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Final Supplemental Marine Resources Study Sampling and Analysis Plan Mākua Military Reservation Oʻahu, Hawaiʻi

August 2013

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Draft Supplemental Marine Resources Study Sampling and Analysis Plan Mākua Military Reservation Oʻahu, Hawaiʻi

Prepared by:

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Engineer Research and Development Center (ERDC)
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Preface

This Marine Resources Sampling and Analysis Plan (SAP) was prepared for the Environmental Division, Directorate of Public Works, U.S. Army Garrison, Hawai'i. The SAP was prepared under the direction of Colonel Jeffrey R. Eckstein, Commander, and Dr. Jeffrey P. Holland, Executive Director, of the U.S. Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC), Vicksburg, Mississippi.

All photos contained in this document were taken by Kapua Kawelo, Joby Rohrer, Stephen Turnbull, and Kaleo Wong.

All locations in Hawai'i found in this document utilized the *Place Names of Hawaii*, 1974 as a reference source for spelling and punctuation.

Acronyms

25th ID (L)	25th Infantry Division (Light)
%R	Percent Recovery
ADD	Average Daily Dose
ARDL	Applied Research and Development Laboratory
CADD	Chronic Average Daily Dose
CALFEX	Combined Arms Live-Fire Exercises
CFR	Code of Federal Regulation
COC	Chain-of- Custody
COPC	Chemicals of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
DLNR	Department of Land and Natural Resources
DoD	Department of Defense
DOH	Department of Health
DQO	Data Quality Objectives
EIS	Environmental Impact Statement
EL	Environmental Laboratory
ELAP	Environmental Laboratory Accreditation Program
EPC	Exposure Point Concentrations
ERDC	Engineer Research and Development Center
ERDC-ECB- ERDC	Environmental Chemistry Branch
GSL	Geotechnical and Structures Laboratory
GPS	Global Positioning System
HI	Hazard Index
HHRA	Human Health Risk Assessment
IQ	Hazard Quotient
ID	Infantry Division
LADD	Lifetime Average Daily Dose
LCS	Laboratory Control Sample (or Blank Spike)
LCSD	Laboratory Control Sample Duplicate
MC	Military Constituents
MDL	Method Detection Limit
MHT	Maximum Holding Times
MMR	Mākua Military Reservation
MS	Matrix Spike
MSD	Matrix Spike Duplicate

NELAP	National Environmental Laboratory Accreditation Program
NMDS	Non-metric Multidimensional Scaling
PAL	Project Action Level
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PCA	Principal Component Analysis
PELCR	Potential Excess Lifetime Cancer Risk
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
QSM	Quality Systems Management
RAF	Relative Absorption Factors
RAGS	Risk Assessment Guidance for Superfund
RDX	Cyclotrimethylenetrinitramine
RfD	Reference Doses
RL	Reporting Limit
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SF	Slope Factor
SOI	Species of Interest
SOP	Standard Operating Procedure
SV	Screening Values
SVOC	Semi Volatile Organic Compound
UCL	Upper Confidence Level
USACE	U.S. Army Corps of Engineers
USARHAW	U.S. Army Hawai'i
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compound

Executive Summary

The Army conducted marine resources studies in 2007 and 2008, published as a report in 2009, to evaluate whether marine resources including fish, shellfish and other invertebrates and *limu* (edible seaweed) near Mākua Beach and in the Mākua *muliwai* (temporary brackish water pond) on which area residents rely as an important component of their diet are impacted by substances associated with training activities at Mākua Military Reservation (MMR). The study also evaluated whether activities at MMR pose a human health risk to those area residents.

As a result of the Mālama Mākua vs. Gates, Secretary of Defense and McHugh, Secretary of the United States Department of the Army litigation, in June 2012 the Army was ordered to do additional marine resource sampling. In compliance with the Court's ruling the Army will collect and analyze *limu kohu*, *heʻe* (octopus), and *loli* (sea cucumber) obtained for consumption by Waiʻanae Coast residents from near Mākua Beach. The species targeted for sampling represent marine resources that were not sampled in the original marine resources study and were determined from public input to be significant to the local community. The Army will also evaluate whether arsenic if present in *limu kohu, heʻe,* and *loli* is present in the organic or inorganic form. Organic arsenic is generally less toxic than inorganic arsenic, and accounts for most of the arsenic humans are exposed to from consumption of seafood. Lastly, the Army will also collect and analyze *limu kohu*, *heʻe*, and *loli* from two background locations on Oʻahu other than Mākua Beach. The north shore of Oʻahu around Kaʻena Point and Mokulēʻia are designated as the two background locations. Those locations are not expected to have been impacted by military activities. Two sampling efforts will be conducted, one during the dry season (tentatively September 2013) and one during the wet season (tentatively January 2014). The results obtained from these sampling events will then be compared to those obtained from the background locations.

This sampling and analysis plan (SAP) presents the purpose, scope of work, strategy, and methodology that will be used to sample and analyze those marine resources. Target species of *limu*, *heʻe,* and *loli* will be sampled in the nearshore just west of Mākua and from the designated

background locations on Oʻahu. The availability of the target species was verified in a preliminary site survey conducted on 30 April- 1 May, 2013.

Up to eight replicate samples of each target species will be analyzed for a suite of substances of concern specified in the Army's 2007 settlement agreement with Mālama Mākua. To accomplish target chemical analyses, collection of approximately 200 g (7 oz wet weight) of fresh tissue for each sample is required. *Limu*, *heʻe,* and *loli* will be collected by local divers under the guidance of University of Hawaiʻi researchers in accordance with this SAP in the nearshore waters of Mākua from the shore down to a maximum depth of approximately 125 ft. For *limu* and *loli,* due to the low tissue sample mass of a single specimen, two or more organisms of the same species will be pooled to achieve the required weight to conduct the chemical analysis. Individual *heʻe* is expected to provide the required weight for analysis. A preliminary survey conducted 30 April to 1 May 2013 verified the presence of sufficient *limu*, *heʻe*, and *loli* at both Mākua and the background locations of Mokulēʻia and Kaʻena Point. Samples will be delivered to National Environmental Laboratory Accreditation Program (NELAP) certified contract laboratories for analysis.

An evaluation of the risks to human health of area residents from consuming the resources will be conducted based on the data and information collected during this study using U.S. Environmental Protection Agency (USEPA) and Hawaiʻi Department of Health (DOH) guidelines. Human health risk assessment seeks to estimate the nature and probability of adverse health effects in humans who may be exposed to substances found in marine resources used as an important component of their diet.

1 Introduction and Project Overview

This sampling and analysis plan (SAP) presents the purpose, scope of work, strategy, and methodology that will be used to sample and analyze *limu* (edible seaweed), *heʻe* (octopus), and *loli* (sea cucumber) as per the 20 June 2012 ruling for the Mālama Mākua vs. Robert Gates, Secretary of Defense and John McHugh, Secretary of the United States Department of the Army (U.S. District Court 2012). This ruling in summary stated that the defendants shall complete one or more studies of *limu* and other marine resources (e.g., octopus and sea cucumber) near Mākua Beach on which Waiʻanae Coast residents rely for subsistence (obtaining food as a means of maintaining life), in accordance with the terms and conditions set forth in paragraphs 6, 7, and 10 of the 2007 Settlement Agreement (U.S. District Court 2007). The studies shall specify whether arsenic, if present in *limu* or other marine resources, is organic or inorganic and shall determine background contamination by testing *limu* and other marine resources at locations in Hawaiʻi other than Mākua Beach.

The species of interest targeted for sampling represent marine resources that were not sampled in the Marine Resources Study (USARHAW and 25th ID (L) 2009) and were determined via public input to be significant to the local community. Additional marine resources (as per the 20 June ruling, see Table 3) will be sampled in the nearshore waters of the Pacific Ocean just west of the Mākua Military Reservation (MMR) (Figure 1) and also from two nearby background locations (i.e., outside the MMR area-of-interest) on Oʻahu that are not expected to have been impacted by military training (Figure 2).

MMR is approximately 38 miles northwest of Honolulu, on the leeward side of Oʻahu in the Mākua and Kahanahāiki valleys. MMR is bordered on the west by the Farrington Highway and extends mauka (inland) to the ridge of the Waiʻanae Mountains. The nearest township is Mākaha, approximately three miles south.

The installation encompasses almost 4,190 acres with annual rainfall ranging around 50 in. toward the head of the valley to less than 15 in. at the mouth of the valley (Giambelluca, Nullet, and Schroeder 1986). The high

Figure 1. Site location map.

precipitous valley walls surrounding the installation reach heights of 2,100 to 2,900 ft (USARHAW and 25th ID (L) 2009). The broad range in rainfall and topography results in a diversity of vegetation types within the valley.

Site background

Use of Mākua Valley by U.S. armed forces dates back to the 1920s when three parcels on the upper Mākua Valley floor were purchased for howitzer emplacements. After the bombing of Pearl Harbor in 1941, the Army used its' authority under martial law to take over the entire Mākua-Ka'ena Point area for security and training. In 1942, the Army issued a real estate directive for 6,600 acres of land at Mākua that were already being used.

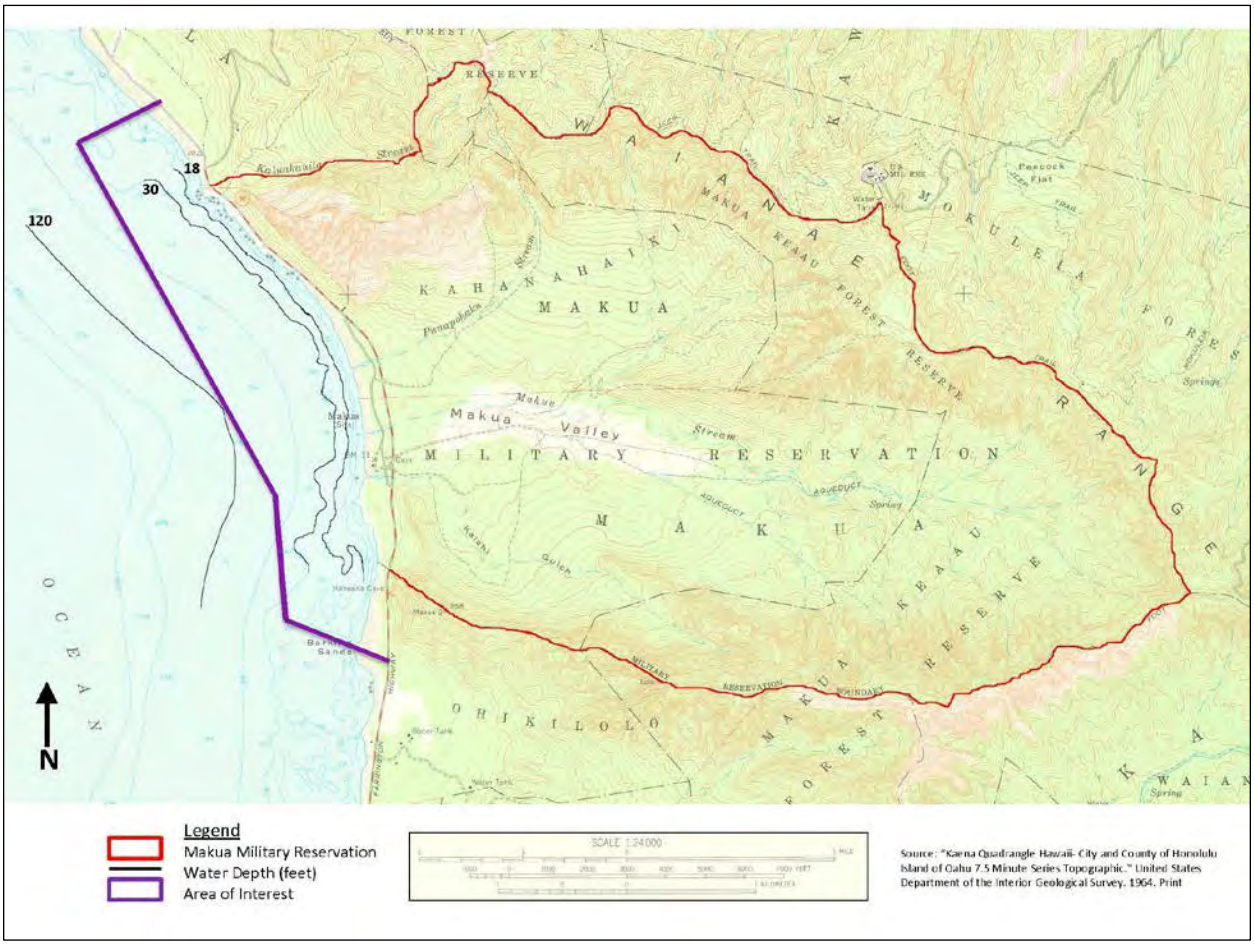

Figure 2. Study area.

Private parcels within the property were obtained by condemnation, whereas territorial lands were conferred by the territorial governor's consent. In 1943, the territorial government granted a revocable permit for the military to use 6,600 acres "to assist in the present war effort extending for the duration of the present war and six months thereafter." The site was used extensively for bombing and infantry training, but no records of munitions expended on Mākua were kept. Mākua has remained under Army control ever since. After Hawai'i was granted statehood in 1959, the federal government exercised its option to set aside lands for its continued use (Tetra Tech, Inc. 2005c).

Previous investigations

On 4 October 2001, Mālama Mākua and the Department of Defense (DoD) entered into a Settlement Agreement and Stipulated Order (referred to herein as the Settlement Agreement District Court 2001)). The 25th Infantry Division (ID) agreed to complete an Environmental Impact Statement

(EIS) regarding the proposal to resume live-fire training at MMR. Under the terms of the Settlement Agreement, the Army could conduct a limited number of Combined Arms Live-Fire Exercises (CALFEXs) for up to three years (through October 2004). In October 2004, the Army started preparing the EIS required under the Settlement Agreement and has since only conducted limited, nonlive-fire training at MMR. On 8 January 2007, Mālama Mākua and the DoD entered into a partial Settlement Agreement (referred to herein as the 2007 Settlement Agreement (U.S. District Court 2007)), in which the 25th ID agreed to undertake a marine resources study to determine if the marine resources near MMR were impacted by military training.

The Army conducted a marine resources study to determine whether marine resources (*i.e.*, fish, shellfish and other invertebrates , and *limu*) near Mākua Beach and in the Mākua *muliwai* (temporary brackish water pond) have constituents (e.g., explosives and some metals) primarily associated with proposed training activities at MMR. In addition to evaluating chemicals that are associated with military training, that study also included the analysis of a wide variety of constituents, including explosives, dioxins/furans, metals, organochlorine pesticides, volatile organic compounds, and semivolative organic compounds. That study also evaluated whether the proposed training activities at MMR pose a human health risk to area residents from the consumption of marine resources for subsistence. The results of the marine resources study were published by the Army as the "Marine Resources Study, Field Sampling Results and Risk Assessment, Mākua Military Reservation, Oʻahu, Hawaiʻi" (USARHAW and 25th ID (L) 2009), which will be referred to as the "2009 Marine Resources Study". That report identified a number of constituents in fish, shellfish and other invertebrates, and *limu* that were detected during analysis and are also known to be associated with the type of military training being proposed at MMR. These constituents were RDX (cyclotrimethylenetrinitramine), perchlorate, arsenic, chromium, cobalt, nitroglycerin, and manganese. While other detected analytes may be associated with military training as well as civilian and industrial activities, these were the analytes for which potential health risks were believed to exist. The 2009 Marine Resources Study concluded that although these and other constituents may have been associated with military training at MMR; all except RDX were also linked to geologic (e.g., volcanic rock) and anthropogenic (i.e., human) sources (e.g., fireworks, rodenticides, medication, and gasoline). A comparison of the site data with the available

background data showed little if any difference between constituents found in the Mākua area and the background sites. It was concluded that substances identified for analysis by the Settlement Agreement are not unique to military training and are found at both Mākua and background sites; therefore, it was submitted that proposed military activities were anticipated to have little influence on contaminant levels within marine resources in the Mākua nearshore or *muliwai* areas.

The 2009 Marine Resources Report concluded that the target species of fish, shellfish and other invertebrates, and *limu* investigated were representative of other marine resources within the Mākua area. It was suggested that other marine resources occupying similar trophic levels and ecological niches would contain similar constituents and concentrations as those detected in the species investigated.

In addition, based on the general similarity of carcinogenic and noncarcinogenic health risks between the Mākua area and the background sites, it was apparent that the Army's past activities at MMR were not independently responsible for any human health risks from the constituents detected in marine resources. Considering the concentrations of constituents found in the Mākua area, the numerous possible sources of these constituents, the mobility of these constituents and the fact that they can originate from multiple sources, the report concluded that it was unlikely that future military activities at MMR alone would cause unacceptable risk to human health.

Court order regarding remedies for defendants' settlement violations

The 20 June 2012, ruling stated that the Defendants (the U.S. Army) shall: (1) Complete one or more studies of *limu* and other marine resources (*e.g.*, octopus and sea cucumber) near Mākua Beach on the Waiʻanae coast where residents rely on these resources for subsistence, (2) Specify whether arsenic in the *limu* or other marine resources is organic or inorganic, and (3) Determine background contamination by testing *limu* and other marine resources (US District Court 2012). These marine resources will be sampled in the nearshore waters of the Pacific Ocean just west of the MMR (Figures 1 and 2). They represent an additional effort to sample other marine resources over and above those that were sampled in the 2009 Marine Resources Study and were determined via public input to be significant to the local community. These other additional marine

resources will also be sampled from nearby background locations on O‘ahu that are not expected to have been impacted by activities at MMR.

Objectives and project overview

Objectives

The objective of this study is to investigate whether constituents potentially associated with military training are present in samples of selected species of *limu, heʻe,* and *loli* found near Mākua Beach and relied on for subsistence by area residents. An evaluation of the risks to human health will be conducted based on the data and information collected during this study as well as on results from earlier studies undertaken in the area.

This study will also determine the organic and inorganic fractions of arsenic present in *limu, heʻe,* and *loli*. This two-part objective satisfies the Court Order of 20 June 2012.

Specific project objectives are:

- To address deficiencies identified in the Court Order of 20 June 2012 (U.S. District Court 2012), collect data concerning chemicals of potential concern (COPCs) that may be present in samples of selected species of *limu, heʻe,* and *loli* found near Mākua Beach and relied on for subsistence by area residents.
- Determine based on this study and data in the 2009 Marine Resources Report whether the presence of chemical constituents and non-chemical constituents in those marine species are posing an unacceptable human health risk.
- Collect samples of *limu, heʻe,* and *loli* found near Mākua Beach during two seasons of the year (dry and wet), and analyze samples for the COPCs (Table 2).
- Determine the organic and inorganic fractions of arsenic present in *limu* or other marine resources.
- Conduct a human health risk assessment using data collected during this study and applicable data from prior studies to determine whether the constituents detected in the samples pose an unacceptable threat to human health.
- Conduct all aspects of the study in a transparent manner and inform the community of findings.

Data quality objectives

DQO Table, Steps 1 through 7.

Step One: State the Problem	
Purpose: The purpose of this step is to clearly define the problem that requires new environmental data so that the focus of the study will be clear and unambiguous.	
Activities	
Identify the planning team.	• U.S. Army Garrison Hawai'i • USACE Engineer Research and Development Center (USACE ERDC) • University of Hawai'i (UH)
Identify the primary decision maker.	U.S. Army
Develop a concise description of the problem.	Compounds associated with the historic military use of MMR may be present in nearshore aquatic organisms. It is necessary to determine the potential impact of the presence of MMR related compounds in aquatic organisms on human health. Although the 2009 Marine Resources Study did not identify significant human health concerns, it is necessary to further assess the potential impacts to address the 2012 Court Order. The current study is being undertaken to address deficiencies identified in the 2012 Court Order by conducting the collection and analysis of additional marine organisms consumed by local residents and investigating arsenic speciation.
Specify available resources and relevant deadlines for the study.	Resources available include researchers from the USACE ERDC, University of Hawai'i and contract laboratories. These organizations have qualified personnel, equipment and supplies available to support this investigation. Work must be completed within the specified budget. Commercial laboratories will be used for chemical analysis in order to generate data for use in risk assessment.
Step Two: Identify the Decision	
Purpose: The purpose of this step is to define the decision that will be resolved using data to address the problem.	
Activities	
State the decision.	Are compounds attributable to MMR activities present in organisms consumed by local residents, and if so do they present an unacceptable risk to human health?
Categorize multiple decisions.	Are chemicals of potential concern present in organisms consumed by local residents at concentrations exceeding screening levels? If present at concentrations exceeding applicable screening levels, do the COPCs pose an unacceptable risk to human health? Are the detected COPCs exceeding screening levels attributable to activities at MMR versus resulting from another source (e.g., geologic origin, land-based non-point source pollution runoff)?
State the actions or outcomes that could result from the resolution of the decision.	Possible outcomes or actions include: • no further action. • further study or monitoring activities. • development of best management practices to minimize impact from future activities at MMR on subsistence consumers collecting marine resources in the vicinity.

Step Three: Identify Inputs	
Purpose: The purpose of this step is to identify the informational inputs that will be required to resolve the decision, and to determine which inputs require environmental measurements.	
Activities	
Identify the information that will be required to resolve the decision.	List of constituents for chemical analysis as determined by the Court. Results of 2009 Marine Resources Study. Applicable human health screening levels for the COPCs. Representative sampling and analysis data for the analytes in marine resources targeted for sampling and appropriate for use in risk assessment. Methods for determining whether detected compounds are attributable to activities at MMR (e.g., background sampling and analysis and interpretation of the results).
Determine the sources for each item of information identified.	2009 Marine Resources Study. Published data on fate and transport. Published criteria, regulations, and toxicological data (Screening Values calculated by methods described in US EPA Fish Advisories (USEPA 2000) Sampling and analysis- *limu*, *he'e*, and *loli* at MMR and appropriate background locations. Statistical texts. Human health risk assessment guidance.
Identify the information that is needed to establish the action level for the study.	List of COPCs based on the 2012 Court Order. Sampling and analysis data from appropriate background locations. To the extent that they exist, published human health toxicity values to establish screening levels. Applicable human health screening levels. Appropriate exposure parameters (e.g., consumption values) based on the 2009 Marine Resources Study or other applicable studies.
Confirm that appropriate field sampling techniques and analytical methods exist to provide the necessary data.	Published techniques for collection of and analysis of organisms' samples are available. Standard analytical methods are available for all of the analyses. However, analysis for arsenic requires special procedures. Special attention to clean up is necessary when analyzing organisms to minimize matrix interference. As shown in Section 5, data can be generated at the required reporting limit for most COPCs. For COPCs whose analytical reporting limits are greater than calculated screening values, they will be carried forward into the baseline human health risk assessment for further evaluation of potential health risk using more realistic exposure assumptions.
Step Four: Define Boundaries	
Purpose: The purpose of this step is to specify the spatial and temporal circumstances that are covered by the decision.	
Activities	
Define the domain or geographic area within which all decisions must apply.	The decision unit for this project is the aquatic area potentially impacted by MMR which extends from the shore to the edge of the area of interest shown in Figure 2.

Specify the characteristics that define the population of interest.	In the Risk-based screening, the maximum detected value will be compared to calculated SVs. If the maximum detected value exceeds the SV, then the COPC will be carried forward into the Baseline HHRA for further risk evaluation. The Baseline HHRA will utilize the 95% UCL as the Exposure Point Concentration (EPC). Risk and hazards will be calculated, to the extent possible, with site-specific exposure assumptions taken from the 2009 Marine Resources Study or other studies deemed appropriate or conducted in the area. Because baseline risk and hazards do not account for background concentrations, a supplemental risk characterization will be performed that subtracts background concentrations prior to calculating risk.
When appropriate, divide the population into strata that have relatively homogeneous characteristics.	The use of strata is not necessary for this study.
Define the scale of decision making.	The scale of decision making is defined as the smallest unit to which the decision rule is applied. With regard to human health, the scale of decision making will be defined as the MMR area of interest as shown on Figure 2 unless data developed during the study suggest an alternative stratification.
Determine when to collect data.	Field collection will be timed to occur in two distinct seasons: wet and dry.
Determine the time frame to which the study data apply.	The data will be used to evaluate present and future exposure scenarios.
Identify any practical constraints on data collection.	Cost, equipment, personnel, weather conditions, target species' availability, sample handling and transport, and analytical capabilities. It may be difficult to obtain sufficiently replicate tissue sample mass to allow for the full analytical suite.
Step Five: Develop a Decision Rule	
Purpose: The purpose of this step is to integrate the outputs from previous steps into a single statement that describes the logical basis for choosing among alternative actions.	
Activities	
Specify the parameter that characterizes the population of interest.	For evaluating COPCs against the screening levels, the maximum COPC concentration detected within a decision unit will be used. For the baseline risk assessment, if required, the Exposure Point Concentration (EPC) will be utilized.
Specify the action level for the study.	In the risk-based screening, site-specific maximum COPC concentrations will be compared to conservative screening values calculated using the approach defined in USEPA 2000. Risks and hazards in the baseline HHRA will be compared to the regulatory level of concerns of 10^{-4} and 1 for cancer risk and noncancerous hazards, respectively. Determine which COPCs are attributable to MMR activities by comparison to background locations.

Combine the outputs of the previous DQO steps into an "if…then…" decision rule that defines the conditions that would cause the decision maker to choose among alternative actions.	If the maximum detections of COPCs attributable to activities at MMR exceed human health screening levels, then a Baseline HHRA will be performed. If the EPC derived in the baseline human health risk assessment exceeds that which poses either a Hazard Index of 1.0 or a cancer risk in excess of 10^{-4} for the COPCs attributable to activities at MMR, then further risk analysis, a feasibility study or development of best management practices for future military activities at MMR is warranted. If detected concentrations of COPCs attributable to military training at MMR do not exceed the human health screening levels or if the baseline HHRA reveals risks and hazards less than project goals, then the project team will conclude that the risks posed by military activities at MMR are acceptable, and the site will be recommended for No Further Action. To supplement this, a statistical method such as a principal component analysis (PCA) or non-metric multidimensional scaling (NMDS) to elucidate relationships between COPC and other parameters may be used.
Step Six: Specify Limits on Decision Errors	
Purpose: The purpose of this step is to specify the decision maker's acceptable limits on decision errors, which are used to establish appropriate performance goals for limiting uncertainty in the data.	
Activities	
Define both types of decision errors and identify the potential consequences of each.	False positive – to incorrectly conclude that risk exists when it does not False negative – to incorrectly conclude that a risk does not exist when it does.
Specify a range of possible parameter values where the consequences of decision errors are relatively minor (gray region).	As previously stated, the default for risk screening applications will be to compare the maximum detected concentration to the calculated screening value. For "background to MMR" comparisons, determinations will be based on comparison of site-specific populations to the 95% Upper Tolerance Level (UTL) of the background.
Assign probability values to points above and below the action level that reflect the acceptable possibility for the occurrence of decision errors.	By convention, all human health risk determinations are made at the 95% confidence level.
Check the limits on decision errors to ensure that they accurately reflect the decision maker's concern about the relative consequences for each type of decision error.	Adoption of these DQOs by USACE ERDC and the University of Hawai'i will constitute their agreement with these definitions.
Step Seven: Optimize the Design	
Purpose: The purpose of this step is to identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs.	
Activities	
Review the DQO outputs and existing environmental data.	Adoption of these DQOs by USACE-ERDC and the University of Hawai'i will constitute their agreement with these definitions and the conceptual site model.
Translate the information from the DQOs into a statistical hypothesis.	The maximum concentration of chemical measurements DOES exceed the Screening Level; Risks and hazards calculated in the Baseline HHRA DO exceed the risk level of concerns (i.e., HI>1 or a cancer risk of 10^{-4})

Develop general sampling and analysis design alternatives.	Random sampling is required to support the statistical hypothesis testing. The site will be gridded or sliced and a random number generator will be used to pick the site to be sampled. This will remove any bias that will be introduced by the samplers. If there is not sufficient sample biomass, then the sampler will go to another grid or will use a spiral search pattern to find additional target species for collection until sufficient biomass is obtained.
For each design alternative, formulate the mathematical expressions needed to solve the design problems.	Maximum detected value of X > Comparison Value; HI > 1 @ EPC or increased cancer risk > 10^{-4} @ EPC.
For each design alternative, select the optimal sample size that satisfies the DQOs.	A sufficient number of samples will be acquired in a random sampling scheme to satisfy the decision confidence requirement.
Select the most resource-effective design that satisfies all of the DQOs.	Random sampling scheme will be utilized.
Document the operational details and theoretical assumptions of the selected design in the Sampling and Analysis Plan.	Operational details and theoretical assumptions are discussed in Section 2 of the Sampling and Analysis Plan.

Specific project tasks

- A site survey conducted on 1 May 2013 identified conditions and requirements for access to the study area to collect biological samples (Appendix B). The availability of *limu*, *heʻe,* and *loli* in sufficient quantities for conducting the required analytical work was verified.
- Carry out two rounds of sampling. One round will occur during the dry season (tentatively September 2013) and the second round will occur during the wet season (tentatively January 2014).
- Collect and analyze a sufficient number of samples to determine the concentrations of select constituents in target species.
- Collect *limu*, *heʻe*, and *loli* target species and analyze their tissues for the presence of select constituents. The target species will be collected by local methods of collection, documented, preserved, and prepared for analyses in the same way that they are consumed by the local population.
- Photographs will be taken throughout the investigation to document field activities.
- Carry out analyses of tissue for constituent concentrations following the methods described by USEPA (e.g., SW-846), modifications to the USEPA methods used, or comparable standard methods for analysis. The methods will be selected to ensure comparability of data between the planned data collection efforts and the previous results of analysis of tissue samples. Analytical data packages will be validated using accepted industry practice (USEPA level III validation).

- Analyze all collected samples for a suite of heavy metals, arsenic and organic compounds at a National Environmental Laboratory Accreditation Program (NELAP) laboratory accredited for these analyses. The analytical suite of constituents (Table 2) in the proposed investigation was specified in the 2007 Settlement Agreement (U.S. District Court 2007).
- Compare the conditions in the marine environment near MMR to the conditions at background locations unimpacted by MMR through sampling and analysis of the same target species.
- Analyze laboratory blanks, matrix spike, matrix spike duplicates, and any other analysis needed for QA/QC purposes. The report shall review these results and provide conclusions on the success of the analysis and data usability.
- Conduct a human health risk assessment using data collected during this study and applicable data from prior studies.
- Provide a report of the results of this marine resources investigation.

Project organization

Key personnel and the contract laboratories designated for the marine resources study are organized as indicated below.

Lead agency project manager

The lead agency project manager for the study is the Chief of the Compliance Branch, Environmental Division of Directorate of Public Works. The lead agency project manager will review the project deliverables and provide input to ensure the overarching goals of the project are met. Based on their knowledge, their input helps ensure consistency of the data generated so that they may be pooled for use in assessing the impacts of MMR on marine resources and will meet the requirements of the 2007 Settlement Agreement.

Project manager and technical oversight

The Engineer Research and Development Center (ERDC) project manager (PM) for the study will be Danny Harrelson. The project manager will have overall responsibility for oversight of this effort for MMR. He will oversee and monitor performance of the staff and subcontractors as well as be the liaison between the lead agency project manager, field and laboratory staff and any other subcontractors. An oceanographer from the University of

Hawai'i and Dr. Guilherme Lotufo (ERDC), a research marine biologist, will have joint responsibility for the technical aspects of the work. They will interact with regulatory agency personnel to ensure proper implementation of the SAP as well as assure completion of corrective actions as needed. The oceanographer and Dr. Lotufo will maintain consistency in procedures and work products. They will provide guidance and technical oversight and will review all project reports and deliverables. These marine scientists will plan the activities of and coordinate field personnel on specific assignments.

Project chemist

The ERDC project chemist is Dr. Anthony Bednar. Patricia Tuminello and William Jones of the USACE ERDC will also assist during this project. Dr. Bednar provided input for the development of this SAP as well as the Quality Assurance/Quality Control (QA/QC) and will manage project tasks associated with sampling, preservation and storage requirements as well as coordinate sample preparation, transport, and analysis with the contract laboratories, review analytical data soon after they are received, and implement three-phase QC activities and corrective actions as necessary (see Appendix A for details). Dr. Bednar, Ms. Tuminello, and Mr. Jones will also conduct a project kick-off meeting with the contract laboratories and subconsultants/ subcontractors (where applicable) prior to sample collection and analysis to discuss project matters, including potential interferences and possible corrective actions required.

Contract laboratories

Applied Research and Development Laboratory (ARDL) Inc. is designated as the primary contract laboratory for the study and will be subcontracting some of the analyses to other labs (see Table 1). For analyses not performed in house, ARDL will subcontract various analyses to Pace Analytical, Test America, and Brooks Rand Laboratories. All contract laboratories performing analyses for the current project hold current certification under the DoD ELAP, NELAP, or have demonstrated proficiency in each of the required methods, and have recently generated method detection limit (MDL) data available for review if requested. (Note, however, that MDL studies specific to the matrices to be evaluated in this investigation will not be performed, and certification is not available for non-standard analyses, such as arsenic speciation). Additionally, all contract laboratories will follow quality control limits and guidelines as described in the DoD Quality

Systems Management (QSM). Where specific limits are not prescribed within the QSM, the method specific parameter limits will be used. Laboratory specific quality control limits will only be utilized when neither of the former limits is available. All contract laboratories are able to perform clean-up procedures for tissue matrixes in order to reduce matrix interferences for the target compounds. Contacts and addresses for the designated contract laboratories are provided in Table 1.

Table 1. Primary and subcontract laboratory information by analyte group.

Analyte Group	Primary Lab
Dioxins/Furans (17 congeners of concern)	Pace Analytical 1700 Elam Street Minneapolis, MN 55414 Phone: 612-607-1700
Gasoline (Purgeable Organics) Explosives (Nitroaromatics/Nitramines) Organochlorine Pesticides SVOCs (Pyrene/Phthalates)	ARDL 400 Aviation Drive Mount Vernon, IL 62864 Phone: 618-244-3235 FAX: 618-244-1149 POC: Dean Dickerson
Metals (total) Arsenic Speciation	Brooks Rand Laboratories 3958 6th Avenue NW Seattle, WA 98107 Phone: 206-632-6206
Perchlorate	Test America –Sacramento 880 Riverside Parkway West Sacramento, CA 95605 Phone: 916-373-5600

2 Marine Resources Sampling

This SAP outlines the rationales and procedures for conducting a supplemental marine resources study, including collecting and analyzing samples from the nearshore waters at MMR to achieve the objective of the study. For comparison purposes, samples of each species collected from the nearshore at MMR will also be collected from background locations outside of the MMR area. Per the 2007 settlement agreement, samples will be analyzed for a suite of constituents (Table 2, Appendix A). Such a comprehensive analytical program will require collection of approximately 200 g or 7 oz (wet weight) for each replicate sample. The field sampling program and associated laboratory analysis program has been designed to collect data that can support a human health risk assessment.

Table 2. Sample Constituents.

Analyte	Analyte
Dioxins/Furans (17 congeners of concern)	Explosives (Nitroaromatics/Nitramines)
HpCDD	2,4-DNT
HpCDF	RDX (Cyclonite)
HxCDF	Nitroglycerine
OCDD	Other Energetic Compound
OCDF	Perchlorate
TCDD	Organochlorine Pesticides
Gasoline (Purgeable Organics)	4,4'-DDT
Ethylbenzene	Aldrin
m-Xylene	alpha BHC
p-Xylene	beta BHC
o-Xylene	delta BHC
Toluene	gamma BHC (lindane)
Stryrene	Heptachlor
1,2,4-Trimethylbenzene	Heptachlor epoxide
Metals	SVOCs (Semi Volatile Organic Compounds)
Aluminum	Pyrene
Antimony	Phthalate Esters
Arsenic	Bis(2-ethylhexyl) phthalate
Barium	Di-n-butyl phthalate
Beryllium	Diethyl phthalate

Analyte	Analyte
Cadmium	Dimethyl phthalate
Chromium	Di-n-octyl phthalate
Cobalt	**Arsenic Species**
Copper	As (III)
Iron	As (V)
Lead	Monomethylarsonate (MMA)
Manganese	dimethylarsinate (DMA)
Selenium	
Silver	
Thallium	
Vanadium	
Zinc	
Mercury	
Methyl Mercury	

Summary of the 2009 Marine Resources Study

For the 2009 Marine Resources Study (USARHAW and 25th ID (L) 2009), all biological resources were sampled from nearshore shallow waters of Mākua and nearshore waters at Sandy Beach. Hook and line were used to collect fish, crab traps were used to collect Kona crab. *Limu* and helmet urchin (*Ha'uke'uke*, *Colobocentrotus atratus*) were collected by hand. Spear fishing and scuba diving were not used for sampling. Table 3 provides a summary of *limu*, shellfish and other invertebrates, and fish samples collected, analyzed, and evaluated in the 2009 Marine Resources Study.

Table 3. List of *limu*, invertebrates and fish samples collected, analyzed, and evaluated in the 2009 Marine Resources Study.

Species		Site	Sample Type	Number of Samples
Limu				
Samples containing a combination of species identified as *Acanthophora spicifera, Sargassum muticum*, and *Sargassum polyphyllum*		Nearshore waters at Mākua	Primary	3
			QC	1
Invertebrates				
Samoan crab	*Scylla serrata*	Mākua North *Muliwai*	Primary	1

Species		Site	Sample Type	Number of Samples
Rock crab	*Pachygrapsus minutus*	Nānākuli *Muliwai*	Primary	1
Rock crab	*Pachygrapsus minutus*	Mākua South *Muliwai*	Primary	1
Hawaiian prawn	*Macrobrachium grandimanus*	Nānākuli *Muliwai*	QC	1
		Mākua South *Muliwai*	Primary	1
		Nānākuli *Muliwai*	Primary	1
Helmet urchin	*Colobocentrotus atratus*	Nearshore waters at Mākua	Primary	1
			QC	1
Helmet urchin	*Colobocentrotus atratus*	Nearshore waters at Sandy Beach	Primary	2
			QC	1
Kona crab	*Ranina ranina*	Nearshore waters at Mākua	Primary	1
Fish				
Tilapia	*Tilapia zillii, T. rendalii, Oreochromis macrochir, O. mossambicus, Sarotherdon melanotheron melanotheron*	Mākua North *Muliwai*	Primary	3
		Mākua South *Muliwai*	Primary	2
			QC	1
		Nānākuli *Muliwai*	Primary	3
Hawaiian flagtail	*Kuhlia sandvicensis*	Mākua North *Muliwai*	Primary	1
Striped mullet	*Mugil cephalus*	Mākua South *Muliwai*	Primary	2
			QC	1
Medaka	Poeciliidae sp.	Mākua South *Muliwai*	Primary	2
Picasso triggerfish	*Rhinecanthus rectangulus*	Nearshore waters at Mākua	Primary	1
		Nearshore waters at Sandy Beach	Primary	1
Blackspot sergeant	*Abudefduf sordidus*	Nearshore waters at Mākua	Primary	1
		Nearshore waters at Sandy Beach	QC	1
Manybar goatfish	*Parupeneus multifasciatus*	Nearshore waters at Mākua	Primary	1
		Nearshore waters at Mākua	QC	1
		Nearshore waters at Sandy Beach	Primary	1
Christmas wrasse	*Thalassoma trilobatum*	Nearshore waters at Mākua	Primary	1
		Nearshore waters at Sandy Beach	Primary	1

Fish were collected from the two *muliwai* at MMR and were prepared into twelve samples. The species collected included striped mullet, tilapia, Hawaiian flagtail, and medaka; each sample except one consisted of multiple individuals but only one type of fish. Three fish samples were collected from the background *muliwai* at Nānākuli. All of the fish samples collected at Nānākuli were tilapia.

Four primary fish samples were collected from the nearshore waters of Mākua, consisting of *moano* (manybar goatfish), *humuhumu nukunuku a puaa* (Picasso triggerfish), *kupipi* (blackspot sergeant), and *hinalea* (Christmas wrasse). The single quality control (QC) sample collected from the nearshore waters of Mākua consisted of a single sample of *moano*. These same fish species were collected at the Sandy Beach nearshore background location (Table 2).

Two invertebrate samples were collected from the nearshore waters of Mākua—one each of helmet urchin (*Colobocentrotus atratus*) and Kona crab (*Ranina ranina*). The QC sample consisted of helmet urchin. Helmet urchin was the only species collected (two samples) at Sandy Beach, the nearshore background location, both as the sole primary sample and as the sole QC sample.

Four *limu* samples were collected from the nearshore waters at Mākua. Three species of *limu* were listed as target species for sampling (*Enteromorpha prolifera*, *Codium edule*, and *Gracilaria coronopifolia*); however, the three samples of *limu* for the nearshore waters at Mākua were a combination of the *Acanthophora spicifera*, *Sargassum muticum*, and *Sargassum polyphyllum*. Scientists at the Bishop Museum identified the *limu* species. Even though it was contemplated in the SAP, *limu* was not collected at the background location at Sandy Beach because of its scarcity.

Several marine resources identified as food by area residents were not available in adequate quantities for analysis of all the substances identified for this study. For example, it would have required collecting several thousand individuals of snail species that residents are known to consume to supply adequate biomass for laboratory analyses. Only fish, invertebrate, and *limu* that were available in sufficient quantities were collected. Those species were considered to be representative of the marine resources available at Mākua.

Limited diversity and the small size of the populations of the few species living in the *muliwai* prevented collection of a full suite of primary and QC samples from the *muliwai*. Those samples containing inadequate biomass for the full suite of analyses were analyzed for a combination of energetics and metals only.

Supplemental study species of interest based on public input

An extensive effort was undertaken for this project to gather public input to assist the Army in preparing this SAP. The SAP was formally released on January 18, 2013, to Earthjustice and the public for a 60-day review process that ran through the end of March 2013. Information was gathered from the public in a variety of meetings as well as from State and Federal Government scientists and officials. First, an October 24, 2012, "talk story" meeting was held at the Waiʻanae Army Recreation Center to obtain input from the public. A public meeting was held on February 20, 2013 at Nānākuli High School with an informal information session from 6:30-7:00 with Army subject matter experts, followed by a facilitated public meeting comment session from 7:00 to 9:30. Comments received are summarized in Appendix C with an appropriate response from the Army. A second public meeting was held on March 13, 2013, at the Waiʻanae District Park at the request of the community (as mentioned during the February 20, 2013, public meeting). This public meeting provided additional information on the project with a presentation by Army subject matter experts. Comments received during this meeting are summarized in Appendix C with an appropriate response from the Army. The SAP was also distributed to three public libraries in Waiʻanae, Kapolei, and Waialua. In addition, copies of the Draft work plan were mailed to anyone that requested it. The SAP was and remains available on the U.S. Army Garrison website and can be downloaded in Adobe Acrobat PDF format (http://www.garrison.hawaii.army.mil/makua/MarineResourcesDocs/2013SupplementalMarineResources/MMR_Marine_Resources_Supplemental_SAP.pdf). Copies of the SAP were submitted to the Environmental Protection Agency (EPA) Region 9 in San Francisco, California (this office incorporates the State of Hawaiʻi), State of Hawaiʻi Department of Health Hazard Evaluation and Emergency Response Office, and the State of Hawaiʻi Department of Land and Natural Resources (DLNR), with their comments summarized in Appendix C with an appropriate response from the Army.

A list of species of interest (SOI) was created based on surveys and discussions with local residents from the Waiʻanae coast, regional commercial fisherpersons, local recreational fisherpersons, area divers, and spear fisherpersons (Table 4). as well as information provided from a survey distributed throughout the Waiʻanae Coast resulted in a variety of helpful information that included 21 online surveys, 2 surveys submitted by mail, as well as 8 surveys and 5 personal interviews from the "talk story" meeting as well as the public and information meetings listed above. This

information provided by the community was used to develop the SOI in Table 4. As a result of this information obtained from the public, the present resources study focus is on *limu, he'e*, and *loli* (Figures 3, 4, and 5: all photos contained in this document were taken by Kapua Kawelo, Joby Rohrer, Stephen Turnbull, and Kaleo Wong) identified by island residents as food sources collected in the nearshore waters of Mākua.

Table 4. Species of interest based on public input.

Hawaiian Name	Common Name	Scientific Name
		Limu
Kohu	Red alga	*Asparagopsis taxiformis*
Wāwae'iole	Green alga	*Codium edule*
Līpoa	Brown alga	*Dictyopteris plagiogramma; Dictyopteris australis*
'Ele'ele	Sea lettuce	*Ulva prolifera*
Manauea	Red alga	*Gracilaria coronopifolia*
Huluhuluwaena	Red alga	*Grateloupia filicina*
Lepe'ula'ula	Red alga	*Halymenia formosa*
Līpe'epe'e	Red alga	*Chondrophycus succisus*
Kala	Brown alga	*Sargassum aquifolium*
Pālahalaha	Sea lettuce	*Ulva lactua*
		Echinoderms
Loli	Sea Cucumber	Holothuroidea sp
Wana	Rock boring urchin	*Echinostrephus aciculatus* and other species
Ha'uke'uke	Helmet urchin	*Colobocentrotus atratus*
		Mollusks
He'e, Tako	Octopus	*Octopus cyanea* and *Octopus ornatus*
Mu *he'e*	Bigfin reef squid	*Sepioteuthis lessoniana*
Pipipi	Nerite snail	*Nerita picea*
Opihi makaiauli	Black foot (limpet)	*Cellana exarata*
Opihi alinalina	Yellow foot (limpet)	*Cellana sandwicensis*
		Crustaceans
Ula	Spiny lobster	*Panulirus marginatus*
Ula papapa	Slipper lobster	*Arctides regalis; Scyllarides haanii; Scyllarides squammosus*
	Kona crab	*Ranina ranina*
A'ama Crab	Thin-shelled rock crab	*Grapsus tenuicrustatus*
		Fish
Ulua omilu	Bluefin	*Caranx melampygus*
Moi	Pacific threadfin	*Polydactylus sexfilis*
Oio	Bonefish	*Albula glossodonta*
Weke‘‘a	Yellow-striped goatfish	*Mulloibichthys slavolineatus*
Uouoa	Sharpnose Mullet	*Neomyxus leuciscus*

Hawaiian Name	Common Name	Scientific Name
Amaama	Striped Mullet	*Mugil cephalus*
Mu‘eke	Squid	*Thysanoteuthis rhombus*
Akule	Big eye scad	*Selar crumenothalmus*
Opelu	Mackerel scad	*Decapterus macarellus*
Ulua aukea	Giant trevally	*Caranx ignobilis*

Ten species of *limu* are listed in Table 4 as SOI. Twelve types of invertebrates are listed in Table 4. Out of those, helmet urchins and Kona crab were sampled and evaluated in the 2009 Marine Resources Study and will not be targeted for sampling in the supplemental study. In addition, the gastropods *pipipi* (*Nerita picea*), *opihi makaiauli* (*Cellana exarata*) and *opihi alinalina* (*Cellana sandwicensis*), and thin-shelled rock crab (*Grapsus tenuicrustatus*) will not be targeted for sampling in the supplemental marine resources study because of their small size. A very large number of specimens of those gastropods would be required to produce a single sample at the analytical tissue sample mass requirements (i.e., 200 g). Fish will not be targeted for sampling in the supplemental study because four species of fish from the nearshore area and four species of fish from Mākua were analyzed and evaluated in the 2009 Marine Resources Study. A list of *limu* and invertebrates considered for sampling for the supplemental marine resources study is presented in Table 5.

Table 5. Species of interest targeted for supplemental study.

Hawaiian Name	Common Name	Scientific Name
***Limu* – primary target species**		
Kohu	Red alga	*Asparagopsis taxiformis* (Figure 3)
***Limu* – secondary target species**		
Wāwae'iole	Green alga	*Codium edule*
Lipoa	Brown alga	*Dictyopteris plagiogramma; Dictyopteris australis*
'Ele'ele	Sea lettuce	*Ulva prolifera*
Huluhuluwaena	Red alga	*Grateloupia filicina*
Lepe'ula'ula	Red alga	*Halymenia formosa*
Līpe'epe'e	Red alga	*Chondrophycus dotyi, Chondrophycus succis*
Kala	Brown alga	*Sargassum aquifolium, S. obtusifolium; S. polyphyllum*
Pālahalaha	Sea lettuce	*Ulva lactua*
Invertebrates		
He'e, Tako	Octopus	*Octopus cyanea* (Figure 4)
Loli (Okuhikuhi)	Black Sea cucumber	*Holothuria atra* (Figure 5)

Species targeted for sampling

Limu target species

Limu is the Hawaiian term for plants from moist environments and is commonly applied to benthic algae, including red, green, and brown algae (Figure 3). About 550 species of native marine plants inhabit the coastal

Figure 3. Kohu; *Asparagopsis taxiformis.*

waters of Hawai'i. *Limu* can be eaten raw or cooked and is a source of great nutritional value with vitamins A, B, C, and riboflavin among others. *Limu* varies tremendously from species to species. *Limu* can differ in color, size, and habitat. Depending upon the species, *limu* can be found in shallow to deeper water. Collection (harvesting) also varies for each species. *Limu kohu* (*Asparagopsis taxiformis*) is the seaweed species selected for sampling (Figure 3). It is one of the most popular species of algae consumed in Hawai'i. This species is found on the edges of the reef in areas of constant water motion. It was selected for sampling and analysis by the Ordnance Reef study (Army 2011) and was listed most often as collected

from public survey data collected for this project (see Appendix C public survey form). In addition, the field survey conducted 30 April and 1 May 2013 found that this *limu kohu* was the most prevalent of the native Hawaiian (non-invasive) species at the sampling locations.

Invertebrate target species

Heʻe. *Heʻe* (Figure 4) *is* a mollusk from the class Cephalopoda. The Japanese name, *tako*, is commonly used in Hawaiʻi.

Figure 4. *He'e*, Tako; *Octopus cyanea.*

Hawaiʻi's commercial and recreational octopus fisheries employ mostly spearfishing and lure-and-line fishing. *Heʻe* is valued as food in Hawaiʻi and cooked octopus is commonly consumed as sushi or sashimi. *Heʻe* is also prepared as the Hawaiian specialty "tako poke," mixed salads of diced cooked octopus mixed with onions, other vegetables, and seasonings. Hawaiian octopus is landed every month of the year, but the biggest catches are made September to January. Hawaiʻi's octopus fishery is unusual in that subsistence and recreational fishermen land the large majority of the catch. *Heʻe* are plentiful along the shallow reefs and inshore areas of Kāneʻohe Bay and are sought by both commercial and recreational/subsistence fishers.

The most common *heʻe* consumed in Hawaiian waters, *Octopus cyanea*, known as Big Blue Octopus, Cyane's Octopus, and Daytime Octopus (Figure 4), was selected as the *heʻe* target species for sampling. More of the survey respondents listed collecting *heʻe* during daytime fishing. The field survey conducted found that *heʻe* is likely present in sufficient numbers for collection and analysis of the tissue to be conducted.

Loli. *Loli* are echinoderms from the class Holothuroidea (Figure 5). The common name is sea cucumber, and the Japanese name is *namako*. Some

Figure 5. Loli; Holothuria atra (black sea cucumber).

Hawaiʻians also refer to *loli* as *weli*. Many species of *loli* are used for food and for their medicinal properties, mainly in the Indo-Pacific region, and have been harvested for markets in the Indo-Pacific region for over a thousand years. The whole skin is consumed typically boiled and salted until it shrivels and turns black. In addition, the five muscle bands that run the length of the body are frequently consumed (http://www.youtube.com/watch?v=6mx0GDxfjQ4). Eighty-three species of *loli* are listed as occurring in Hawai'i by the Bishop Museum web page (http://www2.bishopmuseum.org/HBS/invert/holothuroidea.htm). Approximately fourteen species of those are common in Hawai'i's shallow waters, ranging in size from about 1 in. (2.5 cm) to 3 ft (0.9 m), but only certain species are eaten. Hawaiian species reported as used for human consumption include *Actinopyga mauritiana*, *Holothuria whitmaei*, *Actinopyga mauritiana*

and *Holothuria atra* (black sea cucumber) (Figure 5). *Holothuria atra* with the Hawaiian name of *O Kuhi Kuhi* is used for consumption as well as medicine. This species releases a liquid that is used by the Hawaiʻians as an antifungal cream. Since *Holothuria atra* has multiple uses and was found at both the Mākua area and the background locations in sufficient numbers for collection and chemical analysis of the tissue, it has been targeted for sampling.

Marine resources sampling strategy

Samples of target species, *limu*, *heʻe*, and *loli,* will be collected in the near-shore waters of Mākua. Nearshore habitats will be sampled by divers from the shore down to depths necessary for the collection of the target number or mass of specimens. Based on the input from the community, most marine resources are collected at depths of less than 50 ft; however, we are not limiting data collection to that specific depth. The sampling strategy for each location (Mākua, Mokulēʻia, or Kaʻena Point) will be to systematically collect samples from a wide areal distribution. For this effort, the entire length of shoreline will be broken up into 200-m intervals perpendicular to the beach. So for example, the length of the area for sampling from south to north in Figure 2 is approximately 4,000 m long, so the Mākua nearshore area would be divided into twenty 200-m-wide areas. Each of the 20 areas will be given a number, and the order of sampling by the field crew will be selected with a computer based random number generator. This will allow for a wider geographic region to be sampled, and also reduces potential bias in the sampling. For the Mokulēʻia region that stretch of beach is approximately 5,600 m long, so this region would be divided into twenty-eight 200-m-wide beach sample areas. For the Kaʻena Point region, the stretch of beach is approximately 6,000 m long, so the beach would be divided and numbered with thirty 200-m wide sample areas. The sampling will then be conducted from the shore out to a maximum depth of no more than 125 ft (38 m) of water with enough specimens collected for one sample of each of the three target species of *limu*, *heʻe*, and *loli*. The random number generator would be used to select the order for the 20, 28, or 30 beach regions for Mākua, Mokulēʻia, or Kaʻena Point, respectively.

Specimens of two or more separate species will never be combined to create any replicate sample. Single specimens of *heʻe* will be used for analysis. For *limu kohu* and *loli*, pooling of the consumable portions of same species from the same sampling area will be used to create a replicate sample of

sufficient mass for the chemical analyses. Each species sampled in the nearshore waters of Mākua will also be sampled from Mokulēʻia.

Samples will be analyzed for a suite of select constituents (Table 2) as per the 2007 Settlement Agreement. Approximately 200 g of tissue will be collected for each analytical sample in order to obtain sufficient material for analytical analysis and analytical laboratory batch QA/QC (i.e. laboratory blanks, matrix spike, and matrix spike duplicates).

The sampling effort will target replicate samples each of *limu kohu* (*Asparagopsis taxiformis*), *heʻe* (*Octopus cyanea*), and *loli* (*Holothuria atra*) at the nearshore waters of Mākua, Mokulēʻia, and Kaʻena Point for analyses of all COPC listed in Table 2. A different species of *limu (*from those listed in Table 5) found to be abundant at these locations will be targeted for sampling only if *limu kohu* is not available at the nearshore waters of Mākua in sufficient biomass for creating eight samples. Only one single species of *limu* (either *limu kohu* or a different species) will be sampled from the nearshore waters of Mākua and the background locations. An attempt will be made to collect eight samples of each of the target species of *limu*, *heʻe,* and *loli* (Table 5) from the nearshore waters of Mākua and at the two background locations during the dry season and a second time during the wet season resulting in an approximate total of 144 tissue samples analyzed (Table 6). This level of sampling effort will allow for a sufficient number of samples to calculate the average concentrations with a sufficient level of confidence necessary for human health risk assessment. While the collection of eight samples of each of the three target species of *limu kohu*, *heʻe,* and *loli* from the nearshore waters of Mākua and at the two background locations during two seasons is desired and will be attempted, it is not required for the human health risk assessment. A preliminary field survey confirmed the presence and the availability of the target species of *limu, heʻe,* and *loli* in sufficient quantities for conducting the proposed analytical work at the nearshore waters of Mākua and at the two background locations (Appendix B).

Background sampling locations

Overall guidance for selection of background sites is provided by the Environmental Protection Agency. "A background reference area, or control site, is the area where background samples will be collected for comparison with the samples collected on the site. A background reference area should have the same physical, chemical, geological, and biological characteristics as the site being

investigated, but has not been affected by activities on the site (USEPA, 1989). USEPA (1989) further states that "the locations of the background samples must be areas that could not have received contamination from the site, but that do have the same basic characteristics as the medium of concern at the site."

USEPA (2002c) states that "The ideal background reference area would have the same distribution of concentrations of the chemicals of concern as those which would be expected on the site if the site had never been impacted. In most situations, this ideal reference area does not exist. If necessary, more than one reference area may be selected if the site exhibits a range of physical, chemical, geological, or biological variability. Background reference areas are normally selected from off-site areas, but are not limited to natural areas undisturbed by human activities."

Background nearshore sampling will occur at two locations. One location will be on the north shore of Oʻahu around the end of Kaʻena Point. The second background location will be along the coast of Mokulēʻia Beach. These two locations were chosen as representative background sites because they are relatively close to Mākua Beach geographically and are in areas that have a greatly reduced potential for the presence of constituents commonly associated with military training. These areas have comparable ocean currents (although currents may vary in strength between the locations) and wave actions similar to those found at Mākua Beach. The background locations were selected in accordance with USEPA background site selection criteria (USEPA, 2002b).

Each island in the Hawaiian chain of islands has its own unique currents and oceanographic conditions as well as certain differences in the chemical composition of the lavas that constitute the shoreline and extend onto the ocean floor; therefore, it is most appropriate to select background locations on the same island as close in proximity as possible to MMR, but without the impact of military training. In addition, Kaʻena Point and

Table 6. Number of biota samples for each target species per location and sampling season.

Target Species	Sampling Location			Total
	Mākua	Mokulēʻia	Kaʻena Point	
Dry Season				
Limu Kohu	8	8	8	24
He'e	8	8	8	24
Loli	8	8	8	24
Wet Season				
Limu Kohu	8	8	8	24

He'e	8	8	8	24
Loli	8	8	8	24
Total				144

1. All samples will be analyzed for those compounds in Table 2.
2. Subsamples for MS/MSD analysis will be prepared by the lab using the excess biomass from the samples listed in this table.
3. A trip blank will be sent with each shipment containing samples to be analyzed for volatile organic compounds.
4. Mokulēʻia and Ka'ena Point represent background locations.

Mokulēʻia are largely rural areas similar to Mākua Beach. These two locations represent suitable background locations on Oʻahu.

Preliminary field survey of marine resources

To ensure adequate sampling success, a preliminary site survey was performed on 30 June and 1 May 2013 to assess the presence and availability of target species of *limu, heʻe,* and *loli* species in sufficient quantities for conducting the analytical work at the nearshore waters of Mākua and at the two background locations (Figure 6). The survey was conducted by Kapua Kawelo, Joby Rohrer, Stephen Turnbull, and Kaleo Wong. The nearshore area was surveyed down to a depth of approximately 50 ft. Extensive photographic recording was used for the visual taxonomic identification of the species present at Mākua and at the background locations, as well as to visually determine if the estimated abundance at the site. Target species of limu, heʻe, and loli were identified using field guides and expert knowledge. Sufficient biomass of the target species of *limu*, *heʻe*, and *loli* (Table 5) was determined to be available at the nearshore waters of Mākua and at the two background locations (Figure 6). See Appendix B for additional details and photos.

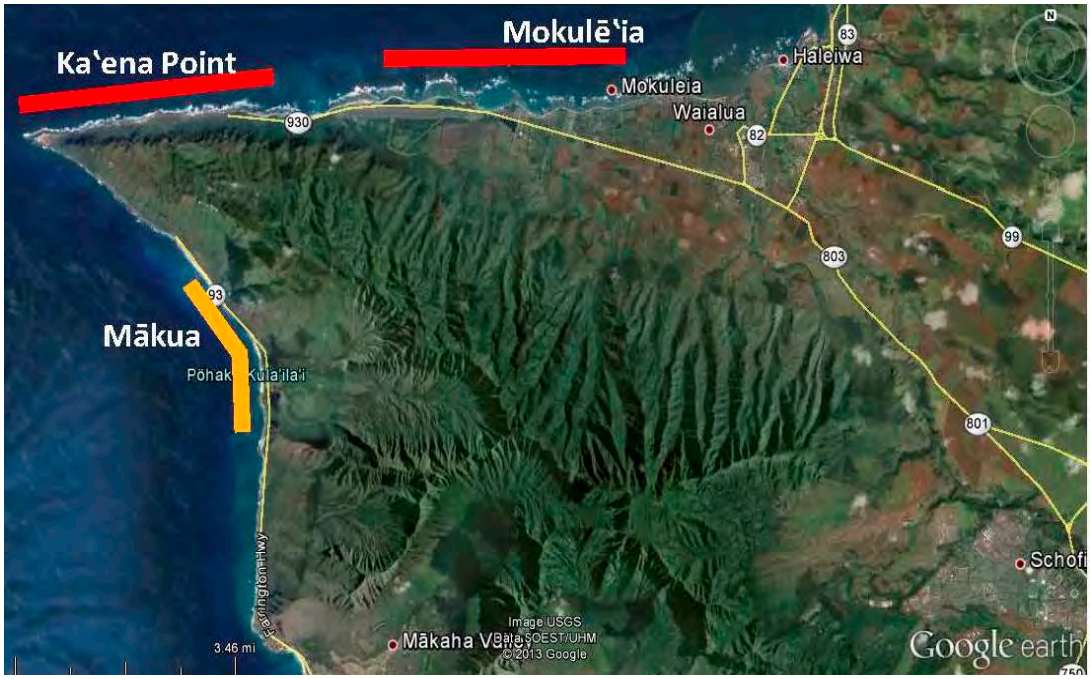

Figure 6. Background sampling locations in relation to Mākua Beach.

Sampling effort

Two sampling efforts will be conducted, one time during the dry season (tentatively September 2014) and a second time during the wet season (tentatively January 2014). The dry season in Hawaii is defined by the Department of Land and Natural Resources (DLNR) to occur from May 1 to October 31 of each year, and the wet season is defined to occur from November 1 to April 30 of each year. Wintertime on the west side of Oʻahu usually brings wave swells traveling from the northwest direction and that can result in large waves. In the late spring, summertime, and fall, the wave swells often arrive from the southwest and can also result in large waves, but generally smaller than in the winter. Sample collection times will largely be dictated by the weather when waves are lower and there are no small craft advisories issued by the National Weather Service. The two sampling periods are designed to evaluate the differences between the wet and dry periods, during the wet periods there can be infrequent flows of surface water from the land areas of Oʻahu to the ocean as a results of larger rainfall events and the two seasons also show differences in the direction of nearshore currents owing to the swell origins and wave directions.

The nearshore area will be sampled by local scuba divers down to a depth of approximately 125 ft. An attempt will be made to directly collect the

target species of *limu, he'e*, and *loli*. Sampled organisms will be identified by species by a scientist from the University of Hawai'i or Bishop Museum. *Limu kohu* will be handpicked using clippers and cut at the stipe above the holdfast. Then, the individual samples will be placed in plastic freezer type bags that have been prelabeled for site ID during collection. Before being weighed, the *limu* samples will be checked for any accidental removal of holdfasts. Any holdfast that was accidently removed will be reattached to the reef. *Loli* and *he'e* will be hand-collected from the sandy substrate, and the individual samples will be placed in plastic freezer type bags that have been prelabeled for site ID. Prior to shipping to the contract laboratories for chemical analysis, the ink sac and beak will be removed from each *he'e*. Similarly, the digestive tract of each *loli* will be removed, as it is typically filled with a substantial amount of sediment. As per public input, the secretion sac of the *loli*, which is used for medicinal purposes, will be included in the sample prepared for chemical analyses.

The randomness of the sampling of the subtidal habitat will be assured by the use of simple random sampling approach, which results in every sample having an equal chance of selection, and each unit assumed as representative of the entire population. Each sampling site will be divided into sampling units. The first sampling unit and subsequent sampling units will be selected using a random number generator, preventing the introduction of sampling bias by the personnel conducting the sampling. For *he'e* and *loli*, if no specimen is found in one sampling unit, an attempt will be made to sample two specimens from the next sampling unit selected for sampling. For *limu*, if the sampling mass is not sufficient for one analytical chemistry replicate, an attempt will be made to sample additional biomass in addition to a whole sample from the next sampling unit selected for sampling.

The location of each sample will be documented using a Global Positioning System (GPS) receiver with meter to sub-meter accuracy and illustrated in the field notes/drawings and geographic information system (GIS) product. This will allow any sampling point to be reacquired in the future if necessary.

Samples will be catalogued, prepared, and stored until processed using synthetic ice which is designed to maintain the samples in coolers. Samples will be transferred as soon as possible to walk in freezers and kept frozen at the University of Hawai'i at Mānoa prior to shipping directly to

the contract laboratories for analysis under chain-of-custody. The preparation of samples, will involve, but is not limited to, eliminating undesirable parts and retaining the parts that are typically consumed by residents. The ink sac and beak from the *heʻe* and the digestive tract of *loli* will be removed in a Class 100 laminar flow hood at UH. *Limu* will be rinsed in a Class 100 laminar flow hood to remove sediment particles, and submitted intact to the laboratory. A ceramic knife will be used for processing *heʻe* and *loli*, and all the plastic ware used for sample storage, handling, and processing will be scrupulously cleaned by a series of acid washing steps that exceed EPA recommendations, as previously described by Spencer et al. (1995) and De Carlo and Spencer (1997). These cleaning procedures were originally developed to minimize trace metal contamination prior to analysis but were equally applicable to prevention of contamination of any type during sample processing.

Sample identification

Field personnel will assign all marine resources sampling media identification numbers, using a multidigit alphanumeric code on a label or tag affixed to the container or to the individual specimens. This code will be assigned to each sample as a unique identification number to track target species samples collected during the study. The sample label will be printed on waterproof paper and will include, at a minimum, the following information (Table 7):

- job and site identifier
- date and time of collection
- sample identification number (including sampling location and target species identification information).

Table 7. Sample ID information.

Location	Sample ID
Mākua Beach	MB
Kaʻena Point	KP
Mokulēʻia	MK
Marine Resource	**Sample ID**
Limu	*Limu*
Heʻe	*Hee*
Loli	*Loli*

Sample handling, packing, and shipping

Samples will be shipped frozen with synthetic ice. Samples will be shipped by overnight express in a sealed cooler and under chain-of-custody (COC) to the analytical laboratories.

Sample custody

The purpose of sample custody procedures is to ensure that the integrity of the samples is maintained during collection, transportation, storage, and analysis. Sample identification documents will be prepared so that sample identification and COC are maintained, and sample disposition is controlled. Sample identification documents will include field notebooks, sample labels, custody seals, and COC records. Laboratory Analytical Requirements and Procedures

All contract laboratories providing testing services are NELAP certified and must have demonstrated proficiency in each of the required methods and must have recently generated MDL data available satisfying sensitivity requirements for the investigation (see *Project Quality Assurance Objectives*). All contract laboratories will follow quality control limits and guidelines as described in the DoD QSM. Where specific limits are not prescribed within the QSM, the method specific parameter limits will be used (e.g., USEPA SW-846). Laboratory specific quality control limits will only be utilized when neither of the former limits is available.

Sample preparation

The laboratory will ensure that sample integrity and COC are maintained. Unless processed immediately, samples will be stored frozen pending preparation for analysis but will be thawed for processing. Samples will be patted dry before homogenizing to reduce entrained water. Unless otherwise modified in this plan, samples will be prepared as described in the USEPA guidance manual for Assessing Chemical Contaminant Data for Use in Fish Advisories (USEPA 2000).

Complex matrices

It is noted that the majority of the analyses required for the current project are to be performed on what is considered a complex and 'non-standard' matrix, that of organisms growing in a high salt solution (seawater). Therefore, it is critical that the contract laboratories understand the

analytical challenges associated with execution of the required analyses and that matrix effect reduction techniques such as simple dilution may not produce data of sufficient quality in most instances. The list of potential matrix effects is extensive and likely not completely known due to the complex nature of marine organisms; however, specific examples are given below to assist in method refinement and modification by the contract laboratory as needed.

Metal determinations are likely to be impacted by polyatomic isobaric interferences in ICP-MS analyses by method 6020 as well as other non-specific matrix effects associated with digestion of complex biological material. Therefore, when appropriate, reaction and collision cell technologies should be applied to reduce these potential interferences. However, these technologies are not completely effective with some environmental matrix interferences, for example, double charged ions, and therefore monitoring of a secondary isotope or parent single charged ions is required for interference identification when possible.

Extraction clean-up procedures should be applied to minimize matrix interferences on explosives by 8330 and LC-MS techniques; furthermore, method 3620 should be considered for pesticides. Other analytical interferences may be encountered due to lipids or other biological components extracted from the organism concurrently with analytes of interest. Anti-foaming agents should be used for VOC analysis when applicable. Other clean-up procedures should be investigated, as needed, such as 3630. This list is merely an introductory example and suggestion, it is expected that the laboratory performing the analyses will have extensive expertise in the analysis of complex matrices and will employ clean-up procedures as needed, and will consult the project team as needed for input where particularly challenging issues are encountered.

Sample collection parameters and holding times

Holding times are the length of time a sample can be stored after collection and prior to analysis without significantly affecting the analytical results. Holding times vary with the analyte, sample matrix, and analytical methodology used to quantify the analytes' concentration. Maximum holding times (MHTs) have been established by the USEPA and have been presented in the Code of Federal Regulations (CFR); however, there is no regulatory approved hold time for arsenic speciation. Literature and Laboratory standard operating procedures (SOPs) vary in suggested hold time

for speciation from days to years, depending on species, matrix, and preservation technique. Holding times can be extended if preservation techniques are employed to reduce biodegradation, volatilization, oxidation, sorption, precipitation, and other physical and chemical processes.

A summary of sample collection parameters and holding times is provided in Table 8. Holding times start at the time of sample collection in the field. All sample containers will be maintained under COC procedures from the time of receipt to the time of sample analysis.

Table 8. Sample collection parameters for Mākua Military Reservation.

Chemical Category (Analytical Method)	Sample Storage	Holding Times
Polychlorinated Dibenzo dioxins and Polychlorinated Dibenzofurans (USEPA 1613B)	Store wrapped in Teflon bags on ice at or below -20°C.	1 year at or below -20°C. [a]
Organochlorine Pesticides (USEPA 8081A)	Store wrapped in Teflon bags on ice at or below -20°C.	1 year at or below -20°C. [a]
Metals (USEPA 200.8 Modified Hg by EPA 1631E; Methyl Hg by EPA 1630 Modified	Store wrapped in Teflon bags on ice at or below -20°C.	6 months at or below -20°C. [a, b] For mercury 28 days [a] (or 6 months b at or below -20°C). No USEPA promulgated method for methyl mercury in biological tissue currently exists.
Arsenic Speciation (USEPA 1632)	Store wrapped in Teflon bags on ice at or below -20°C., preserve where techniques have been developed	1 year at or below -20°C. [a]
VOCs/SVOCs USEPA 8270C, 8260B	Store wrapped in Teflon bags on ice at or below -20°C.	Holding times for tissue samples have not been established. Tissue samples should be stored frozen (-20°C) until analysis. [c]
Nitroaromatics and Nitramines USEPA 8330	Store wrapped in Teflon bags on ice at or below -20°C.	Maximum sample holding times for frozen tissues have not been established for explosives analysis. [d]
Perchlorate USEPA 6850	Store wrapped in Teflon bags on ice at or below -20°C.	Maximum sample holding times for frozen tissues have not been established for perchlorate analysis. [d]

[a] USEPA 2000.

[b] USGS National Water Quality Assessment Program (Crawford and Luoma 1993) recommends a maximum holding time of six months for all metals, including mercury.

[c] USEPA Method 5032 Volatile Organic Compounds by Vacuum Distillation (1996).

[d] SW-846 On-line http://www.epa.gov/sw-846/main.htm.

3 Data Review and Reporting

Data verification and validation

All contract laboratories will review all data for accuracy, consistency, and QA/QC nonconformances and will submit appropriate documentation in project deliverables supporting these verification activities. Additionally, the laboratories will identify any outliers or errors before reporting data to ERDC. Any outliers or data values significantly different from the population that result from errors detected during data review and verification will be identified and corrected.

In addition to the review of the laboratory's analytical data, a third party data validation will be performed to verify and ascertain the reliability of the analytical data for use in the risk assessment calculations. The third party will be a separate contractor from the laboratory or the field sampling contractor to provide an independent review of the data.

Review of the analytical data will be conducted incrementally on each data package. Analytical results will be thoroughly reviewed before inclusion in the report. There are three steps for review to achieve acceptable data for the purposes of this project. These steps are defined below.

Step 1 - Laboratory Data Review

The analytical laboratories will review their data before releasing data packages/reports to ERDC. This step is applicable for all data collected in support of this project. Laboratory records document the history of the sample and analysis from the time it enters the laboratory. The following list describes some of the commercial laboratory-specific records that may be compiled:

- Chain-of-Custody (COC)
- Sample Log-in Record
- Internal COC
- Extraction/Digestion Log
- Instrument Maintenance Log
- Instrument Sequence Log
- Raw Data for all Samples and Associated QA/QC

- All Generated Summary Report Forms
- All Manual Integration Records (before and after pictures)
- Standard Receipt and Preparation Log
- Certificates of Analyses for all Standards
- Exception Reports
- Corrective Action Records
- SOPs.

Process: Once the commercial laboratory receives samples, they are logged into the laboratory's laboratory information management system (LIMS). Minimum information content for log-in includes the field sample number, laboratory receipt date, COC status, condition in which sample arrived and any anomalies (e.g., intact, cracked lids, frozen, etc.), analyses requested, and other pertinent observations (temperature, preservation status, appearance etc.).

Personnel involved in sample extraction, digestion or other sample preparation techniques maintain a record of those activities in a bound logbook that is maintained as part of the project record. Other laboratory records contain the times that samples were prepared and analyzed to verify that holding times were met, and that COC and proper preservation were maintained. Any deviations from the approved QAPP, time of day, and date are also documented. Corrective action procedures to replace samples violating the protocol are also noted. Bound logbooks documenting all reference materials used for analytical purposes are maintained. General QC records, such as instrument calibration, routine monitoring of analytical performance, and calibration verification are maintained. Project-specific information from the QA/QC checks such as laboratory blanks (reagent, rinsate, and method), spikes (matrix, matrix duplicate, analysis MS, and surrogate spike), calibration check samples (zero check, span check, and mid-range check), replicates, splits, and so on are included in lab QA/QC reports to facilitate data quality analysis. Each instrument has a logbook reflecting routine and emergency maintenance activities, tuning, calibration, and all analytical activities conducted on the instrument.

Laboratories typically perform a three level review consisting of the following steps. The first level of review is performed by the responsible technician/analyst. The technician/analyst verifies that QC acceptance criteria have been met and that instrument operating conditions were

appropriate to the analysis performed. The second level is a peer review of the technician/analyst observations, calculations, and QC criteria, i.e., quality assurance or QA. A preliminary report is assembled as necessary, assuming any anomalies identified by the peer have been reconciled. A senior staff member performs the final review (QA), which consists of the completeness review of the final report.

Product: The analytical data will be provided in EPA Level III reports with laboratory QC data. Definitive level data reports include sample identification information, analytical results, and a summary of the QC data. The QC data include calibrations and verifications of precision, accuracy, and representativeness where appropriate; hard copies of all supporting information, including copies of instrument printouts, and all log pages pertaining to the work. Analytical results will include statements of sensitivity for non-detects whenever applicable. All case files will contain copies of or references to all relevant raw and processed data. However, as with bound logbooks, these data may not be replicated in each case file. If data manipulation or reduction is performed electronically, outside of the raw data produced by purchased instrumentation, the formulae or macros employed for these purposes will be validated by comparing the results of a sample manual calculation to the result produced electronically. This validation will be documented and maintained in central files. If dilutions are run for a sample, all results will be reported so that the concentrations of all components can be ascertained.

Step 2 - Data Verification

Verification is a completeness check that is performed before the data review process continues in order to determine whether the required information (the complete data package) is available for further review. It involves a review of all data inputs to ensure that they are present. The question answered by this step is: Are the inputs present? (Yes or no). Although this step is not designed for use in qualitative review (e.g., a compliance check that takes place during step IIa of the validation process), it is essential for ensuring the availability of sufficient information for subsequent steps. The Project Chemist will be responsible for completing the data verification and assessment. This step is applicable for all data collected in support of this project.

The third party data validation contractor will prepare data usability summary reports that asses the "usability" of a particular set of data, with this report included as an Appendix to the report for this effort. The third party data validation contractor will perform a review of the entire sampling and analytical laboratory process including; receipt and handling of data packages, project tracking, peer review for all data validation activities, electronic data transfer and verification processes. In addition, draft data sets will be submitted by the analytical laboratories to the data validation contractor with a weekly or twice monthly conference call to provide additional information on potential analytical data concerns.

Process: This is the process of evaluating the completeness, consistency, and compliance of a data package against the DQOs. This process requires a definitive data package. This verification process will include the following: review of the initial and continuing calibrations, results of the LCS, the MS/MSD, results of surrogate recoveries, results of associated method and extraction blanks, and results for laboratory duplicates.

Product: Following data verification, ERDC or their contractor will identify any corrective actions that may be needed. Corrective action may include re-sampling by the field team, preparation of a new split of the sample for analysis, or re-injection/re-analysis of previously prepared samples by the laboratory.

Step 3 - Data Validation

While the Army is responsible for the overall data validation, a third party validation contractor will be used to validate the laboratory data. Data validation procedures will be conducted in accordance with the requirements of *Intergovernmental Data Quality Task Force, Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA, June 2008, and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, USEPA, January 2010.* Additionally, all analytical results generated by the laboratory using manual integration will undergo data validation, as required by USEPA policy.

Process: Data validation will be Level III for the analytical data reported by the laboratories.

Product: Full data validation consists of validating the data using the guidelines in the UFP-QAPP and the USEPA National Functional Guidelines. Full validation includes recalculating the positive hits above the MRL. The validator will qualify the data as "U" for levels below the MDL, "J" for estimated values, and "R" for rejected values. If serious problems are encountered during the validation process, validation should be conducted on the next 10 percent of the raw data, and so on until a level of confidence is reached to accept or reject the data.

Data values that are significantly different from the population are referred to as "outliers." Outliers can result from improper sampling or analytical methodology, matrix interferences, errors in data transcription, and real, but extreme changes in analytical parameters. Outliers resulting from errors found during data validation will be identified and corrected, and those that cannot be attributed to analytical, calculation, or transcription errors will be retained in the database for further evaluation.

The original data quality objectives will be reviewed and a comparison of the results of the collected data with the quality objectives will be made by the ERDC chemists and the risk assessor. All data points will be evaluated to determine whether the information can be included in the site evaluation as the basis decision making. This evaluation will include the following items:

- Evaluation of the data validation results and assessment
- Reconciliation of all data received with that proposed in the SAP and the analyses requested on the COC documentation
- Compilation of all missing data points and notification of the PM and Laboratory QA Officer
- Review of laboratory QC check data applicable to all samples in one analytical batch for all sample shipments received
- Compilations of all check points outside method control ranges
- Assessment of the impact of laboratory QC data on data quality
- Review of field QC check data applicable to all samples in one sample shipment and for all shipments from the site
- Calculation of RPD values from concentrations of compounds or elements in the laboratory replicate pairs, as well as compilation of all blank contamination
- Assessment of the impact of field data on data quality
- Closure of all corrective action directives

- Assessment of project DQOs
- Calculations of project completeness.

The data validation will be performed independent of the laboratory generating the data and will be documented in the final report prepared upon receipt of the final data package. The process will identify any data omissions and out-of-control data points for QC included in the evaluation and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analysis may be made by the PM based on the extent of the deficiencies and their importance in the overall context of the project.

The data validation procedures will use the guidance and criteria in the UFP-QAPP, EPA's *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (January 2010) and *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (June 2008). Data evaluations will also be based on the QA/QC requirements of the referenced analytical procedures, QC objectives presented in this SAP, and professional judgment of the evaluator. At a minimum, data validation will include evaluation of:

- Sample receipt records
- Technical holding times
- Constituent MRLs
- Instrument tuning and calibrations
- Laboratory duplicate RPD results
- MS/MSD analyses (for organics only)
- MS/Post digestion spike analyses (for inorganics only)
- LCS (Laboratory Control Sample)
- Blank analyses
- Surrogate analyses (for organics only)
- Laboratory case narratives.

These data will be evaluated against established criteria defined in the project DQOs, and the criteria established in UFP-QAPP, EPA's *Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (January 2010) and *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*(June 2008), and the approved analytical method.

A report will be prepared and submitted to summarize the results of the data validation effort and to present the sample analysis results in tabular format. The format of the report will be as follows:

- Executive Summary
- Narrative summary of QA/QC activities
- Narrative summary of QA/QC results
- Data Summary Tables
- COC
- Laboratory Case Narratives (as required).

Data summary and reporting

At the conclusion of the supplemental marine resources sampling and analysis activities, results of the study will be presented in the form of a data report that will include tables, along with relevant analytical detection limits and QA/QC data. ERDC will also prepare a narrative report, summarizing the work conducted, the procedures used, interpretation and discussion of the data obtained, the conclusions reached, and recommendations made, if applicable.

All reports will be submitted initially in draft form by ERDC to the U.S. Army Garrison, Hawai'i for review and comment. Following incorporation of comments, ERDC will produce final hard copy and electronic versions of these deliverables, in numbers specified by the project scope of work. The U.S. Army Garrison, Hawai'i will distribute any subsequent reports to other interested parties. The validated data sets will be used for the calculations required in the risk assessment.

4 Human Health Risk Assessment

Risk assessment is a scientific process used to determine if site contamination is likely to cause unacceptable risks to human or ecological receptors. A human health risk assessment (HHRA) will be prepared using U.S. Environmental Protection Agency (USEPA) and Hawai'i Department of Health (DOH) guidelines, including:

- United States Environmental Protection Agency's (USEPA) Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (USEPA 2000)
- USEPA's Risk Assessment Guidance for Superfund (RAGS): Human Health Evaluation Manual, Part A (USEPA 1989) and other USEPA guidance documents (USEPA 1991a, 1991b, 1992, 1997, 2001, 2002a, 2004, and 2011a)
- Hawai'i Department of Health (DOH), State of Hawai'i. Evaluation of Environmental Hazards as Sites with Contaminated Soil and Groundwater (DOH 2011)
- USEPA's Regional Screening Level (RSL) Tables. Revised November 2012 (USEPA 2012).

The HHRA's objective is to evaluate from an extensive set of calculations whether contamination by COPCs in biota collected in the nearshore waters adjacent to MMR pose a risk to human health. Another objective is to determine whether the calculated human health risks from MMR are different than the risks associated with background concentrations of COPCs in other marine resources assumed to be unimpacted by MMR activities.

Risk-based screening human health risk assessment methodology

Generally, the first step of an HHRA is a risk-based screening assessment. The risk-based screening assessment compares maximum site contaminant concentrations to conservative screening values (SVs) or Project Action Levels (PALs). If the maximum site concentration for a COPC exceeds the project SV or PAL, then the COPC is carried forward into a baseline HHRA for further risk evaluation. For this assessment, multiple screening level approaches will be considered, including those promulgated by the USEPA Fish Advisories guidance document (USEPA

2000) and the USEPA RSL Fish Consumption Guidance (USEPA 2012). Although neither approach provides SVs that are directly applicable for the media to be evaluated in this assessment (i.e., sea cucumber, *limu*, and octopus), screening values for the consumption of fish using the USEPA Fish Advisories approach will be used to conservatively screen for potential risks and hazards. Table 9 presents the equations, exposure assumptions, toxicity values and Final SVs calculated for this assessment.

Table 9 also provides a comparison of calculated SVs to laboratory reporting limits. Most environmental contaminants at a site are not detected in every sample. A contaminant that is not detected above the detection limit in a sample could actually be present at a concentration that is less than the detection limit. It is therefore critical that the analytical methods selected for a site are sensitive enough to support the needs of the risk assessment (i.e., the detection limits for COPCs should be less than the screening levels to which they are being compared). For this assessment, if the laboratory reporting limit for a COPC is greater than the calculated SV, the COPC will be carried forward into the baseline HHRA.

Baseline human health risk assessment methodology

The remainder of this section describes the methodology of the quantitative baseline HHRA.

The HHRA can be divided into five steps that are organized as follows:

1. Hazard Identification (Data Evaluation and Reduction)
2. Exposure Assessment
3. Toxicity Assessment
4. Risk Characterization
5. Uncertainty Analysis.

The Hazard Identification step, sometimes known as the Data Evaluation and Reduction step is the process of identifying COPCs for evaluation in the HHRA. The Exposure Assessment step identifies the CSM for a site and includes an evaluation of all plausible exposure pathways. The Toxicity Assessment step identifies toxicity values and effects to evaluate carcinogenic risks and non-carcinogenic hazards. The Risk Characterization step integrates the information from previous steps to produce numerical estimates of carcinogenic risks and noncarcinogenic hazards. The final step, the Uncertainty Analysis identifies key

Table 9. Calculation of screening values.

EPA Fish Advisories (USEPA 2000)	
Noncarcinogens	**Carcinogens**
SVn = (RfD * BW)/CR	SVc = [(MRL/CSF)*BW]/CR
where:	where:
SVn = Screening value for a noncarcinogen (mg/kg; ppm)	SVc = Screening value for a carcinogen (mg/kg; ppm)
RfD = Oral reference dose (mg/kg -d) — see table below	MRL = Maximum acceptable risk level (dimensionless) From EPA Office of Water — 1.00E-05
BW = Mean body weight of the general population or subpopulation of concern (kg). BW=70 kg for all adults (EPA, 1999) — 70	CSF = Oral cancer slope factor (mg/kg-d) — see table below
CR = Mean daily consumption rate of the species of interest by the general population or subpopulation of concern averaged over a 70-yr lifetime (kg/d). CR=17.5 g/d for adult residential receptors. — 0.0175	BW = Mean body weight of the general population or subpopulation of concern (kg). BW=70 kg for all adults (EPA, 1999) — 70
	CR = Mean daily consumption rate of the species of interest by the general population or subpopulation of concern averaged over a 70-yr lifetime (kg/d). CR=17.5 g/d for adult residential receptors. — 0.0175

Noncarcinogens				Carcinogens							
Analyte	RfD From EPA IRIS (mg/kg-d)	RfD From EPA RSL's (mg/kg-d)	FINAL RfD (mg/kg-d)	CSF From EPA IRIS (mg/kg-d)	CSF From EPA RSLs (mg/kg-d)	FINAL CSF (mg/kg-d)	Fish Advisories SVn (mg/kg)	Fish Advisories SVc (mg/kg)	Final SV from Fish Advisories (mg/kg)	Proposed RL (mg/kg)	Proposed RL exceeds Fish Advisories SV (Y/N)
Dioxins/Furans											
HpCDD	not defined	not defined	not defined	not defined	1.30E+03	1.30E+03	not defined	3.08E-05	3.08E-05	5.00E-06	N
HpCDF	not defined	not defined	not defined	not defined	1.30E+03	1.30E+03	not defined	3.08E-05	3.08E-05	5.00E-06	N
HxCDD	not defined	not defined	not defined	not defined	1.30E+04	1.30E+04	not defined	3.08E-06	3.08E-06	5.00E-06	Y
HxCDF	not defined	not defined	not defined	not defined	1.30E+04	1.30E+04	not defined	3.08E-06	3.08E-06	5.00E-06	Y
PeCDD	not defined	not defined	not defined	not defined	1.30E+05	1.30E+05	not defined	3.08E-07	3.08E-07	5.00E-06	Y
PeCDF	not defined	not defined	not defined	not defined	3.90E+04	3.90E+04	not defined	1.03E-06	1.03E-06	5.00E-06	Y
OCDD	not defined	not defined	not defined	not defined	3.90E+01	3.90E+01	not defined	1.03E-03	1.03E-03	1.00E-05	N
OCDF	not defined	not defined	not defined	not defined	3.90E+01	3.90E+01	not defined	1.03E-03	1.03E-03	1.00E-05	N
TCDF	not defined	not defined	not defined	not defined	1.30E+04	1.30E+04	not defined	3.08E-06	3.08E-06	1.00E-06	N
TCDD	7.00E-10	7.00E-10	7.00E-10	not defined	1.30E+05	1.30E+05	2.80E-06	3.08E-07	3.08E-07	1.00E-06	Y
Gasoline (Purgeable Organics)											
Ethylbenzene	1.00E-01	1.00E-01	1.00E-01	not defined	1.10E-02	1.10E-02	4.00E+02	3.64E+00	3.64E+00	2.50E-02	N
m-Xylene	2.00E-01	2.00E-01	2.00E-01	not defined	not defined	not defined	8.00E+02	not defined	8.00E+02	2.50E-02	N
p-Xylene	2.00E-01	2.00E-01	2.00E-01	not defined	not defined	not defined	8.00E+02	not defined	8.00E+02	2.50E-02	N
o-Xylene	2.00E-01	2.00E-01	2.00E-01	not defined	not defined	not defined	8.00E+02	not defined	8.00E+02	2.50E-02	N
Toluene	8.00E-02	8.00E-02	8.00E-02	not defined	not defined	not defined	3.20E+02	not defined	3.20E+02	2.50E-02	N
Stryrene	2.00E-01	2.00E-01	2.00E-01	not defined	not defined	not defined	8.00E+02	not defined	8.00E+02	2.50E-02	N
1,2,4-Trimethylbenzene	not defined	not defined	not defined	not defined	not defined	not defined	not defined	not defined	not defined	2.50E-02	NSL

Noncarcinogens				Carcinogens							
Analyte	RfD From EPA IRIS (mg/kg-d)	RfD From EPA RSL's (mg/kg-d)	FINAL RfD (mg/kg-d)	CSF From EPA IRIS (mg/kg-d)	CSF From EPA RSLs (mg/kg-d)	FINAL CSF (mg/kg-d)	Fish Advisories SVn (mg/kg)	Fish Advisories SVc (mg/kg)	Final SV from Fish Advisories (mg/kg)	Proposed RL (mg/kg)	Proposed RL exceeds Fish Advisories SV (Y/N)
Metals											
Aluminum	not defined	1.00E+00	1.00E+00	not defined	not defined	not defined	4.00E+03	not defined	4.00E+03	2.80E-01	N
Antimony	4.00E-04	4.00E-04	4.00E-04	not defined	not defined	not defined	1.60E+00	not defined	1.60E+00	5.00E-03	N
Inorganic Arsenic	3.00E-04	3.00E-04	3.00E-04	1.50E+00	1.50E+00	1.50E+00	1.20E+00	2.67E-02	2.67E-02	1.00E-02	N
Barium	2.00E-01	2.00E-01	2.00E-01	not defined	not defined	not defined	8.00E+02	not defined	8.00E+02	6.00E-02	N
Beryllium	2.00E-03	2.00E-03	2.00E-03	not defined	not defined	not defined	8.00E+00	not defined	8.00E+00	8.00E-03	N
Cadmium	1.00E-03	1.00E-03	1.00E-03	not defined	not defined	not defined	4.00E+00	not defined	4.00E+00	3.00E-03	N
Chromium (VI)	3.00E-03	3.00E-03	3.00E-03	not defined	5.00E-01	5.00E-01	1.20E+01	8.00E-02	8.00E-02	1.80E-02	N
Cobalt	not defined	3.00E-04	3.00E-04	not defined	not defined	not defined	1.20E+00	not defined	1.20E+00	6.00E-02	N
Copper	not defined	4.00E-02	4.00E-02	not defined	not defined	not defined	1.60E+02	not defined	1.60E+02	3.00E-02	N
Iron	not defined	7.00E-01	7.00E-01	not defined	not defined	not defined	2.80E+03	not defined	2.80E+03	8.00E-02	NSL
Lead	not defined	not defined	not defined	not defined	not defined	not defined	not defined	not defined	not defined	4.00E-03	N
Manganese	1.40E-01	1.40E-01	1.40E-01	not defined	not defined	not defined	5.60E+02	not defined	5.60E+02	2.40E-02	N
Mercury	3.00E-04	3.00E-04	3.00E-04	not defined	not defined	not defined	1.20E+00	not defined	1.20E+00	1.20E-07	N
Methyl Mercury	not defined	1.00E-04	1.00E-04	not defined	not defined	not defined	4.00E-01	not defined	4.00E-01	1.00E-06	N
Selenium	5.00E-03	5.00E-03	5.00E-03	not defined	not defined	not defined	2.00E+01	not defined	2.00E+01	6.00E-02	N
Silver	5.00E-03	5.00E-03	5.00E-03	not defined	not defined	not defined	2.00E+01	not defined	2.00E+01	2.00E-02	N
Thallium	not defined	1.00E-05	1.00E-05	not defined	not defined	not defined	4.00E-02	not defined	4.00E-02	4.00E-02	N
Vanadium	not defined	5.00E-03	5.00E-03	not defined	not defined	not defined	2.00E+01	not defined	2.00E+01	1.40E-02	N
Zinc	3.00E-01	3.00E-01	3.00E-01	not defined	not defined	not defined	1.20E+03	not defined	1.20E+03	2.00E-03	N

Noncarcinogens				Carcinogens							
Analyte	RfD From EPA IRIS (mg/kg-d)	RfD From EPA RSL's (mg/kg-d)	FINAL RfD (mg/kg-d)	CSF From EPA IRIS (mg/kg-d)	CSF From EPA RSLs (mg/kg-d)	FINAL CSF (mg/kg-d)	Fish Advisories SVn (mg/kg)	Fish Advisories SVc (mg/kg)	Final SV from Fish Advisories (mg/kg)	Proposed RL (mg/kg)	Proposed RL exceeds Fish Advisories SV (Y/N)
Explosives (Nitroaromatics/ Nitramines)											
2,4 – Dinitrotoluene	2.00E-03	2.00E-03	2.00E-03	not defined	0.31	3.10E-01	8.00E+00	1.29E-01	1.29E-01	5.00E-01	Y
RDX	3.00E-03	3.00E-03	3.00E-03	1.10E-01	0.11	1.10E-01	1.20E+01	3.64E-01	3.64E-01	5.00E-01	Y
Nitroglycerin	not defined	1.00E-04	1.00E-04	not defined	0.017	1.70E-02	4.00E-01	2.35E+00	4.00E-01	5.00E-01	Y
Perchlorate	7.00E-04	7.00E-04	7.00E-04	not defined	not defined	not defined	2.80E+00	not defined	2.80E+00	4.00E-05	NSL
Organochlorine Pesticides											
4,4'-DDT	5.00E-04	5.00E-04	5.00E-04	0.34	3.40E-01	3.40E-01	2.00E+00	1.18E-01	1.18E-01	1.00E-02	N
Aldrin	3.00E-05	3.00E-05	3.00E-05	17	1.70E+01	1.70E+01	1.20E-01	2.35E-03	2.35E-03	5.00E-03	Y
alpha BHC	not defined	8.00E-03	8.00E-03	6.3	6.30E+00	6.30E+00	3.20E+01	6.35E-03	6.35E-03	5.00E-03	N
beta BHC	not defined	not defined	not defined	1.8	1.80E+00	1.80E+00	not defined	2.22E-02	2.22E-02	5.00E-03	N
delta BHC	not defined	not defined	not defined	not defined	not defined	not defined	not defined	not defined	not defined	5.00E-03	NSL
gamma BHC (Lindane)	3.00E-04	3.00E-04	3.00E-04	not defined	1.10E+00	1.10E+00	1.20E+00	3.64E-02	3.64E-02	5.00E-03	N
Heptachlor	5.00E-04	5.00E-04	5.00E-04	4.5	4.50E+00	4.50E+00	2.00E+00	8.89E-03	8.89E-03	5.00E-03	N
Heptachlor epoxide	1.30E-05	1.30E-05	1.30E-05	9.1	9.10E+00	9.10E+00	5.20E-02	4.40E-03	4.40E-03	5.00E-03	Y

Noncarcinogens				Carcinogens							
Analyte	RfD From EPA IRIS (mg/kg-d)	RfD From EPA RSL's (mg/kg-d)	FINAL RfD (mg/kg-d)	CSF From EPA IRIS (mg/kg-d)	CSF From EPA RSLs (mg/kg-d)	FINAL CSF (mg/kg-d)	Fish Advisories SVn (mg/kg)	Fish Advisories SVc (mg/kg)	Final SV from Fish Advisories (mg/kg)	Proposed RL (mg/kg)	Proposed RL exceeds Fish Advisories SV (Y/N)
VOCs/SVOCs											
Pyrene	3.00E-02	3.00E-02	3.00E-02	not defined	not defined	not defined	1.20E+02	not defined	1.20E+02	1.98E+00	N
Phthalate Esters:											
Bis(2-ethylhexyl) phthalate	2.00E-02	2.00E-02	2.00E-02	1.40E-02	1.40E-02	1.40E-02	8.00E+01	2.86E+00	2.86E+00	1.98E+00	N
Di-n-butyl phthalate	1.00E-01	1.00E-01	1.00E-01	not defined	not defined	not defined	4.00E+02	not defined	4.00E+02	1.98E+00	N
Diethyl phthalate	8.00E-01	8.00E-01	8.00E-01	not defined	not defined	not defined	3.20E+03	not defined	3.20E+03	1.98E+00	N
Dimethyl phthalate	not defined	not defined	not defined	not defined	not defined	not defined	not defined	not defined	not defined	1.98E+00	NSL
Di-n-octyl phthalate	not defined	1.20E-02	1.20E-02	not defined	not defined	not defined	4.80E+01	not defined	4.80E+01	1.98E+00	N
Metal Speciation											
Inorganic Arsenic	3.00E-04	3.00E-04	3.00E-04	1.50E+00	1.50E+00	1.50E+00	1.20E+00	2.67E-02	2.67E-02	TBD	TBD

Notes:

Final RfD values are the lower value between the EPA IRIS and EPA RSL values. Final CSF values are the higher value between the EPA IRIS and EPA RSL values.

Screening Values calculated by methods described in US EPA Fish Advisories (USEPA, 2000) using default parameters and the lower RfD and higher CSF from EPA IRIS or EPA RSLs.

Final Screening Value (SV) is the lowest of the carcinogenic and noncarcinogenic SV.

No Screening Value could be determined for Trimethylbenzene, 1,2,4- as only the inhalation pathway is considered (only an RfC defined has been defined).

CSFs for the dioxin congeners are calculated from the toxicity of 2, 3, 7, 8-TCDD based on World Health Organization toxic equivalency factors (WHO, 2005).

Exact congener of PeCDF was not defined, therefore the conservative approach used a TEF of 0.3 for 2, 3, 4, 7, 8-PeCDF.

IRIS - EPA Integrated Risk Information System.

NSL - No Screening Level available to compare to Proposed RL.

RL - Reporting Limit.

RSL - EPA Region Screening Level Tables (USEPA, 2012).

uncertainties and evaluates their potential impacts on the risks. Each of these steps is discussed in detail in the following sections.

Hazard identification (data evaluation and reduction)

The purpose of the hazard identification (data evaluation and reduction) process is to ensure the data collected is appropriate for use in a HHRA and to identify COPCs. COPCs are those chemicals for which there are reason to believe they are present at the site and may have potential adverse impact to human health. A list of COPCs is determined after a thorough evaluation of all relevant datasets and data quality. The HHRA will be conducted using data collected during this study and applicable data from prior studies. Data quality review procedures were presented in Section 4. All organic compounds and metals analyzed and detected in biological samples from the site are identified as COPCs for this risk assessment (Table A2). Any chemical not detected in any biota species will be eliminated from further evaluation in the risk assessment process unless the reporting limit concentration is above the screening level concentration.

Exposure assessment

The purpose of the exposure assessment is to quantify human exposure to chemical constituents for complete exposure pathways. Human exposures will be assessed for consumption of marine resources from the nearshore environment following standard USEPA guidance and Hawaiʻi - specific consumption rates, as applicable and available (USARHAW and 25th ID (L) 2009). In this HHRA, past, current and future uses of the water adjacent to MMR will be evaluated to determine potential relevant exposure scenarios. While these exposure scenarios represent hypothetical people and activities, they reflect the physical description of MMR and the surrounding residential, industrial and commercial areas, as well as the activities that may typically occur in these areas. The exposure assessment will be divided into the following five subsections:

- Development of the conceptual site model (CSM)
- Methods used to estimate Exposure Point Concentrations (EPCs)
- Exposure factors and algorithms
- Absorption factors and permeability constants
- Method used to estimate average daily dose.

The CSM developed for the area of concern is presented in Figure 7. The CSM identifies the likely contaminant source areas, exposure pathways, and potential receptors. For any contaminant to pose a risk to human health, a complete exposure pathway must exist between the source (e.g., chemicals) and receptor. If a complete exposure pathway does not exist, a receptor has an acceptable (i.e., low) risk because it will not be exposed to the contaminant. The primary purpose of the CSM is to identify the potential pathways for exposure to COPCs that may have been released from activities at MMR. The CSM defines the source area, presents potential routes of transport and fate, identifies media and routes of exposure, and the endpoint receptors. The CSM is a dynamic model that is used to include or exclude sources of COPCs, receptors, or exposure pathways, based on site history and current information. The identified potential exposure routes for this assessment include ingestion of contaminated media (biota). Receptors to be assessed include residents and recreational and subsistence fishermen who reside in areas surrounding MMR. To be health protective and provide a range of risk estimates for the current and future residential scenario, both "high end" and "average" resident seafood consumers will be evaluated. For this project, consumption values of recreational and subsistence fishermen have been determined to be no different than the residential user. Only current and future residents will be quantitatively evaluated in this HHRA. Evaluation of the "high-end" residential consumer scenario will be used as a proxy receptor approximately equivalent to the subsistence fisherman scenario. Evaluation of the "average" residential scenario will be used as a proxy receptor approximately equivalent to the recreational fisherman scenario.

Derivation of EPCs

EPCs for contaminants detected are to be estimated using all relevant analytical data collected during applicable investigations. The USEPA recommends that a reasonable maximum exposure (RME) be based on a plausible upper-bound estimate of exposure rather than the worst case exposure scenario. For the RME scenario, the EPC should be based on the 95% Upper Confidence Limit (UCL) on the arithmetic mean. The underlying distribution of the analytical data should be evaluated to determine if the arithmetic, logarithmic, gamma or non-parametric statistics should be

Development of the CSM

Figure 7
Human Health Risk Assessment
Conceptual Site Model
Mākua Military Reservation, O'ahu, Hawai'i

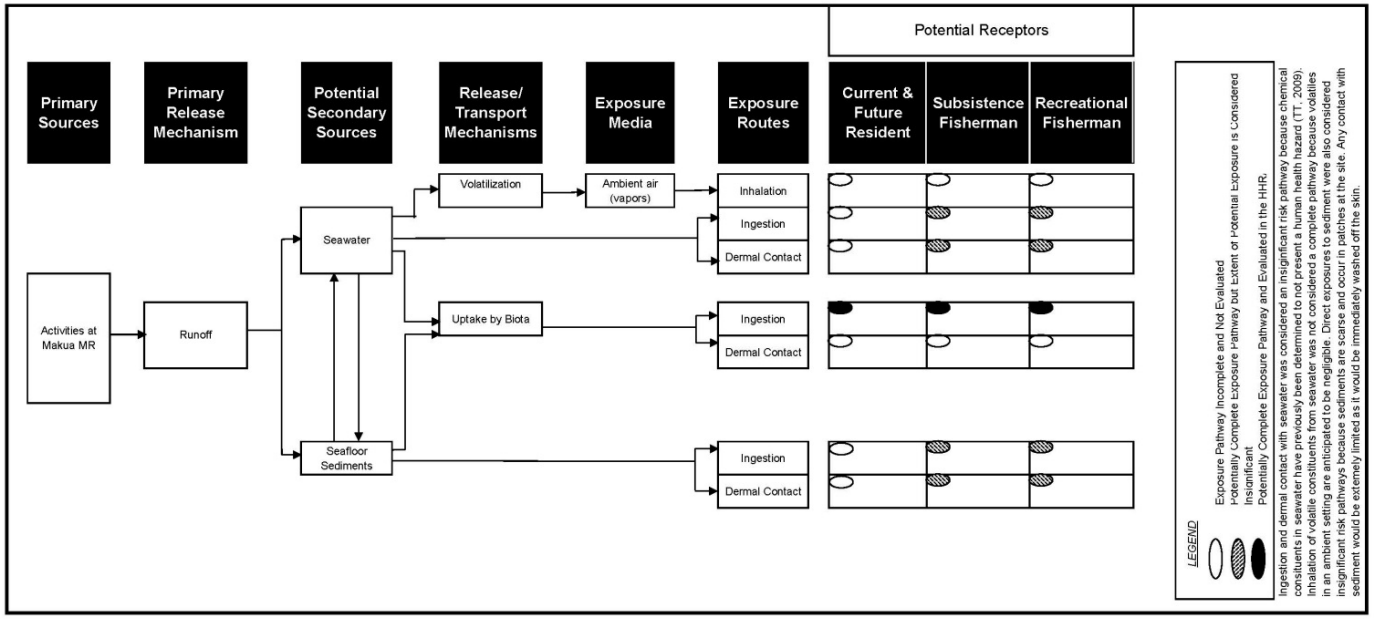

Figure 7. Human health risk assessment conceptual site model for Mākua Military Reservation, O'ahu, Hawai'i.

used (USEPA 2002a). For this assessment, the EPC for the RME scenario will be based on the 95% UCL mean value.

USEPA's ProUCL Version 4.01.00 (ProUCL) software (USEPA 2011b) will be used to calculate the 95% UCL of the mean for each contaminant carried into the HHRA as noted above and per USEPA guidance (USEPA 2002a). This HHRA will use the 95% UCL of the mean values from the ProUCL recommended distribution as the RME EPC. The USEPA has determined that the average concentration of a COPC represents a reasonable estimate of the contaminant concentration in an environmental medium that a receptor may potentially contact when that contact occurs at random over an extended period of time (USEPA 2002a). Consistent with USEPA guidance, when the 95% UCL mean value exceeds the maximum value detected, the RME EPC will be based on the maximum detected value.

As discussed previously, most environmental contaminants at a site are not detected in every sample; therefore, sample specific detection limits must be incorporated into the calculation of EPCs. From a risk assessment perspective, detection limits provide valuable information that should be incorporated into the evaluation. Incorporating non-detected results into the HHRA requires professional judgment and site-specific information. The guiding principle when evaluating non-detected data is that the EPCs should be representative of site conditions. The USEPA recommends that if there is reason to believe that a contaminant is present in a sample at a concentration below the detection limit, then a proxy level should be used to represent the sample concentration for the samples in which the contaminant was not detected. The current risk assessment will use ProUCL's estimates for non-detected sample concentrations, which are based on the distribution of the data set and detection limits. This method is assumed to yield a statistically precise and accurate estimate of non-detect sample concentrations.

Derivation of arsenic EPC

A key objective of this study is to determine the organic and inorganic fractions of arsenic present in *limu* or other marine resources. It is generally assumed that the inorganic fraction of arsenic is most toxic to human health. This assessment will incorporate the fraction of arsenic present in the inorganic form in biota and use the absolute inorganic concentration as the arsenic EPC.

Exposure factors and algorithms

The USEPA has identified standard default exposure factors that are appropriate to use when evaluating exposures at sites (USEPA 1991c). General residential exposure factors are to be used in this assessment where applicable (e.g., exposure frequency, exposure duration, body weight, averaging time etc.). Site-specific exposure factors are further discussed below.

To estimate the potential risk to human health that may be posed by the presence of COPCs in seafood species in the nearshore environment adjacent to MMR, it is first necessary to estimate the potential exposure dose of each COPC. The potential exposure dose is similar to the administered dose or applied dose in a laboratory experiment. The animal-derived cancer slope factors (CSFs) and reference doses (RfDs) used in quantitative risk assessments are based on applied doses in most cases. However, the efficiency of COPC absorption via a particular route and from a particular matrix at the site may differ from the absorption efficiency for the exposure route and matrix used in the experimental study that serves as the basis for the CSF or RfD. Relative absorption factors (RAFs) allow risk assessors to make appropriate adjustments if the efficiency of absorption is known to or expected to differ because of physiological effects and/or matrix or vehicle effects. RAFs can be less than or greater than one, depending on the COPC and potential routes of exposure at a site. When RfDs and CSFs are based on administered doses, the RAF is calculated as the ratio of the estimated absorption for the site-specific medium and route of potential exposure, to the known or estimated absorption for the laboratory study from which the RfD or CSF was derived. In this assessment, oral absorption from the site-specific exposure will be assumed to be the same as absorption in the laboratory study. The oral RAFs were therefore assigned a value of 1 and the potential exposure dose via the oral route will not be modified.

To calculate the dose in which receptors may be exposed, the average ingestion of the seafood species collected in this investigation must be estimated. This investigation will use applicable ingestion rates from the 2009 Marine Resources Study (USARHAW and 25th ID (L) 2009) and the 2012 Ordnance Reef Human Health Risk Assessment (University of Hawai'i 2012). The 2009 Marine Resources Study references Sharma et al. (2003) which surveyed Japanese Americans (n = 54,248), native Hawai'ians (n = 13,629), and whites (n = 47,236) in Hawai'i. The 2012

Ordnance Reef Human Health Risk Assessment conducted a limited seafood consumption survey of residents in the Waianae community to determine average seafood consumption of several species including fish, octopus, crab and *limu*. If these studies do not produce applicable consumption rates for use in this investigation, additional surveys or resources may be referenced to produce accurate site-specific average consumption rates.

Method to estimate average daily dose

Conservative exposure assumptions will be used to construct the exposure scenarios evaluated in the HHRA. Most individuals will not be subject to all the conditions that comprise the scenarios evaluated in this assessment. Individuals who do not meet all conditions of the scenarios evaluated have lower potential exposures to MC; therefore, lower potential risks associated with those exposures.

The Chronic Average Daily Dose (CADD) is an estimate of a receptor's potential daily intake from exposure to contaminants with potential non-carcinogenic effects. Note that Average Daily Dose (ADD) is a term used in risk assessment and does not represent a true average because the assumptions used to derive it do not represent “averages. According to USEPA (1989), the exposure dose should be calculated by averaging over the period of time for which the receptor is assumed to be exposed. The CADD for each contaminant via each route of exposure is compared to the RfD for those contaminants to estimate the potential hazard index due to exposure to that constituent via that route of exposure.

For constituents with potential carcinogenic effects, the Lifetime Average Daily Dose (LADD) is an estimate of potential daily intake over the course of a lifetime. Per USEPA (1989), the LADD is calculated by averaging the assumed exposure over the receptor's entire lifetime. The LADD for each constituent via each route of exposure is combined with the CSF for that constituent to estimate the Potential Excess Lifetime Cancer Risk (PELCR) due to exposure to that constituent via that route of exposure.

Toxicity assessment

The USEPA states that the purpose of the toxicity assessment is to “weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and to provide, where possi-

ble, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects" (USEPA 1989). In essence, the toxicity assessment can also be described as a Dose-Response Assessment. A Dose-Response Assessment is used to identify both the types of adverse health effects a COPC may potentially cause, as well as the relationship between the amount of COPCs to which receptors may be exposed (dose) and the likelihood of an adverse health effect (response). The toxicity assessment will evaluate the potential for the COPCs at the site to cause adverse health effects. The USEPA characterizes adverse health effects as either carcinogenic or non-carcinogenic and dose-response relationships are defined for oral and inhalation routes of exposure. The results of the toxicity assessment, when combined with the results of the exposure assessment, provide an estimate of potential risk. For this assessment, only oral toxicity values will be presented and used.

The toxicity assessment will consist primarily of a tabulation of critical toxicity values obtained preferentially from the most recent postings of toxicity values (both carcinogenic slope factors and noncarcinogenic reference doses), provided in the USEPA Integrated Risk Information System (USEPA 2013), and toxicity values used in the Hawai'i DOH Environmental Action Levels (DOH 2011).

Risk characterization

The risk characterization will follow USEPA (1989) and Hawai'i DOH guidance and will integrate the exposure assessments and toxicity assessment to produce quantitative estimates of potential health risks due to the COPCs detected at the site. The key components of the risk characterization process include the following:

- quantify risks from individual contaminants
- quantify risks from multiple contaminants
- combine risks across exposure pathways.

Due to the fundamental differences in the calculation of critical toxicity values, the estimates of potential excess carcinogenic risk probabilities and noncarcinogenic hazard indices will be developed separately for human receptors. Risks will be determined for both individual chemicals as well as for additive effects. Risk characterization is the starting point for risk

management considerations and the foundation for regulatory decision making, but it is only one of the important components in such decisions.

Quantifying carcinogenic risks

The risk of cancer from contaminant exposure is described in terms of the probability that an exposed individual will develop cancer during a person's lifetime from that exposure. The risk estimate is calculated by multiplying the daily intake of a particular contaminant over a lifetime by the slope factor.

When the carcinogenic risk is less than one in 100 (i.e., 1×10^{-2}), the following equation is used (USEPA 1989):

$$RISK = LADD \times SF$$

When the carcinogenic risk is greater than one in 100 (i.e., 1×10^{-2}), the following exponential equation should be used (USEPA 1989): RISK = 1 - exp (-LADD × CSF) where

RISK = lifetime probability of developing cancer due to exposure to a chemical (contaminant) in the environment
LADD = lifetime average daily dose of a chemical (contaminant) (mg/kg-day)
CSF = carcinogenic slope factor for a chemical (contaminant) $(mg/kg\text{-}day)^{-1}$
exp = the exponential

All carcinogenic risks for contaminants for each scenario and receptor are then summed to yield the total carcinogenic risk. A one in one million carcinogenic risk (i.e., 1×10^{-6}) means that, in a population of 1,000,000 people exposed under an identical exposure scenario (i.e., had exactly the same daily intake of a carcinogen over the same time period), there could be one additional case of cancer in the population above the normal background rate.

Evaluating non-carcinogenic health effects

Adverse non-carcinogenic health effects from exposure to a COPC are quantitatively expressed as a Hazard Quotient (HQ). The HQ is the ratio of

a human's estimated intake of a particular chemical (contaminant) to the RfD.

$$HQ = ADD / RfD$$

where

HQ = Hazard quotient, the ratio of the estimated dose of a chemical (contaminant) to the RfD
ADD = Average daily dose of a chemical (contaminant) (mg/kg-day)
RfD = Reference dose for a chemical (contaminant) (mg/kg-day)

The RfD is the threshold intake level for a particular contaminant below which it is unlikely that even sensitive subpopulations would experience adverse health effects. Usually, only chronic HQs are evaluated, as the sub-chronic effects within a given exposure scenario are typically less than or equal to the chronic effects for the same scenario. For non-carcinogenic health effects, HQs are added across contaminants when they target the same organ, or produce the same critical effect to calculate a segregated HI. Segregation of HIs requires the identification of the adverse effects of each contaminant. Major effect categories include:

- neurotoxicity
- developmental toxicity
- reproductive toxicity
- immunotoxicity
- adverse effects by target organ (i.e., hepatic, renal, respiratory, cardio-vascular, gastrointestinal, hematological, musculoskeletal, dermal, and ocular effects).

If the total segregated HI is less than 1, it indicates that adverse non-carcinogenic health effects are extremely unlikely. If the total segregated HI is greater than 1, it indicates that adverse health effects are possible. Often times all HQs are added together to determine the total HI. If the total HI is greater than 1, then the HQs should be segregated by target organ or critical effect and then compared to the target risk goal.

Supplemental risk characterization

To provide a better understanding of potential risks, the HHRA will also include a supplemental risk characterization that quantifies risks and

hazards above calculated background concentrations. Background biota samples are to be collected as part of this investigation. These samples will be addressed following USEPA guidance "Role of Background in the CERCLA Cleanup Program" OSWER 9285.6-07P (USEPA 2002b), and topics discussed in EPA Region 10 Statistical Experts' Workshop (USEPA 2008) to establish background concentrations found in biota assumed to be not impacted by MMR activities.

Uncertainty analysis

The purpose of the uncertainty analysis is to present an evaluation of the uncertainties that enter the risk assessment at each step of the process to allow regulators, stakeholders, and risk managers to put the risks in proper context. The risks presented in HHRAs are conditional estimates, based on a number of assumptions about exposure and toxicity given a particular land use scenario. Uncertainties are introduced to a risk assessment because a range of values could be used for each assumption, but only a few actually are. Consistent with USEPA policy, more conservative (i.e., upper bound) values are generally chosen for each parameter, while other values (i.e., values closer to the central tendency) may be more representative of site-specific conditions (USEPA 1989). Choosing upper bound values for each parameter typically results in overly conservative risks that do not reflect site-specific conditions. Uncertainties are used to "bracket" the range of risks that could result from choosing alternate values for the parameters used in calculating risks. USEPA Guidance for Risk Characterization states that, "Particularly critical to full characterization of risk is a frank and open discussion of the uncertainty in the overall assessment and in each of its components" (USEPA 1995). There are several key reasons why uncertainty is discussed in the HHRA:

- Risk characterization involves the integration of a variety of different types of information. It is important to communicate the uncertainties associated with the different types of information in order to provide a context for evaluating the overall results.
- For a risk manager or stakeholder to evaluate a HHRA, the magnitude of the uncertainties in the evaluation must be understood.
- Discussions of the uncertainties in a HHRA will help risk managers evaluate the need for collecting additional information (USEPA 1995).

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Appendix A: Quality Assurance and Quality Control

ERDC will implement a QA/QC program during the marine resources study to ensure the precision, accuracy, and representativeness of the analytical results. Essential elements of this QA/QC program are detailed below.

Three-phase quality control process

A three-phase QC program will be implemented during marine resources study, as described below, including a preparatory phase inspection, an initial phase inspection, and a follow-up inspection. Production work will not be performed on a definable task until a successful preparatory and initial phase inspection has been completed. During these inspections, the Project Manager (PM) will verify that the requirements of this SAP have been followed.

Preparatory phase inspection

Before conducting any feature of work, the PM will check that technical requirements have been planned for and that work prerequisites have been identified and met. Discrepancies among existing conditions and approved plans and procedures are to be resolved, and the PM or designee should verify that unsatisfactory and nonconforming conditions identified during a preparatory inspection have been corrected before granting approval to begin work. In addition, the project chemist will hold a project kickoff meeting with the contract laboratories to discuss the SAP and the raw requirements for this study. Results of this meeting will be documented in the preparatory inspection checklist and reported to the U.S. Army Garrison, Hawai‘i, in a letter report.

Initial phase inspection

The second QC phase consists of checks performed during the initial marine resource sampling activities. During the first full day of field work, the PM or designee will monitor the work and verify compliance with the specifications and requirements of the contract, delivery order, and approved plan procedures. The PM or designee is responsible for ensuring

that discrepancies between site practices and approved specifications are identified and resolved. The PM or designee will verify that discrepancies between site practices and approved plans and procedures are resolved and that corrective actions for unsatisfactory and nonconforming conditions or practices have been taken before granting approval to proceed. Results will be summarized in the weekly operational QC report.

Follow-up phase inspection

During each day of marine resource sampling activities, the PM or designee is responsible for monitoring the practices and operations taking place on-site and for verifying continued compliance with the specifications and requirements of the contract, delivery order, and approved project plans and procedures. The PM or designee will verify that discrepancies between site practices and approved plans and procedures are resolved and that corrective actions for unsatisfactory and non-conforming conditions or practices have been met before granting approval to proceed. Results will be summarized in the weekly operational QC report.

Project quality assurance objectives

All analytical data will be reviewed with respect to project-specific data quality objectives, which include attainment of adequate precision, accuracy, representativeness, comparability, and completeness (PARCC). Of the PARCC parameters, precision and accuracy will be evaluated quantitatively through the collection and analysis of QA/QC samples as listed in Table A1. Criteria for individual analyses will follow and adhere to the performance provisions appropriate to the respective contract laboratory QA/QC programs. Standard QC protocols will be followed according to method specified.

Precision

Precision is a measure of reproducibility as determined by the degree of agreement between multiple measurements of the same parameter under identical conditions. Precision is expressed quantitatively as the extent of variability of individual measurements from the mean of multiple measurements.

Table A1. QC samples for precision and accuracy.

QC Type	Precision	Accuracy	Minimum Frequency
Laboratory QC	MS/MSD RPD	MS/MSD %R	1/20 samples
	LCS/LCSD RPD	LCS/LCSD %R	1/20 samples
		Method Blank	1/20samples

Notes:

%R = percent recovery.

LCS/LCSD = laboratory control sample/laboratory control sample duplicate. MS/MSD = matrix spike/matrix spike duplicate.

RSD = relative standard deviation. RPD = relative percent difference.

Method guidance defines an analytical batch as 20 samples, with associated QC included at a rate of at least 1 per 20 sample batch for MS/MSD and LCS.

Laboratory method precision will be evaluated by analyzing laboratory duplicates. The Relative Percent Difference (RPD) for laboratory duplicates will be calculated using following equation:

$$RPD = \{ |A - B|/[(A+B)x100] \} \times 100$$

where:

A = primary sample concentration
B = duplicate sample concentration

Laboratory duplicates will be analyzed at a frequency of at least 5% of each species collected during the study as required by method guidance. Each set of duplicates will be prepared from the parent sample in the laboratory; for composite samples sub-sampling for the duplicate analyses will be done after the material is "homogenized" (i.e., blended). The goal for laboratory precision is a RPD of 35%. Data that do not meet these precision criteria may be qualified as estimated (i.e., "J") during data validation. An independent third party consultant will be used to validate the data. RPDs cannot be calculated in instances where one or more values are non-detects. In addition, RPDs for trace or low-level results may not be appropriate for evaluation of precision. In these cases, an evaluation will be made during data validation based on comparison of the results with respect to the limit of quantitation (LOQ). RPDs will be calculated only if detected concentrations are reported for both duplicates and at least one of the detects is greater than the LOQ. The RPDs of the laboratory duplicate results will be summarized in table form.

The “field” component of the variability will be evaluated by collecting and analyzing eight independent field replicates for each study area and environmental population (e.g., species) of interest. The additional replicates will provide a more reliable measure of precision than field duplicates. The results will be summarized using appropriate descriptive statistics (e.g., for centrality and dispersion). Descriptive statistics will typically include the following (depending on the proportion of data censoring): minimum detected concentration, maximum detected concentration, median, mean, standard deviation, proportion of detects, minimum reporting limit for the non-detects, maximum reporting limits for the non-detects, and 95% upper confidence limit of the mean. Viable and statistical methods (e.g., hypothesis tests for centrality) will be used to compare background concentrations with study area concentrations and the project's decisions limits. Laboratory duplicate results will be averaged prior to conducting statistical comparisons.

Accuracy

Accuracy is a measure of the deviation (or agreement) between an analytical measurement and the true or accepted value for a known material. The accuracy of a measurement system can be affected by errors introduced by cross-contamination in the field sampling process, sample preservation, sample handling, matrix sample preparation, analytical techniques, and cross-contamination in the laboratory. A program of sample spiking will be conducted to evaluate laboratory accuracy. This program includes analysis of the MS/MSD samples, LCS/LCSD samples, and method blanks. MS/MSD and LCS/LCSD samples are analyzed at a frequency of one per batch; a batch of samples is limited to 20 samples. The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy.

Accuracy is expressed as the percent recovery of an analyte that has been added (spiked) to an environmental sample in a known concentration before extraction/analysis. Accuracy is calculated using the following equation:

$$\text{Percent Recovery} = \frac{(C + S) - C}{T} \times 100$$

where:

S = measured spike sample concentration
C = sample concentration
T = true or actual concentration of the spike

Concentrations and recovery limits for spiked samples are based on the type of sample being analyzed. Appropriate spike concentration levels are specified in the analytical methods. If the spiking levels for MS/MSD and LCS/LCSD are not provided, the spiking will be conducted at a mid-calibration concentration level.

Laboratory data will meet the accuracy criteria, which include internal laboratory and method criteria. Data that do not meet the accuracy criteria may be qualified as estimated ("J") or may be rejected ("R") during data validation.

A summary of accuracy results (e.g., a mean and standard deviation of surrogate recovery values for each analytical method, by matrix) may be provided to give an overall assessment of the accuracy.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition. For this project, representative data will be obtained by selecting sampling locations and by collecting multiple specimens. The following questions may be asked to assess representativeness:

- Were the appropriate species sampled?
- Were samples handled correctly?
- Were samples collected from appropriate locations?
- Were an appropriate number of samples collected and analyzed?
- Did other factors bias the results?

Comparability

Comparability is a qualitative parameter that expresses the degree of confidence with which one data set can be compared to another. Comparability of data will be achieved by consistently following proce-

dures for sampling and field activities, by using the same types of sampling equipment at each location, and by using standard measurement units in reporting analytical data. Laboratory data will be reported in consistent units for each analytical test (i.e., mg/kg wet weight for analytical results).

Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this SAP and when none of the QC criteria that affect data usability are exceeded. Data that are validated and qualified as estimated will not be counted against the completeness goal because they are considered usable. Only rejected data or data not collected will be counted against the completeness goal. When all data validation is completed, the percent completeness will be calculated by dividing the number of valid sample results by the total number of sample results planned for this investigation. The following equation is used to determine completeness:

$$\text{Completeness } (\%C) = \frac{V}{T} \times 100$$

where:

%C = percent completeness
V = number of valid samples
T = total number of planned samples

Although a quantitative number can be calculated for each analyte, the data user must use this qualitatively to assess whether the investigation objectives can be met with the data obtained. As a guideline, data completeness should be greater than 90% for each analyte for all samples.

Data that do not meet completeness goals may suggest the need for resampling and analysis or, at a minimum, may suggest that the data set should be used with caution, depending on the effect of the incomplete data on the data quality objectives. Data that were planned but not collected should count against the completeness goal, unless they were omitted for a valid reason and are not anticipated to produce a data gap.

Completeness will also be evaluated as part of the data quality assessment process discussed in Chapter 1 (USEPA 2000a). This evaluation will help determine whether any limitations are associated with the decisions to be made based on the data collected.

Laboratory quality control samples

Laboratory QC samples are prepared and analyzed at the laboratory to evaluate the effectiveness of sample preparation and analysis and to assess analytical precision and accuracy. The types of laboratory QC samples that will be used for this project and their required frequencies are discussed in the following sections. Quality control samples required for analyses are prescribed in the specific method to be performed (e.g., USEPA SW-846 methods). Below are descriptions of QC samples pertinent to most of the analytical procedures to be conducted.

Method blanks

Method blanks are prepared to evaluate whether contamination is originating from the reagents used in sample handling, preparation, or analysis. They are critical in distinguishing between low-level field contamination and laboratory contamination. A method blank consists of laboratory analyte-free water and all of the reagents used in the analytical procedure. It is prepared for every analysis in the same manner as a field sample and is processed through all of the analytical steps. Method blanks will be prepared at the frequency prescribed in the individual analytical method or at a rate of 5% of the total samples if a frequency is not prescribed in the method.

Laboratory control samples or blank spikes

An LCS, or blank spike, originates in the laboratory as de-ionized or distilled water that has been spiked with known concentration of compounds of concern. An LCS is analyzed to verify the accuracy of the calibration standards. These internal QC samples are also used to evaluate laboratory accuracy through the analytical process as LCSs are processed through the same analytical procedure as field samples. LCSs will be analyzed at the frequency prescribed in the analytical method or at a rate of 5% of the total samples if a frequency is not prescribed in the method. If percent recovery results for the LCS or blank spike are outside of the established goals,

laboratory-specific protocols will be followed to gauge the usability of the data.

Matrix spike and matrix spike duplicate samples

Matrix spike (MS) samples are aliquots to which a known amount of a standard solution (spike) with a known concentration is added. MS and MSD samples are processed through the same analytical procedure as field samples and used to determine the accuracy and precision of the analytical procedure in the presence of the sample matrix. They will be prepared and analyzed at a rate of 1/18 field samples (6%).

Method detection limit studies

The MDL is the minimum concentration of a compound that can be measured and reported. The MDL is a specified limit at which there is 99% confidence that the concentration of the analyte is greater than zero. The MDL takes into account sample matrix and preparation. No matrix-specific MDL studies will be performed for this project. It is estimated that the MDL for invertebrate and *limu* tissue may be at least an order of magnitude higher than for the standard solid matrix (soil) for which the laboratory performs annual MDL studies to demonstrate the MDLs for each analysis.

Table A2. Estimated analytical reporting limits by method and lab.

Analyte	Analytical Procedure	Reporting Limits	Analytical Lab
Dioxins/Furans (17 congeners of concern)			
HpCDD	USEPA Method 1613B	5 ng/kg	Pace
HpCDF	USEPA Method 1613B	5 ng/kg	Pace
HxCDD	USEPA Method 1613B	5 ng/kg	Pace
HxCDF	USEPA Method 1613B	5 ng/kg	Pace
PeCDD	USEPA Method 1613B	5 ng/kg	Pace
PeCDF	USEPA Method 1613B	5 ng/kg	Pace
OCDD	USEPA Method 1613B	10 ng/kg	Pace
OCDF	USEPA Method 1613B	10 ng/kg	Pace
TCDF	USEPA Method 1613B	1 ng/kg	Pace
TCDD	USEPA Method 1613B	1 ng/kg	Pace
Gasoline (Purgeable Organics)			
Ethylbenzene	USEPA 8260B	25 µg/kg	ARDL
m-Xylene	USEPA 8260B	25 µg/kg	ARDL

Analyte	Analytical Procedure	Reporting Limits	Analytical Lab
p-Xylene	USEPA 8260B	25 µg/kg	ARDL
o-Xylene	USEPA 8260B	25 µg/kg	ARDL
Toluene	USEPA 8260B	25 µg/kg	ARDL
Stryrene	USEPA 8260B	25 µg/kg	ARDL
1,2,4-Trimethylbenzene	USEPA 8260B	25 µg/kg	ARDL
Metals			
Aluminum	USEPA -200.8	0.28 mg/kg	Brooks Rand
Antimony	USEPA -200.8	0.005 mg/kg	Brooks Rand
Arsenic	USEPA -200.8	0.14 mg/kg	Brooks Rand
Barium	USEPA -200.8	0.06 mg/kg	Brooks Rand
Beryllium	USEPA -200.8	0.008 mg/kg	Brooks Rand
Cadmium	USEPA -200.8	0.003 mg/kg	Brooks Rand
Chromium	USEPA -200.8	0.018 mg/kg	Brooks Rand
Cobalt	USEPA -200.8	0.06 mg/kg	Brooks Rand
Copper	USEPA -200.8	0.03 mg/kg	Brooks Rand
Iron	USEPA -200.8	0.08 mg/kg	Brooks Rand
Lead	USEPA -200.8	0.004 mg/kg	Brooks Rand
Manganese	USEPA -200.8	0.024 mg/kg	Brooks Rand
Selenium	USEPA -200.8	0.06 mg/kg	Brooks Rand
Silver	USEPA -200.8	0.02 mg/kg	Brooks Rand
Thallium	USEPA -200.8	0.04 mg/kg	Brooks Rand
Vanadium	USEPA -200.8	0.014 mg/kg	Brooks Rand
Zinc	USEPA -200.8	0.002 mg/kg	Brooks Rand
Mercury	USEPA -1631E	0.12 ng/g	Brooks Rand
Methyl Mercury	USEPA 1630 modified	1.0 ng/g	Brooks Rand
Energetics			
2,4-DNT	USEPA Method 8330	500 µg/kg	ARDL
RDX (Cyclonite)	USEPA Method 8330	500 µg/kg	ARDL
Nitroglycerine	USEPA Method 8330 modified	500 µg/kg	ARDL
Perchlorate	USEPA Method 6850	50 µg/kg	Test America - Sacramento
Organochlorine Pesticides			
4,4'-DDT	USEPA 8081A	10 µg/kg	ARDL
Aldrin	USEPA 8081A	5 µg/kg	ARDL
alpha BHC	USEPA 8081A	5 µg/kg	ARDL
beta BHC	USEPA 8081A	5 µg/kg	ARDL

Analyte	Analytical Procedure	Reporting Limits	Analytical Lab
delta BHC	USEPA 8081A	5 µg/kg	ARDL
gamma BHC (Lindane)	USEPA 8081A	5 µg/kg	ARDL
Heptachlor	USEPA 8081A	5 µg/kg	ARDL
Heptachlor epoxide	USEPA 8081A	5 µg/kg	ARDL
VOCs/SVOCs			
Pyrene	USEPA Method 8270C	1980 µg/kg	ARDL
Phthalate Esters:			
Bis(2-ethylhexyl) phthalate	USEPA Method 8270C	1980 µg/kg	ARDL
Di-n-butyl phthalate	USEPA Method 8270C	1980 µg/kg	ARDL
Diethyl phthalate	USEPA Method 8270C	1980 µg/kg	ARDL
Dimethyl phthalate	USEPA Method 8270C	1980 µg/kg	ARDL
Di-n-octyl phthalate	USEPA Method 8270C	1980 µg/kg	ARDL
Metal Speciation			
Arsenic Speciation	USEPA Method 1632	TBD	Brooks Rand

Sample quantitation limits

Sample quantitation limits, also referred to as practical quantitation limits, are RLs adjusted for the characteristics of individual samples. The RLs are chemical-specific levels that a laboratory should be able to routinely detect and quantify in a given sample matrix. The RL is usually defined in the analytical method or in laboratory method documentation. The sample quantitation limit takes into account changes in the preparation and analytical methodology that may alter the ability to detect an analyte, including changes such as use of a smaller sample aliquot or dilution of the sample extract. Physical characteristics, such as sample matrix and percent moisture, which may alter the ability to detect the analyte, are also considered. The laboratory will calculate and report sample quantitation limits for all environmental samples.

Control charts

Control charts document data quality in graphic form for specific method parameters, such as surrogates and blank spike recoveries. A collection of data points for each parameter is used to statistically calculate means and control limits for a given analytical method. This information is useful in determining whether analytical measurement systems are in control. In addition, control charts provide information about trends over time in

specific analytical and preparation methodologies. Although they are not required to do so, contract laboratories should maintain control charts for projects-specific analyses. All contract laboratories will follow quality control limits and guidelines as described in the DoD QSM. Where specific limits are not prescribed within the QSM, the method specific parameter limits will be used. Laboratory specific quality control limits will only be utilized when either of the former limits is not available.

Maintenance of laboratory equipment

Contract laboratories will follow a maintenance schedule for each instrument used to analyze samples collected for this project. All instruments will be serviced at scheduled intervals necessary to optimize factory specifications. Routine preventive maintenance and major repairs will be documented in a maintenance logbook.

Calibration of laboratory equipment

Laboratory equipment calibration procedures and frequencies will follow the requirements specified by the laboratory analytical methods used. Qualified analysts will calibrate laboratory equipment and document the procedures and results in a logbook. Instrument calibration and initial and continuing calibration verification shall be in accordance with method specific requirements (e.g., USEPA SW-846) and the DoD QSM.

Appendix B: Preliminary Site Surveys

On 30 April and 1 May 2013, a preliminary site survey was conducted offshore at Mākua and Mokulēʻia Beaches by Kapua Kawelo, Joby Rohrer, Kaleo Wong (local free diving experts), and Stephen J. Turnbull (Hydrogeologist). This preliminary site survey was conducted using free diving techniques in waters no greater than 50 ft deep. The primary goal of this preliminary survey was to verify the presence of *heʻe, loli*, and *limu*, the organisms of interest (Table 4) for this Sampling and Analysis Plan, as well as to confirm the presence of sufficient biomass for chemical analysis outlined in Tables 2 and A2. On 30 April 2013, a survey was conducted off of Mākua Beach (Table B1) verifying the presence of the species of interest and confirming its availability in sufficient biomass to complete the required analysis. The species of interest found available at Mākua Beach were *limu kohu*, day *heʻe*, and *loli* (white spotted and black). On 1 May 2013, a survey was conducted off of Mokulēʻia Beach (Table B2). This survey verified the presence of sufficient biomass for *limu kohu*, day *heʻe*, and *loli* (white spotted and black). Due to the presence of the species of interest in sufficient biomass, Mokulēʻia will serve as the background location for this study.

At both sites, the species of interest were verified through photographs (see below as well as Figures 3, 4, and 5) by the survey team. The preliminary survey results for Mākua Beach and Mokulēʻia are listed below as Tables B1 and B2. All photos below were taken by Kapua Kawelo, Joby Rohrer, Stephen Turnbull, and Kaleo Wong.

Table B1. Preliminary Site Survey at Mākua Beach on 30 April 2013.

Mākua Marine Resources Survey - Day 1 - Mākua Valley - April 30, 2013					
Approx. Time	Depth (ft) Approximate	Location: 21˚ Minutes	Location: 158˚ Minutes	Items Noted, Locations	Photo Number
8:10	N/A	N/A	N/A	Leave boat ramp at Waianae Boat Harbor	
9:10	43	31.157	14.128	location is primarily rock, coral, no *limu* here	
9:10	38	31.156	14.121	location is primarily rock, coral, no *limu* here	
9:15	42	31.158	14.118	location is primarily rock, coral, no *limu* here	B1
9:15	42	31.174	14.117	location is primarily rock, coral, no *limu* here	
9:20	40	31.178	14.117	ledge here, continues to next location listed below	
9:25	33	31.181	14.068	ledge continues from above location to here	

9:25	33	31.181	14.068	some *limu* here, type *Lepe'ahina*	
Approx. Time	Depth (ft) Approximate	Location: 21° Minutes	Location: 158° Minutes	Items Noted, Locations	Photo Number
9:35	25	31.231	13.958	Big hole here in ocean floor. Did not dive into	
9:40	19	31.231	13.968	*limu kohu* at this location, several black *loli*	B2, B3
9:45	25	31.242	13.965	*limu kohu* in this location, next to and some in hole	
10:10	25	31.257	13.951	*Loli* at this location	B4, B5, B6
10:10	13	31.275	13.915	*limu kohu* at this location	B7, B8, B9
10:15	13	31.357	13.828	mostly coral and rock bottom, little *limu*, *loli* between previous location and this one	
10:18	13	31.357	13.828	*limu kohu* at this location, small patch	B10
10:20	20 to 13 and less	31.303	13.761	At this location, Joby and Kaleo swam to the shore to look for species	
10:20	20 to 13 and less	31.303	13.761	Inland of this location, some *limu kohu* and 2 *he'e*	B11, B12, B13, B14
10:20	20 to 13 and less	31.303	13.761	Another *he'e*	
10:35	13	31.303	13.761	No *limu* or *loli* from last location at this location	
10:40	10	31.467	13.761	*limu kohu* 150 ft northeast of this GPS coordinate (approximate), is located off of shelf	B15, B16, B17
10:45	5	31.467	13.812	continuation of small shelf	
10:50	18	31.468	13.829	*loli* at this location, Type is Black *loli*	
11:15	8	31.528	13.814	*Limu kohu* along shelf along edge. No *loli* here	
11:20	20	31.537	13.957	Pictures taken here along the bottom. Shows coral and rocky bottom	B18, B19
11:30	20	31.639	13.843	Some *limu kohu* here	B20
11:30	20	31.639	13.843	North from this point is largely sandy, no *limu kohu* few *loli* here – off of main Mākua Beach area	
11:45	46	32.008	13.983	House (location of some fish hiding here), 1cteeted *loli* at this location	
11:50	40	32.012	13.989	1 teeted *loli* at this location	B21, B22
11:50	35	32.045	13.988	squid hole here (no broken shells or overturned coral)	
11:55	32	32.147	14.000	small hole at this location with fish	B23
12:00	32	32.145	14.001	one teeted *loli* at this location	
12:10	8-10	32.302	13.986	Moved northward along coast from this location, some small patches of *limu kohu* here	B24, B25

Approx. Time	Depth (ft) Approximate	Location: 21° Minutes	Location: 158° Minutes	Items Noted, Locations	Photo Number
12:20	7-9	32.347	14.039	some *limu kohu* just inland of this spot	
12:30	20	32.097	14.160	drove boat from previous location to this location, mostly flat sand, no *loli*	
12:35	20	32.090	14.160	mostly flat sand, no *loli*	
12:40	12	32.393	14.114	went back to this location and motored north from here, *loli* here (brown and white spotted)	B26
13:00	15	32.425	14.161	*He'e* located 25 off of beach, approximately 1/2 between 2 round culverts in mountain side	B27
13:05	15	32.425	14.161	Small patch of *limu kohu* here	B28, B29
13:10	15	32.505	14.258	lack of *limu kohu* in this area	
13:10	15	32.508	14.222	lack of *limu kohu* in this area	
13:15	14	32.508	14.259	kule fish here, some *loli* (brown and white speckled)	B30
13:20	8	32.547	14.275	*limu kohu* here, small patch, it is short, 2-in. tall, in clumps	B31, B32, B33
13:25	8	32.540	14.281	black *loli* (sand covered)	B34
13:30	8	32.522	14.255	3-day *he'e* here in this approximate location	B35
13:50	10	32.496	14.235	*limu kohu* in patches from above location to this location, *loli* here on the rocks spots with little sand	B36
14:00	10	32.721	14.500	ran from previous location to this location, No *he'e*	
14:30	50	32.386	14.493	ran from previous location to this location. No *he'e*, *loli,* and *limu kohu*	
15:00	42	32.271	14.195	motored from previous location -- sandy difficult to see *loli*, *he'e,* and *kohu* in deeper water	
15:05	42	32.271	14.200	sandy difficult to see *loli*, *he'e,* and *kohu* in deeper water	
15:05	43	32.113	14.126	sandy difficult to see *loli*, *he'e,* and *kohu* in deeper water	
15:10	46	32.149	14.142	motored to this location, mostly sandy, no apparent *loli*, *he'e,* or *limu kohu*	
15:25	32.5	32.051	14.061	2 black *loli* here	B37
15:30	35	32.089	14.060	another 2 black *loli*	
15:45	45.3	31.963	13.987	brown and white spotted *loli*	B38
15:50	33.8	31.783	13.940	teeted *loli* here	
16:00				End of survey of Mākua Beach area	

Figure B1

Figure B2

Figure B3

Figure B4

Figure B5

Figure B6

Figure B7

Figure B8

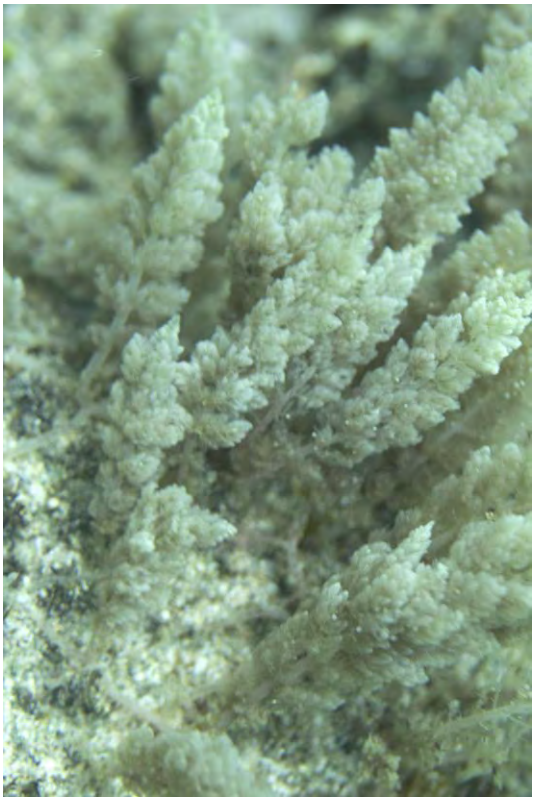

Figure B9

Figure B10

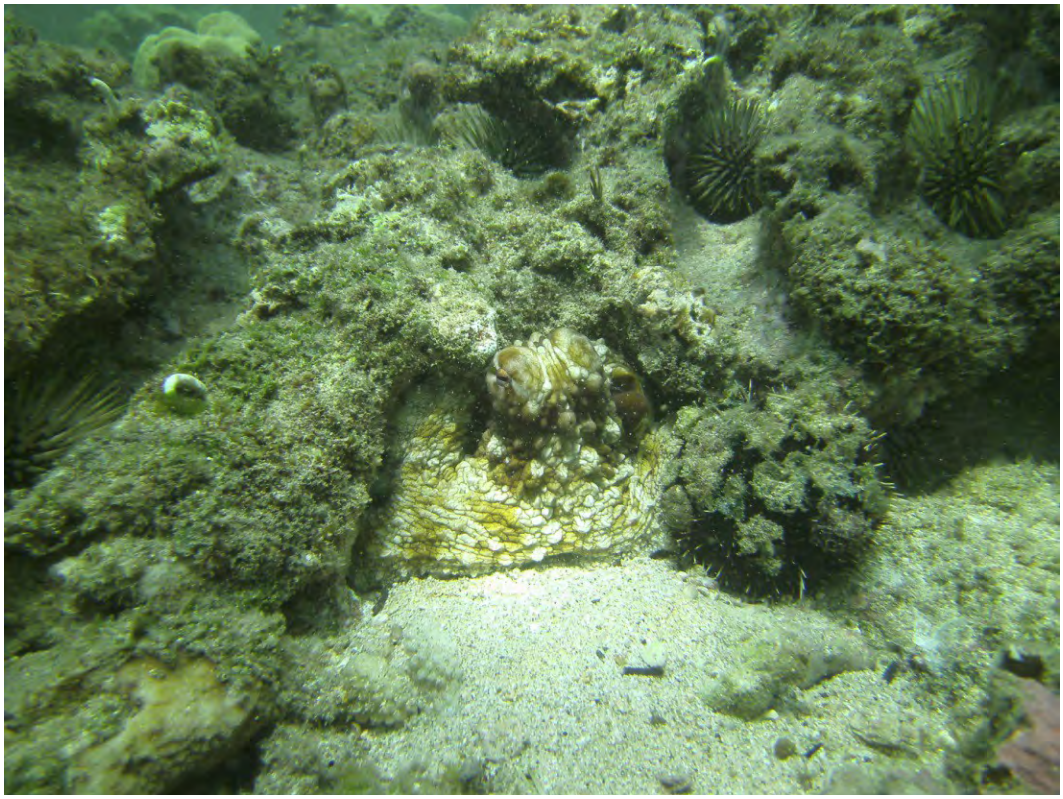

Figure B11

Figure B12

Figure B13

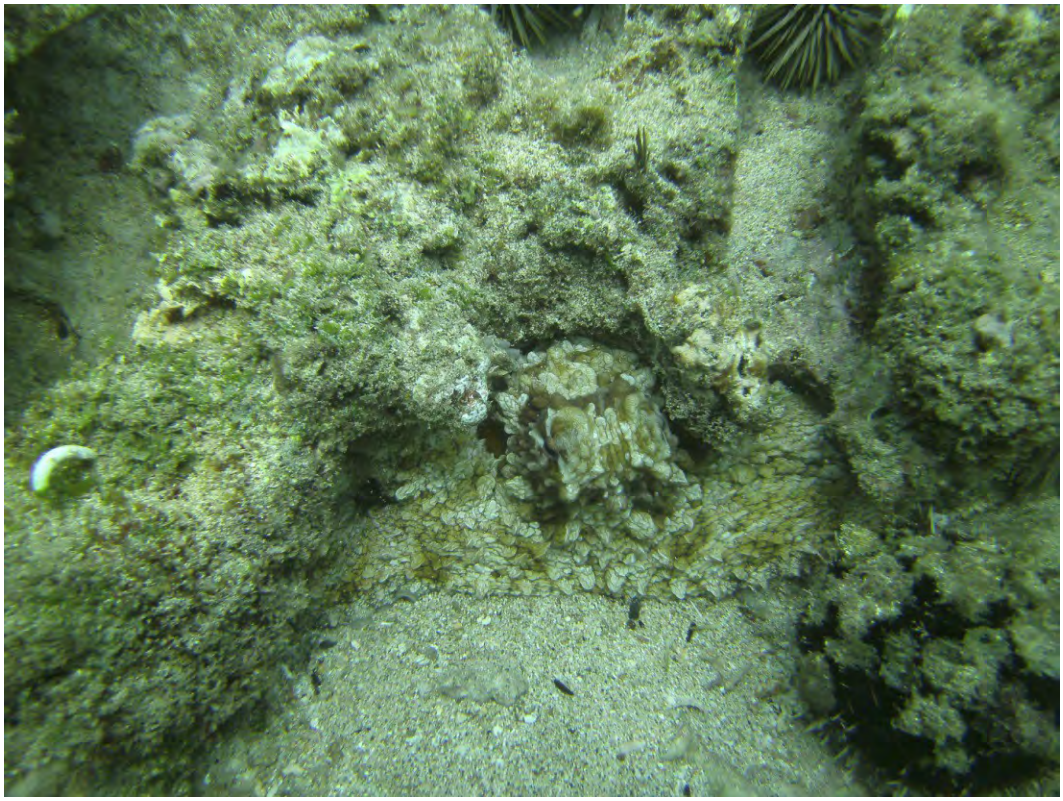

Figure B14

Figure B15

Figure B16

Figure B17

Figure B18

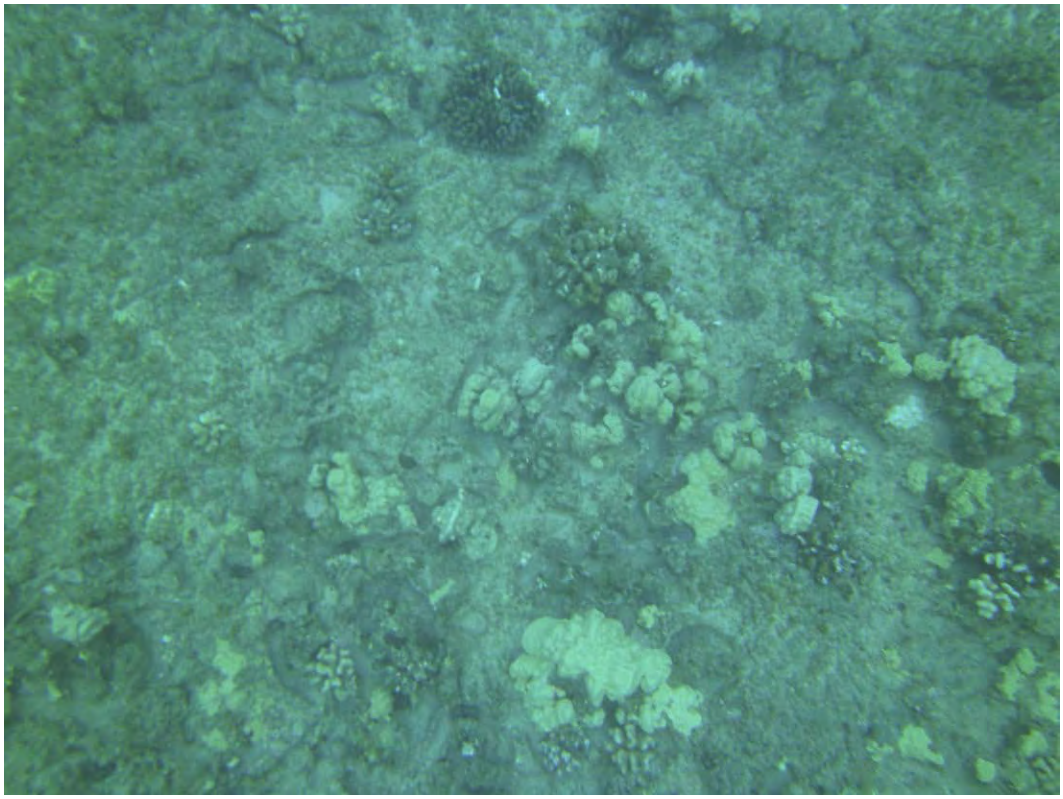

Figure B19

Figure B20

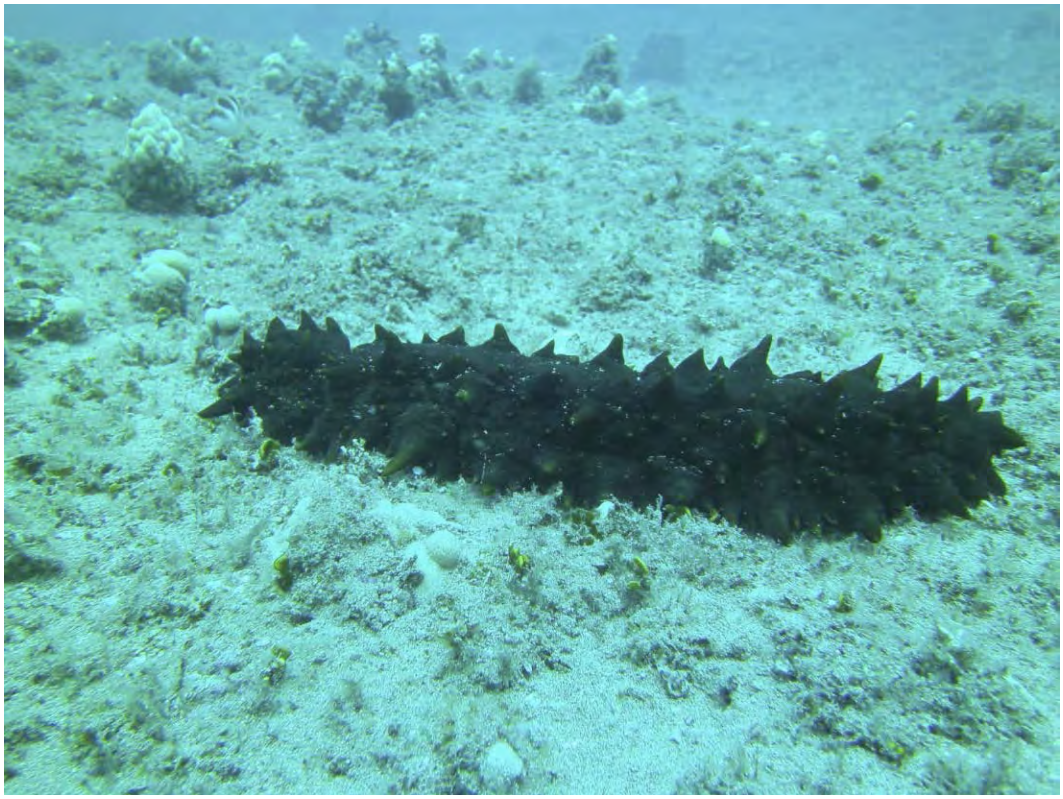

Figure B21

Figure B22

Figure B23

Figure B24

Figure B25

Figure B26

Figure B27

Figure B28

Figure B29

Figure B30

Figure B31

Figure B32

Figure B33

Figure B34

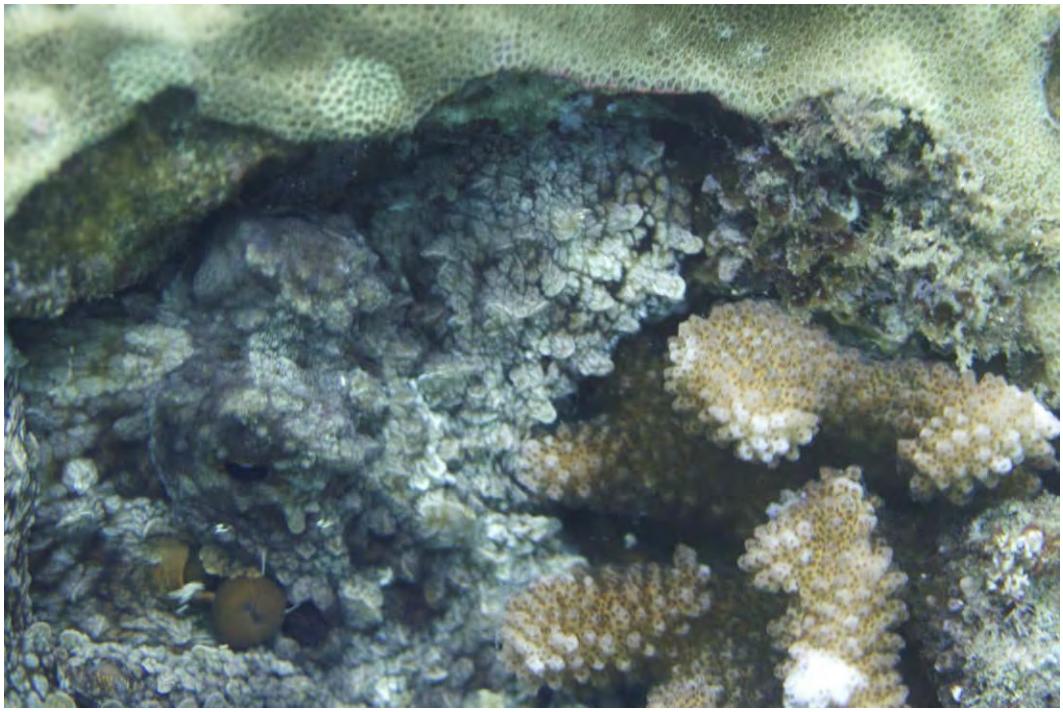

Figure B35

Figure B36

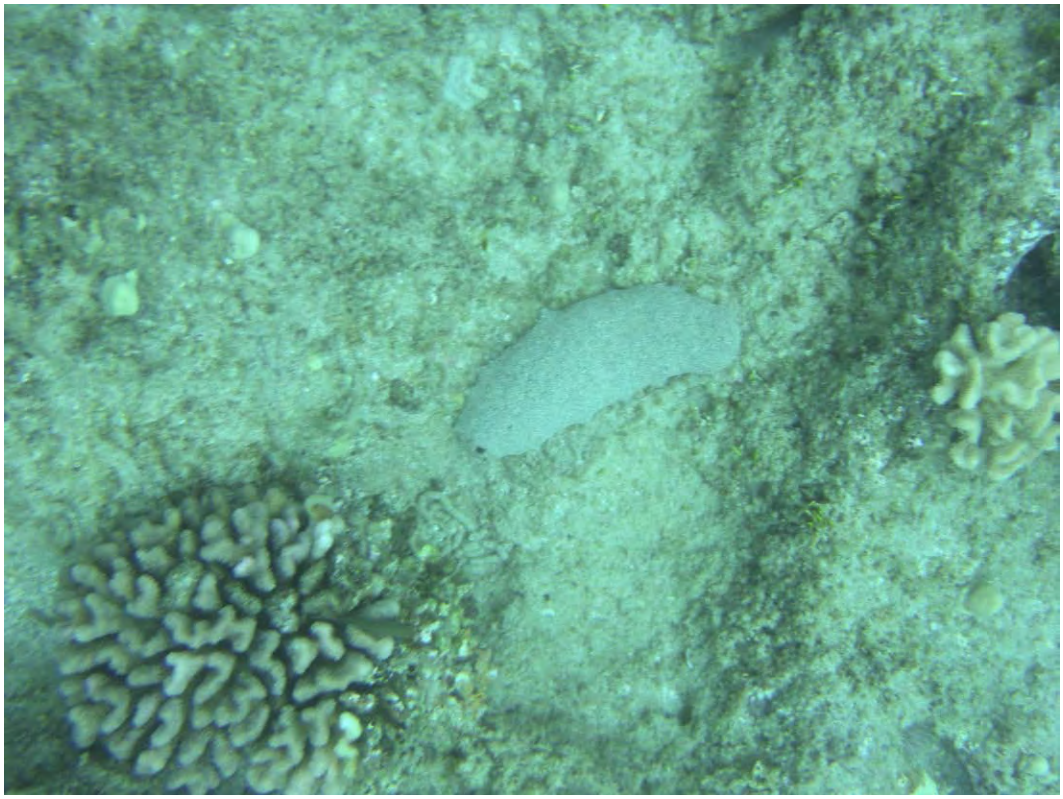

Figure B37

Figure B38

Table B2. Preliminary Site Survey at Mokulēʻia Beach on 1 May 2013.

Mākua Marine Resources Survey - Day 2 - North Shore, Mokulēʻia Area - May 1, 2013		
Approx. Time	Items Noted, Locations	Photo Number
12:30	Beach Access 257A, Silva Channels area of Mokulēʻia, North Shore	
12:30	Looking again for *limu kohu*, *he'e*, and *loli*	
12:40	Went out 300 to 350 ft from beach area into Ocean, small *limu kohu* plant	B39
12:45	team swam 1 – 300- to 350- ft long lines out from beach	
12:50	in first line saw 9 black *loli*, 1 brown/white speckled *loli*	B40, B41
13:00	team swam another 300- to 350-ft line - 10 black *loli*, 1 brown/white speckled *loli*, also some *limu pepeiao* (picture 81)	B42, B43, 44
13:15	team swam another 300- to 350-ft line - 9 black *loli*, some are very large, 2 brown and white spotted *loli*	B45, B46
14:00 - 14:10	large patches of *limu kohu* on shelf along where waves are breaking, 300 to 350 ft out, patch is 3 to 4 ft wide and 1/4 mile long, also shows *po'opa'a* fish (stocky hawkfish/ *Cirrhitus pinnulatus*)	B47, B48, B49, B50, B51
14:30	found two *he'e* (day) 300 ft out, many places for them to hide	B52
15:00	Beach Access 254A, area opposite Dillingham Airfield	
15:10	Team swam a number of transects approximately 300 ft from beach	
15:15	300-ft-long transect contained 2 brown/white spotted *loli* and 6 black *loli* (covered in sand), small *limu kohu* plants seen in this transect, also shows *Halimeda discoidea limu*	
15:30	a second transect was swam 350 ft from shore, 80 ft north of first transect, 1 brown/white *loli* and 8 black *loli* (sand covered) seen, bed of *limu kohu* out approximately 300 ft seen. *Wrangelia elegantissima limu* (picture 100) and *Halimeda discoidea limu* also found (picture 100 and 103)	
15:45	a third transect was swam 350 ft from shore, 80 ft north of first transect, 1 brown/white *loli* and 8 black *loli* (sand covered) seen, bed of *limu kohu* out approximately 300 ft seen	B53, B54, B55
16:15	a fourth transect was swam 350 ft from shore, 80 ft north of first transect, 1 brown/white *loli* and 2 black *loli* (sand covered) seen, bed of *limu kohu* out approximately 300 ft seen	B56
	he'e hiding in holes	B57
16:30	A large patch of *limu kohu* on shelf along where waves are breaking, 350 ft out, patch is 3 to 4 ft wide and 1/5 mile long.	B58

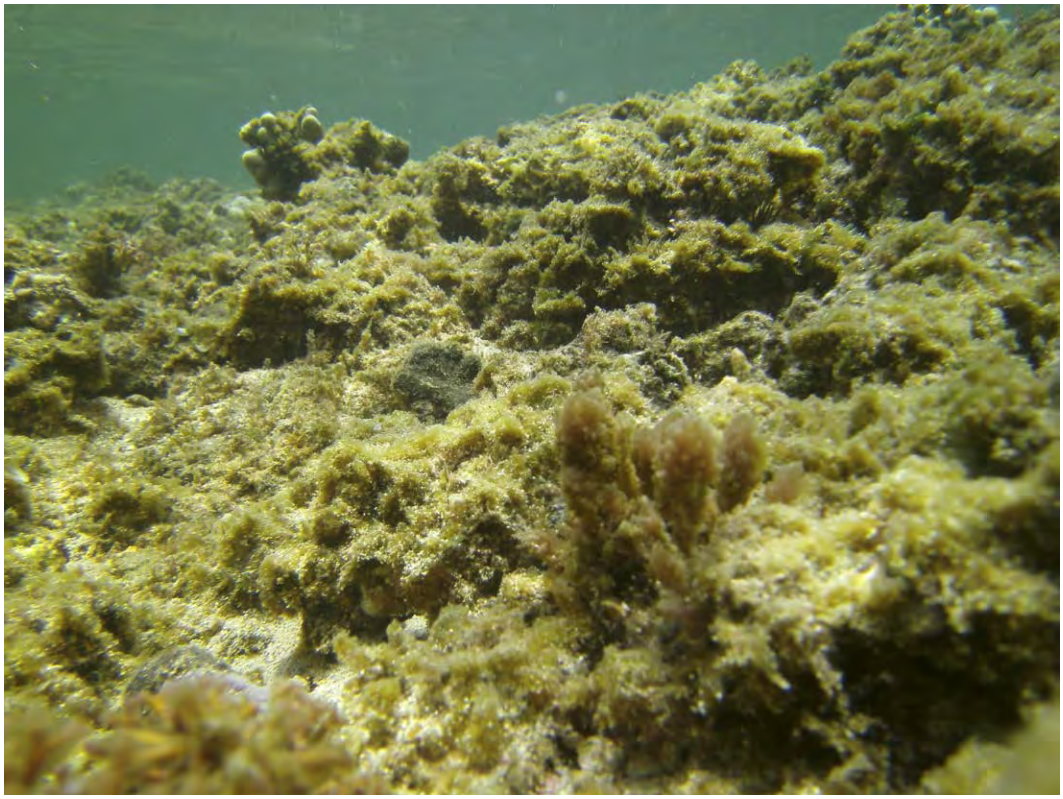

Figure B39

Figure B40

Figure B41

Figure B42

Figure B43

Figure B44

Figure B45

Figure B46

Figure B47

Figure B48

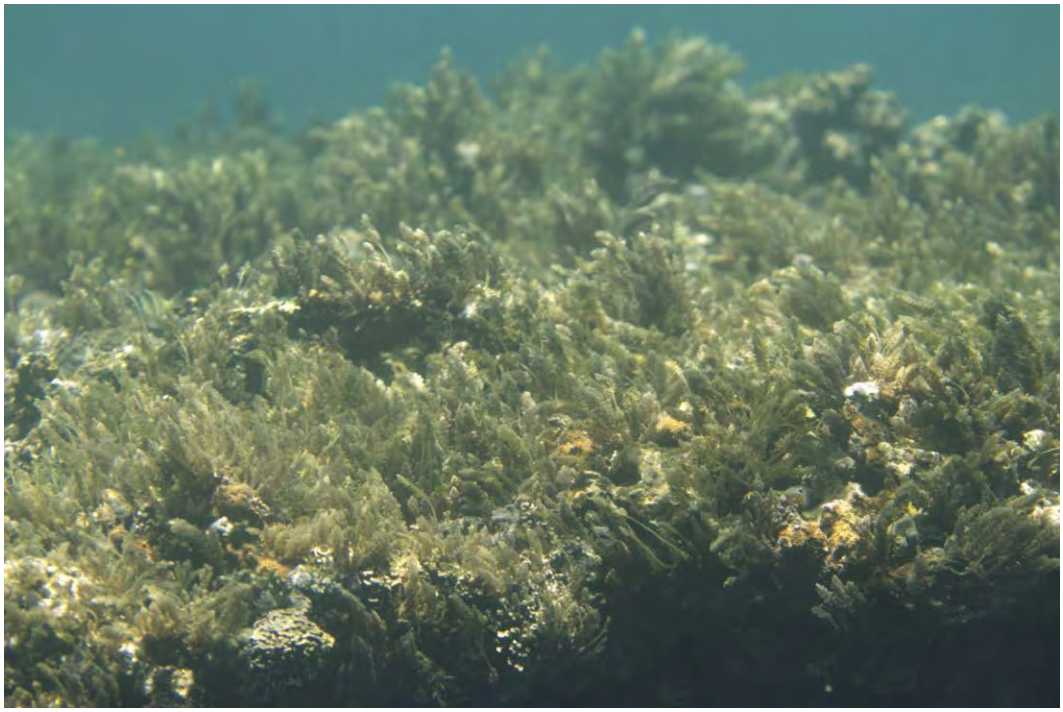

Figure B49

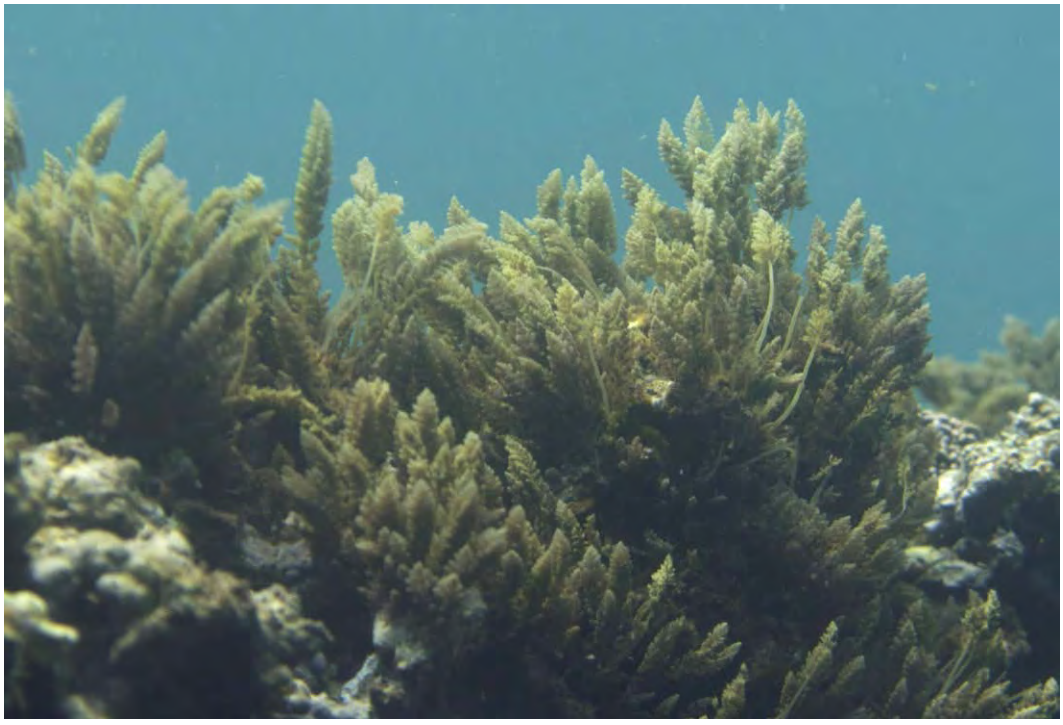

Figure B50

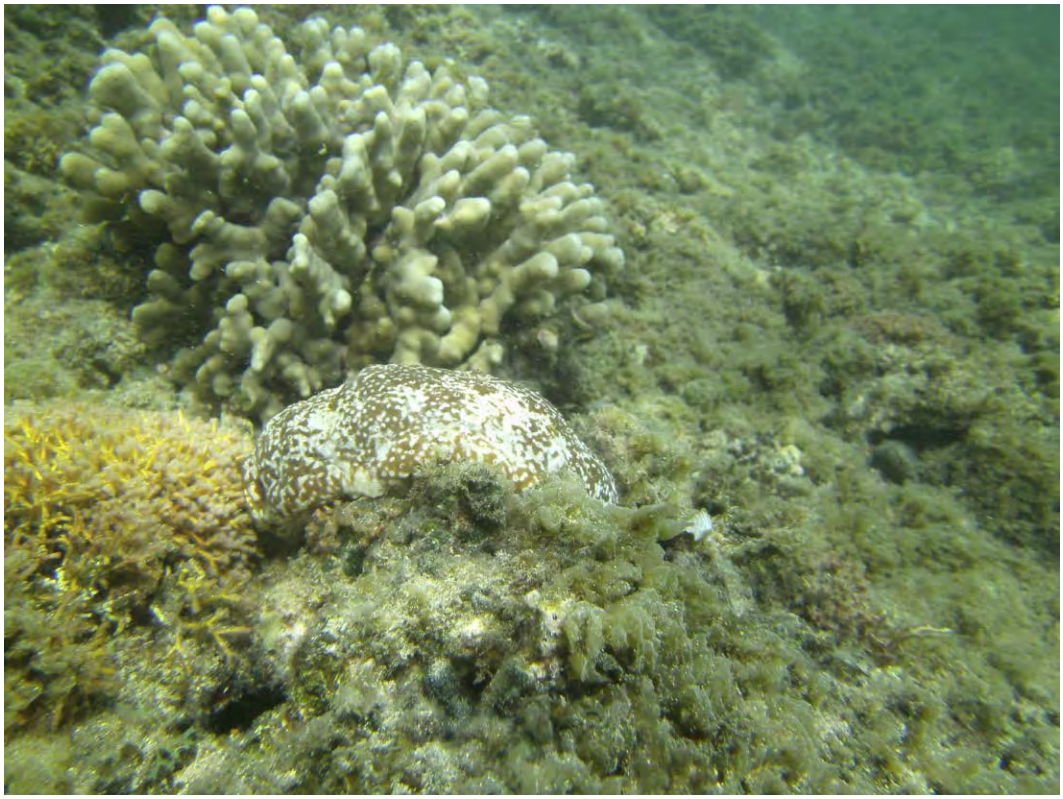

Figure B51

Figure B52

Figure B53

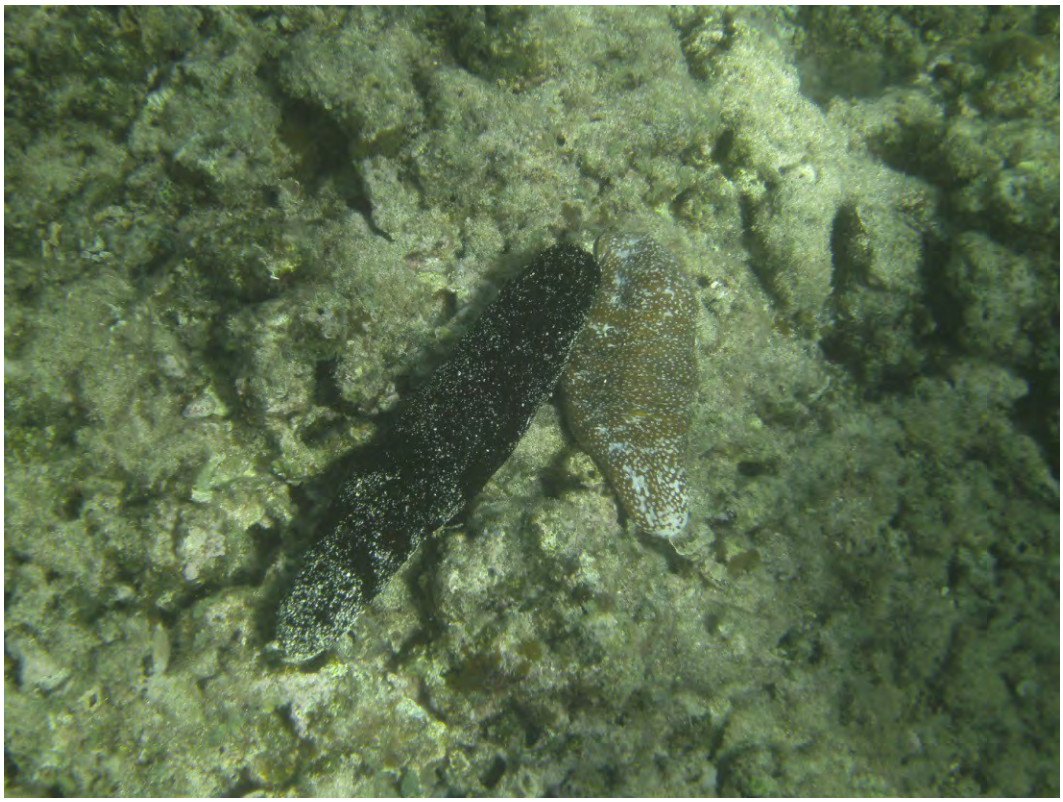

Figure B54

Figure B55

Figure B56

Figure B57

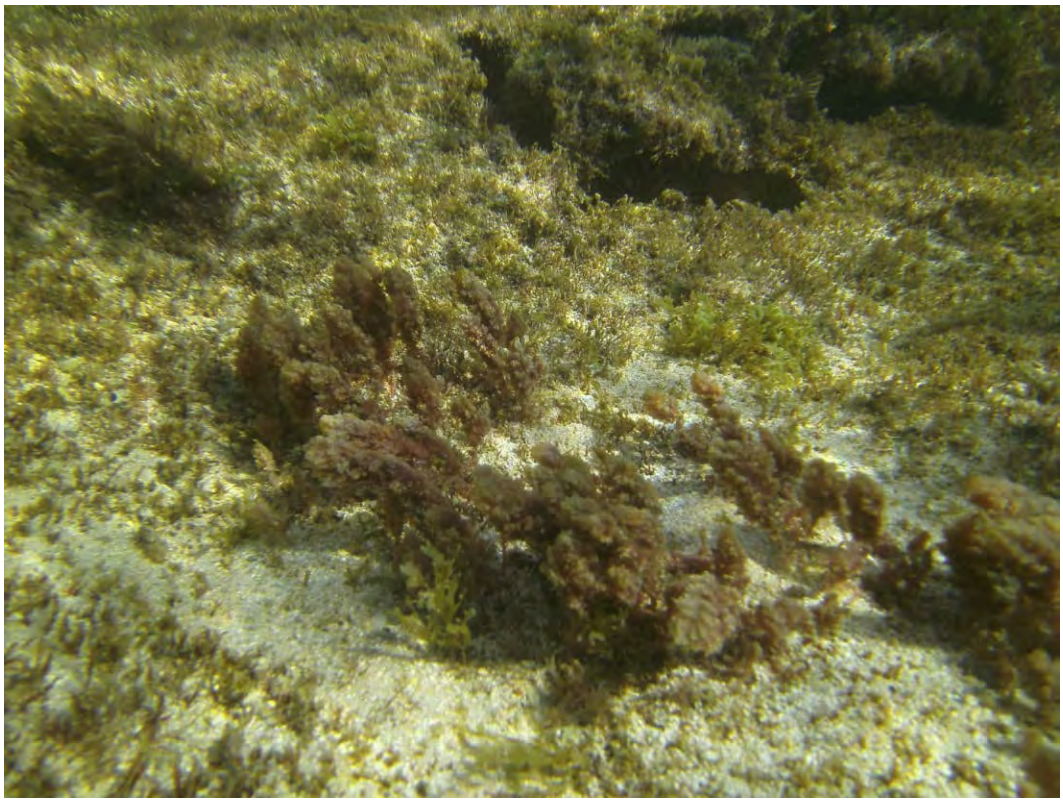

Figure B58

Appendix C: Public Comments and Responses

An Extensive effort was undertaken for this project to gather public input to assist the Army in preparing this SAP. The SAP was formally released on January 18, 2013, to Earthjustice and the public for a 60-day review process that ran through the end of March 2013. Information was gathered from the public in a variety of meetings as well as from State and Federal Government scientists and officials. First, an October 24, 2012, "talk story" meeting was held at the Waiʻanae Army Recreation Center to obtain input from the public. A public meeting was held on February 20, 2013 at Nānākuli High School with an informal information session from 6:30-7:00 with Army subject matter experts, followed by a facilitated public meeting comment session from 7:00 to 9:30. Comments received are summarized in Appendix C with an appropriate response from the Army. A second public meeting was held on March 13, 2013, at the Waiʻanae District Park at the request of the community (as mentioned during the February 20, 2013, public meeting). This public meeting provided additional information on the project with a presentation by Army subject matter experts. Comments received during this meeting are summarized in Appendix C with an appropriate response from the Army. The SAP was also distributed to two public libraries in Waiʻanae and Kapo-lei. In addition, copies of the Draft work plan were mailed to anyone that requested it. The SAP was and remains available on the U.S. Army Garrison website and can be downloaded in Adobe Acrobat PDF format (http://www.garrison.hawaii.army.mil/makua/MarineResourcesDocs/2013SupplementalMarineResources/MMR_Marine_Resources_Supplemental_SAP.pdf). Copies of the SAP were submitted to the Environmental Protection Agency (EPA) Region 9 in San Francisco, California (this office incorporates the State of Hawaii), State of Hawaii Department of Health Hazard Evaluation and Emergency Response Office, and the State of Hawaii Department of Land and Natural Resources (DLNR), with their comments summarized in Appendix C with an appropriate response from the Army.

Below is a summary of the outreach performed by the Army's Public Affairs office to assist with obtaining input from the interested public. Additional information on the project was also provided elected city councilpersons, State of Hawaii House and Senate Representatives, the Waiʻanae Neighborhood Board, the Nānākuli Neighborhood Board, the

Waiʻanae Military Community Advisory Council (WMCAC), the Waiʻanae Community Information Council (CIC) (see list below) . The Survey (Appendix D) was also distributed to the Waiʻanae Boat Fishing Club and Waiʻanae Boat Harbor (50 copies), Waiʻanae Library (50 copies), as well as a number of civic and community organizations listed below.

Marine Resources Survey (see below) was distributed during October, 2012 to:

- Leeward coast elected officials; State House Representatives Jo Jordan and Karen Awana, State Senator Maile S.L. Shimabukuro, and City Council Member Tom Berg.
- Waiʻanae Military Civilian Advisory Council members
- Waiʻanae and Nānākuli Neighborhood Board.
- 50 copies distributed at both the Waiʻanae Public Library and the Waiʻanae Boat Harbor
- Distributed to 11 Oʻahu Leeward Coast civic and community association organizations that included: Nani O' Wai-ʻanae, Puʻu Haleakala Community Association, Mākaha Hawaiian Civic Club, Nānāikapono Hawaiian Civic Club, Waiʻanae Coast Rotary Club, Waiʻanae Hawaiian Civic Club, Waiʻanae Kai, Homestead Association, American Legion Post 12, Waiʻanae Lions Club. Ladies Veterans of Foreign Wars Auxiliary #849
- Conducted public talk story event/input session at Pililāʻau Army Recreation Center (also called Waiʻanae Recreation Center) 6:30-8:30 p.m. Collected six surveys and took information from approximately 18 attendees.
- Sent electronic mail surveys to two additional people requesting them.

Supplemental Marine Resources SAP was released in January 2013 and distributed to:

- Advertised release of work plan in Star Advertiser for five days (three weekday and two weekend days).
- Provided copies to the Waiʻanae and Kapolei Branches of the State of Hawaii Public Library.
- Submitted electronic mail notifications of the draft plan release to 24 community survey respondents, and members of the Waiʻanae Community Information Council (CIC).

- Mailed copies of the work plan to City Council Member Kimberly Marcos Pine, Representative Karen Awana, Representative Jo Jordan, and Sen. Maile Shimabukuro.
- Waiʻanae and Nānākuli Neighborhood Board members (10 copies)
- The Army's Native Hawaiian Liaison (Trisha Kehaulani Watson) also shared the release with: Waiʻanae Hawaiian Civic Club, Mākaha Hawaiian Civic Club, Office of Hawaiian Affairs, Oʻahu Council of Hawaiian Civic Clubs, Aha Kiole (Oʻahu)

U.S. Army Garrison-Hawaii
Makua Marine Resources Survey

Please return surveys by October 31, 2012. To complete this survey online go to:
https://www.surveymonkey.com/s/Marine_Resources_Survey

The U.S. Army in Hawaii is conducting a Marine Resources study at Makua Beach and is seeking the Leeward Coast community's assistance. The purpose of this study is to determine whether military activities at Makua Military Reservation have impacted marine resources in the area.

As residents, your input is essential in helping us identify, find and test the species that you rely on for food or other purposes. We appreciate your interest and involvement in this study.

In order to validate and be able to utilize the information you are providing, we need you to include your first and last name, and contact information (phone or email).

First and last name: *(required)*	
Email / Phone: *(required)*	

1) Do you consider yourself a Waianae Coast resident? ☐ Yes ☐ No

2) Do you rely on ocean resources at Makua Beach — other than fish or shellfish — for food or any purpose besides food? ☐ Yes ☐ No *(If you checked "no" please skip to question #13.)*

3) If yes, on which of the following do you rely?

- ☐ limu (seaweed)
- ☐ he'e, tako (octopus)
- ☐ weli/loli (sea cucumber)
- ☐ Other _____

4) Please describe the resources you rely on (any that were selected above) as completely as possible, including any common names, nicknames or species. Please be as descriptive as possible; include the size, shapes and/or colors.

_____
_____
_____
_____

5) Do you collect these ocean resources yourself, or do you get them from another source? Check all that apply.

☐ I collect the resources myself ☐ I get the resources from another source. *(If from another source, which source? Please provide contact information for that source, if known.)*

_____
_____
_____
_____

6) If you collect the resources yourself, approximately where at Makua Beach do you get these resources? Please include approximate depth, if known.

_____
_____
_____
_____ *(continue on back)*

7) What method(s) do you use to collect, gather or hunt for these resources?

_____
_____
_____
_____

8) Is there a specific time of day you collect, gather or hunt for these resources?

_____
_____
_____

9) Is there a specific time of year you collect, gather or hunt for these resources?

_____
_____
_____

10) Are there any other locations on Oahu or the other Hawaiian Islands where you collect, gather or hunt for the ocean resources you identified?

_____
_____
_____

11) How often and how much (quantity) of these ocean resources do you eat?

_____
_____
_____

12) Would you be willing to help scientists locate samples of these resources?

_____
_____
_____

13) The Marine Resources Study will include planning, sampling and analysis phases. Do you wish to receive updates and additional information throughout the study? ☐ Yes ☐ No

Please return this survey in any of the following ways, by Oct. 31, 2012:

Email: usaghi.pao.comrel@us.army.mil
Fax: 808-656-3162
Mail: USAG-HI Directorate of Public Works
Attn: Michelle Mansker, Environmental Division
947 Wright Ave., WAAF
Schofield Barracks, HI 96857
Phone: Input may be provided by phone. Call U.S. Army Garrison-Hawaii Public Affairs at 808-656-3158/3159/3160 between 8 a.m.-4 p.m.
Online: To fill out the survey online go to: https://www.surveymonkey.com/s/Marine_Resources_Survey by Oct. 31, 2012.

In Person: Community can also provide input in person and talk story with Army staff, Oct. 24, from 6:30-8:30 p.m., at the Pililaau Army Recreation Center, 85-010 Army St., Waianae. We will have photos of limu species and other marine resources for reference. For more information please call U.S. Army Garrison-Hawaii Public Affairs at 808-656-3158/3159/3160.

Mahalo for your time and input!

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, MR. PAUL MURAKAWA, APRIL 2013

1. Comment: On the list of organisms that will be targeted for testing during this study (Table 4 on page 17), there are three (3) organisms that are regulated by the State of Hawai'i. For the red algae (*Gracilaria coronopifolia* or manauea), please provide the number of pounds to be collected per day as well as the total number of pounds you intend to collect for the whole project.

   Response: We will not be collecting the red algae (*Gracilaria coronopifolia* or *G. manauea*).

2. Comment: With regards to the day octopus (*Octopus cyanea* or *he'e*) and the night octopus (*Octopus ornatus* or *he'e* makoko), the draft document states on page 25, "Single specimens of *he'e* will be used for analysis." Does this mean a single specimen of day or night octopus will be required from each sampling site (total of four octopi will be collected for the entire study)?

   Response: We intend to collect only enough biomass of day octopus (*Octopus cyanea*) from each of the three sampling locations, Mākua, Mokulē'ia, and Ka'ena Point for analysis.

3. Comment: Also, be advised that the Army may need to apply for a Special Activities Permit from DAR to collect the regulated species on your list of targeted species for testing.

   Response: Comment noted. We are not planning to collect any regulated species.

4. Comment: Additionally, under the section discussing sampling effort on page 29, in the second full paragraph, it states that "…the certified 'scientific divers' to directly collect octopus, lobster, and sea cucumber; however, appropriate

trapping techniques will be used to capture lobsters as needed …". Lobster is not listed on Table 4 (species targeted for this study). Are lobsters a "targeted test species," and if they are, which species and how many are needed for the study?

Response: Lobster is not a targeted test species and will not be collected. Reference was an error.

5. Comment: The State regulates the take/harvest of lobsters. Both the spiny and slipper lobsters are State protected resources. There are specific seasons, open for taking/harvesting them and a closed season when the take/harvest of lobsters is prohibited. Several other regulations pertaining to the take/harvest of Hawai'i's lobster resources include; a minimum size restriction for lobsters, take/harvest method restrictions, the condition that lobsters be in when taken/harvested. Lobsters cannot be mutilated in any way, that is, they cannot be speared and they must be taken/harvested whole, they cannot be "tailed." The taking/harvesting of female spiny lobsters is not allowed at any time, even during the open season. If you do intend to collect lobsters for toxicity testing, please make the correction on Table 4 and again be advised that the Army may need to apply for a Special Activity Permit to collect the State regulated species on your list of targeted species for toxicity testing.

Response: Lobster is not a targeted test species and will not be collected.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, MR. FENIX GRANGE, APRIL 2013

1. Comment: DOH and US EPA actively participated in the oversight of the Study Design and Sampling and Analysis Plan(s) for the Ordnance Reef Project, working closely with the Army Corps of Engineers, University of Hawai'i, and the community. The biota collection design and field implementation was exceptionally well done, and provided defensible results that directly addressed community concerns and built confidence that the food supply was safe, despite the ongoing presence of unexploded munitions in the waters off Ordnance Reef. Many of the comments below (marked OrdReef) encourage you to use sampling approaches and analytical techniques that were successful in that project. Please refer to the document, available online at ftp://ftp.environetinc.com/Remedial%20Investigation/.

   Response: Documents concerning the Ordnance Reef Project were consulted during the finalization of this SAP.

2. Comment: In general, the final sampling plan will need greater detail about exact field activities, species, collection techniques, sampling handing and preparation and analyses than the present draft contains. We encourage you to refer to and use language directly from the Ordnance Reef documents, where appropriate, as that work was carefully vetted through multiple reviews. As we have learned, use of local divers and community experts to evaluate sampling locations, collect biota and work side by side with your scientists will create buy-in with local stakeholders and result in greatly improved sample collection and quality.

   Response: Greater detail about exact field activities, species, collection techniques, sampling handing and preparation, and analyses were added to the final SAP. Local divers have

advised on sampling locations and will collect the specimens during the sampling phase of this project.

3. Comment: Effective, ongoing community engagement as respond to comments and finalize the work plan will go a long way to convincing the community of the scientific validity of the proposed study. If the community feels that the concerns raised by the citizen's lawsuit have been appropriately addressed, then they can trust the results of the study and feel comfortable that they can make informed decisions about the local foods they feed their families. DOH would be happy to assist you with community engagement and health concerns as you move forward.

   Response: Comment noted.

4. Comment: We concur with the *loli* and *heʻe* selection, and kohu as one of the *limu* to be collected. We recommend, however, that a minimum of three different species be collected as they may uptake arsenic suite differently. In particular, we would recommend targeting Kala, and another species determined to be present and most prevalent at both the subject and background sites. OrdReef: Kohu was collected and analyzed and located at both the subject and control sites.

   Response: *Limu kohu* was the sole algal species selected for sampling in Ordnance Reef project. To meet the objectives of this project, *limu kohu* was also selected as the sole algal species targeted for sampling in this study. It is one of the most popular species of algae to eat and has been reported by community members as being present throughout Ordnance Reef (HI-06) as well as in the nearshore waters at Mākua Military Reservation.

5. Comment: See comment below regarding background locations. Especially as there are no action levels for many of the constituents in these test species, it is crucial that reference samples of the same species are collected, to assess for impacts from Mākua military activities. Therefore,

limu species selection should be based on availability of species at Mākua and the reference sites.

Response: A preliminary site survey effort (April 30- May 1, 2013), described in detail in Appendix B, confirmed that *limu kohu* in the nearshore waters at Mākua Military Reservation and at the background locations, Mokulēʻia and Kaʻena Point.

6. Comment: OrdReef: We strongly recommend that the preliminary field survey, identification of reference site and sample collection be subcontracted to local divers who are intimately familiar with the local ecology.

Response: A preliminary site survey was conducted on April 30-May 1, 2013 and is described in detail in Appendix B. Local divers have advised on sampling locations and will collect the target species.

7. Comment: OrdReef: Add a footnote to the table referring to the later section, entitled, "Proposed Analytical Procedures." Please review OrdReef and update methods and sample preparation techniques throughout to ensure the highest quality data will be generated. As an example, use the same method for total arsenic as OrdReef so the data are comparable, and refer to the OrdReef laboratory methods for octopus and *limu*. Consider working with the same laboratories where possible as they have specific experience with the matrix interference challenges posed by the *limu*, and developed the method, I believe, for energetics in octopus. Arsenic speciation was performed by Brooks Rand Laboratories on aliquots of tissue prepared by TestAmerica West Sacramento……. Brooks Rand conducted the arsenic speciation by analyzing for inorganic arsenic using a modified EPA method 7632 and total arsenic using a modified EPA method 1638.

Response: Documents concerning the Ordnance Reef Project were consulted during the revision of this SAP. The final SAP was updated for analytical methods and sample

preparation techniques to ensure the highest quality data will be generated. Contract laboratories of comparable quality will conduct the analyses of biota samples.

8. Comment: While it is important to understand speciated arsenic concentrations in biota collected during this study, it will be essential to communicate to the community that arsenic is not a constituent in conventional munitions, and thus, to our knowledge, there would not be a contribution from Mākua munitions activities.

   Response: Comment noted.

9. Comment: That said, certain species of seaweed selectively bioaccumulate arsenic from the environment, concentrating inorganic arsenic to unhealthy levels. Kala, one of the target species commonly eaten by the local community, is in the same genera as another, Sargasso seaweed, hijiki, (*Sargassum fusiforme*; synonym Hizikia Fusiformis) which is known to pose a health risk because it bioaccumulates inorganic arsenic. This species has not been tested in Hawai'i and may present a risk to local consumers if it behaves similarly to hijiki. Collecting and analyzing Kala, ensuring adequate sample numbers and presence at the reference site would provide important health information for the local community. Reference: Yokoi K and A. Konomi.2012. Toxicity of so-called edible hijiki seaweed (*Sargassum fusiforme*) containing inorganic arsenic Regul Toxicol Pharmacal. 2012 Jul; 63(2): 291-7. doi: 10.1 016/j.yrtph.2012.04.006. Epub 2012 Apr 27.

   Response: To meet the objectives of this project, *limu kohu* was the algal species targeted for sampling in this study. It is one of the most popular species of algae to eat (based on the public input from the Survey) and has been reported by community members as being present at the nearshore waters at Mākua and the background locations. The public surveys we conducted indicated that *limu kohu* was the primary species target for subsistence.

10. Comment: OrdReef: Studies at OrdReef and Pearl Harbor have not shown risks from inorganic arsenic from fish or other biota. Concentrations of arsenic in biota were remarkably similar across the various strata. …. A finding of greater interest, however, is that the overwhelming majority (approximately 99%) of arsenic was present in the less toxic organic form in crab, octopus, and fish. A considerably larger fraction (approximately 6% to 50%) of the arsenic found in seaweed was present in the inorganic form, although total concentrations of arsenic in seaweed were the lowest of all biota.

    Response: Comment noted.

11. Comment: Text refers to a primary background site, but doesn't identify it. I assume you are referring to the broad area on the north shore between Kaʻena Pt and Waialua. DOH concurs that that area is an appropriate general location for the primary reference site. Text should be amended to make it clear throughout that sampling will occur at the subject site and the primary background site, except under certain conditions.

    Response: The final SAP was revised to state that the two background locations are on the north shore of Oʻahu around from the end of Kaʻena Point and along the coast at Mokulēʻia Beach.

12. Comment: ODOH disagrees with the selection of Nānākuli as an alternate background site, due to confounding factors from urban inputs. Similarly, Sandy Beach is not ideal. We recommend you use the OrdReef control site, off Mākaha as the alternate background site. While it has some urban impacts, it is close to the subject site and has had successful collections of octopus and Kohu. Data from the OrdReef study control site could be considered in the overall data analysis.

    Response: The final SAP was revised to state that the two background locations are on the north shore of Oʻahu

around Kaʻena Point and along the coast at Mokulēʻia Beach. A preliminary site survey was conducted off of Mākua and Mokulēʻia on April 30- May 1, 2013 and indicated sufficient biomass was available at both sites.

13. Comment: After the preliminary field survey is complete, a short tech memo or other material should be provided to DOH identifying sampling site locations, with similar habitat and adequate density of sampling targets. Target *limu* species should be prioritized based on abundance and presence. Please provide GPS boundaries or clear delineation on a detailed aerial. Existing map and textual information is too vague.

    Response: A preliminary site survey was conducted April 30- May 1, 2013, and it is described in detail in Appendix B of this document.

14. Comment: You state, "….. species of *limu* sampled from nearshore waters of Mākua may not be found or may be found in insufficient quantities for chemical analysis at the primary background sites. If that occurs, sampling of *limu* and other marine resources will be attempted at Nānākuli and then at Sandy Beach." Add the following statement, "*Limu* sampling is intended to collect the same type of *limu* at all sample sites" and follow the OrdReef approach "Seaweed was not abundant and was difficult to locate at any given sample site. Because of this, seaweed was often harvested over a larger geographic area in the vicinity of a given sample site until a sufficient mass was collected to enable laboratory analyses: Because *limu* gathering is likely to occur broadly across the subject site and the background sites, it is appropriate and defensible to composite from a number of areas to get adequate mass. That said, each sample should be separately bagged, and composited by species only after expert examination of each sample for taxonomy.

    Response: A preliminary survey (April 30- May 1, 2013) indicated that *limu kohu* is present at both the nearshore waters at

Mākua Beach and along the coast of Mokulēʻia. If necessary, due to sparse and heterogeneous distribution, *limu* will be collected over a broad area.

15. Comment: An oversampling approach will also assist with ensuring adequate sample mass is collected across the sites to be compared. Apply the oversampling strategy employed at Ordnance Reef for invertebrates to *limu*. Add language similar to the following: OrdReef: Oversampling occurred throughout each sampling event, and at the end of fieldwork. The species harvested in the greatest abundance at sample sites from all four strata were submitted to the laboratory for analysis. For sample sites where the "prevalent" species could not be collected, the next most prevalent species collected was submitted for analysis.

    Response: A preliminary site survey indicated that *limu kohu*, and the target species of octopus and sea cucumber are present in both the nearshore waters at Mākua Beach and the background locations in sufficient quantity to successfully obtain eight replicate samples per site per season. Additional samples will be collected and maintained frozen at UH if additional organisms are present in adequate abundance at the sampling sites.

16. Comment: With knowledgeable fisherman and well selected sites, adequate octopus samples should be available at Mākua and the primary reference site. Octopus were caught by the tactical spearing technique… Please add language similar to OrdReef.

    A secondary goal of biota sampling was to attempt to collect fish and invertebrate samples of relatively similar size or mass (i.e., within 10% to 20%, if possible). This would allow the comparison of biota of approximately the same age or stage of development. For the majority of the samples this was achieved. Approximately 80% of octopus samples were within roughly 70% of mass.

Response: A preliminary site survey indicated that *limu kohu*, and the target species of octopus and sea cucumber are present in both the nearshore waters at Mākua Beach and the background locations in sufficient quantity. We will attempt to collect samples of relatively similar mass (i.e., within 20%).

17. Comment: Text refers to using certified "scientific divers." Instead, please follow the OrdReef approach: Fishermen from the community who are very familiar with the area were used to conduct the biota sampling effort. The study team members, on a separate vessel, led the fishermen to a potential sample site.... The fishermen then dove the site to search for ...and collect the targeted biota.....and returned to the surface to transfer the ... biota samples to the study's field team. At this point, the study's field team took a CPS reading, queried the fishermen to determine the habitat type munitions at which the fishermen collected samples, and recorded relevant details on field sampling or note sheets (Appendix C).

The study's field team documented the location of each sample site within approximately a 30-ft (10-m) accuracy using a diver placed float and handheld CPS. CPS readings are actually rough estimates of the actual sampling location. This is true because of inherent CPS errors and the fact that, given currents, divers (the fishermen) are not able to maintain a position directly over a sample site as they surface. Nevertheless, the approximate recording of sample site location allowed the sampling results to be correlated with the results from the January, 2009 study and the Ordnance Reef study and will facilitate future sampling, if necessary. Table 2-1 lists the samples collected during the April 2009 and September to October 2009 sampling events and provides information such as collection site, date, time, depth, and coordinates. ..... The currents within Ordnance Reef (HI-06) were an important aspect of stratum selection. The study team consulted with local fishing experts and others familiar with the area prior to finalizing the sampling design.

Response: In this study, local divers familiar with the sampling sites will conduct biota sampling effort. UH and USACE personnel will process the samples and appropriately label containers and will document the location of each sample site.

18. Comment: Text refers to collecting lobster, but Table 4 does not include lobster as a targeted species. Will lobsters be collected as a target species?

Response: Lobster is not a target species and will not be collected. The statement "... however, appropriate trapping techniques will be used to capture lobsters as needed ..." was deleted.

19. Comment: OrdReef Text refers to processing samples to remove "undesirable parts." More exact language is needed. Please use approach described in the OrdReef document, as follows: The ink sac and beak were removed from each specimen of octopus in a Class 100 laminar flow hood. *Limu* specimens that were also rinsed in a Class 100 laminar flow hood to remove sediment particles were submitted intact to the laboratory. For sea cucumber, only the gut should be removed, so as to remove sediment within the digestive system.

Response: Comment has been noted and wording has been changed.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, MR. DAVID HENKIN, APRIL 2013

1. Comment: In order to give the public—including independent experts—a meaningful opportunity to comment on the Draft SSAP, it was vital that the Army make available all of the references cited in the document. That did not occur. At the February 20, 2013 public meeting, I requested a copy of the Wai'anae Ordnance Reef (HI-06) Health and Human Risk Assessment (University of Hawai'i 2012), which Dr. Rensel had requested as part of his review of the Draft SSAP. I was told that the document was in draft form and was not authorized for public release.

   Response: All information regarding the Ordnance Reef Documents is in the process of being finalized for public release.

2. Comment: In our comments at the February 20, 2013 public meeting, we expressed concerns regarding the Draft SSAP's statement (page 29) that "(t)he processing of samples will involve… eliminating undesirable parts and retaining the parts that are typically consumed by residents." The draft failed, however, to identify which parts of samples would be deemed "undesirable" and which "typically consumed." As a result, members of the public commenting on the Draft SSAP have no way to know which portions of the samples are proposed for testing. We attempted to make up for this deficiency in the Draft SSAP by asking individuals who gather at Mākua for subsistence whether there are any parts of the proposed species of interest—*limu*, *loli*, *he'e*—that residents typically remove before consuming them. We were told that for *limu*, residents eat pretty much the whole plant, other than the hold-fast, which should be left in place. For *loli*, residents typically remove stomach contents before eating the rest of the animal. In addition, some people remove the skin,

particularly if the *loli* is older or larger and the skin is correspondingly tough. Others eat the skin, other than the hard beak.

Response: The ink sac and beak from each specimen of *heʻe* will be removed prior to analysis. *Limu* and *loli* will be rinsed to remove sediment particles. Additionally, the gut of each specimen of *loli* will be removed prior to analysis.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, DR. JACK RENSEL, APRIL 2013

1. Comment: In one respect, the Draft SSAP's identification of species (SOI) for the supplemental study substantially improves on the Army's prior efforts. For the first time, the Army has included within the SOI demersal (bottom dwelling), relatively non-mobile or sessile nearshore species like sea cucumbers. These organisms have the potential to provide important information about the degree of contamination from military training at Mākua Military Reservation (MMR). As I emphasized in prior comments, bottom-dwelling animals like sea cucumbers spend their lives in potentially contaminated fine sediments and, thus, are important indicators of the extent to which contaminants from military activities at MMR are washing down during storm events and entering the food chain.

   Response: Comment noted.

2. Comment: In other respects, the Draft SSAP's identification of SOI falls short. Table 4 on 17 purports to list "Species of interest targeted for supplemental study," including ten species of *limu* that the Army concluded are consumed by Waiʻanae Coast residents. The accompanying text on pages 25 states, however, that "(t)he sampling effort will target eight samples of *limu kohu* (*Asparagopsis taxiformis*)." "Other species of *limu* from Table 4 found to be abundant at the site will be considered for sampling" only if "*limu kohu* is not available at the nearshore waters of Mākua in sufficient biomass for creating eight composite samples." Draft SSAP at 26. Table 4 is, therefore, highly is misleading because, in fact, only one species of *limu* is targeted for sampling; the other nine species are merely alternates in case *limu kohu* is unavailable. The Draft SSAP's proposal to sample only one species of *limu* raises important questions that the draft plan fails to answer.

The central question is whether there is any justification for sampling only A. *taxiformis*, a question of which the Draft SSAP is completely silent. While *limu kohu* may be popular in Hawaiʻi, it is far from the only *limu* that people in Hawaiʻi commonly gather and eat. Is there information indicating that A. *taxiformis* is more prevalent at Mākua than the other *limu* listed in Table 4 or the most commonly consumed algae from the leeward coast and the Mākua are specifically? Is there information available that indicates that this algae will be physiologically and metabolically the same as other seaweeds collected and consumed by residents of the region with respect to contaminant dynamics? The draft plan gives no insight into any of these key issues, which must be satisfactorily addressed before the Army can justify its extremely limited proposed list of sampling targets.

Response: The Army will adequately comply with the June 20, 2012, court order by sampling and analyzing one species of *limu* from the nearshore waters at Mākua Beach and the two background locations, around Kaʻena Point and along the coast of Mokulēʻia. To meet the objectives of this project, a single species of *limu* was targeted for sampling in this study. *Limu kohu* was chosen as the target species of *limu* because it was the most common *limu* species referenced in the surveys and at public meetings.

3. Comment: The Draft SSAPs uncertainty regarding the availability at Mākua of *limu kohu* that, even at this late date, after years of "study," apparently no one in the Army's team has bothered to examine the availability of SOIs in the waters offshore of Mākua, by diving or even the use of widely available and inexpensive video drop cameras. There is no excuse for the Army's failure to perform this basic preliminary field work.

Response: A preliminary site survey conducted April 30- May 1, 2013, indicated that *limu kohu* is present at both the nearshore waters at Mākua Beach and the two

background locations, around Kaʻena Point and along the coast of Mokulēʻia.

4. Comment: On page 29, the Draft SSAP makes reference to "trapping techniques… to capture lobsters," but no other part of the draft plan mentions lobsters as an SOI. The reference to lobsters is an apparent holdover from the very first draft sampling plan, which does not inspire confidence given the extent of review that should have taken place before the Army issued this draft.

   Response: Lobster is not a target organism and will not be collected. The statement "…however, appropriate trapping techniques will be used to capture lobsters as needed …" was deleted.

5. Comment: One of the most significant aspects controlling the accuracy and usefulness of any field study seeking to interpret results by comparison to one or more reference areas is the process used to select such areas. Reference area selection is of particular importance in the case of the Army's study because it calculates environmental and human health risks as incremental risk above the risks found at background areas. Thus, selection of reference areas that contain sources of contaminants not present at Mākua would result in underestimates of the extent to which military activities at MMR contribute to contamination of the marine resources found in Mākua's nearshore waters.

   Response: The reference site needs to be on Oʻahu to be representative of the island's current and geologic background conditions. A representative background location would have to be on Oʻahu otherwise, the location would not be representative because the basalt composition of each island is different. The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia.

6. Comment: The Draft SSAP improperly refers to the reference as "background" or, once on page 12, "control" sites. The use of the term "control site" is particularly inappropriate to describe locations for field work; the term is reserved for controlled laboratory conditions, where all conditions can be "controlled."

   Response: In the revised version, "control site" was replaced with "background locations" as per the July 20, 2012, Court ruling.

7. Comment: We previously highlighted the lack of justification for the selection of either Nānākuli or Sandy Beach as reference sampling locations. Both locations are likely to have been compromised by a variety of major pollutant sources which render them unsuitable s reference areas for comparison to Mākua.

   Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

8. Comment: Nānākuli is an urbanized area whose watershed includes drainage from the Navy's Lualualei ammunition magazine, which has been active since 1934. Because of the age and extensive size of this facility, selection of Nānākuli as a MMR reference area would require extensive prestudy and justification, which the Army has, to date, failed to do. Older military facilities in the United States were often subject to on-site dumping of contaminated waste products such as spent cleaning solvents, petroleum lubricants, and other wastes. Burning of waste solids and liquids, land use practices such as the use of highly persistent and toxic pesticides, inadequate wastewater collection and treatment are but a few of the documented problems at some older military facilities.[3]

Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

9. Comment: Despite my and others' repeated comments about the potentially significant sources of contamination at Nānākuli from both military and civilian sources, the Army has failed to offer any justification for selecting Nānākuli as a reference site, other than the supposition that it was unlikely to be affected by activities at MMR. Even if that were an accurate assumption, the relevant question is whether the Nānākuli site allows one to assess the level of contaminants that would be present at Mākua in the absence of military activities. Mākua is a relatively remote, non-urbanized area that, in the absence of military training at MMR, would have few local sources of contamination, and remote sources, such as the ammunition dumping grounds further south, would be diluted significantly by the time they got to Mākua. The same cannot be said of Nānākuli, an area that has potentially significant contaminant inputs from surrounding modern-era urbanization and historic and current operations as a military magazine, both of which should rule out use of Nānākuli as a valid reference area.

Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

10. Comment: The Draft SSAP's identification of Sandy Beach as a reference area is likewise unjustified. In the 2009 Marine Resources Study (at page 2-4), the Army stated that Sandy

Beach allegedly "is considered to be similar to the Mākua nearshore area because both support rocky areas and sandy beaches, with very low rainfall." This statement is erroneous and misleading for numerous reasons. Sandy Beach is not similar in exposure, energy level of waves, undercurrents near the beach, beach morphology (cross sectional aspects perpendicular to shore), exposure to prevailing winds, and relationship to ocean currents. Unlike the Mākua nearshore area, the overall circulation at Sandy Beach (i.e., presence or absence of eddy circulation near the shore) is unknown. Moreover, as the Army discovered in conducting its 2009 study, Sandy Beach is not biologically comparable due to a lack of intertidal species of *limu*. Since the Army is obliged to sample *limu* as part of this supplemental study, this last factor alone should rule out Sandy Beach as a reference site. Moreover, the similarities between Sandy Beach and Mākua that the Army mentions do not make up for the substantial differences noted above. While both are on O'ahu and have rocky and sandy beaches in adjacent areas, the same can be said of many other beaches along Oʻahu's leeward or windward coasts. Rainfall is also somewhat similar, but Sandy Beach's lack of stream input distinguishes it from Mākua, which receives storm water runoff from three separate streams. Even if Sandy Beach were not otherwise disqualified, the presence of the East Honolulu Waste Water Treatment Plant and outfall alone would render the site inappropriate as a background location for Mākua, which lacks any sewage treatment facilities. Recent Clean Water Act discharge data indicates that sewage discharges from the East Honolulu facility average 4.4 million gallons per day. The outfall is unusually shallow—only about twelve meters deep—and lies less than a quarter mile from shore. A properly selected background location would not have such a potentially confounding source of contamination.[4]

Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia. Based on the EPA's criteria for background

locations, the selection of those background locations is appropriate. Additional explanation has been added in section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

11. Comment: The sewage treatment plant (STP) discharge at Sandy Beach is "treated" but the treatment used in such STPs is focused first on removing solids and then biological oxygen demand of organic materials. Harmful and persistent chemicals are often trapped in the sludge byproducts of STPs, but many dissolved and even fine particulate-bound contaminants escape treatment to be discharged into ambient waters.

    Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia.

12. Comment: In addition to Nānākuli and Sandy Beach, the Draft SSAP proposes as a reference area a location "on the north shore of Oʻahu west of Mokuleʻia and Waialua, around Ka'ena Point Area" (page 27). This third "location" is actually a rather large stretch of coastline. The Army's failure to indicate with greater precision where exactly it proposes to sample renders public review of this aspect of the Draft SSAP all but meaningless.

    Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

13. Comment: Notably, the Draft SSAP indicates that sampling would occur on the northwest shore of Oʻahu only "if sufficient biomass is available." This qualification indicates that the Army does not, in fact, know whether the target species are present at the proposed reference site. As with the

selection of Sandy Beach—where there was no *limu* to sample—for the 2009 study, the Army has once again failed to perform standard preliminary field investigations that are critical to a scientifically defensible study.

Response: A preliminary site survey conducted April 30 –May 1, 2013 (described in detail in Appendix B), indicated that *limu kohu* as well as the loli and heʻe are present at both the nearshore waters at Mākua Beach and the two background locations, around Kaʻena Point and along the coast of Mokulēʻia.

14. Comment: There is no justification for limiting the reference sampling to one area, especially when the Army has failed to do any field study sampling or literature review to demonstrate that any of the proposed reference areas is representative of the conditions that would exist at Mākua in the absence of military training activities at MMR.

Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

15. Comment: Moreover, the failure to ensure the availability of SOI at the North Shore locations raises the specter that reference samples will likely be collected only at Nānākuli, which, as discussed above, is a highly polluted location whose use as a reference would mask potentially elevated contamination at Mākua. The Draft SSAP states (page 27) that, if target *limu* and invertebrates are not successfully sampled "at the primary background sites," which presumably refers to the North Shore, sampling would then be "attempted at Nānākuli and then at Sandy Beach." The draft plan also specifies that target species would be "collected from a single background site." Since Nānākuli is to be sampled before Sandy Beach and, in any event,

Sandy Beach lacks the target *limu* species, the proposed sampling design makes it a certainty that Nānākuli will be the reference location if the Army is unable to sample the target species in sufficient quantities at the North Shore sites. This major issue of probable shortcutting of the use of multiple reference sites is not clearly identified in the narrative, and is only apparent to a diligent reader through careful reading.

Response: A preliminary site survey conducted April 30 –May 1, 2013 (described in detail in Appendix B), indicated that *limu kohu* as well as the loli and heʻe are present at both the nearshore waters at Mākua Beach and the two background locations, around Kaʻena Point and along the coast of Mokulēʻia.

16. Comment: Selection of appropriate reference areas for the draft sampling plan should be delayed until after preliminary field studies, proposed in the Draft SSAP, are completed. Those preliminary field studies should be predicated by the use of available tools and local/regional expertise to identify potentially appropriate reference locations. It would take very little time or effort to check with a local seaweed expert to find out if the North Shore area sufficient quantities and types of *limu* to support the study objectives and to use existing tools and references to examine site conditions.

Response: A preliminary site survey effort (conducted April 30- May 1, 2013), described in detail in Appendix B, confirmed that *limu kohu* as well as the loli and heʻe occur in sufficient biomass in the nearshore waters at Mākua Beach and the two background locations, around Kaʻena Point and along the coast of Mokulēʻia.

17. Comment: One resource that could possibly be used, but was not, is the Pacific Island Ocean Observing System (PacIOOS) Voyager GIS system, readily available to anyone on line

(http://pacioos.org). An example below shows benthic habitats including algae density for part of the island of Oʻahu. There is no excuse for not using this tool and others in preparation of a serious and scholarly sampling and analysis plan.

Response: Comment noted. A preliminary site survey effort (conducted 30 April- 1 May 2013), described in detail in Appendix B, confirmed that *limu kohu* occurs in sufficient biomass in the nearshore waters at Mākua Beach and the two background locations, around Kaʻena Point and along the coast of Mokulēʻia.

18. Comment: On pages 27 and 28, the Draft SSAP briefly describes an intended preliminary field survey of marine resources. This preliminary field survey should have been completed before the Draft SSAP's preparation. Since the Army failed to do this, it should take the necessary steps now to identify suitable reference areas and then circulate a revised and properly documented draft plan for public review and comment.

Response: A preliminary site survey effort (conducted April 30- May 1, 2013), described in detail in Appendix B, confirmed that *limu kohu* as well as the loli and heʻe occur in sufficient biomass in the nearshore waters at Mākua Beach and the two background locations, around Kaʻena Point and along the coast of Mokulēʻia.

19. Comment: The final paragraph of the section related to the preliminary field survey (3rd paragraph, page 28) states that the surveyors will perform a “qualitative description of abundance and distribution” and that “an estimate of biomass available for analysis will be documented” as part of the pre-study. The preliminary field survey should include a quantitative assessment rather than just a look-see using an unknown approach and level of diligence. The draft should specify the methodology for the preliminary field survey and a description of how the surveyors will report the results of their investigation. Once the preliminary

surveys are completed, the revised Draft SSAP should provide interested parties with a summary of both the information gathered and the tentative conclusions regarding the choice of suitable reference areas.

Response: A preliminary site survey (conducted April 30- May 1, 2013) was conducted and it is described in detail in Appendix B.

20. Comment: The Draft SSAP fails to specify the strategies that must be utilized to stratify the surveys to increase the likelihood of finding the necessary biomass of samples in the habitats that we know each targeted species occupies. In the absence of a sampling stratification strategy, surveyors may intentionally or unintentionally collect samples in a biased manner, rendering nil their chances of assessing accurately the conditions on the ground.

Response: The randomness of the sampling of the subtidal habitat will be assured by the use of simple random sampling approach, which results in every sample having an equal chance of selection, and each unit assumed as representative of the entire population. The first sampling unit and subsequent sampling units will be selected using a random number generator, preventing the introduction of sampling bias by the personnel conducting the sampling. For octopus and sea cucumber, if no specimen is found in one sampling unit, an attempt will be made to sample two specimens from the next sampling unit selected for sampling. For *limu*, if the sampling mass is not sufficient for one analytical chemistry replicate, an attempt will be made to sample additional biomass in addition to a whole sample from the next sampling unit selected for sampling.

21. Comment: It matters where the samples are taken within a large geographic area and the habitat type from which they are collected. For example, was the sampled sea bottom rock, boulders, gravel, course sand, mixed sand and fines, silt, clay, rock, gravel, or other? In this regard, an experienced

field technician or scientist can easily identify the general substrate by inspection. Was a specific sample collected nearshore to *muliwai* discharge or offshore away from the possible source of terrestrial contamination. The sampling plan must specify conservatively to sample near or on sea bottoms that have more fine-grained material such as silt and clay and as near to shore as possible, but not in the surf zone. The types of habitat described above do in fact occur from our own observations while snorkeling in the Mākua area, such as between rock ledges where finer sediments tend to accumulate.

Response: Marine scientists will be on site during sample collection and will work with local divers (who will be collecting the samples) to identify the appropriate substrate where the samples will be collected.

22. Comment: The SSAP should specify that the investigators must use readily available and accurate GPS equipment to record accurately the location of samples that are collected at both Mākua and the reference sites. This detailed location information should then be reported in the study report, so the public will be able to ascertain whether the Army sampled in the locations and habitat types (e.g., fine sediment areas, rather than hard substrate that wave action scours clean) most likely to accumulate contaminants. The lack of precise location information in the 2009 Marine Resources Study created a substantial and unnecessary obstacle to assessing the adequacy of the sampling effort.

Response: Each sample will be tagged with its corresponding GPS information and a description of the sampling location which will include a description of the substrate.

23. Comment: The fact that the Army proposes to begin collecting these data before the public comment period on the Draft SSAP has closed raises questions on whether, in fact, the public has a meaningful opportunity to propose modifications to

the plan or whether the Army is just going through the motions and intends to proceed as planned.

Response: Comment noted.

24. Comment: I have long maintained that the Army should have characterized and described the subject area from literature and available physical model results before conducting any surveys. These efforts should have included a bathymetric map with cross-section profiles perpendicular to shore and identification of sediment types (as contaminants are often associated with fine clays and silts).

Response: A preliminary site survey characterizing and describing the subject area was conducted on 30 April- 1 May 2013. The results including photographs and GPS coordinates can be found in Appendix B.

25. Comment: Now that current meters are to be deployed, what is the goal of this action in the context of improving our knowledge of the area and the transport of chemicals of potential concern (COPCs)?

Response: Current meters will no longer be deployed.

26. Comment: The Draft SSAP states (on page 29) that "(t)wo sampling efforts will be conducted," one time in March/April and a second time during July/August. It is unclear; however, if the summer month biological sampling will proceed if sufficient biomass is obtained in the first sampling effort in spring. The draft plan should be revised to clarify that both sampling efforts will be conducted, with the same level of sampling effort each time. Since species can accumulate and store contaminants at different rates under different seasonal conditions, to access accurately human health risks from consuming marine resources, it is vital to gather samples at different times of year.

Response: The SAP was revised to clarify that both sampling efforts will be conducted using the same level of sampling effort each time. One sampling effort will occur during the dry season (tentatively September 2013) and the second sampling effort will occur during the wet season (tentatively January 2014).

27. Comment: The Draft SSAP state (page 29) that the processing of samples will include "eliminating undesirable parts and retaining the parts that are typically consumed by residents." I agree that, to assess human health risks, it is important to focus testing for COPCs on those portions of marine resources that are actually consumed. The Draft SSAP fails, however, to identify which parts of the target species it considers "undesirable" (and, thus, will not be tested) and which parts it considers to be "typically consumed by residents." There is, accordingly, no way for the public to provide meaningful input during this comment period on whether or not the sampling plan got it right. The Army should revise the Draft SSAP to include the missing information and recirculate to the public for comment.

Response: The ink sac and beak from each specimen of octopus and the gut of each specimen of sea cucumber will be removed prior to analysis. *Limu, he'e*, and *loli* will be rinsed to remove sediment particles. The limu will be cut from steadfast to obtain sufficient biomass and to allow the limu to continue grow.

28. Comment: While the decision to limit composite samples to individuals of the same species represents an improvement on the 2009 Marine Resources Study, compositing is still undesirable. By pooling several individuals into one sample, compositing averages the contaminant load present in the individual samples. As a result, it can hide potentially high contamination levels present in individual specimens of a species and also can prevent the identification of specific locations (e.g., in fine sediment areas or near the discharge of Mākua's streams) where marine

resources are more likely to be contaminated. Use of a compositing can, therefore, will deprive the public of useful information regarding potential adverse health risks. Individual specimens should be collected and analyzed separately to gather important variability information needed to conduct statistical comparisons among the Mākua and reference location results. Without true replicate samples, no defensible conclusions can be reached regarding the statistical significance of differing average levels of contamination among reference and Mākua locations. This was the case with prior surveys where there was no attempt to quantify these important issues, but rather the results were merely used in the risk analysis without comment or consideration of differences.

Response: Specimens of two or more separate species will not be combined to create any composite sample. Single specimens of *he'e* will be used for replicate analysis. For *limu* and *loli*, pooling of the edible portions of same species from the same sampling area will be used to create a replicate sample of sufficient mass for the chemical analyses. Each species sampled in the nearshore waters of Mākua Beach will also be sampled from both of the background locations.

29. Comment: Not only is the proposal in the Draft SSAP to use composite samples undesirable, but it also is unjustified. In the case of sea cucumbers, the only invertebrate SOI other than octopus (which will not be composited), the Army's failure to perform any preliminary survey—at Mākua or at any of the proposed reference locations—means there is no basis to assume that individual specimen weights will be insufficient for testing.

Response: Specimens of two or more separate species will not be combined to create any composite sample. Single specimens of *he'e* will be used for replicate analysis. For *limu* and *loli*, pooling of the edible portions of same species from the same sampling area will be used to create a replicate sample of sufficient mass for the chemical anal-

yses. Each species sampled in the nearshore waters of Mākua Beach will also be sampled from both of the background locations.

30. Comment: In the case of *limu*, it is vital to avoid compositing when analyzing arsenic contamination and speciation. Based on the Army's prior sampling efforts, we already know there is a concern for arsenic contamination. The sampling plan for this supplemental study must be adequate to determine the extent to which arsenic contamination poses a human health risk. To do that, the study must test multiple and separate *limu* samples (known as "replicates" in statistical analyses) from different specimens, not just separate fronds from a single specimen, to determine if statistical differences exist among test and reference samples. Failing this step, the study would commit an error known as "pseudo-replication" and violate the fundamental rules of field biology sampling.

Response: *Limu* from several specimens from a given sampling location must be composite to yield sufficient biomass for any of the proposed chemical analysis. Compositing the *limu* is representative of method used by residents when sampling this marine resource for consumption. The randomness of the sampling of the subtidal habitat will be assured by the use of simple random sampling approach, which results in every sample having an equal chance of selection, and each unit assumed as representative of the entire population. The first sampling unit and subsequent sampling units will be selected using a random number generator, preventing the introduction of sampling bias by the personnel conducting the sampling. For *limu*, if the sampling mass is not sufficient for one analytical chemistry replicate, an attempt will be made to sample additional biomass in addition to a whole sample from the next sampling unit randomly selected for sampling.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, JEFFREY A. FORAN, APRIL 2013

1. Comment: The Draft SSAP states (p. 15) that its "list of species of interest (SOI) was created based on surveys and discussions with local residents from the Waianae coast, regional commercial fisherpersons, local recreational fisherpersons, area divers, and spear fisherpersons." To allow peer review of whether the SOI listed in Table 3 to the Draft SSAP are appropriate, the Army should make publicly available copies of the surveys and notes from its discussions, as well as the analysis the Army performed to arrive at this list of SOI.

   Response: Information obtained from surveys, discussions, and public meetings is available through the Public Affairs Office of the U.S. Army Garrison Hawai'i.

2. Comment: There is no indication in the Draft SSAP that any of the individuals that the Army consulted are themselves subsistence consumers. Selecting species that are preferred by recreational fishers who do not eat their catch or by commercial fishers, who may not sell their catch to area residents, would not result in useful data to assess contamination of those specific marine species that area residents gather for personal consumption. There is no way to ascertain whether the Draft SSAP suffers from this defect, since it does not provide detail regarding with target species were selected based on information from area residents who consume marine resources from Mākua, as opposed to those species suggested by non-subsistence consumers.

   Response: Public meetings and surveys were conducted to gather input from area residents concerning their methods of collection and consumption of marine resources from Mākua Beach. (Please see the U.S. Army Garrison-Hawaii

Mākua Marine Resources Survey that precedes these comments.)

3. Comment: In addition, as noted in my prior comments, SOI selection should be based on statistically supportable quantitative data that accurately represent collection and consumption by anglers and local residents, including subsistence consumers. If this is not done, the species that are ultimately assessed in the Supplemental Marine Resources Study may not be those of greatest interest to, or used and consumed most frequently by local anglers and others. This would preclude accurate assessment of the human health risks to subsistence consumers of Mākua's marine resources, precluding the Army from achieving one of the study's primary objectives. Review of the surveys and interview notes, as well as of the Army's analysis of those data, is necessary to determine whether the Draft SSAP's list of SOI is based on a statistically appropriate identification of species that accurately represent collection and consumption by subsistence users.

   Response: Public meetings and surveys were conducted to gather input from area residents concerning their methods of collection and consumption of marine resources from Mākua Beach. (Please see the U.S. Army Garrison-Hawaii Mākua Marine Resources Survey that precedes these comments.)

4. Comment: I previously criticized the Army's failure to sample any benthic species, which accumulate contaminants in their tissues and, therefore, play an important role in the transport of toxicants through the food chain. Without a thorough understanding of benthic species, the Marine Resources Study may have missed species with the highest tissue contaminant residues or those at greatest ecological risk from the effects of toxicants associated with activities at Mākua Military Reservation (MMR). Assuming that statistically appropriate data otherwise support the identification of octopus and sea cucumber as SOI for

subsistence consumers, the Draft SSAP's proposal to sample these benthic species reflects an improvement over prior sampling designs.

Response: Comment noted.

5. Comment: The Draft SSAP states (p. 27) that "(b) background near-shore sampling … will be conducted primarily in three locations": 1. on north shore of Oʻahu west of Mokuleʻia and Waialua, around Kaʼena Point Area if sufficient biomass is available. 2. on western shore of Oʻahu near Nānākuli. 3. on the eastern site of Oʻahu near Sandy Beach. As noted in prior comments, the Army's selection of Nānākuli and Sandy Beach as reference sites to compare with Mākua is seriously flawed. The location of a discharge outfall from the East Honolulu Wastewater Treatment Plant offshore at Sandy Beach may significantly influence contaminant loads and contaminant tissue burdens at this background site. Likewise, Nānākuli *muliwai*, which is located in the middle of an urban area and downstream from Lualualei Naval Magazine, may also be subject to significant contaminant loadings. As a result, samples collected from these sites would not represent true background (i.e., the conditions one would find at Mākua in the absence of military activities at MMR).

Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia.

6. Comment: The north shore of Oʻahu west of Mokulēʻia and Waialua may likewise be subject to sources of anthropogenic pollution not present at Mākua. While this stretch of coastline is not urbanized, currents may carry contaminants from past and current agricultural operations in the Waialua area, from activities at Haleʻiwa Harbor, as well as runoff from the Waialua and Haleʻiwa urbanized area. Before selecting this—or any other—reference site to determine background concentrations, the Army must

address differing phenomena related to the fate and transport of contaminants derived from local sources. Failure to perform that assessment and to select appropriate reference sites can lead to an inaccurate assessment of the extent, nature, and impact of contamination at the MMR site.

Response: Each island in the chain is unique, and using a background location from Molokaʻi would not be a representative background location. A preliminary site survey was conducted off Mākua and Mokulēʻia on April 30- May 1, 2013, and it verified the appropriateness and representativeness of Mokulēʻia and Kaʻena Point as the two background locations (see Appendix B).

7. Comment: Since the Draft SSAP's stated intent (p. 7) is to identify and characterize contamination "associated with military training" at MMR, the Army must determine background concentrations from sites unaffected by sources of contamination that would not be present at Mākua in the absence of military activities at MMR. If the Army believes there are potential sources of contaminants to the nearshore areas at Mākua other than MMR, such as a wastewater treatment plant discharge outfall or urban non-point runoff, contaminant loads from these sources should be characterized as part of a comprehensive site assessment. Since such sources do not co-exist with MMR, there is no justification for the Army's apparent assumption they are co-contributors of contaminants to the site.

Response: Comment noted.

8. Comment: The Draft SSAP states (p. 29) that "*Limu* will be hand-picked using clippers and cut at the stipe above the holdfast and identified, and then the individual samples will be placed in a netted bag or a bucket of water during collection." It fails, however, to discuss the method used to identify the *limu* to be picked in the first place. To provide scientifically reliable results, the SSAP must

ensure that the underlying sampling is conducted properly.

Response: *Limu* will be identified to the species level by a local expert at the time of sampling.

9. Comment: One standard sampling technique would be to place or establish a transect along which all or some established subset of *limu* would be sampled. This same procedure would then be used at all sites to ensure that sampling bias is minimized as much as possible and that sampling procedures between sites is a consistent as possible. Otherwise, individuals conducting sampling can simply choose the *limu* at each site that will—and will not—be sampled, which is not a scientifically defensible sampling method.

Response: The randomness of the sampling of the subtidal habitat will be assured by the use of simple random sampling approach, which results in every sample having an equal chance of selection, and each unit assumed as representative of the entire population. The first sampling unit and subsequent sampling units will be selected using a random number generator, preventing the introduction of sampling bias by the personnel conducting the sampling. For octopus and sea cucumber, if no specimen is found in one sampling unit, an attempt will be made to sample two specimens from the next sampling unit selected for sampling. For *limu*, if the sampling mass is not sufficient for one analytical chemistry replicate, an attempt will be made to sample additional biomass in addition to a whole sample from the next sampling unit selected for sampling. Each sample will be tagged with its corresponding description of specific sampling site, including substrate, depth and proximity to potential sources of contamination such as *muliwai*.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, WILLIAM PRESCOTT, APRIL 2013

1. Comment: Will you be getting samples from Ule-hawa stream in Nānākuli Run off from the rubbish dump on Lualualei Naval Road enters the stream which then goes into the ocean. It would be interesting to know what if any contaminants are in the water, effects on seafood and how it compares with other areas. And I thought you'd be interested in the enclosed regarding Mākua and ceded lands as they may add to what you already have.

   Response: Thank you for the suggestion, but Ulehawa Canal is not part of the Supplemental Marine Resources Study area. The objective of this study is to investigate whether constituents potentially associated with military training are present in samples of selected species of limu, heʻe, and loli found near Mākua Beach and relied on for subsistence by area residents. An evaluation of the risks to human health will be conducted.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, NICHOLAS YOUNGLESON, APRIL 2013

1. Comment: I would like to suggest that, if possible, the study include the possibility of a Marine Reserve, where no fishing, spear fishing, or gathering of marine resources is allowed. I have noticed the huge decline in marine resources along the Leeward coast over the last 10 years. It is my belief and understanding that this is mostly as a result of over-fishing and gathering, I am by the way a keen fisherman. For the protection of our marine resources, we need marine sanctuaries that allow growth and regeneration of our coastal resources. The sanctuaries need to be well defined (posted) and strictly patrolled. I also believe that the military (being the largest importer of people to the islands) has a duty to support land and marine husbandry, especially insuring that all their personnel are taught about the island's fragile ecosystem and encouraged to protect and help the ecosystem. Mahalo for your efforts.

   Response: Thank you for the comment, but establishing a Marine Reserve is outside the scope of this Supplemental Marine Resources Study.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, TOM LENCHANKO, APRIL 2013

1. Comment: pule paulele. oia ua ike a aia la. Thomas Joseph Lenchanko Hawaiian National 03/14/2013. kahuakai ola ko laila waha olelo aha kukaniloko koa mana mea ola kanaka mauli. eli eli kau mai

   Translation: Prayer of faith. He knew and alas, the speaker survived the journey to Kukaniloko and the powerful warrior brought life to the native Hawaiians. So it was.

   Response: Comment noted. Thank you.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, GLEN KILA, APRIL 2013

1. Comment: In reply to Tom Lenchanko's Comment: Aloha e Tom, Mahalo nui. Akua lako. Glen

   Translation: Calling out to Tom. Many thanks, In God. Glen.

   Response: Comment noted. Thank you.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, S. JOE ESTORES, APRIL 2013

1. Comment: This is perhaps late in the formulation of this particular analysis but I will state some of the questions or concerns that I have. The first is, when talking about the risk to human beings, it appears that the risks are mainly targeted to consumption of the food. I believe that the study is supposed to be looking at our marine resources and a marine resource in Hawai'i is not only for food. It's for recreation. It's for exploration. So, given that Mākua was used for Naval guns, shooting from offshore, I am not certain that all of the projectiles hit the impact area wherever it was in the valley. I am assuming that there were some projectiles landed short on the beach or in the water. Now, limiting ourselves to constituents or evidence of contaminated fish and edible resources, we are not looking at the possibility of unexploded ordnance or duds or practice rounds that have landed in the water and yet they may not have contaminated the fish. So, I question why we're not looking at the possibility of rounds or ammunition that still may exist in the waters perhaps covered over by coral but yet they are present. And that tells me that the study should consider what cause the fish to be contaminated. It sounded like they're only considering the water runoff from the valley as a source of the contamination. I submit that the contamination could be from the coral or the beaches where perhaps ammunition still exist. I don't know if that has already been examined or investigated or inspected. If it has, I'd like to know the results of that. In general, when I look at the Ahupua'a system in the Hawaiian culture, it is the land area from the top of the mountain all the way into the ocean. So, if we have contamination on ground level in the valley, at ground level, we must also consider that that ground level continues under the ocean. And so, if we are concerned about looking at contamination in the

valley, we must also look at contamination from the land area that extends from the beach out to 100 to 200 ft deep. That land area is part of the Ahupua'a system. So, that to me is a significant aspect of the study. Now, in addition to that, when it comes to using the marine resources, the marine resources being the beach and the water for recreation, so that tells me that if there is going to be any diving or respiration in that area of the study, it might be risk—there may be risk involved there and we'll only find out if somebody moves—happen to move an unexploded ordnance in the coral and either get injured or get killed. That's too late to find out that we did not—we did not cover the area completely. Final statement is, I consider the area of study here as a total ecological system and that ecological system involves, not only the fish, the crabs, the *limu*, it involves the coral; it involves the sand; it involves the water. That integration of all those elements constitutes this area. We're limiting ourselves to looking at only contaminated fish and edible items. That is to me, not covering the risk assessment in its full spectrum of possibilities.

So, I appreciate the opportunity to make these comments. I hope that whoever going to look at the comments will provide feedback. I hope to look at the feedback as to whether or not my comments are appropriate or not. Thank you very much.

Response: Thank you for your comments. The objective of this study is to investigate whether constituents potentially associated with military training are present in samples of selected species of limu, heʻe, and loli found near Mākua Beach and relied on for subsistence by area residents. An evaluation of the risks to human health will be conducted.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, ALBERT H. SILVA, APRIL 2013

1. Comment: Okay. So, I want to not discuss so much but tell about is this idea that the problem that we're going to with the Army gathering all this information to justify or the safeness of the area of Mākua both on the land and in the ocean, especially, with the seafood that the people consume like *limu* and fish, and like the *loli*, and the other sea urchins and crabs, I guess, to defend themselves. Where it should be, I believe, misusing or misdirecting the purpose of the Army's ability to really sort of defend itself because the Army is a defense force and it's not so much a force that regulates or keeps control over contaminants to the land. It should be another department besides the Army to do all that research and study. No different than any other, like EPA, Environmental Protection kind of problems occur whether it be radioactive or chemicals that affect the civilian or the government population, the people. And so, this area that I believe is wrongful for the Army to be doing all these study and having this responsibility. I think what it really does, it sort of damages the relationship with the communities. And the communities are confused, meaning the communities, meaning the citizens are confused that the Army did whatever. It shouldn't be that way. It should be that the Army does what it does and the other governmental agencies do what they are supposed to do, maintain information or provide information to the communities whether it's safe enough to live or to consume whatever—whether vegetation or animal or creatures. It shouldn't be the Army's responsibility. The Army should just do what they are doing, defend our country, provide protection to our people, no different than the police department having to go and investigate a case that involves chemicals that's used in a civilian place. So, I think it should be the same thing that the kind of

system—you know, through the system that the Army should not be doing what they are doing. No. Wrong. I really believe it's wrong. It should be like the EPA or some other governmental agency. I know I'm getting to repeat myself but it's something that—it's a thought that has been bothering me because the Army got to go find other professionals, other kind of people. And they're not familiar with it; so, why not the EPA or whatever governmental agency be in charge of that? That's my effort to bring out a thought that I believe is not correct. It's incorrect because it's not right that the Army's got to do it. They don't have the expertise. It's the EPA or health agencies. That's where it should be. Don't mind me. I'm repeating myself but it's so—because I don't have a—you know, I haven't written out these points that I want to make. I'm trying to be understood and I think—I hope maybe we'll generate some interest so that someone can sort of evaluate and see if it's worthy or not. And if it isn't, well I made an effort. That's how I want to put it. I'm making an effort to contribute. Thank you very much. The Army, I believe, should stay away from these confrontational experiences with communities. It doesn't help the Army. It doesn't the people. The people are really misdirected with these kinds of problems and I hope we can improve or reduce or lure our relationships between the Army, the Navy, and these kinds of responsible people like the EPA, the people. If they want to pick on anybody, pick on the EPA because they're made and structured for that, that purpose. I believe the EPA should be the environmental protection or protective agencies. So, thank you very much again.

Response: As dictated by the June 20, 2012, court ruling, for this study the Army is required to evaluate the human health impacts (see Section 4 of the Sampling and Analysis Plan). While it does seem appropriate for EPA to be handling this issue, the responsibility falls on the Army as part of the Environmental Impact Statement for Live Fire Training at Mākua Military Reservation. The SAP was peer reviewed by other agencies including University of

Hawaii, USEPA Region 9, Hawaii State DOH, U.S. Army Center for Health and Promotion & Preventive Medicine, and Hawaii State Department of Land and Natural Resources. It is the Army's responsibility to do the survey but will be scrutinized by other agencies including the University of Hawaii, USEPA Region 9, Hawaii State DOH, U.S. Army Center for Health and Promotion & Preventive Medicine, and Hawaii State Department of Land and Natural Resources

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, WILLIAM J. AILA JR., APRIL 2013

1. Comment: So, points I need to get across: I highly recommend they hire local fisherman to collect the samples. I highly recommend that they add red weke and kona crab, in addition to the *heʻe*, the octopus, and the *limu kohu* and they already have the *loli* but that too. I think the methodology for capture or collection of sample should be the same methodology for ordnance reef. I want to reiterate, I think the background, or what they're calling the control area should be off island because the sights that they're proposing have had military use. So, if you want to compare something to an area that's supposedly "untainted," you can't use areas that have had military use. That's why I suggested the North Shore or Molokaʻi Ridge. We all know was never occupied by the U.S. military when they train, no offense to you. I don't think that they should limit to 50 ft off shore. They should go deeper, whatever depth necessary to collect the samples because the *limu kohu* can be covered by sand during some times of the year and opened up at other times of the year. So, if it's at 80 ft and they can't find it closer to shore, they should collect it when it's available, when the high surf moves the sand. It's hard because you guys aren't fisherman. So, you don't understand this. When the high surf comes in, it moves the sand towards the—actually, moves the sand away from the shore then the near shore *limu kohu* is going to be open and available. When the south swells come, it pushes the sand back up on the shore. Then the deeper *limu kohu* is going to be available for sampling. They're not going to know that because they're not fishermen. They're not maah to the area. They should use the same analysis of the samples in ordnance because that was worked out between the Department of Health, the EPA, the State of Hawaiʻi, and the community. So, the same sampling techniques and how they do the sampling

techniques in the lab as well chain of custody should be the same as ordnance reef. The risk assessment now, when they get that information back from the laboratory should be compared to the risk assessment that was specifically created for the Waiʻanae Coast as described in ordnance reef study. The one thing they didn't mention if they were going to homogenized or non-homogenized individual samples. They said they weren't going to combine different species but the question becomes, when they capture the specimen, are they going to homogenize that specimen or are they going to remove the intestines? It should be the same sampling regime or methodology as at ordnance reef so we can compare the results in both places. And I think that's it. The last thing is, they're no way they're going to get the winter samples this year because April is not winter here. So, they're going to have to wait till next year. And winter is usually December through February in Hawaiʻi. That's particularly important for Waiʻanae because we usually get most of our rain within that time frame. So, that's why it's very important that the sampling be done correctly. The heavy rains are gone already in April. Last thing is, thank you for your time and your patience.

Response: The Army plans to use local fisherman for collection of the samples. Red weke (goatfish) is a fish, and Kona crab is a crustacean. The fish and shellfish species were collected as part of the previous Marine Resources Study and will not be collected for this study. Background locations on Molokaʻi would not be representative, and the Army is planning to use two background locations, around Kaʻena Point and along the coast of Mokulēʻia. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in Section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations. The collection depth of 50 ft or less was obtained from the public surveys, but we can extend the depth if necessary for collection of the samples. The preliminary site survey

(conducted April 30- May 1, 2013) verified the presence of the species of interest in sufficient biomass in nearshore waters at Mākua and Mokulēʻia. The risk assessment will consider the Waiʻanae Coast seafood consumption information as outlined in the Ordnance Reef Study. Methodology for capture or collection of sample should be the same methodology for Ordnance Reef. Specimens of two or more separate species will not be homogenized to create any composite sample. Single specimens of *heʻe* and *loli* will be used for replicate analysis; however, for *limu*, the edible portions of same species from the same sampling area will be homogenized to create a replicate sample of sufficient mass for the chemical analyses. The Sampling Plan has been modified to include both a dry (tentatively September 2013) and wet seasons (tentatively January 2014).

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, JR KEONEAKAPU WILLIAMS., FEBRUARY 2013

1. Comment: I'm also a cultural practitioner. I go to Mākua Beach maybe four or five days a week. I just have a question on the collecting of the *limu*. There are certain ways to gather *limu*. I want to know who you guys are going to be using to collect the *limu*. I may suggest a local fishermen or maybe a local cultural practitioner to go out there to grab the *limu*. Because you can't just yank 'em right off. You gotta actually cut it. Just an easy suggestion.

   Response: Local divers have advised on sampling locations and will be used to collect the biota during the sampling phase of this project. See Section 2 of the Sampling and Analysis Plan for more details regarding the collection methods of *limu*.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, KEKAIMANLINO KA'OPIO, FEBRUARY 2013

1. Comment: I live in Waiʻanae also and I wouldn't call myself a practitioner. I like to be with the land and the surroundings and stuff like that. But I do have some questions on how long the study is going to be for, and by collecting the *limu*, because there is different seasons and sometimes it does get covered over with sand and you cannot get samples, and if other things is going to be considered, like the night squid. There is a night squid and day *heʻe* that live there, and who's going to be catching these things? You know, because that is taking the food that is actually food for people that use it, and if it's going to be like, you know, preserved or like thrown into bottles and jars and stuff like that and chopped up, I would have a concern with that. Also, with the impact of different ordnances, if it affects the *limu* growth, the other things–we do have some things with us that we'd like to show you that we've collected from the beach and this is stuff that washes up on the beach. It's actually in the sand. It's on the *limu*. It's in the coral. It's ordnances that have blown up—I don't know when, but we have bags of it. And there are children that play there on the beach. We would like to show it to you. It's pretty—a lot of it does have like firing things on it. And we would like to see if it does affect the *limu* and the fish around there. We recently moved to Waiʻanae and, you know, I try to see all the different things. We've been there for almost three seasons and we've watched the *limu* come and go and the sand recede and then the rocks get exposed. So there is different cycles that go through, and if you're taking that into consideration, that information. That's all I have.

   Response: The Army is planning to collect samples during both the dry and wet seasons. Only the amount needed to conduct an accurate analysis will be collected. To meet the

objectives of this project, a single species of octopus will be collected. Day octopus (*Octopus cyanea*) was selected as the target species.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, DAVID HENKIN, FEBRUARY 2013

1. Comment: And one of the things that has been just a real enduring concern in this community is a desire to know whether the food that families put on the table for the children and to sustain themselves, whether it's safe. It's not any news to anyone that families on the Waianae coast, many of them rely on the resources from the sea in order to be an important part of their diet.

   Response: The objective of this study is to investigate whether constituents potentially associated with military training are present in samples of selected species of *limu*, *he'e*, and *loli* found near Mākua Beach and relied on for subsistence by area residents. An evaluation of the risks to human health will be conducted

2. Comment: And, you know, underlying some of the issues that have come up over the years in litigation, where we've had a pretty firm conviction that military training at Mākua is causing damage, whether endangered species or cultural sites or what have you, with respect to marine resources it really is a sincere desire to know what's currently, we believe, unknown, which is what is the extent of the contamination. And frankly, Colonel, if the results of the scientifically valid study were that everything is safe to eat, that would be the best news that the Army could give to this community. The reason we've been pursuing this information and questioning some of the past studies is not out of a desire to be litigious, but it's really out of a desire to know. Because at the end of the day, when you're handing something to a kid, you just want to make sure that it's going to be safe. So we had some concerns about some of the past studies and there's an opportunity here with respect to the *limu* study and what's called awkwardly in the settlement agreement other marine

resources—so in this case, mainly *he'e* and *loli* encourage the Army to do that.

Response: As outlined in the Environmental Impact Statement from 2009, the impacts from military training are mitigated. We understand your concern. We are doing this to address those concerns (whether the food is safe from the impacts of MMR) in relation to Mākua Beach and is outlined in the work plan.—The Army will specifically be looking at *loli* and *he'e*. The objective of this study is to investigate whether constituents potentially associated with military training are present in samples of selected species of *limu*, *he'e*, and *loli* found near Mākua Beach and relied on for subsistence by area residents. An evaluation of the risks to human health will be conducted

3. Comment: Before the meeting, I had an opportunity to talk with Dr. DeCarlo, who I understand is going to be—both from reading this and from what was said tonight—is going to be instrumental in helping the study be carried out. And I asked him, 'Have you read the comments that we've been submitting over the years from, not—we've submitted comments from experts that were tainted with technical assistance funds that we received through the settlement so that we could get that scientific input. And my understanding is that he has not yet had an opportunity to see and review 15 those comments that we've made over the years. And I think that's unfortunate, because if he and the others working on this sampling plan had seen them, we could have avoided some of the mistakes that I'm going to be talking about. We'll submit them again with our written comments and we will get written comments in.

Response: These referenced comments from previous years have responses in Appendix F of the 2009 Marine Resources Report. In addition, Dr. DeCarlo has been provided with those previous comments.

4. Comment: At this stage here, before you come out with a sampling analysis plan, you should have done the pre-survey investigation to find out what resources are available in adequate numbers and quantities in order to do the testing. So when you do the sampling analysis plan, it should say, we already know what's out there. It's not meant to be kind of a black box. So it's very difficult—it's going to be difficult for the experts that we're retaining to review this to really say whether what you're proposing to do is going to be good, bad, or indifferent because you haven't told us what it is you're going to collect and where you're going to collect it. So what you have done, and we appreciate it, is that you've gone out and done a much more thorough survey of the local community. We provided some information in the litigation and you then went out and ground-truthed that, and when you look at table four, which is the list of potential targets that you're going to be sampling for, there's a huge overlap between what we were saying folks gather out there and what you've concluded folks gather out there, and that's a good thing. So now we're starting from a similar perspective in terms of what we're going to be looking at. But I was disappointed to see that you haven't actually gone out to Mākua or the various places that you're looking at as possible references to see if the things are there. And so it's hard to comment on the study, because we don't know what it is you're actually going to gather.

   Response: A preliminary site survey was conducted on April 30-May 1, 2013, off the North Shore and Mokulēʻia as well as the area off of Mākua Beach. The results of this survey effort are included as Appendix B in the Sampling and Analysis Plan.

5. Comment: The Army appears to want to do comparisons between Mākua, which, other than the military activities that have been there since basically Pearl Harbor, is a rather isolated portion of Oʻahu, without any urbanization, without any industrial or polluting activities. It's basically fairly remote. Then you want to compare that with Nānākuli,

where we are right now, which is a watershed. It is heavily urbanized and has a lot of human caused contaminants getting into the nearshore waters. That's really not comparing like with like. In fact, when you used Nānākuli *muliwai* as a comparison on an earlier round of these studies, you actually found that for many types of contaminants, the *muliwai* at Nānākuli had much higher levels of contamination than the *muliwai* at Mākua.

Response: Nānākuli was not chosen as a background location. Mokulēʻia and Kaʻena Point were chosen as the background locations, and a preliminary site survey conducted on April 30- May 1, 2013,off Mākua and Mokulēʻia verified the appropriateness and representativeness of their use as background locations (see Appendix B).

6. Comment: Sandy Beach has a wastewater treatment facility that discharges very near where you were sampling.

Response: Sandy Beach was not selected as a background location. Mokulēʻia and Kaʻena Point were chosen as the background locations, and a preliminary site survey conducted on April 30- May 1, 2013,off Mākua and Mokulēʻia verified the appropriateness and representativeness of their use as background locations (see Appendix B).

7. Comment: Army look for reference sites that don't have other anthropogenic inputs of contaminants that would not be at Mākua in the absence of military activities. You've got to find something relatively pristine.

Response: Mokulēʻia and around Kaʻena Point were chosen as the background locations. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in Section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

8. Comment: So you're now proposing the north shore, basically from Kaʻena Point out to Mokulēʻia. That might be a good location.

   Response: The SAP was revised to state that the two background locations will be around Kaʻena Point and along the coast of Mokulēʻia. A preliminary site survey conducted on 30 April to 1 May 2013 off Mākua and Mokulēʻia verified the appropriateness and representativeness of their use as background locations (see Appendix B).

9. Comment: There are ways, EPA standards that one applies in order to figure out a good reference site, and that should be documented in your sampling and analysis plan so that when we have experts look at what are going to be used as references, they can do peer review.

   Response: Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in Section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

10. Comment: The reason it's really important that you do these pre-surveys to find out if your target species are located—are going to be found inadequate numbers at both Mākua and the background study is because in order to compare apples with apples, you need to compare the same type of *limu* that you gather at Mākua, let's say *limu kohu* with *limu kohu* gathered at the reference site.

    Response: A preliminary site survey indicated that *limu kohu*, and the target species of octopus and sea cucumber are present at both the nearshore waters at Mākua Beach and Mokulēʻia in sufficient quantity to successfully obtain nine replicate samples per site. For *limu*, *heʻe*, and *loli*, the same species collected at Mākua will be collected at the two background locations.

11. Comment: Because different plants take up contaminants in different ways. Different animals take up contaminants. So if you gather a day octopus at Mākua, it needs to be compared with a day octopus from your reference site. You can't compare a night octopus with a day octopus.

    Response: For *limu*, *heʻe*, and *loli*, the same species collected at Mākua will be collected at the background locations.

12. Comment: I just want to raise a few additional points. The issue was raised—Bill, you raised the issue about how you can tell the difference between the contamination coming from the surface runoff from other areas and the military related contaminants. As I said, the Army has done studies that show that the streams flowing out of Mākua have a number of contaminants flowing in them, and the only one operating in this valley—and these are coming from the military reservation, not anything in the near shore area. The only one operating since World War II, since Pearl Harbor, pretty much, is the military. So that's why we're doing the studies and that's why we need to have a careful selection of their reference sites, because we don't want to get bad information that confuses contaminants that are generally in our environment because of other reasons and the Army's activities. That's why we want them to do good reference sites, so we can distinguish between the military and non-military.

    Response: Mokulēʻia and around Kaʻena Point were chosen as the background locations. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in Section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

13. Comment: It's also important when you gather the samples—and this was not done in the past, but it's so easy to do today—to provide information in the report with GPS of the exact location where the samples were taken, because it does

make a difference with the sample if these particular samples grow in sandy, silty areas, versus rocky areas.

Response: The Army is planning to provide a GPS coordinate for each sample location.

14. Comment: Dr. DeCarlo talked about seasonality and that he agreed that that was important, and when I read through the sampling plan, I was concerned that if you went out in the spring and you got enough samples, you might not come back in the summer, and what I'm hearing is that hopefully there will be this seasonal sampling, because different species are present at different times of year, they might have different life cycles at different times of the year.

Response: The Sampling Plan has been modified to include a sampling effort during the dry season (tentatively September 2013) and a second sampling effort during the wet season (tentatively January 2014) to coincide with periods of more rainfall.

15. Comment: So in a revised sampling plan, you should give that information to the public so that the different fishermen can get back to you and say, I eat that part of the octopus or, No, I always throw that away, because otherwise, different parts of the animal can take up different contaminants. And so it's just not clear that the samples will accurately reflect what people consume, and that, in order to do a valid, meaningful study, is important. The other thing that's important when you do—when you get your samples is you can't mix different species together. The last go around, there were a number of different species that were put together in what were called these composite samples, and when you mix up different species, you lose a lot of information because different species will take up contaminants at different rates. Likewise, to the extent possible, you should not mix together different individuals, because as we've heard, there's variability

between individuals and what they may be taking up, and if you blend them together, you get an average.

Response: Details on sample preparation were added to the revised SAP. The ink sac and beak from each specimen of octopus and the gut of each specimen of sea cucumber will be removed prior to analysis. *Limu* will be rinsed to remove sediment particles. Specimens of two or more separate species will not be combined to create any composite sample. Single specimens of *heʻe* will be used for analysis. For *limu* and *loli*, pooling of the edible portions of same species from the same sampling area will be used to create a replicate sample of sufficient mass for the chemical analyses. Each species sampled in the nearshore waters of Mākua will also be sampled from both of the background locations.

16. Comment: I'm very happy to hear that you are planning to retain both fishermen, particularly someone like Mr. Jellings, who has earned the confidence of the community, because that collection of the species from the marine environment is where the rubber hits the road. And if you pick up the wrong thing, everything goes bad from there. And if you hire people that the community trusts, then they'll know if he says it's *limu* lipoa, it was *limu* lipoa and it wasn't something else.

Response: Local scuba divers will collect the samples. Local marine scientists will also be on site during collection to identify and verify the type of species collected.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, VINCE KANAʻI DODGE, FEBRUARY 2013

1. Comment: Are your contractors, the people that are going to carry the study, are they going to be able to go in the water this time? Because last time, for some reason, they were not able to go in the water, they were not able to dive.

   Response: The Army is planning to use local scuba divers to collect samples.

2. Comment: I think, extensively about that in the past, so we hope that you would review those comments and maybe consider, you know, west end of Molokaʻi or some other reference place that is much more like Mākua and definitely not tainted.

   Response: Mokulēʻia and around Kaʻena Point were chosen as the background locations. Based on the EPA's criteria for background locations, the selection of those background locations is appropriate. Additional explanation has been added in Section 2 of the Sampling and Analysis Plan concerning the appropriateness of the chosen background locations.

3. Comment: You know, Waialua, the whole Waialua ahupua'a watershed, there's a lot of runoff and there's been a lot of contamination in the days of sugar cane, and now there's contamination with the amount of poisoning that the GMO farms are using. So there's going to be contaminants in that water and a lot turbidity and what not in that water, so I wouldn't recommend that.

   Response: The two background locations will be around Kaʻena Point and along the coast of Mokulēʻia. See Section 2 and Appendix B for more details.

4. Comment: If you're a good fisherman, you know where it is, you know generally when it's there.

   Response: Comment noted.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, DEAN HAMER, FEBRUARY 2013

1. Comment: I have to say I don't have extensive knowledge of the details of this study, as that hasn't been presented, but from what I can tell that has been presented, the study is really scientifically just inadequate, and the reason for that is that in any study like this you don't want to just know is there arsenic; you want to know how much arsenic is there and how certain are you that it's there or that it's not there.

   Response: The analytical methods proposed for use by the analytical laboratory provide a concentration value for each compound, so the Army will evaluate how much of each compound such as arsenic is present.

2. Comment: And lastly, there has to be some longitudinal element. You can't just go look once. You got to look a number of different times to see if things are changing or if they're stable.

   Response: The Army is planning to perform sampling during the wet and dry seasons to assess this variability.

3. Comment: I've also done a lot of work on the communication of complex scientific ideas to the public, and it's a very tricky thing, because if you throw too much numbers and numerology and phraseology at people, you go way over their head. But if you don't tell people anything, then it's just not transparent.

   Response: The Army will strive to communicate the results of the Marine Resources study in a simple manner in keeping with transparency.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, MELVA AILA, FEBRUARY 2013

1. Comment: I just wanted to let you know if you're familiar with the ordnance reef project, that project was done really, really well, and through the whole project was transparency, there was a modeling and sampling and mythologies that were done specifically for Waiʻanae, and it wasn't comparing information to projects done on the mainland.

   Response: The Army is planning to use local divers and University of Hawaiʻi faculty and to collect samples, as requested by the community, to build a similar level of trust with Waiʻanae Coast residents.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, WILLIAM HOOHULI, FEBRUARY 2013

1. Comment: When you ate the fish over the years, did you feel anything wrong? Answer the question. So how can you guys say that the fish is toxic?

   Response: The first Marine Resources Study found that the human health and ecological risks for the area off of Mākua Beach are similar to other areas on Oʻahu. (NOTE: Hoohuli was addressing the whole audience at the February public meeting).

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, BILL PRESCOTT, FEBRUARY 2013

1. Comment: So if you guys looking for contamination, take a look at Ulehawa Canal. That bugger is full.

   Response: Thank you for the suggestion, but Ulehawa Canal is not part of the Mākua Marine Resources evaluation. (NOTE: This question was directed to the audience present at the public meeting on February 20, 2012).

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, CATHIE ALANA, FEBRUARY 2013

1. Comment: I think it is extremely important to, first of all, understand the complexity of what you're getting into. And it is not helter skelter. It is extremely important that you understand which *limu* you're choosing, why you're choosing it, and to not forget that some of these are considered la'au—medicine. They have healing purposes. That's one concern that I have. The second concern is in having worked as adjunct staff to different projects; my concern is that we do not have a lab here. So what are the variable facts of transporting this *limu* to the mainland? It is a major, major, major concern, because if you have worked with la'au, there's a spiritual connection, and when you remove the la'au from the aina, it changes.

   Response: We are planning to use local divers and marine scientists from the University of Hawai'i to provide the correct interpretation of the type of *limu*. Unfortunately, there are no analytical laboratories that can perform the required analyses of the suite of constituents listed in Table 2 of the SAP under the EPA methods, so the samples must be shipped frozen to the mainland. Keeping them frozen should allow for accurate analyses by the laboratory.

RESPONSE TO COMMENTS

RE: MĀKUA MILITARY RESERVATION DRAFT SAMPLING AND

ANALYSIS PLAN, ALBERTA SILVA, FEBRUARY 2013

1. Comment: Now, I believe that whatever information that is needed to verify that whatever fish, *limu*, plant life in Mākua is safe for us, they will be able to tell us, the health department.

   Response: The Army's requirements are separate from those of the State of Hawai'i Department of Health as required by the subject Court Order.

2. Comment: Going after our defense system, costing us more money to protect our well-being from some other country taking over us? We shooting ourselves in the foot, believe me. We're just wasting—we create distrust.

   Response: Comment noted.

3. Comment: We're here because we'd like the information about whether the fish and the *limu* and *he'e*, and the *loli*, whether they're safe to eat.

   Response: The objective of this study is to investigate whether constituents potentially associated with military training are present in samples of selected species of *limu*, *he'e*, and *lol*i found near Mākua Beach and relied on for subsistence by area residents. An evaluation of the risks to human health will be conducted.