Revised Task 6 – Environmental Hazard Evaluation

Former ConocoPhillips Terminal
411 and 439 Pacific Street
Honolulu, Hawaii

TMK Nos. (1) 1-5-013:010 and 012

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LIST OF ACRONYMS

Acronym	Definition
amsl	above mean sea level
AST	Aboveground Storage Tank
BEI	Brewer Environmental Industries, LLC
bgs	below ground surface
BMP	Best Management Practices
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DLNR	Department of Land and Natural Resources, State of Hawaii
DOH	Department of Health, State of Hawaii
EAL	Environmental Action Level
EHE	Environmental Hazard Evaluation
EHM	Environmental Hazard Management
EPA	Environmental Protection Agency
EPM	Exposure Prevention Management
ERL	Environmental Response Law
ESI	Environmental Science International, Inc.
HAR	Hawaii Administrative Rules
HEER	Hazard Evaluation and Emergency Response
HFC	Hawaiian Fertilizer Company
HRS	Hawaii Revised Statutes
HVOC	Halogenated Volatile Organic Compound
IARC	International Agency for Research on Cancer
LCS	Laboratory Control Sample
Lowe's	Lowe's Home Improvement Warehouse
MNA	Monitored Natural Attenuation
MRL	Method Reporting Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MTBE	Methyl Tert-Butyl Ether
O&M	Operation and Maintenance
PAH	Polycyclic Aromatic Hydrocarbon
PG&F	Pacific Guano and Fertilizer Company
ppm	parts per million
QA	Quality Assurance
QC	Quality Control
RAA	Remedial Alternatives Analysis
SPLP	Synthetic Precipitation Leachate Procedure
SVOC	Semi-Volatile Organic Compound
TMK	Tax Map Key
TPH-d	Total Petroleum Hydrocarbon as Diesel Fuel
TPH-g	Total Petroleum Hydrocarbon as Gasoline
TPH-o	Total Petroleum Hydrocarbon as Oil
TTLR	Tanker Truck Loading Rack

Acronym	Definition
UIC	Underground Injection Control
Unocal	Union Oil Company of California
UST	Underground Storage Tank
VOC	Volatile Organic Compound
VRP	Voluntary Response Program

SECTION 1 – INTRODUCTION

This environmental hazard evaluation [EHE] report is submitted in fulfillment of Task 6 of the Voluntary Response Program [VRP] agreement between the State of Hawaii Department of Health [DOH] and Lowe's Home Improvement Warehouse, Inc. [Lowe's]. The subject of the VRP agreement is the site of the former ConocoPhillips Honolulu bulk fuel terminal, hereinafter referred to as the "Terminal," and the site of the Brewer Environmental Industries, LLC [BEI], Hawaii facility. The Terminal property is located at 411 and 439 Pacific Street (Tax Map Key [TMK] Nos. (1) 1-5-013:010 and (1) 1-5-013:012) and the BEI Hawaii property is located at 311 Pacific Street (TMK No. (1) 1-5-013:023).

Lowe's purchased all three parcels from ConocoPhillips with the intent of developing a Lowe's retail store. In preparation for the planned construction of the store, the Terminal was demolished. However, the BEI Hawaii facility plans to continue operations under its existing lease. The EHE described in this report does not include the BEI Hawaii facility.

The VRP agreement provides a means of allowing Lowe's to conduct environmental investigation, release response activities, and remediation under the close oversight of the DOH Hazard Evaluation and Emergency Response [HEER] Office. Once the environmental investigation, release response activities, and remediation have been completed to the DOH's and the public's satisfaction, Lowe's will receive a *Letter of Completion* [LOC], which will carry with it an exemption from future environmental liability for specific, agreed-upon contaminants of potential concern [COPCs]. The exemption from future liability will be transferable to subsequent prospective purchasers.

ConocoPhillips and Lowe's are cooperating in order to expedite the VRP process. After meeting the requirements of the VRP agreement, ConocoPhillips intends to request that the DOH issue a letter stating that no further environmental investigation or remediation is required (i.e., a *No Further Action* letter) for the property.

The VRP agreement includes ten tasks. The first five tasks have been completed. This report documents the work conducted in accordance with Task 6. The first six tasks are summarized briefly below.

Task 1 – Summary of Environmental Work. This report presented a comprehensive summary of environmental information relating to the property (Environmental Science International, Inc. [ESI], 2005). The purpose of Task 1 was to provide a summary of all environmental data, information, and known environmental conditions resulting from previous activities and documented environmental investigations of the property.

Task 2 – General Work Plan. This plan included a data gap analysis and provided a general outline for conducting an environmental site characterization of the property (ESI, 2006).

Task 3 – Detailed Work Plan. This plan presented the scope of work for a detailed soil, groundwater, and soil vapor investigation designed to characterize the current environmental

condition of the property. Areas of potential concern were identified and a preliminary conceptual site model [CSM] was developed. The goal of the investigation was to acquire the data necessary to assess the potential risk to human health and ecological receptors posed by contamination at the property, as well as to develop remedial alternatives (ESI, 2007a).

Task 4 – Site Characterization. The site characterization report (ESI, 2007b) presented the results of the implemented detailed work plan that was presented in Task 3. The results of soil, groundwater, and soil vapor sampling and analysis were presented; the types of contamination were identified; and the extent and magnitude of contamination were summarized.

Task 5 – Remedial Alternatives Analysis [RAA]. The RAA (ESI, 2007c) identified, screened, developed, and analyzed remedial alternatives to address environmental concerns identified during the site characterization. The overall objective of the RAA was to select the most efficient, cost-effective, and reliable remedial solution that best protects human health and sensitive ecological receptors.

Task 6 – Environmental Hazard Evaluation. The purpose of the EHE is to identify and evaluate the potential hazards to human health and sensitive ecological receptors posed by the contaminants of concern identified during the site characterization and aid in the selection of final remedial actions. The identified potential hazards include the following.

- Gross Contamination.
- Direct Exposure.
- Vapor Intrusion.
- Leaching.
- Ecotoxicity.
- Contamination of Drinking Water Supplies.

The overall objective of the EHE is to evaluate these environmental hazards with respect to potentially affected human and ecological populations under (1) current site conditions, (2) conditions during planned construction activities, and (3) anticipated future conditions for the planned use of the property. This EHE report was prepared following the general guidelines presented in the DOH technical report, *Screening For Environmental Concerns At Sites With Contaminated Soil and Groundwater* (DOH, 2005).

Subsequent tasks will include a public participation plan and draft remedial action memorandum (VRP Task 7), a final remedial action memorandum (VRP Task 8), a remedial implementation report (VRP Task 9), and a letter of completion (VRP Task 10).

SECTION 2 – BACKGROUND

2.1 PROPERTY LOCATION AND SETTING

The property is located in the Iwilei district of Honolulu, a commercial and light industrial area (Figure 1). The property is bordered on the east by Pacific Street, on the south by the BEI Hawaii facility, on the west by North Nimitz Highway, and on the north by Home Depot and Weyerhaeuser (Figure 2). The property lies seaward of the underground injection control [UIC] line, at a surface elevation of approximately 6 to 8 feet above mean sea level [amsl]. The nearest major bodies of surface water are Kapalama Channel and Honolulu Harbor, approximately 1,000 feet to the south, and Nuuanu Stream, approximately 0.4 miles to the east.

2.2 CLIMATOLOGIC CONDITIONS

Climatologic conditions in the area of the property consist of warm to moderate temperatures and low to moderate rainfall. The property is on the southern central coastal plain of Oahu (leeward of the prevailing east to northeasterly trade winds). The average annual precipitation is 15 inches, which occurs mainly between November and April (Atlas of Hawaii, 1983, State of Hawaii Department of Land and Natural Resources [DLNR], 1986). Average temperatures range from the low 60's to high 80's (degrees Fahrenheit). The annual pan evaporation is approximately 80 inches (DLNR, 1985).

2.3 REGIONAL AND SITE GEOLOGY

Oahu consists of the eroded remnants of two shield volcanoes, Waianae and Koolau. The property is located on a relatively flat, alluvial flood plain of the Koolau volcanic shield. Lavas erupted during the shield-building phase of the volcano belong to the *Koolau Volcanic Series* (Stearns and Vaksvik, 1935). Following formation of the Koolau shield, a long period of volcanic quiescence occurred, during which the shield was deeply eroded. Following this erosional period, eruptive activity resumed. Lavas and pyroclastic material that erupted during this period belong to the *Honolulu Volcanic Series* (Stearns and Vaksvik, 1935).

The soil in the area of the property is classified by the United States Department of Agriculture [USDA] Soil Conservation Service as part of the Lualualei-Fill Land-Ewa Association [FL] or *fill land mixed*, which consists of dredged materials from the ocean or hauled from nearby areas (Foote, et al., 1972). The land that the property occupies was dredged from Honolulu Harbor in 1840 to widen and deepen the channel. Debris from the Chinatown fire reportedly was used as fill at a later date (circa 1900).

In the immediate area of the property, consolidated calcareous marine sediments dominate, although the property lies on artificial fill composed of marine deposits (Stearns and Vaksvik, 1935; Stearns, 1939). Based on records of drilled wells (Stearns and Vaksvik, 1938), the property is underlain by alternating coral (up to 30 feet thick) and clay (up to 25 feet thick) layers down to approximately 90 feet below ground surface [bgs]. These deposits are underlain by basalt lavas interbedded with clays and boulders. The lavas likely belong to the *Nuuanu*

Volcanics (Stearns and Vaksvik, 1935), which are part of the Honolulu Volcanic Series and whose source has been identified as the Luakaha vent (Macdonald et al., 1983). Underlying the Nuuanu Volcanics are alternating coral and clay layers down to approximately 600 feet bgs, where basalts of the Koolau Volcanic Series are encountered.

2.4 LITHOLOGY

The subsurface lithology at the property was determined using field observations of the shallow stratigraphy exposed in the test pits and of the soil samples collected from the two deep monitoring well borings and the four geotechnical borings installed during the site characterization (ESI, 2007b). A cross section showing the subsurface lithology at the property is provided in the Remedial Alternatives Analysis (ESI, 2007c).

The upper 2 to 8 feet consist of fill. The type of fill varies across the property. Debris from the Chinatown fires covers approximately 70 percent of the property, principally the area of the three tank farms. The debris consists of black, silty soil with glass bottles, ceramic material, metal fragments, rocks, brick, wood, and other materials. In other areas, the fill consists of basalt gravel (base course) and black, silty clays.

Underlying the fill down to approximately 45 to 50 feet bgs are lagoonal deposits consisting of coralline sands, silts, and gravels. The lagoonal deposits are underlain by a dense alluvial deposit that consists of sandy clays and silts. The thickness of the alluvial deposit, as determined from the geotechnical borings, varies from 22 to 33 feet. Underlying the alluvial deposit are intercalated lagoonal and alluvial sediments down to at least 89 feet bgs.

2.5 REGIONAL AND SITE HYDROGEOLOGY

Groundwater in Hawaii exists in two principal types of aquifers. The first and most important type, in terms of drinking water resources, is the basal aquifer. The basal aquifer exists as a lens of fresh water floating on and displacing seawater within the pore spaces, fractures, and voids of the basalt that forms the underlying mass of each Hawaiian island. In parts of Oahu, including the area of the property, groundwater in the basal aquifer is confined by the overlying caprock sediment deposits and is under pressure. Waters that flow freely to the surface from wells that tap the confined basal aquifer are referred to as *artesian*.

The second type of aquifer is the shallow caprock aquifer, which consists of various kinds of unconfined and semi-confined groundwater. In the area of the property, the caprock is a thick (greater than 500 feet) sequence of nearly impermeable clays and coral. This sequence separates the caprock aquifer from the basal aquifer. The impermeable nature of these materials and the artesian nature of the basal aquifer severely restrict the downward migration of groundwater from the upper caprock aquifer.

The property is underlain by the *Kalihi Aquifer System* of the *Honolulu Aquifer Sector* (Mink and Lau, 1990). The upper sedimentary aquifer is not a drinking water source, has moderate salinity, is not considered ecologically important, is considered replaceable, and has a high vulnerability

to contamination. The shallow water table at the property varies from four to seven feet bgs depending on location. The shallow water table at the property is tidally influenced because of its proximity to the coast. During low tides, the general direction of groundwater flow in the shallow aquifer is to the south, towards the ocean (i.e., Kapalama Channel), whereas during high tides, the general direction of groundwater flow in the shallow aquifer is to the north, away from the ocean (CH2M Hill, 2004).

The basal (drinking water) aquifer resides in Koolau Volcanic Series lavas, which in the area of the property are greater than 600 feet bgs. This aquifer is considered as a potential drinking water source, is considered fresh water, and irreplaceable with a low vulnerability to contamination (Mink and Lau, 1990). There are 15 non-drinking water wells within a half-mile of the property (Table 2.1). The nearest drinking water supply well is approximately one mile north and upgradient of the property, and there are no drinking water wells downgradient. Based on the direction and distance to the nearest drinking water well, the thickness of the caprock, and the depth to the basal (drinking water) aquifer, it is unlikely that releases of hazardous substances at or in the immediate vicinity of the property have impacted or could impact drinking water sources.

2.6 PROPERTY OWNERSHIP

The earliest recorded owner of the property was Hawaiian Fertilizer Company [HFC]. In 1922, HFC merged with Pacific Guano and Fertilizer Company [PG&F] and continued to operate on the 311 and 411 Pacific Street parcels through 1961. During this time, the 439 Pacific Street parcel was owned by Union Oil Company of California, Inc. [Unocal]. In 1961, Unocal purchased the 311 and 411 Pacific Street parcels. In 1997, Unocal sold the property and ongoing operations to the Tosco Corporation. In 2001, Phillips Petroleum Company acquired Tosco Corporation and became owner of the property. In 2002, Conoco, Inc., merged with Phillips Petroleum Company to become ConocoPhillips. Lowe's purchased the property from ConocoPhillips in 2005.

2.7 PROPERTY HISTORY

Prior to 1900, HFC formulated and distributed fertilizers and chemicals at the property. In 1914, the HFC facility contained approximately ten buildings, which were used to store phosphate, potassium carbonate (potash), ammonium sulfate (sulfate of ammonia), sodium nitrate (nitrate of soda), and other chemicals.

In 1922, PG&F continued to operate the property as a chemical and fertilizer production and storage facility. Fertilizers and chemicals used for processing sugar, pineapple, and coffee were mixed, bagged, and stored at the property. A 1927 Sanborn map indicates that the buildings on the property included a sulfur warehouse, a copperas (ferrous sulfate) plant, acid chambers, an acid phosphate plant, a bag warehouse, a bag mill, a dryer, an oil tank, a laboratory, a mixing plant, an office, a machine shop, and storage buildings (ESI 2005).

TABLE 2.1
Nearest Water and Injection Wells
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Lowe's VRP – Former ConocoPhillips Terminal

Well Identification Number	Well Name or Location	Date Constructed	Elevation (amsl)	Distance from Site (miles)	Gradient/ Direction	Depth (feet bgs)	Owner	Status/Use
Non-Drinking Water Wells								
3-1952-14	Iwilei #119	1923	4	Adjacent	upgradient/North	682	HON Gas	Steam, Sealed
3-1952-24	Kapalama SW1	1947	4	Adjacent	upgradient /NE	80	HON Gas	Cooling, Sealed
3-1952-25	Kapalama SW2	1947	4	Adjacent	upgradient /NE	81	HON Gas	Cooling, Sealed
3-1952-29	Kapalama Battery	1951	-	0.10	cross-gradient/East	40	Castle & Cooke	Sealed
3-1952-32	Kapalama Battery	1957	-	0.18	cross-gradient/East	40	Castle & Cooke	Industrial
3-1952-33	Kapalama Battery	1957	-	0.19	cross-gradient/East	40	Castle & Cooke	Sealed
3-1952-11	Iwilei	1913	5	0.20	upgradient/NE	513	Castle & Cooke	Industrial
3-1952-13	Iwilei	1923	4	0.20	upgradient/NE	650	Castle & Cooke	Industrial
3-1952-26	Kapalama Battery	1950	-	0.20	upgradient/NE	36	DEL Monte Corp.	Industrial
3-1952-27	Kapalama Battery	1950	-	0.20	upgradient/NE	35	DEL Monte Corp.	Industrial
3-1952-28	Kapalama Battery	1950	-	0.20	upgradient/NE	35	DEL Monte Corp.	Industrial
3-1952-31	Kapalama Battery	1954	-	0.20	cross-gradient/East	42	Castle & Cooke	Industrial
3-1952-12	Iwilei	1920	6	0.21	upgradient/NE	599	CANN SLF Store	Industrial
3-1952-20	Kapalama Battery	1927	5	0.25	upgradient/NE	540	Castle & Cooke	Industrial
3-1952-23	Kapalama	1939	4	0.40	upgradient/NE	100	HAW Gas Production	Unused
Injection Wells								
Unknown	Disposal Well 1	1951	4	Adjacent	upgradient /NE	75	HON Gas	Disposal, Sealed
Unknown	Disposal Well 2	1971	4	Adjacent	upgradient /NE	65	HON Gas	Disposal, Sealed
3-1952-04	Iwilei	1900	16	Adjacent	cross-gradient/NE	150	AHIN Y Trust	Observation
3-1952-01	Iwilei	1882	21	0.12	upgradient/North	384	Hawn Evangl CL	Sealed
3-1952-03	Iwilei	1900	5	0.17	cross-gradient/West	530	Oahu R R & L	Unused
3-1852-01	Ala Moana Blvd	1937	-	0.25	downgradient/South	60	Chun Hoon MKT	Other
3-1952-02	Iwilei	1883	30	0.32	downgradient/SE	600	FELIX F	Sealed

Source: DLNR (1993).
amsl above mean sea level
bgs below ground surface
- not reported

The Terminal consisted of three inter-connected tank farms built in 1923, 1941, and 1970. The 1923 and 1941 Tank Farms were located on the 439 Pacific Street parcel, and the 1970 Tank Farm was located on the 411 Pacific Street parcel (Figure 3).

Initial construction of the Unocal Terminal took place from 1921 to 1927. The Terminal would eventually consist of three interconnected tank farms constructed in 1923, 1941, and 1970. The 1923 and 1941 Tank Farms were located at 439 Pacific Street, and the 1970 Tank Farm was located at 411 Pacific Street (Figure 3). By 1927, the Terminal consisted of eight aboveground storage tanks [ASTs] used to store petroleum products, a tanker truck loading rack [TTLR], and railroad platforms. The ASTs were contained in a single tank yard surrounded by a containment wall (the 1923 Tank Farm).

In 1941, several new ASTs were constructed, and the TTLR and railroad platforms were removed. A containment wall was constructed around the new ASTs (the 1941 Tank Farm). By 1950, structures on the property included the lube and bag warehouse, tire battery and accessory [TBA] warehouses, acid production and storage areas, parts and oil emulsion warehouses, sulfur warehouse, the copperas plant, a cafeteria and an office (Figures 4 and 5).

The majority of the chemical and fertilizer buildings at the property were demolished in the late 1960s and early 1970s to make room for the expanded fuel terminal operations. By the mid-1970s, the expansion of the tank farm (the 1970 Tank Farm) and the construction of additional TTLRs and a new warehouse had been completed.

In 2005, Lowe's purchased the property. Demolition of the Terminal was completed in March 2007 and construction of a Lowe's retail store is anticipated. Upon completion of the demolition, the property was graded and left as an open, unpaved lot.

SECTION 3 – CONTAMINANTS OF CONCERN

The COPCs were identified based on historical activities conducted at the property. The contaminants of concern were identified based on the results of the site characterization conducted at the property.

3.1 CONTAMINANTS OF POTENTIAL CONCERN

The COPCs were identified based on historical activities conducted at the property. These COPCs were incorporated into the VRP agreement, along with the potentially impacted media. The media identified in the VRP agreement are soil, soil vapor, and groundwater.

The historical activities conducted at the property and the potential chemicals associated with those activities have been presented in the *Summary of Environmental Work* submitted as Task 1 under the VRP agreement (ESI, 2005) and in the *General Work Plan* submitted as Task 2 under the VRP agreement (ESI, 2006). The COPCs identified in the VRP agreement are summarized in Table 3.1.

3.2 CONTAMINANTS OF CONCERN

The contaminants of concern were identified based on the results of the site characterization, which was conducted as Task 4 under the VRP agreement. These contaminants are discussed in detail in the site characterization report (ESI, 2007b).

Those COPCs detected at concentrations above DOH EALs in soil, groundwater, and soil vapor are considered contaminants of concern. They include total petroleum hydrocarbons as gasoline [TPH-g], as diesel fuel [TPH-d], and as oil [TPH-o]; benzene, toluene, ethylbenzene, xylenes [BTEX]; methyl-tert-butyl ether [MTBE]; styrene; halogenated volatile organic compounds [HVOCs]; polycyclic aromatic hydrocarbons [PAHs]; tetrachloroethylene [PCE]; pesticides; and metals (inorganics). In addition, free-phase petroleum product (e.g., gasoline, diesel fuel, fuel oils, lubricating oils) is considered a contaminant of concern. The contaminants of concern are summarized in Table 3.2.

The PAHs identified as contaminants of concern include acenaphthene, acenaphthylene, anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[a]pyrene, benzo[g.h,i]perylene, chrysene, dibenzo[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene. The pesticides include pentachlorophenol and 4,4'-DDT. The inorganics include arsenic, barium, cadmium, chromium, lead, mercury, and silver.

TABLE 3.1
Contaminants of Potential Concern
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Contaminant of Potential Concern	Specific Contaminant
Total Petroleum Hydrocarbons	Total Petroleum Hydrocarbons as Gasoline, as Diesel Fuel, and as Oil
Free-Phase Petroleum Product	Gasoline Diesel Fuel Fuel Oils Lubricating Oils
Volatile Organic Compounds	Benzene Toluene Ethylbenzene Xylenes Methyl-Tert-Butyl Ether
Halogenated Volatile Organic Compounds	Tetrachloroethylene Trichloroethylene 1,1,1-Trichloroethane 1,1-Dichloroethylene Vinyl Chloride
Semi-Volatile Organic Compounds	Acenaphthene Benzo[a]pyrene Fluoranthene Naphthalene
Organochlorine Pesticides	Aldrin Alpha-BHC Beta-BHC Delta-BHC Gamma-BHC (Lindane) Chlordane Alpha-Chlordane Gamma-Chlordane 4,4'-DDD 4,4'-DDE 4,4'-DDT Dieldrin Endosulfan I Endosulfan II Endosulfan Sulfate Endrin Heptachlor Heptachlor Epoxide Methoxychlor Toxaphene
Chlorinated Herbicides	2,4-D

Contaminant of Potential Concern	Specific Contaminant
	2,4-DB 2,4,5-T 2,4,5-TP (Silvex) Dalapon Dicamba Dichloroprop Dinoseb MCPA MCPP Pentachlorophenol
Asbestos	Asbestos-Containing Building Materials Paint Transite Piping
Lead-Based Paint	Lead
Metals	Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver

TABLE 3.2
Summary of Contaminants of Concern
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Contaminant of Concern	Soil	Groundwater	Soil Vapor
TPH-g	✓	✓	✓
TPH-d	✓	✓	n/a
TPH-o	✓	✓	n/a
Benzene	✓	✓	✓
Toluene	✓	✓	✓
Ethylbenzene	✓	✓	
Xylenes	✓	✓	✓
MTBE			✓
Styrene	✓	✓	
PAHs	✓	✓	
Tetrachloroethylene			✓
Pentachlorophenol	✓	✓	n/a
4,4'-DDT		✓	n/a
Arsenic	✓	✓	n/a
Barium	✓		n/a
Cadmium	✓		n/a
Chromium	✓		n/a
Lead	✓	✓	n/a
Mercury	✓		n/a
Silver	✓	✓	n/a

✓	Detected at concentrations above DOH EALs.
TPH-g	Total Petroleum Hydrocarbons as gasoline.
TPH-d	Total Petroleum Hydrocarbons as diesel fuel.
TPH-o	Total Petroleum Hydrocarbons as oil.
MTBE	Methyl-Tert-Butyl Ether.
PAHs	Polycyclic Aromatic Hydrocarbons.
n/a	not analyzed.

SECTION 4 – POTENTIAL ENVIRONMENTAL HAZARDS

There are several potential environmental hazards that must be evaluated at release sites, such as the property. The hazards associated with contaminated soil include direct exposure, vapor intrusion, leaching, impacts to terrestrial habitats, and gross contamination. The hazards associated with contaminated groundwater include contamination of drinking water supplies, vapor intrusion, impacts to aquatic habitats, and gross contamination. Both current and future potential hazards were considered. These hazards are summarized in Table 4.1.

The potential environmental hazards were screened for their applicability to the property. Those potential hazards that are not of concern at the property were eliminated from further evaluation. Those hazards that could be of concern were retained and are evaluated further in Section 7. This screening of potential environmental hazards assumes conservatively, that no remediation will be performed and no institutional or engineered controls will be implemented.

4.1 GROSS CONTAMINATION

Gross contamination refers broadly to physical conditions that present odor, nuisance, and general pollution concerns. It includes free product, objectionable odors and tastes (in drinking water), and general resource degradation. At high levels, certain types of gross contamination can become a physical hazard (e.g., the presence of flammable vapors or liquids, such as those associated with gasoline). In general, the contaminants in areas considered to be grossly contaminated are relatively immobile, are nontoxic to humans, and do not threaten ecological receptors.

Gross contamination in soil includes potentially mobile free product, nuisance odors, aesthetics, the generation of explosive vapors, and general resource degradation. Gross contamination in groundwater includes potentially mobile free product, contaminated drinking water supplies, nuisance odors from surface water, objectionable taste in drinking water, a petroleum hydrocarbon sheen on surface water, and general resource degradation.

In the absence of institutional and/or engineered controls, future human populations at the property could be exposed to gross contamination (e.g., free product, objectionable odors). The gross contamination hazard is evaluated further in Section 7.

4.2 DIRECT EXPOSURE

The direct exposure hazard involves human contact with contaminated soil, groundwater, or soil vapor either directly or indirectly. Direct contact can be made through incidental ingestion, dermal contact, or the inhalation of dust in outdoor air. Indirect contact can be made through the inhalation of soil vapors in outdoor air. In general, the contaminants in areas considered to present a direct exposure hazard are relatively immobile, are highly toxic to humans, and do not threaten ecological receptors.

TABLE 4.1
Summary of Potential Environmental Hazards
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Lowe's VRP – Former ConocoPhillips Terminal

Media	Risk	Environmental Hazard	Description
Contaminated Soil	Human Health	Direct Exposure	Incidental ingestion or dermal absorption of contaminants in soil. Incidental inhalation of vapors or dust in outdoor air.
		Vapor Intrusion	Exposure to volatile contaminants in soil from the intrusion of vapors from the subsurface into buildings.
	Groundwater	Leaching	Contamination of groundwater resources by leaching of contaminants from soil by infiltrating surface water (e.g., rainfall, irrigation water).
	Ecological	Impacts to Terrestrial Habitats	Impacts to terrestrial flora and fauna by toxic contaminants.
	Physical	Gross Contamination	Potentially mobile free product, nuisance odors, aesthetics, generation of explosive vapors, general resource degradation.
Contaminated Groundwater	Human Health	Contamination of Drinking Water Supplies	Contamination of groundwater that is a current or potential source of drinking water by toxic contaminants.
		Vapor Intrusion	Exposure to volatile contaminants in groundwater from the intrusion of vapors from the subsurface into buildings.
	Ecological	Impacts to Aquatic Habitats	Impacts to aquatic flora and fauna by toxic contaminants through the discharge of groundwater into surface waters.
	Physical	Gross Contamination	Potentially mobile free product, contaminated drinking water supplies, nuisance odors, generation of explosive vapors, objectionable taste in drinking water, petroleum hydrocarbon sheen on surface water, general resource degradation.

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. The direct exposure hazard is evaluated further in Section 7.

4.3 SOIL VAPOR INTRUSION

Vapor intrusion involves the exposure of human populations to volatile chemical compounds that have entered a building or other enclosed structure from contaminated subsurface soil or contaminated groundwater. In general, the contaminants in areas considered to present a vapor intrusion hazard are volatile chemicals that are toxic to humans through the inhalation of vapors.

In the absence of remediation and institutional and engineered controls, future human populations at the property could be exposed to VOC vapors. The vapor intrusion hazard is evaluated further in Section 7.

4.4 LEACHING

Leaching is the movement of soil contaminants in vadose zone soils into underlying groundwater through chemical and physical mechanisms. The principal chemical mechanism is the dissolution of contaminants into water (e.g., percolating rainwater, irrigation water) moving downwards through the vadose zone. Physical mechanisms include (1) the entrainment of contaminants bound in a colloid phase by water moving through the vadose zone and (2) mass movement of contaminants through the vadose zone by infiltrating water. In general, the contaminants in areas considered to present a leaching hazard typically are mobile, volatile chemicals that are toxic to humans but do not threaten ecological receptors.

In the absence of engineered controls at the property, groundwater could be contaminated through the leaching of contaminants from vadose zone soils by infiltrating water. The leaching hazard is evaluated further in Section 7.

4.5 ECOTOXICITY

Ecotoxicity refers to the capability of a contaminant to damage an ecological population, ecological community, or ecosystem. The ecotoxicity of a contaminant typically is based on its toxicity to one or more species, its persistence in the environment, and its ability to bioaccumulate. The two populations under consideration are flora and fauna in terrestrial (i.e., land) habitats and flora and fauna in aquatic (i.e., marine) habitats.

4.5.1 Impacts to Terrestrial Habitats

Impacts to terrestrial flora and fauna can occur through exposure of populations to contaminated soil. In general, the contaminants in areas considered to present a terrestrial ecotoxicity hazard typically are relatively immobile, non-volatile chemicals that are toxic to ecological receptors. Because there are no current or future sensitive ecological receptors at the property, terrestrial ecotoxicity is not considered a concern and will not be evaluated further.

4.5.2 Impacts to Aquatic Habitats

Impacts to aquatic (i.e., marine) flora and fauna can occur through the discharge of contaminated groundwater into surface waters. In general, the contaminants in areas considered to present a marine ecotoxicity hazard typically are mobile, volatile chemicals that are toxic to ecological receptors. In the absence of engineered controls, sensitive marine populations could be exposed to groundwater contaminants entering the ocean via a potential preferential pathway (i.e., the current and future storm drains). The marine ecotoxicity hazard is evaluated further in Section 7.

4.6 Contamination of Drinking Water Supplies

Contamination of drinking water supplies involves the potential exposure of human populations to chemical compounds that have entered a drinking water aquifer. This could occur directly or indirectly. Direct contamination of drinking water supplies can occur when contaminants directly enter a drinking water aquifer. Indirect contamination of drinking water supplies can occur when contaminated shallow caprock groundwater migrates downwards and impacts a deeper drinking water aquifer. In general, the contaminants in areas considered to present a drinking water contamination hazard typically are mobile, soluble chemicals that are toxic to humans but do not threaten ecological receptors. Because of the depth (greater than 600 feet bgs) to the basal (drinking water) aquifer and the lack of drinking water wells within a mile of the property, contamination of drinking water supplies is not considered a concern and will not be evaluated further.

4.7 Retained Potential Environmental Hazards

Based on the screening described in Sections 4.1 to 4.6, five of the seven potential environmental hazards were retained for further evaluation (see Section 7). Terrestrial ecotoxicity was eliminated from consideration because there are no current or future sensitive ecological populations at the property. Contamination of drinking water supplies was eliminated from consideration because of the depth to the drinking water aquifer and the lack of nearby drinking water wells. The potential environmental hazards retained for further evaluation are summarized in Table 4.2.

TABLE 4.2
Retained Potential Environmental Hazards
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Population	Potential Hazard	Media		
		Soil	Groundwater	Soil Vapor
Human	Gross Contamination	✓	✓	✓
	Direct Exposure	✓	✓	✓
	Vapor Intrusion	✓	✓	✓
	Leaching	✓		
Ecological	Impact to Aquatic Habitats		✓	

✓ Contaminated medium poses a potential hazard.

SECTION 5 – EVALUATION OF HUMAN HEALTH AND ECOLOGICAL RISK

This section presents a more site-specific evaluation of potential toxicological hazards posed to human and ecological populations. Potential human and ecological populations were evaluated with regards to current site conditions, conditions during planned construction activities, and anticipated future conditions for the planned use of the property (i.e., as a Lowe's retail store). This screening of potentially affected human and ecological populations assumes, conservatively, that no remediation will be performed and no institutional or engineered controls will be implemented. These potentially affected populations could be exposed to contamination through contact with contaminated soil, groundwater, or soil vapor.

5.1 EVALUATION OF HUMAN HEALTH RISK

5.1.1 Potentially Affected Human Populations

The property is located within an area that is used exclusively for industrial and commercial purposes. The planned future land use is for a large commercial facility (i.e., a Lowe's retail store). Human populations that could come into contact with contamination under current and anticipated future site conditions include the general public, construction workers, and on-site workers and customers. The potentially affected human populations are summarized in Table 5.1.

TABLE 5.1
Potentially Affected Human Populations
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Human Population	Site Scenario*		
	Current Use	Construction Phase	Future Use
General Public	✓	✓	
Construction Workers		✓	
On-Site Workers & Customers			✓

* In the absence of remediation and without institutional or engineered controls.
✓ Human population is potentially affected.

Current Site Conditions

The property is surrounded by a security fence with a locked gate, and it is manned by a security guard at all times. Human populations that could come into contact with contamination under current site conditions are restricted to the security guards and occasional visitors (i.e., Lowe's, ConocoPhillips, environmental, and regulatory personnel), collectively referred to herein as the *general public*.

Conditions During Planned Construction Activities

During construction of the Lowe's store, the property will be surrounded by a security fence with locked gates, and will be manned by a security guard at all times. The principal human

populations that could come into contact with contamination during construction activities will be construction workers and others involved in the construction activities (e.g., City and County utility workers, Lowe's personnel). Other potentially affected human populations include ConocoPhillips, environmental, and regulatory personnel)

Anticipated Future Conditions (Lowe's Retail Store)

During operation of the Lowe's store, the property will consist of a retail building, a concrete parking structure, concrete- and/or asphalt-paved parking areas and access roads, and small landscaped areas. The principal human populations that could come into contact with contamination during store operation will be on-site workers and customers.

5.1.2 Retained Potentially Affected Human Populations

Based on the screening described in Section 5.1.1, four potentially affected human populations were retained for further evaluation (see Section 7). The potential human populations retained for further evaluation are summarized in Table 5.2.

The following potentially affected human populations were retained.

- The general public.
- Construction workers.
- On-site workers.
- Customers.

5.1.3 Exposure Pathways to Potentially Affected Human Populations

This section presents a more site-specific evaluation of potential direct exposure pathways for potentially affected human populations. Potential exposure pathways were evaluated with respect to human populations under current site conditions, conditions during planned construction activities, and anticipated future conditions for the planned use of the property (i.e., as a Lowe's retail store). This screening of potential exposure pathways assumes, conservatively, that no remediation will be performed and no institutional or engineered controls will be implemented. These potential pathways include ingestion, inhalation, and dermal contact with contaminated soil, groundwater, and soil vapor. The potential exposure pathways are summarized in Table 5.3.

TABLE 5.2
Potentially Affected Human Populations (Without Selected Remedial Alternative)
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Potential Environmental Hazard	General Public (Current Use)			Construction Workers (Construction Phase)			On-Site Workers & Customers (Future Use)		
	Soil	GW	SV	Soil	GW	SV	Soil	GW	SV
Gross Contamination	✓		✓	✓	✓	✓	✓		✓
Direct Exposure	✓		✓	✓	✓	✓	✓		✓
Vapor Intrusion							✓	✓	✓
Leaching	✓			✓			✓		

GW Groundwater
SV Soil Vapor
✓ Human population is potentially affected by environmental hazard.

TABLE 5.3
Exposure Pathways to Human Populations (Without Selected Remedial Alternative)
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Potentially Affected Human Population	Potential Pathway	Soil	GW	SV
General Public (Current Use)	Ingestion	✓		
	Inhalation	✓		✓
	Dermal Contact	✓		✓
Construction Workers (Construction Phase)	Ingestion	✓	✓	
	Inhalation	✓		✓
	Dermal Contact	✓	✓	✓
On-Site Workers & Customers (Future Use)	Ingestion			
	Inhalation			✓
	Dermal Contact			✓
	Dermal Contact		✓	

GW Groundwater
SV Soil vapor
✓ Exposure pathway potentially complete.

Ingestion

Ingestion is the oral intake of a solid or liquid material. The ingestion of contaminated soil or groundwater is a human health risk and it poses a direct exposure hazard.

Current Site Conditions. The property consists of an unpaved lot covered by soil, a stockpile of crushed concrete, and sparse vegetation (i.e., weeds). Groundwater is not exposed at the property. Human populations that could come into direct contact with contaminated soil under current site conditions are restricted to the security guards and occasional visitors (i.e., the general public). However, the nature of human activities at the property (security surveillance) and the absence of contaminated surface soil (contaminated soils are two or more feet deep) make accidental ingestion of contaminated soil highly unlikely. Similarly, accidental ingestion of contaminated groundwater is highly unlikely because groundwater is not exposed at the property.

Conditions During Planned Construction Activities. During construction of the Lowe's store, specific areas of the property will be excavated as part of the selected remedial alternative described in the RAA (ESI, 2007c). Other areas of the property will be excavated during the installation of utility corridors, foundations, and piles. Contaminated subsurface soils and groundwater are likely to be exposed during construction activities. The principal human populations that could come into contact with contaminated soil and groundwater during construction activities will be construction workers and others involved in the construction activities (e.g., City and County utility workers, Lowe's personnel). Accidental ingestion of contaminated soil or groundwater will be of concern during the portion of construction that soil and groundwater are exposed.

Anticipated Future Conditions (Lowe's Retail Store). During operation of the Lowe's store, the property will consist of a retail building, a concrete parking structure, concrete- and/or asphalt-paved parking areas and access roads, and small landscaped areas. Contaminated soil and groundwater will not be exposed during future operation of the retail store. The principal human populations that could come into contact with contaminated soil and groundwater during future store operations will be on-site workers and customers. However, contaminated soil and groundwater will not be exposed during future operation of the retail store. Therefore, accidental ingestion of contaminated soil and groundwater is highly unlikely.

Inhalation

Inhalation is the act of drawing air, other gases, vapors, fumes, smoke, dust, or mists into the lungs. The inhalation of contaminated vapor is a human health risk, and it poses a direct exposure hazard and a vapor intrusion hazard. Sources of contaminated soil vapor include soil, groundwater, and free-phase petroleum product.

Current Site Conditions. The property consists of an unpaved lot covered by soil, a stockpile of crushed concrete, and sparse vegetation. Groundwater is not exposed at the property. Human populations that could come into direct contact with soil vapor under current site conditions are restricted to the security guards and occasional visitors (i.e., the general public).

Conditions During Planned Construction Activities. During construction of the Lowe's store, areas of the property will be excavated as part of remedial activities and during the installation of utility corridors, foundations, and piles. Contaminated subsurface soils and groundwater are likely to be exposed during construction activities, thus increasing the potential for soil vapor to be released. The principal human populations that could come into contact with soil vapor during construction activities will be construction workers and others involved in the construction activities. Inhalation of soil vapors will be of concern during the portion of construction that contaminated soil and groundwater are exposed.

Anticipated Future Conditions (Lowe's Retail Store). During operation of the Lowe's store, the property will consist almost entirely of the retail building and paved areas. Contaminated soil and groundwater will not be exposed during future operation of the retail store. The potential for significant exposure to soil vapor likely will be limited to the interior of the store. The principal human populations that could come into contact with soil vapor during future store operations will be on-site workers and customers inside the retail store.

Dermal Contact

Dermal contact is the direct exposure of skin (typically, this is restricted to vertebrates) to solids, liquids, or gases. Dermal contact with contaminated soil, groundwater, or soil vapor is a human health and ecological risk and it poses a direct exposure hazard.

Current Site Conditions. The property consists of an unpaved lot covered by soil, a stockpile of crushed concrete, and sparse vegetation. Groundwater is not exposed at the

property. Human populations that could come into direct contact with contaminated soil, groundwater, or soil vapor under current site conditions are restricted to the security guards and occasional visitors (i.e., the general public). However, the absence of contaminated surface soil or exposed groundwater makes dermal contact with these materials highly unlikely.

Conditions During Planned Construction Activities. During construction of the Lowe's store, areas of the property will be excavated as part of remedial activities and during the installation of utility corridors, foundations, and piles. Contaminated subsurface soils and groundwater are likely to be exposed during construction activities, which would increase the potential for soil vapor to be released. The principal human populations that could come into contact with contaminated soil, groundwater, or soil vapor during construction activities will be construction workers and others involved in the construction activities. Dermal contact with contaminated soil, groundwater, and soil vapor will be of concern during the portion of construction that soil and groundwater are exposed.

Anticipated Future Conditions (Lowe's Retail Store). During operation of the Lowe's store, the property will consist almost entirely of the retail building and paved areas. Contaminated soil and groundwater will not be exposed during future operation of the retail store. The principal human populations that could come into contact with contaminated soil, groundwater, or soil vapor during future store operations will be on-site workers and customers. However, contaminated soil and groundwater will not be exposed during future operation of the retail store. Therefore, dermal contact with contaminated soil and groundwater is highly unlikely. The potential for dermal contact with soil vapor likely will be limited to the interior of the store.

5.1.4 Retained Potential Exposure Pathways to Human Populations

Based on the screening described in Sections 5.1.1 to 5.1.3, all three potential exposure pathways to human populations were retained for further evaluation (see Section 7). The potential exposure pathways retained for further evaluation are summarized in Table 5.4.

TABLE 5.4
Retained Potential Exposure Pathways to Human Populations
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Potential Pathway	Soil	GW	SV
Ingestion	✓	✓	
Inhalation	✓		✓
Dermal Contact	✓	✓	✓

GW Groundwater
SV Soil vapor
✓ Exposure pathway potentially complete.

The following potential human exposure pathways were retained.

- Ingestion.
- Inhalation.
- Dermal contact.

5.2 EVALUATION OF ECOLOGICAL RISK

5.2.1 Potentially Affected Ecological Populations

The property is located within an area that has been used extensively for industrial and commercial purposes for more than 80 years. The soil at the property consists of fill (soil dredged from Honolulu Harbor and debris from the Chinatown fire). The planned future land use is for the Lowe's retail store. A screening of potentially affected ecological populations that could come into contact with contamination under current and anticipated future site conditions is provided below. The potentially affected ecological populations are summarized in Table 5.5.

TABLE 5.5
Potentially Affected Ecological Populations
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Ecological Population	Site Scenario*		
	Current Use	Construction Phase	Future Use
Marine Flora & Fauna	✓	✓	✓

* In the absence of remediation and without institutional or engineered controls.
✓ Ecological Population is potentially affected.

Current Site Conditions

The property consists of an unpaved lot covered by soil, a stockpile of crushed concrete, and sparse vegetation (i.e., weeds). There are no sensitive ecological populations on the property or on adjacent properties. However, marine populations could be exposed to groundwater contaminants entering the ocean via a potential preferential pathway (i.e., the current storm drain).

Conditions During Planned Construction Activities

During construction of the Lowe's store, specific areas of the property will be excavated as part of the selected remedial alternative described in the RAA (ESI, 2007c). Other areas of the property will be excavated during the installation of utility corridors, foundations, and piles. There are no sensitive ecological populations on the property that will be affected by the construction activities. However, marine populations could be exposed to groundwater contaminants entering the ocean via a potential preferential pathway (i.e., the current and future storm drains).

Anticipated Future Conditions (Lowe's Retail Store)

During operation of the Lowe's store, the property will consist of a retail building, a concrete parking structure, concrete- and/or asphalt-paved parking areas and access roads, and small landscaped areas. There will be no ecological habitats (and, thus, no sensitive ecological populations) present on the property following site development. However, marine populations could be exposed to groundwater contaminants entering the ocean via a potential preferential pathway (i.e., the future storm drain).

5.2.2 Retained Potentially Affected Ecological Populations

Based on the screening described in Section 5.2.1, two potentially affected ecological populations were retained for further evaluation (see Section 7). The potential ecological populations retained for further evaluation are summarized in Table 5.6.

The following potentially affected ecological populations were retained.

- Marine flora.
- Marine fauna.

5.2.3 Exposure Pathways to Potentially Affected Ecological Populations

This section presents a more site-specific evaluation of potential direct exposure pathways for potentially affected ecological populations. Potential exposure pathways were evaluated with respect to ecological populations under current site conditions, conditions during planned construction activities, and anticipated future conditions for the planned use of the property (i.e., as a Lowe's retail store). This screening of potential exposure pathways assumes, conservatively, that no remediation will be performed and no institutional or engineered controls will be implemented. These potential pathways include ingestion, inhalation, and dermal contact with contaminated soil, groundwater, and soil vapor. The potential exposure pathways are summarized in Table 5.7.

Ingestion

Ingestion is the oral intake of a solid or liquid material. The ingestion of contaminated soil or groundwater is a potential ecological risk and it poses a direct exposure hazard.

> **Current Site Conditions.** The property consists of an unpaved lot covered by soil, a stockpile of crushed concrete, and sparse vegetation (i.e., weeds). Groundwater is not exposed at the property. There are no sensitive ecological populations on the property. However, marine populations could ingest contaminants transported to the ocean by groundwater exiting the property via a potential preferential pathway (i.e., the current storm drain).

TABLE 5.6
Potentially Affected Ecological Populations (Without Selected Remedial Alternative)
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Potential Hazard	Marine Flora & Fauna (Current Use)			Marine Flora & Fauna (Construction Phase)			Marine Flora & Fauna (Future Use)		
	Soil	GW	SV	Soil	GW	SV	Soil	GW	SV
Impacts to Aquatic Habitats		✓			✓			✓	

GW Groundwater
SV Soil Vapor
✓ Ecological population is potentially affected by environmental hazard.

TABLE 5.7
Exposure Pathways to Ecological Populations (Without Selected Remedial Alternative)
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Potentially Affected Ecological Population	Potential Pathway	Soil	GW	SV
Marine Flora & Fauna (Current Use)	Ingestion		✓	
	Dermal Contact		✓	
Marine Flora & Fauna (Construction Phase)	Ingestion		✓	
	Dermal Contact		✓	
Marine Flora & Fauna (Future Use)	Ingestion		✓	
	Dermal Contact		✓	

GW Groundwater
SV Soil vapor
✓ Exposure pathway potentially complete.

Conditions During Planned Construction Activities. During construction of the Lowe's store, specific areas of the property will be excavated as part of the selected remedial alternative described in the RAA (ESI, 2007c). Other areas of the property will be excavated during the installation of utility corridors, foundations, and piles. Contaminated subsurface soils and groundwater are likely to be exposed during construction activities. There are no sensitive ecological populations on the property. However, marine populations could ingest contaminants transported to the ocean by groundwater exiting the property via a potential preferential pathway (i.e., the current and future storm drains).

Anticipated Future Conditions (Lowe's Retail Store). During operation of the Lowe's store, the property will consist of a retail building, a concrete parking structure, concrete- and/or asphalt-paved parking areas and access roads, and small landscaped areas. Contaminated soil and groundwater will not be exposed during future operation of the retail store. There are no sensitive ecological populations on the property. However, marine populations could ingest contaminants transported to the ocean by groundwater exiting the property via a potential preferential pathway (i.e., the future storm drain).

Inhalation

Inhalation is the act of drawing air, other gases, vapors, fumes, smoke, dust, or mists into the lungs. The inhalation of contaminated vapor is a potential ecological risk, a direct exposure hazard, and a vapor intrusion hazard. Sources of contaminated soil vapor include soil, groundwater, and free-phase petroleum product.

Current Site Conditions. The property consists of an unpaved lot covered by soil, a stockpile of crushed concrete, and sparse vegetation. Groundwater is not exposed at the property. There are no sensitive ecological populations on the property.

Conditions During Planned Construction Activities. During construction of the Lowe's store, areas of the property will be excavated as part of remedial activities and during the installation of utility corridors, foundations, and piles. Contaminated subsurface soils and groundwater are likely to be exposed during construction activities, thus increasing the potential for soil vapor to be released. There are no sensitive ecological populations on the property.

Anticipated Future Conditions (Lowe's Retail Store). During operation of the Lowe's store, the property will consist almost entirely of the retail building and paved areas. Contaminated soil and groundwater will not be exposed during future operation of the retail store. The potential for significant exposure to soil vapor likely will be limited to the interior of the store. There are no sensitive ecological populations on the property.

Dermal Contact

Dermal contact is the direct exposure of skin (typically, this is restricted to vertebrates) to solids, liquids, or gases. Dermal contact with contaminated soil, groundwater, or soil vapor is a potential ecological risk and it poses a direct exposure hazard.

Current Site Conditions. The property consists of an unpaved lot covered by soil, a stockpile of crushed concrete, and sparse vegetation. Groundwater is not exposed at the property. There are no sensitive ecological populations on the property. However, marine populations could come into direct contact with contaminated groundwater that enters the ocean via a potential preferential pathway (i.e., the current storm drain).

Conditions During Planned Construction Activities. During construction of the Lowe's store, areas of the property will be excavated as part of remedial activities and during the installation of utility corridors, foundations, and piles. Contaminated subsurface soils and groundwater are likely to be exposed during construction activities, which would increase the potential for soil vapor to be released. There are no sensitive ecological populations on the property. However, marine populations could come into direct contact with contaminated groundwater that enters the ocean via a potential preferential pathway (i.e., the current and future storm drains).

Anticipated Future Conditions (Lowe's Retail Store). During operation of the Lowe's store, the property will consist almost entirely of the retail building and paved areas. Contaminated soil and groundwater will not be exposed during future operation of the retail store. There are no sensitive ecological populations on the property. However, marine populations could come into direct contact with contaminated groundwater that enters the ocean via a potential preferential pathway (i.e., the future storm drain).

5.2.4 Retained Potential Exposure Pathways to Ecological Populations

Based on the screening described in Sections 5.2.1 to 5.2.3, two of the three potential exposure pathways to ecological populations were retained for further evaluation (see Section 7). The potential exposure pathways retained for further evaluation are summarized in Table 5.8.

The following potential ecological exposure pathways were retained.

- Ingestion.
- Dermal contact.

TABLE 5.8
Retained Potential Exposure Pathways to Ecological Populations
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Potential Pathway	Soil	GW	SV
Ingestion		✓	
Dermal Contact		✓	

GW Groundwater
SV Soil vapor
✓ Exposure pathway potentially complete.

SECTION 6 – ENVIRONMENTAL ACTION LEVELS

The DOH established the EALs for the purpose of performing screening-level risk assessments (DOH, 2005). They are conservative concentrations that may not be appropriate for a given site. Individual EALs were developed for each of the principal environmental hazards (e.g., gross contamination, direct exposure, vapor intrusion, leaching, ecotoxicity) under different site scenarios (e.g., site location relative to drinking water sources, site location relative surface waters, exposure scenario, carcinogenicity). The Tier I EALs are the most conservative of these individual action levels for a given contaminant.

The property is in the DOH VRP and therefore falls under the Hawaii *Environmental Response Law* [ERL] (i.e., the Hawaii Revised Statutes [HRS], Chapter 128D; DOH, 1988) and the adopted administrative rules (i.e., the Hawaii Administrative Rules [HAR]) for the ERL (i.e., the *State Contingency Plan*; DOH, 1995). The ERL was amended in 1997 to add the VRP. Under the rules of the VRP [HRS Chapter 128D-40(c)], contaminants must be cleaned up to a risk-based standard of not more than one total lifetime cancer risk per one million (i.e., 10^{-6}) for a specific medium (e.g., soil, groundwater).

The DOH Tier I EALs were used in the site characterization (ESI, 2007b) to identify which of the COPCs at the property were contaminants of concern. The contaminants of concern are summarized in Table 3.2. However, the Tier I EALs are not necessarily appropriate for use as final action levels. When a Tier I EAL is exceeded, it is important to identify specific environmental hazards that may be associated with the contamination and evaluate these hazards in more detail on a site-by-site basis. For example, the EALs that are appropriate for use at a construction site (i.e., during the construction phase) are inappropriate for use at that site once construction is complete and industrial or commercial operations have commenced (i.e., during future use). As another example, a Tier I EAL based on ecotoxicity is inappropriate for use at a site where there is no ecotoxicity hazard.

To accurately evaluate the environmental hazards at the property, appropriate EALs must be applied. The purpose of this section is to identify the appropriate EALs for soil, groundwater, and soil vapor to be used in the hazard evaluation presented in Section 7. The selected EALs are summarized in the tables provided in Appendix B (soil), Appendix C (groundwater), and Appendix D (soil vapor). The following information was used in identifying the appropriate EALs.

- Uses of the property (i.e., current use, construction phase, future use).
- The contaminants of concern identified in Section 3 (see Table 3.2).
- The potential hazards identified in Section 4 (see Table 4.2).
- The potential populations identified in Section 5 (see Tables 5.2 and 5.6).
- The potential exposure pathways identified in Section 5 (see Tables 5.3 and 5.7).

6.1 APPLICABILITY OF EALS

Before using EALs to identify areas where specific environmental hazards exist, their applicability should be assessed (DOH, 2005). Factors that could affect the use of an EAL include the following.

- Cumulative health effects.
- High background levels.
- Unusual pH conditions in soil, which could result in enhanced leaching of metals into groundwater.
- Bioaccessibility and bioavailability.
- Laboratory data limitations (e.g., method reporting limits [MRLs] that exceed EALs, quality assurance [QA] and quality control [QC] issues).

6.1.1 Cumulative Health Effects

The potential cumulative health effects of contaminants of concern must be considered. The applicability of EALs as cleanup goals could be compromised if multiple contaminants are detected that produce the same adverse health effects (carcinogenic or non-carcinogenic) because their effects would be cumulative. If more than three known or suspected carcinogens are identified or more than five non-carcinogens that produce similar adverse health effects are identified, a more detailed assessment may be warranted. Based on the results of the assessment, site-specific adjustments of the EALs for human health concerns may need to be performed (DOH, 2005).

During the site characterization (ESI, 2007b), no more than five non-carcinogenic contaminants of concern that produce similar adverse health effects were detected. However, the following known or suspected carcinogens were identified as contaminants of concern at the property (International Agency for Research on Cancer [IARC], 2006).

Known Human Carcinogens

- Benzene
- Benzo[a]pyrene
- Arsenic

Probable Human Carcinogens

- Dibenzo[a,h]anthracene
- Tetrachloroethylene

Possible Human Carcinogens

- Ethylbenzene
- Styrene
- Benzo[a]anthracene
- Benzo[b]fluoranthene
- Chrysene

- Indeno[1,2,3-cd]pyrene
- Naphthalene
- 4,4'-DDT
- Lead

Not Classifiable as a Human Carcinogen

- Chromium (total)

The cumulative, non-cancer risk posed by petroleum can be addressed further through the collection of total petroleum hydrocarbon data and a comparison to action levels for risk-based, direct exposure hazards. An estimation of cumulative cancer risk is not necessary, however, due to the hazards already posed by individual compounds and implementation of the selected remedial alternatives (e.g., capping) described in the RAA (ESI, 2007c).

Chromium VI is a known human carcinogen, but chromium III is not a known, probable, or possible human carcinogen. The chromium concentrations reported in the site characterization (ESI, 2007a) refer to total chromium (i.e., chromium in all valance states). Total chromium is not classifiable as to its carcinogenicity to humans (IARC, 2006). Because of this, the potential carcinogenic hazard posed by chromium VI cannot be assessed.

6.1.2 High Background Levels

If background levels of metals in soil exceed EALs, those background levels can be used as EALs (DOH, 2005). Relatively high background levels of arsenic, chromium, and even lead are common in Hawaii and are unrelated to contamination. For example, the conservative Tier I EAL for arsenic in soil (0.42 parts per million [ppm]) has been replaced by the background value of 20 ppm (DOH, 2006). The DOH recommends that soil be tested for bioaccessible arsenic if total arsenic exceeds this level. This is discussed further in Section 6.1.4.

6.1.3 Unusual pH Conditions in Soil

The EALs used at sites to identify areas where a leaching hazard exists are considered site-specific because of possible differences in soil pH. To determine if the leaching of metals from soil to groundwater is a concern for a particular site, a synthetic precipitation leachate procedure [SPLP] test can be conducted (DOH, 2007). The SPLP test assesses the leachability of contaminants from soil samples. SPLP tests were not conducted as part of the site characterization.

The metals present in subsurface soil at the property are not expected to be a leaching concern because they are poorly soluble to insoluble in water and essentially immobile. However, their mobility is dependent upon several interrelated factors, including pH, oxidation state, inorganic and organic complexation, oxidation-reduction reactions, precipitation/dissolution reactions, and adsorption/desorption reactions. Inorganic forms of metals have low mobility in most soils and tend to be retained in soils containing organic matter. Under normal conditions, metals are not

expected to leach out of soils, and they have a tendency to form compounds of low solubility with the major anions found in groundwater.

The DOH has not established action levels for the leaching of metals from soil. Alternatives include an evaluation of chemical data for collocated soil and groundwater samples, where the soil sample is collected from the capillary fringe of the water table and the groundwater sample is collected from beneath the underlying water table at the same location. Another alternative involves using the SPLP laboratory batch test (DOH, 2007). This issue is discussed on a site-specific basis in Section 7.4.1.

6.1.4 Bioaccessibility and Bioavailability

The risk to human or ecological populations posed by exposure to a contaminant is evaluated in terms of the average daily dose or intake of the contaminant (e.g., in milligrams or micrograms per day; Environmental Protection Agency [EPA] 1989, 2004). Exposure to contaminants can occur through ingestion of contaminated soil or groundwater, inhalation of dust or vapors, and dermal contact.

Bioaccessibility is the amount of a contaminant from ingested soil that is released during digestion and made available for absorption. Bioaccessibility applies to the ingestion of soil or dust and not to inhalation or dermal contact. Bioavailability is a measure of how much of a contaminant is absorbed through ingestion, inhalation, or dermal contact when human or ecological populations are exposed to a contaminant.

A portion of inorganic contaminants (e.g., arsenic, barium, cadmium, chromium, lead, mercury, and silver) can be bound tightly to soil particles and be unavailable for absorption in the human body. This portion of the contaminant generally is not considered toxic. The remaining (bioavailable) portion of the contaminant that is absorbed into the body may cause adverse health effects at high enough concentrations.

The DOH guidance on bioaccessibility and bioavailability of arsenic in soil includes EALs that can be used as alternatives to the Tier I EALs for arsenic-contaminated soils (DOH, 2006). Using this guidance, alternative EALs are employed in this EHE to evaluate the gross contamination hazard and the direct exposure hazard.

6.1.5 Laboratory Data Limitations

Some chemical compounds (e.g., PAHs in groundwater) are difficult to detect at low levels in commercial laboratories. For some of the samples from the site characterization, the laboratory was unable to attain an MRL lower than the EAL for the following chemical compounds.

Soil

- Vinyl chloride
- Chloroform
- Carbon tetrachloride
- 1,2-Dichloroethane
- 1,2-Dichloropropane
- Bromodichloromethane
- 1,1,2-Trichloroethane
- Dibromochloromethane
- 1,2-Dibromoethane
- 1,2,3-Trichloropropane
- 1,1,2,2-Tetrachloroethane
- 1,4-Dichlorobenzene

Groundwater

- Anthracene
- Benzo[a]anthracene
- Chrysene
- Benzo[a]pyrene
- Benzo[g,h,i]perylene
- Indeno[1,2,3-cd]perylene
- Phenanthrene
- Pyrene
- Endrin
- 4,4'-DDT
- Methoxychlor
- Chlordane
- Toxaphene
- Chloroethane

Matrix spike [MS] and matrix spike duplicate [MSD] recoveries fell outside the laboratory control limits for lead in soil analyzed at the primary (i.e., QC) laboratory, although recoveries for the laboratory control samples [LCSs] fell within laboratory control limits. The affected results were qualified as estimated concentrations. A comparison of lead data for QC and QA replicates indicated that the lead concentrations in the QC samples generally were higher than those in the corresponding QA samples. The discrepancies between the QC and QA samples do not affect the usability of the data for their intended purpose.

6.2 EALs FOR SOIL

EALs for soil have been identified for each of the potential environmental hazards identified (Table 4.2). These hazards include gross contamination, direct exposure, vapor intrusion, and leaching.

6.2.1 Gross Contamination

To identify areas where a potential gross contamination hazard exists, shallow soil EALs are considered instead of deep soil EALs, because they are more conservative measures and represent a more cautious approach to identifying areas of gross contamination. The gross contamination hazard is evaluated for the general public (residential EALs), construction workers (commercial/industrial EALs), and on-site workers and customers (commercial/industrial EALs).

6.2.2 Direct Exposure

Direct exposure to contaminated soil is a potentially complete pathway to personnel associated with construction activities and trespassers that may enter the property illegally. During construction, best management practices [BMPs] will be implemented to ensure that direct exposure is minimized.

The exposure pathway to other human populations (i.e., the general public) is considered potentially complete but insignificant under current conditions. Under current conditions, access to the property is restricted, the property is surrounded by a security fence with a locked gate, and the property is manned by a security guard at all times.

In spite of the incomplete pathway for direct exposure of the general public to contaminated soil, areas where a potential direct exposure hazard exists are identified as part of a "worst case" scenario for human exposure. For this case, residential EALs have been applied.

Areas where a direct exposure hazard exists for on-site workers and customers have been identified using commercial/industrial EALs. Areas where a direct exposure hazard exists for construction workers have been identified using construction worker EALs.

6.2.3 Vapor Intrusion

Vapor intrusion can be a significant problem for VOC-contaminated permeable soil. A significant amount of the shallow soil at the property consists of fill, which should be considered highly permeable (DOH, 2005). The areas where a potential soil vapor hazard exists have been identified for the general public (residential EALs), construction workers (commercial/industrial EALs), and on-site workers and customers (commercial/industrial EALs).

6.2.4 Leaching

The leaching hazards posed by contaminated soil have been evaluated by assuming that rainfall is less than 200 centimeters per year, drinking water sources are not threatened, and surface water is greater than 150 meters away. The EALs for this site scenario were used in the hazard evaluation. At the property, annual precipitation is low (15 inches) and the nearest surface water body (Honolulu Harbor), although connected to groundwater, is approximately 300 meters away.

6.2.5 Summary of EALs for Soil

The EALs selected for evaluating the environmental hazards posed by contaminated soils are summarized below and in the table provided in Appendix B.

Gross Contamination

- Final Residential Ceiling Levels for shallow soil.
- Final Commercial/Industrial Ceiling Levels for shallow soil.

Direct Exposure

- Residential.
- Commercial/Industrial Workers.
- Construction Workers.

Vapor Intrusion

- Residential.
- Commercial/Industrial Workers.

Leaching

- Rainfall less than 200 centimeters per year, drinking water not threatened, surface water greater than 150 meters away.

6.3 EALs FOR GROUNDWATER

The EALs for groundwater have been identified for each of the potential environmental hazards identified (Table 4.2). These hazards include gross contamination, direct exposure, vapor intrusion, and marine ecotoxicity (i.e., impacts to aquatic habits).

6.3.1 Gross Contamination

The areas where a potential gross contamination hazard exists have been identified for the general public, construction workers, and on-site workers and customers (assuming that groundwater is not a source of drinking water). The general public and store workers are unlikely human populations because the exposure pathway is considered incomplete. There is the potential that shallow groundwater will be exposed during construction activities, and the current exposure pathway under that scenario is considered potentially complete for construction workers and potential trespassers. Residential and commercial/industrial EALs were considered. The ceiling level was chosen for the EHE.

6.3.2 Direct Exposure

The DOH has not established EALs for direct exposure to contaminated groundwater.

6.3.3 Vapor Intrusion

Areas where a potential vapor intrusion hazard exists have been identified for the general public, construction workers, and on-site workers and customers. The EALs for high permeability soil were used because of the wide distribution of fill at the property. The EALs for residential as well as commercial/industrial land use were used to evaluate the vapor intrusion hazard at the property.

6.3.4 Marine Ecotoxicity

In general, the contaminants that are considered a marine ecotoxicity hazard are mobile, volatile, substances that threaten ecological populations. For sites more than 150 meters from a surface water body, acute surface water goals are used to develop groundwater ecotoxicity EALs. For sites less than 150 meters from a surface water body, the lower chronic surface water goals are used to develop groundwater ecotoxicity EALs.

There are no marine ecological populations at the property. There is, however, a potential hydraulic connection between shallow groundwater beneath the property and the marine environment. In addition, there is the potential that the storm drain at the property could act as a preferential exposure pathway to Honolulu Harbor. The property is located more than 150 meters from the nearest surface water body and therefore the marine aquatic acute toxicity EALs were used to evaluate the marine ecotoxicity hazard. However, as a precaution, in case the contaminated groundwater plume extends to within 150 meters of the nearest surface water body (as in the case of the storm drain), the marine aquatic chronic toxicity EALs also were used to identify areas where a marine ecotoxicity hazard exists.

6.3.5 Summary of Selected EALs for Groundwater

The EALs selected for evaluating the environmental hazards posed by contaminated groundwater at the property are summarized below and in the table provided in Appendix C.

Gross Contamination

- Ceiling values for groundwater that is not a current or potential source of drinking water at sites where rainfall is less than 200 centimeters per year and where surface water is greater than 150 meters away.

Vapor Intrusion

- Residential - High Permeability.
- Commercial/Industrial Workers - High Permeability.

Marine Ecotoxicity

- Marine Acute Toxicity.
- Marine Chronic Toxicity.

6.4 EALs FOR SOIL VAPOR

The EALs for soil vapor have been identified for each of the potential environmental hazards identified (Table 4.2). These hazards include gross contamination, direct exposure, and vapor intrusion.

6.4.1 Gross Contamination

The DOH has not established EALs for gross contamination by contaminated soil vapor.

6.4.2 Direct Exposure

The DOH has not established EALs for direct exposure to contaminated soil vapor.

6.4.3 Soil Vapor Intrusion

Under the current land use, the property has no enclosed buildings. However, during construction activities, the exposure pathway for contaminated soil vapor to construction workers to is potentially complete. During construction, BMPs will be implemented to ensure that the inhalation of VOCs is minimized. For construction workers, shallow soil vapor commercial/industrial EALs were used in identifying areas where a potential soil vapor intrusion hazard exists. The shallow soil vapor commercial/industrial EALs also were used in identifying areas where a potential soil vapor intrusion hazard exists for on-site workers and customers.

Although soil vapors have the ability to migrate to the surface from groundwater and from vadose zone soils, the concentrations of contaminants of concern observed in subsurface soil and groundwater samples collected during the site characterization suggest that the concentrations in outdoor air likely will be low as the soil vapors dissipate readily into the atmosphere. However, the areas where a potential vapor intrusion hazard exists have been identified for the general public as a "worst case" scenario using residential EALs.

6.4.4 Summary of Selected EALs for Soil Vapor

The EALs selected for evaluating the environmental hazards posed by contaminated soil vapor are summarized below and in the table provided in Appendix D.

Vapor Intrusion

- Residential - Shallow soil vapor.
- Commercial/Industrial Workers - Shallow soil vapor.

SECTION 7 – SUMMARY OF POTENTIAL ENVIRONMENTAL HAZARDS

The five identified potential environmental hazards (Section 4) were evaluated with respect to potentially affected human and ecological populations under (1) current site conditions, (2) conditions during planned construction activities, and (3) anticipated future conditions for the planned use of the property (i.e., as a Lowe's retail store).

7.1 GROSS CONTAMINATION

The EALs used to evaluate which contaminants of concern have the potential to pose a gross contamination hazard at the property are provided in the tables included in Appendix B (soil) and Appendix C (groundwater). The contaminants that exceed the EALs are highlighted in these tables and summarized in Table 7.1. The areas of the property where contaminants have the potential to pose a gross contamination hazard are identified in Figure 6 (soil) and Figure 7 (groundwater). These areas are summarized below.

7.1.1 Gross Contamination of Soil

The contaminants of concern in soil for the gross contamination hazard are summarized in Table 7.1. Eleven contaminants of concern exceed residential EALs, but only eight exceed commercial/industrial EALs. Free product is considered to pose a gross contamination hazard under both residential and commercial/industrial site scenarios. Note that the grossly contaminated soil was two to six feet bgs.

The areas where contaminants have the potential to pose a gross contamination hazard under both residential and commercial/industrial site scenarios are identified in Figure 6. Gross contamination in soil poses a potential hazard throughout the property, with the exception of the area of the former ConocoPhillips warehouse and office building. The extent of the area in which the gross contamination hazard is a concern for residential use is only slightly larger than the area in which the gross contamination hazard is a concern for commercial/industrial use.

7.1.2 Gross Contamination of Groundwater

The contaminants of concern in groundwater for the gross contamination hazard are summarized in Table 7.1. Eight contaminants of concern exceed EALs. Note that, under current site conditions, groundwater is not exposed and is 2 to 7 feet bgs. The water table is shallowest in the north-northeast part of the property, close to Pacific Street.

The areas where contaminants have the potential to pose a gross contamination hazard are identified in Figure 7. Gross contamination in groundwater poses a potential hazard along the northeast side of the property (encompassing the former area of TTLR 1), in the west corner of the property, and in the area of the south end of the former 1970 tank yard.

TABLE 7.1
Contaminants in Soil and Groundwater that Exceed Gross Contamination EALs
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Media	Number of Samples	Contaminants Exceeding Gross Contamination (Residential) EALs[1]	Number of Samples Exceeding Gross Contamination (Residential) EALs[1]	Contaminants Exceeding Gross Contamination (Commercial / Industrial) EALs[1]	Number of Samples Exceeding Gross Contamination (Commercial / Industrial) EALs[1]
Soil	402	TPH-g / TPH-d / TPH-o Benzene Xylenes Acenaphthene Fluoranthene Naphthalene Barium Chromium Lead	279	TPH-g / TPH-d / TPH-o Xylenes Fluoranthene Naphthalene Barium Lead	179
Groundwater	63	TPH-g / TPH-d / TPH-o Benzene Toluene Ethylbenzene Naphthalene Benzo[a]pyrene	18	n/a	n/a

1 State of Hawaii Department of Health Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (DOH, 2005, and updates) [Modeled after ESL Surfer, CalEPA (Meillier, 2005)].
n/a not applicable.

7.2 DIRECT EXPOSURE

The EALs used to evaluate which contaminants of concern have the potential to pose a direct exposure hazard at the property are provided in the table included in Appendix B (soil). The contaminants that exceed the EALs are highlighted in this table and summarized in Table 7.2. The areas of the property where contaminants have the potential to pose a direct exposure hazard are identified in Figure 8. These areas are summarized below.

7.2.1 Direct Exposure to Contaminated Soil

The contaminants of concern in soil for the direct exposure hazard are summarized in Table 7.2. Thirteen contaminants of concern exceed residential EALs, ten exceed commercial/industrial EALs, and seven exceed construction worker EALs. Note that the soil contamination is two to six feet bgs.

The areas where contaminants have the potential to pose a direct exposure hazard under the residential, commercial/industrial, and construction worker site scenarios are identified in Figure 8. Direct exposure to contaminated soil poses a potential hazard throughout the property, with the exception of the area of the former ConocoPhillips warehouse and office building. The extent of the area in which the direct exposure hazard is a concern for residential use is only slightly larger than the area where the direct exposure hazard is a concern for the construction worker site scenario.

7.3 SOIL VAPOR INTRUSION

The EALs used to evaluate which contaminants of concern have the potential to pose a vapor intrusion hazard at the property are provided in the tables included in Appendix B (soil), Appendix C (groundwater), and Appendix D (soil vapor). The contaminants that exceed the EALs are highlighted in these tables and summarized in Table 7.3. The areas of the property where contaminants have the potential to pose a vapor intrusion hazard are identified in Figure 11A (soil), Figure 11B (groundwater), and Figures 12 and 13 (soil vapor). These areas are summarized below.

7.3.1 Vapor Intrusion from Contaminated Soil

The contaminants of concern in soil for the vapor intrusion hazard are summarized in Table 7.3. Six contaminants of concern exceed both residential and commercial/industrial EALs. Note that the soil contamination is two to six feet bgs.

TABLE 7.2
Contaminants in Soil that Exceed Direct Exposure EALs
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Media	Number of Samples	Contaminants Exceeding Direct Exposure (Residential) EALs[1]	Number of Samples Exceeding Direct Exposure (Residential) EALs[1]	Contaminants Exceeding Direct Exposure (Commercial / Industrial) EALs[1]	Number of Samples Exceeding Direct Exposure (Commercial / Industrial) EALs[1]	Contaminants Exceeding Direct Exposure (Construction Worker) EALs[1]	Number of Samples Exceeding Direct Exposure (Construction Worker) EALs[1]
Soil	402	TPH-g / TPH-d / TPH-o Benzene Xylenes Benzo[a]pyrene Naphthalene Arsenic Cadmium Chromium Lead Mercury Pentachlorophenol	293	TPH-g / TPH-d / TPH-o Benzene Xylenes Benzo[a]pyrene Naphthalene Arsenic Chromium Lead	231	TPH-d Benzene Xylenes Benzo[a]pyrene Arsenic Chromium Lead	168

1 State of Hawaii Department of Health Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (DOH, 2005, and updates) [Modeled after ESL Surfer, CalEPA (Meillier, 2005)].

TABLE 7.3
Contaminants in Soil, Groundwater, and Soil Vapor that Exceed Soil Vapor Intrusion EALs
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Media	Contaminants Exceeding Soil Vapor (Residential) EALs[1]	Number of Samples Locations	Number of Samples Exceeding Soil Vapor (Residential) EALs[1]	Contaminants Exceeding Soil Vapor (Commercial / Industrial) EALs[1]	Number of Samples Exceeding Soil Vapor (Commercial / Industrial) EALs[1]
Soil	TPH-g / TPH-d Benzene Xylenes Acenaphthene Naphthalene	402	272	TPH-g / TPH-d Benzene Xylenes Acenaphthene Naphthalene	263
Groundwater	TPH-g TPH-d Benzene	63	12	TPH-g Benzene	10
Soil Vapor (Screening)	TPH-g Benzene Toluene Xylenes MTBE Tetrachloroethylene	58	44	TPH-g Benzene Toluene Xylenes MTBE Tetrachloroethylene	34
Soil Vapor (8 hour)	TPH-g Benzene Toluene Xylenes	18	8	TPH-g Benzene Toluene Xylenes	7

1 State of Hawaii Department of Health Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (DOH, 2005, and updates) [Modeled after ESL Surfer, CalEPA (Meillier, 2005)].

The areas where contaminants have the potential to pose a vapor intrusion hazard under the residential and commercial/industrial site scenarios are identified in Figure 11A. Vapor intrusion from contaminated soil poses a potential hazard throughout the property, with the exception of part of the southeast property boundary, in the area of the former ConocoPhillips warehouse. The extent of the area in which the vapor intrusion hazard is a concern for residential use is almost identical to the area in which the vapor intrusion hazard is a concern for the commercial/industrial site scenario.

7.3.2 Vapor Intrusion from Contaminated Groundwater

The contaminants of concern in groundwater for the vapor intrusion hazard are summarized in Table 7.3. Three contaminants of concern exceed residential EALs and two exceed commercial/industrial EALs. Note that, under current site conditions, groundwater is not exposed and is 2 to 7 feet bgs. The water table is shallowest in the north-northeast part of the property, close to Pacific Street.

The areas where contaminants have the potential to pose a vapor intrusion hazard under the residential and commercial/industrial site scenarios are identified in Figure 11B. Vapor intrusion from contaminated groundwater poses a potential hazard in the area extending from the former location of TTLR 1 to the north corner of the property (next to Pacific Street) and in the west corner of the property (in the area of the former pump house).

7.3.3 Vapor Intrusion Hazard

The contaminants of concern in soil vapor are summarized in Table 7.3. Six contaminants exceed both residential and commercial/industrial EALs, based on the results of the screening soil vapor survey. Four of those contaminants exceed the residential and commercial/industrial EALs, based on the results of the 8-hour soil vapor survey.

General Public and Construction Workers

The areas where contaminants have the potential to pose a vapor intrusion hazard under residential and commercial/industrial site scenarios for the general public and for construction workers are identified in Figure 12. Vapor intrusion poses a potential hazard throughout the property, with the exception of the area of the former ConocoPhillips warehouse and office building. The extent of the area in which the vapor intrusion hazard is a concern for residential use is almost identical to the area in which the vapor intrusion hazard is a concern for the commercial/industrial site scenario.

On-Site Workers and Employees

The areas where contaminants have the potential to pose a vapor intrusion hazard under residential and commercial/industrial site scenarios for on-site workers and employees (i.e., during future operation of the Lowe's retail store) are identified in Figure 13. Vapor intrusion poses a potential hazard in the northeast area of the property, encompassing the former area of TTLR 1 and extending into the 1923, 1941, and 1970 tank yards), with the exception of the area of the former ConocoPhillips warehouse and office building. The extent of the area in which the

vapor intrusion hazard is a concern for residential use is almost identical to the area in which the vapor intrusion hazard is a concern for the commercial/industrial site scenario.

7.4 LEACHING

The EALs used to evaluate which contaminants of concern have the potential to pose a leaching hazard at the property are provided in the table included in Appendix B (soil). The contaminants that exceed the EALs are highlighted in this table and summarized in Table 7.4. The areas of the property where contaminants have the potential to pose a leaching hazard are identified in Figure 9. These areas are summarized below.

TABLE 7.4
Contaminants in Soil that Exceed Leaching EALs
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Media	Contaminants Exceeding (Leaching) EALs[1]	Number of Samples	Number of Samples Exceeding (Leaching) EALs[1]
Soil	TPH-g / TPH-d / TPH-o Benzene Toluene Ethylbenzene Xylenes Acenaphthene Benzo[a]pyrene Fluoranthene Naphthalene	402	102

1 State of Hawaii Department of Health Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (DOH, 2005, and updates) [Modeled after ESL Surfer, CalEPA (Meillier, 2005)].

7.4.1 Leaching from Contaminated Soil

The contaminants of concern in soil for the leaching hazard are summarized in Table 7.4. Eleven contaminants exceed the EALs. Note that the soil contamination is two to six feet bgs.

The areas where contaminants in soil have the potential to pose a leaching hazard are identified in Figure 9. Leaching poses a potential hazard primarily in the north area of the property (in the area of former TTLR 1 and in the 1941 tank yard) and in the west-southwest side of the property (along Nimitz Highway).

If uncapped soil (i.e., soil that is covered by a relatively impermeable surface, such as asphalt or concrete) or soil within the saturated zone (i.e., soil at or below the capillary fringe of the water table) contain metals (inorganics) at high concentrations but the groundwater at that location does not contain contaminants at concentrations that warrant potential concern, it is reasonable to conclude that the metals are strongly adsorbed to the soil. This indicates that leaching is not a significant potential environmental hazard under current and anticipated future site conditions.

As discussed in the RAA (ESI, 2007c), the mobility of metals (inorganics) in soils through leaching can be examined by comparing the concentrations of metals in soil and groundwater from the same relative location. The lack of a positive correlation between metal concentrations in soil and metal concentrations in groundwater for samples collected during the site characterization (ESI, 2007b) constitutes strong evidence that leaching of metals from soil into groundwater is not a significant concern.

The leachability of metals at the property has been evaluated further by using data from the site characterization for soil and groundwater samples collected at the same location. All of the samples evaluated were collected at locations that formerly were unpaved, thus allowing for the infiltration of rainwater through vadose zone soils. The results of the calculations are provided in Appendix A and are summarized in Table 7.5.

TABLE 7.5
Summary of Leaching Calculations for Metals
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Metals (Inorganics)	Percent Metal Leached from Soil into Groundwater (%)	
	Soil at or Below Capillary Fringe (# samples)	Soil from Vadose Zone (# samples)
Arsenic	-	0.3 (1)
Barium	0.07 to 0.12 (3)	0.06 to 0.15 (3)
Cadmium	0.04 (1)	0.08 (1)
Chromium	0.01 to 0.11 (3)	0.04 to 0.06 (3)
Lead	0.0003 to 0.01 (7)	0.0003 to 0.006 (9)
Mercury	0.005 (1)	0.005 to 0.009 (3)
Selenium	-	-
Silver	-	-

- Not applicable. Metal was not detected in soil or groundwater.

The maximum calculated percent leaching was for barium (0.12 percent for soil samples collected at or below the capillary fringe of the water table; 0.15 percent for soil samples collected from the vadose zone). There was no significant difference in percent leaching between soil samples collected at the capillary fringe of the water table and soil samples collected from the vadose zone (Table 7.5). Also, there was no significant difference in percent leaching between the one soil sample collected below the capillary fringe of the water table (sample location 37; Appendix A) and the samples collected at the capillary fringe of the water table. Based on these results, the leaching of metals from soil into groundwater is not considered to be a significant environmental hazard and additional evaluation is unwarranted.

TABLE 7.6
Contaminants in Groundwater that Exceed Marine Aquatic EALs
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Media	Contaminants Exceeding Aquatic Toxicity (Marine Acute) EALs[1]	Number of Samples	Number of Samples Exceeding Aquatic Toxicity (Marine Acute) EALs[1]	Contaminants Exceeding Aquatic Toxicity (Marine Chronic) EALs[1]	Number of Samples Exceeding Aquatic Toxicity (Marine Chronic) EALs[1]
Groundwater	TPH-g / TPH-d / TPH-o Benzene Toluene Ethylbenzene Xylenes Benzo[a]pyrene Naphthalene Arsenic Lead Silver Pentachlorophenol	63	37	TPH-g / TPH-d / TPH-o Benzene Toluene Ethylbenzene Xylenes Benzo[a]pyrene Naphthalene Arsenic Lead Silver Pentachlorophenol	58

1 State of Hawaii Department of Health Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (DOH, 2005, and updates) [Modeled after ESL Surfer, CalEPA (Meillier, 2005)].

7.5 MARINE ECOTOXICITY

The EALs used to evaluate which contaminants of concern have the potential to pose a marine ecotoxicity hazard at the property are provided in the table included in Appendix C (groundwater). The contaminants that exceed the EALs are highlighted in this table and summarized in Table 7.6. The areas of the property where contaminants have the potential to pose a leaching hazard are identified in Figure 10. These areas are summarized below.

7.5.1 Impacts to Marine Habitats from Contaminated Groundwater

The contaminants of concern in groundwater for the marine ecotoxicity hazard are summarized in Table 7.6. Thirteen contaminants exceed the EALs for both the acute toxicity hazard and the chronic toxicity hazard. Note that, under current site conditions, groundwater is not exposed and is 2 to 7 feet bgs. The water table is shallowest in the north-northeast part of the property, close to Pacific Street.

The areas where contaminants have the potential to pose a marine ecotoxicity are identified in Figure 10. Marine ecotoxicity poses a potential hazard throughout the property. The extent of the area in which the marine ecotoxicity hazard is a concern for chronic toxicity is slightly larger than the area where the marine ecotoxicity hazard is a concern for acute toxicity.

7.6 SUMMARY OF PRINCIPAL ENVIRONMENTAL HAZARDS

Without remediation or the implementation of institutional and/or engineered controls, all of the identified environmental hazards potentially pose a threat to the human and ecological populations identified under current conditions at the property and during the construction phase of site development. Following development of the property and construction of the Lowe's retail store, three of the identified environmental hazards potentially pose a threat to the human and ecological populations identified for the anticipated future use of the property. A summary of the environmental hazards identified in the hazard evaluation is provided in Table 7.7.

An analysis of possible remedial alternatives was conducted as part of the RAA (ESI, 2007c). The selected remedial alternative (Remedial Alternative 3; ESI, 2007c) employs a combination of engineering controls (capping, soil vapor barrier with passive vapor control system, and an ozone-injection system or similar chemical treatment/barrier system), institutional controls, partial soil removal to remediate areas of TPH-g, BTEX, MTBE, acenaphthene, and naphthalene contamination beneath the Lowe's building footprint, free product recovery system (if feasible), monitored natural attenuation, and realignment of the storm drain.

Implementation of the chosen remedial alternative will eliminate all of the identified environmental hazards for the anticipated future use of the property (i.e., as Lowe's retail store), with the exception of leaching. Because there will be small, landscaped areas, there is the potential that a small amount of leaching could occur. A summary of the environmental hazards remaining following implementation of the chosen remedial alternative is provided in Table 7.8.

TABLE 7.7
Hazard Evaluation Summary (Without Selected Remedial Alternative)
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Population	Potential Hazard	Soil			Groundwater			Soil Vapor		
		Current	Const	Future	Current	Const	Future	Current	Const	Future
Human	Gross Contamination	✓	✓		✓	✓				
	Direct Exposure	✓	✓							
	Vapor Intrusion	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Leaching	✓	✓	✓						
Ecological	Marine Ecotoxicity				✓	✓	✓			

Const Construction Phase
✓ Potential hazard identified.
not applicable.

TABLE 7.8
Hazard Evaluation Summary (With Implementation of Selected Remedial Alternative)
Task 6 – Environmental Hazard Evaluation
Lowe's VRP – Former ConocoPhillips Terminal

Population	Potential Hazard	Soil			Groundwater			Soil Vapor		
		Current	Const	Future	Current	Const	Future	Current	Const	Future
Human	Gross Contamination	✓	✓		✓	✓				
	Direct Exposure	✓	✓							
	Vapor Intrusion	✓	✓		✓	✓		✓	✓	
	Leaching	✓	✓	—						
Ecological	Marine Ecotoxicity				✓	✓				

Const Construction Phase
✓ Potential hazard identified.
— Potential hazard reduced substantially.
not applicable.

7.7 SELECTED REMEDIAL ALTERNATIVE

Based on the results of the RAA (ESI, 2007c), the selected remedial alternative (Remedial Alternative 3; ESI, 2007c) employs a combination of institutional controls, engineering controls (capping, soil vapor barrier and passive vapor control system, ozone-injection system or similar chemical treatment/barrier system), partial soil removal, free product recovery system (if feasible), monitored natural attenuation, and realignment of the storm drain. The remedial response actions associated with the chosen remedial alternative is summarized below.

Institutional Controls

The purpose of institutional controls is to prevent exposure to identified hazards at the Property. Possible institutional controls that will be implemented during various stages of the property development include the following.

- An LOC issued by the DOH, which would include land-use controls, and/or a *Uniform Environmental Covenant*.
- An exposure prevention management [EPM] Plan outlining the environmental oversight and monitoring to be conducted during construction excavation at the property. The plan would include a Soil and Groundwater Management Plan.
- An environmental hazard management [EHM] Plan documenting the extent and magnitude of residual soil and groundwater contamination and identifying potential environmental concerns. The plan would include specifications for the long-term management of identified contamination, including a long-term groundwater monitoring plan.
- An inspection and maintenance plan for the cap (asphalt and/or concrete).

Capping

The purpose of the cap is to reduce the potential direct exposure hazard. The surface of the property will be capped with asphalt and concrete (with small landscaped areas along the perimeter) during and following construction of the Lowe's building.

Soil Vapor Barrier with Passive Vapor Control System

The purpose of the soil vapor barrier and passive vapor control system is to eliminate the potential vapor intrusion hazard in the area of the Lowe's building. Construction of the soil vapor barrier and vapor control system will include the following activities.

- Installing a Liquid Boot® impermeable membrane over the entire area underlying the structural slab of the Lowe's building.
- Installing a passive vapor control system.
- Installing a vapor monitoring system.
- Designing the vapor barrier system such that an active vapor control system can be installed in the future, if conditions warrant.

Ozone-Injection System or Similar Chemical Treatment/Barrier System

The purpose of the ozone-injection system (or similar chemical treatment/barrier system) is to remediate contaminated groundwater and prevent contaminated groundwater from migrating onto the property from an off-site source. Construction of the ozone-injection system would include the following activities.

- Installing injection points along the north-northeast side of the property, next to Pacific Street.
- Installing a control box that includes an ozone generator, an oxygen generator, a manifold, and a programmable controller.
- Installing a series of horizontal piping connecting the control box to the injection points.
- Performing a test of the system following installation.
- Commencing long-term operation of the system.
- Performing ongoing operation and maintenance [O&M] of the system.

Partial Soil Removal

The purpose of partial soil removal is to reduce the vapor intrusion hazard within the Lowe's building footprint. An important remedial response action for reducing the potential vapor intrusion hazard in the area of the Lowe's building is the removal of contiguous areas of TPH-g, BTEX, MTBE, acenaphthene, and naphthalene contaminated soil beneath the Lowe's building footprint. This remedial excavation will include the following activities.

- Excavating approximately 27,000 tons of TPH-g, BTEX, MTBE, acenaphthene, and naphthalene contaminated soil within 100 feet of the Lowe's building footprint.
- Recovering free product on the groundwater in the excavations, if free product is present and recovery is practicable.
- Characterizing and transporting the excavated VOC-contaminated soil to an appropriate permitted facility for disposal, if on-site treatment is not viable due to time constraints related to the construction schedule.
- Backfilling the excavations with clean fill.

Free Product Recovery System

The purpose of free product recovery system is to remove free product and reduce the potential direct exposure hazard. Should a free product system be deemed practicable and feasible construction of the system will likely include the following activities.

- Evaluating various methods of free product recovery to determine if product recovery is feasible.
- Installing a free product recovery system along the Nimitz Highway side of the property if product recovery proves feasible.
- If a free product recovery system is installed, conducting product recovery operations until product recovery no longer is practicable.
- If free product recovery operations are initiated, disposing of recovered free product at an appropriate permitted disposal facility.
- If installed, performing ongoing O&M of the product recovery system.

- Documenting the results of product recovery operations in regular status reports.

Monitored Natural Attenuation

The purpose of monitored natural attenuation [MNA] is to monitor long-term remedial progress at the property. MNA will include the following activities.

- Installing groundwater monitoring wells.
- Conducting routine (e.g., quarterly, semiannually) groundwater sampling and analysis.
- Conducting free product recovery if product is detected in any of the wells.
- Documenting the results of groundwater monitoring in regular status reports.
- Continuing groundwater monitoring until it can be demonstrated that groundwater contaminants are remaining at concentrations that do not warrant concern.

Realignment of the Storm Drain

The purpose of this remedial response action is to prevent the off-site migration of contaminated groundwater or free product via a preferential pathway. Realignment of the storm drain will include the following activities.

- Constructing a new storm drain along the southern property boundary and connecting it to the existing storm water entrance at Pacific Street and the existing storm water exit at Nimitz Highway.
- Removing the current storm drain either by demolishing it in-place or by removing it.
- Backfilling the void created by demolishing or removing the current storm drain with clean fill and sealing the former storm drain at the upgradient and downgradient ends.
- Options for ensuring that the new storm drain does not act as a preferential pathway include installing a liner around the pipeline corridor of the new storm drain or installing slurry walls around the new pipeline at regular intervals.

SECTION 8 – REFERENCES

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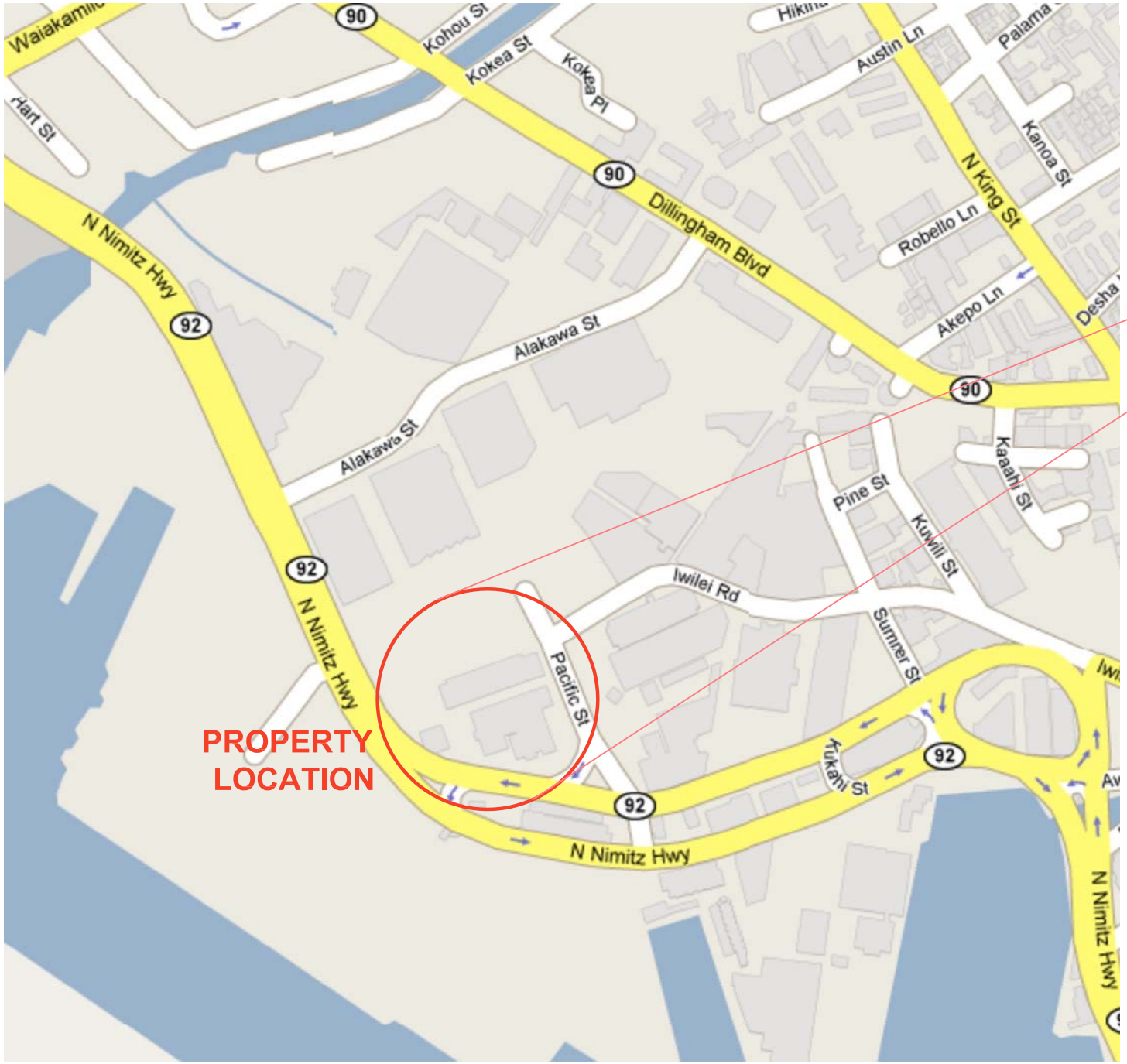
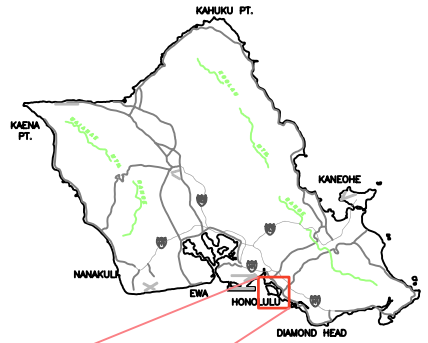
FIGURES





NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

Google Maps, 2007

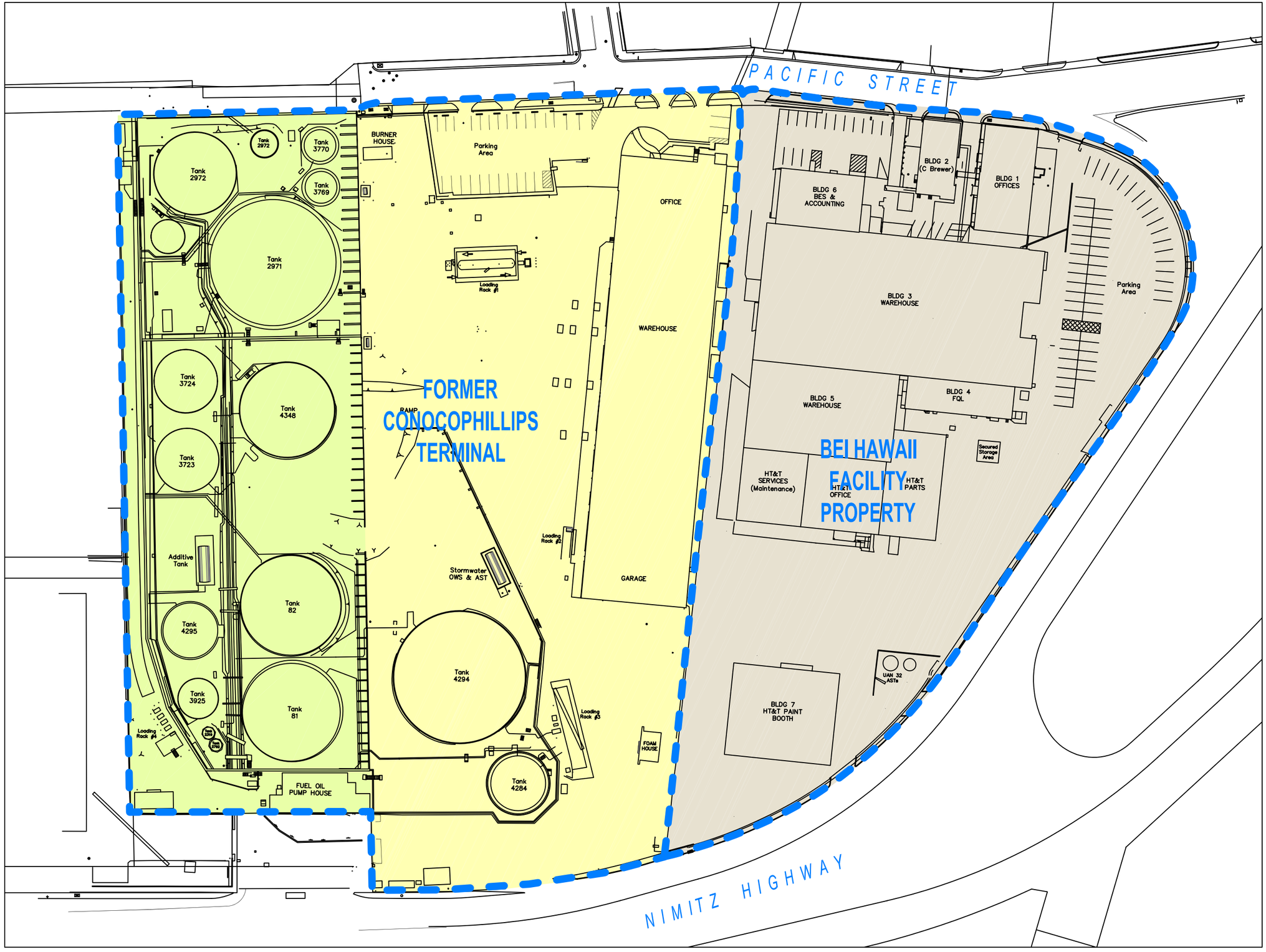
NORTH

FIGURE 1

SITE AREA MAP

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON 2004 LOWE'S PROPERTY SURVEY
- 311 PACIFIC STREET PARCEL 023 TMK (1) 1-5-013:023
- 411 PACIFIC STREET PARCEL 010 TMK (1) 1-5-013:010
- 439 PACIFIC STREET PARCEL 012 TMK (1) 1-5-013:012

NORTH

90 0 90

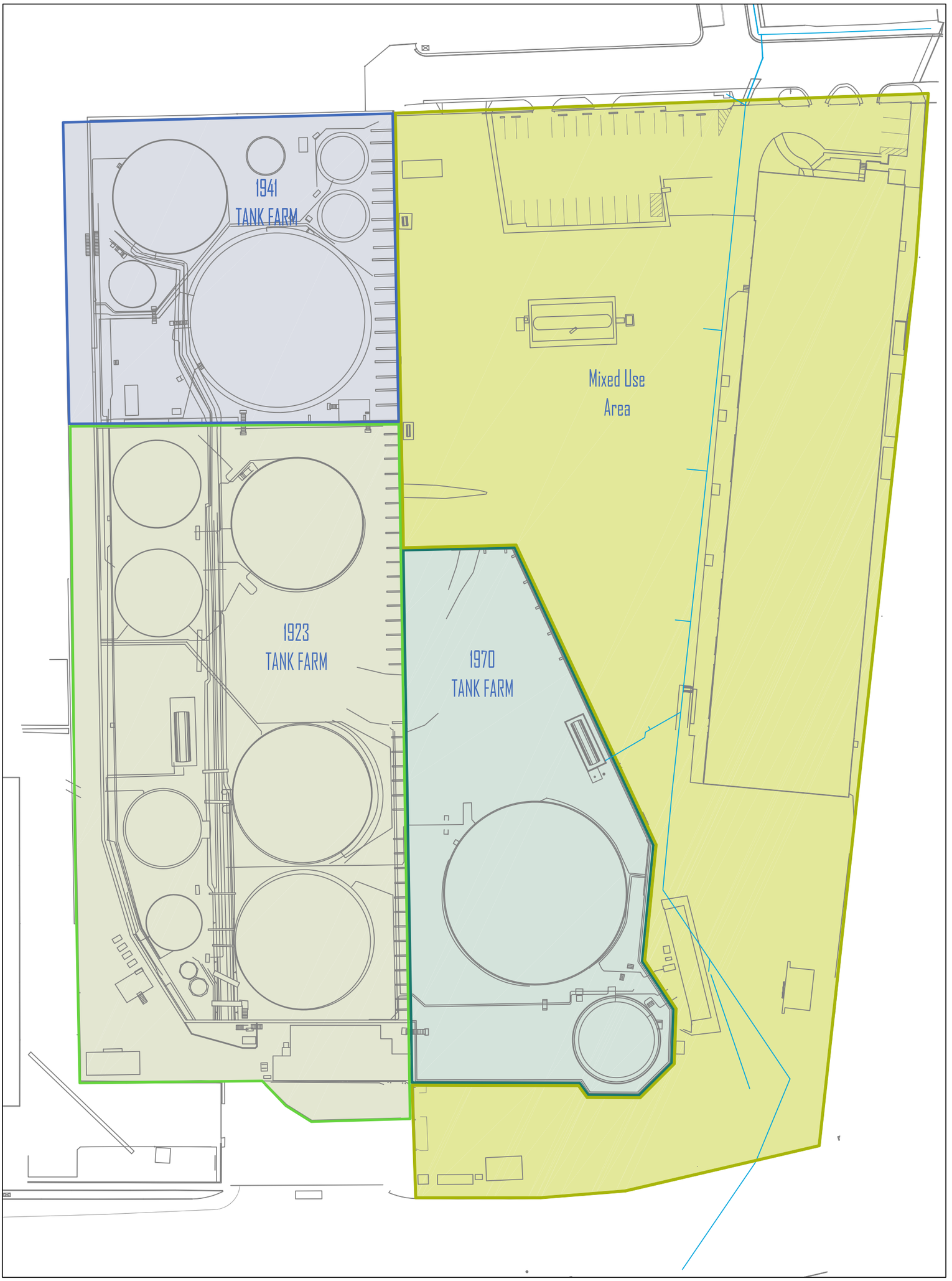
1 inch = 90 feet

FIGURE 2

LOWE'S PROPERTY

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ENVIRONMENTAL SCIENCE INTERNATIONAL



65 0 65

1 inch = 65 feet

NORTH

LEGEND

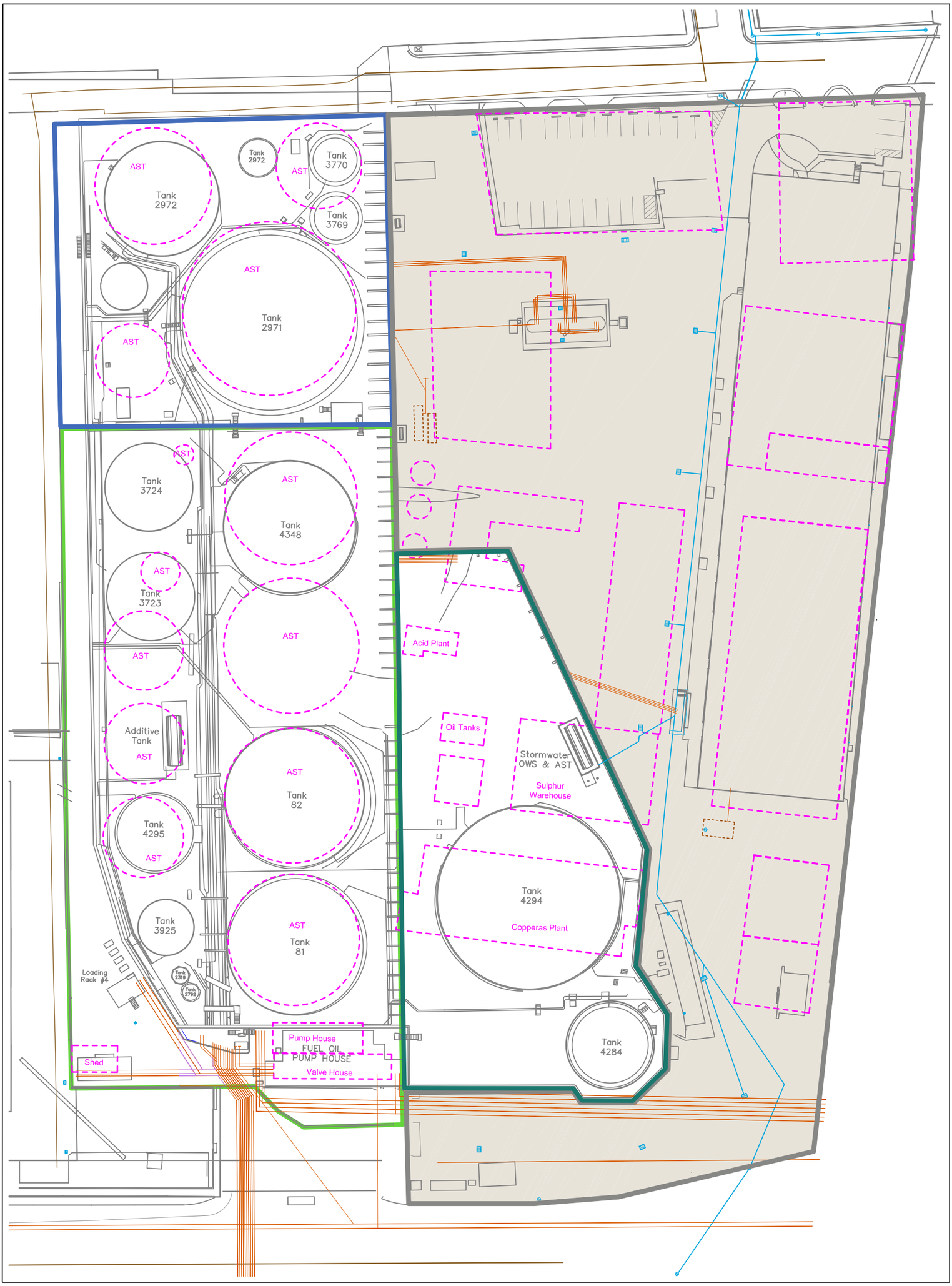
- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON 2004 LOWE'S PROPERTY SURVEY
- 1923 TANK FARM AREA LOCATION
- 1941 TANK FARM AREA LOCATION
- 1970 TANK FARM AREA LOCATION
- MIXED USE AREA LOCATION

FIGURE 3

FORMER CONOCOPHILLIPS TERMINAL

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ENVIRONMENTAL SCIENCE INTERNATIONAL



65 0 65

1 inch = 65 feet

NORTH

LEGEND

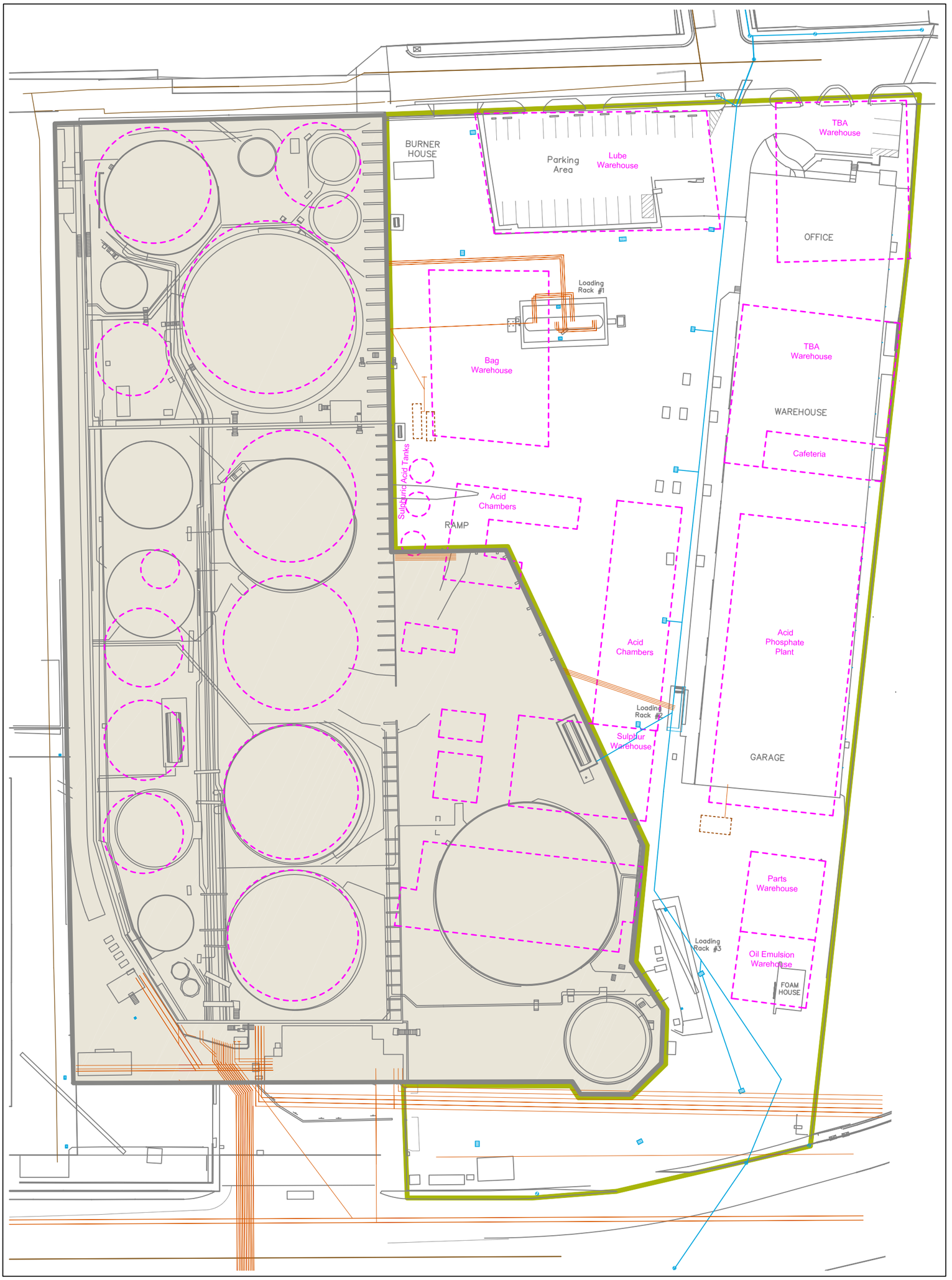
- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON 2004 LOWE'S PROPERTY SURVEY
- 1923 TANK FARM AREA LOCATION
- 1941 TANK FARM AREA LOCATION
- 1970 TANK FARM AREA LOCATION
- MIXED USE AREA LOCATION
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- STORM WATER PIPELINE
- STORM WATER CATCH BASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- NON-REGULATED UNDERGROUND STORAGE TANK

FIGURE 4

HISTORICAL TANK FARM AREAS

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ENVIRONMENTAL SCIENCE INTERNATIONAL



65 0 65

1 inch = 65 feet

NORTH

LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON THE 2004 LOWE'S PROPERTY SURVEY
- 1923, 1941, AND 1970 TANK FARM AREA LOCATIONS
- MIXED USE AREA LOCATION
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION - 1955 SANBORNE FIRE INSURANCE MAP
- STORM WATER PIPELINE
- STORM WATER CATCH BASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- NON-REGULATED UNDERGROUND STORAGE TANK

FIGURE 5

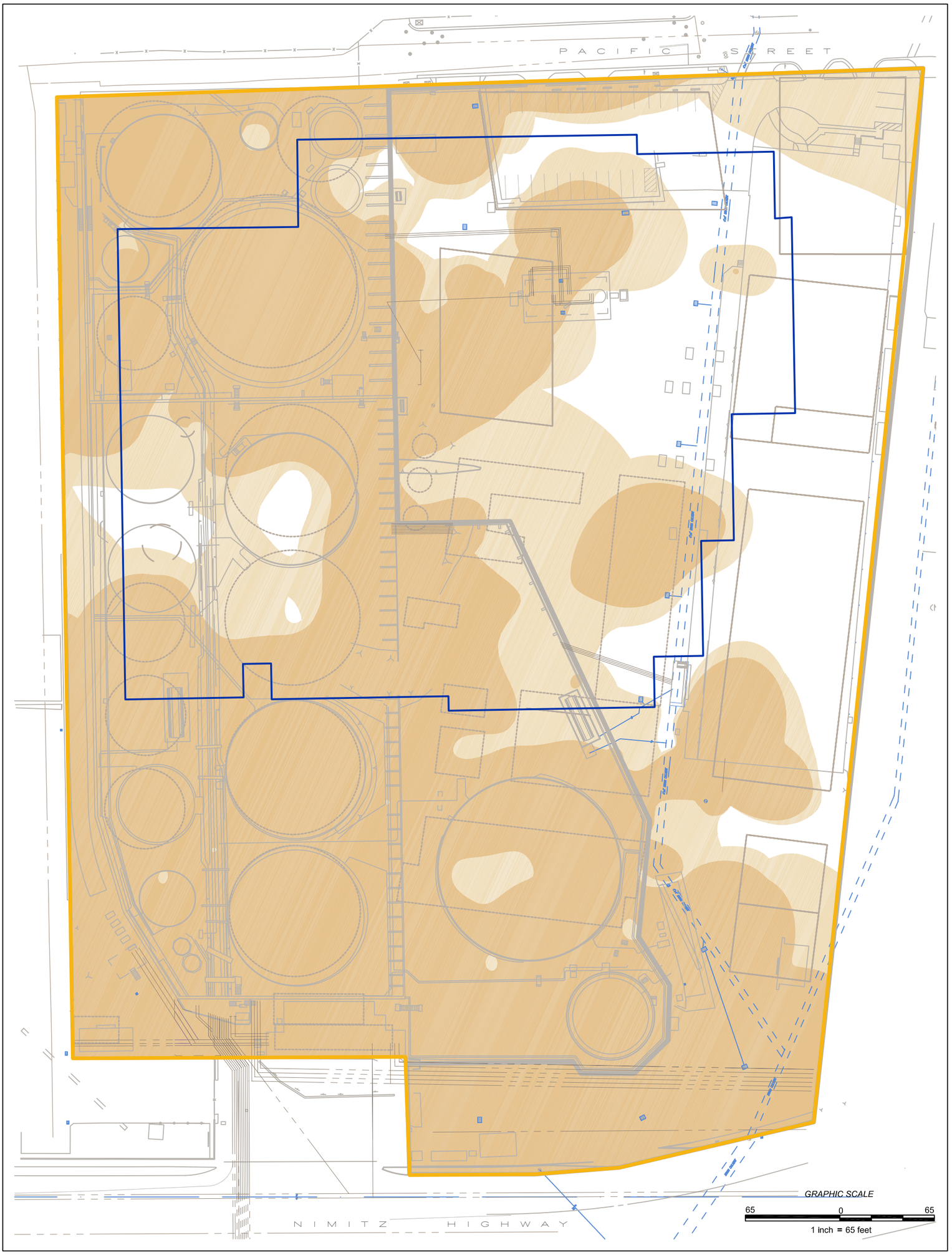
MIXED USE AREA

VOLUNTARY RESPONSE PROGRAM

LOWE'S PROPERTY

IWILEI, HAWAII

ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING RESIDENTIAL EALs FOR GROSS CONTAMINATION IN SOIL
- AREAS EXCEEDING COMMERCIAL/INDUSTRIAL EALs FOR GROSS CONTAMINATION IN SOIL

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, TPH-d, TPH-o, benzene, xylene, acenaphthene, fluoranthene, naphthalene, barium, chromium, and lead were detected in soil at concentrations exceeding the residential and commercial/industrial EALs for gross contamination in soil.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

Work Plan - ESI, 2006

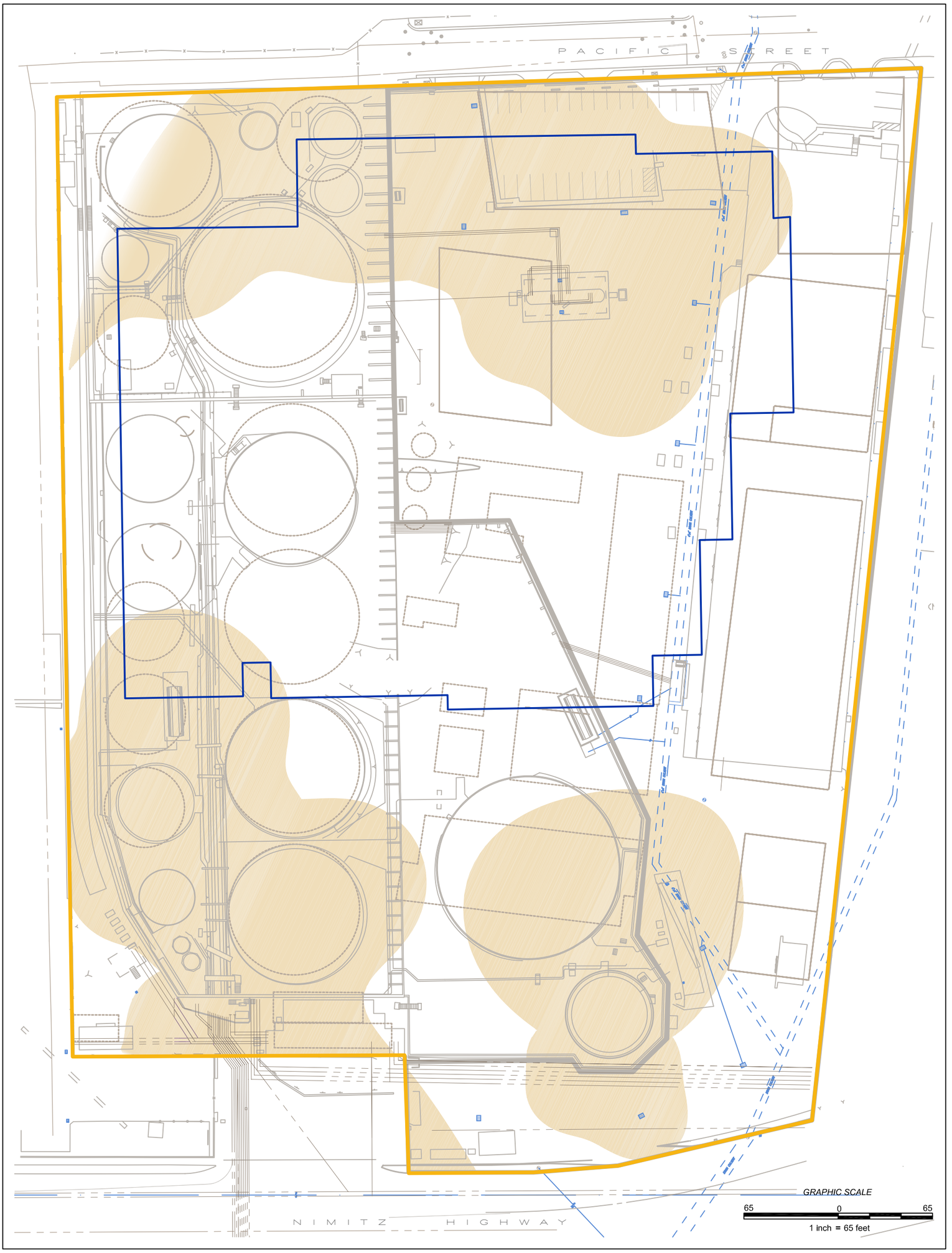
NORTH

FIGURE 6

GROSS CONTAMINATION HAZARD MAP FOR SOIL

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ESI
ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING EALs FOR GROSS CONTAMINATION IN GROUNDWATER

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, TPH-d, TPH-o, benzene, toluene, ethylbenzne, benzo[a]pyrene, and naphthalene were detected in groundwater at concentrations exceeding the EALs for gross contamination in groundwater.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

Work Plan - ESI, 2006

NORTH

FIGURE 7

GROSS CONTAMINATION HAZARD MAP FOR GROUNDWATER

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ESI
ENVIRONMENTAL SCIENCE INTERNATIONAL

LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING RESIDENTIAL EALs FOR DIRECT EXPOSURE TO CONTAMINATED SOIL
- AREAS EXCEEDING COMMERCIAL/INDUSTRIAL EALs FOR DIRECT EXPOSURE TO CONTAMINATED SOIL
- AREAS EXCEEDING CONSTRUCTION WORKER EALs FOR DIRECT EXPOSURE TO CONTAMINATED SOIL

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, TPH-d, TPH-o, benzene xylene, benzo[a]pyrene, naphthalene, arsenic, cadmium, chromium, lead, mercury and pentachlorophenol were detected in soil at concentrations exceeding the residential, commercial/industrial, and construction worker EALs for direct exposure to contaminated soil.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

Work Plan - ESI, 2006

NORTH

FIGURE 8

DIRECT EXPOSURE HAZARD MAP FOR SOIL

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ESI
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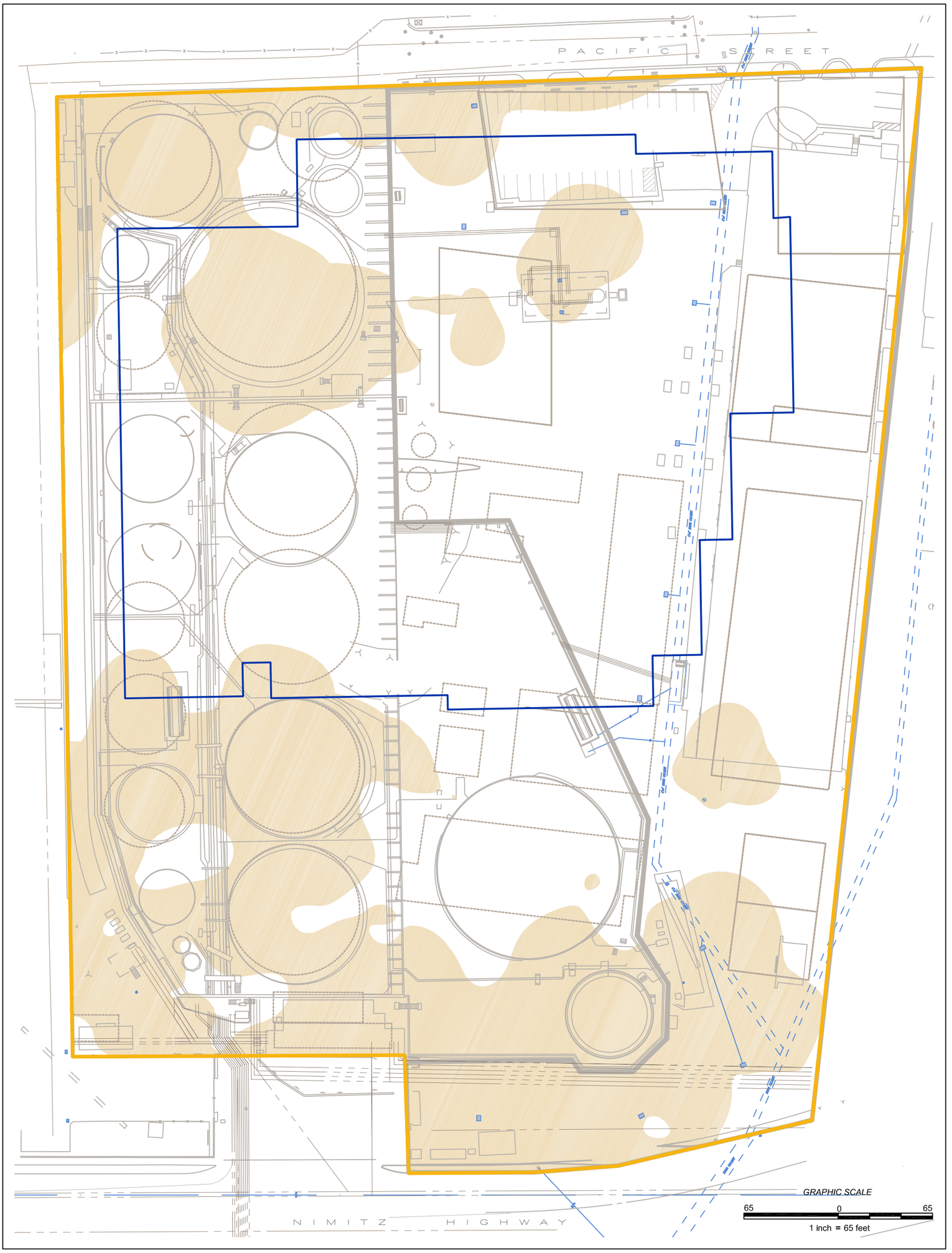

LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING EALs FOR LEACHING

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, TPH-d, TPH-o, benzene, toluene, ethylbenzene, xylenes, acenaphthene, benzo[a]pyrene, fluoranthene, and naphthalene were detected in soil at concentrations exceeding the EALs for leaching.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

Work Plan - ESI, 2006

NORTH

FIGURE 9

LEACHING HAZARD MAP

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

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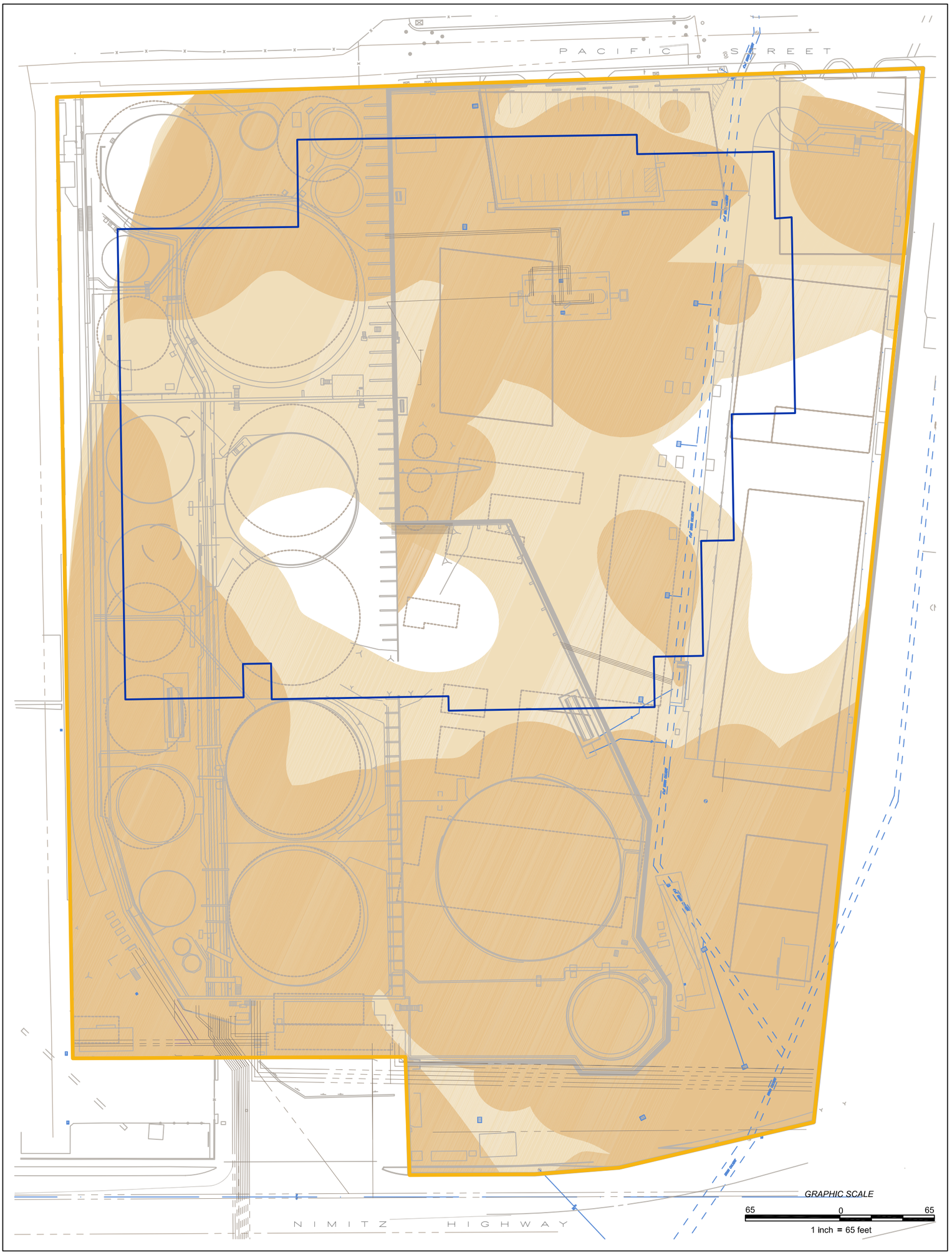


LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING CHRONIC EALs FOR MARINE AQUATIC TOXICITY
- AREAS EXCEEDING ACUTE EALs FOR MARINE AQUATIC TOXICITY

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, TPH-d, TPH-o, benzene, toluene, ethylbenzene, xylene, benzo[a]pyrene, naphthalene, arsenic, lead, silver, and pentachlorophenol were detected in groundwater at concentrations exceeding the chronic and acute EALs for marine aquatic toxicity.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

Work Plan - ESI, 2006

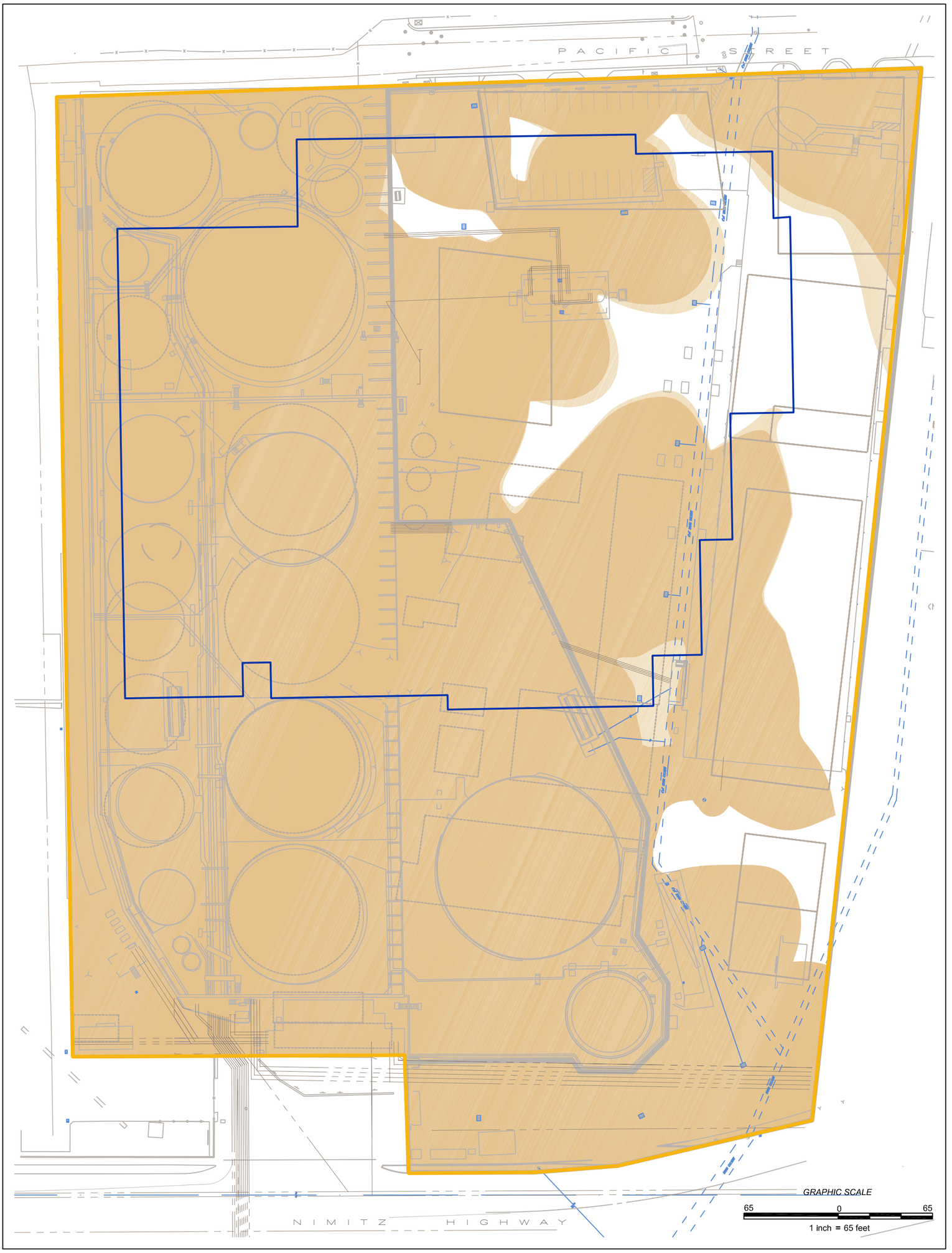
NORTH

FIGURE 10

MARINE TOXICITY HAZARD MAP FOR GROUNDWATER

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ESI
ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING RESIDENTIAL EALs FOR VAPOR INTRUSION FROM SOIL
- AREAS EXCEEDING COMMERCIAL/INDUSTRIAL EALs FOR VAPOR INTRUSION FROM SOIL

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, TPH-d, benzene, xylene, acenaphthene, and naphthalene were detected in soil at concentrations exceeding the residential and commercial/industrial EALs for vapor intrusion from contaminated soil.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

Work Plan - ESI, 2006

NORTH

FIGURE 11A

VAPOR INTRUSION HAZARD MAP FOR SOIL

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

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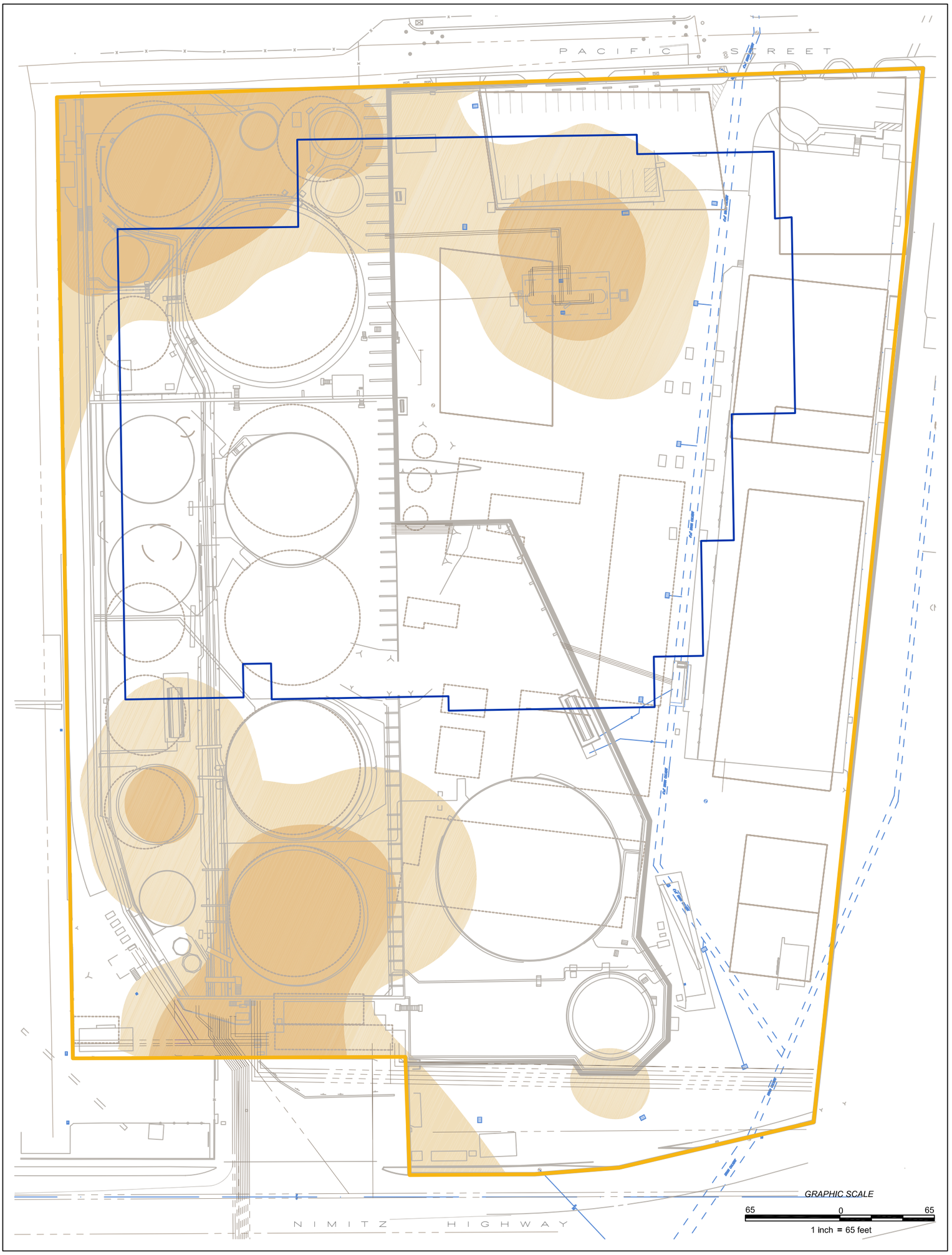
ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING RESIDENTIAL EALs FOR VAPOR INTRUSION FROM GROUNDWATER
- AREAS EXCEEDING COMMERCIAL/INDUSTRIAL EALs FOR VAPOR INTRUSION FROM GROUNDWATER

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, TPH-d, and benzene were detected in groundwater at concentrations exceeding the residential and commercial/industrial EALs for vapor intrusion from groundwater.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

Work Plan - ESI, 2006

NORTH

FIGURE 11B

VAPOR INTRUSION HAZARD MAP FOR GROUNDWATER

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ENVIRONMENTAL SCIENCE INTERNATIONAL

LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING RESIDENTIAL EALs FOR VAPOR INTRUSION FROM SOIL VAPOR
- AREAS EXCEEDING COMMERCIAL/INDUSTRIAL EALs FOR VAPOR INTRUSION FROM SOIL VAPOR

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, benzene, toluene, xylene, MTBE and tetrachloroethylene were detected in soil vapor at concentrations exceeding the residential and commercial/industrial EALs for soil vapor intrusion.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

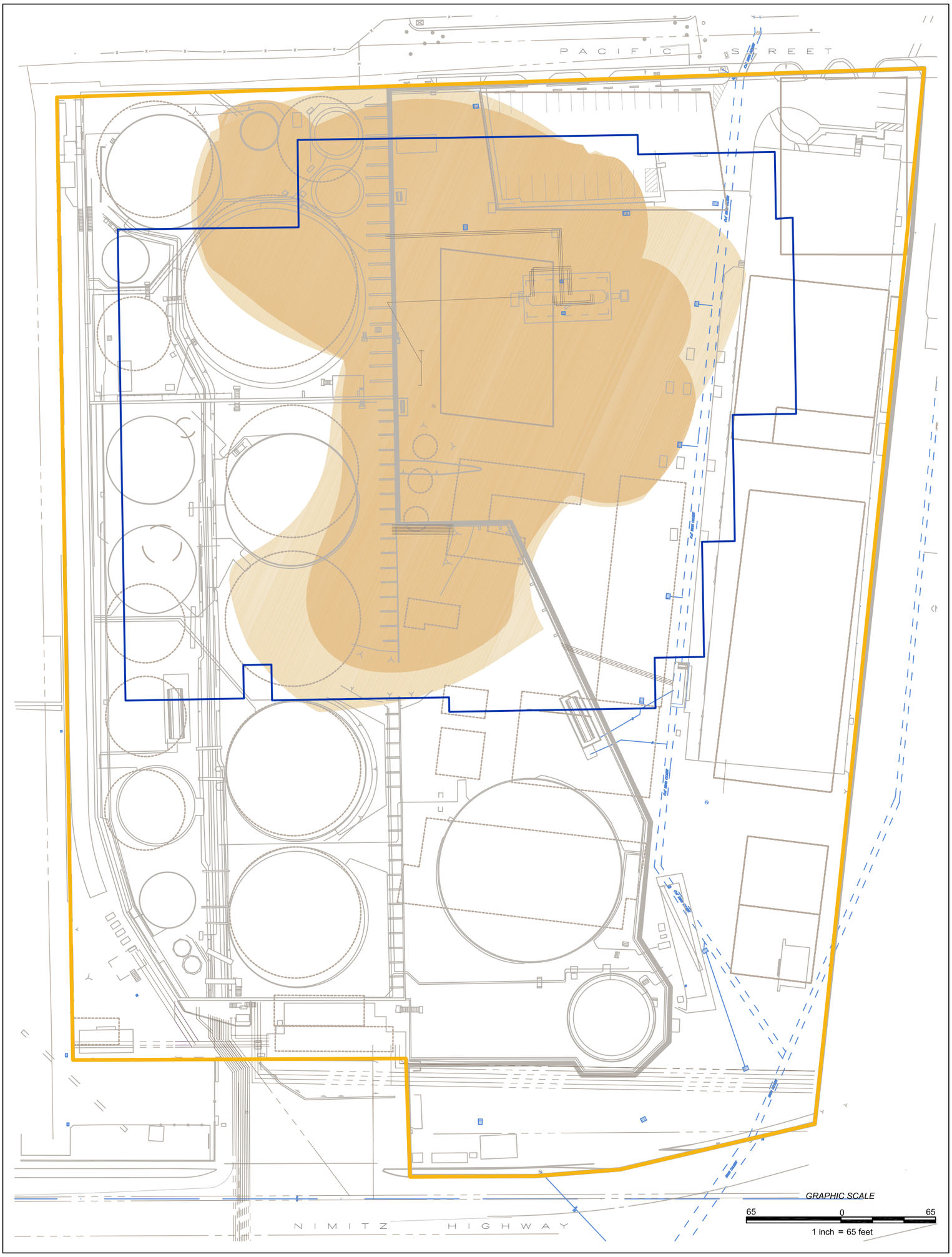
Work Plan - ESI, 2006

NORTH

FIGURE 12
VAPOR INTRUSION HAZARD MAP- SOIL VAPOR FOR CONSTRUCTION WORKERS

CONSTRUCTION WORKERS
LOWE'S PROPERTY
IWILEI, HAWAII

ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- FORMER CONOCOPHILLIPS TERMINAL CONFIGURATION BASED ON LOWE'S PROPERTY SURVEY
- ESTIMATED PACIFIC CHEMICAL & FERTILIZER SITE CONFIGURATION BASED ON 1955 SANBORNE FIRE INSURANCE MAP
- 411 & 439 PACIFIC STREET PROPERTY BOUNDARY
- STORM WATER PIPELINE
- STORM WATER CATCHBASIN
- GAS PIPELINE
- UNDERGROUND PIPELINE
- PROPOSED LOWE'S BUILDING FOOTPRINT
- AREAS EXCEEDING RESIDENTIAL EALs FOR VAPOR INTRUSION FROM SOIL VAPOR
- AREAS EXCEEDING COMMERCIAL/INDUSTRIAL EALs FOR VAPOR INTRUSION FROM SOIL VAPOR

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

Shading indicates areas where TPH-g, benzene, toluene and xylene were detected in soil vapor at concentrations exceeding the residential and commercial/industrial EALs for vapor intrusion.

Contours generated using Golden Software, Surfer 8.

SOURCES

Lowe's Property Survey, 2004

Sanborne Fire Insurance Map, 1955

Work Plan - ESI, 2006

NORTH

FIGURE 13

VAPOR INTRUSION HAZARD MAP- SOIL VAPOR FOR FUTURE ON-SITE WORKERS AND CUSTOMERS

VOLUNTARY RESPONSE PROGRAM
LOWE'S PROPERTY
IWILEI, HAWAII

ENVIRONMENTAL SCIENCE INTERNATIONAL

APPENDIX A

Leaching Calculations - Soil to Groundwater

Table A-1
Leaching Calculations - Soil to Groundwater (Soil Samples at or Below the Capillary Fringe of the Water Table)
Task 6 - Environmental Hazard Evaluation
Lowe's VRP - Former ConocoPhillips Terminal

Sample	Lead			Chromium			Cadmium			Barium			Silver			Arsenic			Selenium			Mercury		
Location	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached
37 (+)	0.011	3400 (J)	0.0003	nd< 0.005	4.7 (J)	0.11	nd< 0.002	4.5	0.04	0.10 (J)	99 (J)	0.101	nd< 0.001	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.0001	nd< 0.5	-
67	nd< 0.005	550	0.0009	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-
70	0.091 (J)	2700	0.003	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-
70	0.082 (J)	2700	0.003	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-
112	0.0092	1600	0.001	nd< 0.005	21	0.02	nd< 0.002	nd< 2.0	-	0.10 (J)	140	0.07	nd< 0.001	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.0001	nd< 0.5	-
119	0.019	200	0.010	nd< 0.005	58	0.01	nd< 0.002	nd< 2.0	-	0.10 (J)	82	0.12	nd< 0.001	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.0001	2.1	0.005
127	0.021 (J)	nd< 10	***	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-
133	0.014 (J)	350	0.004	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-

The soil data are in mg/kg.
The groundwater data are in mg/l.

GW Groundwater.
nd not detected.
na not analyzed.
J Estimated value. Contaminant was at a concentration below the method reporting limit but above the detection limit.
- Not applicable - contaminant not detected in soil or groundwater.
*** Contaminant detected in groundwater, but not in soil.
(+) Sample collected below water table.

Table A-2
Leaching Calculations - Soil to Groundwater (Soil Samples from Vadose Zone)
Task 6 - Environmental Hazard Evaluation
Lowe's VRP - Former ConocoPhillips Terminal

Sample	Lead			Chromium			Cadmium			Barium			Silver			Arsenic			Selenium			Mercury		
Location	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached	GW	Soil	% Leached
37	0.011	200 (J)	0.006	nd< 0.005	nd< 5.0	-	nd< 0.002	nd< 2.0	-	0.10 (J)	nd< 10	***	nd< 0.001	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.0001	nd< 0.5	-
67	nd< 0.005	1800	0.0003	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-
70	0.091 (J)	2700	0.003	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-
70	0.082 (J)	2700	0.003	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-
112	0.0092	820	0.001	nd< 0.005	8.3	0.06	nd< 0.002	nd< 2.0	-	0.10 (J)	65	0.15	nd< 0.001	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.0001	2.1	0.005
112	0.0092	1300	0.001	nd< 0.005	12	0.04	nd< 0.002	nd< 2.0	-	0.10 (J)	100	0.10	nd< 0.001	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.02	nd< 5.0	-	nd< 0.0001	2	0.005
119	0.019	1500	0.001	nd< 0.005	13	0.04	nd< 0.002	2.6	0.08	0.10 (J)	170	0.06	nd< 0.001	nd< 5.0	-	nd< 0.02	7.2	0.3	nd< 0.02	nd< 5.0	-	nd< 0.0001	1.1	0.009
127	0.021 (J)	640	0.003	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-
133	0.014 (J)	870	0.002	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-	na	na	-

The soil data are in mg/kg.
The groundwater data are in mg/l.

GW Groundwater.
nd not detected.
na not analyzed.
J Estimated value. Contaminant was at a concentration below the method reporting limit but above the detection limit.
- Not applicable - contaminant not detected in soil or groundwater.
*** Contaminant detected in groundwater, but not in soil.

APPENDIX B

EALs for Evaluating Environmental Hazards Posed by Contaminated Soil

Appendix B
EALs for Evaluating Environmental Hazards Posed by Contaminated Soil
Task 6 – Environmental Hazard Evaluation
Lowe's VRP - Former ConocoPhillips Terminal

Contaminants of Concern		Maximum Concentration Detected	Potential Environmental Hazards							
			Gross Contamination+		Direct Exposure*			Vapor Intrusion††		Leaching**
			Residential	Commercial / Industrial	Residential	Commercial / Industrial	Construction	Residential	Commercial / Industrial	
Total Petroleum Hydrocarbons (mg/kg)	TPH-g	4,100	100	500	800	3,700	30,000	11	31	2,000
	TPH-d	98,000	500	1,000	800	3,700	30,000	7	20	5,000
	TPH-o	105,000	500	2,500	2,300	31,000	110,000	~	~	5,000
Volatile Organic Compounds (mg/kg)	Benzene	680	500	870	0.64	1.4	590	0.53	1.9	70
	Toluene	170	500	650	650	650	650	650	650	29
	Ethylbenzene	140	400	400	400	400	400	390	390	33
	Xylene	470	420	420	270	420	420	180	420	110
	Methyl-Tert-Butyl Ether	nd< 1	100	500	31	70	21,000	1.6	5.6	8.4
Halogenated Volative Organic Compounds (mg/kg)	Tetrachloroethylene	nd< 1.0	230	230	0.48	1.3	230	0.069	0.24	14
	Trichloroethylene	nd< 0.86	500	1,300	0.52	1.1	49	0.036	0.13	6.8
	1,1,1-Trichloroethane	nd< 2.0	500	1,000	1,200	1,200	1,200	390	1,100	750
	1,1-Dichloroethene	nd< 2.0	500	1,000	120	410	1,500	35	100	670
	Vinyl Chloride	nd< 4.28	500	1,000	0.15	0.38	120	0.020	0.16	1.9
Semi-volatile Organic Compounds (mg/kg)	Acenaphthene	1,700	1,000	2,500	3,700	29,000	170,000	130	130	160
	Benzo[a]pyrene	360	500	1,000	0.62	2.1	24	~	~	130
	Fluoranthene	1,210	500	1,000	2,300	22,000	70,000	~	~	250
	Naphthalene	1,500	500	1,000	55	190	2,300	18	61	42
Organochlorine Pesticides (mg/kg)	Aldrin	nd< 0.0099	1,000	2,500	0.029	0.10	12	~	~	11
	Alpha-BHC	nd< 0.0099	~	~	~	~	~	~	~	~
	Beta-BHC	0.013	~	~	~	~	~	~	~	~
	Delta-BHC	0.004	~	~	~	~	~	~	~	~
	Gamma-BHC	nd< 0.0099	~	~	~	~	~	~	~	~
	Chlordane	nd< 0.200	1,000	2,500	1.6	6.5	790	~	~	15
	Alpha-Chlordane	0.0034	~	~	~	~	~	~	~	~
	Gamma-Chlordane	0.0053	~	~	~	~	~	~	~	~
	4,4' DDD[1]	nd< 0.020	500	1,000	2.4	10	1,200	~	~	750
	4,4' DDE[1]	0.0021	500	1,000	2.4	10	1,200	~	~	1,100
	4,4' DDT[1]	0.009	1,000	2,500	1.7	7.0	870	~	~	4.3
	Dieldrin	0.014	1,000	2,500	0.030	0.11	12	~	~	0.87
	Endosulfan[2] I	nd< 0.0099	500	1,000	370	3,700	12,000	~	~	0.018
	Endosulfan[2] II	nd< 0.020	500	1,000	370	3,700	12,000	~	~	0.018
	Endosulfan Sulfate	nd< 0.020	~	~	~	~	~	~	~	~
	Endrin	0.0027	500	1,000	18	180	600	~	~	0.010
	Heptachlor	nd< 0.0099	1,000	2,500	0.11	0.38	44	~	~	0.19
	Heptachlor Epoxide	nd< 0.0099	1,000	2,500	0.053	0.19	22	~	~	0.20
	Methoxychlor	nd< 0.0990	500	1,000	310	3,100	10,000	~	~	18
	Toxaphene	nd< 0.990	500	1,000	0.40	1.4	170	~	~	0.44
Chlorinated Herbicides (mg/kg)	2,4-D	nd< 1.0	500	1,000	690	7,700	26,500	~	~	14
	2,4-DB	nd< 1.0	~	~	~	~	~	~	~	~
	2,4,5-T	nd< 1.0	~	~	~	~	~	~	~	~
	2,4,5-TP	nd< 1.0	~	~	~	~	~	~	~	~
	Dalapon	nd< 2.0	500	1,000	1,800	18,000	60,000	~	~	1.4
	Dicamba	nd< 1.0	~	~	~	~	~	~	~	~
	Dichloroprop	nd< 1.0	~	~	~	~	~	~	~	~
	Dinosed	nd< 1.0	~	~	~	~	~	~	~	~
	MCPA	nd< 100	~	~	~	~	~	~	~	~
	MCPP	nd< 100	~	~	~	~	~	~	~	~
	Pentachlorophenol	3.4	500	1,000	3.0	9.0	980	~	~	69
Metals (mg/kg)	Arsenic	590	1,000	2,500	20	20	180	~	~	site-specific
	Barium	3,300	1,000	2,500	5,400	12,000	12,000	~	~	site-specific
	Cadmium	70	1,000	2,500	39	510	1,500	~	~	site-specific
	Chromium (Total)	1,500	1,000	2,500	210	220	220	~	~	site-specific
	Lead	5,500	1,000	2,500	400	800	800	~	~	site-specific
	Mercury	57	500	1,000	23	310	1,200	~	~	site-specific
	Selenium	1.2	1,000	2,500	390	5,100	19,000	~	~	site-specific
	Silver	34	1,000	2,500	390	5,100	19,000	~	~	site-specific

DOH EAL	State of Hawaii Department of Health Environmental Action Level.
mg/kg	milligrams per killigram.
	DOH EALs that were exceeded by contaminant concentrations detected in groundwater.
	Laboratory method reporting limit exceeds the DOH EAL.
~	DOH EAL not provided.

APPENDIX C

EALs for Evaluating Environmental Hazards Posed by Contaminated Groundwater

Appendix C
EALs for Evaluating Environmental Hazards Posed by Contaminated Groundwater
Task 6 - Environmental Hazard Evaluation
Lowe's VRP - Former ConocoPhillips Terminal

Contaminants of Concern		Maximum Concentration Detected	Potential Environmental Hazards				
			Gross+ Contamination	Vapor Intrusion[tt]		Impact to Aquatic Habitats*	
				Residential	Commercial / Industrial	Marine Chronic	Marine Acute
Total Petroleum Hydrocarbons (mg/L)	TPH-g	75	5.0	11	31	4	5
	TPH-d	30	2.5	7	20	0.64	3
	TPH-o	6.84	2.5	~	~	0.64	3
Volatile Organic Compounds (mg/L)	Benzene	43	20	1.6	6.7	0.35	2
	Toluene	13	0.40	530	530	3	6
	Ethylbenzene	0.45	0.30	170	170	0.29	0.43
	Xylene	3.5	5.3	160	160	0.10	1
	Methyl-Tert-Butyl-Ether	0.22	1.8	19	80	8	8
Halogenated Volative Organic Compounds (mg/L)	Tetrachloroethylene	nd< 0.005	3.0	0.099	0.42	0.15	3
	Trichloroethylene	nd< 0.005	50	0.074	0.31	0.36	0.70
	1,1,1-Trichloroethane	nd< 0.005	50	500	1,300	0.062	10
	1,1-Dichloroethene	nd< 0.005	15	25	88	0.025	75
	Vinyl Chloride	nd< 0.002	34	0.011	0.11	0.78	0.78
Semi-volatile Organic Compounds (mg/L)	Acenaphthene	0.037	0.20	4.2	4.2	0.040	0.32
	Benzo[a]pyrene	0.0059	0.0019	~	~	0.000014	0.000014
	Fluoranthene	0.0032	0.13	~	~	0.0	0.0
	Naphthalene	0.92	0.21	~	~	0.024	0.078
Organochlorine Pesticides (mg/L)	Aldrin	nd< 0.0001	0.0085	~	~	0.00013	0.0013
	Alpha-BHC	nd< 0.0001	~	~	~	~	~
	Beta-BHC	nd< 0.0002	~	~	~	~	~
	Delta-BHC	nd< 0.0001	~	~	~	~	~
	Gamma-BHC	nd< 0.0001	~	~	~	~	~
	Chlordane	nd< 0.0010	0.025	~	~	0.000004	0.00009
	Alpha-Chlordane	nd< 0.0010	~	~	~	~	~
	Gamma-Chlordane	nd< 0.0010	~	~	~	~	~
	4,4' DDD[1]	nd< 0.0002	0.080	~	~	0.000001	0.0036
	4,4' DDE[1]	nd< 0.0002	0.020	~	~	0.000001	0.014
	4,4' DDT[1]	0.00033	0.0015	~	~	0.000001	0.000013
	Dieldrin	nd< 0.0002	0.093	~	~	0.0000019	0.00071
	Endosulfan[2] I	nd< 0.0002	0.075	~	~	0.0000087	0.000034
	Endosulfan[2] II	nd< 0.0002	0.075	~	~	0.0000087	0.000034
	Endosulfan Sulfate	nd< 0.0002	~	~	~	~	~
	Endrin	nd< 0.0002	0.13	~	~	0.0000023	0.000037
	Heptachlor	nd< 0.0001	0.028	~	~	0.0000036	0.000053
	Heptachlor Epoxide	nd< 0.0001	0.18	~	~	0.0000036	0.000053
	Methoxychlor	nd< 0.0010	0.020	~	~	0.00003	0.00003
	Toxaphene	nd< 0.0100	0.14	~	~	0.0000002	0.00021
Chlorinated Herbicides (mg/L)	2,4-D	nd< 0.001	50	~	~	0.040	0.20
	2,4-DB	nd< 0.004	~	~	~	~	~
	2,4,5-T	nd< 0.001	~	~	~	~	~
	2,4,5-TP	nd< 0.001	~	~	~	~	~
	Dalapon	nd< 0.010	50	~	~	0.30	3
	Dicamba	nd< 0.001	~	~	~	~	~
	Dichloroprop	nd< 0.001	~	~	~	~	~
	Dinosed	nd< 0.002	~	~	~	~	~
	MCPA	nd< 0.200	~	~	~	~	~
	MCPP	nd< 0.200	~	~	~	~	~
	Pentachlorophenol	0.024	5.9	~	~	0.0079	0.013
Metals (mg/L)	Arsenic	0.35	50	~	~	0.036	0.069
	Barium	0.233	50	~	~	2	2
	Cadmium	nd< 0.005	50	~	~	0.0093	0.043
	Chromium (Total)	0.047	50	~	~	10	10
	Lead	1.4	50	~	~	0.0056	0.14
	Mercury	nd< 0.001	50	~	~	0.000025	0.0021
	Selenium	nd< 0.020	50	~	~	0.071	0.30
	Silver	0.024	50	~	~	0.0010	0.0023

DOH EAL	State of Hawaii Department of Health Environmental Action Level.
mg/L	milligrams per liter.
	DOH EALs that were exceeded by contaminant concentrations detected in groundwater.
	Laboratory method reporting limit exceeds the DOH EAL.
~	DOH EAL not provided.

APPENDIX D

EALs for Evaluating Environmental Hazards Posed by Contaminated Soil Vapor

Appendix D
EALs for Evaluating Environmental Hazards Posed by Contaminated Soil Vapor
Task 6 - Environmental Hazard Evaluation
Lowe's VRP - Former ConocoPhillips Terminal

Contaminants of Concern		Soil Vapor Screening Survey*			Soil Vapor 8-Hour Survey*		
		Maximum Concentration Detected	Vapor Intrusion EAL		Maximum Concentration Detected	Vapor Intrusion EAL	
			Residential	Commercial / Industrial		Residential	Commercial / Industrial
Total Petroleum Hydrocarbons (µg/m^3)	TPH-g	172,269,939	51,000	140,000	194,355,828	51,000	140,000
Volatile Organic Compounds (µg/m^3)	Benzene	1,020,859	250	1,100	2,009,816	250	1,100
	Toluene	2,784,458	400,000	1,100,000	4,515,337	400,000	1,100,000
	Ethylbenzene	242,781	1,100,000	3,000,000	286,135	1,100,000	3,000,000
	Xylene	1,517,382	110,000	300,000	997,137	110,000	300,000
	Methyl-Tert-Butyl-Ether	2,519,427	7,400	31,000	71,984	7,400	31,000
Halogenated Volative Organic Compounds (µg/m^3)	Tetrachloroethylene	1,400	320	1,400	135,787	320	1,400
	Trichloroethylene	28	170	720	107,157	170	720
	1,1,1-Trichloroethane	14,000	2,300,000	6,400,000	108,793	2,300,000	6,400,000
	Vinyl Chloride	1,108	220	920	51,534	220	920
Semi-volatile Organic Compounds (µg/m^3)	Acenaphthene	7.25	220,000	610,000	1,060	220,000	610,000
	Naphthalene	4.24	3,100	8,800	474	3,100	8,800

DOH EAL	State of Hawaii Department of Health Environmental Action Level.
µg/m^3	micrograms per cubic meter.
	DOH EALs that were exceeded by contaminant concentrations detected in groundwater.
	Laboratory method reporting limit exceeds the DOH EAL.