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: July 19, 2018, 6:00-7:15 PM Central Daylight Time (CDT)

Meeting Participants:

Army BRAC:	Rose M. Zeiler and Tom Lederle
USACE:	Aaron Williams
USAEC:	Nicholas Smith
Bhate:	Kim Nemmers
APTIM:	William (Bill) Foss
USEPA Region 6:	Rich Mayer, Dorelle Harrison
TCEQ:	April Palmie
RAB:	Present: Paul Fortune, Judy VanDeventer, Tom Walker, and Richard Le Tourneau Absent**:** Carol Fortune; Charles Dixon; Terry Britt; John Pollard, Jr.; and Nigel R. Shivers
Public:	Laura-Ashley Overdyke, Kathy and Calvin Witt, Beth and Mark Hammett, Daren Horton, and Hattie Hackler

---

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 RAB meeting to order at 6:05 pm CDT. Mr. Fortune welcomed everyone. Mr. Calvin Witt and his wife Kathy, Mark and Beth Hammett, and Tom Lederle were welcomed.

Mr. Fortune also noted that Mr. Tom Lederle, who is with the U.S. Army and visits the RAB from time to time, was present. Mr. Lederle stated that he has visited annually since approximately 2001 and has had a relatively long involvement at Longhorn AAP. Mr. Lederle, who is chief of the Army BRAC Division, stated that he tries to visit at least one a year. Mr. Lederle explained that the Base Realignment and Closure (BRAC) process for installations began in 1988 with realignment and/or closure.

Open Items

Rose M. Zeiler, Longhorn Site Manager, explained that the purpose of the RAB meetings is to promote community awareness and obtain constructive community review and comments on environmental restoration activities at the former LHAAP. Ms. Zeiler explained that the RAB meetings are held every three months. Ms. Zeiler stated that the RAB members are a liaison from the Army to the community and noted that applications to become a RAB member are available on the Longhorn Army Ammunition Plant (LHAAP) website. Ms. Zeiler explained that handouts from the meeting and the Administrative Record are also present on the LHAAP website.

Ms. Zeiler noted that the RAB meeting minutes had been sent out in May 2018. Ms. Judy VanDeventer made a motion to approve the April 2018 RAB Meeting minutes. Mr. Richard Le Tourneau seconded the motion.

Mr. Darren Horton of Caddo Lake asked how many RAB members are currently active and how many are allowed. Mr. Horton also asked if there are RAB member openings. Ms. Zeiler stated that there are currently 9 members and that we have had no reason to limit the number of RAB members. Mr. Fortune stated that new members are always welcome.

Defense Environmental Restoration

Overview of Hydrology

Ms. Zeiler explained that due to prior meeting questions, Bhate is presenting information about how groundwater and plumes move. Mr. Bill Foss explained which sites are covered under the Bhate contract. Ms. Zeiler noted that several sites are not under Bhate's contract and these do not have Records of Decision (RODs) yet. Mr. Foss provided an explanation of hydrogeology, the terms used, how an aquifer works, and how a plume moves. Mr. Foss explained that soils are made up of different size grains. The larger the grain size, the easier for groundwater to move within the soils. Mr. Foss explained hydrology terms first. Aquifer is a water bearing layer that produces water in usable quantities. Permeability is how fast something can flow through the material (e.g. gravel has a higher permeability than a clay). Aquitards are lower permeability layers such as a clay, shale or siltstone. Potentiometric surface is the top elevation of the water table measured in monitoring wells and the groundwater elevations in the potentiometric surface are used to determine the groundwater flow direction. A plume is a body of fluid that doesn't belong (has a different chemistry) in the groundwater. DNAPL is an acronym for free product or dense non-aqueous phase liquid, which is a very high concentration of a chemical that has not dissolved, is more dense than water, and is sitting on the bottom of the aquifer. DNAPL may follow a different flow direction than the overall groundwater flow since it sits on the bottom and flows in direction of the bottom of the aquifer. Hydrogeology is distinct from geology because it is the study of groundwater flow through soils and not just soils. Vadose zone soils do not have any groundwater present. Mr. Foss then explained how the different groundwater and soil zones interlace and how a plume might move through an aquifer. Mr. Foss explained that you can have contamination move with the groundwater in a dissolved phase plume, but you can also have contamination stay behind (e.g. DNAPL that sinks). The residual contamination is considered the "source material" because it feeds the dissolved phase plume. Mr. Foss noted that the dissolved phase plume can be very low concentrations. The goal of remediation is typically to remediate both the source material and the dissolved phase plume.

Site LHAAP-0003

Mr. Foss explained that the ROD for LHAAP-03 has been finalized and is awaiting Regulatory signature and concurrence. The remedy has been selected (excavation of soils contaminated with arsenic and lead to prevent leaching to groundwater) and the remedial design will be prepared in the coming months. Mr. Foss explained that LHAAP-03 is a site where the focus is on soils only. The site stored paint shop wastes, including primers containing heavy metals and solvents. The groundwater is being managed under Site LHAAP-58, which is a much larger site in which LHAAP-03 is a small part. LHAAP-03 groundwater is being addressed under Site LHAAP-58 and this is being formally documented via an Explanation of Significant Difference (ESD). Mr. Foss explained that the contaminants of concern are arsenic and lead in soils and that the depth to groundwater is 12 to 16 feet below ground surface (bgs). The groundwater at Site LHAAP-03 is indistinguishable from LHAAP-58. Mr. Foss explained that the contaminated soil will be excavated and disposed of at a properly licensed landfill. Mr. Foss explained that most of the excavation is approximately 2 feet bgs, but there are a couple of deeper areas (approximately 7 feet bgs). The excavation area is approximately 25 feet by 30 feet in area. Mr. Foss explained that additional sampling will be completed to further refine the area of excavation and then a Remedial Design and Remedial Action Work Plan will be prepared. Once the excavation is completed, then a Remedial Action Completion Report (RACR) will be prepared to document the removal action and associated sampling results and other activities.

Mr. Horton asked where the excavated soil goes when it is removed. Mr. Foss explained that the soil will be disposed at a non-hazardous landfill where the soil will likely be used as cover by the landfill to keep odors down. The type of landfill will be determined based upon the waste characterization.

Mr. Fortune asked if the painters were dumping waste, which created this issue. Mr. Foss stated that the area was a waste storage pad and that some of the best practices used today such as secondary containment and keeping containers in a covered area were perhaps not used back then. Mr. Foss stated that spillage and overflow are most likely causes of the contamination and not dumping. Mr. Horton then clarified that this was not a typical LHAAP munitions production site to which Ms. Zeiler concurred.

Mr. Fortune then asked if the former gas station within the maintenance complex had been remediated. Ms. Zeiler stated that a gas station in the LHAAP-58 area had been remediated.

Mr. Le Tourneau asked how many different classes of waste have gone offsite (e.g. Class 1, Class 2 and Class 3). Ms. Zeiler stated that most of the waste goes off as special, non-hazardous waste. Ms. Zeiler stated that some waste has been disposed of as hazardous waste and then explained that a rule called the “mixture rule” had changed such that waste from the filter press at the groundwater treatment plant is now being disposed of as special waste. Waste characterization was then discussed including evaluating for ignitability, toxicity, flashpoint etc. Ms. Zeiler explained that special waste is a term for waste that is non-hazardous but has some known contaminants present. Ms. Nemmers stated that there are two codes for non-hazardous wastes in Texas. Ms. Overdyke asked if at this stage in the cleanup if more special waste is being disposed of compared to more hazardous waste earlier on in the remediation process. Ms. Zeiler stated that large amounts of soil have been disposed as special waste at LHAAP. Mr. Le Tourneau then asked about the rule change and what distance waste is now being transported for disposal. Mr. Foss stated that most hazardous waste disposed of during remediation is due to a characteristic of a high contamination present. Mr. Foss stated that waste is rarely disposed of due to ignitability or some of the other characteristics.   Ms. Nemmers stated that all of the waste currently being disposed of from LHAAP is going off as special waste, but that the waste streams are tested just to make sure that the water is properly disposed.   Ms. Nemmers explained that the waste streams are re-tested annually or when a new waste stream is generated. Mr. Foss stated that hazardous waste may have to go a longer distance to find a licensed facility, but that non-hazardous waste typically is transported to a nearby landfill. Ms. Zeiler stated that some waste from Site LHAAP-18/24 may have gone to a hazardous waste landfill though most of the soils that were removed years ago were thermally treated onsite and placed back onto the site. Mr. Richard Mayer stated that it is unlikely that the soils from Site LHAAP-03 will be hazardous waste given the low level detections of the metals. Mr. Fortune asked where a leaking gasoline tank waste would go. Mr. Mayer stated that testing would be completed to determine where and how to dispose of the waste. Ms. April Palmie stated that the waste would probably go to either a Class I or Class II landfill as non-hazardous characterized waste. Mr. Fortune asked where the soils would go if the gasoline was leaded. Mr. Foss and Mr. Mayer stated that it was possible that the waste could be hazardous due to concentration of benzene or lead. Ms. Zeiler then explained that petroleum sites fall under a different regulatory program.

Overview of Sites

Ms. Nemmers explained the document process under Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Ms. Nemmers explained that the sites managed under the Bhate contract already have a Record of Decision (ROD) in place and that Aaron Williams would be discussing the three sites that do not currently have a ROD later on. Ms. Nemmers explained that an ESD is used when minor changes to the ROD are needed to adjust the remedy selected but that many of the LHAAP RODs have contingency remedies. Ms. Nemmers then explained that once the remedy is implemented, the monitoring or what we call Remedial Action – Operations is completed to evaluate the remedy. Ms. Nemmers explained that most of the sites at LHAAP are in the Remedial Design or later states. Ms. Nemmers explained that many of the RODs for LHAAP have a contingent remedy as part of the foresight for the site.

Ms. Nemmers explained that LHAAP-16 and LHAAP-17 have remedial designs being developed. Ms. Nemmers stated that the injections were completed at LHAAP-58 and that a Remedial Action Completion Report (RACR) was prepared to document implementation of the remedy. The groundwater treatment plant (GWTP) regularly has quarterly reports prepared.

Ms. Nemmers explained that field work started at LHAAP-16 and LHAAP-17 was completed to move forward with the remedies. The wet weather conditions previously have not allowed all of the field work to be completed. However, the areas have dried up and the work will be completed soon. LHAAP-16 requires additional groundwater sampling and installation of injection wells in an area that was not previously accessible. LHAAP-17 requires surface soil samples to be collected in area that is often wet so the samples could not be collected. Ms. Nemmers stated that these additional soil samples will be used to further define the excavation area.

Ms. Nemmers explained that the LHAAP-58 groundwater sampling that was just completed will provide information about how the recent injections did to remediate the solvent plume. Ms. Nemmers then explained that the observed groundwater conditions at LHAAP-58 showed that the monitored wells received treatment. Ms. Nemmers explained that there were two different carbon substrates used at LHAAP-58. One part of LHAAP-58 was treated with sodium lactate (eastern plume) which has shown good results. Emulsified vegetable oil (EVO) was used in the other portion of the site. EVO typically lasts longer but takes a bit longer than sodium lactate to get working. Based upon the groundwater conditions observed, both injection areas look and smell like treatment is occurring. Ms. Nemmers explained that the groundwater was tested prior to the injections for microbes, and the necessary microbes are present naturally. Ms. Nemmers explained that this was good news even though additional microbes were added during the injections. Ms. Nemmers explained that using the two different carbon substrates will help to evaluate which eventually works best. Ms. Zeiler clarified that the eastern plume is continuing to remediate the solvents to which Ms. Nemmers concurred explaining that significant microbial growth has been observed. Ms. Nemmers explained that when microbial growth occurs that solvent concentrations decrease.

Ms. Nemmers then explained that the upcoming field work will lead to documentation that will be prepared in the next few months. This includes the reports for LHAAP-17 and LHAAP-16. Site LHAAP-58 will have quarterly sampling completed in the western plume where the injections were completed to evaluate the remedy. The other activities at LHAAP are ongoing.

Groundwater Treatment Plant
Ms. Nemmers discussed the handouts for the groundwater treatment plant (GWTP). Ms. Nemmers explained that the dry conditions have reduced what is being discharged at the GWTP from earlier in the quarter when the wet conditions allowed for discharge to the Harrison Bayou. Currently, the discharge is to the holding pond. Ms. Nemmers explained that maintenance is being planned for the perchlorate treatment system to improve the effectiveness. Ms. Nemmers explained that the treatment of groundwater is via a batch system using a holding tank to store extracted groundwater from LHAAP-18/24 and to a lesser extent from LHAAP-16 that is then treated by the system. Use of the holding tank allows for continued pumping of the extraction wells even if maintenance is occurring at the GWTP. Ms. Nemmers

explained that the purpose of the treatment system is to control the plume at LHAAP-18/24 and not necessarily remediate the plume. Ms. Nemmers stated that pump and treat takes a much longer time to remediate a site than in situ technologies. Ms. Nemmers explained that extraction also increases with precipitation due to percolation from the ground surface. Ms. Zeiler explained that a ROD is being prepared to further address LHAAP-18/24.

Surface Water Sampling
Ms. Nemmers explained that no surface water was sampled in June 2018 due to dry conditions. Ms. Laura-Ashley Overdike asked if there is any plan to adjust the sampling during a quarter for when there is flow in the creeks. Ms. Palmie explained that no sample is not necessarily bad since the sample is collected to assess whether groundwater is entering the surface water. If the bayou is dry, then groundwater is not discharging into the surface. Ms. Palmie explained that the chart with the discharge information is interesting because it tells whether the GWTP is operating properly, if the bayou is flowing and how much moisture is in the ground so it is hard to really draw conclusions with the information. Ms. Overdike asked what conclusions could be drawn from the chart showing the perchlorate detections in the surface water. Ms. Palmie explained that the spike shown on the figure was not an exceedance because the discharge criteria was higher when the detection occurred.

Site LHAAP-18/24, LHAAP-29 and LHAAP-47
Mr. Aaron Williams explained that HDR is completing work on the sites that don’t have a ROD, which are sites LHAAP-18/24, LHAAP-29 and LHAAP-47. For Sites LHAAP-18 and LHAAP-29, Mr. Williams explained that the proposed plan (PP) is being prepared and then there will be a public comment period along with a public meeting. The Feasibility Study (FS) from January 2017 is the basis of the PP for Site LHAAP-18/24.

Mr. Williams explained that Site LHAAP-47 had a PP prepared but the site was impacted by the 2013 dispute which ended in 2016. So the site got held up and now the Army is re-evaluating the site. Mr. Williams explained that the last sampling completed at LHAAP-47 was in 2010 and now it is 2018. Ms. Zeiler stated that there were ten (10) dry wells present in 2010. Mr. Williams explained that the first step was to evaluate the wells and determine if they are still dry. If those wells were still dry, then the wells will be replaced. Mr. Williams explained that the Army also wanted to complete direct push technology (DPT) sampling where no data was present to fully define the plume. Mr. Williams explained the planned remedy was shown as in situ injections at MW-25 where trichloroethylene (TCE) was detected at 13,000 and downgradient where elevated TCE was also present. The dashed line on the figure of the intermediate plume is where further plume definition is needed. Ms. Overdike clarified whether the slides were showing current data. Mr. Williams stated that the first two slides showed historical data. Ms. Zeiler explained that the contractor is currently in the field.

The dry wells are in a very shallow, thin sand lens. Mr. Williams explained that there is a steady decline in shallow groundwater elevations in the area, including LHAAP-46 to the north that Mr.

Foss discussed. Mr. Williams stated that the wells that were dry in 2010 are still dry today. Mr. Williams explained that when the contractor was using the DPT to collect samples that more than one sample was supposed to be collected but the first interval was dry so only one water sample was collected.

Ms. Overdike asked about the possible reason. Mr. Foss discussed the assessment that has been done on LHAAP-46 to the north of LHAAP-47. Mr. Foss explained that the reason for this decline may be due to decreases in past mounding from leaky water pipes from the production areas and/or drought but that the increase in precipitation does not seem to be eliminating the dry wells.

Mr. Williams explained that the purple marks are the wells being installed and sampled. Mr. Williams explained that there was a surprise detection in the intermediate aquifer, so more wells are being added and the remedy design may be adjusted.

Ms. Zeiler asked if the stream sampling had taken place. Mr. Williams explained that there were to be four stream samples collected. Ms. Overdike asked if the stream testing locations and results could be shared at the next meeting.

Mr. Fortune asked about whether part of the three-year dispute was regarding setting a precedence for all other cleanups under Superfund. Ms. Palmie explained that it is unusual for a state to have its own cleanup standards and that it is even more unusual that these standards were superseded by other standards. Ms. Palmie stated that while there are take aways that could maybe translate to other sites, the overall issue was unique to LHAAP. Ms. Zeiler explained that for certain contaminants and pathways, the USEPA didn't have standards so TCEQ standards were evaluated. Ms. Palmie explained that usually the EPA values are used and that TCEQ values usually don't supersede EPA values and that TCEQ values fill in the gaps.

Next RAB Meeting Schedule and Closing Remarks

Ms. Zeiler then discussed the next meeting. The next RAB meeting will be held on **October 18, 2018,** with a **meeting starting at 6:00 pm CDT** at the Karnack Community Center.

Adjourn
Mr. Fortune motioned to adjourn. Ms. VanDeventer seconded the motion. Meeting adjourned 6:23 pm CDT.

July 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, July 19, 2018
TIME:	6:00 – 7:00 PM
PLACE:	Karnack Community Center, Karnack, Texas

06:00 **Welcome and Introduction**

06:05 **Open Items {RMZ}**

- Purpose of the RAB Meeting
- RAB Administrative Issues
- Minutes (April 2018 RAB Meeting)
- Ongoing Outreach/Website

06:15 **Defense Environmental Restoration Program (DERP) Update {Bhate}**

- LHAAP Geology and Hydrology Discussion
- LHAAP-03 ROD and LHAAP-35A(58) ESD Status Update
- Documents and Field Work Completed in 2nd Quarter 2018
- Three Month Lookahead
- Groundwater Treatment Plant (GWTP) Update

06:45 **Other Defense Environmental Restoration Program (DERP) Update {RMZ}**

06:50 **Next RAB Meeting Schedule and Closing Remarks {RMZ}**

Longhorn Army Ammunition Plant Quarterly Restoration Advisory Board Meeting

Karnack Community Center
July 19, 2018
6:00 PM CDT

Agenda

06:00 Welcome and Introduction

06:05 Open Items {RMZ}
- Purpose of the RAB Meeting
- RAB Administrative Issues
- Minutes (April 2018 RAB Meeting)
- Ongoing Outreach/Website

06:15 Defense Environmental Restoration Program (DERP) Update {Bhate}
- LHAAP Geology and Hydrology Discussion
- LHAAP-03 ROD and LHAAP-35A(58) ESD Status Update
- Documents and Field Work Completed in 2nd Quarter 2018
- Three Month Lookahead
- Groundwater Treatment Plant (GWTP) Update

06:45 Other Defense Environmental Restoration Program (DERP) Update {RMZ}

06:50 Next RAB Meeting Schedule and Closing Remarks {RMZ}

Abbreviations and Acronyms

µg/L	micrograms per liter
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DERP	Defense Environmental Restoration Program
DNAPL	Dense non-aqueous phase liquid
ESD	Explanation of Significant Difference
ft bgs	feet below ground surface
GWTP	groundwater treatment plant
LHAAP	Longhorn Army Ammunition Plant
LNAPL	Light non-aqueous phase liquid
MNA	monitored natural attenuation
MW	monitoring well

PDI	Pre-Design Investigation
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
VOCs	Volatile organic compounds

Purpose of the RAB Meeting

- **Held every three months**
- **The mission of the Longhorn Army Ammunition Plant (LHAAP) Restoration Advisory Board (RAB) is to promote community awareness and obtain constructive community review and comments on environmental restoration activities at the former LHAAP**

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
    - Website is regularly updated to indicate the upcoming field events at each site including groundwater sampling, monitoring well installations, soil sampling, or remediation activities
  - Make suggestions for improving communication – the Army welcomes and appreciates community feedback

RAB Administrative Issues

RAB Membership

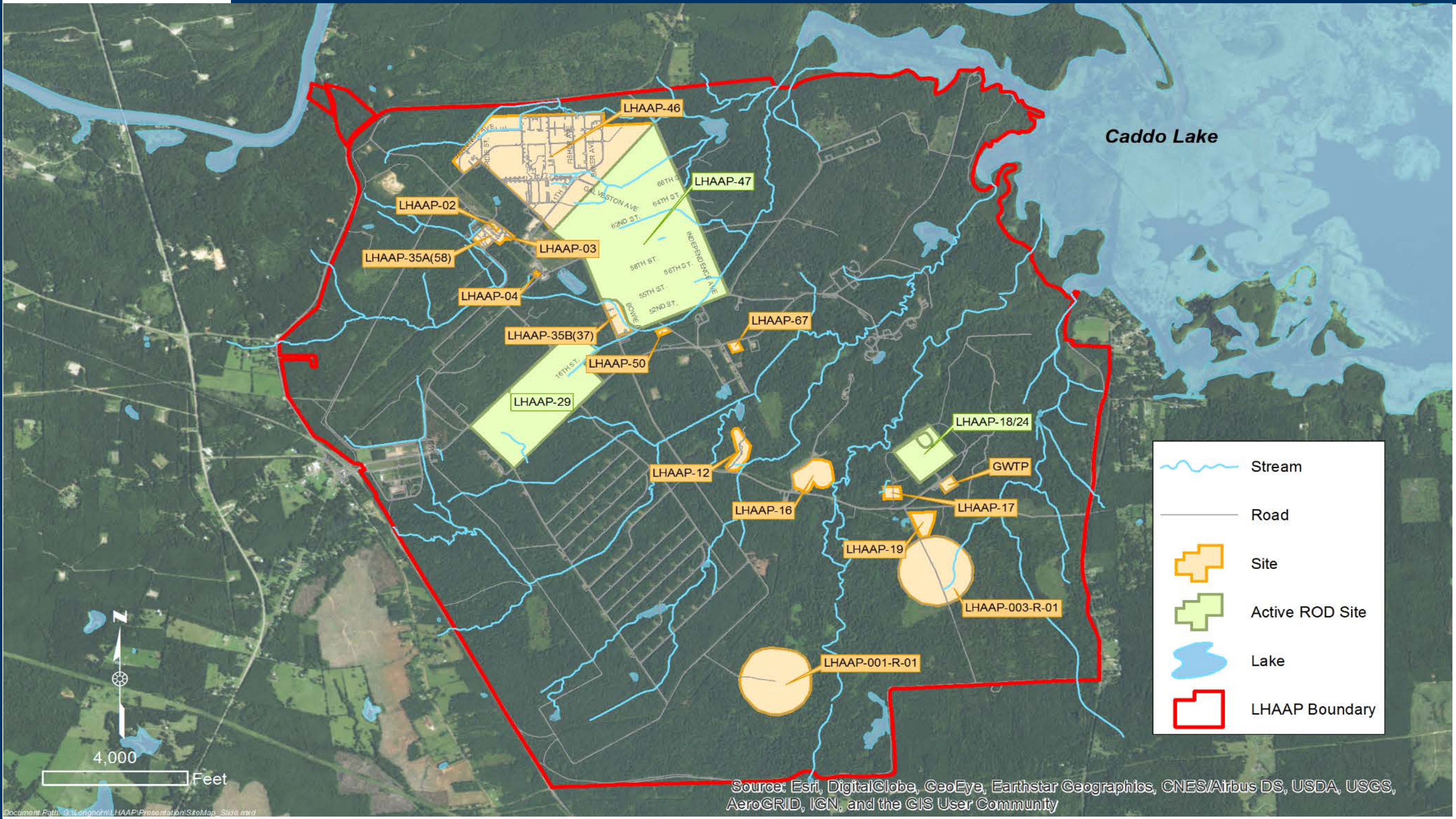
Discussion of April 2018 RAB Meeting minutes/motion to accept

Outreach

- **Website Address: http://www.longhornaap.com/**

Restoration Advisory Board Meeting

Site Map



Hydrogeology 101: Definitions

Permeability: Permeability is a material's ability to allow fluids to pass through it. Permeable materials, such as gravel and sand, allow water to move quickly through them, whereas impermeable material, such as clay, doesn't allow water to flow freely

Aquifer: a water bearing consolidated or unconsolidated geologic unit (such as fractured rock, gravel, or sand) or set of connected units that yields a useable quantity of water

Aquitard: a geologic material, stratum, or formation of low permeability such as clay (also called a confining unit) that impedes movement of water vertically or horizontally

Potentiometric Surface: a map of water-table elevations in an aquifer unit used to identify potential groundwater flow directions and pathways

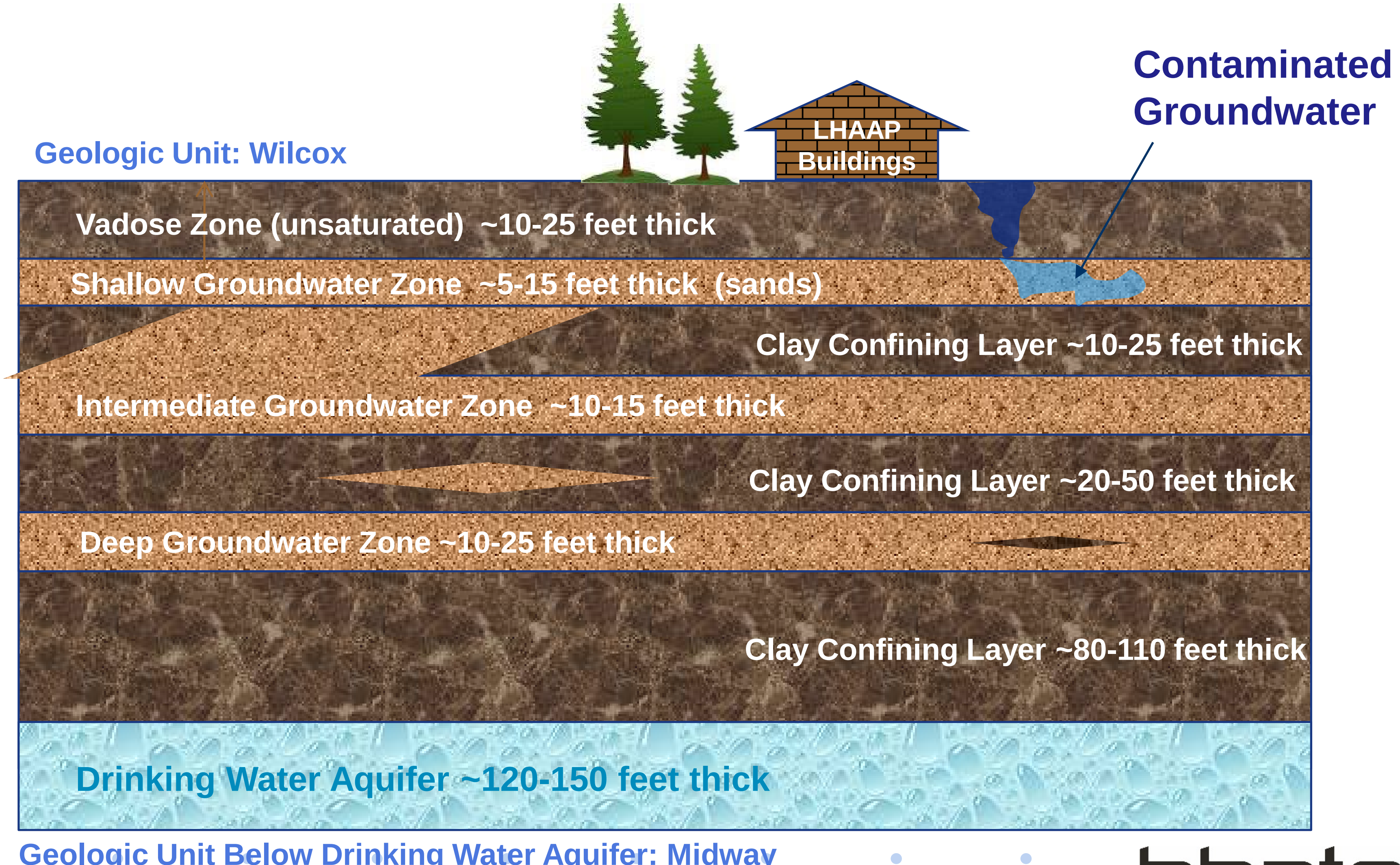
Plume: a three-dimensional body of fluid emanating from source or sources with a chemistry or physical composition differing from the background groundwater

DNAPL: Dense non-aqueous phase liquid. Forms from high concentrations of a contaminant denser than water that will sink when released into a groundwater aquifer

Hydrogeology: The study of the distribution and movement of fluids through geologic formations

Restoration Advisory Board Meeting

Hydrogeology 101: Groundwater Zones at LHAAP



Hydrogeology 101: Contaminant Plume Migration

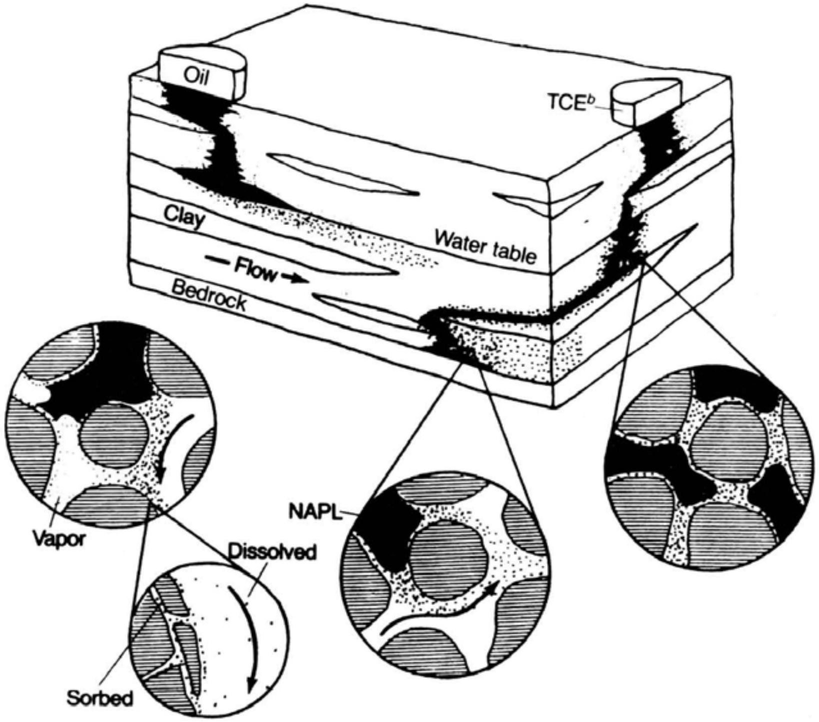


Figure 2.1 Schematic illustration of a DNAPL and a LNAPL in a porous medium, showing geologic and pore scales. A low-permeability clay layer deflects the DNAPL. DNAPL dissolution causes a plume (from Mackay and Cherry, 1989).

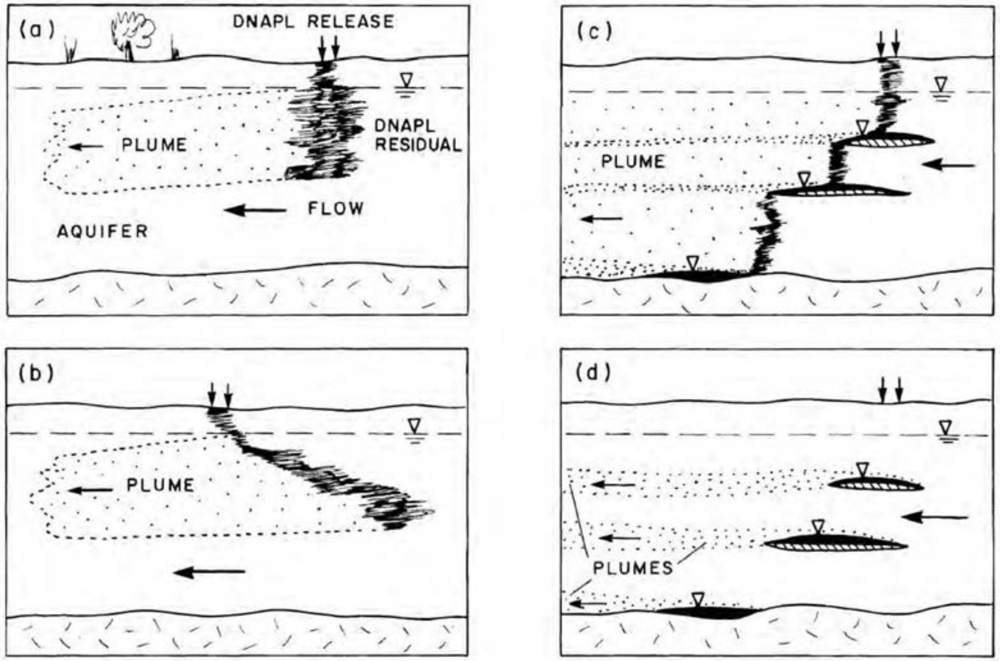


Figure 2.5 Conceptual scenarios for a DNAPL in the groundwater zone in granular aquifers: a) partial penetration; b) partial penetration with offset; c) full penetration with offset; and d) same as part c, but at a later stage after DNAPL residual has disappeared due to dissolution in flowing groundwater. (Pankow and Cherry, 1996)

LHAAP-03 Final Record of Decision

Site Background

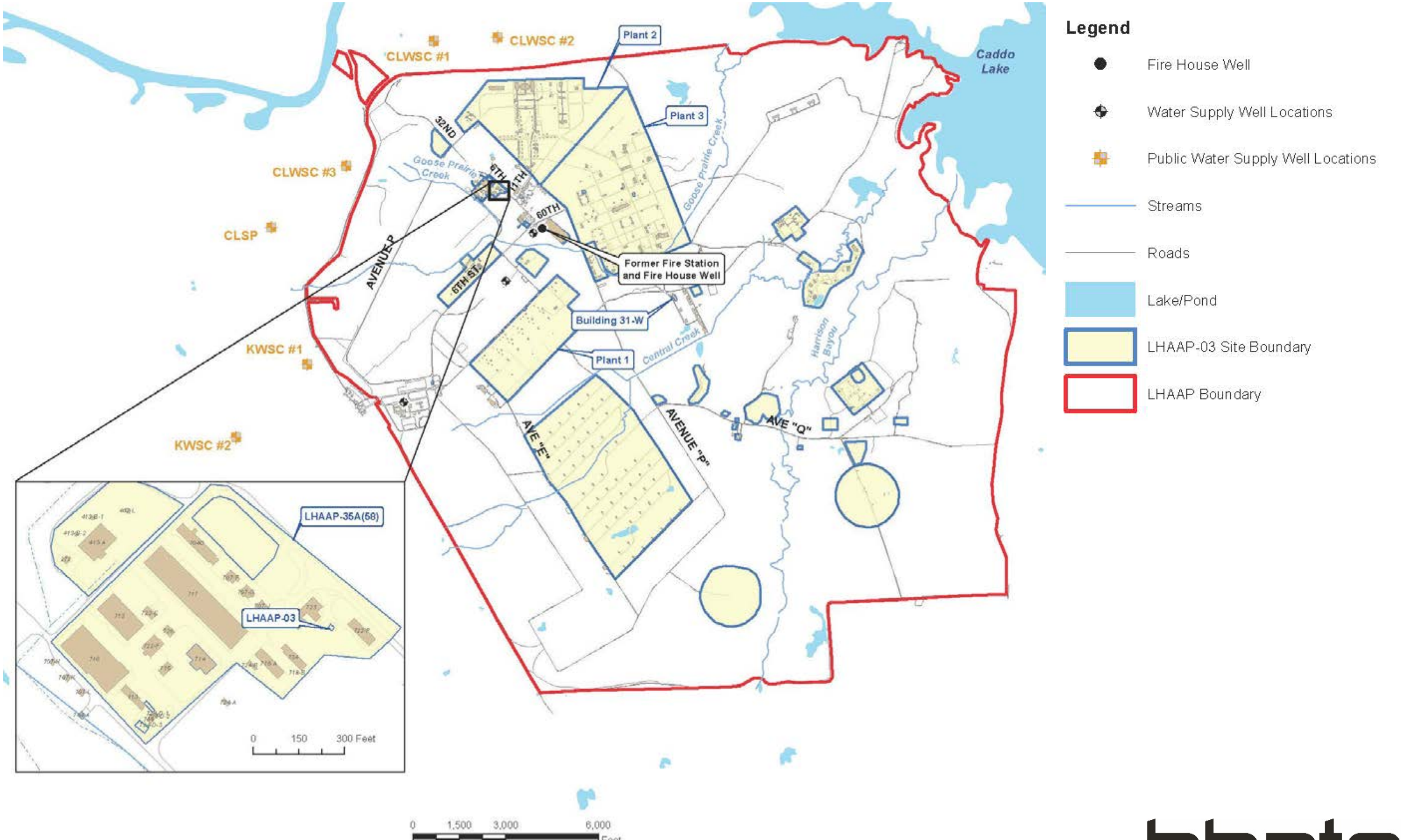
- LHAAP-03 was a waste collection site (approx. 16-feet x 15-feet) outside of the paint shop located within the boundary of LHAAP-35A(58) VOC plume
- Heavy metal-based primers, other waste paint, waste solvents and contaminated rags were collected in a 55-gallon drum on a gravel pad in an open-sided shed
- Soil is contaminated with various heavy metals, but only arsenic and lead are present at concentrations of concern for leaching to groundwater
- Groundwater is generally encountered 12 to 16 feet (ft) below ground surface (bgs) and is indistinguishable from that of LHAAP-35A(58)
- The groundwater contaminated with volatile organic compounds (VOCs) under LHAAP-03 is not site related and is being addressed as part of the remedy for site LHAAP-35A(58)

Investigation Summary

- Human Health Risk Assessment completed in 2003
- Baseline Ecological Risk Assessment completed in 2007 (updated 2014)
- Remedial Investigation/Focused Feasibility Study completed in 2013
- Proposed Plan published for Public Comment in 2013
- Record of Decision (ROD) awaiting regulatory signature/concurrence in July 2018
- ESD is being routed for signatures/concurrence in July 2018

Restoration Advisory Board Meeting

LHAAP-03 Location



bhate ENVIRONMENT & INFRASTRUCTURE

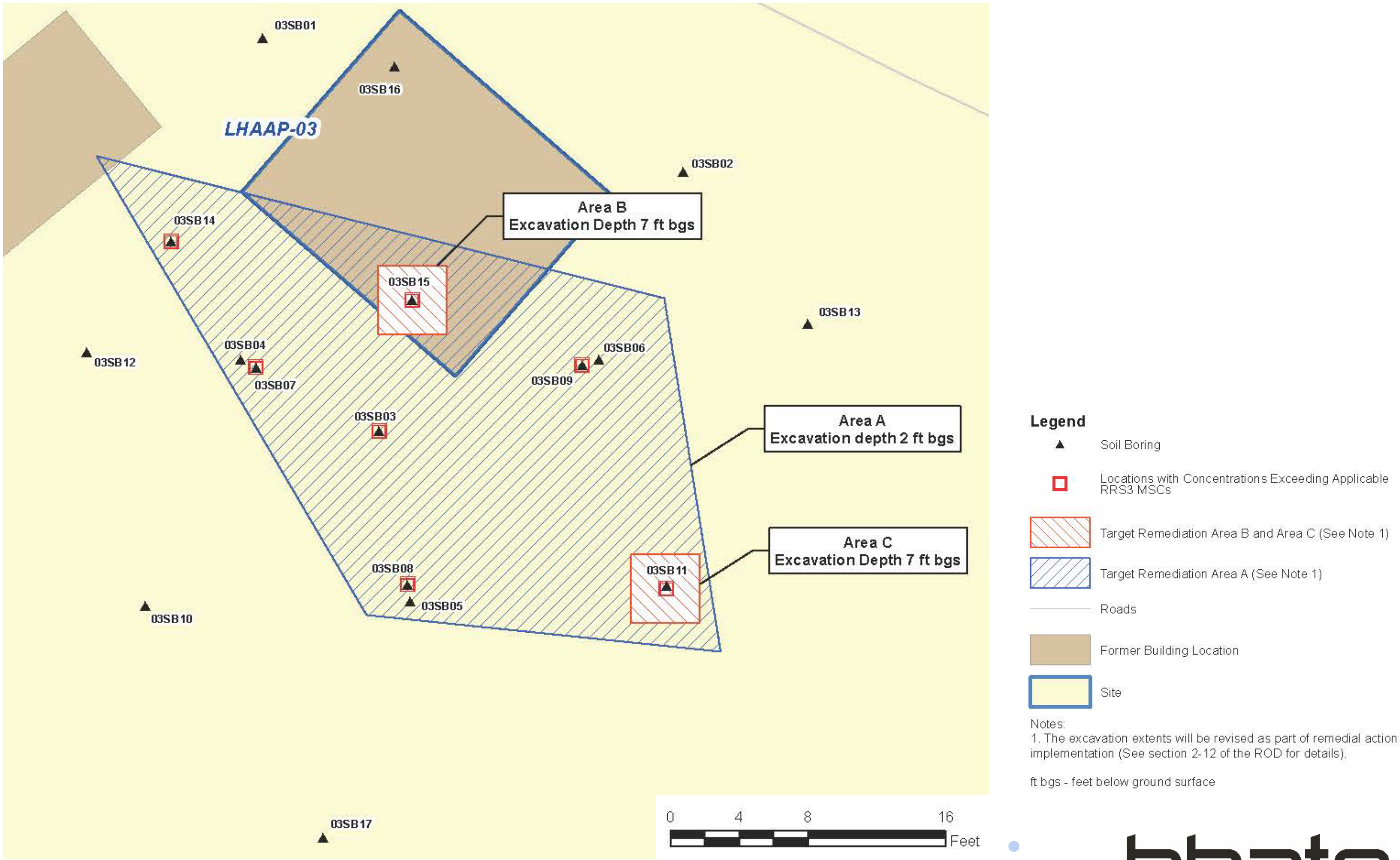
LHAAP-03 Selected Remedy

- Selected Remedy
  - Soil contaminated with lead and arsenic above groundwater protective cleanup values will be excavated and disposed of offsite at an appropriately licensed disposal facility
  - Excavation area will be backfilled with compacted clean fill and re-seeded

- Remedial Path Forward
  - Pre-excavation sampling to refine the extent of excavation
  - Prepare a Remedial Design/Remedial Action Work Plan
  - Implement Remedial Action
  - Prepare Remedial Action Completion Report (RACR)

Restoration Advisory Board Meeting

LHAAP-03 Target Remediation Area



bhate ENVIRONMENT & INFRASTRUCTURE

Documents in Process

Site	Document
LHAAP-03	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	RACR
GWTP, LHAAP-18/24 and Surface Water	Quarterly Evaluation Report First Quarter (January –March (2018

bhate ENVIRONMENT & INFRASTRUCTURE

Completed Field Work

Site	Activity
LHAAP-02	Groundwater Sampling – April 2018
LHAAP-16	Began installation of monitoring and injection wells – April/May 2018; Installation suspended because of wet conditions
LHAAP-17	Pre-Design Investigation (PDI) – Installed new shallow well (April 2018) and sampled. Because of wet soil, soil sampling has not been completed. Waiting for field conditions to change.
LHAAP-19	Repairs to landfill cover
LHAAP-37	Remedial Action – Operation (RA-O) Sampling – May 2018
LHAAP-50	RA-O Sampling – May 2018
LHAAP-58	RA-O Sampling – July 2018
LHAAP-67	RA-O Sampling – July 2018
Surface Water	Surface Water Sampling – June 2018

3 Month Look Ahead - Documents

Site	Document
LHAAP-02	Technical Memo-Semi-Annual Compliance Sampling
LHAAP-03	FINAL ROD; Remedial Design (RD)/Remedial Action Work Plan (RAWP)
LHAAP-03/58	FINAL ESD
LHAAP-12	Annual RA-O Report for 2017 (Year 3)
LHAAP-17	PDI Report
LHAAP-50	Year 3 RA-O Report
LHAAP-58	RACR and Year 4 RA-O Report
GWTP, LHAAP-18/24, LHAAP-16, Surface Water	Quarterly Evaluation Reports: First Quarter (January – March) 2018 and Second Quarter (April – June) 2018

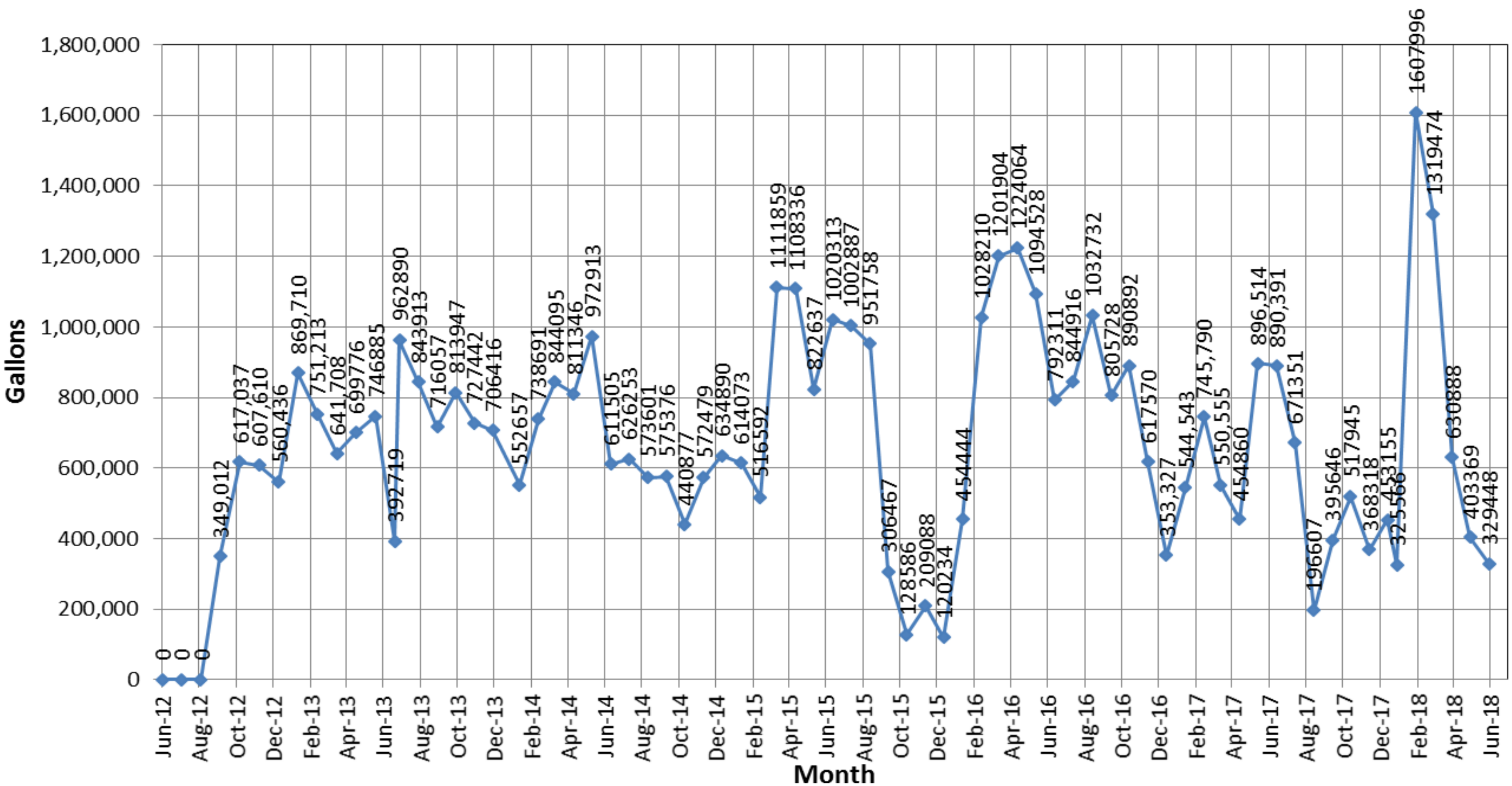
3 Month Look Ahead - Field Work

Site	Activity
LHAAP-16	Once field conditions become dry, completion of monitoring well and injection well installation, pre-remedy groundwater sampling, in-situ bioremediation injections
LHAAP-17	PDI – If site conditions dry up - complete soil sampling
LHAAP-37	RA-O Sampling – August 2018
LHAAP-46	RA-O Sampling – August 2018
LHAAP-58	RA-O of Western Plume Only – September 2018
Surface Water	Collect Surface Water samples

Restoration Advisory Board Meeting

GWTP Update

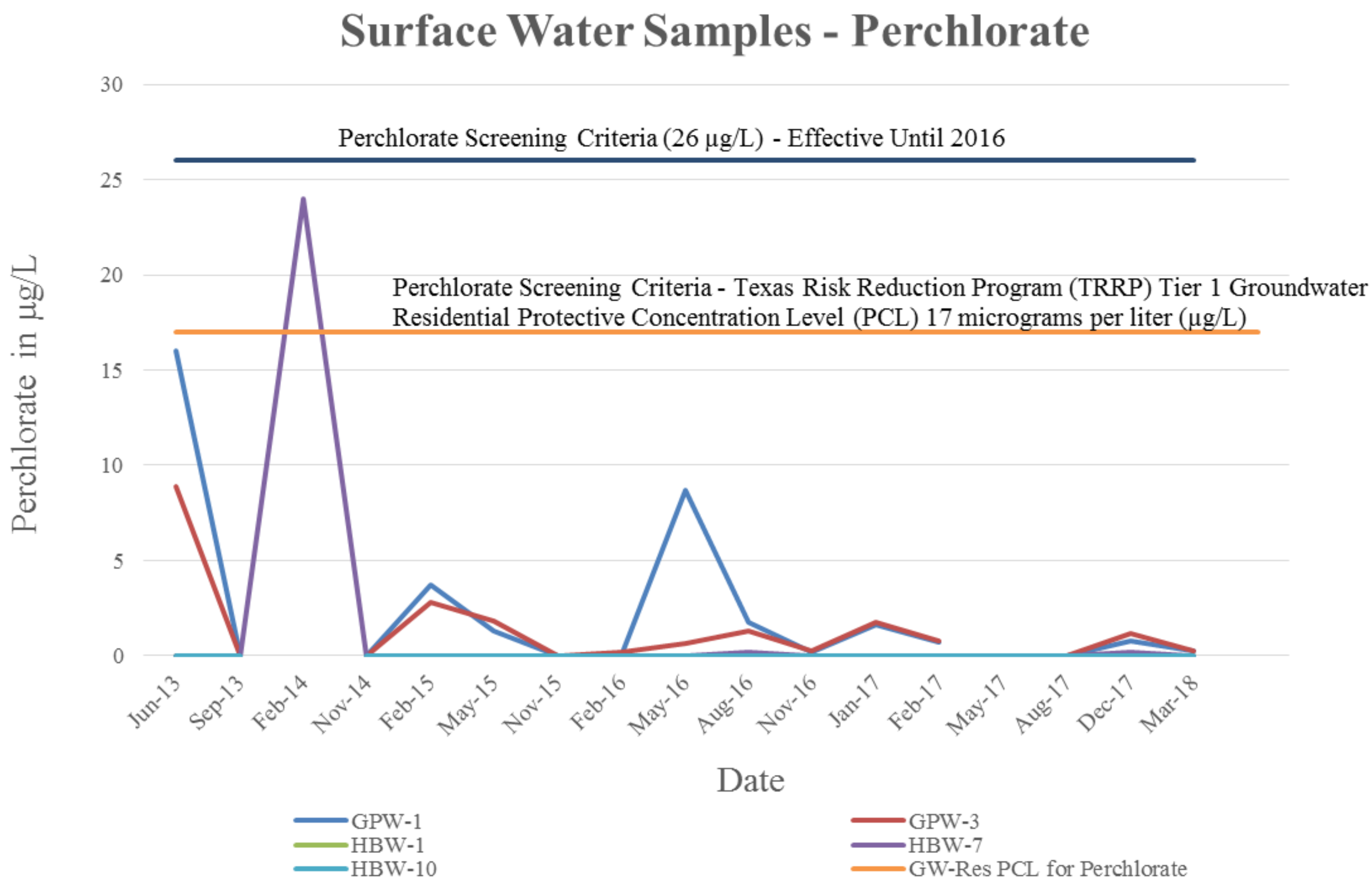
Water Treated and Discharge Monthly from June 2012 through June 2018



bhate ENVIRONMENT & INFRASTRUCTURE

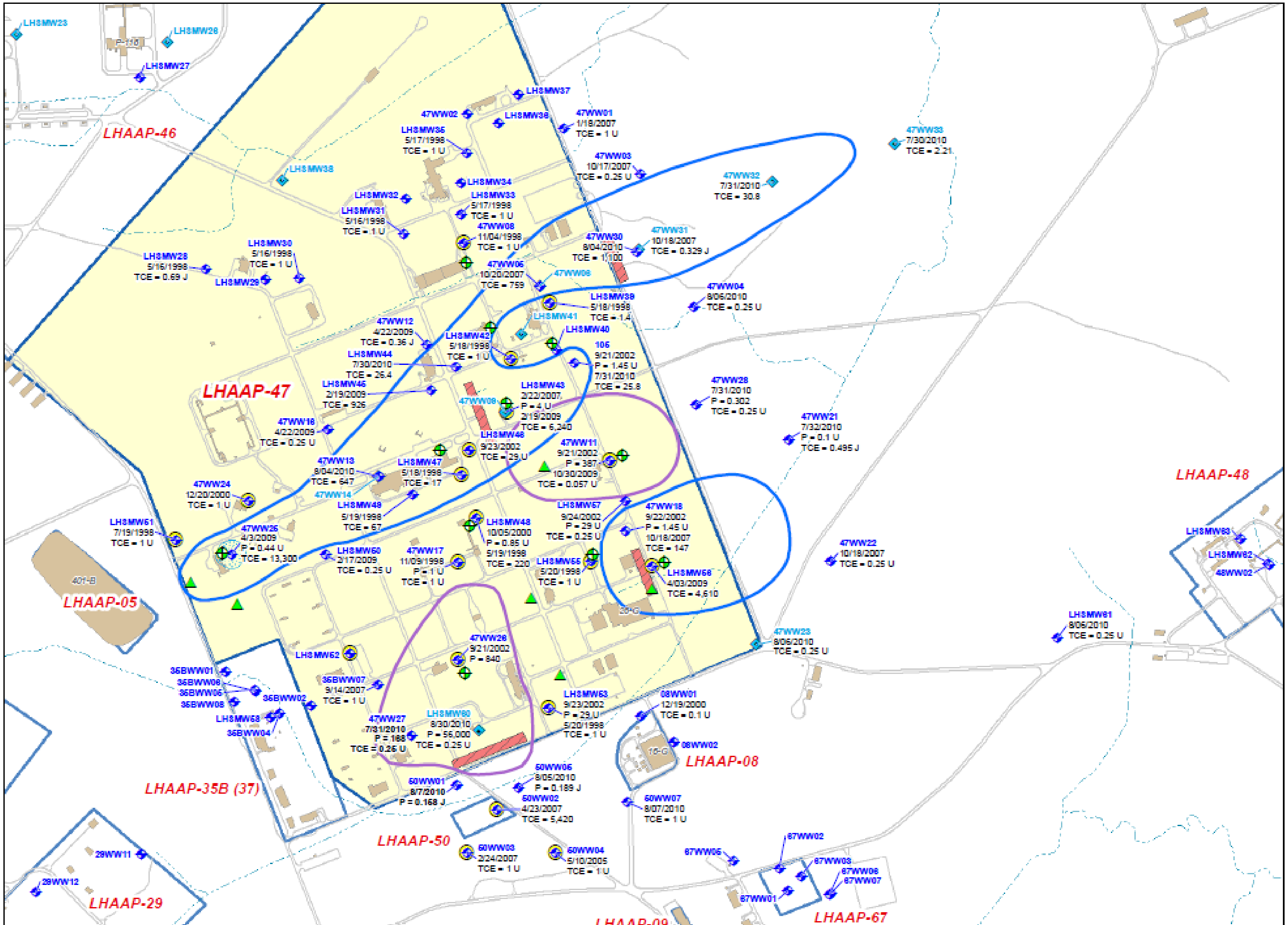
Restoration Advisory Board Meeting

Surface Water Sample Results



bhate ENVIRONMENT & INFRASTRUCTURE

Restoration Advisory Board Meeting



Legend

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Well Dry in 2010
- Proposed Shallow Monitoring Well
- Proposed Soil Boring Location
- Perchlorate Exceeding Shallow Zone T
- Trichloroethene Exceeding Shallow Zon
- Stream
- Road
- Hot Spot DPT Grid ISEB
- ISEB Biobarrier Shallow
- Former Buildings or Concrete Slab
- LHAAP-47 Site Boundary
- Other LHAAP Sites

Source: July 2011 Final Feasibility Study Report Plant 3 Area, Group 4, Longhorn Army Ammunit Karnack, Harrison County, Texas (Shaw, 2011)

Notes:
1. MCL - maximum contaminant level
2. Results reported in micrograms per liter (µg/L).
3. Most recent results are shown (1998 - 2010).
4. Plumes shown are in the interconnected shallow/intermediate zones and use the combined well data of both zones.
5. Biobarriers tied to 500 µg/L trichloroethene.
6. TRRP PCL is the Texas Risk Reduction Program Protective Concentration Level for residential groundwater through ingestion ($^{GW}GW_{Ing}$).
7. P = Perchlorate.
8. TCE = Trichloroethene.
9. U = Concentration below detection.
10. J = Concentration estimated.

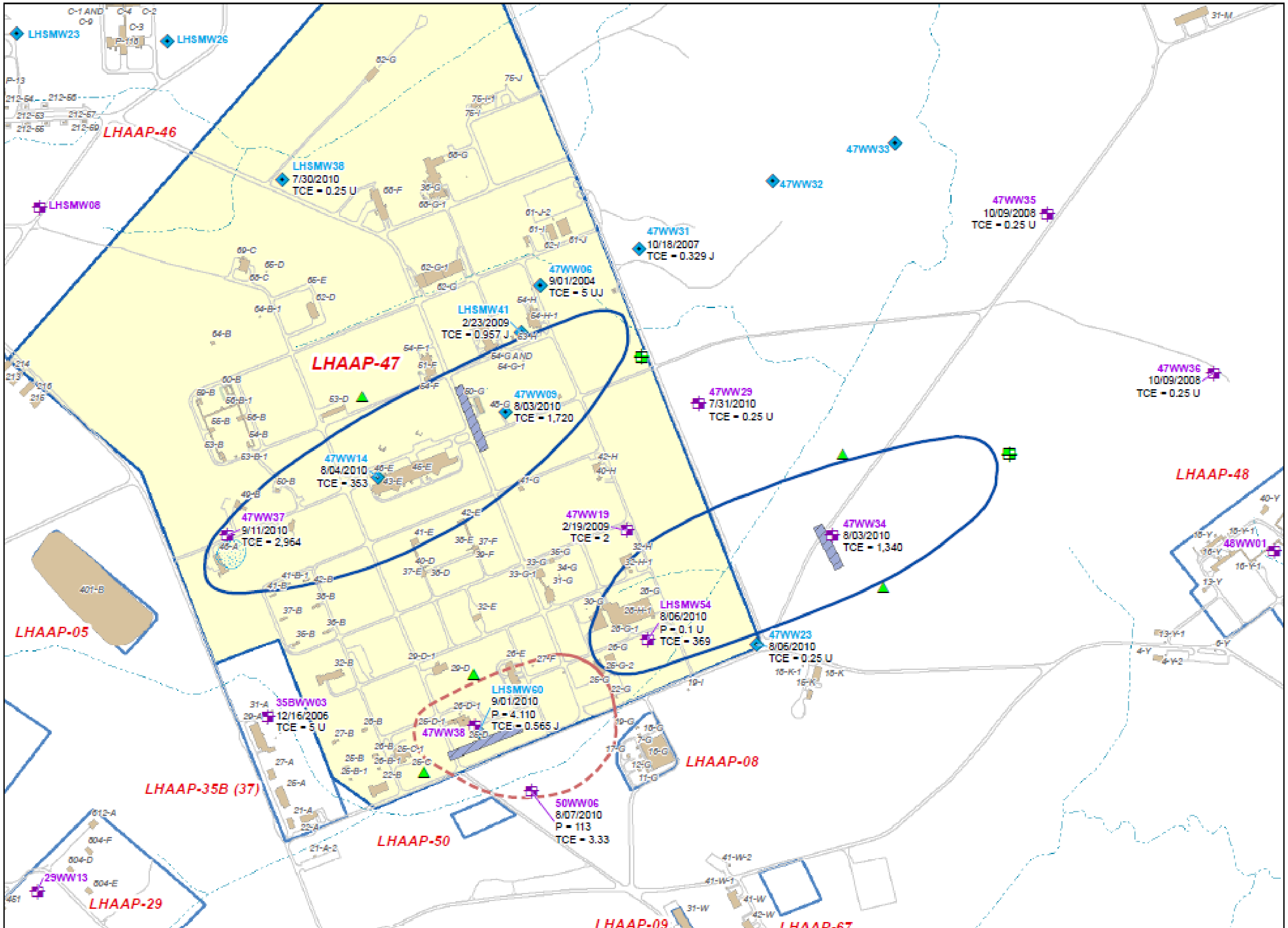
0 350 700 1,400 Feet

AECOM

Figure 3
Proposed Soil Boring and Monitor Well
in Shallow Groundwater Zone
Post Screening Investigation Work
LHAAP-47
Longhorn Army Ammunition Plant
Karnack, Texas

60274185

Restoration Advisory Board Meeting



Notes:
1. MCL - maximum contaminant level
2. Results reported in micrograms per liter (µg/L).
3. Most recent results are shown (1998 - 2010).
4. Plumes shown are in the interconnected shallow/intermediate zones and use the combined well data of both zones.
5. Biobarriers tied to 500 µg/L trichloroethene.
6. TRRP PCL is the Texas Risk Reduction Program Protective Concentration Level for residential groundwater through ingestion ($^{GW}GW_{Ing}$).
7. P = Perchlorate.
8. TCE = Trichloroethene.
9. U = Concentration below detection.
10. J = Concentration estimated.

0 350 700 1,400 Feet

Legend

- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Proposed Intermediate Monitoring Well
- Proposed Soil Boring Location
- Perchlorate Exceeding Intermediate Zor (Dashed Where Inferred)
- Trichloroethene Exceeding Intermediate
- Stream
- Road
- Hot Spot DPT Grid ISEB
- ISEB Biobarrier Intermediate
- Former Buildings or Concrete Slab
- LHAAP-47 Site Boundary
- Other LHAAP Sites

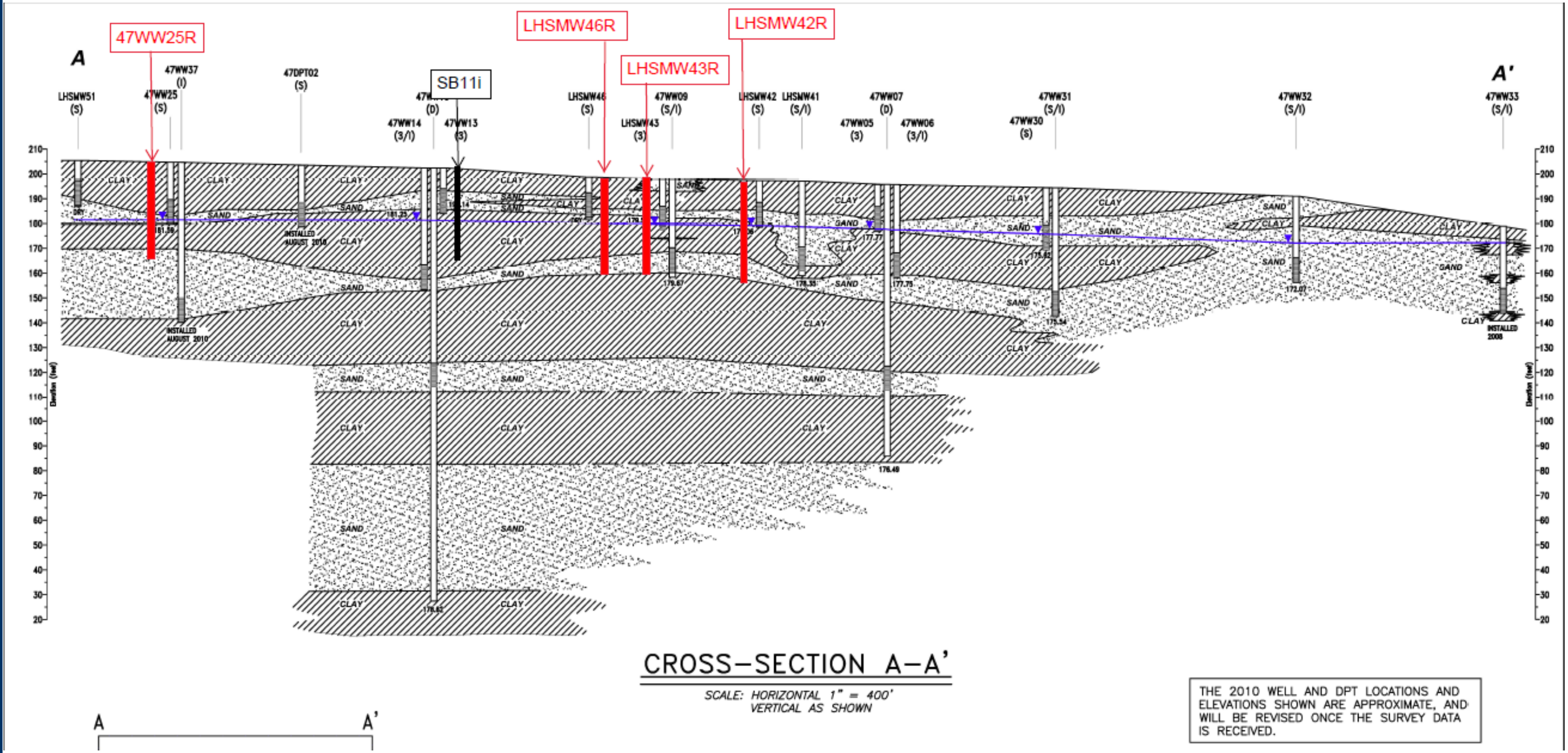
Source: July 2011 Final Feasibility Study Report Plant 3 Area, Group 4, Longhorn Army Ammuniti Karnack, Harrison County, Texas (Shaw, 2011)

AECOM

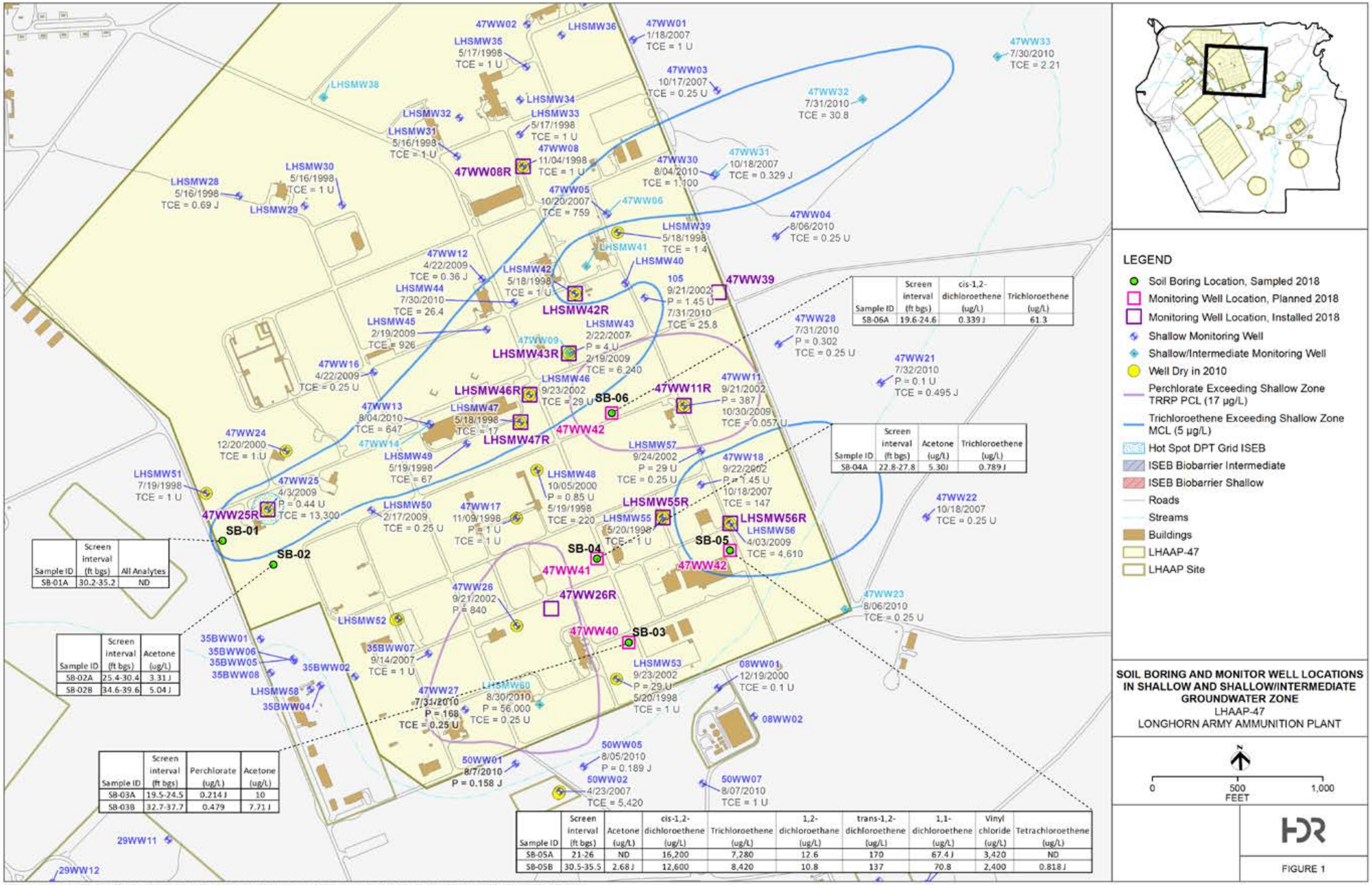
Figure 4
Proposed Soil Boring and Monitor Well L in Intermediate Groundwater Zor
Post Screening Investigation Work
LHAAP-47
Longhorn Army Ammunition Plant
Karnack, Texas

60274185

Restoration Advisory Board Meeting



Restoration Advisory Board Meeting



Sample ID	Screen interval (ft bgs)	All Analytes
SB-01A	30.2-35.2	ND

Sample ID	Screen interval (ft bgs)	Acetone (ug/L)
SB-02A	25.4-30.4	3.31 J
SB-02B	34.6-39.6	5.04 J

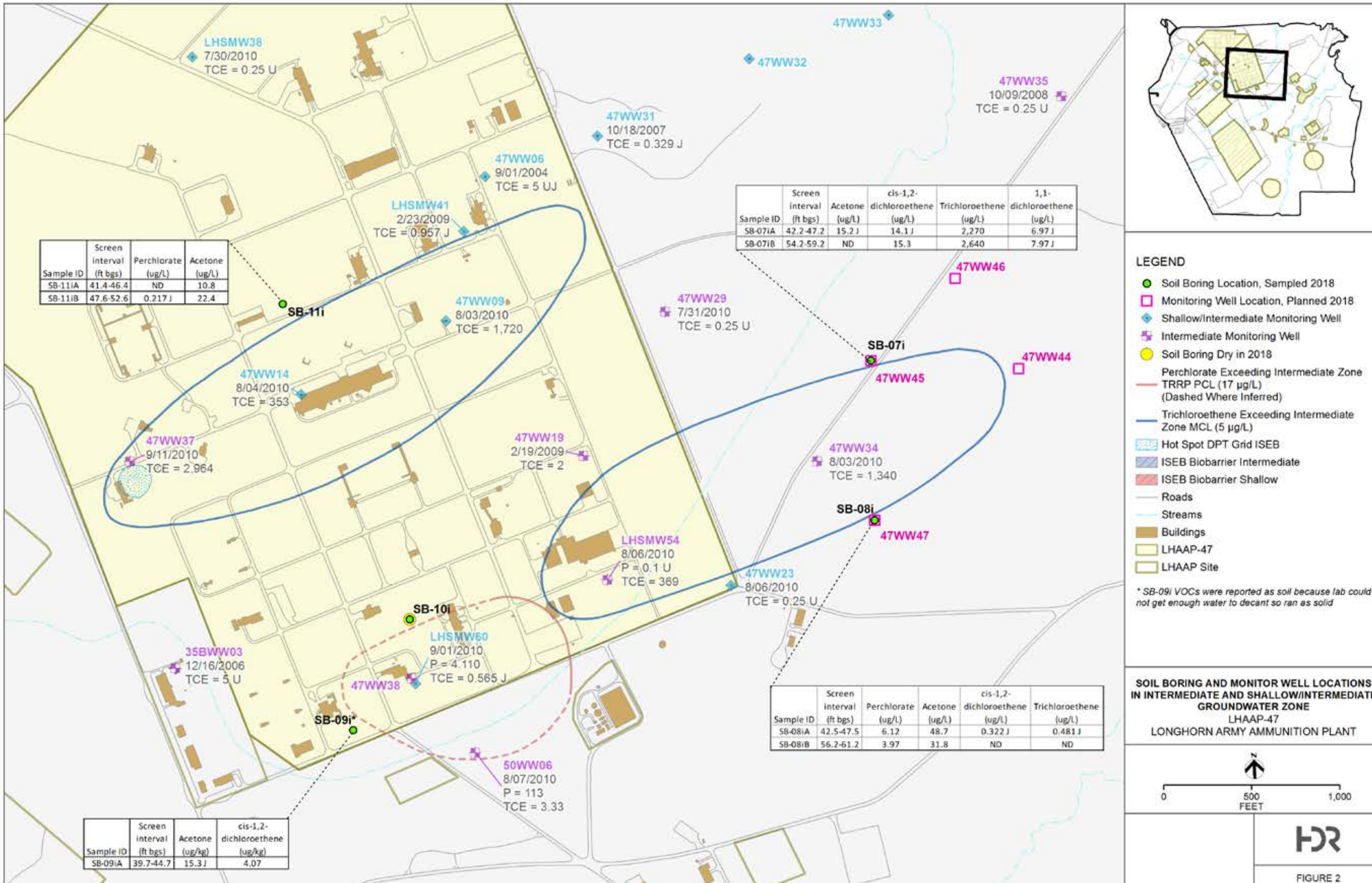
Sample ID	Screen interval (ft bgs)	Perchlorate (ug/L)	Acetone (ug/L)
SB-03A	19.5-24.5	0.214 J	10
SB-03B	32.7-37.7	0.479	7.71 J

Sample ID	Screen interval (ft bgs)	Acetone (ug/L)	Trichloroethene (ug/L)
SB-04A	22.8-27.8	5.30J	0.789 J

Sample ID	Screen interval (ft bgs)	Acetone (ug/L)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)	1,2-dichloroethane (ug/L)	trans-1,2-dichloroethene (ug/L)	1,1-dichloroethene (ug/L)	Vinyl chloride (ug/L)	Tetrachloroethene (ug/L)
SB-05A	21-26	ND	16,200	7,280	12.6	170	67.4 J	3,420	ND
SB-05B	30.5-35.5	2.68 J	12,600	8,420	10.8	137	70.8	2,400	0.818 J

Sample ID	Screen interval (ft bgs)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)
SB-06A	19.6-24.6	0.339 J	61.3

Restoration Advisory Board Meeting



Sample ID	Screen interval (ft bgs)	Perchlorate (ug/L)	Acetone (ug/L)
SB-11iA	41.4-46.4	ND	10.8
SB-11iB	47.6-52.6	0.217 J	22.4

Sample ID	Screen interval (ft bgs)	Acetone (ug/L)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)	1,1-dichloroethene (ug/L)
SB-07iA	42.2-47.2	15.2 J	14.1 J	2,270	6.97 J
SB-07iB	54.2-59.2	ND	15.3	2,640	7.97 J

Sample ID	Screen interval (ft bgs)	Perchlorate (ug/L)	Acetone (ug/L)	cis-1,2-dichloroethene (ug/L)	Trichloroethene (ug/L)
SB-08iA	42.5-47.5	6.12	48.7	0.322 J	0.481 J
SB-08iB	56.2-61.2	3.97	31.8	ND	ND

Sample ID	Screen interval (ft bgs)	Acetone (ug/kg)	cis-1,2-dichloroethene (ug/kg)
SB-09iA	39.7-44.7	15.3 J	4.07

Next RAB Meeting Schedule & Closing Remarks

- Schedule October 2018 RAB Meeting
- Other Issues/Remarks
- Thank you for coming

bhate ENVIRONMENT & INFRASTRUCTURE

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

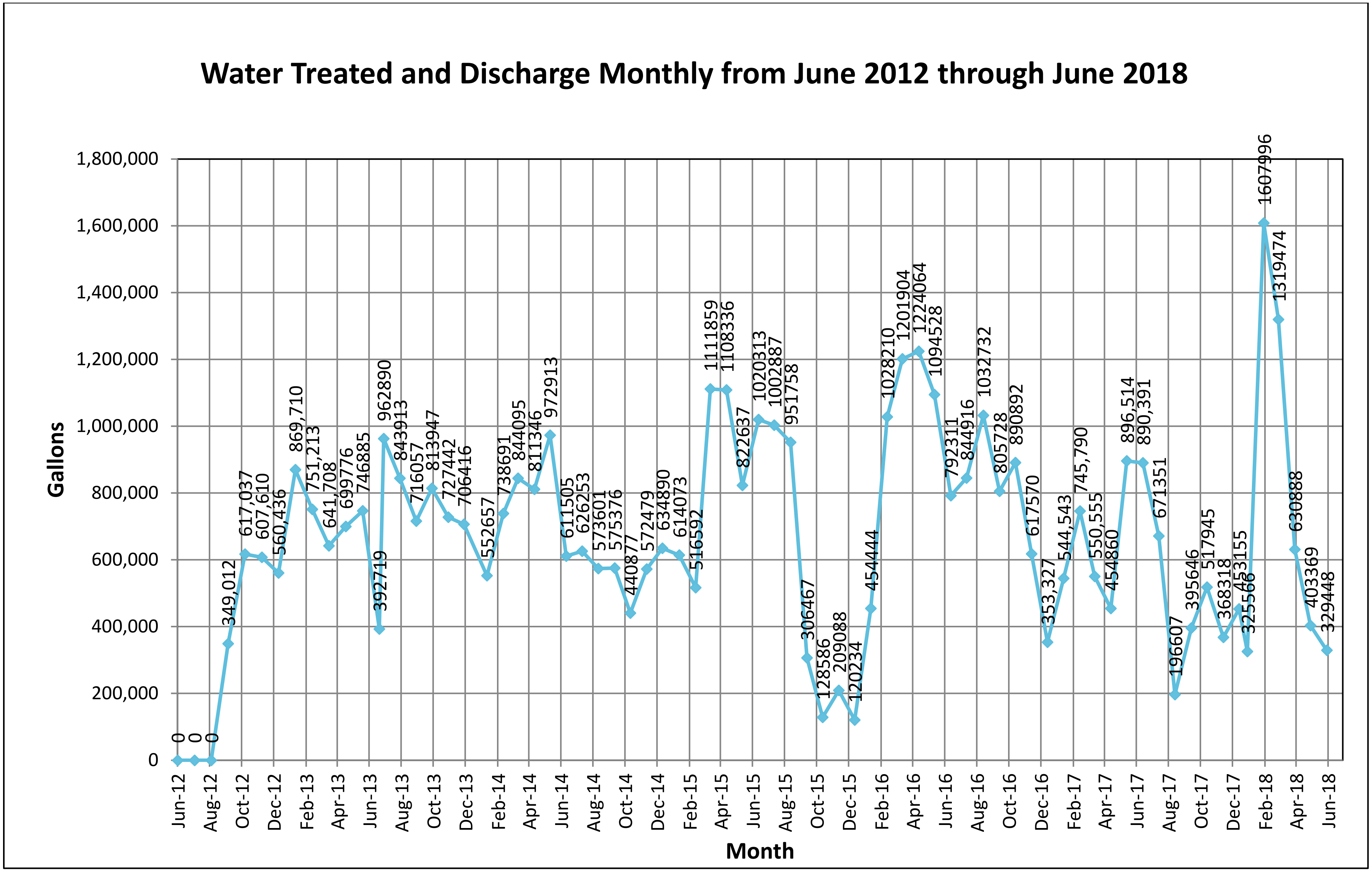
Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15
440,877	572,479	634,890	614,073	516,592	1,111,859	1,108,336	822,637	1,020,313	1,002,887	951,758	306,467

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	Apr-18	May-18	Jun-18
517,945	368,318	453,155	325,566	1,607,996	1,319,474	630,888	403,369	329,448

*Indicates Estimate


Water Treated and Discharge Monthly from June 2012 through June 2018
Gallons
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
0 0 0 349,012 617,037 607,610 560,436 869,710 751,213 641,708 699776 746885 392719 962890 843913 716057 813947 727442 706416 552657 738691 844095 811346 972913 611505 626253 573601 575376 440877 572479 634890 614073 516592 1111859 1108336 822637 1020313 1002887 951758 306467 128586 209088 120234 454444 1028210 1201904 1224064 1094528 792311 844916 1032732 805728 890892 617570 353,327 544,543 745,790 550,555 454860 896,514 890,391 671351 196607 395646 517945 368318 453155 325566 1607996 1319474 630888 403369 329448
Jun-12 Aug-12 Oct-12 Dec-12 Feb-13 Apr-13 Jun-13 Aug-13 Oct-13 Dec-13 Feb-14 Apr-14 Jun-14 Aug-14 Oct-14 Dec-14 Feb-15 Apr-15 Jun-15 Aug-15 Oct-15 Dec-15 Feb-16 Apr-16 Jun-16 Aug-16 Oct-16 Dec-16 Feb-17 Apr-17 Jun-17 Aug-17 Oct-17 Dec-17 Feb-18 Apr-18 Jun-18
Month

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
Apr-18	630,888	0	0	630,888	0
May-18	403,369	0	0	403,369	0
June-18	193,669	0	135,779	0	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	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**	**1st**
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	**2nd**	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**3rd**	**4th**	**2nd**	**3rd**	**4th**
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

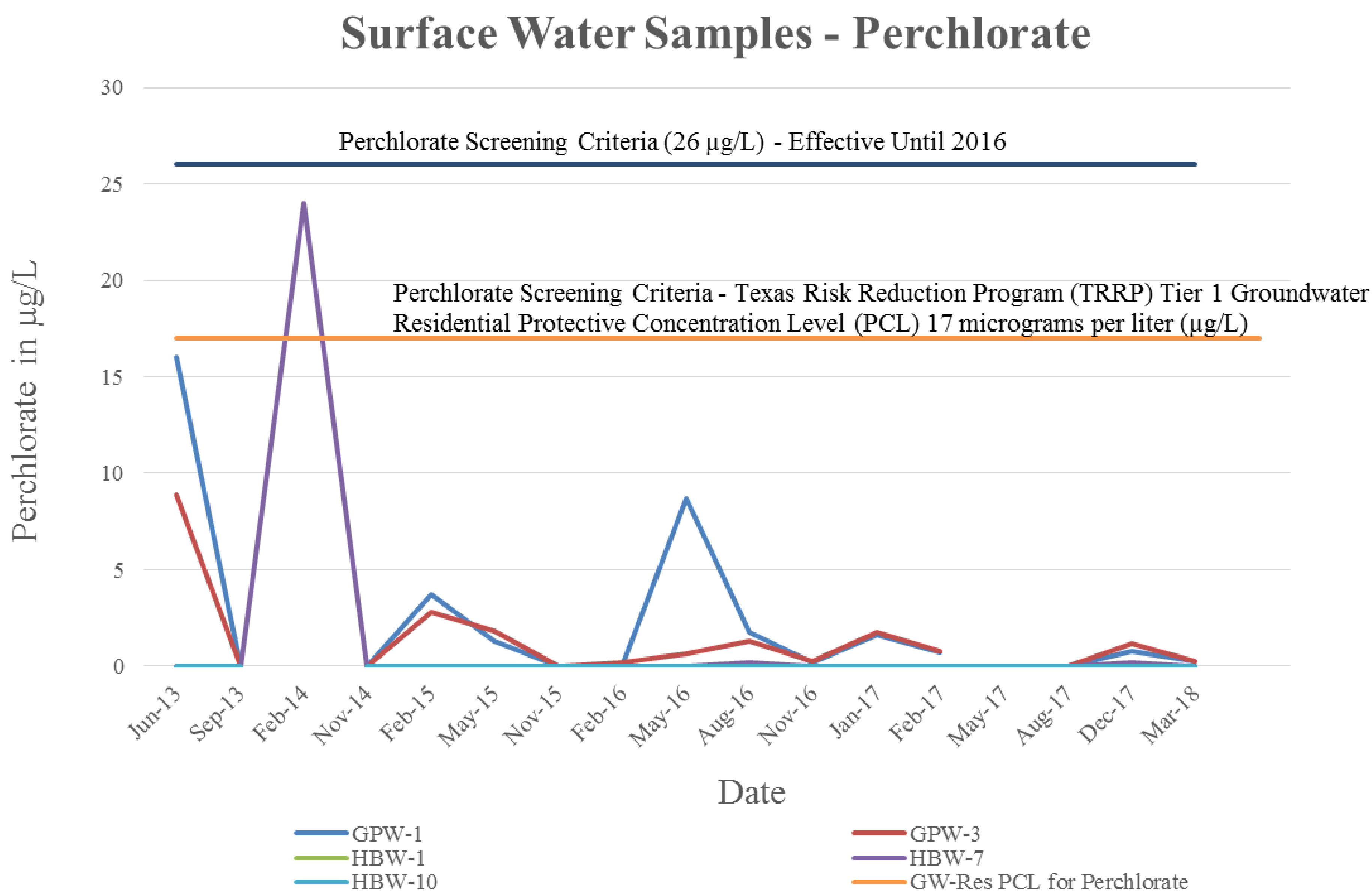
Quarter	**1st**	**2nd**	**3rd**	**4th**	**2nd**	**3rd**	**3rd**	**3rd**	**4th**	**1st**	**2nd**
Creek Sample ID	**Mar 2008**	**Jun 2008**	**Sep 2008**	**Dec 2008**	**May 2009**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Dec 2009**	**Mar 2010**	**Jun 2010**
GPW-1	27	<0.5U	<0.5U	<0.22U	16	<4U	NS	<1.2U	3.7	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	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**	**1st**
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	**2nd**	**3rd**	**4th**	**1st**	**2nd**	**3nd**	**4th**	**1st**	**2nd**	**3rd**	**4th**
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	**1st**	**2nd**	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**	**1st**	**2nd**
Creek Sample ID	**Feb 2016**	**May 2016**	**Aug 2016**	**Nov 2016**	**Feb 2017**	**May 2017**	**Aug 2017**	**Dec 2017**	**Mar 2018**	**Jun 2018**
GPW-1	0.447	6.59	<0.2 U	0.301 J	<1 U	0.263	dry	<4.0 U	<4.0 U	dry
GPW-3	0.474	0.457	0.141	0.563	<1 U	0.274	dry	<4.0 U	<4.0 U	dry
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	dry
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	dry
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	dry

NS – not sampled U – non-detect J – Estimated Dry – no surface water


Surface Water Samples - Perchlorate
30
25
20
15
10
5
0
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)
Perchlorate in µg/L
Jun-13
Sep-13
Feb-14
Nov-14
Feb-15
May-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Jan-17
Feb-17
May-17
Aug-17
Dec-17
Mar-18
Date
GPW-1
GPW-3
HBW-1
HBW-7
HBW-10
GW-Res PCL for Perchlorate

Longhorn Army Ammuntion Plant Creek Sampling Locations