Final Report

Evaluation of Green Island Landfill and Reburial Pit, Former U.S. Coast Guard LORAN Station Kure

Photo from Google Earth

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List of Acronyms

AST	Aboveground Storage Tank
bgs	Below Ground Surface
C	Celsius
CCC	Criteria Continuous Concentration
COC	Chain of Custody
COC	Contaminant of Concern
COPC	Contaminants of Potential Concern
%D	Percent Difference
DLNR	State of Hawaii Department of Land and Natural Resources
DOT	Department of Transportation
DU	Decision Unit
E2	Element Environmental, LLC
EPA	Environmental Protection Agency
ELISA	Enzyme-linked Immunosorbent Assay
ER-L	Effects Range- Low
ER-M	Effects Range- Medium
°F	Degrees Fahrenheit
GC/ECD	Gas Chromatograph/Electron Capture Detector
GC/MS	Gas Chromatograph/Mass Spectrometry
GC/UE	Gas Chromatograph/Ultrasonic Extraction
gms	grams
GPS	Global Positioning System
HDOH	State of Hawaii Department of Health
HRGC/MS	High Resolution Gas Chromatograph/ Mass Spectrometry
ID	Identification
IDW	Investigation-Derived Waste
INALAB	Industrial Analytical Laboratory
LCS	Laboratory Control Sample
LD	Laboratory Duplicate
LLC	Limited Liability Company
LORAN	Long Range Navigation Station
MB	Method Blank
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µL	microliters
MI	Multi-Increment
mL	milliliters
MS/MSD	Matrix Spike/Matrix Spike Duplicate
n/a	Not Analyzed
NELAC	National Environmental Laboratory Accreditation Conference
nm	Nanometer
NOAA	National Oceanic and Atmospheric Administration
NRWQC	National Recommended Water Quality Criteria
NS&T	National Status and Trends
PCB	Polychlorinated Biphenyl
PCS	Pacific Commercial Services, Inc.
mg/kg	parts per million

PRG	Preliminary Remediation Goal
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
%R	Percent Recovery
RMCI	Research Management Consultants, Inc.
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SI	Site Investigation
SMD	Scrap Metal Dump
SOW	Scope of Work
SVOC	Semi-Volatile Organic Compound
TSCA	Toxic Substances Control Act
UCL	Upper Confidence Level
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
WP	Work Plan
yds	yards

Section 1 Introduction

This report presents the sampling methods and analytical results of soil, groundwater, sea water, sediment, and biota samples collected to determine the nature and extent of contamination stemming from potential historic releases of hazardous materials during past operations at the former U.S. Coast Guard (USCG) Long Range Navigation (LORAN) station on Kure Atoll. This investigation was conducted as a follow-on investigation to a soil remediation/removal project completed at the former Scrap Metal Dump (SMD) located on the southwest end of Green Island. The SMD was used as a disposal point for potentially hazardous materials during operation of the LORAN station in the years between 1961 and 1992.

Mobilization of field supplies and field work were conducted between October 17 and November 7, 2008. Major tasks performed during this project included: collection and analysis of surface and subsurface soil and groundwater samples from the vicinity of the former SMD; collection of groundwater samples from the perimeter of the polychlorinated biphenyl (PCB)-impacted soil Reburial Pit; collection of biota, sea water, and sediment samples from the near-shore Kure Lagoon and the Pacific Ocean in the vicinity of the SMD (the southwest tip of Green Island) and from the North Point area of Green Island; and collection of surface soil samples from various points around Green Island. This site investigation report has been prepared by Element Environmental, LLC (E2) for the USCG under Contract No. HSCG86-08-C-6XA611, awarded September 20, 2008.

TestAmerica Tacoma and TestAmerica Honolulu were subcontracted to provide analytical laboratory services for this project. Pacific Commercial Services (PCS) was subcontracted to provide waste disposal services for this project. A large mahalo to the USCG Kukui Commanding Officer Steven Matadobra and his crew for their excellent support and assistance with mobilization of personnel and gear to and from Kure Atoll. A special thanks to Cynthia and Brad Vanderlip of the State of Hawaii Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife for their support and generous hospitality during the entire field effort.

1.1 Project Scope and Objectives

Post remediation sampling completed in 1993 indicated that residual levels of PCBs and heavy metals remain in site soils at the SMD. The purpose of this investigation was to further delineate the extent of PCBs and select heavy metals remaining in soils at the SMD and to also determine if these contaminants have migrated and impacted the near-shore lagoon environment. Specifically, the primary objectives of this project were to determine the concentrations of PCBs and select heavy metals currently present in the SMD near-surface soils, subsurface soils, nearby lagoon biota, lagoon water, lagoon sediment, and groundwater underlying the SMD. Groundwater was also sampled in the vicinity of the Reburial Pit in order to determine if PCBs and/or metals are leaching out of the previously buried soils.

The results of this investigation will be used to determine if additional characterization and/or remediation with regard to the former LORAN Station Kure facilities is necessary to protect human and/or ecological health and the environment.

1.1.1 Investigation Objectives and Approach

The following specific objectives were addressed during this investigation:

- **Assessment of the presence of PCBs contamination in soil at the former SMD location.** The investigation at LORAN Station Kure included sampling and analysis of surface and subsurface soil from in and around the former SMD location.

- **Assessment of the presence of PCBs and metals (arsenic, cadmium, chromium, lead and mercury) contamination in groundwater.** The investigation at LORAN Station Kure included sampling and analysis of groundwater from between the SMD and the lagoon as well as from the perimeter of the Reburial Pit.

- **Assessment of the presence of PCBs and metals (arsenic, cadmium, chromium, lead and mercury) contamination in near-surface soil at various locations on Green Island.** The investigation at LORAN Station Kure included collection and analysis of near-surface soil from various locations on Green Island.

- **Assessment of the presence of PCBs and metals (arsenic, cadmium, chromium, lead and mercury) contamination in lagoon sediment.** The investigation at LORAN Station Kure included collection and analysis of sediment from the near-shore lagoon.

- **Assessment of the presence of PCBs and metals (arsenic, cadmium, chromium, lead and mercury) contamination in biota.** The investigation at LORAN Station Kure included sampling and analysis of biota specimens from the near-shore lagoon.

- **Assessment of the presence of PCBs and metals (arsenic, cadmium, chromium, lead and mercury) contamination in lagoon seawater.** The investigation at LORAN Station Kure included sampling and analysis of seawater samples collected from two of the locations from which biota samples were collected.

1.2 Report Organization

Details of the investigation are presented in the following sections of this report. The site description and site use background are included in Section 2; details of the field investigation and environmental sample collection are included in Section 3; sample analytical results are presented in Section 4; project quality assurance/quality control is outlined in Section 5; and a summary of the investigation, conclusions, and recommendations for the future are presented in Section 6. References used for this report are listed in Section 7, while appendices include the following:

Appendix A	Project Photographs
Appendix B	Analytical Data Tables
Appendix C	Investigation Scale Evaluation of Multi-Incremental Sampling Methodology-Draft

Addendum A Laboratory Analytical Data Reports (included on attached compact diskette)

Section 2 Site Description and Background

2.1 Site Location and Description

Kure Atoll is the northernmost island in the Hawaiian island chain and is located approximately 1,360 miles northwest of Honolulu and about 56 miles northwest of Midway Atoll (Figure 2-1). Kure Atoll consists of a lagoon encircled by an atoll reef, one vegetated island (Green Island) and several small sand spits that vary in size depending upon the tide, currents and shifting sand (Figure 2-2). The primary investigation site area is situated on the southwest shoreline of Green Island, near the end of the runway on the lagoon side. Green Island is just under 1.5 miles long and about 0.35 miles in width and has a maximum elevation of around 15 feet.

2.1.1 Climate

The climate of Kure Atoll consists of two seasons, winter, usually stretching from December through March, and summer, typically from April through November. Winters are typically cooler, rainy, and windy while the summer season is humid and dry, with occasional thunderstorms. Temperatures average about 80 degrees Fahrenheit (°F) during the summer and 70-75 °F during the winter. Average rainfall on nearby Midway Atoll measured approximately 39 inches annually while relative humidity averages about 63 percent.

2.1.2 Geology, Hydrogeology, and Soils

Typical of atolls, Kure Atoll consists of the remnants of a volcanic seamount that has eroded away to its present state, a mostly submerged accumulation of sedimentary material, lying atop varying depositional substrate layers deposited during the last 100,000 years as the sea level fluctuated. Kure is characterized by a shallow lagoon (up to about 45 feet deep) surrounded by fringe reef and said accumulations of sediment in the form of small exposed islands, including the largest and only vegetated land mass, Green Island.

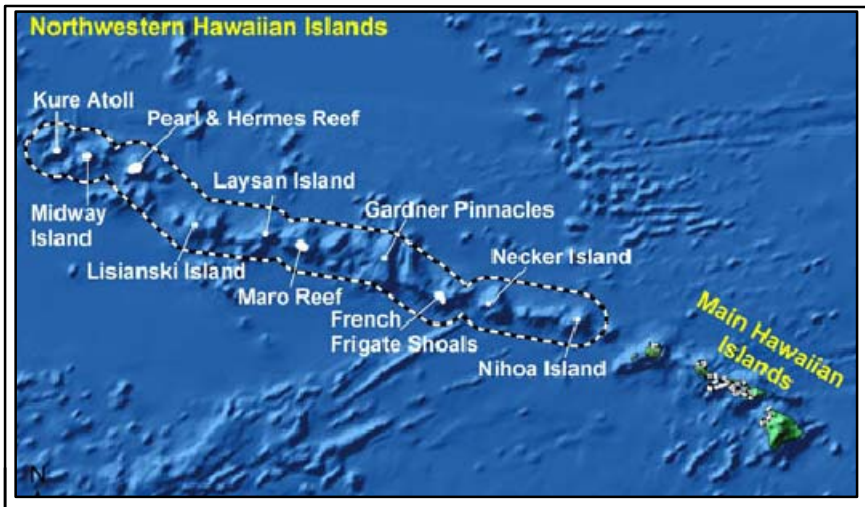
Sand is periodically deposited and robbed from the atoll based on storms and wave action barraging the atoll. Green Island as well as the smaller sand spits are subject to drastic changes in sand deposits depending on wave action.

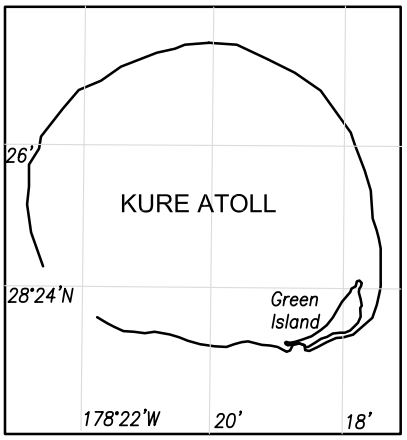
Soils on Kure consist predominantly of sandy deposits and are typically formed on water deposited coral sand. Vegetation on Green Island consists primarily of naupaka. In addition, golden crown-beard, sweet alyssum, ironwood, and coconut trees are present on the island (Woodward-Clyde, 1994).

2.1.3 Identified Contaminant Sources

Based on previous use of the site and the results of previous investigations, the source of contamination at the LORAN Station Kure facility is from debris and waste (including electrical transformers and capacitors) dumped along the southwestern shoreline of Green Island at the former SMD.

Contaminants of concern (COC) at the SMD include those identified during previous investigations, namely, PCBs and heavy metals.





References:
Google Earth,
J. Guinotte MCBI

	DATE: Feb 2009	PROJECT TITLE: FORMER SEPTIC TANK EVALUATION AND CLEANING, FORMER U.S. COAST GUARD STATION KURE
	FIGURE TITLE: KURE ATOLL SITE LOCATION	FIGURE NO.: 2-1

1200' 0' 1200' 2400'

SCALE: 1" = 1200'

	DATE: Feb 2009	PROJECT TITLE: EVALUATION OF GREEN ISLAND LANDFILL AND REBURIAL PIT, FORMER U.S. COAST GUARD STATION KURE
	FIGURE TITLE: LORAN STATION KURE SITE VICINITY	FIGURE NO.: 2-2

2.2 Project Background and Previous Investigations

LORAN Station Kure was constructed on Green Island (located in the southeast portion of the Kure lagoon) in 1960 and used for ship and air navigation by the USCG from 1961 until 1992 (Woodward-Clyde, 1994). The purpose of the LORAN station was to provide a precision radio navigation system to help mariners, aviators, and those interested in terrestrial navigation obtain an accurate position. LORAN works off differences in times of arrival of pulses emitted in precisely known patterns from chains consisting of a master and two or more slave stations, all of precisely known locations. During the operation of LORAN Station Kure, waste generated by the USCG was disposed of on the southwestern end of Green Island, near the southwestern end of the runway. Scrap metal and electrical components (i.e., capacitors, batteries and transformers) containing hazardous materials (such as PCBs) were buried in the SMD located near the southwestern end of the runway. It is assumed that the components containing hazardous materials were dumped from the early 1960's to the late 1970's, when the USCG established a hazardous waste management program (Woodward-Clyde, 1994).

Kure Atoll was first claimed by the King Kalakaua monarchy in 1886 and was owned by the Territory of Hawaii until 1936, at which time it was set aside by the United States for use by the Navy. In 1952, control of Kure Atoll was returned to the Territory of Hawaii until 1959, when the State of Hawaii agreed to let the USCG use Kure Atoll. Kure Atoll became part of a State Seabird Sanctuary in 1978 and a State of Hawaii Wildlife Refuge in 1981 (Woodward-Clyde, 1994).

Under State of Hawaii jurisdiction, Kure Atoll is a State Seabird Sanctuary within the larger Northwestern Hawaiian Islands Marine Refuge. Kure Atoll is also part of the newly established Papahānaumokuākea Marine National Monument. Currently, there are remnants of the former USCG facilities remaining on Green Island, however, there are no permanent inhabitants or operations on Kure Atoll.

2.2.1 Previous Investigations

Previous investigations conducted on Green Island include the following:

- December 1991: The USCG collected approximately six soil samples from the SMD and analyzed them for PCBs. The sample results for all six samples were non-detect. Ten capacitors, one transformer, and four batteries were found at the SMD (Woodward-Clyde, 1994).

- February 1992: The USCG and Woodward-Clyde personnel attempted to drive two piezometers in the vicinity of the SMD in order to collect groundwater samples. Time ran out on the day trip before groundwater samples could be collected from the piezometers.

- March 1992: The USCG and Woodward-Clyde personnel successfully installed three piezometers in the SMD vicinity. Groundwater samples were tested by an analytical laboratory for PCBs. None of the analytes were detected in any of the groundwater samples.

- June 1992: A total of 19 surface and subsurface soil samples along with four wipe samples were collected from the SMD with 13 of the 19 soil samples and two of the four wipe samples testing positive for PCBs. As a result of the positive PCB concentrations,

excavation of the debris from the SMD was halted (debris was being removed from the SMD by the USCG at the same time of the sampling).

Four split soil samples collected from the SMD were analyzed by the E.L. Pacific laboratory in Honolulu, three of which were found to have detectable PCB concentrations, ranging from 1.2 to 115 milligrams per kilogram (mg/kg). Lead was found in eight samples analyzed by the laboratory at concentrations ranging from 3.3 to 1,094 mg/kg (Woodward-Clyde, 1994).

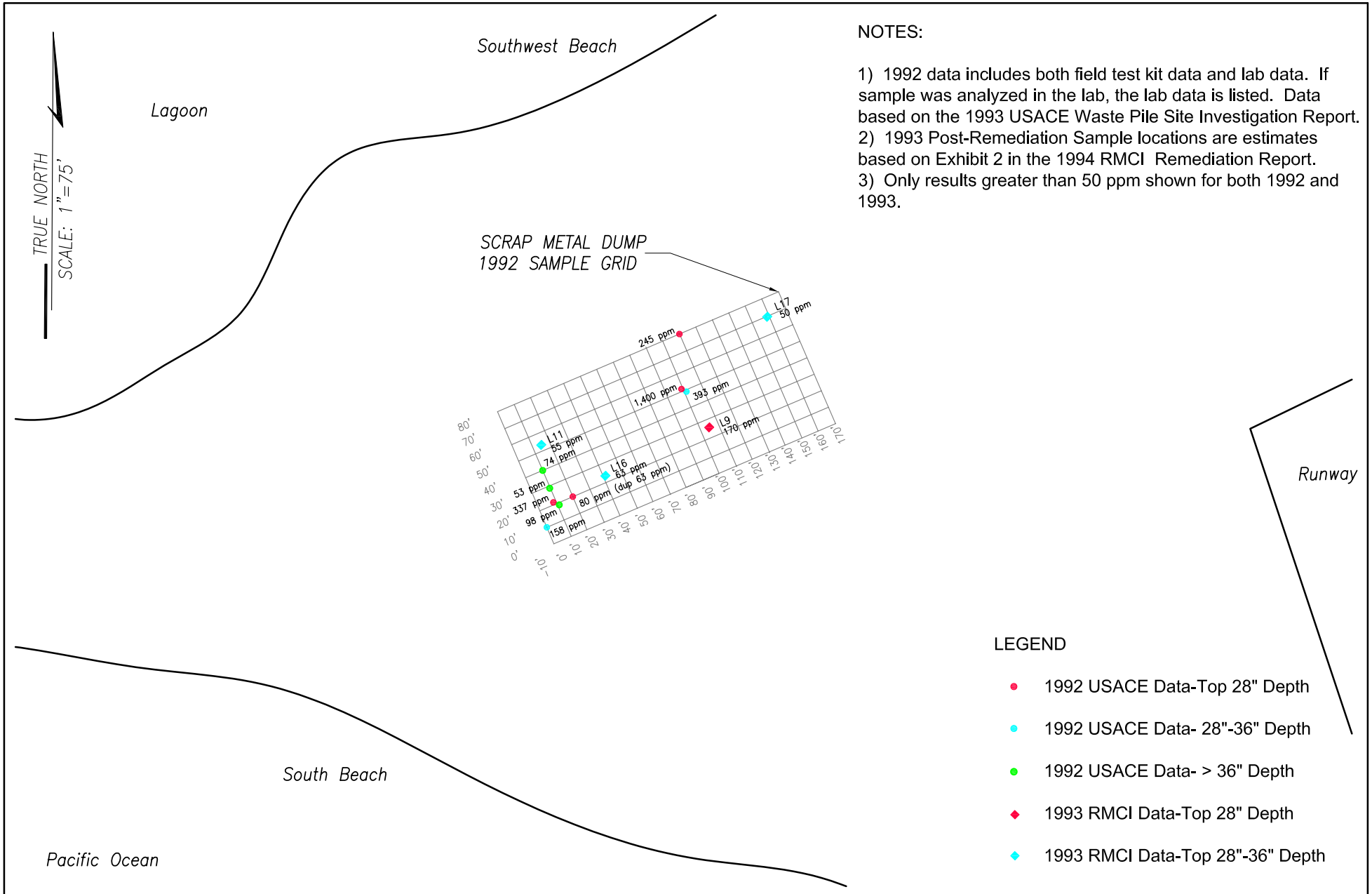
- July 1992: The United States Army Corps of Engineers (USACE) conducted a Site Investigation that included the collection of 116 soil samples from near surface to depths of up to six feet below ground surface (bgs) from the SMD. All of the soil samples were tested for PCBs in the field using a chloride analyzer, with 29 split samples also analyzed by Industrial Analytical Laboratory (INALAB) for total PCBs, total lead, and chromium. Four additional split samples were sent to Aecos Inc. for quality assurance/quality control (QA/QC) purposes. Four shellfish were collected from approximately 100 meters from shore in the vicinity of the SMD and submitted to Analytical Resources Inc. for PCB testing.

  Results of soil samples analyzed both in the field and by the laboratory included 10 PCB concentrations above 50 mg/kg and five PCB concentrations above 100 mg/kg (Figure 2-3). None of the shellfish had detectable concentrations of PCBs.

  Primary laboratory analysis indicated lead concentrations ranging from 13.7 to 2,530 mg/kg and chromium concentrations ranging from 11.6 to 23.7 mg/kg in the 29 samples submitted. There was some discrepancy between the primary laboratory metals results and the QA/QC laboratory metals results, prompting the re-analysis of the 29 soil samples by a third laboratory, Enseco California Analytical Laboratory in Sacramento, California. In general, the sample results from INALAB and Enseco were in good agreement (Woodward-Clyde, 1994).

- July 1993: Research Management Consultants, Inc. (RMCI) removed 700 to 800 cubic yards of soil containing PCB concentrations of less than 25 mg/kg from the SMD and reburied it in a pit (the Reburial Pit) excavated adjacent to the runway near the Aboveground Storage Tanks (ASTs) (Woodward-Clyde, 1994). A total of 36 cubic yards of soil containing concentrations of PCBs greater than 25 mg/kg were removed from the island and disposed of on the mainland (Woodward-Clyde, 1994). RMCI conducted post-remediation sampling of the SMD as well as the Reburial Pit and found PCB concentrations up to 170 mg/kg remaining in the SMD and 110 mg/kg in the Reburial Pit (Figures 2-2 and 2-3).

- September 1993: Woodward-Clyde personnel collected 30 surface soil and off-shore sediment samples in the vicinity of the SMD in order to determine if PCB-impacted soils had migrated into the lagoon via wave action following the removal of the PCB-impacted soil. Additional samples collected included: four groundwater samples collected from trenches excavated between the SMD and the lagoon; two water samples collected from the lagoon; and 22 biota samples collected from three locations within the lagoon (Woodward-Clyde, 1994). PCBs were not detected in any of the samples collected, with the exception of a single soil sample collected about 100 feet north of the SMD that had a PCB concentration of 3.4 mg/kg.



NOTES:

1) 1992 data includes both field test kit data and lab data. If sample was analyzed in the lab, the lab data is listed. Data based on the 1993 USACE Waste Pile Site Investigation Report.
2) 1993 Post-Remediation Sample locations are estimates based on Exhibit 2 in the 1994 RMCI Remediation Report.
3) Only results greater than 50 ppm shown for both 1992 and 1993.

LEGEND

- 1992 USACE Data-Top 28" Depth
- 1992 USACE Data- 28"-36" Depth
- 1992 USACE Data- > 36" Depth
- 1993 RMCI Data-Top 28" Depth
- 1993 RMCI Data-Top 28"-36" Depth

	DATE: Feb 2009	PROJECT TITLE: EVALUATION OF GREEN ISLAND LANDFILL AND REBURIAL PIT, FORMER U.S. COAST GUARD STATION KURE
	FIGURE TITLE: 1992 AND 1993 SMD PCB ANALYTICAL RESULTS SUMMARY	FIGURE NO.: 2-3

- January 1994: Woodward-Clyde prepared the *Kure Atoll Scrap Metal Dump Ecological Risk Assessment* in order to evaluate the potential risk to ecological receptors to PCB and lead contamination found in the SMD and to develop acceptable cleanup goals for PCBs and lead for the site. Ecological risk-based cleanup goals for the SMD were calculated to be 250 to 840 mg/kg for PCBs and 270 to 890 mg/kg for lead (Woodward-Clyde, 1994).

Section 3 Field Investigation and Sample Collection

This section presents a detailed description of the field tasks completed during this follow-on site investigation at the former LORAN Station Kure. The technical approach to the field work procedures was designed to ensure that project tasks were conducted efficiently and safely, and that the environmental data collected met the objectives of the project. The primary focus of this field investigation was to gather analytical and physical data to delineate the extent of COCs identified (PCBs, metals) at the SMD and surrounding areas and the Reburial Pit and surrounding areas during previous investigations as well as to determine if contamination has migrated from the source areas to other areas/matrices (i.e., groundwater, sea water, biota).

Field procedures were conducted in accordance with industry standard methodologies and the project-specific Work Plan/Sampling and Analysis Plan (WP/SAP) (Element 2008).

3.1 Investigation Activities

The following tasks were completed during the 2008 follow-on site investigation at the former LORAN Station Kure:

1. Mobilization and site access;

2. Re-establishment of the ten-foot sampling grid at SMD initially set during the 1992 investigation. Additionally, a five-foot sampling grid was established within the ten-foot grid in order to further delineate a hot spot identified during the 1992 investigation;

3. Collection and analysis of 629 discrete near surface and subsurface soil samples from 225 grid nodes comprising the established sampling grid;

4. Collection and analysis of 17 multi-incremental soil samples from decision units in the surrounding vicinity of the SMD as well as from within the SMD;

5. Collection of five near-surface soil samples from various locations around Green Island;

6. Collection and analysis of nine primary groundwater samples, three from between the north side of the SMD and the lagoon and six from the perimeter of the Reburial Pit;

7. Collection and analysis of two seawater samples from the lagoon.

8. Collection and analysis of ten sediment samples from the near-shore lagoon adjacent to the SMD and adjacent to North Point;

9. Collection and analysis of 18 biota samples from the lagoon and vicinity.

3.2 Site Access, Mobilization, and Demobilization

All field supplies/gear, food, and personnel were mobilized to Green Island via the USCG Cutter Kukui beginning on October 10, 2008 when field supplies/gear and food were loaded on to the Kukui at the USCG installation in Honolulu Harbor, Honolulu, Hawaii. The Kukui then set course for Midway Atoll, taking care of its buoy tending duties along the way. Upon reaching Midway Atoll on the evening of October 18, 2008, the Kukui met up with the project personnel who had flown into Midway on Friday, October 17, 2008 via the Midway-chartered Gulfstream 1. The Kukui, now laden with field supplies/gear, food, and project personnel, set course for Kure Atoll the morning of October 20, 2008, at approximately 0700.

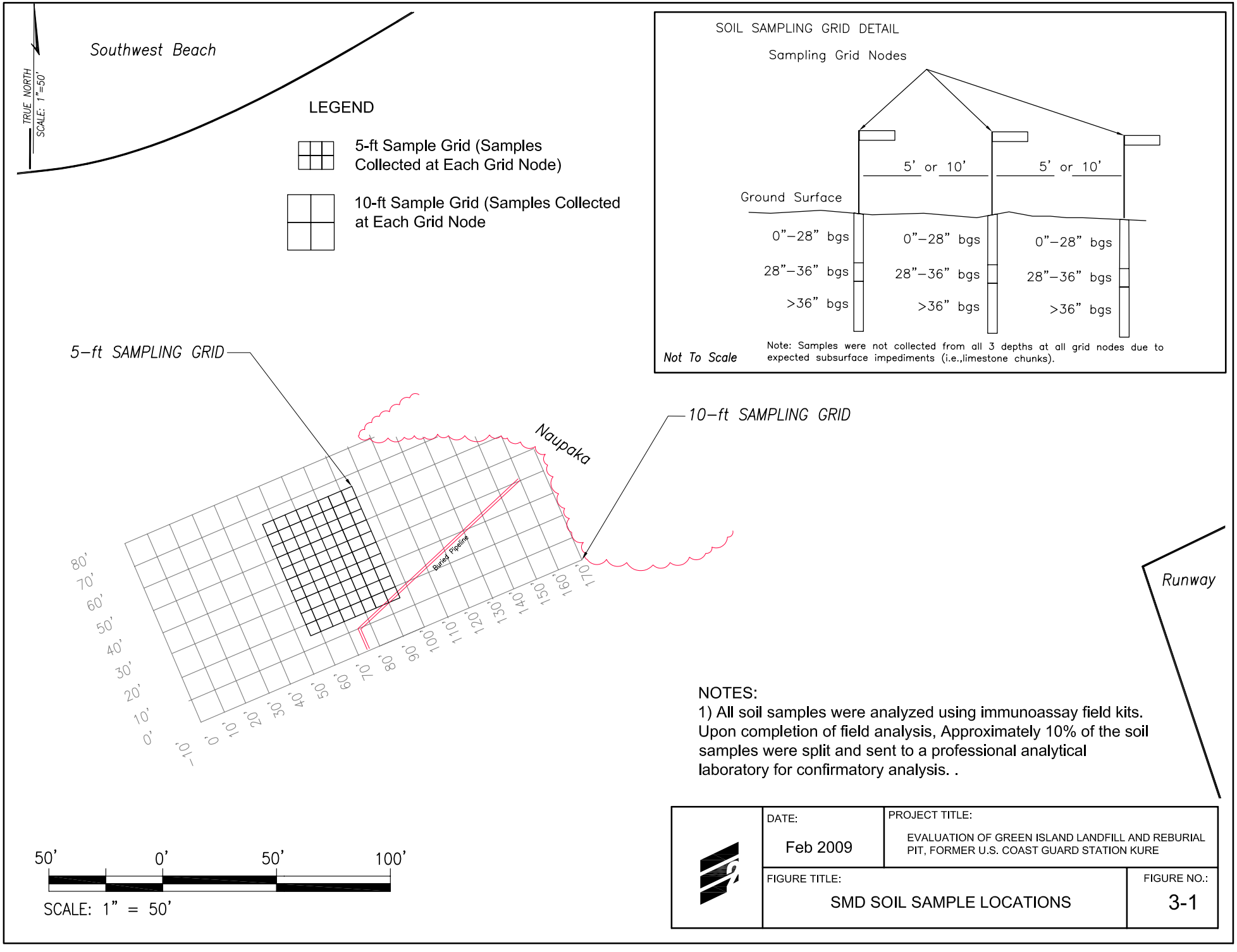
Upon reaching Kure Atoll, all field supplies/gear, food, and personnel were transported to Green Island from the USCG Cutter Kukui via its two small rescue boats. Because of its size, the Kukui remained anchored outside the atoll's lagoon, adjacent to the only opening in the fringe reef, on the southwestern side of the lagoon (Figure 3-1). The two small rescue boats completed the off-loading process by making the five-mile journey across the lagoon to Green Island. Because of waning daylight, the off-loading process had to be split up between two days; with personnel and necessary camping gear/food being off-loaded the day of arrival, and the rest of the field supplies/gear delivered the next morning.

Following completion of all field tasks, arrangements were made with the USCG Cutter Kukui for demobilization on Wednesday, October 28, 2008. This deviated from the original plan of demobilization the following week (the week of November 7, 2008) due to unfavorable weather conditions allowing only small windows for personnel and supplies/gear to be picked up. Field personnel were given a choice of departing on the Kukui October 28 or waiting for the next favorable weather day. All project personnel took this opportunity to depart Kure.

Demobilization consisted of transporting essential field supplies/gear, samples, and personnel back to the Kukui from Green Island. This was done in reverse fashion as the initial mobilization to the island; by using the two small rescue boats to make the journey across the lagoon to the Kukui, which was waiting outside the atoll, adjacent to the opening in the fringe reef. All unnecessary supplies and equipment were left with the Kure Refuge Manager, Cynthia Vanderlip, to aid her in her future stays on Kure Atoll and to cut weight and time on demobilization. This included excess water, food, gasoline, and field equipment such as carts, tents, and camping gear.

3.3 Scrap Metal Dump Soil Sample Grid Establishment

A ten-foot spaced sampling grid was re-established in the same location in the SMD as was initially set during the 1992 investigation. The 1992 sampling grid was approximately 200 feet long and 100 feet wide and originated at the northwest corner of a concrete vault positioned over a fuel pipeline, adjacent to the southwestern end of the runway. The longer axis of the original grid ran in the east-west direction, while the shorter side ran north-south (Figure 3-1). After extensive searching, the origin (concrete vault) of the original sampling grid could not be re-located, most likely due to sand and debris that had buried it during previous years' storm surges. The fuel pipeline, however, was located, and based on the recollections of Mr. Jay Silberman and Dr. Steven Spengler (who were both involved with the previous investigations), a sampling grid within close proximity to the original was established. The longer axis of the new



NOTES:
1) All soil samples were analyzed using immunoassay field kits. Upon completion of field analysis, Approximately 10% of the soil samples were split and sent to a professional analytical laboratory for confirmatory analysis. .

	DATE: Feb 2009	PROJECT TITLE: EVALUATION OF GREEN ISLAND LANDFILL AND REBURIAL PIT, FORMER U.S. COAST GUARD STATION KURE
	FIGURE TITLE: SMD SOIL SAMPLE LOCATIONS	FIGURE NO.: 3-1

sampling grid ran 170 feet in the east-west direction, while the shorter axis ran 80 feet north-south. The new grid was made shorter on both axes than the original due to naupaka growth that had encroached on the SMD since the 1992 investigation. Additionally, the north-east corner of the new ten-foot spaced grid was cut off also because of encroaching naupaka growth.

Samples were collected from intersecting grid nodes of the ten-foot spaced sampling grid and analyzed on Kure for their PCB content using RaPID Assay immunoassay test kits. The PCB concentration data determined from sampling the ten-foot spaced grid was then used to define a "hot-spot" area within the SMD where elevated concentration levels of PCBs were measured. A single, five-foot spaced sampling grid was then established in this hot-spot area, located just west of the center of the ten-foot spaced grid. The longer axis of the five-foot sampling grid ran 50 feet in the north-south direction, while the shorter axis ran 40 feet east-west (Figure 3-1).

3.4 Environmental Sample Collection

3.4.1 General Sampling Methods

Industry sampling protocol was adhered to during the collection of all environmental samples. Disposable sampling equipment was used in order to avoid risk of cross contamination and minimize generation of IDW in the form of decontamination water. The sampler donned a pair of new, disposable, nitrile gloves for the collection of each environmental sample. At the time of collection, samples were placed directly into new plastic baggies for storage during field analysis. Sample locations, collection techniques, etc. were photo-documented throughout the field effort, of which select photographs taken during the various field activities are included in Appendix A. Pertinent field information including sample location and identification, QA/QC duplicate information, and site description was logged in a project-specific field notebook.

3.4.2 Scrap Metal Dump Discrete Soil Sample Collection

A total of 226 near-surface and 403 subsurface discrete soil samples were collected from the grid nodes (intersection of grid lines) of the established sampling grids (both five and ten-foot spaced). Soil samples were collected from the same sample intervals as those collected during the 1992 investigation - surface to 28" bgs (denoted as 4" for sample id purposes), 28" to 36" bgs (denoted as 36" for sample id purposes), and below 36" bgs (denoted as 60" for sample id purposes). The SMD sampling grid soil sample locations are depicted on Figure 3-1.

Soil samples were collected by first using a shovel to dig down to 36" bgs to expose the subsurface soil. A clean trowel was then used to scrape the walls of the hole to gather undisturbed subsurface soil at the available sampling intervals - surface to 28" bgs and 28" to 36" bgs. A slide hammer-driven soil probe equipped with a two-foot acetate liner was then inserted at the bottom of the dug pit and driven down to sample the interval below 36" bgs. Samples were placed directly from the acetate liners into new, respectively labeled Ziploc bags immediately following collection.

All grid samples were analyzed for total PCBs on Kure using RaPID Assay Immunoassay methods, an U.S. Environmental Protection Agency (EPA)-approved method of screening samples. In addition, 19 field duplicates and three field blank samples (field blanks consisted of analyzing certified PCB-free soil) were also analyzed using the immunoassay test kits as a QA/QC measure. A total of 70 of the grid soil samples (25 from surface to 28" bgs, 20 from 28"

to 36" bgs, and 25 from below 36" bgs) with the highest PCB concentrations as measured by the immunoassay test kits were split and submitted to TestAmerica Tacoma for total PCBs analysis via Gas Chromatograph/Mass Spectrometry (GC/MS) to validate and verify the immunoassay PCB results. The eight samples containing the highest total PCB concentrations were then tested for 32 PCB congeners, the congener list was developed by the National Oceanic and Atmospheric Administration (NOAA) National Status and Trends (NS&T) congeners via GC/electron capture detector (ECD). Note: The list of 32 congeners was recommended by NOAA for biota analysis and is a combination of the NOAA 18 list as well as 14 additional congeners chosen by NOAA. This is referred to in this report as the NOAA NS&T 32 congener list, as that is the way the analytical laboratory references this list of congeners. The soil sample containing the single highest PCB concentration from these eight samples was then analyzed for the total list of 209 PCB congeners via GC/MS by the analytical laboratory to verify that the detected analyte was in fact polychlorinated biphenyl compounds.

3.4.3 Scrap Metal Dump Multi-Incremental Soil Sample Collection

The State of Hawaii Department of Health (HDOH) has recently embraced a method of evaluating the magnitude of contamination present at a project site by collecting multi-incremental (MI) samples from various decision units (DUs) at a given site being evaluated. A total of 17 DUs were established within the SMD and its surrounding vicinity (seven within the SMD and ten from surrounding areas) following the completion of the immunoassay analysis of the discrete soil samples collected from the five and ten-foot sampling grids. DUs 11, 12, and 13 correspond to the three sampling depths (surface to 28" bgs, 28" to 36" bgs, and below 36" bgs) within the SMD grids, while DUs 17 and 18 were collected from the hot-spot area identified within the ten-foot sampling grid from depths of 28" to 36" bgs and 48" to 60" bgs. DUs 1 through 8 consist of near surface soils collected from areas immediately surrounding and in the vicinity of the SMD. Triplicate samples were collected from DUs 8 and 13 (samples 9 &10 from DU 8 and samples 14 &15 from DU 13). Figure 3-2 depicts the respective decision unit locations within and surrounding the SMD.

MI samples collected from DUs 11, 12 and 13 (KMI-011, KMI-012, and KMI-013, respectively), were composed of 152, 128 and 128 aliquots, respectively, collected from the ten-foot sampling grid. MI samples collected from DUs 17 and 18 (KMI-017 and KMI-018), were composed of 99 aliquots each from both the five and ten foot grid within the hot-spot area. The ten MI samples collected from the near-surface soils surrounding the SMD (KMI-001 through KMI-010) were comprised of 60 aliquots each. MI sampling was conducted in accordance with HDOH, May 2007 guidance as well as Alaska Department of Environmental Conservation March 2007 guidance, as presented in the project specific Work Plan (Element 2008). Table 3-1 and Figure 3-2 summarize DU and MI sample locations.

Table 3-1: Multi-Incremental Sample Summary

Decision Unit (DU)	DU Location	Sample Depth	Sample ID	Increments Included in Sample	Date of Collection	Time of Collection
1	Adjacent to SMD-South Side	4"	KMI-001	60 increments	10/26/2008	10:08
2	Adjacent to SMD-North Side	4"	KMI-002	60 increments	10/26/2008	10:31
3	Adjacent to Lagoon-North of SMD	4"	KMI-003	60 increments	10/26/2008	10:46

Decision Unit (DU)	DU Location	Sample Depth	Sample ID	Increments Included in Sample	Date of Collection	Time of Collection
4	Adjacent to Lagoon-Northeast of SMD	4"	KMI-004	60 increments	10/26/2008	11:05
5	West of SMD	4"	KMI-005	60 increments	10/26/2008	11:26
6	South of SMD	4"	KMI-006	60 increments	10/26/2008	12:30
7	South of Scrap Metal Storage Area	4"	KMI-007	60 increments	10/26/2008	12:02
8	Scrap Metal Storage Area	4"	KMI-008	60 increments	10/26/2008	12:59
9 (duplicate of 8)	Scrap Metal Storage Area	4"	KMI-009	60 increments	10/26/2008	13:00
10 (duplicate of 8)	Scrap Metal Storage Area	4"	KMI-010	60 increments	10/26/2008	13:15
11	Entire SMD	4"	KMI-011	152 increments	10/27/2008	9:35
12	Entire SMD	36"	KMI-012	128 increments	10/27/2008	15:05
13	Entire SMD	60"	KMI-013	128 increments	10/28/2008	10:55
14 (duplicate of 13)	Entire SMD	60"	KMI-014	128 increments	10/28/2008	11:00
15 (duplicate of 13)	Entire SMD	60"	KMI-015	128 increments	10/28/2008	11:05
17	SMD Hotspot	36"	KMI-017	99 increments	10/28/2008	11:00
18	SMD Hotspot	60"	KMI-018	99 increments	10/28/2008	11:30

Upon collection, samples were labeled, bagged in individual sealable plastic bags, and placed in insulated coolers packed with ice for preservation following industry standards. Samples were both stored in freezers or coolers with ice for the duration of transport back to Honolulu and then to the analytical laboratory located in Honolulu. MI samples KMI-001 through KMI-015 were analyzed by TestAmerica Honolulu for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471A. MI samples KMI-017 and KMI-018 were divided into the following grain size fractions using soil sieves, prior to analyses, in order to determine PCB concentrations in different ranges of soil grain size within the SMD hot spot:

- #10
- #60
- #230
- Fine

Following sieving of soil into the above grain size fractions, soil of each fraction was analyzed by TestAmerica Honolulu for total PCBs by EPA Method 8082.

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	FIGURE TITLE: MULTI-INCREMENTAL SOIL SAMPLE LOCATIONS	FIGURE NO.: 3-2

3.4.4 Green Island Near-Surface Soil Sample Collection

A total of five near surface soil samples were collected from five locations around Green Island to evaluate if contamination has migrated from the known contaminant sites. Soil samples were collected using trowels following clearance of the few surficial inches of soil and vegetation present. Soil samples were analyzed by TestAmerica Tacoma for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and7471A. Soil sample locations are shown on Figure 3-3.

3.4.5 Piezometer Installation and Groundwater Sample Collection

A total of nine piezometers were installed during the field effort. Six piezometers were installed at locations that surrounded the former Reburial Pit, where contaminated debris and soil from the SMD were previously reburied in the mid-1990s. The remaining three piezometers were installed between the SMD and the shoreline. Piezometer locations are shown on Figure 3-3.

Each piezometer was constructed using a one-foot long, one-inch diameter stainless steel screened, drive-point piezometer tip and three feet of stainless steel piping connected to steel piping (stainless used for groundwater-contact portion of piezometer). Each piezometer was decontaminated using alconox detergent prior to installation. Piezometers were driven to a minimum depth of between one to two feet below the groundwater table using a Hilti, electric-powered, roto-hammer with a custom fabricated drive tip. Table 3-2 includes piezometer installation details.

Table 3-2: Piezometer Summary

Piezometer ID	Location	Northing GPS	Westing GPS	Depth to Water BGS (ft)		Depth of Piezometer Tip (ft)	Groundwater Sample ID
				10/22/2008	10/25/2008		
Piezo1-Reburial	Runway Side	28.39090	178.29302	11	10.9	17	KWG-002
Piezo2-Reburial	East Side	28.39112	178.29279	9.5	10.5	13	KGW-001
Piezo3-Reburial	Runway Side	28.39071	178.29343	11.5	11.56	13	KGW-003
Piezo4-Reburial	West Side	28.39080	178.29376	10.5	8.92	13	KGW-004
Piezo5-Reburial	Lagoon Side	28.39107	178.29346	7.5	7.5	12	KGW-005, KGW-006
Piezo6-Reburial	Lagoon Side	28.39116	178.29310	7.9	7.9	10.3	KGW-007
Piezo7-SMD	Lagoon Side of SMD	28.38783	178.30330	6.1	6.1	7.5	KGW-008
Piezo8-SMD	On sand spit near SMD	28.38766	178.30374	4.6	5.1	6.4 (hit refusal)	KGW-009
Piezo9-SMD	Below the SMSA	28.38724	178.30296	9	9	10.8 (hit refusal)	KGW-010

Note: GPS Coordinates in WGS 84, decimal-degrees.

Prior to collection of groundwater samples, approximately three liters of water (or until piezometer went dry) was purged from each piezometer to ensure capture of representative formation groundwater. A total of ten groundwater samples (nine primary and one duplicate)

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	FIGURE TITLE: SURFACE SOIL, GROUNDWATER, BIOTA, SEA WATER AND SEDIMENT SAMPLE LOCATIONS	FIGURE NO.: 3-3

were collected on October 25, 2008. Groundwater samples were collected using a battery-powered peristaltic pump equipped with disposable Teflon tubing. New tubing was used for each groundwater sample to prevent cross-contamination between piezometers. Water collected for metals analysis was filtered in the field using 0.45 micron field filters.

Upon collection, groundwater samples were stored in coolers containing gel ice on Kure and during transport to Honolulu. Upon arrival in Honolulu, samples were repacked with ice and shipped to TestAmerica Tacoma for analysis for total PCBs by EPA Method 8082, metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471A, organochlorine pesticides by EPA 8081A and polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270C.

3.4.6 Sea Water Sample Collection

A total of two sea water samples were collected during this field effort. One sample was collected off of North Point and one sample was collected from the ocean adjacent to the SMD. Sea water samples were shipped to TestAmerica Tacoma for analysis for total PCBs by EPA Method 8082, and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471A. Sample locations are shown on Figure 3-3.

3.4.7 Marine Sediment Sample Collection

A total of ten marine sediment samples were collected during this field effort. Three samples were collected off of North Point and seven samples were collected from the ocean adjacent to the SMD. Sediment samples were shipped to TestAmerica Tacoma for analysis for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471A. A sediment sample summary is included in Table 3-3 while sample locations are shown on Figure 3-3.

Table 3-3: Marine Sediment Sample Summary

Sample ID	Collection Date	Collection Time	Location Collected	Distance from Shore (Yds)
KSED001	10/23/08	13:15	North Point	10
KSED002	10/23/08	13:30	North Point	150
KSED003	10/23/08	13:30	North Point	150
KSED004	10/28/08	16:30	Lagoon nr SMD	10
KSED005	10/28/08	16:30	Lagoon nr SMD	100
KSED006	10/28/08	16:30	Lagoon nr SMD	100
KSED007	10/28/08	16:30	Lagoon nr SMD	100
KSED008	10/28/08	17:00	South Point	15
KSED009	10/28/08	17:00	South Point	15
KSED010	10/28/08	17:00	South Point	15

3.4.8 Biota Sample Collection

Dr. Dennis Mead and Lieutenant Maile Norman of the USCG collected biota samples from each of three sites around the shoreline of Green Island as indicated on Figure 3-3. Species collected included the following:

1. Goatfish (Weke)-a carnivore;
2. Surgeonfish (Kole)-an omnivore;
3. Convict Tang (Manini)-an herbivore.

Table 3-4 summarizes the fish species sampled during this field effort while Table 3-5 summarizes the sampling information.

Table 3-4: Kure Lagoon Biota Sample Species

Genus, Species and Ecological Info	Common Name	Hawaiian Name	Type of Sample Analysis	Photo
Mulloidichthys samoensis-Commonly found in shallow sandy areas of lagoons; feed on mollusks, crustaceans and worms.	Goat fish	*weke*	Whole Body/Whole Fish Composite	
Acanthurus triostegus-Commonly found in lagoons and reef areas, feed on filamentous algae.	Convict Tang	*manini*	Whole Body	
Ctenochaetus stigosus-Commonly found in surge zones in exposed seaward reefs; herbivorous but feed on mollusks as well.	Yellow-Eyed Surgeon	*kole*	Whole Body	

Notes:
Information from *Fishbase.com*
Whole Fish- Fish analyzed whole (guts, head, filets, etc.).
Whole Fish Composite- Fish is too large to be analyzed on a whole basis. Typically, whole fish composites will include 10% skin, 10% vicera and 80% tissue.

Upon collection, biota specimens were weighed, photographed, and placed in individual sealable plastic bags, labeled and frozen onsite for transit to Honolulu. Due to limited support facilities and the need for whole-body chemical analyses, no processing of biota samples, other than identification of species, was performed in the field. From Honolulu, biota samples were shipped to TestAmerica Burlington for analysis.

Table 3-5: Kure Lagoon Biota Sample Summary

Sample ID	Collection Date	Collection Time	Location Collected	Distance from Shore (yds)	Collection Method	Type of Fish	Length (inches)	Weight (gms)
KBI001	10/21/08	15:15	SMD	42	Spear	Convict Tang	6	6
KBI002	10/21/08	15:30	SMD	100	Spear	Convict Tang	5	4.5
KBI003	10/21/08	15:45	SMD	150	Spear	Convict Tang	8	7
KBI004	10/21/08	16:00	SMD	100	Spear	Convict Tang	6	5
KBI005	10/22/08	11:00	SMD	100	Spear	Goatfish	11	14.5
KBI006	10/22/08	11:25	SMD	80	Spear	Goatfish	8	10.5
KBI007	10/22/08	14:25	Southpoint	15	Spear	Goatfish	7	5.75
KBI008	10/22/08	14:40	Southpoint	15	Spear	Goatfish	11	9.25
KBI009	10/22/08	14:55	Southpoint	25	Spear	Convict Tang	6	3.5
KBI010	10/22/08	15:00	Southpoint	15	Spear	Convict Tang	6	5.5
KBI011	10/22/08	15:05	Southpoint	20	Spear	Goatfish	12	7.25
KBI012	10/22/08	15:10	Southpoint	20	Spear	Convict Tang	7	7.0
KBI013	10/23/08	11:35	Northpoint	125	Spear	Convict Tang	6	6.25
KBI014	10/23/08	11:45	Northpoint	150	Spear	Surgeonfish	8	6.25
KBI015	10/23/08	11:55	Northpoint	150	Spear	Convict Tang	5	3.25
KBI016	10/23/08	12:10	Northpoint	150	Spear	Convict Tang	6	5.0
KBI017	10/23/08	12:40	Northpoint	300	Spear	Goatfish	11	7.0
KBI018	10/23/08	12:55	Northpoint	150	Spear	Surgeonfish	7	5.5

The 18 biota specimens were analyzed for total PCBs as whole fish or whole fish composites (depending on the fish size) by the analytical laboratory. Biota samples were analyzed by GC/ECD for the NOAA NS&T 32 congener list by the analytical laboratory. GC/ECD sample data are presented as the 32 PCB congeners and Aroclor totals. In addition, the biota sample containing the highest PCB levels was analyzed by High Resolution (HR) GC/MS for total PCBs via EPA Method 1668a, with data presented by the complete list of individual congeners (209 total congeners) and as the sum of all PCBs detected.

3.5 Investigation Derived Waste

In order to minimize decontamination and the generation of investigation derived waste (IDW) in the form of decontamination rinse water, disposable sampling trowels and disposable acetate probe liners were used to collect soil at each sample location. Soil and/or sediment adhering to non-disposable sampling equipment (such as the shovel used to excavate subsurface sample locations) were scraped off at each sample location before moving on to the next sampling location. The resultant volume of IDW was minimal and disposable items (sampling tubes, PPE, etc.) were brought off the island and discarded as municipal waste.

Methanol waste from the immunoassay kits was disposed of at the Midway Island power-generating incinerator following completion of the project.

3.6 Significant Deviations from the Work Plan

Due to site conditions and circumstances encountered at the time of the field investigation, the following work task was modified from the original plan. The most significant changes included:

1. The project WP called for establishment of two five-foot sampling grids within the ten-foot grid based on previous investigation results. Following re-establishment of the 1992 10-foot grid, soil samples were collected from the 10-foot grid and analyzed in the field in order to determine the location of elevated concentrations of PCBs within the landfill. Results of the initial chemical analysis of 10-foot grid soil samples indicated a single area of elevated PCB concentrations (rather than two separate areas) and it was determined that only one five-foot grid was necessary to further delineate the hot spot region present within the SMD.

The change detailed above did not adversely affect the overall investigation purpose, and served to enable a more thorough, representative investigation and was implemented for just that purpose.

Section 4 Sample Analysis and Investigation Results

Soil samples collected from the SMD were analyzed for total PCBs in the field using immunoassay test kits. Split soil samples, groundwater, sea water and sediment samples were sent to TestAmerica Tacoma for analysis while biota samples were sent to TestAmerica Burlington for analysis. Multi-incremental soil samples were sent to TestAmerica Honolulu for analysis. A sample and analysis summary is included in Table 4-1.

Table 4-1: Sample and Analysis Summary

Analyte	Matrix									
	Soil		Sediment		Biota		Groundwater		Sea Water	
	Primary	QC	Primary	QC	Primary	QC	Primary	QC	Primary	QC
PCBs by Immunoassay (performed on Kure, 10% splits sent to lab)	629	19	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total PCBs by EPA 8082	75 (also 17 MI samples)	2 MI triplicates	10	1	18	n/a	9	1	2	n/a
PCB congeners (NOAA NS &T 32) by EPA 8082 M	8	n/a	n/a	n/a	18	n/a	n/a	n/a	n/a	n/a
PCB congeners (complete list) by EPA 1668a	1	n/a	n/a	n/a	1	n/a	n/a	n/a	n/a	n/a
Percent Lipids by NOAA NS & T	n/a	n/a	n/a	n/a	18	n/a	n/a	n/a	n/a	n/a
Metals by EPA 6020 (6010B for water)	5 (also 13 MI samples)	4 MI duplicates	10	1	n/a	n/a	9	1	2	n/a
Chlorinated pesticides by EPA 8081A	n/a	n/a	n/a	n/a	n/a	n/a	9	1	n/a	n/a
Semi-Volatiles by EPA 8270C	n/a	n/a	n/a	n/a	n/a	n/a	9	1	n/a	n/a

Notes:
QC=Quality Control.
n/a=analyte not tested for

Analytical methods used by the analytical laboratory are from EPA publication SW-846 "*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.*" Laboratory data packages are included on the attached compact diskette as Addendum A.

4.1 Data Evaluation Criteria

Results of soil sampling were compared to the HDOH Environmental Action Levels (EALs), (HDOH EAL Table B-2, Summer 2008). Results of sediment sample analysis were compared to National Oceanic and Atmospheric Administration (NOAA) National Status and Trends (NS&T) sediment criteria, both effects range low, (ER-L) and effects range medium (ER-M). Groundwater sample results were compared to the HDOH EALs for Surface Water Estuarine Habitats (HDOH EAL Table D-2c, Summer 2008), while lagoon water sample results were compared to HDOH EALs for Aquatic Habitat Goals-Marine Water chronic aquatic toxicity (HDOH EAL Table D4a, Summer 2008). Biota sample results were compared to previous biota sample concentrations found in the northwest Hawaiian Islands.

4.2 Scrap Metal Dump Discrete Soil Sample Analysis Results

SMD soil sampling included collection of soil samples from two sampling grids-an initial 10-foot grid and a 5-foot hotspot grid. A total of 152 surface and 255 subsurface soil samples were collected from the 10-foot grid. A total of 74 surface and 148 subsurface soil samples were collected from the 5-foot grid. All soil samples collected from the SMD were analyzed for total PCBs using RaPID assay immunoassay field test kits. PCB concentrations were found to be the highest in soil collected from below 36", with concentrations at this interval from the hotspot having a mean of 3.6 milligrams per kilogram (mg/kg) (excluding the single highest concentration). Immunoassay results are summarized in Table 4-2 and on Figure 4-1. Complete immunoassay results are included in Tables B-1 through B-3 in Appendix B.

Table 4-2: Field Immunoassay PCB Results Summary-SMD Soil

Depth	Sample Grid	Number of Samples	Number Exceeding HDOH EAL[1] (1.1 mg/kg)	Max PCB (mg/kg)	Mean PCB (mg/kg)	Median PCB (mg/kg)	Percentage Samples PCB Exceeds X mg/kg				
							X> 0.15	X> 0.5	X> 1.0	X> 5.0	X> 10.0
4"	10' only	152	5	22.68	0.47	0.0844	33.8%	16.2%	5.8%	1.9%	0.6%
4"	10' and 5' All	226	20	22.68	0.59	0.0976	38.5%	20.9%	10.7%	1.6%	1.1%
4"	Hot Spot	74	15	11.7	0.76	0.19	53.7%	35.2%	24.1%	3.7%	1.9%
36"	10' only	128	2	19.79	0.791(0.65 mean excluding max detect PCB value)	0.029	25.2%	18.7%	12.2%	5.0%	0.7%
36"	10' and 5' All	202	48	620	4.92 (2.07 mean excluding max detect PCB value)	0.065	48.4%	39.2%	24.0%	10.6%	5.5%
36"	Hot Spot	74	46	620	10.26 (4.29 mean excluding max detect PCB value)	0.97	72.8%	62.1%	48.5%	22.3%	10.7%
Below 36"	10' only	127	2	3667.2	30.92 (1.59 mean excluding max detect PCB value)	0.036	28.0%	18.4%	10.4%	6.4%	4.0%
Below 36"	10' and 5' All	201	44	3667.2	20.2 (1.78 mean excluding max detect PCB value)	0.072	41.2%	31.2%	21.6%	8.0%	4.0%

Depth	Sample Grid	Number of Samples	Number Exceeding HDOH EAL[1] (1.1 mg/kg)	Max PCB (mg/kg)	Mean PCB (mg/kg)	Median PCB (mg/kg)	Percentage Samples PCB Exceeds X mg/kg				
							X> 0.15	X> 0.5	X> 1.0	X> 5.0	X> 10.0
Below 36"	Hot Spot	74	42	3667.2	41.76 (3.6 mean excluding max detect PCB value)	0.75	69.8%	57.3%	42.7%	15.6%	8.3%

Notes:
[1]HDOH EAL from Table B-2-Final EAL

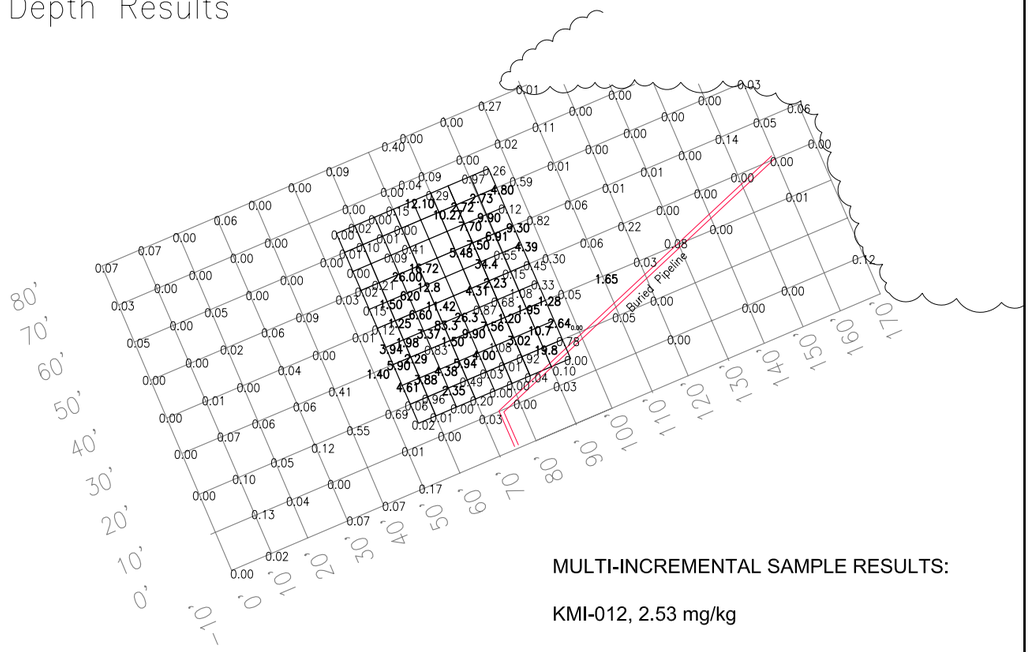
A total of 70 of the discrete soil samples analyzed via immunoassay kits in the field were split and sent to the analytical laboratory for confirmation analysis for total PCBs via gas chromatograph/ultrasonic extraction (GC/UE) by EPA method 8082. Comparison of the field results indicated a good correlation between immunoassay and laboratory results, with 62 of the 70 results meeting the relative percent difference (RPD) criteria (RPD criteria is detailed in Section 5). Laboratory analytical results of the 70 split samples are included in Appendix B, Table B-4. Laboratory data sheets are included in Addendum A.

4.3 Scrap Metal Dump Multi-Incremental Soil Sample Analysis Results

A total of ten MI samples were collected from areas surrounding the SMD, five collected from within the entire SMD and two collected from within the hotspot identified within the SMD. MI samples were analyzed for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471A. PCBs were detected above laboratory reporting limits in only one of the ten MI samples collected from the areas surrounding the SMD. KMI-001, collected adjacent to the south and west sides of the SMD had a PCB concentration of 0.337 mg/kg (Aroclor 1254). The MI sample collected from within the SMD from the 4" depth (KMI-011) contained a comparable PCB concentration of 0.353 mg/kg, (Aroclor 1254) while the MI sample collected from within the SMD from the 36" depth (KMI-012) contained a PCB concentration of 2.53 mg/kg (Aroclor 1260). The triplicate samples collected from within the SMD from the 60" depth (KMI-013, KM-014 and KMI-015) contained concentrations of PCBs (Aroclor 1260) of 40, 36.4 and 33.6 mg/kg, respectively.

Lead was detected in sample KMI-009 (a duplicate of KMI-008 and KMI-010) at 358 mg/kg, exceeding the HDOH EAL for lead of 200 mg/kg. No other metals were detected above regulatory standards. Table 4-3 and Figure 4-2 provide a results summary for the MI samples collected from the SMD and vicinity. Complete laboratory analytical results are included in Appendix B, Table B-5 while laboratory data sheets are included in Addendum A.

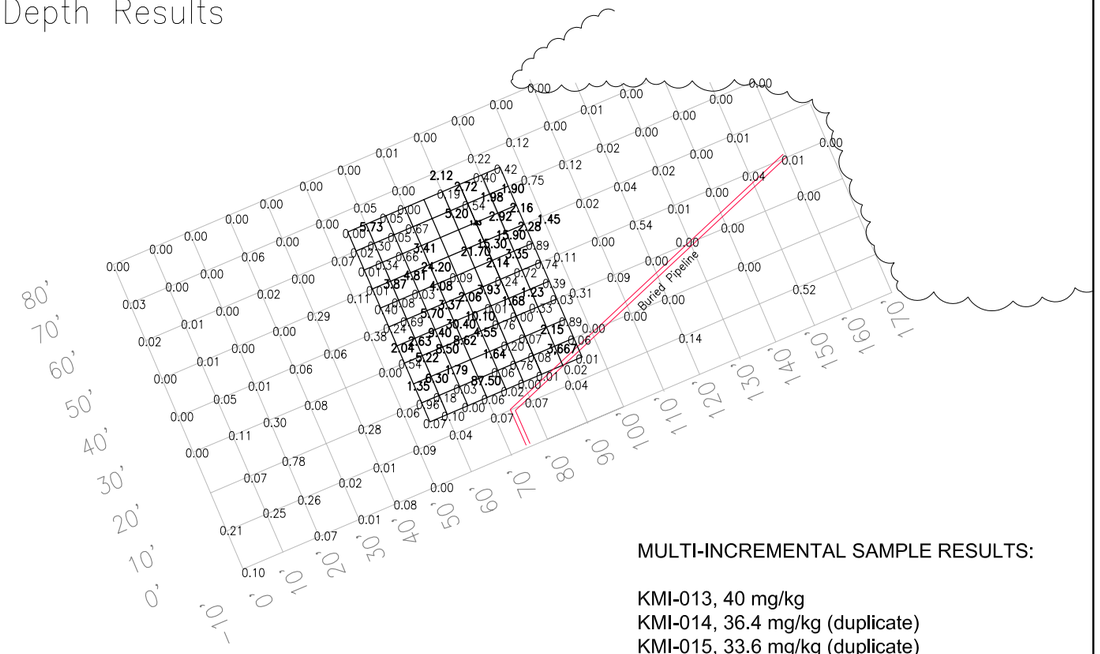
36” Depth Results



MULTI-INCREMENTAL SAMPLE RESULTS:

KMI-012, 2.53 mg/kg

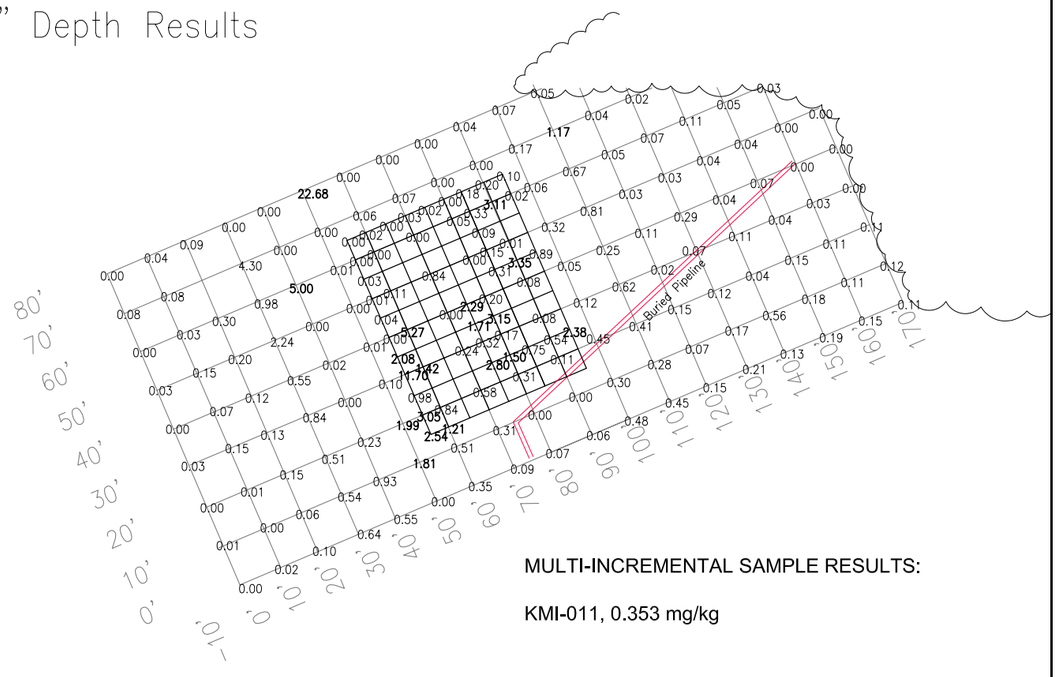
60” Depth Results



MULTI-INCREMENTAL SAMPLE RESULTS:

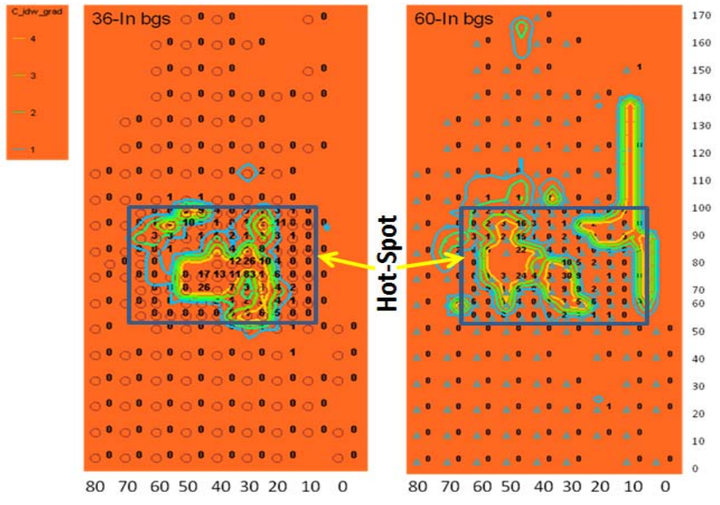
KMI-013, 40 mg/kg
KMI-014, 36.4 mg/kg (duplicate)
KMI-015, 33.6 mg/kg (duplicate)

4” Depth Results



MULTI-INCREMENTAL SAMPLE RESULTS:

KMI-011, 0.353 mg/kg



NOTES:

1) Some grid nodes were not sampled due to refusal or restricted access due to naupaka bushes and roots.
2) All results in mg/kg.

LEGEND

3.24 Bolded Text-Result Greater Than 1.1 mg/kg

36" DEPTH HOT SPOT MULTI-INCREMENTAL SAMPLE RESULTS-VARIOUS GRAIN SIZE FRACTIONS:

KMI-017 #10, 3.88 mg/kg
KMI-017 #60, 14.1 mg/kg
KMI-017 #230, 25.8 mg/kg
KMI-017, Fine, 72.7 mg/kg

60" DEPTH HOT SPOT MULTI-INCREMENTAL SAMPLE RESULTS-VARIOUS GRAIN SIZE FRACTIONS:

KMI-018 #10, 2.31 mg/kg
KMI-018 #60, 33.2 mg/kg
KMI-018 #230, 44.7 mg/kg
KMI-018, Fine, 81.6 mg/kg

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PROJECT TITLE:
EVALUATION OF GREEN ISLAND LANDFILL AND REBURIAL PIT, FORMER U.S. COAST GUARD STATION KURE

FIGURE TITLE:
SCRAP METAL DUMP DISCREET SOIL SAMPLE IMMUNOASSAY RESULTS AND MULTI-INCREMENTAL LABORATORY RESULTS

DATE:
Feb 2009

FIGURE NO.:
4-1

	DATE: Feb 2009	PROJECT TITLE: EVALUATION OF GREEN ISLAND LANDFILL AND REBURIAL PIT, FORMER U.S. COAST GUARD STATION KURE
	FIGURE TITLE: SMD VICINITY MULTI-INCREMENTAL SOIL SAMPLE ANALYTICAL RESULTS	FIGURE NO.: 4-2

Table 4-3: MI Testing Results Summary-SMD and Vicinity

Decision Unit (DU)	DU Location	Sample Depth	Sample ID	PCB Concentration
1	Adjacent to SMD-South Side	4"	KMI-001	0.337 mg/kg
2	Adjacent to SMD-North Side	4"	KMI-002	ND (0.0329)
3	Adjacent to Lagoon-North of SMD	4"	KMI-003	ND (0.0309)
4	Adjacent to Lagoon-Northeast of SMD	4"	KMI-004	ND (0.0327)
5	West of SMD	4"	KMI-005	ND (0.0327)
6	South of SMD	4"	KMI-006	ND (0.0321)
7	South of Scrap Metal Storage Area	4"	KMI-007	ND (0.0325)
8	Scrap Metal Storage Area	4"	KMI-008	ND (0.0316)
9 (duplicate of 8)	Scrap Metal Storage Area	4"	KMI-009	0.0049 J mg/kg
10 (duplicate of 8)	Scrap Metal Storage Area	4"	KMI-010	ND
11	Entire SMD	4"	KMI-011	0.353 mg/kg
12	Entire SMD	36"	KMI-012	2.53 mg/kg
13	Entire SMD	60"	KMI-013	40 mg/kg
14 (duplicate of 13)	Entire SMD	60"	KMI-014	36.4 mg/kg
15 (duplicate of 13)	Entire SMD	60"	KMI-015	33.6 mg/kg

Note: ND (0.0329) = result and reporting limit

PCB results of the various grain size fractions derived from MI samples KMI-017 and KMI-018 collected from the SMD Hot spot indicate that the most elevated PCB concentrations are in the finer soil fractions, with the fine silt fraction containing an order of magnitude higher PCB concentration (~70-80 mg/kg) than the coarse >2 mm sand/gravel fraction (2-4 mg/kg). Table 4-4 includes a summary of the results for the two MI samples collected from the SMD Hot Spot. Complete laboratory analytical results are included in Appendix B, Table B-6 while laboratory data sheets are included in Addendum A.

Table 4-4: MI Testing Results Summary-SMD Hot Spot Various Grain Size Fractions

Decision Unit (DU)	DU Location	Sample Depth	Sample ID	Sieve Size	Grain Size (mm)	Sample Weight	Percentage (%) of Sample	PCB Concentration
17	SMD Hotspot	36"	KMI-017-#10	#10	>2	110 grams	9%	3.88 mg/kg (Aroclor 1254)
			KMI-017-#60	#60	>0.25	975 grams	83%	14.1 mg/kg (Aroclor 1254)
			KMI-017-#230	#230	>0.063	95 grams	8%	25.8 mg/kg (Aroclor 1254)
			KMI-017-Fine	Fine	<0.063	1.5 grams	0.1%	72.7 mg/kg (Aroclor 1254)

Decision Unit (DU)	DU Location	Sample Depth	Sample ID	Sieve Size	Grain Size (mm)	Sample Weight	Percentage (%) of Sample	PCB Concentration
18	SMD Hotspot	60"	KMI-018-#10	#10	>2	220 grams	18.5%	2.31 mg/kg (Aroclor 1254)
			KMI-018-#60	#60	>0.25	880 grams	74%	33.2 mg/kg (Aroclor 1260)
			KMI-018-#230	#230	>0.063	82.5 grams	7%	44.7 mg/kg (Aroclor 1260)
			KMI-018-Fine	Fine	<0.063	2.5 grams	0.2%	81.6 mg/kg (Aroclor 1260)

4.4 Green Island Near-Surface Soil Sample Analysis Results

A total of five near-surface soil samples were collected from locations around Green Island and analyzed for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471 A. Trace PCBs (0.02 mg/kg) were detected in sample KGI-2.0-004, collected from South Beach along the vegetation line of the dune, along a 30-foot long on-shore, limestone bench. There were no other detections of PCBs exceeding laboratory reporting limits.

Metals were detected at low concentrations in all five samples, with none exceeding regulatory levels. Complete laboratory analytical results are included in Appendix B, Table B-7 while laboratory data sheets are included in Addendum A.

4.5 Groundwater Sample Analysis Results

A total of ten groundwater samples (nine primary samples and one duplicate) were collected from nine piezometers installed around the perimeter of the Reburial Pit and between the shoreline and the SMD. Groundwater samples were analyzed for total PCBs by EPA Method 8082, metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471A, organochlorine pesticides by EPA 8081A and semi-volatile organic compounds (SVOCs) by 8270C. The groundwater collected for metals analysis was filtered in the field using 0.45 micron field filters.

Analytical results indicated a detection of PCBs at 0.40 µg/L in the water sample collected from Piezometer #8 (Sample KGW-009), located just west of the SMD. The sample was analyzed twice to confirm the PCBs concentration, with a second result of 0.39 ug/L. These concentrations exceed the HDOH EAL for PCBs for Surface Water Estuarine Habitats of 0.000079 µg/L. PCBs were not detected in any other groundwater samples.

The SVOC constituent benzo(a)pyrene was detected in two samples, KGW-008 (0.035 µg/L) collected from Piezometer #7 and in KGW-010 (0.033 µg/L) collected from Piezometer #9. Both benzo(a)pyrene results exceed the HDOH EAL for Surface Water Estuarine Habitats (0.014 µg/L). Both Piezometers #7 and #9 are located in the vicinity of the SMD (Figure 4-3).

The pesticide 4,4'-DDD was detected in three groundwater samples; KGW-001 (0.001 µg/L) collected from Piezometer #2, KGW-003 (0.002 µg/L) collected from Piezometer #3 and KGW-

005 (0.001 µg/L) collected from Piezometer #5. All three detections equal or exceed the HDOH EAL for Surface Water Estuarine Habitats of 0.00031 µg/L for 4,4'-DDD. 4,4'-DDT was detected in a single sample, KGW-009 (0.0088 µg/L) collected from Piezometer #8, exceeding the HDOH EAL for Surface Water Estuarine Habitats (0.000008 µg/L). Heptachlor was detected in two samples, KGW003 at 0.0010 µg/L (Piezometer #3) and KGW004 at 0.0013 µg/L. Both heptachlor detections exceeded the HDOH EAL for Surface Water Estuarine Habitats (0.0009 µg/L). Heptachlor epoxide was detected in three samples, KGW001 at 0.0011 µg/L (Piezometer #2), KGW009 at 0.0027 µg/L (Piezometer #8) and KGW010 at 0.0011 µg/L (Piezometer #9). All three detections exceeded the HDOH EAL for Surface Water Estuarine Habitats (0.000039 µg/L).

Arsenic was detected in all ten groundwater samples at concentrations exceeding the HDOH EAL for Surface Water Estuarine Habitats (0.00014 mg/L). Mercury was detected in five samples, three from the reburial pit vicinity and two from the SMD vicinity, at concentrations ranging from 0.000056 to 0.000083 mg/L, all exceeding the HDOH EAL for Surface Water Estuarine Habitats (0.000025 mg/L).

Groundwater analytical results are summarized on Figure 4-3. Complete laboratory analytical results are included in Appendix B, Table B-8 while laboratory data sheets are included in Addendum A.

4.6 Sea Water Sample Analysis Results

A total of two sea water samples were collected during this field effort, one from the Lagoon off of North Point and one from the Lagoon off of the SMD. Both sea water samples were analyzed for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471 A.

PCBs were not detected in either sea water sample. Mercury was detected in both sea water samples (KSW-001 at 0.000041 mg/L and KSW-002 at 0.000084 mg/L) at concentrations exceeding the HDOH EAL of 0.000025 mg/L.

Sea water analytical results are summarized on Figure 4-3. Complete laboratory analytical results are included in Appendix B, Table B-7 while laboratory data sheets are included in Addendum A.

4.7 Marine Sediment Analysis Results

A total of ten marine sediment samples were collected from three locations: North Point, the Lagoon near the SMD and South Point. Sediment samples were analyzed for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471A.

PCBs were not detected above laboratory reporting limits in any of the sediment samples. Trace metals concentrations were detected, but none above regulatory standards. Marine sediment laboratory analytical results are included in Appendix B, Table B-9 while laboratory data sheets are included in Addendum A.

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4.8 Biota Sample Analysis Results

A total of 18 biota specimens were sent to TestAmerica Burlington for analysis as whole fish for NOAA NS&T 32 PCB congeners. A total of 15 specimens contained detectable levels of PCBs, with total PCBs detected ranging from 2 to 90 µg/kg. Total PCBs were calculated for biota by using the NOAA NS&T 18 PCB congener method where the sum of the NOAA NS&T 18 PCB congeners is multiplied by two. Biota laboratory analytical results are summarized in Table 4-5 and on Figure 4-4. Complete laboratory analytical results are summarized in Table B-10 in Appendix B and laboratory data sheets are included in Addendum A.

Table 4-5: PCBs Testing Results Summary-Biota

Sample Media	Primary Samples	Detections Above Reporting Limit	Mean	Detections Range
Biota	18	15	19.52 µg/kg	2-90 µg/kg

Biota specimens captured in the vicinity of the SMD and at South Point had significantly higher PCB concentrations than those found in biota captured at North Point. Due to the small sample size, the mean of the PCB concentrations was used for comparison rather than the 95% upper confidence level (UCL). The mean of the PCB concentrations found in biota captured from the Lagoon adjacent to the SMD and the near-shore on the ocean-side adjacent to the SMD (South Point) is 28.7 µg/kg. The mean of the PCB concentrations found in biota captured from North Point is 1.2 µg/kg.

Table B-11 in Appendix B provides a comparison of PCB values identified in biota from each of the three areas.

In addition to PCBs, biota specimens were tested for total metals (arsenic, cadmium, chromium, lead and mercury). Results indicate that arsenic is present in all 18 biota specimens at concentrations ranging from 0.59 to 21.5 mg/kg, with all of the most elevated levels found in the goatfish. Cadmium was detected in ten fish at concentrations ranging from 0.015 to 0.38 mg/kg. Chromium was detected in all 18 fish at concentrations ranging from 0.74 to 1.1 mg/kg. Lead was detected in six biota at concentrations ranging from 0.015 to 0.22 mg/kg. Mercury was detected in four fish at concentrations ranging from 0.0083 to 0.044 mg/kg. A summary of metals analytical results is presented in Table 4-6 while complete laboratory analytical results are summarized in Table B-12 in Appendix B. Laboratory data sheets are included in Addendum A.

Table 4-6: Metals Testing Results Summary-Biota

Sample Media and Analytical Method	Primary Samples	Detections Above Reporting Limit	Mean	Detections Range
Biota	18	Arsenic 18	5.51 mg/kg	0.59-21.5 mg/kg
		Cadmium 10	0.202 mg/kg	0.015-0.38 mg/kg

Sample Media and Analytical Method	Primary Samples	Detections Above Reporting Limit	Mean	Detections Range
		Chromium 18	0.98 mg/kg	0.74-1.1mg/kg
		Lead 6	0.0754 mg/kg	0.015-0.22 mg/kg
		Mercury 4	0.0208 mg/kg	0.0083-0.044 mg/kg

In an effort to interpret concentrations of PCBs and metals identified in biota collected from Kure, Table 4-7 below compares concentrations found in biota during this effort to concentrations found in biota collected during previous investigations at Kure as well as concentrations found in biota at other Northwest Hawaiian Islands.

Table 4-7: Northwest Hawaiian Island Biota Contaminant Comparison

Island Site	Carnivorous Fish[1]		Herbivorous Fish[2]		Invertebrates[3]		Offshore Sediment		Seawater	
	PCBs (µg/kg)	Lead (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	PCBs (µg/L)	Lead (mg/L)
Kure Atoll- This Study										
Kure Atoll Landfill	36.6	0.04	14.6	0.06	-	-	<9.8	0.19	< 0.044	< 0.17
Kure Atoll South Point	46.9	0.13	24	0.13	-	-	<9.8	0.86	-	-
Kure Atoll North Point	2.4	0.04	1	0.05	-	-	<9.7	0.46	< 0.042	< 0.17
Kure Atoll- Previous Study-2003										
Kure Atoll Landfill	< 60	0.29	-	-	-	-	< 20	< 0.75	< 1.0	< 100
Kure Atoll South Point	< 60	0.67	-	-	-	-	< 20	< 0.75	-	-
Kure Atoll North Point	< 60	0.38	-	-	-	-	< 20	0.8	-	-
Kure Atoll- Previous Study-1993										
Kure Atoll Landfill	< 80	0.1	< 80	0.15	< 60	-	-	-	-	< 5.0
Kure Atoll North Point	< 80	0.17	< 80	0.25	-	-	-	-	-	-
Other Northwest Hawaiian Island Atolls										
Midway Atoll Landfill	7,662	-	13,666		113		113	-	0.0012	
Midway Atoll Inner Harbor	-	-	4,021	-	37.5	-	-	-	0.00003	
Midway Atoll Reference	13.6		36.3		0.51		0.13		< 0.00012	
Tern Island Landfill	8,879	0.4	1,158	0.5	7,322	0.6	588	32.15	0.0045	< 5.0
Tern Island Northwest	275	0.15	317	0.2	121.7	0.4	96.7	16.03	-	-
Tern Island Northeast	218	0.1	43.8	0.23	66.9	1.95	3	2.7	-	-

Island Site	Carnivorous Fish[1]		Herbivorous Fish[2]		Invertebrates[3]		Offshore Sediment		Seawater	
	PCBs (µg/kg)	Lead (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	PCBs (µg/kg)	Lead (mg/kg)	PCBs (µg/L)	Lead (mg/L)
Tern Island Southwest	-	-	45	< 0.1	-	-	-	-	-	-
Tern Island Southeast	271	0.25	59.4	0.2	49.5	0.1	-	-	0.0007	< 5.0
Tern Island Reference	0.08	-	2.34	-	5.95		-	0.16	-	-
Johnston Atoll West Sand Island			840				45			
Johnston Atoll Herbicide Orange site			79.4							

Notes:
Concentrations shown are averages for each biota type/area.
< concentration is not detected above laboratory reporting limit, reporting limit is shown (i.e., <9.7).
[1]Carnivorous Fish: Kure (weke); Tern (weke); Midway (weke)
[2]Herbivorous Fish: Kure (manini, kole); Tern (manini); Midway (damselfish); Johnston (damselfish)
[3]Invertebrates: Kure (Lithoconus litteratus,Conus sp.,Chelyconus Fulman Kirai,Terebra maculata); Tern (a'ama); Midway (Echinometra, Holothuria, Octopus)
Data from Spengler et al, 1995

800' 0' 800' 1600'

SCALE: 1" = 800'

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	FIGURE TITLE: BIOTA SAMPLE ANALYTICAL RESULTS	FIGURE NO.: 4-4

Section 5 Data Quality Assessment and Quality Control

This section presents data quality assessment for data derived during this project. The field activities consisted of the collection of soil, sediment, water, and biota samples from the former LORAN Station Kure site and vicinity. All environmental sampling and analyses activities were conducted in adherence to the project-specific Quality Assurance Procedures Plan (QAPP) that was submitted as part of the project Work Plan (Element 2008) prior to the initiation of field work.

The usability of the data collected during this site investigation (SI) depended on its quality. A large number of factors included in the sample collection and analysis process had the potential to impact the overall quality of the data generated during the SI. Adhering to proper sample collection techniques, observing and documenting chain-of-custody (COC) procedures and using certified analytical laboratories and approved analytical methods have ensured that the quality of data generated by the SI accurately represents conditions at the site and its vicinity.

5.1 Field Sampling Quality Control

Sample representativeness was ensured through the use of trained sampling personnel, industry-standardized procedures (as detailed in the project Work Plan, Element 2008), peer review of field logs and notes and collection of quality control (QC) samples.

Field QC sample collection was conducted in adherence to industry standards and consisted of collection of field duplicates, which were sent “blind” to the analytical laboratory and equipment rinsates. The laboratory used extra volume from primary samples to run matrix spike/matrix spike duplicate (MS/MSD) samples.

5.1.1 Field Duplicates

All SMD soil samples were analyzed in the field using immunoassay screening test kits. A total of 19 field duplicates were also analyzed in the field using the immunoassay test kits. In order to confirm test kit results, approximately 10% of the soil samples were split and sent to a commercial analytical laboratory for analysis of PCBs. In addition, a duplicate groundwater sample was collected from Piezometer #5 (sample pair KGW-005 and KGW-006) and submitted blind to the analytical laboratory. Field duplicates are collected in order to assess the precision of the sample results as well as the sample collection and analytical process. Field duplicate samples were submitted to the laboratory with unique sample identification (ID) numbers so as to be “blind” to the laboratory.

5.1.2 Equipment Rinsates

Disposable equipment (i.e., acetate liners for the soil probe) was used for soil and sediment sample collection, thus eliminating the need to collect equipment rinsates during these sampling activities.

5.1.3 Sample Handling and Custody

Industry standard sample handling and custody procedures were adhered to during all sampling and sample handling activities.

All samples were kept at approximately 4 ± 2 degrees C in insulated coolers packed with frozen gel ice. Chain of Custody forms were placed inside sealable plastic storage bags and placed inside the sample coolers for shipment, while project copies were maintained on-site. Coolers were then closed, sealed with waterproof tape, and the lid sealed with two custody seals to enable detection of tampering. Coolers were delivered directly to the Federal Express shipping office in Honolulu, Hawaii upon return to Oahu by the Element field crew. U.S. Department of Transportation (DOT) regulations were followed for packaging and shipment of samples.

5.1.4 Intended Deviations of Field Standard Operating Procedures

There were no deviations from standard operating procedures during field activities for this project.

5.2 Analytical Quality Control Procedures

Analytical methods utilized during this project included both field screening (immunoassay) and standard laboratory methods.

5.2.1 Immunoassay Analytical Procedures

A total of 226 surface and 403 subsurface soil samples were analyzed for total PCBs using RaPID Assay immunoassay test kits and a portable spectrophotometer. The RaPID Assay system for PCB analysis applies the principles of enzyme-linked immunosorbent assay (ELISA) to determine the concentration of PCBs. In ELISA, an enzyme is chemically linked to a PCB molecule (or analog) to create a labeled PCB reagent called a conjugate. The conjugate is mixed with an extract from the sample being tested, followed by mixing with paramagnetic particles that have PCB specific antibodies. The PCB in the sample being tested and the conjugate are bound to antibody binding sites on the paramagnetic particles. At the end of an incubation period, a magnetic field is applied to hold the paramagnetic particles in the tube. The unbound reagents are decanted, and the paramagnetic particles with the PCB-antibody complexes are washed with a washing solution.

After the reagent solution is washed away, the remains are either PCB-antibody complexes or PCB-enzyme-antibody complexes bound to the paramagnetic particles. Since the PCBs in the sample being tested and PCB-enzyme conjugates compete for antibody binding sites, they are bound to the paramagnetic particles in proportion to their concentration in the original reagent mixture. The presence of PCBs is detected by adding an enzyme substrate (hydrogen peroxide) and chromogen (3,3',5,5'-tetramethylbenzidine). The enzyme on the PCB-enzyme conjugate catalyzes the conversion of the substrate/chromogen mixture into a colored product. After an incubation period, the reaction is stopped and stabilized by the addition of acid. Since PCBs on the PCB-enzyme conjugate were in competition with PCBs in the sample being tested for the antibody sites, the color developed is inversely proportional to the concentration of PCBs in the sample. The color developed is quantified with a small, handheld photometer.

The first step in the immunoassay analysis procedure is sample extraction. The soil collection tube containing a sieved (through #10 mesh) soil sample is placed upright in the Styrofoam

rack, and one vial (20 mL) of the PCB extraction solution is added. The tube is shaken vigorously and continuously for at least 60 seconds. After shaking, the tube is positioned upright in the rack and allowed to sit at least 5 minutes. Filtration of the sample follows. The soil collection tube is inverted over a collection vial, and pressure is applied to the plunger tube handle on the collection tube. The collection vial is filled with approximately 10 to 20 drops (0.5 to 1 mL) of extract.

A pipette is used to transfer 25 µL of the extract directly into a vial containing PCB extract diluent (25 mL of a buffered saline solution containing preservative and stabilizers without any detectable PCBs) and mixed by inverting the vial several times. The test tubes that will be used for the analysis, one each for calibration standards, control, and sample are prepared (200 µL of the appropriate standard, control, or sample added to each tube) and labeled. The PCB antibody-coupled paramagnetic particles (500 µL) are then added to each tube, and the tubes are vortexed for 1 to 2 seconds, taking care to minimize foaming. The test tubes are then allowed to incubate for 15 minutes at room temperature.

Following incubation, the test tubes are placed in the magnetic separation rack for 2 minutes. The tubes are then decanted and rinsed with 1 mL of washing solution and vortexed for another 1 to 2 seconds. The tubes are returned to the magnetic separation unit for 2 additional minutes, followed by decanting. The rinse, vortex and decant step is repeated one more time, followed by the addition (500 µL) of color solution to each tube. The tubes are again vortexed for 1 to 2 seconds and incubated for 20 minutes at room temperature. After incubation, 500 µL of stopping solution is added to each tube, and the sample preparation is complete.

The washing solution added to a clean test tube serves as an analysis blank. All of the prepared test tubes are read using the RPA-I RaPID photometric analyzer set at 450 nm. For samples that had higher PCB concentration, additional dilution (e.g., 1 to 10, 1 to 100) was performed to bring the readings to within the linear calibration range.

During immunoassay analysis, three blind blanks were analyzed as a QC measure. Blanks consisted of certified PCB-free soil (Wibby Blank Soil, Lot # 820060294). Immunoassay analysis blank results were as follows:

Table 5-1: Immunoassay Analysis Blank Results

Blank Sample ID	Result (mg/kg)
Blank-1	ND
Blank-2	ND
Blank-3	ND

5.2.2 Laboratory Analytical Procedures

The laboratory selected to perform the analyses (TestAmerica Laboratories) has a QA/QC program in place and is certified by National Environmental Laboratory Accreditation Conference (NELAC). All analyses were conducted according to the guidance outlined in EPA SW-846 (EPA 1997) and the *Department of Defense, Quality Systems Manual for*

Environmental Laboratories (Department of Defense Environmental Data Quality Workgroup 2000).

5.2.3 Intended Deviations from Laboratory Standard Operating Procedures

There were no deviations for the analytical methods used during this project.

5.3 Data Validation

5.3.1 Data Quality Assessment

Data quality was assessed by evaluating precision, accuracy, representativeness, completeness, and comparability parameters both qualitatively and quantitatively.

5.3.1.1 Precision

Comparison of duplicates to primary samples (or precision of the analysis) is expressed as the RPD between analytical results for the duplicate and the primary sample sent to the laboratory. Precision is defined as the agreement between a set of replicate measurements without assumption or knowledge of the true value. Precision limits for laboratory measurements were evaluated by comparing the sample/sample duplicate results using the following criteria:

1. For analytes with the primary sample concentration greater than five times the reporting limit, the duplicate sample results should agree within approximately 50 percent for soil samples (have an RPD of 50 percent or less).

2. For analytes with either or both sample concentrations less than five times the reporting limit, duplicate soil sample concentrations should agree within approximately five times the reporting limit.

Comparison of Primary and Duplicate Sample Immunoassay Analytical Results for Soil

A total of 19 blind duplicates were analyzed using immunoassay test kits. The RPDs of all 19 sample pairs were within the 50 percent criteria. Field duplicate results and comparison to primary sample results for those duplicates analyzed in the field using immunoassay kits are presented in Table 5-2.

Table 5-2: Immunoassay Analysis Field Duplicate Comparison

Sample ID	Primary Sample Result (mg/kg)	Duplicate Sample Result (mg/kg)	RPD
3-40/65	7.63	5.70	7.2%
3-25/60	5.91	6.30	1.6%
2-40/65	5.62	6.60	4.0%
3-60/80	12.60	5.20	20.8%
2-30/55	6.88	5.90	3.8%

Sample ID	Primary Sample Result (mg/kg)	Duplicate Sample Result (mg/kg)	RPD
2-25/75	7.89	4.00	16.4%
40/60	5.48	5.27	1.0%
2-30/80	6.36	7.56	4.3%
2-50/80	5.02	5.48	2.2%
3-30/60	5.94	5.22	3.2%
3-30/70	7.47	8.62	3.6%
2-50/90	7.31	6.91	1.4%
DU17-1	2.64	4.80	14.5%
DU17-2	5.25	5.70	2.1%
DU17-3	4.14	3.90	1.5%
DU17-4	5.57	5.10	2.2%
2-40/100	0.27	0.30	2.1%
DU11A	0.14	0.17	5.8%
DU11B	0.25	0.81	26.6%
		Average RPD	6.5%

Comparison of Immunoassay and Laboratory Analytical Results for Soil Samples

Upon review and comparison of the data generated from both immunoassay field test kits and duplicate laboratory-analyzed samples, it was determined that the immunoassay method is an effective method of detecting PCBs present in site soils. This is validated by the analytes' concentrations being detected at similar concentration ranges in split samples analyzed by the project laboratory (comparison included in Table 5-3 below). A total of 70 split samples were sent to the commercial analytical laboratory for confirmation analysis. A total of 62 of the 70 sample pairs were in agreement (as per the RPD criteria described above). The eight sample pairs that were not in agreement can be attributed to sample matrix heterogeneity or immunoassay results that were outside the linear range of the curve for the immunoassay method. Overall, the immunoassay kits were an effective method of screening site soils for the presence of PCBs. Duplicate laboratory data sheets are included in Addendum A.

Table 5-3: Immunoassay to Laboratory Analysis Duplicate Comparison

Lab Sample IDs	Field Sample IDs	Field PCB Concentration (mg/kg)	Lab PCB 1254 (mg/kg)	Lab PCB 1260 (mg/kg)	Agreement?
KGI-4.0-006	KGI-006	ND (<0.5)	ND (<0.01)	ND (<0.01)	Yes
KGI-4.0-016	60,10	ND (<0.5)	ND (<0.01)	ND (<0.01)	Yes
KGI-4.0-026	70,20	ND (<0.5)	ND (<0.01)	ND (<0.01)	Yes
KGI-4.0-033	50,30	ND (<0.5)	ND (<0.01)	ND (<0.01)	Yes
KGI-4.0-035	70,30	4.3	ND (<0.01)	ND (<0.01)	**No**
KGI-4.0-038	10,40	0.93	0.35	0.41	Yes

Lab Sample IDs	Field Sample IDs	Field PCB Concentration (mg/kg)	Lab PCB 1254 (mg/kg)	Lab PCB 1260 (mg/kg)	Agreement?
KGI-4.0-043	60,40	5	0.019	ND (<0.01)	**No**
KGI-4.0-048	20,50	1.99	2.2	1.3	Yes
KGI-4.0-054	80,50	22.68	0.0049	ND (<0.01)	**No**
KGI-4.0-057	20,60	0.84	0.89	0.5	Yes
KGI-4.0-059	40,60	5.27	6.3	2.6	Yes
KGI-4.0-062	70,60	ND (<0.5)	0.0094	ND (<0.01)	Yes
KGI-4.0-066	20,70	0.58	0.6	0.42	Yes
KGI-4.0-069	50,70	0.84	2.3	0.83	Yes
KGI-4.0-075	20,80	0.31	0.31	0.39	Yes
KGI-4.0-079	60,80	ND (<0.5)	0.12	ND (<0.01)	Yes
KGI-4.0-088	60,90	3.11	0.012	ND (<0.01)	**No**
KGI-4.0-094	20,100	0.45	0.25	0.32	Yes
KGI-4.0-107	60,110	0.67	0.18	0.22	Yes
KGI-4.0-108	70,110	1.17	0.0065	ND (<0.01)	**No**
KGI-4.0-113	30,120	ND (<0.5)	0.12	0.076	Yes
KGI-4.0-118	0,130	ND (<0.5)	0.19	0.12	Yes
KGI-4.0-122	40,130	ND (<0.5)	0.11	0.054	Yes
KGI-4.0-141	10,160	ND (<0.5)	0.084	0.047	Yes
KGI-4.0-148	10,170	ND (<0.5)	0.19	0.1	Yes
KGI-36.0-158	20,140	ND (<0.5)	0.024	0.015	Yes
KGI-36.0-175	30,80	7.56	14	4.7	Yes
KGI-36.0-185	20,90	19.8	100	160	**No**
KGI-36.0-192	20,60	0.96	3.7	1.1	Yes
KGI-36.0-207	10,60	ND (<0.5)	0.3	0.1	Yes
KGI-36.0-215	40,70	11.4	36	6.3	Yes
KGI-36.0-217	40,80	4.31	12	2.2	Yes
KGI-36.0-219	40,90	ND (<0.5)	0.12	0.056	Yes
KGI-36.0-225	40,120	ND (<0.5)	0.34	0.25	Yes
KGI-36.0-263	70,60	ND (<0.5)	0.025	0.013	Yes
KGI-36.0-271	60,90	2.73	8.9	1.7	Yes
KGI-36.0-273	60,100	0.59	0.68	0.34	Yes
KGI-36.0-279	50,70	16.72	19	5.1	Yes
KGI-36.0-285	40,150	ND (<0.5)	0.02	0.01	Yes
KGI-36.0-309	50,90	6.91	18	5.5	Yes
KGI-36.0-311	50,80	5.48	9.8	3.7	Yes
KGI-36.0-333	10,10	ND (<0.5)	0.15	ND (<0.01)	Yes
KGI-36.0-365	30,40	ND (<0.5)	0.082	ND (<0.01)	Yes
KGI-36.0-387	70,70	ND (<0.5)	0.067	ND (<0.01)	Yes
KGI-36.0-395	60,80	10.27	15	6.4	Yes

Lab Sample IDs	Field Sample IDs	Field PCB Concentration (mg/kg)	Lab PCB 1254 (mg/kg)	Lab PCB 1260 (mg/kg)	Agreement?
KGI-60.0-157	10,150	ND (<0.5)	0.035	0.02	Yes
KGI-60.0-160	10,120	ND (<0.5)	ND (<0.01)	ND (<0.01)	Yes
KGI-60.0-169	30,130	ND (<0.5)	ND (<0.01)	ND (<0.01)	Yes
KGI-60.0-183	30,70	8.62	22	6.5	Yes
KGI-60.0-186	30,60	5.22	13	4.9	Yes
KGI-60.0-193	20,90	3667.2	3000	4600	Yes
KGI-60.0-197	20,70	87.5	2.1	2.2	**No**
KGI-60.0-214	40,60	0.69	2.2	0.79	Yes
KGI-60.0-216	40,70	3.37	7.9	3.3	Yes
KGI-60.0-218	40,80	3.93	11	ND (<0.01)	**No**
KGI-60.0-222	40,100	ND (<0.5)	0.27	0.68	Yes
KGI-60.0-224A	40,110	ND (<0.5)	0.082	0.075	Yes
KGI-60.0-232	10,20	0.26	0.31	0.24	Yes
KGI-60.0-238	50,0	ND (<0.5)	0.037	0.015	Yes
KGI-60.0-262	70,30	ND (<0.5)	ND (<0.01)	ND (<0.01)	Yes
KGI-60.0-270	60,60	ND (<0.5)	0.17	0.074	Yes
KGI-60.0-272	60,90	1.98	2.8	2.6	Yes
KGI-60.0-276	50,60	3.87	5.5	1.8	Yes
KGI-60.0-280	50,70	24.2	43	12	Yes
KGI-60.0-304	50,120	ND (<0.5)	0.12	0.066	Yes
KGI-60.0-310	50,90	15.9	21	6.3	Yes
KGI-60.0-314	60,110	ND (<0.5)	0.085	0.27	Yes
KGI-60.0-338	30,10	ND (<0.5)	0.069	0.024	Yes
KGI-60.0-384	40,50	ND (<0.5)	0.47	0.12	Yes
KGI-60.0-396	60,80	5.2	13	6.4	Yes
Number of Field/Lab Sample Pairs that Meet Replicability Criteria					**62 of 70**

Comparison of Primary and Duplicate Sample Laboratory Analytical Results for Groundwater

The above precision criteria were met by the duplicate groundwater sample analytes. A comparison of primary and duplicate laboratory sample results is included in Table B-13 in Appendix B.

Comparison of Total PCBs Results as Aroclors and Total PCBs Results Derived from NOAA NS&T 32 Congener Analyses for Soil

The eight soil samples containing the highest PCB concentrations via the immunoassay field test kits were analyzed for the NOAA NS&T 32 congeners (subset of the total list of 209 congeners) with total PCBs calculated by using the NOAA NS&T 18 method (multiplying the sum of the NOAA NS&T 18 congeners by two) as well as total PCBs, reported as Aroclors. A

comparison of the NOAA NS&T 32 data and the total Aroclors data is included in Appendix B, Table B-14. In addition, the single sample containing the highest PCB congeners concentrations (Sample KGI-60.0-193) was then analyzed for total congeners (all 209) using a high resolution method for QC purposes. However, the PCB congener concentrations proved too high to accurately quantify all 209 congeners, since the peaks of individual congeners ended up interfering with one another.

The comparison between total PCB results derived from the NOAA NS&T 32 congener list and the total PCBs reported as Aroclors had a good correlation, resulting in the same order of magnitude concentrations. An exact PCB total could not be derived from the Aroclor data, as the sum of the seven Aroclors would result in an artificially high total PCB concentration.

Comparison of Total PCBs Results Derived from NOAA NS&T 32 Congener Analyses and Total List of 209 Congeners for Biota

All primary biota samples were analyzed for the NOAA NS&T 32 congeners (subset of the total list of 209 congeners) with total PCBs calculated by using the NOAA NS&T 18 method (multiplying the sum of the NOAA NS&T 18 congeners by two). The sample containing the highest PCB congeners (Sample KGI-60.0-193) was then analyzed for total congeners (all 209) using a high resolution method for QC purposes (high resolution results are presented in Table B-15, Appendix B) and the total PCBs derived from the total 209 list was compared to the total PCBs derived from using the NOAA NS&T 18 sum method. The case narrative notes that the PCB concentrations in this sample were extremely high, causing saturation of several of the congener peaks, even after diluting the sample 1,000 times as well as co-elution of peaks. Thus the total PCBs derived from the sum of the 209 congeners could not be accurately quantified and are biased low due to these issues. Detailed explanation is included in the case narrative provided by the laboratory in Addendum A.

5.3.1.2 Accuracy

Accuracy is defined as the degree of agreement of a measurement to an accepted reference or true value. When applied to a set of observed values or measurements, accuracy is a combination of random and systematic (bias) error. Analytical accuracy is defined as the percent recovery (%R) of an analyte in a reference standard or spiked sample. Accuracy limits for laboratory control sample (LCS) and MS/MSD samples are established by individual laboratories. The acceptance criteria for accuracy are dependent on the analytical method, and are based on historical laboratory data. Failure to meet the accuracy limits will be described in the sample delivery group (SDG) case narrative and summarized in the data review reports. All accuracy limits of LCS and MS/MSD samples for this project were acceptable according the SDG case narratives.

The percent differences (%Ds) of the continuing calibration is also an indication of accuracy. Sample results are qualified "UJ" for non-detects and "J" for detects, if the %D for a continuing calibration is out of control.

5.3.1.3 Representativeness

Representativeness is the degree that data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness was achieved by conducting sampling in compliance with the sample collection procedures described in the project-specific Sampling and Analysis Plan (SAP). Homogenized field duplicate samples were collected and used as a means to assess field

representativeness. The SAP detailed preliminary sample points; however, once on site, the number and types (matrix) of samples collected at each area of the investigation site were reassessed to insure that the site was adequately sampled. Sample locations were biased towards areas where chemical releases would likely migrate and/or accumulate.

5.3.1.4 Completeness

Completeness is defined as the overall percentage of valid analytical results (including estimated values) compared to the total number of analytical results reported by the laboratory. The completeness goal for this project is 90 percent. Successful completion of data acquisition can only be accomplished if both the field and laboratory portions of the project are performed according to the procedures described in the QAPP. Completeness of data for this project is considered to be 100 percent, as all data are considered usable based on the methods used to collect samples, handing of samples and analysis by the analytical laboratory.

5.3.1.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Comparability can be related to accuracy and precision because these quantities are measures of data reliability. Data are considered comparable if collection techniques, measurement procedures, methods, and reporting are equivalent for the samples within a sample set. Comparability for sampling was determined to be acceptable based on the following criteria:

- A consistent approach to sampling was applied throughout the program;
- Samples were consistently preserved; and
- Sampling was performed during the same time of year and under similar physical conditions.

Data comparability for this project is considered acceptable based on the protocols adhered to during collection, handling and analysis of the project samples.

Section 6 Summary, Environmental Hazard Assessment and Conclusions

6.1 Summary

In October-November 2008 Element Environmental, LLC and the USCG completed a follow-on environmental site investigation at the former USCG LORAN Station Kure, Kure Atoll, located in the Northwest Hawaiian Islands. The primary focus was on a former landfill (the SMD) located on the southwest end of Green Island (the largest of the islands comprising Kure Atoll). The SMD was used for disposal of miscellaneous waste (including metal debris and electrical components) during operation of the LORAN station between the years of 1961 and 1992. Previous investigations conducted at the site in the early 1990s detected PCBs in the SMD area soils which led to a remedial effort that consisted of removing 700-800 cubic yards of PCB-impacted soil (PCBs less than 25 mg/kg) from the SMD and reburying the soil at a location in the center of the island along the former runway (referred to as the Reburial Pit). In addition, 36 cubic yards of PCB-impacted soil (PCBs greater than 25 mg/kg) were transported off-island for disposal on the U.S. Mainland. Confirmation samples collected from the SMD following removal of PCB-impacted soil indicated PCB concentrations of up to 170 mg/kg remained in the SMD.

The primary objective of this project was to further investigate and evaluate PCB and metals contamination identified in soils at the SMD as well as to determine if contaminants have migrated from the SMD and/or the Reburial Pit to groundwater or the nearby marine environment. This project included collection and analysis of surface and subsurface soil, groundwater, sea water, marine sediment and biota.

A total of 629 primary samples were collected from the SMD and analyzed for PCBs in the field using RaPID assay-immunoassay field test kits. A total of 70 of these samples were split and sent to a commercial analytical laboratory for confirmation analysis of PCBs. In addition, 17 MI samples (including 4 duplicates) were collected from the SMD and surrounding vicinity. A total of ten marine sediment samples, 18 biota samples and two sea water samples were collected from the lagoon on both the north and south ends of Green Island and sent to an analytical laboratory for analysis of PCBs and metals. Five near surface soil samples were collected from various locations around Green Island and also analyzed for PCBs and Metals. Lastly, groundwater samples were collected from nine piezometers (installed during the field effort) and analyzed for SVOCs, organochlorine pesticides, PCBs and metals.

6.1.1 SMD Soil Sample Analytical Results

SMD soil sampling included collection of soil samples from two sampling grids: an initial 10-foot spaced grid and a 5-foot grid. A total of 152 surface and 255 subsurface soil samples were collected from the 10-foot grid. A total of 74 surface and 148 subsurface soil samples were collected from the 5-foot grid (Figure 3-1). All soil samples collected from the SMD were analyzed for total PCBs using RaPID assay immunoassay field test kits. Results indicated elevated PCB concentrations within the 40-foot by 50-foot hotspot extending to depths of 60 inches below ground surface. PCB concentrations were found to be the highest in soil collected from below 36 inches, with concentrations at this interval of the hotspot having a mean of 3.6 mg/kg (excluding the single highest concentration of 3667.2 mg/kg measured from this depth interval).

A total of 70 of the discrete soil samples analyzed via immunoassay kits in the field were split and sent to the analytical laboratory for confirmation analysis for total PCBs via EPA Method 8082. Comparison of the field results indicated a good correlation between immunoassay and laboratory results, with 62 of the 70 results meeting the RPD criteria.

A total of ten MI samples were collected from areas surrounding the SMD, five collected from within the entire SMD and two collected from within the hotspot identified within the SMD (Figure 3-2). MI samples were analyzed for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471A. PCBs were detected above laboratory reporting limits in only one of the ten MI samples collected from the areas surrounding the SMD. KMI-001, collected adjacent to the south and west sides of the SMD had a PCB concentration of 0.337 mg/kg (Aroclor 1254). The shallow MI sample collected from within the SMD from the 4" depth (KMI-011) contained a comparable PCB concentration of 0.353 mg/kg, while the MI sample collected from within the SMD from the 36" depth (KMI-012) contained a somewhat higher PCB concentration of 2.53 mg/kg (Aroclor 1260). The triplicate samples collected from within the SMD from the 60" depth (KMI-013, KM-014 and KMI-015) contained concentrations of PCBs (Aroclor 1260) of 40, 36.4 and 33.6 mg/kg, respectively.

Lead was detected in sample KMI-009 (a duplicate of KMI-008 and KMI-010) at 358 mg/kg, exceeding the HDOH EAL of 200 mg/kg for lead. No other metals were detected above regulatory standards in samples collected from the SMD and surrounding areas.

PCB results of the various grain size fractions derived from MI samples KMI-017 and KMI-018 collected from the SMD hotspot indicate that the most elevated PCB concentrations are present in the finer silt-size soil fractions, with the fine fraction containing an order of magnitude higher PCB concentration than the #10 coarse sand/gravel fraction.

Comparison of the MI results to the discrete sample results indicate that the MI results provide a more representative overall concentration of PCBs within the landfill. A statistical analysis of the extensive grid-based discrete sample data found that by using the discrete data means alone, the concentrations of PCBs would have been represented as falsely low 89% of the time and would have indicated that there were no PCBs present 7-15% of the time (Spengler et al, 2009). The comparison of discrete and MI data are discussed in detail in the as yet to be published paper *Investigation Scale Evaluation of Multi-Incremental Sampling Methodology* by S.R. Spengler et, al (included in Appendix C).

6.1.2 Groundwater Sample Analytical Results

A total of ten groundwater samples (nine primary samples and one duplicate) were collected from nine piezometers installed around the perimeter of the Reburial Pit and between the shoreline and the SMD. Groundwater collected for metals analysis was filtered in the field using 0.45 micron field filters.

Analytical results indicated a detection of PCBs at 0.40 µg/L in the water sample collected from Piezometer #8 (Sample KGW-009), located just west of the SMD. The sample was analyzed twice to confirm the PCBs concentration, with a second result of 0.39 ug/L. These concentrations exceed the HDOH EAL for PCBs for Surface Water Estuarine Habitats of 0.000079 µg/L. PCBs were not detected in any other groundwater samples.

The SVOC constituent benzo(a)pyrene was detected in two samples, KGW-008 (0.035 µg/L) collected from Piezometer #7 and in KGW-010 (0.033 µg/L) collected from Piezometer #9. Both

benzo(a)pyrene results exceed the HDOH EAL for Surface Water Estuarine Habitats (0.014 µg/L). Both Piezometers #7 and #9 are located in the vicinity of the SMD (Figure 4-3).

The pesticide 4,4'-DDD was detected in three groundwater samples; KGW-001 (0.001 µg/L) collected from Piezometer #2, KGW-003 (0.002 µg/L) collected from Piezometer #3 and KGW-005 (0.001 µg/L) collected from Piezometer #5. All three detections equal or exceed the HDOH EAL for Surface Water Estuarine Habitats of 0.00031 µg/L for 4,4'-DDD. 4,4'-DDT was detected in a single sample, KGW-009 (0.0088 µg/L) collected from Piezometer #8, exceeding the HDOH EAL for Surface Water Estuarine Habitats (0.000008 µg/L). Heptachlor was detected in two samples, KGW003 at 0.0010 µg/L (Piezometer #3) and KGW004 at 0.0013 µg/L. Both heptachlor detections exceeded the HDOH EAL for Surface Water Estuarine Habitats (0.0009 µg/L). Heptachlor epoxide was detected in three samples, KGW001 at 0.0011 µg/L (Piezometer #2), KGW009 at 0.0027 µg/L (Piezometer #8) and KGW010 at 0.0011 µg/L (Piezometer #9). All three detections exceeded the HDOH EAL for Surface Water Estuarine Habitats (0.000039 µg/L).

Arsenic was detected in all ten groundwater samples at concentrations exceeding the HDOH EAL for Surface Water Estuarine Habitats (0.00014 mg/L). Mercury was detected in five samples, three from the reburial pit vicinity and two from the SMD vicinity, at concentrations ranging from 0.000056 to 0.000083 mg/L, all exceeding the HDOH EAL for Surface Water Estuarine Habitats (0.000025 mg/L).

6.1.3 Green Island Near-Surface Soil Sample Analysis Results

A total of five near-surface soil samples were collected from locations around Green Island and analyzed for total PCBs by EPA Method 8082 and metals by EPA Methods 6010B and 7471 A. Trace levels of PCBs (0.02 mg/kg) were detected in sample KGI-2.0-004, which was collected from South Beach along the vegetation line of the dune, along a 30-foot long on-shore, limestone bench. There were no other detections of PCBs exceeding laboratory reporting limits.

Metals were detected at low concentrations in all five samples, with none exceeding HDOH EALs for sites where drinking water source is not threatened and surface water is within 150 meters.

6.1.4 Sea Water Sample Analysis Results

A total of two sea water samples were collected during this field effort, one from the Lagoon off of North Point and one from the Lagoon off of the SMD. Both sea water samples were analyzed for total PCBs by EPA Method 8082 and metals (arsenic, cadmium, chromium, lead and mercury) by EPA Methods 6010B and 7471 A.

PCBs were not detected in either sea water sample. Mercury was detected in both sea water samples (KSW-001 at 0.000041 mg/L and KSW-002 at 0.000084 mg/L) at concentrations exceeding the HDOH EAL of 0.000025 mg/L.The SVOC constituent benzo(a)pyrene was detected in two samples, KGW-008 (0.035 µg/L) collected from Piezometer #7 and in KGW-010 (0.033 µg/L) collected from Piezometer #9. Both benzo(a)pyrene results exceed the HDOH EAL for Aquatic Habitat Goals-freshwater-chronic aquatic toxicity of 0.014 µg/L. Both Piezometers #7 and #9 are located in the vicinity of the SMD.

6.1.6 Biota Sample Analysis Results

A total of 18 biota specimens were sent to TestAmerica Burlington for analysis as whole fish for NOAA NS&T 32 PCB congeners. A total of 15 specimens contained detectable levels of PCBs, with total PCBs detected ranging from 2 to 90 µg/kg. Total PCBs were calculated for biota results by using the NOAA NS&T 18 congener method where the sum of the NOAA NS&T 18 congeners is multiplied by two.

Biota specimens captured in the vicinity of the SMD and at South Point had significantly higher PCB concentrations than those found in biota captured at North Point. Due to the small sample size, the mean of the PCB concentrations was used for comparison rather than the 95% upper confidence level (UCL). The mean PCB concentration found in biota captured from the Lagoon adjacent to the SMD and the near-shore on the ocean-side adjacent to the SMD (South Point) is 28.7 µg/kg. The mean for PCB concentrations found in biota captured from off of North Point is 1.2 µg/kg.

In addition to PCBs, biota specimens were tested for total metals. Results indicate that arsenic is present in all 18 biota specimens at concentrations ranging from 0.59 to 21.7 mg/kg, with the most elevated levels found in the goatfish. Cadmium was detected in ten fish at concentrations ranging from 0.015 to 0.38 mg/kg. Chromium was detected in all 18 fish at concentrations ranging from 0.74 to 1.1 mg/kg. Lead was detected in six biota samples at concentrations ranging from 0.015 to 0.22 mg/kg. Mercury was detected in four fish at concentrations ranging from 0.0083 to 0.044 mg/kg.

6.2 Environmental Hazard Assessment

6.2.1 Risk to Receptors

Assessment of the data generated during this investigation indicates that PCB concentrations are present in subsurface soil (below 36 inches) in the former SMD landfill at levels exceeding the HDOH EAL of 1.1 mg/kg (EAL for direct exposure for sites where groundwater source is not threatened and are less than 150 meters from surface water (HDOH Table B-2). In addition, both surface and subsurface soil within the SMD contains concentrations of PCBs exceeding NOAA NS&T ER-L or ER-M standards for sediment (0.0227 and 0.18 mg/kg, respectively). PCB concentrations were found in a groundwater sample in the vicinity of the SMD but not in groundwater samples in the vicinity of the Reburial Pit. Thus, the following potential environmental hazards/receptors have been identified with respect to the former SMD landfill:

1. Direct exposure hazard to residents;

2. Direct exposure hazard for long-term workers and construction workers;

3. Potential erosion and runoff of contaminated soil into aquatic habitats, and possible subsequent uptake of PCBs into aquatic organisms;

4. Potential leaching of contamination into groundwater beneath SMD and Reburial Pit.

With respect to the above listed potential hazards, the following should be noted:

3. Potential erosion and runoff of contaminated soil into aquatic habitats, and possible subsequent uptake of PCBs into aquatic organisms;

4. Potential leaching of contamination into groundwater beneath SMD and Reburial Pit.

With respect to the above listed potential hazards, the following should be noted:

1. There are no permanent residents or workers on the atoll. In addition, visitors to Green Island do not generally frequent the SMD site due to its relatively small size and remote location at the southwest tip of the island.

2. An ecological risk assessment (ERA) completed in 2000 at a similar atoll environment, Tern Island, found that a PCB concentration of three mg/kg was a sufficient cleanup goal for protection of aquatic ecological receptors evaluated (ruddy turnstone, Laysan albatross, wedge-tailed shearwater, and adult and juvenile Hawaiian monk seals) (USCG, 2000). The mean concentrations of PCBs found in the SMD (MI samples) were below 3 mg/kg in the upper two sample intervals (near surface to 36 inches below ground surface), with only the soil at depth (below 60 inches) found to contain concentrations of PCBs greater than 3 mg/kg.

3. There was no PCB contamination identified in groundwater samples collected from the vicinity of the Reburial Pit.

4. Arsenic and mercury concentrations found in groundwater were similar to those found in the background sea water sample.

5. Though analysis of sediment samples collected from the lagoon adjacent to the landfill did not indicate detectable concentrations of PCBs, the most significant potential exposure scenario (in addition to future occupant's direct exposure) is erosion and/or runoff of contaminated soil from the SMD into the adjacent shoreline area and lagoon. The Tern Island ERA concluded that the cleanup goal of three mg/kg for PCBs for soil in the landfill adjacent to the lagoon would be adequately protective of the aquatic environment in the event of erosion of PCB contaminated soil into the adjacent lagoon or ocean water (USCG, 2000). Thus, concentrations of PCBs in sediment impacted by erosion and dispersion of the contaminated SMD soil into the lagoon would most likely be significantly lower than PCB concentrations identified in the SMD soil.

6.3 Conclusions

Observations made during the field investigation, as well as interpretation of data generated during this project, led to the following conclusions:

Former SMD

- PCB-impacted soil remains in the former SMD with one hot spot containing significantly elevated PCB concentrations. Approximately 635 cubic yards of soil containing PCB concentrations greater than the HDOH direct exposure EAL of 1.1 mg/kg comprise the hotspot area within the SMD. **NOTE: This estimate is based on the results of limited field sampling and is only a general estimate. This estimate is estimated to be within ± 25% (within about 200 cubic yards).**

- Benzo(a)pyrene, pesticide 4,4'-DDT and mercury were detected in groundwater samples collected from the vicinity of the SMD just above their respective EALs.

Reburial Pit

- Groundwater samples collected from the perimeter of the Reburial Pit did not have detectable levels of PCBs, indicating that PCBs from PCB-impacted soil buried in the Reburial Pit during the remediation conducted in 1993 have not migrated into the groundwater.

- The pesticide 4,4'-DDD was detected in three groundwater samples while mercury was detected in two groundwater samples collected in the vicinity of the Reburial Pit.

Marine Environment

- Analysis of biota samples indicate that biota from the marine environment on the southern part of Green Island (near the SMD) contain slightly elevated PCB levels when compared to biota captured from waters on the northern end of Green Island; However the overall PCB levels measured in the biota on Kure are significantly lower than concentration levels measured on other Northwest Hawaiian Islands (i.e. Midway and Tern Island).

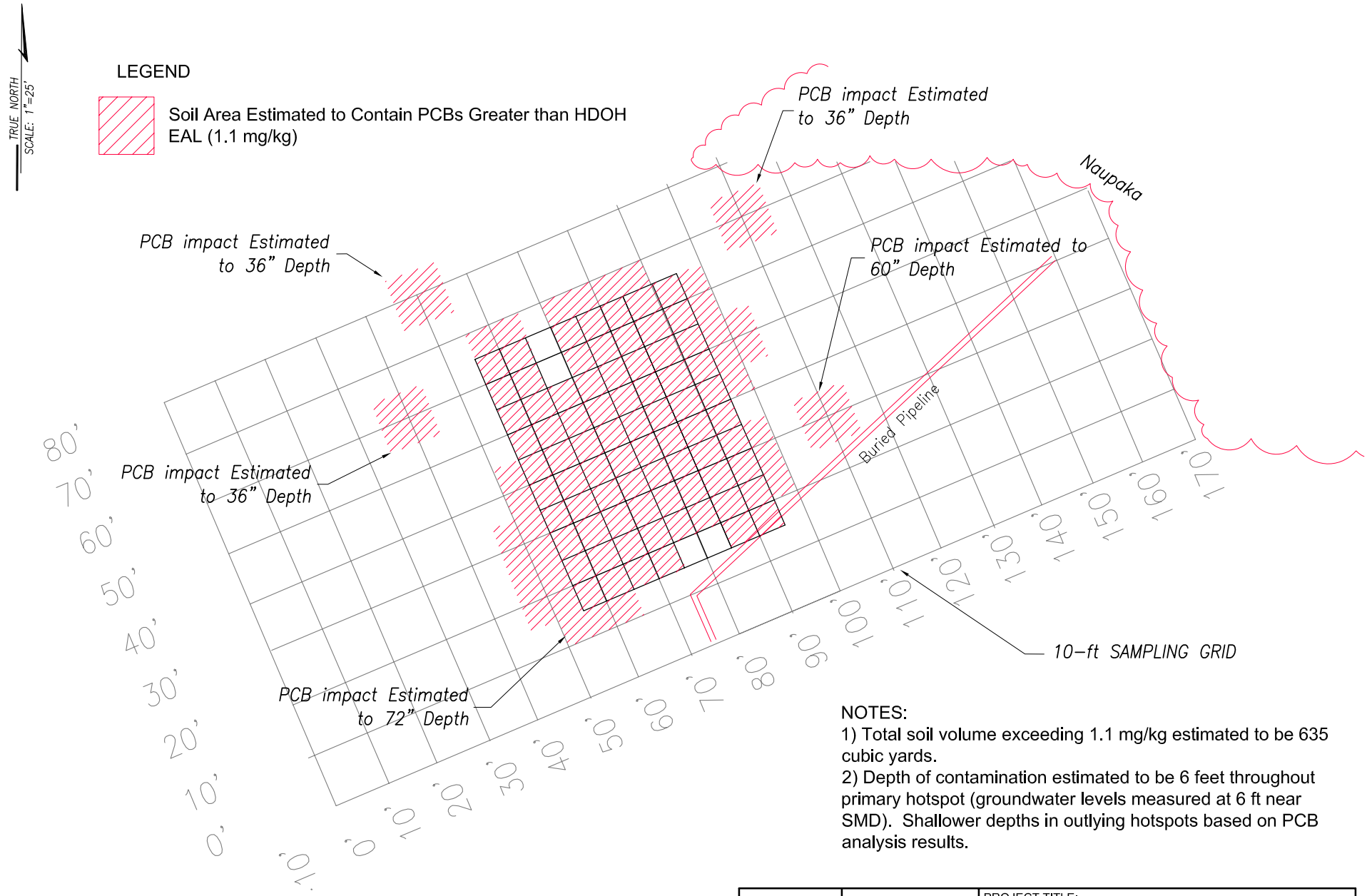
- Sediment and sea water samples did not contain detectable levels of PCBs.

- Sea water samples contained mercury concentrations exceeding the HDOH EAL for Aquatic Habitat Goals-marine water-chronic aquatic toxicity.

- All biota samples contained arsenic and chromium concentrations exceeding laboratory reporting limits.

Green Island Near-Surface Soil

- No significant concentrations of metals or PCBs were detected in five near-surface soil samples collected from various locations around Green Island.



NOTES:
1) Total soil volume exceeding 1.1 mg/kg estimated to be 635 cubic yards.
2) Depth of contamination estimated to be 6 feet throughout primary hotspot (groundwater levels measured at 6 ft near SMD). Shallower depths in outlying hotspots based on PCB analysis results.

25' 0' 25' 50'

SCALE: 1" = 25'

	DATE: Feb 2009	PROJECT TITLE: EVALUATION OF GREEN ISLAND LANDFILL AND REBURIAL PIT, FORMER U.S. COAST GUARD STATION KURE
	FIGURE TITLE: EXTENT OF SMD PCB CONCENTRATIONS EXCEEDING HDOH EAL	FIGURE NO.: 6-1

6.4 Recommendations

Former SMD

It is recommended that soils present within the SMD that contain elevated concentrations of PCBs be removed or remediated on-site. Analytical results indicate that PCBs may have migrated into the shallow groundwater, into near-surface soils near the SMD as well as into the adjacent marine environment, as evidenced by the slightly elevated PCB levels measured in the near-shore biota collected from off-shore the SMD. It is recommended that an additional groundwater sample be collected from the vicinity of the SMD and filtered prior to analysis for PCBs. It may also be prudent to collect several soil samples from just above the groundwater level at the site and have them analyzed for PCBs. This sampling could be done as part of the confirmation sampling that would be conducted during future remedial efforts at the SMD.

Reburial Pit

It is recommended that groundwater beneath the Reburial Pit be monitored periodically to ensure that PCBs from impacted soil are not migrating from this site.

Marine Environment

Following removal of the assumed source of contamination (PCB-impacted soil present within the SMD), it is recommended that the on-going periodic monitoring program (including collection and analysis of biota, sea water, sediment and soil) be continued.

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Woodward-Clyde Consultants 1994. *Past Practice Assessment/Hazard Ranking System Evaluation for Kure Atoll LORAN Station, Hawaii.* April.

29 Code of Federal Regulations Part 1910.120, Hazardous Waste Operations and Emergency Response.

29 Code of Federal Regulations Part 1910.1200, Hazard Communication.

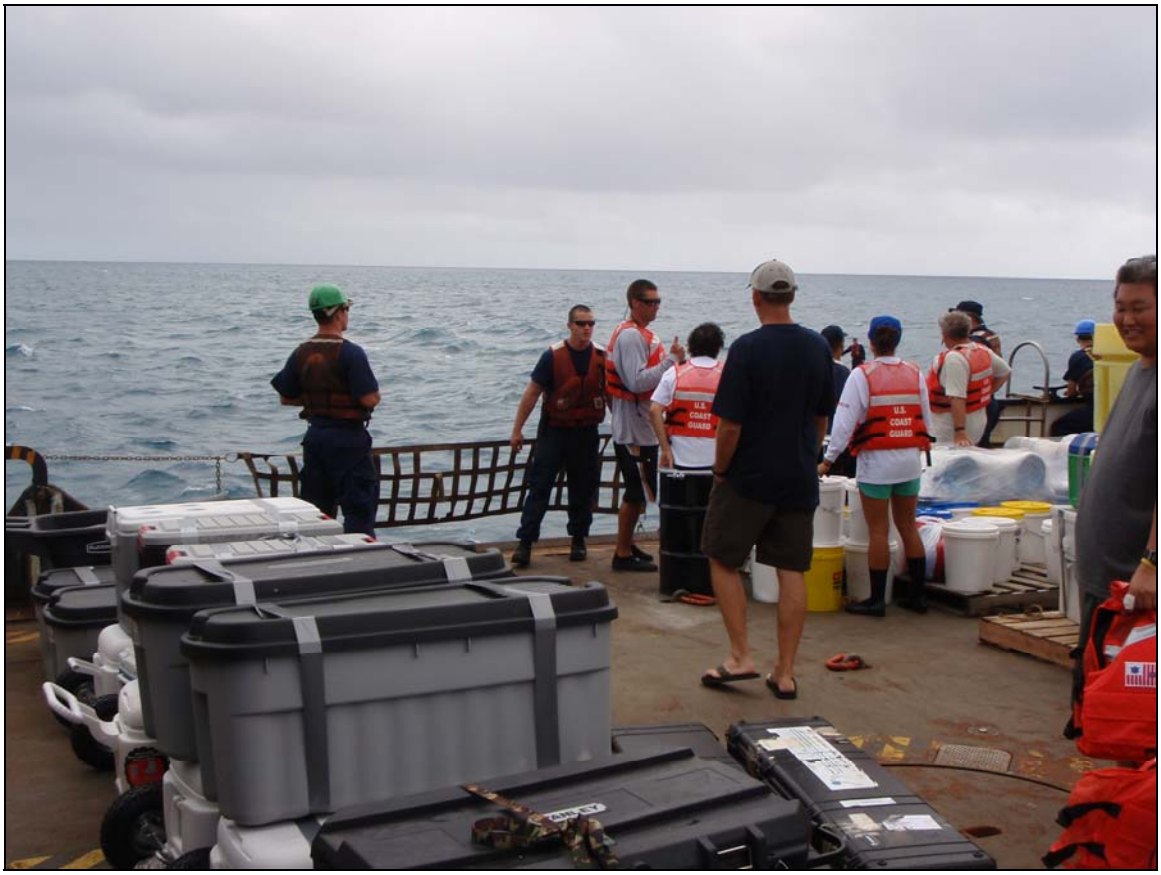
Appendix A
Project Photographs

Packing field gear and supplies in Honolulu.

Crew boarding the G1 in Honolulu, bound for Midway Island.

U.S. Coast Guard Buoy-Tender, *Kukui* at harbor at Midway Atoll.


Field gear aboard the *Kukui*.



Preparing gear for transport to Green Island.

Crew offloading *Kukui*.

Offloading gear for transport to Kure.

Small craft transport to Green Island.

Base-camp setup on Green Island.

Base-camp.

Looking east from West Point peninsula (west of SMD) toward South Beach.

Looking northeast from West Point peninsula (west of SMD) toward Southwest Beach.

Looking west toward West Point from SMD.

SMD grid layout and soil sampling-note hotspot is predominantly comprised of area covered by the Naupaka bush shown here.

Pipeline located within SMD.

Collection of soil samples within SMD.

Soil sampling cart and decon supplies.

Piezometers prior to decon and installation.

Pre-digging of piezometer location.

Installation of Solinst Drive-point piezometer using Bosch Roto-Hammer.

Collection of groundwater sample from peizometer using peristaltic pump.

Trekking to base camp from the SMD along former U.S. Coast Guard runway.

Biota sample collection.

Organizing and labeling soil samples.

Running immunoassay analysis on soil samples in field laboratory.

Refuge Manager, Cynthia Vanderlip, stoked about her new davit!

Green Island pier, recovered ocean debris awaiting transport to Honolulu.

Transport back to *Kukui* following completion of field work.

Here’s to an awesome trip!

Da Critters…..

Da Crew…

Jay “The Total Jay Package” Silberman

Dr. Dennis Mead

Lieutenant Maile Norman

Austin Lutey and Matt Neal

Ryan Yamauchi

Roger Aoki

Dr. Steven Spengler

Refuge Manager Cynthia Vanderlip

Brad Vanderlip

Appendix B
Analytical Data Tables

SOIL SAMPLE DATA TABLES

WATER SAMPLE DATA TABLES

SEDIMENT SAMPLE DATA TABLES

BIOTA SAMPLE DATA TABLES

Table B-1: SMD 4" Soil Sample Immunoassay Field Analytical Results, 2008 Investigation, Kure Atoll

Y-Axis	X-Axis														
	0	10	15	20	25	30	35	40	45	50	55	60	65	70	80
0	0.00	0.01		0.00		0.03		0.00		0.03		0.00		0.08	0.00
10	0.02	0.00		0.01		0.15		0.07		0.15		0.03		0.08	0.04
20	0.10	0.06		0.15		0.13		0.12		0.20		0.30			0.09
30	0.64	0.54		0.51		0.84		0.55		**2.24**		0.98		**4.30**	0.00
40	0.55	0.93		0.23		0.00		0.02		0.00		5.00		0.00	0.00
50	0.00	**1.81**		**1.99**		0.10		0.01		0.00		0.01		0.00	**22.68**
55			**2.54**	**3.05**	0.98	**11.70**	**2.08**	0.00	0.04	0.01	0.03	0.00	0.00		
60	0.35	0.51	**1.21**	0.84		1.42		**5.27**		0.11		0.00	0.02	0.06	0.00
65													0.00		
70	0.09	0.31		0.58		0.24		0.00		0.84		0.00	0.03	0.07	0.00
75					**2.80**	0.32	**1.71**	**2.29**					0.02		
80	0.07	0.00		0.31	**1.50**	0.17	**3.15**	0.20		0.00		0.05	0.00	0.00	0.00
85					0.75				0.31	0.15	0.09	0.33	0.18		
90	0.06	0.00		0.11	0.54	0.08		0.08		0.01		**3.11**	0.20	0.00	0.04
95					**2.38**							0.02	0.10		
100	0.48	0.30		0.45		0.12		0.05		0.32		0.06		0.17	0.07
110	0.45	0.28		0.41		0.62		0.25		0.81		0.67		1.17	0.05
120	0.15	0.07		0.15		0.02		0.11		0.03		0.05		0.04	
130	0.21	0.17		0.12		0.07		0.29		0.03		0.07		0.02	
140	0.13	0.56		0.04		0.11		0.04		0.04		0.11			
150	0.19	0.18		0.15		0.04		0.07		0.04		0.05			
160	0.15	0.11		0.11		0.03		0.00		0.00		0.03			
170	0.11	0.12		0.11		0.00		0.00		0.00					

Note:
Bold- Value exceeds HDOH EAL of 1.1 mg/kg.

Table B-2: SMD 36” Soil Sample Immunoassay Field Analytical Results, 2008 Investigation, Kure Atoll

Y-Axis \ X-Axis	0	10	15	20	25	30	35	40	45	50	55	60	65	70	80
0	0.00			0.00		0.00		0.00		0.00		0.05		0.03	0.07
10	0.02	0.13		0.10		0.07		0.01		0.00		0.00		0.00	0.07
20		0.04		0.05		0.06		0.00		0.02		0.05		0.00	0.00
30	0.07	0.00		0.12		0.06		0.04		0.06		0.00		0.00	0.06
40	0.07			0.55		0.41		0.00		0.09		0.00		0.00	0.00
50	0.17	0.01		0.69		**1.40**		0.01		0.03		0.00			0.00
55			0.02	0.06	**4.61**	**5.90**	**3.94**	0.12	0.15	0.02	0.00	0.01	0.00		
60		0.00	0.01	0.96	**3.88**	**2.29**	**1.98**	**1.25**	**1.50**	0.21		0.10	0.02	0.00	0.09
65			0.00	**2.35**	**4.38**	0.83	**3.37**	**6.60**	**620**	**26.00**	0.09	0.01	0.00		
70		0.03	0.20	0.49	**5.94**	**1.50**	**83.3**	**11.42**	**12.8**	**16.72**	0.41	0.00	0.15	0.00	
75			0.00	0.03	**4.00**	**9.90**	**26.3**						**12.10**	0.04	0.40
80		0.00	0.00	0.01	1.08	**7.56**	0.87	**4.31**		**5.48**		**10.27**	0.29	0.09	0.00
85			0.04	0.92	**3.02**	**1.20**	0.68	**2.23**	**34.4**	**7.50**	**7.70**	**2.72**			
90		0.03	0.10	**19.8**	**10.7**	**1.95**	1.08	0.15	0.55	**6.91**	**9.90**	**2.73**	0.97	0.00	0.00
95			0.00	0.78	**2.64**	**1.28**	0.33	0.45	**4.39**	**9.30**	0.12	**4.80**	0.26		
100				0.00		0.05		0.30		0.82		0.59		0.02	0.27
110				0.05		**1.65**		0.06		0.06		0.01		0.11	0.01
120		0.00		0.00		0.03		0.22		0.01		0.00		0.00	
130						0.08		0.00		0.01		0.00		0.00	
140		0.00		0.00		0.00		0.00		0.00		0.00			
150		0.00						0.00		0.14		0.00			
160						0.01		0.00		0.05		0.03			
170		0.12						0.00		0.06					

Note:
Bold- Value exceeds HDOH EAL of 1.1 mg/kg.

Table B-3: SMD 60” Soil Sample Immunoassay Field Analytical Results, 2008 Investigation, Kure Atoll

Y-Axis	X-Axis														
	0	10	15	20	25	30	35	40	45	50	55	60	65	70	80
0	0.10	0.21				0.00		0.00		0.00		0.02		0.03	0.00
10		0.25		0.07		0.11		0.05		0.01		0.01		0.00	0.00
20	0.07	0.26		0.78		0.30		0.01		0.00		0.00		0.00	0.00
30	0.01	0.02				0.08		0.06		0.00		0.02		0.06	0.00
40	0.08	0.01		0.28				0.06		0.29		0.00		0.00	0.00
50	0.00	0.09		0.06		0.00		0.38		0.11		0.07		0.00	0.00
55			0.07	0.96	**1.35**	0.54	**2.04**	0.24	0.40	0.01	0.01	0.02	0.00		
60		0.04	0.10	0.18	**6.30**	**5.22**	**2.63**	0.69	0.08	**3.87**	0.34	0.30	**5.73**	0.05	0.00
65			0.00	0.03	**1.79**	**8.50**	**9.40**	**5.70**	0.03	**4.81**	0.66	0.05	0.05		
70		0.07	0.06	**87.50**		**8.62**	**30.40**	**3.37**	**4.08**	**24.20**	**3.41**	0.67	0.00	0.00	0.01
75			0.02	0.06	**1.64**	**4.55**	**10.10**	**2.06**	0.09						
80		0.07	0.00	0.76	0.20	0.76	0.01	**3.93**		**21.70**		**5.20**	0.19	**2.12**	0.00
85			0.01	0.08	0.07	0.00	**1.68**	0.24	**2.14**	**15.30**	**1.83**	0.54	**2.72**		
90		0.04	0.02	**3667**	**2.15**	0.33	**1.23**	0.72	**3.35**	**15.90**	**2.92**	**1.98**	0.40	0.22	0.00
95			0.01	0.06	0.89	0.03	0.39	0.74	0.89	**2.28**	**2.16**	**1.90**	0.42		
100				0.00		0.31		0.11		**1.45**		0.75		0.12	0.00
110				0.00		0.09		0.00		0.02		0.12		0.00	0.00
120		0.14		0.00		0.00		0.54		0.04		0.02		0.01	
130						0.00		0.01		0.02		0.00		0.00	
140				0.00		0.00		0.00		0.00		0.00			
150		0.52						0.04		0.01		0.00			
160						0.00		0.01				0.00			
170								0.00							

Note:
Bold- Value exceeds HDOH EAL of 1.1 mg/kg.

Table B-4: SMD Laboratory Split Soil Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:		KGI-4.0-006		KGI-4.0-016		KGI-4.0-026		KGI-4.0-033		KGI-4.0-035		KGI-4.0-038		KGI-4.0-043		KGI-4.0-048		KGI-4.0-054		KGI-4.0-057		KGI-4.0-059		KGI-4.0-062		KGI-4.0-066		KGI-4.0-069		KGI-4.0-075		KGI-4.0-079		KGI-4.0-088		KGI-4.0-094		KGI-4.0-107	
SAMPLE MATRIX:		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil	
DEPTH (below ground surface):		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"		4"	
DATE COLLECTED:		10/21/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008	
ANALYTE	HDOH EAL	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)
POLYCHLORINATED BIPHENYLS																																					
Aroclor-1016		ND	0.0097	ND	0.0099	ND	0.0094	ND	0.0096	ND	0.0099	ND	0.0099	ND	0.0094	ND	0.094	ND	0.0097	ND	0.097	ND	0.94	ND	0.0099	ND	0.097	ND	0.094	ND	0.0094	ND	0.0097	ND	0.0094	ND	0.0098	ND	0.0097
Aroclor-1221		ND	0.0097	ND	0.0099	ND	0.0094	ND	0.0096	ND	0.0099	ND	0.0099	ND	0.0094	ND	0.094	ND	0.0097	ND	0.097	ND	0.94	ND	0.0099	ND	0.097	ND	0.094	ND	0.0094	ND	0.0097	ND	0.0094	ND	0.0098	ND	0.0097
Aroclor-1232		ND	0.0097	ND	0.0099	ND	0.0094	ND	0.0096	ND	0.0099	ND	0.0099	ND	0.0094	ND	0.094	ND	0.0097	ND	0.097	ND	0.94	ND	0.0099	ND	0.097	ND	0.094	ND	0.0094	ND	0.0097	ND	0.0094	ND	0.0098	ND	0.0097
Aroclor-1242	ns	ND	0.0097	ND	0.0099	ND	0.0094	ND	0.0096	ND	0.0099	ND	0.0099	ND	0.0094	ND	0.094	ND	0.0097	ND	0.097	ND	0.94	ND	0.0099	ND	0.097	ND	0.094	ND	0.0094	ND	0.0097	ND	0.0094	ND	0.0098	ND	0.0097
Aroclor-1248		ND	0.0097	ND	0.0099	ND	0.0094	ND	0.0096	ND	0.0099	ND	0.0099	ND	0.0094	ND	0.094	ND	0.0097	ND	0.097	ND	0.94	ND	0.0099	ND	0.097	ND	0.094	ND	0.0094	ND	0.0097	ND	0.0094	ND	0.0098	ND	0.0097
Aroclor-1254		ND	0.0097	ND	0.0099	ND	0.0094	ND	0.0096	ND	0.0099	**0.35**	0.0099	**0.019**	0.0094	**2.2**	0.094	0.0049 J	0.0097	**0.89**	0.097	**6.3**	0.94	0.0094 J	0.0099	**0.6**	0.097	**2.3**	0.094	**0.31**	0.0094	**0.12**	0.0097	**0.012**	0.0094	**0.25**	0.0098	**0.18**	0.0097
Aroclor-1260		ND	0.0097	ND	0.0099	ND	0.0094	ND	0.0096	ND	0.0099	**0.41**	0.0099	ND	0.0094	**1.3**	0.094	ND	0.0097	**0.5**	0.097	**2.6**	0.94	ND	0.0099	**0.42**	0.097	**0.83**	0.094	**0.39**	0.0094	ND	0.0097	ND	0.0094	**0.32**	0.0098	**0.22**	0.0097
Total PCBs	1.1																																				

SAMPLE ID:		KGI-4.0-108		KGI-4.0-113		KGI-4.0-118		KGI-4.0-122		KGI-4.0-141		KGI-4.0-148		KGI-36.0-158		KGI-36.0-175		KGI-36.0-185		KGI-36.0-192		KGI-36.0-207		KGI-36.0-215		KGI-36.0-217		KGI-36.0-219		KGI-36.0-225		KGI-36.0-263		KGI-36.0-271		KGI-36.0-273		KGI-36.0-279	
SAMPLE MATRIX:		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil	
DEPTH (below ground surface):		4"		4"		4"		4"		4"		4"		36"		36"		36"		36"		36"		36"		36"		36"		36"		36"		36"		36"	
DATE COLLECTED:		10/22/2008		10/22/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008	
ANALYTE	HDOH EAL	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)
POLYCHLORINATED BIPHENYLS																																					
Aroclor-1016		ND	0.0096	ND	0.0096	ND	0.01	ND	0.0097	ND	0.0098	ND	0.0095	ND	0.0095	ND	0.99	ND	9.8	ND	0.098	ND	0.0095	ND	0.97	ND	0.97	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.98	ND	0.096	ND	0.96
Aroclor-1221		ND	0.0096	ND	0.0096	ND	0.01	ND	0.0097	ND	0.0098	ND	0.0095	ND	0.0095	ND	0.99	ND	9.8	ND	0.098	ND	0.0095	ND	0.97	ND	0.97	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.98	ND	0.096	ND	0.96
Aroclor-1232		ND	0.0096	ND	0.0096	ND	0.01	ND	0.0097	ND	0.0098	ND	0.0095	ND	0.0095	ND	0.99	ND	9.8	ND	0.098	ND	0.0095	ND	0.97	ND	0.97	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.98	ND	0.096	ND	0.96
Aroclor-1242	ns	ND	0.0096	ND	0.0096	ND	0.01	ND	0.0097	ND	0.0098	ND	0.0095	ND	0.0095	ND	0.99	ND	9.8	ND	0.098	ND	0.0095	ND	0.97	ND	0.97	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.98	ND	0.096	ND	0.96
Aroclor-1248		ND	0.0096	ND	0.0096	ND	0.01	ND	0.0097	ND	0.0098	ND	0.0095	ND	0.0095	ND	0.99	ND	9.8	ND	0.098	ND	0.0095	ND	0.97	ND	0.97	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.98	ND	0.096	ND	0.96
Aroclor-1254		0.0065 J	0.0096	**0.12**	0.0096	**0.19**	0.01	**0.11**	0.0097	**0.084**	0.0098	**0.19**	0.0095	**0.024**	0.0095	**14**	0.99	**100**	9.8	**3.7**	0.098	**0.3**	0.0095	**36**	0.97	**12**	0.97	**0.12**	0.0097	**0.34**	0.0098	**0.025**	0.0097	**8.9**	0.98	**0.68**	0.096	**19**	0.96
Aroclor-1260		ND	0.0096	**0.076**	0.0096	**0.12**	0.01	**0.054**	0.0097	**0.047**	0.0098	**0.1**	0.0095	**0.015**	0.0095	**4.7**	0.99	**160**	9.8	**1.1**	0.098	**0.1**	0.0095	**6.3**	0.97	**2.2**	0.97	**0.056**	0.0097	**0.25**	0.0098	**0.013**	0.0097	**1.7**	0.98	**0.34**	0.096	**5.1**	0.96
Total PCBs	1.1																																				

SAMPLE ID:		KGI-36.0-285		KGI-36.0-309		KGI-36.0-311		KGI-36.0-333		KGI-36.0-365		KGI-36.0-387		KGI-36.0-395		KGI-60.0-157		KGI-60.0-160		KGI-60.0-169		KGI-60.0-183		KGI-60.0-186		KGI-60.0-193		KGI-60.0-197		KGI-60.0-214		KGI-60.0-216		KGI-60.0-218		KGI-60.0-222		KGI-60.0-224A	
SAMPLE MATRIX:		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil	
DEPTH (below ground surface):		36"		36"		36"		36"		36"		36"		36"		60"		60"		60"		60"		60"		60"		60"		60"		60"		60"		60"	
DATE COLLECTED:		10/24/2008		10/24/2008		10/24/2008		10/25/2008		10/25/2008		10/25/2008		10/25/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008	
ANALYTE	HDOH EAL	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)
POLYCHLORINATED BIPHENYLS																																					
Aroclor-1016		ND	0.0099	ND	0.96	ND	0.99	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.94	ND	0.0094	ND	0.0095	ND	0.0096	ND	0.97	ND	0.96	ND	94	ND	0.099	ND	0.097	ND	0.96	ND	0.97	ND	0.0098	ND	0.0096
Aroclor-1221		ND	0.0099	ND	0.96	ND	0.99	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.94	ND	0.0094	ND	0.0095	ND	0.0096	ND	0.97	ND	0.96	ND	94	ND	0.099	ND	0.097	ND	0.96	ND	0.97	ND	0.0098	ND	0.0096
Aroclor-1232		ND	0.0099	ND	0.96	ND	0.99	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.94	ND	0.0094	ND	0.0095	ND	0.0096	ND	0.97	ND	0.96	ND	94	ND	0.099	ND	0.097	ND	0.96	ND	0.97	ND	0.0098	ND	0.0096
Aroclor-1242	ns	ND	0.0099	ND	0.96	ND	0.99	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.94	ND	0.0094	ND	0.0095	ND	0.0096	ND	0.97	ND	0.96	ND	94	ND	0.099	ND	0.097	ND	0.96	ND	0.97	ND	0.0098	ND	0.0096
Aroclor-1248		ND	0.0099	ND	0.96	ND	0.99	ND	0.0097	ND	0.0098	ND	0.0097	ND	0.94	ND	0.0094	ND	0.0095	ND	0.0096	ND	0.97	ND	0.96	ND	94	ND	0.099	ND	0.097	ND	0.96	ND	0.97	ND	0.0098	ND	0.0096
Aroclor-1254		**0.02**	0.0099	**18**	0.96	**9.8**	0.99	**0.15**	0.0097	**0.082**	0.0098	**0.067**	0.0097	**15**	0.94	**0.035**	0.0094	ND	0.0095	ND	0.0096	**22**	0.97	**13**	0.96	**3000**	94	**2.1**	0.099	**2.2**	0.097	**7.9**	0.96	**11**	0.97	**0.27**	0.0098	**0.082**	0.0096
Aroclor-1260		**0.01**	0.0099	**5.5**	0.96	**3.7**	0.99	ND	0.0097	ND	0.0098	ND	0.0097	**6.4**	0.94	**0.02**	0.0094	ND	0.0095	ND	0.0096	**6.5**	0.97	**4.9**	0.96	**4600**	94	**2.2**	0.099	**0.79**	0.097	**3.3**	0.96	ND	0.97	**0.68**	0.0098	**0.075**	0.0096
Total PCBs	1.1																																				

SAMPLE ID:		KGI-60.0-232		KGI-60.0-238		KGI-60.0-262		KGI-60.0-270		KGI-60.0-272		KGI-60.0-276		KGI-60.0-280		KGI-60.0-304		KGI-60.0-310		KGI-60.0-314		KGI-60.0-338		KGI-60.0-384		KGI-60.0-396	
SAMPLE MATRIX:		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil	
DEPTH (below ground surface):		60"		60"		60"		60"		60"		60"		60"		60"		60"		60"		60"		60"		60"	
DATE COLLECTED:		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/24/2008		10/25/2008		10/25/2008		10/25/2008	
ANALYTE	HDOH EAL	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)
POLYCHLORINATED BIPHENYLS																																					
Aroclor-1016		ND	0.0098	ND	0.0097	ND	0.0097	ND	0.0097	ND	0.098	ND	0.096	ND	0.94	ND	0.0096	ND	0.96	ND	0.0098	ND	0.0096	ND	0.01	ND	0.93											
Aroclor-1221		ND	0.0098	ND	0.0097	ND	0.0097	ND	0.0097	ND	0.098	ND	0.096	ND	0.94	ND	0.0096	ND	0.96	ND	0.0098	ND	0.0096	ND	0.01	ND	0.93											
Aroclor-1232		ND	0.0098	ND	0.0097	ND	0.0097	ND	0.0097	ND	0.098	ND	0.096	ND	0.94	ND	0.0096	ND	0.96	ND	0.0098	ND	0.0096	ND	0.01	ND	0.93											
Aroclor-1242	ns	ND	0.0098	ND	0.0097	ND	0.0097	ND	0.0097	ND	0.098	ND	0.096	ND	0.94	ND	0.0096	ND	0.96	ND	0.0098	ND	0.0096	ND	0.01	ND	0.93											
Aroclor-1248		ND	0.0098	ND	0.0097	ND	0.0097	ND	0.0097	ND	0.098	ND	0.096	ND	0.94	ND	0.0096	ND	0.96	ND	0.0098	ND	0.0096	ND	0.01	ND	0.93											
Aroclor-1254		**0.31**	0.0098	**0.037**	0.0097	ND	0.0097	**0.17**	0.0097	**2.8**	0.098	**5.5**	0.096	**43**	0.94	**0.12**	0.0096	**21**	0.96	**0.085**	0.0098	**0.069**	0.0096	**0.47**	0.01	**13**	0.93											
Aroclor-1260		**0.24**	0.0098	**0.015**	0.0097	ND	0.0097	**0.074**	0.0097	**2.6**	0.098	**1.8**	0.096	**12**	0.94	**0.066**	0.0096	**6.3**	0.96	**0.27**	0.0098	**0.024**	0.0096	**0.12**	0.01	**6.4**	0.93											
Total PCBs	1.1																																				

Bold - Value Exceeds Laboratory Reporting Limit

Bold - Value Exceeds Regulatory Limit

HDOH EAL, from Table B-2 (Potentially impacted groundwater is not a current or potential drinking water source; Surface water body is located within 150m of release site). PCB value from Final EAL column.

J- Value is estimated, analyte detected but below the reporting limit

Table B-5: SMD MI Soil Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:		KMI-001		KMI-002		KMI-003		KMI-004		KMI-005		KMI-006		KMI-007		KMI-008		KMI-009 (dup of 008)	
SAMPLE MATRIX:		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil	
DEPTH (below ground surface):		4"		4"		4"		4"		4"		4"		4"		4"		4"	
DATE COLLECTED:		10/26/2008		10/26/2008		10/26/2008		10/26/2008		10/26/2008		10/26/2008		10/26/2008		10/26/2008		10/26/2008	
ANALYTE	HDOH EAL (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)
POLYCHLORINATED BIPHENYLS																			
Aroclor-1016		ND	0.0315	ND	0.0329	ND	0.0309	ND	0.0327	ND	0.0322	ND	0.0321	ND	0.0325	ND	0.0316	ND	0.033
Aroclor-1221		ND	0.0631	ND	0.0658	ND	0.0617	ND	0.0654	ND	0.0643	ND	0.0641	ND	0.0649	ND	0.0633	ND	0.066
Aroclor-1232		ND	0.0315	ND	0.0329	ND	0.0309	ND	0.0327	ND	0.0322	ND	0.0321	ND	0.0325	ND	0.0316	ND	0.033
Aroclor-1242	ns	ND	0.0315	ND	0.0329	ND	0.0309	ND	0.0327	ND	0.0322	ND	0.0321	ND	0.0325	ND	0.0316	ND	0.033
Aroclor-1248		ND	0.0315	ND	0.0329	ND	0.0309	ND	0.0327	ND	0.0322	ND	0.0321	ND	0.0325	ND	0.0316	ND	0.033
Aroclor-1254		**0.337**	0.0315	ND	0.0329	ND	0.0309	ND	0.0327	ND	0.0322	ND	0.0321	ND	0.0325	ND	0.0316	0.0049 J	0.033
Aroclor-1260		ND	0.0315	ND	0.0329	ND	0.0309	ND	0.0327	ND	0.0322	ND	0.0321	ND	0.0325	ND	0.0316	ND	0.033
Total PCBs	1.1																		
Metals																			
Arsenic	20	ND	9.62	ND	9.62	0.782 J	9.62	ND	9.43	ND	9.9	0.834 J	9.71	1.38 J	9.9	2.50 J	9.43	3.42 J	9.9
Cadmium	12	0.904 J	9.62	ND	9.62	ND	9.62	ND	9.43	ND	9.9	ND	9.71	0.982 J	9.9	2.13 J	9.43	2.31 J	9.9
Chromium	500	4.78 J	9.62	3.14 J	9.62	3.11 J	9.62	3.04 J	9.43	3.09 J	9.9	3.71 J	9.71	5.51 J	9.9	**11.3**	9.43	**13.9**	9.9
Lead	200	11.2 J	19.2	ND	19.2	ND	19.2	ND	18.9	ND	19.8	5.92 J	19.4	3.02 J	19.8	**84.6**	18.9	**358**	19.8
Mercury	4.7	0.00126 J	0.00481	ND	0.00439	ND	0.00431	ND	0.0049	ND	0.00439	0.00360 J	0.0049	0.000702	0.00446	**0.0414**	0.00439	**0.0748**	0.00431

SAMPLE ID:		KMI-010		KMI-011		KMI-012		KMI-013		KMI-014		KMI-015	
SAMPLE MATRIX:		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil	
DEPTH (below ground surface):		4"		4"		4"		4"		4"		4"	
DATE COLLECTED:		10/26/2008		10/27/2008		10/27/2008		10/26/2008		10/26/2008		10/26/2008	
ANALYTE	HDOH EAL	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)
POLYCHLORINATED BIPHENYLS													
Aroclor-1016		ND	0.0328	ND	0.0323	ND	0.324	ND	6.41	ND	6.43	ND	6.6
Aroclor-1221		ND	0.0656	ND	0.0645	ND	0.647	ND	12.8	ND	12.9	ND	13.2
Aroclor-1232		ND	0.0328	ND	0.0323	ND	0.324	ND	6.41	ND	6.43	ND	6.6
Aroclor-1242	ns	ND	0.0328	ND	0.0323	ND	0.324	ND	0.0097	ND	6.43	ND	6.6
Aroclor-1248		ND	0.0328	ND	0.0323	ND	0.324	ND	0.0097	ND	6.43	ND	6.6
Aroclor-1254		ND	0.0328	**0.353**	0.0323	**1.53**	0.324	ND	0.0097	ND	6.43	ND	6.6
Aroclor-1260		ND	0.0328	ND	0.0323	**2.53**	0.324	**40**	0.0097	**36.4**	6.43	**33.6**	6.6
Total PCBs	1.1												
Metals													
Arsenic	20	2.92 J	9.8	ND	9.8	ND	9.8	ND	9.62	ND	9.52	1.07 J	9.8
Cadmium	12	1.76 J	9.8	ND	9.8	ND	9.8	ND	9.62	ND	9.52	ND	9.8
Chromium	500	**12.2**	9.8	4.68 J	9.8	5.35 J	9.8	5.30 J	9.62	5.03 J	9.52	5.57 J	9.8
Lead	200	**75.6**	19.6	**25.9**	19.6	17.8 J	19.6	76.4	19.2	**158**	19	**103**	19.6
Mercury	4.7	**0.0673**	0.00439	0.00444 J	0.00446	**0.101**	0.00439	**0.207**	0.00962	**0.188**	0.00893	**0.226**	0.0227

Bold - Value Exceeds Laboratory Reporting Limit

Bold - Value Exceeds Regulatory Limit

HDOH EAL, from Table B-2 (Potentially impacted groundwater is not a current or potential drinking water source; Surface water body is located within 150m of release site). PCB value from Final EAL Column.

J- Value is estimated, analyte detected but below the reporting limit

Table B-6: SMD Hotspot MI Soil Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:		KMI-017-#10		KMI-017-#60		KMI-017-#230		KMI-017-Fine		KMI-018-#10		KMI-018-#60		KMI-018-#230		KMI-018-Fine	
SAMPLE MATRIX:		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil		SubSurface Soil	
DEPTH (below ground surface):		36"		36"		36"		36"		60"		60"		60"		60"	
DATE COLLECTED:		10/28/2008		10/28/2008		10/28/2008		10/28/2008		10/28/2008		10/28/2008		10/28/2008		10/28/2008	
ANALYTE	HDOH EAL (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)
POLYCHLORINATED BIPHENYLS																	
Aroclor-1016		ND	0.662	ND	3.33	ND	6.64	ND	17.9	ND	0.331	ND	3.33	ND	6.67	ND	13.2
Aroclor-1221		ND	1.32	ND	6.67	ND	13.3	ND	35.7	ND	0.662	ND	6.67	ND	13.3	ND	26.3
Aroclor-1232		ND	0.662	ND	3.33	ND	6.64	ND	17.9	ND	0.331	ND	3.33	ND	6.67	ND	13.2
Aroclor-1242	ns	ND	0.662	ND	3.33	ND	6.64	ND	17.9	ND	0.331	ND	3.33	ND	6.67	ND	13.2
Aroclor-1248		ND	0.662	ND	3.33	ND	6.64	ND	17.9	ND	0.331	ND	3.33	ND	6.67	ND	13.2
Aroclor-1254		**3.88**	0.662	**14.1**	3.33	**25.8**	6.64	**72.7**	17.9	**2.31**	0.331	ND	3.33	ND	6.67	ND	13.2
Aroclor-1260		ND	0.662	ND	3.33	ND	6.64	ND	17.9	ND	0.331	**33.2**	3.33	**44.7**	6.67	**81.6**	13.2
Total PCBs	1.1																

Bold - Value Exceeds Laboratory Reporting Limit

Bold - Value Exceeds Regulatory Limit

HDOH EAL, from Table B-2 (Potentially impacted groundwater is not a current or potential drinking water source; Surface water body is located within 150m of release site). PCB value from Final EAL Column.

J- Value is estimated, analyte detected but below the reporting limit

Table B-7: Green Island Soil Sample Analytical Results, 2008 Investigation, Kure Atol

SAMPLE ID:		KGI-2.0-001		KGI-2.0-002		KGI-2.0-003		KGI-2.0-004		KGI-2.0-005	
SAMPLE MATRIX:		Surface Soil		Surface Soil		Surface Soil		Surface Soil		Surface Soil	
DEPTH (below ground surface):		4"		4"		4"		4"		4"	
DATE COLLECTED:		10/26/2008		10/26/2008		10/26/2008		10/26/2008		10/26/2008	
ANALYTE	**HDOH EAL (mg/kg)**	**RESULT (mg/kg)**	**RPRT LIMIT (mg/kg)**	**RESULT (mg/kg)**	**RPRT LIMIT (mg/kg)**	**RESULT (mg/kg)**	**RPRT LIMIT (mg/kg)**	**RESULT (mg/kg)**	**RPRT LIMIT (mg/kg)**	**RESULT (mg/kg)**	**RPRT LIMIT (mg/kg)**
POLYCHLORINATED BIPHENYLS											
Aroclor-1016	ns	ND	0.0099	ND	0.0097	ND	0.0095	ND	0.0097	ND	0.0097
Aroclor-1221		ND	0.0099	ND	0.0097	ND	0.0095	ND	0.0097	ND	0.0097
Aroclor-1232		ND	0.0099	ND	0.0097	ND	0.0095	ND	0.0097	ND	0.0097
Aroclor-1242		ND	0.0099	ND	0.0097	ND	0.0095	ND	0.0097	ND	0.0097
Aroclor-1248		ND	0.0099	ND	0.0097	ND	0.0095	ND	0.0097	ND	0.0097
Aroclor-1254		ND	0.0099	ND	0.0097	ND	0.0095	**0.02**	0.0097	ND	0.0097
Aroclor-1260		ND	0.0099	ND	0.0097	ND	0.0095	ND	0.0097	ND	0.0097
Total PCBs	1.1										
Metals											
Arsenic	20	1.3 B	0.2	1.1 B	0.19	1.3 B	0.19	1.5 B	0.19	1.4 B	0.19
Lead	12	0.71 B	0.2	0.33 B	0.19	0.42 B	0.19	0.80 B	0.19	0.53 B	0.19
Cadmium	500	0.081 J B	0.2	0.16 J B	0.19	0.39 B	0.19	0.20 B	0.19	0.11 J B	0.19
Chromium	200	3.2	0.2	4.3	0.19	4.6	0.19	4.9	0.19	4.6	0.19
Mercury	4.7	ND	0.017	ND	0.018	0.0065 J	0.017	ND	0.019	ND	0.02

Bold - Value Exceeds Laboratory Reporting Limit

Bold - Value Exceeds Regulatory Limit

HDOH EAL, from Table B-2 (Potentially impacted groundwater is not a current or potential drinking water source; Surface water body is located within 150m of release site). PCB value from Final EAL Column.

J- Value is estimated, analyte detected but below the reporting limit

B- Compound was found in the laboratory blank and the sample

Table B-14: SMD Soil Sample Analytical Results Congener Comparison, 2008 Investigation, Kure Atoll

SAMPLE ID:	KGI-4.0-054		KGI-36.0-185		KGI-36.0-215		KGI-36.0-279		KGI-60.0-183		KGI-60.0-193		KGI-60.0-280		KGI-60.0-310	
SAMPLE MATRIX:	Surface Soil		Subsurface Soil		Subsurface Soil		Subsurface Soil		Subsurface Soil		Subsurface Soil		Subsurface Soil		Subsurface Soil	
DATE COLLECTE	10/22/2008		10/23/2008		10/24/2008		10/24/2008		10/23/2008		10/23/2008		10/24/2008		10/24/2008	
ANALYTE	RESULT	RPRTING LIMIT	RESULT	RPRTING LIMIT	RESULT	RPRTING LIMIT	RESULT	RPRTING LIMIT	RESULT	RPRTING LIMIT	RESULT	RPRTING LIMIT	RESULT	RPRTING LIMIT	RESULT	RPRTING LIMIT
POLYCHLORINATED BIPHENYL CONGENERS (ug/kg)																
PCB 8 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 18 (BZ)	0.06	0.18	ND	440	270	89	110	120	33	91	4700	8800	170	88	180	89
PCB 28 (BZ)	ND	0.18	ND	440	1900	89	300	120	160	91	7700	8800	530	88	650	89
PCB 44 (BZ)	0.051	0.18	110	440	1100	89	430	120	340	91	4200	8800	740	88	580	89
PCB 49 (BZ)	ND	0.18	ND	440	770	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 52 (BZ)	0.074	0.18	170	440	`1400	89	880	120	840	91	6800	8800	1400	88	1000	89
PCB 66 (BZ)	ND	0.18	ND	440	1300	89	310	120	310	91	ND	8800	490	88	700	89
PCB 77 (BZ)	ND	0.18	ND	440	890	89	680	120	720	91	ND	8800	ND	88	730	89
PCB 81 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 87 (BZ)	0.43	0.18	360	440	1100	89	940	120	1000	91	9300	8800	1700	88	1000	89
PCB 101 (BZ)	0.37	0.18	1600	440	970	89	920	120	940	91	42000	8800	1600	88	950	89
PCB 105 (BZ)	0.54	0.18	ND	440	800	89	570	120	660	91	ND	8800	1100	88	680	89
PCB 114 (BZ)	ND	0.18	110	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 118 (BZ)	0.28	0.18	110	440	470	89	510	120	510	91	2600	8800	890	88	500	89
PCB 123 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 126 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 128 (BZ)	0.45	0.18	ND	440	400	89	440	120	450	91	ND	8800	790	88	440	89
PCB 138 (BZ)	1.1	0.18	7200	440	1300	89	1400	120	1500	91	160000	8800	2600	88	1400	89
PCB 153 (BZ)	0.71	0.18	12000	440	930	89	1000	120	1100	91	280000	8800	1900	88	1000	89
PCB 156 (BZ)	0.25	0.18	ND	440	200	89	200	120	230	91	ND	8800	370	88	210	89
PCB 157 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 167 (BZ)	0.041	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 169 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 170 (BZ)	0.31	0.18	8500	440	170	89	220	120	190	91	190000	8800	390	88	190	89
PCB 180 (BZ)	0.37	0.18	16000	440	230	89	300	120	250	91	350000	8800	520	88	250	89
PCB 183 (BZ)	0.071	0.18	3400	440	ND	89	ND	120	ND	91	76000	8800	ND	88	ND	89
PCB 184 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
PCB 187 (BZ)	ND	0.18	8800	440	ND	89	ND	120	ND	91	200000	8800	ND	88	ND	89
PCB 189 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	3200	8800	ND	88	ND	89
PCB 195 (BZ)	ND	0.18	1300	440	ND	89	ND	120	ND	91	29000	8800	25	88	ND	89
PCB 206 (BZ)	ND	0.18	670	440	ND	89	ND	120	ND	91	15000	8800	ND	88	ND	89
PCB 209 (BZ)	ND	0.18	ND	440	ND	89	ND	120	ND	91	ND	8800	ND	88	ND	89
Sum PCBs	**8.63**		**109940**		**19680**		**14780**		**14566**		**2584000**		**26290**		**17040**	
TOTAL POLYCHLORINATED BIPHENYL AS AROCLORS (mg/kg)																
Aroclor-1016	ND	0.0097	ND	9.8	ND	0.97	ND	0.96	ND	0.97	ND	94	ND	0.94	ND	0.96
Aroclor-1221	ND	0.0097	ND	9.8	ND	0.97	ND	0.96	ND	0.97	ND	94	ND	0.94	ND	0.96
Aroclor-1232	ND	0.0097	ND	9.8	ND	0.97	ND	0.96	ND	0.97	ND	94	ND	0.94	ND	0.96
Aroclor-1242	ND	0.0097	ND	9.8	ND	0.97	ND	0.96	ND	0.97	ND	94	ND	0.94	ND	0.96
Aroclor-1248	ND	0.0097	ND	9.8	ND	0.97	ND	0.96	ND	0.97	ND	94	ND	0.94	ND	0.96
Aroclor-1254	0.0049 J	0.0097	**100**	9.8	**36**	0.97	**19**	0.96	**22**	0.97	**3000**	94	**43**	0.94	**21**	0.96
Aroclor-1260	ND	0.0097	**160**	9.8	**6.3**	0.97	**5.1**	0.96	**6.5**	0.97	**4600**	94	**12**	0.94	**6.3**	0.96

Bold - Value Exceeds Reporting Limit

Sum PCBs based on sum of NOAA 18 congeners multiplied by 2

BZ#170 - NOAA 18 Congener (included in PCB sum)

J- Value is estimated, analyte detected but below the reporting limit

U- The analyte of interest was not detected above the detection limit

B- Value greater than detection limit but less than reporting limit

P- Greater than 40% difference for detected concentrations between two GC columns. Higher of the two values is reported.

Table B-15: SMD Soil Sample Analytical Results Total 209 Congener Comparison, 2008 Investigation, Kure Atoll

SAMPLE ID:	KGI-60.0-193 (Full Congener List)			KGI-60.0-193 (NOAA 32 Congener List)	
SAMPLE MATRIX:	Subsurface Soil			Subsurface Soil	
DATE COLLECTED:	10/23/2008			10/23/2008	
ANALYTE	RESULT	QUALIFIER	DTCTN LIMIT	RESULT	RPRTING LIMIT
POLYCHLORINATED BIPHENYL CONGENERS (ug/kg)					
BZ#1	ND		21		
BZ#2	NC		0.021		
BZ#3	ND		21		
BZ#4	420	C	21		
BZ#5	ND		21		
BZ#6	NC		0.021		
BZ#7	NC		0.021		
BZ#8	ND		21	ND	8800
BZ#9	NC		0.021		
BZ#10	420		21		
BZ#11	NC		0.021		
BZ#12	NC		0.021		
BZ#13	NC		0.021		
BZ#14	NC		0.021		
BZ#15	1,600		21		
BZ#16	NC		0.021		
BZ#17	NC		0.021		
BZ#18	1,300		21	4700	8800
BZ#19	NC		0.021		
BZ#20	NC		0.021		
BZ#21	NC		0.021		
BZ#22	NC		0.021		
BZ#23	NC		0.021		
BZ#24	NC		0.021		
BZ#25	NC		0.021		
BZ#26	NC		0.021		
BZ#27	NC		0.021		
BZ#28	3,600		21	7700	8800
BZ#29	NC		0.021		
BZ#30	ND		21		
BZ#31	4,000		21		
BZ#32	NC		0.021		
BZ#33	NC		0.021		
BZ#34	NC		0.021		
BZ#35	NC		0.021		
BZ#36	NC		0.021		
BZ#37	1,700		21		
BZ#38	NC		0.021		
BZ#39	NC		0.021		
BZ#40	NC		0.021		
BZ#41	NC		0.021		
BZ#42	NC		0.021		
BZ#43	NC		0.021		
BZ#44	5,200		21	4200	8800
BZ#45	NC		0.021		
BZ#46	NC		0.021		
BZ#47	1,900		21		
BZ#48	1,900		21		
BZ#49	NC		0.021	ND	8800
BZ#50	NC		0.021		
BZ#51	NC		0.021		
BZ#52	6,400	C, SA	21	6800	8800
BZ#53	NC		0.021		
BZ#54	ND		21		
BZ#55	NC		0.021		
BZ#56	NC		0.021		
BZ#57	NC		0.021		
BZ#58	NC		0.021		
BZ#59	NC		0.021		
BZ#60	NC		0.021		
BZ#61	NC		0.021		
BZ#62	NC		0.021		
BZ#63	NC		0.021		
BZ#64	NC		0.021		
BZ#65	NC		0.021		
BZ#66	4,800	C, E	21	ND	8800
BZ#67	NC		0.021		
BZ#68	NC		0.021		
BZ#69	NC		0.021		
BZ#70	NC		0.021		
BZ#71	NC		0.021		
BZ#72	NC		0.021		
BZ#73	6,400	C, SA	21		
BZ#74	NC		0.021		
BZ#75	1,900	C	21		
BZ#76	NC		0.021		
BZ#77	ND	G	630	ND	8800
BZ#78	NC		0.021		
BZ#79	NC		0.021		
BZ#80	4,800	C, E	21		
BZ#81	ND	G	390	ND	8800
BZ#82	NC		0.021		
BZ#83	NC		0.021		
BZ#84	NC		0.021		
BZ#85	NC		0.021		
BZ#86	NC		0.021		
BZ#87	NC		0.021	9300	8800
BZ#88	NC		0.021		
BZ#89	13,000	C, SA	21		
BZ#90	13,000	C, SA	21		
BZ#91	NC		0.021		
BZ#92	NC		0.021		
BZ#93	NC		0.021		
BZ#94	NC		0.021		
BZ#95	NC		0.021		
BZ#96	NC		0.021		
BZ#97	NC		0.021		
BZ#98	NC		0.021		
BZ#99	NC		0.021		
BZ#100	NC		0.021		
BZ#101	13,000	C, SA	21	42000	8800
BZ#102	NC		0.021		
BZ#103	NC		0.021		
BZ#104	ND		21		
BZ#105	6,800	C, E, J	2.1	ND	8800
BZ#106	7,600	C, E, J	21		
BZ#107	NC		0.021		
BZ#108	NC		0.021		
BZ#109	NC		0.021		
BZ#110	NC		0.021		
BZ#111	NC		0.021		

Table B-15: SMD Soil Sample Analytical Results Total 209 Congener Comparison, 2008 Investigation, Kure Atoll

BZ#112	NC		0.021		
BZ#113	NC		0.021		
BZ#114	160		2.1	ND	8800
BZ#115	NC		0.021		
BZ#116	NC		0.021		
BZ#117	NC		0.021		
BZ#118	7,600	C, E, J	2.1	2600	8800
BZ#119	NC		0.021		
BZ#120	NC		0.021		
BZ#121	NC		0.021		
BZ#122	NC		0.021		
BZ#123	ND	G	5,300	ND	8800
BZ#124	NC		0.021		
BZ#125	NC		0.021		
BZ#126	2,500	SAT	2.1	ND	8800
BZ#127	6,800	C, E, J	21		
BZ#128	5,600	E	2.1	ND	8800
BZ#129	NC		0.021		
BZ#130	NC		0.021		
BZ#131	NC		0.021		
BZ#132	NC		0.021		
BZ#133	NC		0.021		
BZ#134	NC		0.021		
BZ#135	NC		0.021		
BZ#136	NC		0.021		
BZ#137	180		21		
BZ#138	12,000	C, SA	2.1	160000	8800
BZ#139	NC		0.021		
BZ#140	NC		0.021		
BZ#141	NC		0.021		
BZ#142	NC		0.021		
BZ#143	NC		0.021		
BZ#144	NC		0.021		
BZ#145	NC		0.021		
BZ#146	NC		0.021		
BZ#147	NC		0.021		
BZ#148	NC		0.021		
BZ#149	NC		0.021		
BZ#150	NC		0.021		
BZ#151	NC		0.021		
BZ#152	NC		0.021		
BZ#153	12,000	SAT	21	280000	8800
BZ#154	NC		0.021		
BZ#155	ND		21		
BZ#156	8,000	E	2.1	ND	8800
BZ#157	710	JA	2.1	ND	8800
BZ#158	NC		0.021		
BZ#159	NC		0.021		
BZ#160	NC		0.021		
BZ#161	NC		0.021		
BZ#162	NC		0.021		
BZ#163	12,000	C, SA	21		
BZ#164	12,000	C, SA	21		
BZ#165	NC		0.021		
BZ#166	NC		0.021		
BZ#167	4,100	E	2.1	ND	8800
BZ#168	NC		0.021		
BZ#169	ND		2.1	ND	8800
BZ#170	19,000	C, SA	2.1	190000	8800
BZ#171	NC		0.021		
BZ#172	NC		0.021		
BZ#173	NC		0.021		
BZ#174	NC		0.021		
BZ#175	NC		0.021		
BZ#176	NC		0.021		
BZ#177	NC		0.021		
BZ#178	NC		0.021		
BZ#179	NC		0.021		
BZ#180	26,000	SAT, I	2.1	350000	8800
BZ#181	NC		0.021		
BZ#182	12,000	SAT	21		
BZ#183	NC		0.021	76000	8800
BZ#184	NC		0.021	ND	8800
BZ#185	NC		0.021		
BZ#186	NC		0.021		
BZ#187	12,000	SAT	21	200000	8800
BZ#188	ND		21		
BZ#189	4,000	E	2.1	3200	8800
BZ#190	19,000	C, SA	21		
BZ#191	NC		0.021		
BZ#192	NC		0.021		
BZ#193	NC		0.021		
BZ#194	19,000	C, SA	21		
BZ#195	11,000	SAT	21	29000	8800
BZ#196	NC		0.021		
BZ#197	NC		0.021		
BZ#198	NC		0.021		
BZ#199	NC		0.021		
BZ#200	NC		0.021		
BZ#201	NC		0.021		
BZ#202	6,800	SAT	21		
BZ#203	NC		0.021		
BZ#204	NC		0.021		
BZ#205	NC		0.021		
BZ#206	11,000	E, JA	21	15000	8800
BZ#207	NC		0.021		
BZ#208	2,700	E	21		
BZ#209	270		21	ND	8800
Sum PCBs	**326,160**			**2584000**	

Bold - Value Exceeds Reporting Limit

Sum PCBs based on sum of NOAA 18 congeners multiplied by 2

BZ#170 - NOAA 18 Congener (included in PCB sum)

NC-The recovery and/or RPD were not calculated

C-Co-eluting isomer

E-Estimated result. Result concnetration exceeds the calibration range

G-Elevated reporting limit. The reporting limit is elevated due to matrix interference

JA-The analyte was positively identified, but the quantitation is an estimate

B-Method blank contamination. The associated method blank contains the target analyte at a reportable level

SAT-Result is a minimum concentration due to high level of analyte saturating the instrument detector

Table B-8: Water Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:	REGULATORY STANDARDS		KGW001			KGW002			KGW003			KGW004			KGW005			KGW006 (Dup of KGW005)			KGW007			KGW008		
SAMPLE MATRIX:			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater			Groundwater		
SAMPLE LOCATION:			Piezometer 2			Piezometer 1			Piezometer 3			Piezometer 4			Piezometer 5			Piezometer 5			Piezometer 6			Piezometer 7		
DATE COLLECTED:			10/25/2008			10/25/2008			10/25/2008			10/25/2008			10/25/2008			10/25/2008			10/25/2008			10/25/2008		
ANALYTE	HDOH EAL Marine[1]	HDOH EAL Surface Water Estuary Habitats[2]	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT
SVOCs (ug/L)																										
Naphthalene	24	21	ND	0.11	0.04	ND	0.1	0.038	ND	0.11	0.038	0.044 J	0.12	0.042	0.051 J	0.11	0.041	0.056 J	0.1	0.037	ND	0.11	0.038	ND	0.1	0.037
2-Methylnaphthalene	2.1	2.1	ND	0.15	0.034	ND	0.14	0.031	ND	0.14	0.032	ND	0.15	0.035	ND	0.15	0.034	0.037 J	0.13	0.031	ND	0.14	0.032	ND	0.13	0.031
1-Methylnaphthalene			ND	0.11	0.013	ND	0.1	0.013	ND	0.11	0.013	ND	0.12	0.014	ND	0.11	0.014	0.014 J	0.1	0.012	ND	0.11	0.013	ND	0.1	0.012
Acenaphthylene	30	30	ND	0.11	0.012	ND	0.1	0.011	ND	0.11	0.012	ND	0.12	0.013	ND	0.11	0.012	ND	0.1	0.011	ND	0.11	0.012	ND	0.1	0.011
Acenaphthene	40	20	ND	0.11	0.011	ND	0.1	0.01	ND	0.11	0.011	ND	0.12	0.012	ND	0.11	0.011	ND	0.1	0.01	ND	0.11	0.011	ND	0.1	0.01
Fluorene	3.9	3.9	ND	0.11	0.013	ND	0.1	0.013	ND	0.11	0.013	ND	0.12	0.014	ND	0.11	0.014	ND	0.1	0.012	ND	0.11	0.013	ND	0.1	0.012
Phenanthrene	4.6	4.6	ND	0.11	0.012	ND	0.1	0.011	ND	0.11	0.012	ND	0.12	0.013	ND	0.11	0.012	ND	0.1	0.011	ND	0.11	0.012	ND	0.1	0.011
Anthracene	0.73	0.73	ND	0.11	0.009	ND	0.1	0.0084	ND	0.11	0.0085	ND	0.12	0.0094	ND	0.11	0.0091	0.0086 J	0.1	0.0082	ND	0.11	0.0085	ND	0.1	0.0082
Fluoranthene	8	8	ND	0.11	0.018	ND	0.1	0.017	ND	0.11	0.017	ND	0.12	0.019	ND	0.11	0.018	ND	0.1	0.016	ND	0.11	0.017	ND	0.1	0.016
Pyrene	2	2	ND	0.11	0.019	ND	0.1	0.018	ND	0.11	0.018	ND	0.12	0.02	ND	0.11	0.019	ND	0.1	0.017	ND	0.11	0.018	ND	0.1	0.017
Benzo(a)anthracene	0.027	0.018	ND	0.11	0.027	ND	0.1	0.025	ND	0.11	0.026	ND	0.12	0.028	ND	0.11	0.027	ND	0.1	0.025	ND	0.11	0.026	ND	0.1	0.025
Chrysene	0.35	0.018	ND	0.11	0.024	ND	0.1	0.022	ND	0.11	0.022	ND	0.12	0.025	ND	0.11	0.024	ND	0.1	0.022	ND	0.11	0.022	ND	0.1	0.021
Benzo(b)fluoranthene	0.092	0.018	ND	0.11	0.029	ND	0.1	0.027	ND	0.11	0.028	ND	0.12	0.031	ND	0.11	0.029	ND	0.1	0.027	ND	0.11	0.028	ND	0.1	0.027
Benzo(k)fluoranthene	3.7	0.018	ND	0.11	0.027	ND	0.1	0.025	ND	0.11	0.026	ND	0.12	0.028	ND	0.11	0.027	ND	0.1	0.025	ND	0.11	0.026	ND	0.1	0.025
Benzo(a)pyrene	0.014	0.014	ND	0.22	0.021	ND	0.21	0.02	ND	0.21	0.02	ND	0.24	0.022	ND	0.23	0.022	ND	0.21	0.019	ND	0.21	0.02	0.035 J	0.2	0.019
Indeno(1,2,3-cd)pyrene	0.092	0.018	ND	0.11	0.022	ND	0.1	0.021	ND	0.11	0.021	ND	0.12	0.024	ND	0.11	0.023	ND	0.1	0.021	ND	0.11	0.021	ND	0.1	0.02
Dibenzo(a,h)anthracene	7.5	0.018	ND	0.11	0.02	ND	0.1	0.019	ND	0.11	0.019	ND	0.12	0.021	ND	0.11	0.02	ND	0.1	0.018	ND	0.11	0.019	ND	0.1	0.018
Benzo(g,h,i)perylene	0.1	0.1	ND	0.11	0.022	ND	0.1	0.021	ND	0.11	0.021	ND	0.12	0.024	ND	0.11	0.023	ND	0.1	0.021	ND	0.11	0.021	ND	0.1	0.02
Organochlorine Pesticides (ug/L)																										
Aldrin	0.13	0.000026	ND	0.011	0.00066	ND	0.011	0.00064	ND	0.011	0.00067	ND	0.011	0.00069	ND	0.012	0.00069	ND	0.011	0.00067	ND	0.011	0.00063	ND	0.01	0.00062
alpha-BHC	ns	ns	ND	0.011	0.0028	ND	0.011	0.0028	ND	0.011	0.0029	ND	0.011	0.003	ND	0.012	0.003	ND	0.011	0.0029	ND	0.011	0.0027	ND	0.01	0.0027
beta-BHC	ns	ns	0.0063 J	0.022	0.0016	0.0041 J	0.021	0.0016	0.0018 J	0.022	0.0017	0.0039 J	0.023	0.0017	0.0088 J	0.023	0.0017	0.0059 J	0.022	0.0017	ND	0.021	0.0016	ND	0.021	0.0015
delta-BHC	ns	ns	ND	0.011	0.00055	ND	0.011	0.00053	ND	0.011	0.00056	ND	0.011	0.00057	ND	0.012	0.00058	ND	0.011	0.00056	ND	0.011	0.00053	ND	0.01	0.00051
gamma-BHC (Lindane)	ns	ns	ND	0.011	0.00066	ND	0.011	0.00064	ND	0.011	0.00067	ND	0.011	0.00069	ND	0.012	0.00069	ND	0.011	0.00067	ND	0.011	0.00063	ND	0.01	0.00062
4,4'-DDD	0.001	0.00031	0.0010 J	0.022	0.00087	ND	0.021	0.00085	0.0020 J	0.022	0.0009	ND	0.023	0.00091	0.0010 J	0.023	0.00092	ND	0.022	0.00089	ND	0.021	0.00085	ND	0.021	0.00082
4,4'-DDE	0.001	0.0002.2	ND	0.022	0.0012	ND	0.021	0.0012	ND	0.022	0.0012	ND	0.023	0.0013	ND	0.023	0.0013	ND	0.022	0.0012	ND	0.021	0.0012	ND	0.021	0.0011
4,4'-DDT	0.001	0.000008	ND	0.022	0.0011	ND	0.021	0.0011	ND	0.022	0.0011	ND	0.023	0.0011	ND	0.023	0.0012	ND	0.022	0.0011	ND	0.021	0.0011	ND	0.021	0.001
Dieldrin	0.0019	0.000025	ND	0.022	0.00098	ND	0.021	0.00096	ND	0.022	0.001	ND	0.023	0.001	ND	0.023	0.001	0.0015 J	0.022	0.001	ND	0.021	0.00095	0.0010 J	0.021	0.00093
Endosulfan I	0.056	0.0087	ND	0.022	0.00055	ND	0.021	0.00053	0.00070 J	0.022	0.00056	ND	0.023	0.00057	ND	0.023	0.00058	ND	0.022	0.00056	ND	0.021	0.00053	0.00080 J	0.021	0.00051
Endosulfan II	0.056	0.0087	0.0012 J	0.022	0.00098	ND	0.021	0.00096	0.0019 J	0.022	0.001	0.0014 J	0.023	0.001	ND	0.023	0.001	ND	0.022	0.001	ND	0.021	0.00095	0.0018 J	0.021	0.00093
Endosulfan sulfate	ns	ns	0.0015 J	0.022	0.00087	ND	0.021	0.00085	0.0025 J	0.022	0.0009	ND	0.023	0.00091	ND	0.023	0.00092	ND	0.022	0.00089	ND	0.021	0.00085	ND	0.021	0.00082
Endrin	0.0023	0.0023	0.00092 J	0.022	0.00076	0.0012 J	0.021	0.00075	0.0020 J	0.022	0.00079	ND	0.023	0.0008	ND	0.023	0.00081	0.0013 J	0.022	0.00078	ND	0.021	0.00074	0.0012 J	0.021	0.00072
Endrin aldehyde	ns	ns	0.0013 J	0.055	0.0011	ND	0.053	0.0011	0.0037 J	0.056	0.0011	ND	0.057	0.0011	ND	0.058	0.0012	ND	0.056	0.0011	ND	0.053	0.0011	ND	0.051	0.001
Heptachlor	0.0038	0.0009	ND	0.011	0.00055	ND	0.011	0.00053	0.0010 J	0.011	0.00056	0.0013 J	0.011	0.00057	ND	0.012	0.00058	ND	0.011	0.00056	ND	0.011	0.00053	ND	0.01	0.00051
Heptachlor epoxide	0.0038	0.000039	0.0011 J	0.011	0.00098	ND	0.011	0.00096	ND	0.011	0.001	ND	0.011	0.001	ND	0.012	0.001	ND	0.011	0.001	ND	0.011	0.00095	ND	0.01	0.00093
Methoxychlor	0.03	0.03	ND	0.11	0.0011	ND	0.11	0.0011	ND	0.11	0.0011	ND	0.11	0.0011	ND	0.12	0.0012	ND	0.11	0.0011	ND	0.11	0.0011	ND	0.1	0.001
Endrin ketone	ns	ns	ND	0.022	0.00076	ND	0.021	0.00075	0.0032 J	0.022	0.00079	ND	0.023	0.0008	ND	0.023	0.00081	ND	0.022	0.00078	ND	0.021	0.00074	ND	0.021	0.00072
Toxaphene	0.0002	0.0002	ND	1.1	0.29	ND	1.1	0.29	ND	1.1	0.3	ND	1.1	0.31	ND	1.2	0.31	ND	1.1	0.3	ND	1.1	0.29	ND	1	0.28
alpha-Chlordane	ns	ns	ND	0.011	0.00055	ND	0.011	0.00053	ND	0.011	0.00056	ND	0.011	0.00057	0.00087 J	0.012	0.00058	ND	0.011	0.00056	ND	0.011	0.00053	ND	0.01	0.00051
gamma-Chlordane	ns	ns	ND	0.011	0.0012	ND	0.011	0.0012	ND	0.011	0.0012	ND	0.011	0.0013	ND	0.012	0.0013	ND	0.011	0.0012	ND	0.011	0.0012	ND	0.01	0.0011
METALS (mg/L)																										
Arsenic	0.19	0.00014	**0.0024**	0.002	0.00024	**0.0029**	0.002	0.00024	**0.0061**	0.002	0.00024	**0.0054**	0.002	0.00024	**0.0033**	0.002	0.00024	**0.0030**	0.002	0.00024	**0.0086**	0.002	0.00024	**0.0048**	0.002	0.00024
Cadmium	0.0093	0.003	ND	0.002	0.00014	ND	0.002	0.00014	ND	0.002	0.00014	ND	0.002	0.00014	ND	0.002	0.00014	ND	0.002	0.00014	ND	0.002	0.00014	ND	0.002	0.00014
Chromium	0.074	0.074	0.00054 J	0.002	0.00037	ND	0.002	0.00037	0.00055 J	0.002	0.00037	0.00045 J	0.002	0.00037	0.00052 J	0.002	0.00037	0.00046 J	0.002	0.00037	0.00052 J	0.002	0.00037	0.0013 J	0.002	0.00037
Lead	0.0056	0.0056	ND	0.002	0.00017	ND	0.002	0.00017	ND	0.002	0.00017	ND	0.002	0.00017	ND	0.002	0.00017	ND	0.002	0.00017	ND	0.002	0.00017	ND	0.002	0.00017
Mercury	0.000025	0.000025	ND	0.0002	0.000041	ND	0.0002	0.000041	0.000062 J	0.0002	0.000041	ND	0.0002	0.000041	ND	0.0002	0.000041	0.000083 J	0.0002	0.000041	0.000078 J	0.0002	0.000041	**0.000071 J**	0.0002	0.000041
POLYCHLORINATED BIPHENYLS (ug/L)																										
Aroclor-1016	0.03	0.000079	ND	0.55	0.49	ND	0.53	0.048	ND	0.56	0.051	ND	0.57	0.051	ND	0.58	0.052	ND	0.56	0.05	ND	0.53	0.048	ND	0.51	0.046
Aroclor-1221			ND	0.55	0.068	ND	0.53	0.066	ND	0.56	0.07	ND	0.57	0.071	ND	0.58	0.071	ND	0.56	0.069	ND	0.53	0.066	ND	0.51	0.064
Aroclor-1232			ND	0.55	0.045	ND	0.53	0.044	ND	0.56	0.046	ND	0.57	0.047	ND	0.58	0.047	ND	0.56	0.046	ND	0.53	0.043	ND	0.51	0.042
Aroclor-1242			ND	0.55	0.045	ND	0.53	0.044	ND	0.56	0.046	ND	0.57	0.047	ND	0.58	0.047	ND	0.56	0.046	ND	0.53	0.043	ND	0.51	0.042
Aroclor-1248			ND	0.55	0.078	ND	0.53	0.076	ND	0.56	0.08	ND	0.57	0.081	ND	0.58	0.082	ND	0.56	0.079	ND	0.53	0.075	ND	0.51	0.073
Aroclor-1254			ND	0.55	0.048	ND	0.53	0.047	ND	0.56	0.049	ND	0.57	0.05	ND	0.58	0.051	ND	0.56	0.049	ND	0.53	0.047	ND	0.51	0.045
Aroclor-1260			ND	0.55	0.043	ND	0.53	0.042	ND	0.56	0.044	ND	0.57	0.045	ND	0.58	0.045	ND	0.56	0.043	ND	0.53	0.041	ND	0.51	0.04
Total PCBs			ND			ND			ND			ND			ND			ND			ND			ND		

[1]=HDOH EAL from Table D-4a (Summary of Aquatic Habitiat Goals). All values from chronic aquatic toxicity column.

[2]=HDOH EAL from Table D-2c (Surface Water Action Levels Estuarian Habitats). All values from Final Surface Water Action Level column.

Note: Some action levels are below the laboratory reporting limits. In these cases, the reporting limit is considered the action level, as per HDOH guidance.

Bold - Value Exceeds Reporting Limit

Value Exceeds Regulatory Limit

na-not analyzed

ns - No standard

J- Value is estimated, analyte detected above method detection limit but below the reporting limit

U- The analyte of interest was not detected above the detection limit

B- Compound was found in the laboratory blank and in the sample

Table B-8: Water Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:	REGULATORY STANDARDS		KGW009			KGW009 Re-Run			KGW010			KSW001			KSW002		
SAMPLE MATRIX:			Groundwater			Groundwater			Groundwater			Sea Water			Sea Water		
SAMPLE LOCATION:			Piezometer 8			Piezometer 8			Piezometer 9			North Point			SMD		
DATE COLLECTED:			10/25/2008			10/25/2008			10/25/2008			10/25/2008			10/25/2008		
ANALYTE	HDOH EAL Marine[1]	HDOH EAL Surface Water Estuary Habitats[2]	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT
SVOCs (ug/L)																	
Naphthalene	24	21	ND	0.11	0.041	na	na	na	ND	0.097	0.035	na	na	na	na	na	na
2-Methylnaphthalene	2.1	2.1	ND	0.15	0.034	na	na	na	ND	0.13	0.029	na	na	na	na	na	na
1-Methylnaphthalene			ND	0.11	0.014	na	na	na	ND	0.097	0.012	na	na	na	na	na	na
Acenaphthylene	30	30	ND	0.11	0.013	na	na	na	ND	0.097	0.011	na	na	na	na	na	na
Acenaphthene	40	20	ND	0.11	0.011	na	na	na	ND	0.097	0.0097	na	na	na	na	na	na
Fluorene	3.9	3.9	ND	0.11	0.014	na	na	na	ND	0.097	0.012	na	na	na	na	na	na
Phenanthrene	4.6	4.6	ND	0.11	0.013	na	na	na	0.012 J	0.097	0.011	na	na	na	na	na	na
Anthracene	0.73	0.73	ND	0.11	0.0092	na	na	na	ND	0.097	0.0078	na	na	na	na	na	na
Fluoranthene	8	8	ND	0.11	0.018	na	na	na	ND	0.097	0.016	na	na	na	na	na	na
Pyrene	2	2	ND	0.11	0.019	na	na	na	ND	0.097	0.016	na	na	na	na	na	na
Benzo(a)anthracene	0.027	0.018	ND	0.11	0.027	na	na	na	ND	0.097	0.023	na	na	na	na	na	na
Chrysene	0.35	0.018	ND	0.11	0.024	na	na	na	ND	0.097	0.02	na	na	na	na	na	na
Benzo(b)fluoranthene	0.092	0.018	ND	0.11	0.03	na	na	na	ND	0.097	0.025	na	na	na	na	na	na
Benzo(k)fluoranthene	3.7	0.018	ND	0.11	0.027	na	na	na	ND	0.097	0.023	na	na	na	na	na	na
Benzo(a)pyrene	0.014	0.014	ND	0.23	0.022	na	na	na	0.033 J	0.19	0.018	na	na	na	na	na	na
Indeno(1,2,3-cd)pyrene	0.092	0.018	ND	0.11	0.023	na	na	na	ND	0.097	0.019	na	na	na	na	na	na
Dibenzo(a,h)anthracene	7.5	0.018	ND	0.11	0.021	na	na	na	ND	0.097	0.017	na	na	na	na	na	na
Benzo(g,h,i)perylene	0.1	0.1	ND	0.11	0.023	na	na	na	ND	0.097	0.019	na	na	na	na	na	na
Organochlorine Pesticides (ug/L)																	
Aldrin	0.13	0.000026	ND	0.011	0.00068	na	na	na	ND	0.011	0.00064	na	na	na	na	na	na
alpha-BHC	ns	ns	ND	0.011	0.003	na	na	na	ND	0.011	0.0028	na	na	na	na	na	na
beta-BHC	ns	ns	ND	0.023	0.0017	na	na	na	ND	0.021	0.0016	na	na	na	na	na	na
delta-BHC	ns	ns	0.0030 J	0.011	0.00057	na	na	na	ND	0.011	0.00053	na	na	na	na	na	na
gamma-BHC (Lindane)	ns	ns	0.00085 J	0.011	0.00068	na	na	na	ND	0.011	0.00064	na	na	na	na	na	na
4,4'-DDD	0.001	0.00031	ND	0.023	0.00091	na	na	na	ND	0.021	0.00085	na	na	na	na	na	na
4,4'-DDE	0.001	0.0002.2	ND	0.023	0.0013	na	na	na	ND	0.021	0.0012	na	na	na	na	na	na
4,4'-DDT	0.001	0.000008	0.0088 J	0.023	0.0011	na	na	na	ND	0.021	0.0011	na	na	na	na	na	na
Dieldrin	0.0019	0.000025	ND	0.023	0.001	na	na	na	ND	0.021	0.00096	na	na	na	na	na	na
Endosulfan I	0.056	0.0087	ND	0.023	0.00057	na	na	na	ND	0.021	0.00053	na	na	na	na	na	na
Endosulfan II	0.056	0.0087	ND	0.023	0.001	na	na	na	ND	0.021	0.00096	na	na	na	na	na	na
Endosulfan sulfate	ns	ns	ND	0.023	0.00091	na	na	na	ND	0.021	0.00085	na	na	na	na	na	na
Endrin	0.0023	0.0023	0.0012 J	0.023	0.0008	na	na	na	ND	0.021	0.00075	na	na	na	na	na	na
Endrin aldehyde	ns	ns	0.0024 J	0.057	0.0011	na	na	na	0.0013 J	0.053	0.0011	na	na	na	na	na	na
Heptachlor	0.0038	0.0009	0.00069 J	0.011	0.00057	na	na	na	ND	0.011	0.00053	na	na	na	na	na	na
Heptachlor epoxide	0.0038	0.000039	0.0027 J	0.011	0.001	na	na	na	0.0011 J	0.011	0.00096	na	na	na	na	na	na
Methoxychlor	0.03	0.03	ND	0.11	0.0011	na	na	na	ND	0.11	0.0011	na	na	na	na	na	na
Endrin ketone	ns	ns	ND	0.023	0.0008	na	na	na	ND	0.021	0.00075	na	na	na	na	na	na
Toxaphene	0.0002	0.0002	ND	1.1	0.31	na	na	na	ND	1.1	0.29	na	na	na	na	na	na
alpha-Chlordane	ns	ns	ND	0.011	0.00057	na	na	na	ND	0.011	0.00053	na	na	na	na	na	na
gamma-Chlordane	ns	ns	ND	0.011	0.0013	na	na	na	0.0013 J	0.011	0.0012	na	na	na	na	na	na
METALS (mg/L)																	
Arsenic	0.19	0.00014	**0.0032**	0.002	0.00024	na	na	na	**0.0033**	0.002	0.00024	**0.003**	0.002	0.00024	**0.0031**	0.002	0.00024
Cadmium	0.0093	0.003	ND	0.002	0.00014	na	na	na	ND	0.002	0.00014	ND	0.002	0.00014	ND	0.002	0.00014
Chromium	0.074	0.074	0.00052 J	0.002	0.00037	na	na	na	0.00072 J	0.002	0.00037	0.00057 J	0.002	0.00037	0.00045 J	0.002	0.00037
Lead	0.0056	0.0056	0.00027 J	0.002	0.00017	na	na	na	ND	0.002	0.00017	ND	0.002	0.00017	ND	0.002	0.00017
Mercury	0.000025	0.000025	ND	0.00025	0.000041	na	na	na	0.000056 J	0.0002	0.000041	0.000041 J	0.0002	0.000041	0.000084 J	0.0002	0.000041
POLYCHLORINATED BIPHENYLS (ug/L)																	
Aroclor-1016	0.03	0.000079	ND	0.57	0.051	ND	0.51	0.046	ND	0.53	0.048	ND	0.5	0.045	ND	0.47	0.042
Aroclor-1221			ND	0.57	0.071	ND	0.51	0.063	ND	0.53	0.066	ND	0.5	0.061	ND	0.47	0.058
Aroclor-1232			ND	0.57	0.047	ND	0.51	0.042	ND	0.53	0.044	ND	0.5	0.041	ND	0.47	0.039
Aroclor-1242			ND	0.57	0.047	ND	0.51	0.042	ND	0.53	0.044	ND	0.5	0.041	ND	0.47	0.039
Aroclor-1248			ND	0.57	0.081	ND	0.51	0.072	ND	0.53	0.076	ND	0.5	0.07	ND	0.47	0.067
Aroclor-1254			0.4 J	0.57	0.05	0.39 J	0.51	0.045	ND	0.53	0.047	ND	0.5	0.044	ND	0.47	0.042
Aroclor-1260			ND	0.57	0.044	ND	0.51	0.04	ND	0.53	0.042	ND	0.5	0.039	ND	0.47	0.037
Total PCBs			ND						ND			ND			ND		

[1]=HDOH EAL from Table D-4a (Summary of Aquatic Habitiat Goals). All values from chronic aquatic toxicity column.

[2]=HDOH EAL from Table D-2c (Surface Water Action Levels Estuarian Habitats). All values from Final Surface Water Action Level column.

Note: Some action levels are below the laboratory reporting limits. In these cases, the reporting limit is considered the action level, as per HDOH guidance.

Bold - Value Exceeds Reporting Limit

Value Exceeds Regulatory Limit

na-not analyzed

ns - No standard

J- Value is estimated, analyte detected above method detection limit but below the reporting limit

U- The analyte of interest was not detected above the detection limit

B- Compound was found in the laboratory blank and in the sample

Table B-13: Groundwater Sample Analytical Results, Duplicate Comparison, 2008 Investigation, Kure Atoll

SAMPLE ID:	KGW005			KGW006 (Dup of KGW005)			Result < 5 times RL**	RPD Duplicate	RPD Criteria Met***
SAMPLE MATRIX:	Groundwater			Groundwater					
SAMPLE LOCATION:	Piezometer 5			Piezometer 5					
DATE COLLECTED:	10/25/2008			10/25/2008					
ANALYTE	RESULT	RPRTNG LIMIT	DTCN LIMIT	RESULT	RPRTNG LIMIT	DTCN LIMIT			
SVOCs (ug/L)									
Naphthalene	0.051	0.11	0.041	0.056	0.1	0.037	Yes	-9.3457944	Yes
2-Methylnaphthalene	ND	0.15	0.034	0.037	0.13	0.031	Yes	NDC	Yes
1-Methylnaphthalene	ND	0.11	0.014	0.014	0.1	0.012	Yes	NDC	Yes
Acenaphthylene	ND	0.11	0.012	ND	0.1	0.011	Yes	NDC	Yes
Acenaphthene	ND	0.11	0.011	ND	0.1	0.01	Yes	NDC	Yes
Fluorene	ND	0.11	0.014	ND	0.1	0.012	Yes	NDC	Yes
Phenanthrene	ND	0.11	0.012	ND	0.1	0.011	Yes	NDC	Yes
Anthracene	ND	0.11	0.0091	0.0086	0.1	0.0082	Yes	NDC	Yes
Fluoranthene	ND	0.11	0.018	ND	0.1	0.016	Yes	NDC	Yes
Pyrene	ND	0.11	0.019	ND	0.1	0.017	Yes	NDC	Yes
Benzo(a)anthracene	ND	0.11	0.027	ND	0.1	0.025	Yes	NDC	Yes
Chrysene	ND	0.11	0.024	ND	0.1	0.022	Yes	NDC	Yes
Benzo(b)fluoranthene	ND	0.11	0.029	ND	0.1	0.027	Yes	NDC	Yes
Benzo(k)fluoranthene	ND	0.11	0.027	ND	0.1	0.025	Yes	NDC	Yes
Benzo(a)pyrene	ND	0.23	0.022	ND	0.21	0.019	Yes	NDC	Yes
Indeno(1,2,3-cd)pyrene	ND	0.11	0.023	ND	0.1	0.021	Yes	NDC	Yes
Dibenzo(a,h)anthracene	ND	0.11	0.02	ND	0.1	0.018	Yes	NDC	Yes
Benzo(g,g,i)perylene	ND	0.11	0.023	ND	0.1	0.021	Yes	NDC	Yes
Organochlorine Pesticides (ug/L)									
Aldrin	ND	0.012	0.00069	ND	0.011	0.00067	Yes	NDC	Yes
alpha-BHC	ND	0.012	0.003	ND	0.011	0.0029	Yes	NDC	Yes
beta-BHC	0.0088	0.023	0.0017	0.0059	0.022	0.0017	Yes	39.455782	Yes
delta-BHC	ND	0.012	0.00058	ND	0.011	0.00056	Yes	NDC	Yes
gamma-BHC (Lindane)	ND	0.012	0.00069	ND	0.011	0.00067	Yes	NDC	Yes
4,4'-DDD	0.001	0.023	0.00092	ND	0.022	0.00089	Yes	NDC	Yes
4,4'-DDE	ND	0.023	0.0013	ND	0.022	0.0012	Yes	NDC	Yes
4,4'-DDT	ND	0.023	0.0012	ND	0.022	0.0011	Yes	NDC	Yes
Dieldrin	ND	0.023	0.001	0.0015	0.022	0.001	Yes	NDC	Yes
Endosulfan I	ND	0.023	0.00058	ND	0.022	0.00056	Yes	NDC	Yes
Endosulfan II	ND	0.023	0.001	ND	0.022	0.001	Yes	NDC	Yes
Endosulfan sulfate	ND	0.023	0.00092	ND	0.022	0.00089	Yes	NDC	Yes
Endrin	ND	0.023	0.00081	0.0013	0.022	0.00078	Yes	NDC	Yes
Endrin aldehyde	ND	0.058	0.0012	ND	0.056	0.0011	Yes	NDC	Yes
Heptachlor	ND	0.012	0.00058	ND	0.011	0.00056	Yes	NDC	Yes
Heptachlor epoxide	ND	0.012	0.001	ND	0.011	0.001	Yes	NDC	Yes
Methoxychlor	ND	0.12	0.0012	ND	0.11	0.0011	Yes	NDC	Yes
Endrin ketone	ND	0.023	0.00081	ND	0.022	0.00078	Yes	NDC	Yes
Toxaphene	ND	1.2	0.31	ND	1.1	0.3	Yes	NDC	Yes
alpha-Chlordane	0.00087	0.012	0.00058	ND	0.011	0.00056	Yes	NDC	Yes
gamma-Chlordane	ND	0.012	0.0013	ND	0.011	0.0012	Yes	NDC	Yes
METALS (mg/L)									
Arsenic	**0.0033**	0.002	0.00024	**0.0030**	0.002	0.00024	Yes	9.5238095	Yes
Cadmium	ND	0.002	0.00014	ND	0.002	0.00014	Yes	NDC	Yes
Chromium	0.00052	0.002	0.00037	0.00046	0.002	0.00037	Yes	12.244898	Yes
Lead	ND	0.002	0.00017	ND	0.002	0.00017	Yes	NDC	Yes
Mercury	ND	0.0002	0.000041	0.000083	0.0002	0.000041	Yes	NDC	Yes
POLYCHLORINATED BIPHENYLS (ug/L)									
Aroclor-1016	ND	0.58	0.052	ND	0.56	0.05	Yes	NDC	Yes
Aroclor-1221	ND	0.58	0.071	ND	0.56	0.069	Yes	NDC	Yes
Aroclor-1232	ND	0.58	0.047	ND	0.56	0.046	Yes	NDC	Yes
Aroclor-1242	ND	0.58	0.047	ND	0.56	0.046	Yes	NDC	Yes
Aroclor-1248	ND	0.58	0.082	ND	0.56	0.079	Yes	NDC	Yes
Aroclor-1254	ND	0.58	0.051	ND	0.56	0.049	Yes	NDC	Yes
Aroclor-1260	ND	0.58	0.045	ND	0.56	0.043	Yes	NDC	Yes
Total PCBs	ND			ND					

Notes:

**If either the primary sample or duplicate sample is <5 times the RPRTING Limit, the criteria is yes.

***Two precision criteria are discussed in Section 6.3.1.1 of the report. Criteria 1 is used if results are > 5 times the RPRTING Limit, Criteria 2 is used if the results are < 5 times the RPRTING Limit

NDC- no detected concentration in either one or both samples. If concentration is detected in only one sample, detection is lower than 5 times the reporting limit.

Bold - Value Exceeds Reporting Limit

na-not analyzed

ns - No standard

Table B-9: Marine Sediment Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:			KSED-001		KSED-002		KSED-003		KSED-004		KSED-005		KSED-006		KSED-007		KSED-008		KSED-009		KSED-010	
SAMPLE MATRIX:			Marine Sediment		Marine Sediment		Marine Sediment		Marine Sediment		Marine Sediment		Marine Sediment		Marine Sediment		Marine Sediment		Marine Sediment		Marine Sediment	
DEPTH (below ground surface):			Bottom Surface		Bottom Surface		Bottom Surface		Bottom Surface		Bottom Surface		Bottom Surface		Bottom Surface		Bottom Surface		Bottom Surface		Bottom Surface	
DATE COLLECTED:			10/23/2008		10/23/2008		10/23/2008		10/28/2008		10/28/2008		10/28/2008		10/28/2008		10/28/2008		10/28/2008		10/28/2008	
ANALYTE	NOAA NS&T ER-L (mg/kg)[1]	NOAA NS&T ER-M (mg/kg)[2]	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)	RESULT (mg/kg)	RPRT LIMIT (mg/kg)
POLYCHLORINATED BIPHENYLS																						
Aroclor-1016	ns	ns	ND	0.0097	ND	0.0095	ND	0.0095	ND	0.0098	ND	0.0096	ND	0.0094	ND	0.0095	ND	0.0098	ND	0.0098	ND	0.0093
Aroclor-1221	ns	ns	ND	0.0097	ND	0.0095	ND	0.0095	ND	0.0098	ND	0.0096	ND	0.0094	ND	0.0095	ND	0.0098	ND	0.0098	ND	0.0093
Aroclor-1232	ns	ns	ND	0.0097	ND	0.0095	ND	0.0095	ND	0.0098	ND	0.0096	ND	0.0094	ND	0.0095	ND	0.0098	ND	0.0098	ND	0.0093
Aroclor-1242	ns	ns	ND	0.0097	ND	0.0095	ND	0.0095	ND	0.0098	ND	0.0096	ND	0.0094	ND	0.0095	ND	0.0098	ND	0.0098	ND	0.0093
Aroclor-1248	ns	ns	ND	0.0097	ND	0.0095	ND	0.0095	ND	0.0098	ND	0.0096	ND	0.0094	ND	0.0095	ND	0.0098	ND	0.0098	ND	0.0093
Aroclor-1254	ns	ns	ND	0.0097	ND	0.0095	ND	0.0095	ND	0.0098	ND	0.0096	ND	0.0094	ND	0.0095	ND	0.0098	ND	0.0098	ND	0.0093
Aroclor-1260	ns	ns	ND	0.0097	ND	0.0095	ND	0.0095	ND	0.0098	ND	0.0096	ND	0.0094	ND	0.0095	ND	0.0098	ND	0.0098	ND	0.0093
Total PCBs	0.0227	0.18																				
Metals																						
Arsenic	8.2	70	**0.92 B**	0.19	**1.9 B**	0.2	**1.9 B**	0.19	**0.99 B**	0.19	**1 B**	0.19	**1 B**	0.2	**1 B**	0.19	**1.1 B**	0.2	**1.1 B**	0.19	**0.86 B**	0.19
Lead	46.7	218	**0.33 B**	0.19	**0.45 B**	0.2	**0.59 B**	0.19	**0.20 B**	0.19	0.15 J, B	0.19	**0.23 B**	0.2	0.17 J, B	0.19	**0.37 B**	0.2	**1.8 B**	0.19	**0.41 B**	0.19
Cadmium	1.2	9.6	0.054 J, B	0.19	0.043 J, B	0.2	0.040 J, B	0.19	0.032 J, B	0.19	0.038 J, B	0.19	0.039 J, B	0.2	0.036 J, B	0.19	0.053 J, B	0.2	0.049 J, B	0.19	0.049 J, B	0.19
Chromium	81	370	**2.7**	0.19	**3.6**	0.2	**3**	0.19	**2.5**	0.19	**2.9**	0.19	**2.8**	0.2	**2.6**	0.19	**2.1**	0.2	**2.7**	0.19	**1.6**	0.19
Mercury	0.15	0.71	ND	0.018	0.0097 J	0.019	ND	0.019	ND	0.018	ND	0.019	ND	0.019	0.0096 J	0.019	0.0060 J	0.018	ND	0.02	ND	0.019

Bold - Value Exceeds Laboratory Reporting Limit

Bold - Value Exceeds Regulatory Limit

[1]=NOAA Status and Trends, Effects Range Low (concentration above which adverse effects may begin)

[2]=NOAA Status and trends, Effects Range Medium

J- Value is estimated, analyte detected but below the reporting limit

B- Compound was found in the laboratory blank and the sample

Table B-10: Biota Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:	KBI-001		KBI-002		KBI-003		KBI-004		KBI-005		KBI-006	
SAMPLE MATRIX:	Biota		Biota		Biota		Biota		Biota		Biota	
BIOTA TYPE:	Convict Tang		Convict Tang		Convict Tang		Convict Tang		Goatfish		Goatfish	
DATE COLLECTE	10/21/2008		10/21/2008		10/21/2008		10/21/2008		10/22/2008		10/22/2008	
SAMPLE TYPE:	Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish	
ANALYTE	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)
POLYCHLORINATED BIPHENYL CONGENERS												
PCB 8 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 18 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 28 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 44 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 49 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 52 (BZ)	2.2	2	1.3	2	ND	2	ND	2	1.2	1.9	ND	2
PCB 66 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 77 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 81 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 87 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 101 (BZ)	ND	2	0.73	2	ND	2	ND	2	1.3	1.9	ND	2
PCB 105 (BZ)	1.8	2	2.5	2	ND	2	ND	2	3.8	1.9	3.3	2
PCB 114 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 118 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 123 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	0.51	2
PCB 126 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 128 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 138 (BZ)	2.3	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 153 (BZ)	4.2	2	5.6	2	1.6	2	1.2	2	12	1.9	8.9	2
PCB 156 (BZ)	ND	2	ND	2	ND	2	ND	2	1.9	1.9	1.4	2
PCB 157 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 167 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 169 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 170 (BZ)	ND	2	0.88	2	ND	2	ND	2	0.99	1.9	0.89	2
PCB 180 (BZ)	0.84	2	2	2	ND	2	ND	2	2.2	1.9	2	2
PCB 183 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 184 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 187 (BZ)	ND	2	2	2	ND	2	ND	2	ND	1.9	ND	2
PCB 189 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 195 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 206 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
PCB 209 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	1.9	ND	2
percent lipids	4.3	0.1	4.3	0.1	4.9	0.1	2.9	0.1	6.6	0.1	1.8	0.1
Sum PCBs	**22.68**		**30.02**		**3.2**		**2.4**		**42.98**		**30.18**	

Bold - Value Exceeds Reporting Limit

Sum PCBs based on sum of NOAA 18 congeners multiplied by 2

BZ#170 - NOAA 18 Congener (included in PCB sum)

J- Value is estimated, analyte detected but below the reporting limit

U- The analyte of interest was not detected above the detection limit

B- Value greater than detection limit but less than reporting limit

P- Greater than 40% difference for detected concentrations between two GC columns. Higher of the two values is reported.

Table B-10: Biota Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:	KBI-007		KBI-008		KBI-009		KBI-010		KBI-011		KBI-012	
SAMPLE MATRIX:	Biota		Biota		Biota		Biota		Biota		Biota	
BIOTA TYPE:	Goatfish		Goatfish		Convict Tang		Convict Tang		Goatfish		Convict Tang	
DATE COLLECTE	10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008	
SAMPLE TYPE:	Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish	
ANALYTE	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)
POLYCHLORINATED BIPHENYL CONGENERS												
PCB 8 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 18 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 28 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 44 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 49 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 52 (BZ)	ND	2	ND	2	ND	2	ND	2	1.2	2	1.3	2
PCB 66 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 77 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 81 (BZ)	ND	2	ND	2	ND	2	ND	2	0.41	2	ND	2
PCB 87 (BZ)	ND	2	0.87	2	ND	2	2.2	2	1.3	2	1.2	2
PCB 101 (BZ)	1.1	2	ND	2	1.5	2	2.2	2	2	2	1.6	2
PCB 105 (BZ)	2.7	2	3.4	2	1.1	2	2.1	2	5.6	2	2.5	2
PCB 114 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 118 (BZ)	ND	2	ND	2	1.7	2	1.7	2	ND	2	ND	2
PCB 123 (BZ)	0.91	2	0.76	2	ND	2	ND	2	ND	2	ND	2
PCB 126 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 128 (BZ)	ND	2	ND	2	ND	2	ND	2	1.2	2	ND	2
PCB 138 (BZ)	ND	2	ND	2	ND	2	ND	2	11	2	ND	2
PCB 153 (BZ)	7.2	2	7	2	3.1	2	6.2	2	17	2	8.6	2
PCB 156 (BZ)	ND	2	1.1	2	ND	2	ND	2	2.9	2	ND	2
PCB 157 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 167 (BZ)	0.59	2	0.54	2	ND	2	ND	2	1.2	2	0.42	2
PCB 169 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 170 (BZ)	0.93	2	1.1	2	ND	2	ND	2	2.7	2	ND	2
PCB 180 (BZ)	1.9	2	ND	2	ND	2	ND	2	4.3	2	2.4	2
PCB 183 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 184 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 187 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 189 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 195 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 206 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 209 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
percent lipids	1.2	0.1	0.94	0.1	3.8	0.1	3.1	0.1	1.5	0.1	3	0.1
Sum PCBs	**27.66**		**23**		**14.8**		**24.4**		**90**		**32.8**	

Bold - Value Exceeds Reporting Limit

Sum PCBs based on sum of NOAA 18 congeners multiplied by 2

BZ#170 - NOAA 18 Congener (included in PCB sum)

J- Value is estimated, analyte detected but below the reporting limit

U- The analyte of interest was not detected above the detection limit

B- Value greater than detection limit but less than reporting limit

P- Greater than 40% difference for detected concentrations between two GC columns. Higher of the two values is reported.

Table B-10: Biota Sample Analytical Results, 2008 Investigation, Kure Atoll

SAMPLE ID:	KBI-013		KBI-014		KBI-015		KBI-016		KBI-017		KBI-018	
SAMPLE MATRIX:	Biota		Biota		Biota		Biota		Biota		Biota	
BIOTA TYPE:	Convict Tang		Surgeon Fish		Convict Tang		Convict Tang		Goatfish		Surgeon Fish	
DATE COLLECTE	10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008	
SAMPLE TYPE:	Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish	
ANALYTE	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)	RESULT (ug/kg)	RPRTING LIMIT (ug/kg)
POLYCHLORINATED BIPHENYL CONGENERS												
PCB 8 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 18 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 28 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 44 (BZ)	ND	2	1.4	2	ND	2	ND	2	1.2	2	1	2
PCB 49 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 52 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 66 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 77 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 81 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 87 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 101 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 105 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 114 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 118 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 123 (BZ)	ND	2	1.2	2	ND	2	ND	2	ND	2	1.3	2
PCB 126 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 128 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 138 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 153 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 156 (BZ)	ND	2	ND	2	ND	2	1.4	2	ND	2	ND	2
PCB 157 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 167 (BZ)	ND	2	0.63	2	ND	2	0.64	2	0.7	2	ND	2
PCB 169 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 170 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 180 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 183 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 184 (BZ)	ND	2	ND	2	ND	2	2.2	2	ND	2	ND	2
PCB 187 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 189 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	0.49	2
PCB 195 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 206 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
PCB 209 (BZ)	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
percent lipids	2.5	0.1	0.68	0.1	3.8	0.1	3.6	0.1	1	0.1	2.1	0.1
Sum PCBs	0		**2.8**		0		0		**2.4**		**2**	

Bold - Value Exceeds Reporting Limit

Sum PCBs based on sum of NOAA 18 congeners multiplied by 2

BZ#170 - NOAA 18 Congener (included in PCB sum)

J- Value is estimated, analyte detected but below the reporting limit

U- The analyte of interest was not detected above the detection limit

B- Value greater than detection limit but less than reporting limit

P- Greater than 40% difference for detected concentrations between two GC columns. Higher of the two values is reported.

Table B-11: Biota Sample Analytical Results, Area Comparison, 2008 Investigation, Kure Atoll

SMD BIOTA				SOUTH POINT BIOTA				NORTH POINT BIOTA				All BIOTA DATA				SMD AND SOUTH POINT DATA			
SAMPLE ID	DATE COLLECTED	BIOTA TYPE	TOTAL PCBS (ug/kg)	SAMPLE ID	DATE COLLECTED	BIOTA TYPE	TOTAL PCBS (ug/kg)	SAMPLE ID	DATE COLLECTED	BIOTA TYPE	TOTAL PCBS (ug/kg)	SAMPLE ID	DATE COLLECTED	BIOTA TYPE	TOTAL PCBS (ug/kg)	SAMPLE ID	DATE COLLECTED	BIOTA TYPE	TOTAL PCBS (ug/kg)
KBI-001	10/21/2008	Convict Tang	**22.68**	KBI-007	10/22/2008	Goatfish	**27.66**	KBI-013	10/23/2008	Convict Tang	0	KBI-001	10/21/2008	Convict Tang	**22.68**	KBI-001	10/21/2008	Convict Tang	**22.68**
KBI-002	10/21/2008	Convict Tang	**30.02**	KBI-008	10/22/2008	Goatfish	**23**	KBI-014	10/23/2008	Surgeon Fish	**2.8**	KBI-002	10/21/2008	Convict Tang	**30.02**	KBI-002	10/21/2008	Convict Tang	**30.02**
KBI-003	10/21/2008	Convict Tang	**3.2**	KBI-009	10/22/2008	Convict Tang	**14.8**	KBI-015	10/23/2008	Convict Tang	0	KBI-003	10/21/2008	Convict Tang	**3.2**	KBI-003	10/21/2008	Convict Tang	**3.2**
KBI-004	10/21/2008	Convict Tang	**2.4**	KBI-010	10/22/2008	Convict Tang	**24.4**	KBI-016	10/23/2008	Convict Tang	0	KBI-004	10/21/2008	Convict Tang	**2.4**	KBI-004	10/21/2008	Convict Tang	**2.4**
KBI-005	10/22/2008	Goatfish	**42.98**	KBI-011	10/22/2008	Goatfish	**90**	KBI-017	10/23/2008	Goatfish	**2.4**	KBI-005	10/22/2008	Goatfish	**42.98**	KBI-005	10/22/2008	Goatfish	**42.98**
KBI-006	10/22/2008	Goatfish	**30.18**	KBI-012	10/22/2008	Convict Tang	**32.8**	KBI-018	10/23/2008	Surgeon Fish	**2**	KBI-006	10/22/2008	Goatfish	**30.18**	KBI-006	10/22/2008	Goatfish	**30.18**
												KBI-007	10/22/2008	Goatfish	**27.66**	KBI-007	10/22/2008	Goatfish	**27.66**
Mean PCB Concentration			**21.91**	**Mean PCB Concentration**			**35.44**	**Mean PCB Concentration**			**1.2**	KBI-008	10/22/2008	Goatfish	**23**	KBI-008	10/22/2008	Goatfish	**23**
												KBI-009	10/22/2008	Convict Tang	**14.8**	KBI-009	10/22/2008	Convict Tang	**14.8**
												KBI-010	10/22/2008	Convict Tang	**24.4**	KBI-010	10/22/2008	Convict Tang	**24.4**
												KBI-011	10/22/2008	Goatfish	**90**	KBI-011	10/22/2008	Goatfish	**90**
												KBI-012	10/22/2008	Convict Tang	**32.8**	KBI-012	10/22/2008	Convict Tang	**32.8**
												KBI-013	10/23/2008	Convict Tang	0				
												KBI-014	10/23/2008	Surgeon Fish	**2.8**	**Mean PCB Concentration**			**28.68**
												KBI-015	10/23/2008	Convict Tang	0				
												KBI-016	10/23/2008	Convict Tang	0				
												KBI-017	10/23/2008	Goatfish	**2.4**				
												KBI-018	10/23/2008	Surgeon Fish	**2**				
												Mean PCB Concentration			**19.52**				

Bold - Value Exceeds Reporting Limit

Sum PCBs based on sum of NOAA 18 congeners multiplied by 2

Table B-12: Biota Sample Analytical Results-Metals, 2008 Investigation, Kure Atoll

SAMPLE ID:	KBI-001		KBI-002		KBI-003		KBI-004		KBI-005		KBI-006	
SAMPLE MATRIX:	Biota		Biota		Biota		Biota		Biota		Biota	
BIOTA TYPE:	Convict Tang		Convict Tang		Convict Tang		Convict Tang		Goatfish		Goatfish	
DATE COLLECTE	10/21/2008		10/21/2008		10/21/2008		10/21/2008		10/22/2008		10/22/2008	
SAMPLE TYPE:	Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish	
ANALYTE	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)
METALS												
Arsenic	**0.81**	0.1	**0.6**	0.1	**0.63**	0.1	**0.68**	0.1	**17.4**	0.1	**21.5**	0.1
Cadmium	**0.32**	0.1	**0.26**	0.1	**0.37**	0.1	0.07	0.1	0.015	0.1	0.038	0.1
Chromium	**0.92**	0.2	**0.99**	0.2	**1.1**	0.2	**1**	0.2	**0.87**	0.2	**0.92**	0.2
Lead	0.07	0.1	0.048	0.1	0.061	0.1	0.042	0.1	0.049	0.1	0.019	0.1
Mercury	0.013	0.033	0.015	0.033	0.021	0.033	0.011	0.033	**0.044**	0.033	**0.034**	0.033

SAMPLE ID:	KBI-007		KBI-008		KBI-009		KBI-010		KBI-011		KBI-012	
SAMPLE MATRIX:	Biota		Biota		Biota		Biota		Biota		Biota	
BIOTA TYPE:	Goatfish		Goatfish		Convict Tang		Convict Tang		Goatfish		Convict Tang	
DATE COLLECTE	10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008		10/22/2008	
SAMPLE TYPE:	Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish	
ANALYTE	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)
METALS												
Arsenic	**18.4**	0.1	**10.6**	0.1	**0.78**	0.1	**0.59**	0.1	**8**	0.1	**0.78**	0.1
Cadmium	ND	0.1	ND	0.1	**0.21**	0.1	**0.3**	0.1	0.049	0.1	**0.23**	0.1
Chromium	**0.93**	0.2	**0.79**	0.2	**1.1**	0.2	**1.1**	0.2	**1.1**	0.2	**1.1**	0.2
Lead	**0.16**	0.1	0.037	0.1	**0.1**	0.1	**0.15**	0.1	**0.22**	0.1	**0.13**	0.1
Mercury	0.017	0.033	0.026	0.033	0.014	0.033	0.019	0.033	0.028	0.033	0.0083	0.033

SAMPLE ID:	KBI-013		KBI-014		KBI-015		KBI-016		KBI-017		KBI-018	
SAMPLE MATRIX:	Biota		Biota		Biota		Biota		Biota		Biota	
BIOTA TYPE:	Convict Tang		Surgeon Fish		Convict Tang		Convict Tang		Goatfish		Surgeon Fish	
DATE COLLECTE	10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008		10/23/2008	
SAMPLE TYPE:	Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish		Whole Fish	
ANALYTE	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)	RESULT (mg/kg)	RPRTING LIMIT (mg/kg)
METALS												
Arsenic	**0.85**	0.1	**1.7**	0.1	**2**	0.1	**0.87**	0.1	**10**	0.1	**3**	0.1
Cadmium	**0.38**	0.1	**0.12**	0.1	**0.24**	0.1	**0.36**	0.1	ND	0.1	0.074	0.1
Chromium	**1.1**	0.2	**0.96**	0.2	**1.1**	0.2	**1**	0.2	**0.82**	0.2	**0.74**	0.2
Lead	0.041	0.1	0.015	0.1	**0.11**	0.1	0.053	0.1	0.036	0.1	0.016	0.1
Mercury	0.012	0.033	**0.037**	0.033	0.012	0.033	0.015	0.033	0.013	0.033	0.035	0.033

Bold - Value Exceeds Reporting Limit

J- Value is estimated, analyte detected but below the reporting limit

U- The analyte of interest was not detected above the detection limit

B- Value greater than detection limit but less than reporting limit

P- Greater than 40% difference for detected concentrations between two GC columns. Higher of the two values is reported.

Appendix C

Draft Investigation Scale Evaluation of Multi-Incremental Sampling Methodology

Investigation Scale Evaluation of Multi-Incremental Sampling Methodology

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Abstract A series of discrete and multi-incremental (MI) samples were collected from a 5- and 10-foot spaced sampling grid established within a former landfill located on Kure Atoll, Northwest Hawaiian Islands. A total of 712 soils samples were collected from three decision units established at three depths (~4 inches bgs, 28-36 inches bgs, and 48-60 inches bgs) within the 170 foot by 80 foot landfill, which is also known as the Scrap Metal Dump (SMD). These samples were analyzed in the field for total polychlorinated biphenyl (PCB) concentration using a quantitative, immunoassay-based method. Subsequent analyses of 70 field duplicates at an analytical laboratory confirmed the accuracy of the field PCB results. The mean PCB concentration measured in the grid samples collected from the shallow, intermediate and deep decision units were 0.47, 0.84 and 31.9 mg/kg respectively. Much of the contamination in the lower portions of the SMD landfill is present in isolated "nuggets" of very high levels of PCB, with detected maximum PCB concentrations reaching 3,668 mg/kg in the deep decision unit soils. The fine grain soil fraction contains roughly 20 times the PCB concentration present in the coarse grain fraction of the landfill soils.

Because each sub-sample used to create the five MI samples generated for the landfill were analyzed in the field, the resulting analytical data set allowed a comparison of the PCB concentration measured in the MI samples with the mean PCB concentrations measured in all of the corresponding sub-samples used to create the MI sample. Analysis of the data showed that the MI samples accurately reflected the mean PCB concentration present in the landfill despite the heterogeneous, log-normal distribution of PCB present in the medium to coarse grained coralline derived sands. This result is due in part to the post-sampling homogenization processing performed on the MI sample in the laboratory prior to sub-sampling, extraction and analysis.

A Monte-Carlo analysis was conducted on the field PCB data collected to simulate the range in PCB concentrations that would have been determined using a traditional Remedial Investigation (RI) approach involving the collection of eight (8) soil samples from within the SMD. This analysis found that in the deep soils, the standard RI approach would have yielded a false negative result (i.e. greatly underestimated the PCB concentration present in this decision unit) with respect to the Department of Health regulatory limit 44% of the time. This analysis also found that 7 to 15% of the time the RI sampling approach would not have detected any PCB contamination at levels above the field analysis detection limit (0.25 mg/kg) in the decision unit soils.

Key words: multi-incremental sampling, PCB contamination, landfill

INTRODUCTION

An environmental investigation was conducted at the former LORAN Station at Kure Atoll (Figure 1) by consultants from Element Environmental (E2) and Coast Guard personnel from the Civil Engineering Unit Honolulu. Field personnel flew to Midway from Honolulu on October 17 and were transported to Kure by the Coast Guard buoys tender *Kukui* on October 20, 2008. Field work was conducted on Kure Atoll from October 20 to 29, 2008. The *Kukui* transported the field personnel back to Midway on the afternoon of October 29.

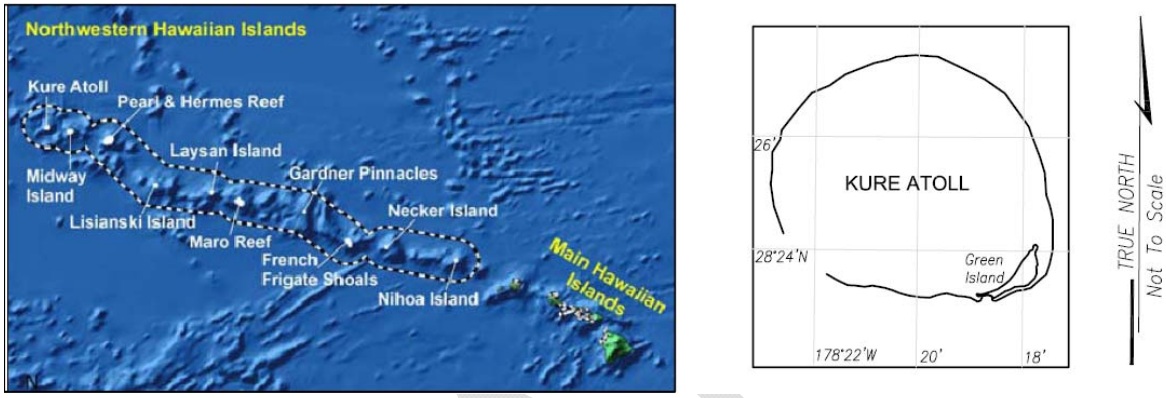


FIGURE 1: Location of Kure Atoll

The focus of the investigation involved conducting extensive grid sampling at the former Scrap Metal Dump (SMD) landfill located on the south-western end of the main island on the atoll, Green Island. Sieve analysis of the impacted soils collected from the SMD indicate that the landfill soils are dominated by medium to coarse grain sands, with 50 to 85 weight% of the material in the SMD being coarser than a #60 sieve and finer than a #10 sieve (Table 1).

TABLE 1: Grain Size Analysis on Seven Soils Recovered from the SMD Landfill

Soil Description	Grain Size (mm)	Sieve Size	Sample ID / Weight Percent of Soil Size Fraction						
			3-25,90	3-65,80	3-25,95	2-10,170	2-25,95	1-0,50	2,0-50
Fine Gravel	>4	#5	14.5%	6.3%	13.1%	4.6%	12.0%	26.7%	0.6%
Very Fine Gravel	>2	#10	22.2%	8.9%	19.0%	19.7%	11.2%	10.6%	5.2%
Medium to Coarse Sand	>0.25	#60	63.2%	82.6%	65.7%	72.5%	68.1%	50.4%	84.8%
Fine Sand	>0.063	#230	0.0%	2.2%	2.2%	3.3%	8.8%	12.3%	9.5%
Silt	< 0.063	Finer	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%

The origin of the sampling grid (coordinate 0/0) was established just to the lagoon side of the six-inch diameter fuel pipeline that is exposed at the vegetation line just inland of the beach on Green Island (GPS coordinate of origin 28.38729N/178.30365W). The grid was extended 170 feet in the direction of the fuel pipeline (roughly parallel to the orientation of the overgrown runway) and 80 feet in the direction of the lagoon.

Sampling nodes were established with 10 foot spacing by placing flags at each location. Soil samples were collected at each nodal grid from four-inches below ground surface (bgs) (Decision Unit 11) and from 28 to 36 inches bgs (Decision Unit 12) by hand digging pits in the sand and scrapping approximately 200 grams of soil into a labelled ziplock bag from these respective depths using a sampling trowel. The deepest soil samples (Decision Unit 13) were collected from 48 to 60 inches bgs by hand-driving a Lucite lined sampler from the base of the dug pit at each sampling node to five feet bgs. The samples collected from the 10-foot spaced sampling grid were analyzed on Kure for their PCB content using Ensys immunoassay test kits. The PCB concentration data determined from the 10-foot spaced samples were used to delineate a hot-spot area within the SMD where elevated concentration levels of PCB soil contamination exist. A five-foot sampling grid was then established within this PCB "hot-spot" sub-area. The location of the 50-foot by 40-foot "hot-spot" area within the sampling grid is illustrated in Figure 2 below. The contours in this figure delineate areas containing soils with concentrations in excess of 1 mg/kg (light blue) to 4 mg/kg PCB (yellow).

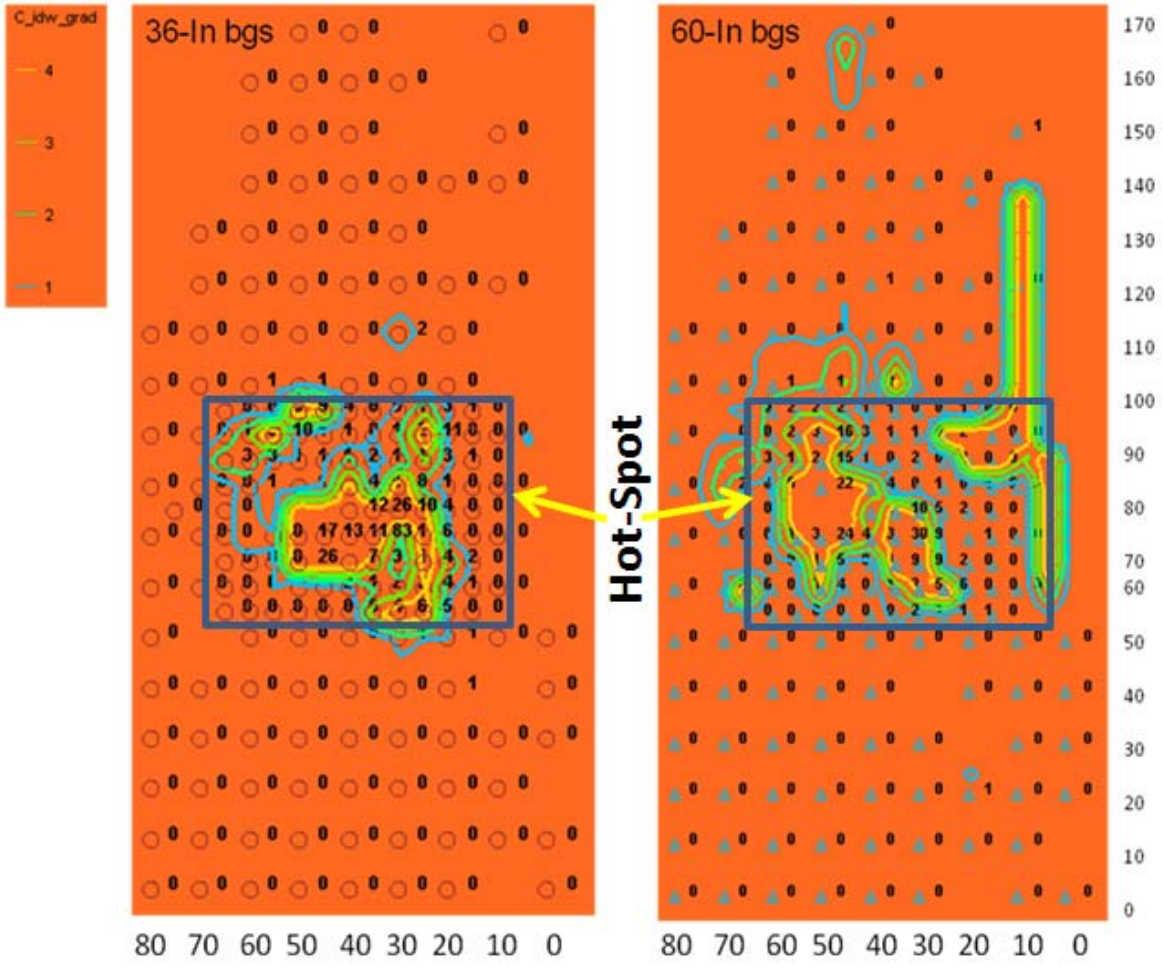


FIGURE 2: Grid Sample Nodes at SMD and Delineated PCB Hot Spot at 36 and 60 Inches Depth

A total of 712 individual PCB analyses were conducted during the course of the field investigation, including field duplicates and dilution samples. A total of 151, 124 and 121 nodal samples were collected from the three depth intervals sampled within the initial 10-foot grid established within the landfill. A summary of the field and MI sample data collected from the 10-foot grid is summarized in Table 2.

TABLE 2: Field and MI Sample PCB Results Obtained on 10-Foot Grid Samples

Soil Sample Location	Number of Samples	Max PCB	Field Data		Lab Data	
			Individual MI Grid Sample Result		Laboratory Data [Aroclor 1254]	Laboratory Data [Aroclor 1260]
			Mean of All Results	95% UCL of All Results		
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
DU11: 4-Inch bgs SMD	151	22.7	0.47	0.79	0.35	
DU12: 30-36 Inches bgs SMD	124	19.8	0.84	1.34	1.53	2.53
DU13: 48-60 Inches bgs SMD	121	3,667	31.93	91.3		40
DU14: Duplicate of DU13 Sample						36.4
DU15: Duplicate of DU13 Sample						33.6

The laboratory PCB results indicate that the shallow landfill soils (~4 inches bgs) are contaminated with Aroclor 1254 while the deepest impacted soils (48 to 60 inches bgs) are contaminated with Aroclor 1260. The intermediate depth soils (28 to 36 inches bgs) are contaminated with both Aroclor 1254 and 1260. The distribution of PCB concentrations measured in the deep Decision Unit (DU13) soils is highly skewed with a log-normal distribution. Detectable levels of PCB were detected in 43% of the grid points sampled from this deep decision unit. Figure 3 shows the distribution of the detected PCB concentrations in the shallow and deep landfill soils. These types of contaminant distribution are relatively common at environmental sites containing both organic and inorganic (i.e. metals) contamination.

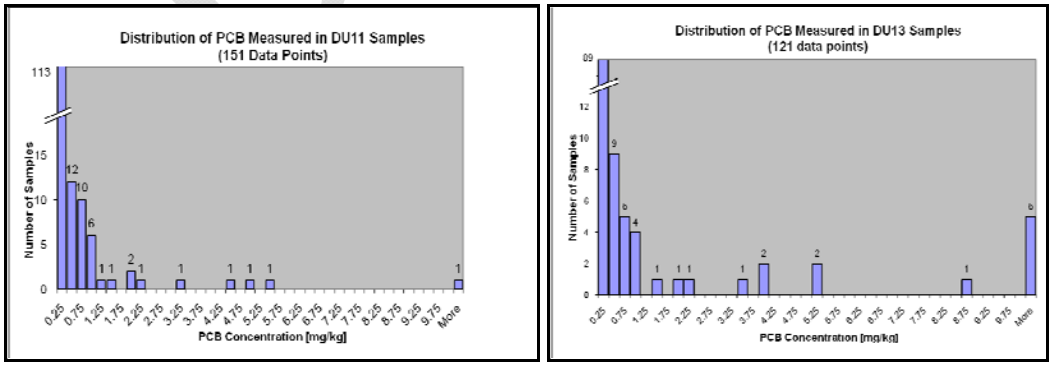


FIGURE 3: Skewed, Log-Normal Soil PCB Concentrations Present in DU11 and DU13 Soils

The two MI samples collected from the intermediate and deep depths within the hot-spot were sieved into four separate grain size fractions which were then analyzed for PCB content in the laboratory. The highest concentration levels of PCB are concentrated in the finer grained fractions of the impacted landfill soils. The fine to coarse gravel fraction of the two hot-spot MI samples contained between 2 to 4 mg/kg PCBs while the fine grain (<0.063 mm; >#230 sieve) silt size fraction contained between 73 to 82 mg/kg PCBs (Table 3).

TABLE 3: PCB Concentration in Various Grain Size Fractions in Hot Spot Soils

Soil Sample Location	Number of Samples	Max PCB	Field Data		Lab Data	
			Individual MI Grid Sample Result			
			Mean of All Results	95% UCL of All Results	Laboratory Data [Aroclor 1254]	Laboratory Data [Aroclor 1260]
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
DU16 DU12 Hot Spot Area	103	620	10.26	24.5	3.88 (> #10)	
					14.1 (> #60)	
					25.8 (> #230)	
					72.7 (Fine)	
DU17 DU13 Hot Spot Area	96	3,667	41.76	98.2	2.31 (> #10)	
						33.2 (> #60)
						44.7 (> #230)
						81.6 (Fine)

FIELD DATA UNCERTAINTY ANALYSIS

The precision of the immunoassay analytical method used on Kure was evaluated by analyzing 19 field duplicates during the course of the field investigation. These duplicate analyses typically involved re-analyzing a field sample extract in separate analytical runs. The duplicate analysis results indicate that the analytical uncertainty related to analysis of the soil samples using the immunoassay method is on the order of 6.5%.

The accuracy of the immunoassay method was evaluated by analyzing splits of 70 field samples at Test America-Tacoma to confirm the immunoassay PCB results obtained in the field. In the laboratory, the concentration of PCB in soils was determined using EPA Method 8082. The immunoassay method is based upon quantification of Aroclor 1254 and has a "reactivity factor" of 1.56 for Aroclor 1260. Many of the samples analyzed by the analytical laboratory yielded PCB concentration values as both Aroclor 1254 and Aroclor 1260. No attempt was made to adjust the field PCB concentration based upon the Aroclor type identified in the associated laboratory field duplicate sample.

The agreement of the field and laboratory PCB results was evaluated based upon the relative percent difference of the field/lab sample results, which is calculated as follows:

Relative Percent Difference (RPD) = $[X_1 - X_2]/X_{ave} \times 100$

where:

X_1 = PCB concentration measured using the immunoassay method;

X_2 = PCB concentration measured in the laboratory using USEPA Method 8082; and

X_{ave} = average PCB concentration measured in field and laboratory = $((X_1 + X_2) / 2)$

The agreement between the lab and field data were evaluated using the following criteria:

- For soil samples with PCB concentrations greater than five times the immunoassay method detection limit (0.25 mg/kg), the field duplicate sample results should agree within 50 percent.
- For soil samples where either or both sample concentrations are less than five times the analytical reporting limit, duplicate soil sample concentrations should agree within five times the reporting limit.

Based upon the criteria described above, the field immunoassay and laboratory PCB data agreed in 62 out of 70 (89%) duplicate sample pairs.

MI SAMPLE ANALYSIS

The State of Hawaii Department of Health has recently embraced the method of evaluating the magnitude of contamination (and associated risk to human health) present at a project site by collecting MI samples from delineated "Decision Units" within the site. MI sampling involves collecting a representative portion of soil from within a designated decision unit. The MI sample is created in the field by combining several sub-samples of soil (typically a minimum of 30 samples) from each decision unit. The MI sample is further homogenized during processing at the analytical laboratory to assure extraction and analysis of a representative aliquot of soil. The procedures for collection, processing and analysis of MI samples are specifically designed to minimize the sampling error due to spatial and compositional heterogeneity at a project site with the ultimate goal of efficiently obtaining a "representative" mean contaminant concentration for the Decision Unit.

Proponents of MI sampling have asserted the following advantages for this sampling and characterization approach:

- The method is particularly useful as an initial screen for sites with little to no information regarding historic use.
- MI sampling can be very effective for the determination of a "representative" arithmetic mean of constituents that exhibit a high degree of spatial/distributional heterogeneity in the sampled matrix.
- Fewer samples are sent to the analytical laboratory for analysis, resulting in a reduction in analytical costs.

IMPACT OF HOMOGENIZATION OF MI SAMPLE PRIOR TO ANALYSIS

A critical step in the production of a representative MI sample is the post-processing of the sample collected in the field, which is typically conducted in the laboratory prior to

extraction and analysis of a sub-sample of the submitted MI sample. In the laboratory, the MI sample is further homogenized by first drying the sample, passing the dried sample through a 2mm sieve (the coarse grain fraction retained in the sieve is discarded), and spreading out the sieved sample to a constant depth onto a tray. A rectangular metal scoop is then used to collect thirty separate one gram aliquots from the tray in a stratified random manner. An alternative homogenization method involves use of a rotary sample splitter to split and sub-sample the MI sample collected in the field. The representative sub-sample produced from the original MI sample using these methods is then extracted for PCB analysis.

A sub-sample was collected of each MI sample in the field and this sub-sample was then analyzed in triplicate using the immunoassay method. Due to the lack of splitting and mechanical homogenization equipment on Kure, the methodology used to homogenize the sub-sample analyzed in the field was not as rigorous as the methodology employed at the commercial laboratory. The average resulting RPD between the field MI sample results and the average PCB results obtained on all individual grid samples within a decision unit using the immunoassay method was relatively high at 62% (Table 4). In comparison, the average PCB concentration measured using the immunoassay method for all the nodal point samples from each decision unit compared relatively well (RPD = 20%) with the associated laboratory PCB result for the corresponding MI sample. This lower RPD is believed to reflect the improved characterization of the sample analyzed at the laboratory resulting from the more effective homogenization of the sub-sample created for extraction and analysis in the laboratory.

TABLE 4: Relative Percent Difference of Mean of Individual Decision Unit Analyses and Corresponding MI Sample Result

Average Immunoassay MI Sample Result	Average Individual Immunoassay Sample Results	Relative Percent Difference
0.86	0.47	35.6%
2.38	0.84	55.0%
9.09	31.93	91.1%
13.59	10.26	17.8%
9.2	41.76	108.2%
	Average RPD	**61.6%**
Average Laboratory MI Sample Result	**Average Individual Immunoassay Sample Results**	**Relative Percent Difference**
0.35	0.47	20.5%
1.53	0.84	35.4%
36.67	31.93	9.0%
14.1	10.26	20.0%
33.2	41.76	15.8%
	Average RPD	**20.1%**

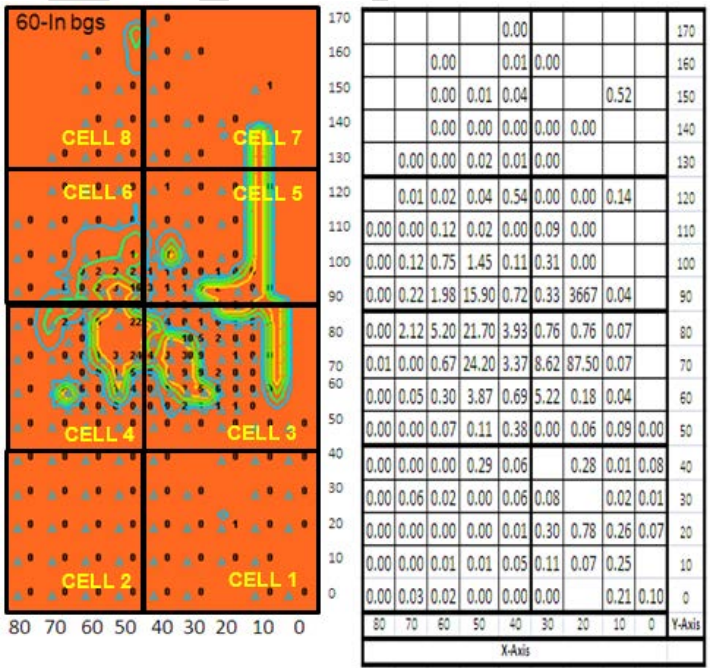
In addition, the results obtained on the triplicate MI samples collected from the deep (48 to 60 inches bgs) 10-foot sampling grid (40.0, 36.4 and 33.6 mg/kg; average

RPD=11.6%; Table 2) showed that the homogenization procedures used in preparing the MI samples in the laboratories for analysis were successful at reducing the measured variability of PCBs in these three separate MI samples to the level of analytical uncertainty (±10%) that is typically associated with PCB analyses at commercial laboratories (Marvin Heskett-Test America, personal communication).

COMPARISON OF MI AND DISCRETE SAMPLING RESULTS

The State of Hawaii Department of Health (HDOH) has proposed that the MI sampling approach be used as an initial screening of potentially contaminated sites where the objective is to determine the mean level of contamination present. The MI sample results obtained for a delineated decision unit are then compared to default regulatory standards, such as the Hawaii Department of Health Environmental Action Levels (EAL) or the Environmental Protection Agency Regional Screening Levels (RSL), to determine whether additional characterization or remediation of the decision unit is required to be protective of human health. The 95% Upper Confidence Level (UCL) of the data set is the statistical parameter that is typically compared to the regulatory action level.

A Monte-Carlo simulation was performed on the PCB data collected from the three 10-foot grid decision units within the SMD. This analysis was performed to compare the MI sampling result with the range in mean and 95% UCL PCB concentrations obtained by randomly selecting measured field grid point PCB results from eight separate sub-cells established within the investigation area (Figure 4). This analysis assumes that a typical initial remedial investigation (RI) of a landfill the size of the SMD would involve collection of surface and sub-surface samples at eight discrete locations spread across the estimated lateral extent of the landfill.



				0.00					170
		0.00		0.01	0.00				160
		0.00	0.01	0.04			0.52		150
		0.00	0.00	0.00	0.00	0.00			140
	0.00	0.00	0.02	0.01	0.00				130
	0.01	0.02	0.04	0.54	0.00	0.00	0.14		120
0.00	0.00	0.12	0.02	0.00	0.09	0.00			110
0.00	0.12	0.75	1.45	0.11	0.31	0.00			100
0.00	0.22	1.98	15.90	0.72	0.33	3667	0.04		90
0.00	2.12	5.20	21.70	3.93	0.76	0.76	0.07		80
0.01	0.00	0.67	24.20	3.37	8.62	87.50	0.07		70
0.00	0.05	0.30	3.87	0.69	5.22	0.18	0.04		60
0.00	0.00	0.07	0.11	0.38	0.00	0.06	0.09	0.00	50
0.00	0.00	0.00	0.29	0.06		0.28	0.01	0.08	40
0.00	0.06	0.02	0.00	0.06	0.08		0.02	0.01	30
0.00	0.00	0.00	0.00	0.01	0.30	0.78	0.26	0.07	20
0.00	0.00	0.01	0.01	0.05	0.11	0.07	0.25		10
0.00	0.03	0.02	0.00	0.00	0.00		0.21	0.10	0
80	70	60	50	40	30	20	10	0	Y-Axis

FIGURE 4: Sub-Division of SMD Landfill into Eight Discrete Sampling Areas

A total of 1,000 individual simulations were performed on the field data collected from each decision unit. During each simulation, a PCB value from each of the eight cells was randomly selected and the mean and 95% UCL value of the resulting combined data set determined. The results of this analysis for the three decision units are summarized in Table 5 below.

TABLE 5: Summary of Monte Carlo Analysis Results

Monte Carlo Analysis Results (1000 trials)	Shallow Soils: DU11	Intermediate Soils: DU12	Deep Soils: DU13
Mean of Monte Carlo Simulated Means (mg/kg)	0.45	0.84	33.62
Field Measured Mean (mg/kg)	0.47	0.84	31.93
Field Measured 95% UCL (mg/kg)	0.79	1.34	91.3
Percentage of Simulated RI 95% UCL Results Above UCL (1.1 mg/kg)	25.1%	45.8%	56.1%
Percentage of Simulated RI 95% UCL Results Below UCL (1.1 mg/kg)	74.9%	54.2%	43.9%
Percentage All Eight Randomly Selected RI Results Below Analytical Detection Level of 0.25 mg/kg	10.8%	15.2%	6.8%

The frequency of time that the traditional RI sampling approach evaluated in this Monte Carlo analysis led to an incorrect conclusion was evaluated by determining the frequency of false positive and negative EAL results obtained for the DU11 and DU13 soils, respectively. The MI and discrete soil sampling results obtained from the DU11 soils indicate that the mean and 95% UCL PCB concentrations present in the 151 individual grid samples as well as the composite MI sample collected (0.47, 0.79 and 0.35 mg/kg respectively) are below the HDOH screening Environmental Action Level (EAL) value of 1.1 mg/kg. The Monte Carlo analysis indicates that collection of eight samples from this Decision Unit using the traditional RI sampling approach (by sub-sampling the actual grid-PCB field data collected) would have resulted in a false positive result, where the calculated 95% UCL result exceeded the EAL of 1.1 mg/kg, 25% of the time.

The MI and discrete soil sampling results obtained from the DU13 soils indicate that the mean and 95% UCL PCB concentrations present in the 121 individual grid samples as well as the composite MI sample collected (31.9, 91.3 and 36.7 mg/kg respectively) are significantly above the HDOH EAL (1.1 mg/kg). The Monte Carlo analysis indicates that collection of eight samples from this Decision Unit would have resulted in a false negative result, where the calculated 95% UCL result was less than the EAL of 1.1 mg/kg, a stunning 44% of the time, despite the MI sample collected from this depth containing roughly 30 times the PCB concentration of the screening regulatory value. These false negative results would have eliminated the rationale to conduct additional characterization sampling of the site in order to provide accurate data on the spatial extent and mass of contamination present within the decision unit.

The distribution of 95% UCL values calculated in the Monte Carlo analysis for DU11 and DU13 are depicted in Figure 5 while Figure 6 depicts the calculated 95% UCL

values in comparison to the "true" 95% UCL value determined for these two decision units based upon the field grid sampling results.

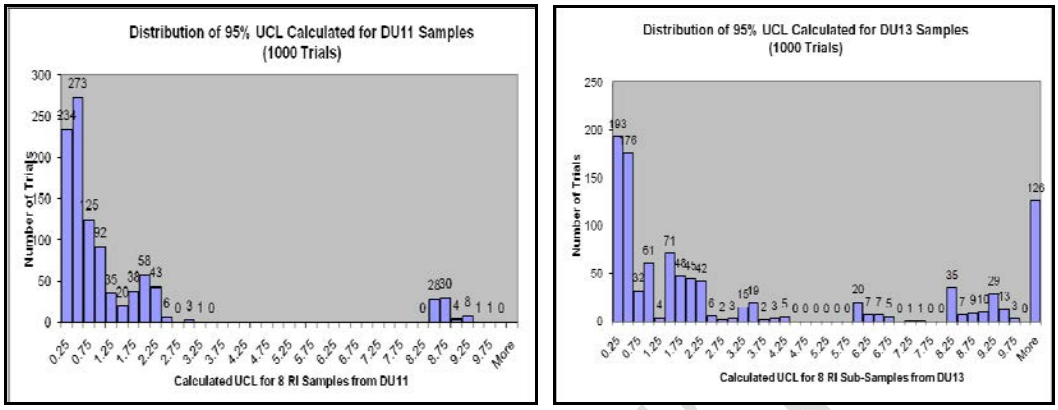


FIGURE 5: Distribution of 95%UCL Values Calculated in Monte Carlo Analysis

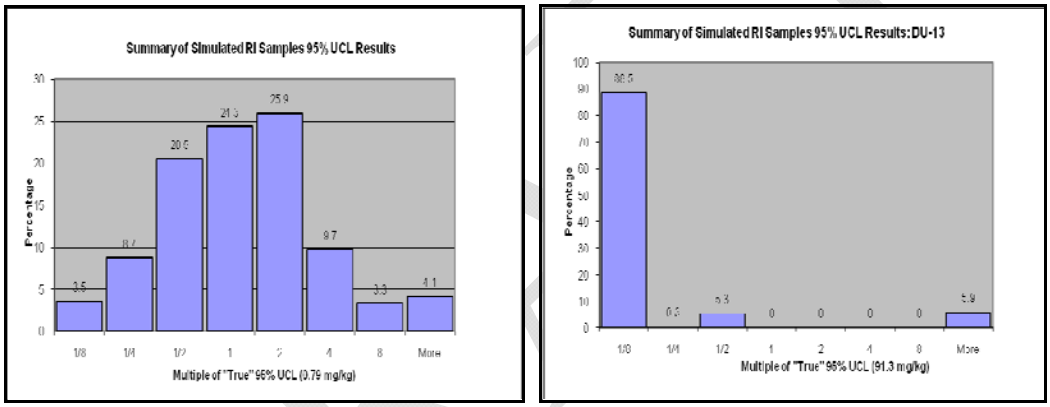


FIGURE 6: Comparison of Distribution of Simulated 95% UCL Values to the "True" 95% UCL Value for DU11 and DU13

Figure 6 shows that the use of the standard RI sampling methodology in DU13 would have led to a large over-estimation of the "true" mean PCB concentration within the landfill roughly 6% of the time as a result of the discrete sampling encountering the "nugget" of elevated PCB contamination present at this depth within the landfill. Alternatively, the standard RI sampling approach would have greatly under-estimated the "true" mean PCB concentration 89% of the time due to the discrete sampling approach not encountering the elevated "nugget" of PCB contamination present in the landfill. In contrast, random sub-sampling of the shallow decision unit data (DU11), which is less skewed than the deep data set (Figure 3), yielded a roughly normal distribution of simulated 95% UCL values around the "true" UCL value determined in the field samples.

The Monte Carlo analysis also found that the RI sampling approach would not have detected any PCB contamination at levels above the field analysis detection limit (0.25 mg/kg) between 7 to 15% of the time in the eight random soils collected from the three decision units. This result would have led to the false conclusion that no PCB contamination exists within the associated depth of the SMD landfill.

SUMMARY

The sampling results obtained on Kure Atoll verify that the MI sampling approach is useful as an initial screening of sites where the objective is to determine a representative mean level of contamination present within a particular decision unit. Within the Scrap Metal Dump, the MI sampling methodology was effective at incorporating isolated hot-spots, or "nuggets", of contamination present within the landfill into the mean contaminant concentration determined for the landfill. Additional homogenization of the sample in the laboratory prior to selecting a sub-sample of the MI sample for extraction and subsequent analysis was found to be critical in achieving representative results from the MI sample.

A statistical analysis of the extensive field grid-based PCB data set collected on Kure found that traditional RI sampling of the landfill would have significantly underestimated the MI sampling result 89% of the time in the deep unit soils and would have yielded a false negative result with respect to the HDOH EAL 44% of the time, despite the fact that this decision unit contains a mean and 95% UCL PCB concentration between 30 to 90 times the EAL. The Monte Carlo analysis also showed that RI sampling would have incorrectly concluded that the various decision units within the landfill contained no PCBs between 7 to 15% of the time.