ENVIRONMENTAL HAZARD MANAGEMENT PLAN

KAKAAKO MAKAI DISTRICT
Honolulu, Oahu, Hawaii

Prepared For:
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TABLE OF CONTENTS

TABLES

ACRONYMS

AST	aboveground storage tank
bgs	below ground surface
BMPs	Best Management Practices
BTEX	benzene, toluene, ethylbenzene, xylenes
C&C	City and County of Honolulu
COC	contaminants of concern
COPC	contaminants of potential concern
CSM	conceptual site model
DBCP	1,2-dibromo-3-chloropropane
DOH	State of Hawaii, Department of Health
DPW	Department of Public Works
DWWM	Department of Wastewater Management
EAL	DOH Tier 1 Environmental Action Levels
EHE	Environmental Hazard Evaluation
EHMP	Environmental Hazard Management Plan
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
ETC	EnviroServices and Training Center, LLC
HCDA	Hawaii Community Development Authority
HEER	Hazard Evaluation and Emergency Response
µg/l	micrograms per liter
mg/kg	milligrams per kilogram
MtBE	methyl tertiary-butyl ether
ng/kg	nanograms per kilogram
PAHs	polynuclear aromatic hydrocarbon
PBRC	Pacific Biosciences Research Center
PCBs	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
PPE	personal protective equipment
PRGs	Preliminary Remediation Goals
SSHP	Site-specific Safety and Health Plan
SVOCs	semi-volatile organic compounds
TEQ	Toxic Equivalency
TLCG	The Limtiaco Consulting Group
TMK	Tax Map Key
TPH	total petroleum hydrocarbons
TPH-D	TPH as diesel
TPH-G	TPH as gasoline
TPH-O	TPH as oil
UH	University of Hawaii
UIC	Underground Injection Control
UST	underground storage tank
VOCs	volatile organic compounds
WWPS	wastewater pump station

1.0 CERTIFICATIONS AND LIMITATIONS

The Limtiaco Consulting Group (TLCG) and EnviroServices & Training Center, LLC (ETC) have completed this Environmental Hazard Management Plan (EHMP) for the Kakaako Makai District (see Figure 1). The findings and conclusions contained herein are professional opinions based solely upon visual observations and interpretation of the historical information and documents available to TLCG and ETC at the time this EHMP was prepared.

This report is intended for the sole use of the Client, State of Hawaii, Hawaii Community Development Authority (HCDA), exclusively for the project site indicated. The scope of services performed in execution of this project may not be appropriate for satisfying the needs of other users, and any use or reuse of this report or the findings and conclusions presented herein is unauthorized and at the sole risk of said user.

TLCG and ETC make no guarantee or warranty; either expressed or implied, except that our services are consistent with good commercial or customary practices designed to conform to acceptable industry standards and governmental regulations. No warranty or representation, expressed or implied, is included or intended in its proposal, contracts, or reports. Opinions stated in this report apply only to the site as outlined and apply to the conditions present at the time of the project. Moreover, these opinions do not apply to future site changes.

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2.0 INTRODUCTION/PURPOSE

The Limtiaco Consulting Group (TLCG) was retained by the Hawaii Community Development Authority (HCDA) to prepare this Environmental Hazard Management Plan (EHMP) for portions of the Kakaako Makai District in Honolulu, Oahu, Hawaii (site) as part of a larger project. EnviroServices & Training Center, LLC (ETC) was contracted by TLCG to assist with preparation of this EHMP.

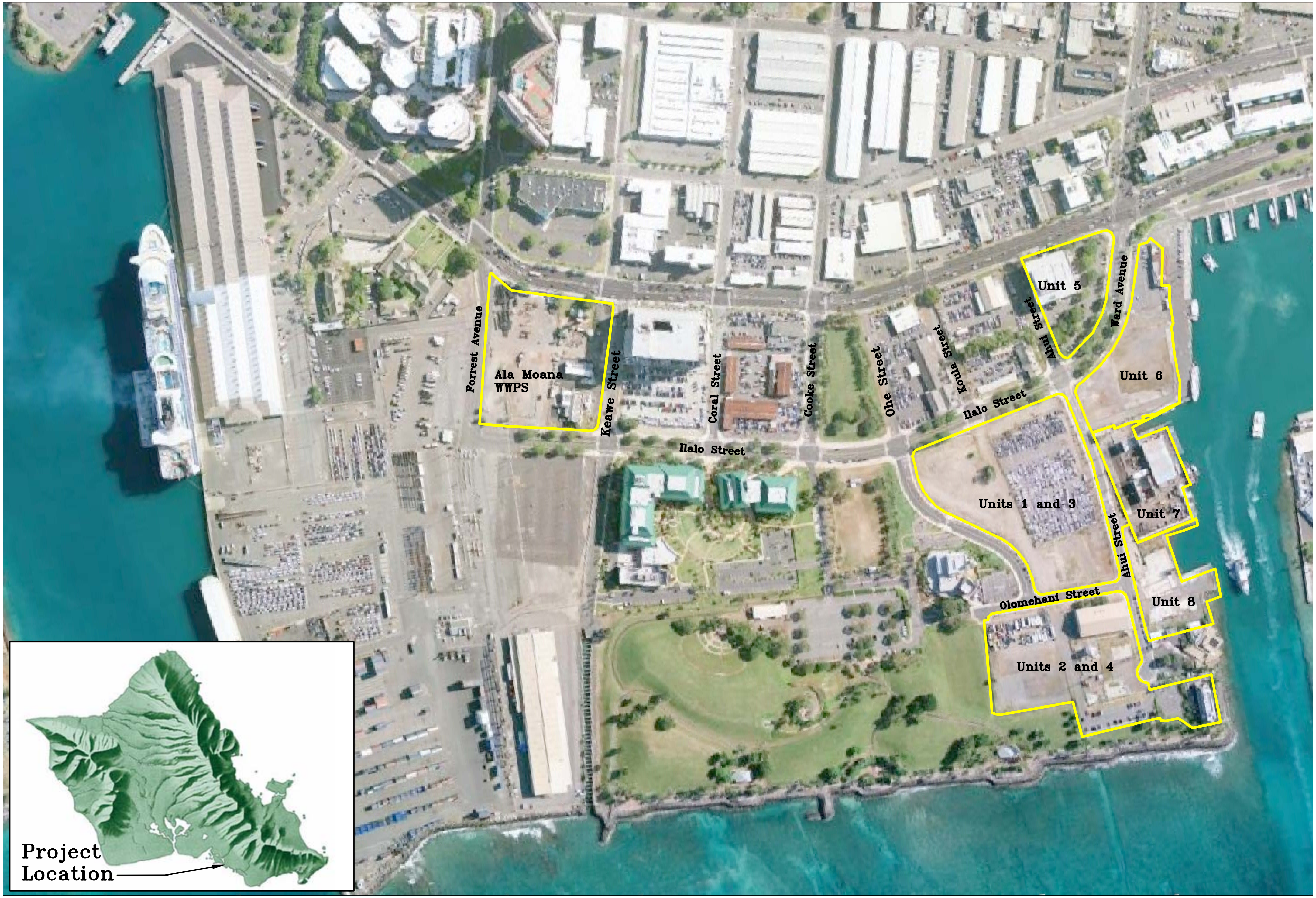
The subject of this EHMP is portions of the Kakaako Makai District. These portions include certain land areas located southwest (makai) of Ala Moana Boulevard, bounded by Forrest Avenue to the northwest and the Kewalo Basin to the southeast. The specific parcels being evaluated in this EHMP include the following Tax Map Key (TMK) parcels with the name referenced in the EHMP in parentheses:

- 2-1-060: Parcels 4 and 6 (Unit 1)
- 2-1-060: Parcel 2 (Unit 2)
- 2-1-060: Parcel 5 (Unit 3)
- 2-1-060: Parcel 1 (Unit 4)
- 2-1-058: Parcel 6 (Unit 5)
- 2-1-058: Portion of Parcel 95 (Unit 6)
- 2-1-058: Parcels 2, 47, and 107 (Unit 7)
- 2-1-058: Parcels 41, 82 to 86, and 91 (Unit 8)
- 2-1-015: Parcels 22, 23, 43, 44, and 53 (Ala Moana Wastewater Pump Station)

Figure 1 shows the various areas encompassed by this EHMP.

Previous investigations at these sites generally included the collection and analysis of soil and groundwater samples. A more detailed analysis of the previous investigations can be found in the June 2009 *Environmental Hazard Evaluation* (EHE) prepared by TLCG and ETC. The contaminants targeted in these investigations included total petroleum hydrocarbons (TPH) of varying carbon ranges (gasoline, diesel, oil), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) including polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), heavy metals, various pesticides, and dioxins/furans.

The risks associated with these contaminants will be managed under this EHMP in general accordance with the Hawaii Department of Health's (DOH) June 2007 document, *Long Term Management of Petroleum-Contaminated Soil and Groundwater*. The EHMP is meant to document the extent and magnitude of the contaminated soil and groundwater left in place at the site, summarize the potential environmental hazards associated with the contamination, and provide details for the long term management of the contamination.



Aerial Photo Source: Google, 2009

EnviroServices & Training Center LLC	Project 09-2002	Figure 1 Site Location Map Environmental Hazard Management Plan Kakaako Makai District Honolulu, Oahu, Hawaii
	Not to Scale	
	June 2009	

3.0 SITE BACKGROUND

3.1 Site Description

The project area is currently owned by HCDA and consists of approximately 35 acres of land within the Kakaako Makai District (Figure 1). The land areas being evaluated include Kakaako Brownfields Project Units 1 through 8 and the Ala Moana Wastewater Pump Station property. These areas encompass TMKs 2-1-060: Parcels 1, 2, 4, 5, and 6; 2-1-058: Parcels 2, 6, 41, 47, 82 to 86, 91, 95 (portion), and 107; and 2-1-015: Parcels 22, 23, 43, 44, and 53.

3.2 Site History and Land Use

3.2.1 Area Wide History - Kakaako Makai District

The original southern coastline of Honolulu generally followed the present location of Ala Moana Boulevard and the Kakaako Makai District was previously situated at or below sea level. Between 1913 and 1927, a seawall was constructed and artificial "fill" materials were deposited behind the seawall. The fill material consisted of ash from the burning of municipal refuse, unburned refuse, construction debris, household debris, automobile batteries, and other miscellaneous refuse items. The deposited fill material caused the coastline to move south and thereby established new land for development in the Kakaako Makai District. In 1930, the first of two incinerators was built on the southeast portion of Ahui Street. In the mid 1940's, a second incinerator was also constructed in the area (Noda and Cotton, 1997). From the late 1940's until the 1960's, land areas seaward of both incinerators were expanded to the south with fill material and ash from the incinerators.

On October 30, 1997, the U.S. Environmental Protection Agency (EPA) granted the DOH funds to proceed with a brownfields study in the Kakaako Makai District. The DOH forwarded the funds to the HCDA to evaluate the extent of contamination within the area and proceed with redeveloping the area if possible. Since this time, a number of investigations have been performed within the Kakaako Makai District and certain areas have been developed, including the Kakaako Waterfront Park and the Children's Discovery Center.

The site investigations revealed that certain portions of the investigation area were impacted by various contaminants as a result of the fill materials used to create the Kakaako Makai District and from previous commercial/industrial land use. In 2006, the State of Hawaii mandated by law that the Kakaako Makai District could not be used for residential purposes. The Hawaii Revised Statutes §206E-31.5 states:

> **Prohibitions.** Anything contained in this chapter to the contrary notwithstanding, the authority is prohibited from:
>
> (1) Selling or otherwise assigning the fee simple interest in any lands in the Kakaako community development district to which the authority in its corporate capacity holds title, except with respect to:
>
> (A) Utility easements;
> (B) Remnants as defined in section 171-52;
> (C) Grants to state or county department or agency; or
> (D) Private entities for purposes of any easement, roadway, or infrastructure improvements; or
>
> (2) Approving any plan or proposal for any residential development in that portion of the Kakaako community development district makai of Ala Moana Boulevard and between Kewalo basin and the foreign trade zone. [L 2006, c 317, §1]

Therefore, any residential development in the Kakaako Makai District area is strictly prohibited.

3.2.2 Kakaako Brownfields Project Units 1 and 3

Records indicate that Unit 1 was previously divided into three separate use areas. The north portion of Unit 1 contained five metal-framed buildings and one modular building; the remainder of the area was paved. The north portion was used for light maintenance activities and yard space by the City & County of Honolulu (C&C) Department of Transportation Services, Traffic Signs and Street Lighting Maintenance Section and the Department of Public Works (DPW), Survey Office and Materials Testing Laboratory. This area contained transformers that could have been filled with PCBs. Additionally, the Traffic Sign Yard previously contained several underground storage tanks (USTs) for fueling that had been removed. Two groundwater monitoring wells were also observed indicating that the USTs may have leaked.

The south portion of Unit 1 was utilized by the C&C DPW, Refuse Collection Division. The majority of the area was used for parking refuse collection vehicles; however, there was a single modular building with several storage sheds for light maintenance work located on the north portion of this area.

The seaward half of the south portion was utilized for employee parking and was paved in patches.

Unit 3 was utilized as the main baseyard for conducting heavy maintenance. The area contained approximately ten structures and three USTs for fueling operations. The USTs were replaced with aboveground storage tanks (ASTs) in 1999. The entire area associated with Unit 3 was covered with either a structure or pavement.

3.2.3 Kakaako Brownfields Project Units 2 and 4

Records indicate that from 1956 to 1993, Unit 2 was utilized as a C&C baseyard. Activities included maintenance and repair of automotive and heavy equipment, vehicle fueling, painting, and welding. The area contained three structures on concrete slabs and the majority of the land area was paved. The northern portion of Unit 2 contained a 500-gallon diesel UST (UST Facility ID 9-103095) that was removed in August 1993. The UST had been used for prior boiler operations and several holes were observed in the tank when it was removed from the ground. Subsequent release response activities and groundwater monitoring were performed from 1995 to 2002, including contaminant plume delineation. The DOH issued a "no further action" required letter on May 24, 2002 in regards to the UST.

Since 1965, Unit 4 has been leased by the University of Hawaii (UH), which constructed and occupied the J.K.K. Look Laboratory and the Pacific Biosciences Research Center (PBRC). Structures on the site included six buildings, an animal pen, and a gas pump shed. The Look Lab was formerly used for marine research and ocean engineering activities, which included physical testing and hyperbaric studies. The Look Lab was also formerly the site of the State of Hawaii hyperbaric treatment center. PBRC is a branch of UH which operates as an educational and research facility (EKNA, 1997). File review also indicated that one 8,000-gallon methanol-gasoline UST (UST Facility ID 9-102414) located on the west portion of Unit 4 was removed in May 1998 and no release was observed.

3.2.4 Kakaako Brownfields Project Unit 5

Unit 5 has historically served as office space for the Army and Air Force Exchange System and the State of Hawaii. Previous investigations noted that Unit 5 is generally upwind and at the outer limit of the area that may have been impacted by aerial ash fall from the former Kewalo Incinerator facility (EKNA, 1999).

3.2.5 Kakaako Brownfields Project Unit 6

Since 1933, Unit 6 had been utilized as a tuna processing plant by Hawaiian Tuna Packers. Their operations included fish processing and canning as well as ice creation. Four USTs were removed from the site; one tank stored gasoline and three tanks stored bunker oil for fueling the boilers. In 1999, the buildings that housed these operations were demolished.

3.2.6 Kakaako Brownfields Project Unit 7

Unit 7 has been utilized as a shipyard by Honolulu Marine, Inc. from 1950 until the present. Prior to 1950, the area was a part of the tuna processing plant operated on Unit 6. The shipyard activities include ship building, painting, metal and fiberglass work, repairs, maintenance, and fuel transfers.

3.2.7 Kakaako Brownfields Project Unit 8

Records indicate that from 1949 through 1955, Unit 8 was used as an ash and refuse storage and disposal area. After 1955, Unit 8 was occupied by GRG Enterprises, Inc. who sub-leased warehouse areas on the site to various companies for industrial activities such as fish brokering, processing, and sales. In 1999, EKNA observed several fill ports around the Basin Marine sub-tenant that indicated fuel USTs were present. Previous investigations indicated that in 2002 there were six buildings and three trailers at the site (AMEC, 2002). Additionally, a UST excavation area located on the eastern central portion of the unit was identified along with a hydraulic lift area. Between 2002 and 2007, the tenant leases expired and the buildings were demolished.

3.2.8 Ala Moana Wastewater Pump Station Property

The B.P. Bishop Estate originally owned the land known as the Ala Moana Wastewater Pump Station (WWPS) area and deeded the area to the Hawaiian Government on September 9, 1891. As a result of an outbreak of bubonic plague in 1898, the Department of the Interior contracted Rudolph Hering to engineer Honolulu's sanitary sewer system. In 1900, the historic Ala Moana Wastewater Pump Station and a Screen House were constructed on TMK 2-1-15: Parcel 44 located on the corner of Ala Moana Boulevard and Keawe Street. Sewage historically arrived via the single story Screen House and was pumped to the 1900 Pumping Station. Construction drawings from 1898 indicated that the Screen House contained a pit approximately 11'-9" below the finish floor level which led to the underground storage reservoir located on TMK 2-1-15: Parcel 43. The wastewater was eventually discharged into the ocean at a depth of 40 feet.

Two additions were later built to support the facility. In 1925, an additional building was constructed to house a high-speed, electric powered pump and was later demolished in 1979. The 1900 Pump House was turned into a machine shop, storeroom and office after the construction of the 1925 Pump House and remained in operation until 1982. In 1939 a second Pump House (aka 1939 Pump House) was constructed with a pit located approximately 34 feet below grade.

The use of the Historic Ala Moana WWPS was discontinued by the C&C when the new pumping station was built in 1955 on TMK 2-1-15: Parcels 22 and 23 on the corner of Ilalo Street and Keawe Street. The new pumping station is currently in operation and consists of two buildings, WWPS #1 and WWPS #2. The 1900 Pump House, the 1939 Pump House, and the 1900 Screen House were classified as historical buildings and in 1979 the 10,000 square foot underground storage reservoir was backfilled.

TMK 2-1-15: Parcel 53 is located west of the new and historical pumping stations. In 1918 the Territory of Hawaii transferred the majority of the harbor as well as the area in Parcel 53 to the War Department by Executive Order #2901. The area was known as part of the 75-acre Fort Armstrong Complex. Ownership of the land was transferred to Inter-Island Steam Navigation Company, Ltd, then to Overseas Terminal, Ltd. and finally to the Territory of Hawaii in 1950. The State of Hawaii now uses this area as a container yard and for harbor support facilities. C&C drawings from 1953 indicate that a warehouse with boiler room facilities was located in this area. However, all structures have since been removed. The area was leased to Motor Imports International from 1985 through 1991 who utilized the area as a temporary storage site for vehicles. Then from 1991 through 1998, the site was leased to Mark Snyder & Associates dba Hawaii Port Processors for the same purpose.

3.3 Current Land Use

3.3.1 Kakaako Brownfields Project Units 1 and 3

Kakaako Brownfields Project Units 1 and 3 consist of approximately 7.5 acres located between Ilalo Street and Olomehani Street. Unit 1 is identified by TMK 2-1-60: Parcels 4 and 6 and Unit 3 is identified by TMK 2-1-60: Parcel 5. Since the closure of the C&C baseyards on these units, nearby Ohe Street has been rerouted through Parcels 4 and 6 and the portion of Koula Street between Units 1 and 3 has been closed. The resulting area has recently been referred to as the “Piano Lot” based on its shape. There are currently no structures present on the combined Units 1 and 3, and groundcover currently consists of bare soil and gravel. A portion of the combined Units 1 and 3 is temporarily utilized for vehicle parking.

3.3.2 Kakaako Brownfields Project Units 2 and 4

Kakaako Brownfields Project Units 2 and 4 consist of approximately 11.4 acres of improved land located south of Olomehani Street. Unit 2 is identified as TMK 2-1-60: Parcel 2 and is surrounded by Kakaako Waterfront Park to the northwest and southwest. Unit 4 is located southeast of Unit 2 and is identified as TMK 2-1-60: Parcel 1. Both units exhibit a slight to moderate gradient towards Olomehani Street. Unit 2 is currently vacant with no structures present and consists of bare soil, gravel, and intermittent areas of pavement. Limited vehicle parking occurs on Unit 2.

Unit 4 is currently being leased by the UH PBRC and encompasses an L-shaped area. Koula Street, which previously separated Units 2 and 4, has been converted into a paved driveway that leads to the southern parking lot on Unit 4. An additional asphalt paved parking lot is located to the east and can be accessed from Ahui Street. Two structures remain on the unit; the warehouse for the former Look Lab is located on the northern portion of the site and the PBRC research building is located on the southeastern portion of the unit. A large majority of the structures located in the central portion of Unit 4 have been demolished and only the concrete foundations remain. Additionally, an empty AST (reportedly a former hyperbaric chamber) stands south of the former Look Lab warehouse. The majority of the groundcover at Unit 4 consists of bare soil, gravel, and pavement.

3.3.3 Kakaako Brownfields Project Unit 5

Unit 5 consists of a single 2.2-acre area identified as TMK 2-1-58: Parcel 6 located at the southwestern corner of the Ala Moana Boulevard and Ward Avenue intersection. A five-story reinforced concrete structure on the unit is occupied by various State of Hawaii agencies, including the DOH. The remainder of the parcel is composed of an asphalt parking lot and landscaped areas.

3.3.4 Kakaako Brownfields Project Unit 6

The Kakaako Brownfields Project Unit 6 consists of 3.6 acres located between the Kewalo Basin and Ward Avenue and is identified as the northwestern portion of TMK 2-1-58: Parcel 95. The Fisherman's Wharf restaurant is located on the eastern portion of the Parcel, but is not included in Unit 6. The northern portion of the unit has been paved and is utilized for vehicle parking; however, the southern portion of the unit is vacant and consists of gravel and sparse vegetation.

3.3.5 Kakaako Brownfields Project Unit 7

Unit 7 is situated between Kewalo Basin and Ahui Street at TMK 2-1-58: Parcels 2, 47, and 107. The 2.5-acre site is currently leased by Honolulu Marine, Inc. for shipyard activities. The site contains a one story warehouse located adjacent to Kewalo Basin and several boat docking areas fronting the structure. Additionally, a boat ramp is located on the northern portion of the unit. A conveyor system is located adjacent to Ahui Street to bring the water craft into the maintenance area. A retaining wall is constructed on the south and eastern corner of the unit around the unpaved parking area.

3.3.6 Kakaako Brownfields Project Unit 8

Unit 8 is located south of Unit 7 between Kewalo Basin and Ahui Street and consists of approximately 2 acres. The area is identified as TMK 2-1-58: Parcels 41, 82 through 86, and 91 and was previously utilized by various industrial tenants. Currently, the site is vacant and all of the structures on the site have been demolished, leaving only the concrete foundations. The groundcover within the majority of the site consists of concrete slabs, asphalt pavement, and imported fill material (coral sand). The remainder of the site consists of bare soil, gravel and sparse vegetation.

3.3.7 Ala Moana Wastewater Pump Station

The Ala Moana Wastewater Pump Station area consists of 5.2 acres located on the southwest corner of Ala Moana Boulevard and Forrest Avenue. The area is identified as TMK 2-1-15: Parcels 22, 23, 43, 44, and 53. Parcels 22 and 23, located on the northwest corner of Ilalo Street and Keawe Street contain the active Ala Moana Wastewater Pump Station. The active Pump Station consists of two buildings and a paved parking area. The majority of the site is paved; however, there is a small landscaped area on the southeastern corner of the site. Currently the active Ala Moana Wastewater Pump Station is the largest in the State of Hawaii and conveys wastewater from two force mains to the Sand Island Wastewater Treatment facility.

The historic Ala Moana Wastewater Pump Station is located on Parcels 43 and 44 on the southwestern corner of Ala Moana Boulevard and Keawe Street. The three historic structures ("1900 Pump House," "1939 Pump House," and "Screen House") that remain on the Historic Ala Moana Pumping Station site are included on both the National Register of Historic Places (1978) and the State Register of Historic Places (1977).

Parcel 53 located to the west of the active and historic Pump Stations is currently utilized as a construction baseyard area. The northern portion of Parcel 53 contains a trailer office and is mainly used to stage vehicles, equipment, and materials. The groundcover throughout the entire parcel consists of gravel and bare soil.

3.4 Future Use

Future use of the Kakaako Makai District by law is currently limited to non-residential activities. Long-term development plans for the area have not yet been determined. Plans for interim use of the various areas have generally been identified as commercial in nature. The exception to this would be Unit 8, which is anticipated to be used as a fishing area for children as part of a tag and release program.

3.5 Climatologic Conditions

The main features of Oahu's climate include mild temperatures throughout the year ranging from 88˚F (31˚C) to 74˚F (23˚C) and moderate humidity of 53% during the day. The northeasterly trade winds generated by a high pressure center north of the islands are the dominant factor that governs the climate in Hawaii. Two mountain ranges on Oahu, the Koolau Mountains which extend along the northeastern side of the island and the Waianae Mountains which extend along the southwestern side of the island, influence every aspect of the climate. Both mountain ranges serve to block the trade wind moisture and as a result, showers occur almost daily on the windward side while on the leeward side showers are light. The trade winds are generally strongest during the summer (May through October) and are periodically disrupted by storms in the winter (October through April), which result in heavy rain and thunderstorms throughout the island. At the site, the average annual rainfall reported by the U.S. Department of Agriculture is between 10 to 40 inches, most of which occurs during the winter months.

3.6 Geology and Hydrogeology

3.6.1 Regional Geology

Oahu is formed by the erosional remnants of two shield volcanoes. These are the Waianae range to the west and the Koolau range to the east. The Waianae volcano is estimated to have formed 2.4 to 3.6 million years before present. It consists of a tholeiitic lava shield with a thick cap of transitional to alkalic rock. Rejuvenation-stage volcanics of undifferentiated age occur in Kolekole Pass and on the south flank of the Waianae shield. Dike orientations define northwest and southwest rift zones (Macdonald, et al., 1983).

The Koolau volcano is estimated to have formed 1.8 to 2.6 million years before the present. It consists of a tholeiitic lava shield and lacks an alkalic cap. It has well defined major dike complex trending northwest-southwest. A third, minor rift zone referred to as the Kaau rift trends southward from Kaau crater, near the upland crest of the Koolau Ridge. After a long dormant period and periods of deep erosion, the Koolau volcano developed abundant and scattered rejuvenation-stage vents, typically aligned on northeast-striking fissures (Macdonald, et al., 1983).

3.6.2 Site Geology

The soil at the property is mapped as mixed fill land, which consists of areas filled with material dredged from the ocean or hauled from nearby areas, garbage, and general material from other sources. Fill land occurs primarily near Pearl Harbor and in Honolulu, adjacent to the ocean. Average annual rainfall in the area is less than 200 cm per year. This land type is generally used for urban development including airports, housing areas, and industrial facilities (USDA, 1972).

As described in Section 3.2.1, prior to 1913, the southern coastline of Honolulu generally followed the present location of Ala Moana Boulevard. Artificial fill was used to expand the coastline seaward starting in 1913. Artificial fill used to create the current property included municipal waste and municipal incinerator ash.

3.6.3 Regional Hydrogeology

Basal groundwater is formed by rainwater percolating down through the residual soils and permeable volcanic rock. The entire island situated below sea level, except within rift zones of the volcanoes, is saturated with ocean salt water and thus forms a basal lens called the "Ghyben-Herzberg" lens. A zone of transition between the fresh groundwater and the ocean salt water occurs due to the constant movement of the interface as a result of tidal fluctuations, seasonal fluctuations in recharge and discharge and aquifer development (Macdonald, et al., 1983).

Downward percolation of rainwater may be stopped by impermeable layers such as dense lava flows, alluvial clay layers and volcanic ash. The groundwater then forms a perched or high level aquifer, which is not in contact with salt water. Recharge of the aquifer occurs in areas of high rainfall, which are the interior mountainous areas. The groundwater flows from the recharge areas to the areas of discharge along the shoreline. Frictional resistance to groundwater flow causes it to pile up within the island until it attains sufficient hydraulic head to overcome friction. Thus, basal groundwater tends to slope toward the shoreline.

3.6.4 Site Hydrogeology

According to Mink & Lau, 1990, the property is underlain by the Nuuanu Aquifer System, which is part of the Honolulu Aquifer Sector on the island of Oahu. The aquifer is classified with the system identification number 30102116 (13321). This system includes an unconfined basal aquifer in sedimentary (nonvolcanic) lithology. The groundwater in this aquifer is described as being currently used as well as ecologically important, but is not a direct drinking water source. The groundwater contains a moderate salinity (1,000 to 5,000 mg/l Cl^-) and is described as replaceable with a high vulnerability to contamination (Mink and Lau, 1990). The site is further underlain by a second aquifer of the same system. The aquifer is a confined, basal aquifer in flank compartments, and is classified with the system identification number 30302121 (11113). The lower aquifer is described as a currently used drinking water source containing groundwater with a fresh salinity (<250 mg/l Cl^-). It is described as irreplaceable with a low vulnerability to contamination (Mink and Lau, 1990). Previous groundwater monitoring activities in and around the subject property indicated that groundwater was detected at depths ranging from 5.8 feet bgs to 8.5 feet below ground surface (bgs).

3.7 Surface Water Bodies / Drinking Water Wells / Ecological Habitats

The nearest surface water bodies are the Kewalo Basin, located adjacent and to the east, and Mamala Bay, located adjacent and to the south, of the site. Review of the underground injection control (UIC) line maps and the August 26, 1993 *Hawaii Ground Water Index and Summary* indicated that the property is located approximately 0.25 to 0.5 miles below the UIC line. The closest drinking water wells, 1849-10, 1849-13, 1849-14, 1849-15, and 1849-16 are located above the UIC line approximately 1.75 miles east of the site. There are no wells located downgradient of the site and the land use of the neighboring properties is recreational and commercial/industrial. No ecological habitats were identified at the property. However, the adjacent Kewalo Basin and Mamala Bay support coral reefs and local bird populations.

4.0 CONTAMINANTS OF CONCERN

The contaminants of concern (COC) were identified in the EHE based on the analytical data from various site investigations conducted between 1997 and 2009. COC were selected by comparing mean concentrations of the existing data to current DOH Tier 1 Environmental Action Levels (EALs) for unrestricted land use in areas that are less than 150 meters from the nearest surface water body and are not considered a current or potential drinking water source.

The resultant COC were identified by area and sample matrix (surface and near surface soils, subsurface soils, and groundwater) in Table 1 for soils and Table 2 for groundwater. For the purposes of the EHE, it was assumed that non-detectable concentrations of COC were not present in values above DOH EALs. This includes non-detected COC with method detection limits or reporting limits above DOH EALs. Furthermore, the “surface and near surface soil” categorization generally includes soil samples collected from the top 2 to 3 feet of soil at a site. The “subsurface soil” categorization generally includes soil samples collected from 3 feet bgs and deeper.

Table 1: Contaminants of Concern - Soil

COC	Sample Matrix	Units 1& 3	Units 2 & 4	Unit 5	Unit 6	Unit 7	Unit 8	AM WWPS
TPH-O	Surface Soil	X	X			X	X	
Benzo(a)pyrene	Surface Soil	X	X			X	X	X
Dibenz(a,h)anthracene	Surface Soil					X	X	
Diethylphthalate	Surface Soil		X					
Dimethylphthalate	Surface Soil					X	X	
Naphthalene	Surface Soil	X						
Dieldrin	Surface Soil		X				X	
PCB (Total)	Surface Soil	X						
Antimony	Surface Soil		X			X		
Arsenic	Surface Soil		X			X		
Copper	Surface Soil	X	X			X	X	
Lead	Surface Soil	X	X			X	X	
Mercury	Surface Soil					X		
Thallium	Surface Soil					X		
Zinc	Surface Soil		X			X	X	
Dioxins/Furans	Surface Soil		X				X	X
TPH-D	Subsurface Soil		X					
TPH-O	Subsurface Soil		X					
1,1,2,2-Tetrachloroethane	Subsurface Soil		X					
2-Methylnaphthalene	Subsurface Soil		X					
Benzo(a)pyrene	Subsurface Soil		X				X	X
Diethylphthalate	Subsurface Soil	X	X					
Naphthalene	Subsurface Soil	X						
Dieldrin	Subsurface Soil		X				X	
PCB (Total)	Subsurface Soil	X						
Antimony	Subsurface Soil		X				X	
Arsenic	Subsurface Soil		X					
Copper	Subsurface Soil		X			X	X	
Lead	Subsurface Soil	X	X				X	
Nickel	Subsurface Soil		X					
Zinc	Subsurface Soil	X	X				X	
Dioxins/Furans	Subsurface Soil		X				X	

Note: Arithmetic mean concentration of COC exceeds DOH Tier 1 EAL for unrestricted land use.

Table 2: Contaminants of Concern - Groundwater

COC	Sample Matrix	Units 1& 3	Units 2 & 4	Unit 5	Unit 6	Unit 7	Unit 8	AM WWPS
TPH-G	Groundwater						X	
TPH-D	Groundwater						X	
TPH-O	Groundwater		X		X	X		
Benzene	Groundwater				X			
Toluene	Groundwater							X
Xylenes	Groundwater				X			X
DBCP	Groundwater							X
Anthracene	Groundwater		X				X	
Benzo(a)anthracene	Groundwater		X					
Diethylphthalate	Groundwater	X	X					
Fluoranthene	Groundwater						X	
Fluorene	Groundwater						X	
2-Methylnaphthalene	Groundwater				X		X	
Naphthalene	Groundwater				X			
Phenanthrene	Groundwater						X	
Pyrene	Groundwater						X	
Arsenic	Groundwater				X	X		X
Copper	Groundwater				X	X	X	
Mercury	Groundwater		X			X		X
Selenium	Groundwater	X						X
Silver	Groundwater		X					X
Vanadium	Groundwater					X		
Zinc	Groundwater					X	X	
Dioxins/Furans	Groundwater		X				X	

Note: Arithmetic mean concentration of COC exceeds DOH Tier 1 EAL for unrestricted land use.

5.0 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) provides a generalized framework regarding site-specific conditions relevant to potential contaminants, contaminant sources, migration pathways, routes of exposure, and potential receptors that may be affected by the contaminants. Establishment of this framework is essential for assessing risks associated with the contaminants, determining who is at risk, determining appropriate remedial strategies, and addressing unacceptable risks. A CSM diagram is provided in Figure 2.

The suspected sources of contamination at the various properties are the historic use of municipal waste and municipal incinerator ash as fill, as well as surface and subsurface releases from commercial/industrial land use. The COC identified in Section 4.0 above were compiled through review of previous environmental investigations performed at the various properties.

5.1 Potential Receptors

For the purposes of this EHMP, the following potential receptors were identified:

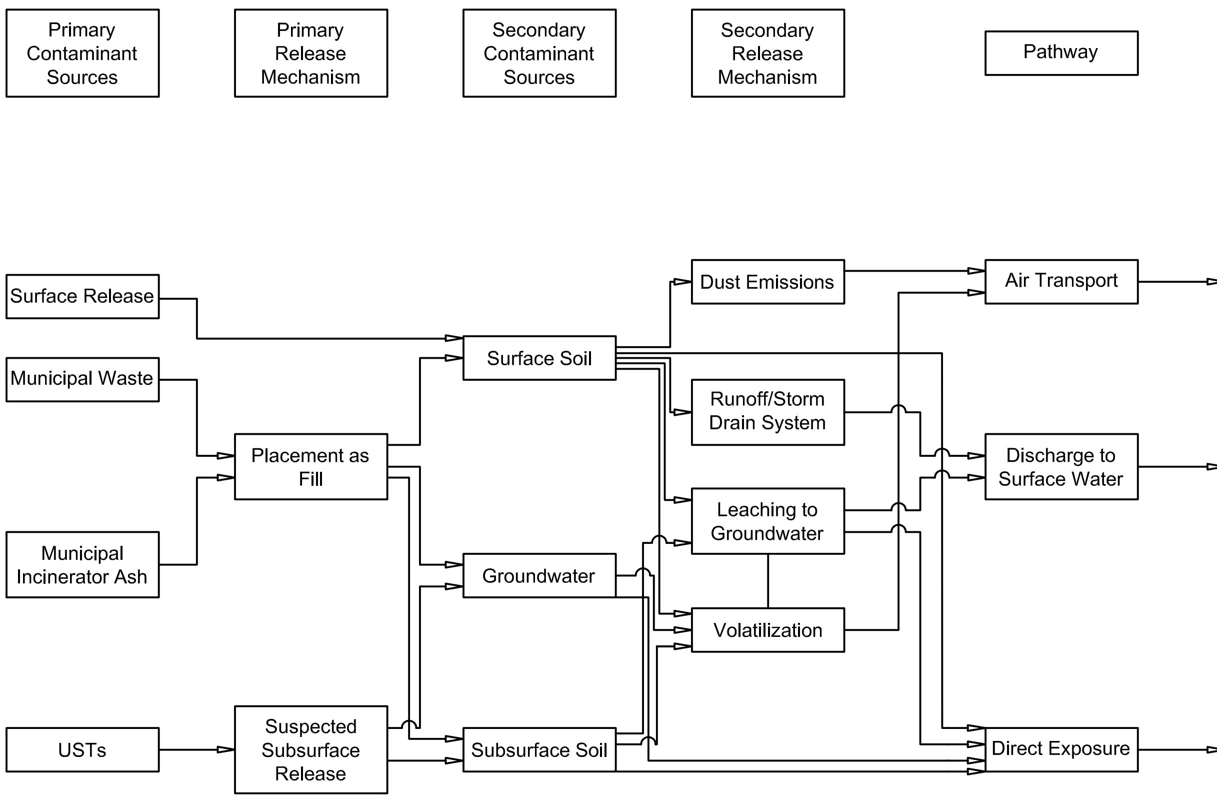
- Current on-site workers, trespassers, recreational users (i.e., users of Kakaako Waterfront Park), and future on-site users (residential land use currently prohibited in the Kakaako Makai District, interim land use will be commercial/industrial with the exception of Unit 8);
- Future construction workers (i.e., utilities installation, site development);
- Current and future off-site users (i.e. recreational users such as park users and fishermen, transient populations); and
- Current and future ecological receptors (aquatic only, no terrestrial habitats anticipated in heavily populated urban areas).

5.2 Exposure Pathways

Exposure is defined as the contact of an organism with a chemical or physical agent. An exposure pathway is defined as the course a chemical or physical agent takes from a source to an exposed organism. It describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a site. In order for an exposure pathway to be considered potentially complete, four elements must exist: 1) a source or release from a source; 2) a transport/exposure media; 3) an exposure point (point of contact with the contaminated medium); and 4) an exposure route. The potential exposure pathways present at the property are described below.

5.2.1 Soil Exposure Pathway

Direct contact with soil may result in incidental oral ingestion and/or dermal absorption of COC. Although generally associated with surface soil, direct contact may also occur with subsurface soil during trenching and excavation work.



Exposure Route	Human On-Site Users	Terrestrial Flora / Fauna	Aquatic Flora / Fauna
Ingestion	X	X	
Inhalation	X	X	
Dermal Contact	X	X	
Ingestion		X	X
Dermal Contact		X	X
Ingestion	X		
Inhalation	X		
Dermal Contact	X		

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Project 09-2002

June 2009

Figure 2
Conceptual Site Model Diagram
Environmental Hazard Management Plan
Kakaako Makai District
Honolulu, Oahu, Hawaii

5.2.2 Air Exposure Pathway

Air exposure pathways become potential routes of exposure when COC enter the air via volatilization or via adsorption to fugitive dust particles. Volatilization occurs when COC partition to the air. Such volatilization may occur from surface soil, subsurface soil, and/or groundwater. When considering volatilization from subsurface soil or groundwater, transport of COC occurs through void spaces in unsaturated soils, asphalt, and concrete to the outdoor air or to future indoor air through foundation cracks. Generation of fugitive dust may occur through disturbance of affected soil, such as wind or construction activities. Dust particles may be inhaled, may settle on human skin and be ingested (hand to mouth), and/or may settle on vegetation ingested by humans.

5.2.3 Sediment Exposure Pathway

Receptors may be exposed to COC in sediment as a result of surface runoff during storm events. Sediment may accumulate in the adjacent marine environment and be available for contact with various receptors. Recreational users of the marine environment (swimmers, surfers, fishermen) may come into direct contact with sediment and be exposed through oral ingestion and/or dermal absorption. Ecological receptors may live directly in the impacted sediment and may be exposed to COC through feeding within the sediment. As a secondary transport mechanism, COC may bioaccumulate in ecological receptors (i.e., fish, shellfish), then be ingested by human receptors.

5.2.4 Groundwater Exposure Pathway

Receptors may be exposed to COC in the groundwater by direct contact or by inhaling volatile COC emitted from the groundwater to air. This exposure pathway becomes especially significant during construction activities when the groundwater at the property is exposed and may be pumped out of trenches or excavations. Ecological receptors may also be affected in shallow marine environments within groundwater discharge zones.

6.0 SUMMARY OF ENVIRONMENTAL HAZARDS

This section identifies the various environmental hazards that exist at each unit based on the analysis conducted in the EHE. For the areas within the Kakaako Makai District, the potential environmental hazards associated with contaminated soils include direct exposure, vapor emissions to indoor air, gross contamination, leaching to groundwater, and impacts to terrestrial habitats. Additionally, contaminated groundwater may pose environmental hazards to aquatic habitats. Table 3 below provides a summary of environmental hazards and COC associated with unrestricted land use. Table 4 below provides a summary of environmental hazards and COC associated with commercial/industrial land use (with the exception of Unit 8, which will be used in the near future as a children's fishing area and therefore hazards and COC associated with unrestricted land use were provided).

Table 3: Summary of Environmental Hazards and COC - Unrestricted

Area	Matrix	Environmental Hazard	Contaminants of Concern
Units 1 & 3	Surface soil	Direct exposure	TPH-O, benzo(a)pyrene, PCBs, lead
		Vapor emissions	Naphthalene
		Gross contamination	TPH-O
		Leaching to groundwater	TPH-O
	Subsurface soil	Direct exposure	PCBs, lead
		Vapor emissions	Naphthalene
	Groundwater	Aquatic ecotoxicity	Selenium
Units 2 & 4	Surface soil	Direct exposure	TPH-O, benzo(a)pyrene, antimony, arsenic, lead, dioxins/furans*
		Gross contamination	TPH-O, lead
		Leaching to groundwater	TPH-O, dieldrin
	Subsurface soil	Direct exposure	TPH-D, TPH-O, benzo(a)pyrene, antimony, arsenic, copper, lead, dioxins/furans*
		Vapor emissions	1,1,2,2-tetrachloroethane
		Gross contamination	TPH-D, TPH-O, copper, lead, zinc
		Leaching to groundwater	TPH-D, TPH-O, 2-methylnaphthalene, dieldrin
	Groundwater	Aquatic ecotoxicity	TPH-O, anthracene, benzo(a)anthracene, mercury, silver, dioxins/furans
Unit 5	NA	NA	NA
Unit 6	Groundwater	Aquatic ecotoxicity	TPH-O, benzene, xylenes, 2-methylnaphthalene, naphthalene, arsenic, copper
Unit 7	Surface soil	Direct exposure	TPH-O, benzo(a)pyrene, dibenzo(a,h)anthracene, antimony, arsenic, copper, lead, mercury, thallium
		Gross contamination	TPH-O, copper, zinc
		Leaching to groundwater	TPH-O
		Terrestrial ecotoxicity**	Arsenic, copper, lead, mercury, zinc
	Subsurface soil	Direct exposure	Copper
		Terrestrial ecotoxicity**	Copper
	Groundwater	Aquatic ecotoxicity	TPH-O, arsenic, copper, mercury, vanadium, zinc

* Mean dioxins/furans TEQ concentrations fall within the "intermediate risk" range for unrestricted land use

** Terrestrial ecotoxicity concerns associated with runoff of surface soil particles to adjacent surface waters

Table 3, Cont'd: Summary of Environmental Hazards and COC - Unrestricted

Area	Matrix	Environmental Hazard	Contaminants of Concern
Unit 8	Surface soil	Direct exposure	TPH-O, benzo(a)pyrene, dibenzo(a,h)anthracene, lead, dioxins/furans***
		Gross contamination	TPH-O
		Leaching to groundwater	Dieldrin
		Terrestrial ecotoxicity**	Copper, lead, zinc
	Subsurface soil	Direct exposure	Benzo(a)pyrene, antimony, lead, dioxins/furans***
		Terrestrial ecotoxicity**	Antimony, copper, lead, zinc
		Leaching to groundwater	Dieldrin
	Groundwater	Aquatic ecotoxicity	TPH-G, TPH-D, 2-methylnaphthalene, anthracene, fluoranthene, fluorene, phenanthrene, pyrene, copper, zinc, dioxins/furans
Ala Moana WWPS	Surface soil	Direct exposure	Benzo(a)pyrene, dioxins/furans***
	Subsurface soil	Direct exposure	Benzo(a)pyrene
	Groundwater	Aquatic ecotoxicity	Toluene, xylenes, DBCP, arsenic, mercury, selenium, silver

** Terrestrial ecotoxicity concerns associated with runoff of surface soil particles to adjacent surface waters

*** Mean dioxins/furans TEQ concentrations fall within the "low risk" range for unrestricted land use

Table 4: Summary of Environmental Hazards and COC – Commercial/Industrial

Area	Matrix	Environmental Hazard	Contaminants of Concern
Units 1 & 3	Surface soil	Direct exposure Leaching to groundwater	Lead TPH-O
	Groundwater	Aquatic ecotoxicity	Selenium
Units 2 & 4	Surface soil	Direct exposure Leaching to groundwater	Arsenic, lead TPH-O, dieldrin
	Subsurface soil	Gross contamination Leaching to groundwater	TPH-D, lead TPH-D, TPH-O, 2-methylnaphthalene, dieldrin
	Groundwater	Aquatic ecotoxicity	TPH-O, anthracene, benzo(a)anthracene, mercury, silver, dioxins/furans
Unit 5	NA	NA	NA
Unit 6	Groundwater	Aquatic ecotoxicity	TPH-O, benzene, xylenes, 2-methylnaphthalene, naphthalene, arsenic, copper
Unit 7	Surface soil	Direct exposure Gross contamination Leaching to groundwater Terrestrial ecotoxicity**	Arsenic Copper TPH-O Arsenic, copper, lead, mercury, zinc
	Groundwater	Aquatic ecotoxicity	TPH-O, arsenic, copper, mercury, vanadium, zinc
Unit 8	Surface soil	Direct exposure Gross contamination Leaching to groundwater Terrestrial ecotoxicity**	TPH-O, benzo(a)pyrene, dibenzo(a,h)anthracene, lead TPH-O Dieldrin Copper, lead, zinc
	Subsurface soil	Leaching to groundwater	Dieldrin
	Groundwater	Aquatic ecotoxicity	TPH-G, TPH-D, 2-methylnaphthalene, anthracene, fluoranthene, fluorene, phenanthrene, pyrene, copper, zinc, dioxins/furans
Ala Moana WWPS	Groundwater	Aquatic ecotoxicity	Toluene, xylenes, DBCP, arsenic, mercury, selenium, silver

** Terrestrial ecotoxicity concerns associated with runoff of surface soil particles to adjacent surface waters

The June 2009 EHE was prepared to consolidate environmental investigation data, identify the COC and mean COC concentrations within the various sites, compare such data to current DOH EALs, and evaluate potential environmental hazards that may exist. The retained environmental hazards identified in the EHE were applicable to commercial/industrial land use anticipated for the various areas in the intermediate term since long-term plans have not been finalized. The exception to this would be Unit 8, where interim plans identify the area for use by children as a fishing area. Since Unit 8 will be utilized by sensitive receptors, the EHE compared data to EALs for unrestricted land use.

For the purposes of this EHMP, the environmental hazards and associated COC were presented for both unrestricted land use and commercial/industrial land use. Hazards and COC associated with unrestricted land use should be considered whenever existing soils are disturbed, when determining final disposition of excavated site soils, and when considering activities that may result in sediment from site soils entering surface water bodies.

7.0 ENGINEERING AND INSTITUTIONAL CONTROLS

Engineering and institutional controls are often used to mitigate environmental hazards by separating the residual COC in soil and/or groundwater at a site from potential receptors, thus breaking the exposure pathways.

7.1 Current Remedial Plans

The June 2009 EHE identified environmental hazards at various sites within the overall project area, assuming future commercial/industrial land use. Specifically, direct exposure hazards (assuming commercial/industrial land use) associated with residual COC were identified in the surface/near surface soils within Units 1 & 3, Units 2 & 4, Unit 7, and Unit 8 (assuming unrestricted land use). Based on the average COC concentrations for each of these areas, the HCDA is currently planning to construct an asphalt-paved parking lot within Units 1 & 3, and install a 6-inch gravel cap within portions of Units 2 & 4 and Unit 8 as interim remedial measures (see attached June 5, 2009 letter from DOH HEER Office to HCDA). Areas that are already paved with concrete or asphalt, or areas that contain structures with impermeable concrete foundation slabs will not be altered. In addition to these areas, a 6-inch gravel cap will be placed on a strip of bare soil located on Unit 6, between an existing asphalt paved driveway and the fence line of Unit 7. Previous investigations indicated elevated lead concentrations in discrete soil samples collected from this area.

Although the EHE identified direct exposure hazards associated with residual COC in surface/near surface soils within Unit 7, placement of a gravel cap will not be performed with current HCDA plans. Unit 7 is currently in use as an operating shipyard, and therefore remedial options, such as the construction of a barrier, are not feasible at this time. HCDA will be working directly with its tenant to address the environmental hazards identified within Unit 7, separate from the current remedial plans.

The installation of the interim asphalt/gravel caps at the various areas will provide a physical barrier between the COC in soils and potential surface receptors. Furthermore, the caps will minimize runoff of sediment during storm events into the storm drain system and/or directly into adjacent surface water bodies. The caps, however, will not prevent potential leaching of COC into the groundwater or discharge of COC-impacted groundwater out to surface water bodies. These hazards were considered a lesser concern based on the amount of time that has elapsed since COC were initially released (via filling and commercial/industrial land use).

No institutional controls are currently required for the various sites within the Kakaako Makai District since there is a prohibition against development for residential use. However, future development plans at the various sites will need to consider the existing environmental hazards. Permanent remedial measures at the various sites will be dependent upon the nature of the development.

7.2 Long-Term Monitoring and Preventive Maintenance of Engineered Controls

Routine upkeep of the interim asphalt or gravel caps will be required to prevent potential breaches and re-establishment of exposure pathways. This may include inspecting and sealing cracks in the asphalt as well as various other general maintenance procedures. The thickness of the gravel cap should be routinely measured to ensure that the integrity of the cap is maintained. Over time, additional gravel may need to be added to high traffic areas due to potential erosion and degradation. Future development of the site should take into consideration the function of the cap in containing environmental hazards associated with the COC.

7.3 Breach or Failure of Engineered Controls

The asphalt and gravel caps act as barriers at the site and a breach of the barriers could potentially occur during future construction activities that disturb the underlying soil. Such a breach may create a direct exposure pathway for contaminants in the soil to potential receptors. If such activities are planned, the measures described in Section 8.0 should be used to minimize exposure risks.

Furthermore, removal or breaches in the caps may allow COC particles to accumulate in surface runoff, which may then enter surface water bodies either directly (runoff from adjacent shorelines) or through the existing storm drain system. Care should be taken to avoid exposure of existing site soils to minimize and/or eliminate this potential occurrence.

The aquatic habitats in Kewalo Basin and Mamala Bay may also be impacted if construction activities at the various sites require dewatering activities. If feasible, any dewatering effluent should be maintained within the site (pumping from one trench to another). If off-site discharge of dewatering effluent is required, representative samples of the effluent should be collected and analyzed to determine COC concentrations prior to any discharge activities. Treatment of dewatering effluent may be required to remove COC prior to discharge.

8.0 MANAGEMENT OF CONTAMINATED SOILS AND GROUNDWATER

The risks associated with the presence of contaminated soil and groundwater at a site typically becomes exacerbated during site construction and development due to excavation activities. Therefore, property owners, developers, and contractors need to be cognizant of the hazards associated with the residual contaminants and contaminated media. Appropriate controls to address contaminated soils and groundwater need to be accounted for in site development plans for both the short-term and long-term protection of potential receptors.

8.1 Current Construction Plans

Currently, plans are being prepared for the construction of an asphalt parking lot within Units 1 and 3 and within a portion of the Ala Moana WWPS. In addition, a 6-inch gravel cap will be placed over unpaved surfaces within Units 2 and 4, a portion of Unit 6, and within Unit 8. These activities are being performed as interim remedial measures to address certain environmental hazards associated with residual COC in site soils.

The contractor selected to perform the work will be required to utilize employees with current 40-hour HAZWOPER certification (per 29 CFR 1910.120) for any activities that may require handling of contaminated soils. The contractor will also be required to prepare a site-specific safety and health plan in accordance with 29 CFR 1910.120 to address, at a minimum, potential worker hazards, levels of worker protection, work zones, controls to protect surrounding areas from hazards associated with disturbance of site soils, and air monitoring requirements. Furthermore, the contractor will be required to prepare a contaminated soils handling and management plan to describe tasks, sequencing of operations, controls, and procedures that will be implemented during any work that may disturb contaminated soils.

The project plans and specifications prepared for the construction of interim remedial measures will also require the contractor to implement strict dust control measures, vehicle decontamination procedures, and erosion control procedures. Dust control is of particular importance since generation of fugitive dust is anticipated to be the primary factor associated with contaminant migration and exposure of potential receptors (inhalation of dust particles entrained with COC, ingestion of dust particles that settle on skin, etc.). Vehicle decontamination and erosion control procedures serve to minimize, if not prevent, migration of contaminants off-site and into surface water bodies.

8.2 Future Site Development

Plans for future site development should identify and account for environmental hazards that need to be addressed to protect potential receptors from exposure to contaminated media. Controls should be specified in project planning and bidding documents that provide both short-term and long-term protection for potential receptors.

Two of the key elements for management of potential risks associated with contaminated soil and groundwater include the education of site workers through communication of the hazards associated with various work tasks and the implementation of exposure management controls.

8.2.1 Education and Communication

All construction workers who have contact with soils and groundwater should be educated on the site conditions and potential risks associated with contaminants found at the site. In particular, workers should be aware of the COC for the site (Section 4.0) and the hazards the COC pose (Section 6.0). In addition, workers should be aware that routes of exposure to the COC are generally via inhalation of airborne particulates, inhalation of vapors, ingestion of soil, and absorption through the skin and eyes.

The most common method of informing construction personnel of potential exposure risks is to prepare a Site Safety and Health Plan (SSHP). The SSHP should describe the contaminants of concern, routes of exposure, and potential symptoms of exposure. The plan should also describe personal protection measures, controls, and work practices to minimize the risk of exposure. Construction personnel should be required to review the SSHP and certify that they have reviewed the plan and understand the risks involved with the project.

The SSHP should include the requirement that all construction workers receive Hazardous Waste Operations & Emergency Response (HAZWOPER) training in accordance with 29 CFR 1910.120. Additionally, the construction workers should receive medical evaluations prior to the start of work and annually thereafter to determine whether the health of individual workers is being affected by the construction activities.

In addition to understanding how to protect oneself, site construction workers should also be educated on how contaminated soils and groundwater can impact the general public (through migration via air or surface water) and the environment. The importance of implementing controls that are protective of the general public should be emphasized.

8.2.2 Exposure Management Controls

Exposure to contaminated soils and groundwater during construction can generally be controlled by isolating the contaminated media, eliminating routes of exposure and/or eliminating the exposure point. This can be accomplished by implementing controls during the construction phase. Such controls are provided below.

A. Contaminant Detection and Monitoring

An air monitoring program should be implemented as the primary contaminant detection and monitoring system. Air monitoring should be conducted for at least three (3) full 8-hour shifts in each work area or during each work task to assess workers' exposure to airborne contaminants during excavation or soil disturbance activities. The contractor should be responsible for determining which contaminants are to be monitored (based on the work areas) to satisfy OSHA requirements and such information shall be included in the SSHP. The data obtained from work area air samples should be used to evaluate the effectiveness of control measures and to determine the appropriate level of personal protection.

In addition, area air monitoring at the project site perimeter should be conducted. Prior to start of earthwork activities, background air samples should be collected at the property to identify baseline air quality data. Throughout the project, air samples should be collected on a daily basis at the project site perimeter to monitor for contaminant migration through fugitive dust and/or vapors. Data from perimeter monitoring should be used to evaluate the effectiveness of control measures implemented on-site.

B. Worker Protection

The use of personal protective equipment (PPE) is a key measure used to eliminate the exposure point for site construction workers by placing a physical barrier between the worker and the contaminant. Workers should be provided with the opportunity to don PPE prior to the start of any work requiring disturbance of site soils. Once available, work area air monitoring data can be used to evaluate the adequacy of the selected level of worker protection. The SSHP should detail the specific PPE that will be required during various earthwork activities.

Immediately after leaving the work area, workers should remove PPE and wash hands and face with soap and water. At no time should workers be allowed to smoke, drink, or eat within the work zone and/or near contaminated soil/groundwater.

C. Dust Control

Standard procedures to minimize dusty conditions, such as spraying water on the soil, should be utilized at the site by the contractor. Dust barriers should be constructed along the perimeter of the site if extensive earthwork is anticipated. Controlled spraying of the area with water to suppress dust migration during any soil disturbance work should be conducted during any earthwork activities. The contractor should ensure that throughout the construction process, work at the site does not cause significant deterioration of existing air quality. Specifically, the Contractor shall ensure compliance with ambient air quality standards established in HAR 11-59 and shall comply with air pollution control requirements specified in HAR 11-60.1, at a minimum.

D. Erosion Control Measures

Erosion control measures should be established prior to commencement of any earthwork activities to prevent site soils from migrating via surface water runoff into adjacent roadways, drainage systems, and/or surface water bodies. The contractor should be responsible for determining whether certain permits associated with site grading and/or stockpiling are appropriate (i.e., NPDES, County grading/stockpiling permits, etc.) and whether an erosion control plan is necessary. Typically, Best Management Practices (BMPs) associated with erosion control measures are designed to ensure that soil from a site are retained on site and prevented from ultimately entering surface water bodies. Such BMPs may include (but are not limited to) installation of a silt fence along the property perimeter, physically redirecting potential storm water runoff from leaving the site, and/or installation of controls to prevent tracking of dirt and debris off-site on vehicle tires.

E. Soil Excavation, Handling, and Stockpiling

Construction activities should be structured to result in minimal soil disturbance and to minimize dust generation. When excavation of site soils is necessary for development, activities should be sequenced to minimize the potential for exposure of site workers. As an example, all earthwork (trenching for utilities, site grading, etc.) be performed prior to mobilization of other trade personnel to minimize the number of workers at the site that may be exposed to airborne particulates.

Another control that can be implemented to isolate contaminated soils during construction activities is to place a barrier on or along exposed surface soils, such as lining the walls of an open trench with polyethylene sheeting or placing a thin layer of clean, imported fill material immediately after completing foundation excavations.

If excavated soil needs to be transported, whether on-site or off-site, controls should be implemented to minimize the generation of fugitive dust. This may include spraying water on loads of excavated soil or covering truck loads with fabric.

Any excavated soil that needs to be stockpiled on-site temporarily should be placed on a minimum 10-mil thick layer of polyethylene sheeting in a designated stockpile area. All stockpiles should then be covered using minimum 6-mil thick polyethylene sheeting. The covering should be secured with inert material (i.e., clean, imported fill; etc.) to anchor the polyethylene cover to the stockpile to prevent the cover from being blown off during high wind conditions. The edges of the stockpile should then be secured to prevent run-on of storm water or run-off of soil particles. This can be accomplished by rolling the edges of the polyethylene liner and the polyethylene cover together and securing the rolled ends with heavy, inert materials. Alternatively, a berm can be constructed around the soil stockpile using clean, imported fill material.

Final disposition of excavated soils will be dependent upon site development plans. If feasible, excavated soils should be used on-site. Such soil should be placed under paved surfaces (concrete foundations, asphalt paving) when possible. At a minimum, soils excavated from the site should be placed under a 12-inch thick clean soil cap with some type of permeable marker (e.g., geotextile fabric) used to identify the interface between the contaminated soil and the clean, imported soil cap. The soil cap will need to be monitored periodically to ensure the integrity of the cap. All remedial measures associated with long-term use of the various project areas need to be discussed with the DOH HEER Office to ensure adequate protection of future property users and the environment.

If development plans require the off-site disposal of excavated soil, such soil will need to be sufficiently characterized and information will need to be provided to the government-permitted disposal facility. The disposal facility will have the discretion of accepting or rejecting the overburden soil.

F. Groundwater Handling and Disposal

If development plans require the disturbance of groundwater at the site (i.e., trench dewatering), controls will be needed to prevent the release of untreated groundwater to surface water bodies. If possible, groundwater should be retained on-site rather than being discharged or disposed off-site. This may be accomplished through construction of temporary settling basins, groundwater discharge trenches, or other means.

If discharge of groundwater off-site is necessary, the contractor will need to obtain the appropriate permits (i.e., NPDES, discharge permits, etc.) prior to release. The contractor will ensure that the groundwater being discharged has been sufficiently characterized and that any COC in the groundwater meets applicable threshold criteria (e.g., surface water quality standards, etc.). Should characterization of groundwater indicate elevated contaminant concentrations, groundwater may need to be treated on-site (i.e., settling, mechanical filtration, etc.) or disposed at a government-approved facility.

9.0 REFERENCES

- AMEC Earth and Environmental. May 2002. *Draft Site Characterization Study, Kakaako Brownfield Unit 8.*
- AMEC Earth and Environmental. September 2004. *Phase I ESA Kakaako Pump Station.*
- Ecology and Environment, Inc. April 2004. *Preliminary Recommendations for Remedial Alternatives at the Kakaako Unit 8 Property.*
- Ecology and Environment, Inc. January 2004. *Kakaako Unit 8, Supplemental Phase 2, Draft.*
- Ecology and Environment, Inc. February 2005. *Brownfields Targeted Site Assessment of Units 6 and 7.*
- Edward K. Noda and Associates, Inc. and Cotton Consulting, Inc. September 1997. *Phase I Environmental Site Assessment.*
- Edward K. Noda and Associates, Inc. and Cotton Consulting, Inc. July 1999. *Phase II Field Investigation.*
- Environet, Inc. November 2004. *Final Site Investigation Report, Ala Moana Wastewater Pump Station.*
- Environet, Inc. December 2005. *Phase I ESA, Phase I, Parking Garage, Kakaako Makai District.*
- Environet, Inc. January 2009. *Final Phase II ESA, Kakaako Parking Garage.*
- EnviroServices & Training Center, LLC. May 2007. *Revised Phase I ESA, Historic Ala Moana Pumping Station.*
- EnviroServices & Training Center, LLC. June 2008. *Phase II ESA and Preliminary Remedial Alternatives Analysis Report, Historic Ala Moana Pumping Station.*
- The Limitaco Consulting Group and EnviroServices & Training Center, LLC. July 2006. *Phase I ESA, Kakaako Waterfront - Point Panic.*
- The Limitaco Consulting Group and EnviroServices & Training Center, LLC. April 2007. *Site Investigation and Preliminary Remedial Alternatives Analysis Report.*
- The Limitaco Consulting Group and EnviroServices & Training Center, LLC. June 2009. *Environmental Hazard Evaluation – Kakaako Makai District.*
- Macdonald, G.A., A.T. Abbot, and F.L. Peterson. 1983. *Volcanoes and the Sea*. University of Hawaii Press.
- Masa Fujioka & Associates. January 2001. *Removal of Contaminated Soil Monitoring, Kewalo Corp Yard.*

- Masa Fujioka & Associates. October 3, 2002. *Subsurface Environmental Investigation, Kewalo Unit 3.*
- Mink, John F. and Stephen L. Lau. March 1990. Aquifer Identification and Classification for Oahu: Groundwater Protection Strategy for Hawaii.
- Muranaka Environmental Consultants, Inc. August 1998. *Hazardous Materials Survey Report.*
- R.M. Towill Corporation. November 1996. *Phase I ESA for Ala Moana Wastewater Pump Station.*
- R.M. Towill Corporation. April 2003. *Phase II Environmental Site Investigation, Ala Moana Wastewater Pump Station.*
- State of Hawaii, Department of Health, Environmental Management Division. October 2008. *Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater. Volume 1: User's Guide, Hawaii Edition.*
- State of Hawaii, Department of Health, Hazard Evaluation and Emergency Response Office. March 2000. *Technical Guidance Manual for UST Closure and Release Response Activities, 2nd Edition.*
- State of Hawaii, Department of Health, Hazard Evaluation and Emergency Response Office. June 27, 2007. *Long-Term Management of Petroleum-Contaminated Soil and Groundwater.*
- State of Hawaii, Department of Health, Hazard Evaluation and Emergency Response. December 2007. *Laboratory Analytical Results for Lead in Soil at KKFC Site.*
- State of Hawaii, Department of Health, Hazard Evaluation and Emergency Response Office. December 31, 2008. *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan.*
- State of Hawaii Department of Land and Natural Resources. August 26, 1993. *Hawaii Ground Water Index & Summary.*
- United States Department of Agriculture, Soil Conservation Service. August 1972. *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*.
- US Department of Interior Geological Survey. 1998. Honolulu Quadrangle, Island of Oahu, 7.5 Minute Series (Topographic Map).