Record of Decision
Old Wahiawa Landfill
NAVAL COMPUTER AND TELECOMMUNICATIONS AREA MASTER STATION, PACIFIC, OAHU, HAWAII

September 2009

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

Comprehensive Long-Term Environmental Action Navy
Contract Number N62742-03-D-1837, CTO 0008

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ACRONYMS AND ABBREVIATIONS

§	Section
ARAR	applicable or relevant and appropriate requirements
BEHP	bis(2-ethylhexyl)phthalate
BERA	baseline ecological risk assessment
bgs	below ground surface
Bldg.	building
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	chemical of potential concern
CFR	Code of Federal Regulations
CSM	conceptual site model
DoD	Department of Defense
DOH	State of Hawaii Department of Health
DON	Department of the Navy
eco-SBC	ecological soil benchmark concentration
EPA	Environmental Protection Agency, United States
FS	feasibility study
gpd	gallons per day
HI	hazard index
HQ	hazard quotient
IAS	initial assessment study
LTMM	long-term monitoring and maintenance
LUC	land use control
MCL	maximum contaminant level
mg/L	milligram per liter
NAVFAC Hawaii	Naval Facilities Engineering Command, Hawaii
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NCTAMS PAC	Naval Computer and Telecommunications Area Master Station, Pacific
No.	number
NPL	National Priority List
OU	operable unit
OWLF	Old Wahiawa Landfill
PCB	polychlorinated biphenyl
PAH	polynuclear aromatic hydrocarbon
PP	Proposed Plan
PRG	preliminary remediation goal
RAB	restoration advisory board
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SRA	screening risk assessment
TBC	to be considered
TCE	trichloroethene
TPH	total petroleum hydrocarbon
U.S.	United States
U.S.C.	United States Code
VOC	volatile organic compound
SVOC	semivolatile organic compound
WP	work plan
WQS	water quality standards

1. Declaration

1.1 Site Name and Location

This Record of Decision (ROD) has been prepared by the United States (U.S.) Navy (Navy) for the Old Wahiawa Landfill (OWLF) located within the Naval Computer and Telecommunications Area Master Station, Pacific (NCTAMS PAC), Wahiawa, Oahu, Hawaii (Figure 1). NCTAMS PAC Wahiawa is one of two operable units (OUs) located within the NCTAMS PAC National Priority List (NPL) site. (The second OU within the NCTAMS PAC NPL site is the Naval Radio Transmitting Facility.) NCTAMS PAC Wahiawa is identified on the NPL as U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Information System Number (No.) HI0170090054.

This ROD has been prepared for the Naval Facilities Engineering Command, Hawaii (NAVFAC Hawaii) under the Comprehensive Long-Term Environmental Action Navy III program, Contract No. N62742-03-D-1837, Contract Task Order No. 0008.

This ROD incorporates elements of a streamlined Remedial Action Completion Report, as described in the Department of Defense (DoD)/EPA *Joint Guidance on Streamlined Closeout and NPL Deletion Process* (DoD 2006) and U.S. Department of the Navy (DON) *Guidance to Documenting Milestones Throughout the Site Closeout Process* (DON 2006b).

1.2 Statement of Basis and Purpose

This ROD documents for the Administrative Record the decision by the DON, the State of Hawaii Department of Health (DOH), and EPA to undertake a response action at the OWLF. The ROD substantiates the need for the response action, evaluates response action alternatives, identifies the selected response action alternative, and presents the rationale for the recommended response action approach.

This ROD presents the selected final remedy for the OWLF, Wahiawa, Oahu, Hawaii. The final remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) 42 United States Code (U.S.C.) Sections 9601, et seq., the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, and the Office of the President Executive Order 12580. Information supporting the decisions leading to the selected remedy is contained in the Administrative Record for the site. The DOH concurs with this decision as indicated by signatures contained in Section 1.7 of this ROD.

1.3 Assessment of Site

The OWLF, which covers approximately 4 acres, is a remote, densely vegetated, closed landfill. The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

1.4 Description of the Selected Remedy

The Navy and EPA Region 9, in coordination with EPA Headquarters, and with the concurrence of the DOH, have selected long-term monitoring and maintenance (LTMM) and land use controls

(LUCs)[1] as the remedy for the OWLF site. LUCs, which include the implementation and site maintenance of institutional controls, are designed to (1) restrict land use to activities compatible with maintaining protective barriers, and (2) ensure long-term viability of the final remedy.

This remedy will ensure that the contaminated soils are not disturbed, and that potential routes for exposure are not created due to future land uses or land use changes.

The LUC elements of the selected final remedy include the following:

- Site access control
- Land use restrictions
- Recording the land use restriction in the facility planning records/land use database
- Five-year reviews

Access restriction will consist of warning signage to prohibit unauthorized access to the OWLF. Land use restrictions will be implemented by the Navy to prohibit any land modifications (e.g., vegetation clearing, regrading, excavation, landscaping, and construction of structures) that could potentially expose contaminated soil at the OWLF. Records of the land use restrictions will be maintained in the facility planning documents/land use database.

The implementation and maintenance of, and compliance with, LUCs and LTMM will be confirmed by annual inspections to be performed by the Navy. These annual inspections will include an assessment of the integrity of the existing landfill cover to ensure that it remains protective of human health and the environment. A LUC Work Plan (WP) has been prepared and submitted by the Navy (Earth Tech 2008). The LUC WP will be finalized to detail how the specific LUCs and LTMM will be implemented and maintained, and specifies the requirements for annual inspections and five-year reviews (Earth Tech 2008).

The decision for selecting LTMM and LUCs is based on the following:

- Adoption of the containment approach presented in the EPA guidance, *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA 1993) and *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills* (EPA 1996). According to this guidance, the EPA considers containment an appropriate remedy for the source areas of solid waste municipal landfill sites where the threat posed to human health and the environment is relatively low and long-term, and where the volume and heterogeneity of the waste generally make treatment impractical.
- Results of an evaluation process that considered various remedial alternatives.
- Unsuitability of the OWLF for unrestricted land use due to past practices in which contaminated media have been placed in the landfill.

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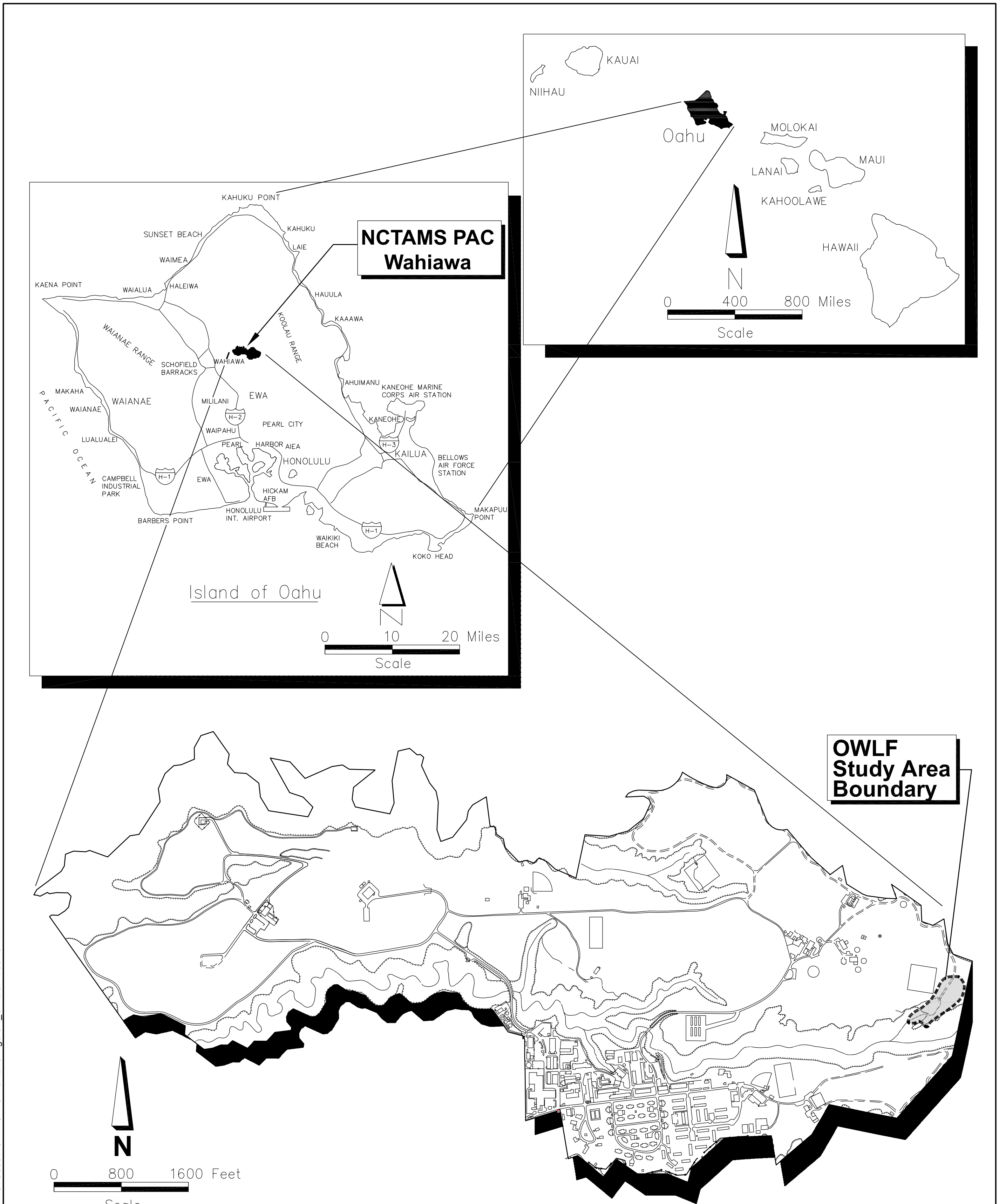
[1] Text in blue font identifies where detailed cross-reference site information is available (Attachment C). In the event of any inconsistency between the text in this ROD and the text in any of the cross-reference documents, the text in this ROD will take precedence.



Source: Earth Tech (1996a).

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Figure 1
Facility Location Map
Old Wahiawa Landfill
NCTAMS PAC Wahiawa, Oahu, Hawaii

The response action objective of protecting human health and the environment is achieved through implementation of the selected remedy: LTMM and LUCs. This decision is supported by documents in the information repository for NCTAMS PAC Wahiawa. The Restoration Advisory Board (RAB) composed of representatives of the DOH, EPA Region 9, Navy, and the community provided review and comment leading to selection of this decision.

1.5 STATUTORY DETERMINATIONS

The Navy is the lead agency for environmental cleanup at Navy sites, such as the implementation of LTMM and LUCs at the OWLF. The EPA and DOH have provided oversight during environmental investigations and cleanup activities on Navy properties. The selected remedy described in Section 1.4 is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements (ARARs), is cost-effective, and uses, to the maximum extent practicable, permanent solutions and alternative treatment technologies.

The use of LTMM and LUCs is consistent with the cleanup objective to provide a permanent cost-effective remedy for contaminated soil, and significantly reduces the risk to human health and the environment. However, the final remedy does not satisfy the statutory preference for treatment as a principal element of the final remedy, because treatment of the large volume of heterogeneous waste contained in the landfill is impractical and cost-prohibitive. The selected final remedy is consistent with the presumptive remedy of waste containment for CERCLA solid waste landfill sites, in accordance with the Superfund Accelerated Cleanup Model. The final remedy also complies with ARARs and is cost-effective.

Because this final remedy results in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, statutory reviews will be conducted in 5-year intervals after initiation of the selected final remedy, as required under CERCLA Section 121(c), 42 U.S.C. Section 9601(c) and the NCP, 40 CFR Section 300.430(f)(4)(ii). Five-year reviews will be performed to ensure that LUCs and landfill cover integrity remain protective of human health and the environment.

1.6 DATA CERTIFICATION CHECKLIST

The following information is included in Section 2, the Decision Summary, of this ROD (additional information can be found in the Administrative Record file for the OWLF):

- Chemicals of potential concern (COPCs) (Section 2.5.5)
- Current and reasonably anticipated future land use assumptions used in the risk assessments and ROD (Section 2.6)
- Summary of pre-response action potential human health risks (Section 2.7.1)
- How source materials constituting principal threat are addressed (Section 2.11)
- Potential land and groundwater use available at the site as a result of the selected final remedy (Sections 2.6 and 2.12.5)
- Key factors that led to selecting the final remedy (Section 2.12.1)
- Estimated capital, annual monitoring and maintenance, and total present worth cost, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.14.8)

1.7 SIGNATURE AND SUPPORT AGENCY ACCEPTANCE OF FINAL REMEDY

The Navy and EPA Region 9, in coordination with EPA Headquarters, and with the concurrence of the DOH, have selected the remedy described in this ROD, and have determined that the recommended response alternative of LTMM and LUCs at the OWLF is protective of human health and the environment. In accordance with CERCLA requirements, Five-Year Reviews will be necessary to ensure that the selected final remedy remains protective of human health and the environment at the OWLF of NCTAMS PAC, Wahiawa, Oahu, Hawaii.

9/4/09

Aaron Y. Poentis
Regional Environmental Program Manager
By direction of:
Commander, Navy Region Hawaii

Date

2/3/10

Michael M. Montgomery
Assistant Director
Federal Facilities and Site Cleanup Branch
U.S. EPA Region 9

Date

The State of Hawaii Department of Health concurs with the selected remedy as documented in this ROD.

2-18-10

Keith E. Kawaoka, D. Env.
Program Manager
Hazard Evaluation and Emergency Response Office
State of Hawaii, Department of Health

Date

2. Decision Summary

2.1 SITE NAME, LOCATION, AND DESCRIPTION

The OWLF is located within the NCTAMS PAC Wahiawa and covers approximately 4 acres of densely wooded land near the eastern perimeter of the facility. The landfill is closed; capped with soil and anchored by dense vegetation (see Figure 2, Figure 3, and Figure 4). The site is bound to the southwest by a remote, rugged, heavily overgrown gulch. An unnamed intermittent stream lies at the bottom of the gulch and flows westward during heavy rainfall. The DON is the lead agency for environmental response actions at the OWLF. The EPA and DOH have provided oversight during the environmental investigation activities at the OWLF. Funding for the site work at OWLF is provided by the Navy Environmental Restoration Program.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 Site History

The NCTAMS PAC Wahiawa operates and maintains communications facilities for the Navy in the eastern Pacific. It is part of the Defense Communications System and of the military satellite communications system. From the 1940s until 1973, the OWLF served as the primary disposal area for wastes (mostly municipal) generated on base. Refuse was originally dumped into the southwestern end of the gulch. As usage increased, the landfill was operated more traditionally, with alternating layers of waste and soil. Previous investigations indicated that the landfill has no engineered liner with a maximum landfill thickness of 41 feet below ground surface (bgs). The OWLF was closed in 1973, which was prior to the passage of the Resource Conservation and Recovery Act. In 1978, it was leveled and covered with a 3-foot-deep soil layer to meet the then-current landfill closure requirements.

NCTAMS PAC Wahiawa has been the subject of five previous environmental investigations:

- An initial assessment study (NEESA 1986)
- A site inspection (HLA 1989)
- An expanded site inspection (ANL 1992)
- A remedial investigation (RI) (Earth Tech 2006b)
- A feasibility study (FS) (Earth Tech 2007b)

Initial Assessment Study. The Naval Energy and Environmental Support Activity conducted an initial assessment study (IAS). The purpose of the study was to identify areas that may require further investigation or cleanup. The study identified potentially contaminated sites from historical records, aerial photographs, field inspections, and interviews. The IAS report (NEESA 1986) recommended that a site inspection be conducted to determine whether contamination existed at the OWLF and to develop recommendations for further action.

Site Inspection. The Navy conducted a site inspection at the OWLF by determining the presence or absence of contamination in the surface and subsurface soil. Soil samples were collected to assess levels of soil contamination and the extent of downgradient contaminant migration. The site inspection report (HLA 1989) concluded that lead and mercury in site soil may be the result of historical waste management practices.

Expanded Site Inspection. The Navy conducted a supplemental or expanded site inspection to further investigate the OWLF (ANL 1992). Sampling results generally supported the findings of the 1989 site inspection. Lead and mercury were detected in soil samples, but at concentrations well below the EPA Region 9 preliminary remediation goals (PRGs) for residential soil (EPA Region 9 2004). Total petroleum hydrocarbons (TPH), and oil and grease were also detected in soil samples.

Remedial Investigation. The Navy completed a RI (Earth Tech 2006b) based on the findings and recommendations of the two site inspections. The initial scope of the RI was to collect and evaluate the data needed to quantify risk associated with the OWLF and, if necessary, identify appropriate remedial actions. The RI report identified five polynuclear aromatic hydrocarbons (PAHs), three metals (chromium, thallium, and vanadium), total polychlorinated biphenyls (PCBs), and cyanide as COPCs in soil. Although other metals, including lead and mercury, were also detected in soil; concentrations were below either the 2004 PRGs and/or the estimated background range. Estimates of human and ecological risks were below target points of departure for surface soil. Human health and ecological risk estimates for subsurface soil indicated that chromium presented unacceptable risks/hazards. The RI concluded that a response action may be required for the OWLF to protect human health and the environment.

The perched groundwater, which was encountered at approximately 40 feet bgs, is not likely to represent a potential source of drinking water and is distinct from the regional water supply, the Schofield Aquifer; a high level, unconfined aquifer, contained in dike compartments. The unconfined top of the Schofield Aquifer is approximately 800 to 900 feet bgs at NCTAMS PAC Wahiawa. (Earth Tech 2006b). Perched groundwater beneath the OWLF contains the following site related contaminants; the organic compounds trichloroethene (TCE) and bis(2-ethylhexyl)phthalate (BEHP) and the inorganic chemicals aluminum, cobalt, copper, iron, manganese, and zinc at concentrations exceeding the screening criteria. BEHP and TCE were detected in the perched aquifer at concentrations that were below their respective maximum contaminant levels (MCLs) (with the exception of one detection of BEHP that was a laboratory estimated value reported above the MCL).

No organic compounds were detected at concentrations above the acute or chronic State of Hawaii Water Quality Standards (WQSs) in the surface water samples collected at the OWLF. Carbon disulfide was the only organic chemical detected in the surface water. Four metals were detected at concentrations above WQS values; chromium, copper, lead, nickel, and zinc (dissolved phase). The surface water does not support ecological receptors; therefore, WQSs were used for comparison only, and are not considered ARARs or to be considered (TBC) requirements.

Feasibility Study. A FS was conducted to evaluate response action alternatives to address contamination in subsurface soils at the OWLF and to recommend a site-specific response action (Earth Tech 2007b). A variety of response alternatives were initially screened based on implementability, effectiveness, and cost. Three alternatives were retained for further evaluation, (1) No Action, (2) LTMM and LUCs, and (3) Cover Reinforcement, LTMM, and LUCs.

2.2.2 Enforcement Activities

No enforcement activities have been conducted for the OWLF at NCTAMS PAC, Oahu, Hawaii.

Figure 2
Looking from the Outside Border into the OWLF
(located approximately at the start of the brush)
Old Wahiawa Landfill
NCTAMS PAC Wahiawa, Oahu, Hawaii

Figure 3
Survey Points along the Perimeter of the OWLF
Old Wahiawa Landfill
NCTAMS PAC Wahiawa, Oahu, Hawaii

Figure 4
Warning Signage Posted on the Boundary of the OWLF
Old Wahiawa Landfill
NCTAMS PAC Wahiawa, Oahu, Hawaii

2.3 COMMUNITY PARTICIPATION

Public participation in the decision process for environmental activities at NCTAMS PAC Wahiawa has continually been encouraged throughout the environmental restoration and site closure processes. In an effort to involve the public in the decision-making process, a RAB was established. The RAB is composed of DOH, EPA Region 9, Navy, and community representatives. The Navy has held RAB meetings (typically on a semi-annual basis) and other public meetings, as well as issued fact sheets that summarize the site investigation and cleanup activities. The RAB has provided review and comment leading to selection of LTMM and LUCs as the final remedy for the OWLF. Additionally, the Navy also established a point-of-contact for the public at NAVFAC Hawaii.

A notice of availability for the Proposed Plan (PP) for the OWLF was published in the *Honolulu Advertiser* and *Star-Bulletin* on 1 June 2007. A public comment period was held from 7 June through 7 July 2007. In addition, a public meeting was conducted on 7 June 2007, to present the PP. At this meeting, the Navy answered questions about the site and the PP. No written comments on the PP were received during the comment period. The Navy's responses to verbal comments are presented in the Responsiveness Summary, which is included as Attachment A of this ROD. Corresponding changes to this document incorporate these responses. The complete transcript of the public meeting is available in the Administrative Record file.

Throughout the investigation and cleanup process, the Navy has prepared various documents to inform and update the community on the progress of OWLF environmental investigation and cleanup activities. These project documents, including work plans, technical reports, and other materials relating to the OWLF investigation activities, can be found in the information repository at the following addresses:

Wahiawa Public Library
820 California Ave.
Wahiawa, Hawaii 96786
(808) 622-6345

Hamilton Library at the University of Hawaii at Manoa
Hawaiian and Pacific Collection
2550 McCarthy Mall
Honolulu, Hawaii 96822
(808) 956-8264

Additional project information is located in the Administrative Record file located at NAVFAC Pacific in Pearl Harbor. The address for the Administrative Record file is provided below:

Naval Facilities Engineering Command, Pacific
258 Makalapa Drive, Suite 100
Attn: NAVFACPAC EV4
Pearl Harbor, Hawaii 96860-3134
(808) 472-1428

2.4 SCOPE AND ROLE OF RESPONSE ACTION

The OWLF is located at NCTAMS PAC Wahiawa, which in turn is an OU within the NCTAMS PAC. NCTAMS PAC was listed on the NPL on 31 May 1994. The NPL identifies priorities among known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the U.S. and its territories. The Navy, EPA Region 9, and DOH signed a

Federal Facilities Agreement (EPA Region 9, State of Hawaii, and DON 2009), effective July 2009, in which they agreed to:

- Ensure that the environmental impacts associated with past activities at the OWLF are thoroughly investigated and appropriate remedial action taken as necessary to protect the public health, welfare, and the environment;
- Establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the OWLF in accordance with CERCLA, as amended by SARA, the NCP, Superfund Guidance and policy, the Resource Conservation and Recovery Act (RCRA), and RCRA Guidance and policy; and
- Facilitate cooperation, exchange of information, and participation of the parties in such actions.

A response action is necessary to protect human health and the environment at the OWLF from exposure to contaminants in soil at concentrations that pose an unacceptable risk or hazard. Previous investigations have shown that PAHs, metals, PCBs, and cyanide are present in surface and subsurface soils because of past landfill use. Of these contaminants, the primary risk drivers are PAHs, thallium, and chromium. The potential of exposure to these contaminants indicates that a response action is warranted.

The selected remedy for the OWLF is LTMM and LUCs. The cleanup strategy for the OWLF is waste containment and control. This strategy is consistent with EPA (1993) presumptive remedy guidance for solid waste landfill sites.

2.5 Site Characteristics

2.5.1 Site Description

The OWLF covers approximately 4 acres near the eastern perimeter of NCTAMS PAC Wahiawa, and is located approximately 3,200 feet from three other NCTAMS PAC Wahiawa sites (Building [Bldg.] 6 Disposal Area, Old Incinerator Site, and Dump Site near Bldg. 293). Because of the physical separation and variation in the waste types, the four sites are being addressed in separate response actions.

2.5.2 Physical Setting

NCTAMS PAC Wahiawa is located on the Schofield Plateau at an elevation of approximately 1,300 feet above mean sea level. The plateau, which forms central Oahu between the Koolau and Waianae Ranges, was created when Koolau lava flows overlapped the flanks of the older Waianae Range. Near the facility, the plateau slopes gently westward, corresponding to the dip of the underlying lava beds. A thick layer of surface soil covering most of the facility is dissected by a system of narrow, steep-sided gullies formed by erosion. Land bordering the facility is largely agricultural and devoted to pineapple cultivation. The nearest urban area is the town of Wahiawa, located about 1 mile south of the facility.

2.5.3 Geology and Hydrogeology

Three stratigraphic units overlie the deep Waianae Volcanics beneath NCTAMS PAC Wahiawa (Earth Tech 2006b):

- The upper unit is silty clay or clayey silt laterite (ranging from 8 to 13 feet thick), a reddish soil formed by weathering of the Koolau Volcanics. In the gullies, the surface soil is silty clay or clayey silt alluvium deposited in the beds of intermittent streams.

- Below the upper unit is saprolite, ranging from 10 to 100 feet thick, formed by weathering of the Koolau Volcanics. Saprolite is distinguished from the overlying soil by its residual basaltic structure and texture, including fractures and vesicles.
- Unweathered to moderately weathered Koolau Volcanics deposited as lava and tuff flows underlie the saprolite. The lava and tuff flows crop out near the crest of the Koolau Range. Unweathered Koolau volcanic rocks are highly permeable, jointed, dense to very dense vesicular basalt.

The RI indicated that the OWLF is covered by clayey/sandy silt with gravel. Native Helemano silty clay soil extends beneath the landfill, grading downward into saprolite and weathered basalt. Some alluvial clayey silt and silty clay, derived from upgradient erosion, lies beneath the refuse horizon (Earth Tech 2006b).

Groundwater of the Schofield High-Level Aquifer lies within the fractured basalt of the Koolau Volcanic Series and, possibly, at greater depths within the Waianae Volcanics. Basalt dikes form relatively impermeable barriers in the permeable volcanic rock. The dikes divert groundwater to successively lower compartments, creating step-like breaks in the water table. Groundwater flows westward. The potentiometric surface of the aquifer at NCTAMS PAC Wahiawa is 800 to 900 feet bgs, based on initial water level measurements in Well No. 3-3100-02, which taps the Schofield Aquifer below NCTAMS PAC Wahiawa. The well is located approximately 3,000 feet westward and downgradient of OWLF, and according to the well log, it is 960 feet deep, and there is a low permeability layer of clay located between 125 and 129 feet bgs. The well has supplied municipal water to NCTAMS PAC Wahiawa since April 1997, and is sampled quarterly by the DOH. Analytical data from the well shows no impact from contaminants found at the OWLF.

Perched groundwater, which has been encountered at approximately 40 feet bgs, occurs locally where less permeable strata impede the downward flow of surface water. It is not likely to represent a potential source of drinking water and is distinct from the regional water supply, the Schofield Aquifer, which occurs at an approximate depth of 900 feet (Earth Tech 2006b).

2.5.4 Sources of Contamination

The landfill, which was used from 1940 to 1973, received wastes that included pigment, paints, plastic, metals, waste oils, solvents, and other hazardous materials (NEESA 1986). Additionally, pesticide containers and pesticide tank rinsates were reportedly dumped in the landfill. Waste generators included the power plant and repair and maintenance facilities (e.g., electrical shop, antenna maintenance shop, calibration shop).

2.5.5 Sampling Strategy and Results

During the RI, soil gas, surface soil, subsurface soil, surface water, and perched groundwater samples were collected and analyzed for organic compounds and metals.

2.5.5.1 Soil Gas and Soil Sampling

A soil gas survey detected scattered, non-correlated occurrences of organic compounds but did not indicate specific hot spots. Table 1 and Table 2 present the analytical results for organic contaminants and metals in OWLF soil based on 41 surface and 68 subsurface soil samples collected during the RI. Based on the RI data, the following chemicals were identified as COPCs for soil:

- PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene)
- Total PCBs

- Metals (chromium, thallium, vanadium)
- Cyanide

PAH and metals exceedances occurred in surface and subsurface soil. For PCBs (total), the only exceedance was slight, in one subsurface soil sample collected from 8 feet bgs. The cyanide exceedance occurred in a single soil sample collected from 30 feet bgs. Surface soil (the landfill cover) covering about half of the OWLF study area had exceedances for thallium, and approximately one-third of that area also had exceedances for PAHs. There were also scattered exceedances of chromium and one exceedance of vanadium. However, the distribution of these occurrences indicated that they may be attributed to the background conditions. Although aluminum, arsenic, iron, and manganese concentrations exceeded their respective EPA Region 9 residential and/or industrial PRGs, they did not exceed their respective estimated background ranges, and these metals, were therefore not considered COPCs.

2.5.5.2 WATER SAMPLING

For surface water samples, no organic compounds were detected at concentrations above the acute or chronic State of Hawaii WQSs. Carbon disulfide was the only organic chemical detected in the surface water. Four metals, aluminum, chromium, copper, and zinc were detected at concentrations above WQS values. Zinc was the only metal detected in the dissolved phase at a concentration exceeding the WQS value. The WQS used for chromium is for chromium VI, whereas the surface water samples were analyzed for total chromium. Also, WQS values listed for copper, lead, nickel, and zinc are minimum standards and may be higher depending on the calcium carbonate hardness. The surface water does not support ecological receptors; therefore, WQSs were used for comparison only, and are not considered ARARs or TBC requirements.

Samples of the perched groundwater were collected from two out of three monitoring wells installed at the OWLF site. These wells were completed in localized water bearing zones found at variable depth horizons that yield water intermittently (following heavy precipitation). Table 3 and Table 4 show the analytical results of the perched groundwater samples collected from the wells. Organic compounds potentially attributable to the landfill were either not detected in the perched groundwater or were detected at concentrations less than the EPA Region 9 tap water PRGs. TCE and BEHP were detected at very low levels. Cobalt and copper concentrations in filtered samples exceeded the Tier 1 action levels, but were well below the EPA Region 9 tap water PRG and MCL (for copper; no MCL is established for cobalt). Manganese concentrations in filtered samples exceeded the tap water PRG. Aluminum and iron concentrations exceeded their respective secondary MCLs. Zinc concentrations exceeded the Tier 1 action level.

TCE, BEHP, and six metals; aluminum, cobalt, copper, iron, manganese, and zinc were identified as COPCs in the perched groundwater on the bases of these screening criteria, however, the perched groundwater is only present intermittently, and does not represent a potential source of drinking water.

Table 1: Organic Compounds Detected in OWLF Soil

Contaminant	No. of Detects F	No. of Detects B	Concentration Range (mg/kg)	Residential PRG (mg/kg) [a]	Industrial PRG (mg/kg) [a]	PRG Qualifier
VOCs						
2-Butanone (MEK)	—	1	0.035	22,311	113,264	nc
Acetone	—	40	0.007 – 7.8 J	14,127	54,321	nc
Carbon disulfide	—	2	0.002 – 0.003 J	355	720	nc (sat)
Dichloromethane	—	15	0.002 – 0.017	9.107	20.53	ca

Contaminant	No. of Detects F	No. of Detects B	Concentration Range (mg/kg)	Residential PRG (mg/kg) [a]	Industrial PRG (mg/kg) [a]	PRG Qualifier
Ethylbenzene	—	1	0.002 J	395	395	sat
Xylene (total)	—	1	0.010 J	271	420	nc (sat)
SVOCs						
2-Methylnaphthalene	0	1	0.290 J	NS	NS	N/A
Acenaphthene	0	1	0.420 J	3,682	29,219	nc
Acenaphthylene	1	0	0.380 J	NS	NS	N/A
Anthracene	3	1	0.260 J – 0.550	21,896	100,000	nc (max)
Benzo[a]anthracene	5	1	0.100 J – **4.4**	0.621	2.11	ca
Benzo[a]pyrene	5	0	**0.600 – 3.9** J	0.062	0.211	ca
Benzo[b]fluoranthene	6	0	0.270 J – **9.5** J	0.621	2.11	ca
Benzo[g,h,i]perylene	5	0	0.290 J – 1.5 J	NS	NS	N/A
Benzo[k]fluoranthene	5	0	0.360 J – 3.4 J	6.22	21.1	ca
Bis[2-ethylhexyl]phthalate	13	10	0.100 J – 22	34.74	123	ca* (ca)
Carbazole	3	0	0.370 J – 0.500	24.32	86.2	ca
Chrysene	5	1	0.096 J – 7.2	62.15	211	ca
Dibenz[a,h]anthracene	1	0	**0.430** J	0.062	0.211	ca
Dibenzofuran	0	1	0.340 J	145	1,563	nc
Fluoranthene	7	2	0.200 J – 14	2,294	22,000	nc
Fluorene	0	1	0.560	2,747	26,281	nc
Indeno[1,2,3-cd]pyrene	4	0	0.390 J – ***1.2*** J	0.621	2.11	ca
Naphthalene	1	1	0.600 –1.2	55.92	187.7	nc
Phenanthrene	5	2	0.2275 – 1.5	NS	NS	N/A
Pyrene	7	3	0.150 J – 17	2,316	29,126	nc
TPHs						
TPH-GRO	—	12	0.390 – 34	100 [b]	N/A	N/A
TPH-DRO	18	14	7.8 – 380	500 [b]	N/A	N/A
Pesticides/PCBs						
4,4'-DDD	3	6	0.003 – 0.068	2.437	9.95	ca
4,4'-DDE	9	7	0.0025 J – 0.093	1.72	7.03	ca
4,4'-DDT	10	4	0.0031 J – 0.058	1.72	7.03	ca*
BHC (β)	0	1	0.068 J	0.316	1.26	ca
Chlordane (α)	4	3	0.002 J – 0.014	1.624	6.47	ca*
Dieldrin	2	1	0.0064 – 0.012	0.030	0.108	ca
Endosulfan (α and β)	6	0	0.0022 J – 0.560 J	367	3,694	nc
Endrin	1	0	0.060 J	18.33	184.7	nc
Endrin aldehyde	3	0	0.0028 – 0.010 NJ	NS	NS	N/A
Endrin ketone	3	0	0.0056 J – 0.016 NJ	NS	NS	N/A
Heptachlor epoxide	6	0	0.0016 J – 0.0073 NJ	0.053	0.189	ca*
PCBs (total) [c]	5	2	0.025 – ***0.233***	0.222	0.744	ca** (ca*)
Aroclor 1254	5	1	0.041 J – 0.190	0.222	0.744	ca** (ca*)
Aroclor 1260 [c]	2	2	0.025 J – 0.073 J	0.222	0.744	ca** (ca*)
Chlorinated Herbicides						
2,4,5-T	0	3	0.0067 J – 0.017 NJ	611	6,156	nc
2,4-DB	0	4	0.056 J – 0.670 J	489	4,925	nc
Dicamba	1	6	0.0062 J – 0.022 J	1,833	18,468	nc
Dichloroprop	0	1	0.056 J	NS	NS	N/A
Silvex (2,4,5-TP)	0	1	0.012 J	489	4,925	nc
Organophosphorus Pesticides and Carbamate/Urea Pesticides						
Monocrotophos	0	1	0.087 J	NS	NS	N/A
Bromacil	0	1	0.160 J	NS	NS	N/A
Carbofuran	2	0	0.490 NJ – 0.900	306	3,078	nc
Chlorpropham	1	0	1.1 NJ	12,220	100,000	nc (max)
Diuron	0	1	0.150 NJ	122.2	1,231	nc
Linuron	1	0	0.810 NJ	122.2	1,231	nc

Contaminant	No. of Detects F	No. of Detects B	Concentration Range (mg/kg)	Residential PRG (mg/kg) [a]	Industrial PRG (mg/kg) [a]	PRG Qualifier
Neburon	6	2	0.088 NJ – 4.0 NJ	NS	NS	N/A
Propoxur (Baygon)	0	1	0.210 NJ	244	2,462	nc

Concentrations exceeding EPA Region 9 (2004) residential soil PRGs are in ***bold italics***.
Concentrations exceeding EPA Region 9 (2004) industrial soil PRGs are in **bold**.
PRG Qualifier: ( ) indicates qualifier for Industrial PRG if different from Residential PRG qualifier.

— no data
4,4'-DDD 4,4'-dichlorodiphenyldichloroethane
4,4'-DDE 4,4'-dichlorodiphenyldichloroethylene
4,4'-DDT 4,4'-dichlorodiphenyltrichloroethane
B subsurface soil
c* The noncancer PRG would be exceeded if the cancer value listed is multiplied by 100.
c** The noncancer PRG would be exceeded if the listed cancer value is multiplied by 10.
ca cancer PRG
DRO diesel range organics
F surface soil
GRO gasoline range organics
J Positively identified – estimated concentration
max PRG concentration exceeds the ceiling limit concentration of 100,000,000 micrograms per kilogram (µg/kg).
MEK methyl ethyl ketone
mg/kg milligram per kilogram
N/A not applicable
nc noncancer PRG
NJ Tentatively identified – estimated concentration
NS no standard
sat soil saturation
SVOC semivolatile organic compounds

[a] Residential and industrial PRGs are from EPA Region 9 (2004).
[b] The standard of comparison for TPH is the DOH Tier 1 Action Level, rather than a PRG. Values are listed for soil levels with SW >150m and with GW not a potential drinking source.
[c] PRG values for Aroclor 1254 are listed for Total PCBs and for Aroclor 1260.

Table 2: Metals and Cyanide Detected in OWLF Soil

Metal	No. of Detects F	No. of Detects B	Concentration Range (mg/kg)	Residential PRG (mg/kg) [a]	Industrial PRG (mg/kg) [a]	PRG Qualifier	Estimated Background Upper Bound (mg/kg) [b]
Aluminum	41	58	29,108 J – **112,000**	76,142	100,000	nc (max)	156,000
Antimony	41	55	1.5 J – 14.2 J	31	409	nc	7
Arsenic	39	19	0.63 – **20.5** J	0.390	1.590	ca* (ca)	22
Barium	41	57	2.9 – 214	5,375	66,577	nc	293
Beryllium	1	4	0.19 – 1.2	154	1,941	nc (ca**)	5.7
Cadmium	0	1	0.7 J	37	451	nc	2
Calcium	41	54	55.8 – 126,000	NS	NS	N/A	360,000
Chromium	42	70	109 – ***787***	211	448	ca	599
Cobalt	42	70	11.3 – 119	903	1,921	ca** (ca*)	157
Copper	42	70	34.7 – 183	3,129	40,877	nc	235
Cyanide	31	12	0.08 – **88.1**	10.8	35.4	nc	NS
Iron	41	58	***65,900*** **– 217,500**	23,463	100,000	nc (max)	219,000
Lead	41	58	1.42 – 296 J	400	800	nc	117
Magnesium	41	58	125 – 2,200	NS	NS	N/A	NS
Manganese	41	58	93.1 – ***1,810***	1,762	19,458	nc	7,040
Mercury	41	32	0.05 – 2.5	23	307	nc	1
Nickel	39	58	1.07 – 511	1,564	20,439	nc	579
Potassium	41	56	31.38 – 1,090	NS	NS	N/A	NS
Selenium	21	11	1.1 J – 11.1 J	391	5,110	nc	11
Silver	0	3	0.35 – 1	391	5,110	nc	3.1
Sodium	0	1	3,040	NS	NS	N/A	NS
Thallium[c]	11	5	0.94 J – ***17.4***	5.162	67	nc	4.8

Metal	No. of Detects F	No. of Detects B	Concentration Range (mg/kg)	Residential PRG (mg/kg) [a]	Industrial PRG (mg/kg) [a]	PRG Qualifier	Estimated Background Upper Bound (mg/kg) [b]
Vanadium	41	58	***92.3*** – ***<u>630</u>*** J	78	1,022	nc	560
Zinc	41	56	30.6 – <u>361</u>	23,463	100,000	nc (max)	214

Text in ***bold italics*** identifies concentrations that exceed EPA Region 9 (2004) residential soil PRGs.
Text in **bold** identifies concentrations that exceed EPA Region 9 (2004) residential and industrial soil PRGs.
Text that is <u>underlined</u> identifies concentrations that exceed the background value (if a background range is quantified).
PRG Qualifier: ( ) indicates qualifier for Industrial PRG if different from Residential PRG qualifier.
B subsurface soil
c* The noncancer PRG would be exceeded if the cancer value listed is multiplied by 100.
c** The noncancer PRG would be exceeded if the listed cancer value is multiplied by 10.
ca cancer PRG
F surface soil
J estimated concentration
max PRG concentration exceeds the ceiling limit concentration of 100,000,000 µg/kg.
N/A not applicable
nc noncancer PRG
NS no standard
RAll background cadmium results were rejected by data validation.
sat soil saturation
[a] Residential and industrial PRGs are from EPA Region 9 (2004).
[b] Estimated upper bound of background range, as discussed in C.3, RI Report (Earth Tech 2006b).
[c] The thallium residential PRG is derived from thallic oxide.

Table 3: Organic Compounds Detected in OWLF Perched Groundwater

Contaminant	No. of Detects	Concentration Range (µg/L)	Federal MCL (µg/L) [a]	Tier 1 Action Level (µg/L) [b]	Tap Water PRG (µg/L) [c]	PRG Qualifier
VOCs						
Trichloroethylene	2	***2–3 J***	5	74	0.028	ca
SVOCs						
Acenaphthene	1	4.5 J	NS	200	370	nc
Bis(2-ethylhexyl)-phthalate	1	***16 J***	6,000	32	4.8	ca
Carbamate/Urea Pesticides						
Neburon	1	0.92	NS	NS	NS	N/A
Propoxur (Baygon)	1	1.25 J	NS	NS	150	nc

Text in ***bold italics*** identifies concentrations that exceed EPA Region 9 (2004) tap water PRGs.
µg/L micrograms per liter
ca cancer PRG
J positively identified – estimated concentration
N/A not applicable
nc noncancer PRG
NS no standard
[a] Federal MCL values from EPA (2002).
[b] Values are listed for 2005 DOH Tier 1 groundwater action levels with SW >150m and with GW not a potential drinking source.
[c] Tap water PRG values are from EPA Region 9 (2004).

Table 4: Metals and Cyanide Detected in OWLF Perched Groundwater

Metal	No. of Detects		Concentration Range (µg/L)		Federal MCL (µg/L) [a]	Tier 1 Action Level (µg/L) [b]	Tap Water PRG (µg/L) [c]	PRG Qualifier
	Total	Diss.	Total	Diss.				
Aluminum	2	2	**1,745–2,160**	U	50–200 [d]	NS	36,000	nc
Barium	2	2	8.6–12.1 J	8.4–10.2	2,000	2,000	2,600	nc
Calcium	2	2	39,600–53,600	38,400 J –53,300	NS	NS	NS	N/A
Chromium	2	2	8.35–16.7	0.87–2.7	100	74	55,000 [e]	N/A
Cobalt	2	2	**30.75** J **–55.6** J	**28.8** J **–54.1** J	NS	3.0	730	nc
Copper	2	2	**3.4** J **–6.3l** J	2.9–**3.9**	1,300 [f]	2.9	1,500	nc
Cyanide	2	–	1.3 J –4.2 J	NA	200	1.0	730	nc
Iron	2	2	**2,540–4,960**	**918.6** J **–2,560** J	300 [d]	NS	11,000	nc
Lead	2	2	1.33	1.38–3.1	15 [f]	29	NS	N/A
Magnesium	2	2	7,970–10,400	7,941.5–9,930 J	NS	NS	NS	N/A
Manganese	2	2	***13,750–15,600***	***13,798–15,500 J***	50 [d]	NS	880	nc
Mercury	2	2	1.1–1.62	0.37–0.49	2.0	2.1	11	nc
Nickel	2	2	27.15–57.1	21.6–196 J	NS	5.0	730	nc
Potassium	2	2	1,410–1,840	1,330 J –1,750	NS	N/A	NS	N/A
Silver	2	2	U	0.42	100 [d]	1.0	180	nc
Sodium	2	2	14,450 J – 20,800 J	14,307 J – 20,500 J	NS	N/A	NS	N/A
Vanadium	2	2	3.2–4.5	U	NS	19	36	nc
Zinc	2	2	**30.5–109** J	**32.65** J **–74.6** J	5,000 [d]	22	11,000	nc

Text in **bold** identifies concentrations that exceed the MCL or DOH Tier 1 action level.
Text in ***bold italics*** identifies concentrations that exceed EPA Region 9 (2004) tap water PRGs.

µg/L micrograms per liter
Diss. dissolved
J positively identified – estimated concentration
N/A not applicable
NA not analyzed
nc noncancer PRG
NS no standard
U Undetected

[a] Federal MCL 2002.
[b] Values are listed for 2005 DOH Tier 1 groundwater action levels with SW >150m and GW not a potential drinking source.
[c] Tap water PRG values are from EPA Region 9 2004.
[d] Federal MCL is secondary.
[e] Tap water PRG value for chromium III is listed for chromium.
[f] MCL for copper and lead are regulated by treatment techniques limiting corrosiveness. Fewer than 10% of water samples may exceed this action level.

2.5.6 Conceptual Site Model

The conceptual site model (CSM) is used to guide the evaluation of potential exposures so that relevant pathways, exposure routes, and ultimately risk can be evaluated in the screening risk assessment (SRA). The primary purpose of the CSM is to structure the SRA in order to determine whether exposure pathways are incomplete (requiring no further evaluation) or potentially complete. Only potentially complete exposure pathways are evaluated quantitatively in the risk assessment, which is consistent with EPA guidance (EPA 1989). A potentially complete exposure pathway must include all of the following elements before a quantitative assessment is performed:

- Sources and type of chemicals present
- Affected media
- Chemical release and transport mechanisms (e.g., spillage and advection, vaporization)
- Known and potential routes of exposure (e.g., ingestion, dermal contact, inhalation)
- Known or potential human and environmental receptors (e.g., residents, workers, wildlife)

The absence of any one of these elements results in an incomplete exposure pathway. Thus, for an incomplete pathway with no potential human or ecological exposure, the potential for adverse health effects would be deemed negligible and would not warrant further evaluation.

The CSMs developed for the OWLF describe the contaminant sources, contaminant migration mechanisms, and receptor exposure pathways potentially present at the OWLF. It is a dynamic model developed from previous investigations within the RI human health and ecological SRAs (Earth Tech 2006b). The CSMs are summarized in Figure 5 for human health and Figure 6 for ecological health. Potential human receptors for the OWLF include both child and adult trespassers, offsite nearby residents under the current land use setting, and commercial/industrial workers and both child and adult residents under the future land use setting. The most important potential routes of exposure are direct contact with, and incidental ingestion of contaminated soil and surface water.

2.5.7 Sensitive Populations, Habitats, and Natural Resources

There are no sensitive populations, habitats, or natural resources at the OWLF.

2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USE

Current Site Use. The NCTAMS PAC Wahiawa operates and maintains communications facilities for the Navy in the eastern Pacific, which is considered an industrial/commercial use. It is part of the Defense Communications System and of the military satellite communications system. The OWLF lies within a steep wooded gulch atop weathered basaltic flows. The OWLF is currently closed as a landfill and is unused vacant land. The site boundaries are shown in Figure 1.

Future Site Use. NCTAMS PAC Wahiawa, including the OWLF, will be maintained by the Navy for use as a communications facility, which is considered an industrial/commercial use. There are no plans for development of the steep gulch walls and no land use changes are anticipated in the foreseeable future for the OWLF.

Groundwater Classification and Use. The State of Hawaii does not currently have an EPA-approved comprehensive state groundwater protection plan in place; therefore, federal and other state guidance was considered to determine the status of groundwater at the OWLF, as well as site-specific factors. The groundwater at the OWLF site was classified in accordance with the *Classification of Shallow Caprock Groundwater at Navy Oahu Facilities, Oahu, Hawaii* (Earth Tech 2007a). This classification was developed through a partnership with EPA Region 9 and the DOH to develop and agree upon a framework for groundwater classification at Navy facilities in Hawaii. This framework allows site-specific factors to be considered to determine whether groundwater meets the criteria for beneficial use as a public or private drinking water source in the future as defined in the EPA Groundwater Protection Strategy (EPA 1988).

According to the *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy* (EPA 1988), groundwater is classified as Class I, II, or III, as follows:

- Class I groundwater is highly vulnerable to contamination and is an irreplaceable source of drinking water for a substantial population, or is ecologically vital.
- Class II groundwater is a current or potential source of drinking water.
- Class III groundwater is not a potential source of drinking water and is of limited beneficial use.

The deep Wahiawa System aquifer meets the criteria for Class I groundwater. However, the perched groundwater is not likely to meet the criteria for classification as either Class I or Class II groundwater. Under the federal guidelines, a potential source of drinking water (Class I or II) is defined as a groundwater source "capable of yielding a quantity of drinking water to a well or spring sufficient for the needs of an average family." This yield is established at 150 gallons per day (gpd) or 0.104 gallon per minute sustainable throughout the year. Groundwater is considered suitable for drinking purposes if it has a "total dissolved solids concentration of less than 10,000 milligrams per liter (mg/L), which can be used without treatment, or that can be treated using methods reasonably employed in a public water system" (EPA 1988). Although the available groundwater data indicate that the total dissolved solids concentration of the perched groundwater at the OWLF is less than 10,000 mg/L, the boring and well monitoring observations indicate that perched groundwater at the OWLF is not likely to yield 150 gpd sustainable throughout the year (Earth Tech 2006b).

2.7 SUMMARY OF SITE RISKS

The human health and ecological SRAs are summarized below and are presented in their entirety as Appendix C of the RI Report (Earth Tech 2006b).

2.7.1 Human Health Screening Risk Assessment

A human health SRA was conducted for the OWLF to help risk managers evaluate risks associated with exposure at the site and determine whether further action is warranted at the site to protect human health. This section summarizes the human health SRA. Analytical results from surface soil (0 to 0.5 foot bgs), subsurface soil (0.5 foot to 12 feet bgs), surface water, and groundwater analyses were used to identify the human health COPCs for each exposure medium evaluated in the SRA. All analytes detected in surface and subsurface soils, surface water, and perched groundwater were evaluated as preliminary COPCs for the human health SRA. A summary of the human health risks is presented in Table 5, and the human health CSM for the OWLF is presented in Figure 5.

Table 5: Summary of Human Health Risk at OWLF

	Cancer Risk - Excluding Background		Hazard Index - Excluding Background	
Exposure Scenario	RME	CTE	RME	CTE
Residential - Surface Soil	1×10^{-5}	2×10^{-6}	7	1
Residential - Subsurface Soil	3×10^{-6}	5×10^{-7}	0.4	0.07
Industrial - Surface Soil	4×10^{-6}	2×10^{-7}	0.5	0.1
Industrial - Subsurface Soil	1×10^{-6}	4×10^{-8}	0.03	<0.01
Child Woodland Trespasser - Surface Soil	2×10^{-6}	3×10^{-7}	0.4	0.07
Commercial Worker - Surface Soil	2×10^{-6}	2×10^{-7}	0.06	0.02
Construction Worker - Surface Soil	1×10^{-6}	5×10^{-8}	2	0.06
Construction Worker - Subsurface Soil	1×10^{-7}	1×10^{-8}	[a]	[a]
Residential — Surface Water	N/A	N/A	N/A	N/A
Residential - Perched Groundwater	N/A	N/A	N/A	N/A

CTE central tendency exposure
N/A not applicable
RME reasonable maximum exposure
[a] No carcinogenic and/or noncarcinogenic COPC above background for this receptor.

Contaminant Source	Transport Mechanism	Exposure Route	Receptors: Current Use: Woodland Trespasser (Adult/Child)	Receptors: Current Use: Offsite Resident	Receptors: Future Use: Commercial Workers	Receptors: Future Use: Residents or Industrial Onsite Workers (Adult/Child)	Rationale
Surface Soil	Direct Contact	Direct Contact	Potentially Complete	Insignificant	Potentially Complete	Potentially Complete	Direct contact with surface soil potentially complete for future residents, future onsite workers, woodland trespassers, and ecological receptors.
		Incidental Ingestion	Potentially Complete	Insignificant	Potentially Complete	Potentially Complete	
	Air Transport	Inhalation of Particulates	Insignificant	Insignificant	Insignificant	Potentially Complete	Air transport of nonvolatile chemicals of potential concern in dust by air is considered to be insignificant for the woodland trespasser and commercial worker due to dense vegetation and high rainfall. Air transport of VOCs is considered insignificant because of their infrequent detection and low concentration in surface and subsurface soil. Inhalation of particulates and VOCs for offsite residents is considered insignificant because the concentrations off site would be negligible due to the distance. Inhalation of particulates and VOCs may be a potentially complete exposure pathway for future onsite residents and industrial workers.
		Inhalation of VOCs	Insignificant	Insignificant	Insignificant	Potentially Complete	
	Surface Water	Dermal Adsorption	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	No permanent surface water exists at the four sites of NCTAMS PAC Wahiawa. However, following rainfall, there is a potential for water to accumulate in holes and ditches. Dermal adsorption and incidental ingestion of surface water run-off is potentially complete for all current and future receptors assuming there is surficial contamination. The bio-accumulation /consumption of fish and vegetables is incomplete due to the lack of fish habitiat, the current site conditions; the OWLF lies within a steep wooded gulch atop weathered basaltic flows, and that the future intended use is industrial/commercial.
		Incidental Ingestion	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	
		Bio-Accumulation/ Consumption of Fish and Vegetables	Incomplete	Incomplete	Incomplete	Incomplete	
Subsurface Soil	Direct Contact	Dermal Adsorption	Incomplete	Incomplete	Incomplete	Potentially Complete	Because woodland trespassers and commercial workers are unlikely to engage in activities that would expose subsurface soil, the subsurface soil is considered incomplete for woodland trespassers and commercial workers. Direct contact with, and incidental ingestion of, subsurface soil is potentially complete for future onsite workers and future residents engaged in landscaping or construction activities.
		Incidental Ingestion	Incomplete	Incomplete	Incomplete	Potentially Complete	
	Unsaturated/ Saturated Zone Transport to Groundwater	Dermal Adsorption	Incomplete	Incomplete	Incomplete	Incomplete	The principal aquifer at NCTAMS PAC is 800-900 feet bgs. Because of the depth of the principal aquifer, the low to moderate permeability of the intervening soil and rock, and the low concentrations of constituents detected in the perched aquifer below OWLF, the groundwater pathway is considered incomplete. The perched groundwater is a feature that only yields water intermittently under condition of heavy precipitation. A subsequent groundwater sampling event was attempted at the three monitoring wells, however the wells were dry; therefore the analytical results were not repeatable and the pathway is incomplete.
		Incidental Ingestion	Incomplete	Incomplete	Incomplete	Incomplete	
		Inhalation of VOCs	Incomplete	Incomplete	Incomplete	Incomplete	
		Drinking Water	Incomplete	Incomplete	Incomplete	Incomplete	

Figure 5
Human Health Conceptual Site Model
Old Wahiawa Landfill
NCTAMS PAC Wahiawa, Oahu, Hawaii

Release History	Contributing Sources	Transport Mechanisms	Exposure Route	Ecological Receptors[1]	Rationale
The Old Wahiawa Landfill is a valley fill created by disposal if construction debris into a small gulch that is upstream and tributary to the main gulch upon which the other 3 disposal sites are located. Over time household and other waste may have been deposited there. Contamination could occur in both surface and subsurface soil.	Surface Soil (0-2 feet)	Windborne Particulates	Inhalation of Fugitive Particulates	Insignificant	Inhalation may be a potentially complete pathway from fugitive dust generated during dry, windy conditions or during construction or remediation activities. However, the gulch is heavily vegetated and wind-blown dust is unlikely to be generated.
		Volatilization	Inhalation of VOCs	Insignificant	While VOCs may volatilize into soil air spaces and migrate to the soil surface where they may be emitted to the atmosphere, the surface soil depths are expected not to contain VOCs due to volatility of constituents. VOC exposure for terrestrial birds and mammals is considered insignificant in comparison to ingestion exposure.
		Direct Contact	Incidental Ingestion of Soil	Potentially Complete	Terrestrial ecological receptors may be exposed by ingestion of contaminated surface soil during foraging and/or grooming activities.
			Dermal Absorption	Insignificant	Dermal exposure by terrestrial birds and mammals is possible, but exposure parameters for these receptors are lacking; therefore, quantitative evaluation of this pathway is not presented. Dermal exposure is considered insignificant in comparison to ingestion.
		Bio-uptake	Ingestion of Plants/Animals (bio-uptake)	Potentially Complete	Terrestrial ecological receptors may eat the natural vegetation growing on site and feed on soil invertebrates living on site.
	Subsurface Soil	Direct Contact	Dermal Absorption Incidental Ingestion	Incomplete	Infiltration to subsurface soil is possible after heavy rainfall; however, ecological receptors are not expected to have significant exposure to subsurface soils.
			Inhalation of VOCs Inhalation of Particulates	Incomplete	Infiltration to subsurface soil is possible after heavy rainfall; however, ecological receptors are not expected to have significant exposure to subsurface soils.
	Groundwater	Direct Contact	Ingestion of Groundwater Dermal Absorption Inhalations of VOCs	Incomplete	Groundwater does not discharge to the surface. Terrestrial ecological receptors are not expected to be exposed to surface water.
	Surface Waters Runoff and discharge of groundwater	Direct Contact	Dermal Absorption Ingestion Inhalation of VOCs	Incomplete	Runoff water flows in the gulch in response to precipitation. Water does not persist long enough in the gulch to support aquatic or benthic communities nor provide a regular drinking water source for terrestrial animals. Groundwater does not discharge to the surface. Terrestrial ecological receptors are not expected to be exposed to groundwater.

(1) Future conditions are assumed to be the same as current conditions for ecological receptors. No future scenarios are run.

Figure 6
Ecological Conceptual Site Model
Old Wahiawa Landfill
NCTAMS PAC Wahiawa, Oahu, Hawaii

2.7.1.1 SURFACE AND SUBSURFACE SOIL

Reported incremental lifetime cancer risks and target hazard indices for OWLF soils represent results after excluding contributions from background metals concentrations. If the cancer risk exceeds the 1×10^{-6} point of departure and/or the non-cancer hazard index (HI) exceeds a target of 1.0, a potential risk to human receptors may exist.

For surface soil (0 to 0.5 foot bgs depth), the incremental lifetime cancer risks for the future resident and industrial worker under the reasonable maximum exposure (RME) scenario are 1×10^{-5} and 4×10^{-6}, respectively. The non-cancer hazard for the future resident exceeded the target HI of 1 under the RME scenario. Much of this non-cancer hazard was due to exposure to vanadium (approximately 76 percent) and thallium (approximately 21 percent). Non-cancer hazard risk for the industrial worker did not exceed a target HI of 1. The incremental lifetime cancer risks for the woodland trespasser and commercial worker under the RME scenario are 2×10^{-6}. The non-cancer hazard for the woodland trespasser and commercial worker did not exceed the target HI of 1.

The evaluation of subsurface soil (0.5 foot to 12 feet bgs) at the OWLF identified incremental lifetime cancer risks for the future resident under the RME scenario is 3×10^{-6}. The industrial worker receptor under the RME scenario meets an incremental lifetime cancer risk of 1×10^{6}. All subsurface soil HIs were less than 1. The woodland trespasser and commercial worker are unlikely to be exposed to subsurface soil, and were therefore not evaluated.

2.7.1.2 SURFACE WATER

The incremental lifetime cancer risk associated with chemicals detected in the surface water was not estimated because no carcinogenic chemicals were detected in water samples. The cumulative non-cancer hazard associated with the chemicals in the surface water was at the target HI of 1.

No organic compounds were detected at concentrations above the acute or chronic State of Hawaii WQSs in OWLF surface water. Carbon disulfide was the only organic chemical detected in the surface water. Four metals were detected at concentrations above WQS values (aluminum, chromium, copper, and zinc). Surface water was evaluated as a potential source of drinking water, and no individual chemicals exceeded regulatory criteria (EPA Region tap water PRGs) for domestic use.

2.7.1.3 GROUNDWATER

The evaluation of groundwater in the perched aquifer below the OWLF identified an incremental lifetime cancer risk and a non-cancer hazard based on COPCs present that exceeded the points of departure. The exceedances are due mainly to the contributions of one semivolatile organic compound (SVOC) (BEHP), one volatile organic compound (VOC) (TCE), and one metal (manganese). However, the perched groundwater below the OWLF site is not intended for consumption as discussed in Section 2.6. Additionally, the probability of contaminant release and transport to the Schofield Aquifer is low or unlikely because of the following:

- The depth to the principal aquifer, which is the source of drinking water at the site, is deep; approximately 900 feet bgs.
- The low to moderate permeability of the intervening soil and rock limit the capacity for contaminant infiltration and migration. The Schofield Plateau was formed by ponding of lava and tuff flows from the Koolau range on the eroded slope of the Waianae Range (Stearns 1985). Recharge is by infiltration of rainwater from the Koolau Range, and by rainwater and stream flow infiltration on the Schofield Plateau (Earth Tech 2006b). Basalt dikes form relatively impermeable barriers in the permeable volcanic rock, diverting

groundwater to successively lower compartments, and creating step-like breaks in the water table (Earth Tech 2006b).

- Contaminant adsorption to the stratigraphic units as detailed in Section 2.5.3 and summarized below is expected to attenuate COPCs in the subsurface:
  - The upper unit is silty clay or clayey silt laterite, with silty clay or clayey silt alluvium deposited in the beds of intermittent streams.
  - Saprolite ranging from 10 to 100 feet thick underlies the silty clay and laterite soils. The clay component of the saprolite would be expected to retard the movement of organic contaminants in the subsurface.
  - Unweathered to moderately weathered Koolau Volcanics deposited as lava and tuff flows underlie the saprolite. Unweathered Koolau volcanic rocks are highly permeable, jointed, dense to very dense vesicular basalt.
- The nature and extent of detected COPCs (Organics and Metals).
  - The low concentrations of the detected organics, TCE and BEHP, (below their corresponding MCLs with the exception of one detection of BEHP that was a laboratory estimated value reported above the MCL) identified in the perched aquifer beneath the OWLF. TCE and BEHP will dissipate through volatilization into a gas phase in the unsaturated zone.
  - The metals detected in the perched groundwater were aluminum, cobalt, copper, iron, manganese, and zinc. Aluminum exceeded the secondary MCL in one unfiltered (total) sample but not in the corresponding filtered sample. Therefore, the aluminum is likely associated with particulates associated with the unfiltered sample rather than being a constituent of groundwater. Cobalt and copper concentrations exceeded the DOH Tier 1 EALs, but were well below the tap water PRG and MCL (copper only, no MCL for cobalt is established). Iron and manganese concentrations exceeded their secondary MCLs, and manganese also exceeded the tap water PRG. Aluminum, cobalt, copper, iron, manganese, zinc in perched groundwater are not considered a threat to the underlying Schofield Aquifer for the reasons stated up above. These metals are components of rock and adsorb readily to minerals surfaces. Therefore, transport of these metals to groundwater is expected to be minimal.
- Contamination of the regional groundwater supply has not been identified in the water supply production well located approximately 3,000 feet west and downgradient of the OWLF. Therefore, the chemicals detected in the perched aquifer are unlikely to present adverse effects to human health (Earth Tech 2006b). Additionally, lithologic logs generated during the installation of the production well revealed a lower permeability clay layer at 125 to 129 feet bgs that would be expected to retard the vertical migration of the COPCs.

2.7.2 Human Health SRA Conclusions

After excluding background metals in OWLF surface soils, the incremental lifetime cancer risks for the future resident and industrial worker under the RME scenario are 1×10^{-5} and 4×10^{-6}, respectively, and the non-cancer hazard for the future resident exceeded the target HI of 1. The evaluation of subsurface soil at the OWLF (after excluding background metals) identified incremental lifetime cancer risks for the future resident under the RME scenario of 3×10^{-6}. Further action is required to address the human health risk/hazard associated with exposure to surface and subsurface soil.

No organic compounds were detected at concentrations exceeding drinking water criteria in the surface water samples. Four metals (aluminum, chromium, copper, and zinc) were detected at concentrations above acute or chronic WQS values. However, the risk assessment results indicate that surface water at the OWLF does not exceed target points of departure and therefore, does not present unacceptable risks to human health.

The evaluation of perched groundwater at the OWLF identified incremental lifetime cancer risk and a non-cancer hazard that exceeded target points of departure for one VOC (TCE) and one metal (manganese). However, the perched groundwater does not represent a potential source of drinking water and is too deep to be encountered by potential receptors (see Section 2.6 for further discussion). In addition, as previously stated, the low concentrations of the detected organics, TCE and BEHP, were below their corresponding MCLs (with the exception of one detection of BEHP that was a laboratory estimated value reported above the MCL). Therefore, it is concluded that no further action is required to protect human health from potential exposure to perched groundwater.

2.7.3 Ecological Screening Risk Assessment

The Tier 1 ecological SRA evaluated risks potentially attributable to chemicals detected in soil at the OWLF site. The SRA is intended to comply with the EPA guidance for Steps 1 and 2 of the 8-step *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessment* (EPA 1997) and Tier 1 of the *Navy Policy for Conducting Ecological Risk Assessments* (DON 1999). The SRA process ends with a scientific management decision point. The full ecological SRA is presented in Appendix C of the RI Report (Earth Tech 2006b).

Designation of chemicals as risk-associated agents was assessed with two lines of evidence.

- *Exposure Pathway Analysis*—Comparison of habitat on site to habitat in the immediate area and the habitat's attractiveness to species that may visit the site.
- *Ecological Soil Benchmark Concentrations*—Comparison of maximum chemical concentrations detected in surface soil to EPA ecological soil screening levels and Oak Ridge National Laboratory direct contact screening levels (based on toxicity to plants and soil invertebrates) and conservative site-specific ecological soil benchmark concentrations (eco-SBCs) based on exposure of small mammals and omnivorous birds to soil contaminants through food-chain ingestion.

2.7.3.1 RESULTS

The analytical results from all investigations at the OWLF were used to conduct the ecological SRA. The results of the Tier 1 SRA indicate that concentrations of 14 of the metals detected in soil at the OWLF exceed conservative eco-SBCs for wildlife. Chemicals that failed the Tier 1 ecological SRA were evaluated in the Tier 2 baseline ecological risk assessment (BERA). An ecological conceptual model for OWLF is presented in Figure 6, and a summary of the results of the Tier 2 exposure and hazard quotient (HQ) calculations for the representative mammal and bird are presented in Table 6.

Table 6: Ecological Hazard Quotients and Comparison of Metal RME Concentrations in Soil to Soil Background Concentrations

COPC	Estimated Background [a] (mg/kg)	RME (mg/kg)	RME > Background	HQ For Mammal	HQ For Bird
Aluminum	156,000	50,600	No	500	10
Antimony	7	5.62	No	4	n/a
Arsenic	22	9.76	No	0.09	0.06

COPC	Estimated Background [a] (mg/kg)	RME (mg/kg)	RME > Background	HQ For Mammal	HQ For Bird
Chromium	599	413	No	4	5
Cobalt	157	35.2	No	0.08	0.1
Copper	235	73.6	No	1	2
Lead	117	33.1	No	0.2	0.7
Manganese	7,040	632	No	0.4	0.1
Mercury	1	1.00	No	0.3	3
Nickel	579	178	No	30	4
Selenium	11	4.2	No	8	2
Thallium	**4.8**	***7.49***	***Yes***	**0.8**	**2**
Vanadium	560	410	No	2	40
Zinc	214	138	No	3	2

Bold italics denotes RME exceeds background.
mg/kg milligram per kilogram
n/a not available
[a] Maximum background concentration for Koolau volcanic soils from the *Environmental Background Analysis of Metals in Soil at Navy Oahu Facilities, Oahu, Hawaii.* (Earth Tech 2006a).

The HQs for 10 metals exceed 1: aluminum, antimony, chromium, copper, mercury, nickel, selenium, thallium, vanadium, and zinc. Under the Tier 2 BERA, the HQs for organic compounds were found to be less than 1.

If the chemical concentrations in soil do not exceed background levels, the potential risk to receptors is considered acceptable. Antimony, chromium, copper, mercury, nickel, selenium, vanadium, and zinc were eliminated as COPCs because their RME concentrations did not exceed their respective background range upper bounds (Table 6). Aluminum was eliminated as a COPC based on the OWLF soil pH.

Comparison of metal concentrations to background ranges for site soils showed that thallium (bird HQ = 2) is likely present in soils at concentrations above the background range. However, the low detection frequency (27 percent) and low no-effect HQ (HQ = 2 for birds) for thallium suggests thallium in the surface soil at the OWLF does not present an unacceptable risk of adverse effects to bird and mammal populations; therefore, thallium was also eliminated as a COPC.

2.7.3.2 Ecological SRA Conclusions

For ecological risks calculated during the RI, surface soil at the OWLF was concluded not to present an unacceptable risk of adverse effects to bird or mammal populations due to the low no-effect HQs and the removal of COPCs with regard to the comparison of background concentrations. Birds and mammals were only evaluated for exposure to surface soil through incidental ingestion during foraging and/or grooming activities, ingestion of natural vegetation that grows on the site, and feeding on soil invertebrates that live on the site. Exposure to groundwater, surface water, or subsurface soil was not expected for the following reasons:

- Groundwater does not discharge to the surface at the OWLF,
- Surface water does not persist long enough in the gulches to support aquatic or benthic communities nor provide a regular drinking water source for terrestrial animals and,
- Although infiltration to subsurface soil is possible, exposure to terrestrial animals (e.g., birds and mammals) is not expected to be significant.

As a result, the low no-effect HQs indicated that surface soil at the OWLF did not present an unacceptable risk of adverse effects to bird or mammal populations and need not be considered further for ecological risk.

2.8 Response Action Objectives

Based on the results of the risk evaluations summarized in Section 2.7, a response action is required at the OWLF. The response action objectives for the OWLF are:

- Control site access
- Maintain the viability of the existing landfill cover
- Prevent the disturbance of the surface and subsurface soil
- Reduce the potential risk of exposure by humans to COPCs in surface and subsurface soils

Site risks will be mitigated by instituting site controls that limit or eliminate potential routes of exposure to the COPCs in the surface and subsurface.

2.9 Description of Alternatives

To meet requirements of the NCP for remedial actions, the Final FS conducted for the OWLF preliminarily evaluated a range of response action alternatives based on effectiveness, implementability, and cost (Earth Tech 2007b, DON 2006a). The following alternatives were considered during the initial screening:

- No Action (as a baseline for comparison)
- LTMM and LUCs
- Cover Reinforcement, LTMM and LUCs
- Phytoremediation
- Electrokinetic Separation
- Solidification/Stabilization, In Situ and Ex Situ
- Soil Washing
- Excavation (all contaminated surface soil) and Disposal

With the exception of the “No Action” alternative, alternatives receiving a “poor” ranking during the initial screening either in effectiveness or implementability were not considered for further evaluation. The three alternatives that were retained for further evaluation included the following:

Alternative No. 1 No Action (as a baseline for comparison)

Alternative No. 2 LTMM and LUCs

Alternative No. 3 Cover Reinforcement, LTMM, and LUCs

2.9.1 Description of Alternative Components

The major components and expected outcomes of each alternative are summarized below:

No Action. The “No Action” alternative is not expected to be protective of human health or the environment. Neither human receptors nor ecological receptors are protected from potential exposure to COPCs in site soils. Neither short-term nor long-term site risks are addressed by the baseline alternative.

LTMM and LUCs. LTMM of the existing landfill cover would reduce the likelihood of exposure to surface soils, subsurface soils, and landfill waste by providing early detection of erosion or slope displacement. Instituting site access control and land use restrictions at the OWLF is expected to reduce long-term site risks by limiting the potential of exposure to COPCs in the site soils. Human and ecological receptors would be protected from direct contact with contaminants in surface and subsurface soil by the existing soil cover.

LTMM, LUCs, and Cover Reinforcement. LTMM would reduce the likelihood of exposure to surface soils, subsurface soils, and landfill waste by providing early detection of erosion or slope displacement of the reinforced landfill soil cover. Instituting site access control and land use restrictions at the OWLF is expected to reduce long-term site risks by limiting the potential of exposure to COPCs in the site soils. Human and ecological receptors would be protected from direct contact with contaminants in surface and subsurface soil by the reinforced soil cover. The existing landfill cover was installed in 1978. Reinforcement of the existing landfill cover would add an additional barrier to exposure to subsurface soils and landfill wastes.

2.10 COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP (40 CFR Part 300) requires evaluation of response action alternatives by nine criteria of effectiveness, implementability, and cost. The criteria are summarized in Table 7.

Table 7: Criteria for Detailed Evaluation of the Response Action Alternatives

Criterion	How the Criterion is Applied
Effectiveness	
Overall protection of human health and the environment	Assesses the ability of an alternative to eliminate, reduce, or control the risks associated with exposure pathways including direct contact, potential migration, and risks to ecosystems.
Short-term effectiveness	Assesses the capability of an alternative to protect human health and the environment during implementation of the alternative (the construction, removal, and disposal).
Long-term effectiveness and permanence	Measures the ability of an alternative to permanently protect human health and the environment.
Reduction in toxicity, mobility, or volume of contaminants through treatment	Evaluates the ability of an alternative to permanently or significantly reduce the toxicity, mobility, or volume of the chemicals particularly through treatment.
Compliance with ARARs	Evaluates the potential of an alternative to achieve chemical-, location-, and action-specific ARARs.
Implementability	
Implementability	Evaluates the technical feasibility or difficulty of applying the alternative at the site, the reliability of the technology, the unknowns associated with the alternative, and the need for treatability studies. Assesses regulatory agency concurrence and the need for permits and waivers. Assesses mobilization needs, the accessibility of equipment, and number of trained personnel required to complete the alternative.
State acceptance	Evaluates the likelihood of approval by the State.
Community acceptance	Assesses the anticipated level of acceptance by the community.
Cost	
Capital, O&M, and NPV cost	Assesses the capital, operation, and maintenance costs of each alternative.

NPV net present value
O&M operations and maintenance

Table 8 presents a summary of the comparative analysis of the three remedial action alternatives presented in the FS (Earth Tech 2007b). Each alternative is evaluated against the nine NCP criteria and rated according to the ability of the alternative to achieve response action objectives.

Based on the marginal risks present at the OWLF, the recommended alternative is Alternative 2: implementation of LTMM and LUCs to prevent exposure to contaminated soil.

2.11 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that treatment will be used to address the principal threats (i.e., source material that is highly toxic and/or highly mobile) posed by a site wherever practicable. No highly toxic or highly mobile source material was identified at the OWLF. Therefore, no principal threat wastes exist at the OWLF.

2.12 SELECTED FINAL REMEDY

2.12.1 Summary of the Rationale for the Selected Final Remedy

The primary objective of the final remedy at the OWLF is to prevent exposure to COPCs (elevated levels of metals and PAHs) present in the buried landfill wastes, surface soils, and subsurface soils, thereby minimizing potential risks to human health and the environment. Based on the evaluation of alternatives conducted in the FS and presented in Table 8, LTMM and LUCs were identified to be effective in meeting the goals of the remedy and, therefore, selected as the best alternative. LUCs will include warning signage for effective access restriction, deed restrictions to prohibit any future development in the event the site is transferred to a non-federal entity, and annual inspections to identify any signs of erosion including exposure of subsurface soil and evidence of unauthorized or inappropriate land use. Five-year reviews will be performed to ensure that LUCs remain effective. Cover maintenance and LUCs at the OWLF will be conducted to verify that the site is maintained and the cover remains intact. Additional source removal and landfill capping will not be required at the OWLF because dense vegetation has established itself since the closure of landfill. Current site conditions, specifically the heavy vegetative cover, have been in place for 40 years with no known erosion problems. In addition, this dense vegetation has created a competent surface that provides protection against soil erosion and an additional barrier to deter contact with subsurface soil for both human and ecological receptors. Additional source removal and landfill capping would eliminate the protective stabilization of the vegetative cover and established root system, exposing the soils to potentially heavy flood events. In addition, LTMM and LUCs provide adequate control of COPCs and effectively control site risk, representing the best balance of the various decision criteria.

Table 8: Comparative Analysis of Response Action Alternatives – OWLF

Alternative	No. 1 No Action		No. 2 LTMM and LUCs		No. 3 Cover Reinforcement, LTMM, and LUCs	
Description	No action will be taken to reduce the toxicity, mobility, or volume of contamination. No action will be taken to minimize potential threats that may result from waste exposures in the future.	Score[a]	The existing soil cover that was placed over the landfill in 1978 is anchored by heavy vegetation. LTMM will be performed annually to verify landfill slope stability and to ensure that the landfill is not subjected to erosional effects due to wind, water, or slope destabilization. Visual observations will be made to identify areas of exposed waste, if any, that may result from slope displacement or from wind or water erosion. This alternative will be re-evaluated should LTMM results indicate potential concern for waste exposure or slope instability. Erosional effects identified in the annual inspections will need to be addressed, though no costs were budgeted for estimation purposes. Warning signage will be erected for effective access restriction. Administrative restrictions will prohibit any future development of the site to ensure that contaminated soil is not disturbed. Five-year reviews will be performed to ensure that LUCs remain effective. Groundwater monitoring is not warranted as part of LTMM because the depth to the aquifer (regional water supply) is approximately 900 feet bgs, the low levels and nature of contaminants in the intermittent, shallow, and spatially isolated groundwater, the lithology of low permeability soil and a lower permeability clay layer at 125 to 129 feet bgs, and that no contamination has been detected in previous groundwater data.	Score[a]	This alternative includes reinforcement of the existing cover. The southwestern edge of the landfill is steep and is drained by an intermittent stream that could potentially result in erosion and possible slope instability. To prevent waste exposure either due to erosion or slope displacement, a rip-rap cover or geosynthetic erosion control material will be placed over the steep portion of landfill. Rip-rap or geosynthetic material is typically used to stabilize cover system on steep slopes. The area will be cleared of vegetation prior to placement of rip-rap or geosynthetic material. LTMM will be performed annually to verify landfill slope stability and to ensure that the landfill is not subjected to erosional effects due to wind, water, or slope destabilization. Visual observations will be made to identify areas of exposed waste, if any, that may result from slope displacement or from wind or water erosion. This alternative will be re-evaluated should LTMM results indicate potential concern for waste exposure or slope instability. Erosional effects identified in the annual inspections will need to be addressed, though no costs were budgeted for estimation purposes. Warning signage will be erected for effective access restriction. Administrative restrictions will prohibit any future development of the site to ensure that contaminated soil is not disturbed. Five-year reviews will be performed to ensure that LUCs remain effective. Groundwater monitoring is not warranted as part of LTMM because the depth to the aquifer (regional water supply) is approximately 900 feet bgs, the low levels and nature of contaminants in the intermittent, shallow, and spatially isolated groundwater, the lithology of low permeability soil and a lower permeability clay layer at 125 to 129 feet bgs and no contamination has been detected in previous groundwater data. However, this alternative will be supplemented by review of groundwater data from the regional water supply wells located at NCTAMS PAC to confirm that the aquifer has not been impacted by migration of contaminants from the OWLF.	Score[a]

Alternative	No. 1 No Action		No. 2 LTMM and LUCs		No. 3 Cover Reinforcement, LTMM, and LUCs	
Overall Protection of Human Health and Environment	Exposure of human receptors to landfill wastes may occur and may remain undetected without any monitoring or visual inspection.	Poor (1)	Potential exposure of human receptors to landfill wastes is minimized by LTMM of the existing soil cover providing early detection of erosional effects, if any, and taking actions, as necessary. LUCs prevent future construction activities or development of the site.	Very Good (4)	Added benefit over Alternative 2 is limited. Potential exposure of human receptors to landfill wastes is enhanced by cover reinforcement on steep slope. Potential exposure of human receptors to landfill wastes is minimized by LTMM providing early detection of erosional effects, if any, and taking actions, as necessary. LUCs prevent future construction activities or development of the site.	Very Good (4)
Compliance with ARARs and TBC Requirements	Will not comply with all ARARs.	Poor (1)	Complies with ARARs and TBCs.	Excellent (5)	Complies with ARARs and TBCs.	Excellent (5)
Long-term Effectiveness and Permanence	Inadequate to protect human health and the environment. This alternative does not satisfy the NCP preference for treatment.	Poor (1)	LTMM on an annual basis, over 30-year period would ensure long-term effectiveness of this alternative. If necessary, corrective action will be taken to ensure that the exposure risk is manageable. Adequacy and reliability of controls are good. This alternative does not satisfy the NCP preference for treatment.	Good (3)	Added benefit over Alternative 2 is limited. Cover reinforcement would restrict exposure over the long-term, reducing human health risks. Inspection and maintenance program would ensure reliability of cover reinforcement. With the slope stabilized, the exposure risk is significantly reduced. Adequacy and reliability of controls are very good. LTMM on an annual basis, over a 30-year period would ensure long-term effectiveness of this alternative. If necessary, corrective action will be taken to ensure that the exposure risk is manageable. Adequacy and reliability of controls are good. This alternative does not satisfy the NCP preference for treatment.	Very Good (4)
Reduction in Toxicity, Mobility, and Volume Through Treatment	No reduction in toxicity, mobility, or volume.	Poor (1)	No reduction in toxicity, mobility, or volume.	Poor (1)	No reduction in toxicity, mobility, or volume.	Poor (1)
Short-term Effectiveness	Not effective in reducing risk to workers, community, or the environment.	Poor (1)	Effective in reducing risk to workers, community, and the environment.	Very Good (4)	Established vegetation anchors existing soil cover. Removal of established vegetation results in an increased short term risk of exposure to workers, community and environment.	Very Good (4)
Implementability	No technical and/or administrative feasibility issues with implementation of this alternative.	Excellent (5)	No technical feasibility issues associated with implementation. Material and equipment for alternative are readily located on-island. No administrative issues associated with implementation.	Excellent (5)	No technical feasibility issues associated with implementation. Material and equipment for alternative are readily located on-island. No administrative issues are associated with implementation.	Excellent (5)
Cost	NPV = $0	Excellent (5)	NPV = $234,371	Very Good (4)	NPV = $680,792[b]	Fair (2)

Alternative	No. 1 No Action		No. 2 LTMM and LUCs		No. 3 Cover Reinforcement, LTMM, and LUCs	
Projected Regulator Acceptance	Alternative would not likely be accepted since implementation does not result in risk management or risk reduction.	Poor (1)	Regulator approval is achievable since the alternative is protective of human health by eliminating potential exposure pathway (risk reduction).	Very Good (4)	Regulator approval is achievable since the alternative is protective of human health by eliminating potential exposure pathway (risk reduction).	Very Good (4)
Projected Community Acceptance	Alternative would not likely be accepted since implementation does not result in risk management or risk reduction.	Poor (1)	Community acceptance is achievable since the alternative is protective of human health by eliminating potential exposure pathway (risk reduction).	Very Good (4)	Community acceptance is achievable since the alternative is protective of human health by eliminating potential exposure pathway (risk reduction).	Very Good (4)
TOTAL SCORE		**Fair 17**		**Very Good 34**		**Very Good 33**

ARARs applicable or relevant and appropriate requirements
NPV net present value
TBCs to be considered
[a] Scores based on scale of excellent = 5, very good = 4, good = 3, fair = 2, and poor = 1.
[b] The RACER estimate prepared for Alternative 3 during the FS assumes minor stabilization of a standard landfill soil cover, which implies a gently sloping, grass-covered surface at or above the elevation of the surrounding grade. The OWLF is a canyon fill that was leveled and covered with a 3-foot-deep soil layer to meet the 1978 closure requirements. The canyon is heavily vegetated with mature trees and thick undergrowth. Standard entry and egress of construction equipment into the canyon is not possible. Stabilization of the OWLF soil cover would require that (1) a crane be used to lower earth-moving equipment into the gulch from the canyon rim; (2) established vegetation be cleared to allow access and cover repair; (3) the containerized cover fill be introduced into the gulch using the crane; (4) the cover be stabilized; (5) the earth-moving equipment be extracted using the crane; and (6) the stabilized area be revegetated. During this process, the equipment in the gulch and the solid waste fill are subject to damage and erosion by flash-flood events. All of these problems were encountered downstream of the OWLF during the soil removal action at the Building 6 Disposal Area (AEIR 2009). Based on the lessons learned at the Building 6 Disposal Area, stabilization of the OWLF soil cover is estimated to cost approximately 2x the RACER-estimated cost of $340,396, or $680,792.

2.12.2 Description of Selected Final Remedy Components

The Navy and EPA Region 9, in coordination with EPA Headquarters and with the concurrence of the DOH, have selected LTMM and LUCs as the final remedy for the OWLF. The elements of the selected final remedy include the following:

- LUCs
- Annual monitoring and maintenance (as required)
- Five-year reviews

These components are described below:

Land-Use Controls. LUCs will be used to control access to and restrict use of the site to ensure that the impacted soils are not disturbed. LUCs will also ensure potential routes for exposure are not created due to land use changes. LUCs for this site will apply to the land within the site boundaries as shown in Figure 7.

Site access restrictions will prevent unauthorized entry. LUCs will be instituted to prohibit any land modification that disturbs the existing cover and potentially expose landfill wastes at the OWLF (e.g., vegetation clearing, excavation, and construction of structures).

The Navy is responsible for implementing, maintaining, reporting on, and enforcing the LUCs. This may be modified to include another party should the site-specific circumstances warrant it. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity. The Navy shall implement internal procedures for upholding LUCs by maintaining a database of the LUCs (i.e., Naval Installation Restoration Information Solution).

LUCs will be maintained at the OWLF until the concentrations of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted land use and exposure. LUCs will then be terminated. A LUC WP has been prepared and submitted (Earth Tech 2008). The LUC WP will be finalized to contain implementation and maintenance actions, including periodic inspections and reporting requirements, notification requirements, specific responsibilities, and details on LUC enforcement. The LUC WP is the Remedial Action Work Plan for implementation of LUCs as the remedy for this site.

Monitoring and Maintenance. The annual physical site inspection, which will consist of a general site inspection and slope stability evaluation is described in Section 3.2.3 of the LUC WP (Earth Tech 2008) for the OWLF. If maintenance is required, the Navy shall take timely action to address the maintenance issues to minimize the chance of unauthorized access and disturbance of the OWLF cover, and potential exposure of trespassers to contaminated media.

Five-Year Reviews. Five-year reviews are required for all CERCLA response actions that leave contaminants in place at concentrations above levels that allow for unlimited land use and unrestricted exposure. Because chemicals, particularly chromium, remain in place at such concentrations, five-year reviews will be performed by the Navy to ensure that the final remedy remains effective to prevent exposure of contaminated soil.

2.12.3 Engineering and Land Use Control Performance Objectives

Performance objectives for the LUCs being implemented as an integral part of the final remedy for the OWLF are to restrict current and future land use to activities compatible with maintaining the existing landfill cover and to ensure long-term viability of the final remedy. Specific LUC performance objectives include the following:

- Protect human health and the environment.
- Maintain the viability of the landfill cover.
- Protect groundwater quality.
- Prohibit unauthorized access to the OWLF site.
- Ensure that warning signs remain visible and legible and are maintained in good condition.
- Ensure no unauthorized excavation, uncontrolled soil removal, or construction occurs at the OWLF.
- Provide adequate notice of the contaminated media in the OWLF to site users, workers, and any potential landowners.
- Protect worker safety by ensuring that any authorized entry (i.e., LTMM) is performed by personnel that are properly trained for hazardous material operations.
- Ensure that the OWLF site is not used for any purpose that violates the objectives of the LUCs by prohibiting the development and use of this area for residential housing, schools, child care centers, playgrounds, retail, commercial, or industrial facilities.

2.12.4 Summary of the Estimated Final Remedy Costs

The engineering cost estimate for the selected final remedy is $264,371 as provided in Table 9 (Earth Tech 2007b).

2.12.5 Expected Outcomes of the Selected Final Remedy

The selected final remedy will reduce potential future human health risks by containment of landfill wastes/contaminated soil and restricting access and activities at the OWLF. This will be achieved by maintaining both the condition of the existing landfill cover and the cover vegetation at the OWLF to eliminate direct contact with surface soil and buried landfill waste. This final remedy does not change the current or planned future land use or reduce the toxicity or volume of landfill waste or contaminants. The selected final remedy will require that restrictive LUCs be implemented.

2.12.6 Selected Final Remedy Ongoing Activities

Several elements of the selected final remedy for the OWLF will require ongoing maintenance to remain protective of human health and the environment. The landfill cover will require regular inspections and occasional maintenance to remain effective. The warning signage at the OWLF will require regular inspections to ensure visibility and legibility and occasional maintenance to remain effective. In addition to these maintenance items, annual inspections and reports are required to certify compliance with the LUCs, and five-year reviews are required to evaluate the effectiveness of the final remedy.

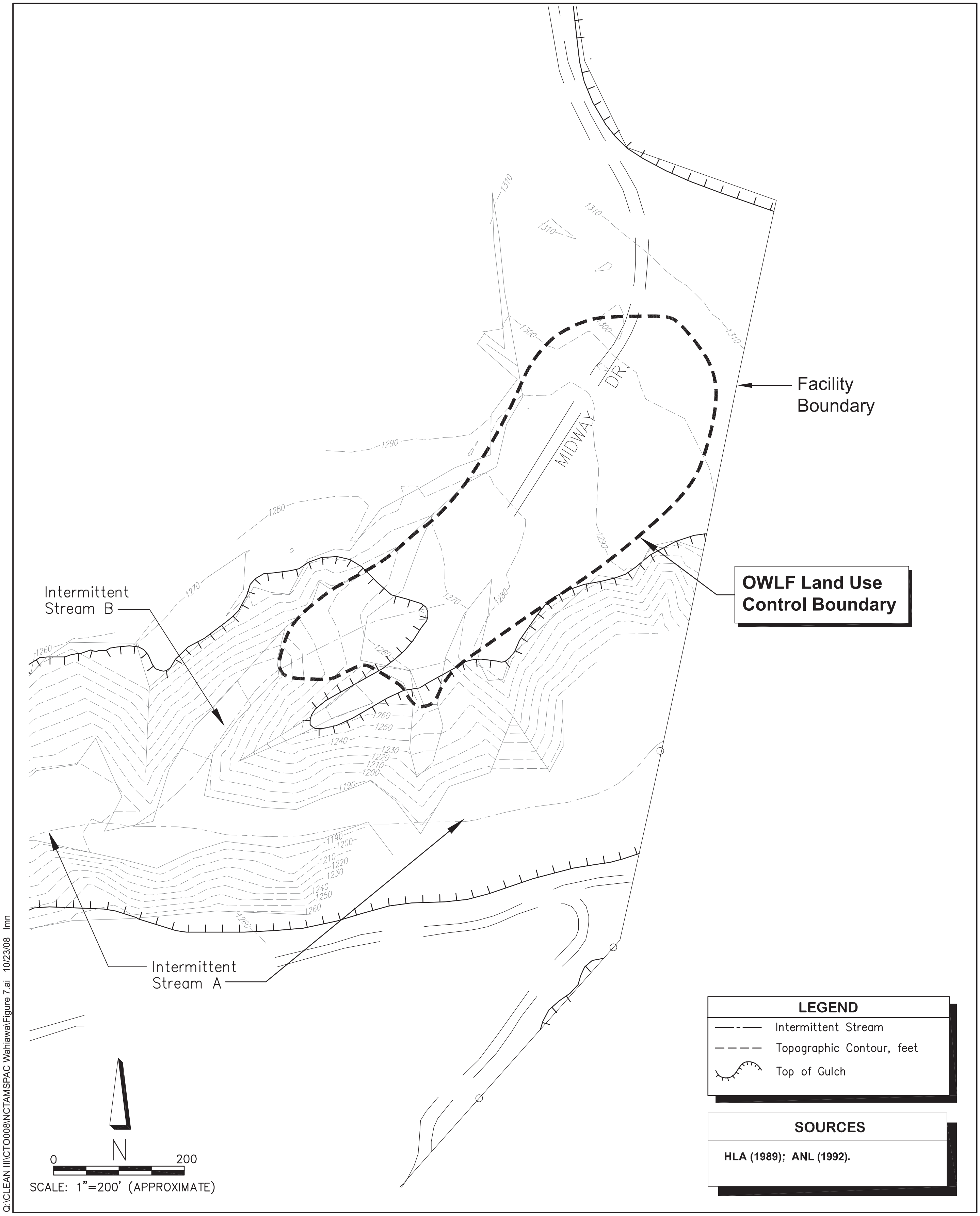

Figure 7
Land Use Control Boundary
Old Wahiawa Landfill
NCTAMS PAC Wahiawa, Oahu, Hawaii

Table 9: Cost-Effectiveness Summary and Selection of Recommended Alternatives – OWLF

Preliminary Alternatives	Retained Alternatives	NPV	Overall Score	Recommended Alternative
• No Action • LTMM and LUCs • Cover Reinforcement, LTMM, and LUCs • Phytoremediation • Electrokinetic Separation • In-situ Solidification/ Stabilization • Soil Washing • Excavation and Disposal at a CERCLA Facility	1. No Action	$0	Fair	2. LTMM and LUCs: Cost effective and offers long-term permanence through risk management.
	2. LTMM and LUCs	$264,371	Very good	
	3. Cover Reinforcement, LTMM, and LUCs	$340,396	Very good	

Scores based on scale of excellent, very good, good, fair, and poor.
NPV net present value

2.13 CONTRIBUTION TO RESPONSE PERFORMANCE

The selected action will provide administrative control that prevents exposure to the contaminated soil and landfill wastes, thereby reducing the threats to human health and the environment.

2.14 STATUTORY DETERMINATIONS

2.14.1 Protection of Human Health and the Environment

The selected final remedy will be protective of human health and the environment by maintaining the integrity of the cover, restricting access to the site, and controlling land use. This will ensure that the impacted soils are not disturbed. Potential risks posed by the site are reduced when new routes for exposure to the COPCs are not created. Short-term exposure risks are avoided by leaving the buried landfill wastes and impacted soils in place.

2.14.2 Compliance with Applicable or Relevant and Appropriate Requirements

CERCLA Section 21(d), 42 U.S.C. Section 9621(d), requires that response actions comply with the ARARs of federal laws or more stringent, promulgated state laws. "Applicable Requirements" are cleanup standards, control standards, and other substantive requirements promulgated under federal environmental laws, state environmental laws, or facility siting laws that specifically address a hazardous substance, remedial action, or other circumstance found at a CERCLA site. "Relevant and Appropriate Requirements" are cleanup standards, control standards, and other substantive requirements promulgated under federal environmental laws, state environmental laws, or facility citing laws that, while not directly applicable to a hazardous substance, remedial action, or other circumstance found at a CERCLA site, address problems or situations sufficiently similar to those encountered that their use is well suited to the site.

Because ARARs do not exist for every chemical or circumstance, non-promulgated federal or state advisories, criteria, or guidance materials (i.e., to be considered [TBC] criteria) may help to determine the contaminant clean-up levels or goals that are protective of human health and the environment and the necessary approach to carry out certain actions or requirements. The NCP does not require agencies to follow TBCs; however, it does suggest that TBC criteria be used when ARARs do not exist and when ARARs alone would not adequately protect human health and the environment.

2.14.3 Identification of ARARs

ARARs and TBC requirements fall into the following three broad categories:

- Chemical-specific, which establishes numerical standards limiting the concentration of substances in the medium of concern or medium affected by the clean-up action.
- Location-specific, which restricts the concentrations of substances or the conduct of the clean-up action on the basis of site location.
- Action-specific, which controls the performance and design standards of a particular clean-up action through technology- or activity-based restrictions.

These three categories are further described in the following sections.

2.14.4 Chemical-Specific ARARs/TBCs

The EPA and DOH have published health-based limits for contaminants such as PAHs, PCBs, and metals in soil that have been determined to be TBC requirements. These chemical-specific TBC requirements are presented in Table 10.

Table 10: Chemical-Specific Applicable or Relevant and Appropriate Requirements and To-Be-Considered Guidance

Source or Authority	Requirement, Standard, or Criterion	Type	Description	Remarks
Federal				
EPA Region 9	Soil Regional Screening Levels	TBC	Provides threshold limits for chemicals present in soils that are protective of human health for residential and industrial land use.	Considered in developing soil clean-up criteria.
40 CFR Part 141	MCLs	Applicable	Provides the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs[a] as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards (40 CFR 141).	Applicable in developing drinking water criteria.
Hawaii				
DOH	Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater (DOH 2005)	TBC	Provides recommended threshold limits for chemicals present in soils that are protective of human health and the environment for unrestricted land use. Provides separate criteria for sites located above potential potable groundwater and non-potable groundwater.	Considered in developing soil clean-up criteria.

MCLG Maximum Contaminant Level Goal
TBC to be considered
[a] MCLGs are the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals (40 CFR 141).

2.14.5 Location-Specific ARARs/TBCs

Typical location-specific ARARs are federal and state statutes and regulations that protect cultural and ecological resources. These ARARs are presented in Table 11.

Table 11: Location-Specific Applicable or Relevant and Appropriate Requirements and To-Be-Considered Guidance

Source or Authority	Requirement, Standard, or Criterion	Type	Description	Remarks
Federal				
National Historic Preservation Act (16 U.S.C. §§ 470, et seq.)	36 CFR Part 800	Applicable	Requires consultation that may require surveys of the site before digging can occur to make sure the cultural resources are not unintentionally dug up and destroyed.	No known eligible resources are within the subject area. Applicable if eligible resources identified during site clearance.
Hawaii				
N/A				

N/A not applicable

2.14.6 Action-Specific ARARs/TBC Requirements

Action-specific ARARs and TBC requirements control the performance and design standards of a specific clean-up action. Table 12 lists potential action-specific ARARs.

Table 12: Action-Specific Relevant and Appropriate Requirements and To-Be-Considered Guidance

Source or Authority	Requirement, Standard or Criterion	Type	Description	Remarks
Federal				
Resource Conservation and Recovery Act (RCRA)	40 CFR 264.310 Hazardous Waste Landfill Requirements	Relevant and Appropriate	Establishes closure and post-closure requirements for landfills known to have received hazardous wastes.	Monitoring and maintenance of a groundwater monitoring system would be relevant and appropriate should future data reveal groundwater contamination from OWLF operations.
Hawaii				
Hawaii Uniform Environmental Covenants Act	Hawaii Revised Statutes § 508C-1 *et seq.*; Division 3, Title 28, Chapter 508C	Relevant and Appropriate	Ensure that controls on contaminated property will be properly identified on legal title and remain enforceable for as long as they are necessary.	Applicable if the site is ever transferred to a non-federal entity.

[a] Because the site has not been transferred, the Hawaii Uniform Environmental Covenants Act does not apply. However, some aspects of this law may be incorporated as part of the LUC alternatives.

2.14.7 RCRA Landfill Applicability

The OWLF is not subject to RCRA closure requirements because placement of wastes occurred prior to the effective date of RCRA, which is November 1980. Therefore, the OWLF is not subject to RCRA post-closure requirements (as specified under 40 CFR Section 264.310) to maintain and monitor a groundwater monitoring system to comply with the applicable part of the regulations. It should be noted that contaminant migration to groundwater is concluded to unlikely be a concern because the depth of the aquifer underlying OWLF is approximately 900 feet bgs, the low concentrations and nature of contaminants in the intermittent, shallow, and spatially isolated groundwater, the lithology of low permeability soil and a lower permeability clay layer at 125 to 129 feet bgs, and that no contamination has been detected in previous groundwater data. The Navy has reviewed groundwater data from the regional water supply wells located at NCTAMS PAC to confirm that the water supplying aquifer has not been impacted by the OWLF operations (Earth Tech 2007b). Although the RCRA post-closure requirement to maintain and monitor a groundwater monitoring system is not applicable, it is relevant and appropriate if future groundwater data reveals that the aquifer has been impacted by OWLF operations.

2.14.8 Cost-Effectiveness of Final Remedy

The selected final remedy is cost-effective and represents a reasonable value for the expended funding. Each response alternative was evaluated to determine whether the overall effectiveness satisfied the threshold criteria. The relationship of the overall effectiveness of the selected alternative was determined to be proportional to its costs. The selected final remedy is effective in meeting response action objectives and protecting human health and the environment, is implementable, and is cost-effective. Table 9 summarizes the cost-effectiveness of the three response action alternatives.

2.14.9 Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected alternative represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner. Specifically, this alternative provides the best short- and long-term effectiveness, is protective of human health and the environment, complies with ARARs, achieves response action objectives, and is feasible.

2.14.10 Preference for Treatment as a Principal Element

The NCP, 40 CFR Section 300.430(a)(1)(iii)(A), establishes the expectation that treatment will be used to address the principal threats at a site where practicable. This final remedy does not satisfy the statutory preference for treatment as a principal element of the final remedy. The source material to be left in place at the OWLF does not constitute a principal threat waste as defined by the EPA.

2.14.11 Five-Year Review Requirement

Because the selected alternative results in contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, five-year reviews are required after the initiation of the final remedy to ensure that the final remedy is protective of human health and the environment.

2.15 DOCUMENTATION OF SIGNIFICANT CHANGES

The PP identified LTMM and LUCs as the Navy's recommended alternative (DON 2007). On 7 June 2007, the PP was released for public comment and a public meeting to present and discuss the PP was held.

The Navy has reviewed all comments received during the 7 June 2007 public meeting. No written comments were received during the public comment period. Based on all site information and risk evaluations completed to date, the Navy, EPA Region 9, and DOH confirmed that the selected final remedy is protective of human health and the environment. None of the comments affect the preference for the selected final remedy. Therefore, no significant changes in the final remedy, as it was originally identified in the PP (DON 2007), were necessary as a result of public comment.

3. Responsiveness Summary

The public comment period for the PP was held between 8 June 2007 and 7 July 2007. The public meeting for the PP was held on 7 June 2007 at the Wahiawa District Park. Responses to the verbal comments received during the public meeting are presented as a Responsiveness Summary in Attachment A within this ROD. The complete transcript of the public meeting is available in the Administrative Record file.

3.1 STAKEHOLDER ISSUES AND LEAD AGENCY RESPONSES

A written transcript of the public meeting conducted on 7 June 2007 was thoroughly reviewed by the Navy to prepare the Responsiveness Summary. The comments and questions from the public have been condensed to provide a better understanding of each specific issue. The Navy, in coordination with the EPA, and with concurrence of the DOH, has selected the final remedy for the OWLF only after careful consideration of the public's comments on the PP.

3.2 TECHNICAL AND LEGAL ISSUES

The key technical issue for the selected final remedy is the continued long-term care of the landfill cover to be protective of human health and the environment. The LUCs will be maintained until the concentrations of hazardous substances in the soil are reduced to levels allowing for unrestricted use and exposure. The Navy is responsible for the long-term care of the OWLF and is committed to conducting inspections and maintenance of the landfill cover.

Potential legal issues for the selected final remedy consist of implementation of the necessary LUCs that include restricting future land use of the former OWLF in accordance with the LUC WP (Earth Tech 2008). The Navy will retain ownership of the landfill site for the foreseeable future and has no plans to transfer the property, or to use the site other than as open space. As a result, the Hawaii Uniform Environmental Covenants Act is not applicable unless the property is transferred (DOH 2007). Any future land owner will be responsible for implementing and maintaining the LUCs, and any activities conducted at the OWLF site that might have impact on the integrity of the landfill cover system will need approval from the Navy and EPA and concurrence of the DOH.

4. References

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40 Code of Federal Regulations (CFR) Part 300. *National Oil and Hazardous Substances Pollution Contingency Plan.* Available: http://ecfr.gpoaccess.gov.

40 Code of Federal Regulations (CFR) Part 141. *National Primary Drinking Water Regulations*. Available: http://ecfr.gpoaccess.gov.

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Attachment A
Responsiveness Summary

<table>
<tr><th>Comment No.</th><th>Question/Comment</th></tr>
<tr><td colspan="2">Questions and Comments Received During the Proposed Plan Meeting (7 June 2007)</td></tr>
<tr><td>1</td><td>Steve Mow, a representative from the Hawaii Department of Health (DOH) asked the following question: Were site-specific RACGs (remedial action cleanup goals) calculated for the contaminants of potential concern (COPCs)? Or were preliminary remediation goals (PRGs) used? For surface soil, subsurface soil, or both?</td></tr>
<tr><td colspan="2">The Navy indicated that risk-based cleanup goals were compared to site analytical results. The analytical results for both the surface and subsurface soil were compared to the Region 9 residential and industrial PRGs. The COPCs that are bulleted on the slide were contaminants found in either or both of the surface and subsurface soil.
The Navy indicated that the United States Environmental Protection Agency (EPA) has a cancer target range of 10^{-4} to 10^{-6}. All cancer risks for surface and subsurface soil for all receptors modeled are within or below this range. Risk assessment results for non-cancer affects found that both the surface and subsurface soil show a potential risk for residents and construction workers. However, when background metals are excluded from the subsurface soil equation, the potential non-cancer risk is below the EPA target goal of 1.</td></tr>
<tr><td>2</td><td>Was there a problem with the results? Are we certain of the data quality?</td></tr>
<tr><td colspan="2">There are no quality issues with the analytical or risk assessment data.</td></tr>
<tr><td>3</td><td>The DOH representative asked: Do you believe that the contaminants in the landfill are going to leach into the groundwater? Was any leaching modeling done in the remedial investigation (RI)? Was any modeling of the contaminants from the landfill to the regional groundwater conducted to show the likelihood is very, very low if not non-existent? Otherwise, how can you say contaminants will not reach the regional groundwater?</td></tr>
<tr><td colspan="2">The Navy indicated that no modeling was performed for groundwater at this site. Trichloroethene (TCE) and bis(2-ethylhexyl)phthalate (BEHP) were detected in two monitoring wells at very low levels (TCE ranging from 2-3 micrograms per liter [µg/L] and BEHP at 16 µg/L). The chemicals were encountered at 40 feet below ground surface (bgs) in two out of three monitoring wells. The regional groundwater aquifer occurs at a depth of 800 to 900 feet bgs at the Old Wahiawa Landfill (OWLF). These wells were completed in localized water bearing zones found at variable depth horizons that yield water intermittently under conditions of heavy precipitation. Groundwater was not encountered in the third monitoring well. The monitoring wells installed in the intermittent water bearing zone were dry upon the subsequent attempt to sample the groundwater; therefore, the analytical results were not repeatable. Additionally, contaminants in downward-percolating groundwater would likely be adsorbed onto the soil and rock before they reach the regional water supply aquifer, particularly in the clay-rich soil at the site. The well log from the base water supply well also indicates the presence of a low permeability layer of clay located at 125 to 129 feet bgs. Metals encountered in the groundwater (aluminum, cobalt, copper, iron, and manganese) are components of rock and adsorb readily to mineral surfaces, and are not considered a threat to the underlying aquifer for the reasons stated above. Analytical data from a nearby production well shows no impact from contaminants found at the OWLF. The production well is installed in the deep drinking water aquifer. Because the production well shows that contaminants from OWLF have not migrated to the deep regional aquifer, and the lithology indicates a layer of low permeability at 125 to 129 feet bgs, it is most unlikely that the low concentration contaminants found in the soil would migrate to the groundwater. All of these factors indicate that a groundwater investigation specifically for the OWLF site is not warranted.</td></tr>
<tr><td>4</td><td>The DOH representative asked: So it's just we think it's not going to make it down? We have nothing to support that other than, we don't think it will? Is that the only thing?</td></tr>
<tr><td colspan="2">The Navy indicated that supporting data for not performing a regional aquifer investigation at the OWLF site is (1) the depth to groundwater at 800 to 900 feet; (2) the low levels of contaminants (TCE ranging from 2-3 µg/L and BEHP at 16 µg/L) in the intermittent, shallow, and spatially isolated groundwater; (3) the lithology of low permeability soil and a lower permeability clay layer at 125 to 129 feet bgs; and (4) the nature of the contaminants (dissolved TCE, a volatile, and metals that readily adsorb to soil particles). All of these are reasons that the contaminants found in the soil and shallow groundwater are not a threat to the underlying regional aquifer.</td></tr>
<tr><td>5</td><td>The DOH representative asked: Do the land use controls prohibit well installation?</td></tr>
<tr><td colspan="2">The Navy indicated that land use controls will include language stating that water well installation is prohibited.</td></tr>
<tr><td>6</td><td>The DOH representative asked: Has the feasibility study been finalized?</td></tr>
<tr><td colspan="2">The Navy indicated that it was completed and submitted to the Navy in January 2007.</td></tr>
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<table>
<tr><th>Comment No.</th><th>Question/Comment</th></tr>
<tr><td>7</td><td>The DOH representative asked: Do you know the lithology all 800 feet down? Wouldn’t the lithology affect how the chemicals migrate through the ground?</td></tr>
<tr><td colspan="2">The Navy indicated that a boring log was obtained from the Navy’s Wahiawa water supply well. The lithology at the site would be expected to retard any downward migration of contaminants.</td></tr>
<tr><td>8</td><td>The DOH representative asked: The Waihakalau leaking underground storage tanks (USTs) (at another unrelated location) impacted groundwater quality at a depth of 700 feet. Couldn’t contamination at the OWLF site similarly impact deep groundwater? TCE is a dense non-aqueous phase liquid (DNAPL), right?</td></tr>
<tr><td colspan="2">The Navy indicated that the USTs leaked pure liquid petroleum products. There is no evidence of any quantity of discrete phase liquid TCE at the OWLF. The low concentrations observed in groundwater do not support the presence of a discrete phase TCE at OWLF.</td></tr>
<tr><td>9</td><td>The DOH representative asked: How will a regional groundwater investigation identify the source of groundwater contaminants?</td></tr>
<tr><td colspan="2">The Navy indicated that although the likelihood of the regional aquifer being impacted from soil and/or shallow groundwater contamination at OWLF is considered negligible for reasons stated above, the proposed regional groundwater study would identify potential groundwater quality impacts as well as the direction of groundwater flow. There is no evidence of groundwater quality impacts based on sampling results from the Wahiawa water supply well.</td></tr>
<tr><td>10</td><td>The DOH representative asked: What is the plan for the regional groundwater study?</td></tr>
<tr><td colspan="2">The Navy indicated that although impacts to the groundwater are unlikely, a regional groundwater investigation is planned to characterize the deep water quality at NCTAMS PAC Wahiawa. Although the OWLF will not be specifically targeted, the monitoring program will characterize water quality in the gulch area. A Work Plan is scheduled for 2008 and deep well drilling will start in 2009. Mr. Robert Kaito is the planned Remedial Project Manager for the Navy.</td></tr>
<tr><td>11</td><td>The DOH representative asked: How are you going to monitor the groundwater with just one well?</td></tr>
<tr><td colspan="2">The Navy indicated that the regional investigation will provide additional monitoring locations. Until wells for the regional investigation are installed, the Navy’s Wahiawa water supply well will be monitored.</td></tr>
<tr><td>12</td><td>The DOH representative asked: Soil contamination at OWLF is primarily polynuclear aromatic hydrocarbons (PAHs) and metals?</td></tr>
<tr><td colspan="2">The Navy indicated that PAHs and metals are the contaminants impacting the surface soil.</td></tr>
<tr><td>13</td><td>Leland Nakai, a representative from the Hawaii Department of Emergency Management (DEM) asked the following question: The perched groundwater contains a number of chemicals but you conclude they pose no threat to the underlying aquifer. Is that because you don’t expect the perched groundwater to make it down to the aquifer?</td></tr>
<tr><td colspan="2">The Navy indicated that TCE and BEHP were detected in two monitoring wells at very low levels (TCE ranging from 2-3 μg/L and BEHP at 16 μg/L). The chemicals were encountered at 40 feet bgs in two out of three monitoring wells. The regional groundwater aquifer occurs at a depth of 800 to 900 feet bgs at the OWLF. These wells were completed in localized water bearing zones found at variable depth horizons that yield water intermittently under conditions of heavy precipitation. Groundwater was not encountered in the third monitoring well. The monitoring wells installed in the intermittent water bearing zone were dry upon the subsequent attempt to sample the groundwater; therefore, the analytical results were not repeatable. Additionally, contaminants in downward-percolating groundwater would likely be adsorbed onto the soil and rock before they reach the regional water supply aquifer, particularly in the clay-rich soil at the site. The well log from the base water supply well also indicates the presence of a low permeability layer of clay located at 125 to 129 feet bgs. Metals encountered in the groundwater (aluminum, cobalt, copper, iron, and manganese) are components of rock and adsorb readily to mineral surfaces, and are not considered a threat to the underlying aquifer for the reasons stated above. Analytical data from a nearby production well shows no impact from contaminants found at the OWLF. The production well is installed in the deep drinking water aquifer. Because the production well shows that contaminants from OWLF have not migrated to the deep regional aquifer, and the lithology indicates a layer of low permeability at 125 to 129 feet bgs, it is most unlikely that the low concentration contaminants found in the soil would migrate to the groundwater. All of these factors indicate that a groundwater investigation specifically for the OWLF site is not warranted.</td></tr>
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<table>
<tr><th>Comment No.</th><th>Question/Comment</th></tr>
<tr><td>14</td><td>The DEM representative asked: The perched aquifer is stable; it’s not migrating then?</td></tr>
<tr><td colspan="2">The Navy indicated that the perched groundwater is intermittent, shallow, and spatially isolated. The first sampling event in the shallow wells followed heavy rain. Groundwater was not present during the second sampling attempt. The area where the water samples were collected is considered to be a localized water bearing zone found at variable depth horizons that yields water intermittently under conditions of heavy precipitation.</td></tr>
<tr><td>15</td><td>The DEM representative asked: A number of items in the surface water exceeded water quality standards, but you conclude that PAHs and metals in the surface soil are safe for people and wildlife. If chemicals exceed the water quality standards, how can you say that they’re safe for people and wildlife?</td></tr>
<tr><td colspan="2">The Navy indicated that a risk evaluation of the surface soils concluded that the non-cancer hazard estimates for the residential scenario at the OWLF site for exposure to contaminants in surface soil is above the target hazard index of 1; therefore, further action is required to address the human health risk/hazard associated with exposure to surface soil. A Feasibility Study for the site found that land use controls will address the health risk/hazard associated with the impacted surface soil.

No organic compounds were detected at concentrations exceeding drinking water criteria in the surface water samples. Four metals (aluminum, chromium, copper, and zinc) were detected at concentrations above acute or chronic Water Quality Standard (WQS) values. However, the risk assessment results indicate that surface water at the OWLF does not exceed target points of departure and therefore, does not present unacceptable risks to human health.

For ecological risk, surface soil at the OWLF does not present an unacceptable risk of adverse effects to bird or mammal populations due to the low no-effect hazard quotients and the removal of COPCs with regard to the comparison of background concentrations.</td></tr>
<tr><td>16</td><td>The DEM representative asked: And you think that that means drinking water standards?</td></tr>
<tr><td colspan="2">The Navy indicated that soil analytical results were compared to the residential preliminary remediation goals (PRGs), the industrial PRGs, and the estimated background upper bound. Surface water analytical results were compared to the WQSs and tap water PRGs.</td></tr>
<tr><td>17</td><td>The DEM representative asked: So you’re thinking that the heavy rainfall concentrated all those items and then when you tested [the monitoring well] that showed the exceedance?</td></tr>
<tr><td colspan="2">The Navy indicated that it appears that the heavy rainfall pooled in a localized area of lower permeability, which allowed groundwater samples to be collected from a shallower depth. The contaminant concentrations in this groundwater may have desorbed from the soil due to the heavy rainfall.</td></tr>
<tr><td>18</td><td>The DEM representative asked: But otherwise, those levels in just the surface soil are considered safe or at safe levels?</td></tr>
<tr><td colspan="2">The Navy indicated that the surface soil is safe when applying the restriction of land use controls.</td></tr>
<tr><td>19</td><td>The DEM representative asked: How many existing water supply wells are being monitored?</td></tr>
<tr><td colspan="2">The Navy indicated that one well, Navy’s Wahiawa well, is being monitored.</td></tr>
<tr><td>20</td><td>The DEM representative asked: Will that give you enough confidence to show that migration to the aquifer has not occurred, just monitoring one well?</td></tr>
<tr><td colspan="2">The Navy indicated since the migration of contaminants to the regional aquifer is negligible, the monitoring of the Navy’s Wahiawa well is sufficient.</td></tr>
<tr><td>21</td><td>The DEM representative asked: That is a municipal well [the one that’s being monitored]?</td></tr>
<tr><td colspan="2">The Navy indicated that it is owned and monitored by the Navy.</td></tr>
<tr><td>22</td><td>The DEM representative asked: That [municipal well] supplies drinking water to the area?</td></tr>
<tr><td colspan="2">The Navy indicated that the [municipal well] supplies drinking water to the area, along with the Army’s Schofield Wells.</td></tr>
</table>

Comment No.	Question/Comment
23	The DEM representative asked: That’s one well that’s being monitored. Typically, in other studies where there is a known plume that is migrating, you typically have a number of sampling draws to try to characterize and show the track of the movement of the plume, and that certainly will help to then institute remediation measures before that plume becomes a problem. So my only concern is that indeed you found some indication that contaminants are in subsurface water, although not currently in the drinking supply well as monitored. Again, without studies and modeling that show that indeed that's not going to happen, confidence levels are not that high.
The Navy indicated that no known groundwater plume is migrating from the OWLF site. No evidence of contamination has been observed in the regional aquifer. The 2007 Annual Water Quality Report of the NCTAMS PAC Water System shows no impact by the contaminants of concern to the Navy’s Wahiawa well. Monitoring of the regional aquifer by more that one well is not warranted at the time by the reasons stated in response No. 1. In the unlikely event that contaminants of concern were to impact the Wahiawa well from the nearby OWLF site, a groundwater investigation of the regional aquifer in that area would be performed.	

Attachment B
Federal Facility Land Use Control ROD Checklist

Region 9

FEDERAL FACILITY LAND USE CONTROL ROD CHECKLIST

(Navy/Army, DLA RODs, #s 1-9 below and RD/RAWP, #s 10-19 below /Air Force RODs, #s 1-19 below)

Cross-Checked Against Navy Record of Decision and Land Use Control Work Plan

No.	Checklist Item	Section Where Addressed
To Be Addressed in the Record of Decision		
1	Map/Figure showing boundaries of the land use controls	Figure 7
2	Document risk exposure assumptions and reasonably anticipated land uses, as well as any known prohibited uses which might not be obvious based on the reasonably anticipated land uses. (For example, where "unrestricted industrial" use is anticipated, list prohibited uses such as on-site company day-care centers, recreation areas, etc.)	Section 2.6; Figure 5 and Figure 6.
3	Describe the risks necessitating the LUCs.	Section 2.7
4	State the LUC performance objectives. We have had comments on these because several of the objectives have not been clear. The following are some examples of what we have been looking for: *(Select from the following or provide text from the DD)* 1. Prevent access or use of the groundwater until cleanup levels are met. 2. Maintain the integrity of any current or future remedial or monitoring system such as monitoring wells, impermeable reactive barriers. 3. Maintain the 12 inch vegetative soil layer to limit ecological contact. 4. Prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities and playgrounds.	Section 2.12.3
5	Generally describe the LUC (restriction), the logic for its selection, and any related deed restrictions/notifications.	Section 2.12.2
6	Duration language: *"Land Use Controls will be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure."*	Section 2.12.2
7	Include language that the Navy is responsible for implementing, maintaining, reporting on, and enforcing the land use controls. This may be modified to include another party should the site-specific circumstances warrant it.	Section 2.12.2
8	Where someone else will or the Navy plans that someone else will ultimately be implementing, maintaining, reporting on, and enforcing land use controls, the following language should be included: *"Although the Navy may later transfer [has transferred] these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for remedy integrity."*	Not Applicable for retained lands. Section 2.12.2

No.	Checklist Item	Section Where Addressed
9	Refer to the remedial design (RD) or remedial action work plan (RAWP) for the implementation actions. Because this is a new idea (i.e., including the LUC implementation actions in either or both of these two primary documents), to ensure that the requirement is clear and enforceable, we developed the following language where it makes sense: *"A LUC Remedial Design will be prepared as the land use component of the Remedial Design. Within 90 days of ROD signature, the Navy shall prepare and submit to EPA for review and approval a LUC remedial design that shall contain implementation and maintenance actions, including periodic inspections." Another option is to refer to the enforceable schedule in the IAG for the RD or RAWP."*	Section 2.12.2
To be Addressed in the Land Use Control Work Plan		
10	Commitment by military service to address any situation that may interfere with the effectiveness of LUC: *"Any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the ICs will be addressed by the Navy as soon as practicable, but in no case will the process be initiated later than 10 days after the Navy becomes aware of the breach."*	Section 2 – Land Use Control Performance Objectives
11	Commitment by military service to notify EPA of and address any situation that may interfere with the effectiveness of LUC: *"The Navy will notify EPA and DOH as soon a practicable but no longer than ten days after discovery of any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the ICs The Navy will notify EPA and DOH regarding how the Navy has addressed or will address the breach within 10 days of sending EPA and DOH notification of the breach."*	Section 3.2.7 – Notification of Action(s) that interfere with LUC Effectiveness
12	Notification to EPA and the state regarding land use changes: For a closing base: *"Prior to seeking approval from the EPA and DOH the recipient of the property must notify and obtain approval from the Navy of any proposals for a land use change at a site inconsistent with the use restrictions and assumptions described in this ROD Amendment."* For an active base: *"The Navy shall notify EPA and state 45 days in advance of any proposed land use changes that are inconsistent with land use control objectives or the selected remedy."*	Section 3.2.6 – Notice of Property Conveyance *Note: Only language "For an Active Base" was used.*
13	Notification regarding transfers and federal-to-federal transfers: *"The Navy will provide notice to EPA and DOH at least six (6) months prior to any transfer or sale of [OUs at issue] so that EPA and DOH can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective ICs. If it is not possible for the facility to notify EPA and DOH at least six months prior to any transfer or sale, then the facility will notify EPA and DOH as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to ICs. In addition to the land transfer notice and discussion provisions above, the Navy further agrees to provide EPA and DOH with similar notice, within the same time frames, as to federal-to-federal transfer of property. The Navy shall provide a copy of executed deed or transfer assembly to EPA and DOH."*	Section 3.2.6 – Notice of Property Conveyance
14	Concurrence language: *"The Navy shall not modify or terminate Land Use Controls, implementation actions, or modify land use without approval by EPA and DOH. The Navy shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs."*	Section 2 – Land Use Control Performance Objectives

No.	Checklist Item	Section Where Addressed
15	Monitoring and reporting language: *"Monitoring of the environmental use restrictions and controls will be conducted annually [or more or less frequently as may be determined to be necessary based upon site activities or conditions] by the Navy. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the USEPA and DOH. The annual monitoring reports will be used in preparation of the Five Year Review to evaluate the effectiveness of the remedy.* *The annual monitoring report, submitted to the regulatory agencies by the Navy, will evaluate the status of the ICs and how any IC deficiencies or inconsistent uses have been addressed. The annual evaluation will address whether the use restrictions and controls referenced above were communicated in the deed(s), whether the owners and state and local agencies were notified of the use restrictions and controls affecting the property, and whether use of the property has conformed with such restrictions and controls."*	Section 3.4.2 – Compliance Reporting
16	A comprehensive list of LUCs. If the description of the LUCs in #5 above is comprehensive, it could substitute for #16's listing of LUCs.	Section 1.3.3 – Final Remedy
17	For active facilities, a description of the internal procedures for implementing the LUCs (e.g., orders, instructions, Base Master Plan) and a commitment by the Navy to notify EPA and DOH in advance of any changes to the internal procedures that would affect the LUCs.	Section 1.3.3 – Final Remedy
Generally, #'s 18 and 19 apply at a BRAC installation, but they may have application elsewhere.		
18	Other property transfer language: a. "Deed Restrictions: Each transfer of fee title from the United States will include a CERCLA 120(h)(3) covenant which will have a description of the residual contamination on the property and the environmental use restrictions, expressly prohibiting activities inconsistent with the performance measure goals and objectives. The environmental restrictions are included in a section of the CERCLA 120(h)(3) covenant that the United States is required to include in the deed for any property that has had hazardous substances stored for one year or more, known to have been released or disposed of on the property. Each deed will also contain a reservation of access to the property for the Navy, USEPA, and DOH, and their respective officials, agents, employees, contractors, and subcontractors for purposes consistent with the Navy's Installation Restoration Program ("IRP") or the Federal Facility Agreement ("FFA"). The deed will contain appropriate provisions to ensure that the restrictions continue to run with the land and are enforceable by the Navy." b. "Lease Restrictions: During the time between the adoption of this ROD and deeding of the property, equivalent restrictions are being implemented by lease terms, which are no less restrictive than the use restrictions and controls described above, in this ROD. These lease terms shall remain in place until the property is transferred by deed, at which time they will be superceded by the institutional controls described in this ROD." c. "Notice: Concurrent with the transfer of fee title from the Navy to transferee, information regarding the environmental use restrictions and controls will be communicated in writing to the property owners and to appropriate state and local agencies to ensure such agencies can factor such conditions into their oversight and decision-making activities regarding the property."	N/A – this site is retained land.
19	Ensure that the document adequately describes pre-transfer LUCs, not just post-transfer LUCs.	N/A – this site is retained land.

Attachment C
Detailed Reference Table

Table C-1: Detailed Reference Table

Item	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
1	long-term monitoring and maintenance (LTMM) and land use controls (LUCs)	Section 1.4, page 1	Earth Tech, Inc. 2007b. Feasibility Study, Old Wahiawa Landfill. Naval Computer and Telecommunications Area Master Station, Pacific, Oahu, Hawaii. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. January. Section 5, page 5-1.
2	Revised Final LUC Work Plan	Section 1.4, page 2	Earth Tech, Inc. 2008. Final Land Use Control Work Plan, Old Wahiawa Landfill, Naval Computer and Telecommunications Area Master Station, Pacific, Oahu. Hawaii. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. January. Section 3, page 9.
3	Proposed Plan (PP)	Section 2.3, page 17	DON 2007. Proposed Plan, Old Wahiawa Landfill, Naval Computer and Telecommunications Area Master Station, Pacific, Oahu, Hawaii. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. June.
4	Federal Facilities Agreement	Section 2.4, page 18	Environmental Protection Agency Region 9, State of Hawaii, and United States Department of the Navy (EPA Region 9, State of Hawaii, and DON). 2009. Final Federal Facilities Agreement, NCTAMS PAC, Oahu, Hawaii. October. Section IV, page 7.
5	PRGs	Section 2.5.5.1, page 20	Environmental Protection Agency Region 9. 2004. Region 9 PRG Table. Available: http://www.epa.gov/region09/superfund/prg/files/04prgtable.pdf.
6	conceptual site model (CSM)	Section 2.5.6, page 24	Earth Tech, Inc. 2006b. *Remedial Investigation Report, Old Wahiawa Landfill, Building 6 Disposal Area, Old Incinerator Site, & Dump Site Near Building 293, NCTAMS PAC, Wahiawa, Oahu, Hawaii*. July. Appendix C, Figure C.1.4-1.
7	human health SRA	Section 2.7.1, page 26	Earth Tech, Inc. 2006b. *Remedial Investigation Report, Old Wahiawa Landfill, Building 6 Disposal Area, Old Incinerator Site, & Dump Site Near Building 293, NCTAMS PAC, Wahiawa, Oahu, Hawaii*. July. Appendix C.1, Section 7.2.1, page C.1.7-5.
8	ecological risks calculated during the RI	Section 2.7.3.2, page 34	Earth Tech, Inc. 2006b. *Remedial Investigation Report, Old Wahiawa Landfill, Building 6 Disposal Area, Old Incinerator Site, & Dump Site Near Building 293, NCTAMS PAC, Wahiawa, Oahu, Hawaii*. July. Appendix C.2, Section 3.6.1, page C.2.3-8.
9	Final FS	Section 2.9, page 35	Earth Tech, Inc. 2007b. Feasibility Study, Old Wahiawa Landfill. Naval Computer and Telecommunications Area Master Station, Pacific, Oahu, Hawaii. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific. January. Section 5, page 5-1.