DEPARTMENT OF THE AIR FORCE
HEADQUARTERS, 673D AIR BASE WING
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

MEMORANDUM FOR ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ATTENTION: MR. LOUIS HOWARD

MAR 29 2011

FROM: 673 CES/CEANR
6326 Arctic Warrior Drive
JBER, AK 99506

SUBJECT: Memorandum to the Site File for OUB/Poleline Road Disposal Area

1. Attached is the Memorandum to the Site File for OUB/Poleline Road Disposal Area that includes modifications to the Long Term Monitoring Plan (LTMP) for this site. The details of this modification have been discussed with ADEC and EPA and a draft of this document has been reviewed by both agencies. Agency comments on the draft modified LTMP have been received and accepted by the Air Force and incorporated into this Final LTMP. The modified LTMP will be implemented beginning in 2011.

2. If you have any questions, please feel free to contact me at (907) 384-3074, or by email at Gary.Fink@elmendorf.af.mil.

GARY FINK, GS-13
Chief, Environmental Restoration

Attachment: Memorandum to the Site File for OUB/Poleline Road Disposal Area, January 2011

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS, 673D AIR BASE WING
JOINT BASE ELMENDORF-RICHARDSON, ALASKA

MEMORANDUM FOR USEPA REGION 10
ATTENTION: MR. BILL ADAMS

FROM: 673 CES/CEANR
6326 Arctic Warrior Drive
JBER, AK 99506

SUBJECT: Memorandum to the Site File for OUB/Poleline Road Disposal Area

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Gary Fink

GARY FINK, GS-13
Chief, Environmental Restoration

Attachment: Memorandum to the Site File for OUB/Poleline Road Disposal Area, January 2011

MEMORANDUM TO THE SITE FILE

FOR LONG TERM MONITORING AT THE

POLELINE ROAD DISPOSAL AREA, OPERABLE UNIT B

March 2011

JBER Richardson, ALASKA

This document was compiled in response to discussions concerning possible improvements to long-term monitoring at Operable Unit B (OUB) at the March 2009 Fort Richardson FFA meeting held in Seattle, WA. The recommendations were developed pursuant to an analysis of (at that time) eleven years of groundwater monitoring. These recommendations are meant as a guide for optimizing future groundwater monitoring at Operable Unit B, Poleline Road Disposal Area (PRDA) at JBER Richardson (formerly Fort Richardson), Alaska.

I. SITE REVIEW

The following section is a review of the Record of Decision (RoD) and other regulatory documents meant to be used for background information for the optimization of long term monitoring. For additional information, see the Fort Richardson, Second Five Year Review.

The RoD for PRDA was signed in August 1997. Monitoring began the next year, 1998, and has continued to the present.

Groundwater at Poleline Road is contaminated with volatile organic compounds, including chlorinated solvents. While there are no current uses of groundwater at the site or seeps by which wildlife could be exposed to groundwater, modeling indicates that groundwater at the site eventually could reach Eagle River in a time period of more than 100 years (Figure 1). The Contaminants of Concern (COCs) include: Benzene, Carbon Tetrachloride, cis-1,2-Dichlororethene, trans-1,2-Dichloroethene, Tetrachloroethene (PCE), Trichloroethene (TCE) and 1,1,2,2-Tetrachloroethane (1,1,2,2-TCA) (Table 1).

Remediation of the site is necessary because the NCP Groundwater Protection Strategy requires consideration of current and potential future uses of groundwater in remedy selection, and protection and restoration of groundwater resources if necessary and practicable. As stated in the OUA/OUB Record of Decision (RoD), s. 4.2.3: "Contamination of OUB groundwater, if used as a drinking water source, presents an unacceptable risk to human health. Therefore, groundwater and the "hot spot" source at Poleline Road require remedial action." As indicated below, the remedial technology selected in the RoD, when applied, failed to meet the Remedial Action Objectives. Since this application, no other remedial technologies have been identified that are likely to bring the groundwater into compliance with the RAOs.

A. Remedial Action Objectives (RAOs)

- Reduce contaminant levels in the groundwater to comply with drinking water Maximum Contaminant Level[1] (MCL) standards:
- Prevent contaminated soil from continuing to act as a source of groundwater contamination;
- Prevent the contaminated groundwater from adversely affecting the Eagle River surface water and sediments; and
- Minimize degradation of the State of Alaska's groundwater resources at the site as a result of past disposal practices.

B. Remedial Action

The goal of this remedial action is to restore groundwater to its beneficial use. While the long-term goal of the remedial action is to return all the groundwater within and outside of the source area ("hot spot") to state and federal MCLs (see Table 1) and risk-based criteria, active remediation will be considered complete when: 1) concentrations within the hot spot are below remediation goals for three continuous quarters after remedy shutdown and; 2) the plume is not expanding.

Groundwater at OU-B is not used, and there are no residents or wells downgradient of the site. There are no current plans for commercial or residential development in the site area. Groundwater transport modeling was used to estimate time of travel for detectable concentrations of TCE and 1,1,2,2 TCA (0.005 *mg/L).* The model assumed no depletion or remediation of the contaminant source and no biodegradation over time. The modeled transport time for 0.005 mg/L of TCE to reach the Eagle River is approximately 120 years, and for 1,1,2,2-tetrachloroethane, 170 years. Concentrations of 0.005 mg/L of TCE and 1,1,2,2-TCA do not exceed conservative exposure assumptions, nor do they exceed Alaska Water Quality

[1] Maximum Contaminant Levels: Alaska has adopted federal MCLs in 40CFR141.60 - .66

Standards for ingestion of freshwater organisms. Therefore, concentrations in the leading edge of the plume, if it were to reach the Eagle River, would not pose a threat to human health.

Table 1. Remedial Cleanup Goals for Groundwater

Contaminant of Concern	Remedial Action Objective (mg/L)	Source of RAO
Benzene	0.005	MCL
Carbon Tetrachloride	0.005	MCL
cis-1,2-Dichloroethylene	0.07	MCL
trans-1,2-Dichloroethylene	0.1	MCL
Tetrachloroethylene (PCE)	0.005	MCL
Trichloroethylene (TCE)	0.005	MCL
1,1,2,2-Tetrachloroethane	0.052[1]	RBC

[1] The RAO listed in the ROD appears to be incorrect and the value should have been 0.0053 µg/L. The risk assessment and groundwater model results were all based on an RBC of 0.005 mg/l for PCA.

C. Pre-ROD Response and Selected Remedy

The pre-ROD response (1994) included excavation of approximately 3,600 yards^3 of contaminated soil. After evaluation of the potential risks and the appropriate cleanup standards, the selected alternative for OU-B (from the ROD) is Alternative 6: <u>High Vacuum Extraction (HVE) of the hot spot, site-wide institutional controls, natural attenuation, and long-term monitoring of groundwater</u>.

The key components of the Remedy are outlined below with discussions of the current status:

1. *Treat the hot spot through HVE of soil vapor and groundwater in the perched/shallow aquifer to prevent continuing threat to groundwater*

   <u>The hot spot is defined by the area containing greater than 1 mg/L 1,1 ,2,2-TCA in groundwater</u> (Figure 2). This area represents the main threat at this site. Specifically, the hot spot is the area that contains the contamination and acts as a reservoir for migration of contamination to groundwater. Actively remediating this hot spot addresses the main

threat. Soil vapors extracted from the hot spot soil will be treated as necessary to meet state and federal air quality standards before release to the atmosphere. Extraction wells will be placed in areas of highest contamination and operated until state and federal MCLs and risk-based criteria are achieved in the "hot spot".

Soil and groundwater samples collected after completion of the second treatability study (explained below) indicated that about 95 percent of the contaminants in soil had been removed during system operations, thus reducing the source of groundwater contamination at the site. The system was less successful at treating groundwater contamination, but about 76 percent of groundwater contaminants were removed during system operations.

There is sufficient residual contamination to maintain concentrations that exceed remedial (MCL) standards in the shallow source area.

2. *Treat extracted groundwater through air stripping to achieve state and federal MCLs before discharge*

Groundwater and condensed soil vapors were collected in a knockout tank attached to the extraction system. Contaminants were removed from the water using a cooling tower equipped with an air-stripper. Up to 50 percent of the water added to the cooling tower evaporated. When treated water accumulated in the tower, it was pumped into drip tubes and discharged to the soil surface. Water samples were periodically collected from the treated water tank and analyzed for contaminants. None of samples was found to contain contaminants.

3. *Allow natural attenuation of groundwater contamination in areas outside the hot spot*

Evaluation of daughter products and the natural attenuation (geochemical) parameters suggest reductive dechlorination is occurring within the hot spot. However, dilution appears to be the primary mechanism for reducing contaminant concentrations outside of the hot spot.

A varying number of monitoring wells (12 to 20) at the site have been sampled, at least yearly, for 12 years. Concentrations of COCs in shallow monitoring wells within the hotspot area continue to be above RAOs. However, concentrations of 1,1,2,2-TCA decreased slightly and daughter product concentrations also are declining . Outside the hotspot in the shallow monitoring wells, 1,1,2,2-TCA and TCE are above RAOs in AP-3747, with 1,1,2,2-TCA declining and TCE holding within historical ranges.

Vinyl Chloride has been detected in some hot-spot wells but, has not been detected in wells outside the hotspot. TCE is the primary COC present in the deep aquifer. The farthest downgradient RAO exceedance in the deep aquifer exists at AP-4344 (15 µg/L TCE), where neither increasing nor declining trends are evident.

Other evidence suggesting that natural attenuation is occurring has been gathered over the past couple of years. Contractors sampling groundwater from monitoring wells near the wetlands have reported black precipitate and sulfur smell indicating sulfate reduction of contaminants could be potentially occurring. The recent groundwater monitoring report also includes the results of several geochemical tests of groundwater from the site. The natural attenuation parameters include: dissolved oxygen, pH, nitrate, dissolved iron and manganese, sulfate, methane, ethane, ethylene, and chloride. Comparison of the natural attenuation parameters to background and the declining concentration of several COCs, continues to provide supporting evidence that reductive dechlorination is occurring at the site, especially in the hot spot area.

4. *Evaluate and modify the treatment system as necessary to optimize effectiveness in achieving RAOs*

The dual-phase HVE treatability study completed during the summer of 1998 showed that further design work would be necessary before installation of a reliable system. The dual-phase system, as installed, was prone to shut down and took several hours to restart. The crux of the problem was the drop tubes used to extract air and water. The bottom of the drop tube was set just above the water table in the well. If the water level in the well rose rapidly, the drop tube would be flooded, and unable to further extract either water or air.

Rather than use the selected remedy (HVE) exclusively, Six Phase Soil Heating (SPSH) was also used to treat the hotspot. The ROD stated that if HVE alone failed to remediate the source area within a reasonable time frame, then soil heating would be combined with the selected remedy.

5. *Monitor groundwater to determine the attainment of RAOs and to detect DNAPL*

Duration of the HVE system operation is expected to be from seven years to 12 years for soil and shallow groundwater in the hot spot and 150 years for natural attenuation of remaining groundwater to meet state and federal MCLs and risk-based criteria.

Concentrations of 1,1,2,2-TCA and TCE that exceed the 1 % solubility of these chemicals are found within the hot spot. These high concentrations indicate a need to closely monitor for a denser-than-water non-aqueous phase liquid (DNAPL) during construction and operation of the "hot spot" treatment system.

a. DNAPL was identified in monitoring well AP-3746, during sampling in spring 2004. An SVE system was installed on site to further extract the free-phase liquids. The SVE system removed soil vapor from AP-3746 and four new monitoring wells from May 2005 to January 2006. An estimated 681 pounds of volatile organic compounds were removed by the system. No DNAPL has been observed at the site since January 2006.

The flat gradient of the groundwater in this area indicates decreased probability of significant contaminant transport and the relatively low concentrations of contaminants outside the "hot spot" justify classifying the down-gradient plume as a relatively low-level threat. Concurrent with implementation of the selected remedy will be monitoring of the down-gradient plume to track and assess the natural attenuation of groundwater contaminants.

a. While contaminant concentrations are still above RAOs, primarily in the source area, remediation has resulted in a decline of several orders of magnitude in contaminant concentrations from pre-treatment levels.

6. *Evaluate the effectiveness of HVE to meet long-term restoration goals*

Groundwater samples collected during the initial testing did not clearly indicate that HVE was effective at reducing the concentration of chlorinated solvents in the groundwater at this site. In addition, there were many equipment failures and shutdowns during operation of the system. Analysis of the test data indicated that the cost to operate the HVE system and treat the groundwater produced during system operation greatly exceeded estimates. The increased cost was due in large part to an increase in the time estimated for the HVE system to remediate the groundwater plume, originally 7 to 12 years.

An HVE pilot study was conducted in 1998. Soil gas and groundwater were extracted from two extraction wells. The HVE system primarily removed soil gas from low permeability formations and groundwater removal was a secondary function. System monitoring was conducted twice each week for the duration of the HVE system test. Extracted soil gas and groundwater were periodically sampled and analyzed for VOCs to monitor the effectiveness of the HVE system. Approximately 500,000 gallons of groundwater were extracted and treated during system operation, and an estimated 230 pounds of chlorinated solvents were removed from groundwater. Additionally, the system was estimated to have removed approximately 490 pounds of contaminants from the soil.

Because the system was not effective at reducing groundwater contaminants, HVE, as a remedy for this site, did not appear to meet the long-term restoration goals prescribed in the ROD.

7. *Conduct treatability studies to evaluate innovative technologies with the potential to enhance remedial action and implement successful innovative technologies if the initial remedy proves effective.*

Because the HVE system was not as effective at treating groundwater as anticipated by the ROD, the Army implemented a second treatability study to evaluate SPSH as an enhancement for the selected remedy prescribed in the ROD. The SPSH treatability study ran from July to October 1999. Six-phase heating uses six-phase electricity to resistively heat soils and groundwater and create an *in situ* source of steam to strip contaminants that are then captured using SVE. Both the 1997 and 1999 studies showed removal of contaminants of concern from saturated and unsaturated soil. The 1999 study also showed that SPSH could remove contaminants of concern from groundwater. In 1999, the SPSH system was used to heat a region approximately 110 ft long by 50 ft wide by 35 ft deep for 9 weeks. The volume of soil treated in 1999 was about 20 percent greater than treated in 1997. The mass of chlorinated solvents removed via the extracted soil in 1999 (1,450 lbs) was nearly twice the mass removed in 1997 (756 lbs).

Soil samples collected before SPSH indicated the highest VOC concentrations were detected near the groundwater interface (about 15 to 25 ft bgs). After SPSH was completed, soil samples collected from borings located adjacent to the initial borings showed that approximately 99.9 percent of the PCA present before treatment was removed from the soil within the treatment area. Removal of PCE ranged from 79.5 to 99.6 percent and removal of TCE ranged from 68.5 to 97.2 percent.

8. *Maintain institutional controls (ICs); including restrictions governing site access, construction and well development as long as hazardous substances remain at levels that preclude unrestricted use on site. Implement restrictions on groundwater until contaminant levels are below standards*

To ensure long-term effectiveness of the remedy, institutional controls have been put into place at Poleline Road. Institutional controls restrict access to the site, water use, excavations, and property transfers. Fencing was installed to limit exposure to potential buried munitions. The ICs that are in place are supplementing engineering controls (fencing and gates) for both short-term and long-term management to prevent and limit human and environmental exposure to hazardous substances, pollutants, and contaminants. The Army has inspected this site regularly since the ROD was signed and visual observations verify that the institutional controls are effective. Locked gates limit access to the site and signs posted around the perimeter of the site clearly identify the area as a contaminated site. One component of the IC policy involves obtaining an

Excavation Clearance Request (USARAK Form 81 a – 1 Mar 02) to prevent any site work inconsistent with established ICs at a particular site.

U.S. Army Alaska Institutional Control Standard Operating Procedures (SOP) (APVR-RPW (200-1) and a Memorandum on Institutional Controls [APVR-RPW-EV (200-1c)] establishes the procedures, responsibilities, and policies for complying with institutional controls at Fort Richardson. This document has been provided in Appendix E of the OUD ROD. This document has been reviewed and reissued approximately every two years coinciding with the change of command at U.S. Army – Alaska. The latest update of these documents was approved in January 2009.

In October 2010, both the former Fort Richardson and former Elmendorf Air Force Base became Joint Base Elmendorf Richardson (JBER). It is anticipated that the JBER Command will continue the practice of periodic IC review and renewal.

D. Conceptual Site Model (CSM)

A Conceptual Site Model has been developed to guide the site investigation work. The key components of the CSM are outlined below.

1. The source area is located within a locally perched shallow aquifer encountered around 45 feet below ground surface. This aquifer pinches out in the down-gradient (northeast) direction.

2. The shallow aquifer is underlain by relatively impermeable till that extends from approximately 60 feet to bedrock. Water quality data indicates that contamination is migrating downward through the till. However, groundwater elevation data indicate that there is no hydraulic connection between the till and the surrounding aquifers.

3. The regional aquifer is located to the south and northwest of the shallow aquifer/source area, it is encountered around 150 feet below ground surface.

4. Lateral (down-gradient) displacement of the contamination from the source area has proven limited over the last eleven years;

5. A shallow "no-flow boundary" has been identified extending from the source area to the northeast which has the effect of bounding the lateral migration of contamination to the northwest;

6. No direct hydraulic connection between the shallow aquifer/source area and underlying till has been identified. The presence of contamination within the till may be the result of: migration of contamination along the exterior walls of various monitoring wells and/or slow diffusion through low-permeability soils.

7. It is assumed that, down-gradient of the hot spot, the shallow aquifer plume migrates downward and combines with the deep regional aquifer. However, this location or area has not been identified.

8. Dilution is the primary mechanism for attenuation of the contaminant plume when it enters the regional aquifer. Contaminant plumes clearly associated with the PRDA source area do not exist in the regional aquifer. Currently, there is one down-gradient well screened in the regional aquifer that exceeds the MCL for TCE (AP-4344). The concentration in this well is an order of magnitude less then the TCE concentration measured in the source area and appears stable.

9. Up-gradient of the source area, vertical migration of contaminants to the regional aquifer does occur. This area is defined as the "mixing zone." Contaminants measured here are diluted and only trace contamination has been observed.

10. Plume concentrations in the shallow aquifer show seasonal variation with maximum concentrations usually occurring during the fall sampling events. This increase in COC concentrations is caused by higher groundwater elevations which allows for greater dissolution of NAPL.

11. While remediation has effectively reduced contaminant concentrations in the soil to below RAOs, the residual NAPL present in the source area is sufficient to maintain concentrations above the MCLs in groundwater within the shallow aquifer.

12. Residual NAPL was released within the source area after the large earthquake in November 2002 (Denali Quake, magnitude 7.9). A SVE system was subsequently installed that successfully remediated the released product. Contingencies for monitoring following future 'significant' earthquakes are included in this LTM plan.

13. There is evidence that natural attenuation is occurring at this site within the shallow aquifer.

14. The nearest receptor to the Poleline Road Disposal Area is Eagle River. Eagle River is located 1 mile down-gradient (northeast) of the source area.

II. OBJECTIVES OF THIS REVISION TO THE OUB/POLELINE ROAD LONG-TERM MONITORING PLAN

In essence, the approach for 2010 and beyond is a focusing of sampling effort on the less well-known and -characterized deep/regional aquifer. It is appropriate to do this because the shallow aquifer is stable and has been well characterized in the previous approximately 12 years of monitoring. With this stability in the shallow aquifer, it is important to know how far and in which direction deep aquifer contamination may be moving...if at all. This re-focus will result in a reduction in the number of wells monitored annually while maintaining a sufficient number of "contingency" wells in the network to quickly increase the overall site sampling effort, if necessary. The addition of "contingency" wells to any given year's monitoring program would occur if contaminant concentrations in either the shallow or deep aquifer dramatically increase...in response, for example, to a seismic event. Lastly, a small number of wells will act as "sentinel" wells to be sampled in the year preceding each successive Five-Year Review. It will also result in the decommissioning of a number of wells which are no longer contributing to site characterization or to measuring the attainment of the RAOs. All monitoring wells currently included in the OUB PRDA monitoring network are listed in TABLE A.

The shallow aquifer has been sufficiently characterized to conclude that further intensive monitoring is unlikely to result in new findings. Future emphasis will, therefore, be placed on monitoring the contamination in the regional (deep) aquifer while continuing sampling of a few wells in the shallow aquifer to monitor trends in the source area. Seven wells[2] will be used for

[2] In November 2010, because of contractual obligations, twelve (12) wells will be sampled. However, in 2011 and beyond, seven wells will be included in the "annual" monitoring regime.

routine, "annual" sampling. These wells are listed in TABLE B and shown in FIGURE B. If, in the course of annual monitoring of the regional/deep aquifer, it is determined that contaminant concentrations are increasing significantly, up to an additional 14 monitoring wells can be added to the sampling network to verify these trends, measure changes in contaminant plume concentrations, and the spatial extent of the plume. These additional wells are referred to as "contingency" wells and are listed in TABLE C and shown in FIGURE C. Sampling should occur when the water table is at its annual peak when possible (usually in the fall) to ensure the maximum concentrations are being monitored long-term. The determination to add some or all of the "contingency" wells to the next annual sampling event would be based on "weight of evidence" criteria rather than on a specific numerical criterion. The Remedial Project Managers will review each annual sampling report and decide (based on the data and information in that report and those of preceding sampling years) whether and to what extent to include "contingency" wells in the next upcoming monitoring event.

To insure that longer-term trends are not missed, six wells (listed in TABLE D and shown in FIGURE D) will be sampled in the year prior to the next Five Year Review (2012) and the year prior to each succeeding Five Year Review. These results will be reported with the "annual" well report in those years' reports.

It is the intent of the LTM Plan to decommission eleven wells, inasmuch as it has been determined that these wells no longer provide adequate or useful data for the purposes of the LTM Plan. These wells are listed in TABLE E and shown in Figure E.

A. Analytical Methods

Consistent with the current sampling and analysis plan for OUB, groundwater samples will be analyzed for the primary Contaminants of Concern by SW-846 Method 8260B. Natural attenuation parameters will include chloride and sulfate by EPA Method 300.0, nitrate/nitrite by EPA Method 353.2, light gases (methane, ethane, and ethylene) by method RBK 175, and iron and manganese by SW-846 Method 6020.

B. Data and Trend Analysis

The above-listed natural attenuation parameters will be evaluated to assess the continuation of the previously determined reductive dechlorination.

Mann-Kendall statistical analysis of current and historical well analysis data for the Chemicals of Concern will be used to plot data trends in specific wells. Mann-Kendall has been very informative in clearly demonstrating the effects of active treatment and natural attenuation over the course of twelve or more years of monitoring.

C. Long-Term Monitoring Network

The long-term monitoring network will be broken down into three groups: annually sampled wells, contingency wells, and "five-year review" wells. A fourth group will be those wells scheduled for decommissioning. Well decommissioning will occur only as funding is available.

i. Annual Sampling

AP-3747: Is the furthest down-gradient shallow well with contaminant exceedances; they vary from ND to above MCLs. Changes in concentrations in this area are important to understanding the potential for changes in migration of contaminants beyond the shallow aquifer.

Data suggest the shallow aquifer pinches out north of **AP-3747** where contamination most likely migrates downward. Once contaminants reach the regional aquifer they are diluted by at least an order of magnitude. Continued sampling of down-gradient regional wells will identify changes in contamination migration pathways that could adversely affect Eagle River or other receptors.

AP-3748 is a regional well down-gradient of the source area where trace contamination has been detected historically.

AP-4019 is a regional well co-located with AP-3747 and immediately downgradient of the "hot spot." The screen interval in this well was constructed to be 30 feet. This is too great a length to allow specific analysis of the aquifer source of any measured contaminants. Therefore, this well will be re-drilled (very close to the existing well) upon receipt of funding. This is expected to occur in the summer of 2011 prior, it is hoped, to the time of the 2011 annual groundwater sampling. The replacement well here will be constructed with a more carefully positioned five foot screen interval.

AP-4344 is a regional well down-gradient of the source area where TCE consistently exceeds the MCL. Changes in concentrations in this area are important to understanding changes in contaminant behavior in the regional aquifer. This well is recommended for **annual** sampling.

AP-4353 is screened at greater depth than wells in the source area and has consistent contaminant exceedances suggesting downward vertical migration of contamination. Therefore, continued monitoring of AP-4353 is warranted and if contaminant concentrations begin increasing in this well, other down-gradient wells (specifically, AP-4348/AP-4349) could be sampled. It is recommended that this well only be sampled prior to each 5-year review unless significantly increasing contaminant concentrations appear upgradient.

AP-4550 is in the shallow aquifer co-located with AP-4551 over the "hot spot" and currently has the highest contaminant concentrations observed in the shallow aquifer. Continued monitoring of this well is important to understanding changing trends in the source area.

AP-5246 is a regional well down-gradient of the source area where trace contamination was detected after the well was installed. This well is recommended for **annual** sampling.

For the 2011 monitoring year only due to contract requirements, five additional wells, AP-3744, -3745, -3981, -3989, -4347, and -4349 will be sampled. In 2012 and following years these five wells will be sampled in the year preceding each successive Five-Year Review.

ii. Contingency Wells

AP-4347 and AP-4349 are "contingency" wells, they are located in the regional aquifer to the south and southeast of the shallow plume, respectively. These wells had trace contamination when sampled in June 2003. They will be sampled again in 2010 in order to confirm that there is no regional plume in this area. The frequency of sampling here is contingent on 2010 sampling results.

iii. Sentinel Wells

A group of monitoring wells will be considered "sentinel" wells. These wells surround and are generally down-gradient of the source area. The plan is to sample these wells once every five years one year in advance of each Five-Year Review. Detection of or significant increases in contaminant concentrations here will be considered important and will induce increased sampling.

AP-3982 is a shallow well located to the east of the contaminant plumes. Historically, there were contaminant exceedances at this location. Currently, contaminants are not-detected here. This well should be monitored periodically as a sentry well. This well should be sampled prior to each Five-Year Review.

AP-4350 is the farthest down-gradient regional aquifer well. Contamination has never been detected at this location. This well should be monitored periodically as a sentry well.

AP-3744, AP-3745, AP-3981 and AP-3989: These wells will be routinely considered to be "Five-Year Review" wells but will also act as "contingency" wells" in the event that significantly increasing concentrations are observed in AP-4550. These wells can be sampled to quantify changes in the plume configuration.

- **AP-3989** is near the down-gradient edge of the hot spot.

- **AP-3981** is located near the southwestern edge of the "hot spot." Contaminant concentrations here are relatively low. **AP-3981** has a long monitoring record and will provide a representative sample near the up-gradient edge of the "hot spot."

- **AP-3744** and **AP-3745** help to delineate the edge of the shallow contaminant plumes to the northeast and east respectively.

MEMORANDUM TO THE SITE FILE

FOR LONG TERM MONITORING AT THE

POLELINE ROAD DISPOSAL AREA, OPERABLE UNIT B

March 2011

JBER Richardson, ALASKA

Concurrence by:

Louis Howard

Louis Howard
Alaska Department of Environmental Conservation

Date: March 29, 2011

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FOR LONG TERM MONITORING AT THE

POLELINE ROAD DISPOSAL AREA, OPERABLE UNIT B

March 2011

JBER Richardson, ALASKA

Approved by:

Gary Fink

Gary Fink, GS-13
Chief, Environmental Restoration

Date: 28 Mar 11

MEMORANDUM TO THE SITE FILE

FOR LONG TERM MONITORING AT THE

POLELINE ROAD DISPOSAL AREA, OPERABLE UNIT B

March 2011

JBER Richardson, ALASKA

Concurrence by:

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Bill Adams

Region 10, USEPA

Date: ____________________________

TABLE A: 2010 Long Term Monitoring Plan - OUB Poleline Road Disposal Area
Monitoring Well Network: Data & Sampling Frequency

Monitoring Well ID	Aquifer	Screened Interval (feet bgs)	Total Depth (feet below TOC)[a] (2009)	Depth to Groundwater (feet below TOC) (October 2009)	Sampling Year or Frequency
AP-3744	Shallow	26.5-36.5	37.6	29.76	2012 & at succeeding 5-year reviews
AP-3745	Shallow	18.0-28.0	29.8	23.5	2012 & at succeeding 5-year reviews
AP-3746	Shallow	9.0 -19.0	23.5	dry	Contingency well
AP-3747	Shallow	20.0-30.0	32.2	28.17	Annually
AP-3748	Deep	164.9-169.9	171.6	135.37	Annually
AP-3749	Shallow	12.0-22.0	24.6	22.25	Contingency well
AP-3981	Shallow	29.0-39.0	40.7	25.14	2012 & at succeeding 5-year reviews
AP-3982	Shallow	24.0-34.0	32	28.25	2012 & at succeeding 5-year reviews
AP-3983	Shallow	18.0-28.0	30.3	25.97	**Decommission**
AP-3984	Shallow	20.0-30.0	32.5	29.46	Contingency well
AP-3985	Shallow	22.0-32.0	32.6	27.28	Contingency well
AP-3986	Shallow	23.0-33.0	36.3	27.06	Contingency well
AP-3989	Shallow	24.0-34.0	36.3	29.83	2012 & at succeeding 5-year reviews
AP-4011	Deep	111.2-137.3	138.4	121.92	**Decommission**
AP-4012	Shallow	12.8-38.35	39.18	22.03	Contingency well

Color Key:
Wells to be sampled in 2010 and annually thereafter.
"Contingency" wells to be sampled if significant changes occur in "Annual" monitoring wells.
Wells to be sampled in the year just prior to each 5-Year Review beginning in 2012.

TABLE A: 2010 Long Term Monitoring Plan - OUB Poleline Road Disposal Area Monitoring Well Network: Data & Sampling Frequency

Monitoring Well ID	Aquifer	Screened Interval (feet bgs)	Total Depth (feet below TOC)[a] (2009)	Depth to Groundwater (feet below TOC) (October 2009)	Sampling Year or Frequency
AP-4014	Other	49.3-59.3	59.85	dry	**Decommission**
AP-4017	Deep	76.0-96.0	98.2	66.32	**Decommission**
AP-4019 @	Deep	130.0-150.4	153	138.2	Annually
AP-4021	Other	59-89.3	90.08	89.96	**Decommission**
AP-4022	Shallow	29.0-33.0	34.55	32.3	Contingency well
AP-4344	Deep	152.1-162.1	163.5	151.67	Annually
AP-4345	Deep	149.0-161.0	186.5	157.74	Contingency well
AP-4347	Shallow	34-44	46	38.54	Sample in 2010
AP-4348	Deep	141-151	153.54	138.16	Damaged in 2010! Will sample next year after repair
AP-4349	Deep	70.8-80.8	180.39	76.57	Sample in 2010
AP-4350	Deep	176.3-186.3	188.6	150.06	2012 & at succeeding 5-year reviews
AP-4351	Shallow	38.5-48.5	50.83	30.6	Contingency well
AP-4352	Shallow	20.3-30.3	33.00/33.00	dry	Not routinely sampled # (or **Decommission?)**
AP-4353	Shallow	57.0-67.0	70.00/69.40	33.33	Annually
AP-4354	Shallow	7.4-17.4	18.00/ -	12.5	Contingency well

Color Key:
Wells to be sampled in 2010 and annually thereafter.
"Contingency" wells to be sampled if significant changes occur in "Annual" monitoring wells.
Wells to be sampled in the year just prior to each 5-Year Review beginning in 2012.

TABLE A: 2010 Long Term Monitoring Plan - OUB Poleline Road Disposal Area
Monitoring Well Network: Data & Sampling Frequency

Monitoring Well ID	Aquifer	Screened Interval (feet bgs)	Total Depth (feet below TOC)[a] (2009)	Depth to Groundwater (feet below TOC) (October 2009)	Sampling Year or Frequency
AP-4355	Deep	75.5-85.5	88.23	25.49	Contingency well
AP-4518	Shallow	33.6-43.6	46.80/46.80	27.19	Contingency well
AP-4519	Shallow	33.9-43.9	47.10/47.10	27.22	Contingency well
AP-4521	Perched	10-20	22.8	22.75	**Decommission**
AP-4522	Perched	9.3-19.3	22.1	21.94	**Decommission**
AP-4523	Perched	9.5-19.5	21.52	not measured: dye injection well	*{Not a monitoring well: used for dye injection}*
AP-4524	Perched	9.9-19.9	22.69	22.42	**Decommission**
AP-4525	Deep	113.0-123.0	127.10/127.20	126.56	**Decommission**
AP-4550	Shallow	32.0-42.0	43.00/43.00	27.1	Annually
AP-4551	Deep	87.7-97.7	98.30/98.00	95.84	Contingency well
AP-5246	Deep	148.0-158.0	161.00/161.00	152.1	Annually

Color Key:
Wells to be sampled in 2010 and annually thereafter.
"Contingency" wells to be sampled if significant changes occur in "Annual" monitoring wells.
Wells to be sampled in the year just prior to each 5-Year Review beginning in 2012.

[a] Total depths from field survey conducted in spring and fall 2009.

@ Well AP-4019 needs to be redrilled to shorten the screen interval for more specific sampling

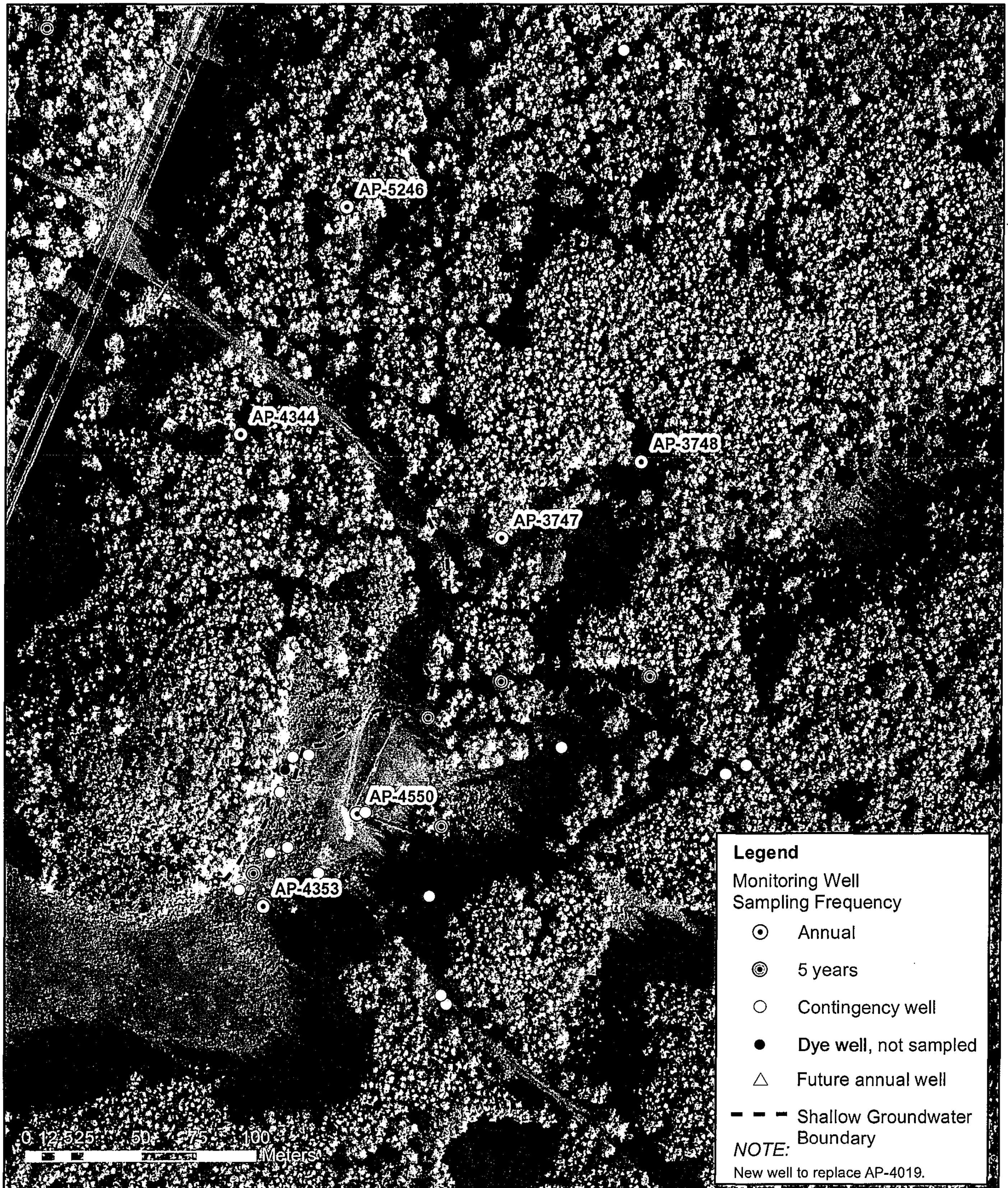
Wells will not be routinely sampled except in case of substantial changes in annually sampled wells

TABLE B: 2010 Long Term Monitoring Plan - OUB Poleline Road Disposal Area Monitoring Well Network: Annual Sampling					
Monitoring Well ID	Aquifer	Screened Interval (feet bgs)	Total Depth (feet below TOC)[a] (2009)	Depth to Groundwater (feet below TOC) (October 2009)	Sampling Year or Frequency
AP-3744*	Shallow	26.5-36.5	37.6	29.76	Sample in 2010*
AP-3745*	Shallow	18.0-28.0	29.8	23.5	Sample in 2010*
AP-3747	Shallow	20.0-30.0	32.2	28.17	Annually
AP-3748	Deep	164.9-169.9	171.6	135.37	Annually
AP-3981*	Shallow	29.0-39.0	40.7	25.14	Sample in 2010*
AP-3989*	Shallow	24.0-34.0	36.3	29.83	Sample in 2010*
~~AP-4019~~ @	~~Deep~~	~~130.0-150.4~~	~~153~~	~~138.2~~	~~Annually~~
AP-4344	Deep	152.1-162.1	163.5	151.67	Annually
AP-4347*	Shallow	34-44	46	38.54	Sample in 2010*
AP-4349*	Deep	70.8-80.8	180.39	76.57	Sample in 2010*
AP-4353	Shallow	57.0-67.0	70	33.33	Annually
AP-4550	Shallow	32.0-42.0	43	27.1	Annually
AP-5246	Deep	148.0-158.0	161	152.1	Annually

[a] Total depths from field survey conducted in spring and fall 2009.

@ Well AP-4019 needs to be redrilled to shorten the screen interval for aquifer-specific sampling. Annual sampling at this well will begin in 2011

* These wells will be sampled in 2010 but will revert to "contingency" or "5-Year" in 2011.



LTM Plan
2010

Figure B
Long Term Monitoring Network
ANNUAL WELLS

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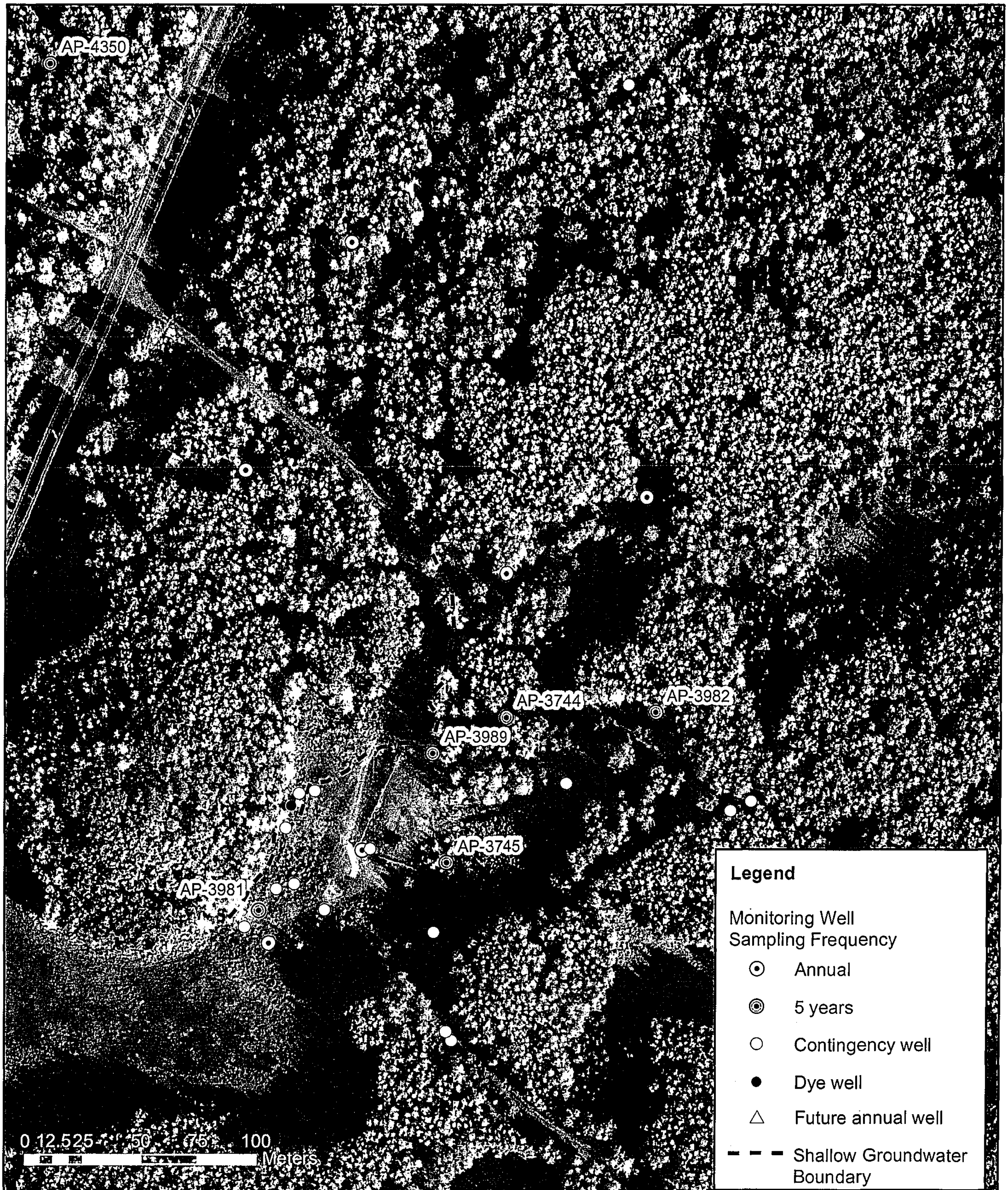
TABLE C: 2010 Long Term Monitoring Plan - OUB Poleline Road Disposal Area Monitoring Well Network: Contingency Wells					
Monitoring Well ID	Aquifer	Screened Interval (feet bgs)	Total Depth (feet below TOC)[a] (2009)	Depth to Groundwater (feet below TOC) (October 2009)	Sampling Year or Frequency
AP-3746	Shallow	9.0 -19.0	23.5	dry	Contingency well
AP-3749	Shallow	12.0-22.0	24.6	22.25	Contingency well
AP-3984	Shallow	20.0-30.0	32.5	29.46	Contingency well
AP-3985	Shallow	22.0-32.0	32.6	27.28	Contingency well
AP-3986	Shallow	23.0-33.0	36.3	27.06	Contingency well
AP-4012	Shallow	12.8-38.35	39.18	22.03	Contingency well
AP-4022	Shallow	29.0-33.0	34.55	32.3	Contingency well
AP-4345	Deep	149.0-161.0	186.5	157.74	Contingency well
AP-4351	Shallow	38.5-48.5	50.83	30.6	Contingency well
AP-4354	Shallow	7.4-17.4	18.00/ -	12.5	Contingency well
AP-4355	Deep	75.5-85.5	88.23	25.49	Contingency well
AP-4518	Shallow	33.6-43.6	46.80/46.80	27.19	Contingency well
AP-4519	Shallow	33.9-43.9	47.10/47.10	27.22	Contingency well
AP-4551	Deep	87.7-97.7	98.30/98.00	95.84	Contingency well

[a] Total depths from field survey conducted in spring and fall 2009.

LTM Plan 2010	Figure C Long Term Monitoring Network CONTINGENCY WELLS	CRREL · Opalia Environmental LLC

TABLE D: 2010 Long Term Monitoring Plan - OUB Poleline Road Disposal Area Monitoring Well Network: Five Year Review Sampling					
Monitoring Well ID	Aquifer	Screened Interval (feet bgs)	Total Depth (feet below TOC)[a] (2009)	Depth to Groundwater (feet below TOC) (October 2009)	Sampling Year or Frequency
AP-3744	Shallow	26.5-36.5	37.6	29.76	2012 & at succeeding 5-year reviews
AP-3745	Shallow	18.0-28.0	29.8	23.5	2012 & at succeeding 5-year reviews
AP-3981	Shallow	29.0-39.0	40.7	25.14	2012 & at succeeding 5-year reviews
AP-3982	Shallow	24.0-34.0	32	28.25	2012 & at succeeding 5-year reviews
AP-3989	Shallow	24.0-34.0	36.3	29.83	2012 & at succeeding 5-year reviews
AP-4350	Deep	176.3-186.3	188.6	150.06	2012 & at succeeding 5-year reviews

[a] Total depths from field survey conducted in spring and fall 2009.



LTM Plan
2010

Figure D
Long Term Monitoring Network
5 YEAR WELLS

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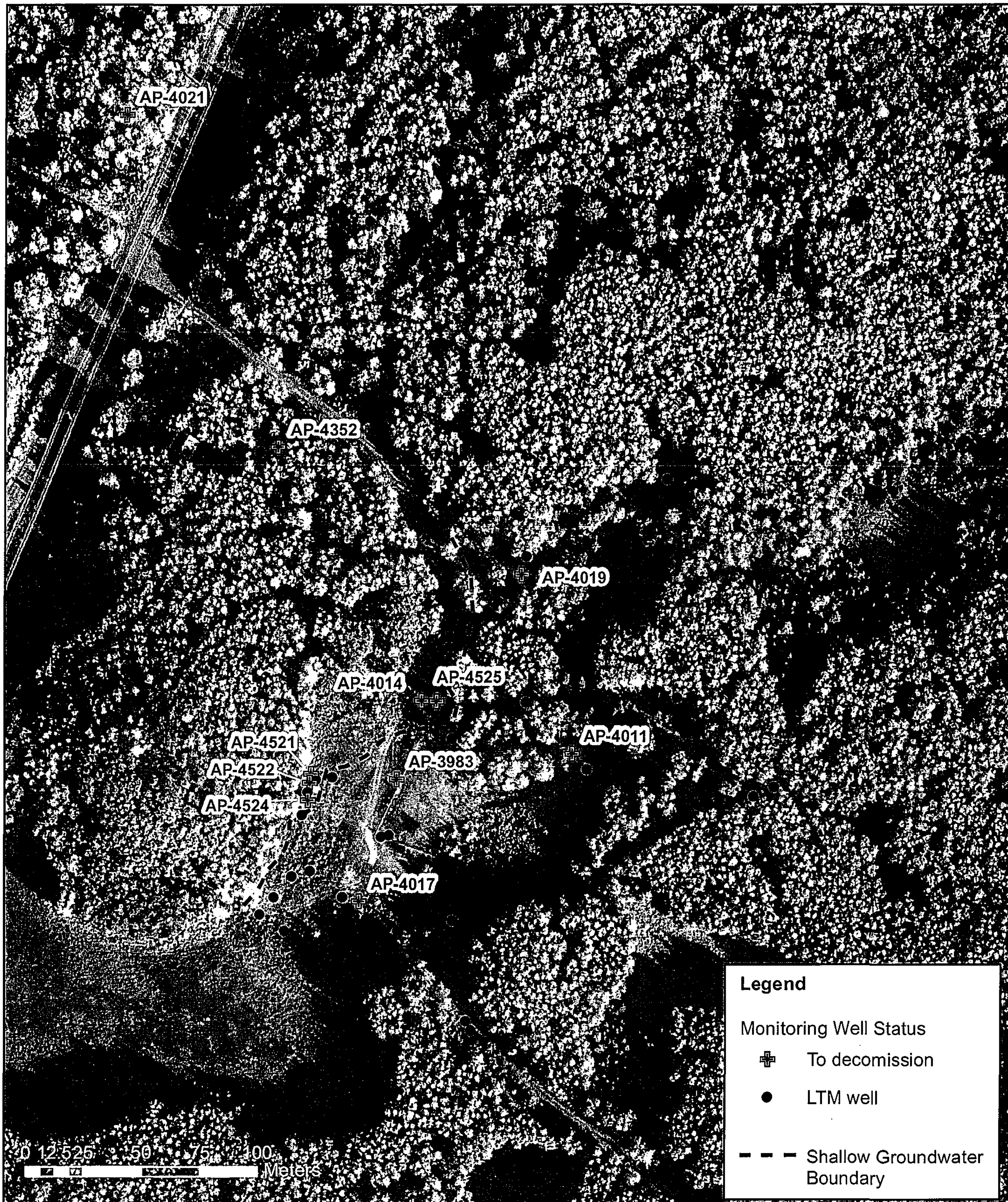
TABLE E: 2010 Long Term Monitoring Plan - OUB Poleline Road Disposal Area Monitoring Well Network: Wells to be Decommissioned					
Monitoring Well ID	Aquifer	Screened Interval (feet bgs)	Total Depth (feet below TOC)[a] (2009)	Depth to Groundwater (feet below TOC) (October 2009)	Sampling Year or Frequency
AP-3983	Shallow	18.0-28.0	30.3	25.97	**Decommission**
AP-4011	Deep	111.2-137.3	138.4	121.92	**Decommission**
AP-4014	Other	49.3-59.3	59.85	dry	**Decommission**
AP-4017	Deep	76.0-96.0	98.2	66.32	**Decommission**
AP-4021	Other	59-89.3	90.08	89.96	**Decommission**
AP-4348	Deep	141-151	153.54	138.16	Damaged in 2010! Potential Decommissioning
AP-4352	Shallow	20.3-30.3	33.00/33.00	dry	**Decommission**
AP-4521	Perched	10-20	22.8	22.75	**Decommission**
AP-4522	Perched	9.3-19.3	22.1	21.94	**Decommission**
AP-4524	Perched	9.9-19.9	22.69	22.42	**Decommission**
AP-4525	Deep	113.0-123.0	127.10/127.20	126.56	**Decommission**



LTM Plan 2010

Figure E
Long Term Monitoring Network
WELLS TO DECOMISSION

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