Record of Decision

Sewage Ponds
Joint Base Pearl Harbor-Hickam
Lualualei Annex, Oahu, Hawaii

NCTAMS PAC, National Priorities List Site

July 2014

Department of the Navy
NAVFAC Hawaii
JBPHH HI 96860-3139

Contract Number: N62742-09-D-1940 CTO HC03

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Appendix B. Comments and Responses

ACRONYMS AND ABBREVIATIONS

ACRONYMS/ ABBREVIATIONS	DEFINITION/MEANING
ºF	Degrees Fahrenheit
AM	Action Memorandum
BERA	Baseline Ecological Risk Assessment
bgs	Below ground surface
Bldg. 1	Building 1
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
COPC	Contaminant of potential concern
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
DOH	State of Hawaii Department of Health
DDD	4,4'-dichlorodiphenyldichloroethane
DDE	4,4'-dichlorodiphenyldichloroethylene
DDT	4,4'-dichlorodiphenyltrichloroethane
DoN	Department of the Navy
DRO	Diesel range organics
EAL	Environmental Action Level
ECC	Environmental Chemical Corporation
Eco-SBC	Ecological soil benchmark concentration
Eco-SSL	Ecological soil screening level
EE	Engineering Evaluation
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ERVs	Ecotoxicity Reference Values
FFA	Federal Facilities Agreement
HAR	Hawaii Administrative Rule
HHRA	Human Health Risk Assessment
HQ	Hazard quotient
JBPHH	Joint Base Pearl Harbor-Hickam
IAS	Initial Assessment Study
LLL	Lualualei
LOAEL	Lowest-observed adverse effect level
LRO	Lubricating-oil range organics
MCL	Maximum contaminant level
µg/l	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter
msl	Mean sea level
MW	Monitoring well
NAVFAC	Naval Facilities Engineering Command
NAVMAG	Naval Magazine
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NCTAMS PAC	Naval Computer and Telecommunications Area Master Station, Pacific
NEESA	Naval Energy and Environmental Support Agency
NFA	No further action

ACRONYMS AND ABBREVIATIONS

ACRONYMS/ ABBREVIATIONS	DEFINITION/MEANING
NMC EAD DET PH	Navy Munitions Command East Asia Division Detachment Pearl Harbor
NOAEL	No-observed adverse effect level
NPL	National Priorities List
NRTF	Naval Radio Transmitting Facility
ORNL	Oak Ridge National Laboratory
PA	Preliminary Assessment
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PWC	Public Works Center
RBSC	Risk-Based Screening Criteria
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Assessment
RI	Remedial Investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
RSE	Removal Site Evaluation
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
SRA	Screening Risk Assessment
SVOCs	Semi-volatile organic compounds
SWMU	Solid Waste Management Unit
TPH	Total petroleum hydrocarbons
TRVs	Toxicity reference values
UCL	Upper confidence limit
VOCs	Volatile organic compounds
WP/SAP	Work Plan/Sampling and Analysis Plan

1. DECLARATION

1.1 Site Name and Location

This Record of Decision (ROD) has been prepared by the U.S. Navy for the Sewage Ponds site located at Joint Base Pearl Harbor-Hickam (JBPHH), Lualualei (LLL) Annex, Naval Radio Transmitting Facility (NRTF). The Sewage Ponds site is part of the Naval Computer and Telecommunications Area Master Station, Pacific (NCTAMS PAC), a National Priorities List (NPL) site, and is hereinafter referred to as the "Site." The Navy, as the lead agency, has completed a Remedial Investigation (RI) at the Site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The NCTAMS PAC NPL site has been assigned the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number of HI0170090054.

The NRTF is located 10 miles southwest of the JBPHH Wahiawa Annex on the west side of Oahu (Figure 1-1). The Site is located within the NRTF which is situated on 1,700 acres in a large, coastal valley. The Site consists of the Building 1 (Bldg. 1) Sewage Pond and a series of connected ponds identified as the Niulii Reservoir Sewage Ponds. The Bldg. 1 Sewage Pond is located at the center of NRTF Lualualei, one mile east of the coastline. The Niulii Reservoir Sewage Ponds are located on Naval Reservation land in the southeastern portion of NRTF (Figure 1-2).

1.2 Statement of Basis and Purpose

The ROD presents a *no further action* (NFA) decision for the Site. The final decision was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on recommendations of the RI Report (Department of the Navy [DoN] 2011). This ROD satisfies U.S. Environmental Protection Agency (EPA) and the State of Hawaii Department of Health (DOH) requirements.

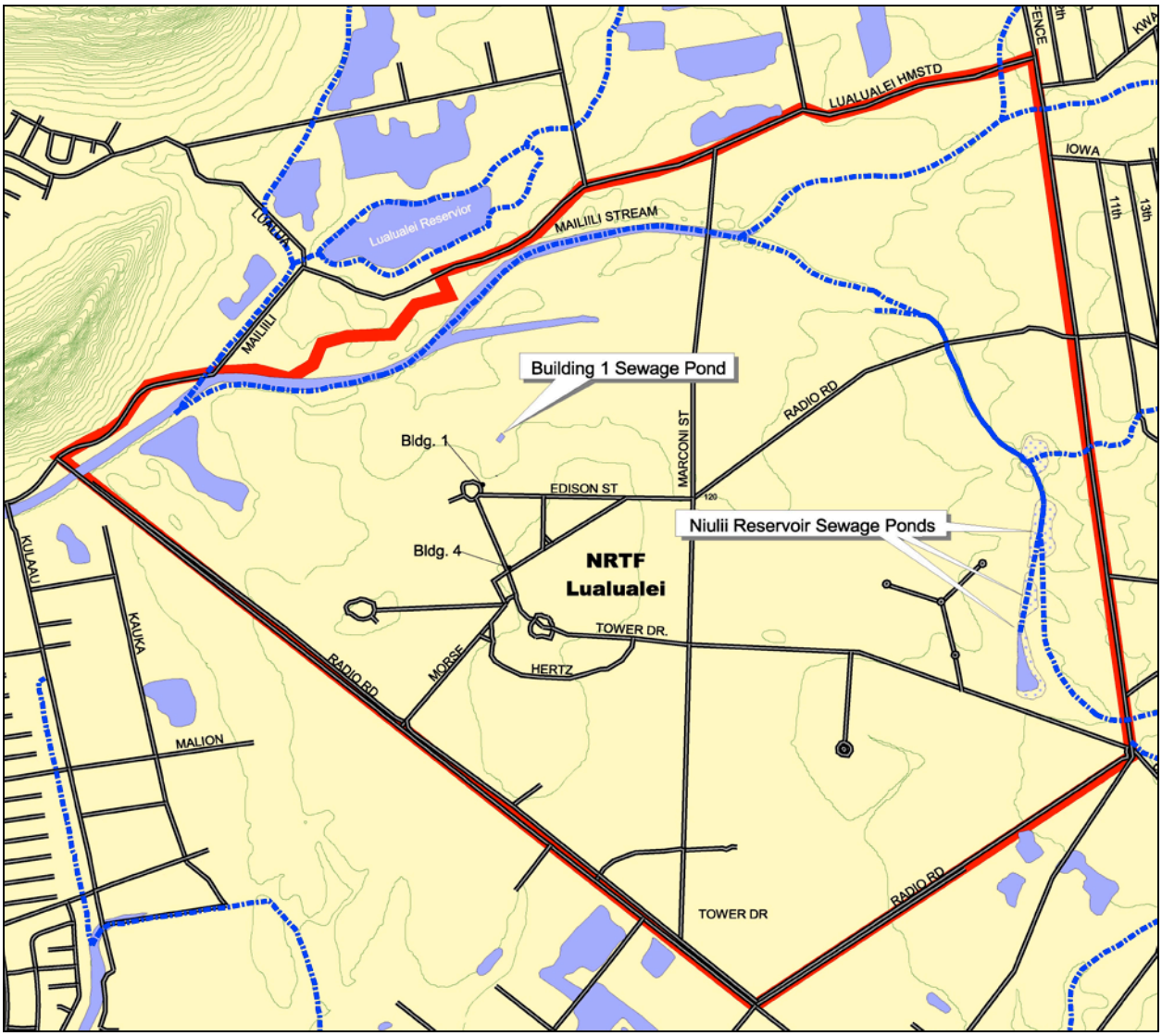
Information supporting the decisions leading to the finding of NFA is contained in the Administrative Record file for the Site. The DOH and the EPA concur with this NFA decision as indicated by signatures in Section 1.6. Information not specifically summarized in this ROD or its references but contained in the Administrative Record file has been considered and is relevant to the selection of the remedy.

The Navy is the lead agency for the Site; the EPA and DOH are support agencies. The Federal Facilities Agreement (FFA) for NCTAMS PAC documents how the Navy intends to meet and implement CERCLA in partnership with the EPA and DOH (DOH, DoN, and EPA 2009a). This ROD documents the final response action selected for the Site and does not include or affect any other sites.

Figure 1-1. Site Location

Source: State of Hawaii Geographic Information System, DoN 2011.

Figure 1-2. Site Layout



Source: City & County of Honolulu Department of Planning and Permitting (DPP), DoN 2011.

1.3 Assessment of Site

An RI of the Site indicated that concentrations of contaminants of potential concern (COPCs) at the Site do not pose an unacceptable risk to human health or the environment (DoN 2011). Concentrations of COPCs in soil, groundwater, surface water, sediment, sludge, and wastewater were compared to the following screening criteria:

- Soil, sediment, and sludge sample results of the RI were compared to EPA Residential Soil Regional Screening Levels (RSLs) (EPA 2011) and DOH Tier 1 Environmental Action Levels (EALs) (DOH 2008), and the established 95th percentile of regional background levels (DoN 2006) for soil.

- Groundwater and surface water results of the RI were compared to EPA Residential Tap Water RSLs (EPA 2011) and DOH Maximum Contaminant Levels (MCLs) (DOH 2004).
- Wastewater results of the RI were compared to EPA Residential Tap Water RSLs.

Since COPCs did not exceed aggregate risk thresholds for the various environmental media of the Site, the RI concluded that CERCLA hazardous substances at the Site do not pose a threat to public health, welfare, or the environment in an unrestricted land use scenario. The Navy has determined that no further action is necessary to protect human health, welfare, or the environment.

1.4 Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and provides a permanent solution. Future five year reviews or regular Site inspections are not required.

Under CERCLA, no further action is required for a site where release conditions do not pose a current or potential threat to human health or the environment. Accordingly, the Navy and EPA, with concurrence of DOH, have determined that no further action is required for the Site under CERCLA because the findings of the 2011 RI and a subsequent evaluation, conducted specifically for the ROD, show that contamination at the Site does not pose a current or potential threat to human health or the environment (DoN 2011). The Site meets the criteria for unrestricted land use. This decision is based on the fact that the COPCs present in soils, surface water, and groundwater at the Site are below their respective screening criteria for the Site, or otherwise do not present an unacceptable risk to human health or the environment.

1.5 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for this site.

Table 1-1. Information and Section Number for ROD Data Certification

Data	ROD Section
Screening criteria established for chemicals of concern and the basis for these levels	Section 1.3
Finding of No Further Action	Section 1.4
COPCs and their respective concentrations	Section 2.4.8
Current and reasonably anticipated future land use	Section 2.5
Current and reasonably anticipated future beneficial uses of groundwater	Section 2.5
Risk represented by the COPCs	Section 2.6

1.6 Authorizing Signatures

The Navy and EPA Region 9, in coordination with EPA headquarters, and with concurrence from the DOH, have selected "No Further Action" as the final remedy for the Sewage Ponds at Joint Base Pearl Harbor-Hickam, Lualualei Annex, Naval Radio Transmitting Facility as described in this ROD. This final remedy is protective of human health and the environment.

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Captain, U.S. Navy
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3/12/14
Date

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7-1-14
Date

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2. DECISION SUMMARY

This section summarizes the site location, description, history, and environmental investigations conducted at the Site.

2.1 Site Name, Description, and Location

The Sewage Ponds are part of the NRTF at JBPHH Lualualei Annex, located on the western coast of Oahu. The NRTF is comprised of approximately 1,700 acres and is located next to Navy Munitions Command East Asia Division Detachment Pearl Harbor (NMC EAD DET PH), formerly known as Naval Magazine (NAVMAG) Pearl Harbor. As described in Section 1.1, the Sewage Ponds are part of NCTAMS PAC that is identified on the NPL with EPA CERCLIS identification number HI0170090054.

The Site consists of two separate areas: the Bldg. 1 Sewage Pond, located in the center of NRTF, and the Niulii Reservoir Sewage Ponds, located in the southeastern portion of NRTF. Neither the Bldg. 1 Sewage Ponds nor the Niulii Reservoir Sewage Ponds discharge to navigable waters. The Site includes the Niulii Reservoir Wildlife Sanctuary that was created in 1972 because the wetland provided by the sewage ponds had become habitat for native Hawaiian birds (DoN 1972).

Over time, the industrial activities and the number of people present at the buildings and discharge areas associated with the Site has significantly decreased, reducing the sources of contamination in number and magnitude and changing the wastewater discharged into the ponds to be more domestic in nature. The source reduction results primarily from the abandonment of facilities at JBPHH Lualualei Annex by the Navy and from removal or remedial actions already conducted under the Navy's Environmental Restoration Program (e.g., the former NAVMAG Pearl Harbor Bld. 4 Pesticide Shop removal action).

At one time, there were 289 buildings and 253 magazines present at the Site. By 2004, 102 of these buildings were demolished, and the magazines were used only for storage (Earth Tech 2004). Of the 187 structures remaining, only 45 were in use as of 2004, and of these, all but 18 were used for storage. The remaining 18 buildings are used for administration, security guard operations and restrooms. Less than 10% of the remaining buildings at the Site are actively used. Buildings not centrally located at NRTF are serviced by separate septic tanks and infiltration fields.

The Bldg. 1 Sewage Pond is approximately one mile inland from the ocean and less than a quarter mile south of the Mailiili Stream (Figure 1-2). The pond measures 60 feet by 110 feet, by 5 feet deep, is lined with black plastic sheeting, and is surrounded by a 3-foot high berm on all sides. The Bldg. 1 Sewage Pond services centrally located buildings at NRTF, after wastewater passes through septic tanks to remove solids. Solids from the septic tanks are removed quarterly and transported to drying beds at the Former Naval Air Station Barbers Point (Helber et al. 1986). Water discharges from the Bldg. 1 Sewage Pond via a drainage swail approximately 750 feet north of the pond. The Bldg. 1 Sewage Pond was designed to receive a maximum flow of 11,000 gallons per day, has a 26-day retention time, and a maximum loading of approximately 100 pounds of biochemical oxygen demand per-acre per-day (Naval Energy and Environmental Support Agency [NEESA] 1986).

The Niulii Reservoir Sewage Ponds are approximately 500 feet west of the western property line at NMC EAD DET PH, JBPHH Lualualei Annex (Figure 1-2). The Niulii Reservoir Sewage Ponds are a system of three ponds operating by gravity flow. The first and second ponds are unlined and surrounded by 6- to 8-foot high berms. The third pond

appears to exist only as a low-lying drainage basin located north of the second pond (Figure 1-2).

Wastewater from the NMC EAD DET PH sanitary system discharges into Sewage Tank S522, a 50,000 gallon settling tank, and is then discharged, along with storm water, into the sewage ponds to oxidize, evaporate, or percolate into the ground. As with the Bldg. 1 Sewage Ponds, a decrease in the number of people present at NMC EAD DET PH has decreased the amount of water discharged to the Niulii Reservoir Sewage Ponds, which now contain approximately one acre of standing water (DoN 2011). In addition, the decrease is associated with a dramatic decline in the industrial use of the Site. Wastewater flows from the first to the second and then third pond via a culvert. At some time, wastewater flowed from the second pond, through a chlorine contact tank, and into the third tank, however, the tank outlets have been sealed with concrete. Additionally, a tank labeled “new septic tank” can be found on Navy drawing number 732033 (DoN 1956), but no information could be found regarding the tank.

2.2 Site History

Construction of the NCTAMS PAC transmitting station at Lualualei began in 1933 and was completed in 1936 (NEESA 1986). The wastewater at NRTF has been treated through septic tanks, stabilization or sewage ponds, and infiltration fields.

Bldg. 1 was built in 1935, and the Bldg. 1 Sewage Pond was built in 1976. The Bldg. 1 Sewage Pond received waste from centrally located buildings and from the sump at Bldg. 4, which was a transportation shop sump that contained oil and contaminated sludge (DoN 1995). Bldg. 1 Sewage Pond may have received contaminated discharges from the Bldg. 4 sump.

The Niulii Reservoir Sewage Ponds were built in the 1930s to receive wastewater from the NMC EAD DET PH of the JBPHH Lualualei Annex residential and administrative buildings that included laboratories, a maintenance shop, and a print shop. Wastes generated by activities in the buildings included degreasers, solvents, waste oil, and ink that were disposed of in sink drains, as well as caustic cleaners that were pH-adjusted and disposed of into the sanitary sewer system. A dry well was designed to pump overflow from Sewage Tank S522 into the ground; however, the well was abandoned by 1952 and overflow was then diverted directly to the sewage ponds (Kearney 1987).

In 1972, the Niulii Reservoir Wildlife Sanctuary was created at the Site because the wetland provided by the sewage ponds had become habitat for native Hawaiian birds (DoN 1972). In 1979, a National Pollutant Discharge Elimination System permit was obtained, and since then only one overflow to the nearby marsh has been recorded. Because there is no longer overflow, the permit was not renewed when it expired in July 2001 (NEESA 1983). As population and activities at NRTF declined, the discharge to the sewage ponds declined as well, reducing the amount of water discharged into the ponds to an area of approximately 1 acre of standing water.

In early 1998, the Navy installed well 2508-14 equipped with a solar-powered submersible pump to provide continuous groundwater flow to the ponds to maintain wildlife habitat (DoN 2001).

Table 2-1 summarizes the relevant previous investigations at the Site and in the vicinity of the Site that may have impacted the Site.

Table 2-1. Summary of Previous Investigations

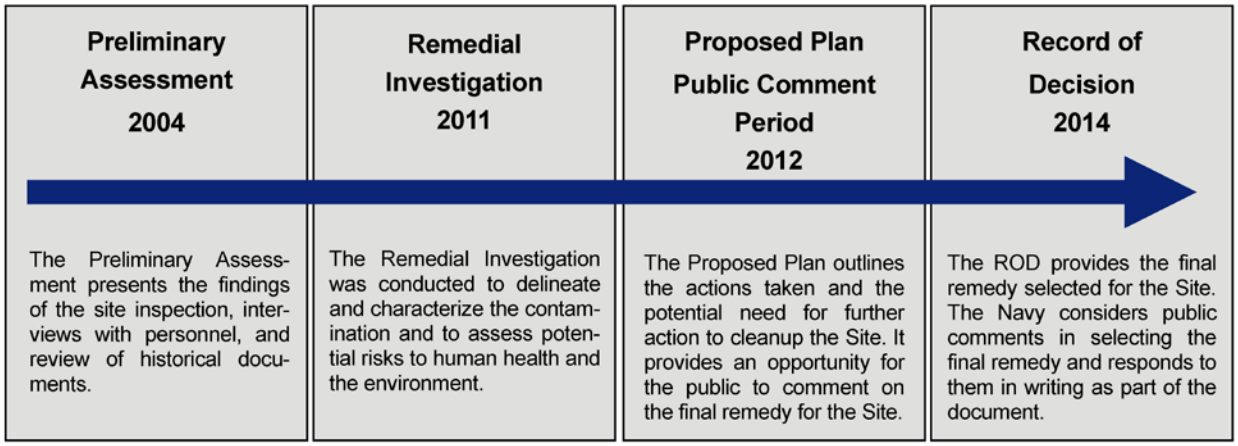
Previous Investigation/Action	Date	Description
Initial Assessment Study (IAS) of Naval Communication Area Master Station Eastern Pacific Area (NEESA 1983)	1983	The IAS identified potentially contaminated sites at NRTF, including the Antenna 354 site, located near Bldg. 1 Sewage Pond. Further action at Antenna 354 was recommended to determine whether impacts from the release of 4,4'-dichlorodiphenyltrichloroethane (DDT) exist.
Resource Conservation and Recovery Act (RCRA) Facilities Assessment (RFA) of Naval Magazine Lualualei (Kearney 1987)	1987	The RFA identified Niulii Reservoir Sewage Ponds as a solid waste management unit (SWMU) that previously received waste solvents and oil that could potentially release hazardous constituents and recommended soil sampling at the sewage ponds.
Site Inspection (SI) of Naval Communication Area Master Station Eastern Pacific Area (Harding et al. 1989)	1989	The SI addressed sites recommended for further investigation in the IAS. The disposal area near Antenna 354 could not be located; therefore, three ground water monitoring wells were installed northeast of the Bldg. 1 Sewage Pond. Volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were not detected in soil or groundwater. However, further investigation was recommended.
Site Inspection of Naval Magazine Headquarters and West Loch Branches (Harding et al. 1990)	1990	An SI conducted at Lualualei concluded that pesticides were present in soil at the Former Bldg. 4 Pesticide Shop and were released into the Niulii Reservoir Sewage Pond. Further soil and groundwater sampling was recommended for the Building 4 Pesticide Shop.
Site Inspection of Various Transformer Sites, NCTAMS Wahiawa (Earth Tech 2002)	2002	Transformers investigated under the SI of Various Transformer Sites included Site 1, southwest of the Bldg. 1 Sewage Pond. Soil and wipe samples were collected at Site 1 and analyzed for the presence of polychlorinated biphenyls (PCBs), and no further action was recommended for Transformer Site 1.
Preliminary Assessment (PA)/SI of Naval Magazine Pearl Harbor Lualualei Branch (Earth Tech 2004)	2004	The PA/SI investigated whether impacts from hazardous materials that drained to and overflowed from Sewage Tank S522 existed at the Niulii Reservoir Ponds. Wastewater, sludge, and sediment samples were collected from the tank and the area surrounding it, and a groundwater monitoring well (MW) (MW-01) was installed. The PA/SI concluded that further investigation was necessary.
RI of Former Bldg. 4 Pesticide Shop (Earth Tech 2004)	2004	An RI was performed for the Former Bldg. 4 Pesticide Shop that included sediment sampling of an intermittent stream drainage that discharges to the Niulii Reservoir Sewage Ponds. The results indicated concentrations of pesticides, dioxins/furans, and metals in soil, VOCs and metals in groundwater, and pesticides in sediment exceeded screening criteria. Further action was recommended for the Former Bldg. 4 Pesticide Shop.
Removal Site Evaluation (RSE) (Earth Tech 2005)	2005	Soil and groundwater samples were collected at the Former Bldg. 4 Pesticide Shop to delineate the extent of contamination identified in the RI of Former Bldg. 4 Pesticide Shop and to determine the extent of the removal action. Chlorinated pesticides, dioxins, arsenic and lead were detected in soil, and VOCs were detected in groundwater.

Previous Investigation/Action	Date	Description
Engineering Evaluation (EE)/Cost Analysis, Action Memorandum (AM), and Basis of Design Report for the Former Bldg. 4 Pesticide Shop (Earth Tech 2005b, Earth Tech 2006a, Earth Tech 2006b)	2005 (EE/CA) and 2006 (AM and Basis of Design Report)	An EE/CA was completed for the Former Bldg. 4 Pesticide Shop to identify the removal action alternatives to address DDT, 4,4'-dichlorodiphenyldichloro-ethylene (DDE), 4,4'-dichlorodiphenyldichloroethane (DDD), arsenic, and lead contamination in soil. The preferred alternative was determined to be excavation of specific areas and offsite disposal.
Removal Action and Final Remediation Verification Report, Non-Time-Critical Removal Action, Former Building 4 Pesticide Shop (Environmental Chemical Corporation [ECC] 2008)	2008	The removal action at the former Bldg. 4 Pesticide Shop was completed in September 2007, and included removal of 970 tons of soil. The site was determined to be suitable for unrestricted land use upon completion of the removal action.
Decision Document for Former Bldg. 4 Pesticide Shop (DoN 2009b)	2009	The Decision Document documented the completion of the removal action at the Former Bldg. 4 Pesticide Shop and determined that the action was adequate to protect human health and the environment, and was approved in February 2010.
Remedial Investigation Report, Sewage Ponds, NRTF Lualualei (DoN 2011)	2011	Based on the results of previous investigations at the Site and the surrounding areas, an RI at Bldg. 1 Sewage Pond and Niulii Reservoir Sewage Ponds was conducted to delineate and characterize the nature and extent of contamination at the Site and to assess potential risks to human health and the environment. Sampling was conducted from June through August 2003 and in February 2004, and the RI was completed in July 2011. Results and conclusions of the RI are included in Section 2.4.8.

2.3 Community Participation

The Navy has encouraged public participation in the decision process for environmental response actions at the Site throughout the environmental restoration and site closeout processes. The Navy has issued a fact sheet that summarizes the site investigations. The public has provided review and comment leading to the selection of the final remedy memorialized in this ROD. The Navy has also established a point-of-contact for the public. The timeline for the CERCLA process at the Site is shown in Figure 2-1.

Figure 2-1. CERCLA Process



The RI was made available to the public in July 2011. A notice of availability of the RI and Proposed Plan was published in the Honolulu Star Advertiser on 12 August 2012. A Public meeting was held on 15 August 2012 at the Waianae Public Library, during which the findings and conclusions of the RI and Proposed Plan were made available to the community. The Fact Sheet and presentation notes summarizing the previous investigation results, findings, and conclusions were distributed. Representatives from the Navy answered questions about the Site at the public meeting. The meeting was also used to solicit a wide cross-section of community input on the reasonably anticipated future land use and potentially beneficial groundwater uses at the Site. A comment period was extended for 30 days after the public meeting, from August 16, 2012 to September 14, 2012. Comments and their responses are included in the *Responsiveness Summary* section of this ROD.

Project documents, including the Work Plan/Sampling and Analysis Plan (WP/SAP), RI, Fact Sheet, Proposed Plan, and other materials relating to the Site have been archived in the information repositories at the following locations:

Waianae Public Library
85-625 Farrington Highway
Waianae, Hawaii 96792
Telephone: (808) 697-7868

University of Hawaii-Manoa
Hamilton Library – Hawaiian and Pacific Collection
2550 McCarthy Mall
Honolulu, Hawaii 96822
Telephone: (800) 956-8264

Additional project information about the Site is located in the Administrative Record File at Naval Facilities Engineering Command (NAVFAC) Pacific. The address for the Administrative Record File is as follows:

Naval Facilities Engineering Command, Pacific
258 Makalapa Drive, Suite 100
JBPHH HI 96860-3134

2.4 Summary of Site Characteristics

The Site includes both the Bldg. 1 Sewage Pond, located at the center of the NRTF, one mile east of the coastline, and the Niulii Reservoir Sewage Ponds, located on Naval Reservation land in the southeastern portion of NRTF, JBPHH Lualualei Annex. The layout of the Site is shown on Figure 1-2.

2.4.1 Climate

The average temperature at the Site is 76 degrees Fahrenheit (ºF), and the average rainfall is 20 inches per year, the majority of which falls during the winter months. The Site is located on the leeward coast, which is sheltered from the prevailing northeasterly wind or *tradewind* (NEESA 1986).

2.4.2 Topography and Elevation

The Site's elevation ranges from 20 to 25 feet above mean sea level (msl) at the Bldg. 1 Sewage Ponds and from 70 to 75 feet above msl at the Niulii Reservoir Sewage Ponds. The Site is situated within the Lualualei Valley, west of the NMC EAD DET PH at JBPHH Lualualei Annex, which extends inland and rises to approximately 3,000 feet above sea level. The terrain of the NRTF is generally flat to slightly rolling, with elevation increasing from the coast towards the mountains.

Runoff from NRTF Lualualei is limited due to the generally flat topography and permeable soil. Cracks in the surface soil which, when paired with porous limestone, lead to subsurface migration. Any runoff that does not percolate into the ground drains to the Mailiili Stream, located along the northern boundary of the NRTF (NEESA 1986). A man-made drainage channel located along the eastern side of the Niulii Reservoir Sewage Pond directs runoff to the Mailiili Stream (DoN 2011).

2.4.3 Geology

The Lualualei Valley is located on the western portion of Oahu, west of the Waianae Mountain Range. The NRTF is located near the relatively flat portion of Lualualei Valley on land that consists of a thin layer of Quaternary-age alluvial and coastal sediments, and reef deposits overlying Tertiary-age Waianae volcanics (NEESA 1986).

Surface and shallow subsurface soils collected from both the area near the Niulii Reservoir and the Bldg. 1 Sewage Pond during the RI were predominantly clayey silt with low to medium plasticity and medium stiffness, and were estimated to contain 85 to 95% fine-grained material (DoN 2011). The soil color was described as dark yellowish brown to dusky brown, and the soil was moist and soft.

Haleiwa silty clay and stony clay loam are present at both the Bldg. 1 Sewage Pond and the Niulii Reservoir Sewage Ponds, and have low to moderate permeability and slight erosion hazard for run off. Additionally, Malama clay loam is present at the Bldg. 1 Sewage Pond and Pulehu clay loam is found at the Niulii Reservoir Sewage Ponds (Harding et al. 1989).

2.4.4 Groundwater Hydrogeology

Information on groundwater beneath the Site includes surrounding areas and indicates that the Site overlies a complex series of strata making up overlying confining caprock and the underlying basal aquifer (DoN 2007).

Groundwater was found at approximately 23 to 26 feet below ground surface (bgs) at the Bldg. 1 Sewage Pond area (approximately 2.2 feet above msl) (DoN 2011). At the Niulii Reservoir site, which is at a higher elevation than Bldg. 1 Sewage Pond, groundwater is present at approximately 68 to 75 feet bgs (2.4 feet above msl).

Based on data collected during the RI and an investigation at a nearby site, groundwater is also known to be encountered at approximately 44 feet bgs (38 feet above msl) at the Niulii Reservoir Sewage Ponds. This groundwater, referred to as perched groundwater, is separate from the underlying basal aquifer. There is an infiltration ditch at the Niulii Wildlife Refuge located 100 feet north of the Niullii Reservoir Sewage Ponds that is a potential source of perched groundwater. The groundwater gradient at the Site is approximately 1 foot per mile, and groundwater flows towards the southwest (Earth Tech 2002).

Three groundwater wells at the Niullii Reservoir Sewage Ponds were advanced to depths ranging from 91 to 95 feet bgs. Groundwater was encountered during drilling in MW-04 and MW-05 at depths of 72 and 70 feet bgs, respectively, and remained stable at about that same depth. Although shallow, perched groundwater was expected near MW-06, groundwater was also first encountered during the drilling of MW-06 at a depth of approximately 73 feet bgs. However, after completion of the well, groundwater in MW-06 stabilized at approximately 44 feet bgs. As a result, it was interpreted that the perched zone reported to the east of this area extends west at least as far as MW-06.

Potentially potable groundwater could be encountered in wells developed at NRTF, JBPHH Lualualei Annex; however, approximately 100 wells have been abandoned in the surrounding area due to chloride concentrations that make the water unsuitable as potable water. Chloride concentrations in groundwater at NRTF range from 500 to 1,000 milligrams per liter (mg/l) (NEESA 1986). The groundwater of the Site has chloride concentrations ranging from 310 to 1,590 mg/l, and total dissolved solids ranging from 2,070 to 7,408 mg/l (DoN 2011). The highest concentration of dissolved solids occurred in groundwater of the Niullii Reservoir Sewage Ponds area and is likely due to the pumping of groundwater to maintain the wildlife habitat, as noted in Section 2.2.

2.4.5 Surface Water

Mailiili Stream is the only stream at NRTF Lualualei, is intermittent, and flows west towards the Pacific Ocean along the northern boundary of NRTF Lualualei (NEESA 1986). There are two reservoirs within Lualualei Valley, one of which is the Niulii Reservoir Sewage Ponds. The other is the Lualualei Reservoir, located on Lualualei Homestead land north of NRTF Lualualei that was drained and is now grass land.

2.4.6 Sensitive Populations and Habitats

As part of the RI, biological surveys were conducted to identify populations and habitats present at the Site. Two biological surveys were conducted at the Niulii Reservoir Sewage

Ponds and one biological survey was conducted at the Bldg. 1 Sewage Pond and a 100-yard area surrounding the pond. The Niulii Reservoir Sewage Pond survey included 35 acres in all, from the ponds to the Bldg. 4 Pesticide Shop at NMC EAD DET PH, JBPHH Lualualei Annex (DON 2011).

Vegetation

At the Bldg. 1 Sewage Pond, 28 plant species were identified, only two of which were indigenous. Both the seaside heliotrope (*Heliotropium curassavicum*) and ‘uhaloa (*Waltheria indica)* are commonly found species. No threatened or endangered species were identified (Aecos 2003).

At the Niulii Reservoir Sewage Ponds, seven native species were identified: *‘ilima* (*Sida fallax*), *pa‘u-o-hi‘iaka* (*Jacquemontia ovalifolia*), hoary abutilon (*Abutilon incanum*), *‘ihi‘ai* (*Oxalis corniculata*), *‘ae‘ae* (*Bacopa monnieri*), *popolo* (*Solanum americanum*), and *‘uhaloa* (*Waltheria indica*). *Ko‘oloa ula* (*Abutilon menziessi*) was the only federally listed endangered plant identified (Aecos 2003).

Wildlife

Three introduced species of mammals were identified at the Bldg. 1 Sewage Pond, along with 12 bird species from six different families (Aecos 2003). No federally or state listed species were identified at the Bldg. 1 Sewage Pond.

Similarly, three introduced species of mammals were identified at the Niulii Reservoir Sewage Ponds, and 23 bird species from 14 separate families were identified. Four of the bird species identified are listed as endangered: Hawaiian Duck *(Anas wyvilliana)*, common moorhen *(Gallinula chloropus sandwichensis)*, Hawaiian coot *(Fulica alai),* and Hawaiian stilt *(Himantopus mexicanus knudseni).* Additionally, the short-eared owl *(Asio flammeus sandwichewnsis)* is listed by the State of Hawaii as endangered on Oahu, the Frigate bird *(Fregata minor palmerstoni)* is an indigenous breeding seabird, and the Pacific Golden Plover *(Pluvialis fulva)* is an indigenous migratory species (Aecos 2002).

Invertebrate species observed at the Site included the praying mantis *(Tenodera* sp.) (egg cases), a black witch moth *(Ascalapha odorata)*, cabbage white *(Pieris rapae)* and Gulf fritillary butterflies *(Agraulis vanillae)*, Chinese grasshoppers *(Oxya chinensis)*, and a native Kamehameha butterfly *(Vanessa tameamea).* Several aquatic species were observed, including the damselfly *(Ischnura ramburi)*, green darner dragonfly *(Anax junius)*, shore fly (*Fam. Ephydridae*), long-jawed spider (*Fam. Tetragnathidae*), and giant marine toad *(Bufo marinus)*. No fish were identified at the Site (Aecos 2002).

2.4.7 Cultural Resources

A National Historic Preservation Act Section 106 Review was requested on 21 June 2002, prior to field work for the RI. The review determined that no historic properties would be affected by the RI at the Site.

2.4.8 Summary of Current Nature and Extent of Contamination

The following is a summary of the current nature and extent of contamination at the Site based on the 2011 RI report (DoN 2011). Results are summarized by building and environmental media. Discrete soil, sediment, sludge, and groundwater sample collection was conducted from June through August 2003 and in February 2004. The operational use of the ponds was dramatically reduced and the industrial activities associated with releases of hazardous substances at the Site had largely ceased by 2004.

Additional information on releases is contained in the RI. The COPC groups are based on historical activities and findings of previous investigations at the Site, and are listed in Table 2-2. The COCPs include metals, pesticides, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs as Aroclors), SVOCs, total petroleum hydrocarbons (TPH), and VOCs.

The sample results were evaluated against screening criteria identified in the RI Work Plan (DoN 2011). The RI screening criteria for soil, sediment, and sludge sample results were EPA residential RSLs (EPA 2011) and DOH Tier 1 EALs (DOH 2008), and the established 95th percentile of regional background levels (DoN 2006) for soil. The RI screening criteria for groundwater and surface water results were EPA Residential Tap Water RSLs (DOH 2004) and DOH MCLs. The RI screening criteria for wastewater were EPA Residential Tap Water RSLs. Although residential screening criteria were considered in the RI as a conservative measure, land use at the Site is unlikely to change from commercial and industrial to residential.

Table 2-2. Summary of Analysis by Media at Bldg. 1 and Niulii Reservoir Sewage Ponds

Media	Bldg. 1 Sewage Pond	Niulii Reservoir Sewage Ponds
Surface Soil	SVOCs, PAHs, pesticides, PCB Aroclors, TPH, and metals	SVOCs, PAHs, pesticides, PCBs as Aroclors, TPH, and metals
Subsurface Soil	VOCs, SVOCs, PAHs, pesticides, PCB Aroclors, TPH, and metals	VOCs, SVOCs, PAHs, pesticides, PCBs as Aroclors, TPH, and metals
Sediment	n/a	VOCs, SVOCs, PAHs, pesticides, PCBs as congeners, metals, and TPH
Sludge	n/a	SVOCs, PAHs, pesticides, PCBs as Aroclors, TPH, and metals
Surface Water	n/a	VOCs, SVOCs, PAHs, pesticides, metals (filtered and unfiltered), and TPH
Groundwater	VOCs, SVOCs, PAHs, pesticides, TPH, metals (total and dissolved), and general chemistry parameters	VOCs, SVOCs, PAHs, pesticides, TPH, metals (total and dissolved), and general chemistry parameters
Wastewater	n/a	VOCs, SVOCs, PAHs, pesticides, metals (filtered and unfiltered), and TPH

n/a not applicable
PAHs polycyclic aromatic hydrocarbons
PCBs polychlorinated biphenyls
TPH total petroleum hydrocarbons
SVOCs semi-volatile organic compounds
VOCs volatile organic compounds

Bldg. 1 Sewage Pond Soil Sampling and Results

Samples were collected from 12 locations: 7 locations within the Sewage Pond and 5 from surrounding locations. Surface and subsurface soil samples (to a depth of 3.0 feet bgs) were collected. Four surface samples were collected at perimeter berms of the pond. Soil samples were analyzed for VOCs (subsurface only), SVOCs, PAHs, pesticides, PCBs as Aroclors, metals, and TPH. No concentrations of VOCs or SVOCs exceeded screening criteria in soil at Bldg. 1 Sewage Pond.

Concentrations of PAHs (benzo[a]anthracene and benzo[b]-fluoranthene) exceeded their respective EPA Residential RSLs and concentrations of benzo[a]pyrene exceeded the EPA Residential RSL and DOH EAL in surface soil samples collected at two locations (Table 2-3); however, no concentrations of PAHs exceeded EPA Residential RSLs or DOH EALs in subsurface soil.

The only pesticide concentration exceeding the screening criteria was DDE in subsurface soil at one location (Table 2-3). An additional step-down sample collected at 3 feet bgs contained lower concentrations of DDE.

Concentrations of arsenic exceeded the EPA Residential RSL, DOH EAL, and 95th percentile background concentrations for the Waianae volcanic soils in surface soil samples collected. Concentrations of antimony, copper, nickel, and zinc exceeded their respective DOH EALs and 95th percentile background concentrations for the Waianae volcanic soils in surface soil samples collected. Concentrations of chromium and iron exceeded their respective EPA Residential RSLs and 95th percentile background concentrations for the Waianae volcanic soils in the surface soil samples collected (Table 2-3). Arsenic was the only metal with a concentration exceeding the EPA Residential RSL and 95th percentile background concentrations in subsurface soil samples.

Concentrations of PCBs as Aroclor 1260 exceeded screening criteria in eight surface soil samples and in one subsurface soil sample collected at 2 feet bgs (Table 2-3). Concentrations of Aroclor 1260 in additional step-down samples at 3 feet bgs were lower.

TPH-diesel range organics (DRO) and TPH-lubricating oil-range organics (LRO) exceeded screening criteria in surface and subsurface soil samples at the Bldg. 1 Sewage Ponds.

Based on the analytical data results of step-down samples, contamination was vertically and horizontally delineated. Concentrations of COPCs not listed in the Table 2-3 did not exceed screening criteria. The complete analytical data results can be found in the RI report.

Bldg. 1 Sewage Pond Groundwater Sampling and Results

Groundwater samples were collected from three monitoring wells installed around the pond. Groundwater samples were analyzed for VOCs, SVOCs, PAHs, pesticides, total and dissolved metals, TPH, and general chemistry parameters (total dissolved solids and chloride). Concentrations of arsenic and selenium in groundwater exceeded DOH MCLs in filtered and unfiltered samples; however, the groundwater beneath the pond is not considered a potential drinking water source due to high chloride content (NEESA 1986). Additionally, concentrations of arsenic and selenium are elevated in upgradient and cross-gradient wells at Bld. 1 Sewage Pond; therefore, the sewage pond is unlikely to be the source of these metals in groundwater at the Site. Analytical data for groundwater showing COPCs exceeding screening criteria are summarized in Table 2-4. Concentrations of COPCs not listed in the table did not exceed screening criteria. The complete analytical data results can be found in the RI report.

Niulii Reservoir Sewage Ponds Soil Sampling and Results

Surface and subsurface soil samples were collected from the dry bed of the first pond, the second pond, the third pond, the drainage swale connecting the third pond and intermittent pond, the intermittent pond, and along the ephemeral drainage channel from the facility boundary at Fence Road. Soil samples were collected from 0 to 3 feet bgs. Soil samples were analyzed for VOCs (subsurface only), SVOCs, PAHs, pesticides, PCBs as Aroclors, metals, and TPH.

In surface soil, concentrations of PCBs as Aroclor 1260 exceeded the EPA Residential RSL; concentrations of TPH-DRO and TPH-LRO exceeded their respective DOH EALs; concentrations of aluminum and manganese exceeded their respective EPA Residential RSL and 95th percentile background concentrations; and vanadium exceeded the DOH EAL and 95th percentile background concentration (Table 2-5).

In subsurface soil samples, concentrations of acetone exceeded the DOH EAL and concentrations of benzo[a]pyrene, dibenz[a,h]anthracene, and Aroclor 1260 exceeded their respective EPA Residential RSLs (Table 2-5). Concentrations of Aroclor 1260 were lower in subsurface soil than in surface soil at the Site, indicating contamination decreases with depth. The metals aluminum, arsenic, cobalt, iron, and manganese exceeded their respective EPA Residential RSLs and 95th percentile background concentrations (Table 2-5). Concentrations of antimony exceeded the DOH EAL and 95th percentile background concentration, and concentrations of cobalt exceeded the EPA Residential RSL, DOH EAL, and 95th percentile background concentration. Concentrations of vanadium and zinc exceeded their respective DOH EAL and 95th percentile background concentrations, but did not exceed EPA Residential RSLs.

Analytical data for soil showing COPCs exceeding screening criteria is summarized in Table 2-5. Concentrations of COPCs not listed in the table did not exceed screening criteria. The complete analytical data results can be found in the RI report.

Niulii Reservoir Groundwater Sampling

Groundwater samples were collected from three monitoring wells installed around the pond and from Public Works Center (PWC) well 2508-14 during sampling events conducted in August 2003 and February 2004. Groundwater samples were analyzed for VOCs, SVOCs, PAHs, pesticides, total and dissolved metals, TPH, and general chemistry parameters (total dissolved solids and chloride).

Organic compounds were not detected in monitoring well GW-04 during either sampling round. Concentrations of carbon tetrachloride, chloroform, delta-benzene hexachloride, and fluorene were detected in groundwater samples. However, only concentrations of carbon tetrachloride (0.2 micrograms per liter [µg/l]) and chloroform (2 µg/l) exceeded EPA tap water RSLs in unfiltered groundwater samples at monitoring well GW-05. Groundwater from monitoring well GW-06 contained concentrations of acetone, methylene chloride, and DDE in August 2003 and Endrin in February 2004 at levels that did not exceed RSLs. Concentrations of metals were reported in all of the groundwater samples. The metals arsenic and selenium were detected at concentrations exceeding their respective DOH MCLs in filtered and unfiltered samples in monitoring well GW-05, and chromium was similarly detected at concentrations exceeding the DOH MCL in samples at PWC well 2508-14. However, the groundwater beneath the ponds is not considered to be a potential drinking water source due to high chloride content (NEESA 1986). Additionally, concentrations of arsenic and selenium are elevated in an upgradient well at Niulii Reservoir Sewage Ponds; therefore the sewage pond is unlikely to be the source of these metals in groundwater at the Site.

Groundwater from PWC well 2508-14 contained hexachlorocyclopentadiene, at concentrations below the tap water RSL and metals. At monitoring well GW-05, only arsenic (23.3 µg/l) was detected above the EPA tap water RSL (0.045 µg/l) and the DOH MCL (10 µg/l). Analytical data for groundwater showing COPCs exceeding screening criteria is summarized in Table 2-6. Concentrations of COPCs not listed in the table did not exceed screening criteria. The complete analytical data results can be found in the RI report (DoN 2011).

Table 2-3. Summary of Bldg. 1 Sewage Pond Soil Exceedances

Analyte	Number of Samples	Frequency of Detection	Maximum Detection	95th Percentile Background Conc.	Residential RSL	Number above Residential RSL [a]	DOH EAL	Number above DOH EAL [a]
Surface Soil Exceedances								
PAHs (µg/kg)								
Benzo[a] anthracene	9	77.8%	330	n/a	150	2	1,500	—
Benzo[a]pyrene	9	66.7%	340	n/a	15	3	150	2
Benzo[b]-fluoranthene	9	100.0%	780 J	n/a	150	2	1,500	—
PCBs (µg/kg)								
Aroclor 1260	13	100.0%	1,700	n/a	220	8	1,100	3
TPH (mg/kg)								
DRO	9	100.0%	290	n/a	n/a	—	100	3
LRO	9	100.0%	1,300	n/a	n/a	—	500	3
Metals (mg/kg)								
Antimony	9	11.1%	6.8 J	2.2	31	—	6.3	1
Arsenic	9	44.4%	26 J	15	0.39	1	20	1
Chromium	9	100.0%	288 J	142	280	1	500	—
Copper	9	100.0%	617 J	119	3,100	—	230	1
Iron	9	100.0%	208,000	115,000	55,000	1	n/a	—
Nickel	9	100.0%	180 J	153	1,500	—	150	1
Zinc	9	100.0%	730 J	200	23,000	—	600	1
Subsurface Soil Exceedances								
Chlorinated Pesticides (µg/kg)								
DDE	11	45.5%	1,700 NJ	n/a	1,400	1	1,400	1
PCBs (µg/kg)								
Aroclor 1260	11	45.5%	1,400	n/a	220	1	1,100	1
Metals (mg/kg)								
Arsenic	9	11.1%	2 J	4.5	0.39	1	20	—

— no exceeding samples
mg/kg milligrams per kilogram
n/a not applicable
EAL Environmental Action Level
RSL Regional Screening Level
J estimated value
µg/kg micrograms per kilogram

[a] For metals, number of RSL or EAL exceedances includes samples exceeding 95th percentile background concentration only.

Table 2-4. Summary of Bldg. 1 Sewage Pond Groundwater Exceedances

Analyte	Frequency of Detection	Maximum Detection	Tap Water RSL	Number above Tap Water RSL	DOH MCL	Number above DOH MCL
Unfiltered Groundwater						
General Chemistry (mg/l)						
Total Dissolved Solids	100.0%	3,296	n/a	—	500 *	7
Chloride	100.0%	1,590	n/a	—	250 *	7
Metals (µg/l)						
Arsenic	85.7%	35.9	0.045	6	10	6
Selenium	100.0%	156 J	180	—	50	7
Filtered Groundwater						
Metals (µg/l)						
Arsenic	57.1%	35.6	0.045	4	10	4
Selenium	100.0%	155 J	180	—	50	6

— no exceeding samples µg/l micrograms per liter
mg/l milligrams per liter n/a not applicable
* Secondary MCL (EPA 2012)

Table 2-5. Summary of Niulii Reservoir Sewage Ponds Soil Exceedances

Analyte	Frequency of Detection	Maximum Detection	95th Percentile Background Conc.	Residential RSL	Number above Residential RSL [a]	DOH EAL	Number above DOH EAL [a]
Surface Soil Exceedances							
PCBs (µg/kg)							
Aroclor 1260	89.2%	870	n/a	220	8	1,100	—
TPH (mg/kg)							
DRO	100.0%	210	n/a	n/a	—	100	2
LRO	100.0%	810 J	n/a	n/a	—	500	1
Metals							
Aluminum	100.0%	97,100	84,000	77,000	6	n/a	—
Manganese	100.0%	2790	2,700	1,800	1	n/a	—
Vanadium	100.0%	234 J	221	550	—	110	1
Subsurface Soil Exceedances							
VOCs (µg/kg)							
Acetone	45.5%	6,500 J	n/a	61,000,000	—	860	3
PAHs (µg/kg)							
Benzo[a]pyrene	9.1%	19 J	n/a	15	1	150	—
Dibenz[a,h]anthracene	3.0%	21 J	n/a	15	1	150	—
PCBs (µg/kg)							
Aroclor 1260	42.4%	390	n/a	220	2	1,100	—
Metals (mg/kg)							
Aluminum	100.0%	98,300	84,000	77,000	1	n/a	—
Antimony	3.0%	25.3	2.2	31	—	6.3	1

Analyte	Frequency of Detection	Maximum Detection	95th Percentile Background Conc.	Residential RSL	Number above Residential RSL [a]	DOH EAL	Number above DOH EAL [a]
Arsenic	24.2%	5.5 J	4.5 [b]	0.39	2	20	—
Cobalt	100.0%	86.9	67	23	1	40	1
Iron	100.0%	116,000	115,000	55,000	1	n/a	—
Manganese	100.0%	5,850	2,700	1,800	8	n/a	—
Vanadium	45.5%	225 J	221	550	—	110	1
Zinc	100.0%	641 J	200	23,000	—	600	1

— no exceeding samples J estimated value mg/kg milligrams per kilogram
µg/kg microgram per kilogram n/a not available
[a] For metals, number of RSL or EAL exceedances includes samples exceeding 95th percentile background concentration only.

Table 2-6. Summary of Niulii Reservoir Sewage Ponds Groundwater Exceedances

Analyte	Frequency of Detection	Maximum Detection	Tap Water RSL	Number above Tap Water RSL	DOH MCL	Number above DOH MCL
Unfiltered Groundwater						
VOCs (µg/l)						
Carbon tetrachloride	25%	0.27 J	0.2	2	5	—
Chloroform	25%	0.44 J	0.19	2	n/a	—
General Chemistry (mg/l)						
TDS	100.0%	7,408	n/a	—	500*	8
Chloride	100.0%	1590	n/a	—	250*	8
Metals (mg/kg)						
Arsenic	100.0%	29.9	0.045	7	10	6
Chromium	100.0%	224	n/a	—	100	2
Selenium	100.0%	137 J	180	—	50	4
Filtered Groundwater						
Metals (µg/l)						
Arsenic	100.0%	29.2	0.045	7	10	4
Chromium	100.0%	105	n/a	—	100	1
Selenium	100.0%	133 J	180	—	50	4

— no exceeding samples n/a not applicable µg/l micrograms per liter
* Secondary MCL (EPA 2012)

Niulii Reservoir Sewage Ponds Sediment Sampling

Seven sediment samples were collected from the first pond and analyzed for VOCs, SVOCs, PAHs, pesticides, PCB congeners, metals, and TPH. Concentrations of aluminum, arsenic, cobalt, iron, and manganese exceeded EPA residential RSLs in sediment samples. Concentrations of acetone, TPH-DRO, cobalt, selenium, and vanadium exceeded DOH EALs in one or more sediment samples. The complete analytical data results can be found in the RI.

Niulii Reservoir Sewage Ponds Sludge Sampling

Sludge material observed on the vegetation beneath the outfall pipe in the first pond was sampled and analyzed for SVOCs, PAHs, pesticides, PCBs as Aroclors, metals, and TPH.

Concentrations of PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene), pesticides (DDD and DDT), and metals (aluminum, arsenic, cobalt, and iron) exceeded EPA residential RSLs. Benzo[a]pyrene, dibenz[a,h]anthracene, cobalt, vanadium, and zinc also exceeded DOH EALs. Zinc was the only metal that exceeded the 95th percentile background concentration for the Waianae volcanic soils. The presence of other pesticides and PCBs could not be conclusively discounted because of the required sample dilution resulting in elevated reporting limits. Concentrations of TPH-DRO exceeded the DOH EAL. The complete analytical data results can be found in the RI report.

Niulii Reservoir Sewage Ponds Wastewater Sampling

A wastewater sample was collected from a sewage tank located between Sewage Tank S522 and the sewage ponds and analyzed for VOCs, SVOCs, PAHs, pesticides, metals, and TPH. Concentrations of TPH-DRO, TPH-LRO, toluene, bis(2-ethylhexyl)phthalate, diethylphthalate, and naturally occurring metals were detected. However, no concentrations of COPCs exceeded the EPA tap water RSLs. The complete analytical data results can be found in the RI report.

Niulii Reservoir Surface Water Sampling

Screening criteria were based on *National Recommended Water Quality Criteria for Freshwater* (EPA 2005), *DOH Water Quality Standards for Inland Freshwater* Hawaii Administrative Rule (HAR) 11-54 (DOH 2004), or Great Lakes Tier II Values (EPA 1994). Two surface water samples were collected from the first pond and analyzed for VOCs, SVOCs, PAHs, pesticides, metals, and TPH. Concentrations of toluene, di-n-butyl phthalate, pyrene, and metals were detected but did not exceed screening criteria. Concentrations of aluminum, arsenic, barium, chromium, cobalt, copper, iron, manganese, nickel, selenium, silver, vanadium, and zinc exceeded one or more screening criteria. All other COPC concentrations did not exceed their respective screening criteria. The complete analytical data results can be found in the RI report.

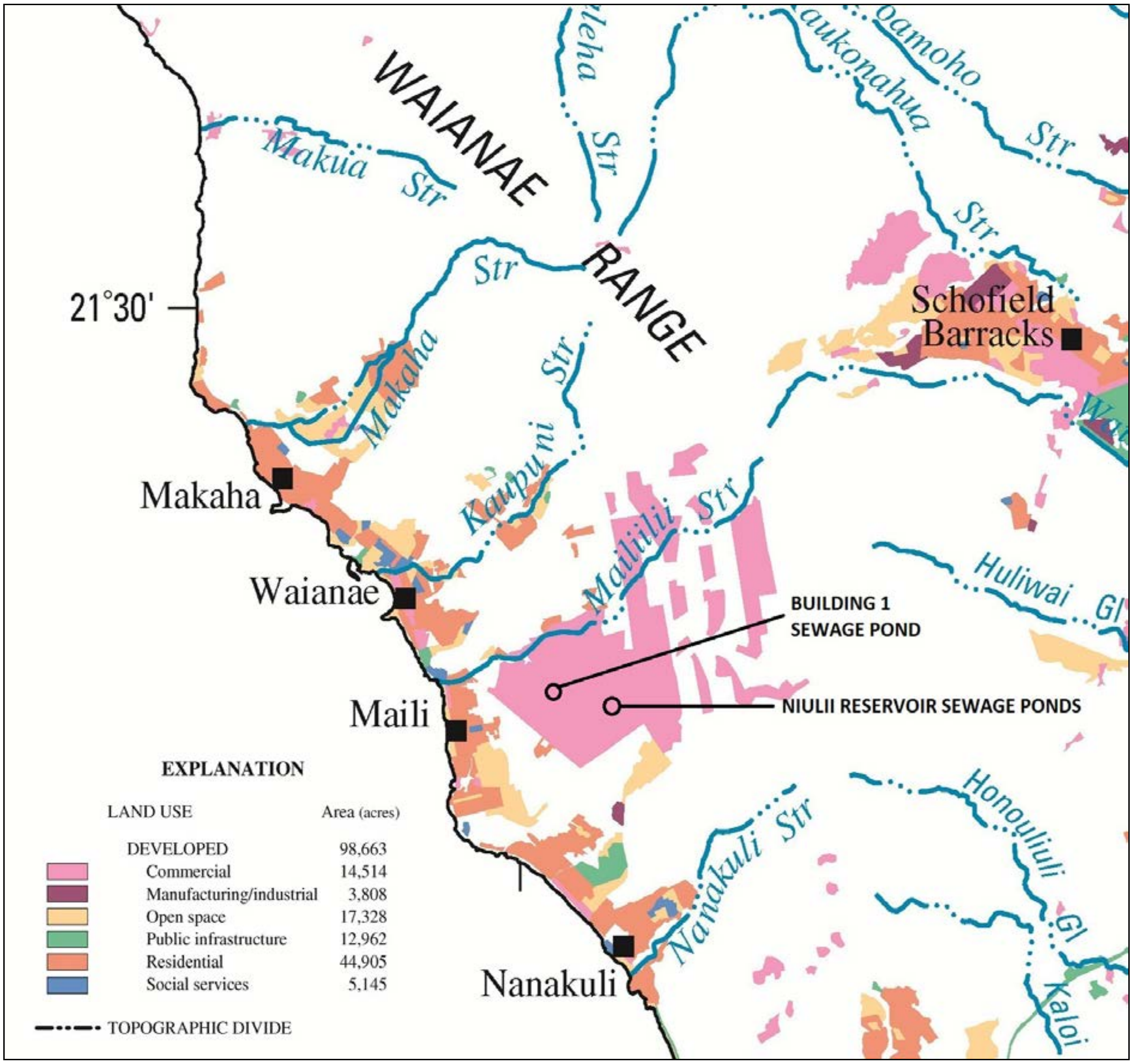
2.5 Current and Potential Future Site Uses

The NRTF Lualualei is zoned for commercial use (Figure 2-2), and includes transmitting towers, an area of vacant housing, and operational support facilities (e.g., offices and general maintenance facilities). The NRTF is contiguous to NMC EAD DET, JBPHH Lualualei Annex and surrounded by agricultural and small areas of urban and conservation land use districts. As with the Site, a reduction in industrial activities occurred at the NMC EAD DET in the 1990s and ordnance-related activities are no longer conducted at the LLL Annex.

The nearest urban area is the town of Maili, which lies approximately 1 mile west of the Naval Reservation. The near-term future use of the Site is anticipated to remain the same; however the long-term future use is uncertain.

Although the caprock groundwater at NRTF Lualualei may meet the EPA criteria for Class II groundwater (e.g., yielding at least 150 gallons per day with total dissolved solids concentration less than 10,000 mg/l), the caprock at this area would not yield a sufficient quantity of groundwater with water quality parameters acceptable for a drinking water supply. Groundwater underlying the Site is not used for drinking water or irrigation purposes, and is not expected to be used for these purposes in the future.

Figure 2-2. Land Use Map



Source: U.S. Geological Survey, 1998.

2.6 Summary of Site Risk

The risk assessment estimates what risks the Site poses if no action is taken. It provides the basis for taking action, if necessary, and identifies the contaminants and exposure pathways, if any, that need to be addressed by a remedial action. Due to the presence of COPCs exceeding risk-based screening criteria in the RI, both human health and ecological risk assessments were conducted for the Site to further evaluate potential risks.

2.6.1 Conceptual Site Model

The conceptual site model (CSM) is a dynamic model that is used to include or exclude sources of COPCs, receptors, or exposure pathways, based on site history and current information. The human health CSM identifies the exposure pathways that are potentially complete, insignificant, or incomplete for selected current and future human and ecological receptors. Figure 2-3 summarizes potential exposure pathways for current and future

potential receptors at the Site. Although the Site is not considered for property transfer at this time, future residential and/or industrial use is possible; therefore, these receptors are included in the CSM. For the CSM, groundwater beneath the sewage ponds was assumed to be potentially potable.

Surface Soil Exposure Pathways and Receptors

Potentially complete pathways for humans include absorption through the skin and incidental ingestion. Potentially complete pathways for ecological receptors include ingestion of soil and bioaccumulation uptake from surface soil. Inhalation of particulates was considered a potentially complete pathway for current industrial workers, future residents, and construction and industrial workers.

Surface Water and Sediment Exposure Pathways and Receptors

The surface water and sediment exposure pathway for humans at the Site is exposure to surface water by industrial workers who remove vegetation at the southern pond of the Niulii Reservoir Sewage Ponds to maintain habitat, which could lead to dermal contact with surface water and suspended sediment.

Subsurface Soil and Groundwater Exposure Pathways and Receptors

Exposure pathways to subsurface soil are potentially complete for future residents and construction workers through dermal absorption, incidental ingestion, and inhalation of particulates from subsurface soil. Exposure pathways to groundwater are potentially complete for future industrial workers, trespassers/hunters, ecological receptors, and future residents or construction workers through dermal absorption or incidental ingestion of groundwater that is pumped to the Niulii Reservoir Sewage Ponds. Groundwater is currently not used as drinking water at the Site and is not anticipated to be used as drinking water in the near future.

2.6.2 Human Health Risk Assessment

The Human Health Evaluation included a Tier 1A Risk-Based Screening, Tier 1B Site-Specific Risk-Based Evaluation and a Tier 2 Baseline Human Health Risk Assessment (DoN 2011).

Potential exposure to detected COPCs in surface and subsurface soil, groundwater, surface water, and sediment was evaluated for trespassers/hunters (adult and child), onsite construction and industrial workers, future residents (adult and child), and ecological receptors. Potentially complete current and future exposure pathways for each receptor are summarized in Table 2-7. Surface soil and sediment exposure pathways included direct contact, bio-uptake, and contact with soil or sediment in surface water. Subsurface exposure pathways included direct contact and indirect contact with subsurface soil and groundwater. Although groundwater is not presently used at the Site, it is pumped into the Niulii Reservoir Sewage Ponds to maintain the surface water level and was evaluated as part of the risk assessment as if groundwater were to be used in the future.

The results of the risk assessment indicated that no site chemicals are present at levels that present potentially unacceptable risk to human health and the environment. A response action is not necessary to protect human health or welfare from actual or threatened releases of pollutants or contaminants from the Site. A description of the risk assessment and results are included in the following sections.

2.6.3 Tier 1 Human Health Evaluation

The Tier 1A Risk-Based Screening used the maximum concentrations of COPCs to identify those COPCs that needed further risk evaluation. Reasonable maximum exposure (RME) and central tendency exposure (CTE) exposure point concentration (EPC) for each COPC were used to quantify the risk posed by COPCs by media. The RME and CTE EPCs were calculated for each medium (soil, groundwater, surface water, and sediment), and for soil, separate RME and CTE EPCs were calculated for surface and subsurface soils.

The RME EPC represents a high-end level of exposure and the CTE EPC an average level of exposure. The RME EPC was based on the lower value of the 95 percent upper confidence limit (UCL) of the mean chemical concentration of each COPC and the maximum concentration of the respective COPC. The CTE EPC represents the average concentration of each COPC.

For the Tier 1A Risk-Based Screening, maximum concentrations, CTE EPCs, and RME EPCs were compared to residential and industrial RSLs (EPA 2011) and calculated CTE screening values. Additionally, to comply with Navy Human Health Risk Assessment guidance (DoN 2008), the maximum concentration of each detected chemical was compared to the DOH EAL for select chemicals that do not have RSLs, so that they could be further evaluated. A sludge sample from the Niulii Reservoir Sewage Ponds was included in the surface soil data set for Niulii Sewage Ponds in the Tier 1A Risk-Based Screening.

Cumulative incremental lifetime cancer risks and hazard indices were calculated by summarizing incremental lifetime cancer risks and hazard indices based on RME EPCs, CTE EPCs and RSLs of each COPC to represent the risk to human health posed by each medium or horizon (soil).

The RME EPC- and CTE EPC-based incremental lifetime cancer risks and hazard indices were calculated for two different sets of data for soil and sediment, one including metal background values and one excluding metal background values.

The cumulative incremental lifetime cancer risk represents cancer risk and the Hazard Index represents non-cancer risk.

- Noncancer risk goal (i.e., hazard index goal) = 1.
- Cancer risk goal = 1E-06 (i.e., one increase incidence of cancer in a population of 1,000,000 people exposed).

The calculated RME and CTE incremental lifetime cancer risks and hazard indices were compared to noncancer and cancer risk goals as outlined in the EPA guidance (EPA 1989, 1991). For the noncancer goal, EPA guidance uses a noncancer hazard index (sum of the HQs for multiple substances) equal to or less than 1 to determine if adverse noncancer health effects are unlikely to occur. For cancer risk, the EPA emphasizes the use of one chance in one million (i.e., 1E-06) as the point of departure risk value while allowing site or remedy-specific factors, including potential future uses, to enter into the evaluation of what may be appropriate for a given site in the target risk management range of 1E-06 to 1E-04.

The results of the Tier 1A Risk-Based Screening provided a list of COPCs with EPCs that exceeded soil or tap water RSLs, therefore requiring further evaluation in the Tier 1B Site-Specific Risk-Based Evaluation of cumulative incremental lifetime cancer risks and hazard indices for standard residential and industrial receptors. Table 2-8 lists the COPCs carried forward to the Tier 1B Site-Specific Risk-Based Evaluation for the Bldg. 1 Sewage Ponds and the Niulii Reservoir Sewage Ponds. Table 2-9 summarizes the incremental lifetime

cancer risks and hazard indices calculated during the Tier 1A Risk-Based Screening for residential and industrial receptors, along with incremental lifetime cancer risks and hazard indices calculated during the Tier 1B Site-Specific Risk-Based Evaluation.

For the Tier 1B Site-Specific Risk-Based Evaluation, COPCs were chemicals with EPCs that exceeded soil or tap water RSLs in the Tier 1A Risk-Based Screening. The Tier 1B Site-Specific Risk-Based Evaluation evaluated potential current or future receptors including trespassers (adult/child), hunters, and onsite construction/utility workers.

Tier 1B risk-based screening criteria (RBSC) are concentrations of constituents in soil that are considered protective of human health under a specific exposure scenario. Tier 1B RBSC were calculated for each exposure scenario by integrating the exposure and toxicity information with the cancer risk goal of 10E-6 and noncancer risk goal of 1. As for the Tier 1A Risk-Based Screening, RME and CTE EPCs were calculated for comparison against the receptor-specific RBSC. Based on RME and CTE EPCs, incremental lifetime cancer risks and hazard indices were calculated.

The results of the Tier 1B Site-Specific Risk-Based Evaluation are summarized as cumulative incremental lifetime cancer risks and hazard indices for the Bldg. 1 Sewage Pond and the Niulii Reservoir Sewage Ponds in Table 2-9 and Table 2-10, respectively.

Tier 1 Human Health Risk Evaluation Results at Bldg. 1 Sewage Pond

Results of the risk assessment, as presented in the RI and Table 2-9, show that the total incremental lifetime cancer risks for surface soil at Bldg. 1 Sewage Ponds for all human receptors are within the EPA target risk management range of 10^{-6} to 10^{-4}. The estimated total surface soil non-cancer hazard indices at Bldg. 1 Sewage Ponds for all receptors are below the EPA target hazard index of 1 when concentrations of metals within established background ranges are excluded, except for the child resident (Appendix A). The child resident hazard index is 3 when concentrations of metals within established background ranges are excluded and is driven solely by surface soil concentrations of iron.

Although the maximum detected concentration of iron is above background levels for the Waianae Volcanic Soils (134,000 mg/kg), the sample value (157,000 mg/kg) is an average between field duplicate results from location NL-02. The primary sample result (106,000 mg/kg) was below background. The field duplicate result (208,000 mg/kg) was above background. It should be noted that other metals (antimony, arsenic, chromium, copper, and nickel) concentrations in the primary sample were within their respective background ranges and consistent with other metal concentrations detected throughout the Bldg. 1 Sewage Pond. However, all the detected metals in the duplicate sample exceeded their respective background ranges. Given the co-located nature of the samples it is unlikely the source of contamination is indicative of a release; rather it is plausible that the metal concentrations observed in the field duplicate are attributable to metallic debris within this sample. Therefore, the result is likely to be an outlier and inclusion of that analytical result overestimates the contribution of iron to the hazard index for exposure to Bldg. 1 surface soil.

As such, a subsequent evaluation was conducted, specifically for this ROD, in which the field duplicate metal results were removed from the dataset. Maximum detected metal concentrations in surface soil at Bldg. 1 Sewage Ponds were compared against screening criteria utilized in the RI; EPA RSLs (EPA 2009) and DOH EALs (2009). The 95 percent UCLs were re-calculated and the cancer risks and non-cancer hazards were re-evaluated. Results show that the total incremental lifetime cancer risks for all human receptors are within or below the EPA target risk management range of 10^{-6} to 10^{-4}. The estimated total

surface soil non-cancer hazard indices at Bldg. 1 Sewage Ponds for all receptors are also below the EPA target hazard index of 1 when concentrations of metals within established background ranges are excluded. More specifically, for the child resident, that had a hazard index of 3, now the hazard index is 0.2, as shown in the data set included as Appendix A. Therefore, exposure to surface soil at the Bldg.1 Sewage Pond is considered to be acceptable.

Cumulative incremental lifetime cancer risks for all receptors considered during the Tier 1A and Tier 1B risk assessment for subsurface soil were within the target risk management range of 1E-06 to 1E-04 (or below), and hazard indices for receptors are all less than or equal to 1 when concentrations of metals within established background ranges are excluded.

For groundwater, cumulative incremental lifetime cancer risks and hazard indices for the residential receptor exceeded the target risk management range of 1E-06 to 1E-04 and 1, respectively; however, groundwater is not considered a current drinking water source.

Tier 1 Human Health Risk Evaluation Results at Niulii Reservoir Sewage Ponds

The cumulative cancer risk for surface soil, subsurface soil, and sediment were all within the target range of 10^{-6} to 10^{-4} (or below) for all receptors at the Niulii Reservoir Sewage Ponds.

Hazard indices for all receptors are less than or equal to 1 when concentrations of metals within established background ranges are excluded.

For groundwater and surface water, cumulative incremental lifetime cancer risks and hazard indices for the residential receptor exceeded the target risk management range of 1E-06 to 1E-04 and 1, respectively; however, groundwater and surface water are not considered as current drinking water.

Figure 2-3. Exposure Pathway Scenarios

Contributing Sources	Transport Mechanisms	Exposure Route	Receptors: Current Land Use: Industrial Workers	Current Land Use: Trespassers and Hunters (Adult/Child)	Current Land Use: Ecological Receptors	Future Land Use: Residents (Adult/Child) [a]	Future Land Use: Industrial Workers	Future Land Use: Trespassers and Hunters (Adult/Child)	Future Land Use: Construction Workers [a]	Future Land Use: Ecological Receptors [b]	Rationale
Surface Soil/ Sediment	Direct Contact	Dermal Absorption	Potentially Complete	Potentially Complete	Insignificant	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Insignificant	Dermal absorption and incidental ingestion of surface soil are potentially complete pathways for current trespassers and hunters. Exposure for onsite terrestrial ecological receptors will not be assessed because of a lack of exposure parameters for this pathway. Dermal absorption and incidental ingestion pathways are potentially complete for residential users and construction workers. Conditions for ecological receptors are assumed to remain the same in the future.
		Incidental Ingestion	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Same as above for human receptors. Terrestrial ecological receptors may incidentally ingest surface soil during foraging and/or grooming activities.
	Air Transport	Inhalation of VOCs	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	The inhalation pathway for VOCs is considered incomplete for both human and ecological receptors because VOCs in surface soil volatilize to the atmosphere quickly, especially in a warm climate. No significant levels of VOCs are expected to persist because they would have largely volatilized during transport and discharge of wastewater and storm water.
		Inhalation of Particulates	Potentially Complete	Insignificant	Insignificant	Potentially Complete	Potentially Complete	Insignificant	Potentially Complete	Insignificant	Inhalation of contaminated dust is a potentially complete pathway for current and future industrial workers, future residents, and future construction workers. Future construction workers could be exposed to contaminated dust during excavation work. Exposure for onsite terrestrial ecological receptors will not be assessed because of a lack of exposure factors for this pathway. Inhalation of particulates only applies to sediment that is dry, not sediment that is under water.
	Bio-uptake	Ingestion of Plants/Animals	Incomplete	Potentially Complete	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Incomplete	Potentially Complete	There are no agricultural activities on site. Hunters may ingest animals that forage on site. Ecological receptors may eat the natural vegetation growing on site and feed on prey living on site.
	Surface Water	Dermal Absorption	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Exposure to dissolved contaminants in surface water is a potentially complete pathway for all receptors except the construction worker at the Niulii Reservoir, because major construction would be discouraged in a wildlife management area.
		Incidental Ingestion	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Exposure to dissolved contaminants in surface water is a potentially complete pathway for all receptors except the construction worker at the Niulii Reservoir, because major construction would be discouraged in a wildlife management area.
		Inhalation of VOCs	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	Incomplete	The inhalation pathway for VOCs is considered incomplete for both human and ecological receptors because VOCs in surface water volatilize to the atmosphere quickly, especially in a warm climate. No significant levels of VOCs are expected to persist because they would have largely volatilized during transport and discharge of wastewater and storm water.
		Bioaccumulation/ Consumption of Food	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Incomplete	Potentially Complete	Exposure to dissolved contaminants in surface water is a potentially complete pathway for all receptors except the construction worker at the Niulii Reservoir, because major construction would be discouraged in a wildlife management area.
Subsurface Soil/ Sediment	Unsaturated/ Saturated Zone Transport to Groundwater	Dermal Absorption; Incidental Ingestion; Inhalation of VOCs	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Potentially Complete	Contaminants could migrate to groundwater below the site. Exposure to dissolved contaminants in groundwater is a potentially complete pathway for all receptors because the ponds are replenished with water from a nearby supply well. Dermal absorption, incidental ingestion, and inhalation pathways are potentially complete for all receptors.
	Direct Contact	Dermal Absorption; Incidental Ingestion; Inhalations of VOCs; Inhalation of Particulates	Incomplete	Incomplete	Incomplete	Potentially Complete	Incomplete	Incomplete	Potentially Complete	Incomplete	Direct contact with subsurface soil is incomplete for all current human and ecological receptors. Exposure to subsurface soil may occur when future residents or onsite workers engage in gardening or construction activities. Ecological receptors are not expected to come into contact with subsurface soil. Inhalation of particulates only applies to sediment that is dry, not to sediment under water.

[a] Although this parcel is not considered for property transfer at this time, future residential and/or industrial land use is possible.
[b] Future conditions are assumed to be the same as current conditions for ecological receptors. No future scenarios are run.

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Table 2-7. Exposure Pathway Summary

Medium	Exposure Pathway	Receptor							
		Current Land Use			Future Land Use				
		Industrial Workers	Tress-passers/ Hunters	Ecological Receptors	Residents	Industrial Workers	Tress-passers/ Hunters	Construction Workers	Ecological Receptors
Surface Soil and Sediment - Direct Contact	Dermal absorption	**PC**	**PC**	IS	**PC**	**PC**	**PC**	**PC**	IS
	Incidental ingestion	**PC**	**PC**	**PC**	**PC**	**PC**	**PC**	**PC**	**PC**
	Inhalation	**PC**	IS	IS	IS	**PC**	IS	PC	IS
	Bio-uptake	-	**PC**	**PC**	**PC**	-	**PC**	-	**PC**
Surface Soil and Sediment via Surface Water	Dermal absorption	**PC**	**PC**	**PC**	**PC**	**PC**	**PC**	-	**PC**
	Incidental ingestion								
	Bio-uptake								
Subsurface Soil Direct Contact	Dermal absorption	-	-	-	**PC**	-	-	**PC**	-
	Incidental ingestion								
	Inhalation								
	Bio-uptake								
Subsurface Soil via Ground Water	Dermal absorption	**PC**	**PC**	**PC**	**PC**	**PC**	**PC**	**PC**	**PC**
	Incidental ingestion								
	Inhalation								
	Bio-uptake								

PC potentially complete
"-" incomplete
IS insignificant

Table 2-8. COPCs Selected for the Tier 1B Site-Specific Risk-Based Evaluation

Medium				
Surface Soil	**Subsurface Soil**	**Groundwater**	**Sediment**	**Surface Water**
Bldg. 1 Sewage Ponds				
Benzo(a)anthracene	Aroclor 1260	Arsenic	Not Sampled	Not Sampled
Benzo(a)pyrene	DDE	Selenium		
Benzo(b)fluoranthene	Aluminum			
Aroclor 1260	Arsenic			
Aluminum	Cobalt			
Arsenic	Iron			
Cobalt	Manganese			
Iron				
Niulii Reservoir Sewage Ponds				
Dibenz(a,h)anthracene	Benzo(a)pyrene	Arsenic	Aluminum	Arsenic
Dibenz(a,h)anthracene	Benzo(a)pyrene	Arsenic	Aluminum	Arsenic
Indeno(1,2,3-cd)pyrene	Dibenz(a,h)-anthracene	Chromium	Arsenic	Cobalt
Aroclor 1260	Aluminum	Selenium	Cobalt	Manganese
Aluminum	Arsenic	Carbon Tetrachloride	Iron	
Arsenic	Cobalt	Chloroform	Manganese	
Cobalt	Iron			
Iron	Manganese			
Manganese				

Source: DoN 2011

Table 2-9. Summary of Tier 1B Human Health Cumulative Cancer Risks and Noncancer Effects for Bldg. 1 Sewage Pond

Human Health Receptor	CTE Scenario				RME Scenario			
	Cumulative Incremental Lifetime Cancer Risk Including Backgr. Metals	Hazard Index Including Backgr. Metals	Cumulative Incremental Lifetime Cancer Risk Excluding Backgr. Metals	Hazard Index Excluding Backgr. Metals	Cumulative Incremental Lifetime Cancer Risk Including Backgr. Metals	Hazard Index Including Backgr. Metals	Cumulative Incremental Lifetime Cancer Risk Excluding Backgr. Metals	Hazard Index Excluding Backgr. Metals
Surface Soil [a]								
Resident	4E–05	6E+00	2E–05	2E+00	7E–05	9E+00	3E–05	3E+00
Industrial Worker	1E–06	2E–01	3E–07	4E–02	1E–05	5E–01	3E–06	1E–01
Child Trespasser	1E–05	6E–01	4E–06	0E+00	2E–05	1E+00	7E–06	0E+00
Hunter	2E–07	6E–03	1E–07	0E+00	1E–06	2E–02	5E–07	0E+00
Construction Worker	6E–07	5E–01	1E–07	0E+00	8E–06	1E+00	2E–06	0E+00
Subsurface Soil [a]								
Resident	6E–06	4E+00	4E–06	1E–02	1E–05	7E+00	9E–06	2E–02
Industrial Worker	5E–07	2E–01	4E–07	4E–02	4E–06	5E–01	3E–06	1E–01
Construction Worker	1E–07	7E–01	6E–08	0E+00	2E–06	1E+00	1E–06	0E+00
Groundwater (2003 Sampling)								
Resident (total metals)	3E–04	3E+00	—	—	8E–04	4E+00	—	—
Resident (dissolved metals)	3E–04	3E+00	—	—	8E–04	4E+00	—	—
Construction Worker (total metals)	2E–08	7E–03	—	—	2E–07	1E–02	—	—
Construction Worker (dissolved metals)	2E–08	6E–03	—	—	2E–07	1E–02	—	—
Groundwater (2004 Sampling)								
Resident (total metals)	2E–04	2E+00	—	—	5E–04	3E+00	—	—
Resident (dissolved metals)	2E–04	2E+00	—	—	5E–04	2E+01	—	—
Construction Worker (total metals)	1E–08	4E–03	—	—	1E–07	9E–03	—	—
Construction Worker (dissolved metals)	1E–08	5E–03	—	—	1E–07	1E–02	—	—

Notes: CTE – central tendency exposure RME – reasonable maximum exposure

[a] Cumulative incremental lifetime cancer risks and hazard indices including background include all detected metals. Cumulative incremental lifetime cancer risks and hazard indices excluding background exclude metals with maximum detected concentrations greater than the background range

Table 2-10: Summary of Tier 1B Human Health Cumulative Cancer Risks and Noncancer Effects for Niulii Reservoir Sewage Ponds

Human Health Receptor	CTE Scenario				RME Scenario			
	Cumulative Incremental Lifetime Cancer Risk Including Backgr. Metals	Hazard Index Including Backgr. Metals	Cumulative Incremental Lifetime Cancer Risk Excluding Backgr. Metals	Hazard Index Excluding Backgr. Metals	Cumulative Incremental Lifetime Cancer Risk Including Backgr. Metals	Hazard Index Including Backgr. Metals	Cumulative Incremental Lifetime Cancer Risk Excluding Backgr. Metals	Hazard Index Excluding Backgr. Metals
Surface Soil [a]								
Resident	2E–05	4E+00	1E–05	3E–01	3E–05	7E+00	2E–05	2E–01
Industrial Worker	3E–07	2E–01	2E–07	6E–03	3E–06	3E–01	2E–06	1E–02
Child Trespasser	4E–06	7E–01	3E–06	0E+00	8E–06	9E–01	7E–06	0E+00
Hunter	9E–08	5E–03	8E–08	0E+00	5E–07	2E–02	4E–07	0E+00
Construction Worker	1E–07	6E–01	9E–08	0E+00	2E–06	1E+00	1E–06	0E+00
Subsurface Soil [a]								
Resident	9E–06	5E+00	2E–06	2E+00	2E–05	8E+00	3E–06	2E+00
Industrial Worker	4E–07	2E–01	3E–08	1E–01	4E–06	4E–01	4E–07	2E–01
Construction Worker	2E–07	8E–01	4E–09	0E+00	2E–06	2E+00	6E–08	0E+00
Groundwater (2003 Sampling)								
Resident (total metals)	2E–04	4E+00	—	—	7E–04	6E+00	—	—
Resident (dissolved metals)	2E–04	3E+00	—	—	6E–04	4E+00	—	—
Construction Worker (total metals)	2E–08	1E–02	—	—	2E–07	2E–02	—	—
Construction Worker (dissolved metals)	2E–08	5E–03	—	—	2E–07	1E–02	—	—
Groundwater (2004 Sampling)								
Resident (total metals)	1E–04	2E+00	—	—	4E–04	2E+00	—	—
Resident (dissolved metals)	2E–04	2E+00	—	—	5E–04	3E+00	—	—
Construction Worker (total metals)	2E–08	4E–03	—	—	2E–07	8E–03	—	—
Construction Worker (dissolved metals)	1E–08	4E–03	—	—	1E–07	7E–03	—	—

Human Health Receptor	CTE Scenario				RME Scenario			
	Cumulative Incremental Lifetime Cancer Risk Including Backgr. Metals	**Hazard Index Including Backgr. Metals**	**Cumulative Incremental Lifetime Cancer Risk Excluding Backgr. Metals**	**Hazard Index Excluding Backgr. Metals**	**Cumulative Incremental Lifetime Cancer Risk Including Backgr. Metals**	**Hazard Index Including Backgr. Metals**	**Cumulative Incremental Lifetime Cancer Risk Excluding Backgr. Metals**	**Hazard Index Excluding Backgr. Metals**
Sediment [a]								
Resident	2E–05	6E+00	5E–07	5E–02	4E–05	1E+01	1E–06	8E–02
Industrial Worker	1E–06	3E–01	1E–08	8E–04	9E–06	5E–01	1E–07	2E–03
Child Trespasser	5E–06	1E+00	0E+00	1E–02	9E–06	2E+00	0E+00	2E–02
Hunter	8E–08	9E–03	0E+00	0E+00	8E–07	3E–02	0E+00	0E+00
Surface Water								
Resident (total metals)	1E–04	7E+00	—	—	4E–04	1E+01	—	—
Resident (dissolved metals)	2E–04	5E+00	—	—	5E–04	7E+00	—	—
Child Trespasser (total metals)	2E–08	3E–03	—	—	1E–07	2E–02	—	—
Child Trespasser (dissolved metals)	3E–08	1E–03	—	—	1E–07	1E–02	—	—
Hunter (total metals)	7E–09	7E–04	—	—	1E–07	3E–03	—	—
Hunter (dissolved metals)	8E–09	4E–04	—	—	1E–07	2E–03	—	—

[a] Cumulative Incremental lifetime cancer risks and hazard indices including background include all detected metals. Cumulative incremental lifetime cancer risks and hazard indices excluding background exclude metals with maximum detected concentrations greater than the background range.

2.6.4 Tier 2 Human Health Risk Assessment Addendum

Based on discussions with the EPA and DOH an Addendum to the Tier 1A Risk-Based Screening and Tier 1B Site-Specific Risk-Based Evaluation was completed for the 2011 RI report using updated toxicity values and statistics to further evaluate risk at the Site for the child residential receptor (DoN 2011).

Based on the results of the Tier 1A Risk-Based Screening and Tier 1B Site-Specific Risk-Based Evaluation, the following media were considered further in the Tier II Human Health Risk Assessment (HHRA) Addendum:

- Surface soil at Bldg. 1 Sewage Pond
- Surface soil at Niulii Reservoir Sewage Ponds
- Subsurface soil at Niulii Reservoir Sewage Ponds

Contaminants that were not ruled out in the Tier 1 Risk-Based Screening were carried forward into the Tier 2 HHRA Addendum because concentrations at the Site exceeded the respective RSLs or EALs (Table 2-11). Exposure pathways included in the Tier 2 HHRA addendum were incidental ingestion, dermal contact, and inhalation of ambient vapors and fugitive dust from soil. The child resident was chosen as the only receptor, because it is the receptor requiring the greatest level of protection.

For Niulii Reservoir Sewage Ponds surface soil, the statistics for the HHRA Addendum were run twice, once with and once without the sludge sample NL-40, which is located directly beneath the sewage outfall pipe connected to a 50,000 gallon settling tank. It is not likely that any person would be repeatedly exposed to the sludge at the NL-40 location.

Results of the Tier 2 HHRA Addendum indicated that the cumulative incremental lifetime cancer risk for surface soil and subsurface soil at the Bldg. 1 Sewage Ponds are within the target cancer risk management range of 10^{-6} to 10^{-4} for all receptors (Table 2-11). The hazard indices for surface and subsurface soil under the RME scenario are less than the target noncancer hazard of 1 for all receptors except the potential resident when metals within background concentrations are excluded (Table 2-12). Refer to Section 2.6.3 for a detailed discussion of the risk for surface soil exposure at Bldg. 1 Sewage Pond.

The incremental lifetime cancer risk for groundwater exceeded the target cancer risk range of 10^{-6} to 10^{-4} and the target hazard index of 1 for the potential resident due to the presence of arsenic and selenium, if groundwater were to be used as drinking water. However, groundwater beneath the sites is not considered suitable as, or a potential source of drinking water. Exposure to groundwater otherwise is considered acceptable.

Results of the Tier 2 HHRA Addendum indicated that the cumulative cancer risk for surface and subsurface soil at Niulii Sewage Ponds for all human receptors are within the EPA target risk management range of 10^{-6} to 10^{-4} (Table 2-11). The estimated total surface and subsurface soil hazard index at Niulii Sewage Ponds for all human receptors are below the EPA target hazard index of 1 when concentrations of metals within established background ranges are excluded (Table 2-12). Therefore, exposure to surface soil at the Niulii Reservoir Sewage Ponds is considered to be acceptable.

Table 2-11: Tier II Total Incremental Lifetime Cancer Risks for Child Resident

COPC	Bldg. 1 Sewage Pond	Niulii Sewage Ponds	Niulii Sewage Ponds	Niulii Sewage Ponds	Niulii Sewage Ponds
	Surface Soil	Surface Soil (including NL-40)	Surface Soil (excluding NL-40)	Sludge Sample (NL-40)	Subsurface Soil
Acetone	n/a	n/a	n/a	n/a	n/a
alpha-BHC (Hexachlorocyclohexane, alpha)	n/a	1.85E–08	1.85E–08	n/a	n/a
alpha-Chlordane	n/a	6.36E–09	6.36E–09	n/a	6.82E–09
Aluminum	n/a	n/a	n/a	n/a	n/a
Antimony	n/a	n/a	n/a	n/a	n/a
Aroclor 1260	3.01E–06	1.25E–06	1.25E–06	n/a	2.18E–07
Arsenic	1.40E–05	3.74E–06	2.14E–06	3.74E–06	3.78E–06
Barium	n/a	n/a	n/a	n/a	n/a
Benzo[a]anthracene	1.89E–06	2.96E–06	8.45E–08	8.95E–06	4.93E–08
Benzo[a]pyrene	1.06E–05	1.76E–05	4.04E–07	7.97E–05	4.19E–07
Benzo[b]fluoranthene	6.82E–06	2.43E–06	1.54E–07	1.09E–05	n/a
Benzo[k]fluoranthene	2.84E–07	1.09E–07	n/a	4.80E–07	n/a
beta-BHC (Hexachlorocyclohexane, beta)	n/a	6.06E–09	6.06E–09	n/a	n/a
Bis(2-ethylhexyl)phthalate	1.43E–07	2.16E–08	n/a	n/a	n/a
Cobalt	4.33E–08	5.03E–08	5.04E–08	4.86E–08	5.66E–08
Copper	n/a	n/a	n/a	n/a	n/a
DDD	n/a	1.86E–06	n/a	5.72E–06	n/a
DDE	7.54E–08	9.51E–08	9.51E–08	n/a	7.06E–08
DDT	n/a	9.52E–06	2.56E–08	2.95E–05	4.08E–09
Dibenz[a,h]anthracene	n/a	1.26E–05	n/a	2.84E–05	2.29E–06
Dieldrin	n/a	4.29E–08	4.29E–08	n/a	5.61E–08
gamma-Chlordane	n/a	1.78E–09	1.78E–09	n/a	4.44E–09
Indeno[1,2,3-cd]pyrene	n/a	1.94E–06	n/a	5.02E–06	n/a
Iron	n/a	n/a	n/a	n/a	n/a
Manganese	n/a	n/a	n/a	n/a	n/a

COPC	Bldg. 1 Sewage Pond	Niulii Sewage Ponds	Niulii Sewage Ponds	Niulii Sewage Ponds	Niulii Sewage Ponds
	Surface Soil	Surface Soil (including NL-40)	Surface Soil (excluding NL-40)	Sludge Sample (NL-40)	Subsurface Soil
Mercury	n/a	n/a	n/a	n/a	n/a
Naphthalene	n/a	n/a	n/a	n/a	n/a
Nickel	3.49E–09	2.65E–09	2.59E–09	3.94E–09	2.92E–09
Selenium	n/a	n/a	n/a	n/a	n/a
Silver	n/a	n/a	n/a	n/a	n/a
Tetrachloroethene	n/a	n/a	n/a	n/a	1.78E–09
Trichloroethene	n/a	n/a	n/a	n/a	1.29E–11
Vanadium	n/a	n/a	n/a	n/a	n/a
Zinc	n/a	n/a	n/a	n/a	NA
Total/Cumulative Incremental Lifetime Cancer Risk:					
Cumulative Incremental lifetime cancer risk (including background):	4.E–05	5.E–05	4.E–06	2.E–04	7.E–06
Cumulative Incremental lifetime cancer risk (excluding 95 % background):	4.E–05	5.E–05	2.E–06	2.E–04	3.E–06

Risks and hazards estimated for hypothetical child resident only as this is the most sensitive receptor. Carcinogenic risks were not age-adjusted.
n/a not available; chemical not detected.

Table 2-12. Estimated Total Surface Soil Hazard Indexes

COPC	Bldg. 1 Sewage Pond	Niulii Sewage Ponds	Niulii Sewage Ponds	Niulii Sewage Ponds	Niulii Sewage Ponds
	Surface Soil	Surface Soil (including NL-40)	Surface Soil (excluding NL-40)	Sludge Sample (NL-40)	Subsurface Soil
Acetone	n/a	n/a	n/a	n/a	1.79E–05
alpha-BHC (Hexachlorocyclohexane, alpha)	n/a	4.29E–06	4.29E–06	n/a	n/a
alpha-Chlordane	n/a	4.24E–04	4.24E–04	n/a	4.55E–04
Aluminum	1.02E+00	9.76E–01	9.74E–01	1.01E+00	9.01E–01
Antimony	1.26E–01	1.25E–01	1.25E–01	n/a	8.09E–01
Aroclor 1260	n/a	n/a	n/a	n/a	n/a
Arsenic	3.65E–01	9.72E–02	5.55E–02	9.72E–02	9.81E–02
Barium	1.91E–02	2.33E–02	2.34E–02	1.96E–02	2.62E–02
Benzo(a)anthracene	n/a	n/a	n/a	n/a	n/a
Benzo(a)pyrene	n/a	n/a	n/a	n/a	n/a
Benzo(b)fluoranthene	n/a	n/a	n/a	n/a	n/a
Benzo(k)fluoranthene	n/a	n/a	n/a	n/a	n/a
beta-BHC (Hexachlorocyclohexane, beta)	n/a	n/a	n/a	n/a	n/a
Bis(2-ethylhexyl)phthalate	5.97E–03	9.00E–04	n/a	n/a	n/a
Cobalt	1.91E+00	2.21E+00	2.22E+00	2.14E+00	2.49E+00
Copper	1.42E–01	2.43E–02	2.28E–02	5.56E–02	2.42E–02
DDD	n/a	n/a	n/a	n/a	n/a
DDE	n/a	n/a	n/a	n/a	n/a
DDT	n/a	6.53E–01	1.76E–03	2.02E+00	2.80E–04
Dibenz(a,h)anthracene	n/a	n/a	n/a	n/a	n/a
Dieldrin	n/a	6.25E–04	6.25E–04	n/a	8.18E–04
gamma-Chlordane	n/a	1.18E–04	1.18E–04	n/a	2.96E–04
Indeno(1,2,3-cd)pyrene	n/a	n/a	n/a	n/a	n/a
Iron	2.47E+00	1.71E+00	1.71E+00	1.86E+00	1.69E+00
Manganese	1.78E–01	2.19E–01	2.21E–01	1.19E–01	3.18E–01
Mercury	4.10E–02	1.39E–02	8.63E–03	8.79E–02	5.13E–03

COPC	Bldg. 1 Sewage Pond	Niulii Sewage Ponds	Niulii Sewage Ponds	Niulii Sewage Ponds	Niulii Sewage Ponds
	Surface Soil	**Surface Soil (including NL-40)**	**Surface Soil (excluding NL-40)**	**Sludge Sample (NL-40)**	**Subsurface Soil**
Naphthalene	3.36E–06	3.85E–05	8.72E–07	1.05E–04	2.62E–06
Nickel	8.11E–02	6.16E–02	6.02E–02	9.15E–02	6.79E–02
Selenium	3.52E–03	3.84E–03	3.84E–03	n/a	2.47E–03
Silver	8.53E–03	8.27E–03	6.90E–03	2.33E–02	3.26E–03
Tetrachloroethene	n/a	n/a	n/a	n/a	3.84E–06
Trichloroethene	n/a	n/a	n/a	n/a	n/a
Vanadium	4.62E–01	4.36E–01	4.33E–01	4.96E–01	3.76E–01
Zinc	2.59E–02	1.01E–02	n/a	n/a	n/a
Total/Cumulative Non-carcinogenic Hazard Index:					
Cumulative Hazard Index (including background):	**7**	**7**	**6**	**8**	**7**
Cumulative Hazard Index (excluding 95 % background):	**3**	**2**	**2**	**2**	**7**
Cumulative Hazard Index (excluding max background):	3	0.8	0.1	2	1

Risks and hazards estimated for hypothetical child resident only as this is the most sensitive receptor. Carcinogenic risks were not age-adjusted.
n/a not available; chemical not detected.

2.6.5 Baseline Ecological Risk Assessment

The Baseline Ecological Risk Assessment (BERA) included a Step 1 and 2 Screening Risk Assessment (SRA) and a Step 3a BERA. The SRA was completed as a technical memorandum in March 2005 (Earth Tech 2005b).

Step 1 of the SRA included identification of representative species, COPCs, establishment of assessment and measurement endpoints, performance of an exposure pathway analysis, a toxicity evaluation, and development of a CSM. Step 2 of the SRA included a quantitative risk analysis. The COPCs that do not pass the SRA are carried into the Step 3a BERA.

Screening Risk Assessment Step 1

The Step 1 SRA identified the northern cardinal *(Cardinalis cardinalis)* and house mouse *(Mus musculus)* as representative species for the Bldg. 1 Sewage Pond site and the Niulii Reservoir Sewage Ponds for the soil exposure pathway. These species are considered representative as they are considered the species with the highest potential of exposure. The wandering tattler *(Heteroscelus incanus)* was added as an additional representative species to represent the sediment exposure pathway at Niulii Reservoir Sewage Ponds.

Surface soil, surface water and groundwater COPCs were included in the SRA for all locations. In addition, sediment at Niulii Reservoir Sewage Ponds was included in the SRA. Target chemicals were considered COPCs for the SRA, with the exception of common nutrients and iron, due to a lack of toxicity data. Preliminary COPCs identified were PAHs, SVOCs, TPH, metals, PCBs, and chlorinated pesticides.

The exposure pathways selected for evaluation in the SRA included uptake of COPCs from surface soil or sediment by vegetation as food for higher trophic level animals, uptake of COPCs from surface soil or sediment by soil invertebrates (represented by earthworms) or benthic fauna as food for higher trophic level animals, uptake of COPCs from surface water by aquatic and sediment-dwelling organisms, ingestion of COPCs in soil or sediment by birds and mammals, ingestion of COPCs in plants by birds and mammals and ingestion of COPCs in soil or sediment invertebrates by birds and mammals

The CSM developed for the sites is presented in Sections 2.6.1 and 2.6.3. Based on the CSM, the SRA evaluated potential exposure to soil, sediment, surface water, and groundwater for terrestrial receptors.

Screening criteria identified for the SRA for direct contact with soil were based on EPA ecological soil screening levels (Eco-SSLs) (EPA 2003), Oak Ridge National Laboratory (ORNL) plant toxicological benchmarks and soil invertebrate toxicological benchmarks (Efroymson et al. 1997). Screening criteria for ingestion of soil were based on ecological soil benchmark concentrations (Eco-SBCs) developed for the SRA (Earth Tech 2005b) that were calculated from chemical- and species-specific exposure factors and toxicity reference values (TRVs) using food-chain models.

The hazard quotient (HQ) method was used to compare soil COPC concentrations to medium-specific, risk-based screening values. An HQ value greater than 1 indicates a potential for adverse impacts to ecological receptors.

Screening Risk Assessment Step 2

Step 2 of the SRA included a quantitative risk analysis with risk calculation, uncertainty analysis and risk characterization that estimated risk using conservative assumptions.

For the Bldg. 1 Sewage Ponds and Niulii Reservoir Sewage Ponds, maximum concentrations of COPCs in surface soil were compared to ORNL Soil Benchmarks to characterize risk for direct contact organisms. Maximum concentrations of COPCs in surface soil of these sites were compared to SRA-developed, Eco-SBC screening concentrations to determine risk to higher trophic level organisms.

In addition, for the Niulii Reservoir Sewage Ponds, maximum concentrations of COPCs in sediments were compared to a sediment screening criterion and Eco-SBC screening criteria to estimate risk to benthic organisms posed by COPCs in sediment, and maximum concentrations in surface water and groundwater were compared against a surface water criterion to estimate the risk to aquatic organisms.

Associated hazard quotients (HQs) were calculated by dividing EPCs by the respective screening values (e.g. ORNL, Eco-SBC) and then compared to the HQ of 1, to determine if potential adverse impact to ecological receptors exists.

Bldg. 1 Sewage Pond Risk Calculations and Characterization

The COPCs considered in the Step 2 SRA for the Bldg. 1 Sewage Pond included PAHs, SVOCs, TPH, metals, PCBs, and chlorinated pesticides. Based on the Step 2 SRA, COPCs with HQs greater than 1 included metals, SVOCs, chlorinated pesticides, and PCBs. Individual COPCs that exceeded the HQ of 1 and were retained for the BERA are summarized in Table 2-13. HQs were less than 1 for PAHs for all exposure scenarios. Primary toxic components in TPH are PAHs, which were addressed in risk considerations for PAHs, and ecological risk-based screening values for TPH are not available; therefore, risk considerations for TPH were addressed in the considerations for PAHs.

Niulii Reservoir Sewage Ponds Risk Calculations and Characterization

The COPCs considered in the Step 2 SRA for the Niulii Reservoir Sewage Ponds included PAHs, SVOCs, TPH, metals, PCBs, and chlorinated pesticides. Based on the Step 2 SRA, the COPCs with SRA HQs exceeding 1 included metals, SVOCs, chlorinated pesticides, and PCBs. Individual COPCs that exceeded the HQ of 1 and were retained for the BERA are summarized in Table 2-13. Hazard quotients are less than 1 for PAHs for all exposure scenarios considered. As noted above, primary toxic components in TPH are PAHs, which are addressed in risk considerations for PAHs, and ecological risk-based screening values for TPH are not available; therefore, risk considerations for TPH components are addressed in the considerations for PAHs.

Step 3a BERA

Based on the high number of COPCs that either exceeded SRA risk thresholds or were not evaluated in the SRA (e.g., based on maximum non-detects exceeding SRA threshold, no bioaccumulation factor , no surface water screening value), all COPCs were carried forward and re-evaluated in a Step 3a BERA. The BERA re-evaluated the SRA COPCs with more realistic assumptions about exposure and updates and adjusted for the water standards (DOH Water Quality Standards and/or National Recommended Water Quality Criteria) and soil bioaccumulation risk (e.g., adding incidental soil ingestion to ingestions of species with bioaccumulation, which lowers the exposure concentration). Further objectives of the Step 3a BERA were to update HQs from the SRA with adjusted exposure assumptions using low no-observed-adverse-effect level (NOAEL) thresholds and to identify COPCs with HQs equal to or larger than 1 and acknowledge risk for these COPCs.

Table 2-13. Summary of COPCs with HQs Exceeding 1 Retained for the BERA

Chemical	Bldg. 1 Sewage Pond Surface Soil	Niulii Reservoir Surface Soil, Sediment, Surface Water, and Groundwater
SVOCs		
bis(2-Ethylhexyl)phthalate	X	X
Pesticides		
DDD		X
DDE	X	X
DDT	X	X
Endrin ketone		X
PCBs		
Aroclor-1260	X	X
Total PCBs	X	X
Total NOAA 18 PCBs		X
Total Dioxin-like PCBs		X
Metals		
Aluminum	X	X
Antimony	X	X
Arsenic	X	
Barium	X	X
Beryllium	X	X
Cadmium	X	X
Chromium	X	X
Cobalt	X	X
Copper	X	X
Lead	X	X
Manganese	X	X
Mercury	X	X
Nickel	X	X
Selenium		X
Silver	X	X
Vanadium	X	X
Zinc	X	X

"X" Indicates that the COPC would be retained for a BERA.

Adjustments to exposure estimates for the Step 3a BERA include the following:

- The lower of male or female body weights for surrogate receptors were applied to generate higher ingestion dose exposure values.
- The same body weights were applied in the numerator and denominator of algorithms for body-weight normalized food ingestion rates. Use of a common body weight in both the numerator and denominator for the exposed organism in the Step 3a BERA yields a more realistic exposure estimate.
- Attachment A of the SRA (Earth Tech 2005b) indicated a presence of higher trophic level bird receptors such as herons (e.g., represented by the cattle egret) at the Niulii Reservoir Sewage Ponds site. Therefore, an additional assessment endpoint for higher trophic level birds represented by a surrogate of the cattle egret was added for the Step 3a BERA evaluation.
- Food ingestion estimates for the house mouse, northern cardinal, wandering tattler, and cattle egret in the BERA incorporate an incidental soil/wet sediment ingestion component along with an invertebrate forage item (represented by an earthworm) for the diet.

- Exposures (EPCs) for the cardinal, tattler, and egret in the BERA were estimates of average exposures (95 percent UCLs of the mean, or maximum if 95 percent UCL is not calculated) based on the entire sampling area occupied by the particular bird for the Bldg. 1 Sewage Pond or the Niulii Reservoir Sewage Ponds
- Exposure estimates for bioaccumulation risk for metals concentrations in surface soil samples were compared to upper bound values of estimated background ranges for surface soil for Waianae Volcanic Soils to determine if soil concentrations might be below background soil concentrations.

Adjustments to effects estimates for the Step 3a BERA included the following:

- Ecotoxicity reference values (ERVs) were updated to more consistently reflect values in commonly used databases or other NOAEL values applied in Navy programs.

The Step 3a BERA was completed and conclusions were drawn. However, based on meetings held in February and March of 2011 between the Navy, EPA, and DOH, refined risk evaluations were conducted to update select portions of the Tier 2 Step 3a BERA to incorporate latest EPA exposure factors and toxicity values used in EPA's Eco-SSL documents (DoN 2011). The Step 3a BERA update addressed COPCs and surface soil exposure only.

Refinements to exposure estimates for the refined Step 3a BERA included the following:

- Species specific minimum body weights.
- The mean of available male and female body weights for surrogate receptors were applied to generate revised ingestion dose exposure values for the Step 3a BERA to generate more realistic exposure values.
- Exposures via soil pathways for the representative species were estimates of average exposures (95 percent UCL of the mean or maximum if 95 percent UCL is not calculated) based on the entire sampling area for each of the sites.
- Bioaccumulation of COPCs in plant and invertebrate forage items were calculated from soil EPCs using the bioaccumulation algorithms based on the EPA's EcoSSL document (EPA 2003).

Refinements to effects estimates for the Step 3a BERA include the following:

- Inclusion of minimum body weights.
- ERVs were updated to more consistently reflect values in commonly used databases.
- Tier 2, Step 3a ERVs included low-observed adverse effect level (LOAEL) as well as NOAELs.

<u>Step 3a BERA Conclusions for Bldg. 1 Sewage Ponds</u>

For terrestrial mammals, six chemicals (antimony, cadmium, chromium, copper, nickel, and selenium) had NOAEL-based HQ values exceeding 1, but a LOAEL-based HQ that did not exceed 1. No other Tier 2 COPCs had NOAEL-based HQ values that exceeded 1. No surface soil chemical at the Bldg. 1 Sewage Pond site presents an unacceptable risk to wildlife populations.

For terrestrial birds, six metals (chromium, copper, lead, mercury, nickel, and vanadium), Aroclor 1260, and bis(2-ethylhexyl)phthalate had NOAEL-based HQ values exceeding 1,

but a LOAEL-based HQ that did not exceed 1. No other Tier 2 COPCs had NOAEL-based HQ values that exceeded 1. No surface soil chemicals at the Bldg. 1 Sewage Pond site present an unacceptable risk to wildlife populations.

Step 3a BERA Conclusions for Niulii Sewage Ponds

For terrestrial mammals, three metals (antimony, nickel, and selenium), and DDD had NOAEL-based HQ values exceeding 1, but a LOAEL-based HQ that did not exceed 1 (when the sludge sample is included). DDT had a Tier 2, LOAEL-based HQ value that equaled 1. No surface soil chemicals had a LOAEL-based HQ that exceeded 1 for terrestrial mammals indicating that adverse effects to mammalian wildlife populations are not expected to occur.

For terrestrial birds, three metals (chromium, copper, and vanadium), Aroclor 1260, DDD, and DDT, had NOAEL-based HQ values exceeding 1, but a LOAEL-based HQ that did not exceed 1. No surface soil chemicals have a LOAEL-based HQ that exceeded 1 at the Niulii Sewage Ponds site and therefore do not present an unacceptable risk to terrestrial avian wildlife populations.

Exposure to sediment (when metals within background levels were excluded) and surface water at the Niulii Reservoir Sewage Ponds were also considered acceptable for ecological receptors.

2.7 Documentation of Significant Changes

There have been no significant changes at the Site since the publication of the Final RI document in 2011.

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3. RESPONSIVENESS SUMMARY

The 30-day comment period for the Proposed Plan was held from August 16, 2012 through September 14, 2012, as announced in a Notice of Availability that was published in the August 12, 2012 (Sunday) edition of the Honolulu Star Advertiser, the largest daily edition newspaper in the State of Hawaii. The public meeting presenting the Proposed Plan was held at the Waianae Public Library on August 15, 2012. The Waianae Public Library is located less than five miles from the Site within the nearby city of Waianae. Comments were received from the community regarding the results of the previous investigations and the Proposed Plan, and are included as Appendix B, along with responses to comments.

3.1 Community Preferences

No community preferences were requested or identified.

3.2 Stakeholders Comments and Responses

Comments received and corresponding comment responses are included in Appendix B. Corresponding verbal and written changes to this document incorporate these responses. No changes to the selected decision are indicated in these comments.

3.3 Technical and Legal Issues

No technical or legal issues have been identified.

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Appendix A

Post-RI Building 1 Sewage Pond Surface Soil Data Set - Excluding Field Duplicate Sample Results for Metals

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Non-cancer Hazard Indicies and Incremental Lifetime Cancer Risk Estimated for Bldg 1 Sewage Pond

COPC	Bldg. 1 Sewage Pond Surface Soil HI	COPC	Bldg. 1 Sewage Pond Surface Soil ILCR
Aluminum	1.01	Aluminum	n/a
Aroclor 1260	n/a	Aroclor 1260	3.02E–06
Arsenic	0.22	Arsenic	8.60E–06
Barium	0.02	Barium	n/a
Benzo(a)anthracene	n/a	Benzo(a)anthracene	1.86E–06
Benzo(a)pyrene	n/a	Benzo(a)pyrene	1.09E–05
Benzo(b)fluoranthene	n/a	Benzo(b)fluoranthene	6.87E–06
Benzo(k)fluoranthene	n/a	Benzo(k)fluoranthene	2.84E–07
Bis(2-ethylhexyl)phthalate	0.01	Bis(2-ethylhexyl)phthalate	1.43E–07
Cobalt	1.91	Cobalt	4.33E–08
Copper	0.14	Copper	n/a
4,4'-DDE	n/a	4,4'-DDE	7.49E–08
Iron	1.66	Iron	n/a
Manganese	0.18	Manganese	n/a
Mercury	0.04	Mercury	n/a
Naphthalene	0.000003	Naphthalene	n/a
Nickel	0.08	Nickel	3.26E–09
Silver	0.01	Silver	n/a
Vanadium	0.46	Vanadium	n/a
Zinc	0.03	Zinc	n/a
Total/Cumulative Non-carcinogenic Hazard Index:		**Total/Cumulative Incremental Lifetime Cancer Risk:**	
Cumulative HI (including background):	**6**	**Cumulative ILCR (including background):**	3.E–05
Cumulative HI (excluding 95 % background):	0.2	**Cumulative ILCR (excluding 95 % background):**	2.E–05
Cumulative HI (excluding max background):	0.2		

Note: Risks and hazards estimated for hypothetical child resident only as this is the most sensitive receptor. Carcinogenic risks were not age-adjusted.

n/a not available; chemical not detected at Building 1 Sewage Pond.

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Appendix B

Comments and Responses

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Responses to questions raised at August 15, 2012 Public Meeting:

1**) Can the VOCs chloroform and carbon tetrachloride detected in the groundwater at the Niulii Sewage Ponds potentially migrate off the property (Section 15, lines 21 and 22 of transcript)?**

It is unlikely that VOCs in the groundwater at the Niulii Sewage Ponds would migrate off property. The irrigation wells are located almost a mile (approximately 5,000 feet) from the southwest of the NRTF property boundary. Given this long distance, and the relatively low levels of the VOCs in the groundwater, the VOCs would most likely breakdown due to biodegradation and natural attenuation processes before they could reach the property line.

2) What is the impact associated with groundwater containing chloroform and carbon tetrachloride being used to irrigate agricultural plots (Section 16, lines 2, 3, 4, and 5)?

The concentrations of both chloroform and carbon tetrachloride in the groundwater are considered safe to drink based on United States Environmental Protection Agency (EPA) standards. If the concentrations of these VOCs in groundwater are safe for humans to drink, then these concentrations are also considered safe if groundwater is used to irrigate crops.

3) Can these VOCs observed in groundwater at Niulii Sewage Ponds concentrate in soil or plants if that groundwater is pumped from down gradient, off-site wells, and used for irrigation purposes (Section 16, lines 9, 10, and 11)?

The VOCs observed in the groundwater at Niulii Sewage Ponds typically do not concentrate or buildup in soil or plants. Both chloroform and carbon tetrachloride evaporate very quickly from water and soil. Given the small amounts of carbon tetrachloride and chloroform in the groundwater, both chemicals would likely evaporate during the irrigation process and not have an opportunity to impact or concentrate in the soil or plants.

4) Should the Navy be consulting with the Commission on Water Resource Management regarding the pumping of groundwater from wells adjacent to NRTF Lualualei for agricultural purposes (Section 16, lines 12 through 20)?

The Navy works closely with the State Department of Health on water quality issues for environmental cleanup sites. The pumping of groundwater from wells adjacent to NRTF Lualualei is part of the environmental cleanup program addressing water quality issues and is not considered a water quantity issue which would require involvement by the Commission on Water Resource Management. According to the Commission on Water Resource Management's website (http://hawaii.gov/dlnr/cwrm/aboutus_commission.htm), "the Commission is responsible for addressing water quantity issues, while water quality issues are under the purview of the State Department of Health." This is further specified in Hawaii Revised Statues, Chapter 174C, State Water Code Sections 174C-5 (12) and 174C-66, specifically stating that the Department of Health has jurisdiction over the State's water quality. For this reason, the Navy believes consulting with the Commission on Water Resource Management is not necessary or appropriate as we already consult with Department of Health.

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November 2012
Reviewer: Mark Ripperda, EPA Region IX

Comment No.	Section No.	Comment
Comment 1	General	It is not clear from the document what the RI entailed. It appears that the RI did not carry out any new sampling, but instead relied on 10-year old sample data from 2003 and 2004. Is this data still reliable? Has anything happened over the past 10 years that would call into question the relevance of this data? Shouldn't the RI have included some updated sampling and analysis?

Response: The RI was published in 2011, and is based on samples collected in 2003 and 2004 in accordance with the approved 2003 *Work Plan & Sampling and Analysis Plan*. No significant changes have been made to the Site since the initial data collection for the RI, and the data were confirmed to be usable during a discussion with stakeholders during the Final RI Report preparation process.

The only occurrence of significance at the Site since 2004 is a continued decrease in wastewater generated at the Site associated with industrial activities. Therefore, in general, source reduction is the only change to the nature of the release areas that may have impacted the sewage ponds, and impacts to the ponds from releases of hazardous materials have likely attenuated over the period in question. This suggests the 2003-2004 data set is indicative of concentrations that are likely greater than those currently at the Site.

The source reduction results primarily from the abandonment, in large part, of the facilities at LLL Annex by the Navy and from removal or remedial actions already conducted at nearby sites (e.g., the former NAVMAG PH Bld. 4 removal action).

The revised document includes the following paragraphs in Section 2.1 to help clarify that the RI data from 2003-2004 is appropriate and represents the historical releases at the Site:

"Over time, the industrial activities and the number of people present at the buildings and discharge areas associated with the Site has significantly decreased, reducing the sources in number and magnitude and changing the wastewater discharged into the ponds to be more domestic in nature. The source reduction results primarily from the abandonment of facilities at JBPHH Lualualei Annex by the Navy and from removal or remedial actions already conducted under the Navy's Environmental Restoration Program (e.g., the former NAVMAG PH Bld. 4 removal action).

At one time, there were 289 buildings and 253 magazines present at the Site. By 2004, 102 of these buildings were demolished, and the magazines were used only for storage (DoN 2004). Of the 187 structures remaining, only 45 were in use as of 2004, and of these, all but 18 were used for storage. The remaining 18 buildings are used for administration, security guard operations and restrooms. Less than 10% of the remaining buildings at the Site are actively used."

Lastly, since the historical activities of the Site had largely ceased by 2003-2004, and the current activities are subject to current regulatory standards and Navy operational procedures (e.g., OPNAVINST 5090.1B), no further sampling or analyses were necessary for the RI.

DoN 2004. *Preliminary Assessment/Site Inspection*, Lualualei Branch, Naval Magazine Pearl Harbor, Oahu, Hawaii, Prepared by Earth Tech, Inc. June 2004.

Comment 2	2.4.4 p. 2-7	The Navy states that 100 wells have been abandoned in the surrounding area due to chloride contamination. Where is the chloride coming from? Is it from treatment of the sewage? If so, is the chloride treatment continuing? If so, will it or existing chlorine in the groundwater pose a threat to additional groundwater wells? Are these wells for drinking water? What is the Navy going to do to prevent additional contamination of drinking water wells from chloride contamination if it is coming from treatment of sewage?

Response: Generally, the closure of groundwater wells in the area is a result of saltwater intrusion to the basal aquifer associated with over-pumping of the unconfined aquifer. Chloride concentrations are

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associated with total dissolved solids in groundwater, including naturally occurring salts associated with the pond leachate. However, because the salts are a regional problem, they more accurately reflect the connection with saltwater or brackish water of the basal aquifer near the shoreline and in contact with shallow groundwater of the Site area. Additional chloride contamination of groundwater based on activity at the Site is unlikely based on the Site's current use.		
Comment 3	General	If this a no action ROD and the sewage ponds will continue to be used, what assurance does the Navy give that in the future other contaminants (hazardous substances) will not be discharged into the ponds? Shouldn't there be continuing 5-year reviews so long as the ponds continue to have discharges of sewage to verify that no hazardous substances have been discharged to the ponds?
Response: It is our understanding that the 2009 FFA identifies only "past activities" as the subject of the response activities conducted under the Navy's IRP and pursuant to CERCLA and DERPs, and more specifically, such activities are based on sites identified by the 1986 NCTAMSPAC IAS and 2004 PA/SI. Further, as indicated above, releases of hazardous substances in wastewater or storm water runoff are not expected at the site due to the significant reduction in industrial activity at the site involving the use of these substances, and current releases of hazardous substances are covered by separate requirements or programs. For example, the Navy's OPNAVINST 5090.1B, *Environmental and Natural Resources Program Manual*, provides Navy policy, identifies key statutory and regulatory requirements, and assigns responsibilities for complying with environmental laws/regulations, protecting the environment, conserving natural resources, preserving cultural and historical resources, and preventing pollution.		
Comment 4	p. 2-17, 2-18, 2-22	Typos: Page 2-17 second to last line: change "welfare form" to "welfare from" Page 2-18, 1st line below last bullet point - change "compare" to "compared" Page 2-22 middle of the page - change "concentration s " to "concentrations"
Response: The typos were corrected per the comment.		
Comment 5	General	Overall, the document looks good, but it uses too many acronyms for a lay person to keep track of - especially In the risk assessment section.
Response: Use of RME, CTE, EPC was reduced, but not removed completely because their use in the HHRA is integral to the assessment. The use of acronyms has been minimized in the revised document. For Site-Specific Risk-Based Evaluation, incremental lifetime cancer risk, hazard index, and risk-based screening, the acronyms were removed per the comment.		

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Reviewer: Wendy Ray, RPM, HDOH HEER Office
Comments Dated April 16, 2013

Comment No.	Section No.	Comment
Comment 1	General	**1. PCBs are the primary risk driver. Reported concentrations of PCBs in soil and sediment samples do not pose a significant risk to human health and the environment under the current land use.** The number and type of samples collected in the targeted areas in 2003 and 2004 would be inadequate under our current guidance. Based on the current use of the property for non-sensitive purposes (e.g., no residences, etc.), the data are adequate to conclude that the low levels of PCBs reported do not pose a risk to NRTF workers.

Response: The comment was noted. However, the Remedial Investigation (RI) was performed under the approved 2003 *Work Plan & Sampling and Analysis Plan.* No significant changes have been made to the Site since the initial data collection for the RI, and the data were confirmed to be usable during a discussion with stakeholders during the Final RI Report preparation process.

Additionally, based on the results of the RI, the site is suitable for industrial use and residential use. However, the Site is unsuited to these future uses without significant redevelopment. If the land use were to change in the future and residential use was proposed, due diligence and other processes for developing former impacted sites would be required under different State and Federal programs. Further sampling in the future may be required and would have to be in accordance with current state and Federal guidance and requirements, and reflect the appropriate conceptual site model.

Comment 2	General	**2. Additional evaluation and investigation should be carried out if a proposal is made for residential or other more sensitive use of the sewage pond areas in the future.** The number of discrete samples collected at the site is inadequate to estimate exposure point concentrations over areas typically assumed for unrestricted, residential use (e.g., 5,000ft^2). For example, the 95% UCL for PCBs in soil and sediment of the 7,000ft^2 sewage pond for Building 1 exceeds exceed our action level for unrestricted land use and would exceed the maximum-allowable, non-cancer Hazard Quotient of 1.0. Exposure point (area) concentrations for PCBs based on multi-increment samples collected within the Bldg 1 pond area and in and around the Niuli'i ponds would likely be higher than estimated in the risk assessment if smaller, residential-size Decision Units were tested using multi-increment samples.

Response: Please refer to the response to General Comment #1 above.

Comment 3	General	No further investigation or remediation is required at this time. However, under HRS 128D, sites closed with zoning restrictions, or that are otherwise unsuitable for unrestricted use will received a NFA with Institutional Controls determination. Such a determination for this site will be contingent upon adherence to specific conditions listed below: • Other land uses such as residential, school, daycare, restaurant, or other "sensitive" uses will require further evaluation and approval by HDOH HEER office. • The conditions of this NFA with Institutional Controls will be provided to any prospective buyer(s) during the sale disclosure process. • Testing of soils is required prior to any removal of soil from the site. • Adherence to the *Technical Guidance Manual for the Implementation of the Hawai'i State Contingency Plan* found on the following website: http://www.hawaiidoh.org/tgm.aspx Please be aware that if there are any future changes to the land use, zoning, or should future information reveal that contaminant exposure at the site is a potential hazard to public health, the environment, or natural resources, HDOH must be notified, and at that time, HDOH may require additional investigation and an EHE-EHMP with a recommendation for further action to be taken. Please make changes within the ROD to reflect the NFA with Institutional Controls. Submit your response to this request at your earliest convenience. Should there be any questions, please do not hesitate to contact me at 586-4653. Thank you very much for your time and consideration in this matter.

Response: The current process is intended to close the CERCLA release investigation at the Site with

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		no further remedial or other actions (e.g., engineering or institutional controls) required. The Site is not suited to residential use without significant changes or redevelopment. However, as noted, if land use were to change in the future and residential use was proposed, processes for developing residential areas would be in accordance with current state and Federal guidance and requirements. Further, should the Site ownership or operational use change or transfer, an Environmental Condition of Property would be required in accordance with Navy/DOD guidance and directives. The evaluation of Site's status as a CERCLA site would be considered for evaluating future suitable uses. Lastly, as noted above, the RI Report recommends no further action and the addition of land use controls is not necessary.