FINAL
Environmental Hazard Evaluation/ Environmental Hazard Management Plan Kamehameha Highway Guideway Test Shaft 13 and Method Shaft 6

Honolulu Rail Transit Project
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Prepared for:
Honolulu Authority for Rapid Transportation

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Abbreviations and Acronyms

bgs	below ground surface
CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
CSEM	conceptual site exposure model
CVOC	chlorinated volatile organic compounds
EAL	Environmental Action Level
EHER	Environmental Hazard Evaluation Report
EHMP	Environmental Hazard Management Plan
EPA	U.S. Environmental Protection Agency
HAR	Hawaii Administrative Rule
HDOH	State of Hawaii Department of Health
HEER	Hazard Evaluation and Emergency Response
HERL	Hawaii Environmental Response Law
HRS	Hawaii Revised Statutes
LNAPL	light, non-aqueous phase liquid
NFA	No Further Action
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyls
PCS	petroleum-contaminated soil
QA	quality assurance
QC	quality control
SCP	Hawaii State Contingency Plan
SHWB	Solid and Hazardous Waste Branch
TPH	total petroleum hydrocarbons
TPH-d	total petroleum hydrocarbons, diesel-range organics
TPH-g	total petroleum hydrocarbons, gasoline-range organics
TPH-o	total petroleum hydrocarbons, oil-range organics
UIC	Underground Injection Control
UST	Underground storage tank
VOC	volatile organic compound

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1.0 Introduction

This Environmental Hazard Evaluation (EHE) and Environmental Hazard Management Plan (EHMP) was prepared to document environmental concerns, and recommendations for management of residual contamination and/or contamination encountered in the field while conducting test and method shaft activities associated with ongoing work to support the Honolulu Rapid Transit Project. The purpose of test shaft and method shaft work is to complete deep borings and concrete to test subsurface conditions and construction methods (e.g., load testing) in advance of the concrete columns that will eventually be constructed to support the elevated rail line. The test and method shaft work is being performed by Kiewit Infrastructure West Co. for the Honolulu Authority for Rapid Transportation (HART). The information gathered from this TS and MS effort will assist with design, planning, and construction of other support columns in the area that will be completed under separate projects. Information from this EHE and EHMP will be carried forward to future work along with any new information gained on environmental conditions as a result of the TS and MS work.

The Honolulu Rapid Transit Project (HRTP) is an elevated dual track rail line that will run from east Kapolei to the Ala Moana Center and be located primarily within existing streets. Because the track is elevated the project must construct large columns to support the track structure. Deep foundations must be constructed underground to support the above ground structure.
This document addresses the upcoming pre-construction Test Shaft 13 (TS13) and Method Shaft 6 (MS6), located between the on- and off-ramps to Kamehameha Highway from Moanalua Road. The method shafts are located directly adjacent to the test shafts and the locations can be found on the attached map (Figure 1-1). TS13 and MS 6 will be approximately 128 feet deep and 8 feet in diameter. Following drilling, the TS13 and MS6 boreholes will be filled with concrete. Soil cuttings will be sampled and analyzed for contaminants of potential concern (COPCs), characterized, and disposed offsite at PVT landfill pending approval of the analytical and waste characterization results.

1.1 Objectives of EHE-EHMP

The purpose of this EHE/EHMP is to evaluate known environmental contamination from the Former Aiea Laundry Facility relative to TS13 and MS6, identify the proposed management of known contamination required to protect site workers and prevent the uncontrolled release and/or movement of contaminants and contaminated materials from and associated site and trench work areas. This EHE/EHMP is specific to TS13 and MS6. In addition, any contamination that is encountered and that remains following completion of TS13 and MS6 shall be documented in an updated EHE/EHMP. The EHE/EHMP should be provided to Contractors, property owners, and other stakeholders as appropriate.

1.2 Reference Sources for Known or Suspected Contaminated Sites

The following guidance documents supported the preparation of this EHE and EHMP:

- *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* (HDOH, Summer 2008, updated March 2009).

- *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater* (HDOH, May 2005 and interim updates through July 31, 2009).
- Chapter 13 of HDOH's *Interim Final Technical Guidance Manual for Implementation of the Hawaii State Contingency Plan* (HDOH, December 31, 2008 and interim updates).
- *Guidance for the Evaluation of Imported and Exported Fill Material, Including Contaminant Characterization of Stockpiles* (HDOH, October 2011).

Because of the limited focus of this EHE/EHMP, the area evaluated included the estimated plume of groundwater contamination from the Former Aiea Laundry Facility. The following reference sources were reviewed:

- *Remedial Investigation/Feasibility Study (RI/FS) Addendum, Former Aiea Laundry Facility* (Department of the Navy, Naval Facilities Engineering Command, Hawaii, January 2012).
- *Aiea Laundry Plume Map* (Email from Lynn Bailey, DOH-HEER, July 23, 2012).

1.3 Regulatory Framework

The test and method shaft work may be governed under various local, state, and federal regulations as described in the Final Environmental Impact Statement produced for the HRTP. The investigation of areas with known or suspected contamination and the management of contaminated material from those areas is also governed under various respect to the environmental including the following:

- Title 40 of the *Code of Federal Regulations* (40 CFR) Part 280
- Hawaii Revised Statutes (HRS) Chapter 342H, Solid Waste Pollution, and Hawaii Administrative Rules (HAR) Title 11, Chapter 58.1, Solid Waste Management Control
- HRS 342H and HAR 11-281, Subchapters 1 through 10
- Hawaii Underground Storage Tank (UST) rules (Hawaii Administrative Rule [HAR] 11-281)
- State Hazardous Waste Rules (HAR 11-260 through 11-280)
- Hawaii Environmental Response Law (HERL) (Hawaii Revised Statutes [HRS] Chapter 128D)
- Hawaii State Contingency Plan (SCP) (HAR 11-451). The HDOH Hazard Evaluation and Emergency Response (HEER) Office provides regulatory oversight for release response actions taken under the SCP.
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) National Oil and Hazardous Substances Pollution
- Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300)

During investigation and remediation activities required by the above regulations, wastes are potentially generated. The generated wastes are subject to environmental laws that address waste generation, handling, and off-site transportation and disposal (or discharge in the case of storm water or wastewater). Solid waste, including but not limited to contaminated soil, shall be managed onsite in accordance with HEER office requirements or disposed of at a permitted solid waste disposal facility. The following are examples of waste management activities that may occur, and the associated environmental laws that may apply during remediation activities:

- Containerizing and accumulating solid and hazardous waste, excavating (actively managing) environmental media containing solid and hazardous waste, treating to land disposal restriction (LDR) requirements for land disposal of hazardous waste, removing waste from underground storage tanks (Resource Conservation and Recovery Act [RCRA])
- Water discharges, including underground injection (Safe Drinking Water Act), storm water management, and treatment before discharge to a wastewater treatment plant (Clean Water Act [CWA])
- Air discharges, including asbestos and emissions from thermal treatment units (Clean Air Act [CAA])
- Generating and storing PCB media (Toxic Substances Control Act [TSCA])
- Packing wastes considered hazardous materials for transport off-site (Hazardous Materials Transportation Act)

Waste management requirements will vary depending on the site/point of origin, generating process, type, quantity, and a number of other factors. Accordingly, this EHE/EHMP may not cover all requirements. However, Contractors are required to comply with all applicable local, state, and federal requirements.

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2.0 Background Information

This section provides a description of the site, a summary of the historical site use and contaminant releases, and a brief description of investigations conducted to date (to the extent known). The following text includes information quoted directly from the document: *Remedial Investigation/Feasibility Study (RI/FS) Addendum, Former Aiea Laundry Facility.*

2.1 Site Description and History

TS13 and MS6 are located between the on and off ramps to Kamehameha Highway from Moanalua Road, just Ewa and makai of Aloha Stadium. The shaft sites are located just outside (south and cross-, down-gradient) of the estimated plume of dissolved-phase groundwater contamination from the Former Aiea Laundry Facility. The Former Aiea Laundry Facility covers approximately four acres at the northeast corner of Moanalua Road and Kaimakani Street in Aiea. The site is approximately 0.3 mile east of the shoreline of Aiea Bay (northeast shore of Pearl Harbor), and is bordered on the northwest by the Saint Elizabeth Church and School, on the north and northeast by the H-1 Freeway, on the far southeast by Aiea Elementary School and Kaimakani Street, and on the southwest by Moanalua Road and Aloha Stadium (see Figure 1-1).

The Former Aiea Laundry Facility started operation in the early to mid-1940s, and dry cleaning activities began in 1952. Tetrachloroethylene (PCE) was used as a dry cleaning solvent until 1970, when Stoddard solvent was substituted. In 1994, use of Stoddard solvent was discontinued, and a self-contained PCE recycling system was used until the laundry facility closed in 1998. The dry cleaning solvents were stored in four underground storage tanks (USTs); an additional UST was used to store diesel/reclaimed fuel oil for the laundry boiler (Department of the Navy, Naval Facilities Engineering Command, Hawaii, January 2012)

2.2 Known and Suspected Contamination

Previous investigations (PRC 1991, HLA 1989, Ogden 1997, AMEC 2002c) have confirmed that the USTs were the primary sources of chlorinated solvent contamination. The USTs and underlying contaminated soil were removed in April 1993. Other contaminant sources at the site included subsurface drain lines, particularly a 6-inch diameter line connected to a floor drain in the laundry building. Chlorinated volatile organic compounds (CVOCs), including PCE and its breakdown products trichloroethylene (TCE), cis-1,2-dichloroethylene (DCE), and vinyl chloride (VC), have been detected in soil, groundwater, and soil vapor, and were identified as chemicals of potential concern (COPCs) for the site. Stoddard solvent and TPH-d were also COPCs at the site. The source of petroleum contaminants at the Former Aiea Laundry Facility is assumed to the former USTs at the site.

A soil vapor extraction (SVE) system was installed in 1996 to remediate and prevent potential migration of CVOCs in subsurface soil and soil vapor. The SVE system operated continuously from October 1996 to October 1997, intermittently from October 1997 to August 1998, and continuously from February to May 2001 and from May 2006 to March 2007. The SVE system is currently inactive; however, soil vapor monitoring (SVM) continues to assess the extent of soil vapor contamination, with the most recent monitoring event occurring in June 2011.[2] The nature and extent of contamination is described in detail in Section 3.2.

In addition to the Former Aiea Laundry Facility, petroleum odors were observed in three geotechnical borings drilled as part of the rail project. The three borings (K1-405, K1-406, and K1-407) are located approximately 500 feet south of TS13 and MS6 (HDOH Release ID Number 2011-1123-1028). In a follow-up report issued by HART, it was noted that petroleum odors were observed at a depths between approximately 10 feet and 30 feet and were most noticeable at the soil/groundwater interface. The report indicated that approximately 800 cubic yards of soil was segregated and disposed and the fuel type appeared to be diesel though no samples were collected from these borings and no analytical results were available. The report identified that a number of fuel pipelines were located near the borings including Chevron pipelines, the abandoned Hickam POL pipeline, and another 10-inch fuel pipeline. There was insufficient data to adequately map the location of these pipelines on Figure 1-1. Finally, it was concluded that the health risks associated with the petroleum contaminated soil were low based on depth of contamination, current and reasonably anticipated land use (parking, road way, and elevated rail), lack of existing and future structures, and that groundwater was not a current or potential drinking water resource.

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[2] *Remedial Investigation/Feasibility Study (RI/FS) Addendum, Former Aiea Laundry Facility* (Department of the Navy, Naval Facilities Engineering Command, Hawaii, January 2012)

3.0 Site Characteristics and Nature and Extent of Contamination

This section describes the physical and chemical characteristics of the site, including the site geology, site hydrogeology, nature and extent of contamination, and fate and transport of contaminants. Sections of the following text are quoted directly from the document: *Remedial Investigation/Feasibility Study (RI/FS) Addendum, Former Aiea Laundry Facility.*

3.1 Site Geology and Hydrogeology

The Island of Oahu was built by the extrusion of basaltic lavas from two shield volcanos. The transit alignment is located along the southern flank of the volcanoes, and the geomorphology and subsurface conditions are directly related to fluctuations of sea level during the Pleistocene Epoch when sea level changed as a result of glaciation on the continents. High sea levels caused the formation of deltas and fans of sediments in the bays, accumulation of reef deposits at high elevations, and the deposition of lagoon/marine sediments in the quiet water protected by fringing reefs. Lower sea levels caused streams to carve valleys in the sediments and reef deposits. Exposure of the sediments and calcareous materials caused consolidation of the soft materials and hardening of reef materials. Erosion from higher elevations deposited soils under high energy conditions. Adding to the dynamic nature of the geology in this area were lava flows and steam explosions causing deposits of volcanic tuff.

In the last 10,000 years, sea level has adjusted to its present stand. Sediments have continued to accumulate in estuarine and lagoons, resulting in thick deposits of soft sediments along the coast in areas that were formerly valleys and drainage ways.
Land development and reclamation projects within the last 100 years have brought the Ewa-Honolulu area to its present landform, including large areas of reclaimed and filled coastal areas. Many of the resulting fills are of poor quality in terms of supporting large structures.

Because of the heterogeneity of subsurface conditions, borings are required at each transit guideway support column to finalize construction techniques and foundation specifications.

There is no site-specific information related to geology but geologic cross-sections of the area just north of the proposed TS13 and MS6 included silts, sands, and clays of variable thicknesses overlying volcanic basalt. Based on the cross-sections depicted in Appendix A, Figures 3-2 thru 3-5, groundwater beneath the TS13 and MS6 is anticipated to be encountered between 10 and 30 feet bgs.

With respect to groundwater, interbedded layers of alluvial and marine deposits created a “caprock” that rests on the underlying basalt layer of the shield volcanoes. The caprock retards the seaward migration of groundwater from the Southern Oahu Basal Aquifer, an EPA-designated “sole-source” aquifer. Groundwater conditions vary. Brackish groundwater occurs at shallow depths in the caprock. Potable, artesian water occurs below the caprock. The caprock sediments occur as a wedge-shaped formation that reaches its greatest thickness near the Aiea Bay shoreline and pinches out near the northeast boundary of the Former Aiea Laundry Facility site. Groundwater flow in the caprock formation is generally directed from the former laundry site toward Aiea Bay. Groundwater within the deep basaltic formation is considered a potential drinking water resource, but groundwater within the caprock formation in the investigation area is not.[3]

3.2 Nature and Extent of Contamination

The data and information acquired during the Former Aiea Laundry Facility investigation included soil, surface water and seep water near the Aiea Bay shoreline, caprock groundwater, soil vapor, and ambient air. Evaluation of the Former Aiea Laundry Facility sampling locations, contaminant concentrations, and the extent of the contaminant plume are depicted relative to TS13 and MS6 on Figure 1-1. As shown on Figure 1-1, TS13 and MS6 appear to be located south of the known extent of the Former Aiea Laundry Facility contaminant plume. In addition to the Former Aiea Laundry Facility, petroleum odors were observed in three geotechnical borings drilled during the rail project. However, these three borings (K1-405, K1-406, and K1-407) were located approximately 500 feet south of TS13 and MS6. Nonetheless, as a conservative approach, soil and groundwater will be tested for CVOCs (PCE, TCE, DCE, and VC) and petroleum contaminants (TPH-g, TPH-d, TPH-o, VOCs, PAHs, PCBs, and RCRA 8 metals). Saturated soil and groundwater will be presumed to be contaminated with CVOCs associated with the Former Aiea Laundry Facility and managed in accordance with the EHMP presented in Section 5.

A partial summary of the contaminated media associated with the Former Aiea Laundry Facility is offered below to identify the COPCs and the relative concentrations in site media.

Soil
Contaminated soil was delineated and removed from the vicinity of the USTs in the former laundry area during the 1993 UST removal action and from the subsurface drainline and drainage swale during the 1996 SVE system installation. Historical subsurface soil data and recent SVM data indicate that CVOCs may remain in subsurface soil at concentrations likely exceeding HDOH Tier 1 EALs. However, the data indicate that CVOC concentrations in surface and near-surface soil beneath the former laundry area are well below HDOH Tier 1 EALs. PCE was detected in 5 of the 6 soil samples analyzed, at concentrations ranging from 0.002 to 0.034 mg/kg, below the HDOH Tier 1 EAL of 0.088 mg/kg.

TCE was detected in 3 of 6 soil samples analyzed, at concentrations ranging from 0.0017 to 0.013 mg/kg, below the HDOH Tier 1 EAL of 0.26 mg/kg.

Cis-1-2-DCE was detected in 1 of 6 soil samples analyzed, at a concentration of 0.18 mg/kg, below the HDOH Tier 1 EAL of 0.31 mg/kg.

Trans-1-2-DCE was not detected in any of the 6 soil samples analyzed, and the highest reporting limit of 0.0095 mg/kg was below the HDOH Tier 1 EAL of 2.67 mg/kg.

VC was detected in 1 of 6 soil samples analyzed, at a concentration of 0.0044 mg/kg, below the HDOH Tier 1 EAL of 0.072 mg/kg.

Surface Water
No COPCs were detected at concentrations above HDOH Tier 1 EALs in any of the Aiea Bay surface water samples.

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[3] *Remedial Investigation/Feasibility Study (RI/FS) Addendum, Former Aiea Laundry Facility* (Department of the Navy, Naval Facilities Engineering Command, Hawaii, January 2012)

Seep Water

Seep water (which is groundwater flowing/discharging to surface water via near shore sediment) samples were collected from shallow monitoring wells installed at near shore sediment locations downgradient of the dissolved-phase plume (See Appendix A, Figure 7-1). Samples were collected at nine seep water sampling locations (SW-15 through SW-23) during two sampling rounds for the RI/FS Addendum investigation; The maximum VC concentration (240 micrograms per liter [µg/L]) represents the Round 1 (July 2007) sample from SW-20. The VC concentration reported for the Round 2 (January 2008) SW-20 sample was 92 µg/L. Historically, only one CVOC (PCE) has been detected at a concentration (149 µg/L) above the HDOH Tier 1 EAL (5 µg/L); the exceedance represents a sample collected from SW01 in 2002. No other CVOCs have shown exceedances since the inception of the seep water monitoring program in 2002. Recent and historical data suggest that VC concentrations in groundwater discharged to Aiea Bay are decreasing, and VC concentrations at potential exposure points in Aiea Bay are well below the project-specific surface water screening criterion due to volatilization and dilution by the surface water. VC was not detected in either the Round 1 or Round 2 surface water samples; the surface water data therefore support this conclusion. The interpolations of PCE, TCE, DCE, and VC in seep water are shown on Appendix A, Figures 7-6, 7-7, 7-8, and 7-9, respectively.

Groundwater

Analytical data representing groundwater samples collected from 25 single-level monitoring wells during previous investigations between 1996 and 2006 indicate that some CVOC concentrations exceeded HDOH Tier 1 EALs in the caprock groundwater. The maximum reported CVOC concentrations were: 546 µg/L of PCE in a 2006 sample from MW-26 (near the Aiea Bay shoreline), 596 µg/L of TCE in a 2004 sample from MW-03 (Former Aiea Laundry Facility, in the source area near the former drain line), 1,510 µg/L of DCE in a 2005 sample from MW-20 (offsite, approximately 200 feet downgradient of the source area), and 15 µg/L of VC in a 2002 sample from MW-04 (Former Aiea Laundry Facility, in the source area near the former UST locations).

The analytical results for the RI/FS Addendum (July–August 2007), indicated the following project-specific screening criteria exceedances:

- PCE concentrations exceeding the HDOH Tier 1 EAL (5 µg/L) were reported for three wells near the Aiea Bay shoreline: MW-26 (170–200 µg/L), MW-26-1 (140 µg/L and 150 µg/L), and MW-35 (120–150 µg/L).
- TCE was detected with concentrations ranging from 0.088 to 43 ug/L. The maximum concentration of 43 exceeded the HDOH Tier 1 EAL of 5.0 ug/L.
- Cis-1-2-DCE was detected with concentrations ranging from 0.070 to 290 ug/L. The maximum concentration of 290 ug/L exceeded the HDOH Tier 1 EAL of 70 ug/L.
- Trans1-2-DCE was detected with concentrations ranging from 0.094 to 66 ug/L Detected concentrations were below the HDOH Tier 1 EAL of 100 ug/L.
- VC was detected in 38 of 116 groundwater samples analyzed, with concentrations ranging from 0.094 to 140 ug/L. The maximum concentration of 140 ug/L exceeded the HDOH Tier 1 EAL of 2.0 ug/L.
- Benzene was detected in 8 of 116 groundwater samples analyzed, with concentrations ranging from 0.062 to 950 ug/L. The maximum concentration of 950 ug/L exceeded the HDOH Tier 1 EAL of 5.0 ug/L.

- Ethyl-benzene was detected in 4 of 116 groundwater samples analyzed, with concentrations ranging from 0.079 to 160 ug/L. The maximum concentratrion of 160 ug/L exceeded the HDOH Tier 1 EAL of 30 ug/L.
- Toluene was detected in 21 of 116 groundwater samples analyzed, with concentrations ranging from 0.02 to 23 ug/L.Detected concentrations were below the HDOH Tier 1 EAL of 40 ug/L.
- Total xylenes were detected in 6 of 116 groundwater samples analyzed, with concentrations ranging from 0.074 to 670 ug/L.The maximum concentration of 670 ug/L exceeded the HDOH Tier 1 EAL of 20 ug/L.
- TPH-DRO were detected in 20 of 85 groundwater samples analyzed, with concentrations ranging from 0.063 to 160 ug/L. The maximum concentration of 160 ug/L exceeded the HDOH Tier 1 EAL of 100 ug/L.

The interpolations of PCE, TCE, DCE, and VC in groundwater are shown on Appendix A, Figures 7-2, 7-3, 7-4, and 7-5, respectively. Interpolations of PCE, TCE, DCE, and VC in seep water and groundwater are depicted on Appendix A, Figures 7-6, 7-7, 7-8, and 7-9, respectively. In addition, the PCE, TCE, DCE, and VC distribution is estimated on cross-sections depicted in Appendix A, Figures 7-10 thru 7-13. Based on review of these figures, TS13 and MS6 do not appear to be in known areas of dissolved-phase contamination associated with the Former Aiea Laundry Facility.

Soil Vapor

The SVM data indicate that elevated concentrations of CVOCs may remain in deep soil vapor (18–22.5 feet bgs) within the Former Aiea Laundry Facility area. PCE and TCE concentrations in the deep soil vapor in source zone have remained relatively constant; however, DCE and VC concentrations in the deep soil vapor have shown slowly increasing trends over time relative to the 1996 baseline data. The SVM data indicate that CVOCs in the deep soil vapor have migrated only short distances in the vertical and horizontal directions. The continued presence of elevated CVOC concentrations in the deep soil vapor suggests that residual-phase contamination may remain in deep soil beneath the source area. The recent data indicate that PCE and TCE are the only CVOCs that occur in soil vapor along the St. Elizabeth Church and School fence line at concentrations exceeding HDOH Tier 1 EALs for shallow soil gas under the unrestricted land use scenario. PCE and TCE were detected at concentrations exceeding the HDOH Tier 1 EALs in the soil vapor samples from beneath the rectory. The results of a 1996 soil vapor sampling program in the Backyard Area suggested that relatively high concentrations of PCE may have existed in subsurface soil at several locations in the Backyard Area; however, data representing subsurface soil samples collected from borings collocated with or adjacent to the soil vapor borings did not support this conclusion. The 2002 RI/FS report (AMEC 2002c) therefore concluded that the PCE detections reported for soil vapor in 1996 did not indicate a large release of contaminants, but suggested a small zone of elevated PCE concentrations in backyard area subsurface soil at approximately 10 feet bgs. The status of soil vapor contamination in the Backyard Area was investigated in 2011 for the RI/FS Addendum. Sample results for the fifteen soil vapor monitoring wells installed indicate that the area of high PCE concentrations observed at 10 feet bgs in the 1996 data was still present. The Navy will collect another round of soil vapor samples and install additional soil vapor monitoring wells in the Backyard Area in 2012.

Ambient Air

For the sampling events at Saint Elizabeth Church and School Property, PCE concentrations exceeding the HDOH Tier 1 EAL for indoor air (0.41 microgram per cubic meter [µg/m3]) were reported for nine of the twelve indoor air samples from the Church lunchroom, kitchen, and hallways, and the rectory office collected in 2009 and 2010. However, in the June 2011 sampling event only one indoor air sample exceeded the HDOH Tier 1 EAL for PCE (1.2 µg/m3) and overall, the ambient air PCE concentrations decreased. TCE was detected in ambient outdoor air samples, including an outdoor air background sample, but the concentrations were well below the HDOH Tier 1 EAL (2.1 µg/m3). No HDOH Tier 1 EAL exceedances were reported for any other COPCs in the indoor or outdoor ambient air samples.

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4.0 Environmental Hazard Evaluation

As recommended in the HDOH guidance document *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* (HDOH, Summer 2008, updated March 2009), a tiered approach was used to assess potential human and ecological exposure pathways, and quantitatively evaluate the potential for hazards at the work sites.
Human and ecological exposure pathways to soil, soil vapor, and groundwater were evaluated based on site-specific, current, and reasonably anticipated land use. This tiered approach provides a focused and cost-effective way to evaluate exposure pathways, potential receptors, and hazards at the site.

4.1 Contamination Screening Evaluation

No known contamination exists within proposed work site areas. No media samples have been collected from the work site areas and therefore, no analytical data exists to compare to HDOH Tier 1 EALs. However, data from the Former Aiea Laundry Facility was screened against HDOH Tier 1 EALs and based on review of existing site data, soil above groundwater and shallow soil vapor in the area of TS13 and MS6 should not be impacted by contaminants from the Former Aiea Laundry Facility site. Groundwater also appears to be cross- and down-gradient of the contaminated groundwater plume associated with the Former Aiea Laundry Facility site. However, as a conservative approach, saturated soil and groundwater will be assumed to be impacted by the solvent plume for purposes of protecting personnel and managing soil and groundwater generated during construction.

4.2 Exposure Assessment

Current and potential future land use, potential receptors, and potential exposure pathways have been evaluated to address the potential for encountering contamination.

4.2.1 Current and Potential Future Land Use

The current and reasonably anticipated future land use at both sites is commercial.

4.2.2 Potential Receptors and Exposure Pathways

The potentially exposed populations under current and reasonably anticipated future conditions consist of site commercial workers and excavation/construction workers.
The potential receptors on the Site include individuals in the following capacities, and organisms in the immediate vicinity and downstream of the work areas. More specifically, the following potential receptors have been identified:

- HRTP Construction Workers
- Landscapers
- Authorized visitors to construction areas
- Trespassers to construction areas
- General public

Potential future hypothetical residents were not considered because the areas will be within the rail right-of-way and not suitable for residential development. In addition, ecological receptors (avian, mammalian, or terrestrial wildlife were not considered because of lack of suitable habitat.

The potential exposure pathways in which commercial and excavation worker could be exposed to hazardous substances include ingestion, inhalation, and dermal contact. These are described briefly below.

- ***Ingestion*** is the oral intake of a solid or liquid material. The ingestion of contaminated soil or groundwater is a direct exposure hazard. Accidental ingestion of contaminated soil or groundwater could occur during construction in portions of the HRTP where contaminated soil and groundwater are exposed. Ingestion of COPCs is most likely to occur when workers fail to clean their hands prior to eating and smoking.

- ***Inhalation*** is the act of drawing air, other gases, vapors, fumes, smoke, dust, or mists into the lungs. Some chemicals in contaminated soil and groundwater could volatilize when the soil and or groundwater is exposed. During excavation and construction activities, contaminated subsurface soils may be disturbed, thus increasing the potential release of dust and volatile compound into the work area, and the risk that COPCs could be inhaled.

- ***Dermal contact*** is the direct exposure of skin to solids, liquids, or gases with contaminated soil, groundwater, or vapor. Upon contact, some substances have the potential to absorb directly into the body through the skin. During drilling, excavation and other construction activities, contaminated soils and groundwater are likely to be encountered, thus increasing the potential for dermal contact.

Contaminant Fate and Transport

Fate and transport for CVOCs in the free product, dissolved, residual, and vapor phases were evaluated for four areas of concern, i.e., the Former Aiea Laundry Facility area, the Saint Elizabeth Church and School property, the Backyard Area, and the near-shore/inter-tidal zone.

Dense Non-Aqueous Liquid Phase (DNAPL)

The Former Aiea Laundry Facility investigation results indicate no evidence of a continuous DNAPL plume in either the vadose or the saturated zones of the caprock formation, and suggest that most of the remaining contamination exists as residual-phase PCE within vadose zone soil in the Former Aiea Laundry Facility area located more than 1,000 feet cross- and up-gradient of TS13 and MS6 locations.

Residual Phase

The residual-phase contamination exists as PCE sorbed to soil particles and held in soil pore spaces by capillary forces and is likely to remain relatively immobile under normal subsurface pressure conditions. The residual-phase contamination appears to be restricted to deep subsurface soil in the Former Aiea Laundry Facility area near the source zone (i.e., the former UST and drain line locations). However, some of the contamination has migrated down to the caprock groundwater table, resulting in a plume of dissolved CVOCs in the groundwater.

Dissolved Phase

Advective and dispersive transport of dissolved-phase CVOCs has resulted in contamination of the caprock groundwater downgradient of the Former Aiea Laundry Facility site. The data indicate that the CVOC plume in groundwater near the shoreline of Aiea Bay does not extend north of MW-28 or south of MW-27, indicating that the width of the plume (in the direction parallel to the shoreline) is approximately 600 feet (Figure 1-1). The multi-level well data show that CVOC concentrations decrease with depth, indicating that the majority of the contamination is restricted to the upper level of the caprock saturated zone. PCE, TCE, and DCE concentrations reported for the seep water samples have been relatively low compared to the concentrations reported for groundwater samples from the near-shore monitoring wells. Although the seep water and near-shore groundwater data represent the same water body, significant decreases in PCE, TCE, and DCE concentrations were observed between the near-shore wells and the seep water wells, suggesting that the CVOCs are retarded and biodegraded as the groundwater flows through the high-plasticity organic clays that dominate the area along the shoreline. However, biodegradation has apparently resulted in increased VC concentrations in the seep water relative to the near-shore groundwater. The local production of VC in the short distance (approximately 100 feet) between the near-shore groundwater wells and the seep water sampling locations indicates that PCE, TCE, and DCE are retarded near the shoreline within groundwater and slowly transformed into VC by biodegradation.

Vapor Phase

CVOC concentrations above HDOH Tier 1 EALs appear to be limited to the Former Aiea Laundry Facility located more than 1,000 feet cross- and up-gradient of the TS13 and MS6 locations. Additionally, CVOC concentrations in the shallow soil vapor in the Former Aiea Laundry Facility have decreased significantly over the 13 years since SVM began in 1996 after installation of the SVE system, however, deep soil vapor in the Former Aiea Laundry Facility source area continues to show relatively high levels of CVOCs. The SVM data suggest that the SVE system has not significantly reduced CVOC concentrations in deep soil vapor due to the presence of residual-phase contamination in the deep soil. The data also indicate that vapor-phase CVOCs are not migrating vertically or horizontally to the Saint Elizabeth Church and School property at concentrations that exceed the HDOH Tier 1 EALs for sub-slab soil vapor. PCE concentrations exceeding the HDOH Tier 1 EAL for indoor air were reported for ambient indoor air samples collected from several locations in the Saint Elizabeth Church and School buildings in 2009 and 2010, but from only one location in 2011. PCE concentrations reported for soil vapor samples from beneath the Saint Elizabeth Church and School buildings were relatively low, suggesting that sources other than soil vapor (e.g., offsite ambient air, dry-cleaned clothing) may contribute to the PCE concentrations reported for the indoor air samples. The results of the August 2011 Backyard Area soil vapor investigation indicated that an area of high PCE concentrations initially observed in 1996 is still present at approximately the same location and depths. The hotspot appears to be limited in its horizontal extent and have a separate soil source, unrelated to the USTs and drainage system at the Former Aiea Laundry Facility.

Risk Assessment Results

The human health risk assessment (HHRA) prepared for the 2002 RI/FS (AMEC 2002a) was updated based on the RI/FS Addendum data. The HHRA evaluated risks potentially associated with current and hypothetical future exposure scenarios for each of the four areas of concern, i.e., the Former Aiea Laundry Facility Area, the Saint Elizabeth Church and School property, the Backyard Area, and the near-shore/inter-tidal zone between the site and Aiea Bay. The risk assessment evaluated risks using conservative RME exposure assumptions. A revision of risk using CTE exposure assumptions was also conducted for receptors/pathways for which the RME risk was above risk thresholds (cancer risk of 1E–06 and non-cancer hazard index (HI) of 1.0). Table ES-2 summarizes the human health risk assessment RME results, i.e., the estimated excess cancer risks and estimated non-cancer risks as hazard indices (HIs). Table ES-3 summarizes the human health risk assessment CTE results, showing the revisions from the RME values for those receptors/pathways that warranted revision of RME estimates. An ecological screening risk assessment (SRA) was completed to evaluate potential risk to aquatic receptors in the near-shore environment of Aiea Bay. No suitable habitat for ecological receptors was identified at or near the Former Aiea Laundry Facility area, including the Saint Elizabeth Church and School property.

Former Aiea Laundry Facility Area, Human Health Risk

Potential routes of exposure for current receptors (i.e., visitors who use the site as a parking lot) and hypothetical future receptors (i.e. residents, industrial workers, and construction workers) include direct contact (ingestion and dermal contact) with soil, inhalation of soil particles in outdoor air, inhalation of chlorinated solvents in indoor and outdoor air, and ingestion or inhalation of chlorinated solvents in groundwater. As shown in Table ES-1 and ES-2, RME risk for direct contact with soil (future industrial worker) was well below 1E–06; RME and CTE risk for groundwater ingestion was greater than 1E–04 for the future resident and future industrial worker; risk from inhalation of chlorinated solvents while bathing was 7E–06 (RME) and 1E–06 (CTE) for lifetime residents; and RME and CTE risk for indoor air inhalation were greater than 1E–04 for the future resident, and were 6E–05 (RME) and 2.2E–05 (CTE) for the future industrial worker.

Although unacceptable risks (i.e., excess cancer risks >1E–04 and HIs >1) were identified for groundwater ingestion and inhalation, and for inhalation of chlorinated solvents in groundwater while bathing, the groundwater exposure pathways are expected to remain incomplete because the caprock groundwater is not a current or potential future source of potable water.

Saint Elizabeth Church and School, Human Health Risk

Potential risks to human receptors at the church and school associated with the vapor intrusion pathway were assessed using the subbasement soil vapor, ambient indoor air, and ambient outdoor air sampling data collected on the Saint Elizabeth Church and School property. As shown in Table ES-2, the risk assessment results indicate that the vapor intrusion pathway poses no unacceptable risk to adults or children, either outdoors or within the Saint Elizabeth Church and School buildings, or to future residents.

Backyard Area, Human Health Risk.

The 2002 HHRA concluded that exposure to chlorinated solvents via the ingestion, dermal contact, and inhalation pathways would pose no unacceptable risk to future residential or industrial receptors in the backyard portion of the Former Aiea Laundry Facility property. The inhalation of outdoor and indoor air pathways in the Backyard Area were reevaluated using the most recent analytical data in the updated HHRA. Inhalation of indoor air presented potentially unacceptable RME risk within the EPA cancer risk management range (Table ES-2), but with uncertainties associated with elevated detection limits in the data set on which the risk was based. The CTE risk was only slightly above the low end of the risk range (Table ES-3). The inhalation of outdoor air did not pose unacceptable risk.

Near-shore/Inter-tidal Zone, Human Health Risk

Risks associated with ingestion and inhalation of the chlorinated solvents detected in groundwater are considered insignificant because the caprock groundwater is not currently used as a source of potable water and is not expected to be used as a potable water source in the future; however, these exposure pathways were evaluated to identify and document the potential risks.

Cancer risk from inhalation of outdoor air by industrial workers under the RME scenario was 3E–06; CTE cancer risk was below 1E–06. Because of the likelihood that risk was overestimated because it did not take into account dilution with uncontaminated Aiea Bay water, and because groundwater would not be used for residences, no unacceptable risks to human health were identified for the near-shore/inter-tidal zone.

Aiea Bay, Ecological Risk

The ecological SRA results indicate that the COPCs detected in groundwater, seep water, and surface water pose no unacceptable risks to the marine environment. PCE was detected at a concentration slightly above the ecological screening criterion in a groundwater sample from one monitoring well (MW-26). However, based on the low frequency of detection and the distance between MW-26 and the Aiea Bay shoreline (approximately 100 feet), chemicals detected in the groundwater are not likely to adversely affect ecological receptors in Aiea Bay.

Remedial Investigation Conclusions

Former Aiea Laundry Facility Area

CVOC concentrations above HDOH Tier 1 EALs for unrestricted use were detected in soil vapor samples from the SVM wells, and the HHRA concluded that inhalation of indoor air could pose unacceptable risks to future receptors under the residential and industrial land use scenario; therefore, further action is recommended to address the vapor intrusion pathway at the Former Aiea Laundry Facility. However, although estimated risks associated with potential ingestion of the groundwater are considered unacceptable, the Former Aiea Laundry Facility groundwater exposure pathways are expected to remain incomplete because the caprock groundwater is not a current or potential future source of potable water. Therefore, no further action is required for caprock groundwater at the Former Aiea Laundry Facility.

Backyard Area (Former Fleet Training Center)

The August 2011 soil vapor sampling results indicate that the relatively high concentrations of PCE identified in the 1996 investigation persist and but appear to be limited to an area near the northeastern property boundary. Since shallow soil analytical data for borings located in that area contained relatively low concentrations of PCE it is likely that there is only an isolated zone of elevated PCE concentrations in subsurface soil at approximately 10 feet bgs (note, additional SVM wells and confirmation samples are planned for 2012).

Saint Elizabeth Church and School

The HHRA concluded that exposure pathways other than vapor intrusion are either incomplete or insignificant, and inhalation of ambient air on the church and school property poses no unacceptable risk to adults or children, either outdoors or inside the buildings. In addition, the RI Addendum results indicate that, due to the limited mobility of vaporphase CVOCs in shallow subsurface soil at the Former Aiea Laundry Facility, CVOCs are not likely to migrate to the Saint Elizabeth Church and School property at concentrations that could threaten human health. Therefore, the RI Addendum results confirm that no further action is necessary for the Saint Elizabeth Church and School, although periodic monitoring of fenceline soil vapor concentrations is recommended to evaluate the continued stability of soil vapor concentrations in that area.

Near-shore/Inter-tidal Zone
PCE concentrations above the project-specific screening criterion for protection of the aquatic environment were reported for groundwater samples from some of the monitoring wells in the near-shore area; therefore, further action is recommended to address caprock groundwater in the near-shore/inter-tidal zone.

The Human Health Pathway Exposure Evaluation for the Former Aiea Laundry Facility is summarized in Appendix A, Figure 8-1. An Ecological Conceptual Site Model is also summarized in Appendix A, Figure 8-3.

4.3 Uncertainties and Limitations

Uncertainties associated with analysis include the inherent variability (standard error) in the data analysis, and heterogeneity of the sample matrix. These uncertainties could contribute to underestimation or overestimation of hazards at the site. As a conservative approach to mitigate the uncertainties and limitations, soil and groundwater will be tested for CVOC (PCE, TCE, DCE, and VC) and petroleum contaminants (TPH-g, TPH-d, TPH-o, VOCs, PAHs, PCBs, cadmium, chromium, and lead). Saturated soil and groundwater will be presumed to be contaminated with CVOCs associated with the Former Aiea Laundry Facility and managed in accordance with the EHMP presented in Section 5.

5.0 Environmental Hazard Management Plan

Although there is no known or suspected contamination anticipated to be encountered at the work areas, a conservative approach has been taken due to the potential for CVOCs in saturated soil and groundwater associated with the Former Aiea Laundry Facility. This EHMP has been developed for management of soil and groundwater as well as contingency planning purposes to identify the appropriate procedures should unanticipated types of contamination or media be encountered. The plan consists of several individual plans, each addressing a specific potential COPC source. The individual plans include the following:

- Soil Management Plan
- Groundwater Management Plan
- Free Product Management Plan
- Vapor Management Plan
- Storm Water Management Plan

These plans include engineering and administrative controls, requirements for personal protective equipment (PPE), and a monitoring program. Before beginning construction work, workers must be informed about the potential hazards posed by COPCs they may encounter and how they can avoid exposure. The primary potential COPCs include PCE, TCE, DCE, and VC. Other COPCs include TPH-g, TPH-d, TPH-o, VOCs (including BTEX, MTBE, naphthalene), methane, PAHs, PCBs, cadmium, chromium, and lead associated with potential fuel releases in the area. The Contractor HSP addresses these COPCs with the primary field screening tools limited to PID or FID measurements.[3] Field screening for contamination will be limited due to the anticipated low concentrations of CVOCs in saturated soil and groundwater. Consequently, all saturated soil and groundwater will be treated as contaminated whether PID measurements are elevated (>1ppm) or not.

A communications plan an important part of an environmental hazard management program. KIWC will notify HART in the event of any changes in site conditions, evidence of contamination and what efforts are being taken to protect workers, the public and the environment from possible exposure to COPCs. HART will in turn, suspend work and immediately notify the HDOH as well to seek further guidance on the necessity for implementing additional measures. The plan should also identify roles, responsibilities, and authority each individual has in making decisions regarding how the health and safety of the worksite is monitored, the requirements for worker protection, and what additional efforts need to be taken to protect the general public and the environment.

Given the limited reuse potential of soil and groundwater generated from construction activities, soil/sediment is anticipated to be disposed offsite, and groundwater will either be reinfiltrated onsite or disposed offsite. Proper characterization of soil and extracted groundwater before removal for disposal includes using existing historical data and/or collecting representative samples to be analyzed for additional criteria required by the receiving facility.

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[3] The ionization potentials for PCE, TCE, DCE, VC, BTEX, and naphthalene are less than the energy potential of the PID which typically contains a 10.6 electronvolt (eV) lamp so should adequately screen ambient air for the presence of these contaminants. Note: The use of a separate detector would be needed if PID measurements exceeded 1ppm to determine whether VC was present.

5.1 Management of Environmental Hazards during Construction Activities

An environmental professional or industrial hygienist with experience in managing the remediation of contaminated properties should be present while working in the TS13 and MS6 areas. The role of the environmental professional will be to:

- Monitor excavated soil for visible or olfactory evidence of contamination
- Monitor groundwater in excavations for visible or olfactory evidence of contamination
- Decontaminate equipment
- Perform field testing of soil and samples
- Collect samples for laboratory analysis
- Advise the contractor on the designation of “decision units”[4]
- Direct the placement of excavated soil in appropriate waste disposal containers
- Direct the pumping of contaminated water to containment vessels
- Provide health and safety guidance related to the potential exposure of workers to COPCs
- Monitor the work activities to ensure compliance with this environmental hazard management plan.

Once contamination is identified, the Contractor shall notify HART, and HART will notify HDOH to report the presence of contamination (a release) and seek guidance and authorization to continue work. Further work should proceed only when HDOH has authorized continuance of the work, HART has authorized the continuance of the work, and the contractor has ensured that appropriate precautions and preparation have occurred. Construction activities that pose a potential risk of exposure to contaminated soil or dust (such as excavation of soil) must be supervised by personnel who have current 40-hour hazardous waste operations (HAZWOPER) certification and 8-hour hazardous waste operations supervisor certification (29CFR1910.120), and who are able to identify potential needs for upgrading the level of health and safety protection. All personnel working in direct contact with contaminated soil shall have current 40-hour HAZWOPER certification and modification to the Contractor’s written Health and Safety Plan (HSP) will also be required to identify HAZWOPER-regulated tasks, associated hazards, monitoring and control measures, and emergency response requirements.

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[4] “A decision unit is an area where a decision is to be made regarding the extent and magnitude of COPCs with respect to potential environmental hazards posed by existing or anticipated future exposure to the COPCs. (Strictly speaking, a decision unit is really a volume rather than area of soil, because the thickness of the decision unit is often a key factor.) A decision unit can be an identified spill area or ‘hot spot,’ a residential yard, a playground or schoolyard, a garden, a commercial/industrial property or other specific area of interest. Average COPC levels are determined in the selection decision units.” [HDOH, “Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater, Volume 1: Users Guide,” Fall 2011, page 1-7]

5.2 Soil Management Plan

The purpose of the soil management plan is to help ensure that if contaminated soil is encountered during construction, the risks associated are understood, and appropriately addressed. As discussed in Section 4.0, the main hazards created by contaminated soil are direct exposure, ingestion of COPCs, inhalation of vapors or dust containing COPCs, and releases of COPCs to the environment through contact with storm water.
Based on observations and analytical results from previous environmental investigations (particularly the Former Aiea Laundry Facility), surface and subsurface soil in the unsaturated zone above groundwater is not anticipated to be contaminated but will be managed as contaminated until the soil can be tested and confirmed not contaminated. However, as a conservative approach subsurface soil in the saturated zone beneath groundwater is anticipated to be contaminated with CVOCs. Whereas petroleum contamination is often apparent through visual and olfactory observations, CVOC contamination cannot be easily determined by visual or olfactory observations. Air monitoring for personnel health and safety is covered under a separate Contractor HSP. Contaminated soils may be discolored, or have an odor.

Further details about the program are provided in the following sections.

5.2.1 Site Preparation for Handling Contaminated Soil

All soil from TS13 and MS6 will be removed, stockpiled, characterized and either reused or disposed following safe work practices and in conformity with HDOH and EPA regulations and guidelines.

5.2.2 Work Activities when Removing Contaminated Soil

An environmental professional will use field observations and measurements to assess the excavated unsaturated soil for the presence of contamination (except for CVOCs which may not be detectable using field techniques). When contamination is suspected, the process for managing excavated soil is summarized below. Note: Soil removed from the saturated zone beneath groundwater will be presumed contaminated and segregated from surface and subsurface soil in the unsaturated zone above groundwater. For TS13 and MS6, excavated soils will stockpiled in the overflow parking lot at Aloha Stadium. KIWC has stockpiling permit GP2012-02-0045 for this location. The soil will be managed as follows:

- At each worksite, contaminated soil (and saturated soil) should be segregated from clean soil in separate waste removal units (waste transporter dump containers or roll-off boxes) lined with chemically-resistant liners as necessary; minimum 15- to 20-millimeter liner thickness (e.g., 2 layers of 10mil polyethylene plastic sheeting)
- Ensure the ground surface on which the stockpile will be placed is relatively free of rocks and other objects that could damage the liner
- Construct stockpiles to allow saturated soil leachate to be captured and contained
- Limit stockpile size to 100 cubic yards per pile

- Cover stockpiles with waterproof material and extend the cover beyond the perimeter so that precipitation runs outside the stockpile footprint
- Leave stockpiles uncovered only when they are actively being worked
- Cover dump containers or roll-off boxes with a waterproof cover as soon as the container has been filled
- Mechanically anchor covers
- Decontaminate equipment used to remove soil by removing gross contamination by spinning/vibrating/agitating mechanical equipment to loosen stuck-on soil
- Following gross removal of contamination, pressure or steam wash equipment if residual contamination is observed Note: Rinsate should be captured and managed in accordance with the groundwater management plan in Section 5.3.

In addition, as described in KIWC's Site-Specific Construction Best Management Practices Plan, all stockpiles will be labeled with the following information:

- MATERIAL NOT REGULATED BY D.O.T "Potential Contaminated Soil- Pending Analysis"
- Date soil was stockpiled
- Name of the generator (HART)
- Activity that produced the material (Shaft excavations)
- Location where the material came from (TS13 or MS6)

5.2.3 Soil Screening for Contamination

Saturated soil will be presumed contaminated and segregated from soil in the unsaturated zone. Soil screening will be conducted for unsaturated soil. The worksite and unsaturated soils excavated from the construction areas will be screened by the Contractor using the following process:

- Visual and olfactory screening of soils for staining, debris, slag, discoloration, or petroleum or unusual odors as the soils are removed from the excavation (Note: CVOC contamination is not readily discernible by visual or olfactory observation)
- Collection of samples in inert sealable containers (plastic bags/or glass jars) and testing of the headspace for volatile organic carbon compounds (VOCs) using a photo-ionization detector (PID) (Soil headspace with PID readings above 1 ppm will be considered potentially contaminated and segregated for additional soil testing as described in Section 5.2.4)
- When elevated VOC readings (>1 ppm) are identified, testing for benzene and VC using a specific meter, e.g., pump and benzene- or VC-specific Drager tubes.

5.2.4 Soil Testing

If no visual, olfactory, or field instrument evidence of contamination is observed, excavated soil will be tested for VOCs ONLY based on the presence of the Former Aiea Laundry Site cross- and up-gradient of the TS13 and MS6 locations. If visual (staining, presence of anthropogenic materials, e.g., debris, or fill), or olfactory evidence of contamination is observed, soil will be tested for other associated COPCs. The collection and testing of samples for waste characterization should be coordinated with the waste disposal facility and is described in KIWC's Hazardous and Contaminated Substance Screening and Sampling Plan:

> *The array of chemical testing to be done will require that two multi-increment samples be taken at each sample location (HDOH, 2009). Each sample location will include a volatile multi-increment sample and a non-volatile multi-incremental sample. Soil samples will be collected and analyzed at a frequency of ten samples per 200 tons (landfill requirements) for each Investigative Derived Waste (IDW). Investigative produced soils will be placed into bins or stockpiled according to waste management plans. Four multi-incremental field samples will be collected from between 10- 20 bins or stockpiles out of every 200 cubic yards of waste material. The four samples will be combined in the lab to produce one sample. The total number of soil samples to be collected at the site will be based on the actual soil volume produced and number of various wastes.*
> *Samples will be collected from interior portions of the bins or stockpiles. The height of collected soil will be no more than five feet. The samples will be collected at depths of approximately six inches to two feet below the surface.*
>
> *To achieve the required sampling depths a shovel or core sampler will be used. A shovel or core sampler can be used to reach soil located at depths of greater than one foot below the surface of a stockpile or bin.*
>
> *The array of chemical testing to be done will require that separate multi-increment samples are taken for volatiles. Soils that will be tested for volatile compounds will be collected as a multi-increment sample, from a depth of 1.5 or 2 feet below the surface, in a separate container. The sampling procedure is as follows:*
>
> 1. *Decontaminate all soil sampling devices prior to collecting samples.*
> 2. *Identify stockpile sampled with sampling number.*
> 3. *Insert a tool into material and remove a sample into a methanol prepared bottle.*
> 4. *Repeat these steps 25-50 times to obtain sufficient sample volume.*
> 5. *Secure the cap tightly.*
> 6. *Label the sample container with the appropriate sample label.*
> 7. *Place filled sample containers on ice immediately.*
> 8. *Complete all chain-of-custody documents and field sheets and record in the field logbook.*

If a soil is presumed to be contaminated, the testing of that soil will be depend on the suspected COPC. Actual sampling and analytical requirements for other COPCs should be determined in consultation with an environmental professional and reviewed/approved by the HDOH. In addition, the disposal facility should be contacted to identify any other requirements. If the sample analytical results indicate that soil or groundwater fails for a hazardous waste criteria, e.g., characteristic ignitable, or fails TCLP), then waste will be managed as a hazardous waste and transported and disposed via hazardous waste manifest to a RCRA Subtitle C permitted disposal facility.

5.2.5 Soil Disposal

Although the Former Aiea Laundry Facility is being investigated under CERCLA, wastes generated as part of the TS13 and MS6 construction are not subject to the CERCLA Offsite Rule because TS13 and MS6 are not within the CERCLA site and the project is not CERCLA-funded. Furthermore, even if TS13 and MS6 were located within the Former Aiea Laundry Facility site boundary, a decision document has not yet been signed for the site and therefore, wastes would be considered IDW and not subject to the CERCLA Off-Site Rule.

Soil results will be compared against HDOH Tier 1 EALs included in Appendix B (Unrestricted Use, groundwater is a current or potential drinking water source, <150m from surface water) and waste disposal criteria. Following comparison with HDOH Tier 1 EALs, soils that will need to be disposed will fall into one of three categories:

- Soils that do not contain COPCs above HDOH Tier 1 EALs
- Soils that contain COPCs above HDOH Tier 1 EALs but are not “hazardous wastes” as defined by the Federal or State of Hawaii regulations
- Soils that are regulated as hazardous wastes by the U.S. EPA or HDOH

The proper disposal of the wastes depends on the category in which the waste soils fall.

<u>Soils with COPCs <HDOH Tier 1 EALs</u>
Non-regulated soil will be disposed off-site at PVT Landfill, which is licensed to receive construction debris, or Waimanalo Gulch Sanitary Landfill, which is licensed to receive residential and general commercial refuse. These soils may also be reused at other sites for unrestricted land use at the discretion of the Contractor.

<u>Soils with COPCs >HDOH Tier 1 EALs but Non-Hazardous Waste</u>
These soils contain COPCs above HDOH Tier 1 EALs, but do not have any of the characteristics of hazardous waste. Soils within this classification will be disposed at PVT Landfill or Waimanalo Gulch Sanitary Landfill.

<u>Hazardous Waste</u>
Hazardous wastes are defined under RCRA in 40 CFR 261 and HAR 11-261 where they are divided into two major categories: characteristic wastes and listed wastes. Characteristic hazardous wastes are materials that are known or tested to exhibit one or more of the following four hazardous traits:

- ignitability (i.e., flammable)
- reactivity
- corrosivity
- toxicity

Testing for characteristic hazardous waste will include the following laboratory analyses:

- Ignitability (EPA Method 1020)
- pH (EPA Method 9045)
- Paint Filter Liquids Test (EPA Method 9095A)

- Toxic Characteristic Leachate Procedure (TCLP) (EPA Method 1311)

In some instances, sample results may be available that were taken for a site investigation (e.g., soil samples from borings). Usually such samples are "total" concentrations rather than TCLP concentrations. The TCLP method (EPA Method 1311) states the following:

- "If a total analysis of the waste demonstrates that individual analytes are not present in the waste, or that they are present but at such low concentrations that the appropriate regulatory levels could not possibly be exceeded, the TCLP need not be run."
- EPA Method 1311 has a 20-fold dilution of the waste when the waste is leached as part of the analysis. This results in the 20x Rule: if the total concentration of a waste is less than 20x the TCLP limit for that contaminant, then the waste will not fail the TCLP for that contaminant.

"Listed hazardous wastes" are materials specifically identified by the U.S. EPA and HDOH as a hazardous. They can come from non-specific sources, specific sources, or discarded chemical products. Note: PCE, TCE, DCE, and VC from the Former Aiea Laundry Facility are not considered 'listed hazardous wastes'.

5.2.6 Engineering and Administrative Controls

Dust and vapor control methods may be needed during open-trench excavation work. These controls include minimizing the size of excavations, covering soil stockpiles, controlling vapor emissions with supplied ventilation, and spraying water to suppress dust. In most areas, Level D personal protection equipment (PPE) will be appropriate for workers during construction and while loading, transporting, disposing, and managing soils. If COPCs exceed threshold concentrations, the PPE will be upgraded to Level C. The criteria for doing so are identified in the Contractor HSP, and in the Vapor Management Plan (Section 6.5).

5.2.7 Periodic Inspections and Preventive Maintenance

Regular and routine inspections of contaminated soil management practices are needed to ensure compliance and to make adjustments in work procedures. Where workers could be exposed to contaminated soil (e.g., open excavations, soil stockpiles), an inspection should occur daily.

Waste soil containment areas should be inspected daily. When damage or defects to any component of the controls needed to prevent exposure to or release of contaminated soil are detected, repairs must take place immediately.

Personal Protective Equipment (PPE) must be inspected for damage and defects before donning. If a defect or damage is identified, it must be replaced.

5.2.8 Record Keeping and Reporting

Detailed records of workspace monitoring, excavation conditions, the contents of soil stockpiles, and release reporting activities must be maintained. Changes in the contaminated soil handling procedures must be reported to supervisors and approved prior to implementing the change. Record keeping will also include tracking the disposition of all soil taken from the TS and MS area, as well as soil reuse on and off site and disposal locations.

5.3 Groundwater Management Plan

This groundwater management plan is intended to help ensure that contaminated groundwater encountered during construction is properly managed. As discussed in Section 4, the main hazards created by contaminated water are direct exposure, ingestion of water containing COPCs, inhalation of volatile COPCs released from water, and releases of COPCs to the environment through an inadvertent release, or improper disposal. Contaminated groundwater is not anticipated to be encountered during TS13 and MS6 construction. However, since the Former Aiea Laundry Facility is located cross- and up-gradient of the TS13 and MS6 locations, groundwater will be presumed to be contaminated with CVOCs (PCE, TCE, DCE, and VC). Some groundwater contamination can be detected through visual and olfactory observations, but the presence of other COPCs, such as elevated concentrations of the suspected CVOCs and heavy metals, may be less apparent. Consequently, the use of field instruments should be used (e.g., PID with minimum 10.6 eV lamp or FID).

The anticipated tasks associated with managing contaminated groundwater are summarized below.

5.3.1 Site Preparation for Handling Contaminated Groundwater

In areas where contaminated groundwater is encountered and must be removed as part of the construction process, safe work practices and HDOH and EPA regulations and guidelines will control how the water is managed. Under many circumstances, contaminated groundwater can be reinfiltrated onsite as long as reinfiltration will not result in the release of contaminated groundwater to previously uncontaminated groundwater or surface water, or mobilize contaminated groundwater beyond existing impacted areas. The presence of contaminated groundwater should be reported to HART immediately, who will in turn notify HDOH for guidance and authorization to continue work. Further work should proceed only when HDOH and HART have authorized continuance of the work and the contractor has ensured that the following precautions and preparations are in place:

- Workers have the appropriate level of PPE
- Water that flows from soils during removal from the excavation can be captured, and temporarily stored in containers pending sampling and analysis
- Water leaching from soil placed in dump boxes or stockpiles can be properly captured, contained and removed for treatment and disposal
- Water can be properly treated and disposed in accordance with environmental regulations and discharge permits

5.3.2 Work Activities when Removing Groundwater

An environmental professional will use field observations and measurements to assess the presence of contamination. When contamination has been confirmed, the process for managing groundwateris summarized below.

- Temporarily store groundwater onsite in appropriate containment, e.g., settling tanks, Baker tanks, ASTs
- Following adequate time for liquid/sediment to settle, measure liquid within the container to ensure that DNAPL is not present Note: DNAPL should be removed

to the extent practicable and handled separately. If sediment is present, it should be handled separately and sampled/analyzed for VOCs together with saturated soil as described in Section 5.2.

- Decontaminate pumps/hoses/tanks by removing solids, pressure or steam washing to remove residual contamination Note: Minor amounts of decontamination fluid can be managed together with groundwater

5.3.3 Groundwater Testing

If no visual, olfactory, or field instrument evidence of contamination is observed, groundwater will be tested for VOCs ONLY based on the presence of the Former Aiea Laundry Site cross- and up-gradient of TS13 and MS6. If visual (free product, discoloration), or olfactory (odor) evidence of contamination is observed, groundwater will be tested for other suspected COPCs.

Although cross- and down-gradient of the known solvent plume associated with the Former Aiea Laundry Facility, groundwater will be presumed contaminated pending sampling and analysis.

The collection and testing of samples for waste characterization should be coordinated with the waste disposal facility and done in the following way:

- Collect at least one representative groundwater sample for groundwater contained in a single container, e.g, Baker tank
- Collect composite samples from separate containers to form a representative sample
- Submit groundwater samples for laboratory analysis of TPH-g, TPH-d, TPH-o, VOCs, PAHs, and cadmium, chromium, and lead and other suspected COPCs (determined from field screening) or as required by permit or permitted receiving facility if taken offsite.

The disposal facility should be contacted to identify any other sampling and analytical requirements.

5.3.4 Groundwater Treatment and Disposal

Following sampling and analysis of groundwater samples, analytical results will be compared to HDOH Tier EALs included in Appendix B and waste disposal criteria. Contaminated groundwater will fall into one of three categories:

<u>Groundwater with COPCs <HDOH Tier 1 EALs</u>
Non-regulated groundwater will be managed in one of the following ways:

- reinfiltrate to surface (as long as does not cause runoff) or to a shallow trench
- request discharge to sanitary sewer from City and County of Honolulu waste water division
- request discharge to storm sewer if concentrations of COPCs are below chronic aquatic toxicity EALs and after all required permits are in place

- coordinate with PVT Landfill to determine acceptance and if accepted, take to PVT Landfill

<u>Groundwater with COPCs >HDOH Tier 1 EALs but Non-Hazardous Waste</u>
Groundwater within this classification will be managed in one of the following ways:

- reinfiltrate/reinject to depth at which water was removed (with or without treatment) via injection well, after all required permits are in place, i.e. UIC permit obtained from HDOH Safe Drinking Water Branch (SDWB)[5]
- treat at surface (e.g., carbon filter or air stripping) to <HDOH Tier 1 EAL and then reinfiltrate to surface (no runoff) or to shallow trench
- request discharge to sanitary sewer from C&C of Honoluu waste water division
- coordinate with PVT Landfill to determine acceptance criteria, and if accepted, take to PVT Landfill
- if PVT landfill cannot accept groundwater for disposal, identify an alternative permitted facility out-of-state that can accept the groundwater

<u>Hazardous Waste</u>
Hazardous wastes are defined under RCRA in 40 CFR 261 and HAR 11-261 where they are divided into two major categories: characteristic wastes and listed wastes. Characteristic hazardous wastes are materials that are known or tested to exhibit one or more of the following four hazardous traits:

- ignitability (i.e., flammable)
- reactivity
- corrosivity
- toxicity

Testing for characteristic hazardous waste will include the following laboratory analyses:

- Ignitability (EPA Method 1020)
- pH (EPA Method 9045)

Note: If the waste is a liquid (<0.5 percent solids), the TCLP method states that the liquid must be run through a filter, then the total analysis concentrations in the liquid must be compared directly to the TCLP limits. There is no 20x Rule for liquids.

“Listed hazardous wastes” are materials specifically identified by the U.S. EPA and HDOH as a hazardous. They can come from non-specific sources, specific sources, or discarded chemical products. Note: PCE, TCE, DCE, and VC from the Former Aiea Laundry Facility are not considered ‘listed hazardous wastes’.

Hazardous waste will be managed in one of the following ways:

- treat to <HDOH Tier 1 EALs and reinfiltrate to surface or to shallow trench

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[5] The HDOH HEER office may be delegated authority to oversee the installation, use, abandonment of UIC wells in specific areas of the rail project after HART has demonstrated familiarity and proper compliance with UIC permit requirements.

- treat to <HDOH Tier 1 EALs and take to PVT Landfill or another permitted non-hazardous waste landfill
- dispose offsite (out-of-state) at RCRA permitted hazardous waste facility

If treatment of hazardous waste groundwater is considered, the Contractor shall notify HDOH SHWB in advance to identify and discuss appropriate treatment options. The treatment of water will generate residue waste, including sediment removed from the water, alum or other chemicals used to precipitate contaminants, and waste carbon used to remove organic compounds. These solid wastes will be either treated to remove any COPCs (e.g. regeneration of carbon), or the sediments will be disposed as either hazardous or non-hazardous waste. Residuals from groundwater treatment (e.g., spent carbon that is not regenerated and sediments) will be allowed to dry and then tested for characteristic hazardous waste similar to soil.

Testing for characteristic hazardous waste will include the following laboratory analyses:

- Ignitability (EPA Method 1020)
- pH (EPA Method 9045)
- Paint Filter Liquids Test (EPA Method 9095A)
- Toxic Characteristic Leachate Procedure (TCLP) (EPA Method 1311)

5.3.5 Engineering and Administrative Controls

Volatile COPCs in water discharged from excavations could emit vapors at noxious concentrations. The emission of vapors into the workplace should be monitored by an on-site environmental professional or industrial hygienist. Vapor control methods (e.g., vapor suppressants) to control the emissions of volatile COPCs from water are unlikely to be needed during construction. When elevated concentrations of volatile chemicals are observed, workers should be removed from the area, and the area should be vented until the COPC concentrations become acceptable.

In most areas, Level D personal protection equipment (PPE) will be appropriate for workers during construction and while loading, transporting, disposing, and managing soils. If COPCs exceed threshold concentrations, the PPE will be upgraded to Level C. The criteria for doing so are identified in the project Health and Safety Plan. Respiratory protection and vapor monitoring are described in the Vapor Management Plan (Section 5.4).

5.3.6 Periodic Inspections and Preventive Maintenance

Regular and routine inspections of the procedures used to capture, store, treat and dispose water are needed to ensure compliance with this plan, and to make any needed adjustments in work procedures. All water treatment processes should occur in secure areas with regular surveillance. Containers, transfer pipes and hoses, and any treatment systems should be inspected for leakage. In active construction areas, an inspection of the procedures being followed and equipment should occur each work day.

PPE must be inspected for damage and defects before donning. If defects or damage is identified, it must be replaced.

5.3.7 Record Keeping and Reporting

Detailed records of workspace monitoring activities, water storage, treatment, and disposal processes, and spill response activities must be maintained. Changes in the contaminated groundwater handling procedures must be reported to supervisors and approved prior to implementing the change.

5.4 Free Product Management Plan

Free product in the form of light nonaqueous phase liquid (LNAPL) may be encountered in former petroleum storage or release areas. Although not anticipated, free product may also include dense nonaqueous phase liquid (DNAPL) associated with the Former Aiea Laundry Facility. LNAPL is typically readily evident by strong odors of hydrocarbon compounds, and visual evidence of (1) free-flowing, black, viscous product, (2) a thin layer of black, viscous product, (3) a discontinuous layer of product, or (4) a petroleum hydrocarbon sheen. Vapors emitted from the excavation area may contain a variety of volatile compounds including benzene, toluene, ethyl benzene, and xylene. LNAPL (and specifically PCE, TCE, DCE, and VC) may have a mild to strong sweet, ether-like odor. As discussed in Section 5.5, the presence of free product increases both the risk of exposure, and the risk of a possible fire or explosion particularly in confined spaces such as trenches or walled structures.
The best method to prevent the accumulation of explosive vapors in open trenches is to capture and remove either the free product, or remove the water containing free product before vapors can accumulate and vapor concentrations can rise above explosive levels. This can be accomplished using dewatering pumps, the placement of absorption pillows or mats to capture the hydrocarbons, or the use of suppression foam within the trench.

In cased boreholes, LNAPL will most likely be present only when excavating soil near the uppermost groundwater surface. Since the source of DNAPL would be from the Former Aiea Laundry Facility, it is difficult to determine the depth in groundwater though DNAPL tends to sink in groundwater.

5.4.1 Site Preparation for Handling Free Product

The basic procedures needed to handle contaminated soil and groundwater should guide the preparation of work areas for addressing free product. In addition to following safe work practices, the work area should be monitored using an explosimeter, which measures the concentrations of explosive gases and work should be suspended when vapors are detected at greater than 10 percent of the Lower Explosive Limit (LEL). A Class A-B-C fire extinguisher should be present on-site at all times. The availability of additional suppression foam should be identified.

5.4.2 Free Product Management

If free product is found during construction, work should be suspended and the Contractor will notify HART, who will in turn, notify the HDOH for guidance and authorization to proceed. Further work should proceed only when HDOH and HART have authorized continuance of the work and the contractor has ensured that the following precautions and preparations are in place:

- The ambient air space within the work area should be monitored for evidence of an explosive environment.

- Free product should be removed to the extent practicable
- Following completion of product recovery, absorbent pads, socks or other apparatus should be allowed to dry and be properly disposed.
- Recovered fuel should be tested and either processed for blending/reuse or properly disposed.

5.4.3 Free Product Testing and Disposal

LNAPL will be tested in the field using a Chlor-D-Tect field test kit to test for the presence of halogens. LNAPL may also be tested for other suspected contaminants, e.g., cadmium, chromium.

LNAPL will be classified into one of two categories:

- LNAPL with halogens <1,000ppm and/or additives that were part of the original formulation, e.g., EDB, lead, MTBE, etc., then LNAPL will be transported to a local processing facility for blending/reuse for its intended purpose
- LNAPL with halogens >1,000 ppm and/or contaminants not part of the original formulation, e.g, cadmium, chromium, then LNAPL will be considered hazardous and transported a hazardous waste facility.

DNAPL will be considered hazardous waste and transported and disposed of accordingly.

5.4.3 Engineering and Administrative Controls

If free product is encountered, the workspace atmosphere will be monitored for LEL. Criteria for protection of workers are identified in the Contractor HSP. Respiratory protection and vapor monitoring are described in the Vapor Management Plan (Section 6.4).

5.4.4 Periodic Inspections and Preventive Maintenance

Regular and routine inspections of the procedures needed to capture, store, treat and dispose water and soil should also be used to detect and address free product if it is found. When free product is identified, the environmental professional or industrial hygienist should complete an initial evaluation of the explosive concentrations within all confined spaces in the area, and regularly monitor work spaces until the risk posed by the free product passes. PPE must be inspected for damage and defects before donning. If defects or damage is identified, it must be replaced.

5.4.5 Record Keeping and Reporting

Detailed records of workspace monitoring (including LEL measurements), product recovery, and response activities must be maintained. If changes in the free product handling procedures are needed, they must be reported to supervisors, and adjustments must be made.

5.5 Vapor Management Plan

The purpose of the vapor management plan is to identify and address volatile substances that could degrade air quality, or create dangerous conditions during construction activities. The principal hazards posed by volatized COPCs above are direct exposure through inhalation, and the flammability and explosivity of many COPC substances. Although naturally-occurring methane, an explosive gas, could exist, the sections of the HRTP route with increased concern are where contaminated soil, contaminated groundwater, and free product are encountered.

This plan describes the necessary controls for minimizing the exposure of workers to hazardous vapors, and reducing the risk of explosions and fires created by COPCs. Included are procedures to detect and mitigate potential fire and explosion hazards posed by the generation of explosive vapors.

5.5.1 Vapor Management

If volatile COPCs are found during excavation activities, the concentrations of these vapors must be controlled pursuant to HDOH and EPA regulations and guidelines. The goal of response actions is to ensure workers are not exposed to hazardous volatized COPC concentrations, and that the public is not adversely affected. The tasks needed to manage vapor exposure are summarized below.

- If vapors are encountered while excavating soils, the concentrations of the vapors both within the workspace and at the perimeter of the work area need to monitored.
- Before workers enter an excavation, air monitoring inside the excavation must begin. Air monitoring of LEL and VOC vapor concentrations (including benzene and VC) must continue as long as workers remain in the excavation.
- If air monitoring indicates that vapor concentrations exceed safe threshold levels, workers will be removed from the excavation until it has been properly vented. It is unlikely work will be required in areas requiring Level C or higher respiratory protection.

5.5.2 Exposure Monitoring

The exposure limits are based on OSHA-permissible exposure limits (PELs). The exposure monitoring plan is included in KIWC Health and Safety Plan. KIWC will monitor vapor concentrations using a photo-ionization detector (PID), and respond to elevated concentrations based on the readings:

PID Reading	Action
Above 0.5 ppm	Notify workers of elevated readings and measure for benzene and VC
0 – 20 ppm	Use Level D protection
20 – 100 ppm	Use Level C protection*
>100 ppm	Evacuate area and wait for vapors to dissipate

Normally, air monitoring should be done using a conventional photo-ionization detector (PID) to determine VOC vapor concentrations. If a standard PID air testing yield readings above 1 ppm, a benzene-specific meter (e.g. Drager tube) should be used to measure benzene and VC concentrations, and frequency of explosimeter measurements should be increased. One or more response activities should be undertaken based on the benzene-specific or VC-specific measurements or explosimeter readings:

Benzene Concentration	Response Action in Work Zone
8-hour benzene and VC TWA > PEL (1 ppm) or 15-minute STEL (5 ppm)	Upgrade PPE to Level C
Benzene and VC TWA > PEL (1 ppm)	Conduct short-term exposure monitoring by collecting at least 5 samples within a 15-minute period. Modify work schedule as required.
15-minuteTWA > STEL (5 ppm) or	Upgrade PPE to Level C
Point concentration > OSHA ceiling concentration (25 ppm)	Upgrade PPE to Level C with either full-face respirators or powered air-purifying respirators and protective goggles
8-hour TWA for 1 week > 10 ppm	Stop work immediately, and move workers from work zone
Peak >50 ppm	Stop work immediately, and move workers from work zone
Perimeter concentration > 25 ppm	Stop work immediately
15-minute perimeter concentration > 5 ppm	Extend exclusion zone
Average concentration > 1 ppm	Extend exclusion zone
Peak concentration > 10% of LEL	Stop work immediately, and move workers from work zone

If benzene or VC concentrations at the perimeter of the work zone exceed 0.1 ppm, active vapor control methods should be initiated. These controls include minimizing the size of excavations, backfilling excavations on an expedited schedule if it can be done safely, covering soil stockpiles with plastic sheeting, and initiating vapor control using vapor suppressants.

5.5.3 Engineering and Administrative Controls

Vapors originating from excavations in construction areas normally attenuate rapidly outside the excavation. Vapor control methods, however, may be needed when construction work exposes contaminated soil. Possible vapor emission controls include minimizing the size of excavations, backfilling excavations in a timely manner, covering soil stockpiles with plastic sheeting, vapor control using supplied ventilation, and dust suppression using applied water.

Level D PPE is expected to be appropriate for workers during construction work. As described above, if VOC concentrations rise above threshold limits, the PPE should be upgraded to Level C.

In addition to respiratory protection, the emission and migration of volatile COPCs should be minimized with engineering controls and safe work practices. Engineering controls include barriers that prevent individuals from unnecessarily entering work zones and the use of recycled air conditioning in mobile equipment cabs. Safe work practices include monitoring wind direction and having workers stand upwind of VOC vapor sources whenever possible, or instituting a modified work schedule.

5.5.4 Periodic Inspections and Preventive Maintenance

Routine inspections and air monitoring should be used at all locations where the presence of hazardous vapor is likely or suspected (e.g., open excavations, soil stockpiles). These areas should be inspected daily.

Field instruments (e.g., PID) should be calibrated using an appropriate standard (e.g., 100ppm isobutylene). Calibration records should be maintained. If test equipment is found to be defective or damaged, it must be repaired or replaced.

PPE and monitoring equipment should be inspected for damage and defects before donning. If respiratory protection is required, a daily positive pressure respirator fit test should be performed at the start of each day and filter cartridges should be replaced regularly. If defects or damage to PPE is identified, or a positive pressure respiratory fit test fails, the PPE must be replaced.

5.5.5 Record Keeping and Reporting

Detailed records of workspace monitoring and changes to PPE requirements must be maintained. Daily monitoring results and sampling locations should be documented in field logs. All workers should be informed of and remain apprised of elevated PID and benzene readings.

5.6 Stormwater Management Plan

This plan has been developed to identify how contact of rainfall runoff with contaminated soil or groundwater can be prevented, and to provide appropriate response methods if contact does occur.

If stormwater remains uncontaminated, it is not considered hazardous even if it falls in active work areas. Only when stormwater comes into contact with contaminated soil or water is a risk created by its runoff.

Contaminated stormwater allowed to leave construction areas could expose downstream individuals and ecological receptors to COPCs. Although stormwater runoff from construction areas containing high concentrations uncontaminated soil and non-hazardous water could also harm these populations, the potential harm increases where contaminated soil or groundwater is present.

This plan describes the measures needed to control stormwater in all construction areas. Preventing stormwater from coming into contact with contaminated media is the main goal. As discussed in Section 5.4, the primary activities that create this risk are:

- Stormwater could wash contaminated soil from pavement, unpaved areas, or soil piles, carry particulate matter to storm sewers and waterways, and impact aquatic species.
- Stormwater could leach through stockpiled soils, and the leachate could flow to surface water

- Stormwater leaching through soil stockpiled on an unsealed surface could carry COPCs into underlying soils and water-bearing zones.
- Stormwater entering soil stored in lined roll-off boxes could generate contaminated water, and this water would leach out at storage facilities or at final disposal locations.

5.6.1 Storm Water Management

The best method to prevent environmental impacts from stormwater is to control the release of contaminated soil and groundwater, and prevent contact of stormwater with contaminated soil or water during rainfall events. The following activities are recommended:

- Contaminated soil stored in dump containers or roll-off boxes that is not immediately transported for disposal should be covered as soon as the box has been filled and mechanically anchored.
- Stockpiles shall be constructed to prevent storm water runon and runoff as described in Section 5.2.2.
- Contaminated water removed during dewatering should be captured and contained for subsequent treatment and disposal.
- Contaminated water accidently released outside of containment areas should be captured, and contained using a secondary containment system.
- Site conditions should be periodically inspected to identify contaminated media that has been released and could be exposed to stormwater runoff
- Engineering stormwater controls should be constructed to divert runoff water from active work areas. The control measures should be inspected each day to evaluate their adequacy.
- Open excavations should be backfilled as soon as practicable to limit when stormwater runoff and direct precipitation could enter the excavation.
- Where possible, the edges of excavations should be bermed, thus preventing stormwater runoff from entering.
- Open excavations should be inspected each day to ensure that rainwater won’t overflow the sides of the excavation.
- The weather should be regularly monitored throughout each work day for signs of approaching storms and/or heavy rains and work should be discontinued if possible during inclement weather.

5.6.2 Engineering and Administrative Controls

Engineering controls are recommended to prevent stormwater from entering construction areas, and to capture stormwater that has become contaminated. Additional precautions to mitigate contaminated stormwater runoff include the following.

- Moveable booms should be available to contain spills.
- Absorbent pads should be employed if free product is observed in stormwater runoff.

5.6.3 Periodic Inspections and Preventive Maintenance

A key component of the plan is routine inspections. Where stormwater could come into contact with contaminated media (e.g., open excavations, soil stockpiles) the area should be inspected daily. During storm events, additional inspections should be conducted to ensure that stormwater runoff and direct precipitation do not come into contact with soil stockpiles and that stormwater runoff does not enter open excavations. If stormwater comes in contact with contaminated material, the captured water should be contained and treated prior to disposal.

Storage containers, vehicles, and heavy equipment should be cleaned regularly and inspected to ensure proper functioning. If deterioration or leaks could allow a release of petroleum-based products or hazardous substances, the defective equipment should be replaced.

Although not designed to remove COPCs from water, sediment control filter fabric at all storm drain inlets could help control the release of oils, greases, and other insoluble COPCs. Moveable petroleum-absorbent booms should also be maintained and regularly inspected at storm drain inlets in construction areas.
General site inspections should be periodically performed and documented. During prolonged rainfall, daily or more frequent inspections may be needed.

5.6.4 Record Keeping and Reporting

Detailed records of storm events, inspections of engineering controls, repairs, and response activities should be maintained. If changes in stormwater management procedures are needed, they should be reported to site supervisors, and adjustments in the management program should be made.

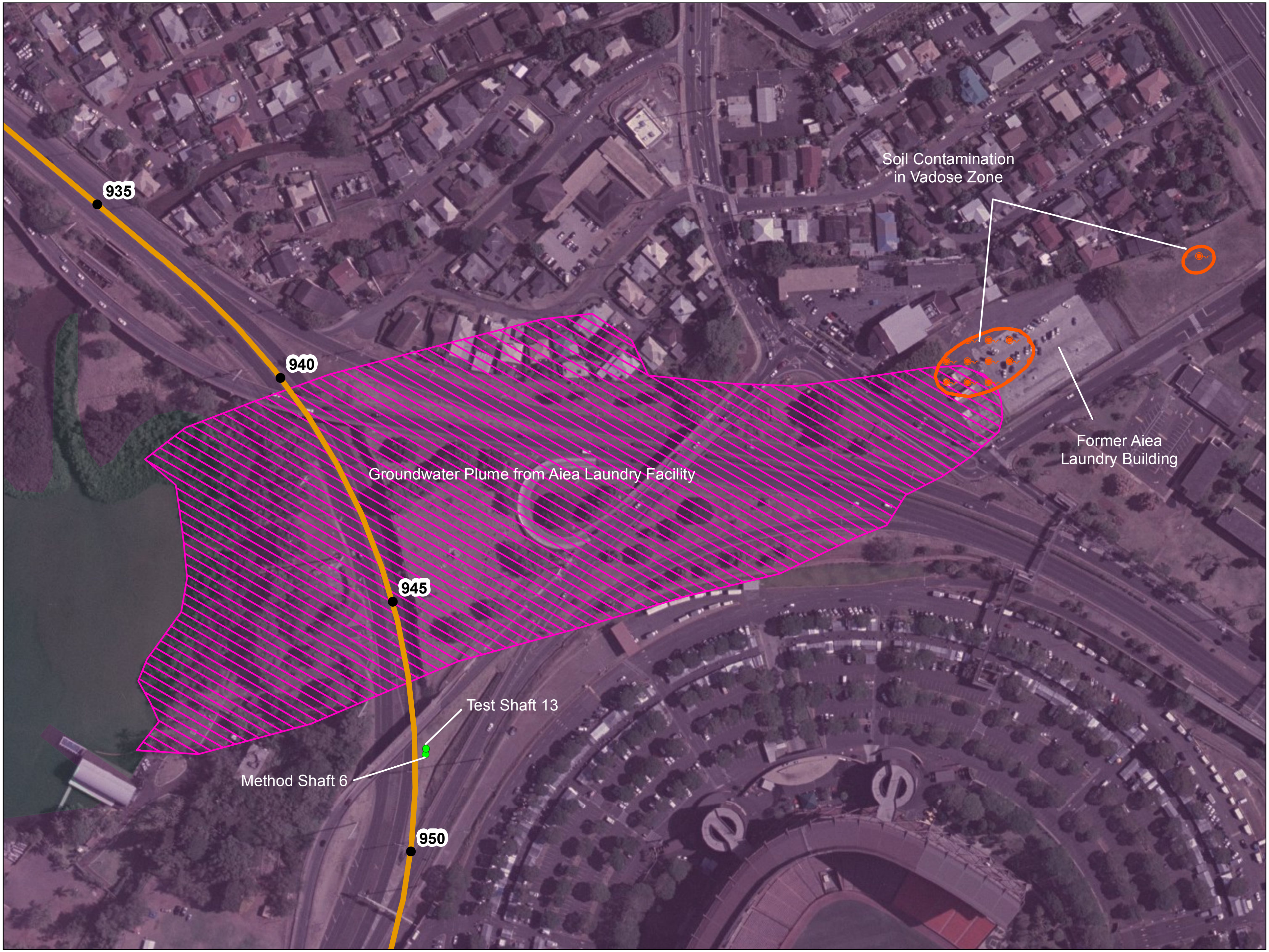

Figure 1-1. Former Aiea Laundry Facility Contamination in Vicinity of TS13 and MS6

Appendix A

Figures from *Remedial Investigation/Feasibility Study (RI/FS) Addendum, Former Aiea Laundry Facility*

Table ES-2: Summary of Human Health Risk Assessment Results - RME Scenario - Former Aiea Laundry Facility RI/FS Addendum

Exposure Media, Route		Former Aiea Laundry Facility Receptor Populations					Saint Elizabeth Church and School Populations						Backyard Area		Near Shore Receptor Populations				Tidal Receptor Populations			
		Future Resident Adult	Future Resident Child	Future Industrial	Future Construction	Current Visitor Adult or Child	School/ Church Adult [a]	School/ Church Child [a]	Sheltered Resident Adult	Sheltered Resident Child	Rectory Resident	Rectory Office Worker	Resident	Industrial	Future Resident Adult	Future Resident Child	Industrial	Construction	Industrial	Construction	Recreation Adult	Recreation Child
Soil																						
Direct Contact	CR	**4E-05** [c]	**4E-05** [c]	7E-10	1E-06 [b]	8E-08 [c]	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	HI	1 [c]	1 [c]	<0.01	**2** [b]	<1 [c]																
Subsurface Soil to Outdoor Air																						
Inhalation	CR	1E-07 [f]	9E-08 [f]	3E-08 [f]	1E-06 [b]	1E-09 [d, f]	4E-08 [a, f]	1E-08 [a, f]	P	P	P	I	2E-09 [f]	4E-10 [f]	I	I	I	I	I	I	I	I
	HI	<0.01	<0.01	<0.01	<0.01	<0.01 [d,f]	<0.01 [a, f]	<0.01 [a, f]					<0.01 [f]	<0.01 [f]								
Indoor air																						
Inhalation	CR	**4E-04** [e]	**4E-04** [e]	**6E-05**	I	I	8E-08 [a, g]	7E-09 [a, g]	9E-07 [a, g]	1E-07 [a, g]	3E-07 [a, g]	7E-08 [g]	**4E-06** [e]	1E-06	5E-07 [e]	5E-07 [e]	1E-07	I	I	I	I	I
	HI	**1.9** [e]	**1.9** [e]	0.42			NA	NA	NA	NA	NA	NA	<0.01 [e]	<0.01	0.01 [e]	0.01 [e]	<0.01					
Groundwater																						
Ingestion	CR	**1E-03**	**6E-04**	**4E-04**	I	I	P	P	P	P	P	P	P	P	**3E-04**	**2E-04**	**1E-04**	P	I	P	I	I
	HI	**2.4**	**5.6**	0.9											**1.1**	**2.5**	0.4					
Inhalation (Bathing)	CR	**6E-06**	**1E-06**	I	I	I	P	P	P	P	P	I	P	I	**3E-06**	4E-07	P	I	I	I	I	I
	HI	**5.7**	**1.4**												0.2	0.1						
Inhalation, Outdoor Air	CR	See results for Subsurface Soil to Outdoor Air		See results for subsurface soil to outdoor air	2E-14	See results for Subsurface Soil to Outdoor Air	See results for Subsurface Soil to Outdoor Air		P	P	P	I	P	I	4E-07	1E-07	1E-07	3E-10	**3E-06**	9E-09	6E-07	1E-07
	HI				NA										<0.01	<0.01	<0.01	<0.01	0.03	0.01	<0.01	<0.01
Surface Water																						
Ingestion	CR	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	9E-07 [d]	
	HI																				<0.01 [d]	

Bold = cancer risk greater than 1×10^{6} or non-cancer HI greater than 1.0

Light grey = cancer risk greater than 1×10^{5}.

Dark grey = cancer risk greater than 1×10^{4}.

P = Pathway considered potentially complete, but not likely to be significant

I = Pathway incomplete or not applicable

CR = Potential carcinogenic risk

HI = Hazard Index, potential non-carcinogenic risk

NA = Not assessed, but not likely to be significant

[a] The maximum value for the lunchroom and the meeting room are presented.

[b] 2002 RI/FS data presented assumed that receptors may be exposed to CVOCs in soil at depths of 0ft to 0.5 ft bgs and volatile COPCS in soil at depths of 0ft to 50 ft bgs.

[c] Risk for adult and child was not separated in the 2002 RI/FS (AMEC 2002c).

[d] The cancer risk was calculated as the lifetime risk.

[e] Risk calculated using Johnson & Ettinger model, which does not distinguish between adult and child risk.

[f] Evaluated using soil vapor data.

[g] Risks calculated using most recent (June 2011) indoor air data.

Table ES-3: Summary of Human Health Risk Assessment Results - CTE Scenario Revisions - Former Aiea Laundry Facility RI/FS Addendum

Exposure Media, Route		Former Aiea Laundry Facility Receptor Populations					Saint Elizabeth Church and School Populations						Backyard Area		Near Shore Receptor Populations				Tidal Receptor Populations			
		Future Resident Adult	Future Resident Child	Future Industrial	Future Construction	Current Visitor Adult or Child	School/ Church Adult [a]	School/ Church Child [a]	Sheltered Resident Adult	Sheltered Resident Child	Rectory Resident	Rectory Office Worker	Resident	Industrial	Future Resident Adult	Future Resident Child	Industrial	Construction	Industrial	Construction	Recreation Adult	Recreation Child
Soil																						
Direct Contact	CR	**4E-05** [c]	**4E-05** [c]	7E-10	1E-06 [b]	8E-08 [c]	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	HI	1 [c]	1 [c]	<0.01	**2** [b]	<1 [c]																
Subsurface Soil to Outdoor Air																						
Inhalation	CR	1E-07 [f]	9E-08 [f]	3E-08 [f]	1E-06 [b]	1E-09 [d, f]	4E-08 [a, f]	1E-08 [a, f]	P	P	P	I	2E-09 [f]	4E-10 [f]	I	I	I	I	I	I	I	I
	HI	<0.01	<0.01	<0.01	<0.01	<0.01 [d,f]	<0.01 [a, f]	<0.01 [a, f]					<0.01 [f]	<0.01 [f]								
Indoor air																						
Inhalation	CR	**1.2E-04**	**1.2E-04**	**2.2E-05**	I	I	8E-08 [a, g]	7E-09 [a, g]	9E-07 [a, g]	1E-07 [a, g]	3E-07 [a, g]	7E-08 [g]	**1.3E-06**	1E-06	5E-07 [e]	5E-07 [e]	1E-07	I	I	I	I	I
	HI	**1.5**	**1.5**	0.42			NA	NA	NA	NA	NA	NA	<0.01 [e]	<0.01	0.01 [e]	0.01 [e]	<0.01					
Groundwater																						
Ingestion	CR	**2.1E-04**	**2.3E-04**	**1.4E-04**	I	I	P	P	P	P	P	P	P	P	**6.3E-05**	**7.8E-05**	**3.6E-05**	P	I	P	I	I
	HI	**1.3**	**4.4**	0.9											0.6	**2.0**	0.4					
Inhalation (Bathing)	CR	9.0E-07	2.0E-07	I	I	I	P	P	P	P	P	I	P	I	4.5E-07	4E-07	P	I	I	I	I	I
	HI	**2.2**	0.5												0.2	0.1						
Inhalation, Outdoor Air	CR	See results for Subsurface Soil to Outdoor Air		See results for subsurface soil	2E-14	See results for Subsurface Soil	See results for Subsurface Soil to Outdoor Air		P	P	P	I	P	I	4E-07	1E-07	1E-07	3E-10	1.0E-06	9E-09	6E-07	1E-07
	HI				NA										<0.01	<0.01	<0.01	<0.01	0.03	0.01	<0.01	<0.01
Surface Water																						
Ingestion	CR	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	9E-07 [d]	
	HI																				<0.01 [d]	

Bold = cancer risk greater than 1×10^{6} or non-cancer HI greater than 1.0

Light grey = cancer risk greater than 1×10^{5}.

Dark grey = cancer risk greater than 1×10^{4}.

P = Pathway considered potentially complete, but not likely to be significant

I = Pathway incomplete or not applicable

CR = Potential carcinogenic risk

HI = Hazard Index, potential non-carcinogenic risk

NA = Not assessed, but not likely to be significant

[a] The maximum value for the lunchroom and the meeting room are presented.

[b] 2002 RI/FS data presented assumed that receptors may be exposed to CVOCs in soil at depths of 0ft to 0.5 ft bgs and volatile COPCS in soil at depths of 0ft to 50 ft bgs.

[c] Risk for adult and child was not separated in the 2002 RI/FS (AMEC 2002c).

[d] The cancer risk was calculated as the lifetime risk.

[e] Risk calculated using Johnson & Ettinger model, which does not distinguish between adult and child risk.

[f] Evaluated using soil vapor data.

[g] Risks calculated using most recent (June 2011) indoor air data.

LEGEND

◐	Newly Installed Monitoring Well Location
◑	Geotechnical Sample Collected in April 2007
◎	Newly Installed Seep Water Sampling Location
◉	Previously Installed Caprock Groundwater Monitoring Well Location
●	Previously Installed Basal Aquifer Groundwater Monitoring Well Location
▲	Surface Water Sampling Location

NOTES

1. Geotechnical data collected in April 2007 during well installation
2. All newly installed wells installed during March and April 2007.

N

0 100 200 400 Feet

Figure 2-2
Seep Water, Surface Water, Newly Installed, and Existing Groundwater Monitoring Well Locations
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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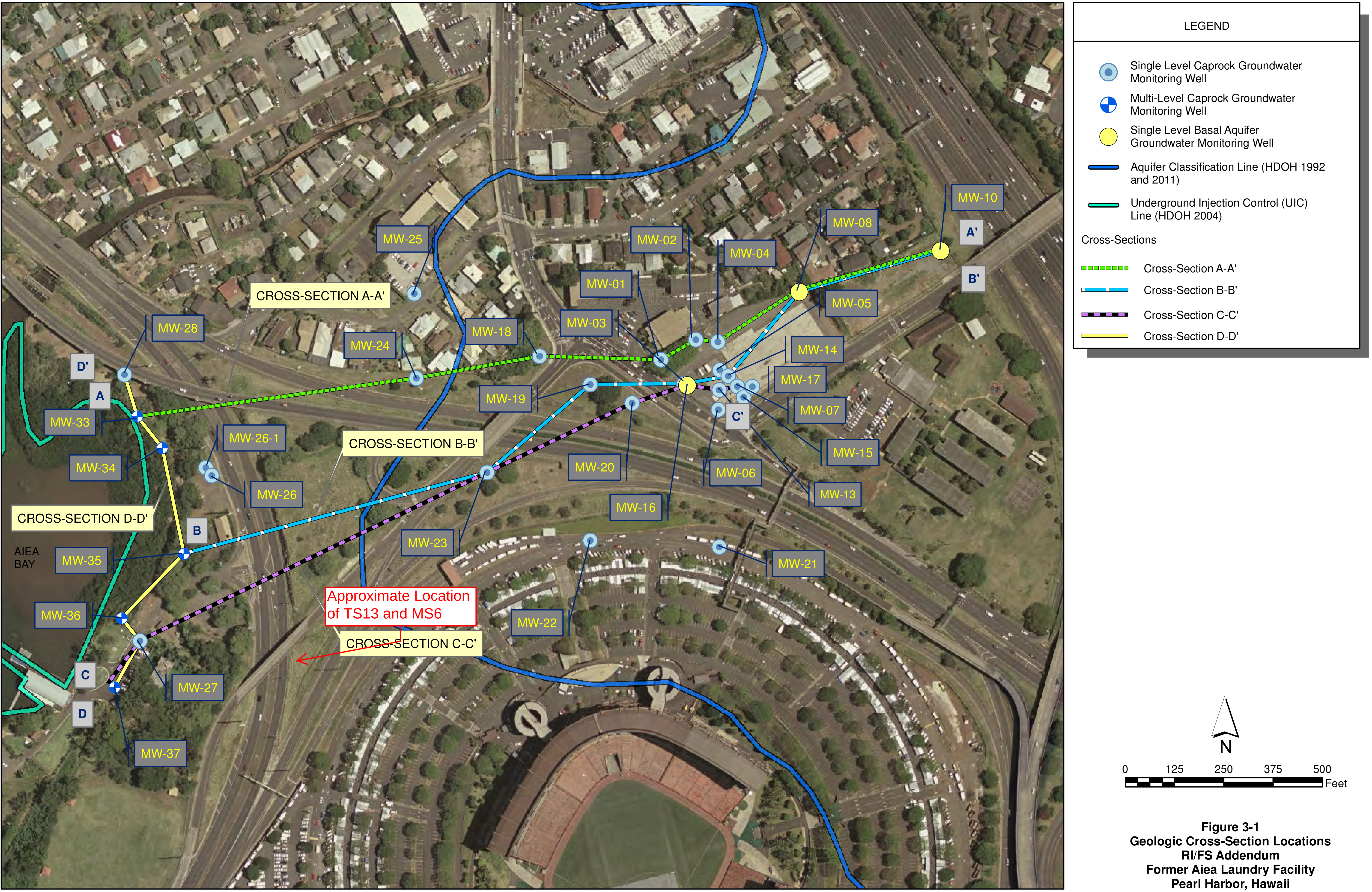

Figure 3-1
Geologic Cross-Section Locations
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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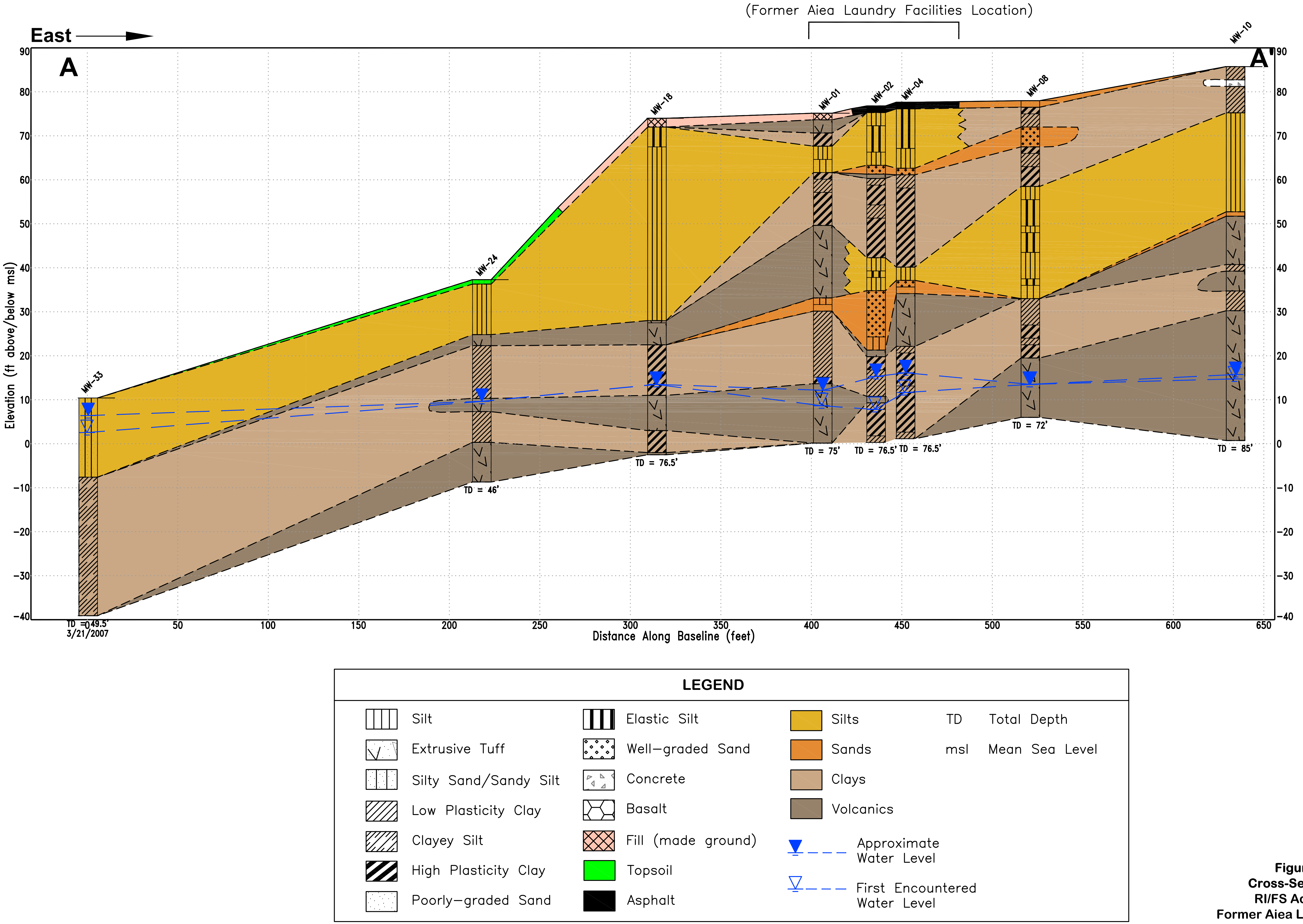

Figure 3-2
Cross-Section A-A'
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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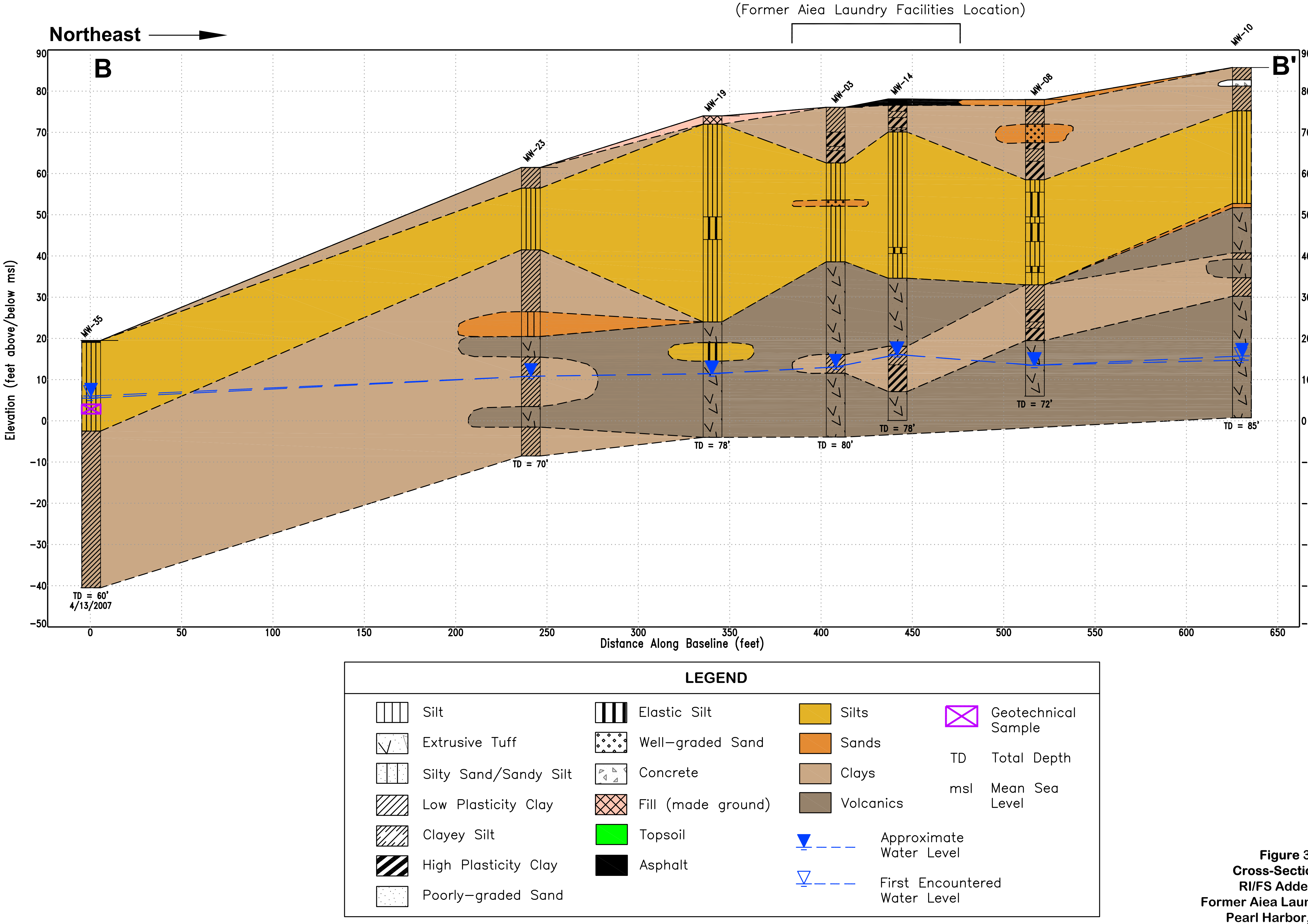

Figure 3-3
Cross-Section B-B'
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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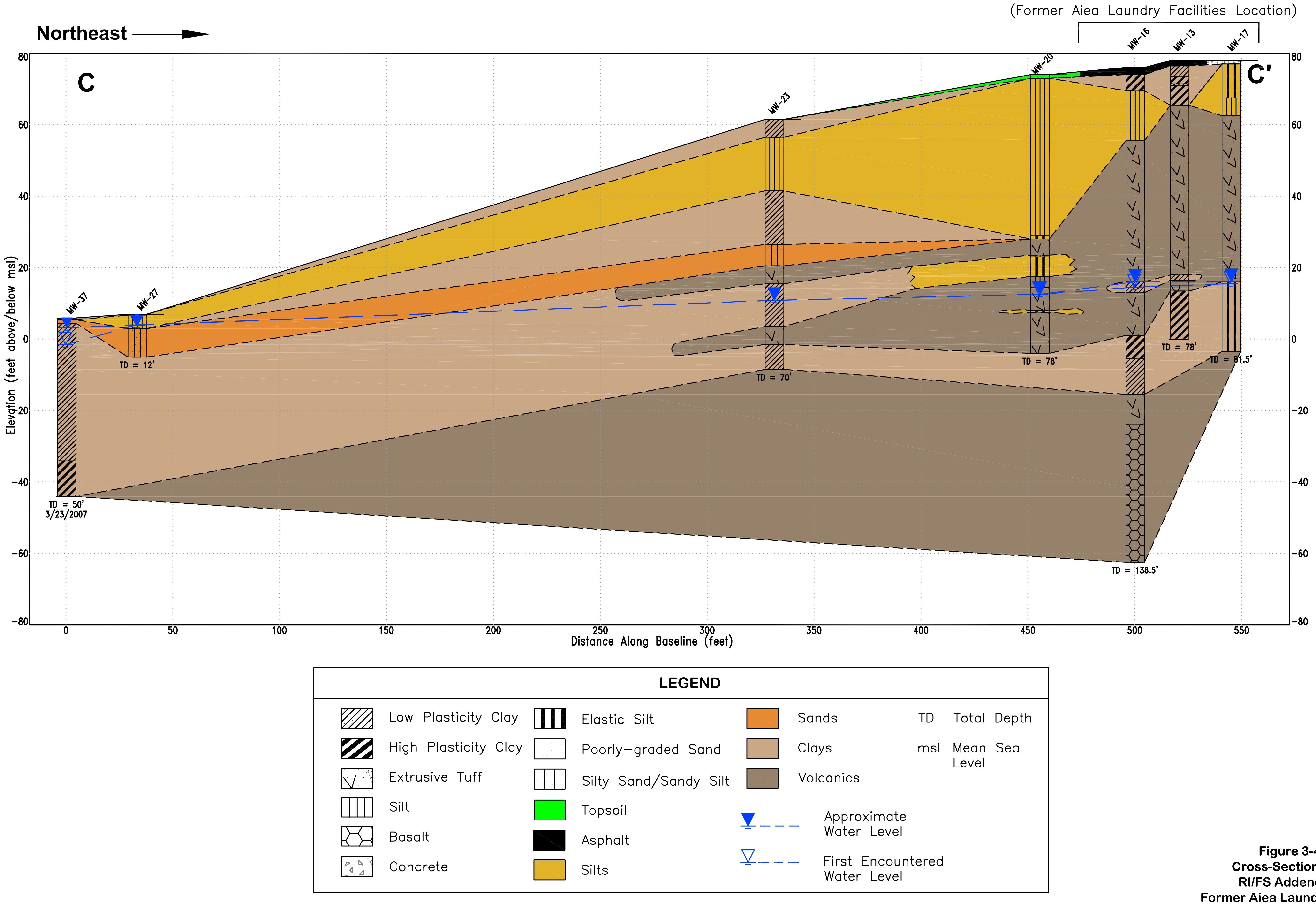

Figure 3-4
Cross-Section C-C'
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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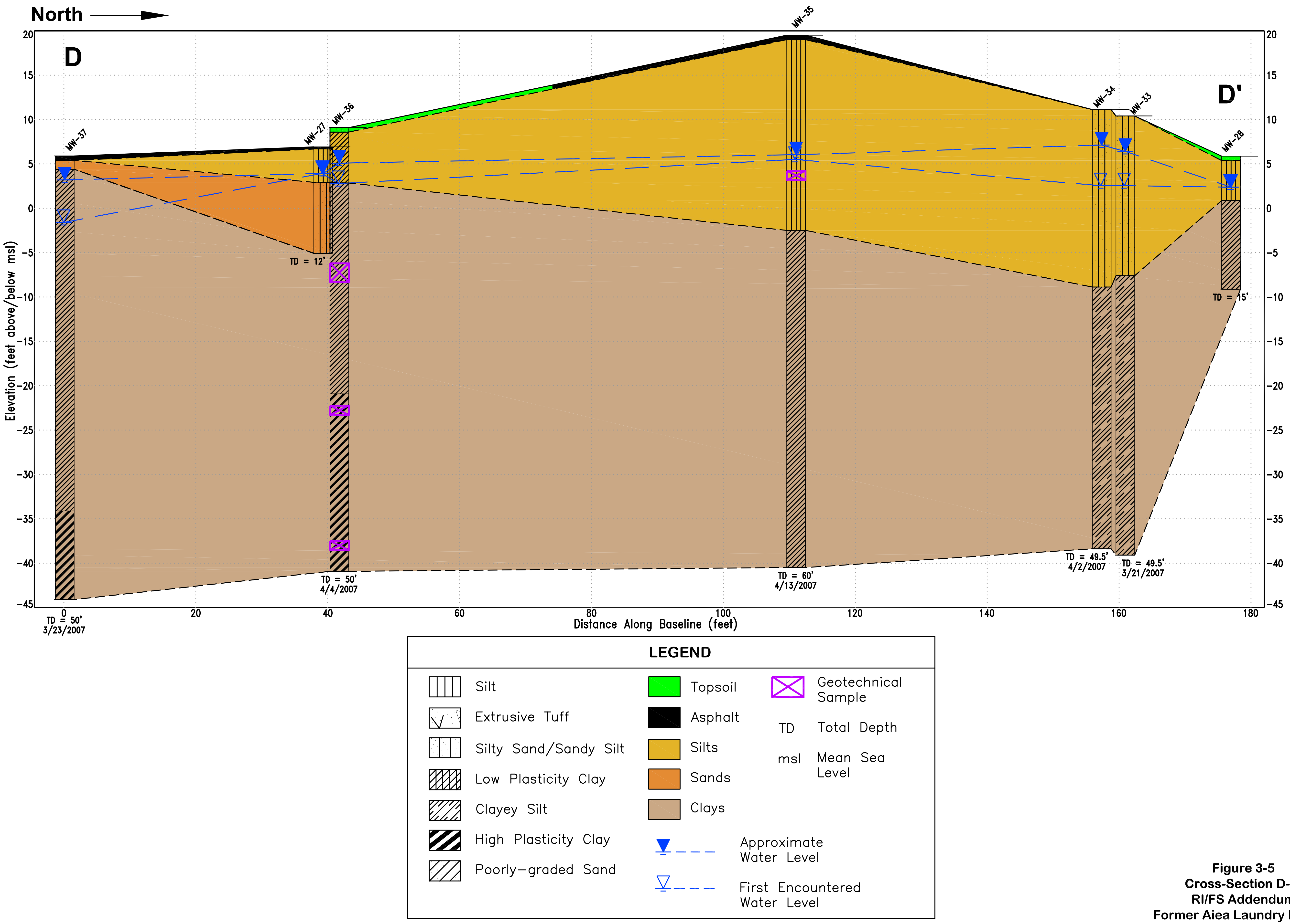

Figure 3-5
Cross-Section D-D'
RI/FS Addendum
Former Aiea Laundry Facility
Oahu, Hawaii

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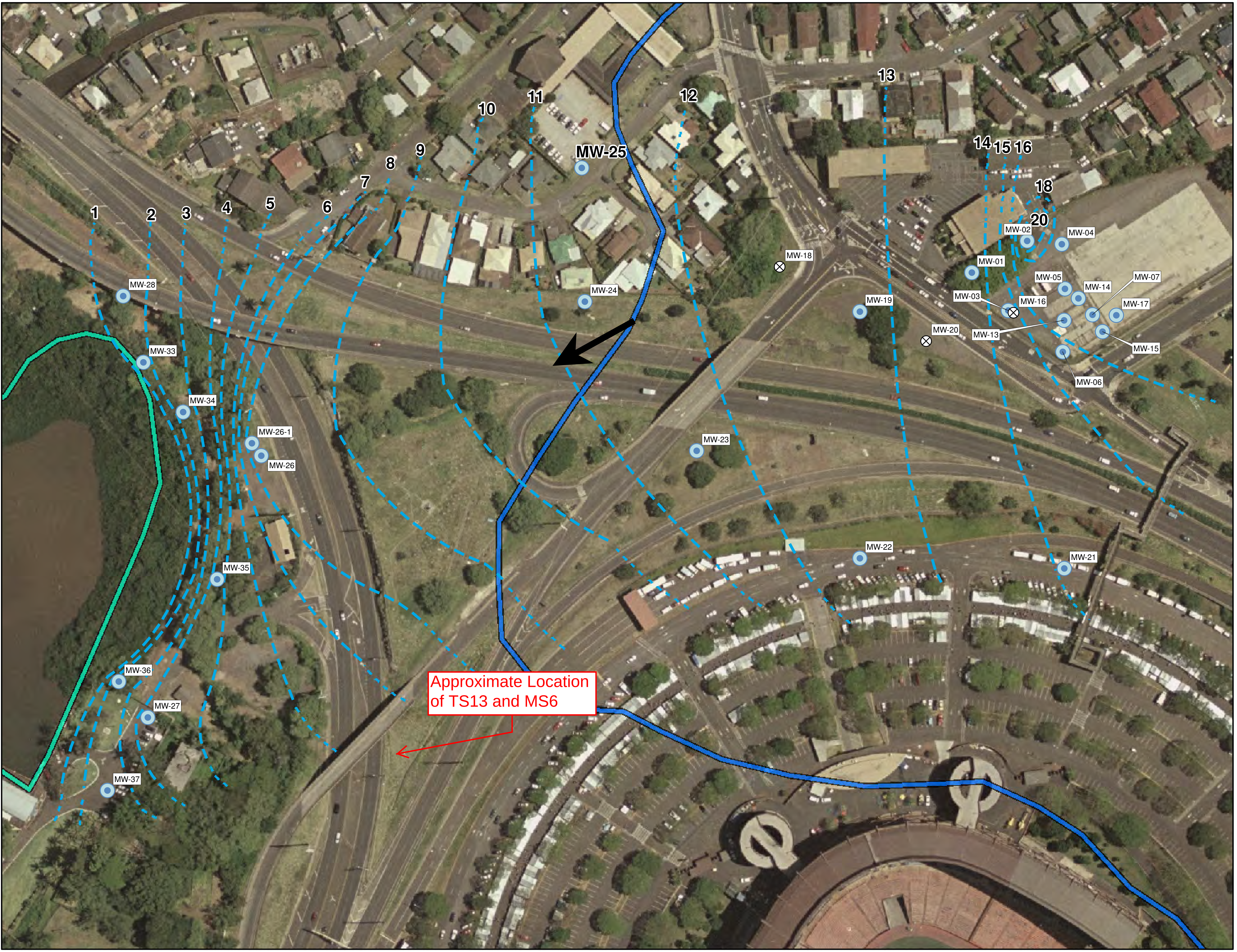

LEGEND

- ◉ Monitoring Well Location
- ⊗ Monitoring Wells not used to calculate gradient or direction
- ← Approximate Groundwater Flow Direction
- 16 - - - Groundwater Table Contour
- ▬ Aquifer Classification Line
- ▬ UIC Line

Well ID	Groundwater Elevation (ft. above msl)
MW-01	13.71
MW-02	20.43
MW-03	14.16
MW-04	16.47
MW-05	16.43
MW-06	15.43
MW-07	16.51
MW-13	16.36
MW-14	16.43
MW-15	16.57
MW-16	16.44
MW-17	16.4
MW-18	11.45
MW-19	12.73
MW-20	11.94
MW-21	14.02
MW-22	12.76
MW-23	11.75
MW-24	11.51
MW-25	11.69
MW-26	8.18
MW-26-1	8.33
MW-27	4.23
MW-28	1.76
MW-33	1.98
MW-34	2.04
MW-35	4.88
MW-36	2.51
MW-37	2.37

NOTES

1. Elevations represent feet above mean sea level (msl).
2. MW-16 was not used in calculation because the well is a basal aquifer well.
3. MW-18 was not used in calculation because the well is physically damaged.
4. MW-20 was not used in calculation because the measured groundwater level is higher than MW-19 (which would imply that groundwater flows back from MW-19 towards MW-20). One of the measured groundwater values is likely inaccurate.

Feet
0 75 150 300
N

Figure 3-6
Groundwater Contour Map and
Approximate Groundwater Flow Direction
on July 6, 2007
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

Figure 7-1
Groundwater, Seep Water and Surface Water Monitoring Network
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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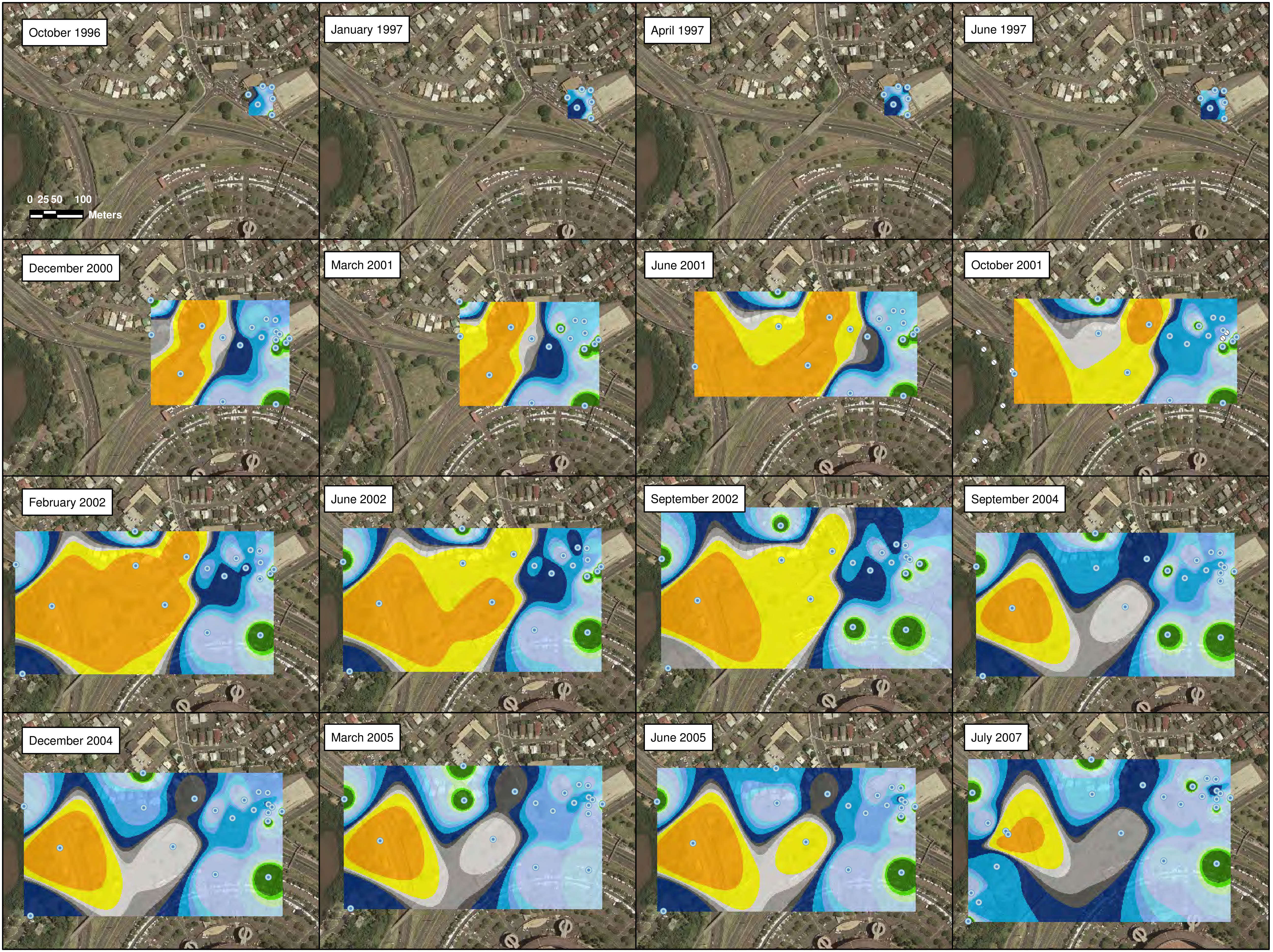

LEGEND

◉ Monitoring Well (Sampled)

PCE Concentration (µg/L)

🟩 0 - 0.01
🟩 0.01 - 0.02
🟩 0.02 - 0.028
🟩 0.028 - 0.1
🟦 0.1 - 1
🟦 1 - 2.9
🟦 2.9 - 5.9
🟦 5.9 - 11
🟦 11 - 26
🟦 26 - 61
⬛ 61 - 74
⬛ 74 - 99
⬜ 99 - 120
🟨 120 - 200
🟧 200 - 590
🟪 590 - 780
🟥 780 - 1,700

NOTE

1. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for PCE are 120 µg/L for locations < 150 meters from surface water, and 140 µg/L for locations > 150 meters to surface water.

N

0 250 500 1,000 Feet

Figure 7-2
Approximate PCE Distribution
1996 to 2007 in Shallow
Caprock Groundwater
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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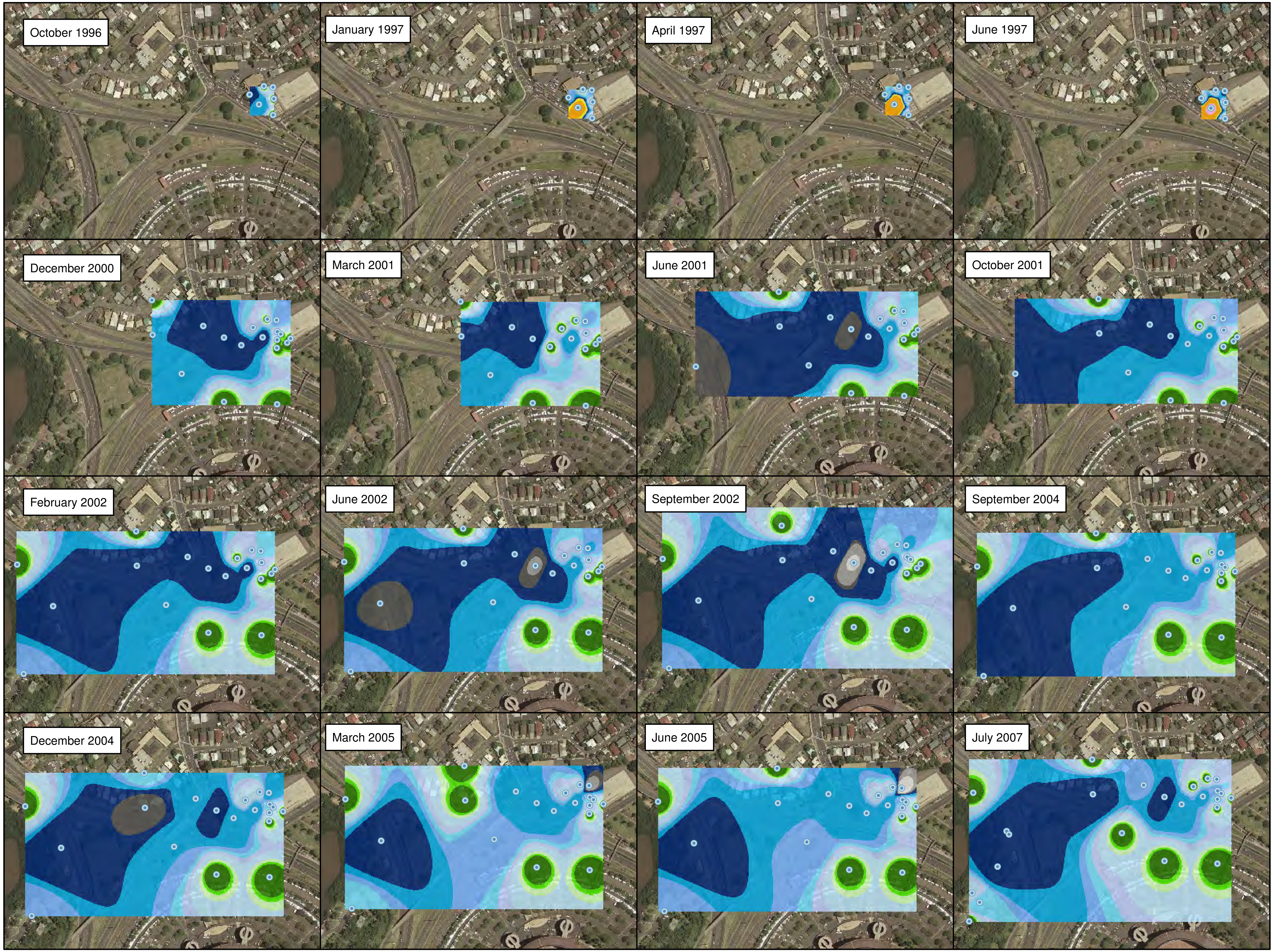

LEGEND

◉ Monitoring Well (Sampled)

TCE Concentration (µg/L)

- 🟩 0 - 0.01
- 🟩 0.01 - 0.02
- 🟩 0.02 - 0.028
- 🟩 0.028 - 0.1
- 🟦 0.1 - 1
- 🟦 1 - 2.9
- 🟦 2.9 - 5.9
- 🟦 5.9 - 11
- 🟦 11 - 26
- 🟦 26 - 61
- ⬛ 61 - 74
- ⬛ 74 - 99
- ⬜ 99 - 120
- 🟨 120 - 200
- 🟧 200 - 590
- 🟪 590 - 780
- 🟥 780 - 1700

NOTE

1. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for TCE are 360 µg/L for locations < 150 meters from surface water, and 480 µg/L for locations > 150 meters to surface water.

N

0 250 500 1,000
Feet

Figure 7-3
Approximate TCE Distribution
1996 to 2007 in Shallow
Caprock Groundwater
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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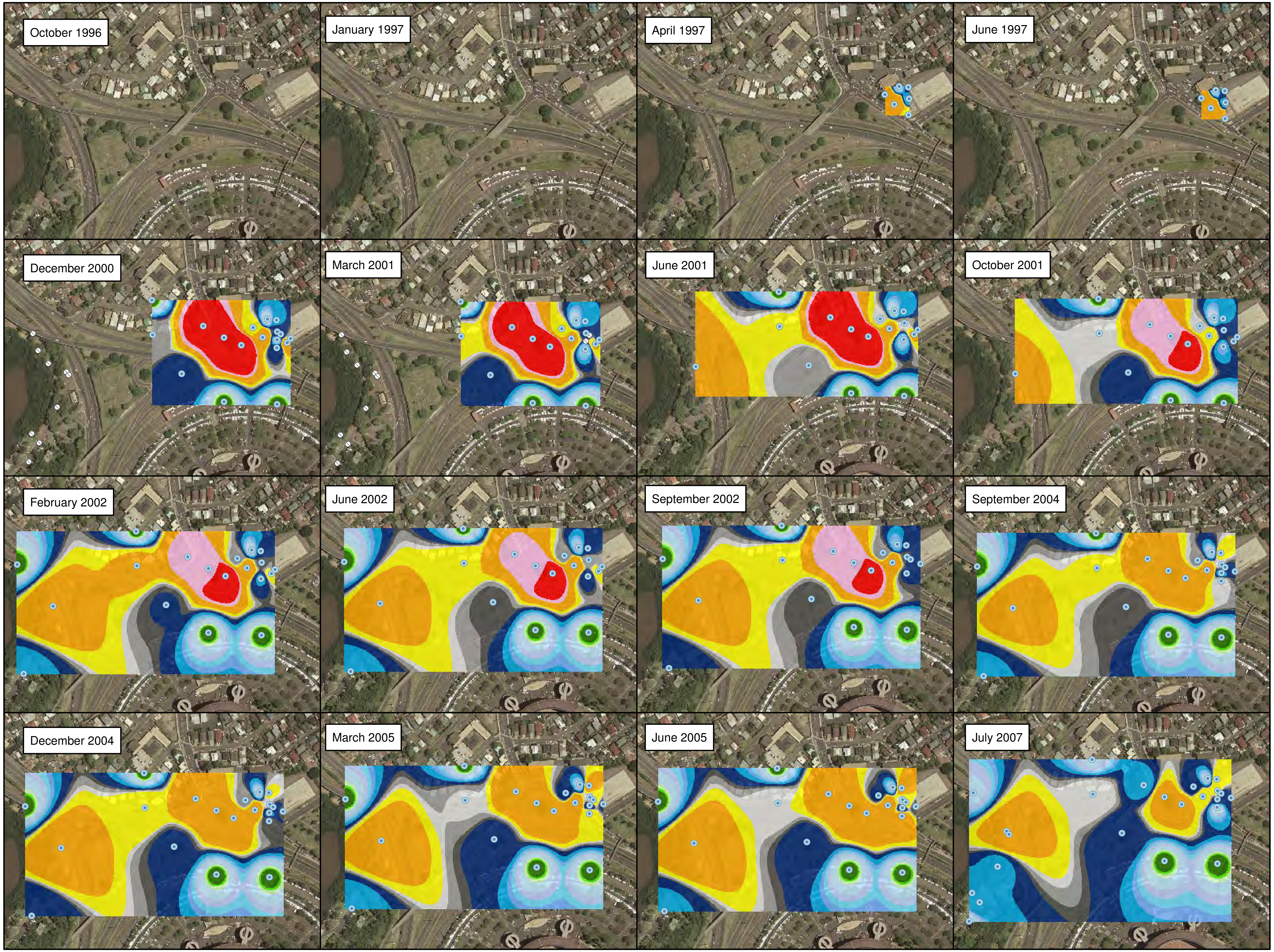

LEGEND

◉ Monitoring Well (Sampled)

DCE Concentration (µg/L)

🟩	0 - 0.01
🟩	0.01 - 0.02
🟩	0.02 - 0.028
🟩	0.028 - 0.1
🟦	0.1 - 1
🟦	1 - 2.9
🟦	2.9 - 5.9
🟦	5.9 - 11
🟦	11 - 26
🟦	26 - 61
⬛	61 - 74
⬛	74 - 99
⬜	99 - 120
🟨	120 - 200
🟧	200 - 590
🟪	590 - 780
🟥	780 - 1700

NOTE

1. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for DCE are 360 µg/L for locations < 150 meters from surface water, and 4,300 µg/L for locations > 150 meters to surface water.

N

0 250 500 1,000
Feet

Figure 7-4
Approximate DCE Distribution
1996 to 2007 in Shallow
Caprock Groundwater
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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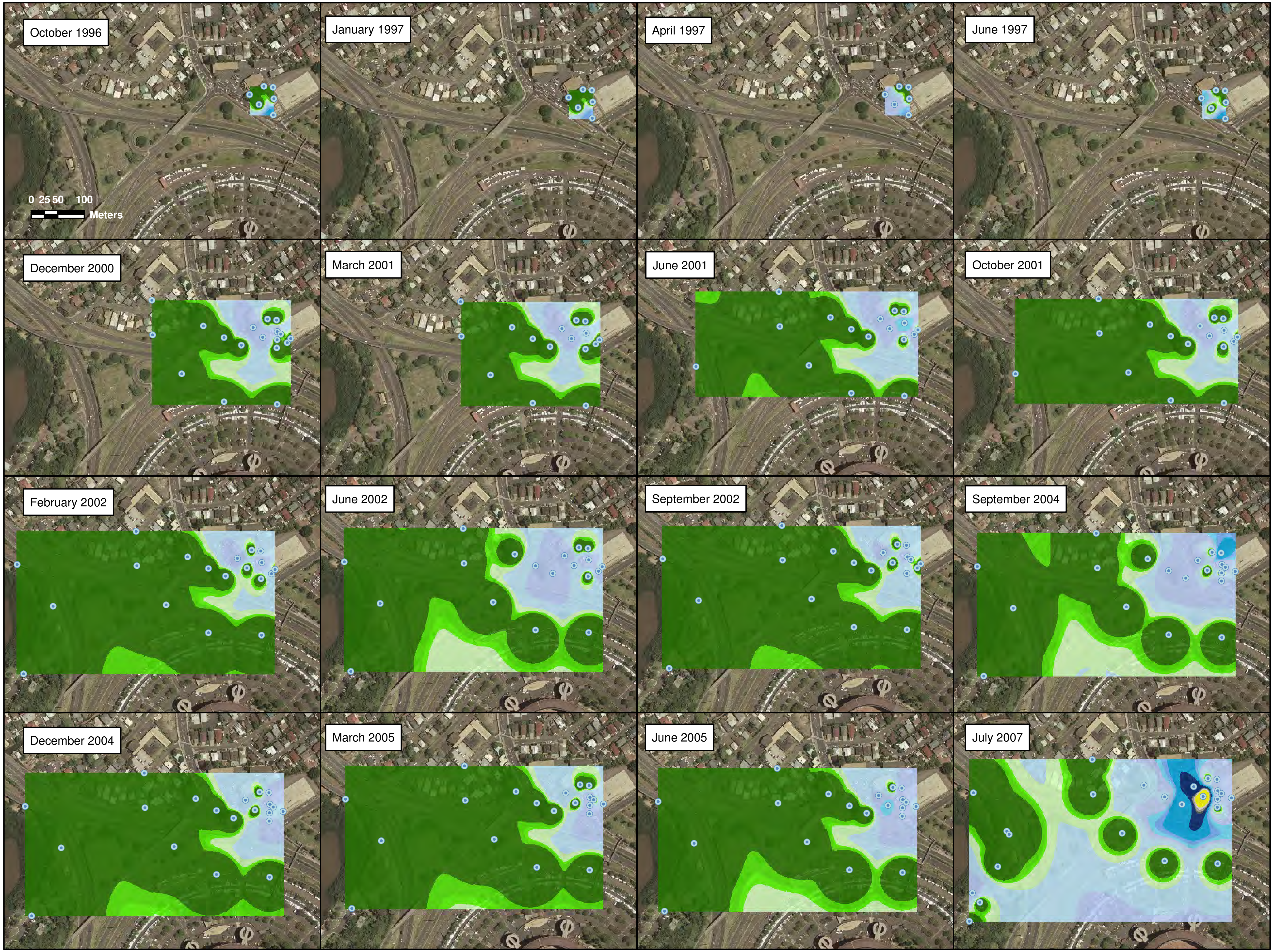


LEGEND

◉ Monitoring Well (Sampled)

VC Concentration (µg/L)

🟩 0 - 0.01
🟩 0.01 - 0.02
🟩 0.02 - 0.028
🟩 0.028 - 0.1
🟦 0.1 - 1
🟦 1 - 2.9
🟦 2.9 - 5.9
🟦 5.9 - 11
🟦 11 - 26
🟦 26 - 61
⬛ 61 - 74
⬛ 74 - 99
⬜ 99 - 120
🟨 120 - 200
🟧 200 - 590
🟪 590 - 780
🟥 780 - 1700

NOTE

1. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking wate) for VC is 780 µg/L for locations < 590 meters to surface water (based on impact to aquatic habitat), and 21 µg/L for locations > 150 meters to surface water (based on vapor intrusion concerns).

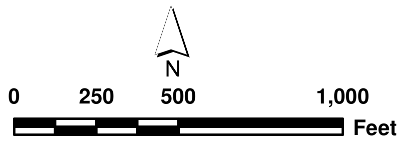
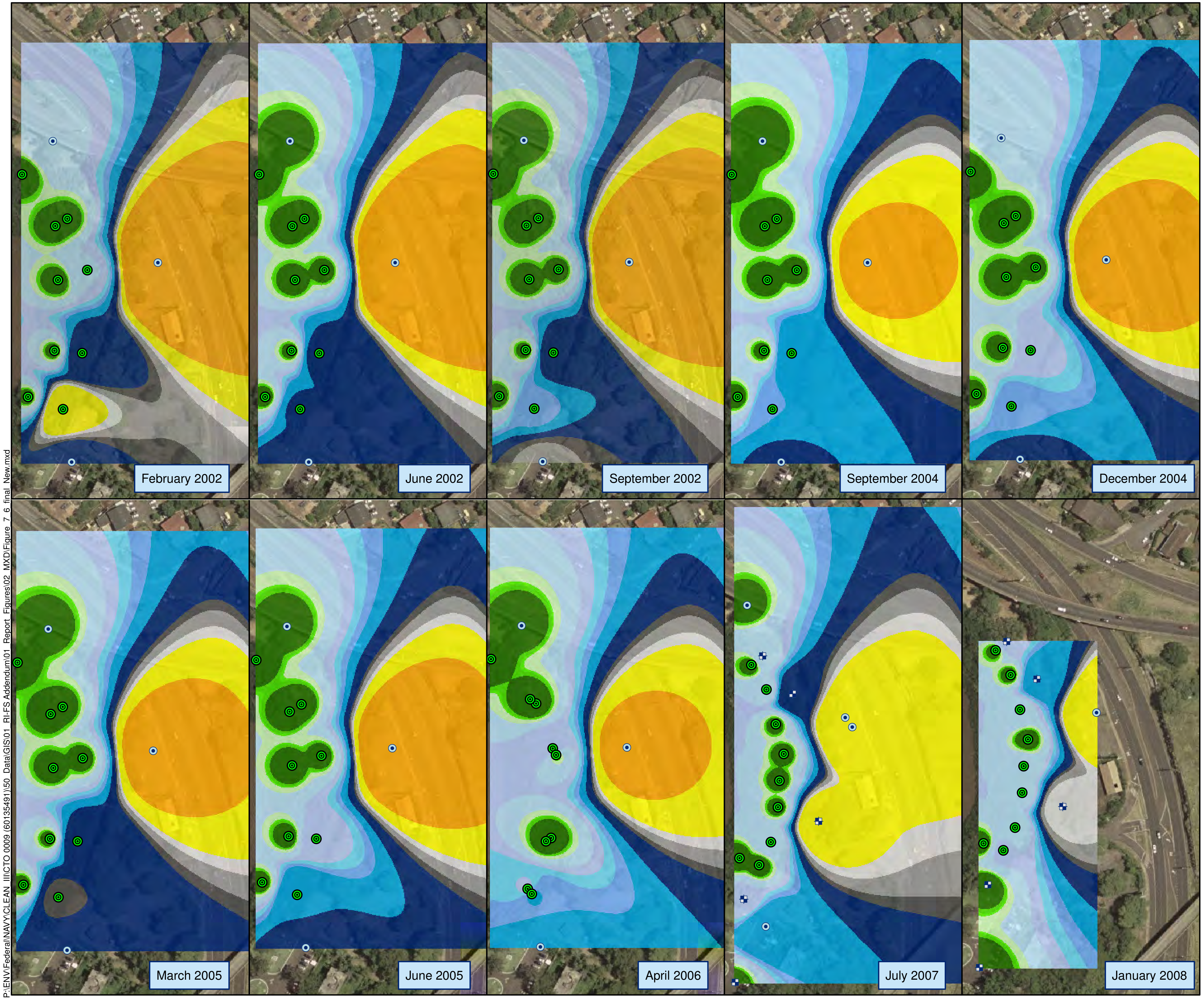


Figure 7-5
Approximate VC Distribution
1996 to 2007 in Shallow
Caprock Groundwater
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii



LEGEND

Monitoring well type

- ◎ Seep Water Well
- ⊙ Single-Level Groundwater Well
- ◩ Multi-Level Groundwater Well

PCE Concentration (µg/L)

■	0 - 0.01	■	26 - 61
■	0.01 - 0.02	■	61 - 74
■	0.02 - 0.028	■	74 - 99
■	0.028 - 0.1	■	99 - 120
■	01 - 1	■	120 - 200
■	1 - 2.9	■	200 - 590
■	2.9 - 5.9	■	590 - 780
■	5.9 - 11	■	780 - 1,700
■	11 - 26		

NOTES

1. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for PCE is 120 µg/L for locations < 150 meters from surface water.
2. For seep water, only low-tide analysis results were used.
3. For analysis with field duplicates, the higher detected value was used.
4. Non detects were set to zero concentration value.
5. For multi-level wells the first interval analytical results were used.
6. Inverse distance weighted interpolation, power = 6.
7. UTM Zone 4N projection, NAD83 datum.
8. Basemap source: http://www.pdc.org/geodata/hawaii/oahu/edc/

N

0 250 500 Feet

Figure 7-6
Combined Seep Water and Groundwater Interpolations for PCE in Caprock Groundwater
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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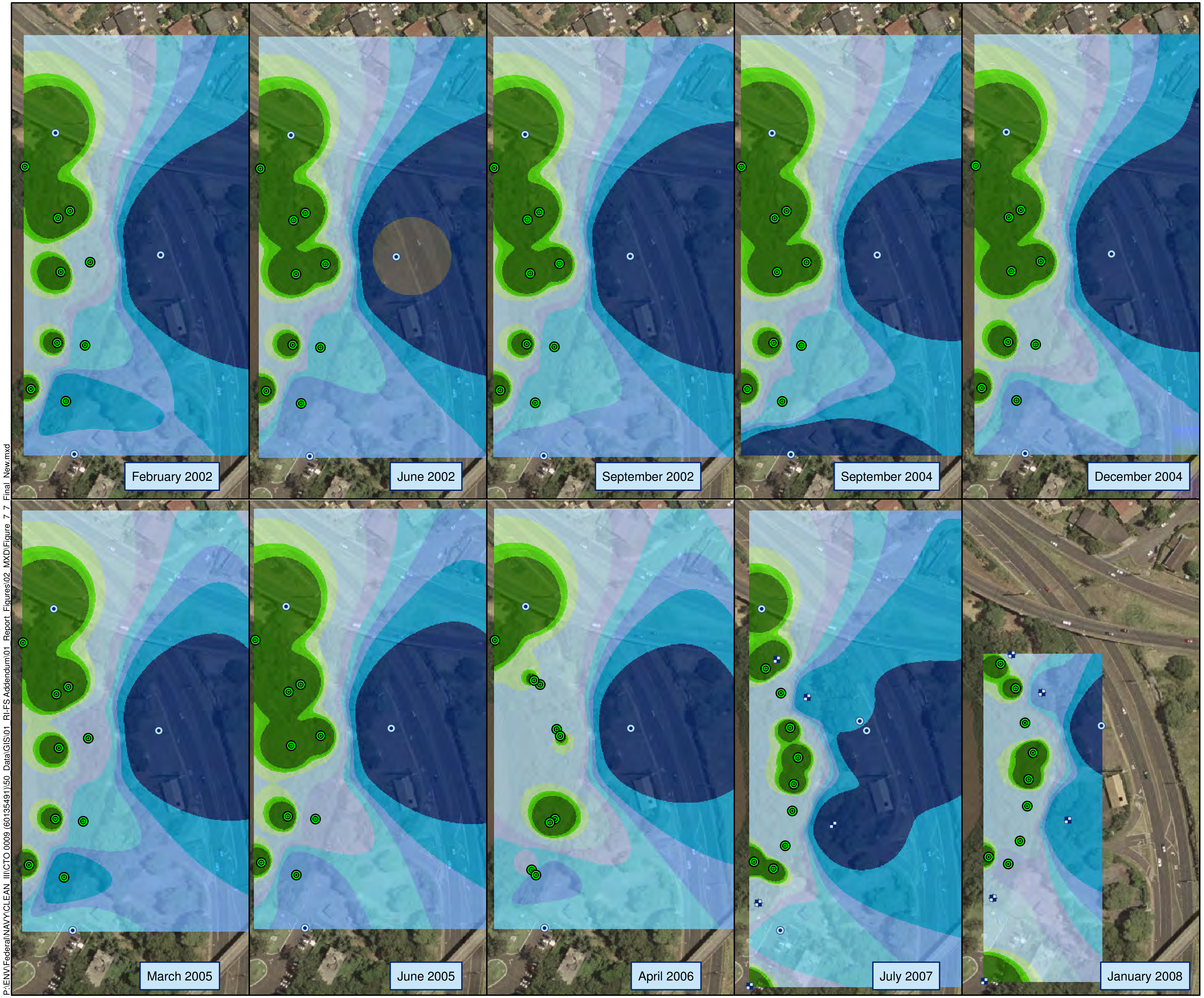


LEGEND

Monitoring well type

- ◉ Seep Water Well
- ◉ Single-Level Groundwater Well
- ◉ Multi-Level Groundwater Well

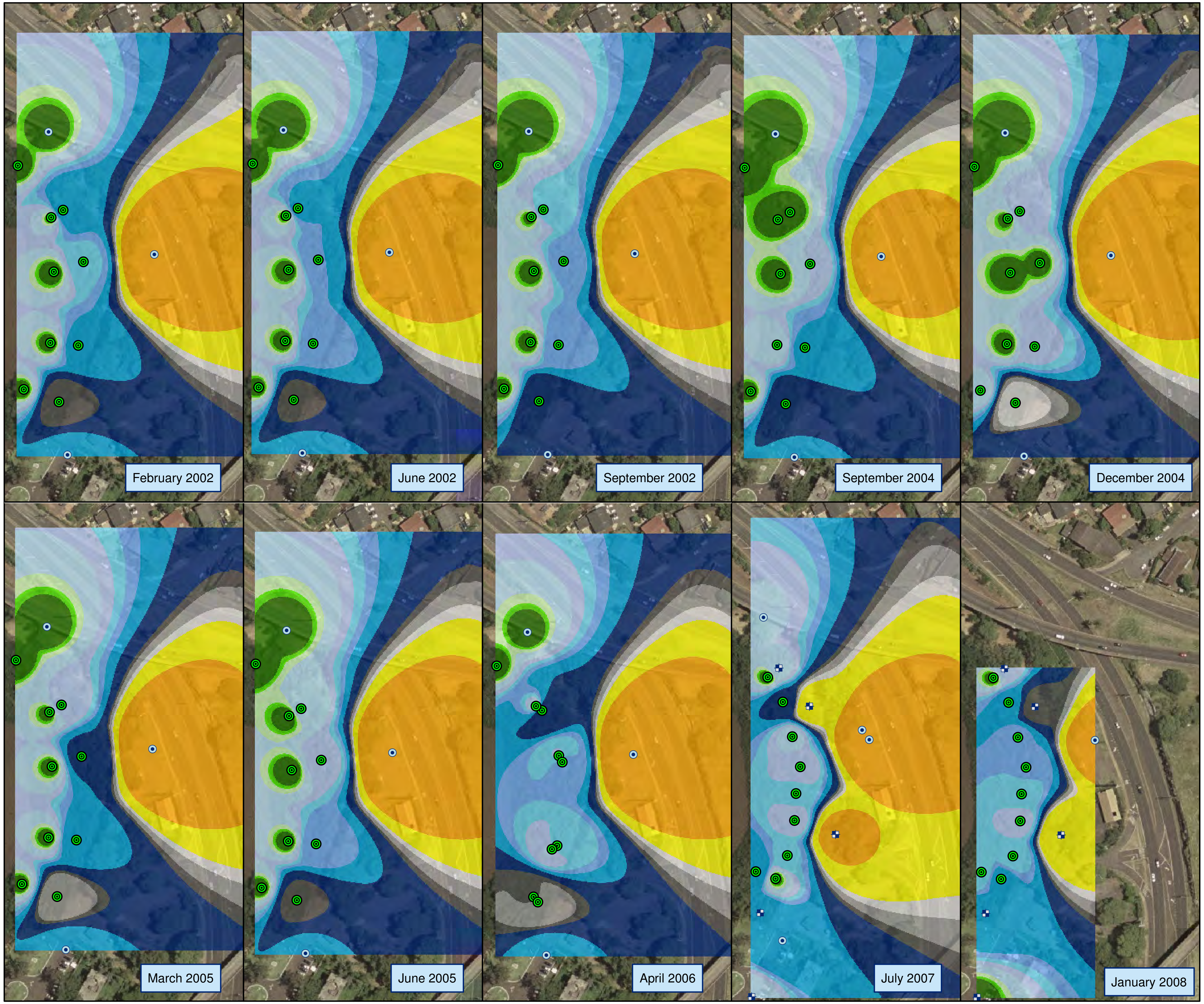
TCE Concentration (µg/L)

🟩	0 - 0.01	🟦	26 - 61
🟩	0.01 - 0.02	⬛	61 - 74
🟩	0.02 - 0.028	⬜	74 - 99
🟩	0.028 - 0.1	⬜	99 - 120
🟦	01 - 1	🟨	120 - 200
🟦	1 - 2.9	🟧	200 - 590
🟦	2.9 - 5.9	🟪	590 - 780
🟦	5.9 - 11	🟥	780 - 1,700
🟦	11 - 26		

NOTES

1. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for TCE is 360 µg/L for locations < 150 meters from surface water.
2. For seep water, only low-tide analysis results were used.
3. For analysis with field duplicates, the higher detected value was used.
4. Non detects were set to zero concentration value.
5. For multi-level wells the first interval analytical results were used.
6. Inverse distance weighted interpolation, power = 6.
7. UTM Zone 4N projection, NAD83 datum.
8. Basemap source: http://www.pdc.org/geodata/hawaii/oahu/edc/

Figure 7-7
Combined Seep Water and Groundwater Interpolations for TCE in Caprock Groundwater
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii



LEGEND

Monitoring well type
- ◎ Seep Water Well
- ⊙ Single-Level Groundwater Well
- ◩ Multi-Level Groundwater Well

DCE Concentration (µg/L)
- 🟩 0 - 0.01
- 🟩 0.01 - 0.02
- 🟩 0.02 - 0.028
- 🟩 0.028 - 0.1
- 🟦 01 - 1
- 🟦 1 - 2.9
- 🟦 2.9 - 5.9
- 🟦 5.9 - 11
- 🟦 11 - 26
- 🟦 26 - 61
- ⬛ 61 - 74
- ⬛ 74 - 99
- ⬜ 99 - 120
- 🟨 120 - 200
- 🟧 200 - 590
- 🟪 590 - 780
- 🟥 780 - 1,700

NOTES

1. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for DCE is 590 µg/L for locations < 150 meters from surface water.
2. For seep water, only low-tide analysis results were used.
3. For analysis with field duplicates, the higher detected value was used.
4. Non detects were set to zero concentration value.
5. For multi-level wells the first interval analytical results were used.
6. Inverse distance weighted interpolation, power = 6.
7. UTM Zone 4N projection, NAD83 datum.
8. Basemap source: http://www.pdc.org/geodata/hawaii/oahu/edc/

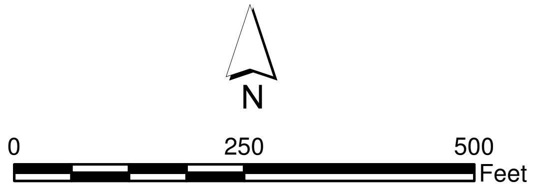


Figure 7-8
Combined Seep Water and Groundwater Interpolations for DCE in Caprock Groundwater
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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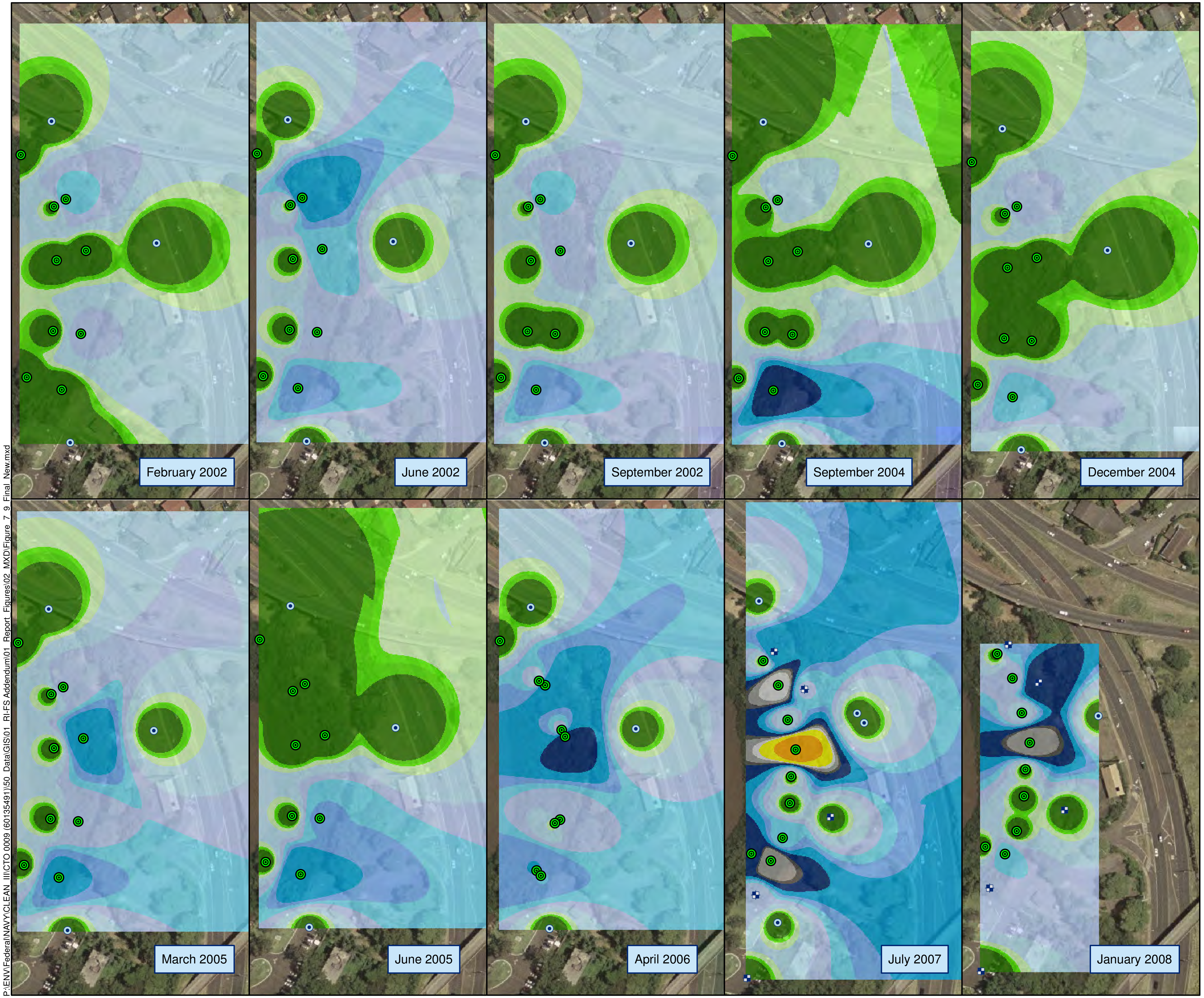

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LEGEND

Monitoring well type
- ◎ Seep Water Well
- ⊙ Single-Level Groundwater Well
- ◩ Multi-Level Groundwater Well

VC Concentration (μg/L)

🟩	0 - 0.01	🟦	26 - 61
🟩	0.01 - 0.02	⬛	61 - 74
🟩	0.02 - 0.028	⬜	74 - 99
🟩	0.028 - 0.1	⬜	99 - 120
🟦	01 - 1	🟨	120 - 200
🟦	1 - 2.9	🟧	200 - 590
🟦	2.9 - 5.9	🟪	590 - 780
🟦	5.9 - 11	🟥	780 - 1,700
🟦	11 - 26		

NOTES

1. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for VC is 780 μg/L for locations < 150 meters from surface water based on impact to aquatic habitat.
2. For seep water, only low-tide analysis results were used.
3. For analysis with field duplicates, the higher detected value was used.
4. Non detects were set to zero concentration value.
5. For multi-level wells the first interval analytical results were used.
6. Inverse distance weighted interpolation, power = 6.
7. UTM Zone 4N projection, NAD83 datum.
8. Basemap source: http://www.pdc.org/geodata/hawaii/oahu/edc/

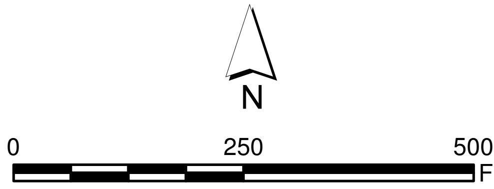
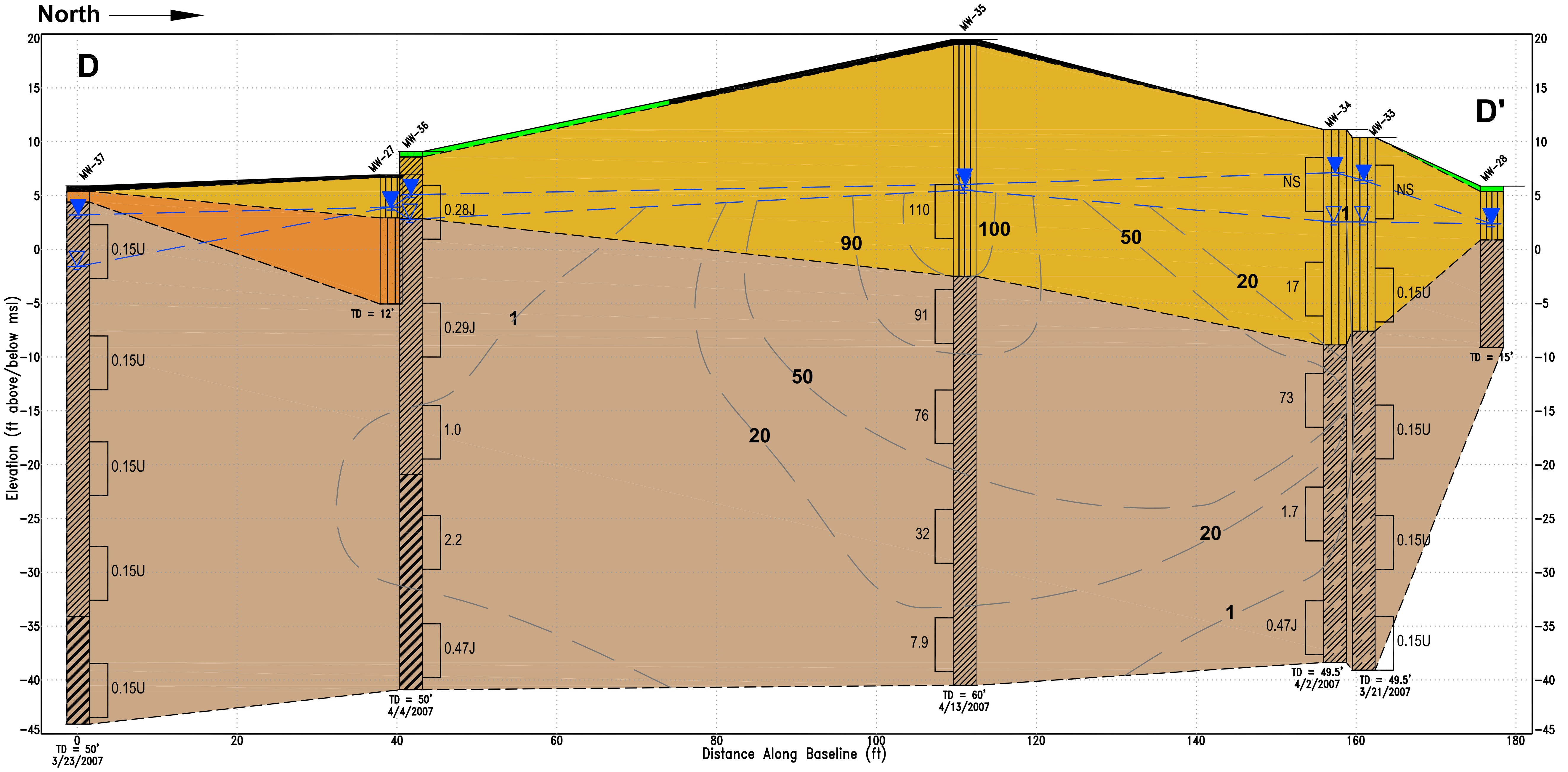


Figure 7-9
Combined Seep Water and Groundwater Interpolations for VC in Caprock Groundwater
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii



Notes:
1. Concentrations in µg/L
2. MW-27 and MW-28 not sampled during January 2008
3. Interval 1 of MW-33 and MW-34 not sampled due to lack of water
4. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for PCE is 120 µg/L for locations < 150 meters from surface water.

LEGEND

▥	Silt	🟩	Topsoil	U	Undetected
▨	Extrusive Tuff	■	Asphalt	J	Estimated, Concentrations Below Detection Limit
▥	Silty Sand/Sandy Silt	🟨	Silts	NS	Interval Not Sampled
▦	Low Plasticity Clay	🟧	Sands	]	Approximate Sample Interval
▨	Clayey Silt	🟫	Clays		
▨	High Plasticity Clay	▼ - - -	Approximate Static Water Level	⌒	PCE Concentration Contour (µg/L)
▨	Poorly-graded Sand	▽ - - -	First Encountered Water Level		

Figure 7-10
PCE Concentration Distribution
January 2008
Cross-Section D-D'
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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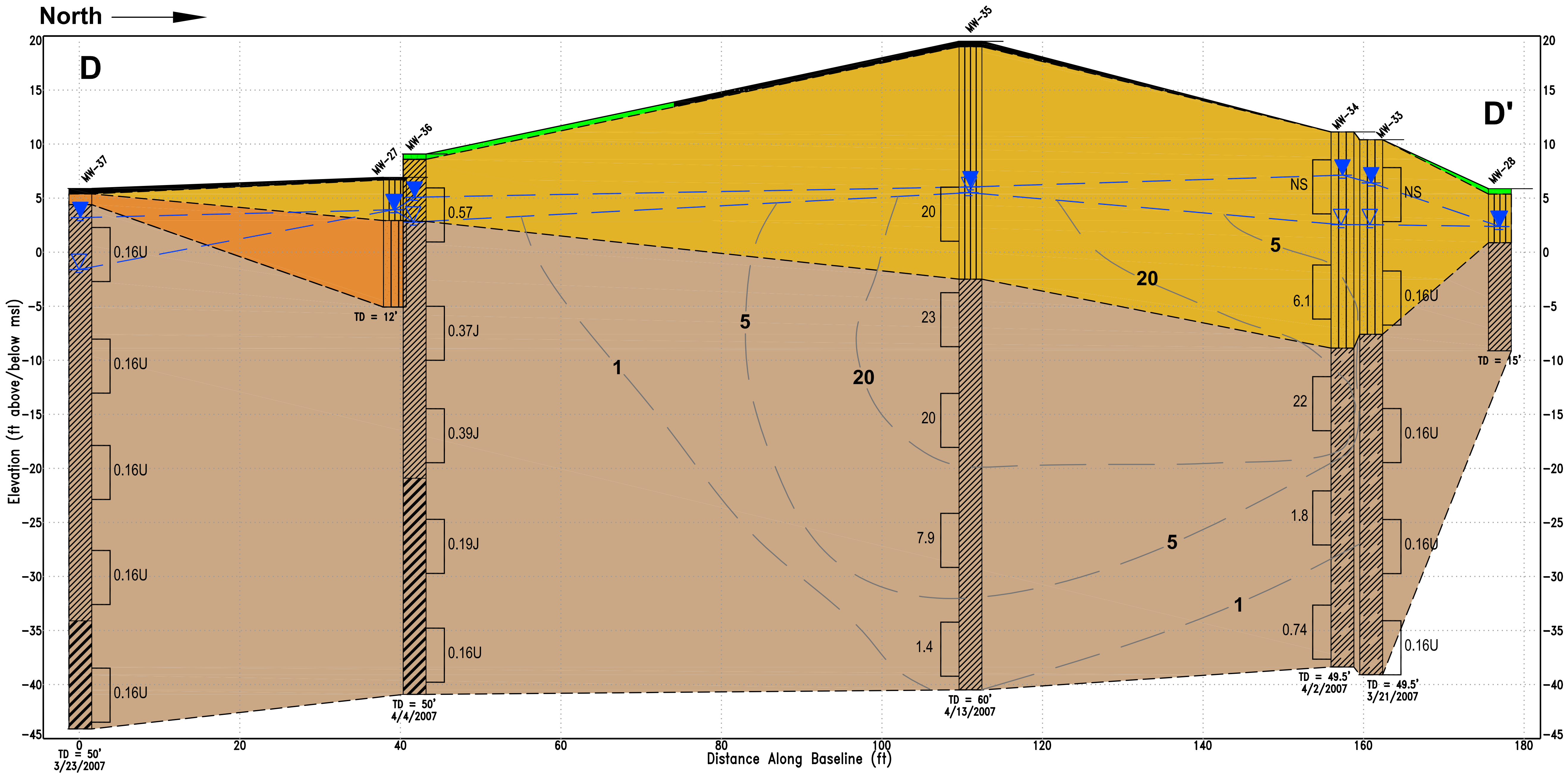

Notes:

1. Concentration in µg/L
2. MW-27 and MW-28 not sampled during January 2008
3. Interval 1 of MW-33 and MW-34 not sampled due to lack of water
4. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for TCE is 360 µg/L for locations < 150 meters from surface water.

LEGEND

▥	Silt	🟩	Topsoil	U	Undetected
⩗	Extrusive Tuff	■	Asphalt	J	Estimated, Concentrations Below Detection Limit
⁞	Silty Sand/Sandy Silt	🟨	Silts	NS	Interval Not Sampled
▦	Low Plasticity Clay	🟧	Sands	]	Approximate Sample Interval
▨	Clayey Silt	🟫	Clays		
▨	High Plasticity Clay	▼ - - -	Approximate Static Water Level	⁀	TCE Concentration Contour (µg/L)
▨	Poorly-graded Sand	▽ - - -	First Encountered Water Level		

Figure 7-11
TCE Concentration Distribution
January 2008
Cross-Section D-D'
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

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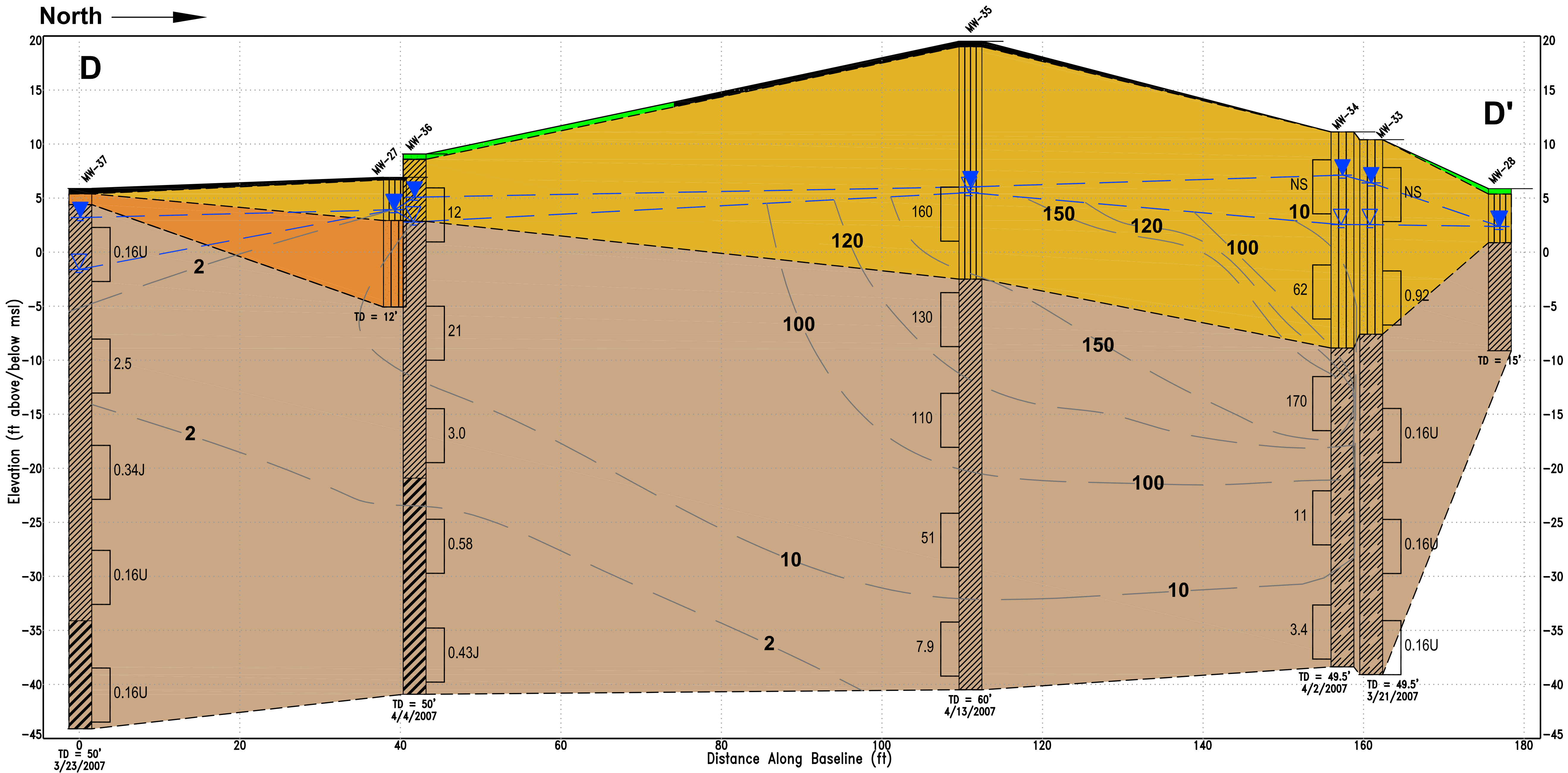
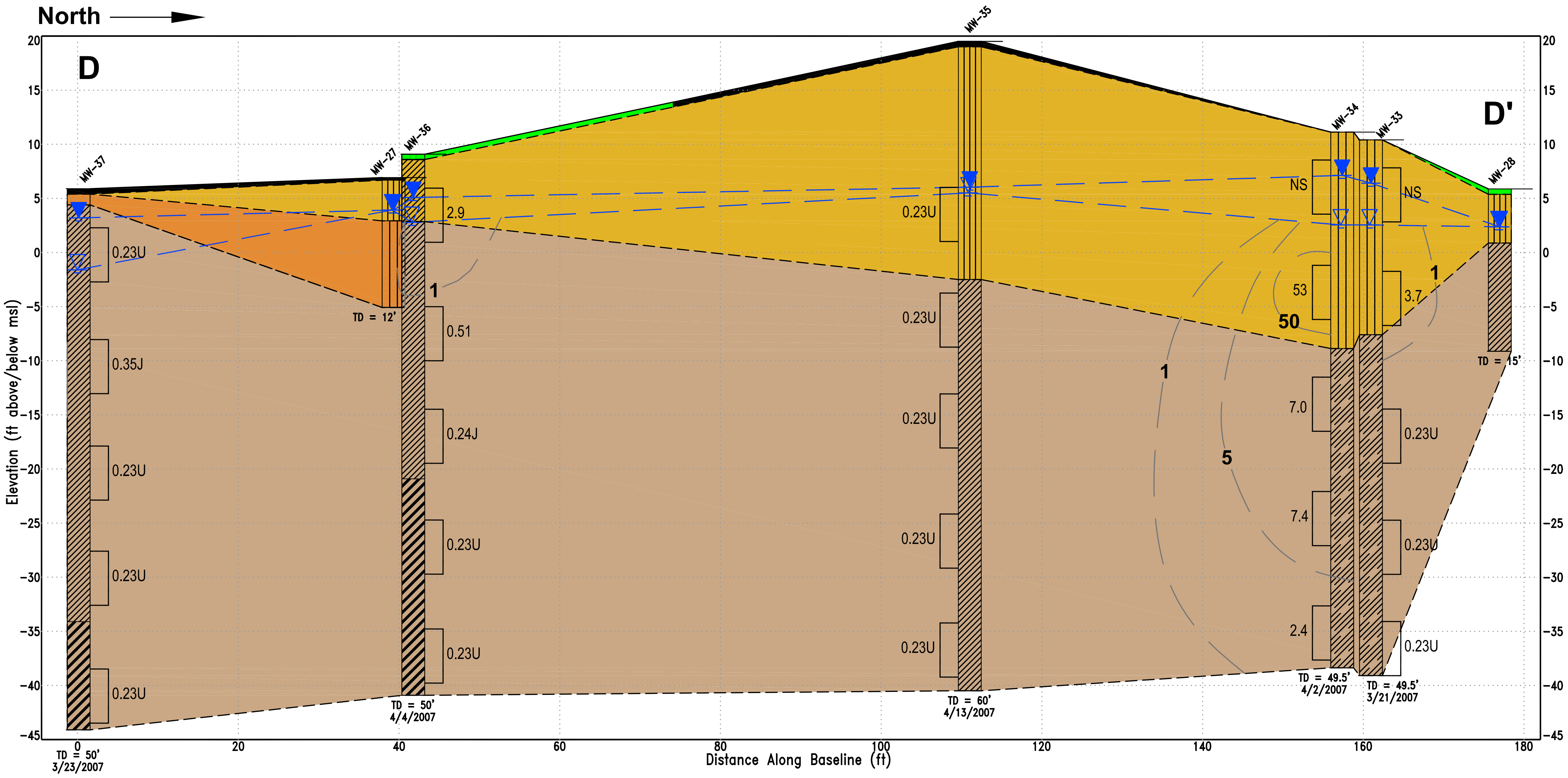


Notes:
1. Concentration in µg/L
2. MW-27 and MW-28 not sampled during January 2008
3. Interval 1 of MW-33 and MW-34 not sampled due to lack of water
4. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for DCE is 590 µg/L for locations < 150 meters from surface water.

LEGEND

▥	Silt	🟩	Topsoil	U	Undetected
▨	Extrusive Tuff	■	Asphalt	J	Estimated, Concentrations Below Detection Limit
▥	Silty Sand/Sandy Silt	🟨	Silts	NS	Interval Not Sampled
▦	Low Plasticity Clay	🟧	Sands	]	Approximate Sample Interval
▨	Clayey Silt	🟫	Clays		
▨	High Plasticity Clay	▼ - - -	Approximate Static Water Level	⁀	DCE Concentration Contour (µg/L)
▨	Poorly-graded Sand	▽ - - -	First Encountered Water Level		

Figure 7-12
DCE Concentration Distribution
January 2008
Cross-Section D-D'
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii



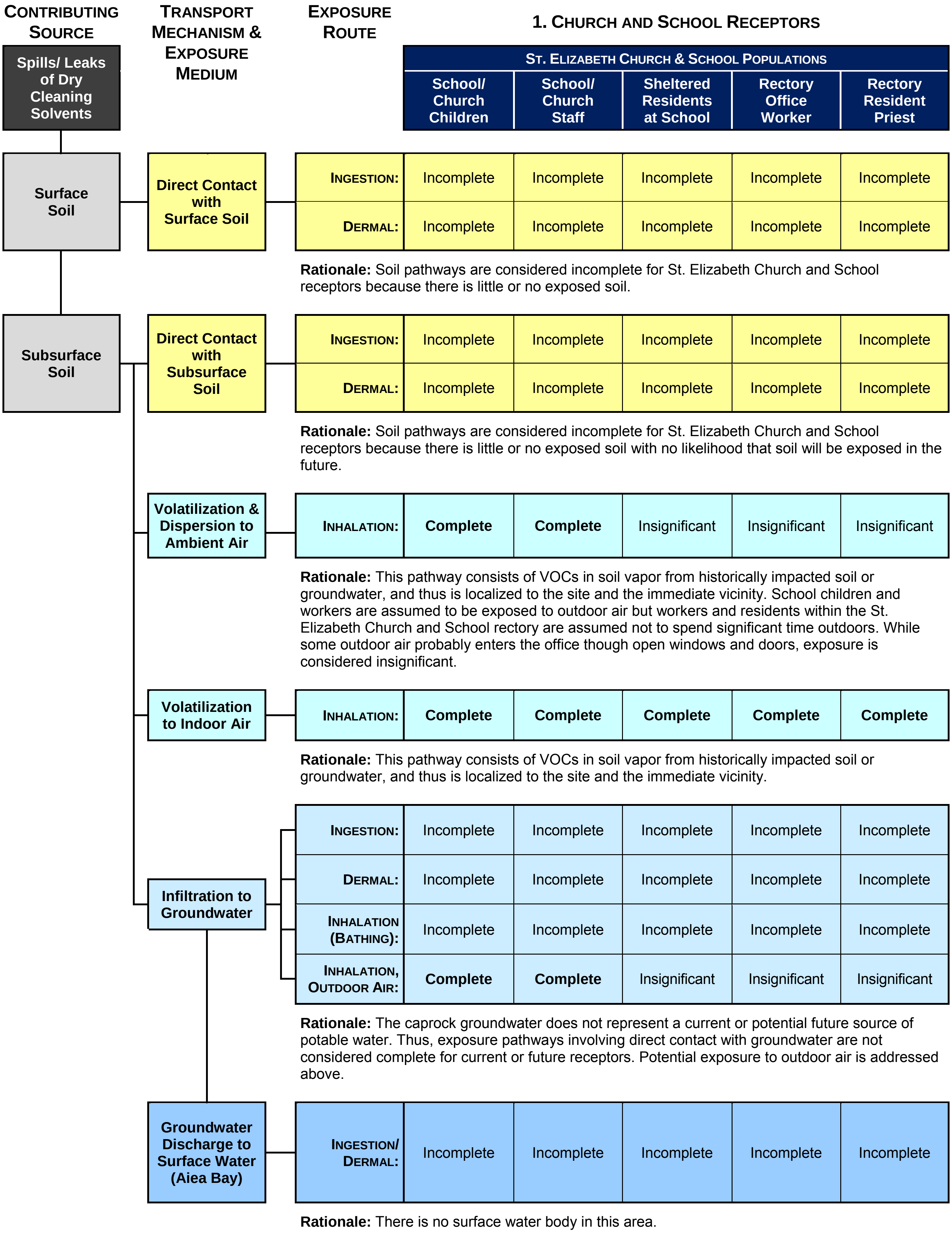
Notes:

1. Concentration in µg/L
2. MW-27 and MW-28 not sampled during January 2008
3. Interval 1 of MW-33 and MW-34 not sampled due to lack of water
4. DOH (2009) Tier 1 EAL (groundwater is not a source of potential drinking water) for VC is 780 µg/L for locations < 150 meters from surface water based on impact to aquatic habitat.

LEGEND

▥	Silt	🟩	Topsoil	U	Undetected
▨	Extrusive Tuff	■	Asphalt	J	Estimated, Concentrations Below Detection Limit
▥	Silty Sand/Sandy Silt	🟨	Silts	NS	Interval Not Sampled
▦	Low Plasticity Clay	🟧	Sands	]	Approximate Sample Interval
▨	Clayey Silt	🟫	Clays		
▨	High Plasticity Clay	▼	Approximate Static Water Level		
▨	Poorly-graded Sand	▽	First Encountered Water Level	⌒	VC Concentration Contour (µg/L)

Figure 7-13
VC Concentrations Distribution
January 2008
Cross-Section D-D'
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii



1. Church and School Receptors

Contributing Source: Spills/ Leaks of Dry Cleaning Solvents → Surface Soil; Subsurface Soil

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	School/ Church Children	School/ Church Staff	Sheltered Residents at School	Rectory Office Worker	Rectory Resident Priest
			St. Elizabeth Church & School Populations				
Surface Soil	Direct Contact with Surface Soil	Ingestion:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete
		Dermal:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete

Rationale: Soil pathways are considered incomplete for St. Elizabeth Church and School receptors because there is little or no exposed soil.

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	School/ Church Children	School/ Church Staff	Sheltered Residents at School	Rectory Office Worker	Rectory Resident Priest
Subsurface Soil	Direct Contact with Subsurface Soil	Ingestion:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete
		Dermal:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete

Rationale: Soil pathways are considered incomplete for St. Elizabeth Church and School receptors because there is little or no exposed soil with no likelihood that soil will be exposed in the future.

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	School/ Church Children	School/ Church Staff	Sheltered Residents at School	Rectory Office Worker	Rectory Resident Priest
Subsurface Soil	Volatilization & Dispersion to Ambient Air	Inhalation:	**Complete**	**Complete**	Insignificant	Insignificant	Insignificant

Rationale: This pathway consists of VOCs in soil vapor from historically impacted soil or groundwater, and thus is localized to the site and the immediate vicinity. School children and workers are assumed to be exposed to outdoor air but workers and residents within the St. Elizabeth Church and School rectory are assumed not to spend significant time outdoors. While some outdoor air probably enters the office though open windows and doors, exposure is considered insignificant.

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	School/ Church Children	School/ Church Staff	Sheltered Residents at School	Rectory Office Worker	Rectory Resident Priest
Subsurface Soil	Volatilization to Indoor Air	Inhalation:	**Complete**	**Complete**	**Complete**	**Complete**	**Complete**

Rationale: This pathway consists of VOCs in soil vapor from historically impacted soil or groundwater, and thus is localized to the site and the immediate vicinity.

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	School/ Church Children	School/ Church Staff	Sheltered Residents at School	Rectory Office Worker	Rectory Resident Priest
Subsurface Soil	Infiltration to Groundwater	Ingestion:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete
		Dermal:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete
		Inhalation (Bathing):	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete
		Inhalation, Outdoor Air:	**Complete**	**Complete**	Insignificant	Insignificant	Insignificant

Rationale: The caprock groundwater does not represent a current or potential future source of potable water. Thus, exposure pathways involving direct contact with groundwater are not considered complete for current or future receptors. Potential exposure to outdoor air is addressed above.

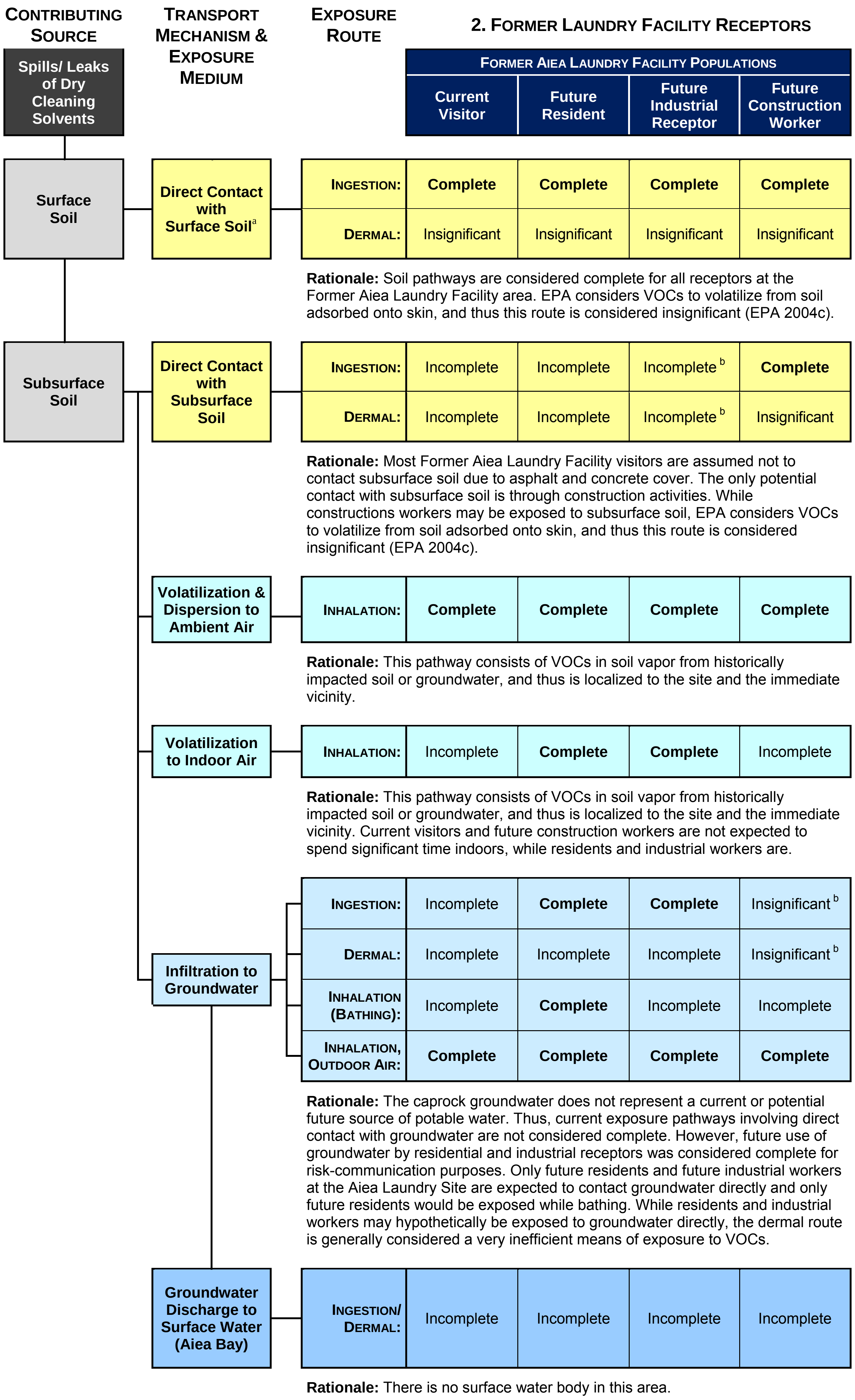
Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	School/ Church Children	School/ Church Staff	Sheltered Residents at School	Rectory Office Worker	Rectory Resident Priest
Infiltration to Groundwater	Groundwater Discharge to Surface Water (Aiea Bay)	Ingestion/ Dermal:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete

Rationale: There is no surface water body in this area.

[a] Only surface soil (collected from 0 to 2 ft bgs) was considered in this addendum.
[b] Standard construction practices, such as dewatering of excavations, are assumed to limit direct exposure to standing water.

bold "**Complete**" = pathway is complete and was evaluated in the revised HHRA.
non- bold "Complete" = pathway is considered complete but was not evaluated in the revised HHRA.

Figure 8-1 (page 1 of 4)
Human Health Exposure Pathway Evaluation
RI/FS Addendum
Former Aiea Laundry Facility
JBPHH, Oahu, Hawaii



FORMER AIEA LAUNDRY FACILITY POPULATIONS

Surface Soil – Direct Contact with Surface Soil[a]

Exposure Route	Current Visitor	Future Resident	Future Industrial Receptor	Future Construction Worker
INGESTION:	**Complete**	**Complete**	**Complete**	**Complete**
DERMAL:	Insignificant	Insignificant	Insignificant	Insignificant

Rationale: Soil pathways are considered complete for all receptors at the Former Aiea Laundry Facility area. EPA considers VOCs to volatilize from soil adsorbed onto skin, and thus this route is considered insignificant (EPA 2004c).

Subsurface Soil – Direct Contact with Subsurface Soil

Exposure Route	Current Visitor	Future Resident	Future Industrial Receptor	Future Construction Worker
INGESTION:	Incomplete	Incomplete	Incomplete [b]	**Complete**
DERMAL:	Incomplete	Incomplete	Incomplete [b]	Insignificant

Rationale: Most Former Aiea Laundry Facility visitors are assumed not to contact subsurface soil due to asphalt and concrete cover. The only potential contact with subsurface soil is through construction activities. While constructions workers may be exposed to subsurface soil, EPA considers VOCs to volatilize from soil adsorbed onto skin, and thus this route is considered insignificant (EPA 2004c).

Volatilization & Dispersion to Ambient Air

Exposure Route	Current Visitor	Future Resident	Future Industrial Receptor	Future Construction Worker
INHALATION:	**Complete**	**Complete**	**Complete**	**Complete**

Rationale: This pathway consists of VOCs in soil vapor from historically impacted soil or groundwater, and thus is localized to the site and the immediate vicinity.

Volatilization to Indoor Air

Exposure Route	Current Visitor	Future Resident	Future Industrial Receptor	Future Construction Worker
INHALATION:	Incomplete	**Complete**	**Complete**	Incomplete

Rationale: This pathway consists of VOCs in soil vapor from historically impacted soil or groundwater, and thus is localized to the site and the immediate vicinity. Current visitors and future construction workers are not expected to spend significant time indoors, while residents and industrial workers are.

Infiltration to Groundwater

Exposure Route	Current Visitor	Future Resident	Future Industrial Receptor	Future Construction Worker
INGESTION:	Incomplete	**Complete**	**Complete**	Insignificant [b]
DERMAL:	Incomplete	Incomplete	Incomplete	Insignificant [b]
INHALATION (BATHING):	Incomplete	**Complete**	Incomplete	Incomplete
INHALATION, OUTDOOR AIR:	**Complete**	**Complete**	**Complete**	**Complete**

Rationale: The caprock groundwater does not represent a current or potential future source of potable water. Thus, current exposure pathways involving direct contact with groundwater are not considered complete. However, future use of groundwater by residential and industrial receptors was considered complete for risk-communication purposes. Only future residents and future industrial workers at the Aiea Laundry Site are expected to contact groundwater directly and only future residents would be exposed while bathing. While residents and industrial workers may hypothetically be exposed to groundwater directly, the dermal route is generally considered a very inefficient means of exposure to VOCs.

Groundwater Discharge to Surface Water (Aiea Bay)

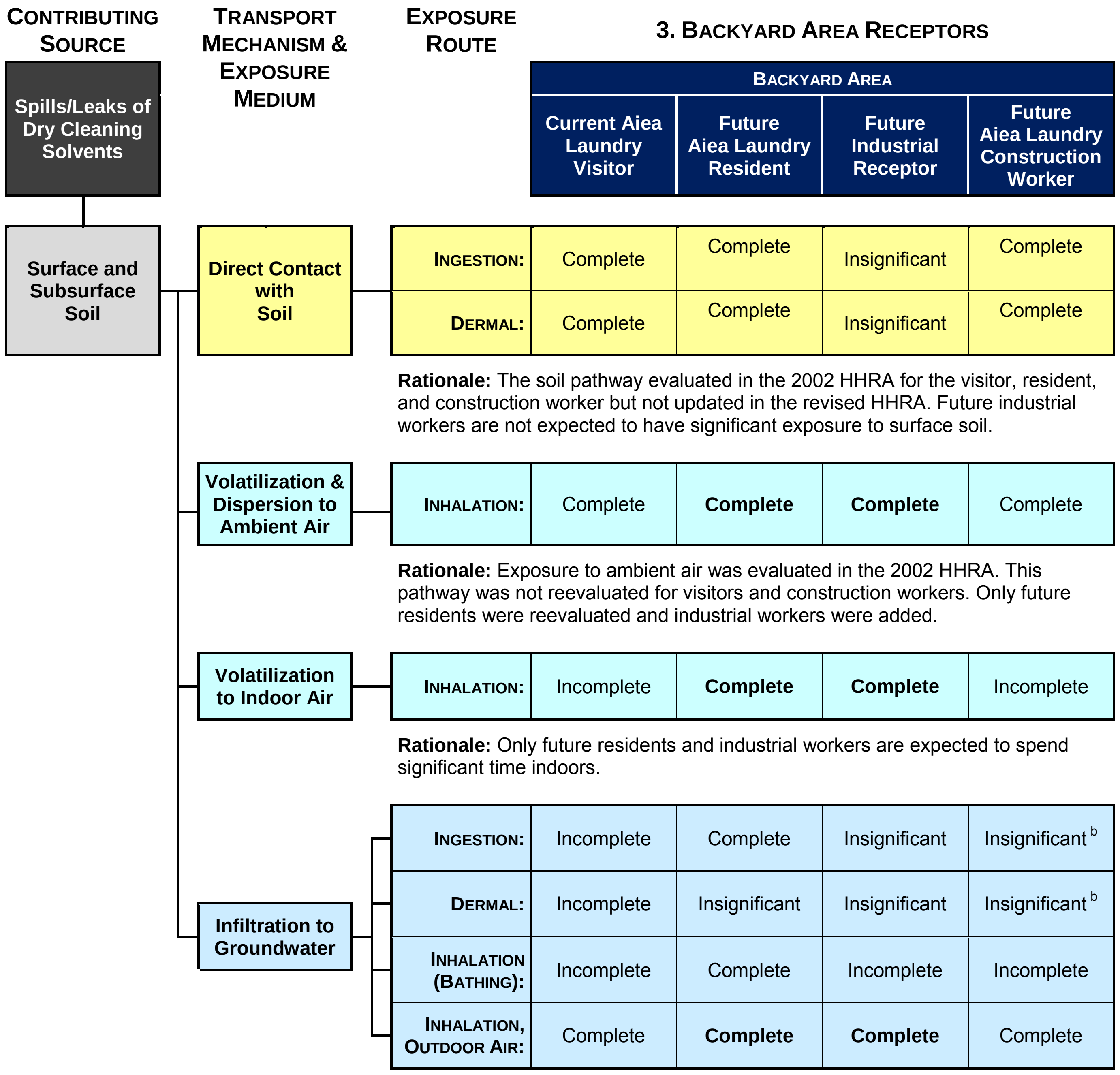
Exposure Route	Current Visitor	Future Resident	Future Industrial Receptor	Future Construction Worker
INGESTION/ DERMAL:	Incomplete	Incomplete	Incomplete	Incomplete

Rationale: There is no surface water body in this area.

[a] Only surface soil (collected from 0 to 2 ft bgs) was considered in this addendum.
[b] Standard construction practices, such as dewatering of excavations, are assumed to limit direct exposure to standing water.

bold "**Complete**" = pathway is complete and was evaluated in the revised HHRA.
non- bold "Complete" = pathway is considered complete but was not evaluated in the revised HHRA.

Figure 8-1 (page 2 of 4)
Human Health Exposure Pathway Evaluation
RI/FS Addendum
Former Aiea Laundry Facility
JBPHH, Oahu, Hawaii



CONTRIBUTING SOURCE	TRANSPORT MECHANISM & EXPOSURE MEDIUM	EXPOSURE ROUTE	3. BACKYARD AREA RECEPTORS			
			BACKYARD AREA			
			Current Aiea Laundry Visitor	Future Aiea Laundry Resident	Future Industrial Receptor	Future Aiea Laundry Construction Worker
Spills/Leaks of Dry Cleaning Solvents → Surface and Subsurface Soil	Direct Contact with Soil	INGESTION:	Complete	Complete	Insignificant	Complete
		DERMAL:	Complete	Complete	Insignificant	Complete

Rationale: The soil pathway evaluated in the 2002 HHRA for the visitor, resident, and construction worker but not updated in the revised HHRA. Future industrial workers are not expected to have significant exposure to surface soil.

Transport Mechanism & Exposure Medium	Exposure Route	Current Aiea Laundry Visitor	Future Aiea Laundry Resident	Future Industrial Receptor	Future Aiea Laundry Construction Worker
Volatilization & Dispersion to Ambient Air	INHALATION:	Complete	**Complete**	**Complete**	Complete

Rationale: Exposure to ambient air was evaluated in the 2002 HHRA. This pathway was not reevaluated for visitors and construction workers. Only future residents were reevaluated and industrial workers were added.

Transport Mechanism & Exposure Medium	Exposure Route	Current Aiea Laundry Visitor	Future Aiea Laundry Resident	Future Industrial Receptor	Future Aiea Laundry Construction Worker
Volatilization to Indoor Air	INHALATION:	Incomplete	**Complete**	**Complete**	Incomplete

Rationale: Only future residents and industrial workers are expected to spend significant time indoors.

Transport Mechanism & Exposure Medium	Exposure Route	Current Aiea Laundry Visitor	Future Aiea Laundry Resident	Future Industrial Receptor	Future Aiea Laundry Construction Worker
Infiltration to Groundwater	INGESTION:	Incomplete	Complete	Insignificant	Insignificant[b]
	DERMAL:	Incomplete	Insignificant	Insignificant	Insignificant[b]
	INHALATION (BATHING):	Incomplete	Complete	Incomplete	Incomplete
	INHALATION, OUTDOOR AIR:	Complete	**Complete**	**Complete**	Complete

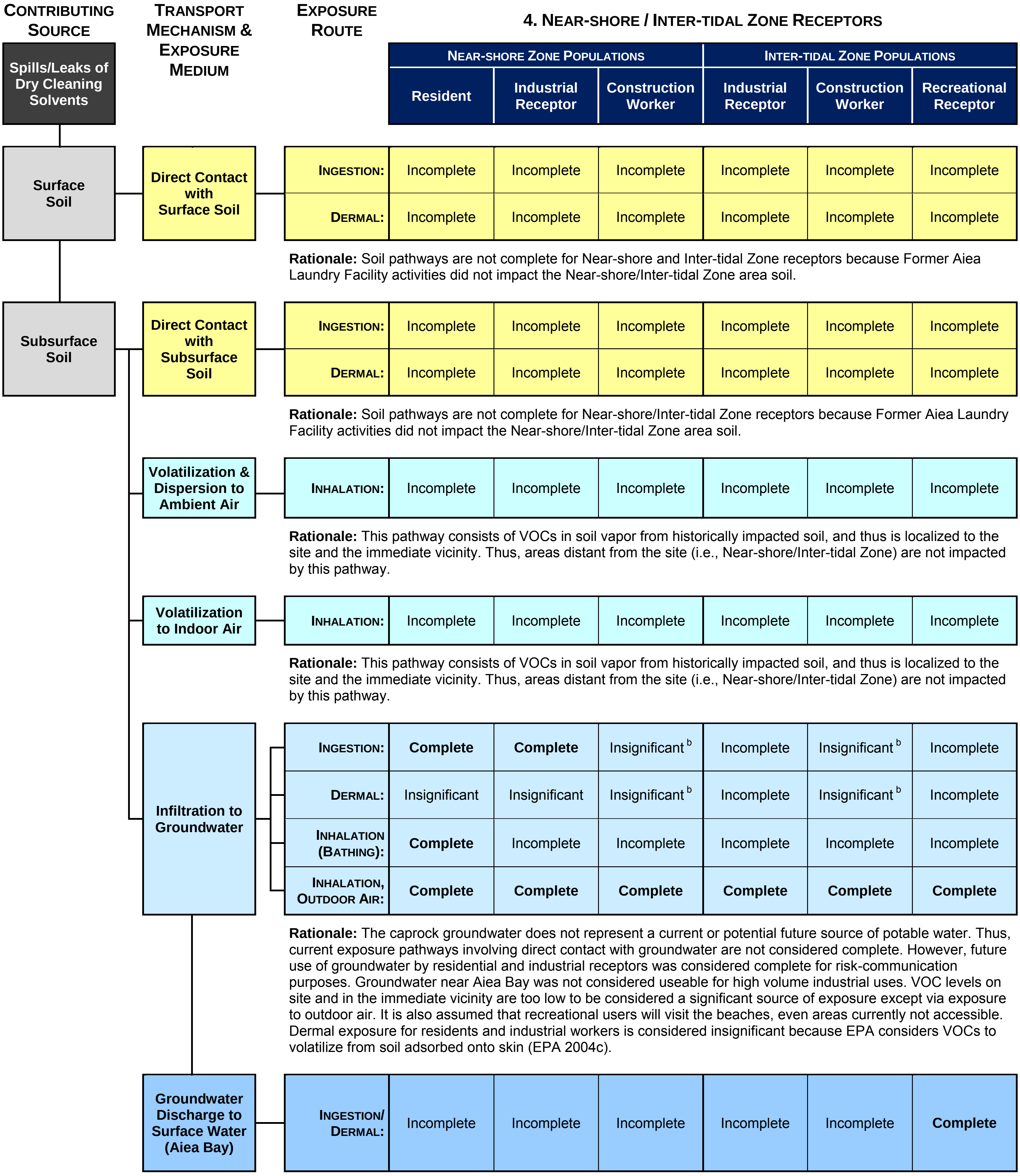
Rationale: Exposure to groundwater was evaluated for the future resident in the 2002 HHRA but was not reevaluated in the revised HHRA. For the other receptors, direct contact with groundwater is not a complete pathway or is an insignificant one. Besides the other rationale provided for the lack of direct contact with groundwater, EPA considers VOCs to volatilize from soil adsorbed onto skin, and thus this route is considered insignificant (EPA 2004c). Exposure to outdoor air was evaluated in the 2002 HHRA. This pathway was not reevaluated for visitors and construction workers. Only future residents were reevaluated and industrial workers were added.

[a] Only surface soil (collected from 0 to 2 ft bgs) was considered in this addendum.
[b] Standard construction practices, such as dewatering of excavations, are assumed to limit direct exposure to standing water.

bold “**Complete**” = pathway is complete and was evaluated in the revised HHRA.
non- bold “Complete” = pathway is considered complete but was not evaluated in the revised HHRA.

Figure 8-1 (page 3 of 4)
Human Health Exposure Pathway Evaluation
RI/FS Addendum
Former Aiea Laundry Facility
JBPHH, Oahu, Hawaii

4. NEAR-SHORE / INTER-TIDAL ZONE RECEPTORS



Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	Near-shore Zone Populations			Inter-tidal Zone Populations		
			Resident	Industrial Receptor	Construction Worker	Industrial Receptor	Construction Worker	Recreational Receptor
Spills/Leaks of Dry Cleaning Solvents Surface Soil	Direct Contact with Surface Soil	Ingestion:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete
		Dermal:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete

Rationale: Soil pathways are not complete for Near-shore and Inter-tidal Zone receptors because Former Aiea Laundry Facility activities did not impact the Near-shore/Inter-tidal Zone area soil.

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	Near-shore Zone Populations			Inter-tidal Zone Populations		
			Resident	Industrial Receptor	Construction Worker	Industrial Receptor	Construction Worker	Recreational Receptor
Subsurface Soil	Direct Contact with Subsurface Soil	Ingestion:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete
		Dermal:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete

Rationale: Soil pathways are not complete for Near-shore/Inter-tidal Zone receptors because Former Aiea Laundry Facility activities did not impact the Near-shore/Inter-tidal Zone area soil.

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	Near-shore Zone Populations			Inter-tidal Zone Populations		
			Resident	Industrial Receptor	Construction Worker	Industrial Receptor	Construction Worker	Recreational Receptor
Subsurface Soil	Volatilization & Dispersion to Ambient Air	Inhalation:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete

Rationale: This pathway consists of VOCs in soil vapor from historically impacted soil, and thus is localized to the site and the immediate vicinity. Thus, areas distant from the site (i.e., Near-shore/Inter-tidal Zone) are not impacted by this pathway.

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	Near-shore Zone Populations			Inter-tidal Zone Populations		
			Resident	Industrial Receptor	Construction Worker	Industrial Receptor	Construction Worker	Recreational Receptor
Subsurface Soil	Volatilization to Indoor Air	Inhalation:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete

Rationale: This pathway consists of VOCs in soil vapor from historically impacted soil, and thus is localized to the site and the immediate vicinity. Thus, areas distant from the site (i.e., Near-shore/Inter-tidal Zone) are not impacted by this pathway.

Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	Near-shore Zone Populations			Inter-tidal Zone Populations		
			Resident	Industrial Receptor	Construction Worker	Industrial Receptor	Construction Worker	Recreational Receptor
Subsurface Soil	Infiltration to Groundwater	Ingestion:	**Complete**	**Complete**	Insignificant[b]	Incomplete	Insignificant[b]	Incomplete
		Dermal:	Insignificant	Insignificant	Insignificant[b]	Incomplete	Insignificant[b]	Incomplete
		Inhalation (Bathing):	**Complete**	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete
		Inhalation, Outdoor Air:	**Complete**	**Complete**	**Complete**	**Complete**	**Complete**	**Complete**

Rationale: The caprock groundwater does not represent a current or potential future source of potable water. Thus, current exposure pathways involving direct contact with groundwater are not considered complete. However, future use of groundwater by residential and industrial receptors was considered complete for risk-communication purposes. Groundwater near Aiea Bay was not considered useable for high volume industrial uses. VOC levels on site and in the immediate vicinity are too low to be considered a significant source of exposure except via exposure to outdoor air. It is also assumed that recreational users will visit the beaches, even areas currently not accessible. Dermal exposure for residents and industrial workers is considered insignificant because EPA considers VOCs to volatilize from soil adsorbed onto skin (EPA 2004c).

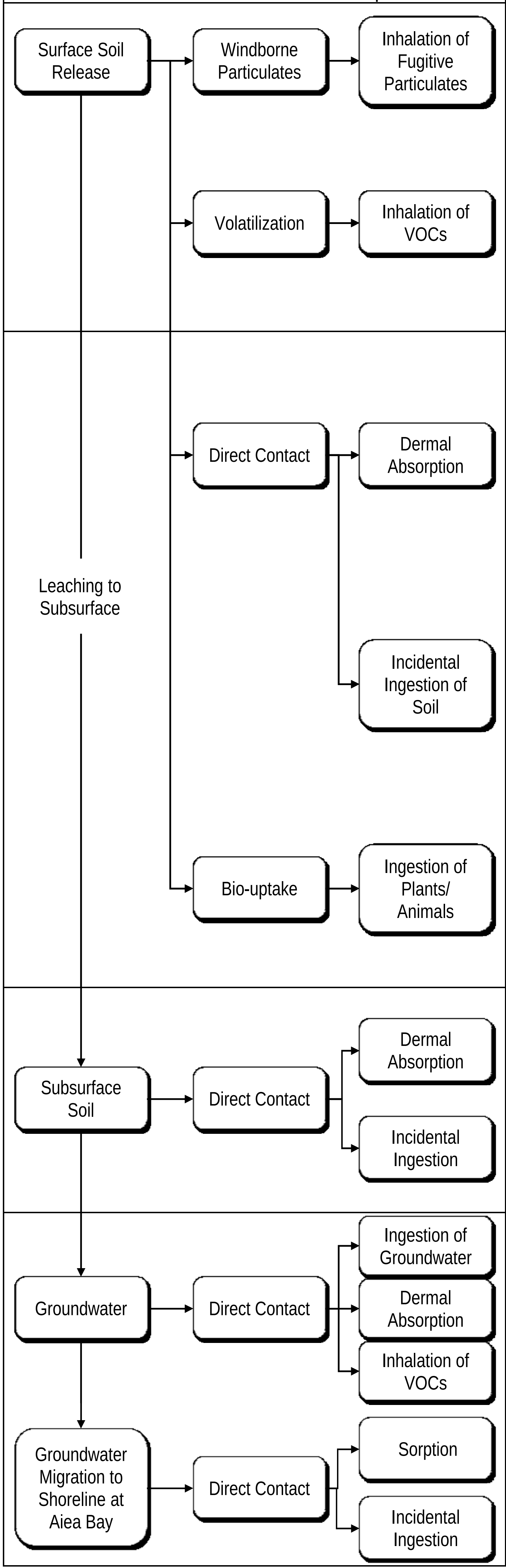
Contributing Source	Transport Mechanism & Exposure Medium	Exposure Route	Near-shore Zone Populations			Inter-tidal Zone Populations		
			Resident	Industrial Receptor	Construction Worker	Industrial Receptor	Construction Worker	Recreational Receptor
	Groundwater Discharge to Surface Water (Aiea Bay)	Ingestion/ Dermal:	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	**Complete**

Rationale: Contact with the water is considered complete only for recreational swimmers.

[a] Only surface soil (collected from 0 to 2 ft bgs) was considered in this addendum.
[b] Standard construction practices, such as dewatering of excavations, are assumed to limit direct exposure to standing water.

bold "**Complete**" = pathway is complete and was evaluated in the revised HHRA.
non- bold "Complete" = pathway is considered complete but was not evaluated in the revised HHRA.

Figure 8-1 (page 4 of 4)
Human Health Exposure Pathway Evaluation
RI/FS Addendum
Former Aiea Laundry Facility
JBPHH, Oahu, Hawaii



Contributing Source	Transport Mechanism	Exposure Route	Current Use Ecological Receptors	Future Use Ecological Receptors[a]	Rationale
Surface Soil Release	Windborne Particulates	Inhalation of Fugitive Particulates	Insignificant	Insignificant	Inhalation of contaminated dust is expected to be insignificant because the site is well vegetated and dust generation is minimal.
	Volatilization	Inhalation of VOCs	Insignificant	Insignificant	VOCs may volatilize into soil air spaces from soil and migrate to the soil surface where they may be emitted to the atmosphere, but scientific data to estimate exposure of wildlife is lacking, so the pathway is not evaluated quantitatively. Exposure to VOCs by breathing contaminated air is expected to be insignificant compared to exposure by ingestion pathways.
	Direct Contact	Dermal Absorption	Insignificant	Insignificant	Dermal absorption of surface soil contaminants is potentially complete for ecological receptors, but scientific data to estimate exposure of wildlife is lacking, so the pathway is not evaluated quantitatively. Soil invertebrates ingested as food by wildlife are assumed to take up soil COECs through the skin. Exposure to COECs by dermal absorption by wildlife is expected to be insignificant compared to exposure by ingestion pathways.
Leaching to Subsurface		Incidental Ingestion of Soil	Insignificant	Insignificant	The former Aiea Laundry Facility and surrounding area are covered with pavements and buildings with mowed grass and common landscape shrubs. There is not sufficient habitat value to attract terrestrial wildlife from nearby habitat of higher quality. Therfore, the frequency and duration of exposure suggests that this is not a significant exposure pathway.
	Bio-uptake	Ingestion of Plants/ Animals	Insignificant	Insignificant	Terrestrial wildlife ingest plant parts (i.e., leaves, seeds, roots) and soil invertebrates that may have taken up COPECs from the soil into their body tissues. There is not sufficient habitat value to attract terrestrial wildlife from nearby habitat of higher quality. Therfore, the frequency and duration of exposure suggests that this is not a significant exposure pathway.
Subsurface Soil	Direct Contact	Dermal Absorption Incidental Ingestion	Incomplete	Incomplete	Ecological receptors are not expected to come into contact with subsurface soils, therefore this exposure pathway is considered incomplete. The majority of bird and mammal exposure comes from ingestion of food (plants and soil invertebrates). The majority of plant and invertebrate chemical exposure is from uptake in the first 2 feet of soil. Less than 3 percent of exposure is from incidental soil ingestion.
Groundwater	Direct Contact	Ingestion of Groundwater Dermal Absorption Inhalation of VOCs	Incomplete	Incomplete	Terrestrial ecological receptors are not expected to be exposed to groundwater, therefore this exposure pathway is considered incomplete.
Groundwater Migration to Shoreline at Aiea Bay	Direct Contact	Sorption Incidental Ingestion	Complete	Complete	Benthic organisms and other aquatic life that live in the near shore area of Aiea Bay may be exposed to COECs in groundwater that seeps into surface water.

(a) Future conditions are assumed to be similar to current conditions for ecological receptors. No future scenarios are run.

COEC	chemical of ecological concern
COPEC	chemical of potential ecological concern

Figure 8-3
Ecological Conceptual Site Model
RI/FS Addendum
Former Aiea Laundry Facility
Pearl Harbor, Hawaii

Appendix B

HDOH Tier 1 EALs for Comparison with Soil and Groundwater Analytical Results (HDOH, Fall 2011, rev January 2012)

TABLE A. ENVIRONMENTAL ACTION LEVELS (EALs)
Groundwater IS Current or Potential Source of Drinking Water

	>150m to Surface Water Body		≤150m to Surface Water Body	
CONTAMINANT	[1]Soil (mg/kg)	[2]Groundwater (ug/L)	[1]Soil (mg/kg)	[2]Groundwater (ug/L)
ACENAPHTHENE	1.2E+02	2.0E+01	1.2E+02	2.0E+01
ACENAPHTHYLENE	1.0E+02	2.4E+02	1.3E+01	3.0E+01
ACETONE	1.0E+00	1.5E+03	1.0E+00	1.5E+03
ALDRIN	9.2E-01	4.0E-03	9.2E-01	4.0E-03
AMETRYN	1.1E+01	1.5E+02	1.1E+00	1.5E+01
AMINO,2- DINITROTOLUENE,4,6-	3.4E+00	7.3E+01	7.0E-01	1.5E+01
AMINO,4- DINITROTOLUENE,2,6-	3.4E+00	7.3E+01	7.0E-01	1.5E+01
ANTHRACENE	4.3E+00	2.2E+01	4.3E+00	7.3E-01
ANTIMONY	2.4E+00	6.0E+00	2.4E+00	6.0E+00
ARSENIC	2.4E+01	1.0E+01	2.4E+01	1.0E+01
ATRAZINE	1.1E-01	3.0E+00	1.1E-01	3.0E+00
BARIUM	1.0E+03	1.0E+03	1.0E+03	2.0E+02
BENZENE	3.0E-01	5.0E+00	3.0E-01	5.0E+00
BENZO(a)ANTHRACENE	1.5E+00	9.2E-02	1.5E+00	2.7E-02
BENZO(a)PYRENE	1.5E-01	2.0E-01	1.5E-01	1.4E-02
BENZO(b)FLUORANTHENE	1.5E+00	9.2E-02	1.5E+00	9.2E-02
BENZO(g,h,i)PERYLENE	3.5E+01	1.3E-01	2.7E+01	1.0E-01
BENZO(k)FLUORANTHENE	1.5E+01	4.0E-01	1.5E+01	4.0E-01
BERYLLIUM	3.1E+01	4.0E+00	3.1E+01	2.7E+00
BIPHENYL, 1,1-	1.0E+01	5.0E-01	1.0E+01	5.0E-01
BIS(2-CHLOROETHYL)ETHER	6.4E-05	1.2E-02	6.4E-05	1.2E-02
BIS(2-CHLOROISOPROPYL)ETHER	3.5E-03	3.2E-01	3.5E-03	3.2E-01
BIS(2-ETHYLHEXYL)PHTHALATE	3.5E+01	6.0E+00	3.5E+01	6.0E+00
BORON	1.0E+02	7.3E+03	1.0E+02	7.3E+03
BROMODICHLOROMETHANE	2.2E-03	1.2E-01	2.2E-03	1.2E-01
BROMOFORM	6.9E-01	8.0E+01	6.9E-01	8.0E+01
BROMOMETHANE	2.2E-01	8.7E+00	2.2E-01	8.7E+00
CADMIUM	1.4E+01	3.0E+00	1.4E+01	3.0E+00
CARBON TETRACHLORIDE	8.7E-02	5.0E+00	8.7E-02	5.0E+00
CHLORDANE (TECHNICAL)	1.6E+01	9.0E-02	1.6E+01	4.0E-03
CHLOROANILINE, p-	6.3E-03	3.4E-01	6.3E-03	3.4E-01
CHLOROBENZENE	2.2E+00	5.0E+01	1.5E+00	2.5E+01
CHLOROETHANE	1.1E+00	1.6E+01	1.1E+00	1.6E+01
CHLOROFORM	2.3E-02	7.0E+01	2.3E-02	7.0E+01
CHLOROMETHANE	1.0E-01	1.8E+00	1.0E-01	1.8E+00
CHLOROPHENOL, 2-	9.2E-03	1.8E-01	9.2E-03	1.8E-01
CHROMIUM (Total)	1.1E+03	1.0E+02	1.1E+03	7.4E+01
CHROMIUM III	1.0E+03	5.7E+02	1.0E+03	7.4E+01
CHROMIUM VI	2.9E+01	1.3E+01	2.9E+01	1.1E+01
CHRYSENE	3.0E+01	1.0E+00	1.0E+01	3.5E-01
COBALT	8.0E+01	3.0E+00	8.0E+01	3.0E+00
COPPER	6.3E+02	2.9E+00	6.3E+02	2.9E+00
CYANIDE (Free)	1.0E+02	1.0E+00	1.0E+02	1.0E+00
CYCLO-1,3,5-TRIMETHYLENE-2,4,6-TRINITRAMINE (RDX)	9.0E-03	6.1E-01	9.0E-03	6.1E-01
DALAPON	1.1E-01	2.0E+02	1.1E-01	2.0E+02
DIBENZO(a,h)ANTHTRACENE	1.5E-01	9.2E-03	1.5E-01	9.2E-03
DIBROMO,1,2- CHLOROPROPANE,3-	9.0E-04	4.0E-02	9.0E-04	4.0E-02
DIBROMOCHLOROMETHANE	1.6E-03	1.6E-01	1.6E-03	1.6E-01
DIBROMOETHANE, 1,2-	3.7E-04	4.0E-02	3.7E-04	4.0E-02
DICHLOROBENZENE, 1,2-	7.5E-01	1.0E+01	7.5E-01	1.0E+01
DICHLOROBENZENE, 1,3-	5.7E-01	5.0E+00	5.7E-01	5.0E+00
DICHLOROBENZENE, 1,4-	4.7E-02	5.0E+00	4.7E-02	5.0E+00
DICHLOROBENZIDINE, 3,3-	7.9E-02	1.5E-01	7.9E-02	1.5E-01
DICHLORODIPHENYLDICHLOROETHANE (DDD)	2.0E+00	2.8E-01	2.0E+00	1.0E-03
DICHLORODIPHENYLDICHLOROETHYLENE (DDE)	1.4E+00	2.0E-01	1.4E+00	1.0E-03
DICHLORODIPHENYLTRICHLOROETHANE (DDT)	1.7E+00	1.3E-02	1.7E+00	1.0E-03
DICHLOROETHANE, 1,1-	9.7E-02	2.4E+00	9.7E-02	2.4E+00
DICHLOROETHANE, 1,2-	2.1E-03	1.5E-01	2.1E-03	1.5E-01

TABLE A. ENVIRONMENTAL ACTION LEVELS (EALs)
Groundwater IS Current or Potential Source of Drinking Water

	>150m to Surface Water Body		≤150m to Surface Water Body	
CONTAMINANT	**[1]Soil (mg/kg)**	**[2]Groundwater (ug/L)**	**[1]Soil (mg/kg)**	**[2]Groundwater (ug/L)**
DICHLOROETHYLENE, 1,1-	1.2E+00	7.0E+00	1.2E+00	7.0E+00
DICHLOROETHYLENE, Cis 1,2-	3.1E-01	7.0E+01	3.1E-01	7.0E+01
DICHLOROETHYLENE, Trans 1,2-	2.7E+00	1.0E+02	2.7E+00	1.0E+02
DICHLOROPHENOL, 2,4-	2.5E-02	3.0E-01	2.5E-02	3.0E-01
DICHLOROPHENOXYACETIC ACID (2,4-D)	3.4E-01	7.0E+01	2.0E-01	4.0E+01
DICHLOROPROPANE, 1,2-	5.2E-02	5.0E+00	5.2E-02	5.0E+00
DICHLOROPROPENE, 1,3-	1.5E-02	4.3E-01	1.5E-02	4.3E-01
DIELDRIN	1.5E+00	4.2E-03	1.5E+00	1.9E-03
DIETHYLPHTHALATE	1.6E+01	9.4E+02	2.6E-02	1.5E+00
DIMETHYLPHENOL, 2,4-	9.9E+00	1.2E+02	9.0E+00	1.1E+02
DIMETHYLPHTHALATE	2.2E+01	9.4E+02	3.5E-02	1.5E+00
DINITROBENZENE, 1,3-	2.1E-01	3.7E+00	2.1E-01	3.7E+00
DINITROPHENOL, 2,4-	5.6E+00	7.3E+01	5.6E+00	7.3E+01
DINITROTOLUENE, 2,4- (2,4-DNT)	2.1E-02	2.2E-01	2.1E-02	2.2E-01
DINITROTOLUENE, 2,6- (2,6-DNT)	3.6E+00	3.7E+01	3.6E+00	3.7E+01
DIOXANE, 1,4-	3.1E-04	6.7E-01	3.1E-04	6.7E-01
DIOXINS (TEQ)	2.4E-04	3.0E-05	2.4E-04	5.0E-06
DIURON	1.3E+00	7.3E+01	1.1E+00	6.0E+01
ENDOSULFAN	1.8E+01	3.4E-02	1.8E+01	8.7E-03
ENDRIN	3.7E+00	3.7E-02	3.7E+00	2.3E-03
ETHANOL	4.5E+00	5.0E+04	4.5E+00	5.0E+04
ETHYLBENZENE	3.7E+00	3.0E+01	3.7E+00	3.0E+01
FLUORANTHENE	4.6E+02	1.3E+02	8.7E+01	8.0E+00
FLUORENE	1.0E+02	2.4E+02	1.0E+02	3.9E+00
GLYPHOSATE	1.0E-01	6.0E+02	1.1E-02	6.5E+01
HEPTACHLOR	1.1E-01	5.3E-02	1.1E-01	3.6E-03
HEPTACHLOR EPOXIDE	5.3E-02	5.3E-02	5.3E-02	3.6E-03
HEXACHLOROBENZENE	3.0E-01	1.0E+00	3.0E-01	1.0E+00
HEXACHLOROBUTADIENE	1.8E-01	8.6E-01	1.8E-01	8.6E-01
HEXACHLOROCYCLOHEXANE (gamma) LINDANE	7.5E-02	1.6E-01	3.7E-02	8.0E-02
HEXACHLOROETHANE	2.7E-01	4.8E+00	2.7E-01	4.8E+00
HEXAZINONE	2.6E+01	1.2E+03	2.6E+01	1.2E+03
INDENO(1,2,3-cd)PYRENE	1.5E+00	9.2E-02	1.5E+00	9.2E-02
ISOPHORONE	7.7E-01	7.1E+01	7.7E-01	7.1E+01
LEAD	2.0E+02	1.5E+01	2.0E+02	5.6E+00
MERCURY	4.7E+00	2.0E+00	4.7E+00	2.5E-02
METHOXYCHLOR	1.6E+01	3.0E-02	1.6E+01	3.0E-02
METHYL ETHYL KETONE	7.7E+00	7.1E+03	7.7E+00	7.1E+03
METHYL ISOBUTYL KETONE	5.0E-01	1.7E+02	5.0E-01	1.7E+02
METHYL MERCURY	1.6E+00	3.0E-03	1.6E+00	3.0E-03
METHYL TERT BUTYL ETHER	2.8E-02	5.0E+00	2.8E-02	5.0E+00
METHYLENE CHLORIDE	1.1E-01	4.8E+00	1.1E-01	4.8E+00
METHYLNAPHTHALENE, 1-	1.8E+00	4.7E+00	7.9E-01	2.1E+00
METHYLNAPHTHALENE, 2-	4.1E+00	1.0E+01	8.7E-01	2.1E+00
MOLYBDENUM	7.8E+01	1.8E+02	7.8E+01	1.8E+02
NAPHTHALENE	4.4E+00	1.7E+01	4.4E+00	1.7E+01
NICKEL	7.6E+02	5.0E+00	7.6E+02	5.0E+00
NITROBENZENE	4.6E-03	1.2E-01	4.6E-03	1.2E-01
NITROGLYCERIN	7.0E-02	3.7E+00	7.0E-02	3.7E+00
NITROTOLUENE, 2-	3.8E-03	6.2E-02	3.8E-03	6.2E-02
NITROTOLUENE, 3-	7.3E+00	1.2E+02	7.3E+00	1.2E+02
NITROTOLUENE, 4-	2.5E-01	4.2E+00	2.5E-01	4.2E+00
PENTACHLOROPHENOL	8.2E-01	1.0E+00	8.2E-01	1.0E+00
PENTAERYTHRITOLTETRANITRATE (PETN)	4.2E-01	1.7E+01	4.2E-01	1.7E+01

TABLE A. ENVIRONMENTAL ACTION LEVELS (EALs)

Groundwater IS Current or Potential Source of Drinking Water

	>150m to Surface Water Body		≤150m to Surface Water Body	
CONTAMINANT	**[1]Soil (mg/kg)**	**[2]Groundwater (ug/L)**	**[1]Soil (mg/kg)**	**[2]Groundwater (ug/L)**
PERCHLORATE	7.0E-03	2.6E+01	7.0E-03	2.6E+01
PHENANTHRENE	4.4E+02	2.4E+02	6.9E+01	4.6E+00
PHENOL	1.6E-01	5.0E+00	1.6E-01	5.0E+00
POLYCHLORINATED BIPHENYLS (PCBs)	1.1E+00	5.0E-01	1.1E+00	1.4E-02
PROPICONAZOLE	6.6E+01	2.6E+02	6.6E+00	2.6E+01
PYRENE	4.4E+01	6.8E+01	4.4E+01	2.0E+00
SELENIUM	7.8E+01	2.0E+01	7.8E+01	5.0E+00
SILVER	7.8E+01	1.0E+00	7.8E+01	1.0E+00
SIMAZINE	9.8E-02	4.0E+00	4.9E-02	2.0E+00
STYRENE	9.1E-01	1.0E+01	9.1E-01	1.0E+01
TERBACIL	3.9E+00	4.7E+02	3.9E+00	4.7E+02
tert-BUTYL ALCOHOL	2.8E-02	4.5E+00	2.8E-02	4.5E+00
TETRACHLOROETHANE, 1,1,1,2-	1.5E-02	5.2E-01	1.5E-02	5.2E-01
TETRACHLOROETHANE, 1,1,2,2-	1.2E-03	6.7E-02	1.2E-03	6.7E-02
TETRACHLOROETHYLENE	8.8E-02	5.0E+00	8.8E-02	5.0E+00
TETRACHLOROPHENOL, 2,3,4,6-	4.9E+00	1.0E+01	5.9E-01	1.2E+00
TETRANITRO-1,3,5,7-TETRAAZOCYCLOOCTANE (HMX)	1.6E+02	1.8E+03	2.9E+01	3.3E+02
THALLIUM	7.8E-01	2.0E+00	7.8E-01	2.0E+00
TOLUENE	3.2E+00	4.0E+01	3.2E+00	4.0E+01
TOXAPHENE	4.4E-01	2.1E-01	4.4E-01	2.0E-04
TPH (gasolines)	1.0E+02	1.0E+02	1.0E+02	1.0E+02
TPH (middle distillates)	1.0E+02	1.0E+02	1.0E+02	1.0E+02
TPH (residual fuels)	5.0E+02	1.0E+02	5.0E+02	1.0E+02
TRICHLOROBENZENE, 1,2,4-	9.8E-02	7.0E+01	9.8E-02	2.5E+01
TRICHLOROETHANE, 1,1,1-	2.3E+01	2.0E+02	7.0E+00	6.2E+01
TRICHLOROETHANE, 1,1,2-	8.9E-03	5.0E+00	8.9E-03	5.0E+00
TRICHLOROETHYLENE	2.6E-01	5.0E+00	2.6E-01	5.0E+00
TRICHLOROPHENOL, 2,4,5-	2.9E+01	1.0E+02	3.2E+00	1.1E+01
TRICHLOROPHENOL, 2,4,6-	1.8E+00	6.1E+00	1.8E+00	6.1E+00
TRICHLOROPHENOXYACETIC ACID, 2,4,5- (2,4,5-T)	6.5E+00	3.7E+02	6.5E+00	3.7E+02
TRICHLOROPHENOXYPROPIONIC ACID, 2,4,5- (2,4,5-TP)	8.7E-01	3.0E+01	8.7E-01	3.0E+01
TRICHLOROPROPANE, 1,2,3-	1.3E-03	6.0E-01	1.3E-03	6.0E-01
TRICHLOROPROPENE, 1,2,3-	1.2E-01	6.2E-01	1.2E-01	6.2E-01
TRIFLURALIN	2.4E+01	8.7E+00	2.4E+01	8.7E+00
TRINITROBENZENE, 1,3,5-	3.9E+01	1.4E+02	8.4E+00	3.0E+01
TRINITROPHENYLMETHYLNITRAMINE, 2,4,6- (TETRYL)	4.9E+01	1.5E+02	4.9E+01	1.5E+02
TRINITROTOLUENE, 2,4,6- (TNT)	1.0E+00	2.2E+00	1.0E+00	2.2E+00
VANADIUM	7.7E+02	1.9E+01	7.7E+02	1.9E+01

TABLE A. ENVIRONMENTAL ACTION LEVELS (EALs)
Groundwater IS Current or Potential Source of Drinking Water

	>150m to Surface Water Body		≤150m to Surface Water Body	
CONTAMINANT	**[1]Soil (mg/kg)**	**[2]Groundwater (ug/L)**	**[1]Soil (mg/kg)**	**[2]Groundwater (ug/L)**
VINYL CHLORIDE	7.2E-02	2.0E+00	7.2E-02	2.0E+00
XYLENES	2.1E+00	2.0E+01	2.1E+00	2.0E+01
ZINC	1.0E+03	2.2E+01	1.0E+03	2.2E+01
Electrical Conductivity (mS/cm, USEPA Method 120.1 MOD)	2.0	0.0E+00	4.0	0.0E+00
Sodium Adsorption Ratio	5.0	0.0E+00	12	0.0E+00

Notes:

1. Based on unrestricted current or future land use. Considered adequate for residential housing, schools, medical facilities, day-care centers, parks and other sensitive uses.
2. Assumes potential impacts to drinking water source and discharge of groundwater into a freshwater, marine or estuary surface water system.

Source of Soil Action Levels: Refer to Appendix 1, Tables A-1 and A-2.

Source of Groundwater Action Levels: Appendix 1, Table D-1a (≤150m to Surface Water Body) and Table D-1b (>150m to Surface Water Body).

Soil data should be reported on dry-weight basis (see Appendix 1, Section 6.2).

Soil Action Levels intended to address direct-exposure, vapor intrusion, groundwater protection (leaching) and gross contamination hazards. Soil gas data should be collected for additional evaluation of potential vapor intrusion hazards at sites with significant areas of VOC-impacted soil. See also Section 4.4 and Table C. The need for a site-specific, ecological risk assessment should be evaluated if sensitive, terrestrial or aquatic habitats are within or nearby areas of contaminated soil.

Groundwater Action Levels intended to address surface water impacts, vapor intrusion and nuisance hazards Use in conjunction with soil gas action levels to evaluate potential impacts to vapor intrusion hazards if groundwater action levels for this concern approached or exceeded (refer to Table C-1a in Appendix 1). See also Section 4.4 and Table C.

Groundwater action levels should be compared to dissolved-phase chemical concentrations unless otherwise instructed by HIDOH.

Groundwater ALs >150m to Surface Water Body: Groundwater screened with respect to acute surface water goals (See Table D-1b).

Groundwater ALs ≤150m to Surface Water Body: Groundwater screened with respect to chronic surface water goals (see Table D-1a).

TPH -Total Petroleum Hydrocarbons: TPH Action Levels must be used in conjunction with Action Levels for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.). See Section 2.6 in text.

TPH soil action levels for gross contamination hazards in isolated soils may be used as final cleanup levels if soil situated >3m deep at residential site and >1m (or otherwise capped) at commercial sites AND site data indicate that remaining contamination will not pose leaching or vapor intrusion hazards (refer to Table F-3 in Appendix 1; TPHg = 4,500 mg/kg, TPHmd & TPHrf = 5,000 mg/kg). TPH soil action levels noted in above table should be applied at sites with elevated threats to drinking water resources or aquatic habitats. Refer to Section 2.6 in text.