FINAL
Valve Pit A
Treatability Study Report
Operable Unit 3
Fort Wainwright, Alaska

Site	ADEC File No.	ADEC Hazard ID
Valve Pit A	108.38.002.01	1678

Contract No. W911KB-12-D-0001

Task Order 33

April 2018

FES

FAIRBANKS ENVIRONMENTAL SERVICES, INC.

DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT COMMAND
DIRECTORATE OF PUBLIC WORKS
1046 MARKS ROAD #4500
FORT WAINWRIGHT, ALASKA 99703-6000

REPLY TO
ATTENTION OF:

April 12, 2018

Directorate of Public Works

Subject: Submission of the FINAL VALVE PIT A TREATABILITY STUDY REPORT – OPERABLE UNIT 3, FORT WAINWRIGHT, ALASKA, to State of Alaska Department Environmental Conservation.

Mr. Dennis Shepard
Alaska Department of Environmental Conservation
Environmental Program Manager
610 University Avenue
Fairbanks, AK 99709

Dear Mr. Shepard:

This letter documents transmission of the Final Treatability Study Report for the Valve Pit A in Operable Unit 3 (OU3) on Fort Wainwright, Alaska.

The document and all native files have been provided on a CD, and may also be retrieved via the Army Aviation and Missile Research Development and Engineering Center (AMRDEC) Safe Access File Exchange (SAFE) system. If you would like to receive a hard copy of this document, please notify us within the next few weeks. A copy of this letter and document is being provided to Ms. Sandra Halstead, Federal Facilities Superfund Site Manager, Environmental Protection Agency, Dr. Laura Buelow, Project Manager, Environmental Protection Agency, and Erica Blake, Environmental Program Specialist, Alaska Department of Environmental Conservation.

If you have questions or concerns regarding this action please contact the undersigned at, (907) 361-9687 or email kristina.a.smith14.civ@mail.mil or you may contact Mr. Brian Adams, Directorate of Public Works, Remedial Program Manager, (907) 361-6623 or email brian.m.adams18.civ@mail.mil.

Kristina A. Smith
Remedial Project Manager
Environmental Division, Restoration

CF:
HQ, USAG FWA CERCLA Administrative Records (w/o encls)

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Subject: Submission of the FINAL VALVE PIT A TREATABILITY STUDY REPORT – OPERABLE UNIT 3, FORT WAINWRIGHT, ALASKA, to Environmental Protection Agency.

Ms. Sandra Halstead
Environmental Protection Agency
Federal Facilities Superfund Site Manager
Alaska Operations Office
222 W. 7th Ave, #19
Anchorage, AK 99513

Dear Ms. Halstead:

This letter documents transmission of the Final Treatability Study Report for the Valve Pit A in Operable Unit 3 (OU3) on Fort Wainwright, Alaska.

This deliverable may be retrieved via the Army Aviation and Missile Research Development and Engineering Center (AMRDEC) Safe Access File Exchange (SAFE) system. If you would like to receive a hard copy or CD of this document, please notify us within the next few weeks. A copy of this document is being provided to Dr. Laura Buelow, Project Manager, Environmental Protection Agency, Mr. Dennis Shepard, Environmental Program Manager, Alaska Department of Environmental Conservation, and Ms. Erica Blake, Environmental Protection Specialist, Alaska Department of Environmental Conservation.

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April 12, 2018

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Subject: Submission of the FINAL VALVE PIT A TREATABILITY STUDY REPORT – OPERABLE UNIT 3, FORT WAINWRIGHT, ALASKA, to Environmental Protection Agency.

Dr. Laura Buelow
Environmental Protection Agency
Project Manager
Hanford Project Office
825 Jadwin Ave, Ste 210
Richland, WA 99352

Dear Dr. Buelow:

This letter documents transmission of the Final Treatability Study Report for the Valve Pit A in Operable Unit 3 (OU3) on Fort Wainwright, Alaska.

This document may be retrieved via the Army Aviation and Missile Research Development and Engineering Center (AMRDEC) Safe Access File Exchange (SAFE) system. If you would like to receive a hard copy or CD of this document, please notify us within the next few weeks. A copy of this document is being provided to Ms. Sandy Halstead, Federal Facilities Superfund Site Manager, Environmental Protection Agency, Mr. Dennis Shepard, Environmental Program Manager, Alaska Department of Environmental Conservation, and Ms. Erica Blake, Environmental Protection Specialist, Alaska Department of Environmental Conservation.

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Kristina A. Smith
Remedial Project Manager
Environmental Division, Restoration

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DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT COMMAND
DIRECTORATE OF PUBLIC WORKS
1046 MARKS ROAD #4500
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April 12, 2018

Directorate of Public Works

Subject: Submission of the FINAL VALVE PIT A TREATABILITY STUDY REPORT – OPERABLE UNIT 3, FORT WAINWRIGHT, ALASKA, to State of Alaska Department Environmental Conservation.

Ms. Erica Blake
Alaska Department of Environmental Conservation
Environmental Program Specialist
610 University Avenue
Fairbanks, AK 99709

Dear Ms. Blake:

This letter documents transmission of the Final Treatability Study Report for the Valve Pit A in Operable Unit 3 (OU3) on Fort Wainwright, Alaska.

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Kristina A. Smith
Remedial Project Manager
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FINAL

Valve Pit A
Treatability Study Report

Operable Unit 3
U.S. Army Garrison Fort Wainwright, Alaska

ADEC File Number	ADEC Hazard ID
108.38.002.01	1678

April 2018

Prepared for

U.S. Army Garrison Fort Wainwright, Alaska

Under Contract to

U.S. Army Corps of Engineers, Alaska District

Post Office Box 6898
JBER, Alaska 99506-0898
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Prepared by

Fairbanks Environmental Services

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LIST OF ACRONYMS AND ABBREVIATIONS

1,1-DCE	1,1-dichloroethene
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ARAR	Applicable or Relevant and Appropriate
AS	air sparge
AWQS	Alaska Water Quality Standards
avgas	aviation gasoline
bgs	below ground surface
CD	compact disc
CFR	Code of Federal Regulations
COC	contaminants of concern
DL	detection limit
DO	dissolved oxygen
DRO	diesel range organics
EPA	Environmental Protection Agency
FEP	Fairbanks-Eielson Pipeline
FES	Fairbanks Environmental Services Inc
FFA	Federal Facilities Agreement
FS	Feasibility Study
GIS	geographic information systems
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRO	gasoline range organics
HLA	Harding Lawson Associates
IC	Institutional Control
ISCO	in-situ chemical oxidation
LNAPL	light non-aqueous phase liquid
LOD	limit of detection
LOQ	limit of quantitation
MED	Manual for Electronic Deliverables
MCL	maximum contaminant level
µg/L	micrograms per liter
mg/L	milligrams per liter
mS/cm	milliSiemens per centimeter
mV	millivolts
N/A	not applicable
NA	natural attenuation
NC	not calculated
ND	not detected
ORC	oxygen-releasing compound
ORP	oxidation-reduction potential
OU3	Operable Unit 3
POL	petroleum, oil, and lubricants
PSE	Preliminary Source Evaluation
PVC	polyvinyl chloride

LIST OF ACRONYMS AND ABBREVIATIONS CONT'D

QAPP	Quality Assurance Project Plan
RAG	Remedial Action Goal
RAO	remedial action objective
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Program Manager
RRO	residual range organics
SAP	Sampling and Analysis Plan
SVE	soil vapor extraction
TAH	Total Aromatic Hydrocarbons
TAqH	Total Aqueous Hydrocarbons
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plan
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers
USARAK	U.S. Army Alaska
UST	underground storage tank
UTM	Universal Transverse Mercator
VPA	Valve Pit A
VPB	Valve Pit B
VOC	volatile organic compounds
WGS84	World Geodetic System of 1984

EXECUTIVE SUMMARY

Valve Pit A (VPA) is located on the west side of Fort Wainwright, Alaska, between River Road and the Chena River, and is associated with a former valve pit along the Fairbanks-Eielson Pipeline (FEP). The primary contaminants of concern (COC) at this site included petroleum and petroleum-related compounds, and the selected remedy identified in the Operable Unit 3 (OU3) Record of Decision (ROD) was installation of an air sparge/soil vapor extraction (AS/SVE) system. The system (or portions of the system) operated between 1996 and 2008, with additional probes installed near the valve pit in 2007 as part of a "Hot Spot" treatment zone. Free product was eliminated at the site, and all ROD COCs were reduced below the remedial action goals (RAG) by 2008. In addition, vapor samples collected from the SVE probes showed asymptotic removal rates and the system was shut down to conduct a contaminant rebound study. Benzene concentrations rebounded above the RAG in two wells within the Hot Spot area in 2009, but the concentrations were significantly below the pre-treatment concentrations. Groundwater samples were analyzed for diesel range organics (DRO) and gasoline range organics (GRO) starting in 2009, and concentrations were identified above the ADEC cleanup levels in the Hot Spot area.

Although the treatment system was effective in reducing a significant portion of the contamination at VPA, sampling results showed contamination remained above ROD RAGs in the Hot Spot area and the treatment system had minimal effect on the residual contamination. As a result, a treatability study was initiated utilizing in-situ chemical oxidation (ISCO) and an oxygen releasing compound (ORC) injection with Regenesis RegenOx™ and Regenesis ORC-Advanced® products. The goal of the study was to evaluate the feasibility and effectiveness of chemical oxidation and enhanced aerobic biodegradation to treat the remaining benzene above remedial goals at VPA.

The in-situ injection was completed in October 2010, and more frequent groundwater sampling was conducted in 2010 and 2011 to evaluate effectiveness of the treatability study. Sampling results showed significant groundwater geochemistry changes in monitoring wells within the treatment area, consistent with chemical oxidation and aerobic biodegradation. Groundwater sampling results also showed an increase in contaminant concentrations in several wells within the Hot Spot area, which was likely due to the surfactant effect from the injection products. Although the contaminant concentrations were not immediately reduced below the ROD RAGs and ADEC cleanup levels within the treatment area, sampling results indicate an overall decreasing trend. In 2016, exceedances of the RAGs and ADEC cleanup levels were observed in only one well (AP-10296MW (VPA-MP1)).

As a result of the treatability study and long term monitoring optimization analysis (LTMO), the treatment system was decommissioned, the groundwater monitoring frequency at the site was reduced from semi-annual to annual, and two wells were eliminated from the monitoring well network, resulting in an annual cost savings of more than 50%. The treatability study suggests that ISCO and enhanced aerobic biodegradation may be a successful approach to achieve remedial goals for benzene in groundwater at similar sites on Fort Wainwright or across Alaska.

1.0 INTRODUCTION

1.1 Valve Pit A Treatability Study Report Purpose

The purpose of this report is to present the results from an in-situ chemical oxidation (ISCO) and oxygen-releasing compound (ORC) injection treatability study at the Valve Pit A (VPA) site. The VPA site is associated with Operable Unit 3 (OU3) on Fort Wainwright, Alaska, and the treatability study was conducted to evaluate the effectiveness of in-situ treatment for the residual contamination remaining above cleanup levels after operation of the Air Sparge/Soil Vapor Extraction (AS/SVE) system. The treatability study was conducted between 2010 and 2011, with the injection completed in October 2010. Groundwater monitoring continued at this site following the treatability study, and sampling results through 2016 are discussed in this report. This document was completed by Fairbanks Environmental Services Inc. (FES) under U.S. Army Corps of Engineers (USACE) contract W911KB-12-D-0001, Task Order 33.

1.2 Report Organization

The Treatability Study Report is organized as follows:

Section 1 – Introduction; Describes the report purpose and organization

Section 2 – Background; Provides a summary of previous investigations, treatability studies, and remedial actions

Section 3 – Treatability Study Overview; description of the materials and methods associated with the ISCO and ORC treatability study

Section 4 – Treatability Study Results; description of groundwater geochemistry and contaminant concentration changes associated with the treatability study

Section 5 – Treatability Study Discussion; discussion of contaminant concentration changes and comparison to cleanup levels, changes to the groundwater monitoring program, and lessons learned from the ISCO/ORC treatability study

Section 6 – References

2.0 BACKGROUND

2.1 Valve Pit A Location and History

VPA is located on Fort Wainwright between River Road and the Chena River, as shown on Figure 2-1. The site is located directly west of the Chena River, and adjacent to an Alaska Railroad bridge. VPA is part of the Railcar Offloading Facility (ROLF), which was connected to the Birch Hill Tank Farm through various offloading headers, underground storage tanks, and underground pipelines. VPA was connected to the Birch Hill Tank Farm by three 8-inch and four 3-inch pipelines. The pipelines crossed under River Road in order to connect to VPA on the northwest side. From VPA to the west, the pipelines were attached to the Alaska Railroad bridge spanning the Chena River, and connected to Valve Pit B (VPB).

The valve pit house at VPA contained an isolation valve pit, which was a safety device to be used in the event that the integrity of the Chena River railroad bridge was compromised. Review of the as-built drawings showed there were no liners under the valve pits (E&E, 1994).

Past spills and releases of potential contaminants from the VPA source area are not well documented. The only documented spill was approximately 20 gallons of lubricant oil released in 1990 (E&E, 1994). However, it is likely other fuel releases occurred at this site. The Tank Farm stored mogas, diesel fuel, avgas, and JP-4 (E&E, 1994), and it is likely that all fuels were transferred through VPA and may have contributed to contamination at the site.

The last tank at the Birch Hill Tank Farm was emptied in September 1993, which resulted in discontinuing use of the distribution pipelines, valve pits, and the ROLF. The pipelines were abandoned in place, although they remained full of fuel and were not cleaned (E&E, 1994). The pipelines were drained, pigged, inerted, and either abandoned in place or removed in several efforts conducted between 2000 – 2006 (OSCI, 2001; BNCI, 2004; BNCI, 2007). The Valve Pit and pipelines in the vicinity of the Valve Pit remain on site due to their proximity to the railroad.

2.2 Preliminary Investigation

Several investigations occurred at VPA prior to the OU3 Remedial Investigation (RI). The first was installation and sampling of a soil gas probe on the west side of VPA. Contaminants identified in the soil gas included benzene, toluene, and xylenes (WCC, 1989).

Based on these results, additional investigation and evaluation of remedial alternatives was conducted as part of a RI and Feasibility Study (FS) (E&E, 1994; E&E, 1995).

2.3 OU3 RI and FS

The OU3 RI was conducted in 1993 (E&E, 1994). The goal of the RI at the VPA site was to determine whether the contamination represented a risk to human health or the environment. In order to achieve these goals, eight soil borings were drilled in the VPA area, and fifteen soil samples were collected; two groundwater monitoring wells were installed, and groundwater samples were collected from these two wells. The RI sampling results identified the contaminant source likely as Jet-A and kerosene, with a maximum concentration of 3,800 mg/kg for kerosene (E&E, 1994). VOCs were also detected in subsurface soils, with a maximum concentration of 360 mg/kg for m+p-xylene (E&E, 1994). Groundwater sample analysis identified gasoline-range organics (GRO) as the predominant fuel signature in groundwater, with a maximum concentration of 43 mg/L (E&E, 1994). The maximum VOC concentration was 12 mg/L of toluene. Benzene was detected at a concentration of 1.7 mg/L in AP-6054, but was not detected in AP-6065. Lead was also detected in groundwater, but was below the maximum contaminant level (MCL). No free product was identified in either well.

The location of the fuel contamination identified in the RI was immediately adjacent to VPA, which suggests that the valve pit and/or associated piping was the source of the contamination (E&E, 1994). The extent of contamination was estimated to extend from the valve pit to the edge of the Chena River, and approximately 200 – 300 feet to the north (E&E, 1994).

The OU3 Feasibility Study (FS) was conducted to identify and screen remedial alternatives for the OU3 sites, including VPA, which was included in Remedial Area 2 (E&E, 1995). Seven preliminary remedial alternatives were identified for Remedial Area 2, and the alternatives were screened based on effectiveness, implementability, and cost (E & E, 1995). The selected remedy was described in the OU3 ROD.

2.4 OU3 ROD

The OU3 ROD was signed under the Federal Facilities Agreement (FFA) in 1996 by the U.S. Army Alaska (USARAK), Alaska Department of Environmental Conservation (ADEC), and Environmental Protection Agency (EPA; USARAK, 1996); and identified operation of an AS/SVE system for soil and groundwater contamination to achieve Safe Drinking Water Act levels, and natural attenuation to meet Alaska Water Quality Standards.

The ROD also identified the following remedial action objectives (RAOs) for OU3, including VPA:

- Restore groundwater to drinking water quality within a reasonable time frame
- Reduce further migration of contaminated groundwater
- Prevent use of groundwater with contaminants at concentrations above Federal Safe Drinking Water Act levels

Remedial action goals (RAGs) for OU3 soil and groundwater were also established in the OU3 ROD. The RAG for soil was protection of groundwater, with active remediation continuing until MCLs are met, and natural attenuation continuing until the AWQS are achieved (USARAK, 1996). Groundwater RAGs were based on state and federal MCLs as shown in Table 2-1 (USARAK, 1996).

Table 2-1. ROD Remedial Action Goals for Groundwater

Contaminants of Concern (COC)	Remedial Action Goal (μg/L)
Benzene	5[a]
Toluene	1,000[a]
Ethylbenzene	700[a]
1,2-Dibromoethane (EDB)	0.05[a]
1,2-Dichloroethane (DCA)	5[a]
1,2,4-Trimethylbenzene (1,2,4-TMB)	1,850[b]
1,3,5-Trimethylbenzene (1,3,5-TMB)	1,850[b]

[a] Based on Federal Safe Drinking Water Act Levels
[b] Based on Risk Based Concentrations (RBCs) equivalent to a noncancer hazard quotient of 1 using residential groundwater exposure assumptions. This RAG was updated in the OU3 ESD (USARAK, 2002) as described in Section 2.5.
μg/L – micrograms per liter

2.5 Explanation of Significant Differences

An ESD was produced for OU3 in 2002 to document post-ROD remedial changes (USARAK, 2002). Post-ROD activities determined that there was more total volume and lateral extent of contamination in OU3 than previously documented. This information required the reevaluation of the remedial actions in the ROD. This evaluation resulted in the conclusion that the scope of remedies selected in the ROD will not fully achieve the RAOs without some significant changes. The ESD documented the changes in some components of the selected remedy described in the ROD and summarized the information that led to making the changes. However, the changes did not fundamentally alter the overall cleanup approach for OU3. The following were identified by the ESD as significant changes to the ROD, as specifically related to Remedial Area 2 (which includes the VPA site):

- Higher contaminant concentrations than previously identified in all source areas
- Larger extent of soil and groundwater contamination at all source areas
- An increase in the cost of the overall remedial actions resulting from the requirement for additional and more extensive treatment systems

As a result of these significant changes, several modifications and clarifications were made to the ROD that were common for all remedial areas. These changes included clarification of institutional controls, implementation of an exit strategy, clarification of trimethylbenzene (TMB) remedial goals, and clarification of Applicable Relevant and Appropriate Requirements (ARAR). In addition to the common changes, significant site specific changes were also made to each of the remedial areas, including the following changes at VPA:

- Expansion of AS/SVE treatment area
- Installation of a thermal/catalytic oxidizer

2.6 Application of ADEC Cleanup Levels

After the ROD objectives have been achieved and/or by agreement of the Army, the EPA, and ADEC; OU3 sites may be transferred to the 2-Party program. To achieve site closure under the 2-Party program, groundwater concentrations must meet the cleanup levels in Table C of Title 18 of the Alaska Administrative Code (AAC), Chapter 75 (ADEC, 2017a). Since the signing of the ROD, the ADEC groundwater cleanup standards in 18 AAC 75 have been revised. The most significant revision was completed in November 2016 utilizing risk-based calculations.

For the purposes of the treatability study report, groundwater concentrations of ROD COCs were compared to the RAGs identified in the ROD, and other COCs (as applicable) were compared to the current ADEC cleanup levels. A complete comparison of the most recent sampling results to the current ADEC cleanup levels is presented in the 2017 OU3 Monitoring Report.

2.7 Remedial Action Summary

Remedial activities at the VPA site began in 1996 with the installation of a small scale AS/SVE system. This system was installed in the center of the known contaminant plume and was designed to treat soil and groundwater contamination that was identified in the RI. The following list summarizes treatment system installation and operation during each field season:

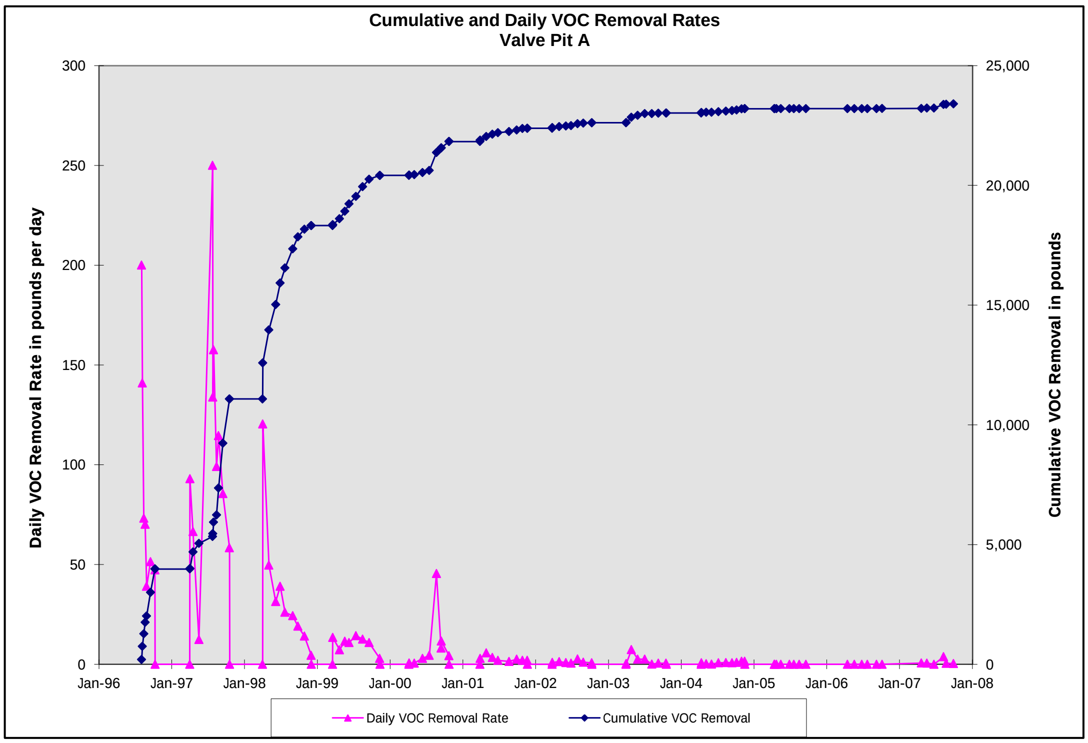
- 1996 – Pilot system (eight AS probes and two SVE wells)
- 1997 – Expanded Zones 1-3. Oxidizer installed & removed
- 2000 – Expanded Zone 4 and horizontal SVE well
- 2002 – Operation of the system changed from year-round to seasonal for the SVE probes in order to prevent operational problems associated with freezing SVE lines. The AS probes continued to operate year-round.
- 2003 – AS and SVE probes were rehabilitated using shock treatment
- 2004 – Shutdown Zones 1 and 3
- 2006 – Shutdown Zones 4 and horizontal well
- 2007 – Hot Spot operation was initiated
- 2009 – Shutdown Zone 2 and Hot Spot, begin rebound study. Decommissioned Zone 4
- 2013 – Decommissioned Zones 1-3. Grout in-place the horizontal well underlying River Road
- 2015 – Replaced three black-iron probes with permanent PVC monitoring wells

2.8 Treatment System Effectiveness

The VPA treatment system consisted of four zones, and the COCs detected above the ROD RAGs in groundwater at the VPA treatment area have included benzene, toluene and ethylbenzene. Free product was also detected in the VPA treatment area. This section describes effectiveness of the VPA treatment AS/SVE system in terms of removal of bulk VOCs, as well as in reducing contaminant concentrations in groundwater.

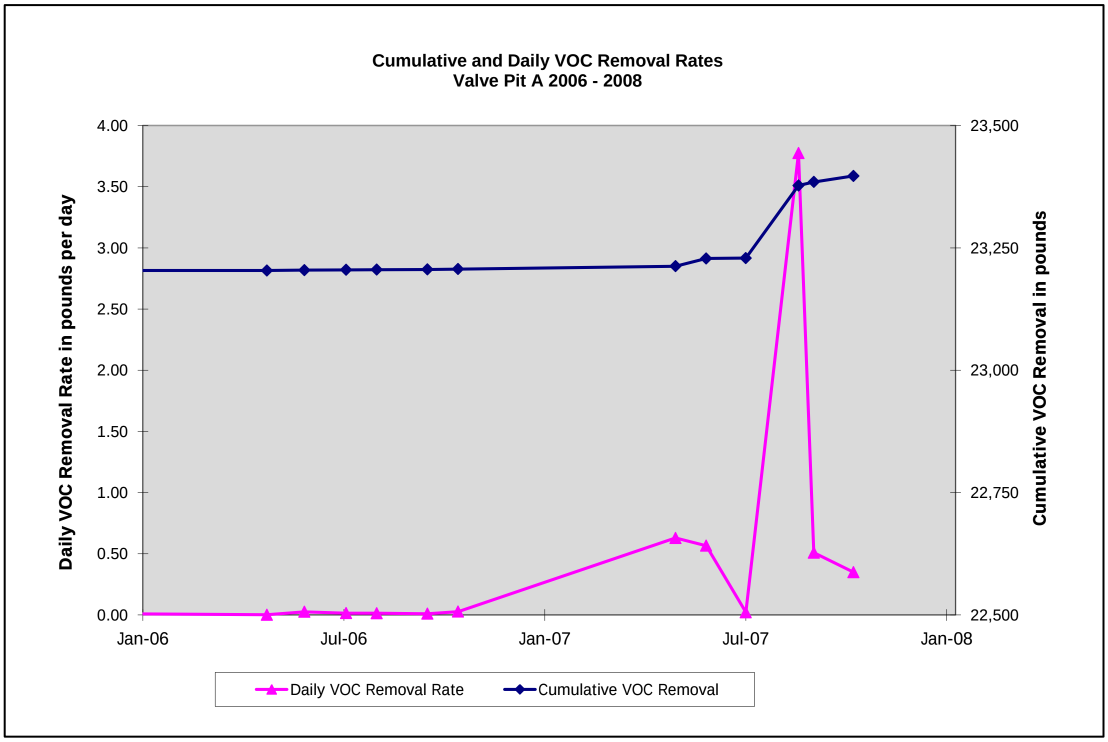
2.8.1 <u>VPA System Performance</u>

Performance of the VPA treatment system was monitored through air samples collected from the SVE system. The air samples were analyzed for total VOCs and for benzene, and the removal rates were evaluated over time. A summary of the daily and cumulative VOC removal rates since treatment system startup are shown in Graph 2-1.



Graph 2-1. VPA Cumulative and Daily VOC Removal Rates

As shown in the graph, the VOC removal rates decreased over time since treatment system operation began in 1996. A slight increase in the daily removal rate was observed in 2007 due to operation of the Hot Spot treatment zone, with an average VOC concentration in 2007 of 12.6 ppmV. However, the VOC concentration decreased in 2008 to an average concentration of 2 ppmV. This change is illustrated in Graph 2-2.



Graph 2-2. 2006 – 2008 VPA Cumulative and Daily VOC Removal Rates

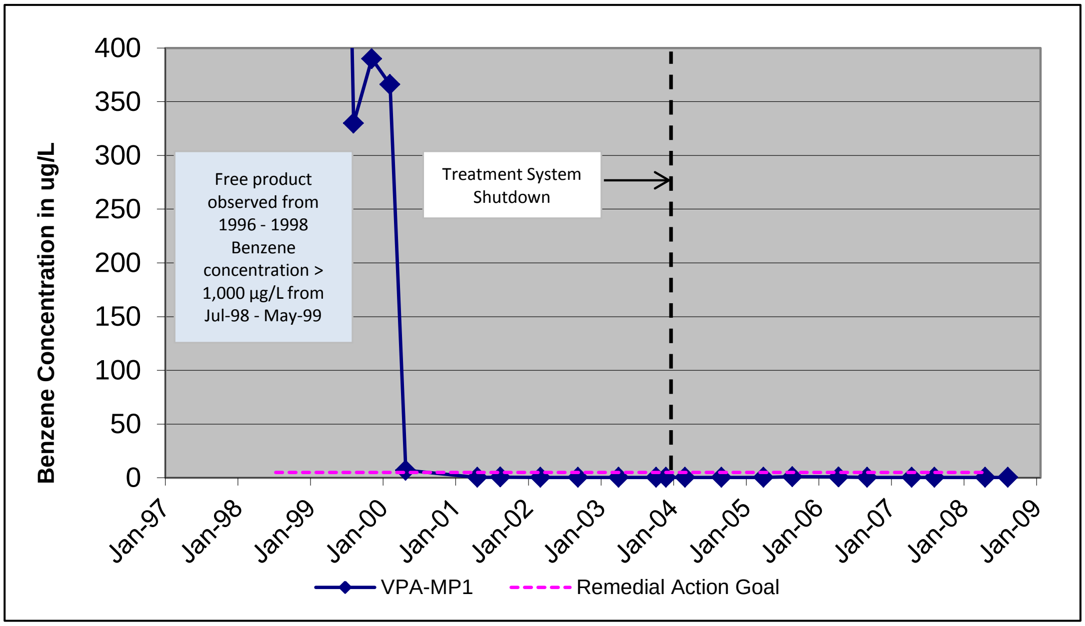
At the time the treatment system was shut down in 2008, the SVE system had removed a cumulative total of approximately 23,411 pounds of VOC (weight equivalency of about 3,793 gallons of gasoline), including approximately 165 pounds of benzene. Since system startup, atmospheric emissions totaled 17,382 pounds of VOC. However, the daily VOC concentrations decreased by up to four orders of magnitude since treatment system installation.

2.8.2 VPA Groundwater Contaminant Concentration Changes

As the contaminants were removed from the soil and groundwater through operation of the AS/SVE system, contaminant concentrations decreased in groundwater as observed in samples collected from the monitoring wells. A summary of the contaminant concentration changes in wells within each treatment zone is presented in the following paragraphs.

Contaminant Trends in Zone 1

Free product was removed from this zone within the first two years of AS/SVE operation. Once product was removed, benzene concentrations in VPA-MP1 exhibited a decreasing trend, but remained above the RAG until 2000. In 2000, both benzene and toluene decreased by orders of magnitude and from 2001 until present have remained below RAGs in this zone. Treatment was shutdown 2004 and contaminant concentrations did not rebound following shutdown. A time series plot showing contaminant concentrations in VPA-MP1 is presented in Graph 2-3.

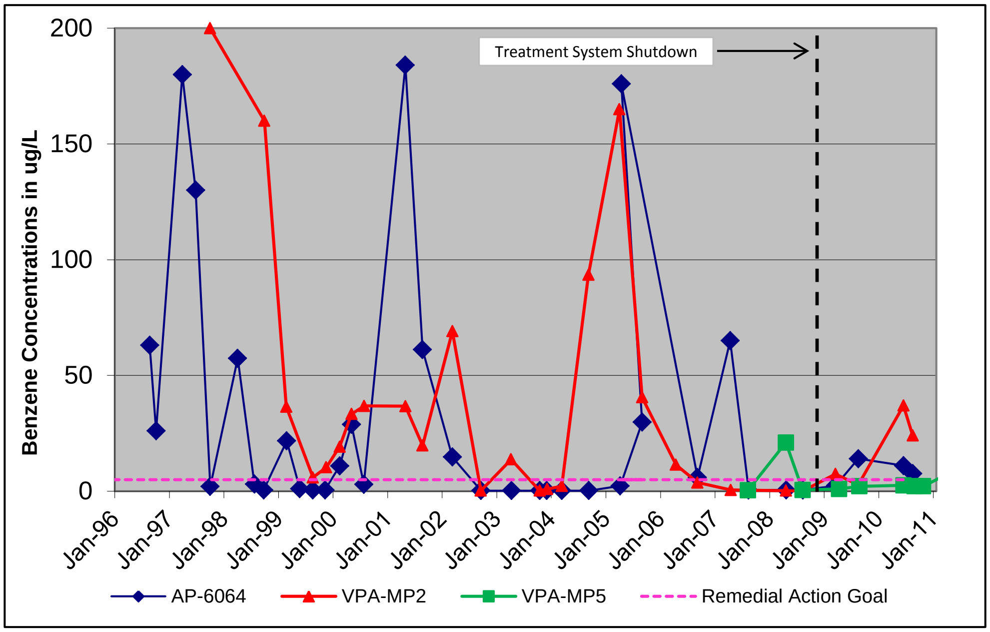


Graph 2-3. Benzene Concentrations over Time in VPA Zone 1

Contaminant Trends in Zone 2

The Valve Pit source area was located primarily in Zone 2. Groundwater monitoring points within Zone 2 include VPA-MP2, VPA-MP5, and AP-6064. Free product was measured in VPA-MP2, which was installed near the valve pit, prior to treatment system startup. Operation of the AS/SVE system removed product within the first year and decreased benzene concentrations from over 4,000 µg/L to below the RAG by January 2000 as shown in Graph 2-4. Benzene was also decreased by several orders of magnitude in AP-6064 between 1996 and 2000. Toluene was detected above the RAG in both of these wells, but was reduced to below RAG within the first two years of system operation.

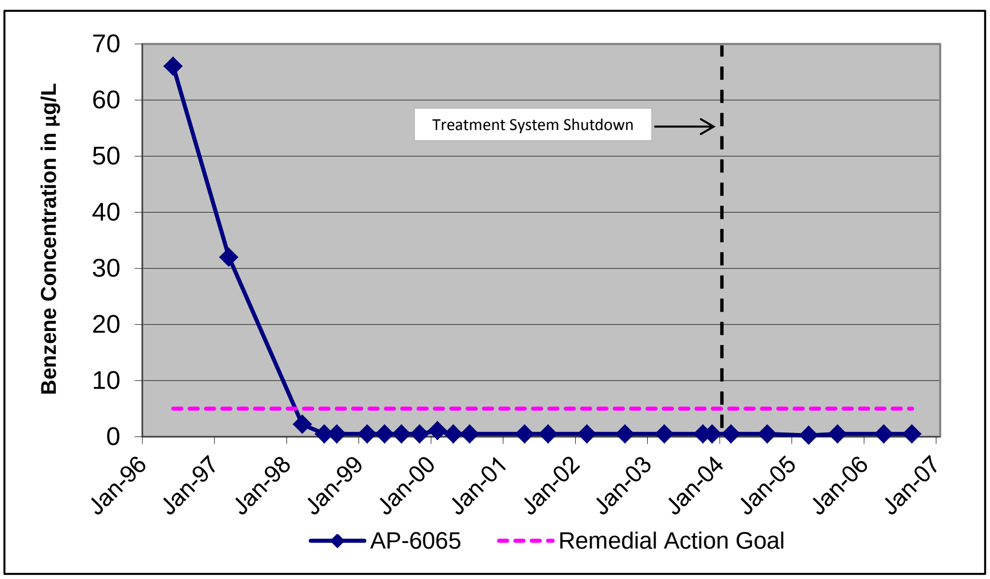
Following the spring 2000 sampling event, benzene concentrations in VPA-MP2 and AP-6064 began to increase, possibly due to decreased airflow in AS probes. AS probes were rehabilitated in 2003 using shock treatment and benzene again decreased to concentrations at or below the RAG in both wells. However, benzene began to increase again by orders of magnitude at VPA-MP2 in 2004 and AP-6064 in 2005. In order to address the persistent benzene in this zone, select AS probes were again rehabilitated, and additional "Hot-Spot" AS probes were installed in the vicinity of these monitoring locations and operated throughout 2007 and 2008. Benzene was again decreased to below the RAG in both wells, along with newly installed VPA-MP5 as illustrated in Graph 2-4. Based on these results, Zone 2 was shutdown for a rebound study in January 2009. Benzene increased slightly above the RAG in VPA-MP2 and AP-6064 during one of the 2009 sampling events, and the concentrations continued to be monitored over time.



Graph 2-4. Benzene Concentrations over Time in VPA Zone 2

Contaminant Trends in Zone 3

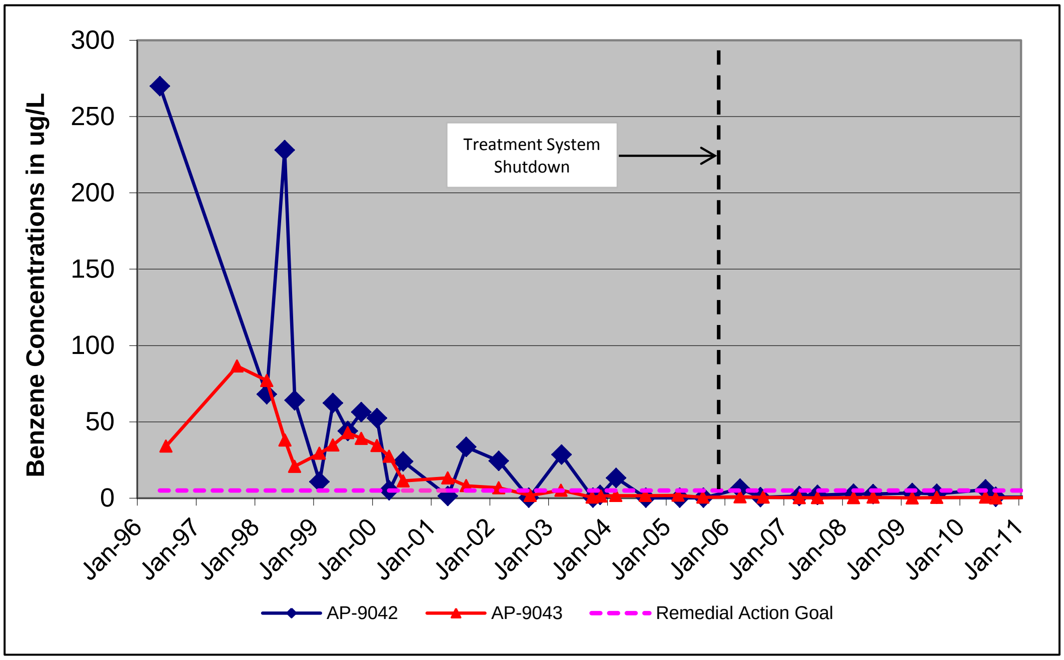
Zone 3 was the zone closest to the Chena River and included monitoring well AP-6065. Free product was removed from this zone within the first two years of AS/SVE operation, and benzene concentrations decreased rapidly in AP-6065 as a result of treatment system operation (illustrated in Graph 2-5). The benzene concentrations remained below the RAG and no contaminant rebound was observed following treatment system shutdown in 2004.



Graph 2-5. Benzene Concentrations over Time in VPA Zone 3

<u>Contaminant Trends in Zone 4</u>

In 2000, the Valve Pit A treatment system was expanded to treat persistent benzene detected in monitoring points downgradient of the treatment area. A horizontal well was installed beneath River Road and a new treatment zone (Zone 4) was installed west of River Road. Benzene concentrations, which had been declining in monitoring wells AP-9042 and AP-9043, decreased further under the influence of Zone 4 AS/SVE operation. Benzene was below RAGs in these wells in 2004 and continued to remain below RAGs through 2009. Zone 4 was shut down in 2006 for rebound study and contaminant concentrations did not show rebound. The benzene concentrations in VPA Zone 4 wells over time are shown in Graph 2-6.



Graph 2-6. Benzene Concentrations over Time in VPA Zone 4

2.9 Contaminant Rebound Evaluation

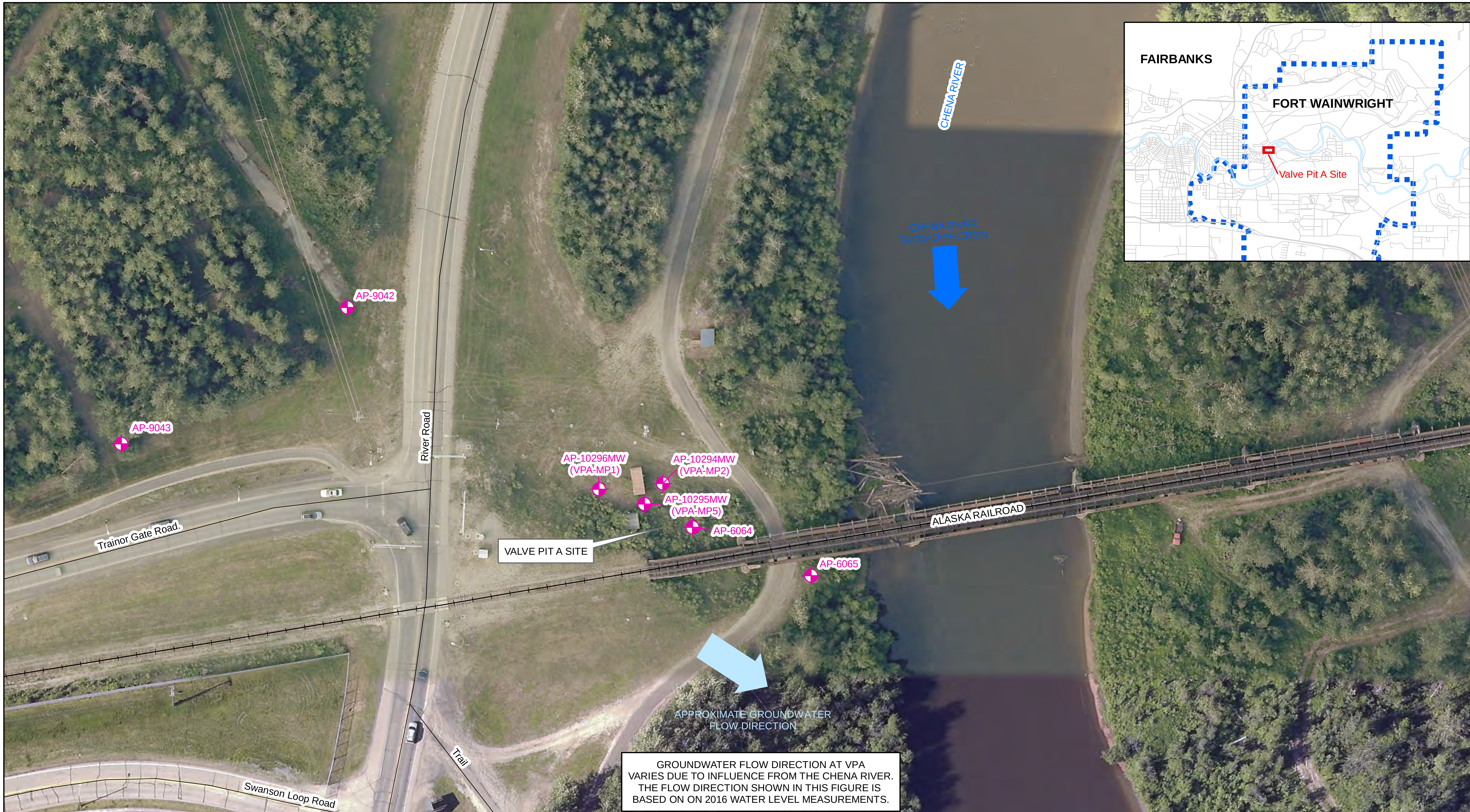
As described in Section 2.7, the VOC removal rates declined significantly in 2008 following installation of the Hot Spot system, and benzene concentrations were below cleanup levels in all wells in the 2008 sampling events. As a result, the Hot Spot system (which was the last zone of the VPA treatment system remaining operational) was shut down to conduct a contaminant rebound study.

Groundwater sampling results from the rebound evaluation showed benzene concentrations increased above the RAG in VPA-MP2 and AP-6064 in 2009. However, the concentrations were much lower than the pre-treatment levels. Also in 2009, groundwater samples were analyzed for DRO and GRO for the first time. Sampling results showed exceedances of ADEC cleanup levels for

DRO in wells in Zones 1, 2, and 4, and GRO exceedances were observed in Zone 2 only (VPA-MP2).

Although benzene did not rebound above the cleanup level in AP-6065, sampling results showed persistent exceedances of the Alaska Water Quality Standards (AWQS) for total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH).

Based on these results, a treatability study using ISCO and ORC was recommended to evaluate the effectiveness for treatment of the residual benzene contamination in the VPA Hot Spot area. Although not a focus of the treatability study, the effectiveness of ISCO and ORC to treat the DRO and GRO contamination in the VPA Hot Spot Area, and the TAH and TAqH exceedances in the AP-6065 area was also evaluated. The treatment mechanisms and procedures are described in Section 3, and the treatability study results are described in Section 4.



NOTES:

1. HORIZONTAL DATUM: UTM ZONE 6N, WGS 1984, METERS
2. AERIAL IMAGERY FROM FORT WAINWRIGHT, 2012
3. VPA-MP1, VPA-MP2, AND VPA-MP5 WERE REPLACED BY AP-10296MW, AP-10294MW, AND AP-10295MW IN APRIL 2015.

LEGEND

- MONITORING WELL
- ROAD
- RAILROAD

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Valve Pit A Site Location
Valve Pit A Treatability Study Report
Operable Unit 3
Fort Wainwright, Alaska

CONTRACT:	FIGURE:	DATE:
W911KB-12-D-0001	2-1	4/18

MONITORING WELL
AS/SVE PIPING
ROAD
RAILROAD
VPA HOT SPOT TREATMENT AREA
VPA TREATMENT ZONES

NOTES:

1. HORIZONTAL DATUM: UTM ZONE 6N, WGS 1984, METERS
2. AERIAL IMAGERY FROM FORT WAINWRIGHT, 2012
3. VPA-MP1, VPA-MP2, AND VPA-MP5 WERE REPLACED BY AP-10296MW, AP-10294MW, AND AP-10295MW IN APRIL 2015.

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Valve Pit A AS/SVE System Layout
Valve Pit A Treatability Study Report
Operable Unit 3
Fort Wainwright, Alaska

CONTRACT:	FIGURE:	DATE:
W911KB-12-D-0001	2-2	4/18

3.0 TREATABILITY STUDY OVERVIEW

3.1 Treatability Study Objective

As described in Section 2, the treatability study was conducted to evaluate the effectiveness of ISCO and enhanced aerobic biodegradation using an ORC to treat the remaining benzene contamination above remedial goals in the VPA hot spot area. The effectiveness of ISCO and the ORC to treat the residual DRO and GRO contamination in the VPA hot spot area, and to reduce the TAH and TAqH concentrations in the vicinity of AP-6065, were secondary goals of the treatability study.

3.2 Regenesis RegenOx™ and ORC Advanced® Technology and Treatment Mechanisms

The products selected for the VPA Treatability Study were Regenesis RegenOx™ and Regenesis ORC Advanced® (ORC-A®). Regenesis RegenOx™ is a chemical oxidation compound that destroys contaminants through a chemical reaction. It consists of two parts: Part A is an oxidizer containing sodium percarbonate, sodium carbonate, sodium silicate and a surface catalyst (silica gel); and Part B is an activator complex (mixture of sodium silicate solution, silica gel, and ferrous sulfate). The two parts are mixed with water prior to injection into the subsurface. The combination of Part A and Part B initiates a mild exothermic reaction, and produces free radicals which destroy the contaminants. However, one advantage of RegenOx™ is that it is much safer to handle than other chemical oxidation compounds since it is based on a solid oxidizer complex rather than a concentrated oxidizer solution. In addition, it has been designed to be used in conjunction with the natural biodegradation processes or enhanced bioremediation. It has been shown to be effective at remediating petroleum hydrocarbon compounds at various sites throughout North America. More information may be found at the Regenesis website https://regenesis.com/.

Regenesis ORC-A® is a calcium-based oxygen releasing compound which is designed to stimulate aerobic biodegradation. The oxygen is released when the compound is mixed in water. However, the release is controlled to deliver oxygen into the subsurface for up to a year after application. ORC-A® is often used in conjunction with Regenesis RegenOx™ to stimulate biodegradation of the remaining contaminants after the chemical oxidation reaction is complete.

3.3 Treatability Study Design

The treatability study design was developed in coordination with recommendations from Regenesis, and was based on the site contaminants, contaminant concentrations, and subsurface soil characteristics. The design is summarized in Table 3-1.

Table 3-1. Treatability Study Design Conditions

Description	Quantity
Treatment Area Size	2,000 square feet
Treatment Zone Thickness	10 feet (10-20 ft bgs)
Number of Injection Points	21
Grid Spacing	10 feet
Soil Type/Porosity	Sandy Gravel / 35%
RegenOx™ Application Rate	24 pounds/foot
ORC-A® Application Rate	3 pounds/foot

In addition to the injection design parameters, a sampling and analysis plan (SAP) was developed to evaluate effectiveness of the injection products as part of the treatability study. This plan is described in Section 3.6. The injection points were also subject to tracking by the EPA Underground Injection Control (UIC) program. A summary of the UIC process is described in Section 3.7.

3.4 Injection Procedures

The Regenesis RegenOx™ and ORC-A® injection was conducted between October 7 and October 13, 2010. Photos from the injection process are shown on the Photo Log in Appendix C. Injection details were documented in field notes included in Appendix A.

The focus of the injection was the VPA Hot Spot, and the area surrounding monitoring well AP-6065. Injection points were completed in the Hot Spot area using a grid with 10-foot spacing, and two injection points were completed near AP-6065 as shown in Figure 3-1. The proximity of the injection points to the existing groundwater monitoring network is also shown on Figure 3-1.

The injection was completed using a Geoprobe 6610DT drill rig fitted with 1.5-inch injection rods and the Geoprobe pressure-activated injection tip. The Regenesis RegenOx™ and ORC-A® were mixed on-site and injected using a ChemGrout 550 piston-driven grout pump. The pressure-activated injection rods were advanced using a Geoprobe 6610DT drill rig. RegenOx™ Part B was shipped as a slurry, and was kept warm to allow measuring of the product for each batch and to maintain the product in solution; a heated tent was used to keep the slurry in a liquid state due to below freezing weather conditions. The RegenOx™ Part A and ORC-A® were shipped as powders and were mixed with water in the mixing hopper on the ChemGrout pump.

Approximately 178 pounds of RegenOx™ Part A, 61 pounds of RegenOx™ Part B, 32 pounds of ORC-A®, and 250 gallons of water were injected into each point, following the recommendations from the manufacturer. The injection points were completed from the “outside in” to reduce contaminant migration outside of the treatment zone. Each injection point was completed from the top down using two-foot intervals (10, 12, 14, 16, and 18 feet bgs). Only minimal surfacing of the injection slurry was observed at the site, and there was no pressure buildup on the pump during the course of the injection. The injection points were numbered sequentially in the order they were completed as shown in Figure 3-1.

After completing an injection point, the rods were disconnected from the injection pump, capped, and allowed to sit for up to an hour prior to removal if significant back pressure was present. This allowed the material to disperse in the subsurface and minimized surfacing of the material after the rods were removed. Once the rods were removed, each borehole was filled with granular bentonite (#8 mesh Benseal®) and hydrated with potable water. The bentonite was added up to the ground surface to seal each injection hole.

The primary issues encountered during the injection at this site were challenges due to cold temperatures, and the corrosivity of the injection slurry. The cold temperatures limited how quickly RegenOx™ Part A could be mixed into a solution. Every effort was made to mix the material at the highest mixing rate and provide the maximum mixing time before the product was injected, without significant impact to the injection timeframe. The cold temperatures also made it difficult to transfer water from the water tanks to the mixing hopper without the hoses freezing. At the end of the day, the water hoses and valves were drained; however, a valve on the injection pump was broken due to water freezing in the valve overnight.

The corrosivity of oxidizer material had an impact on the rubber seals in the piston-driven pump, and several rubber o-rings and gaskets had to be changed during the course of the injection. Once these issues were resolved, the injection process continued smoothly. However, these complications resulted in the injection taking longer than expected (4 days of injection time instead of 2 days). Photos from the injection activities are presented in the Photo Log included in Appendix C.

3.5 GPS Survey

Following completion of the injection, the location of each injection point was surveyed using a handheld GPS unit. The survey was completed using a Trimble GeoXH GPS unit, and the northing and easting data were collected for each location. ESRI ArcPad 8.0 software was used to collect the attributes of each injection point, and the spatial data were post-processed using Trimble Pathfinder Office 4.2. A summary table of the GPS points and locations collected at the site is provided in Appendix B. The points are presented in the World Geodetic System of 1984 datum (WGS84) in the Universal Transverse Mercator (UTM) Zone 6 North (meters) coordinate system.

3.6 Groundwater Sampling

Groundwater monitoring was conducted to evaluate the progress and effectiveness of the RegenOx™ and ORC-A® injection. The monitoring wells listed in Table 3-2 were sampled prior to injection (baseline), and at approximately 1 month, 6 months, and 12-months following the injection. After the initial year of sampling was completed, groundwater samples were collected on an annual monitoring frequency.

Groundwater samples were collected using low-flow sampling techniques and were analyzed for VOCs, GRO, and DRO, using EPA Method 8260B, AK101, and AK102 respectively. Natural attenuation parameters including dissolved iron, manganese, and sulfate were analyzed by SW6020 (or equivalent, for dissolved iron and manganese), and by E300.0 (or equivalent, for sulfate). In addition, the following geochemical parameters were measured and recorded once sampling stability criteria were met: dissolved oxygen (DO), pH, oxidation-reduction potential (ORP), temperature, and conductivity. Quality control samples were collected for each sampling event as described in the SAP/Quality Assurance Project Plan (QAPP; FES, 2010b).

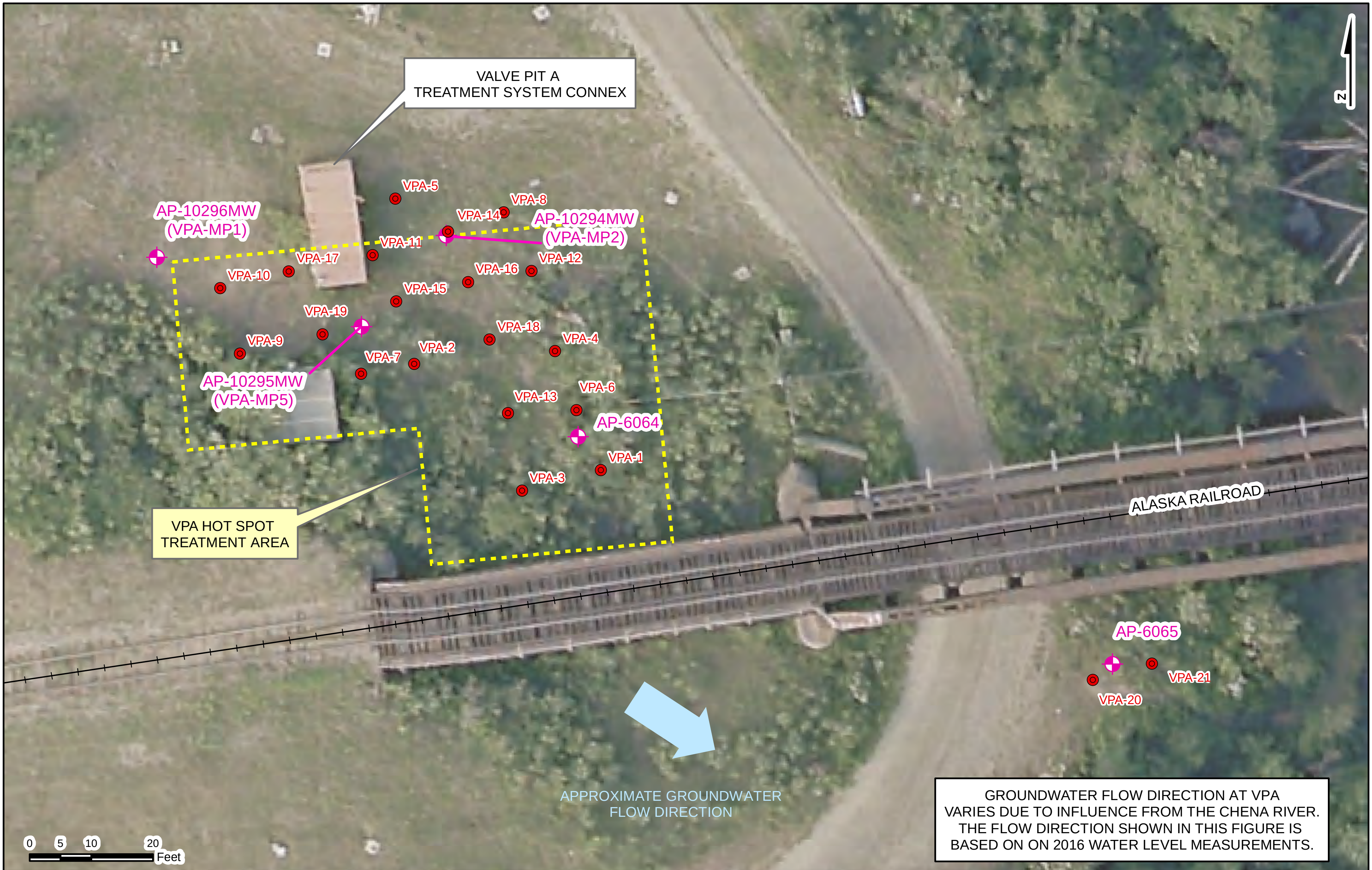
Table 3-2. Groundwater Sampling Summary

Well	Frequency	Analytical Parameters
VPA-MP1 (AP-10296MW)	Baseline, 1-month, 6-months, 12-months	VOCs, GRO, DRO, and Natural Attenuation Parameters[1]
VPA-MP2 (AP-10294MW)		
VPA-MP5 (AP-10295MW)		
AP-6064		
AP-6065		

[1] Natural attenuation parameters include manganese, ferrous (dissolved) iron, and sulfate

3.7 Underground Injection Inventory

The EPA office of Ground Water and Drinking Water maintains an inventory of injection wells used for remediation activities. These wells are classified as Class V injection wells and are regulated by the UIC program, under authority of the Safe Drinking Water Act (Title 40 of the Code of Federal Regulations [CFR] Part 144). In order to meet the requirements of the rule, EPA Form 7520-16 was filled out for the VPA site and submitted to EPA Region 10 prior to the beginning of injection activities. The form detailed the facility, location, owner, and number of injection wells at the site. The completed UIC forms and correspondence with the EPA are included in Appendix D.



NOTES:

1. HORIZONTAL DATUM: UTM ZONE 6N, WGS 1984, METERS
2. AERIAL IMAGERY FROM FORT WAINWRIGHT, 2012

REGENOX INJECTION POINT
MONITORING WELL
RAILROAD
VPA HOT SPOT TREATMENT AREA

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Valve Pit A Injection Locations
Valve Pit A Treatability Study Report
Operable Unit 3
Fort Wainwright, Alaska

CONTRACT:	FIGURE:	DATE:
W911KB-12-D-0001	3-1	4/18

4.0 TREATABILITY STUDY RESULTS

This section presents the results of the treatability study at the VPA site. The results include groundwater geochemistry changes based on field observations and laboratory analysis, along with groundwater contaminant concentration changes.

4.1 Groundwater Geochemistry Evaluation

Groundwater geochemistry at the VPA site was evaluated to determine the impact from the injection. Increases in the ORP, DO concentration, pH, and conductivity were expected due to the products used in the injection; the geochemical parameters are shown on Table 4-1. The changes in groundwater geochemistry are plotted on graphs and presented in Figure 4-1, and a summary of the expected and observed changes in geochemical parameters and the results from groundwater sampling are summarized on Table 4-2.

The graphs in Figure 4-1 show the biggest changes in geochemical parameters after one month were observed in VPA-MP5, AP-6064, and AP-6065, whereas minimal changes were observed in VPA-MP1 and VPA-MP2. Changes that occurred included an increase in dissolved oxygen above the theoretical maximum concentration, significant increase in pH, significant increase in conductivity, and a slight increase in ORP. While all three of these changes were not observed in VPA-MP5, AP-6064, and AP-6065, the groundwater in the vicinity of these wells was clearly impacted by the injection products, as was expected since these wells were located within the treatment area. However, more significant changes were expected in VPA-MP2 since several injection points were located near this probe.

After approximately eight months following the injection (June 2011), the groundwater geochemistry in VPA-MP5, AP-6064, and AP-6065 remained impacted by the injection, and groundwater in the vicinity of VPA-MP2 also showed impact from the injection by a significant increase in conductivity. No significant changes were observed in VPA-MP1 (note that although dissolved oxygen concentrations increased in the VPA wells in June 2011, the increase was observed in wells inside and outside the treatment area, suggesting the increase was a result of natural site fluctuations and not a result of the injection).

Groundwater geochemistry impacts after one year showed pH and conductivity remained elevated in VPA-MP2, VPA-MP5, AP-6064, and AP-6065. Subsequent sampling events (shown in Table 4-1) shows these parameters remained elevated until 2015, when all parameters returned to pre-treatment levels. The dissolved oxygen concentration and ORP changes returned to pre-injection levels after one year following the injection.

4.2 Contaminant Concentration Changes

The impact of the treatability study on contaminants was evaluated by observing benzene, DRO, and GRO concentration changes over time. Concentrations of the ADEC water quality criteria TAH and TAqH (ADEC, 2017b) in AP-6065 were also evaluated. The contaminant concentrations are shown in Table 4-1, with time-series plots shown on Figure 4-2. A map showing groundwater monitoring points and sampling results is included as Figure 4-3. The expected and observed changes in contaminant concentrations are summarized in Table 4-2.

Groundwater samples for the treatability study were collected from the original groundwater probes and monitoring wells installed during the RI and as part of the treatment system operation. VPA-MP1, VPA-MP2, and VPA-MP5 were black-iron probes which were replaced by conventional 2-inch monitoring wells in spring 2015 prior to the 2015 sampling event. Permanent well numbers for the VPA-MP1, VPA-MP2, and VPA-MP5 replacement wells were AP-10296MW, AP-10294MW, and AP-10295MW respectively.

Benzene Concentration Changes

Benzene concentrations were observed above the RAG in AP-6064 and VPA-MP2 prior to the treatability study. Groundwater samples collected approximately one month following the injection showed an increase in benzene concentration in both of these wells, which suggests residual contamination in soil was mobilized to the groundwater by the injection products, where it may be more readily degraded. The benzene concentrations in all other VPA sampling points remained below the RAG. Benzene concentrations decreased in AP-6064 and VPA-MP2 in the eight-month sampling event, and were below the RAG for the first time since 2008 in the one year post-injection sampling event (October 2011).

In contrast to the benzene concentrations in AP-6064 and VPA-MP2, benzene concentrations increased in source area well VPA-MP5. The concentrations did not increase immediately following the injection (1-month post-injection sampling event), but consistently increased between the 8-month and two-year post-injection sampling events. Recent (2016) sampling events have shown benzene concentrations decreased below the RAG in all wells except for VPA-MP1. A time-series plot showing benzene concentrations over time is presented in Figure 4-2.

DRO Concentration Changes

Although the primary target of the VPA treatability study in the Hot Spot area was benzene, DRO concentrations were also evaluated since DRO was identified above the ADEC cleanup level in groundwater. The DRO sampling results are presented in Table 4-1 and a time-series plot of DRO concentrations is shown on Figure 4-2.

The time-series plot shows the DRO concentrations were variable and did not follow a specific pattern after the treatability study injection. However, the visual trend of DRO concentrations over time shown in Figure 4-2 indicates a long-term decreasing trend, likely a result of natural attenuation.

GRO Concentration Changes

Prior to the treatability study injection, GRO was observed above the ADEC cleanup in only one well - source area well VPA-MP2. Immediately following the injection, GRO concentrations increased significantly above the cleanup level in VPA-MP2 and VPA-MP5. This indicates that the injection had the effect of mobilizing residual contamination from the soil to the groundwater where it may be more easily degraded. The long-term visual trend for GRO concentrations since the treatability study as shown in Figure 4-2 indicates GRO concentrations are decreasing. All GRO concentrations were below the ADEC cleanup level in the 2016 sampling event.

TAH and TAqH Concentration Changes

The TAH and TAqH concentrations in AP-6065 have been a concern at the VPA site due to the proximity of the well to the Chena River. The concentrations decreased in the eight-month post-injection sampling event, but were variable in subsequent sampling events. These results suggest the treatability study did not have a significant on the TAH and TAqH concentrations in AP-6065.

Table 4-1 - VPA Groundwater Sample Field-Screening and Analytical Results (since 2006)

Probe/Well Number	Sample Number	Sample Date	Water Elevation (NGVD 29 ft)	Geochemical Parameters						ADEC Contaminants of Concern (µg/L)		ROD Contaminants of Concern (µg/L)							AWQS (µg/L)	
				Dissolved Oxygen (mg/L)	Redox Potential (mV)	Conductivity (mS/cm)	pH	Iron II[7] (mg/L)	Sulfate[7] (mg/L)	DRO (µg/L)	GRO (µg/L)	Benzene	Toluene	Ethylbenzene	1,2,4-TMB	1,3,5-TMB	1,2-DCE	EDB[4]	TAH[2,5]	TAqH[2,5]
REMEDIAL ACTION GOAL / ADEC CLEANUP LEVELS [1] / ALASKA WATER QUALITY STANDARD[2]										**1,500 [1]**	**2,200 [1]**	**5**	**1,000**	**700**	**1,850**	**1,850**	**5**	**0.05**	**10 [2]**	**15 [2]**
AP-10296MW[3] (VPA-MP1)	06FWD003WA	4/27/2006	425.78	2.21	204	0.282	6.81	NA	NA	NA	NA	0.71	1.92	0.91 J	2.87	2.8	ND(0.5)	ND(1)	NA	NA
	06FWD015WA	9/18/2006	426.81	1.29	0.9	0.447	6.2	1.0	10	NA	NA	0.30 J	2.3	0.28 J	8.0	13	ND(1)	ND(1)	NA	NA
	07FWD05WG	4/30/2007	425.44	1.21	20.1	20.1	6.62	3.15	29.1	NA	NA	ND(1)	0.28 J,B	0.21 J	3.2	5.6	ND(1)	ND(1)	NA	NA
	07FWD13WG	8/23/2007	427.38	0.85	25	25	6.48	0.3	6.2	NA	NA	ND(1)	0.22 J	0.13 J	0.96 J	1.3 J	ND(1)	ND(1)	NA	NA
	08FWD04WG	4/30/2008	426.26	2.4	167.6	167.6	5.47	1.9	12.7	NA	NA	ND(1)	0.19 J	0.12 J	0.56 J	1.2	ND(1)	ND(1)	NA	NA
	08FWD09WG	8/23/2008	429.16	0.76	66	66	6.76	0.1	29.3	NA	NA	ND(1)	0.087 J	0.18 J	0.34 J	0.34 J	ND(1)	ND(1)	NA	NA
	09FWD01WG	4/24/2009	425.01	1.04	3.4	3.4	6.04	0	28	**12,000 Q**	920 Q	0.42 J,B,Q	1.2 Q	0.43 J,Q	2.3 Q	4.9 Q	ND(1) Q	ND(1) Q	NA	NA
	09FWD11WG	9/8/2009	427.54	0.81	35.5	35.5	6.21	0.8	33.6	NA	NA	0.15 J	ND(1)	0.13 J	0.54 J	0.51 J	ND(1)	ND(1)	NA	NA
	10FWD03WG	7/1/2010	426.12	0.39	-63.8	0.865	6.35	36.5	0	**34,000**	1,100	0.79 J	1.7	0.53 J	5.9	9.9	ND(1)	ND(1)	NA	NA
	10FWD12WG	9/13/2010	426.60	0.43	-62.7	0.884	6.33	25.5	0	**6,600 QH**	1,000	ND(1.3)	ND(2.5)	ND(1)	5.6 J	11	ND(1)	ND(1)	NA	NA
	10FWD19WG	11/9/2010	425.43	1.28	-71.8	1.007	6.38	39	8.3	**8,400 QH**	670	ND(10)	ND(10)	ND(10)	4.9 J	7.1 J	ND(10)	ND(20)	NA	NA
	11FW3D05WG	6/28/2011	428.18	7.04	96.3	0.945	5.50	8	26	**21,000**	150	0.29 J	0.48 J	ND(1)	0.86 J	1.3	ND(1)	ND(1)	NA	NA
	11FW3D09WG	10/3/2011	427.38	2.81	17.7	1.039	5.87	19	50	**12,000**	220	2.6	0.65 J	0.19 J	3.4	5.9	ND(1)	ND(1)	NA	NA
	12FW3D04WG	10/2/2012	426.26	1.18	17.7	1.039	5.87	67	13	**14,000**	990	1.2	1.4	ND(0.2)	9.9	16	ND(0.2)	ND(0.2)	NA	NA
	13FW3D04WG	5/28/2013	429.24	0.48	-11.2	1.295	6.33	9	9.3	**12,000**	150	0.55 J	0.51 J	ND(0.2)	1.5	1.7	ND(0.2)	ND(0.2)	NA	NA
	14FWOU391WG	10/24/2014	427.03	0.88	36.5	1.332	6.6	25.5 J-	43.7	**15,000**	680	**140**	0.48 J	0.21 J	8.2	11	ND(0.15)	ND(0.2)	NA	NA
	15FWOU3106WG	5/7/2015	428.27	0.43	26.2	1.158	6.16	59.8	11.4	**11,000**	**4,000**	**7.2**	6.4	6.4 J	260	150	ND(0.15)	ND(4)	NA	NA
	16FWOU398WG	7/27/2016	433.16	0.46	-90.7	0.860	6.6	44.7	2.9	**6,500**	1,500	**9.8**	11	9.8	140 J+	61 J+	ND(0.15)	ND(0.2)	NA	NA
AP-10294MW[3] (VPA-MP2)	06FWD002WA	4/27/2006	426.74	1.81	204	0.369	5.89	NM	NM	NA	NA	**11.4 J**	143	19.3	92.3	52.4	ND(0.5)	ND(1)	NA	NA
	06FWD018WA	9/18/2006	427.86	1.04	69	0.499	6.15	7.45	0	NA	NA	3.7	3.1	1.8	5.1	3.8	ND(1)	ND(1)	NA	NA
	07FWD06WG	4/30/2007	427.39	0.51	25.8	0.239	6.43	6.58	28.6	NA	NA	ND(1)	0.61 J	0.49 J	4.3	4.6	ND(1)	ND(1)	NA	NA
	07FWD11WG	8/23/2007	429.01	0.80	-14	0.176	6.55	1.8	60.1	NA	NA	0.42 J	0.52 J	0.93 J	3.8	2.3	ND(1)	ND(1)	NA	NA
	08FWD05WG	5/3/2008	427.32	0.59	44.4	0.114	6.76	1.1	16	NA	NA	0.24 J	26	5.2	39	17	ND(1)	ND(1)	NA	NA
	08FWD12WG	8/25/2008	430.16	0.55	-2.4	0.368	6.66	0.7	15.3	NA	NA	0.13 J	9.0	2.7	18	7.7	ND(1)	ND(1)	NA	NA
	09FWD04WG	4/25/2009	426.17	0.66	13.7	0.578	6.42	37	0	**10,000**	**4,500**	**7.4**	160.0	22	140	52	ND(1)	ND(1)	NA	NA
	09FWD04WG	9/8/2009	428.60	0.73	33.4	0.222	6.3	0.8	14.9	NA	NA	2.7	5.1	1.9	6.7	2.9	ND(1)	ND(1)	NA	NA
	10FWD05WG	7/1/2010	427.19	0.51	-28.2	0.803	6.37	24.8	8.5	**59,000**	1,600	**37**	28.0	7.4	39	15	ND(1)	ND(1)	NA	NA
	10FWD13WG	9/13/2010	427.66	0.22	-22.5	0.819	6.34	26	7.1	**16,000 QH**	830	**24**	35.0	7.4	13	6.5	ND(1)	ND(1)	NA	NA
	10FWD20WG	11/9/2010	426.49	0.71	-156.7	1.924	7.66	15	20.6	**12,000 QH**	**2,500**	**40**	190.0	34	84	53	ND(10)	ND(20)	NA	NA
	11FW3D04WG	6/27/2011	429.31	5.33	126.8	3.144	7.66	5.9	98	**13,000**	**2,300**	**9**	21.0	8.6	170	84	ND(4)	ND(4)	NA	NA
	11FW3D10WG	10/3/2011	428.39	1.92	-136.5	4.654	7.42	7.3	150	**22,000**	**3,600**	3.1	32.0	5.8	220	120	ND(1)	ND(1)	NA	NA
	12FW3D02WG	10/2/2012	427.47	1.31	-136.5	4.654	7.42	10	32	**20,000**	600	1.9	0.91 J	3.6	27	36	ND(0.2)	ND(0.2)	NA	NA
	13FW3D02WG	5/28/2013	430.80	1.24	-12.2	1.666	6.92	1.8	27	**18,000**	470	1.2	3.5	5.9	17	12	ND(0.2)	ND(0.2)	NA	NA
	14FWOU394WG	10/24/2014	428.11	0.48	-28.4	1.928	7.22	11.3 J-	8.6	**12,000**	1,300	**16**	14.0	29	55	32	ND(0.15)	ND(0.2)	NA	NA
	15FWOU3107WG	5/7/2015	428.30	0.43	41.5	0.719	5.99	2.34	6.8	850	1,100	0.20 J	12.0	4.8	43	22	ND(0.15)	ND(0.2)	NA	NA
	16FWOU3104WG	7/27/2016	433.42	0.19	61.4	0.487	6.57	0.0126 J	27.9	370 J	ND(25)	ND(0.1)	ND(0.1)	ND(0.1)	0.12 J,B,J-	ND(0.2)	ND(0.15)	ND(0.2)	NA	NA
AP-6064	06FWD001WA	4/26/2006	426.62	1.63	181	0.552	6.3	2.35	15	NA	NA	**176**	39.5	19.9	26.2	11.3	ND(0.5)	ND(1)	NA	NA
	06FWD016WA	9/18/2006	427.76	2.95	103	0.356	6.19	0.75	0	NA	NA	**5.9**	0.83 J	1.2	1.4	0.4	ND(1)	ND(1)	NA	NA
	07FWD01WG	4/26/2007	428.38	0.80	-5.9	0.237	6.84	5.52	49.9	NA	NA	**65**	7.6	8.0	14	5.6	ND(1)	ND(1)	NA	NA
	07FWD15WG	8/27/2007	428.62	7.53	122.7	0.086	6.86	3	48.9	NA	NA	ND(1)	0.071 J	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	NA	NA
	08FWD07WG	5/6/2008	427.30	9.73	85.6	0.093	7.32	0	47.6	NA	NA	ND(1)	0.13 J	ND(1)	0.48 J	0.42 J	ND(1)	ND(1)	NA	NA
	08FWD11WG	8/25/2008	429.55	5.41	75.1	0.295	7.00	0	22.9	NA	NA	ND(1)	ND(1)	0.17 J	0.33 J	0.30 J	ND(1)	ND(1)	NA	NA
	09FWD03WG	4/24/2009	426.18	7.07	133.3	0.304	7.11	0	22	980	56 B	2.3	0.31 J,B	2.1	3.4	1.8	ND(1)	ND(1)	NA	NA
	09FWD09WG	9/8/2009	428.61	1.26	35.8	0.376	6.79	0	16.3	NA	NA	**14**	ND(1)	0.54 J	0.85 J	0.42 J	ND(1)	ND(1)	NA	NA
	10FWD06WG	7/1/2010	427.15	0.15	54.7	0.437	6.62	0	< 8.0	**3,200**	270	**11**	0.91 J, B	10	14	4.8	ND(1)	ND(1)	NA	NA
	10FWD17WG	9/13/2010	427.65	0.76	26.5	0.302	6.78	0.2	4.1	680	120	**7.5**	0.71 J	2.5	2.4	0.84	ND(1)	ND(1)	NA	NA
	10FWD22WG	11/10/2010	426.50	0.99	75.6	4.602	9.70	0	700	**2,500 QH,Q**	1,000 M	**36**	75	17	34	16	ND(10)	ND(20)	NA	NA
	10FWD23WG[6]				75.6	4.602	9.70	0	700	**4,800 QH**	1,000	**32**	65	17	34	16	ND(10)	ND(20)	NA	NA
	11FW3D03WG	6/27/2011	429.33	4.06	122	1.549	7.94	0.13	55	**2,500**	510	3.8	7.1	9.9	17	9.1	ND(1)	ND(1)	NA	NA
	11FW3D12WG	10/3/2011	428.35	1.96	-39.2	1.774	7.14	0.056 J	67	**2,800**	98	3.6	0.97 J	2.2	3.3	1.7	ND(1)	ND(1)	NA	NA
	12FW3D01WG	10/2/2012	427.42	1.51	-39.2	1.774	7.14	0.054 J	25	**1,600**	43	3.9	0.28 J	0.6 J	0.83 J	0.45 J	ND(0.2)	ND(0.2)	NA	NA
	13FW3D01WG	5/28/2013	430.94	1.67	109.1	0.542	6.88	0.039 J	15	500	36	0.73 J	ND(0.4)	0.34 J	ND(0.2)	ND(0.4)	ND(0.2)	ND(0.2)	NA	NA
	14FWOU396WG	10/24/2014	428.06	1.2	107.6	1.002	6.41	0.137	34.3	**4,000**	41 J	**9**	0.48 J	0.41 J	0.92 J	0.20 J	ND(0.15)	ND(0.2)	NA	NA
	15FWOU3105WG	5/6/2015	428.23	0.64	55.3	0.551	6.58	0.409	8.2	**2,000**	310	**36**	5.4	8.5	19	5.2	ND(0.15)	ND(0.2)	NA	NA
	16FWOU3100WG	7/27/2016	433.47	7.84	28.6	0.165	6.56	0.0624	15.6	110 J,B	ND(25)	ND(0.1)	ND(0.1)	ND(0.1)	0.26 J,B,J+	0.11 J,J+	ND(0.15)	ND(0.2)	NA	NA

Table 4-1 - VPA Groundwater Sample Field-Screening and Analytical Results (since 2006)

Probe/Well Number	Sample Number	Sample Date	Water Elevation (NGVD 29 ft)	Geochemical Parameters						ADEC Contaminants of Concern (µg/L)		ROD Contaminants of Concern (µg/L)							AWQS (µg/L)	
				Dissolved Oxygen (mg/L)	Redox Potential (mV)	Conductivity (mS/cm)	pH	Iron II[7] (mg/L)	Sulfate[7] (mg/L)	DRO (µg/L)	GRO (µg/L)	Benzene	Toluene	Ethylbenzene	1,2,4-TMB	1,3,5-TMB	1,2-DCE	EDB[4]	TAH[2,5]	TAqH[2,5]
REMEDIAL ACTION GOAL / ADEC CLEANUP LEVELS [1] / ALASKA WATER QUALITY STANDARD[2]										**1,500 [1]**	**2,200 [1]**	**5**	**1,000**	**700**	**1,850**	**1,850**	**5**	**0.05**	**10 [2]**	**15 [2]**
AP-6065	06FWD008WA	4/28/2006	427.22	0.95	129	0.347	6.31	NA	NA	NA	NA	ND(0.4)	1.29	7.68	33.7	6.25	ND(0.5)	ND(1)	**26.4**	**27.5**
	06FWD017WA	9/18/2006	427.64	0.84	6.9	0.275	6.4	0.75	0	NA	NA	ND(1)	0.40 J	3.7	19	3.7	ND(1)	ND(1)	NA	NA
	07FWD07WG	4/30/2007	426.23	0.43	-29.6	0.177	6.75	7.3	26.5	NA	NA	ND(1)	0.39 J,B	4.4	19	4.5	ND(1)	ND(1)	**12.6 J**	**15.9 JB**
	07FWD14WG	8/27/2007	428.55	4.31	124	0.059	6.22	1.3	51.3	NA	NA	ND(1)	0.12 J	0.45 J	2.2	0.63 J	ND(1)	ND(1)	NA	NA
	08FWD01WG	4/29/2008	427.27	0.31	33.9	0.106	6.36	6.9	7.2	NA	NA	0.13 J	1.5	3.3	15	3	ND(1)	ND(1)	**12.93**	14.55
	08FWD13WG	8/26/2008	430.14	3.49	244.5	0.226	6.17	ND(0.20)	24	NA	NA	ND(1)	ND(1)	0.16 J	0.36 J	0.30 J	ND(1)	ND(1)	NA	NA
	09FWD07WG	4/25/2009	426.06	1.06	10.1	0.244	6.32	3.3	28.2	480	280	0.19 J,B	0.61 J	4.7	24	7.5	ND(1)	ND(1)	**18.5**	**20.4 J,B**
	09FWD12WG	9/9/2009	428.47	3.46	106.7	0.24	6.06	0.1	9.4	NA	NA	ND(1)	ND(1)	0.40 J	1.7	0.41 J	ND(1)	ND(1)	NA	NA
	10FWD07WG	7/1/2010	427.06	0.22	70.5	0.31	6.77	3.5	< 8.0	930 J	550	0.10 J	0.44 J, B	6.1	39 J	12	ND(1)	ND(1)	**26.3**	**29.9**
	10FWD08WG[6]				70.5	0.31	6.77	3.5	< 8.0	940	430	ND(1) Q	0.32 J, B, Q	5.5	36	12	ND(1)	ND(1)	**24.9**	**28.4**
	10FWD14WG	9/13/2010	427.65	0.19	38	0.226	6.43	2.7	3.3	400	440	0.13 J	0.58 J	4.5	26	6.8	ND(1)	ND(1)	NA	NA
	10FWD18WG	11/9/2010	426.44	19.25	-13	2.889	10.11	4	64.8	**1,700 QH**	900	ND(10)	ND(10)	7.2 J, QH	57 QH	25 QH	ND(10)	ND(20)	NA	NA
	11FW3D07WG	6/28/2011	429.24	5.78	114.9	1.642	9.56	0.48	51	990	690 QL	ND(2)	0.35 J	2	20	17	ND(2)	ND(2)	**13.2**	14.7
	11FW3D08WG[6]							0.54	51	1,000	730 QL	ND(2)	ND(2)	1.9 J	20	18	ND(2)	ND(2)	**13.3**	**15.3**
	11FW3D15WG	10/4/2011	428.14	1.89	-11.4	1.342	9.28	0.61	31	760	800 J, ML	ND(1)	0.43 J	4.6	40	23	ND(1)	ND(1)	**31.6**	**33.2**
	11FW3D16WG[6]							0.6	31	730	810	ND(1)	0.38 J	4.6	40	24	ND(1)	ND(1)	**31.4**	**34.0**
	12FW3D05WG	10/2/2012	427.44	0.28	-11.4	1.342	9.28	0.076 J	28	1,000	920	ND(0.2)	0.35 J	9.1	56	30	ND(0.2)	ND(0.2)	**37.4**	**41.8**
	12FW3D06WG[6]							0.073 J	28	1,000	950	ND(0.2)	0.33 J	8.2	48	27	ND(0.2)	ND(0.2)	**32.8**	**37.3**
	13FW3D05WG	5/29/2013	431.53	6.22	52.3	0.361	8.15	0.52 J	11	250	43	ND(0.2)	ND(0.4)	ND(0.2)	0.59 J	0.64 J	ND(0.2)	ND(0.2)	2.00	2.19
	13FW3D06WG[6]							0.58 J	11	230 J	56	ND(0.2)	ND(0.4)	ND(0.2)	0.59 J	0.63 J	ND(0.2)	ND(0.2)	2.00	2.19
	14FWOU392WG	10/24/2014	427.80	0.33	-8.5	0.432	7.4	0.724	11.5	690 J,J-	650	**7.8 J-**	0.28 J	8.8 J,J-	62 J	22	ND(0.15)	ND(0.2)	**42.5**	**43.3**
	15FWOU3103WG	5/6/2015	428.13	0.50	35.6	0.343	6.65	2.38	6.07	600 J	670	0.36 J	0.64	5.5 J,J-	25	14	ND(0.15)	ND(0.2) J-	**22.0**	**26.8**
	15FWOU3104WG[6]							2.44	6.4	520 J	650	0.32 J	0.72	5.2 J-	22	12	ND(0.15)	ND(0.2) J-	**20.6**	**25.2**
	16FWOU394WG	7/27/2016	433.69	0.38	202.3	0.18	6.68	0.125 J	16.7	52 J,B	ND(25)	ND(0.1)	ND(0.1)	ND(0.1)	ND(0.2)	ND(0.2)	ND(0.15)	ND(0.2)	0.70	0.74
	16FWOU396WG[6]							0.078 J	16.4	59 J,B	9.5 J	ND(0.1)	ND(0.1)	ND(0.1)	0.08 J,B,J+	ND(0.2)	ND(0.15)	ND(0.2)	0.70	0.74
AP-9042[3] (GWP-24)	06FWD006WA	4/27/2006	424.21	1.18	166	0.545	6.98	NA	NA	NA	NA	**6.18**	0.59 J	0.59 J	0.81	ND(1)	ND(0.5)	ND(1)	NA	NA
	06FWD016WA	9/2/2006	426.17	8.18	78.9	0.321	7.11	0.75	62	NA	NA	ND(1)	0.20 J	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	NA	NA
	07FWD04WG	4/30/2007	424.85	2.12	88.9	0.24	7.29	1.66	45.7	NA	NA	1.3	0.17 J,B	ND(1)	0.34 J	ND(1)	ND(1)	ND(1)	NA	NA
	07FWD09WG	8/22/2007	426.59	4.23	51.6	0.255	7.04	3.1	42	NA	NA	2.0	0.13 J	0.73 J	1.1	0.15 J	ND(1)	ND(1)	NA	NA
	08FWD02WG	4/29/2008	424.59	0.31	93.9	0.16	7.11	1.1	14.9	NA	NA	2.8	0.086 J	0.11 J	0.21 J	ND(1)	ND(1)	ND(1)	NA	NA
	08FWD08WG	8/19/2008	427.77	0.68	97.2	0.355	6.87	0	41.3	NA	NA	2.6	5.4	0.46 J	1.0	0.28 J	ND(1)	ND(1)	NA	NA
	09FWD05WG	4/24/2009	423.72	1.25	45.7	0.555	6.8	6.4	2.3	**1,500**	110 B	3.3	0.20 J,B	0.45 J	1.9	0.083 J,B	ND(1)	ND(1)	NA	NA
	09FWD13WG	9/9/2009	426.06	1.04	-7.8	0.428	6.92	0.7	12.1	NA	NA	2.8	ND(1)	2.5	5.8	0.61 J	ND(1)	ND(1)	NA	NA
	10FWD01WG	6/30/2010	424.77	0.15	-82.1	0.483	6.73	6.8	30.1	**2,200**	380 B	**5.6 QH**	0.25 J, B, QH	16 QH	42.0 QH	9.1 QH	ND(1)	ND(1)	NA	NA
	10FWD09WG	9/13/2010	425.27	0.47	64.4	0.303	6.61	3.9	8	220	64 Q	0.74 J	ND(1)	1.2	2.7	0.23 J, Q	ND(1)	ND(2)	NA	NA
	10FWD10WG[6]				64.4	0.303	6.61	3.9	8	240	41 J	0.65 J	ND(1)	0.93 J	2.3	0.16 J	ND(1)	ND(2)	NA	NA
	11FW3D01WG	6/27/2011	426.72	7.4	81.5	0.433	6.64	1.3	10	400	38	0.7 J	ND(1)	0.32 J	1.0	ND(1)	ND(1)	ND(1)	NA	NA
	11FW3D13WG	10/4/2011	425.89	2.59	1.2	0.434	5.98	5.3	7.7	710	46	1.5	ND(0.4)	0.82 J	3.3	ND(1)	ND(0.2)	ND(0.2)	NA	NA
AP-9043[3] (GWP-56S)	06FWD005WA	4/27/2006	426.27	1.47	166	0.495	6.47	NA	NA	NA	NA	0.8	0.96 J	0.95 J	1.33	ND(1)	ND(0.5)	ND(1)	NA	NA
	06FWD020WA	9/18/2006	427.42	1.04	66	0.493	6.51	0	43	NA	NA	ND(1)	0.63 J	0.14 J	0.12	ND(1)	ND(1)	ND(1)	NA	NA
	07FWD03WG	4/27/2007	426.83	0.89	-9.1	0.311	6.9	6.2	38.1	NA	NA	0.26 J	0.21 J	0.31 J	0.78 J	ND(1)	ND(1)	ND(1)	NA	NA
	07FWD10WG	8/22/2007	428.58	4.70	53.9	0.374	6.58	2.1	40.5	NA	NA	0.16 J	0.098 J	0.14 J	0.16 J	ND(1)	ND(1)	ND(1)	NA	NA
	08FWD03WG	4/29/2008	426.56	0.29	100.1	0.158	6.73	7.3	10.7	NA	NA	0.28 J	0.089 J	0.17 J	0.22 J	ND(1)	ND(1)	ND(1)	NA	NA
	08FWD14WG	8/26/2008	429.78	6.54	222.6	0.875	6.72	0	54.2	NA	NA	ND(1)	ND(1)	0.17 J	0.33 J	ND(1)	ND(1)	ND(1)	NA	NA
	09FWD06WG	4/24/2009	425.74	0.74	75.2	0.513	6.79	1.4	10.6	650	93 B	0.12 J,B	0.14 J,B	0.12 J	ND(1)	ND(1)	ND(1)	ND(1)	NA	NA
	09FWD14WG	9/9/2009	428.03	1.01	43.8	0.515	6.87	0	21.8	NA	NA	0.38 J	ND(1)	0.29 J	ND(1)	ND(1)	ND(1)	ND(1)	NA	NA
	10FWD02WG	7/1/2010	426.74	0.29	-46.2	0.45	6.55	1.9	7.5	820 QL	36 J, B	ND(1) QL	0.078 J, B, QL	0.066 J, B, QL	0.46 J, QL	ND(1) QL	ND(1) QL	ND(1) QL	NA	NA
	10FWD11WG	9/13/2010	427.25	0.24	17	0.819	6.34	4.8	8.8	310	140 QH	ND(0.13)	ND(0.25)	ND(0.1)	ND(0.12)	ND(0.14)	ND(1)	ND(1)	NA	NA
	11FW3D02WG	6/27/2011	428.66	4.14	-4.9	0.487	6.72	6	11	900	140	ND(1)	ND(1)	0.25 J	0.76 J	ND(1)	ND(1)	ND(1)	NA	NA
	11FW3D14WG	10/4/2011	427.96	3.49	9.7	0.676	6.18	ND(0.1)	37	200 J	9 J, B	ND(0.2)	ND(0.4)	ND(0.2)	ND(0.2)	ND(0.4)	ND(0.2)	ND(0.2)	NA	NA

Table 4-1 - VPA Groundwater Sample Field-Screening and Analytical Results (since 2006)

Probe/Well Number	Sample Number	Sample Date	Water Elevation (NGVD 29 ft)	Geochemical Parameters						ADEC Contaminants of Concern (µg/L)		ROD Contaminants of Concern (µg/L)							AWQS (µg/L)	
				Dissolved Oxygen (mg/L)	Redox Potential (mV)	Conductivity (mS/cm)	pH	Iron II[7] (mg/L)	Sulfate[7] (mg/L)	DRO (µg/L)	GRO (µg/L)	Benzene	Toluene	Ethylbenzene	1,2,4-TMB	1,3,5-TMB	1,2-DCE	EDB[4]	TAH[2,5]	TAqH[2,5]
REMEDIAL ACTION GOAL / ADEC CLEANUP LEVELS [1] / ALASKA WATER QUALITY STANDARD[2]										**1,500 [1]**	**2,200 [1]**	**5**	**1,000**	**700**	**1,850**	**1,850**	**5**	**0.05**	**10 [2]**	**15 [2]**
AP-10295MW[3] (VPA-MP5)	07FWD12WG	8/23/2007	429.07	0.73	-43.6	0.184	6.54	7.3	30.4	NA	NA	0.36 J,Q	0.46 J,Q	2.6 Q	47 Q	24 Q	ND(1) Q	ND(1) Q	NA	NA
	08FWD06WG	5/3/2008	427.79	0.4	75.3	0.15	6.14	0	11.3	NA	NA	**21**	310	0.12 J	0.59 J	0.97 J	ND(1)	ND(1)	NA	NA
	08FWD10WG	8/23/2008	430.20	0.44	-16.3	0.445	6.63	0.2	3.5	NA	NA	ND(1)	0.14 J	0.21 J	0.54 J	0.53 J	ND(1)	ND(1)	NA	NA
	09FWD02WG	4/25/2009	426.17	1.42	-47.6	0.43	6.38	5.6	0	**5,600**	230	0.92 J,B	0.56 J	0.31 J	2.6	3	ND(1)	ND(1)	NA	NA
	09FWD10WG	9/8/2009	428.68	0.92	-43.2	0.844	6.38	7.3	0	NA	NA	2.1	0.75 J	1	3.9	3	ND(1)	ND(1)	NA	NA
	10FWD04WG	7/1/2010	427.20	0.53	-59.6	1.044	6.55	39.2	< 8.0	**31,000**	430	2.5	3.1	1.7	15	12	ND(1)	ND(1)	NA	NA
	10FWD16WG	9/13/2010	427.69	0.43	-51.4	0.867	6.30	36.4	< 8.0	**6,300 QH**	720	2.1	1.5	4.4	28	18	ND(1)	ND(1)	NA	NA
	10FWD21WG	11/10/2010	426.50	14.2	73.4	14.97	10.26	0	1525	**25,000 QH**	**22,000**	2.1 J, QH	6.8 J, QH	4.2 J, QH	69 QH	60 QH	ND(10)	ND(20)	NA	NA
	11FW3D06WG	6/28/2011	429.17	4.94	110.8	6.316	9.51	1.8	190	**14,000 QL**	**9,700**	**9.6**	64	4.8 J	40	41	ND(5)	ND(5)	NA	NA
	11FW3D11WG	10/3/2011	428.41	1.63	-98.5	4.15	7.83	3.2	90	**11,000**	2,000	**25**	72	6	35	38	ND(1)	ND(1)	NA	NA
	12FW3D03WG	10/3/2012	427.47	1.1	-3	3.270	7.1	21	1.5 J	**26,000**	**9,800**	**28**	2.1	11	41	34	ND(0.2)	ND(0.2)	NA	NA
	13FW3D03WG	5/28/2013	430.81	0.29	-106.3	3.389	7.01	15	0.92 J	**10,000**	1,300	**13**	3.8	6.6	37	33	ND(0.2)	ND(0.2)	NA	NA
	14FWOU395WG	10/24/2014	428.15	0.31	-72	2.158	7.41	19.7 J-	4.9	**23,000**	1,400	**45**	2.9	15	78	53	ND(0.15)	ND(0.2)	NA	NA
	15FWOU3108WG	5/7/2015	428.31	0.39	66.8	1.078	5.88	2.29	24.3	**7,900**	1,100	0.21 J	27	4	50	96	ND(0.15)	ND(0.2)	NA	NA
	16FWOU3102WG	7/27/2016	433.39	0.42	-20.5	0.389	6.65	0.453	16.4	560 J	73 J	ND(0.1)	ND(0.1)	ND(0.1)	0.8 J,J+	0.65 J,J+	ND(0.15)	ND(0.2)	NA	NA

Bold results represent concentrations in excess of ROD RAGs or ADEC cleanup levels
Red line indicates when the treatability study injection occurred.
[1] 18 AAC 75 (ADEC, 2017a)
[2] 18 AAC 70 (ADEC, 2017b)
[3] Replacement wells were installed in 2009 and 2015. Wells that were replaced are shown in parentheses.
[4] 1,2-Dibromoethane results were generated from either Method 8260 or Method 504.1. Results from Method 504.1 were used when available.
[5] For TAH and TAqH calculation purposes, the LOD was used for ND results. Prior to 2012, 1/2 the LOQ was used for ND results.
[6] Denotes sample is a field duplicate of preceding row.
[7] Iron (II) and sulfate results are a combination of field screening and laboratory results

Acronyms/Abbreviations

DCE - dichloroethene
DRO - diesel range organics
EDB - 1,2-dibromoethane
GRO - gasoline range organics
LOD - limit of detection
LOQ - limit of quantitation
µg/L - micrograms per liter
mg/L - milligram per liter
msl - mean sea level
NA - not analyzed
ROD - Record of Decision
TAH - total aromatic hydrocarbons
TAqH - total aqueous hydrocarbons
TMB - trimethylbenzene

Data Qualifiers

ND - Not detected at the detection limit (LOD in parentheses; LOQ in parentheses for data prior to 2012.)
B - Result is qualified as a potential high estimate due to contamination present in a blank sample
J - Result is estimated due to a QC issue or because it is less than the LOQ. If result is biased low or high, it is specified as "J-" and "J+" (2014 data or older).
Q - Result is estimated due to a QC failure (pre-2014 data only). If direction of bias is known, it is further indicated with an "L" (low) or "H" (high).
M - Result is biased due to matrix interference (pre-2014 data only). If direction of bias is known, it is further indicated with an "L" (low) or "H" (high).

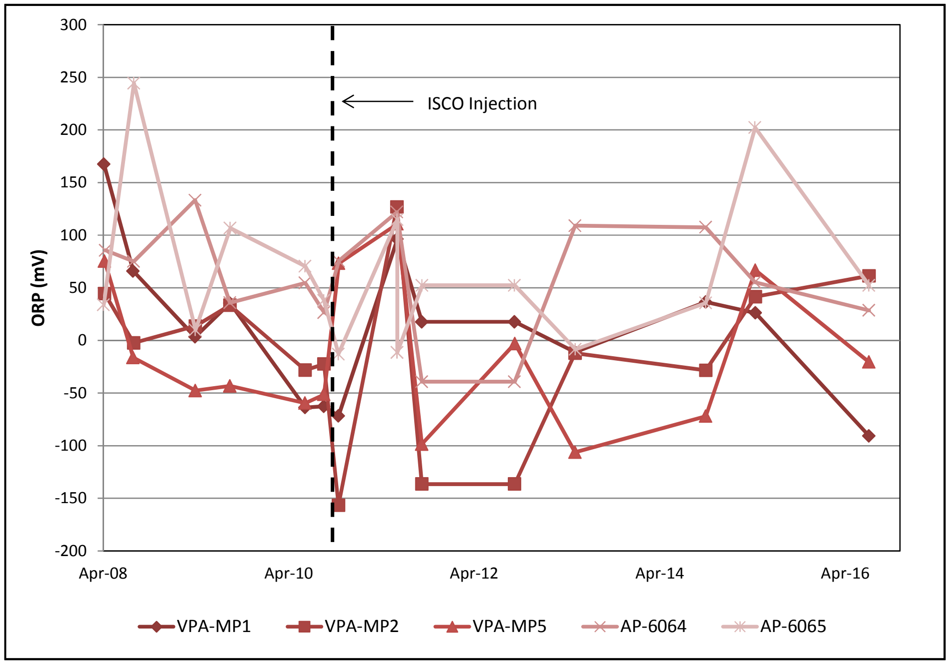
Table 4-2. Valve Pit A RegenOx™ and ORC-A® Injection Trends and Observations

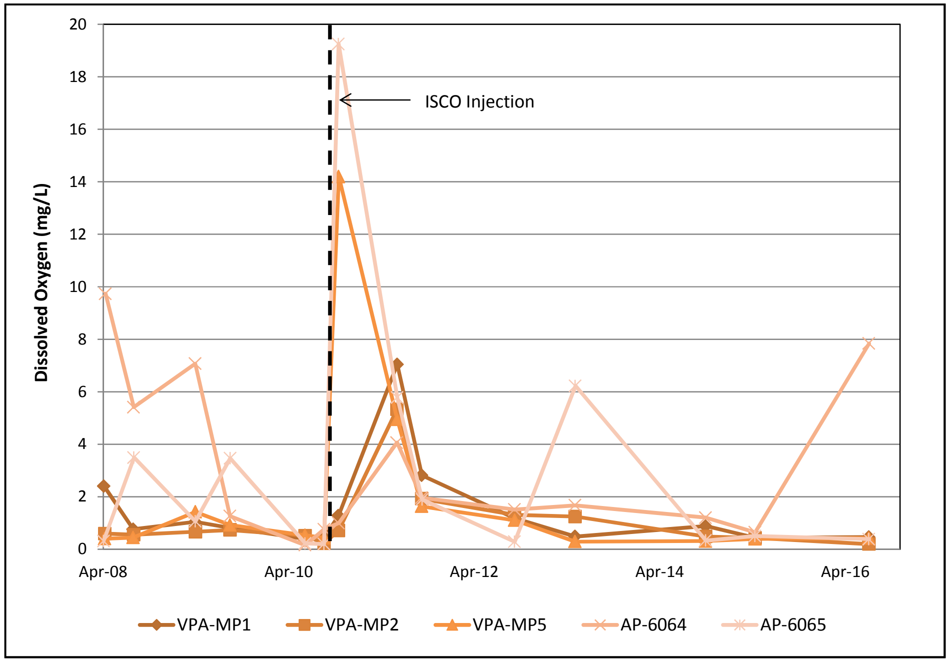
Performance Metric	Expected Result	Observed Result (1 month following injection)	Observed Result (8 months following injection)	Observed Result (12 months following injection)
Dissolved Oxygen	*Increase immediately following the injection, and a decrease over time.*	Significantly increased in VPA-MP5 and AP-6065, and was unchanged in VPA-MP2 and AP-6064 within the treatment area	Dissolved oxygen concentrations were elevated in all wells within the treatment area.	Dissolved oxygen concentrations decreased, but remained slightly elevated in all wells within the treatment area. Impact of the injection on DO concentrations was limited to approximately 1 year.
Redox Potential (ORP)	*Increase immediately following the injection, and a decrease over time.*	ORP increased in monitoring wells where dissolved oxygen increased (VPA-MP5 and AP-6065). ORP decreased in wells where dissolved oxygen concentration was unchanged (in VPA-MP2 and AP-6064)	ORP increased in all wells within the injection area.	ORP decreased to pre-injection levels within the injection area after 12 months.
Dissolved Iron	*Decrease within injection area*	Dissolved iron concentrations decreased in two wells (VPA-MP2 and VPA-MP5), and remained low in the remaining two wells (AP-6064 and AP-6065)	Dissolved iron concentrations decreased in two wells (VPA-MP2 and VPA-MP5), and remained low in the remaining two wells (AP-6064 and AP-6065)	Dissolved iron concentrations decreased in VPA-MP1 and remained low in the remaining wells (VPA-MP2, VPA-MP5, AP-6064 and AP-6065).
Sulfate	*No change within injection area*	Sulfate concentrations increased in all wells within the treatment area	Sulfate concentrations remained elevated in all wells within the treatment area.	Sulfate concentrations remained elevated in all wells within the treatment area.
pH	*Increase immediately following the injection, and a decrease over time.*	pH was observed to increase in all wells within the injection area	pH remained elevated in VPA-MP2, VPA, MP5, AP-6064 and AP-6065. pH decreased in upgradient well VPA-MP1.	pH remained elevated in VPA-MP2, VPA, MP5, AP-6064 and AP-6065. pH decreased in upgradient well VPA-MP1.
Contaminant Concentrations (DRO/GRO/benzene)	*Possible contaminant concentration increase in areas with residual source material remaining in soils. Concentrations are then expected to decrease over time due to chemical oxidation and aerobic biodegradation*	• Significant DRO increase in VPA-MP5, AP-6064, and AP-6065 • Significant GRO increase in VPA-MP2, VPA-MP5, and AP-6064 • Significant benzene increase in VPA-MP2 and AP-6064	• DRO decreased in VPA-MP5, AP-6064, and AP-6065, and DRO increased in VPA-MP1 and VPA-MP2 • GRO decreased in VPA-MP2 and VPA-MP5 (the only wells with GRO above cleanup levels) • Benzene decreased in VPA-MP2 in AP-6064, and benzene increased in VPA-MP5	• DRO decreased in VPA-MP1 and VPA-MP5, and DRO increased in VPA-MP2 and AP-6064. No clear overall trend. Concentrations are similar to pre-injection concentrations. • GRO decreased below cleanup levels in VPA-MP5, and increased in VPA-MP2. Consistent decreasing trend in VPA-MP5. • Benzene decreased in VPA-MP2 in AP-6064, and benzene increased in VPA-MP5

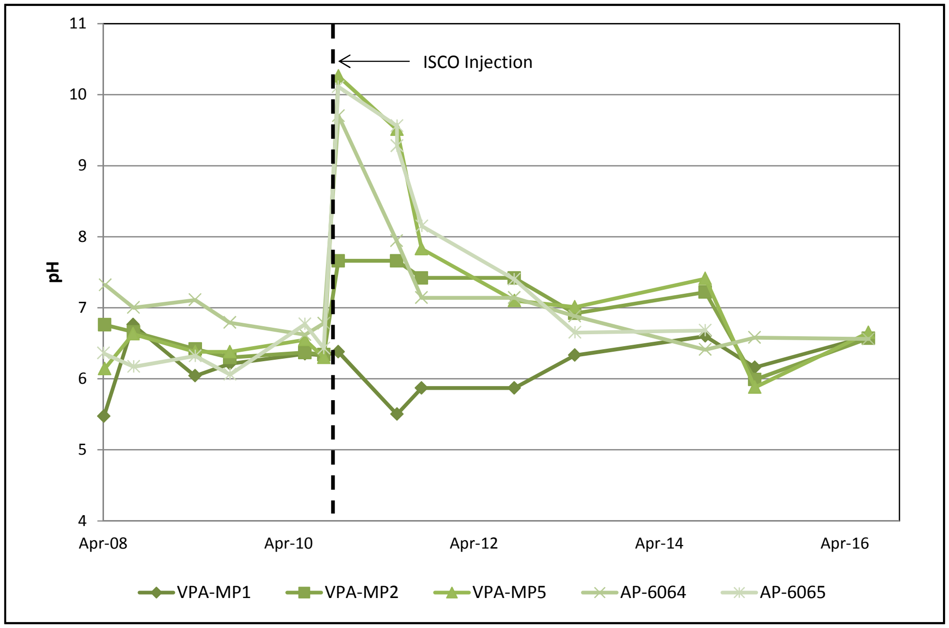
Note: Baseline Sampling Event - September 2010; Regenesis Injection – 10/8/10 - 10/13/10; Post Injection Sampling Event – 11/10/10 (1 month), 6/27/11 (8 months), and 10/3/11 (12 months)

Red indicates a trend consistent with the expected result

Figure 4-1 . Valve Pit A Groundwater Geochemistry Results







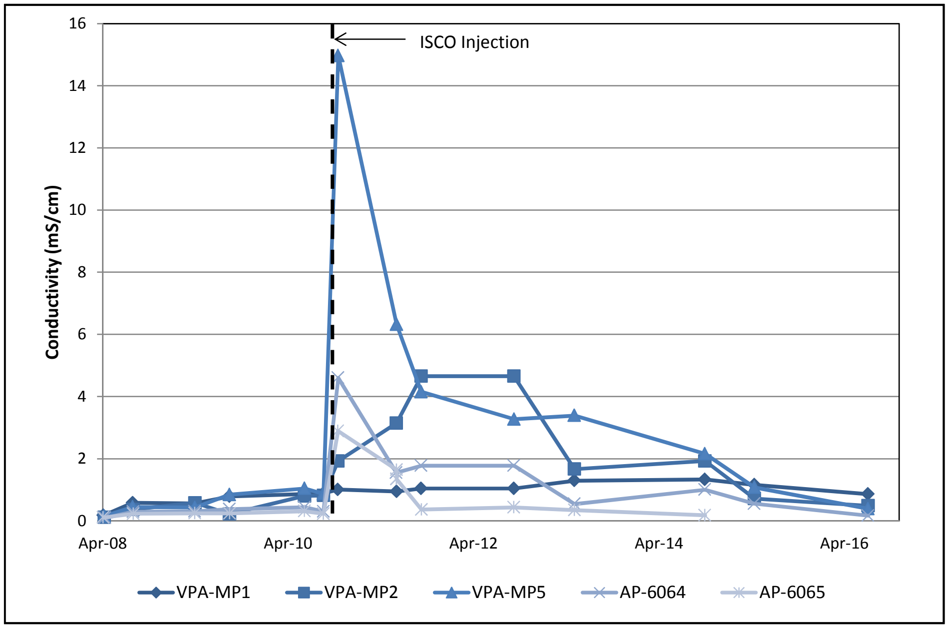
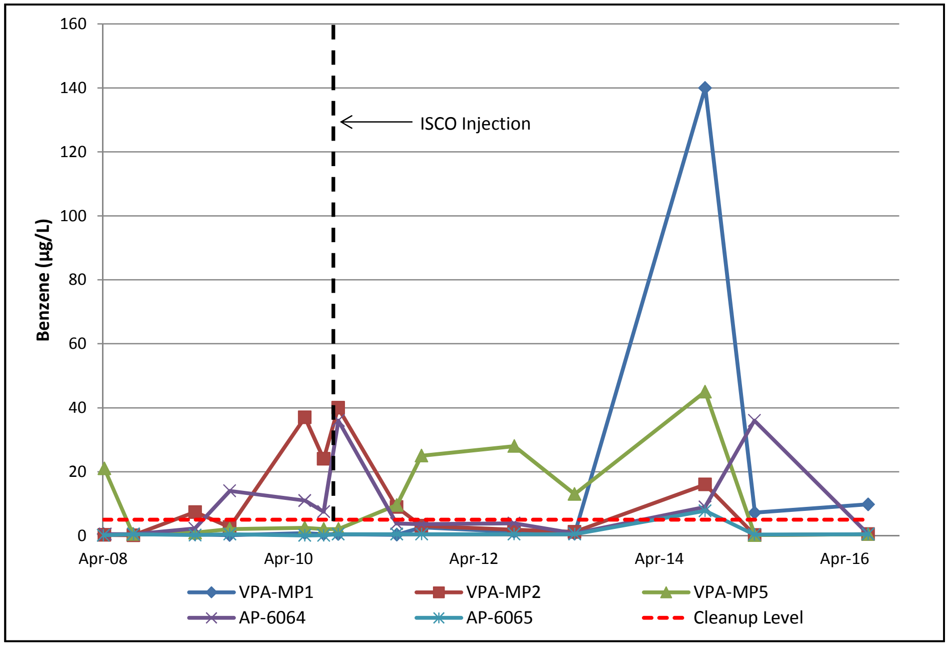
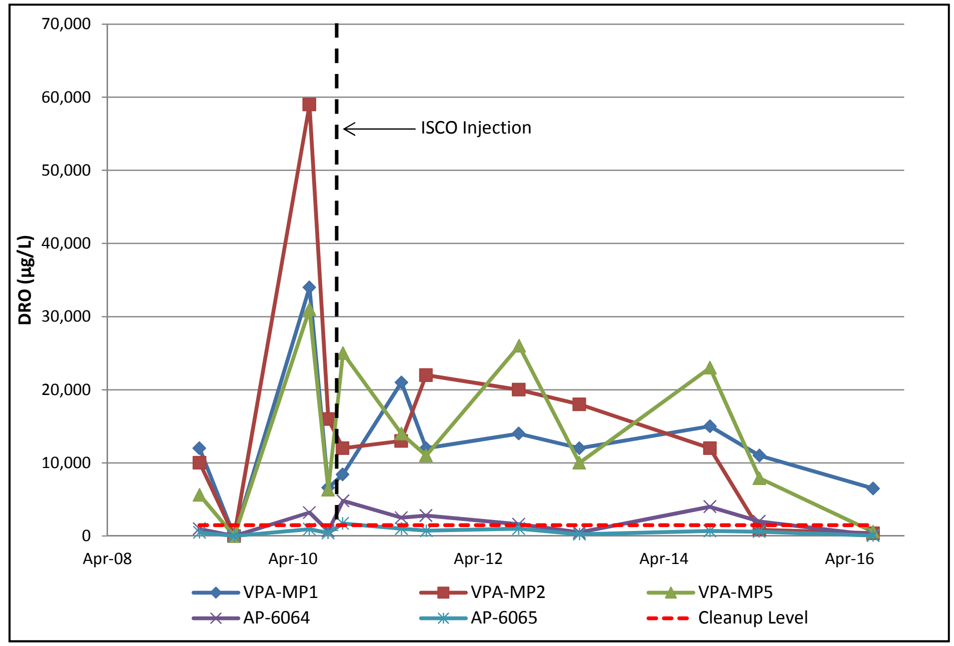
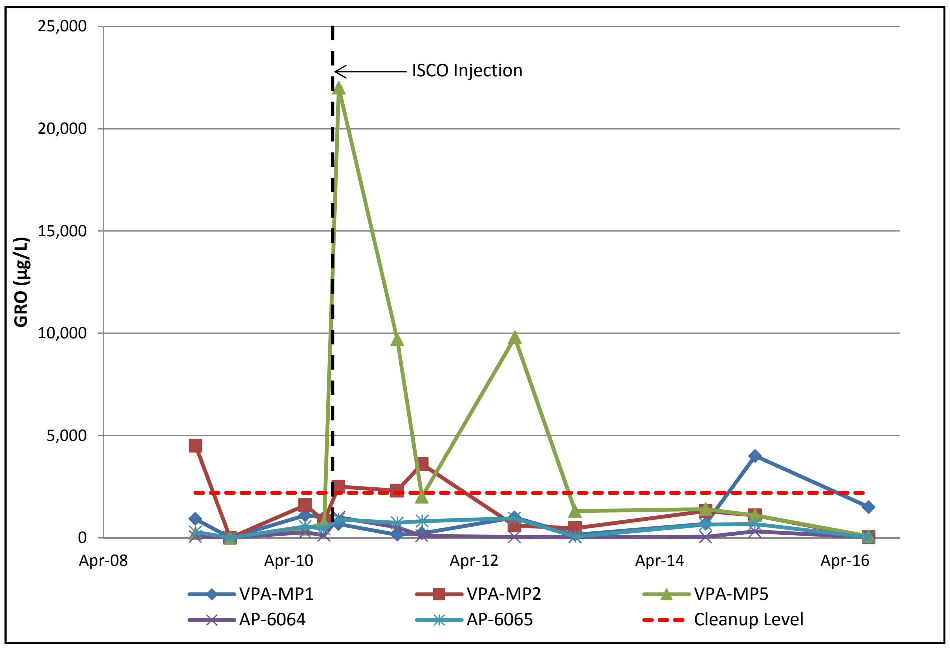
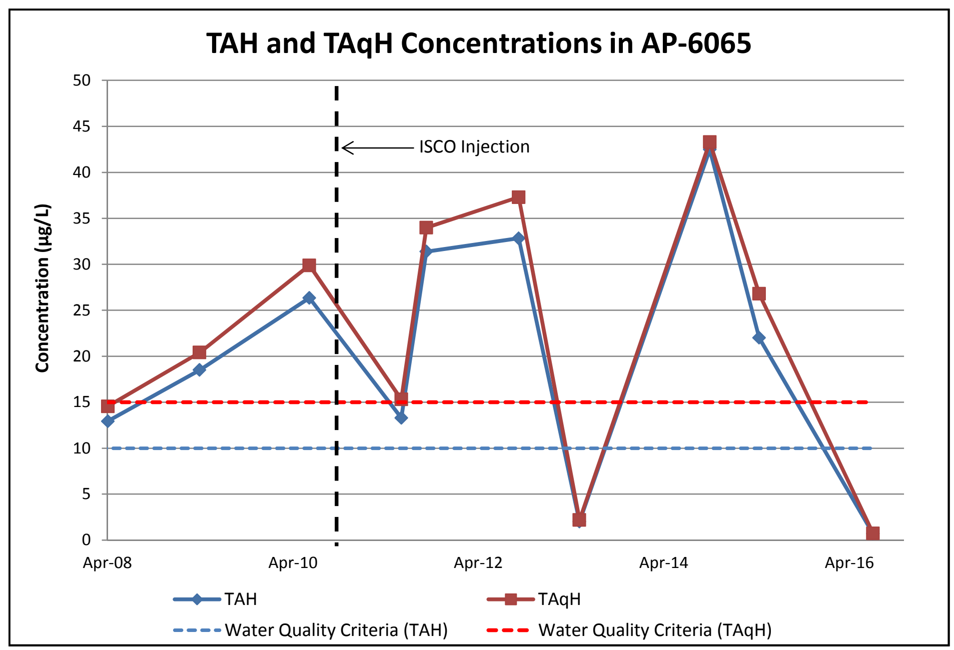


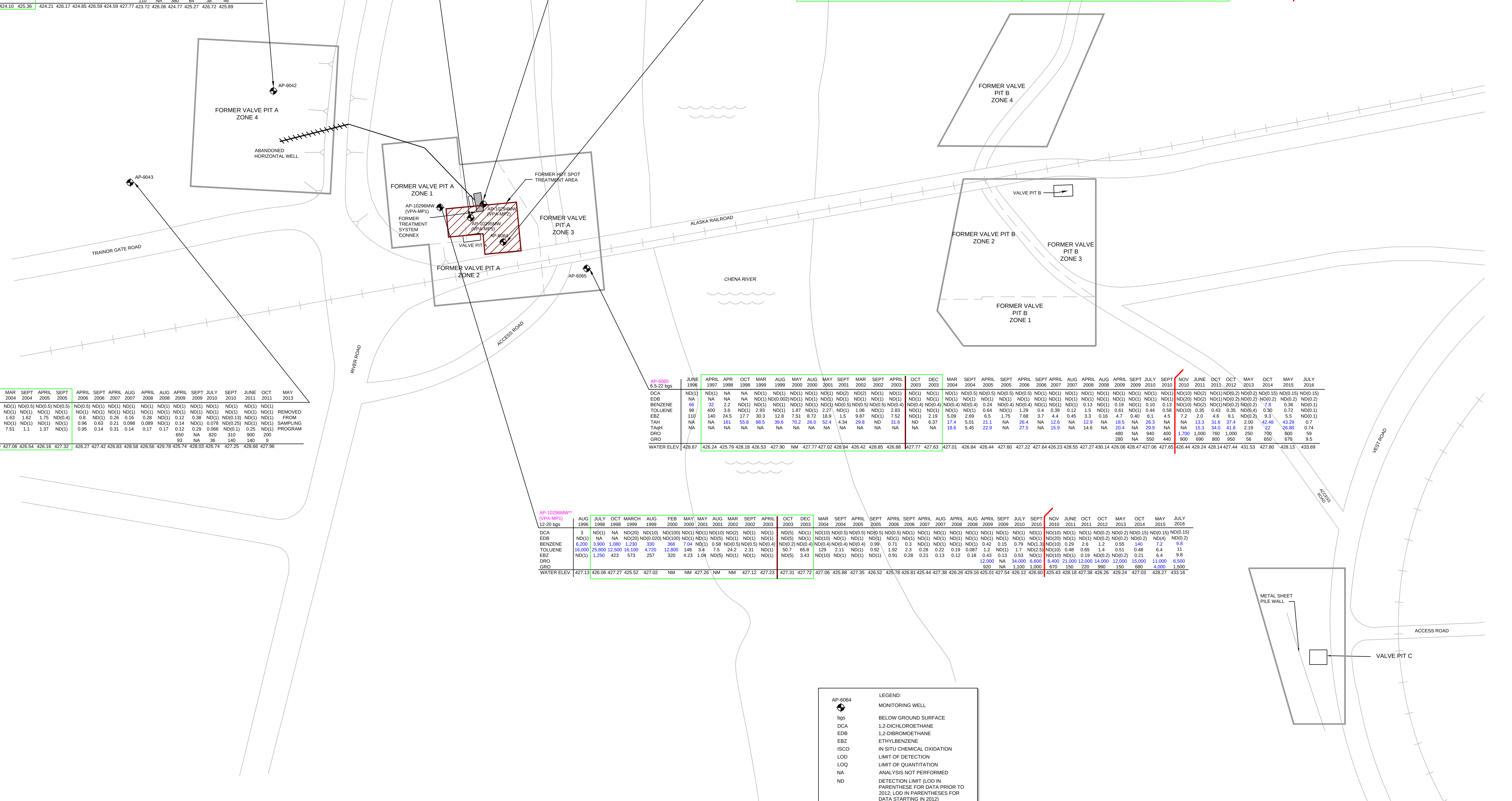
Figure 4-2 . Valve Pit A Groundwater Contamination Results











AP-10295MW** (VPA-MP5) 13-23 bgs

	AUG 2007	MAY 2008	AUG 2008	APRIL 2009	SEPT 2009	JULY 2010	SEPT 2010	NOV 2010	JUNE 2011	OCT 2011	OCT 2012	MAY 2013	OCT 2014	MAY 2015	JULY 2016
DCA	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(10)	ND(5)	ND(1)	ND(0.2)	ND(0.2)	ND(0.15)	ND(0.15)	ND(0.15)
EDB	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(20)	ND(5)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)	ND(0.2)	ND(0.2)
BENZENE	0.36	21	ND(1)	0.92	2.1	2.5	2.1	2.1	9.6	25	28	13	45	0.21	ND(0.1)
TOLUENE	0.46	310	0.14	0.56	0.75	3.1	1.5	6.8	64	72	2.1	3.8	2.9	27	ND(0.1)
EBZ	2.6	0.12	0.21	0.31	1	1.7	4.4	4.2	4.8	6	11	6.6	15	4	ND(0.1)
DRO				5,600	NA	31,000	6,300	25,000	14,000	11,000	26,000	10,000	23,000	7,900	560
GRO				230	NA	430	720	22,000	9,700	2,000	9,800	1,300	1,400	1,100	73
WATER ELEV.	429.07	427.79	430.20	426.17	428.68*	427.20	427.69	426.50	429.17	428.41	427.47	430.81	428.15	428.31	433.39

AP-10294MW** (VPA-MP2) 12-20 bgs

	OCT 1996	OCT 1997	JULY 1998	OCT 1998	MAR 1999	AUG 1999	MAY 2000	AUG 2000	MAY 2001	AUG 2001	MAR 2002	SEPT 2002	APRIL 2003	OCT 2003	DEC 2003	MAR 2004	SEPT 2004	APRIL 2005	SEPT 2005	APRIL 2006	SEPT 2006	APRIL 2007	AUG 2007	MAY 2008	AUG 2008	APRIL 2009	SEPT 2009	JULY 2010	SEPT 2010	NOV 2010	JUNE 2011	OCT 2011	OCT 2012	MAY 2013	OCT 2014	MAY 2015	JULY 2016
DCA	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(5)	ND(1)	ND(1)	ND(1)	ND(10)	ND(2)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(10)	ND(4)	ND(1)	ND(0.2)	ND(0.2)	ND(0.15)	ND(0.15)	ND(0.15)
EDB	ND(1)	NA	ND(10)	ND(1)	ND(1)	ND(0.010)	ND(1)	ND(1)	ND(1)	ND(5)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(20)	ND(4)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)	ND(0.2)	ND(0.2)
BENZENE	4,300	200	379	160	36.5	5.9	33.3	36.8	36.7	19.7	69.1	ND(0.5)	13.7	ND(0.4)	0.9	2.2	93.5	165	40.5	11.4	3.7	ND(1)	0.42	0.24	0.13	7.4	2.7	37	24	40	9	3.1	1.9	1.2	16	0.20	ND(0.1)
TOLUENE	13,000	1,400	1,695	1,285	372	104	135	237	210	109	254	40.6	289	ND(1)	62.8	206	412	598	11.7	143	3.1	0.61	0.52	26	9.0	160	5.1	28	35	190	21	32	0.91	3.5	14	12	ND(0.1)
EBZ	620	45	ND(1)	45	17.6	14	9.57	31.0	19	13.4	11.1	3.04	15.9	ND(1)	6.29	13.2	45.8	74.3	11.8	19.3	1.8	0.49	0.93	5.2	2.7	22	1.9	7.4	7.4	34	8.6	5.8	3.6	5.9	29	4.8	ND(0.1)
DRO																										10,000	NA	59,000	16,000	12,000	13,000	22,000	20,000	18,000	12,000	850	370
GRO																										4,500	NA	1,600	830	2,500	2,300	3,600	600	470	1,300	1,100	ND(25)
WATER ELEV.	427.29	NM	427.07	428.23	426.44	428.02	428.54	427.83	427.09	428.99	426.46	428.89	426.97	429.09	427.77	427.18	426.74	426.74	427.50	426.74	427.86	427.39	429.01	427.32	430.16	426.17	428.60	427.19	427.66	426.49	429.31	428.39	427.47	430.80	428.11	428.30	433.42

AP-9042* (GWP-24) 10.5-18.5 bgs

	JUNE 1996	APRIL 1998	SEPT 1998	MAR 1999	AUG 1999	MAY 2000	AUG 2000	MAY 2001	AUG 2001	MAR 2002	SEPT 2002	APRIL 2003	OCT 2003	DEC 2003	MAR 2004	SEPT 2004	APRIL 2005	SEPT 2005	APRIL 2006	SEPT 2006	APRIL 2007	AUG 2007	APRIL 2008	AUG 2008	APRIL 2009	SEPT 2009	JULY 2010	SEPT 2010	JUNE 2011	OCT 2011	MAY 2013
DCA	ND(50)	NA	NA	ND(2.5)	ND(5)	ND(1)	ND(1)	ND(1)	ND(2)	ND(2)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	
EDB	ND(50)	NA	NA	ND(2.5)	ND(0.010)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	REMOVED
BENZENE	270	68	64	10.7	44	5.04	24	1.22	33.4	24.4	ND(0.5)	28.4	ND(0.4)	1.99	13.2	ND(0.4)	ND(0.4)	ND(0.4)	6.18	ND(1)	1.3	2.0	2.8	2.6	3.3	2.8	5.6	0.74	0.70	1.5	FROM
TOLUENE	550	2.7	ND(1)	ND(2.5)	ND(5)	2.13	1.46	ND(1)	ND(1)	3.71	ND(1)	2.42	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	0.59	0.2	0.17	0.13	0.086	5.4	0.20	ND(1)	0.25	ND(0.25)	ND(1)	ND(1)	SAMPLING
EBZ	440	80	118	42.2	68.2	7.75	63.9	3.54	41.7	26.7	20.9	29.7	2.03	2.87	6.03	ND(1)	ND(1)	ND(1)	0.59	ND(1)	ND(1)	0.73	0.11	0.46	0.45	2.5	16	1.2	0.32	0.82	PROGRAM
DRO																									1,500	NA	2,200	240	400	710	
GRO																									110	NA	380	64	38	46	
WATER ELEV.	427.70	NM	428.22	426.35	427.81	428.42	427.83	427.00	428.98	426.35	429.01	426.89	428.13	427.74	427.06	425.17	424.10	425.36	424.21	426.17	424.85	426.59	424.59	427.77	423.72	426.06	424.77	425.27	426.72	425.89	

AP-6064 6.5-22 bgs

	JUNE 1996	OCT 1996	APR 1997	OCT 1997	APR 1998	OCT 1998	MAR 1999	AUG 1999	MAY 2000	AUG 2000	MAY 2001	AUG 2001	MAR 2002	SEPT 2002	APRIL 2003	OCT 2003	DEC 2003	MAR 2004	SEPT 2004	APRIL 2005	SEPT 2005	APRIL 2006	SEPT 2006	APRIL 2007	AUG 2007	MAY 2008	AUG 2008	APRIL 2009	SEPT 2009	JULY 2010	SEPT 2010	NOV 2010	JUNE 2011	OCT 2011	OCT 2012	MAY 2013	OCT 2014	MAY 2015	JULY 2016
DCA	ND(20)	ND(1)	ND(1)	ND(1)	NA	NA	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(2)	ND(2)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(10)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.15)	ND(0.15)	ND(0.15)
EDB	ND(20)	ND(1)	ND(1)	NA	NA	NA	ND(1)	ND(0.010)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(20)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)	ND(0.2)	ND(0.2)
BENZENE	1,300	26	180	2	57.4	ND(1)	21.7	ND(1)	28.8	2.95	184	61.1	14.7	ND(0.5)	ND(0.4)	ND(0.4)	ND(0.4)	ND(0.4)	ND(0.4)	2.27	29.8	176	5.9	65	ND(1)	ND(1)	ND(1)	2.3	14	11	7.5	36	3.8	3.6	3.9	0.73	9	36	ND(0.1)
TOLUENE	3,400	600	280	3	17.5	ND(1)	1.46	2.39	9.23	1.12	149	3.27	1.47	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	0.33	39.5	0.83	7.6	0.071	0.13	0.13	0.31	ND(1)	0.91	0.71	75	7.1	0.97	0.28	ND(0.4)	0.48	5.4	ND(0.1)
EBZ	480	60	26	16	22.6	4	9.52	3.42	14.7	2.77	9.74	10.3	2.2	ND(1)	ND(1)	3.14	ND(1)	ND(1)	ND(1)	ND(1)	0.45	19.9	1.2	8	ND(1)	ND(1)	0.17	2.1	0.54	10	2.5	17	9.9	2.2	0.6	0.34	0.41	8.5	ND(0.1)
DRO																												980	NA	3,200	680	4,800	2,500	2,800	1,600	500	4,000	2,000	110
GRO																												56	NA	270	120	1,000	510	98	43	36	41	310	ND(25)
WATER ELEV.	428.53	427.28	426.43	427.03	NM	429.54	426.56	427.98	NM	427.84	427.07	429.02	426.46	428.88	426.95	428.22	427.77	427.08	426.95	426.65	427.76	426.62	427.76	428.38	428.62	427.30	429.55	426.18	428.61	427.15	427.65	426.50	429.33	428.35	427.42	430.94	428.06	428.23	433.47

AP-9043* (GWP-567S) 8.5-16.5 bgs

	JULY 1996	OCT 1997	APRIL 1998	SEPT 1998	MAR 1999	AUG 1999	MAY 2000	AUG 2000	MAY 2001	AUG 2001	MAR 2002	OCT 2002	APRIL 2003	OCT 2003	DEC 2003	MAR 2004	SEPT 2004	APRIL 2005	SEPT 2005	APRIL 2006	SEPT 2006	APRIL 2007	AUG 2007	APRIL 2008	AUG 2008	APRIL 2009	SEPT 2009	JULY 2010	SEPT 2010	JUNE 2011	OCT 2011	MAY 2013
DCA	ND(1)	NA	NA	NA	ND(1)	ND(5)	ND(1)	ND(1)	ND(1)	ND(2)	ND(2)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	
EDB	NA	NA	NA	NA	ND(0.0190)	ND(0.002)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	REMOVED
BENZENE	34	86.5	77	86.5	20.8	42.8	27.3	11.2	13.2	8.11	6.71	1.67	5.11	0.52	1.37	1.63	1.62	1.75	ND(0.4)	0.8	ND(1)	0.26	0.16	0.28	ND(1)	0.12	0.38	ND(1)	ND(0.13)	ND(1)	ND(1)	FROM
TOLUENE	3	4.5	1.3	4.5	ND(1)	ND(5)	1.01	1.38	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	0.96	0.63	0.21	0.098	0.089	ND(1)	0.14	ND(1)	0.078	ND(0.25)	ND(1)	ND(1)	SAMPLING
EBZ	26	62	60	30	34.9	43	36	14.6	30.6	24.9	16.9	5.21	19.4	1.09	4.38	7.51	1.1	1.37	ND(1)	0.95	0.14	0.31	0.14	0.17	0.17	0.12	0.29	0.066	ND(0.1)	0.25	ND(1)	PROGRAM
DRO																										650	NA	820	310	900	200	
GRO																										93	NA	36	140	140	9	
WATER ELEV.	427.78	427.07	427.04	428.25	426.38	427.84	428.33	427.84	427.04	429.12	426.37	428.77	426.90	428.18	427.69	427.06	426.54	426.16	427.32	426.27	427.42	426.83	428.58	426.56	429.78	425.74	428.03	426.74	427.25	428.66	427.96	

AP-6065 6.5-22 bgs

	JUNE 1996	APRIL 1997	APR 1998	OCT 1998	MAR 1999	AUG 1999	MAY 2000	AUG 2000	MAY 2001	SEPT 2001	MAR 2002	SEPT 2002	APRIL 2003	OCT 2003	DEC 2003	MAR 2004	SEPT 2004	APRIL 2005	SEPT 2005	APRIL 2006	SEPT 2006	APRIL 2007	AUG 2007	APRIL 2008	AUG 2008	APRIL 2009	SEPT 2009	JULY 2010	SEPT 2010	NOV 2010	JUNE 2011	OCT 2011	OCT 2012	MAY 2013	OCT 2014	MAY 2015	JULY 2016
DCA	ND(1)	ND(1)	NA	NA	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(2)	ND(2)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(10)	ND(2)	ND(1)	ND(0.2)	ND(0.2)	ND(0.15)	ND(0.15)	ND(0.15)
EDB	NA	NA	NA	NA	ND(1)	ND(0.002)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(20)	ND(2)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)	ND(0.2)	ND(0.2)
BENZENE	66	32	2.2	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.4)	ND(0.4)	ND(0.4)	ND(0.4)	ND(0.4)	0.24	ND(0.4)	ND(0.4)	ND(1)	ND(1)	ND(1)	0.13	ND(1)	0.19	ND(1)	0.10	0.13	ND(10)	ND(2)	ND(1)	ND(0.2)	ND(0.2)	7.8	0.36	ND(0.1)
TOLUENE	98	400	3.6	ND(1)	2.93	ND(1)	1.87	ND(1)	2.27	ND(1)	1.06	ND(1)	2.83	ND(1)	ND(1)	ND(1)	ND(1)	0.64	ND(1)	1.29	0.4	0.39	0.12	1.5	ND(1)	0.61	ND(1)	0.44	0.58	ND(10)	0.35	0.43	0.35	ND(0.4)	0.30	0.72	ND(0.1)
EBZ	110	140	24.5	17.7	30.3	12.8	7.51	8.72	18.9	1.5	9.87	ND(1)	7.52	ND(1)	2.19	5.09	2.69	6.5	1.75	7.68	3.7	4.4	0.45	3.3	0.16	4.7	0.40	6.1	4.5	7.2	2.0	4.6	9.1	ND(0.2)	9.3	5.5	ND(0.1)
TAH	NA	NA	161	55.8	98.5	39.6	70.2	26.0	52.4	4.34	29.8	ND	31.6	ND	6.37	17.4	5.01	21.1	NA	26.4	NA	12.6	NA	12.9	NA	18.5	NA	26.3	NA	NA	13.3	31.6	37.4	2.00	42.48	43.29	0.7
TAqH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	18.6	5.45	22.9	NA	27.5	NA	15.9	NA	14.6	NA	20.4	NA	29.9	NA	NA	15.3	34.0	41.8	2.19	22	26.80	0.74
DRO																										480	NA	940	400	1,700	1,000	760	1,000	250	700	600	59
GRO																										280	NA	550	440	900	690	800	950	56	650	670	9.5
WATER ELEV.	428.67	426.24	425.79	428.18	426.53	427.90	NM	427.77	427.02	428.94	426.42	428.85	426.88	427.77	427.63	427.01	426.84	426.44	427.60	427.22	427.64	426.23	428.55	427.27	430.14	426.06	428.47	427.06	427.65	426.44	429.24	428.14	427.44	431.53	427.80	428.13	433.69

AP-10296MW** (VPA-MP1) 12-20 bgs

	AUG 1996	JULY 1998	OCT 1998	MARCH 1999	AUG 1999	FEB 2000	MAY 2000	MAY 2001	AUG 2001	MAR 2002	SEPT 2002	APRIL 2003	OCT 2003	DEC 2003	MAR 2004	SEPT 2004	APRIL 2005	SEPT 2005	APRIL 2006	SEPT 2006	APRIL 2007	AUG 2007	APRIL 2008	AUG 2008	APRIL 2009	SEPT 2009	JULY 2010	SEPT 2010	NOV 2010	JUNE 2011	OCT 2011	OCT 2012	MAY 2013	OCT 2014	MAY 2015	JULY 2016
DCA	3	ND(1)	NA	ND(20)	ND(10)	ND(100)	ND(1)	ND(1)	ND(10)	ND(2)	ND(1)	ND(1)	ND(5)	ND(1)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(10)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.15)	ND(0.15)	ND(0.15)
EDB	ND(1)	NA	NA	ND(20)	ND(0.020)	ND(100)	ND(1)	ND(1)	ND(5)	ND(1)	ND(1)	ND(1)	ND(5)	ND(1)	ND(10)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(20)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)	ND(4)	ND(0.2)
BENZENE	6,200	3,900	1,080	1,230	330	366	7.04	ND(1)	0.58	ND(0.5)	ND(0.5)	ND(0.4)	ND(0.2)	ND(0.4)	ND(0.4)	ND(0.4)	ND(0.4)	0.99	0.71	0.3	ND(1)	ND(1)	ND(1)	ND(1)	0.42	0.15	0.79	ND(1.3)	ND(10)	0.29	2.6	1.2	0.55	140	7.2	9.8
TOLUENE	16,000	25,800	12,500	16,100	4,720	12,800	148	3.4	7.5	24.2	2.31	ND(1)	50.7	65.8	129	2.11	ND(1)	0.92	1.92	2.3	0.28	0.22	0.19	0.087	1.2	ND(1)	1.7	ND(2.5)	ND(10)	0.48	0.65	1.4	0.51	0.48	6.4	11
EBZ	ND(1)	1,250	423	573	257	320	4.23	1.04	ND(5)	ND(1)	ND(1)	ND(1)	ND(5)	3.43	ND(10)	ND(1)	ND(1)	ND(1)	0.91	0.28	0.21	0.13	0.12	0.18	0.43	0.13	0.53	ND(1)	ND(10)	ND(1)	0.19	ND(0.2)	ND(0.2)	0.21	6.4	9.8
DRO																									12,000	NA	34,000	6,600	8,400	21,000	12,000	14,000	12,000	15,000	11,000	6,500
GRO																									920	NA	1,100	1,000	670	150	220	990	150	680	4,000	1,500
WATER ELEV.	427.13	426.06	427.27	425.52	427.02	NM	NM	427.26	NM	NM	427.12	427.23	427.31	427.72	427.06	425.88	427.35	426.52	425.78	426.81	425.44	427.38	426.26	429.16	425.01	427.54	426.12	426.60	425.43	428.18	427.38	426.26	429.24	427.03	428.27	433.16

LEGEND:

AP-6064	MONITORING WELL
bgs	BELOW GROUND SURFACE
DCA	1,2-DICHLOROETHANE
EDB	1,2-DIBROMOETHANE
EBZ	ETHYLBENZENE
ISCO	IN SITU CHEMICAL OXIDATION
LOD	LIMIT OF DETECTION
LOQ	LIMIT OF QUANTITATION
NA	ANALYSIS NOT PERFORMED
ND	DETECTION LIMIT (LOD IN PARENTHESE FOR DATA PRIOR TO 2012; LOD IN PARENTHESES FOR DATA STARTING IN 2012)
NM	NOT MEASURED
ORC	OXYGEN RELEASING COMPOUND
* *	THE TAH RESULT FOR THIS SAMPLE DOES NOT INCLUDE XYLENE CONCENTRATIONS
TAH	TOTAL AROMATIC HYDROCARBONS
TAqH	TOTAL AQUEOUS HYDROCARBONS

REMEDIAL ACTION GOALS
IN µg/L

5	DCA
0.05	EDB
5	BENZENE
1,000	TOLUENE
700	EBZ

ADEC GROUNDWATER
CLEANUP LEVELS
IN µg/L

1,500	DRO
2,200	GRO

AWQS
IN µg/L

10	TAH
15	TAqH

NOTES:

1. VALVE PIT A VAPOR EXTRACTION SYSTEM WAS TURNED ON IN MAY 2008 THEN TURNED OFF IN OCTOBER 2008.
2. ONLY SPRING AND FALL SAMPLE RESULTS ARE PRESENTED.
3. * REPLACEMENT WELLS WERE INSTALLED IN SEPTEMBER 2004. RESULTS FROM SEPTMEBER 2004 AND AFTER ARE FROM SAMPLES COLLECTED FROM REPLACEMENT WELLS. ALL OTHER RESULTS ARE FROM THE GROUNDWATER PROBE SHOWN IN PARENTHESES.
4. BEGINNING IN 2006 TAH AND TAQH CONCENTRATIONS WERE CALCULATED USING HALF THE REPORTING LIMIT FOR ND ANALYTES. PREVIOUS CONCENTRATIONS MAY NOT INCLUDE ESTIMATES FOR ND ANALYTES.
6. DATA FLAGS (QUALIFIERS) ARE NOT SHOWN DUE TO SPACE LIMITATIONS.
7. STARTING IN 2010, THE HIGHEST CONCENTRATION BETWEEN PRIMARY AND DUPLICATE SAMPLES IS SHOWN FOR WELLS WHERE DUPLICATE SAMPLES WERE COLLECTED.
8. **REPLACEMENT WELLS WERE INSTALLED IN SPRING 2015. RESULTS FROM APRIL/MAY 2015 AND AFTER ARE FROM SAMPLES COLLECTED FROM REPLACEMENT WELLS. ALL OTHER RESULTS ARE FROM THE GROUNDWATER PROBE/WELL SHOWN IN PARENTHESES.

KEY:

MONITORING WELL
SCREENED INTERVAL DEPTH IN FEET bgs
ELEVATIONS IN FEET MEAN SEA LEVEL (NGVD '29 DATUM)

AP-6064 8.5-16.5 bgs	JUNE 1996	OCT 1996	APR 1997
DCA	ND(20)	ND(1)	ND(1)
EDB	ND(20)	ND(1)	ND(1)
BENZENE	1,300	26	180
TOLUENE	3,400	600	280
EBZ	480	60	26
WATER ELEVATIONS	428.53	427.28	426.43

CONCENTRATIONS EXCEEDING APPLICABLE STANDARD SHOWN IN BLUE
CONCENTRATIONS IN MICROGRAMS PER LITER µg/L

TREATMENT HISTORY:

THE GREEN BOX REPRESENTS GROUNDWATER SAMPLING EVENTS CONDUCTED WHEN THE TREATMENT SYSTEM ZONE WAS OPERATING

BROWN LINES REPRESENT THE TIME FRAME FOLLOWING AIR SPARGE PROBE REHABILITATION

BLACK LINES REPRESENT WHEN THE HOT SPOT TREATMENT BEGAN

RED LINES REPRESENT WHEN THE TREATABILITY OCCURRED

VALVE PIT A

1. TREATMENT SYSTEM OPERATION INITIATED 1996
2. ZONE 4 AND HORIZONTAL WELL INSTALLED IN 2000
3. SHUTDOWN ZONES 1 AND 3 IN 2004 TO CONDUCT A REBOUND STUDY
4. SHUTDOWN ZONE 4 AND HORIZONTAL WELL IN 2005 TO CONDUCT A REBOUND STUDY
5. HOT SPOT OPERATION BEGAN IN 2007
6. SHUTDOWN ZONE 2 AND HOT SPOT IN 2009 TO CONDUCT A REBOUND STUDY
7. DECOMMISSIONED ZONE 4 IN 2009 AND ZONES 1-3 IN 2013
8. ISCO AND ORC TREATABILITY STUDY INITIATED OCTOBER 2010

NORTH

0 60 120

Scale in Feet

FAIRBANKS ENVIRONMENTAL SERVICES
3538 INTERNATIONAL STREET
FAIRBANKS, ALASKA

ALASKA DISTRICT
CORPS OF ENGINEERS
ANCHORAGE, ALASKA

Groundwater Concentrations at Valve Pit A

Valve Pit A Treatability Study Report
Operable Unit 3
Fort Wainwright, Alaska

CONTRACT:	FIGURE:	DATE:
W911KB-12-D-0001	4-3	1/18

5.0 TREATABILITY STUDY DISCUSSION

This section presents a discussion of the impacts from the treatability study on the monitoring program and the progress towards achieving RAGs and the ADEC cleanup levels. This section also discusses the treatability study cost effectiveness, along with lessons learned that may be helpful for use of this technology at other sites at Fort Wainwright or Alaska in general.

5.1 In-Situ Injection Treatment Effectiveness

As discussed in Section 2, the primary goal of the ISCO and ORC treatability study was to evaluate treatment of the residual benzene contamination remaining above cleanup levels after operation of the Hot Spot AS/SVE system. Groundwater geochemistry results (presented in Section 4) showed changes consistent with addition of the chemical oxidation product up to the 2015 sampling event, although contaminant degradation from chemical oxidation could not be specifically measured. Groundwater geochemistry changes consistent with aerobic biodegradation were observed up to one year following the injection. These results suggest the groundwater conditions resulting from the injection were favorable for treatment of contamination through chemical oxidation and aerobic biodegradation. The length of the impact on groundwater geochemistry (up to five years) beyond what was published in the product literature (up to one year) highlights the impact from localized groundwater flow changes attributed to the Chena River. Groundwater in the ROLF was evaluated as part of the RI, and the groundwater flow direction was found to be impacted by the stage of the Chena River (E&E, 1994). CRREL has also evaluated the groundwater flow and found that the flow direction may vary up to 180° from the regional groundwater flow direction (northwest) (E&E, 1994). It is likely that the injection products were retained within the injection area longer than expected due to impact on groundwater flow from the Chena River.

Evaluation of the contaminant concentration changes in groundwater showed increases in benzene and GRO concentrations in several wells immediately following the injection, which was likely associated with the surfactant effect from the injection products that mobilized contaminants from the soil to the groundwater. The contaminants are more readily degradable in the groundwater phase, and visual trends indicate contaminant concentrations, including DRO, GRO, and benzene, have decreased over time since the injection in 2010. The only exception to the decreasing contaminant trend is the Alaska Water Quality Criteria TAH and TAqH in AP-6065. The TAH and TAqH concentrations have been variable since the injection treatability study, and the injection did not appear to have a significant impact on these parameters in AP-6065.

A comparison of the wells with cleanup level exceedances, including contaminant concentrations before and after the injection, based on the September 2010 and July 2016 sampling results, is presented in Table 5-1.

Table 5-1. VPA Groundwater COC Summary

Sampling Event	Monitoring Wells with Cleanup Level Exceedances (COC – Well ID)	
	ROD COCs	**ADEC COCs**
PRE-INJECTION – September 2010	Benzene: VPA-MP1 – ND **VPA-MP2 – 24 µg/L** **AP-6064 – 7.5 µg/L**	DRO: **VPA-MP1 – 6,600 µg/L** **VPA-MP2 – 16,000 µg/L** **VPA-MP5 – 6,300 µg/L**
POST INJECTION – July 2016	Benzene: **AP-10296MW (VPA-MP1) – 9.8 µg/L** AP-10294MW (VPA-MP2) – ND AP-6064 – ND	DRO: AP-10296MW (VPA-MP1) 1,500 – µg/L AP-10294MW (VPA-MP2) 370 – µg/L AP-10295MW (VPA-MP5) 560 – µg/L

ND = Not detected

BOLD indicates the concentration exceeded the cleanup level

5.2 Changes to the Valve Pit A Monitoring Program

Prior to the injection treatability study, groundwater samples were collected on a semiannual basis at VPA. More frequent samples were collected as part of the treatability study in 2010 and 2011 to evaluate the effectiveness of the injection. In 2011, the groundwater monitoring program at VPA was included in a Long-Term Monitoring Optimization (LTMO) evaluation for OU3 sites, and several changes were recommended. These changes included elimination of monitoring wells in VPA Zone 4 (AP-9042 and AP-9043), and a reduction in sampling frequency from semiannual to annual (FES, 2012).

5.3 Treatability Study Cost Effectiveness

Although a formal cost evaluation was not completed for the treatability study, the general costs were discussed at the January 2013 FFA meeting attended by the Army, ADEC, and EPA. The first consideration was that the AS/SVE treatment system had been removed, and it would be cost prohibitive to install a new system for treatment of the residual benzene contamination. Evaluation of the ISCO/ORC injection costs showed the injection would be approximately equivalent to three years of the semi-annual groundwater monitoring effort.

The impact of the injection was an elimination of two wells from the monitoring program, and a reduction in sampling frequency from semiannual to annual. This provided an annual savings of more than 50% for the monitoring program starting in 2012.

5.4 Treatability Study Lessons Learned

The procedures and results of the treatability study were reviewed to identify factors that may be considered for future injection projects on Fort Wainwright or at other sites in Alaska. The "lessons learned" from the Valve Pit A treatability study include:

- Combination of ICSO and ORC products were easily obtained and shipped to the project site.
- The injection process was relatively easy to accomplish at Fort Wainwright due to the shallow depth to groundwater and high transmissivity of the sandy gravel subsurface soils.
- Although the amount of contaminant destruction due to chemical oxidation was difficult to quantify, temporary geochemical changes were observed in groundwater consistent with chemical oxidation reactions (i.e. ORP and pH increase).
- Groundwater geochemistry results also showed DO concentrations were increased temporarily, consistent with injection of the ORC to stimulate biodegradation.
- Residual influence of the injection, as measured by changes in the groundwater geochemistry parameters of pH and conductivity, was approximately 5 years, which was longer than anticipated based on the product literature. The increased time of influence may be attributed to the influence on groundwater flow direction from the nearby Chena River.
- The concentration of the ISCO product was not measured at the time of sampling, and studies have indicated that if an oxidant is present, it is possible that oxidation will continue after the sample is collected. Recent EPA guidelines regarding sampling at ISCO sites should be considered in future injection projects (EPA, 2012).
- ISCO products were found to be highly corrosive to the rubber components of the injection equipment, and several O-rings and gaskets were changed through the course of the injection.
- Injection of RegenOx™ in cold temperatures required actions to keep the RegenOx™ Part B from freezing since it was shipped as a slurry.
- Teflon tape was required on the threads of the injection rods to minimize surfacing and short circuiting of the injection product.

6.0 REFERENCES

ADEC, 2017a. *18 AAC 75 – Oil and Other Hazardous Substances Pollution Control.* Revised as of November 7, 2017.

ADEC, 2017b. *18 AAC 70 – Water Quality Standards.* Amended as of February 5, 2017.

BNC International (BNCI), 2007. *Technical Memorandum for POL Source Removal – 2006 Field Season.* Fort Wainwright, Alaska.

BNCI, 2004. *Draft Remedial Action Report for POL Source Removal.* Fort Wainwright, Alaska.

E&E, 1995. *Feasibility Study, Operable Unit 3.* Fort Wainwright. April.

E&E, 1994. *Remedial Investigation Report, Operable Unit 3*. Fort Wainwright. September.

Fairbanks Environmental Services (FES), 2017. *2016 OU3 Monitoring Report.* Fort Wainwright, Alaska.

FES, 2013. *2013 Decommissioning of Central Header and Valve Pit A Treatment Systems.* Fort Wainwright, Alaska. December.

FES, 2012. *2011 Monitoring Report, Operable Unit 3.* Fort Wainwright, Alaska. August.

Hart Crowser, 1998. *1997 Monitoring Report, Design Verification Study, Operable Unit 3*. Fort Wainwright, Alaska. March.

Hart Crowser, 1997a. *1996 Monitoring Report, Design Verification Study, Operable Unit 3*. Fort Wainwright Alaska. March.

Oil Spill Consultants, Inc. (OSCI). 2001. *Draft Remedial Action Report for POL Source Removal (Including Options 1, 2, and 3)*. Fort Wainwright, Alaska.

USARAK, 2006. *Second Five Year Review of Records of Decision, Fort Wainwright, Alaska.* September.

USARAK, 2002. *Explanation of Significant Differences, Operable Unit 3.* Fort Wainwright, Alaska. September.

USARAK, 2001. *First Five Year Review of Records of Decision, Fort Wainwright, Alaska.* September.

U.S. Army, 1996. *Record of Decision for Operable Unit 3*. Fort Wainwright, Fairbanks, Alaska. January.

U.S. Environmental Protection Agency (EPA), 2012. *Ground Water Sample Preservation at In-Situ Chemical Oxidation Sites – Recommended Guidelines.* EPA/600/R-12-049. August.

Woodward-Clyde Consultants (WCC), 1989. *Installation Restoration Program Stage 1, Site 3, Fort Wainwright Landfill, Vol. 3.* June

APPENDIX A

FIELD NOTES

10/7/10 Cloudy, 30°F 1/3

0730 Arrive at FES and loaded flatbed for injection work at Valve Pit A

0800 Arrive at DERA building - begin breaking down packaging in the container to load Regenesis products.

0830 Met Paul and Scott and then moved over to VPA. Unloaded trailer and went back to the DERA yard w/ Scott to load Regenesis material.

1100 Left DERA yard - received phone call from Kristin (FES-ANC) about GPS/GIS stuff.

1130 Left DERA yard and filled up 500 gallon water tank @ the fire station

1200 Arrived back on site at VPA and helped Scott organize equipment until Paul came at 1300.

10/7/10 Cloudy, snow, 30°F 2/3

1310 Went back to FES to pick up injection details and verify injection amounts.

1420 Arrived at VPA. Held safety meeting and started setting up to start.

1450 Bryan J. (FES) called and needed GPS help for excavation and sampling locations. Left VPA and went to ROLF to collect GPS points

1520 Arrived back at Valve Pit A. Honda generator to run sump pumps and drill was not working. Paul and Scott were trying to fix it.

As they were trying to fix it, we found there was power in the VPA connex. We plugged an extension cord and power strip in and got the pumps running

10/7/10 Cloudy, 35°F 3/3

1600 As we filled the water batch tank and Scott started rinsing it out, we found a fitting (valve) from the water batch tank to the mixer had cracked. We continued washing out the pump and flusing out the lines. Scott removed the valve, and we cleaned up and put everything away for the day

1710. Left site and returned to FES. Unloaded and left FES at 1730

A.S.

10/8/10 Cloudy, Snow, 30°F 1/3

0740 Arrived at FES and loaded up Flatbed for the day

0800 Left FES for FWA

0815 Arrived on site at VPA, Scott (Hammer Env.) arrived at 0820 and started warming up equipment

0830 Andy (Hammer Env.) Arrived to help set up. He was not here yesterday, and we had a health and safety mtg to discuss operations.

0900 Paul (Hammer Env.) arrived with the new valve, The valve was replaced and we started figuring out the chemical mix.

Each hole - 137 lbs Regenox Part A
51 lbs " Part B
32 lbs ORC-A

10/8/10 Part Cloudy, flurries, 30°F 2/3

Each hole will be broken down into 5 intervals. Each interval will have 50 gallons of water:

27.4 lbs RegenOx Part A
10 lbs RegenOx Part B
6 lbs ORC-A

1015 Start @ VPA-1
10' - would not take injection
12' - full batch
14' - full batch
16' - "
18' - "
20' - "

We noticed the valve in the pump was leaking a significant amount of product. Paul and Scott took apart the part of the pump and found a gasket was bad. Paul left at 1130 to get new gasket before starting hole #2.

1150 Left site to get more water at Firestation.

10/8/10 Cloudy, 35°F 3/3

* Note also that the rods were removed from hole #1 and the hole stayed open

1215 Arrived back on site at VPA with full water tank.

1300 Paul arrived with the other gaskets for the pump

1615 Hole #2
10' - Full Batch
12' - partial
pump quit, Piston would not return to position. Cleaned up and left for the night

1800 Arrived at FES and unloaded. Left FES @ 1810.

AS

10/11/10 Cloudy, 40°F, snow 1/3

0800 Paul Caan called to tell me that they had identified the problem with the pump - fixed groove with epoxy and installed new O-rings. New parts are on order with ChemGrout. He expected that the pump would be back online and we could start injecting by the afternoon.

1145 Load flatbed and prep for injection

1230 Arrived on site and set up for injection

1330 Started again at hole #2
- 12' - full batch
- 14' - full batch ~5gal surfacing
- 16' - full batch
- 18' - full batch

10/11/10 Cloudy, 40°F 2/3

1400 Hole #3
- 10' - started surfacing - pushed to 12'
- 12' - full batch
- 14' - full batch
- 16' " "
- 18' - some slight surfacing

1440 Hole #4
- 10' - full batch
- 12' - full batch
- 14' - full batch
- 16' - ½ batch - tip was clogged drove second rod next to the original hole. Found the tip had been clogged with partially dissolved part A.
  - As Scott was removing the hose, some product splashed in his face. He used a bottle of eye wash and said he felt OK.
- 16' - ½ batch (completes full batch)
- 18' full batch

1540 10' - full batch
12' - "
14' - "
16' - "
18' - "

Faster mixing achieved w/ faster mixing rate. Part A more completely dissolved

1640 Left site for the night

1655 Arrived at FES and unloaded for the night.

1710 Left FES

A.S.

0715 Arrived at FES and loaded flatbed

0740 Met Scott and Paul @ DERA yard to unload the rest of the material. I picked up water on the way back to UPA

0850 Arrived back on site and Hammer (Tim, Andy, Paul, Scott) had set things up and gotten them ready for the first hole

0900 Hole #6
10' - would not inject - surfacing
12' - full batch
14' - full batch
16' - full batch + water to flush it out
18' - Drove new rod adjacent. Found zip ties stuck in the tip. Full batch completed after driving 3rd try
20' Full batch

10/12/10 Cloudy, 35°F, snow 4/5

1620 Hole # 13
10' – full batch
12' – "
14' – "
16' – "
18' – " / Paul left to get water after this hole

1650 Hole # 14
10' – surfacing
12' – full batch
14' – full batch
16' – "
18' – "
20 – "

1725 Hole # 15
10' – full batch
12' – full batch
14' –
16' – "
18' – "

Pump was giving out on the last interval. Hammer took it apart as I was leavin

10/12/10 Cloudy, snow, 35°F 5/5

1800 Left site for FES

1815 Arrived at FES and unloaded and cleaned up for the night

1900 Left FES for the night.

AS.

10/13/10 Cloudy, 32°F 1/4

0715 Arrive at FES and load flatbed

0730 Leave FES for FWA

0745 Arrive at VPA

0815 Hammer arrived on site. I left with Paul to fill up w/ water as Tim/Scott put the new pump on.

0900 Arrived back on site w/ water. Pump had been fixed. Started mixing a batch for hole # 16

0910 Hole #16
10' - full batch
12' - "
14' - "
16' - "
18' - "

0940 Hole #17
10' - 1/2 batch
12' - 1/2 batch

10/13/10 Cloudy, 32°F 2/4

0950 Hole # 17 cont'd
14' - full batch
16' - full batch
18' - "
20' - "

1020 Hole # 18
10' - significant surfacing } full batch
12' - slight surfacing }
14' - full batch
16' - "
18' - "
20' - "

1105 Hole #19
10' - 1/2 batch, then sig. surfacing
12' - 1/2 batch
14' - full batch
16' - "
18' - "
20' - "

Finished this hole, sealed it w/ bentonite, and then moved to the last 2 holes near AP-6065

10/13/10 Cloudy, 30°F

1200 Left site to pick up generator for sump pumps, and radio for Z111 site

1330 Arrived back on site w/ generator and radio. Collected spatial data of VPA injection points completed using Trimble GeoXT and Terrasync
10132010_1

1400 Injection Hole # 20
10' - full batch
12' - "
14' - "
16' - "
18' - "

Some slight surfacing in path down to the river at approximately 5' away from the point, but no product observed in the river

1445 # 21
10' - significant surfacing. Push to 12'
12'
14'

10/13/10 Cloudy, 35°F

16' - full batch
18' - "
20' - " ← Paul went to get water

Finished with that hole and cleaned up and prepared to move to Z111

1630 Left ~~DERA~~ VPA yard and moved to DERA yard to unload garbage and load more injection material.

1730 Left the DERA yard for the Z111 site

1745. Arrived on site and set up pump, compressor, and drill rig for the morning. Finished setting out injection points

1830. Left the site for FES

1845 Arrived at FES and unloaded
1900 Left FES for home.

A.S.

APPENDIX B

SURVEY DATA

Table B-1. Valve Pit A Treatability Study Injection Point Survey Results
Fort Wainwright, Alaska

Point ID	Site Name	X[1]	Y[1]	Narrative	Date	Time
VPA-1	Valve Pit A	469123.7942	7191144.767	RegenOx Injection point	10/13/2010	12:35:42pm
VPA-2	Valve Pit A	469114.4916	7191149.851	RegenOx Injection point	10/13/2010	12:55:27pm
VPA-3	Valve Pit A	469119.911	7191143.685	RegenOx Injection point	10/13/2010	12:36:17pm
VPA-4	Valve Pit A	469121.4398	7191150.611	RegenOx Injection point	10/13/2010	12:34:31pm
VPA-5	Valve Pit A	469113.4224	7191158	RegenOx Injection point	10/13/2010	01:02:43pm
VPA-6	Valve Pit A	469122.5378	7191147.703	RegenOx Injection point	10/13/2010	12:35:02pm
VPA-7	Valve Pit A	469111.8697	7191149.328	RegenOx Injection point	10/13/2010	12:57:50pm
VPA-8	Valve Pit A	469118.7861	7191157.411	RegenOx Injection point	10/13/2010	12:33:00pm
VPA-9	Valve Pit A	469105.8692	7191150.223	RegenOx Injection point	10/13/2010	12:59:21pm
VPA-10	Valve Pit A	469104.8437	7191153.448	RegenOx Injection point	10/13/2010	12:59:55pm
VPA-11	Valve Pit A	469112.3548	7191155.192	RegenOx Injection point	10/13/2010	01:01:32pm
VPA-12	Valve Pit A	469120.2052	7191154.536	RegenOx Injection point	10/13/2010	12:33:58pm
VPA-13	Valve Pit A	469119.1501	7191147.495	RegenOx Injection point	10/13/2010	12:51:36pm
VPA-14	Valve Pit A	469116.0638	7191156.426	RegenOx Injection point	10/13/2010	12:49:36pm
VPA-15	Valve Pit A	469113.5595	7191152.929	RegenOx Injection point	10/13/2010	12:42:53pm
VPA-16	Valve Pit A	469117.0835	7191153.952	RegenOx Injection point	10/13/2010	12:50:22pm
VPA-17	Valve Pit A	469108.2248	7191154.34	RegenOx Injection point	10/13/2010	12:47:12pm
VPA-18	Valve Pit A	469118.1988	7191151.122	RegenOx Injection point	10/13/2010	12:50:58pm
VPA-19	Valve Pit A	469109.9472	7191151.257	RegenOx Injection point	10/13/2010	12:58:31pm
VPA-20	Valve Pit A	469148.2693	7191134.79	RegenOx inection point	10/13/2010	03:15:59pm
VPA-21	Valve Pit A	469151.1707	7191135.632	RegenOx inection point	10/13/2010	03:17:59pm

NOTES:

1. GPS Data collected with a Trimble GeoXT and post-processed using Trimble Pathfinder Office 4.2
2. Spatial Reference: WGS84, UTM, Zone 6N, meters

APPENDIX C

PHOTO LOG

Valve Pit A injection area (view to the east)

Geoprobe 6610DT drill rig and the Valve Pit A injection area (view to the southwest)

Geoprobe pressure-activated tip (view to the southwest)

ChemGrout 500 pump with mixing hopper (view to the west)

Regenesis remediation products (L-R - RegenOx Part A; ORC-A; RegenOx Part B) (view N/A)

Regenesis remediation products in the ChemGrout mixing hopper (view N/A)

Regenesis remediation products staged on site in 5-gallon buckets (view to the southwest)

Completed injection point prior to removing injection rods (view to the northwest)

Filling a completed injection point with bentonite crumbles (view N/A)

Completing an injection point near AP-6065 (view to the southeast)

APPENDIX D

UIC FORMS AND CORRESPONDENCE

Type or print all information. See reverse for instructions. OMB No. 2040-0042 Approval Expires 12/31/2011

INVENTORY OF INJECTION WELLS

EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF GROUND WATER AND DRINKING WATER

(This information is collected under the authority of the Safe Drinking Water Act)

1. DATE PREPARED *(Year, Month, Day)*: 10-09-03

2. FACILITY ID NUMBER: AK6210022426

PAPERWORK REDUCTION ACT NOTICE

The public reporting burden for this collection of information is estimated at about 0.5 hour per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, Director, Collection Strategies Division (2822), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, Washington, DC 20460, and to the Office of Management and Budget, Paperwork Reduction Project, Washington, DC20503.

3. TRANSACTION TYPE *(Please mark one of the following)*

- [ ] Deletion
- [x] First Time Entry
- [ ] Entry Change
- [ ] Replacement

4. FACILITY NAME AND LOCATION

A. NAME *(last, first, and middle initial)*: Fort Wainwright, Alaska

B. STREET ADDRESS/ROUTE NUMBER: Valve Pit A

C. LATITUDE

DEG	MIN	SEC
64	50	36.00

D. LONGITUDE

DEG	MIN	SEC
147	39	04.00

E. TOWNSHIP/RANGE

TOWNSHIP	RANGE	SECT	1/4 SECT
1S	1W	12	

F. CITY/TOWN: Fort Wainwright

G. STATE: AK

H. ZIP CODE: 99703 4500

I. NUMERIC COUNTY CODE:

J. INDIAN LAND *(mark "x")*: [ ] Yes [x] No

5. LEGAL CONTACT:

A. TYPE *(mark "x")*: [ ] Owner [x] Operator

B. NAME *(last, first, and middle initial)*: Malen, Joe

C. PHONE *(area code and number)*: (907) 361-4512

D. ORGANIZATION: U.S. Army Directorate of Public Works

E. STREET/P.O. BOX: 1060 Gaffney Road #4500

F. CITY/TOWN: Fort Wainwright

G. STATE: AK

H. ZIP CODE: 99703 4500

I. OWNERSHIP *(mark "x")*

- [ ] PRIVATE
- [ ] PUBLIC
- [ ] SPECIFY OTHER
- [ ] STATE
- [x] FEDERAL

6. WELL INFORMATION:

A. CLASS AND TYPE		B. NUMBER OF WELLS		C. TOTAL NUMBER OF WELLS	D. WELL OPERATION STATUS				
		COMM	NON-COMM		UC	AC	TA	PA	AN
5	X26		21	21					21
				0					
				0					
				0					
				0					
				0					
				0					

COMMENTS *(Optional)*:

Groundwater remediation injection was completed as part of a CERCLA approved remedy and consisted of 21 one-time use points approximately 10 feet apart. Approximately 240 pounds of a chemical oxidation compound (Regenesis RegenOx) and 32 pounds of an oxygen releasing compound (Regenesis ORC-Advanced) were injected over a depth between 10 to 20 feet below ground surface. The product was injected using direct-push techniques in October 2010.

KEY:

DEG = Degree
MIN = Minute
SEC = Second
SECT = Section
1/4 SECT = Quarter Section

COMM = Commercial
NON-COMM = Non-Commercial
AC = Active
UC = Under Construction
TA = Temporarily Abandoned
PA = Permanently Abandoned and Approved by State
AN = Permanently Abandoned and not Approved by State

EPA Form 7520-16 (Rev. 12-08)

SECTION 1. DATE PREPARED: Enter date in order of year, month, and day.

SECTION 2. FACILITY ID NUMBER: In the first two spaces, insert the appropriate U.S. Postal Service State Code. In the third space, insert one of the following one letter alphabetic identifiers:

D - DUNS Number,
G - GSA Number, or
S - State Facility Number.

In the remaining spaces, insert the appropriate nine digit DUNS, GSA, or State Facility Number. For example, A Federal facility (GSA - 123456789) located in Virginia would be entered as : VAG123456789.

SECTION 3. TRANSACTION TYPE: Place an "x" in the applicable box. See below for further instructions.

Deletion. Fill in the Facility ID Number.
First Time Entry. Fill in all the appropriate information.
Entry Change. Fill in the Facility ID Number and the information that has changed.
Replacement.

SECTION 4. FACILITY NAME AND LOCATION:

A. **Name.** Fill in the facility's official or legal name.
B. **Street Address.** Self Explanatory.
C. **Latitude.** Enter the facility's latitude (all latitudes assume North Except for American Samoa).
D. **Longitude.** Enter the facility's longitude (all longitudes assume West except Guam).
E. **Township/Range.** Fill in the complete township and range. The first 3 spaces are numerical and the fourth is a letter (N,S,E,W) specifying a compass direction. A township is North or South of the baseline, and a range is East or West of the principal meridian (e.g., 132N, 343W).
F. **City/Town.** Self Explanatory.
G. **State.** Insert the U.S. Postal Service State abbreviation.
H. **Zip Code.** Insert the five digit zip code plus any extension.

SECTION 4. FACILITY NAME & LOCATION (CONT'D.):

I. **Numeric County Code.** Insert the numeric county code from the Federal Information Processing Standards Publication (FIPS Pub 6-1) June 15, 1970, U.S. Department of Commerce, National Bureau of Standards. For Alaska, use the Census Division Code developed by the U.S. Census Bureau.
J. **Indian Land.** Mark an "x" in the appropriate box (Yes or No) to indicate if the facility is located on Indian land.

SECTION 5. LEGAL CONTACT:

A. **Type.** Mark an "x" in the appropriate box to indicate the type of legal contact (Owner or Operator). For wells operated by lease, the operator is the legal contact.
B. **Name.** Self Explanatory.
C. **Phone.** Self Explanatory.
D. **Organization.** If the legal contact is an individual, give the name of the business organization to expedite mail distribution.
E. **Street/P.O. Box.** Self Explanatory.
F. **City/Town.** Self Explanatory.
G. **State.** Insert the U.S. Postal Service State abbreviation.
H. **Zip Code.** Insert the five digit zip code plus any extension.
I. **Ownership.** Place an "x" in the appropriate box to indicate ownership status.

SECTION 6. WELL INFORMATION:

A. **Class and Type.** Fill in the Class and Type of injection wells located at the listed facility. Use the most pertinent code (specified below) to accurately describe each type of injection well. For example, 2R for a Class II Enhanced Recovery Well, or 3M for a Class III Solution Mining Well, etc.
B. **Number of Commercial and Non-Commercial Wells.** Enter the total number of commercial and non-commercial wells for each Class/Type, as applicable.
C. **Total Number of Wells.** Enter the total number of injection wells for each specified Class/Type.
D. **Well Operation Status.** Enter the number of wells for each Class/Type under each operation status (see key on other side).

CLASS I Industrial, Municipal, and Radioactive Waste Disposal Wells used to inject waste below the lowermost Underground Source of Drinking Water (USDW).

TYPE
1I Non-Hazardous Industrial Disposal Well.
1M Non-Hazardous Municipal Disposal Well.
1H Hazardous Waste Disposal Well injecting below the lowermost USDW.
1R Radioactive Waste Disposal Well.
1X Other Class I Wells.

CLASS II Oil and Gas Production and Storage Related Injection Wells.

TYPE
2A Annular Disposal Well.
2D Produced Fluid Disposal Well.
2H Hydrocarbon Storage Well.
2R Enhanced Recovery Well.
2X Other Class II Wells.

CLASS III Special Process Injection Wells.

TYPE
3G *In Situ* Gasification Well
3M Solution Mining Well.

CLASS III (CONT'D.)

TYPE
3S Sulfur Mining Well by Frasch Process.
3T Geothermal Well.
3U Uranium Mining Well.
3X Other Class III Wells.

CLASS IV Wells that inject hazardous waste into/above USDWs.

TYPE
4H Hazardous Facility Injection Well.
4R Remediation Well at RCRA or CERCLA site.

CLASS V Any Underground Injection Well not included in Classes I through IV.

TYPE
5A Industrial Well.
5B Beneficial Use Well.
5C Fluid Return Well.
5D Sewage Treatment Effluent Well.
5E Cesspools (non-domestic).
5F Septic Systems.
5G Experimental Technology Well.
5H Drainage Well.
5I Mine Backfill Well.
5J Waste Discharge Well.

PAPERWORK REDUCTION ACT The public reporting and record keeping burden for this collection of information is estimated to average 0.5 hours per response. Burden means the total time, effort, or financial resource expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822), 1200 Pennsylvania Ave., NW., Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed forms to this address.

Aaron Swank

From: Parker.Jennifer@epamail.epa.gov
Sent: Friday, October 22, 2010 9:20 AM
To: Aaron Swank
Subject: Re: Fort Wainwright Injection Well Completion

Thank you for providing this information.

Jennifer Parker, LG, LHG
U. S. Environmental Protection Agency Region 10 Ground Water Unit 1200 Sixth Avenue, Suite 900, OCE-082 Seattle, Washington 98101
(206) 553-1900

From: Aaron Swank <ASwank@fesalaska.com>

To: Jennifer Parker/R10/USEPA/US@EPA

Cc: "Malen, Joseph Mr CIV US USA IMCOM" <joseph.malen@us.army.mil>, "Clare, Gene E Mr CIV US USA IMCOM" <Gene.Clare@us.army.mil>, "Hazlett, Bob C POA" <Bob.C.Hazlett@usace.army.mil>, Craig Martin <CMartin@fesalaska.com>

Date: 10/22/2010 10:05 AM

Subject: Fort Wainwright Injection Well Completion

Jennifer –

I wanted to let you know that we have completed the projects at Valve Pit A, former Building 2111 and 2112, and former Building 1168. All injection points were abandoned and sealed with bentonite. If you need any additional information, just let me know.

Aaron

Aaron Swank
Fairbanks Environmental Services (FES)
3538 International Street
Fairbanks, AK 99701

ASwank@fesalaska.com

Office: 907.452.2468 Mobile: 907.460.0484 Fax: 907.452.2692

THE STATE of ALASKA
GOVERNOR BILL WALKER

Department of Environmental Conservation
DIVISION OF SPILL PREVENTION AND RESPONSE
Contaminated Sites Program
610 University Avenue
Fairbanks, AK, 99709
Main: (907) 451-2182
Fax: (907) 451-2155
www.dec.alaska.gov

File: 108.38.002.01

January 23, 2018

Dept. of the Army
Directorate of Public Works
Attn: IMPC-FWA-PWE (Adams)
1046 Marks Road
Fort Wainwright, Alaska 99703-4500

Re: DEC comments for Draft Valve Pit A Treatability Study Report Operable Unit 3, Fort Wainwright, Alaska, January 2018

Dear Mr. Adams:

The Alaska Department of Environmental Conservation (DEC) has completed a review of the above-referenced document. The document describes results from an in-situ chemical oxidation (ISCO) and oxygen-releasing compound (ORC) injection treatability study at the Valve Pit A (VPA) site in Operable Unit 3 (OU-3). The treatability study was conducted to evaluate the effectiveness of in-situ treatment for residual benzene, diesel range organics (DRO) and gasoline range organics (GRO) contamination remaining above cleanup levels after operation of the Air Sparge/Soil Vapor Extraction (AS/SVE) system. Trends in the groundwater indicated that the contaminants were more readily degradable in the groundwater phase, and contaminant concentrations have decreased over time since the injection in 2010.

DEC is providing comments (See Enclosure). If there are any questions please don't hesitate to contact me at (907) 451-2182 or by email at erica.blake@alaska.gov.

Sincerely,

Erica Blake
Environmental Program Specialist

Enclosure: DEC Review Comments

cc via e-mail: Sandra Halstead, EPA
Kristina Smith, FWA ENVR
Bob Hazlett, USACE
Bob Brock, USACE
Robert Glascott, USACE
Cheryl Churchman, AEC
Dennis Shepard, DEC
Eric Breitenberger, DEC

PROJECT: Treatability Study Report, OU3, Fort Wainwright, Alaska/ Contract No. W911KB-12-D-0001, Task Order 0033

REVIEW COMMENTS **DOCUMENT: Valve Pit A Treatability Study Report**

ADEC	**DATE: 23 Jan 2018** **REVIEWER: Erica Blake** **PHONE:**	**Action taken on comment by:** Aaron Swank – FES (1/26/18)

Item No.	Drawing Sheet No., Spec. Para.	COMMENTS	REVIEW CONFERENCE A - comment accepted W - comment withdrawn (if neither, explain)	CONTRACTOR RESPONSE	RESPONSE ACCEPTANCE (A-AGREE) (D-DISAGREE)
1.	Pg. 2-2, Section 2.4	The Groundwater RAO's cited in the OU-3 ROD Are: - Restore groundwater to drinking water quality within a reasonable time frame. - Reduce further migration of contaminated groundwater - Prevent use of groundwater with contaminants at levels above the Safe Drinking Water Act levels The RAOs cited at Section 2.4 seem to be an interpretation of the ROD RAO's. Please revise to be consistent with the RAOs in the ROD. In addition, it is important to note that the RBC/RAGs for the contaminants 1,2,4 TMB & 1,3,5 TMB each exceed the current non-carcinogenic risk Hazard Index of 1. The cumulative risk from groundwater will also exceed the ADEC carcinogenic risk standard (1 X 10-5) when all RAGs under the ROD and ESD have been achieved. ADEC cumulative risk calculator results = 4.85 X 10-4 for carcinogenic risk. The ADEC cumulative risk calculator uses updated toxicity and risk parameters.	A	The RAOs in Section 2.4 will be revised for consistency with the ROD as indicated. The Army recognizes that the site will be subject to ADEC closure requirements after the ROD objectives are achieved. A brief section will be added to the report describing the relationship between the ROD objectives and current ADEC Cleanup Levels.	A

PROJECT: Treatability Study Report, OU3, Fort Wainwright, Alaska/ Contract No. W911KB-12-D-0001, Task Order 0033

REVIEW COMMENTS **DOCUMENT: Valve Pit A Treatability Study Report**

ADEC	**DATE: 23 Jan 2018** **REVIEWER: Erica Blake** **PHONE:**	**Action taken on comment by:** Aaron Swank – FES (1/26/18)

Item No.	**Drawing Sheet No., Spec. Para.**	**COMMENTS**	**REVIEW CONFERENCE** **A - comment accepted** **W - comment withdrawn** **(if neither, explain)**	**CONTRACTOR RESPONSE**	**RESPONSE ACCEPTANCE (A-AGREE) (D-DISAGREE)**
2.	Table 4-1	Heading: REMEDIAL ACTION GOAL/ADEC CLEANUP LEVELS The Cleanup levels for DRO, Benzene and TAH/TAqH are ADEC cleanup levels. However, the RAGs listed are not ADEC cleanup levels. The levels identified for 1,2,4 TMB & 1.3.5 TMB are not consistent with the cleanup goals listed in Table 2-1. Please clarify RAGs for 1,2,4 TMB & 1.3.5 TMB. Please revise Table to clearly identify RAGs vs ADEC CULs.	A	Table 4-1 will be revised for consistency with Table 2-1, and will clearly identify the basis for the cleanup standard – ROD RAG or ADEC Cleanup level. The basis for the DRO cleanup level is 18 AAC 75, and the basis for the TAH/TAqH water quality standard is 18 AAC 70. However, the basis of the benzene RAG in the ROD is the federal MCL. The correct cleanup level for the TMBs based on the ESD is 1,850 µg/L. This will be corrected in Table 2-1.	A
3.	Page 6-1, Section 6.0	Please add reference to: Alaska Water Quality Standards (AWQS) 18 AAC 70 and Selected Oil and Other Hazardous Substances Pollution Control Statutes and Regulations 18 AAC 75.	A	References to the current versions of 18 AAC 70 and 18 AAC 75 will be added to Section 6.	A
		----- End of Comments ----			

From:	Hazlett, Robert C CIV USARMY CEPOA (US)
To:	Aaron Swank
Cc:	Craig Martin
Subject:	FW: DEC accepts RTCs for OU2 and OU3 Treatability Study Reports (UNCLASSIFIED)
Date:	Tuesday, January 30, 2018 1:59:30 PM
Attachments:	2018_01_26 OU2 DRMO RTCs.doc 2018_01_26 ValvePitA RTCs.doc

CLASSIFICATION: UNCLASSIFIED

ADEC approval of RTCs; still waiting on EPA review for both documents

Bob Hazlett
Environmental Scientist
USACE Alaska District
(907) 753-2623

-----Original Message-----
From: Blake, Erica L (DEC) [mailto:erica.blake@alaska.gov]
Sent: Tuesday, January 30, 2018 10:32 AM
To: Adams, Brian M CIV USARMY IMCOM PACIFIC (US) <brian.m.adams18.civ@mail.mil>
Cc: Halstead, Sandra <Halstead.Sandra@epa.gov>; Smith, Kristina A CIV USARMY IMCOM PACIFIC (US) <kristina.a.smith14.civ@mail.mil>; Hazlett, Robert C CIV USARMY CEPOA (US) <Bob.C.Hazlett@usace.army.mil>; Brock, Robert D CIV USARMY CEPOA (US) <Robert.D.Brock@usace.army.mil>; Glascott, Robert A Jr CIV USARMY CEPOA (US) <Robert.A.Glascott@usace.army.mil>; cheryl.m.churchman.civ@mail.mil; Shepard, Dennis (DEC) <dennis.shepard@alaska.gov>; Breitenberger, Eric (DEC) <eric.breitenberger@alaska.gov>
Subject: [Non-DoD Source] DEC accepts RTCs for OU2 and OU3 Treatability Study Reports

All:

DEC accepts all comment responses for both the OU2 and OU3 treatability study reports. Please provide final copies of both the OU2 DRMO Yard Treatability Study Report and OU3 Valve Pit A Treatability Study Report for comment back-checking and final approval.

If there are any questions please don't hesitate to contact me.

Thanks,

Erica Blake

Environmental Program Specialist

Alaska Department of Environmental Conservation

Contaminated Sites Program

610 University Ave

Fairbanks, Alaska 99709

(907) 451-2182

erica.blake@alaska.gov <mailto:erica.blake@alaska.gov>

CLASSIFICATION: UNCLASSIFIED

Aaron Swank

From:	Hazlett, Robert C CIV USARMY CEPOA (US) <Bob.C.Hazlett@usace.army.mil>
Sent:	Tuesday, April 10, 2018 4:38 PM
To:	Aaron Swank
Cc:	Craig Martin
Subject:	FW: EPA comments on the OU3 and OU5 treatability studies - approval to finalize documents (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Looks like the last two Treatability Study TMs are good to go final! You know the drill.

Bob Hazlett
Environmental Scientist
USACE Alaska District
(907) 753-2623

-----Original Message-----
From: Halstead, Sandra [mailto:Halstead.Sandra@epa.gov]
Sent: Tuesday, April 10, 2018 3:42 PM
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Subject: [Non-DoD Source] EPA comments on the OU3 and OU5 treatability studies - approval to finalize documents

I did a quick skim of the OU3 and OU5 Treatability Study reports, and also the RTCS to ADEC comments.

The documents can be finalized based on the ADEC comments and revisions.

If any larger scale treatment is proposed for either of these sites, I'll engage our ISCO expert Dr. Scott Huling to help. He's terrific and can suggest modifications to help the study be more successful. (also one of the authors of the EPA 2012 reference).

FES anticipated my comment and in the lesson's learned for both OU3 and OU5 and included this tidbit:

The concentration of the ISCO product was not measured at the time of sampling, and

studies have indicated that if an oxidant is present, it is possible that oxidation will

continue after the sample is collected. Recent EPA guidelines regarding sampling at ISCO

sites should be considered in future injection projects (EPA, 2012).

From lessons learned at a JBER site with significant fuel remaining in soils where they wanted to do ISCO treatability (Dr. Huling worked on this project with me....):

Given that DRO and GRO are still present at fairly high levels, the presence of LNAPL product represents significant mass transport and mass transfer challenges, and might limit the effectiveness of both ISCO and enhanced bioremediation. Prior to full-scale ISCO deployment, it is recommended that a re-evaluation of existing data and information be conducted regarding LNAPL product site characterization, and LNAPL product recovery design and implementation. If this is a site containing LNAPL, it is entirely possible that there will be a significant smear zone (i.e., LNAPL product residual at or near the water table where LNAPL product is immobilized by capillary forces in the soil) due to the rise and fall of the water table. The smear zone will lie between the maximum and minimum water table elevations that have occurred over the last few decades. It is recommended that the oxidant be injected in a manner to target the smear zone.

OU5 report, section 5.4 seems to acknowledge the interference of LNAPL: Since the chemical oxidation compounds will react with any contaminant in the subsurface, it should be expected that sites with a significant amount of DRO and/or NAPL (like OU5 WQFS) sorbed to soil or remaining in the pore space will likely require multiple injections for full treatment of the site.

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