Environmental Hazard Evaluation / Environmental Hazard Management Plan for Aboveground Storage Tank 1253

MARINE CORPS BASE HAWAII, KANEOHE, HAWAII

REVISION 01

May 2013

Department of the Navy
Naval Facilities Engineering Command, Hawaii
400 Marshall Road
JBPHH HI 96860-3139

Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-03-D-1837, CTO HC30

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Prepared for:

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EXECUTIVE SUMMARY

INTRODUCTION

This document presents this Environmental Hazard Evaluation (EHE) and Environmental Hazard Management Plan (EHMP), Revision 01 for the Aboveground Storage Tank (AST) 1253 site and its extended area of contamination, located within the Fuel Farm at Marine Corps Base (MCB) Hawaii, Kaneohe, Oahu, Hawaii. Naval Facilities Engineering Command, Hawaii authorized this EHE/EHMP under contract number N62742-03-D-1837, Contract Task Order HC30 of the Comprehensive Long-Term Environmental Action Navy III program.

This EHE/EHMP compiles information from all previous investigations performed relative to the AST 1253 site. Expansion of the administrative boundary for the AST 1253 site is necessary to incorporate two areas at the MCB Hawaii Fuel Farm (hereinafter referred to as the "Fuel Farm") requiring further evaluation and/or management, as specified in the *Remedial Investigation (RI) Report, Former Fuel Farm Sludge Disposal Area, Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii* (AECOM and WCP 2013). AST 1253 and the two areas identified in the RI report, the Proposed Flight Training Simulator Area and the area in proximity to monitoring well MW58 are to be managed under this revised EHE/EHMP, and are hereinafter referred to as the "AST 1253 site."

This EHE and EHMP follows the Hawaii State Contingency Plan (Hawaii Administrative Rules [HAR] 11-451), HAR 11-281 (DOH 2000), and the following guidance documents: *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* (DOH 2011) and *Long-Term Management of Petroleum-Contaminated Soil and Groundwater* (DOH 2007).

According to the *Long-Term Management of Petroleum-Contaminated Soil and Groundwater* (DOH 2007), the principal objectives of an EHE/EHMP are as follows:

- Assess the concentrations of the chemicals of potential concern (COPCs).
- Define the extent and magnitude of contaminated soil and groundwater at the AST 1253 site.
- Document changes to the free-phase product plume over time.
- Evaluate potential environmental hazards that are present.
- Recommend continued monitoring and site closeout procedures.

Both an EHE and an EHMP have been prepared to address contaminated subsurface soil and groundwater at the AST 1253 site. The overall objective of the EHE presented in this document is to evaluate the following potential environmental hazards:

- Direct exposure
- Vapor intrusion
- Leaching
- Ecotoxicity
- Gross contamination

These hazards were evaluated using State of Hawaii Department of Health (DOH) Tier 1 environmental action levels (EALs) (DOH 2011) with respect to potential effects on human health and ecological populations under the following conditions: current site conditions; conditions during known, near-term construction activities; and anticipated future uses of the site.

An EHMP has been developed as environmental hazards have been identified and long-term management is necessary. The EHMP describes the contaminants of concern and associated hazards, any soil or groundwater exposure hazards, future site development plans, wells selected for monitoring, and monitoring frequency and duration. In summary, the EHMP includes the following:

- Description of the contaminants of concern and associated hazards
- Monitoring of free-phase product thickness and COPCs
- Administrative boundaries
- Administrative notices
- Site closeout plan

BACKGROUND

In 1987, Navy personnel discovered that Jet Propellant Grade 5 (JP-5) had leaked from AST 1253 into the subsurface soil. A site investigation (NAVFAC Pacific 1989) determined that the fuel had migrated approximately 315 feet from the center of the AST and ranged up to 71 inches (approximately 6 feet) thick on the surface of the groundwater. From 1995 to 1998, MCB Hawaii participated in a pilot testing initiative to evaluate the ability of bioslurper technology to remove and recover separate-phase fuel from groundwater. The result of the bioslurper initiative was the removal of only a few hundred gallons of JP-5 (Battelle 1999) indicating the impracticability of complete removal of all free-phase product and fulfilling the requirement to remove the product to the extent practicable as outlined in HAR 11-281 (DOH 2000).

A Site Characterization (SC) study was performed as a two-phase investigation in 2007 and 2008. Main SC activities involved a free-phase petroleum product survey to evaluate the lateral and vertical extent of the plume, followed by the collection of subsurface soil and groundwater samples to assess the extent of soil and groundwater contamination attributable to the release of JP-5 from AST 1253.

The data and information collected during the SC were used to characterize the extent of free-phase petroleum product and soil and groundwater contamination associated with the release of JP-5 in the area surrounding AST 1253. At the time of the 2008 SC, the product plume had migrated approximately 440 feet from the center of the AST, and the observed product thickness in monitoring wells ranged up to approximately 1 foot on the surface of the groundwater.

COPC concentrations exceeding the primary DOH EAL screening criteria were detected in only 7 of the 32 subsurface soil samples collected from the soil borings. Total petroleum hydrocarbons (TPH) as diesel range organics (DRO) and JP-5 concentrations above the screening criteria were reported for 5 of the samples, methylnaphthalene concentrations above the screening criteria were reported for 6 samples, and benzo(a)pyrene concentrations above the screening criteria were reported for 1 sample.

COPC concentrations above the primary DOH EAL screening criteria were detected in 38 of the 40 groundwater samples collected. TPH-DRO concentrations above the screening criteria were reported for 14 samples, JP-5 concentrations above the screening level were reported for 13 samples, a benzo(a)pyrene concentration above the screening criteria was reported for 1 sample, and lead concentrations above the screening criteria were reported for 31 samples. Although lead exceedances was detected in 31 of the 40 groundwater samples collected during the 2008 SC, this element is not a constituent of JP-5. The presence of lead in the groundwater indicated that another source of

contamination was present and the nearby Former Fuel Farm Sludge Disposal Area was the suspected source.

A human health screening risk assessment (SRA) and ecological SRA were conducted in conjunction with the 2008 SC. The detections of TPH-DRO, benzo(a)pyrene, and methylnaphthalene in the soil and groundwater during the 2008 SC appeared to be a result of the of JP-5 release from AST 1253. The human health SRA concluded that human health risks associated with contaminated soil and groundwater were below acceptable cancer and non-cancer target risk levels. The ecological SRA concluded that TPH-DRO, JP-5, benzo(a)pyrene, and lead presented a risk to marine receptors if they should migrate to Kaneohe Bay.

Based on recommendations in the 2008 SC report, an EHE/EHMP was prepared in 2009 as the presence of COPCs above site-specific EALs within the AST 1253 site required management of the residual subsurface fuel to prevent unmitigated exposures to site users and ecological receptors (AECOM and WCP 2009). To fulfill the monitoring requirement of the 2009 EHE/EHMP for the AST 1253 site, long-term monitoring (LTM) was initiated to monitor free-phase petroleum product thickness and COPC concentrations in groundwater in specific wells annually for a duration of 3 years commencing in 2010.

An evaluation of the JP-5 product plume in 2012 upon completion of the 3-year LTM period revealed that the product plume had migrated approximately 520 feet to the southwest (at its furthest point near monitoring well MW05) and the product thickness ranged up to approximately 0.49 foot on the surface of the groundwater. Based on the plume extent observed in 2008 and 2012, the free-phase petroleum plume expanded approximately 21 feet per year. However, since all of the monitoring wells were not inspected for free-phase petroleum product at the start of LTM activities, some portions of the plume observed in 2012 may have already existed in 2010. It has been 25 years since the JP-5 spill occurred and it appears that most of the free-phase JP-5 plume head (at the source) has dissipated and exists primarily in residual form adsorbed to the subsurface soil. While further lateral migration of the free-phase petroleum product plume is possible, it is not expected to be significant.

In 2012, an RI was conducted to evaluate the nature and extent of the threat to human health and the environment at the Former Fuel Farm Sludge Disposal Area where the release of petroleum and petroleum-related constituents from disposal pits and leaching trenches were created during 1973 tank-cleaning operations (AECOM and WCP 2013). The primary RI COPCs in soil gas were TPH as gasoline range organics (GRO), benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalene, and methane. The primary RI COPCs in subsurface soil and groundwater were TPH-GRO, TPH-DRO, and TPH as lube oil range organics (LRO), BTEX, polynuclear aromatic hydrocarbons, and total lead.

Subsurface soil, groundwater, and confirmation groundwater sampling during the RI failed to detect levels of lead exceeding the EALs in subsurface soil and groundwater samples. Therefore, lead was recommended to be removed as a COPC.

Naphthalene levels in two soil gas samples collected within the proposed Flight Trainer Simulator Area exceeded the DOH residential soil gas EAL, which is protective of soil gas vapor intrusion into a residence. In addition, TPH-GRO and benzo(a)pyrene exceedances in subsurface soil and groundwater analytical results were observed in samples collected from and proximal to MW58 (located approximately 500 feet south of the AST 1253 JP-5 plume edge). These exceedances in soil gas, subsurface soil and groundwater are likely associated with prior releases from historical underground storage tanks (USTs) that were removed from the Fuel Farm in the 1960s.

The presence of free-phase petroleum product in monitoring wells and COPC exceedances in subsurface soil and groundwater samples collected from the area north of the Former Sludge Disposal Area were consistent with and are likely from the AST 1253 JP-5 release.

RECOMMENDATIONS

Continuation of free-phase product thickness monitoring in monitoring wells at the AST 1253 site is proposed due to the continued presence of free-phase petroleum product observed during the AST 1253 LTM and Former Fuel Farm Sludge Disposal Area RI. Twenty-seven groundwater monitoring wells will be inspected every 3 years over a 6-year period beginning in 2015 to monitor the presence and thickness of free-phase petroleum product. The results will be used to evaluate the free-phase JP-5 product plume for continued biodegradation and potential lateral migration. Single iteration Monitoring Letter Reports describing the results of the 2015 and 2018 monitoring events will be prepared, and at the end of the 2018 monitoring event the plume will be reassessed and consultation with DOH will be conducted regarding the need for continued monitoring or request for conditional no further action (NFA) with institutional controls.

A supplemental RI is proposed to be conducted in the area in proximity to MW58 to assess the nature and extent of the TPH-GRO and benzo(a)pyrene exceedances detected in subsurface soil and groundwater. Additional recommendations and/or revision to this EHE/EHMP will be made based on the results of the supplemental RI. During the supplemental RI, up to four monitoring wells will be installed, and subsurface soil and groundwater samples will be collected for laboratory analysis if no free-phase petroleum product is observed. The samples will be used to quantify the following COPCs that were previously detected, or potentially may be detected:

- TPH-GRO
- TPH-DRO
- TPH-LRO
- BTEX
- Naphthalene
- Methylnaphthalene (total 1- and 2-)

A supplemental RI report will be prepared to evaluate the nature and extent of contamination from the historical site USTs.

At the AST 1253 site, contaminated soils, groundwater, and soil gas concentrations exceeding EALs have been identified due to the residual petroleum hydrocarbons in subsurface soil and groundwater. To provide notice of these potential hazards for future construction projects, MCB Hawaii will enter an expanded Administrative Boundary based on the established extent of the JP-5 free-phase product plume and other areas of contamination. Information regarding this boundary will be entered into the Naval Installation Restoration Information System allowing MCB Hawaii personnel to effectively manage sites requiring land use controls.

With the exception of the MW58 area, the Navy requests DOH concurrence on Conditional NFA for the AST 1253 site. A Conditional NFA denotes that all response actions have been completed at the site to the extent practicable, but long-term management activities remain, to address the AST 1253 site subsurface fuel contamination until 2018 when it will be further addressed with DOH. Further investigation is required for the area in proximity to MW58; therefore, additional recommendations and/or revision to this EHE/EHMP will be made based on the results of the supplemental RI.

CONTENTS

Executive Summary iii

Acronyms and Abbreviations ix

1. Introduction 11

1.1 Location 11
1.2 Surrounding Areas 11
1.3 Site Uses 12
1.4 Site History 12
1.5 Regional and Local Geology and Hydrogeology 13
1.5.1 Regional Geology 13
1.5.2 Site-Specific Soils Classification 13
1.5.3 Site-Specific Geology 14
1.5.4 Regional Hydrogeology 14
1.5.5 Site-Specific Groundwater Hydrogeology 15
1.6 Wildlife 16

2. Development of the Environmental Hazard Evaluation and Environmental Hazard Management Plan 17

2.1 Identification of Contaminants of Concern 18
2.2 2008 SC Screening Risk Assessments 19
2.2.1 Human Health Risk 19
2.2.2 Ecological Risk 20
2.3 2012 RI Risk Evaluations 20
2.3.1 Ecological Receptors 20
2.3.2 Human Receptors 21

3. Environmental Hazard Evaluation 21

3.1 Previous Investigations and Documentation 21
3.1.1 NAVFAC Investigation 21
3.1.2 Bioslurper Pilot Study 21
3.1.3 Phase I and II Site Characterization for AST 1253 22
3.1.4 2009 EHE/EHMP 23
3.1.5 Long-Term Monitoring for AST 1253 23
3.1.6 Remedial Investigation for Former Fuel Farm Sludge Disposal Area 23
3.2 DOH EAL Exceedances 24
3.2.1 Target Indicator Contaminants 24
3.2.2 DOH Tier 1 EAL Exceedances 24
3.3 Current Site Conditions 24
3.3.1 LTM for AST 1253 24
3.3.2 Former Fuel Farm Sludge Disposal Area RI 29
3.4 Potential Environmental Hazards 30
3.4.1 Direct Exposure 31
3.4.2 Soil Vapor Intrusion 31
3.4.3 Leaching 32
3.4.4 Ecotoxicity 32
3.4.5 Gross Contamination 33
3.5 Past Response Actions 33

4. Environmental Hazard Management Plan 34

4.1 LTM Monitoring 34
4.2 Supplemental RI 35
4.3 Administrative Boundaries 35
4.4 Administrative Notices 36
4.5 Site Closeout 37
4.5.1 Need for Continued Oversight by DOH 38

5. References 38

APPENDIXES

Appendix A Estimation of Potential Petroleum-Impacted Soil Remaining

Appendix B Meeting Minutes

Appendix C Response to Comments

FIGURES

1 Site Overview

2 Site Map

3 August 29, 1953 Aerial Overview

4 November 20, 1963 Aerial Overview

5 Groundwater Elevation Contour Map

6 1989 Free-Phase Petroleum Product Thickness Contour Map

7 Phase I SC Free-Phase Petroleum Product Thickness Map (April 2007)

8 2008 SC Subsurface Soil Constituents Exceeding DOH EAL Screening Criteria

9 2008 SC Groundwater Constituents Exceeding DOH EAL Screening Criteria

10 Estimated Extent of Contamination During the 2008 Site Characterization

11 Estimated Extent of Free-Phase Petroleum Product at AST 1253 (August 2012)

12 Soil Gas Constituents Exceeding DOH EAL Screening Criteria

13 Subsurface Soil Constituents Exceeding DOH EAL Screening Criteria

14 Groundwater Constituents Exceeding DOH EAL Screening Criteria

15 Human Health Exposure Pathway Evaluation

16 Ecological Receptors Exposure Pathway Evaluation

17 Proposed LTM Monitoring Wells

TABLES

1 Project-Specific Decision Criteria for COPCs 18

2 Summary of Detected COPCs in Groundwater at AST 1253 Monitoring Wells from 2008 to 2012 24

3 Free-Phase Petroleum Product Thickness Results at AST 1253 26

ACRONYMS AND ABBREVIATIONS

µg/L	microgram per liter
µg/m^3	microgram per cubic meter
AECOM	AECOM Technical Services, Inc.
AST	aboveground storage tank
AVGAS	aviation gasoline
Bldg.	building
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
COPC	chemical of potential concern
CSM	conceptual site model
CTO	contract task order
DOH	Department of Health, State of Hawaii
DRO	diesel range organics
EAL	environmental action level
EHE	Environmental Hazard Evaluation
EHMP	Environmental Hazard Management Plan
EPA	Environmental Protection Agency, United States
GRO	gasoline range organics
HAR	Hawaii Administrative Rules
JP-4	Jet Propellant 4
JP-5	Jet Propellant 5
mg/kg	milligram per kilogram
LRO	lube oil range organics
LTM	long-term monitoring
LUC	land use control
MCB	Marine Corps Base
MOGAS	motor gasoline
msl	mean sea level
NAVFAC	Naval Facilities Engineering Command
NFA	No Further Action
NIRIS	Naval Installation Restoration Information System
PAH	polynuclear aromatic hydrocarbon
PPE	personal protective equipment
RI	remedial investigation
SC	site characterization
SCP	State Contingency Plan
SIM	selected ion monitoring
SRA	screening risk assessment
TPH	total petroleum hydrocarbons
UIC	underground injection control
U.S.	United States
UST	underground storage tank
WCP	Wil Chee – Planning, Inc.
WP	work plan

1. Introduction

At the request of the Naval Facilities Engineering Command (NAVFAC), Hawaii, AECOM Technical Services, Inc. (AECOM) in collaboration with Wil Chee – Planning, Inc. (WCP) has prepared this Environmental Hazard Evaluation (EHE) and Environmental Hazard Management Plan (EHMP), Revision 01 under contract number N62742-03-D-1837, Contract Task Order (CTO) HC30 of the Comprehensive Long-Term Environmental Action Navy III program. This EHE/EHMP Revision 01 is an update to the original EHE/EHMP prepared under contract number N62742-03-D-1837, CTO HC08 (AECOM and WCP 2009). The purpose of this revision is to expand the EHE/EHMP administrative boundary for Aboveground Storage Tank (AST) 1253, located in the Fuel Farm at Marine Corps Base (MCB) Hawaii in Kaneohe on the island of Oahu, Hawaii (Figure 1).

Expansion of the administrative boundary for the AST 1253 site is necessary to incorporate two areas at the MCB Hawaii Fuel Farm (hereinafter referred to as the "Fuel Farm") requiring further evaluation and/or management, as specified in the CTO HC25 *Remedial Investigation (RI) Report, Former Fuel Farm Sludge Disposal Area, Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii* (AECOM and WCP 2013). AST 1253 and two areas identified in the RI report, i.e., the Proposed Flight Training Simulator Area and the area in proximity to monitoring well MW58 (discussed in Section 3.2.2), are to be managed under this revised EHE/EHMP, and are hereinafter referred to as the "AST 1253 site."

This EHE/EHMP, Revision 01 describes the contaminants of concern, defines the extent and magnitude of contaminated soil and groundwater left in place at the AST 1253 site, summarizes identified environmental concerns and associated hazards posed by the contamination, discusses future site plans, and provides a framework for long-term management of site contamination.

The EHE and EHMP in this document follow the Hawaii State Contingency Plan (SCP) (Hawaii Administrative Rules [HAR] 11-451) (DOH 1995), HAR 11-281 (DOH 2000), and the following guidance documents: *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* (DOH 2011) and *Long-Term Management of Petroleum-Contaminated Soil and Groundwater* (DOH 2007).

1.1 Location

The AST 1253 site is located within the Fuel Farm on the western portion of Mokapu Peninsula, southwest of Puu Hawaiiloa cinder cone and southeast of the MCB Hawaii Airfield (Figure 1). The Fuel Farm is bordered by Sixth Street to the northeast, C Street to the southeast, Third Street to the southwest, and support facilities for Buildings (Bldgs.) 373 and 388 to the northwest (Figure 2). A recreational area with two baseball fields is located to the southeast of AST 1253. The Fuel Farm currently utilizes only ASTs for fuel storage, the largest of which are ASTs 1252, 1253, and 6479. The AST 1253 site, which includes the Proposed Flight Training Simulator Area and the area in proximity to MW58, is shown in (Figure 2). The Former Fuel Farm Sludge Disposal Area site is also located within the Fuel Farm approximately 300 feet southwest of ASTs 1252 and 1253 (Figure 2).

1.2 Surrounding Areas

The area surrounding the Fuel Farm is primarily used for military industrial, support, and command operations. A Navy helicopter training facility and operations training center is to the north, a radio battalion is to the west, an auto shop and motor pool office are to the south, and a medical/dental clinic is to the east.

1.3 SITE USES

MCB Hawaii maintains facilities and provides services to support Marine Corps missions. It consolidates Marine Corps assets within an area of 2,951 acres on Mokapu Peninsula, and serves to maintain readiness and global projection of operating forces. Personnel support facilities, troop housing, recreational areas, training areas, administrative and operational offices, Kaneohe Klipper Golf Course, a marina, and an air station make up the majority of the installation.

1.4 SITE HISTORY

Prior to World War II, the Navy constructed Fuel Farm Bldg. 370 along with 136 25,000-gallon underground storage tanks (USTs) to store aviation gasoline (AVGAS), Jet Propellant 4 (JP-4), and motor gasoline (MOGAS) (NEESA 1984). The USTs were installed within an area bounded by Third Street, Fifth Street, and C Street (Figure 3).

In 1959, two 5,000-gallon USTs (KB-54 and KB-55) were installed 150 feet north of Bldg. 370 to store Jet Propellant 5 (JP-5). In 1961, ASTs 1252, 1253, and 1172 were constructed to store JP-5 (Figure 4). ASTs 1252 and 1253 are located south of Sixth Street, approximately 800 feet north of Bldg. 370, and have a capacity of 1,260,000 gallons (30,000 barrels) each. AST 1172 (also known as KB-49) was a 210,000-gallon tank covered with earth (a mounded tank). KB-54, KB-55, and AST 1172 were removed by Morrison Knudsen in 1997 and replaced with new ASTs (WCP 2003).

By 1962, only 20 of the original 136 USTs installed at the Fuel Farm remained active, of which 12 were used to store AVGAS and 8 stored MOGAS (Ogden 1992). By 1963, the 116 inactive tanks had been removed and the excavations backfilled; however, the piping and valve systems of the tanks were left in place (Ogden 1992). As shown in a 1963 aerial photograph (Figure 4), the 20 remaining USTs (KB-25 and KB-329 series A through V) were aligned along the eastern edge of Fifth Street and their associated valve pits were still visible.

In 1973, the use of AVGAS was discontinued and the 20 MOGAS and AVGAS USTs (KB-329A through KB-329H, KB-329J through KB-329N, and KB-329P through KB-329V) were cleaned with sandblasting grit and high-pressure water in a onetime event. To dispose of the cleaning waste, three sludge leaching fields and two disposal pits were excavated adjacent to the KB-329 series tank farm. Referred to as the Former Fuel Farm Sludge Disposal Area, the sludge leaching fields were 18 inches wide by 40 inches deep. One leaching field measured 70 feet long and two measured 200 feet long. Disposal pits were 6 feet deep by 30 inches wide at the base (HLA 1991). Approximately 15,000 gallons of cleaning wastewater and 200 to 300 gallons of an algae sludge that was generated during the tank cleaning were disposed of in the sludge leaching fields and disposal pits (Ogden 1992). A sign warning about the high concentrations of tetraethyl lead contamination was placed over the northernmost leaching field and remains in place today.

According to a 1992 interview with Ron Vargas, Fuel Farm Manager, only 9 of the 20 remaining tanks at the time were active (Ogden 1992). These tanks consisted of four USTs (KB-25, KB-329D, KB-329S, KB-329T), three ASTs (1252, 1253, and 1172), and two 5,000-gallon capacity USTs (KB-54 and KB-55). Most of the tanks stored JP-5. However, according to Mr. Vargas, KB-25 also stored MOGAS (Ogden 1992).

In 1996 and 1997, Morrison Knudsen removed the remaining USTs (including the 20 KB-329-series USTs) at the Fuel Farm along with AST 1172, leaving ASTs 1252 and 1253 as the only original tanks still in use at the Fuel Farm (Morrison Knudsen 1998). USTs KB-54, KB-55, and the original AST 1172 were replaced with ASTs. During removal activities, excavations around tanks KB-25, KB-329S, and KB-329V showed signs of petroleum contamination. These three tanks are listed on

the Department of Health (DOH) Leaking UST database under Release Identification (ID) Number 95-0067.

1.5 REGIONAL AND LOCAL GEOLOGY AND HYDROGEOLOGY

1.5.1 Regional Geology

The Hawaiian Islands are the tops of large shield volcanoes that rose from the ocean floor. The island of Oahu is comprised of two major volcanic mountains: the Koolau range in the east and the Waianae range in the west. MCB Hawaii lies on Mokapu Peninsula on the northwest rift zone of the Koolau volcano (USDA SCS 1972).

The primary geological processes that formed the Kaneohe area are the building of the Koolau shield volcano, post-volcanic erosion, post-erosional eruptions of the Honolulu Volcanic Series, the building of fringing reefs, changes in sea level, and the deposition of alluvial and marine sediments. The main rift zones of the Koolau volcano run in a northwest direction through the Kaneohe area. These rift zones consist of dikes, which are dense, impermeable remnant conduits through which lava extruded from the Koolau volcanic shield. The dikes cut vertically through the more permeable lava flows and are numerous in the lowland areas of Kaneohe. The number of dikes in this central part of the rift zone average more than 100 per mile, and the region is referred to as the dike complex. In the mountain areas, the density of dikes is fewer than 100 per mile consequently this region is referred to as the marginal dike complex. The surface of the Koolau basalts is estimated to be 300 to 1,000 feet below ground surface (bgs) at the Mokapu Peninsula (Stearns 1939).

A long period of quiescence followed the Koolau eruptions. During that time, the volcanic shield was eroded to nearly the present topography. This period lasted at least two million years and was followed by post-erosional eruptions that produced lava flows, cinder cones, and tuff cones of the Honolulu Volcanic Series. Four volcanic cones from the Honolulu Volcanic Series are located on the Mokapu Peninsula: Puu Hawaiiloa, Pali Kilo, Pyramid Rock, and Ulupau. Puu Hawaiiloa and Pali Kilo are cinder cones, Ulupau is a tuff cone, and Pyramid Rock is a nephelinite basalt cone.

Weathering, erosion, and alluvial deposition of the volcanic material shaped the topography between and after the Honolulu Volcanic Series events. At Mokapu Peninsula, younger deposits of alluvium can be found around Ulupau Crater and Puu Hawaiiloa. Younger alluvium is found in inland areas up to an elevation of approximately 200 feet and is comprised mainly of gravel, sand, and silt.

Reef building and marine sediment deposition formed flat areas near sea level in areas fringing the volcanic cones in the central part of Mokapu Peninsula. These low-lying areas connect the volcanic cones of the peninsula with the main part of the island of Oahu.

1.5.2 Site-Specific Soils Classification

The soil series present at the Fuel Farm consist of Ewa Series soil in the northern part of the Fuel Farm and Mamala Series soil in the southern part. Both series are part of the Kaena-Waialua Association, which occurs as a narrow band along the northern and eastern coastlines on the island of Oahu.

The Ewa Series consists of well-drained soils in basins and on alluvial fans, and is geographically associated with Honouliuli, Mamala, Molokai, Pulehu, and Waiakoa soils. This soil formed in alluvium derived from basic igneous rock. Permeability is moderate, runoff is slow, and the erosion hazard is slight. The available water capacity of the soil is approximately 1.3 inches per foot in the surface layer and approximately 1.4 inches per foot in the subsoil. Soil at the northern part of the project site is classified as moderately shallow Ewa silty clay loam, which exists on 2 to 6 percent

slopes. In a representative profile, the surface layer is dark reddish-brown silty clay loam about 18 inches thick. The subsoil, about 42 inches thick, is dark reddish-brown and dark-red silty clay loam that has a subangular blocky structure. The substratum is coral limestone, sand, or gravelly alluvium. The soil is neutral in the surface layer and subsoil. The depth to coral limestone is approximately 20 to 50 inches (USDA SCS 1972).

The Mamala Series in the southern part of the Fuel Farm is composed of shallow, well-drained soils along the coastal plains on Oahu, and is geographically associated with Ewa, Honouliuli, and Lualualei soils. These soils formed in alluvium deposited over coral limestone and consolidated calcareous sand. Permeability is moderate, runoff is very slow to medium, and the erosion hazard is slight to moderate. The available water capacity is about 2.2 inches per foot in the surface layer and 1.9 inches per foot in the subsoil. Specifically, the soil is classified as Mamala stony silty clay loam, which exists on 0 to 12 percent slopes. However, in most places the slope does not exceed 6 percent. Stones, mostly coral rock fragments, are common in the surface layer and in the profile. In a representative profile, the surface layer is dark reddish-brown stony silty clay loam about 8 inches thick. The subsoil is dark reddish-brown silty clay loam about 11 inches thick. The soil is underlain by coral limestone and consolidated calcareous sand at depths of 8 to 20 inches (USDA SCS 1972).

1.5.3 Site-Specific Geology

The geology at the Fuel Farm and surrounding areas was evaluated during the 2008 Site Characterization (SC) and can be categorized into three distinctive areas based on lithology: Cinder Cone Area (north of Sixth Street), Fuel Farm Area (area bounded by Fifth, Third, and C Streets), and Communication Baseyard Area (west of Fifth Street) (Figure 2). Site-specific geologic boring logs for the Fuel Farm area can be found in the 2008 SC Report (Earth Tech and WCP 2008) and the 2013 RI Report (AECOM and WCP 2013).

- **Fuel Farm Area.** The Fuel Farm lithology consists of a surface layer of dark brown clay at ground surface to a depth of approximately 5 feet bgs. Below this area is a mixture of coral-derived fill that extends to a depth of greater than 20 feet bgs. Coral sand was identified as the fill material surrounding the 136 USTs formerly situated in this area (Morrison Knudsen 1998). Since removal of the USTs, the existing topography has been modified. As a result of this, much of the lithology in the Fuel Farm area is fill material. Groundwater was encountered at a depth of approximately 10 feet bgs.
- **Cinder Cone Area.** Soil in this area is residual in origin, derived from the effects of weathering on volcanic tuff deposited by the nearby cinder cone. The soil exposed at the surface is dark brown silty clay that extends to a depth of approximately 10 feet bgs. Below the silty clay is a layer of silty sand that grades into completely weathered volcanic tuff at depths below 15 feet bgs. Groundwater was encountered at a depth of approximately 15 feet bgs.
- **Communication Baseyard Area.** The Communication Baseyard lithology consists of a surface layer of dark brown clay at ground surface to a depth of about 5 feet bgs. Below this is a layer of fine coral sand that extends to a depth of approximately 15 feet bgs. Below the sand layer is a layer of coral gravel and clay sediments. The sand and clay sediment lithology in this area is consistent with marine sediment deposition in a lagoon environment, and is interpreted as native material. Groundwater was encountered at a depth of approximately 9 feet bgs.

1.5.4 Regional Hydrogeology

Rain infiltrating in the mountain regions of Kaneohe is prevented from flowing seaward by impermeable dikes. These dikes form natural groundwater reservoirs. In the mountain regions

(marginal dike zone), the number of dikes per mile is small, and large volumes of water are stored in these dike compartments. In the lowland areas (dike complex zone), the density of dikes increases and less volume of water is stored in these compartments. Consequently, the productive sources of groundwater in the Kaneohe area are found in the mountain areas.

Groundwater utility in Hawaii is determined based on the location of the site with respect to the underground injection control (UIC) line and *Aquifer Identification and Classification for Oahu* (Mink and Lau 1990). MCB Hawaii is located on the coastal plain in an area where near-surface sedimentary caprock groundwater overlies deeper (basal) aquifers in fractured basalt, which is part of the Waimanalo Aquifer System in the Windward Aquifer Sector of the island of Oahu. According to Mink and Lau (1990), MCB Hawaii lies within an area that was assigned two aquifer and status codes:

- Sedimentary caprock aquifer (Aquifer Code 30604116). The sedimentary caprock aquifer is classified as currently used, ecologically important, irreplaceable, low-salinity water, with a high vulnerability to contamination (Status Code 12211).
- Dike-impounded basalt aquifer (Aquifer Code 30604122). This aquifer lies beneath the sedimentary caprock aquifer and is classified as currently used, fresh, irreplaceable, drinking water, with a low vulnerability to contamination (Status Code 11113).

Groundwater situated mauka (inland) of the UIC line is considered a potential source of drinking water provided it is present in a suitably productive geologic formation. Groundwater situated makai (seaward) of the UIC line is not generally considered to be a potential source of drinking water due to high salinity, low permeability and production and/or historical contamination (DOH 2011). MCB Hawaii is located seaward of the UIC line; therefore, the underlying aquifer is not considered a drinking water source. The installation consequently purchases its potable water from the Honolulu Board of Water Supply (NEESA 1984).

Water infiltrating the ground surface at Mokapu Peninsula percolates into a shallow, unconfined groundwater body. The caprock groundwater table at MCB Hawaii is near sea level. Shallow, unconfined groundwater has been observed at Mokapu Peninsula in a number of soil borings and test pits completed for foundation investigations. Water level data reported in these investigations were referenced to mean low water, which is approximately 0.7 feet below mean sea level (msl) (Environet 2005). Water level data from previous environmental investigations across MCB Hawaii indicate the depth to groundwater varies across the installation ranging from 5 to more than 19 feet bgs (Earth Tech and WCP 2008; WCP 2003, 2004a,b). The shallow, unconfined groundwater beneath the site is non-potable and likely tidally influenced. The source of the groundwater is believed to be infiltration of precipitation combined with intrusion of seawater, and is not presently used for drinking water or agricultural purposes (Ogden 1992).

One groundwater well (2545-01) installed by the City and County of Honolulu, Department of Environmental Services exists within an approximately 1-mile radius to the southeast of MCB Hawaii, and is currently unused by the Kailua wastewater treatment facility. According to the Hawaii State Department of Land and Natural Resources Well Database, well 2545-01 is nearest the site at a ground elevation of 12 feet above msl with an average groundwater elevation of 0.5 foot above msl (i.e., a depth to groundwater of approximately 11.5 feet bgs). Well 2545-01 is not a drinking-water well, and the salinity of the water renders it unsuitable for irrigation purposes (DLNR 2011).

1.5.5 Site-Specific Groundwater Hydrogeology

Water infiltrating the ground surface in the Mokapu Peninsula percolates into a shallow, unconfined groundwater body. The shallow groundwater body may receive recharge as leakage from the basalt aquifer. However, it is unlikely that potential contaminants from the AST 1253 site could migrate

from the shallow groundwater body to the basalt aquifer because of the distance between the two and the upward pressure gradient from the basalt aquifer toward the shallow groundwater body. Because the shallow groundwater body is surrounded by surface water bodies on all sides, groundwater elevations occur near sea level and are influenced by the tidal cycle. The depth to groundwater at the Fuel Farm ranges from 9 to 15 feet bgs. The major surface-water body in the downgradient area of the site is Kaneohe Bay, which is located approximately 2,500 feet to the southwest (Figure 1).

In order to further evaluate the hydraulic gradient at the site, a complete round of groundwater level measurements from all Fuel Farm monitoring wells were manually collected during the same tidal cycle during AST 1253 long-term monitoring (LTM) Event No. 3 (further discussed in Section 3.1.5) (AECOM and WCP 2012b). In conjunction with the groundwater level survey, each monitoring well was inspected for the presence of free-phase petroleum product.

Groundwater levels were measured in all accessible groundwater monitoring wells on 23 August 2012. Every effort was made to measure the potentiometric surface with as little tidal variation as possible; therefore, all monitoring wells were measured between a 0.24- and a 0.32-foot tide based on the Mokuoloe tidal station located in Kaneohe Bay. Groundwater elevations in monitoring wells containing free-phase petroleum product were corrected for depression of the fuel/water interface caused by the weight of the JP-5 petroleum product.

Groundwater surface elevations in monitoring wells ranged from approximately 0.82 to 1.91 feet above msl (Figure 5). The groundwater elevation varied from 1.9 to 1.5 feet above msl to the northwest of AST 1253. South of AST 1253, the groundwater elevation dropped slightly to 1.3 to 0.8 feet msl. Based on the measured levels, the potentiometric surface across the Fuel Farm generally slopes south to southeast towards Kaneohe Bay at a hydraulic gradient of 0.00069 foot per foot.

A groundwater elevation contour map (Figure 6) was developed presenting the configuration of the caprock potentiometric surface across the investigation area on 23 August 2012. Some significant anomalies were observed to the east and west of AST 1253, and may be due to the differing hydraulic conductivities of variable lithologies at the site. In general, this contour map is somewhat similar to the contour map presented in the 2008 SC Report (Earth Tech and WCP 2008) in that the potentiometric surface slopes south to southeast towards Kaneohe Bay

1.6 WILDLIFE

Two wildlife management areas are located at MCB Hawaii on Mokapu Peninsula: Ulupau Wildlife Management Area and Nuupia Ponds Wildlife Management Area.

Ulupau Wildlife Management Area is located on the northern slopes of Ulupau Head (Figure 1). The red-footed booby is the primary nesting species at the Ulupau Wildlife Management Area. The red-footed booby colonization began during the early 1940s and was well established by 1946. Other species that nest at the Ulupau Wildlife Management Area include the black noddy, the Laysan albatross, the brown booby, and a variety of other shore birds (Rauzon 1992).

Nuupia Ponds Wildlife Management Area was set aside in 1966 as a wildlife conservation area as a result of an agreement with the Marine Corps Air Station Kaneohe Bay, the State of Hawaii, the United States (U.S.) Department of the Interior, and the Navy. Nuupia Ponds represents one of the most important nesting and feeding areas for the endangered Hawaiian Stilt on the island of Oahu (Environet 2005). According to the 2005 Environmental Baseline Survey, MCB Hawaii Environmental Compliance and Protection Department personnel indicated that there are over 50 protected species of migratory or indigenous waterfowl that are found at MCB Hawaii, including four listed endangered waterbirds: (1) Hawaiian stilt; (2) Hawaiian gallinule; (3) Hawaiian coot; and

(4) Hawaiian duck. They frequent Nuupia Ponds, but also are seen in many of the scattered smaller delineated wetlands. When it rains, these endangered birds routinely and predictably disperse to opportunistically feed in rain puddles and ephemeral ponds/drainage ditches around the entire base. In addition to avian species, there are at least 16 native species of aquatic life found at Nuupia Ponds (Environet 2005).

There are no wildlife management areas within or adjacent to the Fuel Farm. The most common avian species observed at the Fuel Farm during the SC and RI field investigations were the Cattle Egret and the migratory Pacific Golden Plover.

2. Development of the Environmental Hazard Evaluation and Environmental Hazard Management Plan

The AST 1253 site is considered a petroleum hydrocarbon site and, therefore, not regulated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) because petroleum is not considered a hazardous substance under that law. However, the State of Hawaii's SCP (HAR 11-451) (DOH 1995), HAR 11-281, *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater* (DOH 2011), and *Long-Term Management of Petroleum-Contaminated Soil and Groundwater* (DOH 2007) provide regulatory oversight for closeout and management of residual petroleum.

The SCP approach requires the development of an EHE and, when appropriate, an EHMP. The EHE and EHMP for the AST 1253 site serve the following purposes:

- To identify and evaluate potential environmental hazards to human health and ecological receptors from residual petroleum at the site;
- To evaluate whether no further action (NFA) or Conditional NFA with institutional controls are appropriate; and
- To prepare general guidelines for management and continued free-phase petroleum product monitoring at the site.

The overall objective of the EHE is to evaluate the following potential environmental hazards:

- Direct exposure
- Vapor intrusion
- Leaching
- Ecotoxicity
- Gross contamination

These hazards were evaluated using DOH Tier 1 environmental action levels (EALs) (DOH 2011) with respect to potential effects on human and ecological populations under the following conditions: current site conditions; conditions during known, near-term construction activities; and anticipated future uses of the AST 1253 site. It is important to note that while the EHE uses DOH Tier 1 EAL values, the 2008 SC included a human-health screening risk assessment (SRA), which concluded that the only complete pathway to human receptors would be to construction/trench workers at the site if the current land use remains industrial. The ecological SRA concluded that the groundwater migration and discharge pathway represents a potentially complete exposure pathway for benthic and aquatic receptors in Kaneohe Bay (Earth Tech and WCP 2008).

Both an EHE and an EHMP have been prepared to address subsurface contamination resulting from petroleum releases from the AST 1253 and historical Fuel Farm USTs. EHMPs are developed for sites where potential environmental hazards have been identified and long-term management is necessary. An EHMP includes the following:

- Monitoring of free-phase product thickness
- Administrative boundaries
- Administrative notices
- Site closeout plan

Administrative boundaries define areas with subsurface soil, groundwater, and soil gas petroleum concentrations that may pose environmental hazards to some site users. Administrative notices are provided to limit exposure of the identified site users to the petroleum-containing subsurface soil, groundwater, and soil gas. Additional details of administrative boundaries and notices are provided in the EHMP (Section 4).

2.1 IDENTIFICATION OF CONTAMINANTS OF CONCERN

In accordance with 2011 DOH guidance, current analytical results for soil gas, soil and/or groundwater sampling conducted as part of the Former Fuel Farm Sludge Disposal RI (AECOM and WCP 2013) and LTM (AECOM and WCP 2010b, 2011b, 2012b) were first compared to DOH Tier 1 EALs. Analytes whose concentrations exceeded the initial Tier 1 EALs were identified as chemicals of potential concern (COPCs) and then compared against project site-specific Tier 1 EALs to evaluate the potential environmental hazards associated with AST 1253 site contaminants.

EALs applicable to soil gas are for vapor intrusion. EALs applicable to groundwater are for discharges to surface water and gross contamination. The only EALs applicable to soil are for vapor intrusion, direct exposure, and leaching. Leaching was the only EAL considered for total petroleum hydrocarbons (TPHs). Table 1 presents the project-specific decision criteria identified for the project.

Table 1: Project-Specific Decision Criteria for COPCs

Analyte	Soil Gas DOH Tier 1 EAL (µg/m^3) [a]	Soil DOH Tier 1 EAL (mg/kg) [a]	Groundwater DOH Tier 1 EAL (µg/L) [a]
TPH by SW-846 Method 8015C			
GRO	130,000	100 [b]	5,000
DRO	N/A	500 [b]	2,500
LRO	N/A	500 [b]	2,500
BTEX by SW-846 Method 8260C			
Benzene	N/A	0.67 [c]	1,700
Ethylbenzene	N/A	21 [c]	300
Toluene	N/A	32 [d]	400
Total Xylenes	N/A	45 [c]	1,000
PAHs by SW-846 Method 8270D SIM			
1-Methylnaphthalene	N/A	26 [c]	100
2- Methylnaphthalene	N/A	28 [c]	100
Naphthalene	72	4.5 [c]	210

µg/L microgram per liter
µg/m^3 microgram per cubic meter
BTEX benzene, toluene, ethylbenzene, xylenes
DRO diesel range organics

GRO gasoline range organics
LRO lube oil range organics
mg/kg milligram per kilogram
PAH polynuclear aromatic hydrocarbon
N/A not applicable (these are not identified as soil gas COPCs)
SIM selected ion monitoring
TPH total petroleum hydrocarbon
[a] DOH 2011. The value is the lowest applicable EAL for unrestricted sites, where groundwater beneath site is not a drinking water source and distance to the nearest surface water body is greater than 150 meters.
[b] Direct exposure
[c] Vapor intrusion
[d] Leaching

2.2 2008 SC Screening Risk Assessments

Human health and ecological SRAs were performed as part of the 2008 SC (Earth Tech and WCP 2008). Risk was evaluated by examining stressors, exposure pathways linking stressors to receptors, and receptors. Due to the petroleum exclusion of CERCLA Section 101(14), AST 1253 was evaluated under the Hawaii SCP (DOH 1995). Additionally, the SRA was restricted in scope to dissolved-phase petroleum constituents in groundwater and unsaturated petroleum constituents in soil.

2.2.1 Human Health Risk

The following steps were performed during the human health SRA:

- Develop a conceptual evaluation model
- Evaluate relevant data sets
- Estimate exposure point concentrations
- Calculate screening cumulative health risks
- Evaluate health risks posed by lead
- Evaluate the results of the human health SRA

The human health SRA concluded that onsite construction and onsite trench workers may become exposed to JP-5 and related chemicals through direct contact with subsurface soils through incidental ingestion, dermal absorption, inhalation of volatile organic compounds, and particulate inhalation. Exposure to nonpotable groundwater is incomplete since the water table (12 to 18 feet bgs) is below typical depths of excavation.

The human health risk SRA also concluded that all groundwater exposure pathways are incomplete or insignificant, except for construction/trench worker exposure. Surface water is also incomplete since groundwater contamination has not reached the nearest surface water body, Kaneohe Bay, located approximately 2,500 feet to the southwest.

Since all other chemicals in soil were present at concentrations below DOH EALs, only TPH as diesel range organics (DRO) and JP-5 were evaluated for potential human health risks. Risks were evaluated using the maximum detected concentration under the default DOH EAL exposures. The human health SRA determined that human health risks associated with contaminated soil and groundwater are below acceptable U.S. Environmental Protection Agency (EPA) cancer and non-cancer target risk levels.

2.2.2 Ecological Risk

The ecological SRA estimated risks to ecological receptors that may potentially be exposed to chemicals that may have been released to soil and groundwater from AST 1253. The assessment was conducted by examining subsurface contamination, its potential transport, and its effects on the marine environment. The ecological SRA was structured according to Navy policy (DON 1999) to fulfill the requirements of an EPA SRA and Navy Tier 1 ecological SRA. The following steps were used to conduct the ecological SRA (Earth Tech and WCP 2008):

- Review existing collected ecological data
- Evaluate stressors, exposure pathways, and receptors present
- Determine contaminants of ecological concern

Concentrations of JP-5 and TPH-DRO exceeded screening levels for benthic and aquatic ecological receptors in Kaneohe Bay in 12 onsite groundwater monitoring wells. Benzo(a)pyrene and lead also exceeded their respective screening values. Therefore, the site failed the Tier 1 ecological risk screen for these COPCs, and the ecological SRA concluded that, if they should migrate to Kaneohe Bay, TPH-DRO, JP-5, benzo(a)pyrene, and lead present a risk to marine receptors. However, given that the plume of free-phase petroleum product had moved only about 440 feet to the southwest at the time of the 2008 SC (Earth Tech and WCP 2008), and Kaneohe Bay is about 2,500 feet to the southwest of AST 1253, it would take many more years for the plume to reach Kaneohe Bay. In addition, natural degradation during this long migration was expected to greatly reduce the amount of petroleum product that may eventually enter the bay, and surface/harbor water would quickly disperse contaminant plume constituents.

Human health and ecological risks that were identified during the 2008 SC human health and ecological SRA (Earth Tech and WCP 2008) and 2013 RI Report (AECOM and WCP 2013) are discussed in Section 3.

2.3 2012 RI Risk Evaluations

This section summarizes the result of Tier 1 screening risk evaluations performed for the Former Fuel Farm Sludge Disposal Area RI. The screening risk evaluations were conducted to evaluate the nature and extent of the threat to human health and the environment resulting from petroleum-related releases from the Former Sludge Disposal Area. Exceedances in soil gas were located approximately 250 feet to the southeast of the Former Sludge Disposal Area in the proposed location of the Flight Training Simulator building(s). Exceedances in subsurface soil and groundwater at the northern end of the Former Sludge Disposal Area were consistent with and are attributed to the known JP-5 release from AST 1253. Exceedances in subsurface soil and groundwater at and proximal to MW58 south of the Former Sludge Disposal Area may be attributed to historical USTs that were removed in the 1960s.

2.3.1 Ecological Receptors

As stated in Section 1.6, there are over 50 protected species of migratory or indigenous waterfowl that are found at MCB Hawaii, including four listed endangered waterbirds, i.e., the Hawaiian stilt, Hawaiian gallinule, Hawaiian coot, and Hawaiian duck. They frequent Nuupia Ponds, but also are seen in many of the scattered smaller delineated wetlands. When it rains, these endangered birds routinely and predictably disperse to opportunistically feed in rain puddles and ephemeral ponds/drainage ditches around the entire base. However, the avian species most commonly observed at the Former Sludge Disposal Area during the RI field investigation were the cattle egret and the Pacific golden plover, neither of which are listed as threatened, endangered, or a species of concern.

For ecological receptors, the exposure pathways from subsurface soils and groundwater are considered incomplete, as ecological receptors are known to forage in surface soils and all known contamination is in the subsurface. Although there is a potential for groundwater contamination to enter surface waters located approximately 2,500 feet to the south, it is unlikely given the distance to Kaneohe Bay.

2.3.2 Human Receptors

The Former Sludge Disposal Area is located within an active fuel farm and the site is unlikely to be re-zoned for residential use in the future. All site contamination is in the subsurface at depth; therefore, any exposure pathways to contaminated soil gas, subsurface soil, and groundwater are considered incomplete for onsite workers, trespassers, and recreational users. Excavation/ construction workers at the site may be exposed to subsurface soil during excavation, trenching, and/or other construction activities. Exposure to contaminated groundwater is unlikely as groundwater is 10 to 15 feet bgs. Although there is a potential for groundwater contamination to enter surface waters located 2,500 feet to the south, it is unlikely given the distance to Kaneohe Bay.

3. Environmental Hazard Evaluation

3.1 Previous Investigations and Documentation

Investigations at the Fuel Farm began in 1987 and have continued to the present. A summary of environmental investigations associated with the AST 1253 site and Former Sludge Disposal Area is presented in the following paragraphs.

3.1.1 NAVFAC Investigation

In 1987, the Navy noticed a 3-inch drop in the level of JP-5 in AST 1253. The Navy performed an investigation and found that an estimated 60,000 gallons of JP-5 had leaked into the surrounding soil (NAVFAC 1989). The tank was emptied and a structural defect was noted in the tank bottom. The defect was thought to have been caused by sandblasting during cleaning of the tank in May 1983 (Ogden 1992). The Navy repaired the tank and subsequently installed a lined secondary containment system beneath both AST 1253 and AST 1252.

Upon discovery of the leak, the Navy initiated a two-phase investigation to evaluate the extent of subsurface fuel contamination (NAVFAC 1989). In November 1987, 15 soil borings spaced 20 to 25 feet apart were drilled approximately 25 feet outward and around the circumference of AST 1253. Free-phase fuel thickness in the borings ranged from 12 to 87 inches. To determine the lateral extent of the fuel leak, the Navy performed the second phase of the investigation in July 1988. A total of 67 boreholes were drilled to depths of 20 feet bgs on a 50-foot grid measured from the center of AST 1253. The boreholes were stepped outward from the tank until no free-phase fuel was encountered. The data from this investigation were used to construct a “fuel thickness contour map” shown as Figure 6. Data indicated that the released JP-5 had migrated approximately 315 feet from the center of AST 1253, and that the fuel thickness in the subsurface ranged up to 71 inches.

3.1.2 Bioslurper Pilot Study

In 1995, MCB Hawaii participated in a short-term pilot testing initiative performed by Battelle Memorial Institute to evaluate bioslurper technology (Battelle 1995). Data gathered from the pilot test were used to design a full-scale bioslurper system at AST 1253 to remove and recover JP-5 from the groundwater through a series of extraction wells. In 1995, 30 extraction wells were installed to depths of 16.5 feet bgs in the berm surrounding AST 1253, and to 19.5 feet bgs to the north of the tank, outside of the berm. Each well was completed so that approximately 6 feet of the well screen interval was below the groundwater table. A total of 99 soil samples were collected at various depths

during installation of the wells and analyzed for TPH-DRO, and benzene, toluene, ethylbenzene, and xylenes (BTEX). Analytical results showed that TPH-DRO was detected in 56 of the soil samples collected at or below 9 feet bgs at concentrations ranging from 15 to 13,300 milligrams per kilogram (mg/kg). Toluene was detected in 27 of the 56 samples at levels ranging from 5 to 45 mg/kg. Ethylbenzene was also detected in 2 samples at 33 and 50 mg/kg, and xylenes were detected in 3 samples at 8, 46, and 67 mg/kg. Soil samples from two background wells also installed in 1995 to the east of AST 1253 showed elevated levels of TPH-DRO and toluene, indicating that the plume had migrated in this direction (Battelle 1999).

The bioslurper system was initiated in November 1997. In May 1998, direct-push core sampling on the west and south side of Bldg. 6468 indicated that the JP-5 plume had reached this location. An additional 18 extraction wells were installed along the southwest perimeter of the building. The bioslurper system was run until December 1998 when the testing was discontinued after only 290 gallons of fuel were extracted (Battelle 1999).

3.1.3 Phase I and II Site Characterization for AST 1253

A SC investigation of AST 1253 was performed in a two-phase approach, which included collecting subsurface soil and groundwater samples for laboratory analysis to determine the area and degree of contamination, and evaluating the nature of petroleum and petroleum-related constituents from the JP-5 released from the tank. Phase I was conducted in April 2007 to establish baseline conditions from existing extraction and groundwater monitoring wells. Phase II was conducted from November 2007 through January 2008, and included subsurface soil sampling, monitoring well installation, and groundwater sampling to further evaluate the nature and extent of the release.

During SC Phase I activities, measurable free-phase petroleum product was found in several extraction wells. As shown on Figure 7, over 3 feet of free-phase petroleum product was observed beneath the AST 1253 secondary containment berm. Over 1 foot of free-phase petroleum product was observed in monitoring well MW01, which is located approximately 350 feet southwest of AST 1253, and 0.01 foot of free-phase petroleum product was observed in monitoring well MW03, which is located approximately 420 feet southwest of the AST. Four extraction wells located approximately 200 to 300 feet east to northeast of AST 1253 contained up to 0.72 feet of free-phase petroleum product.

During Phase II of the SC, additional monitoring wells were installed creating a groundwater monitoring well network consisting of 39 monitoring wells distributed across the Fuel Farm and associated area. However, the soil boring for MW31 was never completed as a monitoring well during the SC. Free-phase petroleum product was observed on soil cuttings during drilling of MW31 and the borehole was abandoned for that reason. Subsurface soil samples collected for the 2008 SC were found to contain TPH-DRO, JP-5, benzo(a)pyrene, and methylnaphthalene at concentrations above project-specific screening criteria. These exceedances were associated with seven monitoring wells as shown on Figure 8.

During the 2008 SC, the primary contaminant found in the subsurface soil plume was TPH-DRO (C14–C20) and TPH-LRO (C20–C30). Based on SC data, it was surmised that the impacted soil generally ranged in a 9- to 16-foot-thick layer. Lithology of the site is generally described as sand, silt- and clay-sized sediment, volcanic tuff, and coral limestone. The estimated volume of petroleum-impacted soil is 57,398 cubic yards (see Appendix A for detailed calculations). Petroleum-impacted soil is considered any soil that has TPH concentrations greater than 5,000 mg/kg.

TPH-DRO concentrations in groundwater above the 2008 DOH EAL screening criteria were reported for 14 samples, JP-5 concentrations above the DOH EAL were reported for 14 groundwater

samples, and a benzo(a)pyrene concentration above the DOH EAL was reported for 1 groundwater sample (Earth Tech and WCP 2008). BTEX constituents were non-detect. Figure 9 summarizes the groundwater constituents that exceeded the DOH screening criteria during the SC. Figure 10 shows the estimated extent of groundwater contamination in relation to the free-phase petroleum product measured during the 2008 SC.

Lead was detected in 31 of the 40 unfiltered groundwater samples collected during this SC (Figure 9). However, lead is not a constituent of JP-5 so its detection in the groundwater indicated that another source of contamination was present. Tetraethyl lead was a component of AVGAS that was stored in Fuel Farm USTs until 1973. Sludge and wastewater from the cleaning and closure of these USTs were disposed of in leaching fields constructed at the Fuel Farm, and a previous investigation of this area found evidence of lead in the groundwater (HLA 1991). Based on this information, it seemed likely that the former USTs and Former Sludge Disposal Area could be the source or contributors to the lead contamination in the groundwater. Additional investigation to further delineate the extent of the lead contamination was recommended (Earth Tech and WCP 2008).

As discussed in Section 2.2, the 2008 SC also included human health and ecological SRAs for AST 1253.

3.1.4 2009 EHE/EHMP

Based on the recommendations of the 2008 SC report, an EHE/EHMP (AECOM and WCP 2009) was prepared under CTO HC08. Based on the data presented in the EHE/EHMP, the presence of COPCs above site-specific EALs within the AST 1253 site required management of the residual subsurface fuel to prevent unmitigated exposures to site users and ecological receptors. To monitor the presence and thickness of free-phase petroleum product associated with AST 1253, LTM was initiated to fulfill the monitoring requirement of the 2009 EHE/EHMP (AECOM and WCP 2009).

3.1.5 Long-Term Monitoring for AST 1253

To fulfill the monitoring requirement of the 2009 EHE/EHMP for the AST 1253 site as described in the LTM work plan (WP) (AECOM and WCP 2010a) and LTM WP Revision 01 (AECOM and WCP 2012a), the LTM approach was initiated to monitor free-phase petroleum product thickness and COPC concentrations in groundwater in specific wells annually for a duration of 3 years. Groundwater samples collected from selected monitoring wells were analyzed for TPH-DRO, TPH as lube oil range organics (LRO), BTEX, and polynuclear aromatic hydrocarbons (PAHs). LTM investigation results for AST 1253 are discussed in further detail in Section 3.3.1.

3.1.6 Remedial Investigation for Former Fuel Farm Sludge Disposal Area

In 2012, an RI was conducted to evaluate the nature and extent of the threat to human health and the environment presented by the release of petroleum and petroleum-related constituents from disposal pits and leaching trenches created during 1973 tank-cleaning operations. Soil gas, subsurface soil, and groundwater samples were collected and analyzed to compare site-specific COPCs to DOH EALs. Soil gas samples were collected and analyzed for TPH-GRO, BTEX, naphthalene, and methane. Subsurface soil and groundwater samples were collected and analyzed for TPH-GRO, -DRO, -LRO, BTEX, PAHs, and lead. The results of the RI are discussed in further detail in Section 3.3.2.

3.2 DOH EAL EXCEEDANCES

3.2.1 Target Indicator Contaminants

The following chemical groups were identified as target indicator contaminants for soil and groundwater impacted by TPH-GRO, -DRO, -LRO, benzo(a)pyrene, and naphthalene.

3.2.2 DOH Tier 1 EAL Exceedances

Analytical results for soil and groundwater samples collected during the AST 1253 LTM and Former Sludge Disposal Area RI were compared to appropriate DOH Tier 1 EALs. The following analytes were identified as COPCs exceeding DOH Tier 1 EALs:

- Soil Gas
  - Naphthalene
- Soil
  - TPH-GRO
  - TPH-DRO
  - TPH-LRO
  - Benzo(a)pyrene
- Groundwater
  - TPH-GRO
  - TPH-DRO

3.3 CURRENT SITE CONDITIONS

Investigation results from LTM Event No. 3 for AST 1253 and the Former Sludge Disposal Area RI represent the most current conditions at the AST 1253 site, and are discussed below.

3.3.1 LTM for AST 1253

Comparison of groundwater analytical results from the 2008 SC and LTM Event Nos. 1, 2, and 3 indicate that concentrations of COPCs fluctuated in LTM monitoring wells MW13, MW15, and MW17 south and east of AST 1253. During LTM Event No. 3, all detected COPC concentrations in groundwater samples collected from the LTM monitoring wells were below their respective DOH EALs. A comparison of groundwater analytical results generated from the 2008 SC and LTM Event Nos. 1, 2, and 3 is presented in Table 2.

Table 2: Summary of Detected COPCs in Groundwater at AST 1253 Monitoring Wells from 2008 to 2012

Extraction/ Monitoring Well	Sampling Event	Analyte				
		TPH-DRO	Toluene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene
EW03	2008 SC	Free-Phase Petroleum Product (0.63 foot thick)				
	2010 LTM Event No. 1	Free-Phase Petroleum Product (0.09 foot thick)				
	2011 LTM Event No. 2	Free-Phase Petroleum Product (0.04 foot thick)				
	2012 LTM Event No. 3	No Measurable Free-Phase Petroleum Product				
EW11	2008 SC	Free-Phase Petroleum Product (0.83 foot thick)				
	2010 LTM Event No. 1	No Measurable Free-Phase Petroleum Product				
	2011 LTM Event No. 2	No Measurable Free-Phase Petroleum Product				
	2012 LTM Event No. 3	Free-Phase Petroleum Product (0.25 foot thick)				

Extraction/ Monitoring Well	Sampling Event	Analyte				
		TPH-DRO	Toluene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene
MW09	2008 SC	160	1.0 U	N/A	N/A	0.10 U
	2012 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
MW13	2008 SC	1,400	1 U	2	2	2.5
	2010 LTM Event No. 1	450	0.34 U	0.7 J	0.37 J	0.49 J
	2011 LTM Event No. 2	590 ++	0.34 U	3.6 J	2.5	2.0 J
	2012 LTM Event No. 3	550 ++	0.34 U	0.82	0.34	0.39
MW15	2008 SC	***5,800***	1 U	77 J	91 J	120 J
	2010 LTM Event No. 1	1,400	0.22 J	16	18	31
	2011 LTM Event No. 2	***2,800 ++***	0.23 J	12 J	14	25 J
	2012 LTM Event No. 3	960 ++	0.34 U	7.7	9.1	12
MW17	2008 SC	1,200	1 U	12	2.4	0.40 U
	2010 LTM Event No. 1	520	0.34 U	0.12 UJ	0.12 UJ	0.15 J
	2011 LTM Event No. 2	230 ++	0.34 U	0.12 UJ	0.12 U	0.25 J
	2012 LTM Event No. 3	350 ++	0.34 U	0.12 U	0.12 U	0.10 U
MW19	2008 SC	1,300	1 U	38	49	16
	2010 LTM Event No. 1	840	0.34 U	0.12 U	0.12 U	0.31
	2011 LTM Event No. 2	540 ++	0.34 U	0.12 UJ	0.12 U	0.11 J
	2012 LTM Event No. 3	Vehicle parked over monitoring well; therefore, MW19 was inaccessible.				
MW23	2008 SC	120 U	1 U	0.1 U	0.1 U	0.1 U
	2010 LTM Event No. 1	80.8 U	0.34 U	0.12 U	0.12 U	0.1 U
	2010 LTM Event No. 1 (duplicate)	80.8 U	0.34 U	0.12 U	0.12 U	0.1 U
	2011 LTM Event No. 2	80.8 U	0.34 U	0.12 UJ	0.12 U	0.1 UJ
	2011 LTM Event No. 2 (duplicate)	80.8 UJ	0.34 U	0.12 UJ	0.12 U	0.1 UJ
	2012 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
MW25	2008 SC	120 U	1 U	0.1 U	0.1 U	0.1 U
	2010 LTM Event No. 1	80.8 U	0.34 U	0.12 U	0.12 U	0.1 U
	2011 LTM Event No. 2	80.8 U	0.34 U	0.12 UJ	0.12 U	0.1 UJ
	2012 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
MW28	2008 SC	330	1 U	0.42 U	0.42 U	0.42 U
	2010 LTM Event No. 1	80.8 U	0.34 U	0.12 U	0.12 U	0.1 U
	2011 LTM Event No. 2	80.8 U	0.34 U	0.12 UJ	0.12 U	0.1 UJ
	2012 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.1 U
	2012 LTM Event No. 3 (duplicate)	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
MW29	2008 SC	***5,400 J***	1 U	18 J	16 J	0.4 U
	2010 LTM Event No. 1	Free-Phase Petroleum Product (0.16 foot thick) [b]				
	2011 LTM Event No. 2	Free-Phase Petroleum Product (0.05 foot thick) [b]				
	2012 LTM Event No. 3	Free-Phase Petroleum Product (0.13 foot thick) [b]				
MW32	2008 SC	670	1.0 U	0.098 U	0.098 U	0.098 U
	2010 LTM Event No. 1	Was not monitored during LTM Event No. 1				
	2011 LTM Event No. 2	Free-Phase Petroleum Product (0.25 foot thick) [b]				
	2012 LTM Event No. 3	Free-Phase Petroleum Product (0.10 foot thick) [b]				

Extraction/ Monitoring Well	Sampling Event	Analyte				
		TPH-DRO	Toluene	1-Methylnaphthalene	2-Methylnaphthalene	Naphthalene
MW36	2008 SC	2,400	1 U	0.1 U	0.1 U	0.1 U
	2010 LTM Event No. 1	Free-Phase Petroleum Product (0.38 foot thick) [b]				
	2011 LTM Event No. 2	Free-Phase Petroleum Product (0.36 foot thick) [b]				
	2012 LTM Event No. 3	Free-Phase Petroleum Product (0.34 foot thick) [b]				
MW39	2008 SC	120 U	1.0 U	0.049 J	0.098 U	0.098 U
	2012 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
MW40 [c]	2012 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
MW41 [c]	2012 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
MW42 [c]	2012 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
	2012 LTM Event No. 3 (duplicate)	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
MW43 [c]	2011 LTM Event No. 3	80.8 U	0.34 U	0.12 U	0.12 U	0.10 U
2011 DOH EAL [a]		*2,500*	*400*	*100*	*100*	*210*

Note: All units are in µg/L.
Bold Italic values denote COPC concentrations that exceed the DOH EAL.
Sources: Earth Tech and WCP 2008, AECOM and WCP 2010b, 2011a, 2011b, 2012b.
++ the laboratory analyst has noted that the chromatogram of this sample is mainly lower boiling hydrocarbons
J laboratory-estimated qualifier
N/A not analyzed
No. Number
U non-detect qualifier
UJ estimated non-detect qualifier
[a] EAL is for unrestricted land use, where drinking water is not threatened, and the distance to surface water is greater than 150 meters from the site (DOH 2008, 2009a). The only EAL applicable to groundwater is for discharges to surface water (AECOM and WCP 2009).
[b] As specified in the LTM WP (AECOM and WCP 2010a) and LTM WP Rev. 01 (AECOM and WCP 2012a), groundwater samples were not collected when measurable free-phase petroleum product was detected in groundwater monitoring wells.
[c] Groundwater monitoring well installed during LTM Event No. 3.

Free-phase petroleum product was present in monitoring wells MW01, MW02, MW03, MW04, MW05, MW07, MW20, MW29, MW32, and MW36, representing plume migration to the north, west, and southwest since 2008. Free-phase petroleum product monitoring results for the 2008 SC and all three LTM events are presented in Table 3. The estimated extent of free-phase petroleum product is shown on Figure 11, which also includes current free-phase petroleum product thicknesses from LTM Event No. 3. The LTM Event No. 3 report summarizes all groundwater analytical results and observed free-phase petroleum product from 2008 to 2012 for the three LTM events (AECOM and WCP 2012b).

Table 3: Free-Phase Petroleum Product Thickness Results at AST 1253

Well Number	Product Thickness During 2008 Site Characterization (feet)	Product Thickness in August 2010, LTM Event No. 1 (feet)	Product Thickness in August 2011, LTM Event No. 2 (feet)	Product Thickness in August 2012, LTM Event No. 3 (feet)
EW03	0.63	0.09	0.04	—
EW11	0.83	—	—	0.25
MW01	1.01			0.49
MW02	—			0.02
MW03	0.01			0.01 [b]
MW04	—			0.01 [b]
MW05	—			0.01
MW06	—	Unable to locate, monitoring well is damaged and/or buried		

Well Number	Product Thickness During 2008 Site Characterization (feet)	Product Thickness in August 2010, LTM Event No. 1 (feet)	Product Thickness in August 2011, LTM Event No. 2 (feet)	Product Thickness in August 2012, LTM Event No. 3 (feet)
MW07	—			0.02
MW08	—		— [a]	—
MW09	—	—	—	—
MW10	—			—
MW11	—			—
MW12	—			—
MW13	—	—	—	—
MW14	—			—
MW15	—	—	—	—
MW16	—			—
MW17	—	—	—	—
MW18	—	Unable to locate, monitoring well is damaged and buried		
MW19	—	—	—	—
MW20	—			0.32
MW21	—			—
MW22	—			—
MW23	—	—	—	—
MW24	—			—
MW25	—	—	—	—
MW26	—			—
MW27	—		—	Unable to access
MW28	—	—	—	—
MW29	—	0.16	0.05	0.13
MW30	—		— [a]	—
MW31	Product observed in boring, boring was abandoned, and monitoring well was never installed			
MW32	—		0.25	0.1
MW33	—		— [a]	—
MW34	—		—	—
MW35	—	Unable to locate, monitoring well is damaged and buried		
MW36	—	0.38	0.36	0.34
MW37	—		—	—
MW38	—		—	—
MW39	—		—	—
MW40	New monitoring well installed in August 2012 for AST 1253 LTM			—
MW41	New monitoring well installed in August 2012 for AST 1253 LTM			—
MW42	New monitoring well installed in August 2012 for AST 1253 LTM			—
MW43	New monitoring well installed in August 2012 for AST 1253 LTM			—
MW50	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—
MW51	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—
MW52	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—
MW53	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—
MW54	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—
MW55	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—
MW56	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—
MW57	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—

Well Number	Product Thickness During 2008 Site Characterization (feet)	Product Thickness in August 2010, LTM Event No. 1 (feet)	Product Thickness in August 2011, LTM Event No. 2 (feet)	Product Thickness in August 2012, LTM Event No. 3 (feet)
MW58	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—
MW59	New monitoring well installed in April 2012 for Former Sludge Disposal Area RI			—

Note: Shaded cells indicate monitoring well was not inspected.
Sources: Earth Tech and WCP 2008, AECOM and WCP 2010b, 2011a, 2011b, 2012b.
— No measureable free-phase petroleum product was observed in the existing extraction or groundwater monitoring well
No. Number
[a] Monitoring results from the February 2011 monitoring well inspection (AECOM and WCP 2011a).
[b] Monitoring wells MW03 and MW04 were both observed to have 0.01 foot of product in April 2012.

The AST 1253 LTM has seen movement of the JP-5 free-phase product plume to the north, west, and southwest since the 2008 SC and the plume appears to have encroached into the upper portion of another site located at the Fuel Farm, the Former Sludge Disposal Area (discussed below in Section 3.3.2).

Investigation results during LTM Event No. 3 indicate that a free-phase petroleum product plume still exists beneath and near AST 1253 (AECOM and WCP 2012b). Free-phase petroleum product was present in monitoring wells MW01, MW02, MW03, MW04, MW05, MW07, MW20, MW29, MW32, and MW36, representing plume migration to the north, west, and southwest since 2008.

In 1989, data indicated that the released JP-5 had migrated approximately 315 feet from the center of AST 1253, and that the free-phase petroleum thickness in the subsurface was up to 6 feet. At the time of the 2008 SC, the product plume had migrated approximately 440 feet to the southwest (at its furthest point near monitoring well MW03), and the observed product thickness in monitoring wells was up to approximately 1 foot. During LTM Event No. 3, the product plume was observed to have migrated approximately 520 feet to the southwest (at its furthest point near monitoring well MW05) and the product thickness was up to approximately 0.49 foot. Based on these distances in 2008 and 2012, the free-phase petroleum plume expanded approximately 21 feet per year. However, since all of the monitoring wells were not inspected for free-phase petroleum product at the start of LTM activities, some portions of the plume observed in 2012 may have already existed in 2010. It has been 25 years since the JP-5 spill occurred and it appears that most of the free-phase JP-5 plume head (at the source) has dissipated and exists primarily in residual form adsorbed to the subsurface soil. While further lateral migration of the free-phase petroleum product plume is possible, it is not expected to be significant.

A meeting was held on 20 November 2012 with representatives from DOH, NAVFAC Hawaii, AECOM, and WCP to discuss cumulative results of free-phase petroleum product measurements and groundwater sampling/analytical events at the MCB Hawaii Fuel Farm relative to the AST 1253 release, and to determine the next course of action as specified in the 2009 EHE/EHMP. At the meeting, DOH indicated there was no need to continue groundwater sampling and analysis based on the LTM data over the last 3 years; however, monitoring of free-phase petroleum product should continue until measurements get close to 0.1 foot. Meeting minutes documenting this meeting are included in Appendix B. This approach is compliant with the Hawaii State Contingency Plan, where contamination left in place has been remediated and presumptive remedies have been applied “to the extent practicable” (HAR Chapter 11-281).

On 15 March 2013, a meeting was held with representatives from DOH, NAVFAC Hawaii, AECOM, and WCP to discuss further actions at the AST 1253 site, Former Flight Training Simulator Area, and Southeast Area in proximity to MW58. As a result of this meeting, DOH concurred that additional groundwater sampling for the AST 1253 site could cease and that future

LTM activities would include free-phase petroleum product monitoring every 3 years for a 6-year period beginning in the year 2015. In addition, DOH concurred with consolidating the Fuel Farm petroleum-related release areas, including the Former Fuel Farm Sludge Disposal Area, to be managed under a single EHE/EHMP. Meeting minutes documenting this meeting are included in Appendix B. Therefore, the current administrative boundaries covered by the 2009 AST 1253 EHE/EHMP (AECOM and WCP 2009) have been revised to include the Former Flight Training Simulator Area and the Southeast Area in proximity to MW58.

3.3.2 Former Fuel Farm Sludge Disposal Area RI

For the RI, naphthalene was the only COPC in soil gas detected at concentrations above its DOH EAL. Soil gas samples from SG17 and SG24 collected in the recreational field area in proximity to the proposed Flight Training Simulator Area had results (both estimated concentrations of 160 micrograms per cubic meter [$\mu g/m^3$]) that exceeded the DOH residential soil gas EAL of 72 $\mu g/m^3$ (as shown on Figure 12); however, the DOH commercial/industrial soil gas EAL of 240 $\mu g/m^3$ was not exceeded. These two soil gas samples were collected in proximity to the proposed Flight Training Simulator Area. These exceedances appear to be associated with a prior release from historical USTs that were removed in the 1960s.

The detection of free-phase petroleum product in monitoring wells MW03 and MW20, very high concentration detections of TPH-DRO and TPH-LRO in a soil sample from boring B01, and TPH-DRO detected in a groundwater sample from monitoring well MW21 are likely associated with the JP-5 release from AST 1253. TPH-DRO was detected at a concentration of 5,000,000 mg/kg at the capillary fringe (14 to 15.5 feet bgs) in soil boring B01, which exceeds the DOH Tier 1 project-specific screening criteria of 500 mg/kg (as shown in Figure 13). Gray staining was observed on the sandy soil sample from soil boring B01, as well as a strong petroleum odor. One subsurface soil sample collected at the capillary fringe (14 to 15.5 feet bgs) in soil boring B01 exceeded the DOH Tier 1 screening criteria. TPH-LRO was detected at a concentration of 460,000 mg/kg in soil boring B01, which exceeds the DOH Tier 1 screening criteria of 500 mg/kg. Soil boring B01 is located within the observed JP-5 free-phase petroleum product plume area delineated during LTM Event No. 3 for AST 1253, and the plume is believed to be the source of the TPH-DRO and TPH-LRO detected in subsurface soil at this location. AST 1253 LTM Event Nos. 1, 2, and 3 have seen movement of the JP-5 free-phase product plume to the north, west, and southwest since the 2008 SC and the plume appears to be encroaching into the Former Fuel Farm Sludge Disposal Area site.

The TPH-GRO concentration detected in MW58 (7,300 micrograms per liter [µg/L]) exceeded the DOH Tier 1 project-specific screening criteria of 5,000 µg/L. Confirmation sample results from MW58 again detected TPH-GRO at concentrations of 7,600 µg/L in the primary sample, and 7,500 µg/L in its duplicate sample (as shown in Figure 14). In addition, TPH-GRO was detected in a subsurface soil sample collected at the capillary fringe in the soil boring for MW58 at a concentration of 200 mg/kg, which exceeds the DOH Tier 1 screening criteria of 100 mg/kg (Figure 13). Approximately 150 feet north of MW58, TPH-GRO and benzo(a)pyrene were detected in subsurface soil in soil boring B10 at a concentrations of 490 and 0.76 mg/kg, respectively. These soil concentrations in B10 were also detected at the capillary fringe. Though purportedly related, these petroleum-related constituents do not appear to be associated with the Former Sludge Disposal Area due to the lack of DOH EAL exceedances detected within the Former Fuel Farm Sludge Disposal Area. The petroleum-related constituents detected in soil boring B10 and MW58 may be related to a prior release from historical USTs that were removed in the 1960s or a release from fuel lines that historically ran through that area. In addition, a fuel truck loading area was historically located in the same location as MW58.

In addition, subsurface soil, groundwater, and confirmation groundwater sampling during the RI failed to detect levels of lead in subsurface soil and groundwater samples exceeding EALs. The detections of higher concentrations of lead during the 2008 SC are likely due to the limitations of the sampling method resulting in turbid groundwater samples being collected; thereby, causing elevated lead concentrations in analyzed unfiltered groundwater samples.

Findings convey that detections in soil gas, subsurface soil, and groundwater that exceed project-specific screening criteria were observed, but the contamination source was not believed to be associated with the Former Fuel Farm Sludge Disposal Area. On 27 June 2012 and 20 November 2012, meetings were held with representatives from DOH, NAVFAC Hawaii, AECOM, and WCP to discuss soil gas, subsurface soil, and groundwater analytical results for the RI field investigation at the Former Fuel Farm Sludge Disposal Area. As a result of these meetings, concurrence was attained that while several detections in soil gas, subsurface soil, and groundwater exceeded project-specific screening criteria, the observed contamination is not believed to be associated with the Former Fuel Farm Sludge Disposal Area, and this particular site could be recommended for unconditional NFA. In addition, it was agreed that the observed petroleum contamination in the proposed Flight Training Simulator Area and the area in proximity to MW58 may be associated with historical USTs removed in the 1960s. Meeting minutes documenting the 27 June 2012 and 20 November 2012 meetings are included in Appendix B.

On 15 March 2013 a meeting was held with representatives from DOH, NAVFAC Hawaii, AECOM, and WCP to discuss further actions for the AST 1253 site, the Former Flight Training Simulator Area, and the Southeast Area in proximity to MW58. As a result of this meeting, DOH concurred that additional groundwater sampling for the AST 1253 site would cease and that future LTM activities would include free-phase petroleum product monitoring every 3 years for a 6-year period beginning in the year 2015. In addition, DOH concurred with consolidating the MCB Hawaii Fuel Farm petroleum-related release areas to be managed under a single EHE/EHMP. Therefore, the current administrative boundaries covered by the current AST 1253 EHE/EHMP (AECOM and WCP 2009) will be revised to include the Former Flight Training Simulator Area and the Southeast Area in proximity to MW58.

3.4 POTENTIAL ENVIRONMENTAL HAZARDS

Residual contamination at a site may pose environmental hazards. A potential environmental hazard is identified when COPC concentrations in soil gas, soil, or groundwater exceed the DOH Tier 1 EALs. For the AST 1253 site, the DOH Tier 1 EALs for vapor intrusion, gross contamination, direct exposure, and leaching were evaluated.

A site-specific EAL exceedance identifies potential receptors, as well as the exposure path necessary to create a hazard. Evaluation of potential human receptors and exposure pathways to subsurface soil and to groundwater assessed by this EHE include current and future onsite receptors (e.g., residents, occupational workers, construction/trench workers, trespassers).

An expanded explanation of the different types of environmental hazards, as well as their applicability to the site, is provided in Sections 3.4.1 through 3.4.5.

A human health screening risk assessment to evaluate the nature and extent of the threat to human health and the environment caused by the 1987 leak of JP-5 from AST 1253 into the soil was performed as a part of the 2008 SC study. A conceptual site model (CSM) describing potential human health and ecological receptor exposure pathways to petroleum-related contaminants in soil gas, subsurface soil, and groundwater (Earth Tech and WCP 2008; AECOM and WCP 2013) is attached as Figure 15 and Figure 16.

3.4.1 Direct Exposure

Direct exposure describes either direct or indirect human contact with contaminated soil, groundwater, or soil vapor. Direct contact can be made through ingestion, dermal contact, or the inhalation of dust in outdoor air. Indirect contact can be made through inhalation of soil vapors in outdoor air. In the absence of institutional and engineered controls, future human populations at the property could be exposed to contaminated soil (including contaminated dust), groundwater, or soil vapor inside of buildings (DOH 2011). Although the AST 1253 site is currently not utilized for continual human habitation, evaluation of a hypothetical onsite resident (adult/child) was included as a possible scenario.

Since groundwater is not a source of drinking water and its depth is greater than 9 feet bgs (the designated limit for direct exposure), the exposure pathway for direct contact with contaminated groundwater is incomplete.

Direct exposure to chemicals in subsurface soil is also not anticipated since residents are not likely to come into contact with subsurface soils greater than 2 feet bgs during gardening or home remodeling. Because all potential routes of exposure are either incomplete or insignificant, the degree of potential exposure for future onsite residents is minimal. The same would be expected for industrial/commercial workers or trespassers that would seldom frequent the site.

However, onsite construction/trench workers may become exposed to JP-5 and petroleum-related constituents through direct contact with subsurface soils or through incidental ingestion and dermal absorption. Exposure to non-potable groundwater is incomplete since the water table, at 9 to 15 feet bgs, is below typical depths of excavation. Since potential exposure routes from groundwater are incomplete or insignificant, the only potentially complete exposure pathway for the onsite construction/trench worker is contact with contaminated subsurface soil.

Direct exposure to surface water is also incomplete since groundwater contamination has not reached Kaneohe Bay, the nearest surface water body, and over the past 25 years the plume migration has been insignificant.

3.4.2 Soil Vapor Intrusion

Vapor intrusion involves the exposure of human populations to volatile chemical compounds that have entered a building or other enclosed structures from contaminated subsurface soil or contaminated groundwater (DOH 2011).

Naphthalene was the only COPC in shallow soil gas detected at concentrations above the DOH EAL in the recreational ball field area in proximity to the proposed Flight Training Simulator Area.

Current land use at the proposed Flight Training Simulator Area is primarily a recreational ball field (located within an industrial setting) with no enclosed buildings on the site. Therefore, the current vapor intrusion pathway is considered incomplete without an enclosed building present. Future use of the area, however, is considered industrial based on the proposed construction of a Flight Training Simulator building(s). Therefore, soil gas vapor intrusion into the proposed building(s) would be considered a complete exposure pathway for an indoor worker or visitor.

The exposure pathway for naphthalene in soil gas is insignificant for onsite construction workers if excavation of the area is conducted as workers would be working outside in the open air and not in a confined area where vapors could accumulate. The indoor inhalation exposure pathway would be incomplete for the current onsite recreational user since there are no enclosed buildings associated with the proposed Flight Training Simulator Area.

3.4.3 Leaching

Leaching is the movement of soil contaminants in vadose zone soils into underlying groundwater via chemical and physical mechanisms. The principal chemical mechanism is dissolution of contaminants into water (e.g., percolating rainwater and irrigation water) and moving downwards through the vadose zone. Physical mechanism include entrainment of contaminants bound in a colloid phase and/or mass movement of contaminants via infiltrating water through the vadose zone.

Petroleum hydrocarbons in soil associated with the AST 1253 release have already reached groundwater; consequently, the groundwater is already impacted thereby eliminating the need to evaluate vadose zone hydrocarbons. The extensive network of monitoring wells in the area has allowed MCB Hawaii to evaluate the concentration of petroleum hydrocarbons in groundwater beneath and near AST 1253, and the presence of free-phase petroleum product. In addition, groundwater within MCB Hawaii is not a current or potential drinking water source, thereby eliminating the need to evaluate the impact to a current or potential drinking water source (DOH 2011).

3.4.4 Ecotoxicity

Ecotoxicity refers to the capability of a contaminant to damage an ecological population, community, or ecosystem. A contaminant's ecotoxicity value is derived from (1) its toxicity to one or more species, (2) its persistence in the environment, and (3) its ability to bioaccumulate. Typically, effects on both terrestrial flora and fauna and aquatic flora and fauna are evaluated.

3.4.4.1 TERRESTRIAL ECOTOXICITY

Impacts to terrestrial flora and fauna can occur through exposure to contaminated soil. Because of the industrial nature of the Fuel Farm, habitat to support feeding and nesting of terrestrial ecological receptors is limited. Paved and industrial areas near AST 1253 have limited habitat value. Areas of mowed turf grasses and landscape shrubs, and the recreational field provide the only terrestrial habitat. The limited habitat may be used by introduced species adapted to living in close proximity to human activity. No endangered species or sensitive habitats have been identified at or near the Fuel Farm area. There are no wildlife management areas within or adjacent to the AST 1253 site. It is possible that buildings and vegetation near AST 1253 could be used as refuge by common urban fauna such as the house mouse, Norway and black rats, house sparrow, Java sparrow, and common mynah. The most common avian species observed at the AST 1253 site during the RI field investigation were the cattle egret and the Pacific golden plover foraging in the open landscaped grassy areas within the Fuel Farm area.

Past leaks from tank systems at the Fuel Farm have been confined to subsurface soil. Subsurface soil samples detected most contaminants at depths between 8.5 and 9 feet bgs; therefore, bio-uptake from terrestrial plants and all exposure pathways to terrestrial ecological receptors are considered incomplete.

3.4.4.2 AQUATIC ECOTOXICITY

Impacts to aquatic flora and fauna can occur through the discharge of contaminated groundwater into surface waters; consequently, the impact of ocean mixing needs to be considered when evaluating ecotoxicity results. Shallow, confined, and semi-confined groundwater is present in the formation beneath MCB Hawaii. Dissolved chemicals detected in groundwater could migrate to Kaneohe Bay, approximately 2,500 feet southwest of the AST 1253 plume. Marine benthos and aquatic organisms in Kaneohe Bay are potential ecological receptors for COPCs in groundwater migrating from the Fuel Farm into marine waters.

The shallow groundwater beneath the Fuel Farm is in direct hydraulic connection with Kaneohe Bay. Groundwater flow direction is to the southeast toward Kaneohe Bay. At the point where it discharges, groundwater would commingle with bay pore water in the sediment, until it is completely mixed with saltwater above the sediment-saltwater interface. The entire groundwater migration and discharge process would likely result in dilution (i.e., mixing) or attenuation of chemical concentrations in the groundwater. Therefore, the groundwater migration and discharge pathway represents a potentially complete exposure pathway for benthic and aquatic receptors in Kaneohe Bay, particularly if attenuation along the groundwater flow path is not considered. As site-related chemicals associated with the groundwater migrate toward the Kaneohe Bay, they are expected to be attenuated or reduced due to biological degradation, dilution and dispersion, chemical oxidation, or volatilization.

A CSM diagram that outlines the ecological exposure pathways for contaminants is provided as Figure 16.

3.4.5 Gross Contamination

Gross contamination refers to any physical condition that presents general pollution, odor, or nuisance concerns. In soil, this includes mobile free-phase product, aesthetics, explosive vapors, nuisance odors, and general resource degradation. In drinking water, this includes potentially mobile free-phase product, contaminated drinking water supplies, objectionable odors and tastes, a petroleum hydrocarbon sheen on surface water, and general resource degradation. Certain types of gross contamination at high levels can become a physical hazard.

Free-phase petroleum product continues to exist in the subsurface beneath the AST 1253 site. However, gross contamination hazards are not a significant concern at this site, due to the depth of contamination and the area being covered by pavement, buildings, or other structures. As groundwater underlying the site is not used as a drinking water source, gross contamination concerns such as odor should not be an issue as the water table is approximately 10 to 20 feet bgs.

3.5 PAST RESPONSE ACTIONS

Past response actions for the AST 1253 site are summarized in the paragraphs below and include a full-scale bioslurper system, Phase I SC activities, and Phase II SC activities.

The full-scale bioslurper system was implemented in 1997 to recover and remove JP-5 from the groundwater through a series of extraction wells. A total of 48 extraction wells were installed—30 wells in 1995 and 18 wells in 1998—to assist in removal of subsurface free-phase product. The system ran until December 1998 and extracted 290 gallons of fuel (Battelle 1999).

In 2007, Phase I activities, as part of the SC study, commenced with the intent to identify locations where potentially hazardous conditions exist. A free-phase petroleum product level survey was conducted in accordance with Section 5.3.1 of NAVFAC, Pacific Environmental Restoration Program Procedure I-C-3, *Monitoring Well Sampling* (DON 2007). Groundwater samples taken from existing monitoring wells were analyzed for the following COPCs: TPH-DRO and -LRO, BTEX, PAHs, and lead.

In December 2007, 29 new groundwater monitoring wells were installed in support of the Phase II SC activities. Subsurface soil samples and groundwater samples were collected to monitor contamination.

From 2010 to 2012, as specified in the 2009 EHE/EHMP, the LTM approach was initiated to monitor free-phase petroleum product thickness and COPC concentrations in groundwater in specific

wells annually for a duration of 3 years. Groundwater samples collected from selected monitoring wells were analyzed for TPH-DRO, -LRO, BTEX, and PAHs.

In 2012, an RI was conducted at the Former Fuel Farm Sludge Disposal Area to evaluate the nature and extent of the threat to human health and the environment presented by the release of petroleum and petroleum-related constituents from disposal pits and leaching trenches created during 1973 tank-cleaning operations at the site. Soil gas, subsurface soil, and groundwater samples were collected and analyzed to evaluate the presence or absence of site-specific COPCs exceeding DOH Tier 1 EALs. Soil gas samples were collected and analyzed for TPH-GRO, BTEX and naphthalene, and methane. Subsurface soil and groundwater samples were collected and analyzed for TPH-GRO, -DRO, -LRO, BTEX, PAHs, and lead.

4. Environmental Hazard Management Plan

Based on the data presented in the EHE, the identification of soil, groundwater, and soil gas concentrations above site-specific EALs within the AST 1253 site requires MCB Hawaii to manage the residual subsurface fuel to prevent unmitigated exposures to site users and ecological receptors.

4.1 LTM MONITORING

Continuation of free-phase product thickness monitoring in monitoring wells at the AST 1253 site is proposed due to the presence of free-phase petroleum product observed in site monitoring wells since the 2008 SC. The following site monitoring wells selected for free-phase product thickness monitoring only will be inspected every 3 years over a 6-year period commencing in 2015 and concluding in 2018 to determine the continued presence and thickness of free-phase petroleum product (Figure 17):

- MW05
- MW07
- MW08
- MW09
- MW11
- MW12
- MW13
- MW14
- MW15
- MW16
- MW17
- MW19
- MW20
- MW21
- MW26
- MW28
- MW29
- MW30
- MW32
- MW33
- MW34
- MW36
- MW37
- MW39
- MW40
- MW41
- MW43

If no free-phase petroleum product is observed, the depth to groundwater and the total depth of the monitoring well will be recorded to ensure the viability of the monitoring well. The specified monitoring wells represent those that are upgradient, cross-gradient, downgradient, and within the estimated extent of the AST 1253 free-phase petroleum product plume observed since the 2008 SC.

Free-phase petroleum product monitoring at the AST 1253 site will occur in accordance with the following schedule:

- Prepare an addendum to *Long-Term Monitoring Work Plan, Aboveground Storage Tank 1253, Marine Corps Base Hawaii, Kaneohe, Oahu, Hawaii, Revision 01* (AECOM and WCP 2012a) to address the additional proposed LTM effort.
- Inspect monitoring wells within and at the periphery of the AST 1253 contaminant plume every 3 years over a 6-year period commencing in 2015.

- Prepare single-iteration Monitoring Letter Reports describing the results of the 2015 and 2018 monitoring events.
- At the end of the 2018 monitoring event
  - Assess contaminant plume migration
  - Consult with DOH regarding the need for continued monitoring or request for conditional NFA with institutional controls.

4.2 SUPPLEMENTAL RI

A supplemental RI is proposed to be conducted in the area in proximity to MW58 to assess the nature and extent of the TPH-GRO and benzo(a)pyrene exceedances detected in subsurface soil and groundwater. The supplemental RI will occur in accordance with the following schedule:

- Prepare an addendum to *Work Plan, Remedial Investigation, Former Fuel Farm Sludge Disposal Area, Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii,* (AECOM and WCP 2011c) to address the supplemental RI.
- Install up to four additional monitoring wells upgradient, down-gradient, and cross-gradient of the detected petroleum contamination in proximity to MW58.
- Collect subsurface soil and groundwater samples from the designated wells when no free product is observed.
- Analyze subsurface soil and groundwater samples for the following COPCs:
  - TPH-GRO by SW-846 Method 8015C (EPA 2007)
  - TPH-DRO by SW-846 Method 8015C
  - TPH-LRO by SW-846 Method 8015C
  - BTEX by SW-846 Method 8260C
  - Naphthalene by SW-846 Method 8270D-SIM
  - Methylnaphthalene by SW-846 Method 8270D-SIM (EPA 2007)
- Prepare a Supplemental RI Report describing the results of the investigation.
- Consult with DOH regarding the need for continued monitoring or further investigation. Additional recommendations and/or revision to this EHE/EHMP will be made based on the results of the supplemental RI.

4.3 ADMINISTRATIVE BOUNDARIES

At the AST 1253 site, contaminated soils, groundwater, and soil gas concentrations exceeding EALs have been identified due to the residual petroleum hydrocarbons in subsurface soil and groundwater. To provide notice of these potential hazards for future construction projects, MCB Hawaii will enter an Administrative Boundary based on the established extent of the JP-5 free-phase product plume and other areas of contamination as shown on Figure 17.

Information regarding this boundary will be entered into the Naval Installation Restoration Information System (NIRIS). Once operational, the NIRIS system will include a Web-based tool called “LUC [Land Use Control] Tracker,” that allows MCB Hawaii personnel to effectively manage their LUCs. LUC information, such as reports and maps, are uploaded to the LUC Tracker, thereby allowing users to run various queries to obtain specific LUC data for a site. Until the LUC Tracker is functional, MCB Hawaii will continue to manage administrative notices through project reviews.

MCB Hawaii Environmental Compliance and Protection Department personnel will review planning and design documents for construction projects to ensure the appropriate notices are provided.

4.4 ADMINISTRATIVE NOTICES

Administrative Notices will include the following information pertaining to the Administrative Boundary:

- Onsite soils containing contaminants above DOH screening criteria present a direct exposure hazard to onsite construction/trench workers.
- Free-phase petroleum product may be encountered if excavations are extended to groundwater. Dewatering may occur, but will need to follow the guidelines presented below:
  - Dewater may be discharged back into the ground in close proximity to the construction site as long as any portion of the dewater does not enter a storm drain, or is discharged to surface waters or to a pit where the depth is greater than its width.
  - When the dewater has visible oil, the oil should be removed as much as practicable before the dewater is discharged to the ground.
- Soils excavated from near the water table may contain elevated concentrations of TPH and require proper handling and disposal in accordance with the following guidelines:
  - Clean and petroleum-impacted soil will not be mixed.
  - Petroleum-impacted soil will be re-deposited in the same area and as much as possible, at the same depth that it was originally encountered.
  - The top 2 feet of the excavation should be filled with clean material to minimize human contact with petroleum-impacted soil.
  - Excess soil that will be transported off site for disposal shall be sampled and tested to ensure compliance with DOH and disposal facility guidelines and permit requirements.
- Excavated soils may contain elevated concentrations of volatile petroleum hydrocarbons and may require appropriate response actions to ensure the health and safety of onsite personnel in accordance with the following guidelines:
  - Air monitoring will be conducted during excavation associated with future construction activities.
  - Air monitoring will be conducted when workers are required to enter excavations where petroleum contaminated soil or free-phase petroleum product is encountered.
  - If warranted by air monitoring results, onsite workers will be notified of the need to upgrade personal protective equipment (PPE) to include respiratory protection.
  - In addition to respiratory protection practices, engineering controls and safe work practices will be employed.
- Volatile petroleum hydrocarbons in shallow soils may require appropriate response actions to prevent vapor intrusion when the floors of existing buildings are modified, major structural changes are made to buildings, or a new building is constructed within the AST 1253 site area:
  - A soil gas investigation may be necessary and if appropriate, install control measures such as a floor vapor barrier.
  - New buildings may need vapor barriers to meet current DOH requirements.
- Excavation machinery decontamination and PPE may be required for operations in this area.

4.5 SITE CLOSEOUT

In 1989, data indicated that the released JP-5 from AST 1253 had migrated approximately 315 feet from the center of the AST, and that the free-phase petroleum thickness in the subsurface was up to 6 feet. At the time of the 2008 SC, the product plume had migrated approximately 440 feet to the southwest (at its furthest point near monitoring well MW03), and the observed product thickness in monitoring wells was up to approximately 1 foot. During LTM Event No. 3, the product plume was observed to have migrated approximately 520 feet to the southwest (at its furthest point near monitoring well MW05) and the product thickness was up to approximately 0.49 foot. It has been 25 years since the JP-5 spill occurred and it appears that most of the free-phase JP-5 plume head (at the source) has dissipated and exists primarily in residual form adsorbed to subsurface soil. While further lateral migration of the free-phase petroleum product plume is possible, it is not expected to be significant. Consequently, it may take many more years until the plume reaches Kaneohe Bay (if at all) situated approximately 2,500 feet southwest of the site. In the meantime, natural attenuation may biodegrade the petroleum plume and reduce its size.

A supplemental RI is proposed to be conducted in the area in proximity to MW58 to assess the nature and extent of the TPH-GRO and benzo(a)pyrene exceedances detected in subsurface soil and groundwater. The installation of additional monitoring wells, and analysis of subsurface soil and groundwater samples is necessary to evaluate TPH-GRO and benzo(a)pyrene exceedances which appear to be attributable to historical USTs that were removed in the 1960s. Additional recommendations and/or revision to this EHE/EHMP will be made based on the results of the supplemental RI.

Due to naphthalene exceedances in soil gas, there is a potential for soil gas vapor intrusion exposure in the proposed area for a future Flight Training Simulator building(s). While current exposure to naphthalene in soil gas is incomplete for all exposure pathways, applicable LUCs are required to protect future exposures if an enclosed building is constructed in the area.

Due to the expansion of the administrative boundaries for the AST 1253 site, additional environmental hazards have been identified and further response actions are included in this EHMP:

- DOH affirmed that while groundwater sampling is no longer necessary, selected monitoring wells are to be inspected every 3 years over a 6-year period commencing in 2015 to assess free-phase petroleum product within designated monitoring wells at the site.
- Additional investigation is required for the area in proximity to MW58, and a supplemental RI is proposed to evaluate the TPH-GRO and benzo(a)pyrene exceedances in subsurface soil and groundwater. Additional recommendations and/or revision to this EHE/EHMP will be made based on the results of the supplemental RI.

With the exception of the MW58 area, the Navy requests DOH concurrence on Conditional No Further Action with institutional controls for the AST 1253 site. A Conditional No Further Action denotes that all response actions have been completed at the site to the extent practicable, but long-term management activities remain to address AST 1253 subsurface fuel contamination until 2018 when it will be further addressed with DOH. Further investigation is required for the area in proximity to MW58; therefore, additional recommendations and/or revision to this EHE/EHMP will be made based on the results of the supplemental RI.

4.5.1 Need for Continued Oversight by DOH

Due to expansion of the administrative boundaries for the AST 1253 site, continued monitoring of the JP-5 plume is necessary, additional investigation is required for the area in proximity to MW58, and LUCs are required for the proposed Flight Training Simulator area.

Therefore, it is recommended that DOH oversight of the AST 1253 site continue during the extended LTM period as free-phase petroleum product plume movement is measured, the supplemental RI is completed, and that the agency be consulted with at the end of the monitoring period to determine whether continued monitoring is required.

5. References

AECOM Technical Services, Inc. and Wil Chee - Planning, Inc. (AECOM and WCP). 2009. *Environmental Hazard Evaluation / Environmental Hazard Management Plan for Aboveground Storage Tank 1253, Marine Corps Base Hawaii, Kaneohe, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. October.

———. 2010a. *Work Plan, Long-Term Monitoring for Aboveground Storage Tank 1253, Marine Corps Base Hawaii, Kaneohe, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. July.

———. 2010b. *Long-Term Monitoring Report, Monitoring Event No. 1, Aboveground Storage Tank 1253, Marine Corps Base Hawaii, Kaneohe, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. November.

———. 2011a. *Inspection Letter Report, Monitoring Well Inspection, Aboveground Storage Tank 1253. Marine Corps Base Hawaii, Kaneohe, Oahu, Hawaii*. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. March.

———. 2011b. *Long-Term Monitoring Report, Monitoring Event No. 2, Aboveground Storage Tank 1253, Marine Corps Base Hawaii, Kaneohe, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. December.

———. 2011c. *Work Plan, Remedial Investigation, Former Fuel Farm Sludge Disposal Area, Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. April.

———. 2012a. *Long-Term Monitoring Work Plan, Aboveground Storage Tank 1253, Marine Corps Base Hawaii, Kaneohe, Oahu, Hawaii, Revision 01.* JBPHH, HI: Naval Facilities Engineering Command, Pacific. February.

———. 2012b. *Long-Term Monitoring Report, Monitoring Event No. 3, Aboveground Storage Tank 1253, Marine Corps Base Hawaii, Kaneohe, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. December.

———. 2013. *Remedial Investigation Report, Former Fuel Farm Sludge Disposal Area, Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. December.

Battelle Memorial Institute (Battelle). 1995. *Test Plan for Bioslurping Field Studies at Marine Corps Base Hawaii, Kaneohe Bay, Hawaii*. Prepared for Marine Corps Base Hawaii, Environmental Compliance and Protection Department. April.

———. 1999. *Bioslurper System Operation at Marine Corps Base Hawaii Kaneohe Bay – Summary of Data*. Prepared for Marine Corps Base Hawaii, Environmental, Compliance and Protection Department. August.

Department of Health, State of Hawaii (DOH). 1995. Hawaii Administrative Rules, Title 11, Chapter 451: *State Contingency Plan.* Honolulu. 2 August.

———. 2000. *Underground Storage Tanks*. Hawaii Administrative Rules, Title 11, Chapter 281. 12 January.

———. 2004. Hawaii Administrative Rules, Title 11, Chapter 54: *Water Quality Standards.* August.

———. 2007. *Long-Term Management of Petroleum Contaminated Soil and Groundwater. Addendum to Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*. Hazard Evaluation and Emergency Response Office. June.

———. 2009. *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan.* Draft. Hazard Evaluation and Emergency Response Office. June.

———. 2011. *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater.* Hawaii Edition. Office of Hazard Evaluation and Emergency Response. Revised January 2012. Fall.

Department of Land and Natural Resources, State of Hawaii (DLNR). 2011. Personal communication with Ryan Imata. December.

Department of the Navy, United States (DON). 1999. *Navy Policy for Conducting Ecological Risk Assessments.* Letter from A. A. Granuzzo, Chief of Naval Operations, to Commander, Naval Facilities Engineering Command. Ser. N453E/9U595355. Washington. 5 April.

———. 2001. *Navy Policy for Conducting Human Health Risk Assessments Under the Environmental Restoration Program.* Chief of Naval Operations Letter Ser. N453E/ 1U595168. Washington, DC. 12 February.

Earth Tech, Inc. and Wil Chee – Planning, Inc. (Earth Tech and WCP). 2008. *Site Characterization Report, Aboveground Storage Tank 1253, Marine Corps Base Hawaii, Kaneohe, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. December.

Environet, Inc. 2005. *Final Environmental Baseline Survey to Support the Utility Privatization of Marine corps Base Hawaii's Electrical Distribution and Wastewater Systems, MCBH Kaneohe Bay and Building 700 at MCBH Bellows, Oahu, Hawaii.* Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. May.

Environmental Protection Agency, United States (EPA). 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.* 3rd ed., Revision 6. Office of Solid Waste. November. On-line updates at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

Mink, J. F. and L. S. Lau. 1990. *Aquifer Identification and Classification for Oahu: Groundwater Protection Strategy for Hawaii.* Revised. Tech. Report No. 179. Honolulu: Univ. of Hawaii, Water Resources Research Center. February.

Morrison Knudsen Corporation (Morrison Knudsen). 1998. *Closure/Site Assessment Report, KB-329 Series Underground Storage Tanks, Marine Corps Base Hawaii, Kaneohe, Oahu.* Removal of Fuel Storage Tanks at Various Federal Facilities in Hawaii. U.S. Army Corps of Engineers – Pacific Ocean Division. November.

Harding Lawson Associates (HLA). 1991. *Site Inspection, Fuel Farm Sludge Disposal Area, Marine Corps Air Station, Kaneohe Bay, Oahu, Hawaii.* Prepared for Naval Facilities Engineering Command, Pacific. September.

Naval Energy and Environmental Support Activity (NEESA). 1984. *Initial Assessment Study of Marine Corps Air Station Kaneohe Bay, Hawaii*. April.

Naval Facilities Engineering Command, Pacific. (NAVFAC Pacific). 1989. *Investigation of Underground Fuel Contamination from Main Jet Fuel Tank at Marine Corps Air Station, Kaneohe Bay*. May.

Ogden Environmental and Energy Services Company, Inc. (Ogden). 1992. *Fuel Farm Sludge Disposal Area and Tank 1253, Work Plan, CTO 0055, Marine Corps Air Station, Kaneohe Bay, HI*. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific.

Rauzon, M. J. 1992. *Final Fish and Wildlife Management Plan for Marine Corps Air Station, Kaneohe Bay, O'ahu Hawai'i*. Vols. One and Two. Prepared by Marine Endeavors, Berkeley, California.

Stearns, H. T. 1939. *Geological Map and Guide of the Island of Oahu, Hawaii.* Bulletin 2, Division of Hydrography, Territory of Hawaii. Honolulu. (Prepared in cooperation with the Geological Survey, U.S. Department of the Interior).

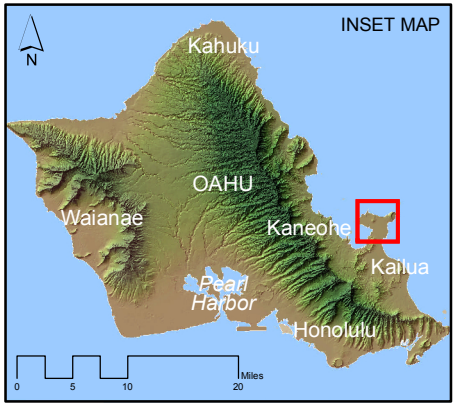
United States Department of Agriculture, Soil Conservation Service (USDA SCS). 1972. *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii.* In cooperation with the Univ. of Hawaii Agricultural Experiment Station. Washington. August.

Wil Chee - Planning, Inc. (WCP). 2003. *Remedial Investigation and Response Report, MCBH – Tank Farm, KB-49, KB-54 and KB-55, Remedial Investigation of Various Former UST Sites at Marine Corps Base Hawaii (MCBH) and Camp Smith, Oahu, Hawaii.* Prepared for United States Army Engineer District, Honolulu. December.

———. 2004a. *Remedial Investigation and Response Report, MCBH – Tank Farm, Building 329, KB-329S and KB-329V, Remedial Investigation of Various Former UST Sites at Marine Corps Base Hawaii (MCBH) and Camp Smith, Oahu, Hawaii.* Prepared for United States Army Engineer District, Honolulu. February.

———. 2004b. *Remedial Investigation and Response Report, MCBH – Tank Farm, KB-25, Remedial Investigation of Various Former UST Sites at MCBH and Camp Smith, Oahu, Hawaii*. Prepared for United States Army Engineer District, Honolulu. March.

Figures



LEGEND

- AST 1253 Site
- Roads
- 100-foot Groundsurface Elevation Contour
- Wetland
- Ponds
- Airfield
- Buildings and Structures

NOTES

1. Map Projection is North American Datum 1983 HARN

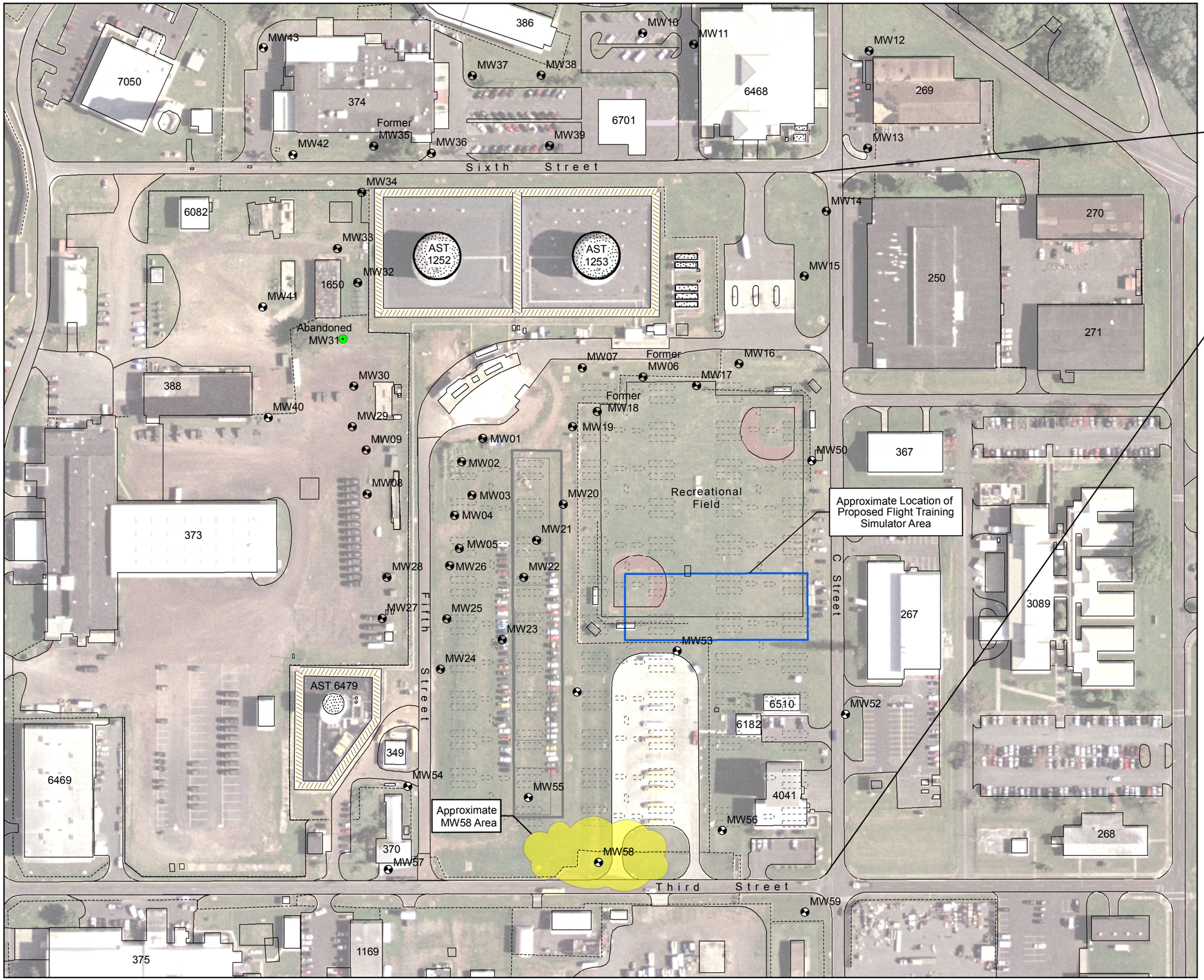
SOURCES

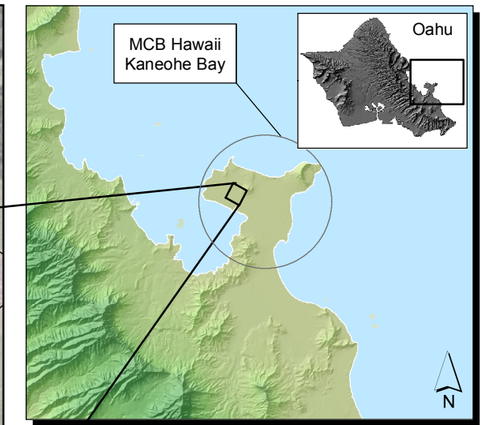
1. MCBH Kaneohe Bay Facilities Geodatabase (2011)

N

2,000 1,000 0 2,000 Feet

Figure 1
Site Overview
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii





LEGEND

- Former Sludge Disposal Area
- Active Tank
- AST Berm
- Fence Line
- Former Underground Storage Tank
- Former Valve Pit or Tank Vault
- Monitoring Well

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

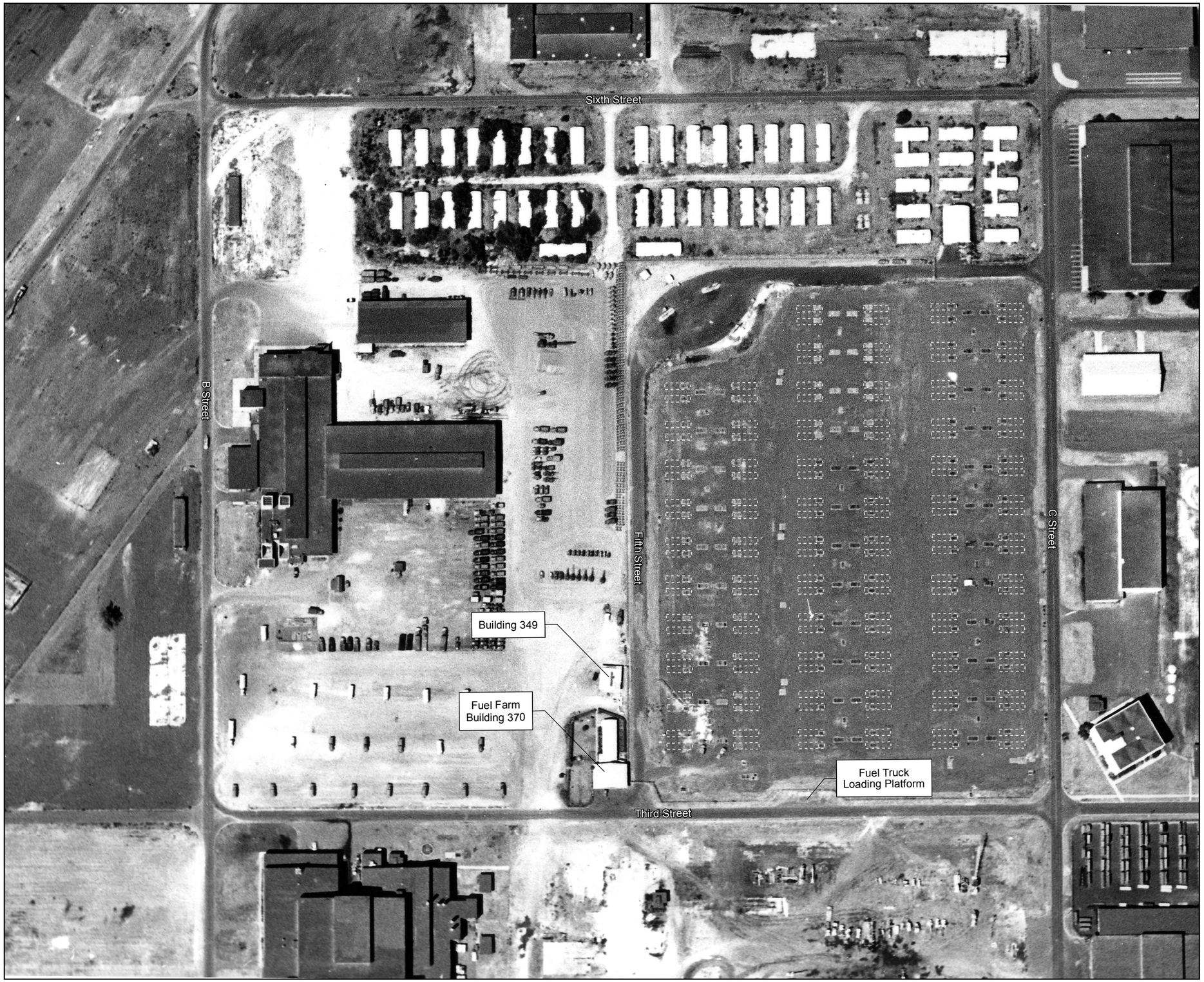
SOURCE

1. Harding Lawson Associates, 1991
2. MCBH-KBAY Facilities Geodatabase, November 2011
3. City and County of Honolulu GIS Data, August 2001
4. Dept of the Navy, Y & D Drawing No. 950721, 1962

N

200 100 0 200 Feet

Figure 2
Site Map
Environmental Hazard Evaluation /
Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



LEGEND

Former Underground Storage Tank

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

SOURCE

1. R.M. Towill, #1048-5
2. Department of the Navy, Y & D Drawing No. 950721, 1962

N

200 100 0 200
Feet

Figure 3
August 29, 1953 Aerial Overview
Environmental Hazard Evaluation /
Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

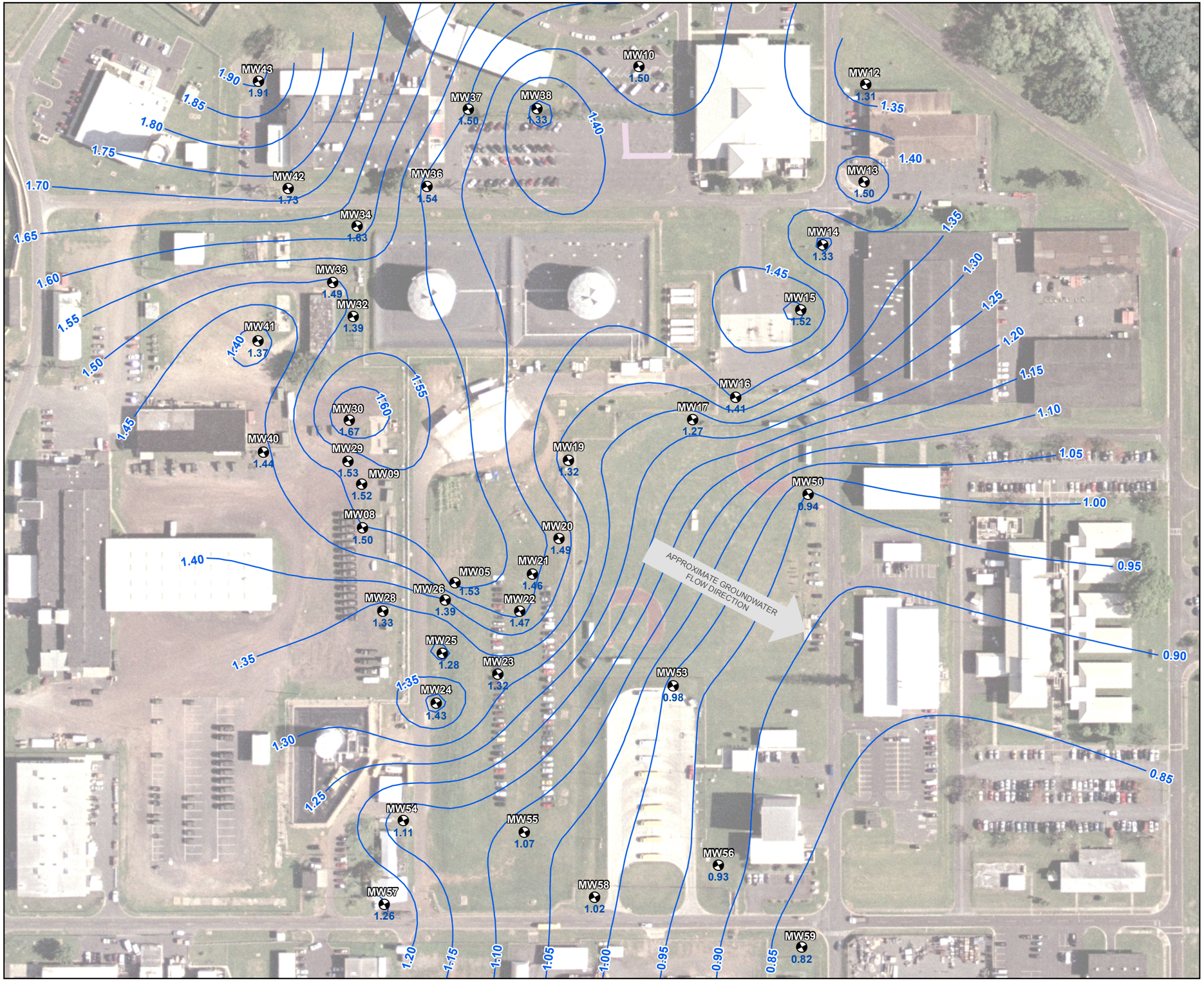
SOURCE

1. R.M. Towill, #2956-20

N

200 100 0 200 Feet

Figure 4
November 20, 1963 Aerial Overview
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



LEGEND

—1:50—	Estimated Groundwater Elevation Contour (ft msl)
MW01	Gauged Monitoring Well
1.32	Groundwater Elevation (ft msl)

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

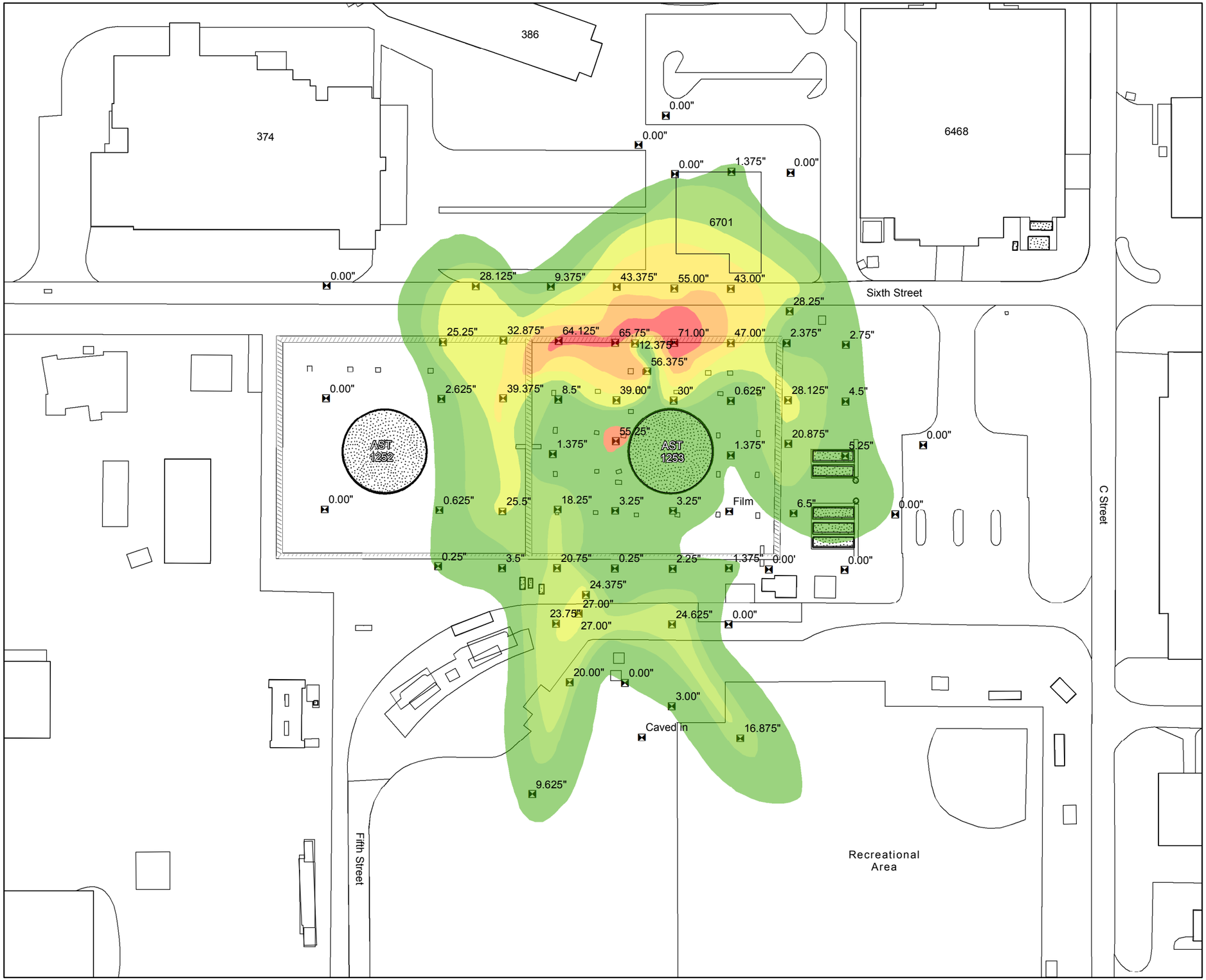
SOURCE

1. MCBH-KBAY Facilities Geodatabase, July 2004
2. Base Map: USGS Hawaii Data Clearing House
3. Sam O. Hirota, Inc., January 2008, April and August 2012

N

200 100 0 200
Feet

Figure 5
Groundwater Elevation Contour Map
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



LEGEND

- Subsurface Soil Drive Point
- Active Tank
- AST Berm
- Fuel Thickness
  - 5.0 ft+
  - 4.5 ft to 5.0 ft
  - 4.0 ft to 4.5 ft
  - 3.0 ft to 4.0 ft
  - 2.0 ft to 3.0 ft
  - 1.5 ft to 2.0 ft
  - 1.0 ft to 1.5 ft
  - 0.0 ft to 1.0 ft

NOTES

1. The accuracy of this map is limited to the quality and scale of the source informationand is not suitable for mapping engineering applications and is not to be used for "As Built."
2. Groundwater was not sampled during the NAVFAC Pacific Fuel Investigation at Aboveground Storage Tank 1253.

SOURCE

1. Plume contours adapted from Pacific Division, Naval Facilities Engineering Command, May 1989
2. MCBH-KBAY Facilities Geodatabase, July 2004

N

110 55 0 110 Feet

Figure 6
1989 Free-Phase Petroleum Product Thickness Contour Map
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii

LEGEND

- Groundwater Monitoring Well (MW)
- Extraction Well (EW)
- EW03 / 0.63' — Well Number / Free-Phase Petroleum Product Thickness
- EW (could not access)
- Active Tank
- AST Berm
- Fence
- Product Thickness
  - 1.0 ft+
  - 0.0 ft to 1.0 ft

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

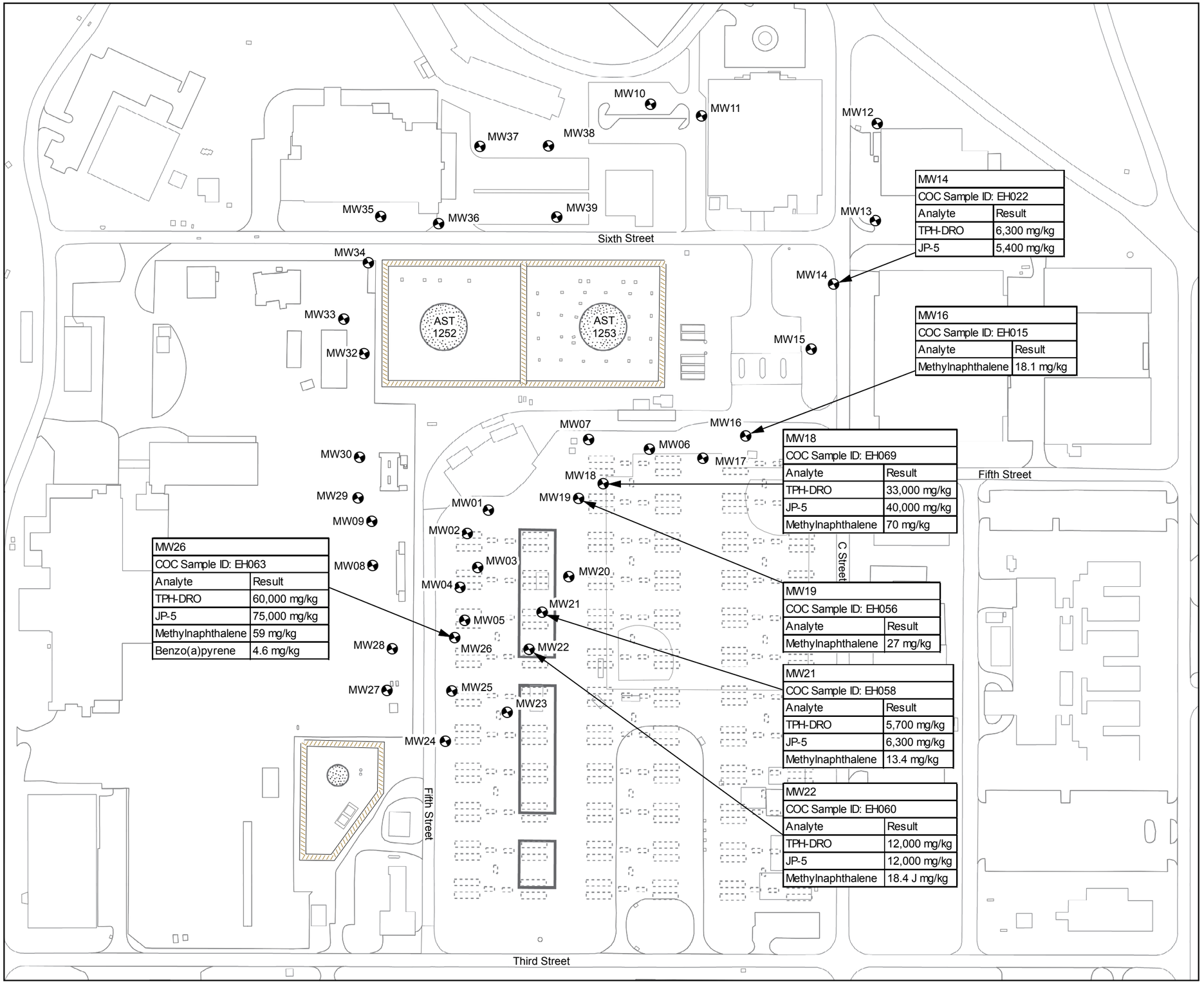
2. The indicated free-phase petroleum product values are only provided for the extraction and groundwater monitoring wells that contained measureable free-phase product.

SOURCE

1. MCBH-KBAY Facilities Geodatabase, July 2004

2. Naval Facilities Engineering Command, Hawaii, Site Characterization Report, Aboveground Storage Tank 1253, December 2008

Figure 7
Phase I SC Free-Phase Petroleum Product Thickness Map (April 2007)
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



MW14	
COC Sample ID: EH022	
Analyte	Result
TPH-DRO	6,300 mg/kg
JP-5	5,400 mg/kg

MW16	
COC Sample ID: EH015	
Analyte	Result
Methylnaphthalene	18.1 mg/kg

MW18	
COC Sample ID: EH069	
Analyte	Result
TPH-DRO	33,000 mg/kg
JP-5	40,000 mg/kg
Methylnaphthalene	70 mg/kg

MW26	
COC Sample ID: EH063	
Analyte	Result
TPH-DRO	60,000 mg/kg
JP-5	75,000 mg/kg
Methylnaphthalene	59 mg/kg
Benzo(a)pyrene	4.6 mg/kg

MW19	
COC Sample ID: EH056	
Analyte	Result
Methylnaphthalene	27 mg/kg

MW21	
COC Sample ID: EH058	
Analyte	Result
TPH-DRO	5,700 mg/kg
JP-5	6,300 mg/kg
Methylnaphthalene	13.4 mg/kg

MW22	
COC Sample ID: EH060	
Analyte	Result
TPH-DRO	12,000 mg/kg
JP-5	12,000 mg/kg
Methylnaphthalene	18.4 J mg/kg

LEGEND

- Soil Boring / Groundwater Monitoring Well
- Active Tank
- AST Berm
- Former Underground Storage Tank
- Former Valve Pit or Tank Vault
- Former Sludge Disposal Area

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

2. Only the analytes above the screening criteria are shown.

SOURCE

1. Pacific Division, Naval Facilities Engineering Command, May 1989

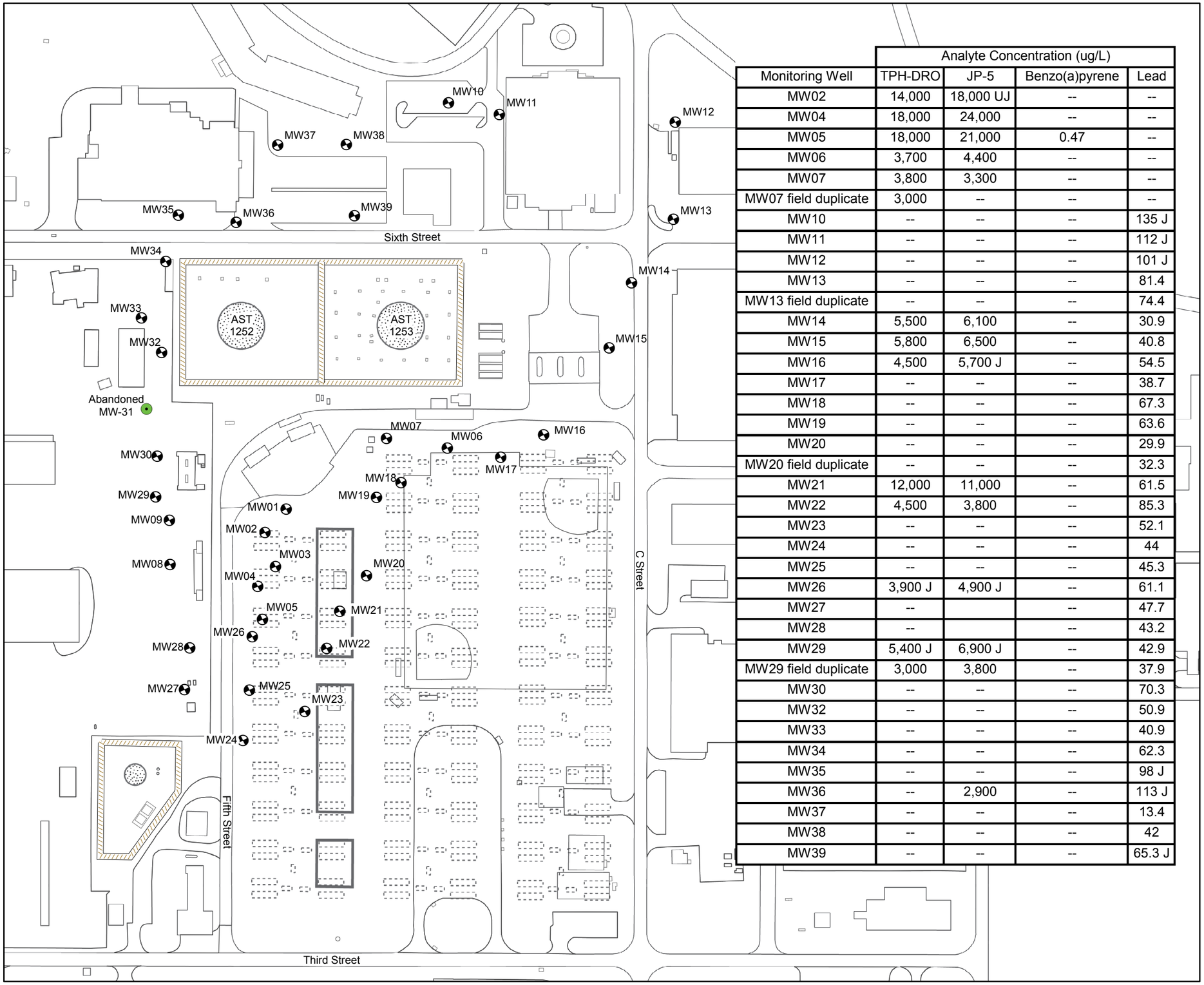
2. MCBH-KBAY Facilities Geodatabase, July 2004

3. Sam O. Hirota, Inc., January 2008

N

200 100 0 200 Feet

Figure 8
2008 SC Subsurface Soil Constituents Exceeding DOH EAL Screening Criteria
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



Monitoring Well	Analyte Concentration (ug/L)			
	TPH-DRO	JP-5	Benzo(a)pyrene	Lead
MW02	14,000	18,000 UJ	--	--
MW04	18,000	24,000	--	--
MW05	18,000	21,000	0.47	--
MW06	3,700	4,400	--	--
MW07	3,800	3,300	--	--
MW07 field duplicate	3,000	--	--	--
MW10	--	--	--	135 J
MW11	--	--	--	112 J
MW12	--	--	--	101 J
MW13	--	--	--	81.4
MW13 field duplicate	--	--	--	74.4
MW14	5,500	6,100	--	30.9
MW15	5,800	6,500	--	40.8
MW16	4,500	5,700 J	--	54.5
MW17	--	--	--	38.7
MW18	--	--	--	67.3
MW19	--	--	--	63.6
MW20	--	--	--	29.9
MW20 field duplicate	--	--	--	32.3
MW21	12,000	11,000	--	61.5
MW22	4,500	3,800	--	85.3
MW23	--	--	--	52.1
MW24	--	--	--	44
MW25	--	--	--	45.3
MW26	3,900 J	4,900 J	--	61.1
MW27	--		--	47.7
MW28	--		--	43.2
MW29	5,400 J	6,900 J	--	42.9
MW29 field duplicate	3,000	3,800	--	37.9
MW30	--	--	--	70.3
MW32	--	--	--	50.9
MW33	--	--	--	40.9
MW34	--	--	--	62.3
MW35	--	--	--	98 J
MW36	--	2,900	--	113 J
MW37	--	--	--	13.4
MW38	--	--	--	42
MW39	--	--	--	65.3 J

LEGEND

- Groundwater Monitoring Well
- Active Tank
- AST Berm
- Former Underground Storage Tank
- Former Valve Pit or Tank Vault
- Former Sludge Disposal Area

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

2. Dash (--) indicates analyte concentration below the DOH EAL.

SOURCE

1. Pacific Division, Naval Facilities Engineering Command, May 1989

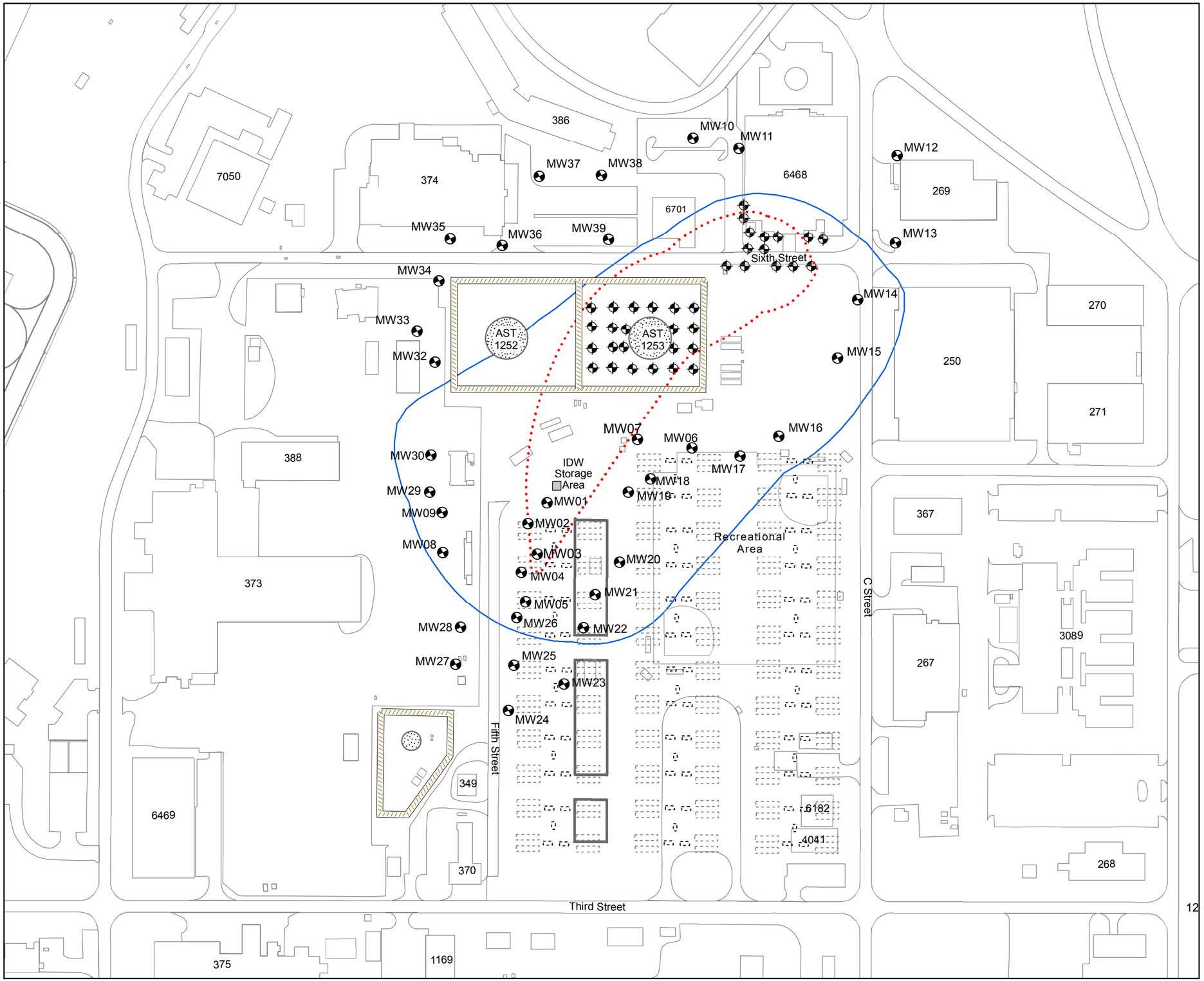
2. MCBH-KBAY Facilities Geodatabase, July 2004

3. Sam O. Hirota, Inc., January 2008

N

200 100 0 200 Feet

Figure 9
2008 SC Groundwater Constituents Exceeding DOH EAL Screening Criteria
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



LEGEND

- Groundwater Monitoring Well
- Extraction Well
- Estimated Extent of Contamination
- Estimated Extent of Free-Phase Petroleum Product
- Active Tank
- AST Berm
- Former Underground Storage Tank
- Former Valve Pit or Tank Vault
- Former Sludge Disposal Area

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

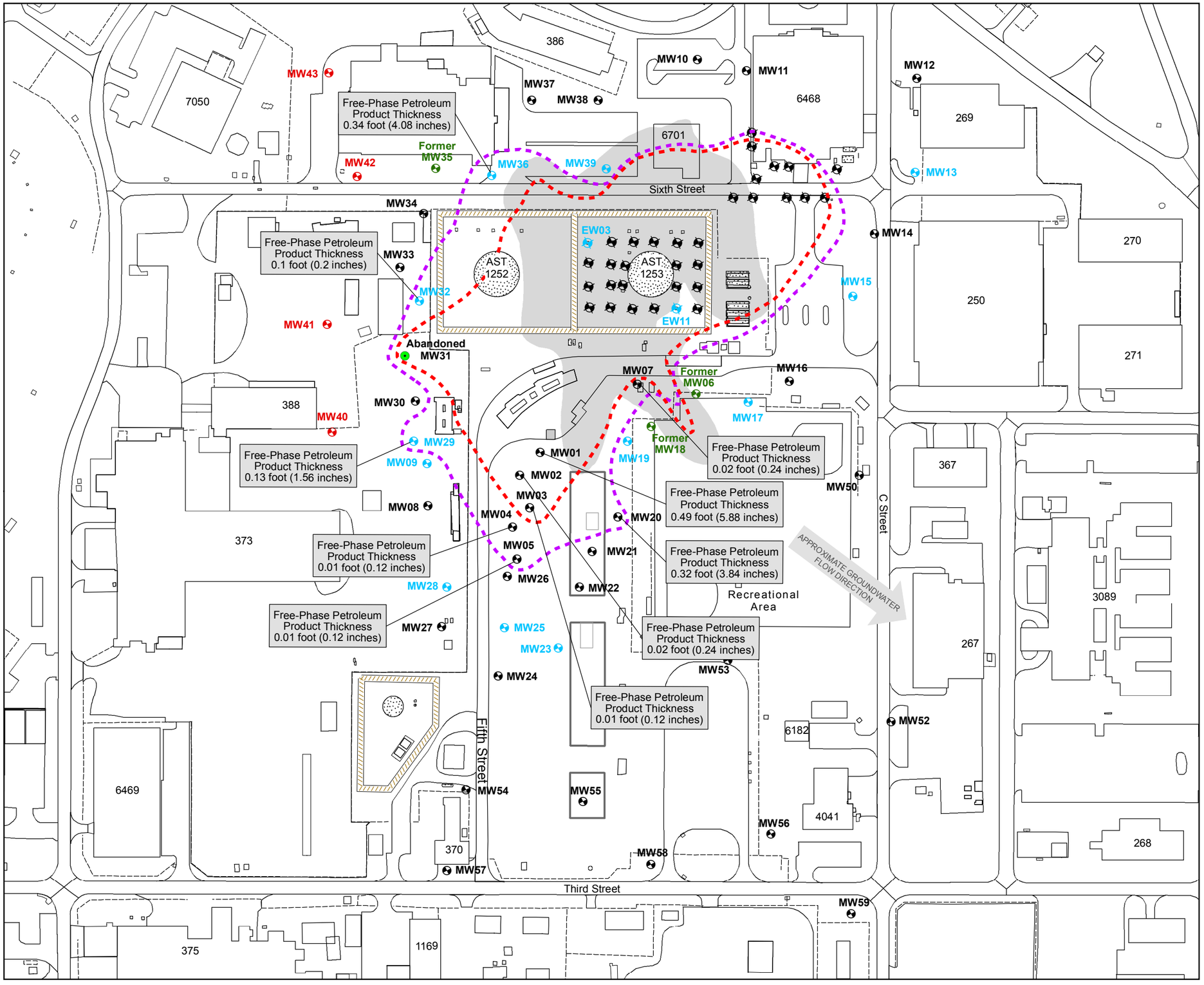
SOURCE

1. Pacific Division, Naval Facilities Engineering Command, May 1989
2. MCBH-KBAY Facilities Geodatabase, July 2004
3. Sam O. Hirota, Inc., January 2008
4. Naval Facilities Engineering Command, Hawaii, Site Characterization Report, Aboveground Storage Tank 1253, December 2008
5. Naval Facilities Engineering Command, Hawaii, Environmental Hazard Evaluation/Environmental Hazard Management Plan, Aboveground Storage Tank 1253, October 2009

N

200 100 0 200 Feet

Figure 10
Estimated Extent of Contamination During the 2008 Site Characterization Environmental Hazard Evaluation / Environmental Hazard Management Plan Aboveground Storage Tank 1253 Marine Corps Base Hawaii Kaneohe, Hawaii



LEGEND

- LTM Monitoring Well Installed in 2012
- Existing LTM Monitoring Well
- Monitoring Well
- Damaged/Missing Monitoring Well
- Abandoned Monitoring Well
- Existing LTM Extraction Well
- Extraction Well
- Estimated Extent of Free-Phase Petroleum Product in 1989
- Estimated Extent of Free-Phase Petroleum Product in 2008
- Estimated Extent of Free-Phase Petroleum Product in 2012
- Active Tank
- AST Berm
- Former Sludge Disposal Area

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

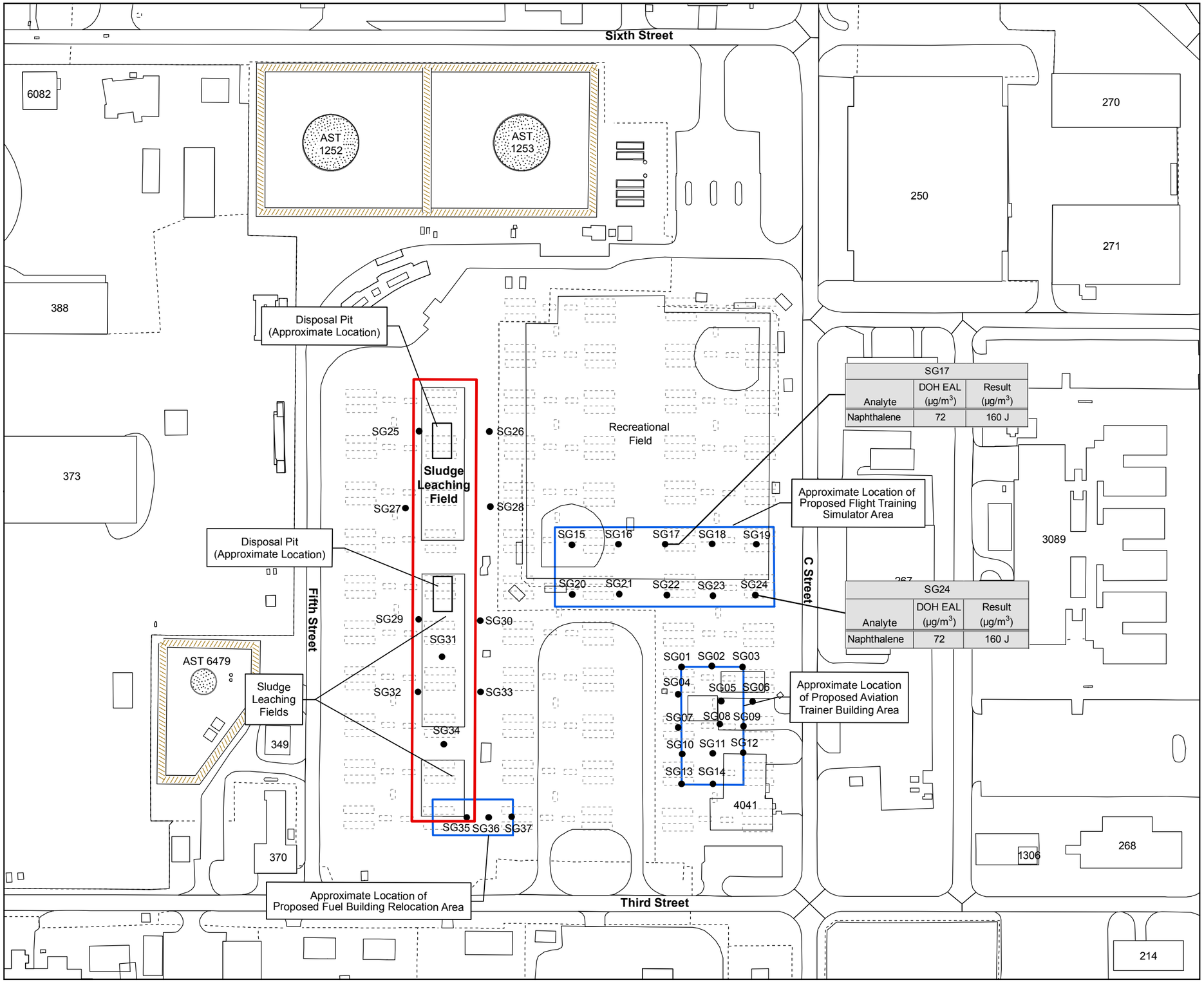
SOURCE

1. Pacific Division, Naval Facilities Engineering Command, May 1989
2. MCBH-KBAY Facilities Geodatabase, July 2004
3. Sam O. Hirota Land Survey, January 2008, April and August 2012

N

200 100 0 200 Feet

Figure 11
Estimated Extent of Free-Phase Petroleum Product at AST 1253 (August 2012)
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



SG17		
Analyte	DOH EAL ($\mu g/m^3$)	Result ($\mu g/m^3$)
Naphthalene	72	160 J

SG24		
Analyte	DOH EAL ($\mu g/m^3$)	Result ($\mu g/m^3$)
Naphthalene	72	160 J

LEGEND

- Former Sludge Disposal Area
- Active Tank
- AST Berm
- RI Soil Gas Sampling Location
- Fence Line
- Former Underground Storage Tank
- Former Valve Pit or Tank Vault

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

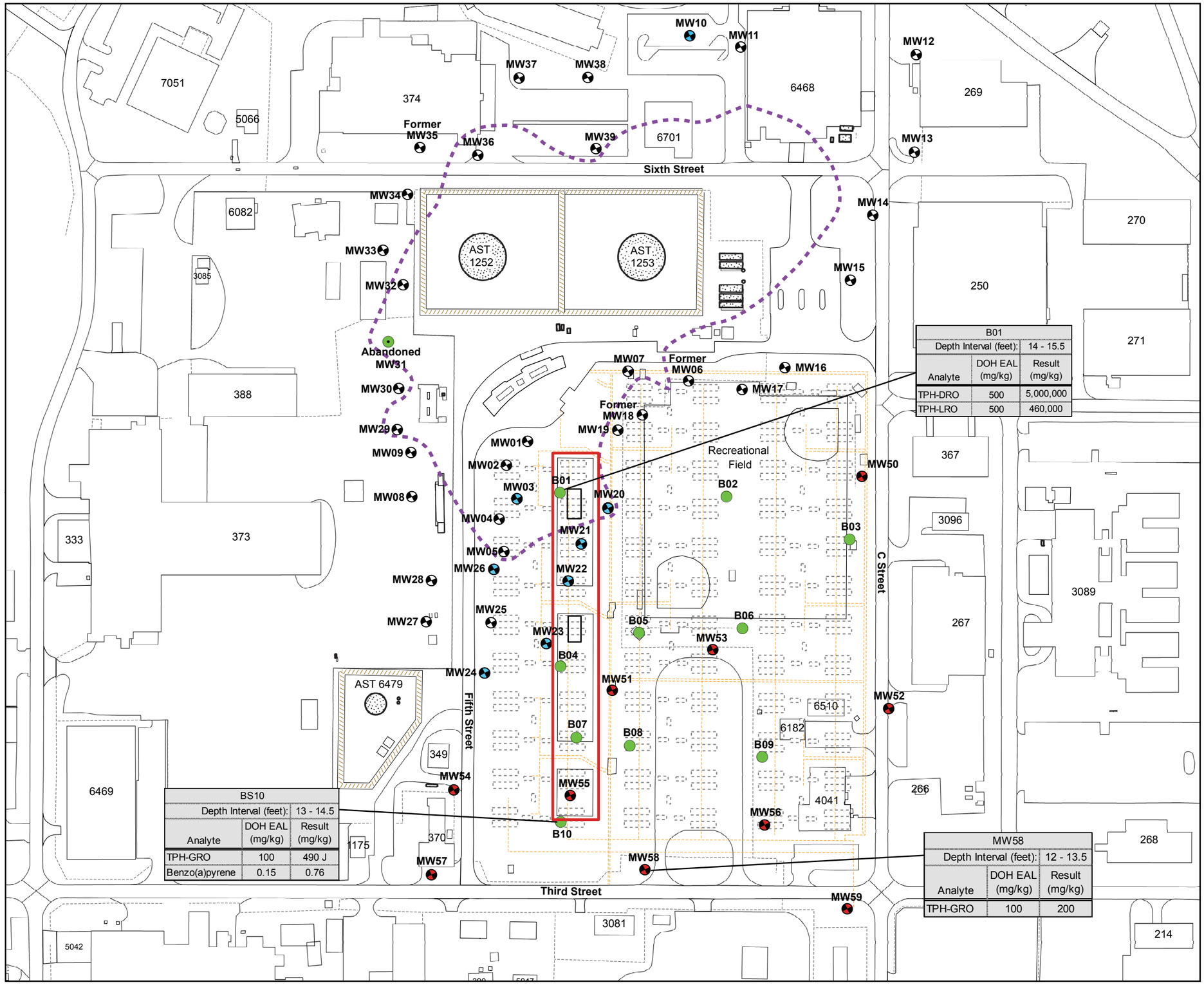
SOURCE

1. Harding Lawson Associates, 1991
2. MCBH-KBAY Facilities Geodatabase, November 2011
3. Dept of the Navy, Y & D Drawing No. 950721, 1962

N

200 100 0 200 Feet

Figure 12
Soil Gas Constituents Exceeding DOH EAL Screening Criteria
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



B01		
Depth Interval (feet):		14 - 15.5
Analyte	DOH EAL (mg/kg)	Result (mg/kg)
TPH-DRO	500	5,000,000
TPH-LRO	500	460,000

BS10		
Depth Interval (feet):		13 - 14.5
Analyte	DOH EAL (mg/kg)	Result (mg/kg)
TPH-GRO	100	490 J
Benzo(a)pyrene	0.15	0.76

MW58		
Depth Interval (feet):		12 - 13.5
Analyte	DOH EAL (mg/kg)	Result (mg/kg)
TPH-GRO	100	200

LEGEND

- New RI Monitoring Well
- Existing Monitoring Well
- Existing RI Monitoring Well Location
- New RI Soil Boring Location
- Abandoned Well
- Former Sludge Disposal Area
- Sludge Leaching Field
- Disposal Pit (Approximate Location)
- Estimated Extent of Free-Phase Petroleum Product in 2012
- Active Tank
- AST Berm
- Former Underground Storage Tank
- Former Valve Pit or Tank Vault
- Fence Line
- Historical AVGAS/MOGAS Fuel Lines

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

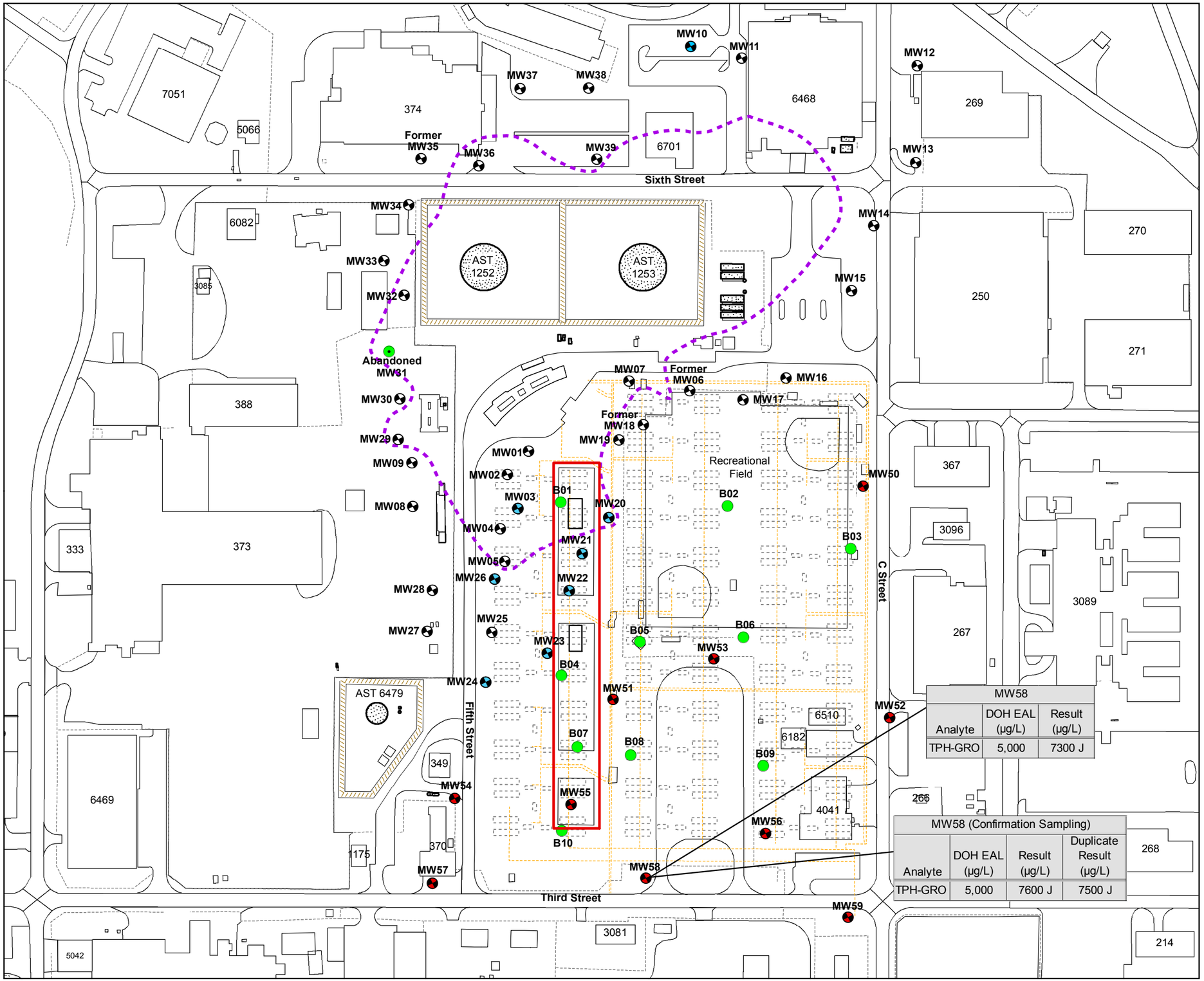
SOURCE

1. Pacific Division, Naval Facilities Engineering Command, May 1989
2. MCBH-KBAY Facilities Geodatabase, November 2011
3. Sam O. Hirota Land Survey, January 2008, April and August 2012
4. Dept of the Navy, Y & D Drawing 950721, 1962

N

200 100 0 200 Feet

Figure 13
Subsurface Soil Constituents Exceeding DOH EAL Screening Criteria
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



MW58		
Analyte	DOH EAL (µg/L)	Result (µg/L)
TPH-GRO	5,000	7300 J

MW58 (Confirmation Sampling)			
Analyte	DOH EAL (µg/L)	Result (µg/L)	Duplicate Result (µg/L)
TPH-GRO	5,000	7600 J	7500 J

LEGEND

- New RI Monitoring Well
- Existing Monitoring Well
- Existing RI Monitoring Well Location
- New RI Soil Boring/Sampling Location
- Abandoned Well
- Former Sludge Disposal Area
- Sludge Leaching Field
- Disposal Pit (Approximate Location)
- Estimated Extent of Free-Phase Petroleum Product in 2012
- Active Tank
- AST Berm
- Former Underground Storage Tank
- Former Valve Pit or Tank Vault
- Fence Line
- Historical AVGAS/MOGAS Fuel Lines

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

SOURCE

1. Pacific Division, Naval Facilities Engineering Command, May 1989
2. MCBH-KBAY Facilities Geodatabase, November 2011
3. Sam O. Hirota Land Survey, January 2008, April and August 2012
4. Dept of the Navy, Y & D Drawing 950721, 1962

N

200 100 0 200 Feet

Figure 14
Groundwater Constituents Exceeding DOH EAL Screening Criteria
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii

Contributing Source	Transport Mechanism	Exposure Route	Scenario	Receptor: Onsite Occupational Worker	Receptor: Onsite Construction Worker	Receptor: Onsite Resident (Adult/Child)	Receptor: Trespasser (Adult/Child)
Free-Phase Petroleum Product							
Surface Soil	Direct Contact	Incidental Ingestion:	Current:	N/A	N/A	N/A	N/A
			Future:	N/A	N/A	N/A	N/A
			Rationale:	Releases of petroleum constituents have only been to subsurface soil and not to surface soil; therefore, surface soil is not a contributing source and all exposure pathways are not applicable.			
		Dermal Contact:	Current:	N/A	N/A	N/A	N/A
			Future:	N/A	N/A	N/A	N/A
			Rationale:	Releases of petroleum constituents have only been to subsurface soil and not to surface soil; therefore, surface soil is not a contributing source and all exposure pathways are not applicable.			
	Air Transport	Inhalation of VOCs:	Current:	N/A	N/A	N/A	N/A
			Future:	N/A	N/A	N/A	N/A
			Rationale:	Releases of petroleum constituents have only been to subsurface soil and not to surface soil; therefore, surface soil is not a contributing source and all exposure pathways are not applicable.			
		Inhalation of Particulates:	Current:	N/A	N/A	N/A	N/A
			Future:	N/A	N/A	N/A	N/A
			Rationale:	Releases of petroleum constituents have only been to subsurface soil and not to surface soil; therefore, surface soil is not a contributing source and all exposure pathways are not applicable.			
	Bio-uptake	Ingestion of Plants/Animals:	Current:	N/A	N/A	N/A	N/A
			Future:	N/A	N/A	N/A	N/A
			Rationale:	Releases of petroleum constituents have only been to subsurface soil and not to surface soil; therefore, surface soil is not a contributing source and all exposure pathways are not applicable.			
	Stormwater Runoff to Surface Water	Incidental Ingestion:	Current:	N/A	N/A	N/A	N/A
			Future:	N/A	N/A	N/A	N/A
			Rationale:	Releases of petroleum constituents have only been to subsurface soil and not to surface soil; therefore, surface soil is not a contributing source and all exposure pathways are not applicable.			
		Dermal Contact:	Current:	N/A	N/A	N/A	N/A
			Future:	N/A	N/A	N/A	N/A
			Rationale:	Releases of petroleum constituents have only been to subsurface soil and not to surface soil; therefore, surface soil is not a contributing source and all exposure pathways are not applicable.			

Notes:
COPC chemical of potential concern
N/A not applicable (exposure route does not exist)
VOC volatile organic compound

Figure 15 (page 1 of 3)
Human Health Exposure Pathway Evaluation
Environmental Hazard Evaluation/Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii

Contributing Source	Transport Mechanism	Exposure Route	Scenario	Onsite Occupational Worker	Onsite Construction Worker	Onsite Resident (Adult/Child)	Trespasser (Adult/Child)
Free-Phase Petroleum Product → Subsurface Soil	Direct Contact	Incidental Ingestion:	Current:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
			Future:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
		Rationale:	Access to subsurface soils is limited to construction/trench workers; possible direct contact may provide a potentially complete exposure pathway for incidental ingestion of subsurface soil. Residents, occupational workers, and trespassers are unlikely to come into direct contact, and thus not ingest, subsurface soils.				
		Dermal Contact:	Current:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
			Future:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
		Rationale:	Access to subsurface soils is limited to construction/trench workers; possible direct dermal contact may provide a potentially complete exposure pathway for contaminants in subsurface soil. Residents, occupational workers, and trespassers are unlikely to come into direct dermal contact with subsurface soils.				
	Air Transport	Inhalation of VOCs:	Current:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
			Future:	**Potentially Complete**	**Potentially Complete**	**Potentially Complete**	**Potentially Complete**
		Rationale:	Inhalation of VOCs is limited by proximity, free-phase petroleum product is limited to the subsurface. Workers engaged in installation or maintenance of subsurface utilities may be exposed to VOCs. Future construction of a new building or residence may potentially expose building inhabitants to VOCs via vapor intrusion.				
		Inhalation of Particulates:	Current:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
			Future:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
		Rationale:	Inhalation of soil particulates is limited by proximity. Construction and trench workers may have potentially complete exposure through inhalation of subsurface soil particulates. The lack of direct contact to subsurface soil for residents, occupational workers, and trespassers makes exposure to subsurface soil particulates extremely unlikely and makes the exposure pathway incomplete.				
	Leaching to Groundwater	Ingestion:	Current:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
			Future:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
		Rationale:	Incidental ingestion of groundwater is possible for receptors engaged in installation or maintenance of subsurface utilities. Groundwater at the site is not used as a potable water source and occurs at a depth greater than 9 feet bgs, therefore, this exposure pathway is incomplete for current and future occupational workers, residents, and trespassers.				
		Dermal Contact:	Current:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
			Future:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
		Rationale:	Dermal contact is possible for receptors engaged in installation or maintenance of subsurface utilities. Groundwater at the site is not used as a potable water source and occurs at a depth greater than 9 feet below ground surface; therefore, this exposure pathway is incomplete for current and future occupational workers, residents, and trespassers.				
		Inhalation of VOCs:	Current:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
			Future:	Incomplete	**Potentially Complete**	Incomplete	Incomplete
		Rationale:	Inhalation of VOCs is possible for receptors engaged in installation or maintenance of subsurface utilities. Groundwater at the site is not used as a potable water source and occurs at a depth greater than 9 feet below ground surface; therefore, this exposure pathway is incomplete for current and future occupational workers, residents, and trespassers.				

Notes:
COPC chemical of potential concern
N/A not applicable (exposure route does not exist)
VOC volatile organic compound

Figure 15 (page 2 of 3)
Human Health Exposure Pathway Evaluation
Environmental Hazard Evaluation/Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii

Contributing Source	Transport Mechanism	Exposure Route	Scenario	Onsite Occupational Worker	Onsite Construction Worker	Onsite Resident (Adult/Child)	Trespasser (Adult/Child)
Free-Phase Petroleum Product	Groundwater Discharge to Kaneohe Bay	Ingestion:	Current:	Incomplete	Incomplete	Incomplete	Incomplete
			Future:	Insignificant	Insignificant	Insignificant	Insignificant
		Rationale:	The potential exposure pathways are incomplete for current onsite receptors because there is no direct connection between the subsurface contamination and surface water. COPCs have not yet reached Kaneohe Bay, so current exposure pathways for offsite receptors are incomplete. While COPCs could potentially migrate to Kaneohe Bay in the future, the distance to and attenuation by Kaneohe Bay waters would make the exposure insignificant.				
		Dermal Contact:	Current:	Incomplete	Incomplete	Incomplete	Incomplete
			Future:	Insignificant	Insignificant	Insignificant	Insignificant
		Rationale:	The potential exposure pathways are incomplete for current onsite receptors because there is no direct connection between the subsurface contamination and surface water. COPCs have not yet reached Kaneohe Bay, so current exposure pathways for offsite receptors are incomplete. While COPCs could potentially migrate to Kaneohe Bay in the future, the distance to and attenuation by Kaneohe Bay waters would make the exposure insignificant.				
		Inhalation of VOCs:	Current:	Incomplete	Incomplete	Incomplete	Incomplete
			Future:	Insignificant	Insignificant	Insignificant	Insignificant
		Rationale:	Contaminated groundwater has not yet reached Kaneohe Bay. Future migration to and mixing within Kaneohe Bay would greatly attenuate possible volatile contaminant concentrations; therefore, this exposure pathway is expected to be insignificant.				
	Bio-uptake	Ingestion of Fish/Shellfish:	Current:	Incomplete	Incomplete	Incomplete	Incomplete
			Future:	Insignificant	Insignificant	Insignificant	Insignificant
		Rationale:	Contaminated groundwater has not yet reached Kaneohe Bay. Future migration to and mixing within Kaneohe Bay would greatly attenuate possible contaminant concentrations; therefore, this exposure pathway is expected to be insignificant.				

Notes:
COPC chemical of potential concern
N/A not applicable (exposure route does not exist)
VOC volatile organic compound

Figure 15 (page 3 of 3)
Human Health Exposure Pathway Evaluation
Environmental Hazard Evaluation/Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii

Contributing Source	Affected Media	Exposure Route	Terrestrial Receptors: Plants	Terrestrial Receptors: Soil Invertebrates	Terrestrial Receptors: Herbivores/ Invertivores/ Omnivores	Terrestrial Receptors: Carnivores
Free-phase Petroleum Product	Surface Soil	Direct Contact:	N/A	N/A	N/A	N/A
		Incidental Ingestion:	N/A	N/A	N/A	N/A
		Food Web Transfer:	N/A	N/A	N/A	N/A

Rationale: Free-phase petroleum product and COPCs occur in the subsurface at depths of approximately 6 feet bgs or more. Plant uptake of contaminants in soil generally occurs through the root zone, between the ground surface and approximately 2 feet bgs. Because of the depth to free-phase petroleum product, terrestrial plants and animals are not likely to contact site contaminants. Therefore, the surface soil pathway is considered not applicable.

	Subsurface Soil	Incidental Ingestion: Inhalation:	N/A	N/A	Incomplete	Incomplete

Rationale: Free-phase petroleum product and COPCs occur in the subsurface at depths of approximately 6 feet bgs or more. Plant uptake of contaminants in soil generally occurs through the root zone, between the ground surface and approximately 2 feet bgs. Deep burrowing animals are not known to live at or visit the site. Because of the depth to free-phase petroleum product, terrestrial plants and animals are not likely to contact site contaminants. Therefore, exposure pathways for incidental ingestion and inhalation are considered incomplete.

	Surface Water (Freshwater and/or Groundwater Seeps)	Ingestion:	Incomplete	N/A	Incomplete	Incomplete

Rationale Free-phase petroleum product and COPCs occur in the subsurface at depths of approximately 6 feet bgs or more. There are no known freshwater or groundwater seeps to exist on or near the site. Because of the depth to free-phase petroleum product, terrestrial plants and animals are not likely to contact site contaminants. Therefore, exposure pathways for ingestion are considered incomplete.

			Aquatic Receptors: Aquatic Life (incl. Plankton)	Aquatic Receptors: Sediment Biota	Aquatic Receptors: Fish (all Trophic Levels)	Aquatic Receptors: Herbivorous/ Invertivorous/ Piscivorous/ Omnivorous Mammals/Birds	Aquatic Receptors: Carnivorous Mammals/Birds
	Groundwater Discharge/ Transition Zone	Direct Contact:	**Potentially Complete**	N/A	**Potentially Complete**	N/A	N/A

Rationale: Aquatic ecological receptors have a potential to contact free-phase petroleum product and COPCs if groundwater migrates to the marine waters of Kaneohe Bay, thus the direct contact exposure pathway for aquatic plants and aquatic animals are considered potentially complete.

	Freshwater/Marine Surface Water	Direct Contact: Ingestion:	**Potentially Complete**	N/A	**Potentially Complete**	**Potentially Complete**	**Potentially Complete**
		Food Web Transfer:	N/A	N/A	**Potentially Complete**	**Potentially Complete**	**Potentially Complete**

Rationale: Aquatic ecological receptors have a potential to contact free-phase petroleum product and COPCs if groundwater migrates to marine waters of Kaneohe Bay, thus the direct contact, ingestion, and food web transfer exposure pathway for aquatic plants and aquatic animals are considered potentially complete.

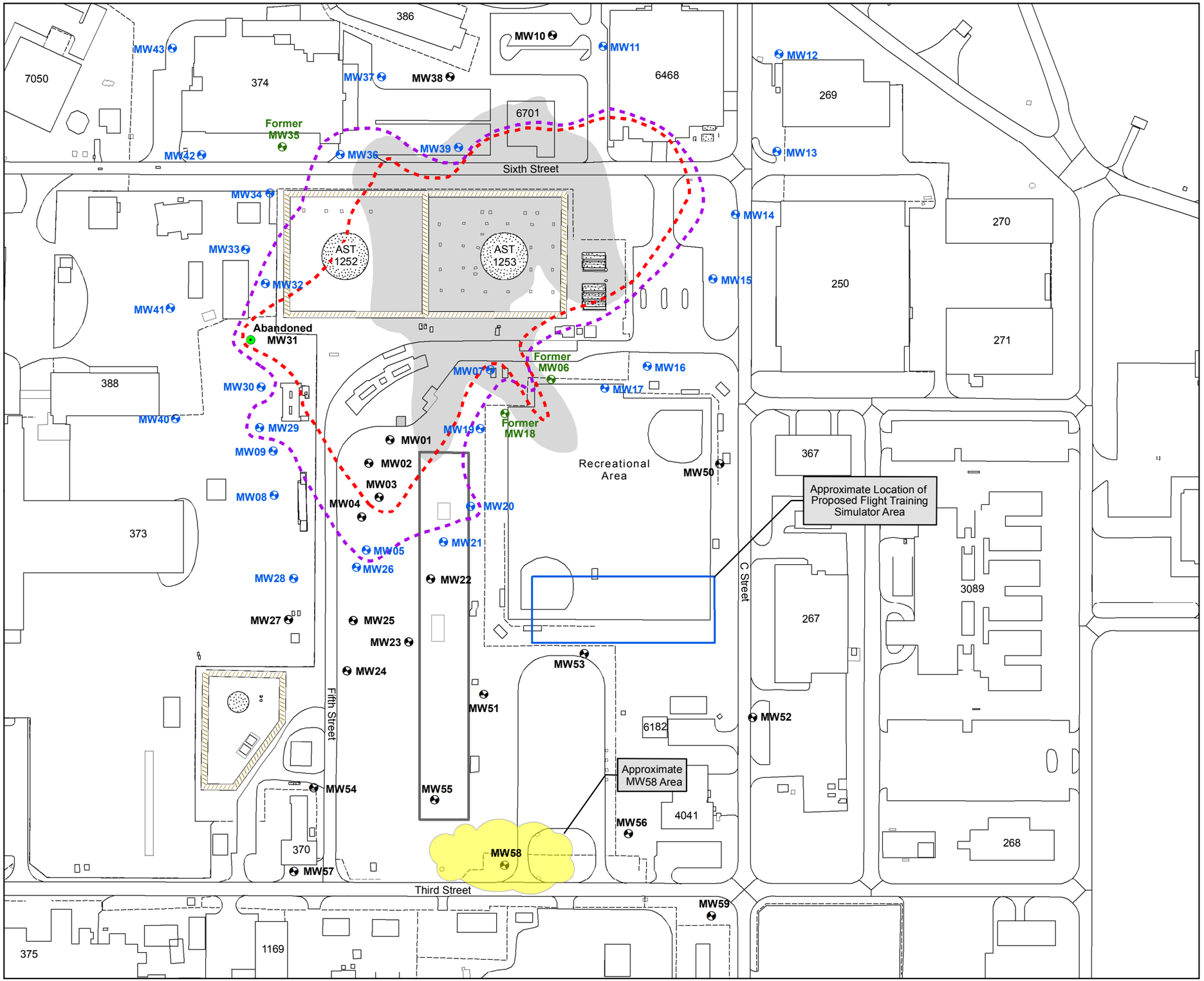
	Freshwater/Marine Sediment (and/or Porewater)	Direct Contact: Ingestion:	N/A	**Potentially Complete**	**Potentially Complete**	**Potentially Complete**	**Potentially Complete**
		Food Web Transfer:	N/A	N/A	**Potentially Complete**	**Potentially Complete**	**Potentially Complete**

Rationale: If free-phase petroleum product and/or COPCs migrate with groundwater, reach Kaneohe Bay, and settle in shoreline or bottom sediments, terrestrial and marine plants and animals may come in contact with sediment. Therefore, the direct contact, ingestion, and food web transfer exposure pathways for aquatic plants and animals are considered potentially complete.

Notes: Volatile organic compounds (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.

N/A not applicable (exposure route does not exist, or is not normally evaluated as such in ecological risk assessment)

Figure 16
Ecological Receptors Exposure Pathway Evaluation
Environmental Hazard Evaluation/Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii



LEGEND

- Proposed LTM Monitoring Well
- Monitoring Well
- Damaged/Missing Monitoring Well
- Abandoned Monitoring Well
- Estimated Extent of Free-Phase Petroleum Product in 1989
- Estimated Extent of Free-Phase Petroleum Product in 2008
- Estimated Extent of Free-Phase Petroleum Product in 2012
- Active Tank
- AST Berm
- Former Sludge Disposal Area

NOTES

1. The accuracy of this map is limited to the quality and scale of the source information and is not suitable for mapping engineering applications and is not to be used for "As Built."

SOURCE

1. Pacific Division, Naval Facilities Engineering Command, May 1989
2. MCBH-KBAY Facilities Geodatabase, July 2004
3. Sam O. Hirota, Inc., January 2008, April and August 2012

N

200 100 0 200 Feet

Figure 17
Proposed LTM Monitoring Wells
Environmental Hazard Evaluation / Environmental Hazard Management Plan
Aboveground Storage Tank 1253
Marine Corps Base Hawaii
Kaneohe, Hawaii

Appendix A
Estimation of Potential Petroleum-Impacted Soil Remaining

ESTIMATION OF POTENTIAL PETROLEUM-IMPACTED SOIL REMAINING

The estimated volume of potential petroleum –impacted soil is 57,398 cubic yards (yd^3).

Using a series of assumptions to estimate the volume of potential petroleum-impacted soil (PPS), and the volume equation of Area (A) times Height (D), the following calculations were made:

Assumptions:

- PPS is soil exceeding the DOH Tier 1 EAL for total TPH.
- Based on the information from the 2008 SC Report for AST 1253 (Earth Tech and WCP 2008), the vertical extent of the PPS within the site is a 9- to 16-foot thick zone within the subsurface. Therefore, the average thickness of petroleum product is an average of 12.5 feet thick throughout the site.

$$9 \text{ (feet)} + 16 \text{ (feet)} = 25 \text{ (feet)}$$

$$25 \text{ (feet)} \div 2 \text{ (feet)} = 12.5 \text{ feet}$$

- The aerial extent of PPS is best represented by the boundaries delineated for the estimated extent of contamination (Figure 10, of the EHE/EHMP, Revision 01).
- Using ArcGIS, the aerial extent of the PPS was found to be 123,979 square feet (ft^2).
- 1 yd^3 = 27 cubic feet (ft^3).

Calculations:

1. Volume of estimated PPS: (aerial extent of PPS) [ft^2] x (depth of PPS) [feet] = estimated PPS [ft^3]

$$123{,}979 \text{ ft}^2 \times 12.5 \text{ feet} = 1{,}549{,}737.5 \text{ ft}^3$$

2. Convert to yd^3:

$$1{,}549{,}737.5 \text{ ft}^3 \div 27 \text{ ft}^3/\text{yd}^3 = 57{,}398 \text{ yd}^3$$

Appendix B
Meeting Minutes

Meeting Minutes
Remedial Investigation for Former Fuel Farm Sludge Disposal Area
Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii
Contract No. N62742-03-D-1837
CLEAN III CTO No. HC25

Date: Wednesday, 27 June 2012
Time: 0900–0955 hours
Location: Teleconference

1. INTRODUCTION, OVERVIEW, AND ATTENDEES

Representatives of the State of Hawaii Department of Health (DOH), Hazard Evaluation and Response (HEER) Office, Naval Facilities Engineering Command (NAVFAC), Hawaii, AECOM Technical Services, Inc. (AECOM), Wil Chee - Planning, Inc. (WCP), and Element Environmental, LLC (E2) conducted a meeting to discuss soil and groundwater analytical results for the remedial investigation (RI) field investigation at the Former Fuel Farm Sludge Disposal Area, Marine Corps Base (MCB) Hawaii, and provide an overview of the recently awarded treatability study to be performed by E2. Handouts consisting of soil and groundwater analytical tables, a product level table, site figures, and the tentative layout for the treatability study wells were provided.

Individuals participating in the teleconference and their respective affiliations are listed below.

Name	Organization	Telephone No.	E-Mail Address
Steven Mow	DOH HEER Office	808-586-4251	steven.mow@doh.hawaii.gov
Joel Narusawa	NAVFAC Hawaii	808-471-1171 ext. 222	joel.narusawa@navy.mil
Wesley Ching	NAVFAC Hawaii	808-471-1171 ext. 361	wesley.ching@navy.mil
Betsy Alspaugh	AECOM	866-327-8485	betsy.alspaugh@aecom.com
Scott Lewis	AECOM	808-356-5329	scott.lewis@aecom.com
Derek Yasaka	WCP	808-596-4688	dyasaka@wcphawaii.com
Rachel Kaminaka	WCP	808-596-4688	rkaminaka@wcphawaii.com
Steve Spengler	Element Environmental, LLC	808-448-1200	sspengler@e2hi.com

Joel Narusawa began the meeting with introductions and indicated that the objective was to discuss Former Sludge Disposal Area results and the treatability study. Mr. Narusawa also noted that several projects (i.e., sludge disposal RI, long-term monitoring [LTM] for aboveground storage tank [AST] 1253, and the treatability study) are occurring at the MCB Hawaii Fuel Farm and then turned the discussion over to Betsy Alspaugh.

2. KEY DISCUSSION POINTS

- Betsy Alspaugh referred everyone to the soil and groundwater data tables and the figure depicting both the AST 1253 and the Former Sludge Disposal Area sites. Ms. Alspaugh explained that the only RI subsurface soil and groundwater analytical data that exceed DOH environmental action levels (EALs) for total petroleum hydrocarbons (TPH) appear at two locations, i.e., the upper portion of the Former Sludge Disposal Area—which overlaps with the AST 1253 site and associated product plume—and the area to the south of the Former Sludge Disposal Area. Ms. Alspaugh also noted that the lead results for all RI groundwater samples (total and dissolved lead results) were either non-detect or very low in comparison to the previously reported lead in groundwater concentrations associated with AST 1253 site

characterization (SC) results which assumed that the Former Sludge Disposal Area was the source of that contaminant.

- Based on the RI soil and groundwater data, Betsy Alspaugh indicated that there does not seem to be significant contamination associated with the Former Sludge Disposal Area site. Ms. Alspaugh stated that the Navy would like to propose the collection of additional groundwater samples from five extant AST 1253 monitoring wells (MW10, MW21, MW22, MW24, and MW26) which contained the highest lead concentrations in groundwater during the SC investigation and exceeded the DOH EAL to determine current concentrations for comparison to RI lead groundwater data. This additional sampling for total and dissolve lead would be done in conjunction with upcoming AST 1253 LTM Event No. 3 scheduled for mid-August 2012. If the lead concentrations in the five additional proposed monitoring wells closely correlate with lead concentrations seen in the Former Sludge Disposal Area wells, the Navy would then like to propose a conditional no further action (NFA) recommendation for the Former Sludge Disposal Area site.
- Joel Narusawa noted that based on a discussion he had with Janice Fukumoto that it was felt the origin of the TPH-gasoline range organics (GRO) exceedance in soil and groundwater south of the Former Sludge Disposal Area is associated with the removal of aviation gasoline underground storage tanks. Mr. Narusawa further indicated that the Navy proposes to handle any remaining TPH issues under the AST 1253 environmental hazard evaluation/environmental hazard management plan, which should then allow for the proposed conditional NFA recommendation for the Former Sludge Disposal Area.
- Steven Mow asked if the groundwater sample collected from monitoring well MW58 exhibited a sheen or contained any free-phase petroleum product. Mr. Mow also asked if a confirmation sample was collected since it appears that the TPH-GRO value exceeds the solubility of TPH in groundwater. Rachel Kaminaka indicated that no sheen or product was detected in this monitoring well. Betsy Alspaugh indicated that only one sample was collected from MW58.
- Steven Mow concurred with the proposed approach for the sampling of monitoring wells MW10, MW21, MW22, MW24, and MW26 for total and dissolved lead, and he also proposed that MW58 be re-sampled (with a duplicate sample collected) to reconfirm the detected TPH-GRO groundwater exceedance. Joel Narusawa and Wesley Ching both agreed to the collection of groundwater samples for analysis of total and dissolved lead in monitoring wells MW10, MW21, MW22, MW24, and MW26 and the re-sampling of MW58 for TPH-GRO only during LTM Event No. 3.
- Joel Narusawa indicated that the purpose of the upcoming treatability study is to abate free-product at the Former Sludge Disposal Area site, but given the soil and groundwater findings a contract modification would be prepared to further address the AST 1253 site area. Mr. Narusawa then turned the meeting over to Steve Spengler to provide an overview of the treatability study.
- Steve Spengler referred everyone to his e-mailed treatability study layout and indicated that three options (Group 1, Group 2, and Group 3) are currently being proposed for the installation of two injection wells and two additional groundwater monitoring wells within each of the proposed Groups. Mr. Spengler also indicated that one existing monitoring well with each Group would be utilized. Mr. Spengler further indicated that the Group 1 option would address the distal end of the existing AST 1253 plume and that the Group 2 option would address the breakdown of the actual residual source area where the contaminant plume resides.

- Steve Spengler indicated that spike injections using conservative tracers (e.g., sodium bromide and sodium chloride) would be used and that a pulse injection system would be employed with the injection system that would be housed in a temporary storage shed. Mr. Spengler also indicated that the injection wells and additional groundwater monitoring wells would be installed in the August 2012 timeframe.
- Steve Spengler indicated that at this time E2 is recommending the Group 1 and 2 configurations and that anything further to the north could be an option.
- Scott Lewis noted that there are already a number of existing wells across the entire area and suggested that these wells be used instead of installing new wells. Mr. Lewis also broached the potential logistical issue associated with the parking of vehicles owned by deployed Marines across the entire area and access to existing groundwater monitoring wells. Mr. Lewis suggested that a possible solution for the Group 1 option would be to shift everything closer to Fifth Street.
- Given that the proposed Group 2 and 3 options overlap with the LTM-related monitoring wells, the upcoming field-related schedule was discussed. Betsy Alspaugh indicated that the field effort associated with the installation of four additional AST 1253 groundwater monitoring wells (MW40, MW41, MW42, and MW43) is scheduled to start on 16 July 2012 and that LTM Event No. 3 is being scheduled for 13-24 August 2012. Steve Spengler indicated that treatability study field-driven efforts could be scheduled so as not to conflict with LTM Event No. 3.
- Betsy Alspaugh also confirmed that MCB Hawaii has directed that no groundwater monitoring wells are to be installed within the Recreational Ball Field area.
- Joel Narusawa asked if suspended solids or salinity analyses were performed on the AST 1253 site groundwater. It was indicated that no analyses of these types had been performed, but that the groundwater was non-potable and assumed to be somewhat brackish. Rachel Kaminaka indicated that groundwater sampling logs could be provided to E2.
- Joel Narusawa asked Steven Mow what his overall thoughts were on the treatability study and the proposed options. Mr. Mow stated that the Group 1 and 2 options seem to be the best to pursue and to do and see what the results show. Mr. Mow also indicated that it would be preferable to use existing groundwater monitoring wells and not install additional wells than absolutely necessary.
- Steven Mow also asked that he be kept in the loop with regards to field work schedules pertaining to the treatability study and LTM Event No. 3.
- Joel Narusawa indicated that the Treatability Work Plan was being prepared in the “old” format and not the uniform federal policy-quality assurance program plan format and that it would be provided in approximately two weeks for information only, not approval.

3. ACTION ITEMS

- WCP will mobilize for and perform LTM Event No. 3 from 13 to 24 August 2012. This effort will also include sampling of a total of six additional groundwater monitoring wells: five monitoring wells (MW10, MW21, MW22, MW24, and MW26) to be analyzed for total and dissolved lead only, and MW58 to be analyzed for TPH-GRO only.
- Joel Narusawa and Wesley Ching will keep Steven Mow apprised on all field-related schedules.
- AECOM and WCP will provide Steve Spengler with groundwater sampling logs.

- Results of the re-sampling of groundwater monitoring well MW58 for TPH-GRO will be provided to Steven Mow and, as warranted, a meeting will be scheduled to further discuss the results.
- Non-validated analytical results for LTM Event No. 3 will be provided to Steve Spengler upon receipt from the analytical laboratory.

The meeting adjourned at approximately 0955 hours.

Meeting Minutes
Aboveground Storage Tank 1253 Long-Term Monitoring and
Former Fuel Farm Sludge Disposal Area Confirmation Sampling
Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii
Contract No. N62742-03-D-1837
CLEAN III CTO Nos. HC30 and HC25

Date: Tuesday, 20 November 2012
Time: 0939–1052 hours
Location: NAVFAC Hawaii Building X-11, Kaleonui (Small) Conference Room

1. INTRODUCTION, OVERVIEW, AND ATTENDEES

Representatives of the State of Hawaii Department of Health (DOH), Hazard Evaluation and Response (HEER) Office, Naval Facilities Engineering Command (NAVFAC), Hawaii, AECOM Technical Services, Inc. (AECOM), and Wil Chee - Planning, Inc. (WCP) conducted a meeting to discuss aboveground storage tank (AST) 1253 long-term monitoring (LTM) Event No. 3 and overall LTM performed under contract task order (CTO) HC30, and Former Fuel Farm Sludge Disposal Area confirmation groundwater sampling activities performed under CTO HC25 at Marine Corps Base (MCB) Hawaii. Handouts consisting of the meeting agenda, groundwater analytical tables, a product level table, and a site figure (Figure 1) were provided to meeting participants.

Individuals participating in the meeting and their respective affiliations are listed below.

Name	Organization	Telephone No.	E-Mail Address
Steven Mow	DOH HEER Office	808-586-4251	steven.mow@doh.hawaii.gov
Wesley Ching	NAVFAC Hawaii	808-471-1171 ext. 361	wesley.ching@navy.mil
Joel Narusawa	NAVFAC Hawaii	808-471-1171 ext. 222	joel.narusawa@navy.mil
Jocelyn Tamashiro	NAVFAC Hawaii	808-471-1171 ext. 362	jocelyn.tamashiro@navy.mil
Betsy Alspaugh	AECOM	866-327-8485	betsy.alspaugh@aecom.com
Scott Lewis	AECOM	808-356-5329	scott.lewis@aecom.com
Rachel Kaminaka	WCP	808-596-4688	rkaminaka@wcphawaii.com
Derek Yasaka	WCP	808-596-4688	dyasaka@wcphawaii.com

Wesley Ching convened the meeting by asking all participants to introduce themselves followed by an explanation of the meeting's purpose, i.e., to discuss cumulative results of free-phase petroleum product measurements and groundwater sampling/analytical events at the MCB Hawaii Fuel Farm relative to the AST 1253 release as well as the Former Fuel Farm Sludge Disposal Area. Wesley Ching further indicated that Jocelyn Tamashiro would become the NAVFAC Hawaii Navy technical representative (NTR) and remedial project manager (RPM) for the AST 1253 site in January 2013. Joel Narusawa also noted that Jocelyn Tamashiro would also become the NTR and RPM for the Former Fuel Farm Sludge Disposal Area in January 2013.

Wesley Ching then turned the meeting over to Betsy Alspaugh—participating in the meeting by telephone—who further introduced the topics to be discussed noting that AST 1253 LTM petroleum product measurements and groundwater sampling and analysis had been performed annually over the last 3 years pursuant to the (October 2009) environmental hazard evaluation (EHE) and environmental hazard management plan (EHMP), and that four new groundwater monitoring wells (MW40, MW41, MW42, and MW43) had been installed at the AST 1253 site in July 2012. Betsy Alspaugh further indicated that confirmation groundwater sampling for total and dissolved lead in

select AST 1253 monitoring wells (MW10, MW21, MW22, MW24, and MW26) and re-sampling of MW58 for total petroleum hydrocarbon (TPH) as gasoline range organics (GRO) resulting from the CTO HC25 27 June 2012 meeting with DOH had been undertaken in conjunction with LTM Event No.3. Betsy Alspaugh then turned the meeting over to Rachel Kaminaka to further discuss the provided handouts.

2. KEY DISCUSSION POINTS

- Rachel Kaminaka referred the meeting participants to the Figure 1 handout depicting the MCB Hawaii Fuel Farm monitoring wells and an approximate configuration of the free-phase petroleum product plume created by the AST 1253 Jet Propellant 5 (JP-5) release. Rachel Kaminaka noted that though measurable free-phase product has been observed in monitoring well MW31 since 2008, not all the monitoring wells were gauged for free-phase product since the beginning of the LTM effort as indicated in the free-phase petroleum product thickness handout. Consequently, the outer of the two amorphous configurations is her estimation of the JP-5 plume size as of LTM Event No. 3 while the inner configuration represents the 2008 site characterization plume estimate. Other meeting participants opined that the JP-5 plume did not appear to have exhibited much movement.
- Joel Narusawa described the JP-5 plume movement as pretty flat and indicated that the ongoing Element Environmental, LLC treatability study and synoptic groundwater study at the MCB Hawaii Fuel Farm should help to determine if continued plume movement is imminent and if in situ remediation of free-phase petroleum is viable. Joel Narusawa suggested that plume variability could be tidally influenced.
- Rachel Kaminaka indicated that—as part of LTM Event No. 3—a comprehensive groundwater survey was conducted over a 4-hour period during a flat tide cycle using all AST 1253 and Former Fuel Farm Sludge Disposal Area monitoring wells confirming the groundwater flow direction shown on Figure 1.
- Scott Lewis concurred that groundwater beneath the MCB Hawaii Fuel Farm is likely tidally influenced and stated that one may see a correlation of synoptic water-level measurements to Kaneohe Bay tidal predictions. Scott Lewis noted that free-phase petroleum product movement may be due to capillary expansion, acknowledged that the estimated plume boundary is a conservative estimate, and indicated that there does not appear to be much dissolved product at the AST 1253 site.
- Referring the meeting participants to the handout containing LTM groundwater analytical data ranging from 2008 through 2012, Rachel Kaminaka noted that the chemicals of potential concern (COPCs) do not exceed project-specific action levels. It was further noted that monitoring well MW15 exhibited the highest TPH concentration as diesel range organics.
- Responding to the question regarding whether or not the AST 1253 LTM should continue, Steven Mow indicated that free-phase petroleum product level measurements should continue until measurements get close to 0.1 foot and further stated that there is no need to continue groundwater sampling and analysis based on the LTM data over the last 3 years. This approach is compliant with the Hawaii State Contingency Plan where contamination left in place has been remediated and presumptive remedies have been applied “to the extent practicable.”
- Scott Lewis acknowledged that there is limited JP-5 plume mobility, i.e., the free-phase petroleum product is entrained in the soil matrix and consequently, is not going anywhere. Scott Lewis asked what would be considered an acceptable monitoring frequency since there is no 5-year review requirement. Steven Mow replied that NAVFAC Hawaii could consider

two alternatives, the first being every 3 years over a 6-year period and the second being annually over the next 3 years. He said that either alternative would suffice as an exit strategy presuming plume movement remains relatively static over that 6- or 3-year period, respectively. Scott Lewis added that the appropriate alternative would depend on how soon NAVFAC Hawaii would want to close the site. Wesley Ching indicated that NAVFAC Hawaii will confer internally and with MCB Hawaii Environmental Compliance and Protection Department to decide upon an appropriate monitoring frequency.

- Regarding what on-site wells to monitor henceforth, Steven Mow suggested gauging those wells along the JP-5 plume perimeter to determine if free-phase petroleum migration is continuing. Scott Lewis suggested also gauging monitoring wells within the plume itself to determine temporal changes in product thickness.
- Steven Mow recommended that the extant AST 1253 EHE/EHMP be revised to include an exit strategy and attendant contingencies directed toward a recommendation of no further action (NFA).
- Wesley Ching indicated that funds should be proposed to properly abandon the AST 1253 extraction wells. Betsy Alspaugh noted that MCB Hawaii is planning to re-line the AST 1253 secondary containment in 2013 and surmised the extraction wells would be properly abandoned at that time.
- Betsy Alspaugh initiated the confirmation groundwater sampling discussion and noted that no total or dissolved lead was detected above the laboratory's reporting limit in the five re-sampled AST 1253 groundwater monitoring wells (MW10, MW21, MW22, MW24, and MW26) as shown on the provided handout. Rachel Kaminaka added that confirmation groundwater samples from monitoring well MW58 located at the southwestern end of the Former Fuel Farm Sludge Disposal Area site near Third Street exhibited high TPH-GRO concentrations consistent with the remedial investigation (RI) groundwater sample concentration. Rachel Kaminaka further noted that the TPH-GRO detections are anomalies and do not appear to be related to the Former Fuel Farm Sludge Disposal Area. Rachel Kaminaka surmised that it may be related to a fuel pipeline along Third Street associated with a series of former underground storage tank (UST) systems that were removed in the early 1960s. Because UST system closure pre-dates UST regulations, no UST closure documentation is purported to exist. NAVFAC Hawaii will confer internally and with MCB Hawaii Environmental Compliance and Protection Department to determine how to administratively address the TPH-GRO contamination detected in monitoring well MW58.
- Given that Former Fuel Farm Sludge Disposal Area COPCs were either not detected or below applicable project-specific action levels, the question arose whether a conditional or unconditional NFA can be requested and, if so, which of the two would be more appropriate. Scott Lewis indicated that he would advocate for an unconditional NFA to which Steven Mow concurred.
- Betsy Alspaugh announced that the AST 1253 LTM Event No. 3 Report and the Former Fuel Farm Sludge Disposal Draft RI Report are scheduled to be submitted to NAVFAC Hawaii no later than 13 December 2012 and 17 December 2012, respectively.
- Betsy Alspaugh recapitulated the results of this meeting as follows:
  - CTO HC30 LTM-related groundwater sampling and analysis can be discontinued.
  - Revise the AST 1253 EHE/EHMP (October 2009) to address free-phase petroleum product measurements only, delete the extraction wells from the monitoring array, and include an exit strategy and applicable contingencies directed toward an unconditional NFA.

- Recommend an unconditional NFA for the Former Fuel Farm Sludge Disposal Area based on no COPCs, receptors, or risk.

3. ACTION ITEMS

- AECOM and WCP are to submit the AST 1253 LTM Event No. 3 Report to NAVFAC Hawaii by 13 December 2012.
- AECOM and WCP are to submit the Former Fuel Farm Sludge Disposal Draft RI Report containing an unconditional NFA to NAVFAC Hawaii by 17 December 2012.
- NAVFAC Hawaii will confer internally and with MCB Hawaii Environmental Compliance and Protection Department to determine an appropriate LTM free-phase petroleum product measurement frequency, i.e., once every 3 years over a 6-year period or once annually over a 3-year period.
- NAVFAC Hawaii will confer internally and with MCB Hawaii Environmental Compliance and Protection Department to determine how to administratively address the non-Fuel Farm Sludge Disposal Area TPH-GRO contamination detected in monitoring well MW58.

The meeting adjourned at approximately 1052 hours.

Meeting Minutes
Aboveground Storage Tank (AST) 1253 Environmental Hazard Evaluation/Environmental Hazard Management Plan (EHE/EHMP) Revision
Marine Corps Base Hawaii, Kaneohe, Hawaii
Contract No. N62742-03-D-1837
CLEAN III CTO No. HC30

Date: Friday, 15 March 2013
Time: 0830–0915 Hours
Location: Teleconference

1. INTRODUCTION, OVERVIEW, AND ATTENDEES

Representatives from the State of Hawaii Department of Health (DOH), Hazard Evaluation and Response (HEER) Office, Naval Facilities Engineering Command (NAVFAC), Hawaii, AECOM Technical Services, Inc., (AECOM), and Wil Chee - Planning Inc. (WCP) participated in a teleconference to discuss the planned revision to the current Aboveground Storage Tank (AST) 1253 environmental hazard evaluation/ environmental hazard management plan (EHE/EHMP) (AECOM and WCP 2009) and proposed inclusion of areas requiring further action identified in the December 2012 Draft Remedial Investigation (RI) Report prepared under Contract Task Order (CTO) HC25, which addresses the Former Fuel Farm Sludge Disposal Area.

Individuals participating in the teleconference and their respective affiliations are listed below.

Name	Organization	Telephone No.	E-Mail Address
Steven Mow	DOH HEER Office	808-586-4251	steven.mow@doh.hawaii.gov
Jocelyn Tamashiro	NAVFAC Hawaii	808-471-1171 Ext. 362	jocelyn.tamashiro@navy.mil
Betsy Alspaugh	AECOM Technical Services, Inc.	866-327-8485	betsy.alspaugh@aecom.com
Scott Lewis	AECOM Technical Services, Inc.	808-356-5329	scott.lewis@aecom.com
Rachel Kaminaka	Wil Chee - Planning, Inc.	808-596-4688	rkaminaka@wcphawaii.com
Derek Yasaka	Wil Chee - Planning, Inc.	808-596-4688	dyasaka@wcphawaii.com

Jocelyn Tamashiro convened the teleconference by introducing all participants followed by an explanation of the meeting's purpose (i.e., to discuss the planned revision to the current AST 1253 EHE/EHMP under CTO HC30 and the proposed inclusion of areas requiring further action identified in the Draft RI Report under CTO HC25). Ms. Tamashiro then turned the meeting over to Betsy Alspaugh.

2. KEY DISCUSSION POINTS

- Betsy Alspaugh indicated that the 2009 EHE/EHMP is to be updated by incorporating results of the three long-term monitoring (LTM) events that occurred in August 2010, 2011, and 2012. Ms. Alspaugh also summarized the sections where the majority of the revisions are to be made.
- Betsy Alspaugh asked Steven Mow if he had an opportunity to review Figure 1 demarcating the groundwater monitoring wells proposed for the next LTM event in 2015 (provided previously via email). Steven Mow replied that he has not, but will do so upon returning to his office. He is presently not in his office so is unable to peruse the figure during this teleconference.

- Steven Mow concurred with the proposed free-phase petroleum product LTM schedule of every 3 years for 6 years beginning in 2015. Mr. Mow recommended the EHE/EHMP cite the section of Hawaii Administrative Rules Chapter 11-281 indicating compliance with the Hawaii State Contingency Plan where free-phase petroleum product has been remediated and presumptive remedies have been applied "to the extent practicable."
- Betsy Alspaugh asked Steven Mow if he is amenable to inclusion of the Proposed Flight Training Simulator Area and Southeast Area in proximity to MW58 in the AST 1253 EHE/EHMP. Steven Mow replied that he is receptive to merging the two sites into a single EHE/EHMP; however, cautioned that doing so could impact future military construction projects at the sites.
- Moving on to discussion of the Former Fuel Farm Sludge Disposal Area Draft RI Report, Betsy Alspaugh acknowledged that naphthalene in soil gas samples exceeded its respective unrestricted use environmental action levels (EALs), however, were below their commercial/industrial EALs at the Proposed Flight Training Simulator Area. In addition, total petroleum hydrocarbons as gasoline and benzo(a)pyrene in subsurface soil and groundwater samples exceeded their respective unrestricted use EALs at the southeast area in proximity to MW58. The current administrative boundaries covered by the current AST 1253 EHE/EHMP will be revised to include the Former Flight Training Simulator Area and the Southeast Area in proximity to MW58.
- Betsy Alspaugh asked Steven Mow if the existing petroleum-impacted soil volume estimate (i.e., Appendix A) in the current EHE/EHMP can be retained in the document. Mr. Mow replied that the existing soil volume estimate can be retained.

3. ACTION ITEMS

- Jocelyn Tamashiro will send an e-mail message to Steven Mow reminding him to review Figure 1, depicting the proposed 2015 LTM monitoring wells.
- Steven Mow will review Figure 1 and provide his opinion by Monday, 18 March 2013.

The teleconference adjourned at approximately 0915 hours.

Appendix C
Response to Comments

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:
13-256-SPM

May 8, 2013

Ms. Jocelyn Tamashiro
Restoration Project Manager
NAVFAC Hawaii EV3
400 Marshall Road, Building X11
Joint Base Pearl Harbor-Hickam, HI 96860-3139

Facility/Site: Kaneohe MCBH, AST 1253

Subject: Review of Draft Environmental Hazard Evaluation / Environmental Hazard Management Plan for Aboveground Storage Tank 1253, MARINE CORPS BASE HAWAII, KANEOHE, HAWAII

Dear Ms. Tamashiro:

The Hawaii Department of Health Hazard Evaluation and Emergency Response (HEER) Office has reviewed the draft EHE/EHMP and has no substantive comments at this time. Please send the finalized document to the HEER office at your earliest convenience and make a formal letter request for No Further Action with Institutional Controls. Should you have any questions concerning the above please feel free to contact me at 586-7574.

Sincerely,

Steven P. Mow
Remedial Project Manager
Hazard Evaluation and Emergency Response Office