	79 - 123				
Dichlorodifluoromethane	38.08	1.0	50	0	76.2	32 - 152				
Ethylbenzene	50.38	1.0	50	0	101	79 - 121				
Hexachlorobutadiene	44.33	1.0	50	0	88.7	66 - 134				
Isopropylbenzene	45.9	1.0	50	0	91.8	72 - 131				
m,p-Xylene	87.2	2.0	100	0	87.2	80 - 121				
Methylene chloride	41.24	2.0	50	0	82.5	74 - 124				
Naphthalene	51.23	1.0	50	0	102	61 - 128				
n-Butylbenzene	43.91	1.0	50	0	87.8	75 - 128				
n-Propylbenzene	41.31	1.0	50	0	82.6	76 - 126				
o-Xylene	43.68	1.0	50	0	87.4	78 - 122				
sec-Butylbenzene	43.79	1.0	50	0	87.6	77 - 126				
Styrene	43.63	1.0	50	0	87.3	78 - 128				
tert-Butylbenzene	42.23	1.0	50	0	84.5	78 - 124				
Tetrachloroethene	46.06	1.0	50	0	92.1	74 - 129				
Toluene	42.66	1.0	50	0	85.3	80 - 121				
trans-1,2-Dichloroethene	47.37	1.0	50	0	94.7	75 - 124				
trans-1,3-Dichloropropene	48.85	1.0	50	0	97.7	73 - 127				
Trichloroethene	48.18	1.0	50	0	96.4	79 - 123				
Trichlorofluoromethane	46.6	1.0	50	0	93.2	65 - 141				
Vinyl chloride	45.65	1.0	50	0	91.3	58 - 137				
Surr: 1,2-Dichloroethane-d4	44.8	1.0	50	0	89.6	81 - 118				
Surr: 4-Bromofluorobenzene	50.54	1.0	50	0	101	85 - 114				
Surr: Dibromofluoromethane	40.66	1.0	50	0	81.3	80 - 119				
Surr: Toluene-d8	51.94	1.0	50	0	104	89 - 112				

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411		Instrument: VOA2		Method: SW8260						
MSD	Sample ID: HS18020820-02MSD	Units: ug/L			Analysis Date: 22-Feb-2018 15:51					
Client ID:	Run ID: VOA2_311411	SeqNo: 4449193		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	42.55	1.0	50	0	85.1	78 - 124	44.17	3.73	20	
1,1,1-Trichloroethane	45.64	1.0	50	0	91.3	74 - 131	47.68	4.37	20	
1,1,2,2-Tetrachloroethane	42.02	1.0	50	0	84.0	71 - 121	42.98	2.28	20	
1,1,2-Trichloroethane	42.68	1.0	50	0	85.4	80 - 119	44.07	3.2	20	
1,1-Dichloroethane	41.98	1.0	50	0	84.0	77 - 125	43.43	3.41	20	
1,1-Dichloroethene	45.65	1.0	50	0	91.3	71 - 131	48.06	5.14	20	
1,1-Dichloropropene	47.93	1.0	50	0	95.9	79 - 125	49.85	3.95	20	
1,2,3-Trichlorobenzene	45.48	1.0	50	0	91.0	69 - 129	45.04	0.952	20	
1,2,3-Trichloropropane	43.87	1.0	50	0	87.7	73 - 122	43.68	0.442	20	
1,2,4-Trichlorobenzene	44.55	1.0	50	0	89.1	69 - 130	44.66	0.249	20	
1,2,4-Trimethylbenzene	44.8	1.0	50	0	89.6	76 - 124	46	2.63	20	
1,2-Dibromo-3-chloropropane	47.66	1.0	50	0	95.3	62 - 128	50.04	4.88	20	
1,2-Dibromoethane	45.83	1.0	50	0	91.7	77 - 121	46.46	1.36	20	
1,2-Dichlorobenzene	39.18	1.0	50	0	78.4	80 - 119	39.79	1.55	20	S
1,2-Dichloroethane	42.87	1.0	50	0	85.7	73 - 128	43.46	1.37	20	
1,2-Dichloropropane	42.27	1.0	50	0	84.5	78 - 122	43.56	3	20	
1,3,5-Trimethylbenzene	44.95	1.0	50	0	89.9	75 - 124	46.86	4.17	20	
1,3-Dichlorobenzene	39.79	1.0	50	0	79.6	80 - 119	41.15	3.36	20	S
1,3-Dichloropropane	42.54	1.0	50	0	85.1	80 - 119	42.94	0.94	20	
1,4-Dichlorobenzene	39.46	1.0	50	0	78.9	79 - 118	39.67	0.518	20	S
2,2-Dichloropropane	43.78	1.0	50	0	87.6	60 - 139	45.81	4.53	20	
2-Butanone	110.8	2.0	100	0	111	56 - 143	108.1	2.52	20	
2-Chlorotoluene	43.72	1.0	50	0	87.4	79 - 122	45.47	3.93	20	
2-Hexanone	108.3	2.0	100	0	108	57 - 139	108.4	0.117	20	
4-Chlorotoluene	44.18	1.0	50	0	88.4	78 - 122	45.26	2.41	20	
4-Isopropyltoluene	41.08	1.0	50	0	82.2	77 - 127	42.04	2.31	20	
4-Methyl-2-pentanone	98.43	2.0	100	0	98.4	67 - 130	98.5	0.0615	20	
Acetone	112.1	2.0	100	0	112	39 - 160	106.2	5.32	20	
Benzene	42.72	1.0	50	0	85.4	79 - 120	44.58	4.26	20	
Bromobenzene	38.18	1.0	50	0	76.4	80 - 120	38.81	1.64	20	S
Bromochloromethane	45.43	1.0	50	0	90.9	78 - 123	46.4	2.13	20	
Bromodichloromethane	43.37	1.0	50	0	86.7	79 - 125	45.2	4.15	20	
Bromoform	48.92	1.0	50	0	97.8	66 - 130	50.04	2.27	20	
Bromomethane	36.78	1.0	50	0	73.6	53 - 141	35.27	4.18	20	

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411		Instrument: VOA2		Method: SW8260						
MSD	Sample ID: HS18020820-02MSD	Units: ug/L			Analysis Date: 22-Feb-2018 15:51					
Client ID:	Run ID: VOA2_311411	SeqNo: 4449193		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	89.68	2.0	100	0	89.7	64 - 133	94.72	5.47	20	
Carbon tetrachloride	45.52	1.0	50	0	91.0	72 - 136	49.3	7.97	20	
Chlorobenzene	41.71	1.0	50	0	83.4	80 - 120	43.35	3.86	20	
Chloroethane	43.61	1.0	50	0	87.2	82 - 118	41.46	5.05	20	
Chloroform	40.49	1.0	50	0	81.0	79 - 124	41.77	3.11	20	
Chloromethane	39.4	1.0	50	0	78.8	50 - 139	44.16	11.4	20	
cis-1,2-Dichloroethene	44.79	1.0	50	0	89.6	78 - 123	45.94	2.55	20	
cis-1,3-Dichloropropene	46.01	1.0	50	0	92.0	75 - 124	46.41	0.865	20	
Dibromochloromethane	45	1.0	50	0	90.0	74 - 126	46.88	4.1	20	
Dibromomethane	46.42	1.0	50	0	92.8	79 - 123	47.57	2.45	20	
Dichlorodifluoromethane	36.53	1.0	50	0	73.1	32 - 152	38.08	4.17	20	
Ethylbenzene	48.12	1.0	50	0	96.2	79 - 121	50.38	4.59	20	
Hexachlorobutadiene	45.01	1.0	50	0	90.0	66 - 134	44.33	1.52	20	
Isopropylbenzene	43.97	1.0	50	0	87.9	72 - 131	45.9	4.29	20	
m,p-Xylene	84.65	2.0	100	0	84.7	80 - 121	87.2	2.96	20	
Methylene chloride	39.86	2.0	50	0	79.7	74 - 124	41.24	3.39	20	
Naphthalene	52.7	1.0	50	0	105	61 - 128	51.23	2.83	20	
n-Butylbenzene	43.07	1.0	50	0	86.1	75 - 128	43.91	1.93	20	
n-Propylbenzene	40.09	1.0	50	0	80.2	76 - 126	41.31	2.98	20	
o-Xylene	41.89	1.0	50	0	83.8	78 - 122	43.68	4.21	20	
sec-Butylbenzene	42.12	1.0	50	0	84.2	77 - 126	43.79	3.88	20	
Styrene	42.3	1.0	50	0	84.6	78 - 128	43.63	3.09	20	
tert-Butylbenzene	40.52	1.0	50	0	81.0	78 - 124	42.23	4.13	20	
Tetrachloroethene	44.41	1.0	50	0	88.8	74 - 129	46.06	3.64	20	
Toluene	40.83	1.0	50	0	81.7	80 - 121	42.66	4.38	20	
trans-1,2-Dichloroethene	45.51	1.0	50	0	91.0	75 - 124	47.37	4.01	20	
trans-1,3-Dichloropropene	47.28	1.0	50	0	94.6	73 - 127	48.85	3.28	20	
Trichloroethene	45.81	1.0	50	0	91.6	79 - 123	48.18	5.04	20	
Trichlorofluoromethane	44.6	1.0	50	0	89.2	65 - 141	46.6	4.38	20	
Vinyl chloride	44.11	1.0	50	0	88.2	58 - 137	45.65	3.42	20	
Surr: 1,2-Dichloroethane-d4	44.68	1.0	50	0	89.4	81 - 118	44.8	0.274	20	
Surr: 4-Bromofluorobenzene	50.99	1.0	50	0	102	85 - 114	50.54	0.899	20	
Surr: Dibromofluoromethane	41.6	1.0	50	0	83.2	80 - 119	40.66	2.3	20	
Surr: Toluene-d8	51.6	1.0	50	0	103	89 - 112	51.94	0.656	20	

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311411	Instrument: VOA2	Method: SW8260
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The following samples were analyzed in this batch:

HS18020787-01	HS18020787-02
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Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

QC BATCH REPORT

Batch ID: R311220		Instrument: UV-2450		Method: SW7196					
MBLK	Sample ID: MBLK-R311220	Units: mg/L		Analysis Date: 15-Feb-2018 13:45					
Client ID:	Run ID: UV-2450_311220	SeqNo: 4444771		PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Chromium, Hexavalent	0.00600	0.0100							U
LCS	Sample ID: LCS-R311220	Units: mg/L		Analysis Date: 15-Feb-2018 13:45					
Client ID:	Run ID: UV-2450_311220	SeqNo: 4444770		PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Chromium, Hexavalent	0.248	0.0100	0.25	0	99.2	80 - 120			
MS	Sample ID: HS18020793-01MS	Units: mg/L		Analysis Date: 15-Feb-2018 13:45					
Client ID:	Run ID: UV-2450_311220	SeqNo: 4444773		PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Chromium, Hexavalent	0.212	0.0100	0.25	0.002	84.0	75 - 125			
MSD	Sample ID: HS18020793-01MSD	Units: mg/L		Analysis Date: 15-Feb-2018 13:45					
Client ID:	Run ID: UV-2450_311220	SeqNo: 4444772		PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Chromium, Hexavalent	0.207	0.0100	0.25	0.002	82.0	75 - 125	0.212	2.39	20

The following samples were analyzed in this batch: HS18020787-01

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Ehhluent Samples
WorkOrder: HS18020787

**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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18020787

Date/Time Received: **15-Feb-2018 09:00**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 15-Feb-2018
 eSignature Date
 Reviewed by: Corey Grandits 15-Feb-2018
 eSignature 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): 2.7c/2.1c UC/C IR25
 Cooler(s)/Kit(s): 43302
 Date/Time sample(s) sent to storage: 02/15/2018 13:11

- 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:

 <p>ALS 10450 Stanciliff Rd., Suite 210 Houston, Texas 77088 Tel. +1 281 530 6658 Fax. +1 281 530 5987</p>	<p>CI Date: 2/14/18 Name: [Signature] Company: [Signature]</p>	<p>JSTODY SEAL Time: 14:30 [Signature] [Signature]</p>	<p>Seal Broken By: [Signature] Date: 2/15/18</p>
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RETURNS MON - SAT
PRIORITY OVERNIGHT

TRK# 7376 9752 1832
0221

77099

TX-US

FedEx

TRK# 7376 9752 1832
0221

THU - 15 FEB 10:30A
PRIORITY OVERNIGHT

AB SGRA

77099

TX-US



FTD 102705 14FTB10 000A 546C171271/000A



Case Narrative

Method: 6850

Analysis: Perchlorate

Analysis SOP: LC-MS-CLO4

ALS WO ID(s): 1804763; 1804764; 1804765;
1805239; 1805240; 1805310

Client: ALS Laboratories (Houston, TX)

Matrix: Water

ELMS Batch (HBN): 2053 (209112)

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 ¹⁸O 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 ¹⁸O 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: Sample 1804765001 was analyzed and reported at a 1:1,000 dilution. Sample 1805310001 was re-analyzed and reported at a 1:10 dilution. The reporting limits have been adjusted accordingly.

Method QC data: The method blank (LMB 588565) was less than 1/2 the CRDL. The recovery for the LCS (588566) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1804763001 (Client ID: LH18/24-SP650_021418). The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The relative percent difference (RPD) was within the performance limits.



Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)

B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 588563). These samples were analyzed in accordance with the requirements found in the DOD QSM Version 5.1. Manual Integrations were performed for datafiles 22FEBD21/26.

Thomas Bosch February 23, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: February 23, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1804763**

Project ID: HS18020787 021418

Purchase Order: HS18020787

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP650-021418	1804763001	02/14/18	02/16/18	



ANALYTICAL REPORT

Workorder: **34-1804763**Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP650-021418	Sampling Site: NA	Collected: 02/14/2018				
Lab ID: 1804763001	Media: 125 mL Nalgene	Received: 02/16/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2053 (HBN: 209112) Analyzed: 02/22/2018 18:19	Instrument ID: LCMS04 Percent Solid: NA 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

Comments

Quality Control: EPA 6850, DoD QSM - (HBN: 209112)

The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

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 02/23/2018 09:38	/S/ Stephen Brose 02/23/2018 11:13

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: als.lt.lab@ALSGlobal.com
Web: www.alsslc.com



ANALYTICAL REPORT

Workorder: 34-1804763

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
Washington	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	ACCLASS (ISO 17025)	ADE-1420	http://www.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1804763

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

00883316

Analysis Information

Workorder: 1804763

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2053 (HBN: 209112)
Analyzed By: Thomas Bosch

Blank

LMB: 588565
Analyzed: 02/22/2018 17:50
Units: ug/L

Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 588566
Analyzed: 02/22/2018 18:04
Dilution: 1
Units: ug/L

Analyte	Result	Target	% Rec	QC Limits
Perchlorate	4.72	5.00	94.4	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1804763001
Analyzed: 02/22/2018 18:19
Dilution: 1
Units: ug/L

MS: 588567
Analyzed: 02/22/2018 18:34
Dilution: 1
Units: ug/L

MSD: 588568
Analyzed: 02/22/2018 18:48
Dilution: 1
Units: ug/L

Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	ND	6.41	5	# 128	78.8 123.8	6.43	# 129	0.269	0.0 20.0

Continuing Calibration Verification

CCV: 588562
Analyzed: 02/22/2018 16:51
Units: ug/L
Criteria: ± 15%

CCV: 588569
Analyzed: 02/22/2018 20:46
Units: ug/L
Criteria: ± 15%

Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	23.6	25.0	94.4	28.1	25.0	112

Interference Check Sample

ICSA: 588564
Analyzed: 02/22/2018 17:20
Units: ug/L
Criteria: ± 30%

Analyte	Result	Target	% Rec.
Perchlorate	1.16	1.00	116

Limit of Detection Verification

LODV: 588563
Analyzed: 02/22/2018 17:06
Units: ug/L
Criteria: ± 50%

LODV: 588570
Analyzed: 02/22/2018 21:00
Units: ug/L
Criteria: ± 50%

Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	0.999	1.00	99.9	1.20	1.00	120



Quality Control Sample Batch Report

00883317

Analysis Information

Workorder: 1804763

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2053 (HBN: 209112)

Prepared By: NA

Analyzed By: Thomas Bosch

Comments

The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch 02/23/2018 09:38	/S/ Stephen Brose 02/23/2018 11:13

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

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Subcontract Chain of Custody

COC ID: 8628

1804763

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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:

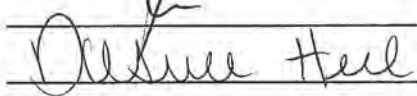
Company: ALS Houston
Contact: Accounts Payable
Address: 10450 Stancliff Rd, Ste 210
Phone: +1 281 530 5656
Reference: HS18020787
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18020787-01	LH18/24-SP650-021418	Water	14 Feb 2018 14:00
SUB_Perch-6850			01 Mar 2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: 

Received By: 

Cooler ID(s): _____

Date/Time: 2/15/18 1800

Date/Time: 2/16/2018 9:45

Temperature(s): _____

SHIPPING DEPT
ALS LABORATORY GROUP
10450 STANCLIFF
SUITE 210
HOUSTON, TX 77099
UNITED STATES US

ACTWTG1: 8.35 LB
CAD: 300130/CAFE3108
DIMS: 14x11x10 IN

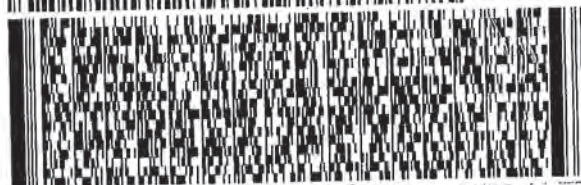
BILL SENDER

TO **KEVIN GRIFFITHS**
ALS ENVIRONMENTAL
960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123

(801) 288-7700

REF: HS18020787/793/815-RJ



FedEx
Express



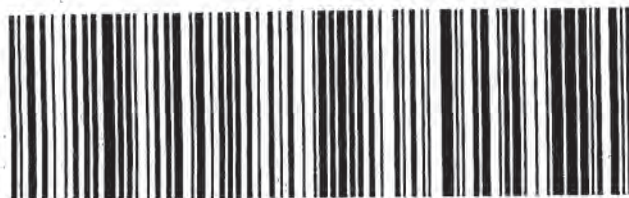
1435/0001/1395
Part # 15569-032 2102 EDP WELB ***
JUL7/01016161610101

TRK# 7376 9752 5194
0201

FRI - 16 FEB 3:00P
STANDARD OVERNIGHT

AX BTFA

84123
UT-US **SLC**





Batch Worklist

Batch: ELMS/2053

Instrument: LCMS04

Created: 2/22/2018 08:05

Rule: EPA 6850, DoD QSM Water



Status: W/P

Analyst: T. Bosch

- Workorder: 1804763 [ENV_LVL4]
- Workorder: 1804764 [ENV_LVL4]
- Workorder: 1804765 [ENV_LVL4]
- Workorder: 1805239 [ENV_LVL4]
- Workorder: 1805240 [ENV_LVL4]
- Workorder: 1805310 [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	588562	CCV for HBN 209112 [ELMS/2053]				CCV	3		E685041C3Q	5311	2/23/2018	2/23/2018	2/22/2018
2	588563	LODV for HBN 209112 [ELMS/2053]				LODV	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018
3	588564	ICS for HBN 209112 [ELMS/2053]				ICS	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018
4	588565	LMB for HBN 209112 [ELMS/2053]				LMB	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
5	588566	LCS for HBN 209112 [ELMS/2053]				LCS	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
6	1804763001	LH18/24-SP650-021418				SAMPLE	3	1804763001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
7	588567	LH18/24-SP650...(1804763001MS)				MS	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
8	588568	LH18/24-SP65...(1804763001MSD)				MSD	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
9	1804764001	LH18/24-SP-650_021418				SAMPLE	3	1804764001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
10	1804765001	LH18/24-SP140_021418				SAMPLE	3	1804765001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
11	1805239001	LHSMW02-021518				SAMPLE	3	1805239001-A	E6850Q41.3	5480	3/15/2018	2/23/2018	2/22/2018
12	1805240001	17WW12-021518				SAMPLE	3	1805240001-A	E6850Q41.3	5480	3/15/2018	2/23/2018	2/22/2018
13	1805310002	LH18/24-SP650_022118_AIX				SAMPLE	3	1805310002-A	E6850Q41.3	5480	3/21/2018	2/23/2018	2/22/2018
14	1805310001	LH18/24-SP650_022118_BIX				SAMPLE	3	1805310001-A	E6850Q41.3	5480	3/21/2018	2/23/2018	2/22/2018
15	588569	CCV for HBN 209112 [ELMS/2053]				CCV	3		E685041C3Q	5311	2/23/2018	2/23/2018	2/22/2018
16	588570	LODV for HBN 209112 [ELMS/2053]				LODV	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #'s: 1804763 (001); 1804764 (001); 1804765 (001); 1805239 (001); 1805240 (001); 1805310 (001,02)

ELMS Batch/HBN ID: 2053 (209112)

Prep Date: 02/22/2018 Analysis Date: 02/22/2018 Analyst: T. Bosch

Analyte: **Perchlorate** Matrix: **Water** Method: **6850**

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\22\FEB18D.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 02/22/2018, sequence 22FEB18D.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-DOD.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	0.80
4.0	0.80
5.0	0.25
10.0	0.25
10.5	0.80
13.0	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 588566; Target = 5.0µg/L. ASTM type II water was used for LMB 588565.

MS/MSD: MS/MSD was performed on sample 1804763001 (Client ID: LH18/24-SP650_021418). 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. Sample 1804765001 was analyzed and reported at a 1:1,000 dilution. Sample 1805310001 was re-analyzed and reported at a 1:10 dilution. The reporting limits have been adjusted accordingly.
- 2) All QC, Blank, CCV, and MS/MSD results were within method parameters, except for the following. The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The ion ratio of m/z 83 to 85 often fails at levels near the reported Detection Limit (DL). The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 588563).
- 3) Sample data can be viewed at two directories within the ALS system: \\ALS\TWS013\LCMS\LCMS04\2018\FEB\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 datafiles 22FEBD21/26.
- 5) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\209112-DOD-ALS-HSTN-LCMS4 or through \\ALS\TWS013\DATAREVIEW\HBN#



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	Created By: T. Bosch	Amount: 10 mL			
MFG: ALS/SLC	Create Date: 05/10/2017	Expires: 05/10/2018			
MFG Lot: TNB: 05/10/17	Lab Lot: CLO4 INT	Usable: Yes			
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17		Lab Lot: CLO4 QC WRK 100.ug/L		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 10 mL	
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018	
MFG Lot: TNB: 05/11/2017	Lab Lot: CLO4 QC INT 10.ug/mL	Usable: Yes	
Part ID:			

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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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

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.



Certificate of Analysis



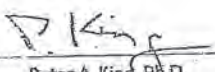
ISO Guide 34 Reference Material

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 (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:
ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



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

February 27, 2018

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

Work Order: **HS18020793**

Laboratory Results for: **Longhorn GW Treatment Plant Monthly Influent Samples**

Dear Marcia,

ALS Environmental received 1 sample(s) on Feb 15, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Influent Samples
Work Order: HS18020793

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18020793-01	LH18/24-SP140_021418	Water		14-Feb-2018 14:00	15-Feb-2018 09:00	<input type="checkbox"/>

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Influent Samples
Work Order:

CASE NARRATIVE

Work Order Comments

- The analysis for Perchlorate was subcontracted to ALS Salt Lake City, UT. Final report attached.
-

Metals by Method SW6020**Batch ID: 125507**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method SW7196**Batch ID: R311220**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Monthly Influent Samples
 Sample ID: LH18/24-SP140_021418
 Collection Date: 14-Feb-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18020793
 Lab ID:HS18020793-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
ICP-MS METALS BY SW6020A		Method:SW6020				Prep:SW3010A / 21-Feb-2018		Analyst: JCJ
Selenium	0.00130	J	0.00110	0.00200	0.00200	mg/L	1	26-Feb-2018 13:34
Silver	0.00100	U	0.000200	0.00100	0.00200	mg/L	1	26-Feb-2018 13:34
HEXAVALENT CHROMIUM BY SW7196A		Method:SW7196				Prep:SW7196		Analyst: JHD
Chromium, Hexavalent	0.00600	U	0.00600	0.00600	0.0100	mg/L	1	15-Feb-2018 13:45
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Method:NA						Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	23-Feb-2018 15:46

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

WEIGHT LOG

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Influent Samples
WorkOrder: HS18020793

Batch ID: 125507 **Method:** ICP-MS METALS BY SW6020A **Prep:** 3010A

SampleID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18020793-01	1	10	10 (mL)	1

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Influent Samples
WorkOrder: HS18020793

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID 125507	Test Name : ICP-MS METALS BY SW6020A		Matrix: Water			
HS18020793-01	LH18/24-SP140_021418	14 Feb 2018 14:00		21 Feb 2018 14:23	26 Feb 2018 13:34	1
Batch ID R311220	Test Name : HEXAVALENT CHROMIUM BY SW7196A		Matrix: Water			
HS18020793-01	LH18/24-SP140_021418	14 Feb 2018 14:00			15 Feb 2018 13:45	1
Batch ID R311458	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18020793-01	LH18/24-SP140_021418	14 Feb 2018 14:00			23 Feb 2018 15:46	1

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Influent Samples
WorkOrder: HS18020793

QC BATCH REPORT

Batch ID: 125507		Instrument: ICPMS04		Method: SW6020					
MBLK	Sample ID: MBLK-125507	Units: mg/L		Analysis Date: 26-Feb-2018 13:28					
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451733	PrepDate: 21-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.00200	0.00200							U
Silver	0.00100	0.00200							U
LCS	Sample ID: LCS-125507	Units: mg/L		Analysis Date: 26-Feb-2018 13:30					
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451734	PrepDate: 21-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.05046	0.00200	0.05	0	101	80 - 120			
Silver	0.04804	0.00200	0.05	0	96.1	80 - 120			
MS	Sample ID: HS18020829-02MS	Units: mg/L		Analysis Date: 26-Feb-2018 13:41					
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451739	PrepDate: 21-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.0473	0.00200	0.05	-0.000831	96.3	80 - 120			
Silver	0.04618	0.00200	0.05	0.000013	92.3	80 - 120			
MSD	Sample ID: HS18020829-02MSD	Units: mg/L		Analysis Date: 26-Feb-2018 13:48					
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451767	PrepDate: 21-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.0494	0.00200	0.05	0	98.8	80 - 120	0.0473	4.34	20
Silver	0.04606	0.00200	0.05	0	92.1	80 - 120	0.04618	0.262	20
PDS	Sample ID: HS18020829-02PDS	Units: mg/L		Analysis Date: 26-Feb-2018 13:50					
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451768	PrepDate: 21-Feb-2018	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit Qual
Selenium	0.1004	0.00200	0.1	0	100	75 - 125			
Silver	0.09696	0.00200	0.1	0	97.0	75 - 125			

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Influent Samples
WorkOrder: HS18020793

QC BATCH REPORT

Batch ID: 125507		Instrument: ICPMS04		Method: SW6020						
SD	Sample ID: HS18020829-02SD	Units: mg/L		Analysis Date: 26-Feb-2018 13:39						
Client ID:	Run ID: ICPMS04_311518	SeqNo: 4451738	PrepDate: 21-Feb-2018	DF: 5						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	Limit	Qual
Selenium	0.0100	0.0100					-0.000831	0	10	U
Silver	0.00500	0.0100					0.000013	0	10	U

The following samples were analyzed in this batch: HS18020793-01

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

ALS Group USA, Corp

Date: 27-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Influent Samples
WorkOrder: HS18020793

QC BATCH REPORT

Batch ID: R311220		Instrument: UV-2450		Method: SW7196					
MBLK	Sample ID: MBLK-R311220	Units: mg/L		Analysis Date: 15-Feb-2018 13:45					
Client ID:	Run ID: UV-2450_311220	SeqNo: 4444771		PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD Limit Qual	
Chromium, Hexavalent	0.00600	0.0100							
								U	
LCS	Sample ID: LCS-R311220	Units: mg/L		Analysis Date: 15-Feb-2018 13:45					
Client ID:	Run ID: UV-2450_311220	SeqNo: 4444770		PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD Limit Qual	
Chromium, Hexavalent	0.248	0.0100	0.25	0	99.2	80 - 120			
MS	Sample ID: HS18020793-01MS	Units: mg/L		Analysis Date: 15-Feb-2018 13:45					
Client ID: LH18/24-SP140_021418	Run ID: UV-2450_311220	SeqNo: 4444773		PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD Limit Qual	
Chromium, Hexavalent	0.212	0.0100	0.25	0.002	84.0	75 - 125			
MSD	Sample ID: HS18020793-01MSD	Units: mg/L		Analysis Date: 15-Feb-2018 13:45					
Client ID: LH18/24-SP140_021418	Run ID: UV-2450_311220	SeqNo: 4444772		PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD Limit Qual	
Chromium, Hexavalent	0.207	0.0100	0.25	0.002	82.0	75 - 125	0.212	2.39 20	

The following samples were analyzed in this batch: HS18020793-01

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Monthly Influent Samples
WorkOrder: HS18020793

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18020793

Date/Time Received: **15-Feb-2018 09:00**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 15-Feb-2018
 eSignature Date

Reviewed by: Corey Grandits 15-Feb-2018
 eSignature 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): 2.7c/2.1c UC/C IR25
 Cooler(s)/Kit(s): 43302
 Date/Time sample(s) sent to storage: 02/15/2018 12:50

- 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:

JSTODY SEAL		Seal Broken By:
Time: 14:30	Date: 1/16/83	
V. SINGEL		
V. S.		

ALS 10450 Stancilff Rd., Suite 210 Houston, Texas 77059 Tel. +1 281 530 5056 Fax. +1 281 530 5887	CI
	Date: 2/19/83 Name: Scott Company: B

RETURNS MON - SAT
 PRIORITY OVERNIGHT

IRM# 7376 9752 1832
 0221

77099

TX-US

THU - 15 FEB 10:30A
 PRIORITY OVERNIGHT

IRM# 7376 9752 1832
 0221

AB SGRA

77099

TX-US
 1/16/83



FID 182786 147C018 500A 548C1/1270/80DA



Case Narrative

Method: 6850

Analysis: Perchlorate

Analysis SOP: LC-MS-CLO4

ALS WO ID(s): 1804763; 1804764; 1804765;
1805239; 1805240; 1805310

Client: ALS Laboratories (Houston, TX)

Matrix: Water

ELMS Batch (HBN): 2053 (209112)

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 ¹⁸O 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 ¹⁸O 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: Sample 1804765001 was analyzed and reported at a 1:1,000 dilution. Sample 1805310001 was re-analyzed and reported at a 1:10 dilution. The reporting limits have been adjusted accordingly.

Method QC data: The method blank (LMB 588565) was less than 1/2 the CRDL. The recovery for the LCS (588566) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1804763001 (Client ID: LH18/24-SP650_021418). The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The relative percent difference (RPD) was within the performance limits.



Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)

B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 588563). These samples were analyzed in accordance with the requirements found in the DOD QSM Version 5.1. Manual Integrations were performed for datafiles 22FEBD21/26.

Thomas Bosch February 23, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: February 23, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1804765**

Project ID: HS18020793 021418

Purchase Order: HS18020793

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP140_021418	1804765001	02/14/18	02/16/18	



ANALYTICAL REPORT

Workorder: **34-1804765**Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP140_021418	Sampling Site: NA	Collected: 02/14/2018				
Lab ID: 1804765001	Media: 125 mL Nalgene	Received: 02/16/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2053 (HBN: 209112) Analyzed: 02/22/2018 19:17	Instrument ID: LCMS04 Percent Solid: NA Report Basis: Wet				
Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	16000	1000	2000	4000	1000	

Comments

Quality Control: EPA 6850, DoD QSM - (HBN: 209112)

The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

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 02/23/2018 09:38	/S/ Stephen Brose 02/23/2018 11:13

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: als.lt.lab@ALSGlobal.com
Web: www.alsslc.com



ANALYTICAL REPORT

Workorder: 34-1804765

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	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.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1804765

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

00883358

Analysis Information

Workorder: 1804765

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2053 (HBN: 209112)
Analyzed By: Thomas Bosch

Blank

LMB: 588565 Analyzed: 02/22/2018 17:50 Units: ug/L			
Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 588566 Analyzed: 02/22/2018 18:04 Dilution: 1 Units: ug/L				
Analyte	Result	Target	% Rec	QC Limits
Perchlorate	4.72	5.00	94.4	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1804763001 Analyzed: 02/22/2018 18:19 Dilution: 1 Units: ug/L			MS: 588567 Analyzed: 02/22/2018 18:34 Dilution: 1 Units: ug/L			MSD: 588568 Analyzed: 02/22/2018 18:48 Dilution: 1 Units: ug/L			
Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	ND	6.41	5	# 128	78.8 123.8	6.43	# 129	0.269	0.0 20.0

Continuing Calibration Verification

CCV: 588562 Analyzed: 02/22/2018 16:51 Units: ug/L Criteria: ± 15%				CCV: 588569 Analyzed: 02/22/2018 20:46 Units: ug/L Criteria: ± 15%		
Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	23.6	25.0	94.4	28.1	25.0	112

Interference Check Sample

ICSA: 588564 Analyzed: 02/22/2018 17:20 Units: ug/L Criteria: ± 30%			
Analyte	Result	Target	% Rec.
Perchlorate	1.16	1.00	116

Limit of Detection Verification

LODV: 588563 Analyzed: 02/22/2018 17:06 Units: ug/L Criteria: ± 50%				LODV: 588570 Analyzed: 02/22/2018 21:00 Units: ug/L Criteria: ± 50%		
Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	0.999	1.00	99.9	1.20	1.00	120



Quality Control Sample Batch Report

00883359

Analysis Information

Workorder: 1804765

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2053 (HBN: 209112)

Prepared By: NA

Analyzed By: Thomas Bosch

Comments

The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch 02/23/2018 09:38	/S/ Stephen Brose 02/23/2018 11:13

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



18098/#2

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Subcontract Chain of Custody

COC ID: 8627

1804765

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18020793
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18020793-01	LH18/24-SP140_021418	Water	14 Feb 2018 14:00
SUB_Perch-6850			01 Mar 2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: [Signature]
Received By: [Signature]
Cooler ID(s): _____

Date/Time: 2/15/18 1800
Date/Time: 02/16/2018 9:45
Temperature(s): _____

ALS-SALT LAKE CITY-RELATED INFORMATION REPORT (CRIR)

1804765

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

Client Name: <u>ALS Houston</u>		Project/Task/Site: <u>HS18020793-01</u>						
Date/Time of Receipt: <u>02/10/2018 9:45</u>		Number of Coolers Received: <u>1</u>						
Condition of Coolers: <u>Acceptable</u> /Unacceptable		Temperature Control: Present/Not <u>Included</u>						
Cooler Custody Seals: <u>Present</u> /Absent/NA		Location Temp Taken: Control/ <u>Between Samples</u>						
Container Custody Seals: <u>Present</u> / Absent /NA		Are all temperatures within project specific guidelines? Yes/No/NA						
Ice Present: <u>Yes</u> /No/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 <u>8261</u>	<u>4</u> °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: <u>Desiree Hill</u>		Signature		<u>Desiree Hill</u>		Printed Name		<u>02/10/2018</u>
								Date

CLIENT-RELATED INFORMATION

<input type="checkbox"/> Missing Cooler	<input type="checkbox"/> Missing Samples/Bottles	<input type="checkbox"/> Incorrect Preservation	<input type="checkbox"/> Insufficient Sample Volume
<input type="checkbox"/> Cooler Conditions	<input type="checkbox"/> Broken/Leaking Samples	<input type="checkbox"/> pH Criteria Not Met	<input type="checkbox"/> Chain of Custody Problems
<input type="checkbox"/> Missing Paperwork	<input type="checkbox"/> Incorrect Bottle Type	<input type="checkbox"/> Residual Chlorine Present	<input type="checkbox"/> Other:
<input type="checkbox"/> Missing/Incorrect Bottle Labels	<input type="checkbox"/> Cooler Temperatures Out of Range	<input type="checkbox"/> Head Space in Bottles	

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

Client Notified? Yes No

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

ALS Project Manager: _____ Returned to Sample Receipt by: _____ Date: _____

Printed Name

Signature



Batch Worklist

HBN: 209112



Instrument: LCMS04

Status: W/P

Created: 2/22/2018 08:05

Analyst: T. Bosch

Batch: ELMS/2053

Rule: EPA 6850, DoD QSM Water

- Workorder: 1804763 [ENV_LVL4]
- Workorder: 1804764 [ENV_LVL4]
- Workorder: 1804765 [ENV_LVL4]
- Workorder: 1805239 [ENV_LVL4]
- Workorder: 1805240 [ENV_LVL4]
- Workorder: 1805310 [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	588562	CCV for HBN 209112 [ELMS/2053]				CCV	3		E685041C3Q	5311	2/23/2018	2/23/2018	2/22/2018
2	588563	LODV for HBN 209112 [ELMS/2053]				LODV	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018
3	588564	ICS for HBN 209112 [ELMS/2053]				ICS	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018
4	588565	LMB for HBN 209112 [ELMS/2053]				LMB	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
5	588566	LCS for HBN 209112 [ELMS/2053]				LCS	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
6	1804763001	LH18/24-SP650-021418				SAMPLE	3	1804763001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
7	588567	LH18/24-SP650...(1804763001MS)				MS	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
8	588568	LH18/24-SP65...(1804763001MSD)				MSD	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
9	1804764001	LH18/24-SP-650_021418				SAMPLE	3	1804764001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
10	1804765001	LH18/24-SP140_021418				SAMPLE	3	1804765001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
11	1805239001	LHSMW02-021518				SAMPLE	3	1805239001-A	E6850Q41.3	5480	3/15/2018	2/23/2018	2/22/2018
12	1805240001	17WW12-021518				SAMPLE	3	1805240001-A	E6850Q41.3	5480	3/15/2018	2/23/2018	2/22/2018
13	1805310002	LH18/24-SP650_022118_AIX				SAMPLE	3	1805310002-A	E6850Q41.3	5480	3/21/2018	2/23/2018	2/22/2018
14	1805310001	LH18/24-SP650_022118_BIX				SAMPLE	3	1805310001-A	E6850Q41.3	5480	3/21/2018	2/23/2018	2/22/2018
15	588569	CCV for HBN 209112 [ELMS/2053]				CCV	3		E685041C3Q	5311	2/23/2018	2/23/2018	2/22/2018
16	588570	LODV for HBN 209112 [ELMS/2053]				LODV	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018

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ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #'s: 1804763 (001); 1804764 (001); 1804765 (001); 1805239 (001); 1805240 (001); 1805310 (001,02)

ELMS Batch/HBN ID: 2053 (209112)

Prep Date: 02/22/2018 Analysis Date: 02/22/2018 Analyst: T. Bosch

Analyte: **Perchlorate** Matrix: **Water** Method: **6850**

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\22FEB18D.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 02/22/2018, sequence 22FEB18D.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-DOD.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	0.80
4.0	0.80
5.0	0.25
10.0	0.25
10.5	0.80
13.0	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 588566; Target = 5.0µg/L. ASTM type II water was used for LMB 588565.

MS/MSD: MS/MSD was performed on sample 1804763001 (Client ID: LH18/24-SP650_021418). 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. Sample 1804765001 was analyzed and reported at a 1:1,000 dilution. Sample 1805310001 was re-analyzed and reported at a 1:10 dilution. The reporting limits have been adjusted accordingly.
- 2) All QC, Blank, CCV, and MS/MSD results were within method parameters, except for the following. The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The ion ratio of m/z 83 to 85 often fails at levels near the reported Detection Limit (DL). The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 588563).
- 3) Sample data can be viewed at two directories within the ALS system: \\ALS\TWS013\LCMS\LCMS04\2018\FEB\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 datafiles 22FEBD21/26.
- 5) Notebook: \\als\TWS013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\209112-DOD-ALS-HSTN-LCMS4 or through \\ALS\TWS013\DATAREVIEW\HBN#



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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 INT		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17		Lab Lot: CLO4 QC WRK 100.ug/L		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 10 mL	
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018	
MFG Lot: TNB: 05/11/2017	Lab Lot: CLO4 QC INT 10.ug/mL	Usable: Yes	
Part ID:			

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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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



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.





Certificate of Analysis



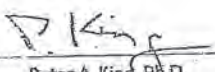
ISO Guide 34 Reference Material

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 (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:
ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



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

February 28, 2018

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

Work Order: **HS18020815**

Laboratory Results for: **Longhorn GW Treatment Plant Weekly Samples**

Dear Marcia,

ALS Environmental received 1 sample(s) on Feb 15, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 28-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18020815

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18020815-01	LH18/24-SP650_021418	Water		14-Feb-2018 14:00	15-Feb-2018 09:00	<input type="checkbox"/>

ALS Group USA, Corp

Date: 28-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order:

CASE NARRATIVE

Work Order Comments

- The analysis for Perchlorate was subcontracted to ALS Salt Lake City, UT. Final report attached.
-

Subcontracted by Method NA**Batch ID: R311458**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E415.1**Batch ID: R311707**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E365.3**Batch ID: R311469**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E350.3**Batch ID: R311075**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 28-Feb-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Weekly Samples
 Sample ID: LH18/24-SP650_021418
 Collection Date: 14-Feb-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18020815
 Lab ID:HS18020815-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
AMMONIA AS N BY E350.3(ISE)								Analyst: SAP
Nitrogen, Ammonia (As N)	10		0.20	0.10	0.20	mg/L	1	16-Feb-2018 11:00
ORTHO PHOSPHATE (PO4) AS P BY E365.3								Analyst: MZD
Phosphorus, Total Orthophosphate (As P)	2.83		0.100	0.250	0.250	mg/L	10	15-Feb-2018 18:30
TOTAL ORGANIC CARBON BY E415.1								Analyst: KMU
Organic Carbon, Total	23.3		0.500	0.500	1.00	mg/L	1	28-Feb-2018 02:43
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)								Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	23-Feb-2018 15:46

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

ALS Group USA, Corp

Date: 28-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18020815

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R311075	Test Name : AMMONIA AS N BY E350.3(ISE)		Matrix: Water			
HS18020815-01	LH18/24-SP650_021418	14 Feb 2018 14:00			16 Feb 2018 11:00	1
Batch ID R311458	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18020815-01	LH18/24-SP650_021418	14 Feb 2018 14:00			23 Feb 2018 15:46	1
Batch ID R311469	Test Name : ORTHO PHOSPHATE (PO4) AS P BY E365.3		Matrix: Water			
HS18020815-01	LH18/24-SP650_021418	14 Feb 2018 14:00			15 Feb 2018 18:30	10
Batch ID R311707	Test Name : TOTAL ORGANIC CARBON BY E415.1		Matrix: Water			
HS18020815-01	LH18/24-SP650_021418	14 Feb 2018 14:00			28 Feb 2018 02:43	1

ALS Group USA, Corp

Date: 28-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18020815

QC BATCH REPORT

Batch ID: R311075		Instrument: WetChem_HS		Method: E350.3	
MBLK	Sample ID: MBLK-R311075	Units: mg/L		Analysis Date: 16-Feb-2018 11:00	
Client ID:	Run ID: WetChem_HS_311075	SeqNo: 4441543	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	0.10	0.20			U
LCS	Sample ID: LCS-R311075	Units: mg/L		Analysis Date: 16-Feb-2018 11:00	
Client ID:	Run ID: WetChem_HS_311075	SeqNo: 4441542	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	10.35	0.20	10	0	104 80 - 120
MS	Sample ID: HS18020503-01MS	Units: mg/L		Analysis Date: 16-Feb-2018 11:00	
Client ID:	Run ID: WetChem_HS_311075	SeqNo: 4441548	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (as N)	10.31	0.20	10	0.03082	103 80 - 120
MSD	Sample ID: HS18020503-01MSD	Units: mg/L		Analysis Date: 16-Feb-2018 11:00	
Client ID:	Run ID: WetChem_HS_311075	SeqNo: 4441547	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (as N)	10.46	0.20	10	0.03082	104 80 - 120 10.31 1.44 20

The following samples were analyzed in this batch: HS18020815-01

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

ALS Group USA, Corp

Date: 28-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18020815

QC BATCH REPORT

Batch ID: R311469		Instrument: UV-2450		Method: E365.3						
MBLK	Sample ID: MBLK-311469	Units: mg/L			Analysis Date: 15-Feb-2018 18:30					
Client ID:	Run ID: UV-2450_311469	SeqNo: 4450320		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	0.0250	0.0250							U	
LCS	Sample ID: LCS-311469	Units: mg/L			Analysis Date: 15-Feb-2018 18:30					
Client ID:	Run ID: UV-2450_311469	SeqNo: 4450321		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	0.225	0.0250	0.25	0	90.0	85 - 115				
MS	Sample ID: HS18020815-01MS	Units: mg/L			Analysis Date: 15-Feb-2018 18:30					
Client ID: LH18/24-SP650_021418	Run ID: UV-2450_311469	SeqNo: 4450324		PrepDate:			DF: 10			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	4.98	0.250	2.5	2.83	86.0	80 - 120				
MSD	Sample ID: HS18020815-01MSD	Units: mg/L			Analysis Date: 15-Feb-2018 18:30					
Client ID: LH18/24-SP650_021418	Run ID: UV-2450_311469	SeqNo: 4450325		PrepDate:			DF: 10			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	5	0.250	2.5	2.83	86.8	80 - 120	4.98	0.401	20	

The following samples were analyzed in this batch: HS18020815-01

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

ALS Group USA, Corp

Date: 28-Feb-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18020815

QC BATCH REPORT

Batch ID: R311707		Instrument: TOC_02		Method: E415.1						
MBLK	Sample ID: WBLKW3-022718	Units: mg/L		Analysis Date: 28-Feb-2018 01:58						
Client ID:	Run ID: TOC_02_311707	SeqNo: 4456115		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	0.500	1.00							U	
LCS	Sample ID: WLCSW3-022718	Units: mg/L		Analysis Date: 28-Feb-2018 02:10						
Client ID:	Run ID: TOC_02_311707	SeqNo: 4456116		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	10.51	1.00	10	0	105	80 - 120				
LCSD	Sample ID: WLCSDW3-022718	Units: mg/L		Analysis Date: 28-Feb-2018 02:21						
Client ID:	Run ID: TOC_02_311707	SeqNo: 4456117		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	10.52	1.00	10	0	105	80 - 120	10.51	0.0951	20	
MS	Sample ID: HS18021068-01MS	Units: mg/L		Analysis Date: 28-Feb-2018 03:06						
Client ID:	Run ID: TOC_02_311707	SeqNo: 4456121		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	15.74	1.00	10	5.585	102	80 - 120				

The following samples were analyzed in this batch: HS18020815-01

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18020815

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18020815

Date/Time Received: **15-Feb-2018 09:00**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 15-Feb-2018
 eSignature Date

Reviewed by: Corey Grandits 15-Feb-2018
 eSignature 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): 2.7c/2.1c UC/C IR25
 Cooler(s)/Kit(s): 43302
 Date/Time sample(s) sent to storage: 02/15/2017 15:30

- 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:



ALS
10450 Stanchiff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5856
Fax. +1 281 530 5887

CI
Date: 2/14/12
Name: SGR
Company: ST

JSTODY SEAL
Time: 11:30
SGR & SANCHEZ
VAL

Seal Broken By:
Date: 2/15/12

TRK# 7376 9752 1832
[0221]

RETURNS MON - SAT
PRIORITY OVERNIGHT

77099

TX - US

STANDARD EX
DATE 7376 9752 1832
[0221]

THU - 15 FEB 10:30A
PRIORITY OVERNIGHT

AB SGRA

77099

TX - US



TIG 182786 147818 6804 5486C17182D78C9A



Case Narrative

Method: 6850

Analysis: Perchlorate

Analysis SOP: LC-MS-CLO4

ALS WO ID(s): 1804763; 1804764; 1804765;
1805239; 1805240; 1805310

Client: ALS Laboratories (Houston, TX)

Matrix: Water

ELMS Batch (HBN): 2053 (209112)

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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: Sample 1804765001 was analyzed and reported at a 1:1,000 dilution. Sample 1805310001 was re-analyzed and reported at a 1:10 dilution. The reporting limits have been adjusted accordingly.

Method QC data: The method blank (LMB 588565) was less than 1/2 the CRDL. The recovery for the LCS (588566) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1804763001 (Client ID: LH18/24-SP650_021418). The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The relative percent difference (RPD) was within the performance limits.



Instrument QC: Instrument initial and continuing calibrations were performed in accordance with published procedures.

NC/CAR(s): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)
B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 588563). These samples were analyzed in accordance with the requirements found in the DOD QSM Version 5.1. Manual Integrations were performed for datafiles 22FEBD21/26.

Thomas Bosch February 23, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: February 23, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1804764**

Project ID: HS18020815 021418

Purchase Order: HS18020815

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP-650_021418	1804764001	02/14/18	02/16/18	



ANALYTICAL REPORT

Workorder: 34-1804764

Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP-650_021418	Sampling Site: NA	Collected: 02/14/2018				
Lab ID: 1804764001	Media: 125 mL Nalgene	Received: 02/16/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2053 (HBN: 209112) Analyzed: 02/22/2018 19:03	Instrument ID: LCMS04 Percent Solid: NA 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

Comments

Quality Control: EPA 6850, DoD QSM - (HBN: 209112)

The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

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 02/23/2018 09:38	/S/ Stephen Brose 02/23/2018 11:13

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: als.lt.lab@ALSGlobal.com
Web: www.alsslc.com



ANALYTICAL REPORT

Workorder: 34-1804764

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	101574	http://www.aihaaccreditedlabs.org
Washington	AIHA LAP LLC (ISO 17025 & IHLAP/ELLAP)	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.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1804764

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

00883399

Analysis Information

Workorder: 1804764

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2053 (HBN: 209112)
Analyzed By: Thomas Bosch

Blank

LMB: 588565 Analyzed: 02/22/2018 17:50 Units: ug/L			
Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 588566 Analyzed: 02/22/2018 18:04 Dilution: 1 Units: ug/L				
Analyte	Result	Target	% Rec	QC Limits
Perchlorate	4.72	5.00	94.4	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1804763001 Analyzed: 02/22/2018 18:19 Dilution: 1 Units: ug/L		MS: 588567 Analyzed: 02/22/2018 18:34 Dilution: 1 Units: ug/L			MSD: 588568 Analyzed: 02/22/2018 18:48 Dilution: 1 Units: ug/L				
Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	ND	6.41	5	# 128	78.8 123.8	6.43	# 129	0.269	0.0 20.0

Continuing Calibration Verification

CCV: 588562 Analyzed: 02/22/2018 16:51 Units: ug/L Criteria: ± 15%				CCV: 588569 Analyzed: 02/22/2018 20:46 Units: ug/L Criteria: ± 15%		
Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	23.6	25.0	94.4	28.1	25.0	112

Interference Check Sample

ICSA: 588564 Analyzed: 02/22/2018 17:20 Units: ug/L Criteria: ± 30%			
Analyte	Result	Target	% Rec.
Perchlorate	1.16	1.00	116

Limit of Detection Verification

LODV: 588563 Analyzed: 02/22/2018 17:06 Units: ug/L Criteria: ± 50%				LODV: 588570 Analyzed: 02/22/2018 21:00 Units: ug/L Criteria: ± 50%		
Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	0.999	1.00	99.9	1.20	1.00	120



Quality Control Sample Batch Report

00883400

Analysis Information

Workorder: 1804764

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2053 (HBN: 209112)

Prepared By: NA

Analyzed By: Thomas Bosch

Comments

The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected.

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch 02/23/2018 09:38	/S/ Stephen Brose 02/23/2018 11:13

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



W

1804764

Chain of Custody

COC ID: 8630

1804764

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18020815
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18020815-01	LH18/24-SP-650_021418	Water	14 Feb 2018 14:00
SUB_Perch-6850			01 Mar 2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By:

Date/Time:

2/15/18 1800

Received By:

Date/Time:

02/16/2018 9:45

Cooler ID(s):

Temperature(s):

SHIPPING DEPT
ALS LABORATORY GROUP
10450 STANCLIFF
SUITE 210
HOUSTON, TX 77099
UNITED STATES US

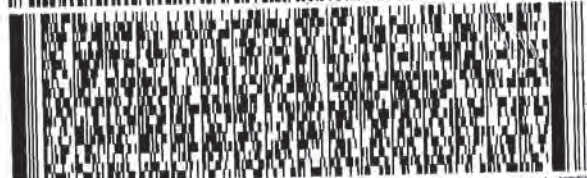
ACTWT: 8.35 LB
CAD: 300130/CAFE310B
DIMS: 14x11x10 IN
BILL SENDER

TO **KEVIN GRIFFITHS**
ALS ENVIRONMENTAL
960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123

(801) 266-7700

REF: HS18020787/793/815 - RJ



FedEx
Express



JT7701610200101

TRK# 7376 9752 5194
0201

FRI - 16 FEB 3:00P
STANDARD OVERNIGHT

AX BTFA

84123
UT-US **SLC**





Batch Worklist

HBN: 209112



Instrument: LCMS04

Status: WP

Created: 2/22/2018 08:05

Analyst: T. Bosch

Batch: ELMS/2053

Rule: EPA 6850, DoD QSM Water

- Workorder: 1804763 [ENV_LVL4]
- Workorder: 1804764 [ENV_LVL4]
- Workorder: 1804765 [ENV_LVL4]
- Workorder: 1805239 [ENV_LVL4]
- Workorder: 1805240 [ENV_LVL4]
- Workorder: 1805310 [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	588562	CCV for HBN 209112 [ELMS/2053]				CCV	3		E685041C3Q	5311	2/23/2018	2/23/2018	2/22/2018
2	588563	LODV for HBN 209112 [ELMS/2053]				LODV	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018
3	588564	ICS for HBN 209112 [ELMS/2053]				ICS	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018
4	588565	LMB for HBN 209112 [ELMS/2053]				LMB	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
5	588566	LCS for HBN 209112 [ELMS/2053]				LCS	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
6	1804763001	LH18/24-SP650-021418				SAMPLE	3	1804763001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
7	588567	LH18/24-SP650...(1804763001MS)				MS	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
8	588568	LH18/24-SP65...(1804763001MSD)				MSD	3		E6850Q413Q	5311	2/23/2018	2/23/2018	2/22/2018
9	1804764001	LH18/24-SP-650_021418				SAMPLE	3	1804764001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
10	1804765001	LH18/24-SP140_021418				SAMPLE	3	1804765001-A	E6850Q41.3	5480	3/14/2018	3/2/2018	2/22/2018
11	1805239001	LHSMW02-021518				SAMPLE	3	1805239001-A	E6850Q41.3	5480	3/15/2018	2/23/2018	2/22/2018
12	1805240001	17WW12-021518				SAMPLE	3	1805240001-A	E6850Q41.3	5480	3/15/2018	2/23/2018	2/22/2018
13	1805310002	LH18/24-SP650_022118_AIX				SAMPLE	3	1805310002-A	E6850Q41.3	5480	3/21/2018	2/23/2018	2/22/2018
14	1805310001	LH18/24-SP650_022118_BIX				SAMPLE	3	1805310001-A	E6850Q41.3	5480	3/21/2018	2/23/2018	2/22/2018
15	588569	CCV for HBN 209112 [ELMS/2053]				CCV	3		E685041C3Q	5311	2/23/2018	2/23/2018	2/22/2018
16	588570	LODV for HBN 209112 [ELMS/2053]				LODV	3		E6850_D3Q	5311	2/23/2018	2/23/2018	2/22/2018



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #'s: 1804763 (001); 1804764 (001); 1804765 (001); 1805239 (001); 1805240 (001); 1805310 (001,02)

ELMS Batch/HBN ID: 2053 (209112)

Prep Date: 02/22/2018 Analysis Date: 02/22/2018 Analyst: T. Bosch

Analyte: **Perchlorate** Matrix: **Water** Method: **6850**

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\FEB\22\FEB18D.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 02/22/2018, sequence 22FEB18D.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-DOD.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	0.80
4.0	0.80
5.0	0.25
10.0	0.25
10.5	0.80
13.0	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 588566; Target = 5.0µg/L. ASTM type II water was used for LMB 588565.

MS/MSD: MS/MSD was performed on sample 1804763001 (Client ID: LH18/24-SP650_021418). 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. Sample 1804765001 was analyzed and reported at a 1:1,000 dilution. Sample 1805310001 was re-analyzed and reported at a 1:10 dilution. The reporting limits have been adjusted accordingly.
- 2) All QC, Blank, CCV, and MS/MSD results were within method parameters, except for the following. The Matrix Spike and duplicate (MS/MSD – 588567/68) failed QC acceptance criteria for percent recoveries. The Matrix Spike and Matrix Spike duplicate is reported for the clients' information only. The sample matrix may be inappropriate for the method selected. The ion ratio of m/z 83 to 85 often fails at levels near the reported Detection Limit (DL). The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 588563).
- 3) Sample data can be viewed at two directories within the ALS system: \\ALS\TWS013\LCMS\LCMS04\2018\FEB\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 datafiles 22FEBD21/26.
- 5) Notebook: \\als\TWS013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\209112-DOD-ALS-HSTN-LCMS4 or through \\ALS\TWS013\DATAREVIEW\HBN#



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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/10/2017		Expires: 05/10/2018	
MFG Lot: TNB: 05/10/17		Lab Lot: CLO4 INT		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17		Lab Lot: CLO4 QC WRK 100.ug/L		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 10 mL	
MFG: ALS/SLC	Create Date: 05/11/2017	Expires: 05/11/2018	
MFG Lot: TNB: 05/11/2017	Lab Lot: CLO4 QC INT 10.ug/mL	Usable: Yes	
Part ID:			

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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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

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.



Certificate of Analysis



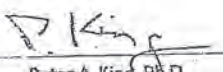
ISO Guide 34 Reference Material

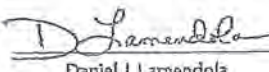
Product Number: ICC-013
Lot Number: CP-0860

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 (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:
ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



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

March 08, 2018

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

Work Order: **HS18021137**

Laboratory Results for: **Longhorn GW Treatment Plant Weekly Samples**

Dear Marcia,

ALS Environmental received 1 sample(s) on Feb 22, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 08-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18021137

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18021137-01	LH18/24-SP650_022118	Water		21-Feb-2018 14:00	22-Feb-2018 09:15	<input type="checkbox"/>

ALS Group USA, Corp

Date: 08-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
Work Order: HS18021137

CASE NARRATIVE

WetChemistry by Method E350.3**Batch ID: R312085**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E415.1**Batch ID: R312060**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E365.3**Batch ID: R311463**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 08-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant Weekly Samples
 Sample ID: LH18/24-SP650_022118
 Collection Date: 21-Feb-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18021137
 Lab ID:HS18021137-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
AMMONIA AS N BY E350.3(ISE)								Analyst: SAP
Nitrogen, Ammonia (As N)	11		0.20	0.10	0.20	mg/L	1	06-Mar-2018 12:00
ORTHO PHOSPHATE (PO4) AS P BY E365.3								Analyst: MZD
Phosphorus, Total Orthophosphate (As P)	2.12		0.100	0.250	0.250	mg/L	10	22-Feb-2018 17:00
TOTAL ORGANIC CARBON BY E415.1								Analyst: KMU
Organic Carbon, Total	28.2		0.500	0.500	1.00	mg/L	1	06-Mar-2018 23:08

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

ALS Group USA, Corp

Date: 08-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18021137

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R311463	Test Name : ORTHO PHOSPHATE (PO4) AS P BY E365.3		Matrix: Water			
HS18021137-01	LH18/24-SP650_022118	21 Feb 2018 14:00			22 Feb 2018 17:00	10
Batch ID R312060	Test Name : TOTAL ORGANIC CARBON BY E415.1		Matrix: Water			
HS18021137-01	LH18/24-SP650_022118	21 Feb 2018 14:00			06 Mar 2018 23:08	1
Batch ID R312085	Test Name : AMMONIA AS N BY E350.3(ISE)		Matrix: Water			
HS18021137-01	LH18/24-SP650_022118	21 Feb 2018 14:00			06 Mar 2018 12:00	1

ALS Group USA, Corp

Date: 08-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18021137

QC BATCH REPORT

Batch ID: R311463		Instrument: UV-2450		Method: E365.3						
MBLK	Sample ID: MBLK-311463	Units: mg/L		Analysis Date: 22-Feb-2018 17:00						
Client ID:	Run ID: UV-2450_311463	SeqNo: 4450271	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.0250	0.0250								U
LCS	Sample ID: LCS-311463	Units: mg/L		Analysis Date: 22-Feb-2018 17:00						
Client ID:	Run ID: UV-2450_311463	SeqNo: 4450272	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	0.228	0.0250	0.25	0	91.2	85 - 115				
MS	Sample ID: HS18021137-01MS	Units: mg/L		Analysis Date: 22-Feb-2018 17:00						
Client ID: LH18/24-SP650_022118	Run ID: UV-2450_311463	SeqNo: 4450274	PrepDate:	DF: 10						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	4.94	0.250	2.5	2.12	113	80 - 120				
MSD	Sample ID: HS18021137-01MSD	Units: mg/L		Analysis Date: 22-Feb-2018 17:00						
Client ID: LH18/24-SP650_022118	Run ID: UV-2450_311463	SeqNo: 4450275	PrepDate:	DF: 10						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Phosphorus, Total Orthophosphate (As P)	4.47	0.250	2.5	2.12	94.0	80 - 120	4.94	9.99	20	

The following samples were analyzed in this batch: HS18021137-01

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

ALS Group USA, Corp

Date: 08-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18021137

QC BATCH REPORT

Batch ID:	R312060	Instrument:	TOC_02	Method:	E415.1					
MBLK	Sample ID: WBLKW1-030618	Units:	mg/L	Analysis Date:	06-Mar-2018 19:15					
Client ID:	Run ID: TOC_02_312060	SeqNo:	4463851	PrepDate:	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Organic Carbon, Total	0.500	1.00								U
LCS	Sample ID: WLCSW1-030618	Units:	mg/L	Analysis Date:	06-Mar-2018 19:30					
Client ID:	Run ID: TOC_02_312060	SeqNo:	4463852	PrepDate:	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Organic Carbon, Total	10.42	1.00	10	0	104	80 - 120				
LCSD	Sample ID: WLCSDW1-030618	Units:	mg/L	Analysis Date:	06-Mar-2018 19:45					
Client ID:	Run ID: TOC_02_312060	SeqNo:	4463853	PrepDate:	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Organic Carbon, Total	10.45	1.00	10	0	104	80 - 120	10.42	0.287	20	
MS	Sample ID: HS18021075-01MS	Units:	mg/L	Analysis Date:	06-Mar-2018 20:18					
Client ID:	Run ID: TOC_02_312060	SeqNo:	4463855	PrepDate:	DF: 1					
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Organic Carbon, Total	13.02	1.00	10	2.817	102	80 - 120				

The following samples were analyzed in this batch: HS18021137-01

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

ALS Group USA, Corp

Date: 08-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18021137

QC BATCH REPORT

Batch ID:	R312085	Instrument:	WetChem_HS	Method:	E350.3					
MBLK	Sample ID: MBLK-R312085	Units: mg/L	Analysis Date: 06-Mar-2018 12:00							
Client ID:	Run ID: WetChem_HS_312085	SeqNo: 4465356	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit	Qual
Nitrogen, Ammonia (As N)	0.10	0.20								U
LCS	Sample ID: LCS-R312085	Units: mg/L	Analysis Date: 06-Mar-2018 12:00							
Client ID:	Run ID: WetChem_HS_312085	SeqNo: 4465355	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit	Qual
Nitrogen, Ammonia (As N)	10.23	0.20	10	0	102	80 - 120				
MS	Sample ID: HS18021217-01MS	Units: mg/L	Analysis Date: 06-Mar-2018 12:00							
Client ID:	Run ID: WetChem_HS_312085	SeqNo: 4465346	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit	Qual
Nitrogen, Ammonia (As N)	10.4	0.20	10	0.1695	102	80 - 120				
MSD	Sample ID: HS18021217-01MSD	Units: mg/L	Analysis Date: 06-Mar-2018 12:00							
Client ID:	Run ID: WetChem_HS_312085	SeqNo: 4465347	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD	RPD Limit	Qual
Nitrogen, Ammonia (As N)	10.31	0.20	10	0.1695	101	80 - 120	10.4	0.869	20	

The following samples were analyzed in this batch: HS18021137-01

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant Weekly Samples
WorkOrder: HS18021137

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18021137

Date/Time Received: **22-Feb-2018 09:15**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 22-Feb-2018
 eSignature Date
 Reviewed by: RJ Modashia 22-Feb-2018
 eSignature 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): 1.3c/1.7c UC/C IR30
 Cooler(s)/Kit(s): 42842
 Date/Time sample(s) sent to storage: 02/22/2018 12:21

- 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:

THU - 22 FEB 10:30A
PRIORITY OVERNIGHT
77099

Fed
EX
7376 9749 9830
9221

AB SGRA

CUSTODY SEAL

210
TH. NO. 1430
SGH BCB 07

Seal Broken By:

Date:



ALS
10450 Shanciff Rd., Box 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5687

Date:
Name:
Company:



10450 Stancliff Rd. Suite 210
Houston, TX 77099
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March 06, 2018

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

Work Order: **HS18021169**

Laboratory Results for: **Longhorn GW Treatment Plant**

Dear Marcia,

ALS Environmental received 2 sample(s) on Feb 22, 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,

A handwritten signature in black ink, appearing to read 'Raj. P. Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18021169

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18021169-01	LH18/24-SP650_022118	Water		21-Feb-2018 14:00	22-Feb-2018 09:15	<input type="checkbox"/>
HS18021169-02	Trip Blank	Water	ALS-012618-40	21-Feb-2018 00:01	22-Feb-2018 09:15	<input type="checkbox"/>

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18021169

CASE NARRATIVE

GCMS Volatiles by Method SW8260**Batch ID: R311741****Sample ID: HS18021062-03MS**

- MS and MSD are for an unrelated sample

WetChemistry by Method SW9056**Batch ID: R311969**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650_022118
 Collection Date: 21-Feb-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18021169
 Lab ID:HS18021169-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	28-Feb-2018 19:42	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	28-Feb-2018 19:42	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	28-Feb-2018 19:42	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	28-Feb-2018 19:42	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	28-Feb-2018 19:42	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650_022118
 Collection Date: 21-Feb-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18021169
 Lab ID:HS18021169-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
cis-1,2-Dichloroethene	3.1		0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	28-Feb-2018 19:42	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	28-Feb-2018 19:42	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 19:42	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>82.8</i>			0	<i>81-118</i>	%REC	1	28-Feb-2018 19:42	
<i>Surr: 4-Bromofluorobenzene</i>	<i>97.3</i>			0	<i>85-114</i>	%REC	1	28-Feb-2018 19:42	
<i>Surr: Dibromofluoromethane</i>	<i>87.5</i>			0	<i>80-119</i>	%REC	1	28-Feb-2018 19:42	
<i>Surr: Toluene-d8</i>	<i>107</i>			0	<i>89-112</i>	%REC	1	28-Feb-2018 19:42	
ANIONS BY SW9056A		Method:SW9056							Analyst: KMU
Chloride	582		4.00	5.00	10.0	mg/L	20	05-Mar-2018 20:45	
Sulfate	55.9		2.00	2.50	5.00	mg/L	10	05-Mar-2018 20:30	

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: Trip Blank
 Collection Date: 21-Feb-2018 00:01

ANALYTICAL REPORT
 WorkOrder:HS18021169
 Lab ID:HS18021169-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	28-Feb-2018 15:37	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	28-Feb-2018 15:37	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	28-Feb-2018 15:37	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	28-Feb-2018 15:37	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	28-Feb-2018 15:37	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: Trip Blank
 Collection Date: 21-Feb-2018 00:01

ANALYTICAL REPORT

WorkOrder:HS18021169
 Lab ID:HS18021169-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD		Method:SW8260							Analyst: AKP
8260C									
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
cis-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	28-Feb-2018 15:37	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	28-Feb-2018 15:37	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	28-Feb-2018 15:37	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>83.3</i>			0	<i>81-118</i>	<i>%REC</i>	<i>1</i>	<i>28-Feb-2018 15:37</i>	
<i>Surr: 4-Bromofluorobenzene</i>	<i>96.4</i>			0	<i>85-114</i>	<i>%REC</i>	<i>1</i>	<i>28-Feb-2018 15:37</i>	
<i>Surr: Dibromofluoromethane</i>	<i>85.6</i>			0	<i>80-119</i>	<i>%REC</i>	<i>1</i>	<i>28-Feb-2018 15:37</i>	
<i>Surr: Toluene-d8</i>	<i>107</i>			0	<i>89-112</i>	<i>%REC</i>	<i>1</i>	<i>28-Feb-2018 15:37</i>	

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R311741	Test Name : VOLATILES ORGANICS BY METHOD 8260C		Matrix: Water			
HS18021169-01	LH18/24-SP650_022118	21 Feb 2018 14:00			28 Feb 2018 19:42	1
HS18021169-02	Trip Blank	21 Feb 2018 00:01			28 Feb 2018 15:37	1
Batch ID R311969	Test Name : ANIONS BY SW9056A		Matrix: Water			
HS18021169-01	LH18/24-SP650_022118	21 Feb 2018 14:00			05 Mar 2018 20:45	20
HS18021169-01	LH18/24-SP650_022118	21 Feb 2018 14:00			05 Mar 2018 20:30	10

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180228	Units: ug/L			Analysis Date: 28-Feb-2018 12:43					
Client ID:	Run ID: VOA2_311741	SeqNo: 4456927	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	0.50	1.0								U
1,1,1-Trichloroethane	0.50	1.0								U
1,1,2,2-Tetrachloroethane	0.50	1.0								U
1,1,2-Trichloroethane	0.50	1.0								U
1,1-Dichloroethane	0.50	1.0								U
1,1-Dichloroethene	0.50	1.0								U
1,1-Dichloropropene	0.50	1.0								U
1,2,3-Trichlorobenzene	0.50	1.0								U
1,2,3-Trichloropropane	0.50	1.0								U
1,2,4-Trichlorobenzene	0.50	1.0								U
1,2,4-Trimethylbenzene	0.50	1.0								U
1,2-Dibromo-3-chloropropane	0.50	1.0								U
1,2-Dibromoethane	0.50	1.0								U
1,2-Dichlorobenzene	0.50	1.0								U
1,2-Dichloroethane	0.50	1.0								U
1,2-Dichloropropane	0.50	1.0								U
1,3,5-Trimethylbenzene	0.50	1.0								U
1,3-Dichlorobenzene	0.50	1.0								U
1,3-Dichloropropane	0.50	1.0								U
1,4-Dichlorobenzene	0.50	1.0								U
2,2-Dichloropropane	0.50	1.0								U
2-Butanone	1.0	2.0								U
2-Chlorotoluene	0.50	1.0								U
2-Hexanone	1.0	2.0								U
4-Chlorotoluene	0.50	1.0								U
4-Isopropyltoluene	0.50	1.0								U
4-Methyl-2-pentanone	1.0	2.0								U
Acetone	1.0	2.0								U
Benzene	0.50	1.0								U
Bromobenzene	0.50	1.0								U
Bromochloromethane	0.50	1.0								U
Bromodichloromethane	0.50	1.0								U
Bromoform	0.50	1.0								U
Bromomethane	0.50	1.0								U

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180228	Units: ug/L			Analysis Date: 28-Feb-2018 12:43					
Client ID:	Run ID: VOA2_311741	SeqNo: 4456927	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	1.0	2.0								U
Carbon tetrachloride	0.50	1.0								U
Chlorobenzene	0.50	1.0								U
Chloroethane	0.50	1.0								U
Chloroform	0.50	1.0								U
Chloromethane	0.50	1.0								U
cis-1,2-Dichloroethene	0.50	1.0								U
cis-1,3-Dichloropropene	0.50	1.0								U
Dibromochloromethane	0.50	1.0								U
Dibromomethane	0.50	1.0								U
Dichlorodifluoromethane	0.50	1.0								U
Ethylbenzene	0.50	1.0								U
Hexachlorobutadiene	0.50	1.0								U
Isopropylbenzene	0.50	1.0								U
m,p-Xylene	1.0	2.0								U
Methylene chloride	1.0	2.0								U
Naphthalene	0.50	1.0								U
n-Butylbenzene	0.50	1.0								U
n-Propylbenzene	0.50	1.0								U
o-Xylene	0.50	1.0								U
sec-Butylbenzene	0.50	1.0								U
Styrene	0.50	1.0								U
tert-Butylbenzene	0.50	1.0								U
Tetrachloroethene	0.50	1.0								U
Toluene	0.50	1.0								U
trans-1,2-Dichloroethene	0.50	1.0								U
trans-1,3-Dichloropropene	0.50	1.0								U
Trichloroethene	0.50	1.0								U
Trichlorofluoromethane	0.50	1.0								U
Vinyl chloride	0.50	1.0								U
Surr: 1,2-Dichloroethane-d4	41.3	1.0	50	0	82.6	81 - 118				
Surr: 4-Bromofluorobenzene	48.48	1.0	50	0	97.0	85 - 114				
Surr: Dibromofluoromethane	42.46	1.0	50	0	84.9	80 - 119				
Surr: Toluene-d8	52.73	1.0	50	0	105	89 - 112				

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180228	Units: ug/L			Analysis Date: 28-Feb-2018 11:54					
Client ID:	Run ID: VOA2_311741	SeqNo: 4456925		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	43.96	1.0	50	0	87.9	78 - 124				
1,1,1-Trichloroethane	43.53	1.0	50	0	87.1	74 - 131				
1,1,2,2-Tetrachloroethane	42.89	1.0	50	0	85.8	71 - 121				
1,1,2-Trichloroethane	44.67	1.0	50	0	89.3	80 - 119				
1,1-Dichloroethane	44.16	1.0	50	0	88.3	77 - 125				
1,1-Dichloroethene	45.71	1.0	50	0	91.4	71 - 131				
1,1-Dichloropropene	47.41	1.0	50	0	94.8	79 - 125				
1,2,3-Trichlorobenzene	44.67	1.0	50	0	89.3	69 - 129				
1,2,3-Trichloropropane	44.01	1.0	50	0	88.0	73 - 122				
1,2,4-Trichlorobenzene	45.06	1.0	50	0	90.1	69 - 130				
1,2,4-Trimethylbenzene	44.54	1.0	50	0	89.1	76 - 124				
1,2-Dibromo-3-chloropropane	45.63	1.0	50	0	91.3	62 - 128				
1,2-Dibromoethane	47.17	1.0	50	0	94.3	77 - 121				
1,2-Dichlorobenzene	41.11	1.0	50	0	82.2	80 - 119				
1,2-Dichloroethane	45.05	1.0	50	0	90.1	73 - 128				
1,2-Dichloropropane	44.55	1.0	50	0	89.1	78 - 122				
1,3,5-Trimethylbenzene	44.54	1.0	50	0	89.1	75 - 124				
1,3-Dichlorobenzene	41.07	1.0	50	0	82.1	80 - 119				
1,3-Dichloropropane	43.67	1.0	50	0	87.3	80 - 119				
1,4-Dichlorobenzene	40.38	1.0	50	0	80.8	79 - 118				
2,2-Dichloropropane	43.83	1.0	50	0	87.7	60 - 139				
2-Butanone	103.7	2.0	100	0	104	56 - 143				
2-Chlorotoluene	44.42	1.0	50	0	88.8	79 - 122				
2-Hexanone	103.1	2.0	100	0	103	57 - 139				
4-Chlorotoluene	45.41	1.0	50	0	90.8	78 - 122				
4-Isopropyltoluene	39.19	1.0	50	0	78.4	77 - 127				
4-Methyl-2-pentanone	92.16	2.0	100	0	92.2	67 - 130				
Acetone	96.55	2.0	100	0	96.6	39 - 160				
Benzene	45.68	1.0	50	0	91.4	79 - 120				
Bromobenzene	40.32	1.0	50	0	80.6	80 - 120				
Bromochloromethane	48.75	1.0	50	0	97.5	78 - 123				
Bromodichloromethane	46.79	1.0	50	0	93.6	79 - 125				
Bromoform	49.13	1.0	50	0	98.3	66 - 130				
Bromomethane	48.8	1.0	50	0	97.6	53 - 141				

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180228	Units: ug/L			Analysis Date: 28-Feb-2018 11:54					
Client ID:	Run ID: VOA2_311741	SeqNo: 4456925	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	91.41	2.0	100	0	91.4	64 - 133				
Carbon tetrachloride	41.11	1.0	50	0	82.2	72 - 136				
Chlorobenzene	42.96	1.0	50	0	85.9	80 - 120				
Chloroethane	42.53	1.0	50	0	85.1	82 - 118				
Chloroform	42.56	1.0	50	0	85.1	79 - 124				
Chloromethane	45.85	1.0	50	0	91.7	50 - 139				
cis-1,2-Dichloroethene	47.33	1.0	50	0	94.7	78 - 123				
cis-1,3-Dichloropropene	49.91	1.0	50	0	99.8	75 - 124				
Dibromochloromethane	46.05	1.0	50	0	92.1	74 - 126				
Dibromomethane	49.59	1.0	50	0	99.2	79 - 123				
Dichlorodifluoromethane	40.05	1.0	50	0	80.1	32 - 152				
Ethylbenzene	47.91	1.0	50	0	95.8	79 - 121				
Hexachlorobutadiene	40.44	1.0	50	0	80.9	66 - 134				
Isopropylbenzene	42.41	1.0	50	0	84.8	72 - 131				
m,p-Xylene	85.22	2.0	100	0	85.2	80 - 121				
Methylene chloride	44.37	2.0	50	0	88.7	74 - 124				
Naphthalene	51.94	1.0	50	0	104	61 - 128				
n-Butylbenzene	40.65	1.0	50	0	81.3	75 - 128				
n-Propylbenzene	39.33	1.0	50	0	78.7	76 - 126				
o-Xylene	43.36	1.0	50	0	86.7	78 - 122				
sec-Butylbenzene	40.16	1.0	50	0	80.3	77 - 126				
Styrene	44.22	1.0	50	0	88.4	78 - 128				
tert-Butylbenzene	39.03	1.0	50	0	78.1	78 - 124				
Tetrachloroethene	42.66	1.0	50	0	85.3	74 - 129				
Toluene	42.01	1.0	50	0	84.0	80 - 121				
trans-1,2-Dichloroethene	47.97	1.0	50	0	95.9	75 - 124				
trans-1,3-Dichloropropene	50.44	1.0	50	0	101	73 - 127				
Trichloroethene	46.7	1.0	50	0	93.4	79 - 123				
Trichlorofluoromethane	41.91	1.0	50	0	83.8	65 - 141				
Vinyl chloride	45.39	1.0	50	0	90.8	58 - 137				
Surr: 1,2-Dichloroethane-d4	43.4	1.0	50	0	86.8	81 - 118				
Surr: 4-Bromofluorobenzene	50.32	1.0	50	0	101	85 - 114				
Surr: Dibromofluoromethane	41.81	1.0	50	0	83.6	80 - 119				
Surr: Toluene-d8	51.17	1.0	50	0	102	89 - 112				

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18021062-03MS	Units: ug/L			Analysis Date: 28-Feb-2018 14:23					
Client ID:	Run ID: VOA2_311741	SeqNo: 4456931	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	43.43	1.0	50	0	86.9	78 - 124				
1,1,1-Trichloroethane	45.82	1.0	50	0	91.6	74 - 131				
1,1,2,2-Tetrachloroethane	40.86	1.0	50	0	81.7	71 - 121				
1,1,2-Trichloroethane	42.38	1.0	50	0	84.8	80 - 119				
1,1-Dichloroethane	42.89	1.0	50	0	85.8	77 - 125				
1,1-Dichloroethene	47.9	1.0	50	0	95.8	71 - 131				
1,1-Dichloropropene	49.67	1.0	50	0	99.3	79 - 125				
1,2,3-Trichlorobenzene	44.28	1.0	50	0	88.6	69 - 129				
1,2,3-Trichloropropane	42.06	1.0	50	0	84.1	73 - 122				
1,2,4-Trichlorobenzene	43.45	1.0	50	0	86.9	69 - 130				
1,2,4-Trimethylbenzene	45.13	1.0	50	0	90.3	76 - 124				
1,2-Dibromo-3-chloropropane	43.83	1.0	50	0	87.7	62 - 128				
1,2-Dibromoethane	44.46	1.0	50	0	88.9	77 - 121				
1,2-Dichlorobenzene	39.46	1.0	50	0	78.9	80 - 119				S
1,2-Dichloroethane	41.61	1.0	50	0	83.2	73 - 128				
1,2-Dichloropropane	42.78	1.0	50	0	85.6	78 - 122				
1,3,5-Trimethylbenzene	46.38	1.0	50	0	92.8	75 - 124				
1,3-Dichlorobenzene	40.43	1.0	50	0	80.9	80 - 119				
1,3-Dichloropropane	41.4	1.0	50	0	82.8	80 - 119				
1,4-Dichlorobenzene	39.43	1.0	50	0	78.9	79 - 118				S
2,2-Dichloropropane	45.08	1.0	50	0	90.2	60 - 139				
2-Butanone	94.88	2.0	100	0	94.9	56 - 143				
2-Chlorotoluene	44.94	1.0	50	0	89.9	79 - 122				
2-Hexanone	97.49	2.0	100	0	97.5	57 - 139				
4-Chlorotoluene	44.97	1.0	50	0	89.9	78 - 122				
4-Isopropyltoluene	41.67	1.0	50	0	83.3	77 - 127				
4-Methyl-2-pentanone	88.58	2.0	100	0	88.6	67 - 130				
Acetone	96.64	2.0	100	0	96.6	39 - 160				
Benzene	44.85	1.0	50	0.5473	88.6	79 - 120				
Bromobenzene	38.51	1.0	50	0	77.0	80 - 120				S
Bromochloromethane	47.51	1.0	50	0	95.0	78 - 123				
Bromodichloromethane	44.03	1.0	50	0	88.1	79 - 125				
Bromoform	47.2	1.0	50	0	94.4	66 - 130				
Bromomethane	43.93	1.0	50	0	87.9	53 - 141				

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18021062-03MS	Units: ug/L			Analysis Date: 28-Feb-2018 14:23					
Client ID:	Run ID: VOA2_311741	SeqNo: 4456931		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	92.81	2.0	100	0	92.8	64 - 133				
Carbon tetrachloride	47.58	1.0	50	0	95.2	72 - 136				
Chlorobenzene	42.25	1.0	50	0	84.5	80 - 120				
Chloroethane	52.6	1.0	50	0	105	82 - 118				
Chloroform	40.72	1.0	50	0	81.4	79 - 124				
Chloromethane	43.48	1.0	50	0	87.0	50 - 139				
cis-1,2-Dichloroethene	45.44	1.0	50	0	90.9	78 - 123				
cis-1,3-Dichloropropene	44.99	1.0	50	0	90.0	75 - 124				
Dibromochloromethane	43.9	1.0	50	0	87.8	74 - 126				
Dibromomethane	46.53	1.0	50	0	93.1	79 - 123				
Dichlorodifluoromethane	37.74	1.0	50	0	75.5	32 - 152				
Ethylbenzene	49.2	1.0	50	0	98.4	79 - 121				
Hexachlorobutadiene	45.89	1.0	50	0	91.8	66 - 134				
Isopropylbenzene	44.6	1.0	50	0	89.2	72 - 131				
m,p-Xylene	86.14	2.0	100	0	86.1	80 - 121				
Methylene chloride	40.46	2.0	50	0	80.9	74 - 124				
Naphthalene	50.34	1.0	50	0	101	61 - 128				
n-Butylbenzene	43.34	1.0	50	0	86.7	75 - 128				
n-Propylbenzene	41.21	1.0	50	0	82.4	76 - 126				
o-Xylene	43.68	1.0	50	0	87.4	78 - 122				
sec-Butylbenzene	43.32	1.0	50	0	86.6	77 - 126				
Styrene	42.85	1.0	50	0	85.7	78 - 128				
tert-Butylbenzene	41.46	1.0	50	0	82.9	78 - 124				
Tetrachloroethene	45.68	1.0	50	0	91.4	74 - 129				
Toluene	41.84	1.0	50	0	83.7	80 - 121				
trans-1,2-Dichloroethene	45.93	1.0	50	0	91.9	75 - 124				
trans-1,3-Dichloropropene	46.64	1.0	50	0	93.3	73 - 127				
Trichloroethene	47.3	1.0	50	0	94.6	79 - 123				
Trichlorofluoromethane	45.71	1.0	50	0	91.4	65 - 141				
Vinyl chloride	45.43	1.0	50	0	90.9	58 - 137				
Surr: 1,2-Dichloroethane-d4	42.35	1.0	50	0	84.7	81 - 118				
Surr: 4-Bromofluorobenzene	49.94	1.0	50	0	99.9	85 - 114				
Surr: Dibromofluoromethane	40.96	1.0	50	0	81.9	80 - 119				
Surr: Toluene-d8	51.49	1.0	50	0	103	89 - 112				

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741		Instrument: VOA2			Method: SW8260					
MSD	Sample ID: HS18021062-03MSD	Units: ug/L			Analysis Date: 28-Feb-2018 14:48					
Client ID:	Run ID: VOA2_311741	SeqNo: 4456932			PrepDate:		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	42.48	1.0	50	0	85.0	78 - 124	43.43	2.22	20	
1,1,1-Trichloroethane	44.75	1.0	50	0	89.5	74 - 131	45.82	2.36	20	
1,1,2,2-Tetrachloroethane	40.81	1.0	50	0	81.6	71 - 121	40.86	0.107	20	
1,1,2-Trichloroethane	41.99	1.0	50	0	84.0	80 - 119	42.38	0.918	20	
1,1-Dichloroethane	42.4	1.0	50	0	84.8	77 - 125	42.89	1.15	20	
1,1-Dichloroethene	44.65	1.0	50	0	89.3	71 - 131	47.9	7.02	20	
1,1-Dichloropropene	47.58	1.0	50	0	95.2	79 - 125	49.67	4.31	20	
1,2,3-Trichlorobenzene	43.99	1.0	50	0	88.0	69 - 129	44.28	0.654	20	
1,2,3-Trichloropropane	42.38	1.0	50	0	84.8	73 - 122	42.06	0.746	20	
1,2,4-Trichlorobenzene	43.24	1.0	50	0	86.5	69 - 130	43.45	0.495	20	
1,2,4-Trimethylbenzene	44.9	1.0	50	0	89.8	76 - 124	45.13	0.51	20	
1,2-Dibromo-3-chloropropane	42.23	1.0	50	0	84.5	62 - 128	43.83	3.72	20	
1,2-Dibromoethane	44.25	1.0	50	0	88.5	77 - 121	44.46	0.465	20	
1,2-Dichlorobenzene	38.8	1.0	50	0	77.6	80 - 119	39.46	1.69	20	S
1,2-Dichloroethane	40.72	1.0	50	0	81.4	73 - 128	41.61	2.17	20	
1,2-Dichloropropane	42.21	1.0	50	0	84.4	78 - 122	42.78	1.35	20	
1,3,5-Trimethylbenzene	45.41	1.0	50	0	90.8	75 - 124	46.38	2.1	20	
1,3-Dichlorobenzene	40.15	1.0	50	0	80.3	80 - 119	40.43	0.678	20	
1,3-Dichloropropane	41.02	1.0	50	0	82.0	80 - 119	41.4	0.934	20	
1,4-Dichlorobenzene	38.55	1.0	50	0	77.1	79 - 118	39.43	2.25	20	S
2,2-Dichloropropane	44.64	1.0	50	0	89.3	60 - 139	45.08	0.978	20	
2-Butanone	97.09	2.0	100	0	97.1	56 - 143	94.88	2.3	20	
2-Chlorotoluene	44.29	1.0	50	0	88.6	79 - 122	44.94	1.45	20	
2-Hexanone	97.86	2.0	100	0	97.9	57 - 139	97.49	0.385	20	
4-Chlorotoluene	44.15	1.0	50	0	88.3	78 - 122	44.97	1.83	20	
4-Isopropyltoluene	40.98	1.0	50	0	82.0	77 - 127	41.67	1.65	20	
4-Methyl-2-pentanone	87.03	2.0	100	0	87.0	67 - 130	88.58	1.77	20	
Acetone	92.93	2.0	100	0	92.9	39 - 160	96.64	3.92	20	
Benzene	43.28	1.0	50	0.5473	85.5	79 - 120	44.85	3.56	20	
Bromobenzene	38.07	1.0	50	0	76.1	80 - 120	38.51	1.15	20	S
Bromochloromethane	45.33	1.0	50	0	90.7	78 - 123	47.51	4.69	20	
Bromodichloromethane	43.04	1.0	50	0	86.1	79 - 125	44.03	2.28	20	
Bromoform	46.2	1.0	50	0	92.4	66 - 130	47.2	2.12	20	
Bromomethane	43.05	1.0	50	0	86.1	53 - 141	43.93	2.03	20	

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741		Instrument: VOA2			Method: SW8260					
MSD	Sample ID: HS18021062-03MSD	Units: ug/L			Analysis Date: 28-Feb-2018 14:48					
Client ID:	Run ID: VOA2_311741	SeqNo: 4456932			PrepDate:			DF: 1		
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	90.64	2.0	100	0	90.6	64 - 133	92.81	2.36	20	
Carbon tetrachloride	45.04	1.0	50	0	90.1	72 - 136	47.58	5.48	20	
Chlorobenzene	41.52	1.0	50	0	83.0	80 - 120	42.25	1.75	20	
Chloroethane	68.51	1.0	50	0	137	82 - 118	52.6	26.3	20	SR
Chloroform	39.87	1.0	50	0	79.7	79 - 124	40.72	2.12	20	
Chloromethane	40.67	1.0	50	0	81.3	50 - 139	43.48	6.68	20	
cis-1,2-Dichloroethene	44.18	1.0	50	0	88.4	78 - 123	45.44	2.81	20	
cis-1,3-Dichloropropene	45.09	1.0	50	0	90.2	75 - 124	44.99	0.209	20	
Dibromochloromethane	44.25	1.0	50	0	88.5	74 - 126	43.9	0.8	20	
Dibromomethane	45.79	1.0	50	0	91.6	79 - 123	46.53	1.6	20	
Dichlorodifluoromethane	36.85	1.0	50	0	73.7	32 - 152	37.74	2.4	20	
Ethylbenzene	47.75	1.0	50	0	95.5	79 - 121	49.2	2.99	20	
Hexachlorobutadiene	45.35	1.0	50	0	90.7	66 - 134	45.89	1.18	20	
Isopropylbenzene	43.6	1.0	50	0	87.2	72 - 131	44.6	2.27	20	
m,p-Xylene	84.37	2.0	100	0	84.4	80 - 121	86.14	2.08	20	
Methylene chloride	39.19	2.0	50	0	78.4	74 - 124	40.46	3.19	20	
Naphthalene	50.25	1.0	50	0	100	61 - 128	50.34	0.182	20	
n-Butylbenzene	43.04	1.0	50	0	86.1	75 - 128	43.34	0.706	20	
n-Propylbenzene	40.4	1.0	50	0	80.8	76 - 126	41.21	1.99	20	
o-Xylene	42.56	1.0	50	0	85.1	78 - 122	43.68	2.59	20	
sec-Butylbenzene	42.55	1.0	50	0	85.1	77 - 126	43.32	1.8	20	
Styrene	42.22	1.0	50	0	84.4	78 - 128	42.85	1.47	20	
tert-Butylbenzene	41.07	1.0	50	0	82.1	78 - 124	41.46	0.965	20	
Tetrachloroethene	44.98	1.0	50	0	90.0	74 - 129	45.68	1.53	20	
Toluene	41.32	1.0	50	0	82.6	80 - 121	41.84	1.25	20	
trans-1,2-Dichloroethene	46.25	1.0	50	0	92.5	75 - 124	45.93	0.696	20	
trans-1,3-Dichloropropene	45.88	1.0	50	0	91.8	73 - 127	46.64	1.63	20	
Trichloroethene	46.14	1.0	50	0	92.3	79 - 123	47.3	2.5	20	
Trichlorofluoromethane	45.23	1.0	50	0	90.5	65 - 141	45.71	1.07	20	
Vinyl chloride	44.03	1.0	50	0	88.1	58 - 137	45.43	3.13	20	
Surr: 1,2-Dichloroethane-d4	43.35	1.0	50	0	86.7	81 - 118	42.35	2.32	20	
Surr: 4-Bromofluorobenzene	49.85	1.0	50	0	99.7	85 - 114	49.94	0.175	20	
Surr: Dibromofluoromethane	41.27	1.0	50	0	82.5	80 - 119	40.96	0.741	20	
Surr: Toluene-d8	51.9	1.0	50	0	104	89 - 112	51.49	0.792	20	

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311741

Instrument: VOA2

Method: SW8260

The following samples were analyzed in this batch: HS18021169-01 HS18021169-02

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

QC BATCH REPORT

Batch ID: R311969		Instrument: ICS2100		Method: SW9056						
MBLK	Sample ID: WBLKW1-030518	Units: mg/L			Analysis Date: 05-Mar-2018 19:32					
Client ID:	Run ID: ICS2100_311969	SeqNo: 4461603		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	0.250	0.500							U	
Sulfate	0.250	0.500							U	
LCS	Sample ID: WLCSW1-030518	Units: mg/L			Analysis Date: 05-Mar-2018 20:01					
Client ID:	Run ID: ICS2100_311969	SeqNo: 4461604		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	20.44	0.500	20	0	102	80 - 120				
Sulfate	20.65	0.500	20	0	103	80 - 120				
LCSD	Sample ID: WLCSDW1-030518	Units: mg/L			Analysis Date: 05-Mar-2018 20:16					
Client ID:	Run ID: ICS2100_311969	SeqNo: 4461605		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	20.84	0.500	20	0	104	80 - 120	20.44	1.92	20	
Sulfate	21.21	0.500	20	0	106	80 - 120	20.65	2.66	20	
MS	Sample ID: HS18021169-01MS	Units: mg/L			Analysis Date: 05-Mar-2018 21:00					
Client ID: LH18/24-SP650_022118	Run ID: ICS2100_311969	SeqNo: 4461608		PrepDate:			DF: 20			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	774.9	10.0	200	582	96.4	80 - 120				
Sulfate	260.7	10.0	200	56.48	102	80 - 120				
MSD	Sample ID: HS18021169-01MSD	Units: mg/L			Analysis Date: 05-Mar-2018 21:14					
Client ID: LH18/24-SP650_022118	Run ID: ICS2100_311969	SeqNo: 4461609		PrepDate:			DF: 20			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Chloride	763.8	10.0	200	582	90.9	80 - 120	774.9	1.44	20	
Sulfate	257.4	10.0	200	56.48	100	80 - 120	260.7	1.27	20	

The following samples were analyzed in this batch:

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

ALS Group USA, Corp

Date: 06-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18021169

**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 Quantitation Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

Unit Reported	Description
mg/L	Milligrams per Liter

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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18021169

Date/Time Received: **22-Feb-2018 09:15**
 Received by: **JRM**

Checklist completed by: Pareesh M. Giga 22-Feb-2018 Reviewed by: _____
 eSignature Date eSignature Date

Matrices: **Water** Carrier name: **FedEx**

- 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): 1.3c/1.7c U/c IR30
 Cooler(s)/Kit(s): 42842
 Date/Time sample(s) sent to storage: 2/22/18 16:45

- 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: _____

CHAIN OF CUSTODY

Name Of Lab Shipping To: ALS 10450 Stanchiff Rd. Suite 210, Houston, Tx. 77099 ATTN: SONIA WEST

Project: BHATE LONGHORN ARMY AMMN. PLANT (LHAAP) GROUNDWATER TREATMENT PLANT (GWTP) KARNACK, TEXAS		Project No.: NWO1312-0150.0 16.0001	
Job: GROUNDWATER TREATMENT PLANT BI-WEEKLY SAMPLES			
Prepared By: Scott Beesinger		P.O Number	
Field Sample I.D. LH18/24-SP650_022118 LH18/24-SP650_022118 Trip Blank	Sample Matrix Water Water Water	Date / Time 02/21/18 / 14:00 02/21/18 / 14:00 02/21/18	MS / MSD 3 3 1 1 2 2
Analyses VOC CHLORIDE, SULFATE		NO. OF CONTAINERS	Remarks (Preservatives, etc.) HCL NONE HCL
Lab I.D.# HS18021169 Bhate Environmental Associates, Inc. LHAAP 18 24			

Additional Remarks: **STANDARD TAT ON ALL PARAMETERS.**

Relinquished By:	Date	Time	Received By:	Date	Time	Relinquished By:	Date	Time	Received By:	Date	Time
<i>Scott Beesinger</i>	02/21/18	14:30									

For Lab Use Only	Date	Time	Airbill No.	Opened By:	Date	Time	Temp of Container	Seal No.	Condition
Received At Lab By:	2/22/18	09:15							
Remarks:									

Locker - 42742 1230
Temp 1.34c CPOY

THU - 22 FEB 10:30A
PRIORITY OVERNIGHT
77099


7376 9749 9930

AB SCRA

CUSTODY SEAL

Time: 11:20
By: [Signature]

Seal Broken By: _____
Date: _____



ALS
10450 Stanchiff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5987

Date: 2/22
Name: _____
Company: _____



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

March 15, 2018

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

Work Order: **HS18030029**

Laboratory Results for: **Longhorn GW Treatment Plant**

Dear Marcia,

ALS Environmental received 1 sample(s) on Mar 01, 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,

A handwritten signature in black ink, appearing to read 'Raj. P. Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 15-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18030029

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18030029-01	LH18/24-SP650-022818	Water		28-Feb-2018 14:00	01-Mar-2018 09:15	<input type="checkbox"/>

ALS Group USA, Corp

Date: 15-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order:

CASE NARRATIVE

Work Order Comments

- The analysis for Perchlorate was subcontracted to ALS Salt Lake City, UT. Final report attached.
-

WetChemistry by Method E365.3**Batch ID: R312108**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E350.3**Batch ID: R312085**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

WetChemistry by Method E415.1**Batch ID: R312060**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 15-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP650-022818
 Collection Date: 28-Feb-2018 14:00

ANALYTICAL REPORT

WorkOrder:HS18030029
 Lab ID:HS18030029-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
AMMONIA AS N BY E350.3(ISE)								Analyst: SAP
Nitrogen, Ammonia (As N)	12		0.20	0.10	0.20	mg/L	1	06-Mar-2018 12:00
ORTHO PHOSPHATE (PO4) AS P BY E365.3								Analyst: MZD
Phosphorus, Total Orthophosphate (As P)	3.16		0.100	0.250	0.250	mg/L	10	02-Mar-2018 13:50
TOTAL ORGANIC CARBON BY E415.1								Analyst: KMU
Organic Carbon, Total	31.2		2.50	2.50	5.00	mg/L	5	06-Mar-2018 23:23
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)								Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	09-Mar-2018 14:02

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

ALS Group USA, Corp

Date: 15-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030029

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID R312060	Test Name : TOTAL ORGANIC CARBON BY E415.1		Matrix: Water			
HS18030029-01	LH18/24-SP650-022818	28 Feb 2018 14:00			06 Mar 2018 23:23	5
Batch ID R312085	Test Name : AMMONIA AS N BY E350.3(ISE)		Matrix: Water			
HS18030029-01	LH18/24-SP650-022818	28 Feb 2018 14:00			06 Mar 2018 12:00	1
Batch ID R312108	Test Name : ORTHO PHOSPHATE (PO4) AS P BY E365.3		Matrix: Water			
HS18030029-01	LH18/24-SP650-022818	28 Feb 2018 14:00			02 Mar 2018 13:50	10
Batch ID R312238	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18030029-01	LH18/24-SP650-022818	28 Feb 2018 14:00			09 Mar 2018 14:02	1

ALS Group USA, Corp

Date: 15-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030029

QC BATCH REPORT

Batch ID: R312060		Instrument: TOC_02		Method: E415.1						
MBLK	Sample ID: WBLKW1-030618	Units: mg/L		Analysis Date: 06-Mar-2018 19:15						
Client ID:	Run ID: TOC_02_312060	SeqNo: 4463851		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	0.500	1.00							U	
LCS	Sample ID: WLCSW1-030618	Units: mg/L		Analysis Date: 06-Mar-2018 19:30						
Client ID:	Run ID: TOC_02_312060	SeqNo: 4463852		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	10.42	1.00	10	0	104	80 - 120				
LCSD	Sample ID: WLCSDW1-030618	Units: mg/L		Analysis Date: 06-Mar-2018 19:45						
Client ID:	Run ID: TOC_02_312060	SeqNo: 4463853		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	10.45	1.00	10	0	104	80 - 120	10.42	0.287	20	
MS	Sample ID: HS18021075-01MS	Units: mg/L		Analysis Date: 06-Mar-2018 20:18						
Client ID:	Run ID: TOC_02_312060	SeqNo: 4463855		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Organic Carbon, Total	13.02	1.00	10	2.817	102	80 - 120				

The following samples were analyzed in this batch: HS18030029-01

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

ALS Group USA, Corp

Date: 15-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030029

QC BATCH REPORT

Batch ID: R312085		Instrument: WetChem_HS		Method: E350.3	
MBLK	Sample ID: MBLK-R312085	Units: mg/L		Analysis Date: 06-Mar-2018 12:00	
Client ID:	Run ID: WetChem_HS_312085	SeqNo: 4465356	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	0.10	0.20			U
LCS	Sample ID: LCS-R312085	Units: mg/L		Analysis Date: 06-Mar-2018 12:00	
Client ID:	Run ID: WetChem_HS_312085	SeqNo: 4465355	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	10.23	0.20	10	0	102 80 - 120
MS	Sample ID: HS18021217-01MS	Units: mg/L		Analysis Date: 06-Mar-2018 12:00	
Client ID:	Run ID: WetChem_HS_312085	SeqNo: 4465346	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	10.4	0.20	10	0.1695	102 80 - 120
MSD	Sample ID: HS18021217-01MSD	Units: mg/L		Analysis Date: 06-Mar-2018 12:00	
Client ID:	Run ID: WetChem_HS_312085	SeqNo: 4465347	PrepDate:	DF: 1	
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC Control Limit RPD Ref Value %RPD RPD Limit Qual
Nitrogen, Ammonia (As N)	10.31	0.20	10	0.1695	101 80 - 120 10.4 0.869 20

The following samples were analyzed in this batch: HS18030029-01

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

ALS Group USA, Corp

Date: 15-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030029

QC BATCH REPORT

Batch ID: R312108		Instrument: UV-2450		Method: E365.3						
MBLK	Sample ID: MBLK-312108	Units: mg/L		Analysis Date: 02-Mar-2018 13:50						
Client ID:	Run ID: UV-2450_312108	SeqNo: 4464611		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	0.0250	0.0250							U	
LCS	Sample ID: LCS-312108	Units: mg/L		Analysis Date: 02-Mar-2018 13:50						
Client ID:	Run ID: UV-2450_312108	SeqNo: 4464612		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	0.223	0.0250	0.25	0	89.2	85 - 115				
MS	Sample ID: HS18030029-01MS	Units: mg/L		Analysis Date: 02-Mar-2018 13:50						
Client ID: LH18/24-SP650-022818	Run ID: UV-2450_312108	SeqNo: 4464614		PrepDate:			DF: 10			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	5.47	0.250	2.5	3.16	92.4	80 - 120				
MSD	Sample ID: HS18030029-01MSD	Units: mg/L		Analysis Date: 02-Mar-2018 13:50						
Client ID: LH18/24-SP650-022818	Run ID: UV-2450_312108	SeqNo: 4464615		PrepDate:			DF: 10			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Phosphorus, Total Orthophosphate (As P)	5.45	0.250	2.5	3.16	91.6	80 - 120	5.47	0.366	20	

The following samples were analyzed in this batch: HS18030029-01

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

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030029

**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 Quantitation 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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18030029

Date/Time Received: **01-Mar-2018 09:15**
 Received by: **JRM**

Checklist completed by: Jared R. Makan 1-Mar-2018
 eSignature Date

Reviewed by: RJ Modashia 1-Mar-2018
 eSignature 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): 2.3c/1.7c UC/C IR25
 Cooler(s)/Kit(s): 42663
 Date/Time sample(s) sent to storage: 03/01/2018 14:40

- 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:

Name of Lab Shipping To: ALS 10450 Stancliff Rd, Suite 210 Houston, TX 77099 (281) 539-5656 ATTN: SONIA WEST

CHAIN OF CUSTODY

Project No.
 NWO1312.0150.0
 15.0001

Job:
GROUNDWATER TREATMENT PLANT WEEKLY SAMPLES

Prepared By:
 Scott Beesinger

Field Sample I.D.	Sample Matrix	Date / Time	Analyses				Remarks (Preservatives, etc.)	Lab I.D.#
			AMMONIA-N	TOTAL ORGANIC CARBON	ORTHO-PHOSPHATE	PERCHLORATE		
LH18/24-SP650_022818	Water	02/28/18 / 14:00	X	X			H2SO4	
LH18/24-SP650_022818	Water	02/28/18 / 14:00	X	X			NONE	

HS18030029

Bhate Environmental Associates, Inc.
 Longhorn GW Treatment Plant



Additional Remarks: Standard TAT on all parameters

Relinquished By:	Date	Time	Received By:	Date	Time	Relinquished By:	Date	Time	Received By:	Date	Time
<i>Scott Beesinger</i>	02/28/18	14:30									

For Lab Use Only			
Received At Lab By:	Date	Time	Airbill No.
<i>Jan</i>	2/1/18	09:15	

Cocher 42663 1/225
Tamp 2-3 CF-0.2

(Word) S-1-est-forms Chain of Custody - BHWecly

ALS 10450 Stancill Rd., Suite 210 Houston, Texas 77069 Tel. +1 281 530 6306 Fax. +1 281 5887	CUSTODY SEAL		Seal Broken By: <i>JMM</i>
	Date: <i>03/01/18</i> Name: <i>AB SGRA</i> Company: <i>Bechtel</i>	Time: <i>14:30</i> Initials: <i>AB</i>	Date: <i>03/01/18</i>

MAR 01 2018

FEDEX
 7376 9752 7484
AB SGRA *42663* / **77099**
 IAH



FD 10270, 2017119 066A 548C1/B 1/10/18CA



Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1806736; 1806586; 1806588;
1806590

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2058 (209974)

General Set Information: There were five 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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: NA

Method QC data: The method blank (LMB 590393) was less than 1/2 the CRDL. The recovery for the LCS (590394) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1806736001 (Client ID: INF Pond-Inlet_030718). 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): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)

B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 590391). These samples were analyzed in accordance with the requirements found in the DOD QSM Version 5.1. Manual Integrations was performed for datafile 08MARD04.

Thomas Bosch March 09, 2018
Analyst Date



ANALYTICAL REPORT

Report Date: March 09, 2018

RJ Masahisa
ALS Environmental (Houston)
10450 Stancliff Road
Suite 210
Houston, TX 77099

Phone: 281 530-5656

E-mail: RJ.Modashia@ALSGlobal.com

Workorder: **34-1806586**

Project ID: HS18030029 022818

Purchase Order: HS18030029

Project Manager Kevin W. Griffiths

Client Sample ID	Lab ID	Collect Date	Receive Date	Sampling Site
LH18/24-SP650-022818	1806586001	02/28/18	03/03/18	



ANALYTICAL REPORT

Workorder: 34-1806586

Client: ALS Environmental
(Houston)

Project Manager: Kevin W. Griffiths

Analytical Results

Sample ID: LH18/24-SP650-022818	Sampling Site: NA	Collected: 02/28/2018				
Lab ID: 1806586001	Media: 125 mL Nalgene	Received: 03/03/2018				
Matrix: Water	Sampling Parameter: NA					
Analysis Method - EPA 6850, DoD QSM						
Preparation: Not Applicable	Analysis: EPA 6850, DoD QSM Water Batch: ELMS/2058 (HBN: 209974) Analyzed: 03/08/2018 16:26	Instrument ID: LCMS04 Percent Solid: NA Report Basis: Wet				
Analyte	Result (ug/L)	DL (ug/L)	LOD (ug/L)	LOQ (ug/L)	Dilution	Qual
Perchlorate	73	1.0	2.0	4.0	1	

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 03/09/2018 11:30	/S/ Stephen Brose 03/09/2018 13:36

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123Phone: (801) 266-7700
Email: alsit.lab@ALSGlobal.com
Web: www.alssl.com



ANALYTICAL REPORT

Workorder: 34-1806586

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/bsdwlabservice.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
Industrial Hygiene	Kansas	E-10416	http://www.kdheks.gov/lipo/index.html
	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.aiclasscorp.com



ANALYTICAL REPORT

Workorder: 34-1806586

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

00883476

Analysis Information

Workorder: 1806586

Limits: Client SOW/Contract Specified
Basis: DoD QSM

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA 6850
Batch: ELMS/2058 (HBN: 209974)
Analyzed By: Thomas Bosch

Blank

LMB: 590393 Analyzed: 03/08/2018 14:46 Units: ug/L			
Analyte	Result	MDL	RL
Perchlorate	ND	1	2.00

Laboratory Control Sample

LCS: 590394 Analyzed: 03/08/2018 15:00 Dilution: 1 Units: ug/L				
Analyte	Result	Target	% Rec	QC Limits
Perchlorate	5.38	5.00	108	78.8 123.8

Matrix Spike - Matrix Spike Duplicate

Sample: 1806736001 Analyzed: 03/08/2018 15:15 Dilution: 1 Units: ug/L			MS: 590395 Analyzed: 03/08/2018 15:29 Dilution: 1 Units: ug/L			MSD: 590396 Analyzed: 03/08/2018 15:44 Dilution: 1 Units: ug/L			
Analyte	Result	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits
Perchlorate	1.80	7.01	5	105	78.8 123.8	7.16	108	2.11	0.0 20.0

Continuing Calibration Verification

CCV: 590390 Analyzed: 03/08/2018 14:02 Units: ug/L Criteria: ± 15%				CCV: 590397 Analyzed: 03/08/2018 17:09 Units: ug/L Criteria: ± 15%		
Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	26.4	25.0	105	27.6	25.0	111

Interference Check Sample

ICSA: 590392 Analyzed: 03/08/2018 14:32 Units: ug/L Criteria: ± 30%			
Analyte	Result	Target	% Rec.
Perchlorate	0.967	1.00	96.7

Limit of Detection Verification

LODV: 590391 Analyzed: 03/08/2018 14:17 Units: ug/L Criteria: ± 50%				LODV: 590398 Analyzed: 03/08/2018 17:23 Units: ug/L Criteria: ± 50%		
Analyte	Result	Target	% Rec.	Result	Target	% Rec.
Perchlorate	1.13	1.00	113	1.10	1.00	110



Quality Control Sample Batch Report

00883477

Analysis Information

Workorder: 1806586

Limits: Client SOW/Contract Specified

Preparation: NA

Analysis: EPA 6850

Basis: DoD QSM

Batch: NA

Batch: ELMS/2058 (HBN: 209974)

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 03/09/2018 11:30	/S/ Stephen Brose 03/09/2018 13:36

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



1806586

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: 8695

1806586

SUBCONTRACT TO:

ALS Laboratory Group
960 LeVoy Dr
Salt Lake City, UT 84123

Phone: +1 801 266 7700

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: HS18030029
TSR: Danielle Winnings

LAB SAMPLE ID	CLIENT SAMPLE ID	MATRIX	COLLECT DATE
ANALYSIS REQUESTED			DUE DATE
1. HS18030029-01	LH18/24-SP650-022818	Water	28 Feb 2018 14:00
SUB_Perch-6850			15 Mar 2018

Comments: Please analyze for the analysis listed above.
Send report to the emails shown above.

QC Level: DOD IV (DoD Data Package)

Relinquished By: _____

Received By: Merrell Hunt

Cooler ID(s): 2400

Date/Time: 3/2/18 18:00

Date/Time: 3/2/2018 901

Temperature(s): 2

ALS-SALT LAKE CITY-RELATED INFORMATION REPORT (CRIR)

COOLER OR CONTAINER INFORMATION CHECKLIST (Fill In or Circle)

Client Name: <u>ALS Houston</u>		Project/Task/Site: <u>1806586</u>						
Date/Time of Receipt: <u>3/3/2018 9:01</u>		Number of Coolers Received: <u>1</u>						
Condition of Coolers:	Acceptable/Unacceptable	Temperature Control:	Present/Not Included					
Cooler Custody Seals:	Present/Absent/NA	Location Temp Taken:	Control/Between Samples					
Container Custody Seals:	Intact/Broken/NA	Are all temperatures within project specific guidelines?	Yes/No/NA					
Ice Present:	Present/Absent/NA	VOA Headspace Present?	Yes/No/NA					
	Intact/Broken/NA							
	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	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 2900	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: <u>Meredith Stewart</u>		Printed Name: <u>Meredith Edwards</u>		Date: <u>3/3/2018</u>				

CLIENT-RELATED INFORMATION

<input type="checkbox"/> Missing Cooler	<input type="checkbox"/> Missing Samples/Bottles	<input type="checkbox"/> Incorrect Preservation	<input type="checkbox"/> Insufficient Sample Volume
<input type="checkbox"/> Cooler Conditions	<input type="checkbox"/> Broken/Leaking Samples	<input type="checkbox"/> pH Criteria Not Met	<input type="checkbox"/> Chain of Custody Problems
<input type="checkbox"/> Missing Paperwork	<input type="checkbox"/> Incorrect Bottle Type	<input type="checkbox"/> Residual Chlorine Present	<input type="checkbox"/> Other:
<input type="checkbox"/> Missing/Incorrect Bottle Labels	<input type="checkbox"/> Cooler Temperatures Out of Range	<input type="checkbox"/> Head Space in Bottles	

BRIEFLY DESCRIBE THE PROBLEM AND THE ACTION TAKEN:

Client Notified? YES NO

Response Required Within 24 Hours

PROJECT MANAGEMENT

PROJECT MANAGER COMMENTS:

ALS Project Manager: _____ Returned to Sample Receipt by: _____ Date: _____

Printed Name Signature



RT 98
ST F1

1
12:00 A
9785
03.03

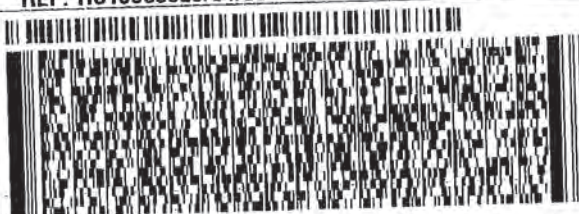
ORIGIN ID:SGRA (281) 530-5656
CLIENT SERVICES
ALS LABORATORY GROUP
10450 STANCLIFF ROAD
SUITE 210
HOUSTON, TX 77099
UNITED STATES US

SHIP DATE: 02MAR18
ACTWGT: 8.95 LB
CAD: 300130/CAFE3108
DIMS: 14x11x10 IN
BILL SENDER

to **KEVIN GRIFFITHS**
ALS ENVIRONMENTAL
960 W. LEVOY DRIVE

SALT LAKE CITY UT 84123

(801) 266-7700
REF: HS18030029/54/55 - RJ



FedEx
Express



SATURDAY 12:00P
PRIORITY OVERNIGHT

TRK# 7376 9752 9785
0201

XO BTFA

84123
UT-US SLC



Batch Worklist



Created: 3/8/2018 13:38
Analyst: T. Bosch

Instrument: LCMS04
Status: WP

HBN: 209974



Batch: ELMS/2058
Rule: EPA 6850, DoD QSM Water
Workorder: 1806586 [ENV_LVL4]
Workorder: 1806588 [ENV_LVL4]
Workorder: 1806590 [ENV_LVL4]
Workorder: 1806736 [ENV_LVL4]

Pos	Lab ID	Sample ID	Prep Initial	Prep Final	Dust Weight	Type	Mix	Container	Procedure	Mgr	Expire Date	Due Date	Run Date
1	590390	CCV for HBN 209974 [ELMS/2058]				CCV	3		E685041C3Q	5311		3/9/2018	3/8/2018
2	590391	LODV for HBN 209974 [ELMS/2058]				LODV	3		E6850_D3Q	5311		3/9/2018	3/8/2018
3	590392	ICS for HBN 209974 [ELMS/2058]				ICS	3		E6850_D3Q	5311		3/9/2018	3/8/2018
4	590393	LMB for HBN 209974 [ELMS/2058]				LMB	3		E6850Q413Q	5311		3/9/2018	3/8/2018
5	590394	LCS for HBN 209974 [ELMS/2058]				LCS	3		E6850Q413Q	5311		3/9/2018	3/8/2018
6	1806736001	INF Pond-Inlet_030718				SAMPLE	3	1806736001-A	E6850Q41.3	5480	4/4/2018	3/9/2018	3/8/2018
7	590395	INF Pond-Inle...(1806736001MS)				MS	3		E6850Q413Q	5311		3/9/2018	3/8/2018
8	590396	INF Pond-Inl...(1806736001MSD)				MSD	3		E6850Q413Q	5311		3/9/2018	3/8/2018
9	1806736002	INF Pond-Outlet_030718				SAMPLE	3	1806736002-A	E6850Q41.3	5480	4/4/2018	3/9/2018	3/8/2018
10	1806586001	LH18/24-SP650-022818				SAMPLE	3	1806586001-A	E6850Q41.3	5480	3/28/2018	3/16/2018	3/8/2018
11	1806588001	LH18/24-SP140_022818				SAMPLE	3	1806588001-A	E6850Q41.3	5480	3/28/2018	3/16/2018	3/8/2018
12	1806590001	LH18/25-SP650_022818				SAMPLE	3	1806590001-A	E6850Q41.3	5480	3/28/2018	3/16/2018	3/8/2018
13	590397	CCV for HBN 209974 [ELMS/2058]				CCV	3		E685041C3Q	5311		3/9/2018	3/8/2018
14	590398	LODV for HBN 209974 [ELMS/2058]				LODV	3		E6850_D3Q	5311		3/9/2018	3/8/2018



ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Documentation

ALS Work Order #'s & Sample #()'s: 1806736 (001,02); 1806586 (001); 1806588 (001); 1806590 (001)

ELMS Batch/HBN ID: 2058 (209974)

Prep Date: 03/08/2018 Analysis Date: 03/08/2018 Analyst: T. Bosch

Analyte: Perchlorate Matrix: Water Method: 6850

Sequence: \\HPCHEM\1\SEQUENCE\CLO4\2018\MAR\08MAR18D.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 02/22/2018, sequence 22FEB18D.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-DOD.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	0.80
4.0	0.80
5.0	0.25
10.0	0.25
10.5	0.80
13.0	0.80

QC DATA: 5.0µL of QC Solution Horizon ID 36749 was used for LCS 590394; Target = 5.0µg/L. ASTM type II water was used for LMB 590393.

MS/MSD: MS/MSD was performed on sample 1806736001 (Client ID: INF Pond-Inlet_030718). 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. The ion ratio of m/z 83 to 85 may fail at levels near the reported Detection Limit (DL). The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 590391).
- 3) Sample data can be viewed at two directories within the ALS system: \\ALSLTWS013\LCMS\LCMS04\2018\MAR\HBN# or through NuGenesis\Tree\PrintData\LCMS\DefaultView.
- 4) Due to limitations of the Chemstation Software, some of the chromatographic peaks require manual integration. Manual Integrations was performed for datafile 08MARD04.
- 5) Notebook: \\alsltws013\ORGANIC\BOSCH\LCMS\Perchlorates\Waters\2018\209974-DOD-ALS-HSTN-LCMS4 or through \\ALSLTWS013\DATAREVIEW\HBN#



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	Created By: T. Bosch	Amount: 10 mL			
MFG: ALS/SLC	Create Date: 05/10/2017	Expires: 05/10/2018			
MFG Lot: TNB: 05/10/17	Lab Lot: CLO4 INT	Usable: Yes			
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/17		Lab Lot: CLO4 QC WRK 100.ug/L		Usable: Yes	
Part ID:					
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		Created By: T. Bosch		Amount: 10 mL	
MFG: ALS/SLC		Create Date: 05/11/2017		Expires: 05/11/2018	
MFG Lot: TNB: 05/11/2017		Lab Lot: CLO4 QC INT 10.ug/mL		Usable: Yes	
Part ID:					
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	Created By: T. Bosch	Amount: 100 mL	
MFG: Ultra Scientific	Create Date: 5/11/2017	Expires: 3/31/2020	
MFG Lot: CP-0860	Lab Lot: CLO4 QC STOCK	Usable: Yes	
Part ID: ICC-013			
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



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.





Certificate of Analysis



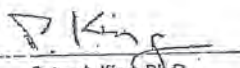
ISO Guide 34 Reference Material

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 (ClO₄)
SRM: Ind. Std.
Lot: 216095148
Matrix: Water
Hazards: Refer to SDS for complete safety information

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



Signal Word: Warning

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



Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

Quality Standards:

ISO Guide 34 • ISO/IEC 17025 • ISO 13485 • cGMP



23118

Product Name: PERCHLORIC ACID, SODIUM SALT
(Isotopic Label & Enrichment Specification) (18O4, 90%+) 100 UG/ML IN WATER

Lot Number: SDDG-013

Catalog Number: OLM-7310-S

Product Information

Chemical Purity Specification: $\geq 98\%$

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 $\mu\text{g/mL}$
Chemical Purity of Neat Material(s)	98%
LC/MS for Concentration	109.4 \pm 2.8 $\mu\text{g/mL}$ (k=2)



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March 16, 2018

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

Work Order: **HS18030054**

Laboratory Results for: **Longhorn GW Treatment Plant**

Dear Marcia,

ALS Environmental received 2 sample(s) on Mar 01, 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,

A handwritten signature in black ink, appearing to read 'Raj Modashia', enclosed in a circular scribble.

Generated By: Jumoke.Lawal
RJ Modashia
Project Manager

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18030054

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS18030054-01	LH18/24-SP140_022818	Water		28-Feb-2018 14:00	01-Mar-2018 09:15	<input type="checkbox"/>
HS18030054-02	Trip Blank	Water	ALS-021518-32	28-Feb-2018 00:01	01-Mar-2018 09:15	<input type="checkbox"/>

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.**CASE NARRATIVE****Project:** Longhorn GW Treatment Plant**Work Order:**

Work Order Comments

- The analysis for Perchlorate was subcontracted to ALS Salt Lake City, UT. Final report attached.

GCMS Semivolatiles by Method SW8270SIM**Batch ID: 125840****Sample ID: LH18/24-SP140_022818 (HS18030054-01)**

- The surrogate recoveries could not be determined due to dilution below the calibration range.

GCMS Volatiles by Method SW8260**Batch ID: R311972****Sample ID: HS18030131-05MS**

- MS and MSD are for an unrelated sample.

Metals by Method SW6020**Batch ID: 126131****Sample ID: HS18030472-02MS**

- MS/MSD and DUPs are for an unrelated sample

Metals by Method SW7470**Batch ID: 125884**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method E1664A**Batch ID: R312478**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method SW9056**Batch ID: R312306**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method E410.4**Batch ID: R312257**

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.
-

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP140_022818
 Collection Date: 28-Feb-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18030054
 Lab ID:HS18030054-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,1,1-Trichloroethane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,1,2,2-Tetrachloroethane	5.0	U	5.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,1,2-Trichloroethane	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,1-Dichloroethane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,1-Dichloroethene	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,1-Dichloropropene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2,3-Trichlorobenzene	5.0	U	4.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2,3-Trichloropropane	5.0	U	5.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2,4-Trichlorobenzene	5.0	U	5.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2,4-Trimethylbenzene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2-Dibromo-3-chloropropane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2-Dibromoethane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2-Dichlorobenzene	5.0	U	5.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2-Dichloroethane	32		2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,2-Dichloropropane	5.0	U	5.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,3,5-Trimethylbenzene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,3-Dichlorobenzene	5.0	U	4.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,3-Dichloropropane	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
1,4-Dichlorobenzene	5.0	U	4.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
2,2-Dichloropropane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
2-Butanone	10	U	5.0	10	20	ug/L	10	05-Mar-2018 12:57	
2-Chlorotoluene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
2-Hexanone	10	U	10	10	20	ug/L	10	05-Mar-2018 12:57	
4-Chlorotoluene	5.0	U	4.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
4-Isopropyltoluene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
4-Methyl-2-pentanone	10	U	7.0	10	20	ug/L	10	05-Mar-2018 12:57	
Acetone	10	U	4.0	10	20	ug/L	10	05-Mar-2018 12:57	
Benzene	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Bromobenzene	5.0	U	4.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Bromochloromethane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Bromodichloromethane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Bromoform	5.0	U	4.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Bromomethane	5.0	U	4.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Carbon disulfide	10	U	6.0	10	20	ug/L	10	05-Mar-2018 12:57	
Carbon tetrachloride	5.0	U	5.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Chlorobenzene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Chloroethane	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP140_022818
 Collection Date: 28-Feb-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18030054
 Lab ID:HS18030054-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
Chloroform	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Chloromethane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
cis-1,2-Dichloroethene	3,600		20	50	100	ug/L	100	05-Mar-2018 13:24	
cis-1,3-Dichloropropene	5.0	U	1.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Dibromochloromethane	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Dibromomethane	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Dichlorodifluoromethane	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Ethylbenzene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Hexachlorobutadiene	5.0	U	10	5.0	10	ug/L	10	05-Mar-2018 12:57	
Isopropylbenzene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
m,p-Xylene	10	U	5.0	10	20	ug/L	10	05-Mar-2018 12:57	
Methylene chloride	27		4.0	10	20	ug/L	10	05-Mar-2018 12:57	
n-Butylbenzene	5.0	U	4.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
n-Propylbenzene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Naphthalene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
o-Xylene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
sec-Butylbenzene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Styrene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
tert-Butylbenzene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Tetrachloroethene	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Toluene	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
trans-1,2-Dichloroethene	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
trans-1,3-Dichloropropene	5.0	U	2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Trichloroethene	7,200		20	50	100	ug/L	100	05-Mar-2018 13:24	
Trichlorofluoromethane	5.0	U	3.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Vinyl chloride	51		2.0	5.0	10	ug/L	10	05-Mar-2018 12:57	
Surr: 1,2-Dichloroethane-d4	84.5			0	81-118	%REC	100	05-Mar-2018 13:24	
Surr: 1,2-Dichloroethane-d4	84.4			0	81-118	%REC	10	05-Mar-2018 12:57	
Surr: 4-Bromofluorobenzene	95.4			0	85-114	%REC	10	05-Mar-2018 12:57	
Surr: 4-Bromofluorobenzene	93.6			0	85-114	%REC	100	05-Mar-2018 13:24	
Surr: Dibromofluoromethane	86.7			0	80-119	%REC	100	05-Mar-2018 13:24	
Surr: Dibromofluoromethane	84.0			0	80-119	%REC	10	05-Mar-2018 12:57	
Surr: Toluene-d8	108			0	89-112	%REC	10	05-Mar-2018 12:57	
Surr: Toluene-d8	108			0	89-112	%REC	100	05-Mar-2018 13:24	

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: LH18/24-SP140_022818
 Collection Date: 28-Feb-2018 14:00

ANALYTICAL REPORT
 WorkOrder:HS18030054
 Lab ID:HS18030054-01
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED
SEMIVOLATILES SIM			Method:SW8270SIM			Prep:SW3510 / 05-Mar-2018		Analyst: ACN
1,4-Dioxane	7.1		1.0	1.0	1.0	ug/L	100	07-Mar-2018 17:22
Surr: 2-Fluorobiphenyl	0	S		0	40-140	%REC	100	07-Mar-2018 17:22
Surr: 4-Terphenyl-d14	0	S		0	40-140	%REC	100	07-Mar-2018 17:22
Surr: Nitrobenzene-d5	0	S		0	40-140	%REC	100	07-Mar-2018 17:22
ICP-MS METALS BY SW6020A			Method:SW6020			Prep:SW3010A / 13-Mar-2018		Analyst: JCJ
Aluminum	0.0417		0.00180	0.00500	0.0100	mg/L	1	15-Mar-2018 14:32
Antimony	0.00100	U	0.000400	0.00100	0.00200	mg/L	1	15-Mar-2018 14:32
Arsenic	0.000956	J	0.000400	0.00100	0.00200	mg/L	1	15-Mar-2018 14:32
Barium	0.104		0.00190	0.00250	0.00400	mg/L	1	15-Mar-2018 14:32
Beryllium	0.00100	U	0.000200	0.00100	0.00200	mg/L	1	15-Mar-2018 14:32
Cadmium	0.00100	U	0.000200	0.00100	0.00200	mg/L	1	15-Mar-2018 14:32
Calcium	140		0.0340	0.100	0.500	mg/L	1	15-Mar-2018 14:32
Chromium	0.00189	J	0.000400	0.00100	0.00400	mg/L	1	15-Mar-2018 14:32
Cobalt	0.00502		0.000200	0.00100	0.00500	mg/L	1	15-Mar-2018 14:32
Iron	0.479		0.0120	0.100	0.200	mg/L	1	15-Mar-2018 14:32
Lead	0.000854	J	0.000600	0.00100	0.00200	mg/L	1	15-Mar-2018 14:32
Magnesium	106		0.0100	0.100	0.200	mg/L	1	15-Mar-2018 14:32
Manganese	0.199		0.000700	0.00100	0.00500	mg/L	1	15-Mar-2018 14:32
Nickel	0.00727		0.000600	0.00100	0.00200	mg/L	1	15-Mar-2018 14:32
Potassium	1.64		0.0180	0.100	0.200	mg/L	1	15-Mar-2018 14:32
Selenium	0.00283		0.00110	0.00200	0.00200	mg/L	1	15-Mar-2018 14:32
Silver	0.00100	U	0.000200	0.00100	0.00200	mg/L	1	15-Mar-2018 14:32
Sodium	720		0.280	2.00	4.00	mg/L	20	15-Mar-2018 15:59
Thallium	0.00100	U	0.000200	0.00100	0.00200	mg/L	1	15-Mar-2018 14:32
Vanadium	0.00100	U	0.000600	0.00100	0.00500	mg/L	1	15-Mar-2018 14:32
Zinc	0.0503		0.00200	0.00250	0.00400	mg/L	1	15-Mar-2018 14:32
MERCURY BY SW7470A			Method:SW7470			Prep:SW7470 / 05-Mar-2018		Analyst: JBA
Mercury	0.0000500	U	0.0000300	0.0000500	0.000200	mg/L	1	06-Mar-2018 10:26
OIL & GREASE (HEM) BY E1664A			Method:E1664A					Analyst: KAH
Oil and Grease	1.00	U	0.610	1.00	2.00	mg/L	1	14-Mar-2018 13:35
CHEMICAL OXYGEN DEMAND BY E410.4			Method:E410.4					Analyst: AJH
Chemical Oxygen Demand	24.0		5.00	5.00	15.0	mg/L	1	09-Mar-2018 14:00
ANIONS BY SW9056A			Method:SW9056					Analyst: KMU
Chloride	790		4.00	5.00	10.0	mg/L	20	09-Mar-2018 07:18
Sulfate	1,260		4.00	5.00	10.0	mg/L	20	09-Mar-2018 07:18
SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)			Method:NA					Analyst: SUB
Subcontract Analysis	See Attached		0	0		NA	1	09-Mar-2018 14:02

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: Trip Blank
 Collection Date: 28-Feb-2018 00:01

ANALYTICAL REPORT
 WorkOrder:HS18030054
 Lab ID:HS18030054-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
1,1,1,2-Tetrachloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,1,1-Trichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,1,2,2-Tetrachloroethane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,1,2-Trichloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,1-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,1-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,1-Dichloropropene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2,3-Trichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2,3-Trichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2,4-Trichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2,4-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2-Dibromo-3-chloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2-Dibromoethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2-Dichlorobenzene	0.50	U	0.50	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2-Dichloroethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,2-Dichloropropane	0.50	U	0.50	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,3,5-Trimethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,3-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,3-Dichloropropane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
1,4-Dichlorobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
2,2-Dichloropropane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
2-Butanone	1.0	U	0.50	1.0	2.0	ug/L	1	05-Mar-2018 11:40	
2-Chlorotoluene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
2-Hexanone	1.0	U	1.0	1.0	2.0	ug/L	1	05-Mar-2018 11:40	
4-Chlorotoluene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
4-Isopropyltoluene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
4-Methyl-2-pentanone	1.0	U	0.70	1.0	2.0	ug/L	1	05-Mar-2018 11:40	
Acetone	1.0	U	0.40	1.0	2.0	ug/L	1	05-Mar-2018 11:40	
Benzene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Bromobenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Bromochloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Bromodichloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Bromoform	0.50	U	0.40	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Bromomethane	0.50	U	0.40	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Carbon disulfide	1.0	U	0.60	1.0	2.0	ug/L	1	05-Mar-2018 11:40	
Carbon tetrachloride	0.50	U	0.50	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Chlorobenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Chloroethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
 Project: Longhorn GW Treatment Plant
 Sample ID: Trip Blank
 Collection Date: 28-Feb-2018 00:01

ANALYTICAL REPORT
 WorkOrder:HS18030054
 Lab ID:HS18030054-02
 Matrix:Water

ANALYSES	RESULT	QUAL	DL	LOD	LOQ	UNITS	DILUTION FACTOR	DATE ANALYZED	
VOLATILES ORGANICS BY METHOD 8260C		Method:SW8260							Analyst: AKP
Chloroform	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Chloromethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
cis-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
cis-1,3-Dichloropropene	0.50	U	0.10	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Dibromochloromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Dibromomethane	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Dichlorodifluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Ethylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Hexachlorobutadiene	0.50	U	1.0	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Isopropylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
m,p-Xylene	1.0	U	0.50	1.0	2.0	ug/L	1	05-Mar-2018 11:40	
Methylene chloride	1.0	U	0.40	1.0	2.0	ug/L	1	05-Mar-2018 11:40	
n-Butylbenzene	0.50	U	0.40	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
n-Propylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Naphthalene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
o-Xylene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
sec-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Styrene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
tert-Butylbenzene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Tetrachloroethene	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Toluene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
trans-1,2-Dichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
trans-1,3-Dichloropropene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Trichloroethene	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Trichlorofluoromethane	0.50	U	0.30	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
Vinyl chloride	0.50	U	0.20	0.50	1.0	ug/L	1	05-Mar-2018 11:40	
<i>Surr: 1,2-Dichloroethane-d4</i>	<i>81.4</i>			0	<i>81-118</i>	<i>%REC</i>	<i>1</i>	<i>05-Mar-2018 11:40</i>	
<i>Surr: 4-Bromofluorobenzene</i>	<i>97.6</i>			0	<i>85-114</i>	<i>%REC</i>	<i>1</i>	<i>05-Mar-2018 11:40</i>	
<i>Surr: Dibromofluoromethane</i>	<i>87.3</i>			0	<i>80-119</i>	<i>%REC</i>	<i>1</i>	<i>05-Mar-2018 11:40</i>	
<i>Surr: Toluene-d8</i>	<i>106</i>			0	<i>89-112</i>	<i>%REC</i>	<i>1</i>	<i>05-Mar-2018 11:40</i>	

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

WEIGHT LOG

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

Batch ID: 125840 **Method:** SEMIVOLATILES SIM **Prep:** 3510_B_SIM

SampleID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18030054-01	1	980	1 (mL)	0.00102

Batch ID: 125884 **Method:** MERCURY BY SW7470A **Prep:** HG_WPR

SampleID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18030054-01	1	10	10 (mL)	1

Batch ID: 126131 **Method:** ICP-MS METALS BY SW6020A **Prep:** 3010A

SampleID	Container	Sample Wt/Vol	Final Volume	Prep Factor
HS18030054-01	1	10	10 (mL)	1

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

DATES REPORT

Sample ID	Client Samp ID	Collection Date	TCLP Date	Prep Date	Analysis Date	DF
Batch ID 125840	Test Name : SEMIVOLATILES SIM		Matrix: Water			
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00		05 Mar 2018 12:19	07 Mar 2018 17:22	100
Batch ID 125884	Test Name : MERCURY BY SW7470A		Matrix: Water			
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00		05 Mar 2018 14:00	06 Mar 2018 10:26	1
Batch ID 126131	Test Name : ICP-MS METALS BY SW6020A		Matrix: Water			
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00		13 Mar 2018 11:00	15 Mar 2018 15:59	20
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00		13 Mar 2018 11:00	15 Mar 2018 14:32	1
Batch ID R311972	Test Name : VOLATILES ORGANICS BY METHOD 8260C		Matrix: Water			
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00			05 Mar 2018 13:24	100
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00			05 Mar 2018 12:57	10
HS18030054-02	Trip Blank	28 Feb 2018 00:01			05 Mar 2018 11:40	1
Batch ID R312238	Test Name : SUBCONTRACT ANALYSIS - PERCHLORATE (EPA 6850)		Matrix: Water			
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00			09 Mar 2018 14:02	1
Batch ID R312257	Test Name : CHEMICAL OXYGEN DEMAND BY E410.4		Matrix: Water			
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00			09 Mar 2018 14:00	1
Batch ID R312306	Test Name : ANIONS BY SW9056A		Matrix: Water			
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00			09 Mar 2018 07:18	20
Batch ID R312478	Test Name : OIL & GREASE (HEM) BY E1664A		Matrix: Water			
HS18030054-01	LH18/24-SP140_022818	28 Feb 2018 14:00			14 Mar 2018 13:35	1

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: 125884		Instrument: HG03		Method: SW7470					
MBLK	Sample ID: MBLK-125884	Units: mg/L		Analysis Date: 06-Mar-2018 09:55					
Client ID:	Run ID: HG03_311947	SeqNo: 4461339		PrepDate: 05-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD Limit Qual	
Mercury	0.0000500	0.000200						U	
LCS	Sample ID: LCS-125884	Units: mg/L		Analysis Date: 06-Mar-2018 10:00					
Client ID:	Run ID: HG03_311947	SeqNo: 4461340		PrepDate: 05-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD Limit Qual	
Mercury	0.00504	0.000200	0.005	0	101	80 - 120			
MS	Sample ID: HS18030111-01MS	Units: mg/L		Analysis Date: 06-Mar-2018 10:09					
Client ID:	Run ID: HG03_311947	SeqNo: 4461344		PrepDate: 05-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD Limit Qual	
Mercury	0.00509	0.000200	0.005	0.000228	97.2	75 - 125			
MSD	Sample ID: HS18030111-01MSD	Units: mg/L		Analysis Date: 06-Mar-2018 10:06					
Client ID:	Run ID: HG03_311947	SeqNo: 4461343		PrepDate: 05-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	RPD %RPD Limit Qual	
Mercury	0.00506	0.000200	0.005	0.000228	96.6	75 - 125	0.00509	0.591 20	

The following samples were analyzed in this batch: HS18030054-01

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: 126131		Instrument: ICPMS04		Method: SW6020						
MBLK	Sample ID: MBLK-126131	Units: mg/L		Analysis Date: 15-Mar-2018 14:28						
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475111		PrepDate: 13-Mar-2018			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.003935	0.0100								J
Antimony	0.00100	0.00200								U
Arsenic	0.00100	0.00200								U
Barium	0.00250	0.00400								U
Beryllium	0.00100	0.00200								U
Cadmium	0.00100	0.00200								U
Calcium	0.100	0.500								U
Chromium	0.00100	0.00400								U
Cobalt	0.00100	0.00500								U
Iron	0.100	0.200								U
Lead	0.00100	0.00200								U
Magnesium	0.100	0.200								U
Manganese	0.00100	0.00500								U
Nickel	0.00100	0.00200								U
Potassium	0.04249	0.200								J
Selenium	0.00200	0.00200								U
Silver	0.00100	0.00200								U
Thallium	0.00100	0.00200								U
Vanadium	0.00100	0.00500								U
Zinc	0.00250	0.00400								U
MBLK	Sample ID: MBLK-126131	Units: mg/L		Analysis Date: 15-Mar-2018 15:50						
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475370		PrepDate: 13-Mar-2018			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sodium	0.07897	0.200								J

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: 126131		Instrument: ICPMS04			Method: SW6020					
LCS	Sample ID: LCS-126131	Units: mg/L			Analysis Date: 15-Mar-2018 14:30					
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475112			PrepDate: 13-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.09485	0.0100	0.1	0	94.8	80 - 120				
Antimony	0.04668	0.00200	0.05	0	93.4	80 - 120				
Arsenic	0.04888	0.00200	0.05	0	97.8	80 - 120				
Barium	0.04512	0.00400	0.05	0	90.2	80 - 120				
Beryllium	0.04763	0.00200	0.05	0	95.3	80 - 120				
Cadmium	0.04636	0.00200	0.05	0	92.7	80 - 120				
Calcium	5.156	0.500	5	0	103	80 - 120				
Chromium	0.04785	0.00400	0.05	0	95.7	80 - 120				
Cobalt	0.04806	0.00500	0.05	0	96.1	80 - 120				
Iron	5.028	0.200	5	0	101	80 - 120				
Lead	0.04414	0.00200	0.05	0	88.3	80 - 120				
Magnesium	4.552	0.200	5	0	91.0	80 - 120				
Manganese	0.04894	0.00500	0.05	0	97.9	80 - 120				
Nickel	0.04881	0.00200	0.05	0	97.6	80 - 120				
Potassium	4.784	0.200	5	0	95.7	80 - 120				
Selenium	0.04512	0.00200	0.05	0	90.2	80 - 120				
Silver	0.0474	0.00200	0.05	0	94.8	80 - 120				
Thallium	0.04365	0.00200	0.05	0	87.3	80 - 120				
Vanadium	0.04672	0.00500	0.05	0	93.4	80 - 120				
Zinc	0.04796	0.00400	0.05	0	95.9	80 - 120				
LCS	Sample ID: LCS-126131	Units: mg/L			Analysis Date: 15-Mar-2018 15:52					
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475371			PrepDate: 13-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sodium	4.686	0.200	5	0	93.7	80 - 120				

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: 126131		Instrument: ICPMS04			Method: SW6020					
MS	Sample ID: HS18030472-02MS	Units: mg/L			Analysis Date: 15-Mar-2018 14:41					
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475117			PrepDate: 13-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.1362	0.0100	0.1	0.0632	73.0	80 - 120				S
Antimony	0.04697	0.00200	0.05	0.000151	93.6	80 - 120				
Arsenic	0.04907	0.00200	0.05	0.000762	96.6	80 - 120				
Barium	0.06834	0.00400	0.05	0.02408	88.5	80 - 120				
Beryllium	0.04064	0.00200	0.05	0.00002	81.2	80 - 120				
Cadmium	0.04478	0.00200	0.05	0.000132	89.3	80 - 120				
Calcium	349.7	0.500	5	345.4	85.5	80 - 120				EO
Chromium	0.04536	0.00400	0.05	0.000324	90.1	80 - 120				
Cobalt	0.04828	0.00500	0.05	0.003523	89.5	80 - 120				
Iron	4.792	0.200	5	0.2489	90.9	80 - 120				
Lead	0.04518	0.00200	0.05	0.000716	88.9	80 - 120				
Magnesium	198.4	0.200	5	198.4	0.00238	80 - 120				SEO
Manganese	0.2801	0.00500	0.05	0.2357	88.8	80 - 120				O
Nickel	0.0526	0.00200	0.05	0.007836	89.5	80 - 120				
Potassium	8.002	0.200	5	3.429	91.5	80 - 120				
Selenium	0.05347	0.00200	0.05	0.003589	99.8	80 - 120				
Silver	0.04234	0.00200	0.05	0.000014	84.6	80 - 120				
Sodium	0.100	0.200	5	0	0	80 - 120				S U
Thallium	0.04325	0.00200	0.05	0.000007	86.5	80 - 120				
Vanadium	0.04736	0.00500	0.05	-0.000104	94.9	80 - 120				
Zinc	0.05324	0.00400	0.05	0.009825	86.8	80 - 120				

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: 126131		Instrument: ICPMS04		Method: SW6020						
MSD	Sample ID: HS18030472-02MSD	Units: mg/L			Analysis Date: 15-Mar-2018 14:43					
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475118	PrepDate: 13-Mar-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.1372	0.0100	0.1	0.0632	74.0	80 - 120	0.1362	0.715	20	S
Antimony	0.0452	0.00200	0.05	0.000151	90.1	80 - 120	0.04697	3.85	20	
Arsenic	0.04836	0.00200	0.05	0.000762	95.2	80 - 120	0.04907	1.45	20	
Barium	0.06914	0.00400	0.05	0.02408	90.1	80 - 120	0.06834	1.16	20	
Beryllium	0.04008	0.00200	0.05	0.00002	80.1	80 - 120	0.04064	1.4	20	
Cadmium	0.04598	0.00200	0.05	0.000132	91.7	80 - 120	0.04478	2.66	20	
Calcium	337.8	0.500	5	345.4	-154	80 - 120	349.7	3.48	20	SEO
Chromium	0.04746	0.00400	0.05	0.000324	94.3	80 - 120	0.04536	4.52	20	
Cobalt	0.04697	0.00500	0.05	0.003523	86.9	80 - 120	0.04828	2.74	20	
Iron	4.716	0.200	5	0.2489	89.3	80 - 120	4.792	1.6	20	
Lead	0.04544	0.00200	0.05	0.000716	89.4	80 - 120	0.04518	0.578	20	
Magnesium	199.6	0.200	5	198.4	25.5	80 - 120	198.4	0.64	20	SEO
Manganese	0.2738	0.00500	0.05	0.2357	76.1	80 - 120	0.2801	2.3	20	SO
Nickel	0.04882	0.00200	0.05	0.007836	82.0	80 - 120	0.0526	7.44	20	
Potassium	8.05	0.200	5	3.429	92.4	80 - 120	8.002	0.599	20	
Selenium	0.0491	0.00200	0.05	0.003589	91.0	80 - 120	0.05347	8.53	20	
Silver	0.04224	0.00200	0.05	0.000014	84.5	80 - 120	0.04234	0.229	20	
Sodium	0.100	0.200	5	0	0	80 - 120	0	0	20	S U
Thallium	0.04401	0.00200	0.05	0.000007	88.0	80 - 120	0.04325	1.75	20	
Vanadium	0.04829	0.00500	0.05	-0.000104	96.8	80 - 120	0.04736	1.94	20	
Zinc	0.05408	0.00400	0.05	0.009825	88.5	80 - 120	0.05324	1.57	20	

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: 126131		Instrument: ICPMS04		Method: SW6020						
PDS	Sample ID: HS18030472-02PDS	Units: mg/L			Analysis Date: 15-Mar-2018 14:46					
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475119	PrepDate: 13-Mar-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aluminum	0.1314	0.0100	0.1	0.0632	68.2	75 - 125				S
Antimony	0.07836	0.00200	0.1	0.000151	78.2	75 - 125				
Arsenic	0.09169	0.00200	0.1	0.000762	90.9	75 - 125				
Barium	0.1104	0.00400	0.1	0.02408	86.3	75 - 125				
Beryllium	0.0812	0.00200	0.1	0.00002	81.2	75 - 125				
Cadmium	0.08602	0.00200	0.1	0.000132	85.9	75 - 125				
Chromium	0.08908	0.00400	0.1	0.000324	88.8	75 - 125				
Cobalt	0.09229	0.00500	0.1	0.003523	88.8	75 - 125				
Iron	8.895	0.200	10	0.2489	86.5	75 - 125				
Lead	0.0875	0.00200	0.1	0.000716	86.8	75 - 125				
Nickel	0.09517	0.00200	0.1	0.007836	87.3	75 - 125				
Potassium	12.28	0.200	10	3.429	88.5	75 - 125				
Selenium	0.08526	0.00200	0.1	0.003589	81.7	75 - 125				
Silver	0.08347	0.00200	0.1	0.000014	83.5	75 - 125				
Thallium	0.08694	0.00200	0.1	0.000007	86.9	75 - 125				
Vanadium	0.09259	0.00500	0.1	-0.000104	92.7	75 - 125				
Zinc	0.09939	0.00400	0.1	0.009825	89.6	75 - 125				
PDS	Sample ID: HS18030472-02PDS	Units: mg/L			Analysis Date: 15-Mar-2018 16:08					
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475378	PrepDate: 13-Mar-2018	DF: 20						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	509.4	10.0	200	369.1	70.2	75 - 125				S
Magnesium	386.4	4.00	200	217	84.7	75 - 125				
Sodium	869.3	4.00	200	713.5	77.9	75 - 125				
PDS	Sample ID: HS18030472-02PDS	Units: mg/L			Analysis Date: 15-Mar-2018 15:57					
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475373	PrepDate: 13-Mar-2018	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Manganese	0.3109	0.00500	0.1	0.2357	75.1	75 - 125				

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: 126131		Instrument: ICPMS04		Method: SW6020						
SD	Sample ID: HS18030472-02SD	Units: mg/L		Analysis Date: 15-Mar-2018 14:39						
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475116	PrepDate: 13-Mar-2018	DF: 5						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Aluminum	0.06348	0.0500					0.0632	0.441	10	
Antimony	0.00500	0.0100					0.000151	0	10	U
Arsenic	0.00500	0.0100					0.000762	0	10	U
Barium	0.0231	0.0200					0.02408	4.08	10	
Beryllium	0.00500	0.0100					0.00002	0	10	U
Cadmium	0.00500	0.0100					0.000132	0	10	U
Chromium	0.00500	0.0200					0.000324	0	10	U
Cobalt	0.004117	0.0250					0.003523	0	10	J
Iron	0.2493	1.00					0.2489	0	10	J
Lead	0.00500	0.0100					0.000716	0	10	U
Manganese	0.2312	0.0250					0.2357	1.91	10	
Nickel	0.006589	0.0100					0.007836	0	10	J
Potassium	4.009	1.00					3.429	16.9	10	R
Selenium	0.0100	0.0100					0.003589	0	10	U
Silver	0.00500	0.0100					0.000014	0	10	U
Thallium	0.00500	0.0100					0.000007	0	10	U
Vanadium	0.00500	0.0250					-0.000104	0	10	U
Zinc	0.01038	0.0200					0.009825	0	10	J
SD	Sample ID: HS18030472-02SD	Units: mg/L		Analysis Date: 15-Mar-2018 16:05						
Client ID:	Run ID: ICPMS04_312510	SeqNo: 4475377	PrepDate: 13-Mar-2018	DF: 100						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Calcium	378.8	50.0					369.1	2.64	10	
Magnesium	230	20.0					217	5.99	10	
Sodium	760	20.0					713.5	6.53	10	

The following samples were analyzed in this batch: HS18030054-01

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: 125840		Instrument: SV-5		Method: SW8270SIM						
MBLK	Sample ID: MBLK-125840	Units: ug/L			Analysis Date: 06-Mar-2018 12:07					
Client ID:	Run ID: SV-5_312182	SeqNo: 4465945		PrepDate: 05-Mar-2018		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	

1,4-Dioxane	0.010	0.010							U
Surr: 2-Fluorobiphenyl	0.09098	0	0.08	0	114	40 - 140			
Surr: 4-Terphenyl-d14	0.06762	0	0.08	0	84.5	40 - 140			
Surr: Nitrobenzene-d5	0.05812	0	0.08	0	72.7	40 - 140			

LCS	Sample ID: LCS-125840	Units: ug/L			Analysis Date: 06-Mar-2018 12:27				
Client ID:	Run ID: SV-5_312182	SeqNo: 4465946		PrepDate: 05-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual

1,4-Dioxane	0.08456	0.010	0.08	0	106	40 - 140			
Surr: 2-Fluorobiphenyl	0.1006	0	0.08	0	126	40 - 140			
Surr: 4-Terphenyl-d14	0.07046	0	0.08	0	88.1	40 - 140			
Surr: Nitrobenzene-d5	0.0667	0	0.08	0	83.4	40 - 140			

LCSD	Sample ID: LCSD-125840	Units: ug/L			Analysis Date: 06-Mar-2018 12:48				
Client ID:	Run ID: SV-5_312182	SeqNo: 4465947		PrepDate: 05-Mar-2018		DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual

1,4-Dioxane	0.08525	0.010	0.08	0	107	40 - 140	0.08456	0.814	20
Surr: 2-Fluorobiphenyl	0.08862	0	0.08	0	111	40 - 140	0.1006	12.7	20
Surr: 4-Terphenyl-d14	0.0721	0	0.08	0	90.1	40 - 140	0.07046	2.3	20
Surr: Nitrobenzene-d5	0.06383	0	0.08	0	79.8	40 - 140	0.0667	4.39	20

The following samples were analyzed in this batch: HS18030054-01

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R311972		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180305	Units: ug/L			Analysis Date: 05-Mar-2018 11:16					
Client ID:	Run ID: VOA2_311972	SeqNo: 4461668	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	0.50	1.0								U
1,1,1-Trichloroethane	0.50	1.0								U
1,1,2,2-Tetrachloroethane	0.50	1.0								U
1,1,2-Trichloroethane	0.50	1.0								U
1,1-Dichloroethane	0.50	1.0								U
1,1-Dichloroethene	0.50	1.0								U
1,1-Dichloropropene	0.50	1.0								U
1,2,3-Trichlorobenzene	0.50	1.0								U
1,2,3-Trichloropropane	0.50	1.0								U
1,2,4-Trichlorobenzene	0.50	1.0								U
1,2,4-Trimethylbenzene	0.50	1.0								U
1,2-Dibromo-3-chloropropane	0.50	1.0								U
1,2-Dibromoethane	0.50	1.0								U
1,2-Dichlorobenzene	0.50	1.0								U
1,2-Dichloroethane	0.50	1.0								U
1,2-Dichloropropane	0.50	1.0								U
1,3,5-Trimethylbenzene	0.50	1.0								U
1,3-Dichlorobenzene	0.50	1.0								U
1,3-Dichloropropane	0.50	1.0								U
1,4-Dichlorobenzene	0.50	1.0								U
2,2-Dichloropropane	0.50	1.0								U
2-Butanone	1.0	2.0								U
2-Chlorotoluene	0.50	1.0								U
2-Hexanone	1.0	2.0								U
4-Chlorotoluene	0.50	1.0								U
4-Isopropyltoluene	0.50	1.0								U
4-Methyl-2-pentanone	1.0	2.0								U
Acetone	1.0	2.0								U
Benzene	0.50	1.0								U
Bromobenzene	0.50	1.0								U
Bromochloromethane	0.50	1.0								U
Bromodichloromethane	0.50	1.0								U
Bromoform	0.50	1.0								U
Bromomethane	0.50	1.0								U

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R311972		Instrument: VOA2		Method: SW8260						
MBLK	Sample ID: VBLKW-180305	Units: ug/L			Analysis Date: 05-Mar-2018 11:16					
Client ID:	Run ID: VOA2_311972	SeqNo: 4461668	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	1.0	2.0								U
Carbon tetrachloride	0.50	1.0								U
Chlorobenzene	0.50	1.0								U
Chloroethane	0.50	1.0								U
Chloroform	0.50	1.0								U
Chloromethane	0.50	1.0								U
cis-1,2-Dichloroethene	0.50	1.0								U
cis-1,3-Dichloropropene	0.50	1.0								U
Dibromochloromethane	0.50	1.0								U
Dibromomethane	0.50	1.0								U
Dichlorodifluoromethane	0.50	1.0								U
Ethylbenzene	0.50	1.0								U
Hexachlorobutadiene	0.50	1.0								U
Isopropylbenzene	0.50	1.0								U
m,p-Xylene	1.0	2.0								U
Methylene chloride	1.0	2.0								U
Naphthalene	0.50	1.0								U
n-Butylbenzene	0.50	1.0								U
n-Propylbenzene	0.50	1.0								U
o-Xylene	0.50	1.0								U
sec-Butylbenzene	0.50	1.0								U
Styrene	0.50	1.0								U
tert-Butylbenzene	0.50	1.0								U
Tetrachloroethene	0.50	1.0								U
Toluene	0.50	1.0								U
trans-1,2-Dichloroethene	0.50	1.0								U
trans-1,3-Dichloropropene	0.50	1.0								U
Trichloroethene	0.50	1.0								U
Trichlorofluoromethane	0.50	1.0								U
Vinyl chloride	0.50	1.0								U
Surr: 1,2-Dichloroethane-d4	41.35	1.0	50	0	82.7	81 - 118				
Surr: 4-Bromofluorobenzene	48.22	1.0	50	0	96.4	85 - 114				
Surr: Dibromofluoromethane	43.62	1.0	50	0	87.2	80 - 119				
Surr: Toluene-d8	53.2	1.0	50	0	106	89 - 112				

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R311972		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180305	Units: ug/L			Analysis Date: 05-Mar-2018 10:27					
Client ID:	Run ID: VOA2_311972	SeqNo: 4461666	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	46.41	1.0	50	0	92.8	78 - 124				
1,1,1-Trichloroethane	48	1.0	50	0	96.0	74 - 131				
1,1,2,2-Tetrachloroethane	43.35	1.0	50	0	86.7	71 - 121				
1,1,2-Trichloroethane	46.26	1.0	50	0	92.5	80 - 119				
1,1-Dichloroethane	46.71	1.0	50	0	93.4	77 - 125				
1,1-Dichloroethene	51.22	1.0	50	0	102	71 - 131				
1,1-Dichloropropene	50.3	1.0	50	0	101	79 - 125				
1,2,3-Trichlorobenzene	46.78	1.0	50	0	93.6	69 - 129				
1,2,3-Trichloropropane	44.39	1.0	50	0	88.8	73 - 122				
1,2,4-Trichlorobenzene	47.79	1.0	50	0	95.6	69 - 130				
1,2,4-Trimethylbenzene	47.8	1.0	50	0	95.6	76 - 124				
1,2-Dibromo-3-chloropropane	44.3	1.0	50	0	88.6	62 - 128				
1,2-Dibromoethane	49.33	1.0	50	0	98.7	77 - 121				
1,2-Dichlorobenzene	42.52	1.0	50	0	85.0	80 - 119				
1,2-Dichloroethane	46.12	1.0	50	0	92.2	73 - 128				
1,2-Dichloropropane	47.73	1.0	50	0	95.5	78 - 122				
1,3,5-Trimethylbenzene	48.65	1.0	50	0	97.3	75 - 124				
1,3-Dichlorobenzene	43.84	1.0	50	0	87.7	80 - 119				
1,3-Dichloropropane	45.56	1.0	50	0	91.1	80 - 119				
1,4-Dichlorobenzene	43	1.0	50	0	86.0	79 - 118				
2,2-Dichloropropane	47.52	1.0	50	0	95.0	60 - 139				
2-Butanone	99.4	2.0	100	0	99.4	56 - 143				
2-Chlorotoluene	47.66	1.0	50	0	95.3	79 - 122				
2-Hexanone	96.75	2.0	100	0	96.7	57 - 139				
4-Chlorotoluene	48.13	1.0	50	0	96.3	78 - 122				
4-Isopropyltoluene	42.73	1.0	50	0	85.5	77 - 127				
4-Methyl-2-pentanone	89.12	2.0	100	0	89.1	67 - 130				
Acetone	97.46	2.0	100	0	97.5	39 - 160				
Benzene	47.79	1.0	50	0	95.6	79 - 120				
Bromobenzene	42.21	1.0	50	0	84.4	80 - 120				
Bromochloromethane	53.13	1.0	50	0	106	78 - 123				
Bromodichloromethane	49.18	1.0	50	0	98.4	79 - 125				
Bromoform	50.65	1.0	50	0	101	66 - 130				
Bromomethane	54.48	1.0	50	0	109	53 - 141				

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R311972		Instrument: VOA2		Method: SW8260						
LCS	Sample ID: VLCSW-180305	Units: ug/L			Analysis Date: 05-Mar-2018 10:27					
Client ID:	Run ID: VOA2_311972	SeqNo: 4461666	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	99.87	2.0	100	0	99.9	64 - 133				
Carbon tetrachloride	45.13	1.0	50	0	90.3	72 - 136				
Chlorobenzene	45.59	1.0	50	0	91.2	80 - 120				
Chloroethane	41.15	1.0	50	0	82.3	82 - 118				
Chloroform	45.32	1.0	50	0	90.6	79 - 124				
Chloromethane	48.64	1.0	50	0	97.3	50 - 139				
cis-1,2-Dichloroethene	50.28	1.0	50	0	101	78 - 123				
cis-1,3-Dichloropropene	51.55	1.0	50	0	103	75 - 124				
Dibromochloromethane	48.22	1.0	50	0	96.4	74 - 126				
Dibromomethane	52.19	1.0	50	0	104	79 - 123				
Dichlorodifluoromethane	47.49	1.0	50	0	95.0	32 - 152				
Ethylbenzene	51.5	1.0	50	0	103	79 - 121				
Hexachlorobutadiene	44.3	1.0	50	0	88.6	66 - 134				
Isopropylbenzene	46.09	1.0	50	0	92.2	72 - 131				
m,p-Xylene	90.41	2.0	100	0	90.4	80 - 121				
Methylene chloride	46.02	2.0	50	0	92.0	74 - 124				
Naphthalene	50.1	1.0	50	0	100	61 - 128				
n-Butylbenzene	44.67	1.0	50	0	89.3	75 - 128				
n-Propylbenzene	42.62	1.0	50	0	85.2	76 - 126				
o-Xylene	46.04	1.0	50	0	92.1	78 - 122				
sec-Butylbenzene	44.42	1.0	50	0	88.8	77 - 126				
Styrene	46.4	1.0	50	0	92.8	78 - 128				
tert-Butylbenzene	42.72	1.0	50	0	85.4	78 - 124				
Tetrachloroethene	46.09	1.0	50	0	92.2	74 - 129				
Toluene	44.28	1.0	50	0	88.6	80 - 121				
trans-1,2-Dichloroethene	51.39	1.0	50	0	103	75 - 124				
trans-1,3-Dichloropropene	52.24	1.0	50	0	104	73 - 127				
Trichloroethene	50.27	1.0	50	0	101	79 - 123				
Trichlorofluoromethane	49.06	1.0	50	0	98.1	65 - 141				
Vinyl chloride	49.49	1.0	50	0	99.0	58 - 137				
Surr: 1,2-Dichloroethane-d4	42.23	1.0	50	0	84.5	81 - 118				
Surr: 4-Bromofluorobenzene	49.77	1.0	50	0	99.5	85 - 114				
Surr: Dibromofluoromethane	41.77	1.0	50	0	83.5	80 - 119				
Surr: Toluene-d8	51.4	1.0	50	0	103	89 - 112				

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R311972		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18030131-05MS	Units: ug/L			Analysis Date: 05-Mar-2018 14:13					
Client ID:	Run ID: VOA2_311972	SeqNo: 4461675	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	40.33	1.0	50	0	80.7	78 - 124				
1,1,1-Trichloroethane	43.51	1.0	50	0	87.0	74 - 131				
1,1,2,2-Tetrachloroethane	38.48	1.0	50	0	77.0	71 - 121				
1,1,2-Trichloroethane	40.59	1.0	50	0	81.2	80 - 119				
1,1-Dichloroethane	41.37	1.0	50	0	82.7	77 - 125				
1,1-Dichloroethene	45.69	1.0	50	0	91.4	71 - 131				
1,1-Dichloropropene	47	1.0	50	0	94.0	79 - 125				
1,2,3-Trichlorobenzene	40.4	1.0	50	0	80.8	69 - 129				
1,2,3-Trichloropropane	38.11	1.0	50	0	76.2	73 - 122				
1,2,4-Trichlorobenzene	40.95	1.0	50	0	81.9	69 - 130				
1,2,4-Trimethylbenzene	41.46	1.0	50	0	82.9	76 - 124				
1,2-Dibromo-3-chloropropane	41.55	1.0	50	0	83.1	62 - 128				
1,2-Dibromoethane	42.32	1.0	50	0	84.6	77 - 121				
1,2-Dichlorobenzene	37.56	1.0	50	0	75.1	80 - 119				S
1,2-Dichloroethane	37.91	1.0	50	0	75.8	73 - 128				
1,2-Dichloropropane	40.9	1.0	50	0	81.8	78 - 122				
1,3,5-Trimethylbenzene	42.17	1.0	50	0	84.3	75 - 124				
1,3-Dichlorobenzene	37.74	1.0	50	0	75.5	80 - 119				S
1,3-Dichloropropane	39.8	1.0	50	0	79.6	80 - 119				S
1,4-Dichlorobenzene	36.27	1.0	50	0	72.5	79 - 118				S
2,2-Dichloropropane	41.82	1.0	50	0	83.6	60 - 139				
2-Butanone	92.01	2.0	100	0	92.0	56 - 143				
2-Chlorotoluene	41.84	1.0	50	0	83.7	79 - 122				
2-Hexanone	91.6	2.0	100	0	91.6	57 - 139				
4-Chlorotoluene	41.13	1.0	50	0	82.3	78 - 122				
4-Isopropyltoluene	38.01	1.0	50	0	76.0	77 - 127				S
4-Methyl-2-pentanone	82.85	2.0	100	0	82.9	67 - 130				
Acetone	83.47	2.0	100	0	83.5	39 - 160				
Benzene	43.3	1.0	50	1.278	84.0	79 - 120				
Bromobenzene	36.25	1.0	50	0	72.5	80 - 120				S
Bromochloromethane	46.21	1.0	50	0	92.4	78 - 123				
Bromodichloromethane	41.34	1.0	50	0	82.7	79 - 125				
Bromoform	45.62	1.0	50	0	91.2	66 - 130				
Bromomethane	45.66	1.0	50	0	91.3	53 - 141				

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R311972		Instrument: VOA2		Method: SW8260						
MS	Sample ID: HS18030131-05MS	Units: ug/L			Analysis Date: 05-Mar-2018 14:13					
Client ID:	Run ID: VOA2_311972	SeqNo: 4461675	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	91.64	2.0	100	0	91.6	64 - 133				
Carbon tetrachloride	41.44	1.0	50	0	82.9	72 - 136				
Chlorobenzene	39.82	1.0	50	0	79.6	80 - 120				S
Chloroethane	38.94	1.0	50	0	77.9	82 - 118				S
Chloroform	39.24	1.0	50	0	78.5	79 - 124				S
Chloromethane	37.95	1.0	50	0	75.9	50 - 139				
cis-1,2-Dichloroethene	43.77	1.0	50	0.9194	85.7	78 - 123				
cis-1,3-Dichloropropene	42.68	1.0	50	0	85.4	75 - 124				
Dibromochloromethane	41.76	1.0	50	0	83.5	74 - 126				
Dibromomethane	44.57	1.0	50	0	89.1	79 - 123				
Dichlorodifluoromethane	37.22	1.0	50	0	74.4	32 - 152				
Ethylbenzene	47.94	1.0	50	0	95.9	79 - 121				
Hexachlorobutadiene	40.1	1.0	50	0	80.2	66 - 134				
Isopropylbenzene	45.36	1.0	50	4.021	82.7	72 - 131				
m,p-Xylene	81.82	2.0	100	0	81.8	80 - 121				
Methylene chloride	39.4	2.0	50	0	78.8	74 - 124				
Naphthalene	53.41	1.0	50	3.313	100	61 - 128				
n-Butylbenzene	39.19	1.0	50	0	78.4	75 - 128				
n-Propylbenzene	39.43	1.0	50	1.998	74.9	76 - 126				S
o-Xylene	41.32	1.0	50	0	82.6	78 - 122				
sec-Butylbenzene	39.51	1.0	50	0	79.0	77 - 126				
Styrene	1.259	1.0	50	0	2.52	78 - 128				S
tert-Butylbenzene	38.22	1.0	50	0.4095	75.6	78 - 124				S
Tetrachloroethene	42.45	1.0	50	0	84.9	74 - 129				
Toluene	39.68	1.0	50	0	79.4	80 - 121				S
trans-1,2-Dichloroethene	45.75	1.0	50	0	91.5	75 - 124				
trans-1,3-Dichloropropene	43.22	1.0	50	0	86.4	73 - 127				
Trichloroethene	48.11	1.0	50	8.255	79.7	79 - 123				
Trichlorofluoromethane	43.65	1.0	50	0	87.3	65 - 141				
Vinyl chloride	45.72	1.0	50	0	91.4	58 - 137				
Surr: 1,2-Dichloroethane-d4	43.54	1.0	50	0	87.1	81 - 118				
Surr: 4-Bromofluorobenzene	50.4	1.0	50	0	101	85 - 114				
Surr: Dibromofluoromethane	41.52	1.0	50	0	83.0	80 - 119				
Surr: Toluene-d8	51.73	1.0	50	0	103	89 - 112				

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R311972		Instrument: VOA2		Method: SW8260						
MSD	Sample ID: HS18030131-05MSD	Units: ug/L			Analysis Date: 05-Mar-2018 14:37					
Client ID:	Run ID: VOA2_311972	SeqNo: 4461676		PrepDate:		DF: 1				
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
1,1,1,2-Tetrachloroethane	40.54	1.0	50	0	81.1	78 - 124	40.33	0.519	20	
1,1,1-Trichloroethane	42.49	1.0	50	0	85.0	74 - 131	43.51	2.39	20	
1,1,2,2-Tetrachloroethane	38.75	1.0	50	0	77.5	71 - 121	38.48	0.706	20	
1,1,2-Trichloroethane	40.56	1.0	50	0	81.1	80 - 119	40.59	0.0675	20	
1,1-Dichloroethane	39.76	1.0	50	0	79.5	77 - 125	41.37	3.96	20	
1,1-Dichloroethene	44.29	1.0	50	0	88.6	71 - 131	45.69	3.11	20	
1,1-Dichloropropene	45.97	1.0	50	0	91.9	79 - 125	47	2.21	20	
1,2,3-Trichlorobenzene	41.62	1.0	50	0	83.2	69 - 129	40.4	2.99	20	
1,2,3-Trichloropropane	37.75	1.0	50	0	75.5	73 - 122	38.11	0.95	20	
1,2,4-Trichlorobenzene	42	1.0	50	0	84.0	69 - 130	40.95	2.53	20	
1,2,4-Trimethylbenzene	41.49	1.0	50	0	83.0	76 - 124	41.46	0.0623	20	
1,2-Dibromo-3-chloropropane	41.13	1.0	50	0	82.3	62 - 128	41.55	1.03	20	
1,2-Dibromoethane	42.52	1.0	50	0	85.0	77 - 121	42.32	0.471	20	
1,2-Dichlorobenzene	36.95	1.0	50	0	73.9	80 - 119	37.56	1.63	20	S
1,2-Dichloroethane	38.7	1.0	50	0	77.4	73 - 128	37.91	2.04	20	
1,2-Dichloropropane	40.86	1.0	50	0	81.7	78 - 122	40.9	0.102	20	
1,3,5-Trimethylbenzene	41.84	1.0	50	0	83.7	75 - 124	42.17	0.78	20	
1,3-Dichlorobenzene	37.88	1.0	50	0	75.8	80 - 119	37.74	0.377	20	S
1,3-Dichloropropane	39.75	1.0	50	0	79.5	80 - 119	39.8	0.117	20	S
1,4-Dichlorobenzene	36	1.0	50	0	72.0	79 - 118	36.27	0.767	20	S
2,2-Dichloropropane	41	1.0	50	0	82.0	60 - 139	41.82	1.97	20	
2-Butanone	90.47	2.0	100	0	90.5	56 - 143	92.01	1.68	20	
2-Chlorotoluene	41.21	1.0	50	0	82.4	79 - 122	41.84	1.52	20	
2-Hexanone	91.43	2.0	100	0	91.4	57 - 139	91.6	0.192	20	
4-Chlorotoluene	41.68	1.0	50	0	83.4	78 - 122	41.13	1.32	20	
4-Isopropyltoluene	37.85	1.0	50	0	75.7	77 - 127	38.01	0.415	20	S
4-Methyl-2-pentanone	85.7	2.0	100	0	85.7	67 - 130	82.85	3.37	20	
Acetone	84.73	2.0	100	0	84.7	39 - 160	83.47	1.49	20	
Benzene	42.36	1.0	50	1.278	82.2	79 - 120	43.3	2.19	20	
Bromobenzene	35.96	1.0	50	0	71.9	80 - 120	36.25	0.81	20	S
Bromochloromethane	43.59	1.0	50	0	87.2	78 - 123	46.21	5.83	20	
Bromodichloromethane	40.87	1.0	50	0	81.7	79 - 125	41.34	1.14	20	
Bromoform	45.21	1.0	50	0	90.4	66 - 130	45.62	0.915	20	
Bromomethane	41.18	1.0	50	0	82.4	53 - 141	45.66	10.3	20	

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R311972		Instrument: VOA2		Method: SW8260						
MSD	Sample ID: HS18030131-05MSD	Units: ug/L			Analysis Date: 05-Mar-2018 14:37					
Client ID:	Run ID: VOA2_311972	SeqNo: 4461676	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Carbon disulfide	88.1	2.0	100	0	88.1	64 - 133	91.64	3.94	20	
Carbon tetrachloride	40.56	1.0	50	0	81.1	72 - 136	41.44	2.14	20	
Chlorobenzene	39.89	1.0	50	0	79.8	80 - 120	39.82	0.175	20	S
Chloroethane	37.89	1.0	50	0	75.8	82 - 118	38.94	2.72	20	S
Chloroform	38.42	1.0	50	0	76.8	79 - 124	39.24	2.09	20	S
Chloromethane	35.65	1.0	50	0	71.3	50 - 139	37.95	6.25	20	
cis-1,2-Dichloroethene	44.34	1.0	50	0.9194	86.8	78 - 123	43.77	1.28	20	
cis-1,3-Dichloropropene	42.43	1.0	50	0	84.9	75 - 124	42.68	0.58	20	
Dibromochloromethane	41.78	1.0	50	0	83.6	74 - 126	41.76	0.0529	20	
Dibromomethane	44.73	1.0	50	0	89.5	79 - 123	44.57	0.348	20	
Dichlorodifluoromethane	34.79	1.0	50	0	69.6	32 - 152	37.22	6.74	20	
Ethylbenzene	47.57	1.0	50	0	95.1	79 - 121	47.94	0.778	20	
Hexachlorobutadiene	40.97	1.0	50	0	81.9	66 - 134	40.1	2.17	20	
Isopropylbenzene	45.19	1.0	50	4.021	82.3	72 - 131	45.36	0.382	20	
m,p-Xylene	81.93	2.0	100	0	81.9	80 - 121	81.82	0.135	20	
Methylene chloride	38.89	2.0	50	0	77.8	74 - 124	39.4	1.31	20	
Naphthalene	53.93	1.0	50	3.313	101	61 - 128	53.41	0.968	20	
n-Butylbenzene	39.79	1.0	50	0	79.6	75 - 128	39.19	1.52	20	
n-Propylbenzene	39.26	1.0	50	1.998	74.5	76 - 126	39.43	0.443	20	S
o-Xylene	41.3	1.0	50	0	82.6	78 - 122	41.32	0.0521	20	
sec-Butylbenzene	39.17	1.0	50	0	78.3	77 - 126	39.51	0.876	20	
Styrene	1.215	1.0	50	0	2.43	78 - 128	1.259	3.57	20	S
tert-Butylbenzene	37.92	1.0	50	0.4095	75.0	78 - 124	38.22	0.797	20	S
Tetrachloroethene	42.48	1.0	50	0	85.0	74 - 129	42.45	0.0808	20	
Toluene	39.73	1.0	50	0	79.5	80 - 121	39.68	0.122	20	S
trans-1,2-Dichloroethene	44.52	1.0	50	0	89.0	75 - 124	45.75	2.73	20	
trans-1,3-Dichloropropene	43	1.0	50	0	86.0	73 - 127	43.22	0.511	20	
Trichloroethene	45.88	1.0	50	8.255	75.2	79 - 123	48.11	4.74	20	S
Trichlorofluoromethane	41.37	1.0	50	0	82.7	65 - 141	43.65	5.36	20	
Vinyl chloride	44.03	1.0	50	0	88.1	58 - 137	45.72	3.76	20	
Surr: 1,2-Dichloroethane-d4	42.33	1.0	50	0	84.7	81 - 118	43.54	2.83	20	
Surr: 4-Bromofluorobenzene	50.53	1.0	50	0	101	85 - 114	50.4	0.255	20	
Surr: Dibromofluoromethane	40.86	1.0	50	0	81.7	80 - 119	41.52	1.61	20	
Surr: Toluene-d8	52.37	1.0	50	0	105	89 - 112	51.73	1.23	20	

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT**Batch ID:** R311972**Instrument:** VOA2**Method:** SW8260

The following samples were analyzed in this batch: HS18030054-01 HS18030054-02

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID:	R312257	Instrument:	WetChem_HS	Method:	E410.4					
MBLK	Sample ID: MBLK-R312257	Units: mg/L	Analysis Date: 09-Mar-2018 14:00							
Client ID:	Run ID: WetChem_HS_312257	SeqNo: 4468001	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	5.00	15.0								U
LCS	Sample ID: LCS-R312257	Units: mg/L	Analysis Date: 09-Mar-2018 14:00							
Client ID:	Run ID: WetChem_HS_312257	SeqNo: 4468000	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	96	15.0	100	0	96.0	85 - 115				
MS	Sample ID: HS18030316-01MS	Units: mg/L	Analysis Date: 09-Mar-2018 14:00							
Client ID:	Run ID: WetChem_HS_312257	SeqNo: 4468002	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	61	15.0	50	18	86.0	80 - 120				
DUP	Sample ID: HS18030316-01DUP	Units: mg/L	Analysis Date: 09-Mar-2018 14:00							
Client ID:	Run ID: WetChem_HS_312257	SeqNo: 4468003	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chemical Oxygen Demand	19	15.0					18	5.41	20	

The following samples were analyzed in this batch: HS18030054-01

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R312306		Instrument: ICS2100		Method: SW9056						
MBLK	Sample ID: WBLKW1-030818	Units: mg/L		Analysis Date: 09-Mar-2018 00:02						
Client ID:	Run ID: ICS2100_312306	SeqNo: 4469079	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	0.250	0.500								U
Sulfate	0.250	0.500								U
LCS	Sample ID: WLCSW1-030818	Units: mg/L		Analysis Date: 09-Mar-2018 00:16						
Client ID:	Run ID: ICS2100_312306	SeqNo: 4469080	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	20.53	0.500	20	0	103	80 - 120				
Sulfate	20.79	0.500	20	0	104	80 - 120				
LCSD	Sample ID: WLCSDW1-030818	Units: mg/L		Analysis Date: 09-Mar-2018 00:31						
Client ID:	Run ID: ICS2100_312306	SeqNo: 4469081	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	19.97	0.500	20	0	99.9	80 - 120	20.53	2.77	20	
Sulfate	20.81	0.500	20	0	104	80 - 120	20.79	0.0673	20	
MS	Sample ID: HS18030366-03MS	Units: mg/L		Analysis Date: 09-Mar-2018 04:24						
Client ID:	Run ID: ICS2100_312306	SeqNo: 4469095	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	61.04	0.500	10	49.24	118	80 - 120				O
Sulfate	51.89	0.500	10	40.12	118	80 - 120				O
MSD	Sample ID: HS18030366-03MSD	Units: mg/L		Analysis Date: 09-Mar-2018 04:38						
Client ID:	Run ID: ICS2100_312306	SeqNo: 4469096	PrepDate:	DF: 1						
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Chloride	60.9	0.500	10	49.24	117	80 - 120	61.04	0.23	20	O
Sulfate	51.71	0.500	10	40.12	116	80 - 120	51.89	0.349	20	O

The following samples were analyzed in this batch:

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

QC BATCH REPORT

Batch ID: R312478		Instrument: Balance1		Method: E1664A						
MBLK	Sample ID: WBLKW-031418	Units: mg/L		Analysis Date: 14-Mar-2018 13:35						
Client ID:	Run ID: Balance1_312478	SeqNo: 4473442		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Oil and Grease	1.00	2.00							U	
LCS	Sample ID: WLCSW-031418	Units: mg/L		Analysis Date: 14-Mar-2018 13:35						
Client ID:	Run ID: Balance1_312478	SeqNo: 4473444		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Oil and Grease	40	2.00	40	0	100.0	78 - 114				
LCSD	Sample ID: WLCSDW-031418	Units: mg/L		Analysis Date: 14-Mar-2018 13:35						
Client ID:	Run ID: Balance1_312478	SeqNo: 4473443		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Oil and Grease	37.2	2.00	40	0	93.0	78 - 114	40	7.25	18	
MS	Sample ID: HS18030276-02MS	Units: mg/L		Analysis Date: 14-Mar-2018 13:35						
Client ID:	Run ID: Balance1_312478	SeqNo: 4473432		PrepDate:			DF: 1			
Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual	
Oil and Grease	38.33	2.00	40	-0.4167	96.9	78 - 114				

The following samples were analyzed in this batch: HS18030054-01

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

ALS Group USA, Corp

Date: 16-Mar-18

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
WorkOrder: HS18030054

**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 Quantitation Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

Unit Reported	Description
mg/L	Milligrams per Liter

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 Dakota	R193 2017-2017	30-Apr-2018
Oklahoma	2017-088	31-Aug-2018
Texas	T104704231-17-19	30-Apr-2018
North Carolina	624-2018	31-Dec-2018

Client: Bhate Environmental Associates, Inc.
Project: Longhorn GW Treatment Plant
Work Order: HS18030054

SAMPLE TRACKING

Lab Samp ID	Client Sample ID	Action	Date	Person	New Location
HS18030054-01	LH18/24-SP140_022818	Login	3/1/2018 5:48:32 PM	LFH	Sub
HS18030054-01	LH18/24-SP140_022818	Login	3/1/2018 5:48:32 PM	LFH	WET231
HS18030054-01	LH18/24-SP140_022818	Login	3/1/2018 5:48:32 PM	LFH	EXT061
HS18030054-01	LH18/24-SP140_022818	Login	3/1/2018 5:48:32 PM	LFH	WET231
HS18030054-01	LH18/24-SP140_022818	Login	3/1/2018 5:48:32 PM	LFH	WET231
HS18030054-01	LH18/24-SP140_022818	Login	3/1/2018 5:48:32 PM	LFH	MET076
HS18030054-01	LH18/24-SP140_022818	Login	3/1/2018 5:48:32 PM	LFH	B038
HS18030054-02	Trip Blank	Login	3/1/2018 8:14:57 PM	LFH	B038

Sample Receipt Checklist

Client Name: Bhate Environmental
 Work Order: HS18030054

Date/Time Received: **01-Mar-2018 09:15**
 Received by: **JRM**

Checklist completed by: Pareesh M. Giga 2-Mar-2018 Reviewed by: RJ Modashia 2-Mar-2018
 eSignature Date eSignature Date

Matrices: **Water** Carrier name: **FedEx**

- 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): 2.3c/1.7c U/c UR25
 Cooler(s)/Kit(s): 42663
 Date/Time sample(s) sent to storage: 3/1/18 20:00

- 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:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

CHAIN OF CUSTODY

Name Of Lab Shipping To: AES 10450 Stancliff Rd., Suite 210 Houston, Tx, 77099 ATTN: SONIA WEST

Project: **BHATE** Project No: **NWO1312.0150.0**
 LONGHORN ARMY AMMN. PLANT (LHAAP) 16.0001
 GROUNDWATER TREATMENT PLANT (GWTP)
 KARNACK, TEXAS

Job: **GROUNDWATER TREATMENT PLANT QUARTERLY INFLUENT SAMPLES**

Prepared By: **Scott Beesinger** P. O. Number

HS18030054

Bhate Environmental Associates, Inc.
 Longhorn GW Treatment Plant



Field Sample I.D.	Sample Matrix	Date / Time	MS / MSD	NO. OF CONTAINERS	Analyses				Remarks (Preservatives, etc.)	Lab I.D.#
					RDD Volatiles	Total Metals	Oil & Grease	Chemical Oxygen Demand		
LH18/24-SP140_022818	Water	02/28/18 / 14:00		4	3	1			HCL	
LH18/24-SP140_022818	Water	02/28/18 / 14:00		1	1				HNO3	
LH18/24-SP140_022818	Water	02/28/18 / 14:00		3			1	1	NONE	
LH18/24-SP140_022818	Water	02/28/18 / 14:00		1			1		H2SO4	
Trip Blank	Water	02/28/18		2	2				HCL	

STANDARD TURN AROUND TIME

Relinquished By:	Date	Time	Received By:	Date	Time	Relinquished By:	Date	Time	Received By:	Date	Time
<i>Scott Beesinger</i>	02/28/18	14:30									

Received At Lab By: *Jim* Date: *2/1/18* Time: *09:15* Airbill No.

For Lab Use Only
 Temp of Container
 Seal No.
 Condition

Remarks:

Cooper - 42663 11225
Tamp - 2.3 CF-0.1

ALS 10450 Stanciliff Rd., Suite 210 Houston, Texas 77039 Tel. +1 281 530 5366 Fax. +1 281 530 5887	(CUSTODY SEAL)		Rep. Broken By ZM
	Date: 2/22/18 Name: SCOTT BEASLEY Company: HART	Time: 17:30 Date: 03/01/18	

42663 MAR 01 2018

THU - 01 MAR 10:30A
PRIORITY OVERNIGHT

7376 9752 7484

AB SGRA 42663 77099 TX-US IAH



FTD 102765 28F7110 05GA 546C170 14/0526A



Case Narrative

Method: 6850
Analysis: Perchlorate
Analysis SOP: LC-MS-CLO4
ALS WO ID(s): 1806736; 1806586; 1806588;
1806590

Client: ALS Laboratories (Houston, TX)
Matrix: Water
ELMS Batch (HBN): 2058 (209974)

General Set Information: There were five 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. 50 μL 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 0.45 μm Syringe filters.

Holding Times: Holding times were met for all analyses.

Dilutions: NA

Method QC data: The method blank (LMB 590393) was less than 1/2 the CRDL. The recovery for the LCS (590394) was within acceptable parameters.

MS/MSD Analysis: The matrix spike and matrix spike duplicate (MS/MSD) was performed on sample 1806736001 (Client ID: INF Pond-Inlet_030718). 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): NA

Sample Calculation: Samples were reported in $\mu\text{g/L}$. Results were calculated in $\mu\text{g/L}$ by the equation $(A) \times (B)$,

where: A = Analyte concentration from the standard curve ($\mu\text{g/L}$)

B = Dilution performed at time of analysis

Miscellaneous Comments: The 83/85 ion ratio failed for the Limit of Detection Verification standard (LODV1 – 590391). These samples were analyzed in accordance with the requirements found in the DOD QSM Version 5.1. Manual Integrations was performed for datafile 08MARD04.

Thomas Bosch March 09, 2018
Analyst Date