2017 National Ocean Dumping Site Monitoring Assessment Report

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2017 National
Site Monitoring Assessment Report
EPA Ocean Dumping Management Program

Executive Summary

The Marine Protection, Research, and Sanctuaries Act (MPRSA), also known as the Ocean Dumping Act, regulates the transportation and dumping of any material into ocean waters. Under the MPRSA, the U.S. Environmental Protection Agency (EPA) is responsible for designating and managing ocean disposal sites used for the permitted disposal of materials. The U.S. Army Corps of Engineers (USACE) is responsible for issuing ocean dumping permits for dredged material using EPA's environmental criteria and subject to EPA review and written concurrence. For all other materials, EPA is responsible for issuing ocean dumping permits. EPA, together with USACE, develops site management and monitoring plans (SMMPs) for each site designated for the ocean disposal of dredged material. EPA's management and monitoring of these ocean sites ensures that disposal activities will not unreasonably degrade or endanger human health, welfare, the marine environment, or economic potentialities.

In Fiscal Year (FY) 2017, EPA managed 99 designated ocean disposal sites located off the U.S. Atlantic, Gulf of Mexico, and Pacific Coasts; and near Puerto Rico, Hawaii, Guam, and American Samoa. This National Ocean Dumping Site Monitoring Assessment Report provides a comprehensive overview of EPA's FY 2017 monitoring activities conducted at seven ocean dredged material disposal sites (ODMDSs) in three EPA coastal Regions:

- Miami, FL ODMDS (Region 4)
- Canaveral Harbor, FL ODMDS (Region 4)
- Mobile, AL ODMDS (Region 4)
- Port Allen, HI ODMDS (Region 9)
- Nawiliwili, HI ODMDS (Region 9)
- Kahului, HI ODMDS (Region 9)
- Rogue River, OR ODMDS (Region 10)

Based on the results of these FY 2017 ocean disposal site surveys:

- Environmentally acceptable conditions were met at each of the surveyed ODMDSs. The data collected confirm that site management practices are working well and will inform site management as well as future updates of the SMMPs for each site. Permitted disposal of dredged material under the MPRSA can continue at these sites.
- Data and information collected from the Nawiliwili ODMDS identified hard-bottom habitat, including a volcanic escarpment marking an ancient shoreline, in the southeastern portion of the site. EPA is in the process of taking the steps necessary to change the location of the surface disposal zone to avoid future deposition of sediment on the hard-bottom habitat within this site.
- EPA also used the data collected during these surveys to:
    - Determine that portions of the Canaveral Harbor ODMDS are approaching capacity and the ODMDS will likely need increase in size to accommodate the disposal of the dredged material from any future expansion or deepening of Port

Canaveral while ensuring protection of the marine environment, human health, and other resources and uses of the ocean;

- Inform a modification of the Mobile ODMDS[1] to allow for the continued disposal of dredged material from the Mobile Harbor Federal navigation channel and provide additional disposal capacity for dredged material generated from the proposed Mobile Harbor Expansion Project;
- Identify the need for additional data collection to determine the extent of the presence and concentration of dioxins and dioxin-like compounds at the Gulfport, MS, Pascagoula, MS, and Mobile, AL ODMDSs;
- Better evaluate the efficacy of various survey methods for characterizing the dredged material disposed of at the Rogue River ODMDS so that EPA can accurately assess potential changes to the seafloor habitat due to disposal; and
- Highlight the importance of collecting additional high-resolution multibeam or side-scan sonar data at the Rogue River ODMDS to enable the seafloor to be characterized more thoroughly and inform EPA management decisions to better protect human health and the marine environment.

[1] The Final Rule for the Modification of an Ocean Dredged Material Disposal Site Offshore of Mobile, Alabama, was published in the Federal Register on May 20, 2020, with an effective date of June 20, 2020 (85 FR 47035). The EPA's *Final Environmental Assessment for Modification of the Ocean Dredged Material Disposal Site Mobile, Alabama, May 2020 (FEA),* provides an extensive evaluation of the criteria and other related factors for the modification of the Mobile ODMDS. The SMMP developed for the modified site is available at https://www.epa.gov/ocean-dumping/site-management-and-monitoring-plan-smmp-mobile-ocean-dredged-material-disposal-site.

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Acronyms and Abbreviations

ANOVA	Analysis of Variance
aRPD	apparent redox potential discontinuity
CFR	Code of Federal Regulations
cm	centimeter
COC	contaminant of concern
CTD	conductivity, temperature and depth meter
cy	cubic yards
DDT	dichloro-diphenyl-trichloroethane
DO	dissolved oxygen
EPA	United States Environmental Protection Agency
ER-L	effects range-low
ER-M	effects range-median
ft	feet
FY	fiscal year
HARS	Historic Area Remediation Site
l	liter
m	meter
m^2	square meter
mg	miligram
MPRSA	Marine Protection, Research, and Sanctuaries Act
ng	nanogram
nmi	nautical mile
nmi^2	square nautical mile
NOAA	National Oceanic and Atmospheric Administration
ODMDS	ocean dredged material disposal site
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	probable effects level
PVI	plan view imaging/image
R/V	research vessel
SDZ	Surface Disposal Zone
SMMP	site management and monitoring plan
SPI	sediment profile imaging/image
SQG	sediment quality guideline
SQUIRT	NOAA Screening Quick Reference Tables
S/V	sailing vessel
SVOC	semi-volatile organic compound
TEL	threshold effects level
TEQ	toxicity equivalent quotient
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WQ	water quality
y^3	cubic yard

1.0 Introduction

The Marine Protection, Research, and Sanctuaries Act (MPRSA), also known as the Ocean Dumping Act, regulates the disposition of any material into the ocean unless expressly excluded under the MPRSA. The MPRSA prohibits or restricts (primarily in terms of material type, amount, and location) ocean dumping that would adversely affect human health, welfare, amenities, the marine environment, ecological systems, or economic potentialities. Section 101 of the MPRSA (33 U.S.C. 1411) generally prohibits the transportation of any material for the purpose of dumping, except as authorized by a permit.

In the United States today, the primary material (in terms of volume) disposed of in the ocean is uncontaminated dredged material, which is sediment that is excavated or otherwise removed from our nation's waterways. The removal of sediment supports a network of coastal ports and harbors that are used for commercial, transportation, national defense, and recreational purposes. In 2017, this marine transportation network, partially facilitated by the dredging of waterways, contributed more than $64 billion and 543,000 jobs to the U.S. economy (National Ocean Economics Program). Other materials that are disposed of in the ocean include fish wastes, vessels, marine mammal carcasses, and human remains for burial at sea.

Under the MPRSA, the U.S. Environmental Protection Agency (EPA) establishes environmental criteria for the evaluation of all permit applications. EPA is the permitting authority for ocean dumping of all materials other than dredged material. In the case of dredged material, the U.S. Army Corps of Engineers (USACE) issues ocean dumping permits (or, in the case of federal projects, authorizes ocean dumping of dredged material) using EPA's environmental criteria. All MPRSA permits and federal projects involving ocean dumping of dredged material are subject to EPA review and written concurrence.

EPA establishes the criteria for the designation of ocean disposal sites and is responsible for designating ocean disposal sites under the MPRSA. EPA considers criteria (published at 40 CFR 228.5 and 228.6) as part of any site designation evaluation. To minimize the adverse impacts of ocean dumping on human health and the marine environment, EPA designates sites based on environmental studies of the proposed site, environmental studies of regions adjacent to the proposed site, and historical knowledge of the impact of disposal on areas having similar physical, chemical, and biological characteristics. EPA analyzes these impacts through environmental assessments or environmental impact statements. In general, EPA designates sites only in areas where ocean dumping will not have a significant impact on various amenities, such as fisheries, coral reefs, and endangered species.

EPA is also responsible for managing all ocean disposal sites designated under the MPRSA. Management of ocean disposal sites involves:

- regulating the times, quantity, and characteristics of the material dumped at the site;
- establishing disposal controls, conditions, and requirements to minimize potential impacts to the marine environment; and
- monitoring the site and surrounding environment to verify that unanticipated or significant adverse effects are not occurring from historical or continued use of the ocean disposal site and that terms of the MPRSA permit are met.

In Fiscal Year (FY) 2017, EPA Regions managed 99 designated ocean disposal sites off the U.S. Atlantic, Gulf of Mexico, and Pacific Coasts; and near Puerto Rico, Hawaii, Guam, and American Samoa. All but one of the 99 ocean disposal sites are designated for the disposal of dredged material permitted under the MPRSA. One EPA-designated site, located offshore of American Samoa, is designated for the disposal of fish processing wastes.

All designated dredged material disposal sites are required to have a site management and monitoring plan (SMMP). EPA, in conjunction with USACE, develops an SMMP for each ocean dredged material disposal site. Each SMMP includes, but is not limited to:

- a baseline assessment of site conditions;
- a monitoring program for the site;
- special management conditions or practices to be implemented at the site that are necessary for protection of the environment;
- consideration of the quantity of disposed material and the presence, nature, and bioavailability of the contaminants in the material;
- consideration of the anticipated long-term use of the site; and
- a schedule for review and revision of the SMMP.

1.1 Ocean Disposal Site Monitoring

EPA monitors environmental conditions in and around ocean disposal sites as part of its implementation of the MPRSA. Under the MPRSA and the ocean dumping regulations, EPA uses monitoring data to:

- Evaluate potential ocean disposal sites and designate ocean disposal sites (MPRSA 102(c)(1); 40 CFR 228.4(b), 40 CFR 228.6(a));
- Assess trends in environmental impact (40 CFR 228.9(a)(1));
- Evaluate disposal impact (40 CFR 228.10(a) and (b));
- Modify disposal site use (40 CFR 228.11(a) and (d));
- Prohibit dumping where necessary (MPRSA 102(c)(2)); and
- Develop an SMMP for each site, which must be reviewed and revised at least every 10 years (MPRSA 102(c)(3)).

EPA Regional Ocean Dumping Coordinators and Chief Scientists plan and conduct ocean disposal site monitoring surveys using scientifically proven principles and methods to assess the physical, biological, and chemical states of ocean disposal sites and the surrounding marine environment. EPA typically evaluates environmental impact at a site by comparing current conditions to those at the time of designation (baseline conditions) along with any other historical survey data. For example, EPA may use monitoring information to evaluate movement and deposition of the dumped material to determine whether or how to modify site use. Ocean areas near the disposal site which are not affected by disposed materials are used for comparisons to assess the impact from disposal. The quantity and spatial distribution of samples collected in each monitoring survey are determined based on survey- and site-specific factors. The information collected from these site assessments inform EPA's ongoing planning and decision-making regarding the management and monitoring of sites.

As part of ocean disposal site surveys, EPA may collect a variety of data to ensure that the dumped material is being adequately tested and that there are no unexpected adverse impacts at and around disposal sites. Sediment samples, water samples, organisms from benthic trawls, sediment plan view images (PVI) (photographs of the surface of the seafloor), and/or sediment profile images (SPI) (photographs of a cross-section of the upper 15-20 cm of the sediment-water interface) may be collected to evaluate the physical and biological state of the benthic environment in and around the disposal site and at reference areas. Parameters used to evaluate benthic habitat or benthic habitat quality include, but are not limited to: sediment grain size, depths of oxygenated sediment and apparent redox potential discontinuity (aRPD) (indicating habitat quality by measuring interactions between sediment chemistry and biological activity within sediment), and sediment penetrability (Rhoads and Germano, 1982). Benthic community health can be classified using defined successional stages and species diversity. Successional stages at a site can range from stage zero (recently disturbed) to stage three (mature), whereas species diversity is a measure that combines species richness (the number of different species) and evenness (the relative abundance of species) to give an overall indication of community structure.

EPA may also analyze sediment samples for contaminants of concern (COCs) including metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), persistent pesticides, semi-volatile organic compounds (SVOCs), organotins, and/or dioxins and furans. To evaluate the potential for disposed dredged material to have an impact on the benthic communities at or near disposal sites, EPA commonly compares contaminant concentrations in sediments collected at and around ocean disposal sites to sediment quality guidelines (SQGs), which are informal benchmarks used to relate chemical concentrations in sediments to the potential toxicity to benthic or aquatic organisms. Many EPA Regions rely on effects range low (ER-L) and effects range median (ER-M) national SQGs developed by the National Oceanic and Atmospheric Administration (NOAA) (NOAA, 1999). Chemical concentrations below the ER-L are not likely to cause adverse effects, while chemical concentrations above the ER-M are likely to cause adverse effects.

2.0 Report Objectives

In FY 2017, EPA scientists conducted surveys at seven EPA-designated ocean disposal sites (Table 1, Figure 1) to inform planning and ongoing decision-making with respect to the management and monitoring of these sites. This national report serves as a comprehensive summary of these EPA monitoring efforts in three of the seven EPA coastal Regions:

- Region 4
  - Miami, FL Ocean Dredged Material Disposal Site (ODMDS)
  - Canaveral Harbor, FL ODMDS
  - Mobile, AL ODMDS
- Region 9
  - Port Allen, HI ODMDS
  - Nawiliwili, HI ODMDS
  - Kahului, HI ODMDS
- Region 10
  - Rogue River, OR ODMDS

Table 1. Area and depth of ocean dredged material disposal sites surveyed in FY 2017.

EPA Region	Ocean Dredged Material Disposal Site	Area (nmi²)	Depth (ft)
4	Miami, FL	1.00	400-800
4	Canaveral Harbor, FL	4.00	47-55
4	Mobile, AL	4.75	45.9 (average)
9	Port Allen, HI	0.78	1460-1610
9	Nawiliwili, HI	0.78	2750-3675
9	Kahului, HI	0.78	1100-1200
10	Rogue River, OR	0.16	45-84

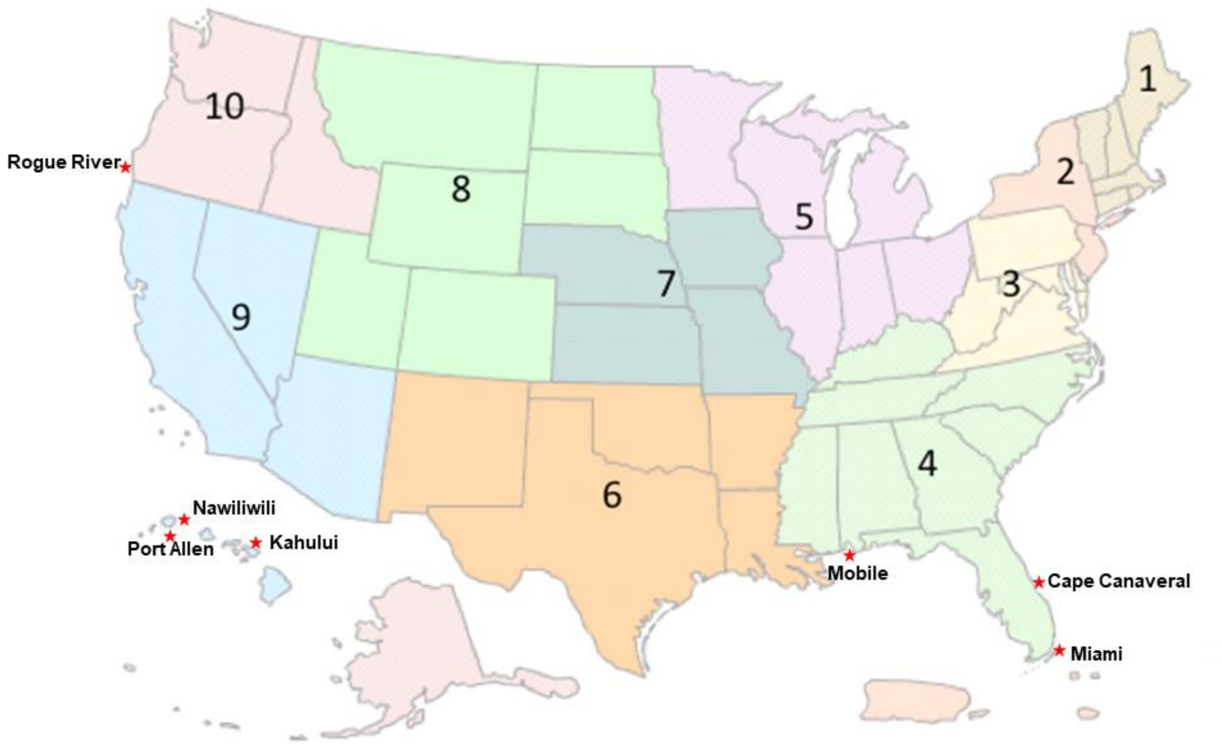

Figure 1. Approximate locations of the seven ocean disposal sites surveyed in FY 2017. Numbers indicate EPA Regions.

3.0 Summary of Monitoring Surveys

A summary of FY 2017 survey objectives, activities, and results, as well as conclusions and recommended management actions resulting from these surveys is presented below.

3.1 Region 4 – Canaveral Harbor and Miami, FL Ocean Dredged Material Disposal Sites

3.1.1 Background

EPA designated the Canaveral Harbor, FL Ocean Dredged Material Disposal Site (ODMDS) in 1991 for the disposal of new work and maintenance material dredged from the Canaveral Harbor Civil Works Navigation Project, the U.S. Navy Trident Submarine Facilities, and the Canaveral Port Authority berthing areas. Region 4 manages this site in quadrants depending on the permitted operation (two for maintenance, one for new work, and one for naval facility work). The site ranges in depth from 47 to 55 ft (14-17 m), has an area of 4 nmi^2, and is located approximately 4.5 nmi offshore of Cocoa Beach, Florida (Figure 2). Since EPA Region 4 conducted its most recent survey of the Canaveral Harbor ODMDS in 2007, over 4.6 million cubic yards (mcy) of dredged material have been disposed of at the site.

EPA designated the Miami ODMDS in 1996. The site is located 4.7 nmi offshore of Miami Beach, Florida, on the upper continental slope, covers an area of 1 nmi^2, and ranges in depth from approximately 400 to 800 ft (122-244 m) (Figure 2). Dredged material from new work and maintenance projects was disposed within approximately 1 nmi of the ODMDS between 1957 and 1968 (prior to the enactment of the MPRSA in 1972) as well as at a nearby interim ocean disposal site[2] (pursuant to the MPRSA) from 1985 until the Miami ODMDS was designated in 1996.

3.1.2 Survey Objectives, Activities, and Findings

On July 7-12, 2017, Region 4 surveyed the Canaveral Harbor and Miami ODMDSs aboard the University of Miami's research vessel (R/V) *F.G. Walton Smith*. The objective of this survey was to collect data for long-term trend assessments so that Region 4 could evaluate the biological, chemical, and physical characteristics of both sites and assess the effectiveness of the Canaveral Harbor SMMP and Miami SMMP in ensuring that MPRSA-authorized/-permitted disposal of dredged material will not unreasonably degrade human health and the marine environment.

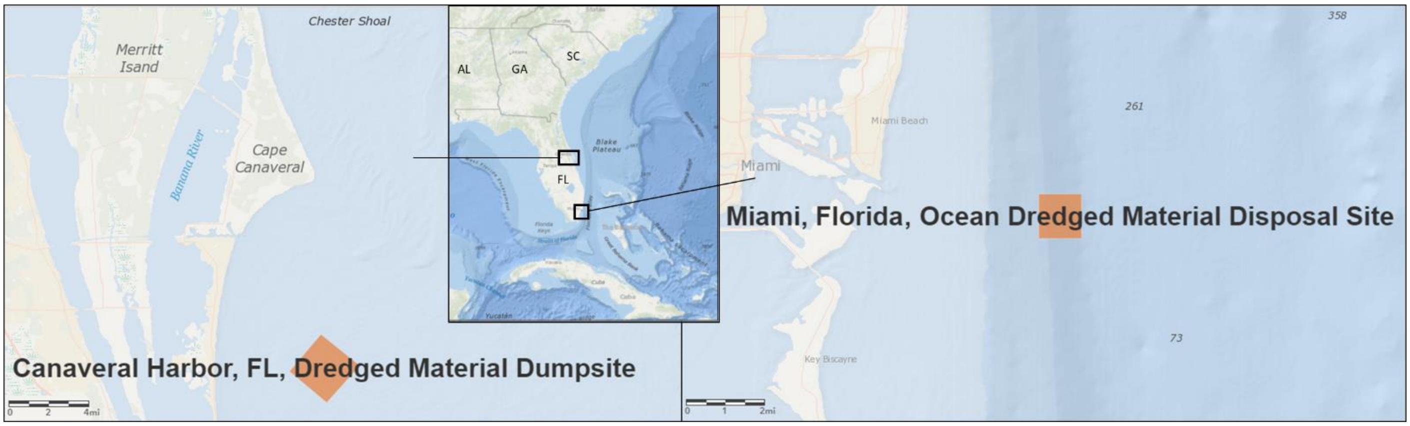

Figure 2. Locations and boundaries of Canaveral Harbor and Miami ODMDSs.

Region 4 collected sediment and biological samples from 12 stations at the Canaveral Harbor ODMDS and 16 stations at the Miami ODMDS (Figure 3) using a 0.04 m^2 Double Young Grab. Half of the sampling stations associated with each site were located inside the boundaries of each ODMDS, allowing Region 4 to compare the chemical and biological results from inside each site to those outside of each site. For laboratory quality assurance purposes, the sediment collected from one station was homogenized and split into two samples for analysis.

Aboard the survey vessel, Region 4 initially evaluated sediment samples by defining color, texture, and other parameters before preserving them for post-survey analyses. Region 4 also collected and processed biological samples by sieving sediment to remove the macroinvertebrates, which were also preserved for post-survey analyses. During post-survey analyses, sediment samples were analyzed for grain size, TOC, total solids, and sediment chemistry parameters including for concentrations of PCBs, pesticides, SVOCs, butyltins, and 12 types of metals (arsenic, aluminum, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc). Macroinvertebrate analysis included species identification and count to calculate taxa richness, density, and diversity within each sample.

Region 4 also conducted a water column profile using a conductivity, temperature, and depth measuring device (CTD) to record in situ water quality parameters including salinity, temperature, and dissolved oxygen (DO).

[2] Interim ocean disposal sites are no longer available for use. MPRSA amendments enacted in 1992 require that no permits for ocean dumping shall be issued for an EPA-established ocean disposal site after January 1, 1997, unless the site has received a final designation. In 2008, EPA repealed expired, and therefore obsolete, provisions regarding interim ocean disposal sites.

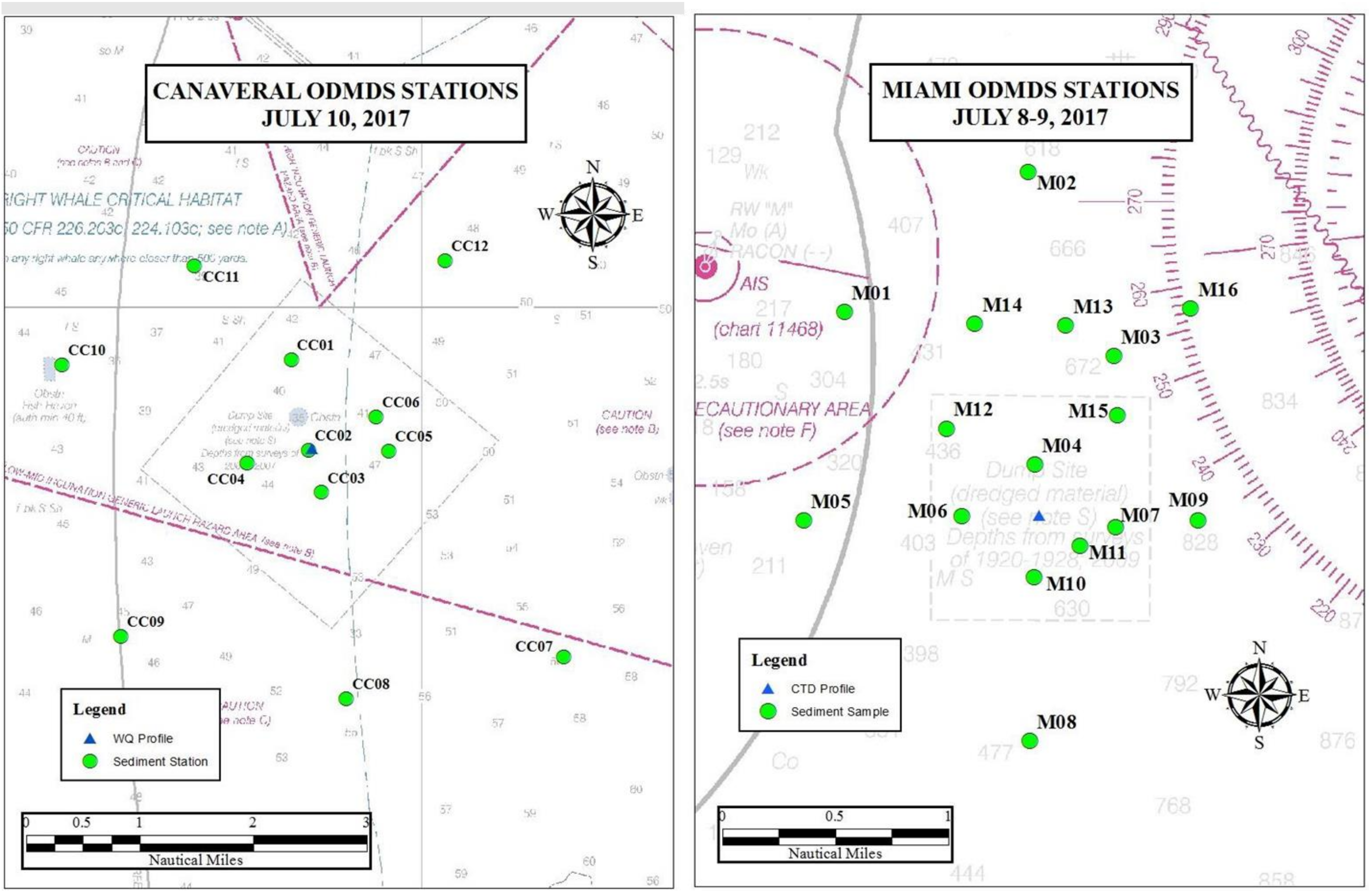

Figure 3. Canaveral Harbor and Miami ODMDSs and stations sampled during the July 2017 survey.

3.1.2.1 Canaveral Harbor ODMDS

Results from the sediment grain size analyses indicated that sediments within and outside of the disposal site boundaries were not significantly different from each other and consisted primarily of fine sands. The similarities in grain size suggest that conditions across the survey area are relatively consistent and that disposal activities are not altering grain size conditions within the site compared to conditions in the surrounding area where no dredged material has been disposed (Figure 4). Region 4 noted that sediment grain size has shifted towards an increased percentage of sand since the survey conducted in 2007 at sampling stations both inside the disposal site boundaries (71% in 2007 and 78% in 2017) and outside the disposal site boundaries (53% in 2007 and 76% in 2017). The fact that this change was observed both inside and outside of the disposal site suggests that the increased percentage of sand found in 2017 is not related to disposal activities. TOC and percent solids were not found to differ between 2007 and 2017 or inside versus outside the ODMDS, indicating no significant changes due to dumping activities.

Analyses of the sediment samples collected from within and around the Canaveral Harbor ODMDS showed that five of the 12 metals analyzed for were present at or below the detection limits. Aluminum, arsenic, chromium, iron, lead, nickel, and zinc were detected, however, none exceeded the TEL or other pertinent effects level. SVOCs, pesticides, and PCBs were not detected.

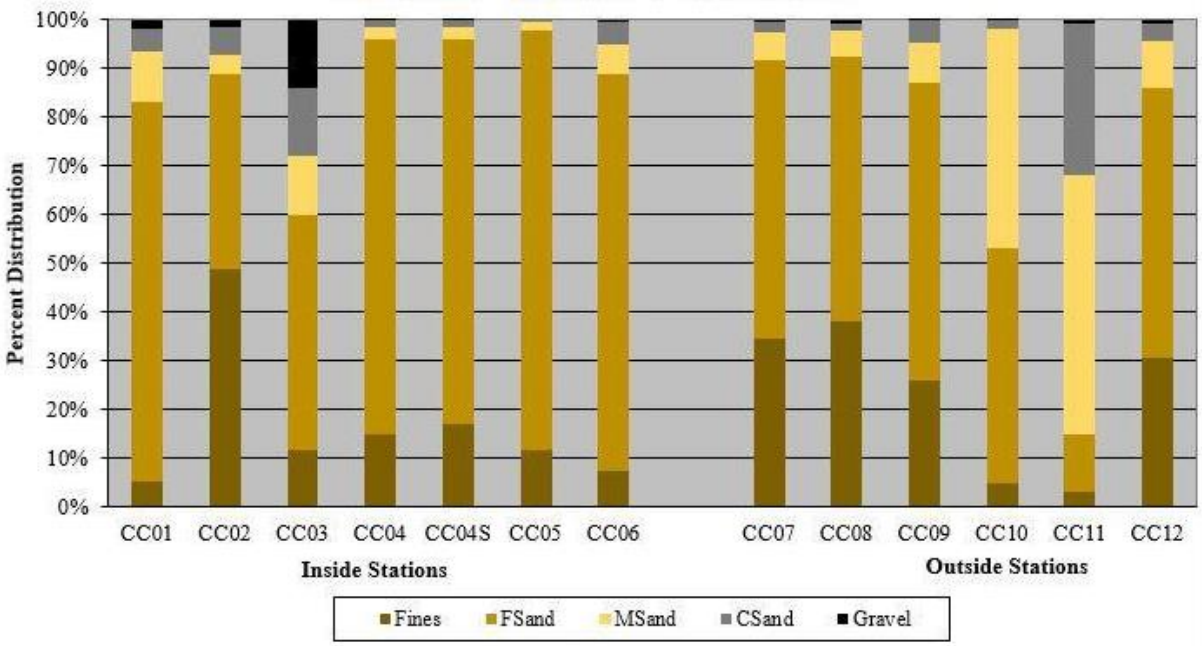

Figure 4. Canaveral Harbor ODMDS grain size distribution.

Butlytins were detected in one sediment sample collected from one station at the Canaveral Harbor ODMDS (station CC04). This was the sample split into two separate samples for quality assurance purposes, and butyltins were not detected in the other half of the split sample. Because the sediment collected from this station was homogenized prior to being split into replicates for analysis, the presence of butyltin in this single replicate was likely a laboratory error and does not reflect actual presence in the environment.

Region 4 found no statistical difference in mean macroinvertebrate taxa richness, density, diversity, or evenness between stations inside and outside the ODMDS based on data collected in 2017 (Barry Vittor and Assoc., 2017) (Figure 5 and Figure 6), which suggests that disposal activities are not currently impacting macroinvertebrate taxa populations compared to the areas outside of the ODMDS that have not received dredged material.

Figure 5. Invertebrate richness at stations inside and outside the Canaveral Harbor ODMDS.

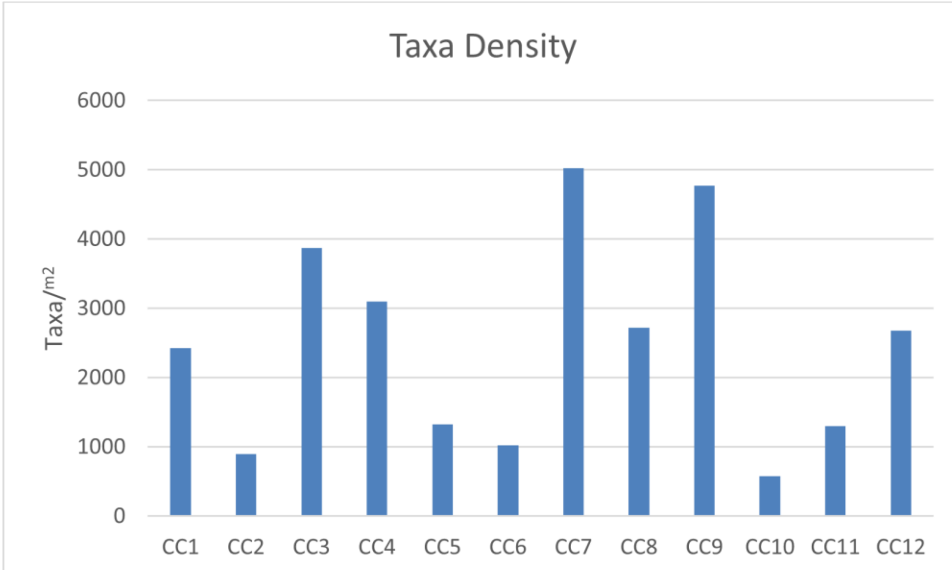

Figure 6. Invertebrate taxa density at sample stations in and around the Canaveral Harbor ODMDS.

However, when mean taxa richness and density at stations inside the ODMDS were compared from 2007 to 2017, statistically significant increases were observed (Barry Vittor and Assoc., 2007, 2017). In comparing stations inside the Canaveral Harbor ODMDS, Region 4 found that mean taxa richness (mean number of taxa) increased from 14.8 in 2007 to 30.3 in 2017. Similarly, mean taxa density (mean number of taxa per m^2) increased from 725 in 2007 to 2,108 in 2017. For stations outside of the ODMDS, mean taxa richness and density were not statistically different between 2007 and 2017. Higher taxa richness and density are generally seen as indicators of a healthy community. Taken together, these results suggest that dumping may have affected invertebrate populations within the Canaveral Harbor ODMDS in the past (whether as a result of contaminants or disturbances related to the changes in the physical characteristics of the site), but that invertebrate populations have recovered over time and are no longer statistically discernable from similar areas outside of the ODMDS where dumping has not occurred.

Sediment grain size both inside and outside the site had a general shift towards sand from 2007 to 2017. Mean percent sand inside the site increased slightly from 71% in 2007 to 78% in 2017 and outside the site went from 53% in 2007 to 76% in 2017.

3.1.2.2 Miami ODMDS

Results from the grain size analysis conducted on sediments collected from within the Miami ODMDS and at stations located outside the disposal site were variable and indicate that there were no differences between sediment grain size distributions within and outside the ODMDS. Region 4 found a mixture of primarily fine sand and silt/clay (i.e., fines) across the study area (Figure 7). Given these results, dumping activities do not appear to have significantly altered the physical sediment characteristics of the site compared to the surrounding area. When comparing the grain size data collected in 2007 to those collected in 2017 from within the boundaries of the ODMDS, Region 4 found that there was an increase in sand and a decrease in fines (33% sand and 63% fines in 2007; 57% sand and 40% fines in 2017). Outside the disposal site, the grain size distribution with respect to percent sand versus fines was virtually unchanged when data from 2007 were compared to 2017. Because the increase in the ratio of sand between 2007 and 2017 was only observed in samples collected within the ODMDS, it could be an indication that dumping activities have shifted the predominant grain size distribution, even if the differences in this distribution between sampling locations inside and outside of the ODMDS are not statistically significant. TOC did not differ between 2007 and 2017 nor inside versus outside the ODMDS, which is expected based on the material type present in the region.

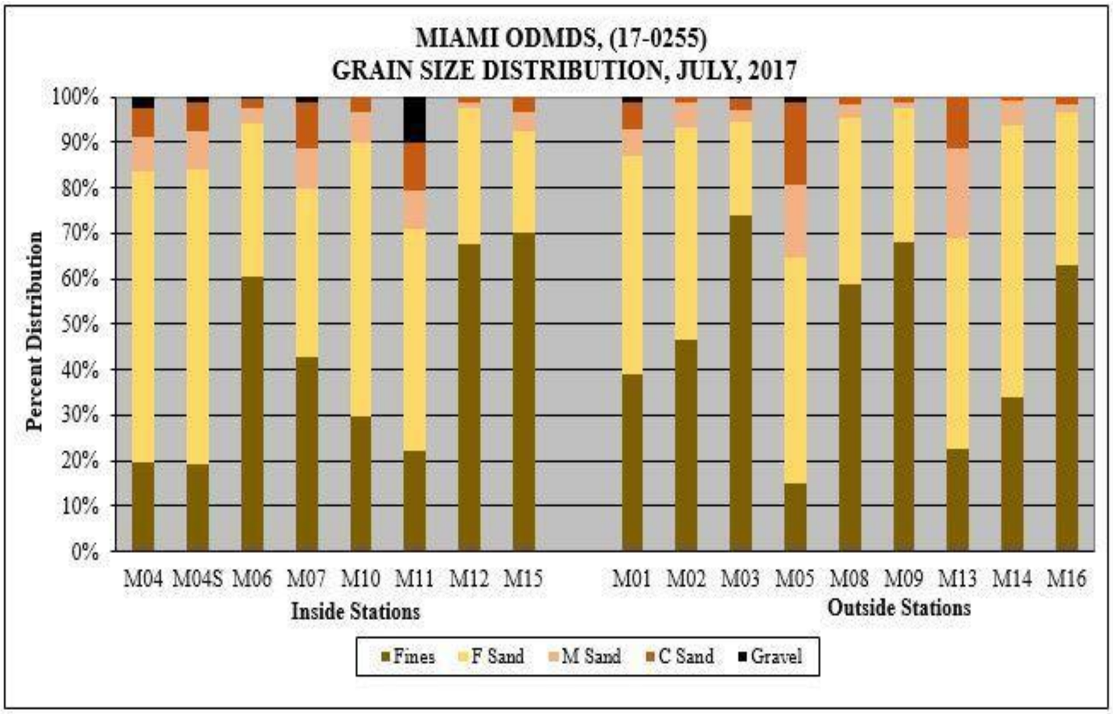

Figure 7. Miami ODMDS grain size distribution.

Concentrations of cadmium, mercury, selenium, and silver were not detected in sediments collected at all stations except M06 (Figure 3). Metal concentrations measured at M06 were higher than those measured at all other stations; however, concentrations were still below Threshold Effects Levels (TELs), or the concentrations below which biological effects are expected to occur only rarely.

Region 4 found that SVOC concentrations at all stations, except station M06, were not detected or were below levels of concern. Four SVOCs were detected in samples collected from station M06:benzo(a)anthracene (110 µg/kg), fluoranthene (390 µg/kg), phenanthrene (230 µg/kg) and pyrene (430 µg/kg).

Two PCB congeners were detected in samples collected from stations M04 and M06. PCB-138 was detected at both M04 and M06 (0.93 µg/kg and 1.7 µg/kg, respectively) and PCB-153 (1.7 µg/kg) was detected at station M06. PCBs were not detected at any other sampling stations.

Prior survey analyses from 2010 showed elevated copper and PCB concentrations in sediment samples collected from within the ODMDS and from stations near the ODMDS. Concentrations of copper and PCBs were lower during the 2017 survey. Although this could indicate the presence of contaminant hotspots in 2010, these differences could also indicate a potential laboratory error in the earlier survey samples or could be due to illegally dumped material that has since dispersed or been covered by authorized dredged material dumping.

Results from butyltin analyses showed that dibutyltin and tetrabutyltin were below analytical detection limits at all stations. However, low concentrations of monobutyltin and tributyltin (TBT) were present at all stations within the ODMDS and at three stations (M02, M13, and M14) outside the ODMDS. Monobutyltin was detected at station M03 and TBT was detected at station M08. Station M06, located inside the ODMDS, had the highest concentrations of monobutyltin (15 µg/kg) and TBT (58 µg/kg). While the presence of butyltin compounds in sediments is generally attributable to port activities, there are no thresholds available by which to assess the potential environmental impacts of butyltin compounds in sediment. Additionally, Region 4 noted the presence of butyltins at significant distances outside the ODMDS, suggesting that the presence of butyltins is unlikely to be due to dumping of dredged material.

Pesticides were not detected at any stations.

Region 4 found no significant difference in taxa density () or taxa diversity (Figure 9) between stations inside versus outside the disposal site. However, Region 4 determined that the mean number of taxa (richness) was significantly higher outside the ODMDS versus inside the ODMDS (Barry Vittor and Assoc., 2017). The difference in taxa richness could be related to the habitat disturbance caused by the disposal of high volumes of dredged material which may favor either more resilient or opportunistic taxa (i.e., taxa more capable of quickly responding to burial by dredged material) or may lead to a homogenization (i.e., more limited local variation in taxa) of the benthic environment due to the addition of dredged material favoring a more limited number of taxa.

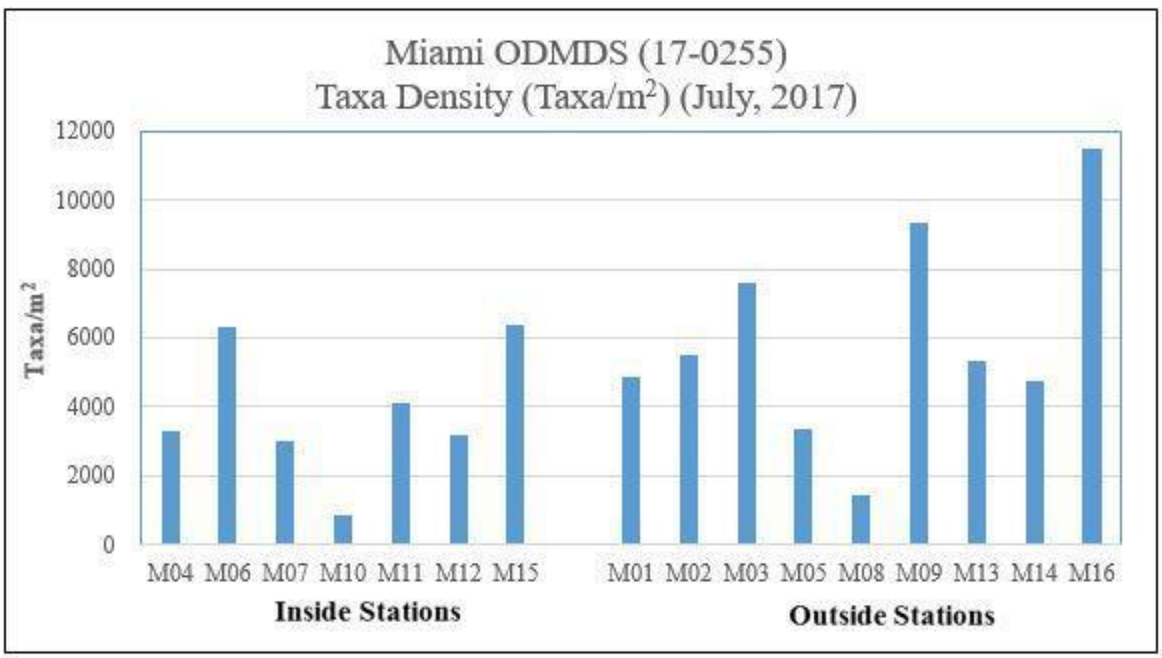

***Figure 8**.* Miami ODMDS macroinvertebrate taxa density.

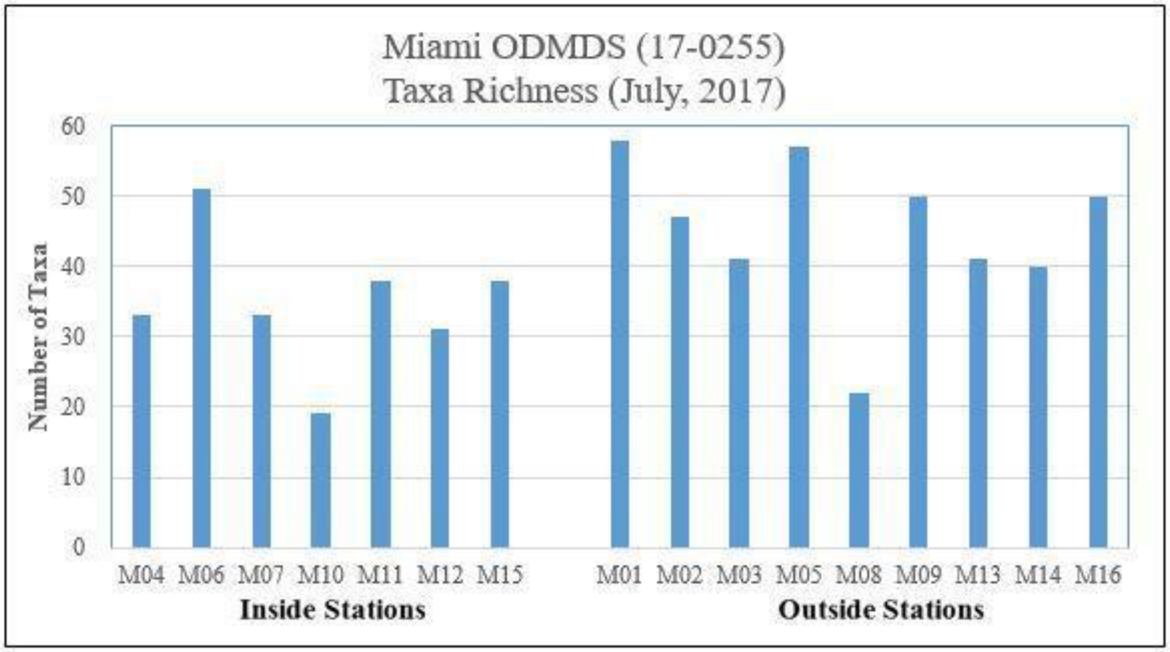

Figure 9. Miami ODMDS macroinvertebrate taxa richness.

Region 4 did not observe significant differences in the benthic macroinvertebrate community when comparing data collected in 2007 to those collected in 2017 (Barry Vittor and Assoc., 2007 and 2017). The benthic community assemblages, both inside and outside of the site, are typical of those found in shallow water benthic habitats (Barry Vittor and Assoc., 2017; Felder and Kemp, 2009). From 2007 to 2017, taxa richness and density both increased slightly, but no statistically significant differences were found. Inside the site, there was a shift from 2007 to 2017 to a higher percentage of sand (33% in 2007 versus 57% in 2017) versus fines (63% in 2007 vs. 40% in 2017).

Outside the site, the Region found that the percent sand versus fines was unchanged between 2007 and 2017. Sediment type and recent dumping activity both may impact benthic communities. The observed shift in sediment grain size and the large dredged material volume disposed at the site could explain why taxa richness within the ODMDS in 2017 was lower than that in the surrounding area. However, the lack of significant change in the benthic macroinvertebrate community between 2007 and 2017 suggests that the community remains resilient to changes related to dumping of high volumes of dredged material and that the observed differences in taxa richness at stations within and outside the ODMDS are not a reflection of temporal effects.

3.1.3 Conclusions and Recommended Management Actions

Region 4 accomplished their survey objectives. The data and information collected during this survey demonstrated that environmentally acceptable conditions are being met at the Canaveral Harbor and Miami ODMDSs and that the management of the sites as described in the SMMPs is working. Results from water, sediment, and benthic biota sample analyses confirm that the SMMPs for these sites are effective and no modifications to either SMMP are necessary at this time. Information collected during this survey will be used to inform further management activities and any potential future SMMP revisions for these sites.

Based on data collected from the Canaveral Harbor ODMDS, Region 4 observed that the benthic community has continued to mature since its previous survey in 2007, even while dredged material disposal activities have continued. Region 4 also noted that some quadrants of the site are reaching capacity, as determined by bathymetric data collected by USACE periodically at the site. Looking to the future, any plans to expand or deepen Port Canaveral will likely require an expansion of the ODMDS because modeling has shown that increasing existing disposal mound heights due to increased dredged material disposal activity may cause the material to move outside of the site boundaries.

Based on data from the Miami ODMDS, Region 4 identified short-term impacts to macroinvertebrate taxa due to the disposal of large volumes of dredged material; these impacts are expected. Region 4 found that the macroinvertebrate population is showing signs of recovery and expects a return to a fully mature benthic community over time. Region 4 did not identify any concerns for site management, including any long-term adverse impacts at the Miami ODMDS because of dredged material disposal operations. Region 4 plans to assess any persistent impacts due to sediment grain size shifts at the site as part of future survey efforts.

3.2 Region 4 – Mobile, AL Ocean Dredged Material Disposal Site

3.2.1 Background

Dredged material from the Mobile Harbor entrance channel has been disposed offshore from Mobile Bay for many years. In 1986, USACE selected two sites for temporary dredged material disposal pursuant to Section 103 of the MPRSA.[3] One of these sites, the Mobile North site (approximately 46 nmi^2) was historically used for the disposal of dredged material. The other site, the Mobile South site, has not been used as a disposal site.

In 1988, EPA designated the Mobile ODMDS, which is located about 4 nmi offshore of Dauphin Island, Alabama (Figure 10). The site comprises an approximately 4.75 nmi^2 area, lies on the shallow continental shelf, and has an average depth of 45.9 ft (14 m). Between 2009 and 2017, over 16 mcy of dredged material were disposed of at the Mobile ODMDS from a variety of maintenance projects, primarily from the Mobile Harbor Federal Navigation Channel.

Region 4 and the USACE Mobile District identified a need to either designate a new ODMDS or modify the existing Mobile ODMDS to accommodate the continued disposal of dredged material associated with the Mobile Harbor Federal navigation channel and allow additional capacity for disposal of dredged material generated from the proposed Mobile Harbor Expansion Project. Region 4 previously conducted several surveys in and around the Mobile ODMDS. In 2003, Region 4 conducted the first of a series of surveys encompassing the eastern half the 50 nmi^2 past Mobile North site (and the area of possible expansion for the Mobile ODMDS) to collect data to contribute to a trend assessment study of the area (USEPA and SESD, 2003). Region 4 conducted additional surveys of the same study area, utilizing the same sampling cells, in 2009 and 2017 to collect data to contribute to the trend assessment and support a potential expansion of the Mobile ODMDS (USEPA, 2009).

[3] Under MPRSA section 103(b), U.S. Army Corps of Engineers (USACE), in consultation with EPA, can "select" a site for dredged material disposal for short-term use in the cases where it is not feasible to use a designated ocean disposal site. EPA must concur on use of sites selected by USACE for the disposal of dredged material.

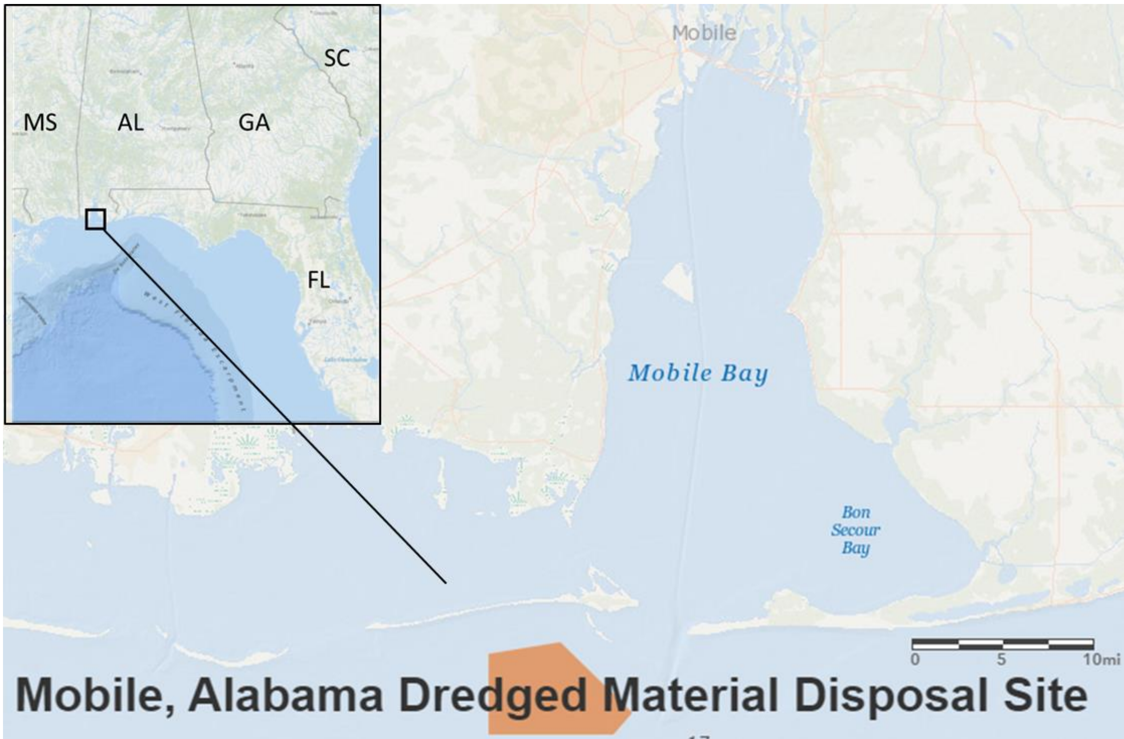

Figure 10. Location and boundary of Mobile ODMDS.

3.2.2 Survey Objectives, Activities, and Findings

In October 2017, Region 4 surveyed the Mobile ODMDS study area aboard the R/V *Pelican*. The Region's objectives were to collect sediment, water, and benthic biota samples as part of a routine trend assessment at the Mobile ODMDS (consistent with the requirements outlined in the SMMP and 40 CFR 228.9 and 228.13) and to support site expansion.

Region 4 sampled 30 stations (Figure 11), four within the designated Mobile ODMDS and 26 in the area being considered for expansion. The Region collected sediment and biological samples using a 0.08 m^2 Double Young Grab. The samples were analyzed for grain size distribution, sediment chemistry, and macroinvertebrate count and distribution. Sediment chemistry included analyses for PCBs, pesticides, SVOCs, metals, TOC, total solids, dioxins, and dioxin-like compounds. Region 4 compared the sediment chemistry results against SQGs and historical concentrations at the ODMDS. The Region also analyzed macroinvertebrate counts for species richness and diversity. In addition, Region 4 measured in-situ water quality parameters, including salinity, temperature, and DO concentrations using a CTD at stations MB10 and MB16 (Figure 11).

Results from the sediment grain size analyses showed that sediments within and around the Mobile ODMDS consisted primarily of fines, including clay, silt, and fine sand. There were relatively small percentages of medium and coarse sand, as well as gravel-sized shell fragments at several stations, especially those closest to the Mobile Entrance Channel (MB15, 16, and 28). There also tended to be more fines on the northern and southern portions of the study area. When comparing sediment grain size distribution in 2017 to grain size distributions measured throughout the study area during previous surveys (2003 and 2009), Region 4 found that the predominant sediment particle size remained relatively unchanged. The grain size distributions throughout the study area were consistent with the effects of natural hydrographic regimes which suggests that disposal activities have not significantly impacted the sediment regime within the Mobile ODMDS and, by extension, should have no negative effects on the future expanded ODMDS.

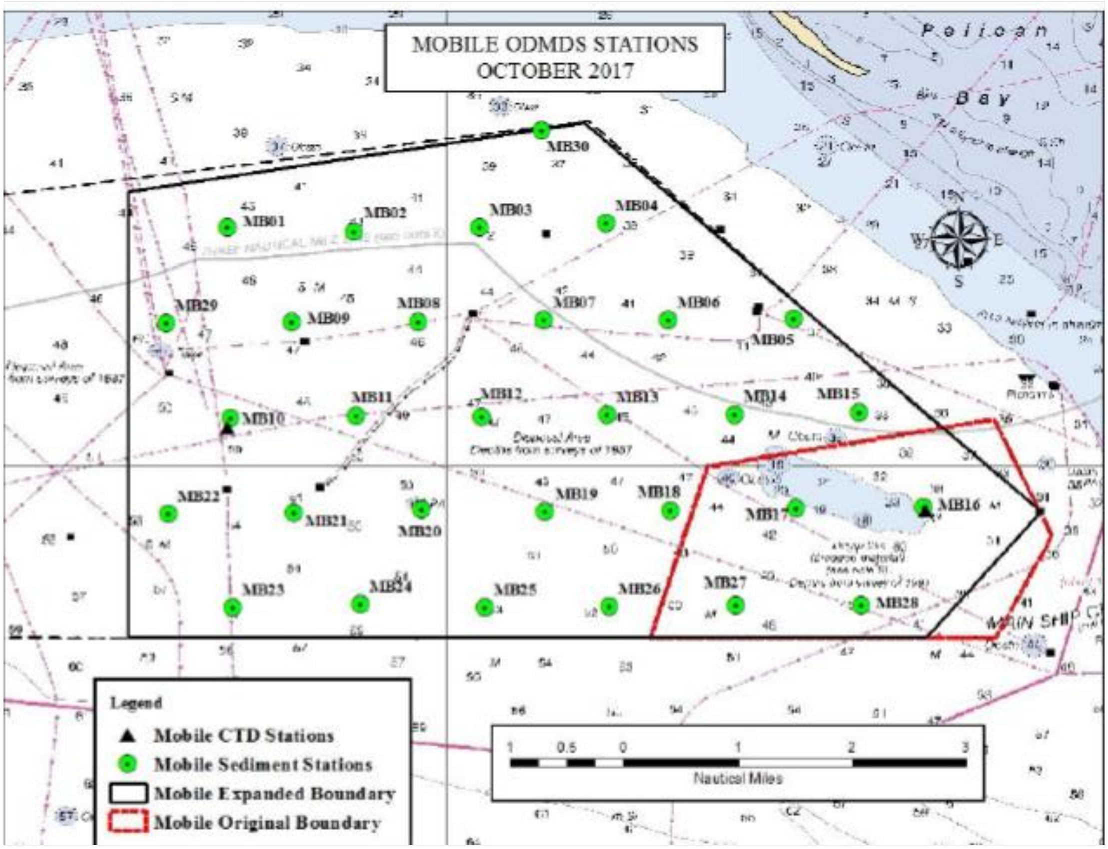

Figure 11. Sediment and water sampling stations (green dots) within the area being studied for potential expansion of the Mobile ODMDS (black polygon).

The Region's chemical analyses of the sediment samples revealed that, with the exception of arsenic and dioxins, all organic and inorganic analyte concentrations were either below analytical detection limits or below levels of concern for toxicity (i.e., the TEL and Probable Effects Level (PEL) listed in the NOAA Screening Quick Reference Tables (SQUIRT)).

Arsenic concentrations were slightly elevated above the TEL (7.24 mg/kg), but well below the PEL (41.6 mg/kg) at 17 of the 30 stations. Region 4 observed similar arsenic concentrations at the Mobile ODMDS during the 2003 and 2009 surveys (USEPA and SESD 2003; USEPA, 2009). There was a relatively strong relationship ($R^2 = 0.95$) between arsenic concentrations and the percentage of fine sediments in the sample, suggesting the presence of arsenic in fine sediments is responsible for the elevated levels in the ODMDS. Slightly elevated arsenic concentrations have been observed in native background sediments around other ODMDSs in the Gulf of Mexico and are considered naturally occurring in marine sediments around the Florida panhandle and the Gulf of Mexico. Based upon the lack of temporal changes in concentrations at the site and the presence of high arsenic concentrations in native sediments in the area, Region 4 determined that arsenic presence is not a concern for ocean disposal activities occurring at the Mobile ODMDS.

Dioxins and dioxin-like compounds were measured using Toxicity Equivalent Quotients (TEQs), which are weighted measures based on the toxicity of each dioxin and dioxin-like compounds relative to the most toxic dioxins; these compounds were present at detectable levels at all sampling stations. At 25 of the 30 stations sampled, Region 4 found that dioxin TEQs were above the TEL value (0.85 ng/kg) but well below the PEL value (21.5 ng/kg). High dioxin TEQs were mostly driven by 2,3,7,8-Tetrachlorodibenzo-p-dioxin found outside the ODMDS, which was measured in concentrations that exceeded the listed TEL. The Region found only two forms of dioxin, Octachlorodibenzodioxin and 1,2,3,4,6,7,8-Heptachlordibenzo-p-dioxin, inside the Mobile ODMDS. Unlike arsenic, dioxins did not appear to have a strong correlation with fine sediment (R^2= 0.75). Given the low concentrations at which dioxin and dioxin-like compounds were detected in samples collected during this survey, Region 4 does not anticipate their presence to pose any significant potential for environmental impacts. However, Region 4 plans to review ocean disposal projects that have occurred from 2010 to 2017 to identify potential sources of dioxins to the Mobile ODMDS and take this into consideration in future reviews of dredged material proposed for disposal at the ODMDS.

Region 4 did not detect pesticides in samples collected from the Mobile ODMDS but did find detectable concentrations of alpha- and gamma-Chlordane at stations MB18 and MB19, located in the future expansion area for the ODMDS. Alpha- and gamma-Chlordane are constituents and isomers of the highly toxic and persistent pesticide Technical Chlordane, which has been banned in the U.S. since 1988. It is uncertain what the source for these isomers are, but chlordane is highly persistent in sediments and can be detected many years after application or disposal. Therefore, it is possible that this chlordane contamination is a result of legacy waste that has been uncovered by the movement of sediment during storms or hurricanes.

Region 4 compared macroinvertebrate data from 2009 with the macroinvertebrate data collected in 2017 and determined that there are no significant differences in macroinvertebrate taxa richness, density, diversity, or evenness between the two surveys or inside versus outside the ODMDS. Macroinvertebrate taxa density and richness tended to be higher in the southwestern portion of the study area (station MB17). The sediment in this area was dominated by finer sands, indicating that benthic substrate may affect the macroinvertebrate community more than disposal operations. Additionally, the macroinfaunal taxa dominating the assemblages at stations within the Mobile ODMDS and the future expansion area for the ODMDS were typical of those found in nearshore shallow-water benthic habitats. Overall, the results from the macroinvertebrate analyses suggest that disposal of dredged material is not adversely affecting benthic macroinvertebrate populations within the Mobile ODMDS and by extension is not expected to negatively affect the future expanded ODMDS.

Results from the water column profile measurements at stations MB16 and MB10 identified slight pycnoclines at approximately 13 ft (4 m) and 39 ft (12 m), respectively. An increase in temperature and decrease in DO were associated with the pycnocline in each location (Figure 12). The difference in tidal flow experienced at station MB16 and MB10 likely influenced the differences in depth of the pycnocline at each location.

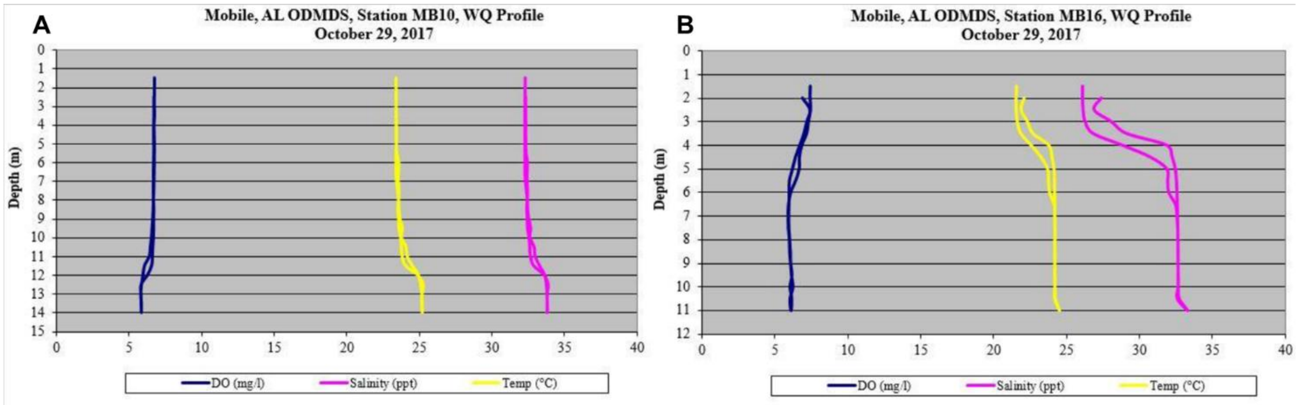

Figure 12. Mobile ODMDS water column profile, A) Station MB10 and B) Station MB16.

3.2.3 Conclusions and Recommended Management Actions

Region 4 met all survey objectives. The data and information collected during this survey demonstrated that dredged material disposal activities from 2003 through 2017 have resulted in little change to the physical, chemical, and biological characteristics of the Mobile ODMDS. The results from the 2017 survey confirm that environmentally acceptable conditions, as outlined in the SMMP, are being met at the Mobile ODMDS and no modifications to the SMMP are necessary at this time.

Data collected on this survey were used to support the modification of the Mobile ODMDS, including the development an Environmental Assessment and SMMP for a modified Mobile ODMDS.[4] The modification of the site allows for the continued disposal of dredged material associated with the Mobile Harbor Federal navigation channel and provides additional capacity for disposal of dredged material generated from the proposed Mobile Harbor Expansion Project. The location of the modified site was selected to avoid impacts to other uses of the oceans, to protect important resources, and to ensure safe navigation.

Region 4 will use the monitoring results to assist in developing future monitoring activities. The survey design followed in 2017 was helpful in collecting data from both the ODMDS and the future expansion area for the ODMDS, so Region 4 intends for future surveys to continue to use the same sampling stations to facilitate comparisons of physical, chemical, and biological changes in the sediment. Based upon resource availability, Region 4 would like to conduct a follow up study to determine the extent of the presence and concentration of dioxins and dioxin-like compounds at the Gulfport, MS; Pascagoula, MS; and Mobile, AL ODMDSs. Lastly, Region 4 intends to continue to routinely monitor the chemical, physical, and biological changes inside and surrounding the ODMDS to ensure that no adverse impacts are occurring and to document any changes to the area as a result of dredged material disposal.

3.3 Region 9 – Kahului, Port Allen, and Nawiliwili, HI Ocean Dredged Material Disposal Sites

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[4] The Final Rule for the Modification of an Ocean Dredged Material Disposal Site Offshore of Mobile, Alabama, was published in the Federal Register on May 20, 2020, with an effective date of June 20, 2020 (85 FR 47035). The EPA's *Final Environmental Assessment for Modification of the Ocean Dredged Material Disposal Site Mobile, Alabama, May 2020 (FEA),* provides an extensive evaluation of the criteria and other related factors for the modification of the Mobile ODMDS. The SMMP developed for the modified site is available at https://www.epa.gov/ocean-dumping/site-management-and-monitoring-plan-smmp-mobile-ocean-dredged-material-disposal-site.

3.3.1 Background

In 2017, EPA Region 9 conducted surveys at three of the five ODMDSs designated in 1981 off the coast of Hawaii: Kahului, Port Allen, and Nawiliwili (Figure 13). These three sites are used infrequently, primarily when the USACE conducts maintenance dredging of the federal channels associated with nearby harbors. Each site includes a small surface disposal zone, within which all disposal actions must take place, and a larger ODMDS site boundary on the seafloor, where most of the sediment is intended to deposit after falling through the water column.

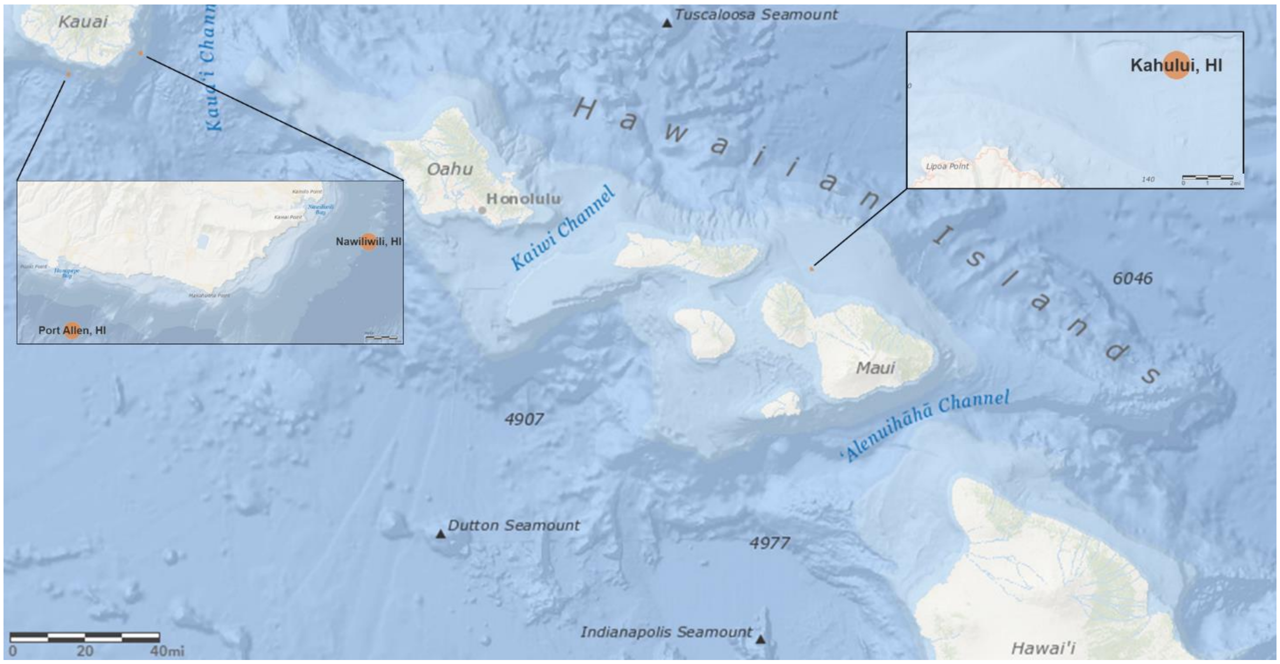


Figure 13. Locations and boundaries of Kahului, Port Allen, and Nawiliwili, HI ODMDS.

Baseline surveys to support the EPA designation of the five Hawaii ODMDSs were conducted in the 1970s. In 1994 and 1995, the U.S. Geological Survey (USGS) conducted acoustic backscatter surveys at the five Hawaii ODMDSs for EPA to map dredged material deposits on the seafloor. Although the South Oahu and Hilo ODMDSs were monitored in 2013, prior to 2017, EPA had not surveyed the Kahului, Port Allen, and Nawiliwili ODMDSs since their designation.

The Kahului ODMDS is approximately 5.5 nmi offshore of Maui, northeast of Kahului Harbor. It is 0.78 nmi^2 in size and is one of the shallowest Hawaii ODMDSs with a depth range of 1,100-1,200 ft (340-365 m). The last disposal of 57,200 cy of dredged material from USACE dredging of federal channels occurred in 2016. The Port Allen ODMDS is approximately 4 nmi south of Port Allen Harbor on Kauai, at a depth of 4,800-5,275 ft (1,460-1,610 m). It is 0.78 nmi^2 in size and is the deepest of the five Hawaii ODMDSs. The last disposal at the Port Allen site occurred in 1999, when 20,900 cy of dredged material was disposed. The Nawiliwili ODMDS is about 4 nmi offshore (southeast) of Nawiliwili Harbor on Kauai, and depths at this site range from 2,750-3,675 ft (840-1,120 m). Nawiliwili ODMDS is 0.78 nmi^2 in size and is the second deepest of the five Hawaii ODMDSs. 64,700 cy of dredged material from a USACE federal project were disposed at Nawiliwili ODMDS in 2016.

3.3.2 Survey Objectives, Activities, and Findings

Region 9 surveyed the Kahului, Port Allen, and Nawiliwili ODMDSs to assess the physical, chemical, and biological characteristics of each site and collect data to update the SMMPs for these sites. As the first part of a two-part survey, on September 27-October 3, 2017, Region 9 conducted multibeam echosounder surveys to provide detailed bathymetry in and around the ocean disposal sites and to detect any unexpected bottom features; this information was used to adjust the sampling plan for the second phase of the survey (Figure 14, Figure 15, Figure 16) . From October 6-23, 2017, aboard the R/V *Norseman II*, Region 9 collected SPI and PVI data as well as sediment samples from stations at each site. The samples were analyzed for metals, dioxins and furans, pesticides (including DDTs), organotins, PAHs, PCBs, grain size characteristics, and benthic community structure (Figure 14-16).

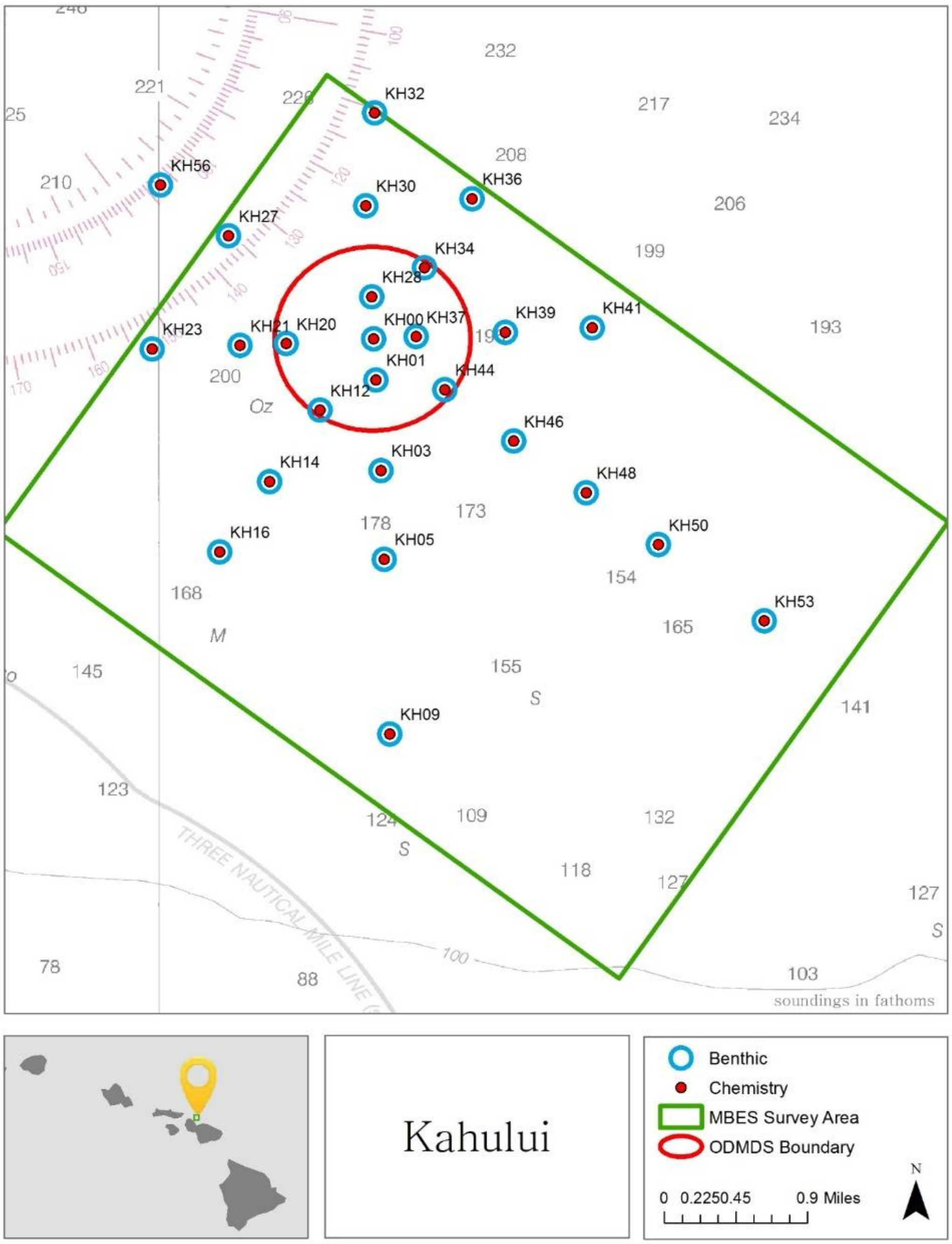


Figure 14. Map of the sediment grab stations and multibeam echosounder (MBES) survey area at the Kahului ODMDS survey area.

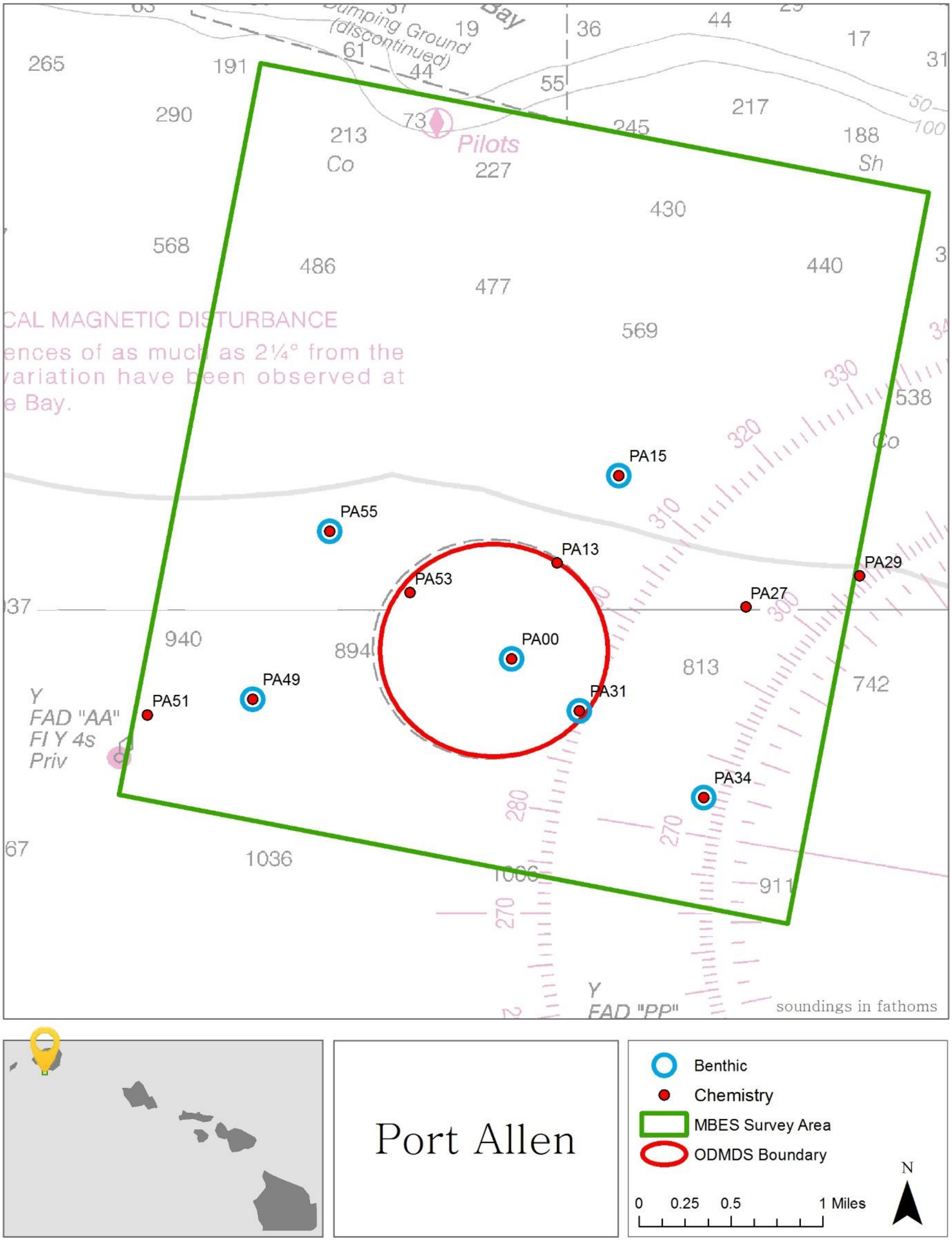


Figure 15. Map of the sediment grab stations multibeam echosounder (MBES) survey area at the Port Allen ODMDS survey area.

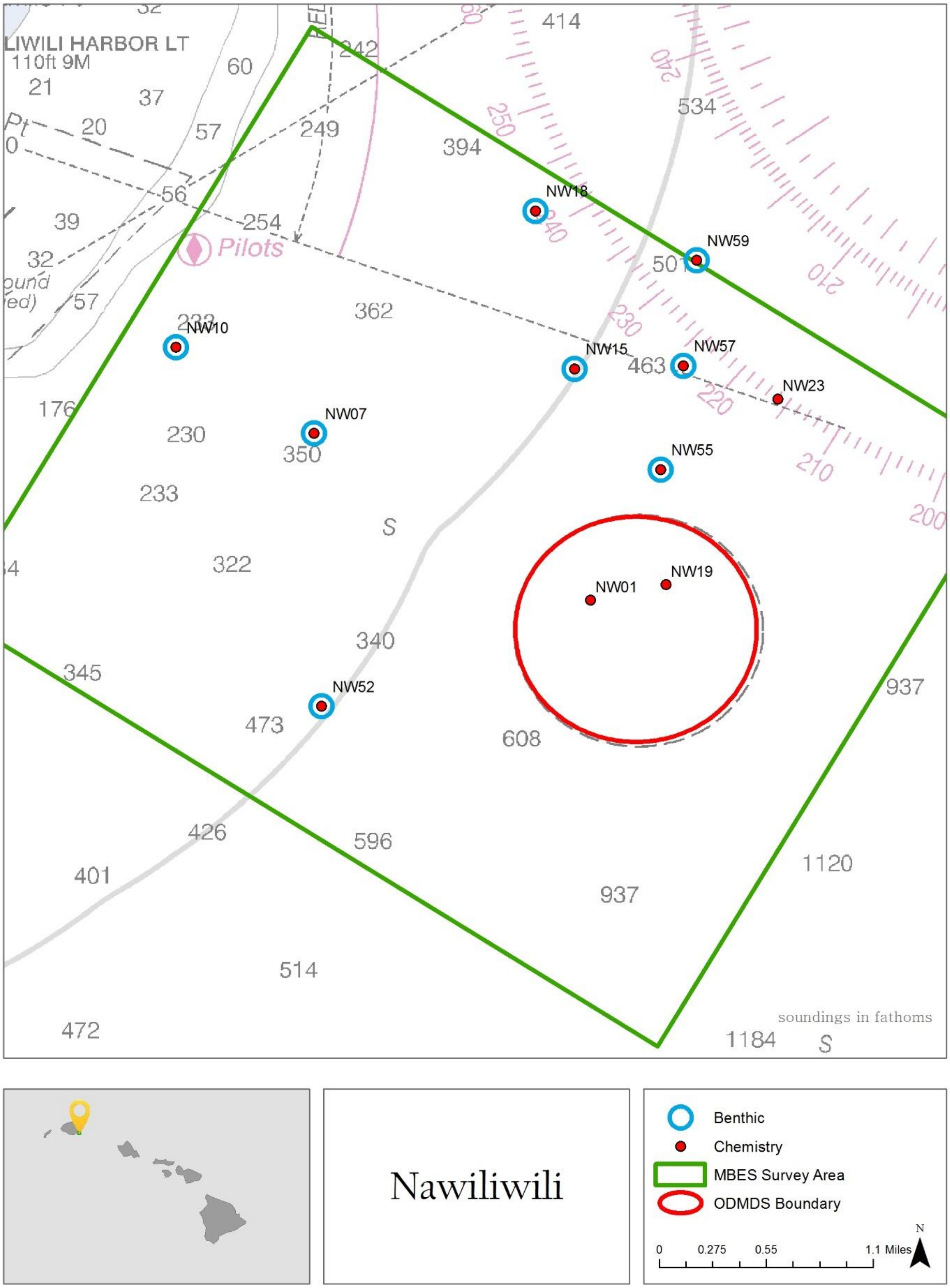


Figure 16. Map of the sediment grab stations multibeam echosounder (MBES) survey area at the Nawiliwili ODMDS survey area.

Results from the SPI survey indicated that certain stations outside of the disposal site boundaries contained dredged material in greater than trace amounts. To determine the effects of dredged material on sediment chemistry, EPA grouped all stations containing dredged material (including outside stations with more than trace amounts of dredged material) as “inside the dredged material footprint” and compared these results to sample stations that contained no dredged material (“outside the dredged material footprint”).

3.3.2.1 Kahului ODMDS

Region 9 collected SPI and PVI at 57 stations in the Kahului survey area (17 stations within the disposal site boundary and 40 stations outside the site boundary). The seafloor habitat both inside and outside the Kahului disposal site was relatively spatially homogenous, with some variability in depth and in the presence of dredged material at the sediment surface. Overall, the dredged material found inside the footprint was consistent with recently disposed dredged material (57,200 cy) disposed in April 2016; sediments consisted of primarily very fine sands with overlying layers of medium and fine sands in places where dredged material was observed (***Figure 17*****Error! Reference source not found.**)). The dredged material observed was primarily medium to fine black and white sand, present as thick layers near the site center and largely contained within the site (Figure 18). At stations outside the site boundary, thin layers and trace amounts of dredged material were observed near the sediment–water interface and biologically mixed into the sediment column.

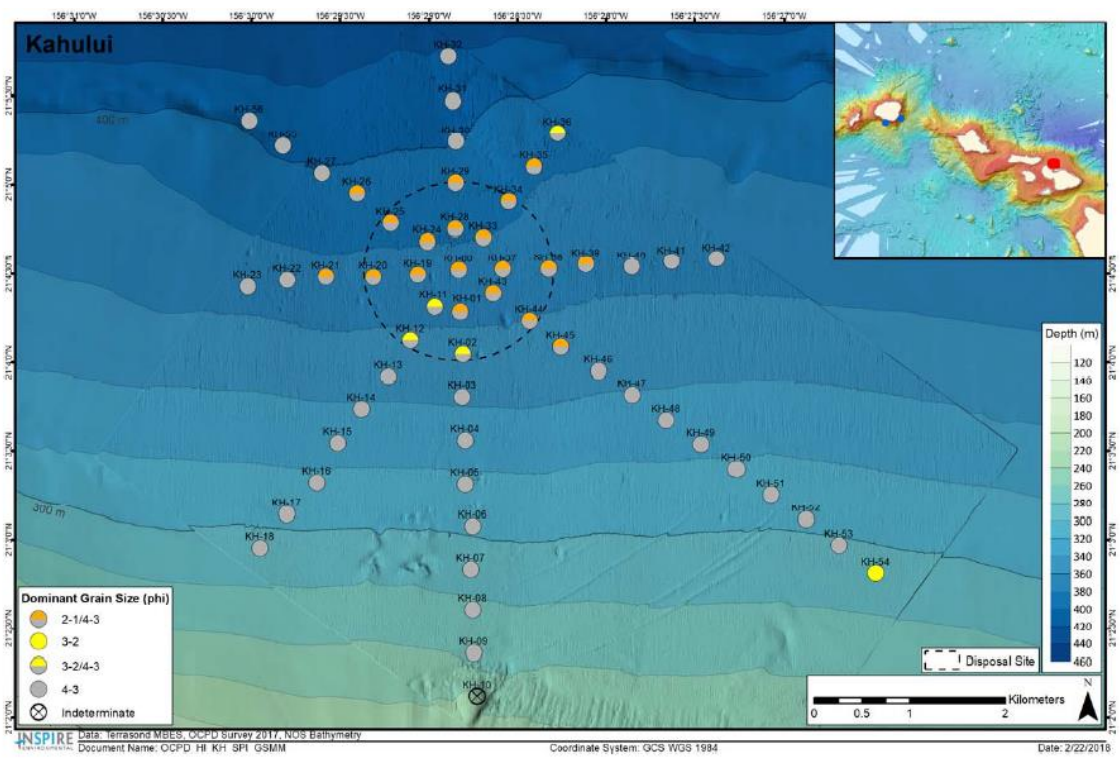
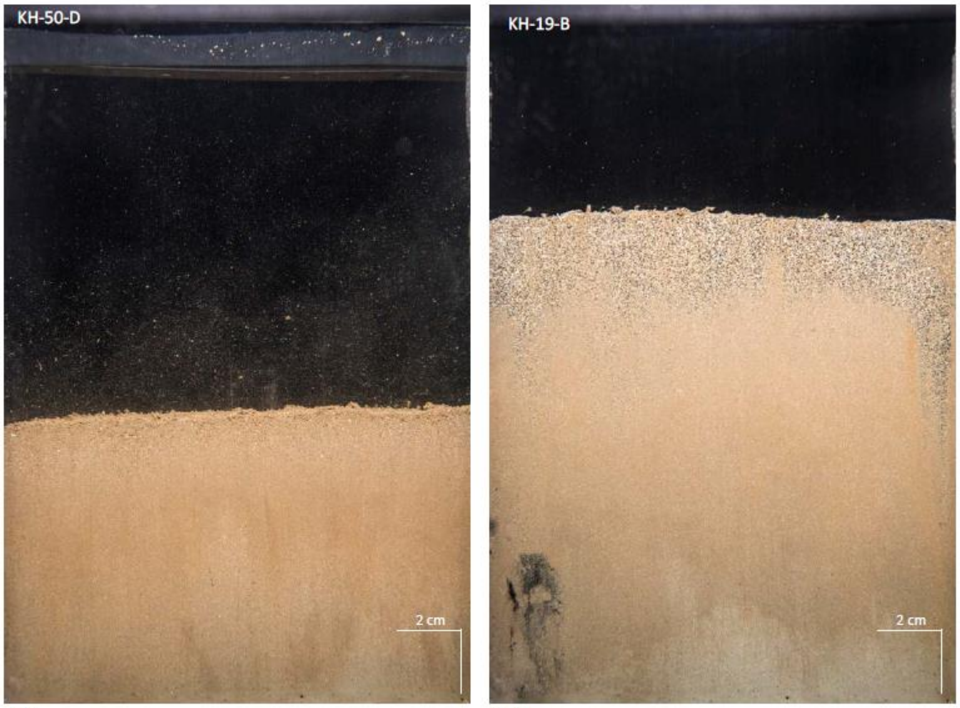


Figure 17. Sediment grain size major mode (phi units) at the Kahului ODMDS survey area from SPI and PVI. Larger phi units represent smaller grain sizes.



(A) (B)

Figure 18. Profile images depicting (A) the very fine sand that was characteristic of sediments at the Kahului ODMDS survey area (no dredged material observed) and (B) very fine sand with a layer of medium sand (dredged material) at the sediment–water interface.

The mean aRPD depths (which indicate habitat quality by measuring interactions between sediment chemistry and biological activity within sediment) were 7.8 cm (SD ± 0.8) within the disposal site boundary and 6.4 cm (SD ± 1.4) outside the site boundary. All aRPD depths measured within the survey area were relatively thick and robust; stations both inside and outside the site had aRPD values not indicative of impairment (Figure 19).

Infaunal and epifaunal communities surveyed with SPI and PVI within the Kahului ODMDS survey area were robust. Infaunal successional stage was found to be largely mature within the Kahului ODMDS survey area. Nearly every station had evidence of mature Stage 3 taxa. Opportunistic Stage 1 taxa were often documented in the presence of Stage 3 taxa resulting in a Stage 1 on 3 designation. Evidence for the presence of Stage 3 fauna included large-bodied infauna, deep subsurface burrows, and/or deep feeding voids. Stage 1 taxa were indicated by the presence of very small tubes at the sediment–water interface. Burrowing anemones were encountered in the PVI at a number of stations, and other epifaunal organisms, such as sea cucumbers and sea stars, were also observed. This suggests a healthy benthic community despite disposal activities (***Figure 20***).

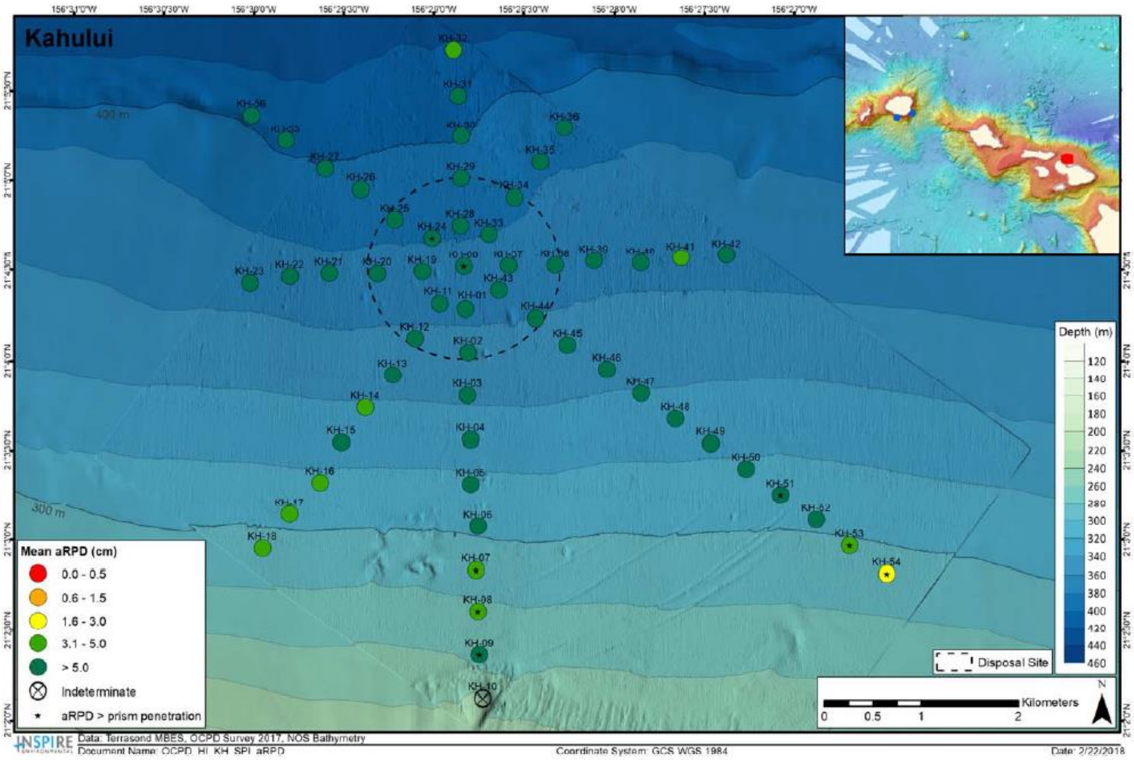


Figure 19. Mean aRPD depths (cm) at the Kahului ODMDS survey area.

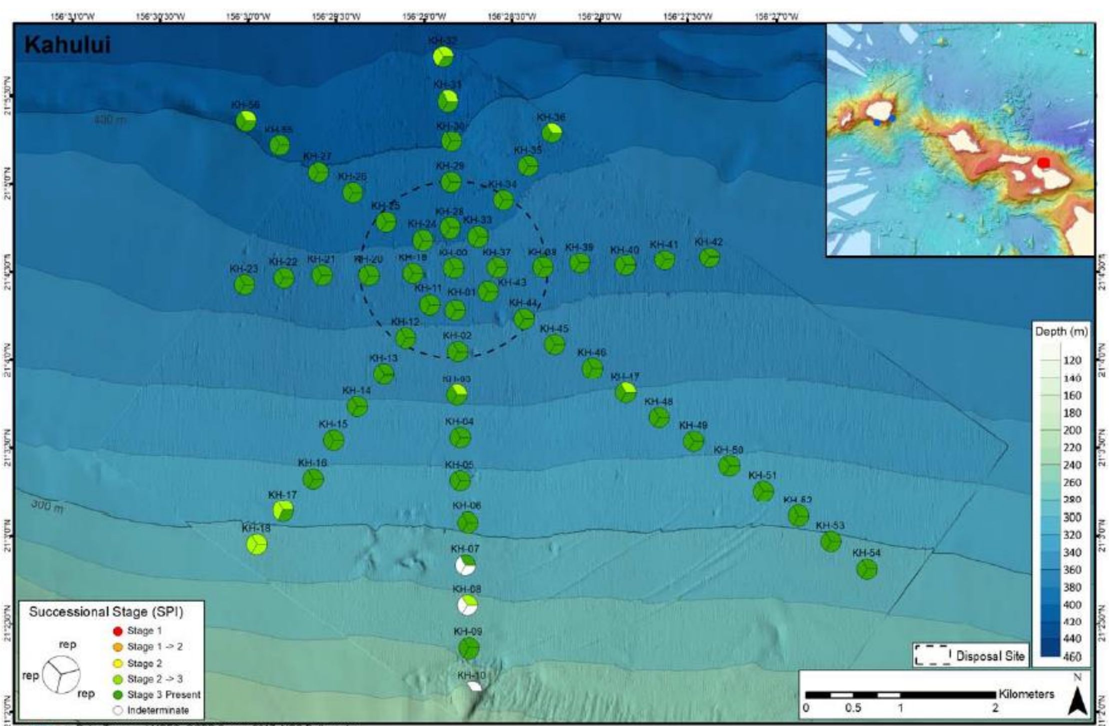


Figure 20. Infaunal successional stages at the Kahului ODMDS survey area. Results shown provide a value for each of three replicate images at each sampling station.

Similarly, analysis of benthic community structure from samples collected at the Kahului ODMDS (eight stations within the disposal site boundary and 18 stations outside of the disposal site boundary) did not show any statistical differences between samples collected inside the site and samples collected outside the site. This suggests that disposal activities are not significantly impacting benthic community structure at the site.

Region 9 collected sediment samples from eight stations within the dredged material footprint and 18 stations outside of the dredged material footprint for chemical analysis. The substrate both inside and outside of the dredged material footprint contained similar distributions of grain sizes. The substrate was predominantly silt and sand, with a slightly lower percentage of clay. Grain size measurements made from sediment grab samples corresponded well with determinations made from SPI images.

Concentrations of arsenic exceeded the ERL in samples collected from across all stations; however, the mean concentration of arsenic in locations outside the dredged material footprint (25.1 mg/kg) was greater than the mean concentration of arsenic inside the footprint (18.7 mg/kg) suggesting that arsenic enrichment is not a result of disposal activity. Chromium concentrations slightly exceeded the NOAA ERL at three stations, but these stations were outside of the dredged material footprint. Nickel concentrations exceeded the ERL at all stations, both inside and outside of the dredged material footprint. Fourteen stations additionally exceeded the ERM for nickel concentrations. However, the mean concentration of nickel inside the dredged material footprint (51.7 mg/kg) was similar to the mean concentration of nickel outside the dredged material footprint (50.1 mg/kg), suggesting that disposal activity is not playing a significant role in increasing nickel concentrations.

Analysis for pesticides indicated that concentrations of total DDT exceeded the ERL at all stations inside and outside of the dredged material footprint. However, the average concentration outside the footprint (15.6 mg/kg) was greater than the mean concentration inside the footprint (15.0 mg/kg) suggesting that enrichment is not related to disposal activities. Additionally, two stations exceeded the ERM; one was inside the footprint (KH03) while the other was outside the footprint (KH41). Both of these stations had similar concentrations of DDT (KH03 (inside) measured 52 mg/kg; KH41 (outside) measured 50.5 mg/kg) which suggests that enrichment is not related to disposal activities. Finally, PCB congener concentrations exceeded the ERL at one station (KH16) outside the dredged material footprint (35 mg/kg). Apart from arsenic, nickel, DDT, and PCBs, all other analytes were below the ERL at all stations across the survey area. Importantly, ranges of concentrations of all analytes inside the site overlapped with those of analytes outside the site, suggesting that any elevated concentrations of contaminants are not related to disposal activities.

3.3.2.2 Port Allen ODMDS

Region 9 collected SPI and PVI from 48 stations in the Port Allen ODMDS survey area (17 stations within the disposal site boundary and 31 stations outside the disposal site boundary). The seafloor habitat both inside and outside the footprint was nearly spatially homogenous, with some variability related to the presence of dredged material at the sediment surface. Sediments were characterized primarily by very fine sands with overlying layers of medium or fine sands in many places where dredged material was observed (Figure 21
Figure 21). Historical dredged material (medium to fine black and white sand) was present as thin biologically reworked layers or in trace amounts at nearly all stations sampled (Figure 22). However, all material observed had been reworked into the sediment column by biota to some extent and no thick deposits were observed. This is consistent with the lack of recent disposal operations. (Dredged material has not been disposed at the Port Allen ODMDS since 1999.)

The mean aRPD depths were 3.1 cm (SD ± 0.8) within the disposal site boundary and 3.3 cm (SD ± 0.9) outside the disposal site boundary (***Figure 23Figure 23***). The aRPD depths measured at the Port Allen ODMDS survey area were moderate to deep and robust; stations both inside and outside the site had aRPD values not indicative of impairment.

Infaunal and epifaunal communities in the Port Allen ODMDS survey area were also robust. Nearly every station had at least one replicate with evidence of mature Stage 3 taxa (Figure 24). Opportunistic Stage 1 taxa were often documented in the presence of Stage 3 taxa, resulting in a Stage 1 on 3 designation. Evidence for the presence of Stage 3 fauna included large-bodied infauna, deep subsurface burrows, and/or deep feeding voids. Stage 1 taxa were indicated by the presence of very small tubes at the sediment–water interface. Epifaunal organisms visible in the PVI captured at the Port Allen ODMDS survey area included brittle stars, hermit crabs, sea cucumbers, and shrimp. This suggests a healthy community despite historical disposal activities.

Region 9 collected sediment for grain size and chemistry analysis from 11 stations in the Port Allen survey area (four stations within the dredged material footprint and seven stations outside the footprint). The substrate both inside and outside of the dredged material footprint contained similar distributions of grain sizes. The substrate was predominantly silt in both locations. However, the material inside the dredged material footprint contained a slightly higher percentage of sand and slightly lower percentage of clay than the material outside of the footprint (Table 5). Grain size measurements made from sediment grab samples supported the determinations made from SPI images.

Concentrations of arsenic, chromium, and copper exceeded the ERL at all stations except PA15; however, mean concentrations of these metals at stations outside the dredged material footprint were greater than the mean concentrations inside the footprint. Additionally, nickel concentrations exceeded the ERM at all stations inside and outside the dredged material footprint, but the mean concentration of nickel was greater outside the footprint than inside. These results suggest that any elevated concentrations of these heavy metals are not the result of disposal activities.

Concentrations of total DDT exceeded the ERL at all stations both inside and outside of the dredged material footprint; however, the mean concentration of DDT in locations outside the dredged material footprint (17.2 mg/kg) was greater than the mean concentration of DDT of stations within the footprint (16.3 mg/kg). PCB concentrations also exceeded the ERL at all stations both inside and outside of the dredged material footprint, and the mean concentration of PCBs in locations outside the dredged material footprint (27.0 mg/kg) was similar to the mean concentration of PCBs inside the footprint (28.3 mg/kg). This suggests that any elevated concentrations of these contaminants were not a result of disposal activities.

All other analytes were below the ERL at all stations across the survey area. Importantly, ranges of concentrations of all analytes inside the site overlapped with those of analytes outside the site which indicates that contaminant concentrations are not a result of disposal activities.

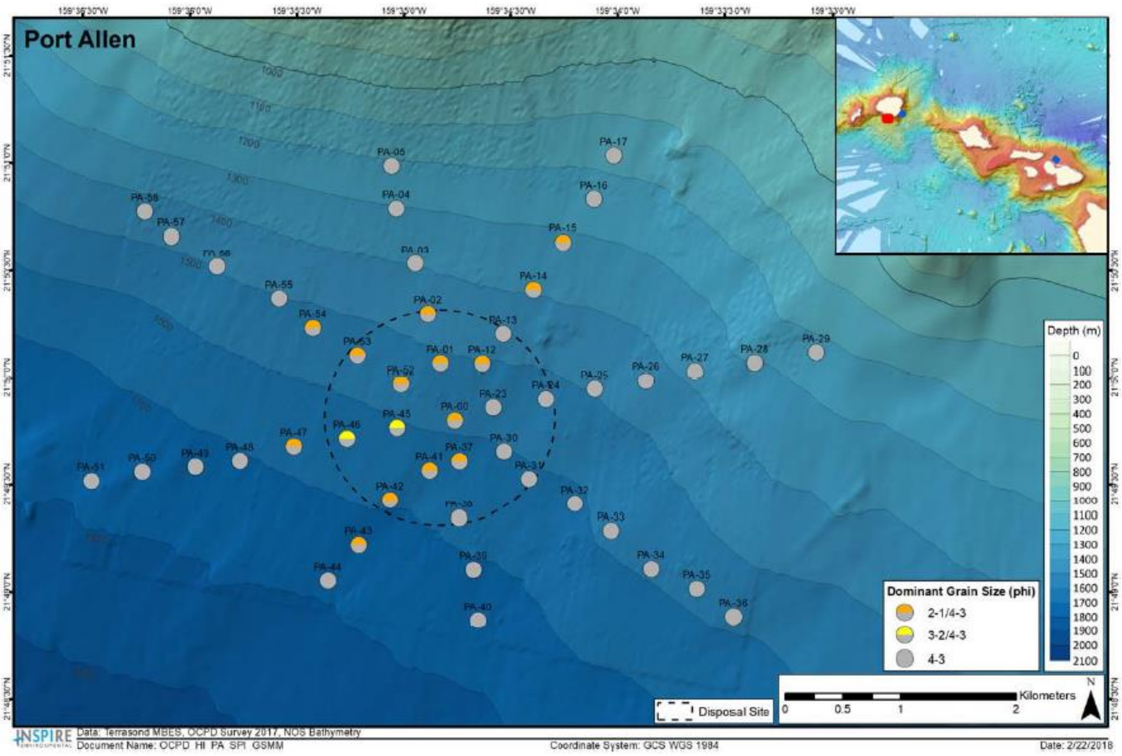


Figure 21. Sediment grain size major mode (phi units) at the Port Allen ODMDS survey area. Larger phi units represent smaller grain sizes.

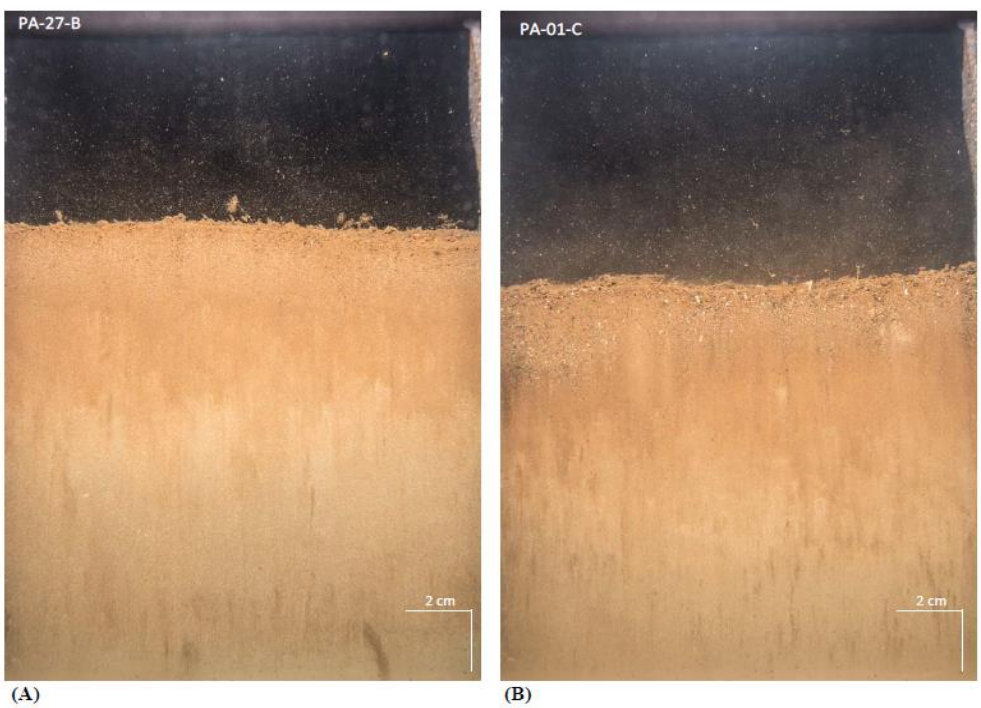


Figure 22. Profile images depicting (A) the very fine sand that was characteristic of sediments at the Port Allen ODMDS survey area and (B) very fine sand with a layer of medium sand (dredged material) at the sediment–water interface.

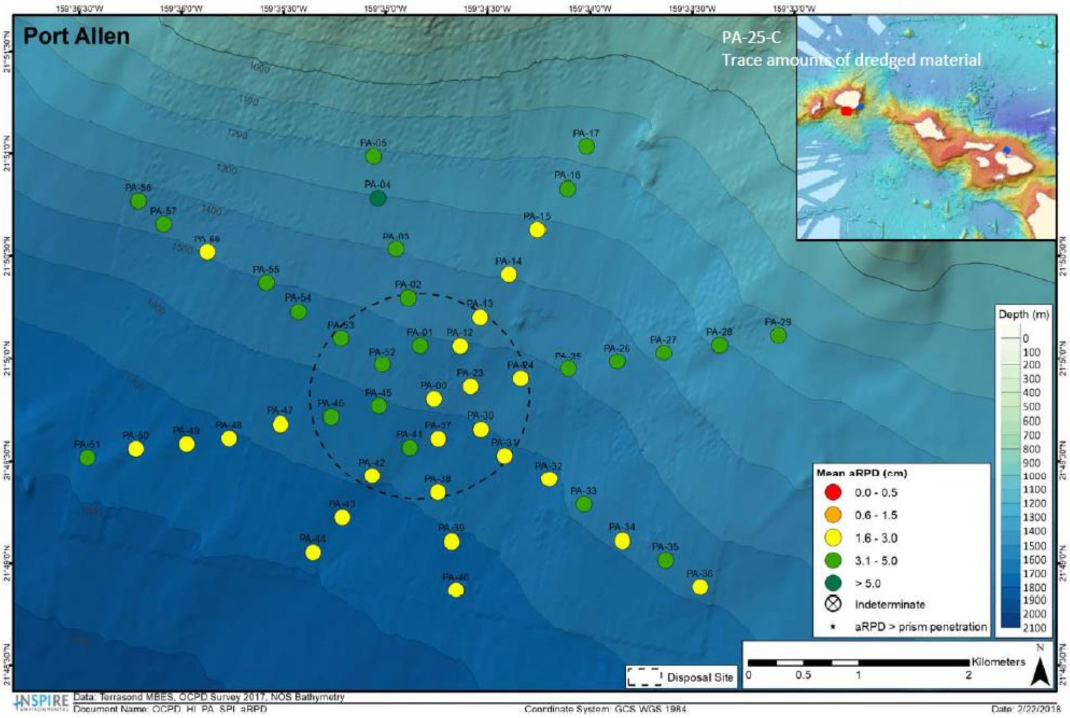


Figure 23. Mean station aRPD depth values (cm) at the Port Allen ODMDS survey area.

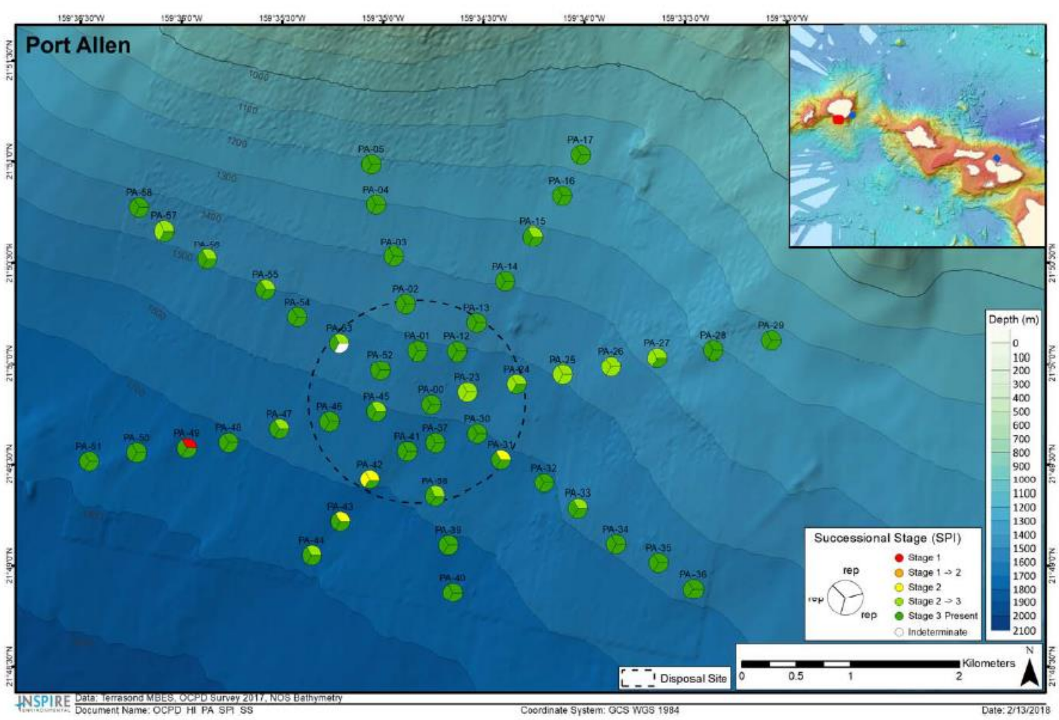


Figure 24. Infaunal successional stages at the Port Allen ODMDS survey area. Results shown provide a value for each of three replicate images at each sampling station.

3.3.2.3 Nawiliwili ODMDS

Region 9 collected SPI and PVI from 44 stations during the Nawiliwili ODMDS survey (11 stations within the disposal site boundary and 33 stations outside the site boundary). The seafloor habitat within the Nawiliwili ODMDS survey area was highly heterogeneous with variability across the survey area in relation to topography, the shoreward depth gradient, and the presence of dredged material. Volcanic outcrops and rippled sands were observed across the survey area. Outcrops were found most notably at the steep drop-off at the eastern edge of the sampled area, and rippled sand was mostly found at the 2,296-2,953 ft (700-900 m) depth range.

Region 9 observed dredged material both within and outside the Nawiliwili ODMDS boundary. Consistent with recent disposal operations (64,700 cy disposed in April 2016), Region 9 observed coral rubble and black or brown pebbles on the seafloor surface (Figure 25, Figure 26). However, definitive determination of the dredged material footprint at the Nawiliwili ODMDS was challenging due to the presence of coral rubble and other coarse material (similar to the material present in the dredged material disposed of at the site) found naturally at many locations throughout the survey area and due to the heterogeneity of the seafloor. Further, hard substrata and compact sands resulted in no to low camera prism penetration depths when conducting SPI at many stations. This limited the Region's ability to measure and evaluate key variables used to assess the condition of the benthic environment. Where these features could be assessed at Nawiliwili, no signs of organic enrichment or impairment were observed.

At many stations throughout the Nawiliwili ODMDS survey area, the optical boundary of the aRPD was not visible either due to no or low prism penetration or due to shallow penetration depths in sandy environments (Figure 27**Figure 28**). Where the aRPD was visible and measurable, the depths were in the moderate to deep range. Due to the hard substrate limiting prism penetration, mean aRPD depths were not available within the disposal site boundary; however mean aRPD depth was 3.5 cm (SD ± 0.7) outside the site boundary, with a range of 2.8-4.8 cm. The distribution of aRPD values outside the ODMDS was relatively narrow and the aRPD values were not indicative of impairment. Although no determinations can be made about the aRPD within site boundaries, this does suggest that effects of disposal activities on the aRPD, if present, are limited to areas within the boundaries of the ODMDS.

Infaunal and epifaunal communities at the Nawiliwili ODMDS survey area appeared to be robust. However, the rocky substrata and coarse dredged material resulted in shallow prism penetration depths which precluded the determination of infaunal successional stage at many stations. Only a single image was successfully collected inside the ODMDS boundary (Figure 28**Error! Reference source not found.**). Due to the presence of hard substrate at the Nawiliwili ODMDS, it was also not possible to collect benthic community samples for analysis within the site. Instead, the samples collected outside of the Nawiliwili site were combined with the samples collected outside of the Port Allen site for statistical comparisons to the community found inside the Port Allen ODMDS, for a total of 16 stations (four within the Port Allen ODMDS, eight outside of the Nawiliwili ODMDS, and four outside of the Port Allen ODMDS). Similarity analyses demonstrated that all the samples collected at the Nawiliwili and Port Allen ODMDSs were not statistically different from each other, except for samples from stations NW15 and NW57. The samples collected at the Port Allen ODMDS showed greater similarity to each other than to the samples collected at Nawiliwili, although this difference is not statistically significant. An analysis of variance (ANOVA) did not show any statistical differences between samples collected from outside the Port Allen and Nawiliwili ODMDSs and samples collected from inside the Port Allen ODMDS. Similar to the community data collected via SPI and PVI, this suggests that disposal activities are not having a significant impact on the benthic communities within the sites.

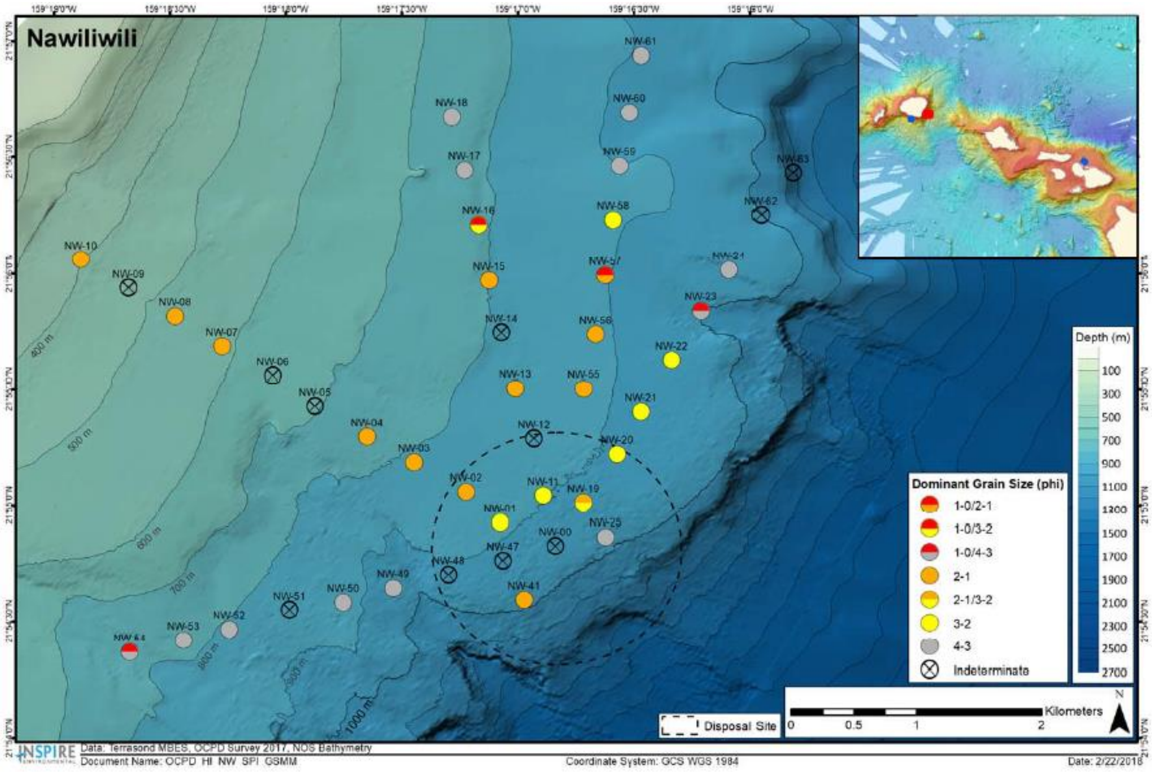


Figure 25. Sediment grain size major mode (phi units) at the Nawiliwili ODMDS survey area. Larger phi units represent smaller grain sizes.

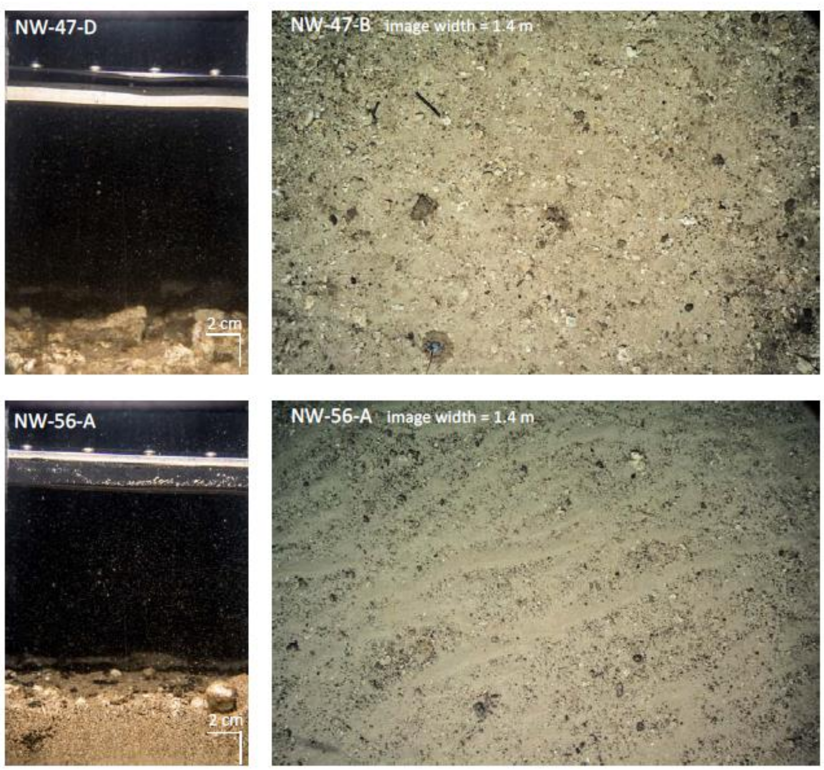


Figure 26. Profile and plan view images depicting coral rubble and black/brown pebbles characteristic of dredged material deposits within and just outside the Nawiliwili ODMDS.

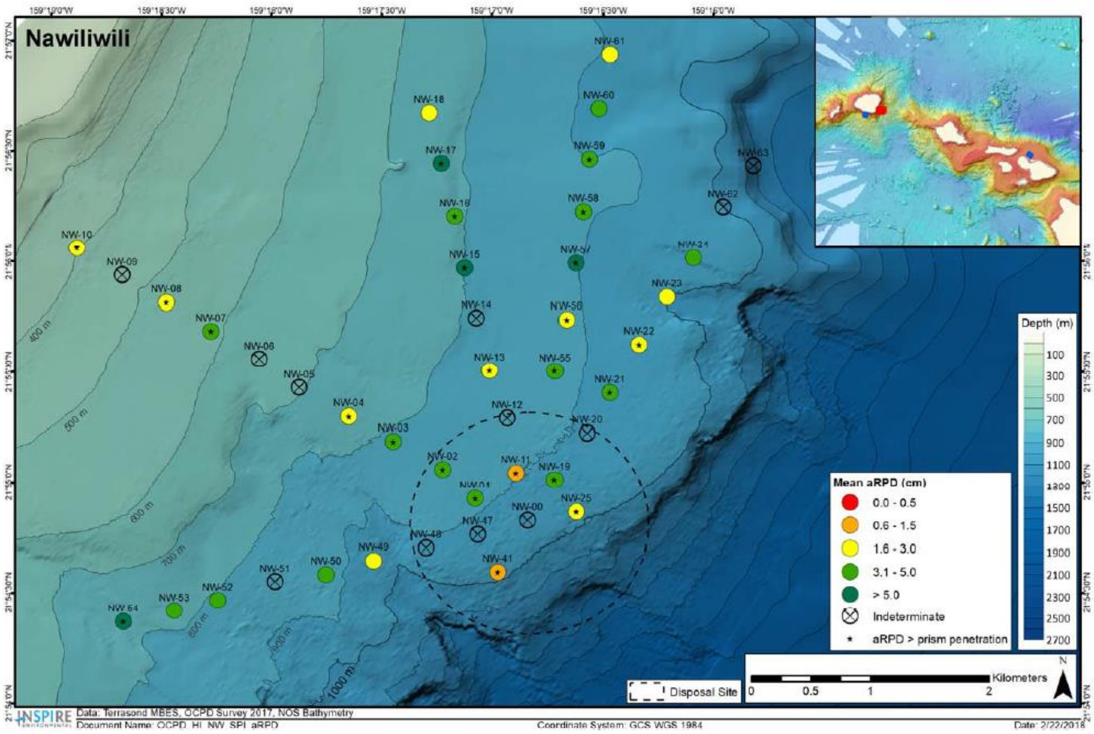


Figure 27. Mean station aRPD depth values (cm) at the Nawiliwili ODMDS survey area.

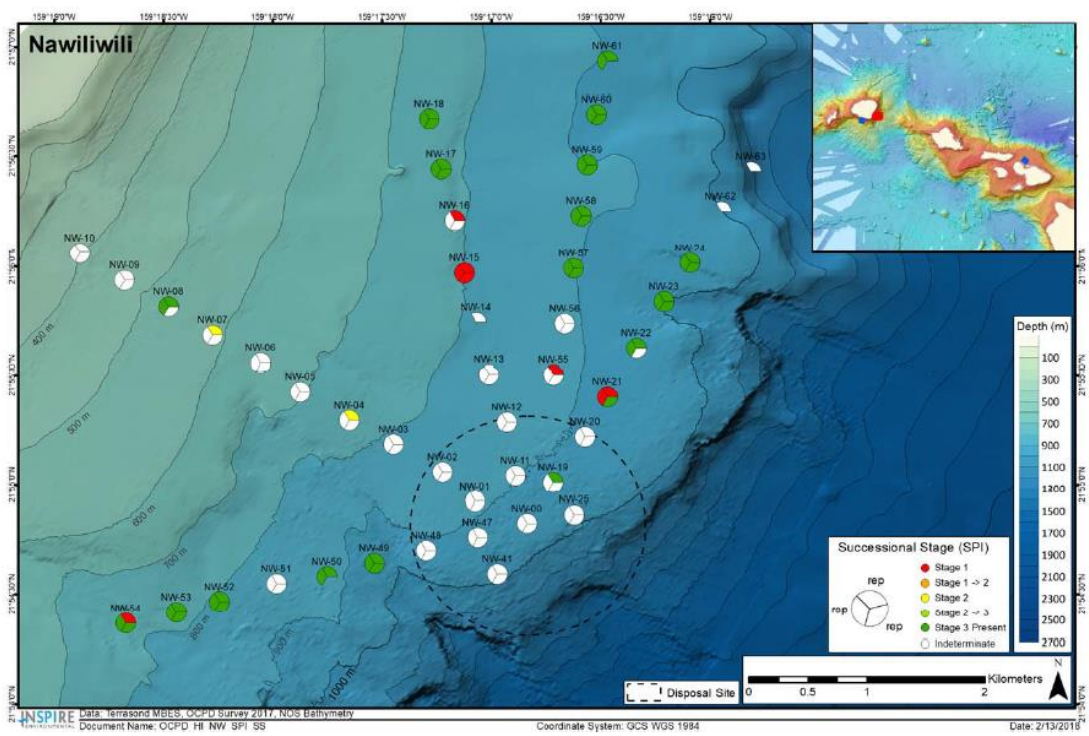


Figure 28. Infaunal successional stages at the Nawiliwili ODMDS survey area. Results shown provide a value for each of three replicate images at each sampling station.

Region 9 collected sediment for grain size and chemistry analysis from 11 stations in the Nawiliwili survey area (two stations within the dredged material footprint and nine stations outside the dredged material footprint). The substrate both inside and outside of the dredged material footprint contained similar distributions of grain sizes. The substrate was predominantly sand in both locations. However, the material inside the dredged material footprint contained a slightly higher percentage of gravel than the material outside of the footprint. Grain size measurements made from sediment grab samples corresponded well with determinations made from SPI images.

Concentrations of arsenic exceeded the ERL across all stations; however, the mean concentration of arsenic outside the dredged material footprint (14.2 mg/kg) was greater than the mean concentration of arsenic inside the dredged material footprint (17.1 mg/kg). Additionally, the station with the greatest concentration of arsenic (NW52 = 22 mg/kg) was located outside of the dredged material footprint suggesting that elevated arsenic concentrations are not related to the disposal activities. Similarly, chromium concentrations exceeded the ERL at several stations both inside and outside of the dredged material footprint, but the station with the greatest concentration of chromium (NW52) was located outside of the dredged material footprint. Nickel concentrations exceeded the ERL at two stations outside the dredged material footprint and exceeded the ERM at nine stations both inside and outside of the dredged material footprint. These results suggest that the presence of these contaminants is not related to disposal activities.

Concentrations of total DDTs exceeded the ERL at all stations across the survey area. However, the mean concentration of DDTs outside the footprint (15.6 mg/kg) was greater than the mean concentration inside of the footprint (15.0 mg/kg), again suggesting that the levels were not an effect of disposal activities. Apart from arsenic, chromium, nickel, and DDTs, all other analytes were below the ERL at all stations across the survey area. Importantly, ranges of concentrations of all analytes inside the site overlapped with those of analytes outside the site, suggesting that contaminant concentrations are likely not a result of disposal activities.

3.3.3 Conclusions and Recommended Management Actions

Region 9 met the objectives of this survey. The data and information collected during the 2017 monitoring survey at the Kahului, Port Allen, and Nawiliwili ODMDSs were used to characterize the physical, chemical, and biological attributes of study area. The Region's analyses of SPI and PVI indicated that trace amounts of dredged material were present outside the ODMDS boundaries at all three sites; however, the bulk of the dredged material appeared to be contained within each of the disposal sites. Advanced Stage 3 fauna were observed across both the Kahului and Port Allen survey stations. Sediment assessment and sampling within and around the Nawiliwili ODMDS were challenging due to the heterogeneity of the seafloor and prevalence of hard substrata. The SPI replicates that Region 9 collected from near the center of the Nawiliwili ODMDS indicated the presence of Advanced Stage 3 fauna. Therefore, disposal of dredged material appears to have had little lasting impact on benthic infaunal recolonization at the Kahului and Port Allen ODMDSs. The sampling challenges at Nawiliwili precluded a conclusive determination about the benthic community at that site but provided sufficient information for a general assessment.

Sediment chemistry analyses showed that concentrations of several metals (arsenic, chromium, nickel, and copper) exceeded screening levels (ERLs) at one or more of the sites. In all cases, metal concentrations were similar inside and outside the ODMDS boundaries which suggests that dumping activities were not responsible for elevated contaminant concentrations. Nickel, which is naturally elevated in native sediments in the Hawaiian Islands, was measured in elevated concentrations in all sediment samples collected from inside and outside of the ODMDS boundaries. Additionally, Region 9 found that concentrations of DDT congeners exceeded the ERM at all three sites. However, the Region found these concentrations at sites both inside and outside of the dredged material footprint, suggesting the presence of elevated DDT concentrations likely reflect historical use of DDT. Similarly, Region 9 found PCB concentrations exceeding the ERL at all stations both inside and outside of the dredged material footprint at the Port Allen site, but mean concentrations inside and outside of the dredged material footprint were similar, suggesting that the elevated PCB concentrations were not a result of disposal activities. All other chemical analytes were either not present in detectable concentrations or measured in concentrations below the ERL.

The grain size distribution in the Kahului ODMDS showed a slightly higher percentage of sand than found at the other sites, consistent with fine sand dredged material previously disposed at the site. At the Port Allen ODMDS, the grain size distribution contained a slightly higher percentage of sand, consistent with medium and fine sand dredged material previously disposed at the site. The grain size distribution in the Nawiliwili ODMDS contained a slightly higher percentage of gravel, consistent with coral rubble and pebble-like dredged material previously disposed at the site. However, apart from these slight differences, grain size distributions inside and outside of the ODMDSs were generally similar. The overall similarity in physical and chemical sediment characteristics between sampling stations inside and outside the dredged material footprint at all three sites indicate that dredged material disposal has not caused adverse physical impacts within the study area.

Overall, the benthic community present in sediment samples collected from inside and outside the disposal footprint of the same ODMDS are more similar to each other than when compared to samples collected from the other two disposal sites. Despite small differences in species compositions, ANOVA results of community metrics indicated that there were no significant differences between samples collected within and outside of the disposal sites. This indicates that dredged material disposal at the Kahului and Port Allen ODMDSs has not adversely impacted the benthic community structure, compared to the communities found living in the adjacent areas that are not impacted by dredged material disposal. Region 9 did not collect samples from inside the boundaries of the Nawiliwili ODMDS because of the prevalence of hard substrata within the site. However, as previously mentioned, the one SPI replicate that achieved sufficient penetration near the center of the Nawiliwili site indicated the presence of Stage 3 mature fauna. The presence of an advanced community structure is indicative of a robust benthic environment within the site boundaries.

Overall, results from the SPI and PVI, sediment chemistry, and benthic community analyses performed during these surveys indicate that the bulk of the dredged material disposed of at the sites appears to have been deposited properly within the site boundaries and that disposal activities have not resulted in any adverse contaminant loading or disturbance to benthic communities. Although there are expected minor and localized physical impacts from dredged material disposal, no significant long-term adverse impacts are apparent to the benthic environment outside of the ODMDS boundaries.

Data and information collected during this survey confirmed that the SMMPs for the Kahului and Port Allen ODMDSs are effective and no modifications to either SMMP appear necessary at this time; that being said, the information collected during this survey will be considered during the next planned update of the SMMPs. The identification of extensive hard-bottom habitat at the Nawiliwili ODMDS, including a volcanic escarpment marking an ancient shoreline in the southeastern portion of the site, has led Region 9 to begin consideration of an update to the SMMP to change the location of the surface disposal zone of the Nawiliwili site. In addition to avoiding deposition of dredged material on high-value habitat, relocating the surface disposal zone at Nawiliwili ODMDS will also facilitate future monitoring efforts by allowing for the collection of SPI and sediment grab samples which cannot be collected from hard-bottom substrate.

3.4 Region 10 – Rogue River Ocean Dredged Material Disposal Site

3.4.1 Background

EPA Region 10 designated the Rogue River ODMDS offshore of Gold Beach, Oregon, in 2009 (Figure 29). The ODMDS is located approximately 1.1 nautical miles southwest of the Rogue River entrance, is 0.14 nmi^2 in area, and covers depths of 45 to 84 feet. Suitable dredged material from the Rogue River federal navigation project, other local USACE projects, and MPRSA-permitted dredged material from non-USACE projects have been disposed at the ODMDS. Recent maintenance volumes dredged by USACE from the Rogue River navigation and entrance channels have averaged 54,000 cy annually (USEPA and USACE, 2009). The Rogue River ODMDS was last surveyed in 2007.

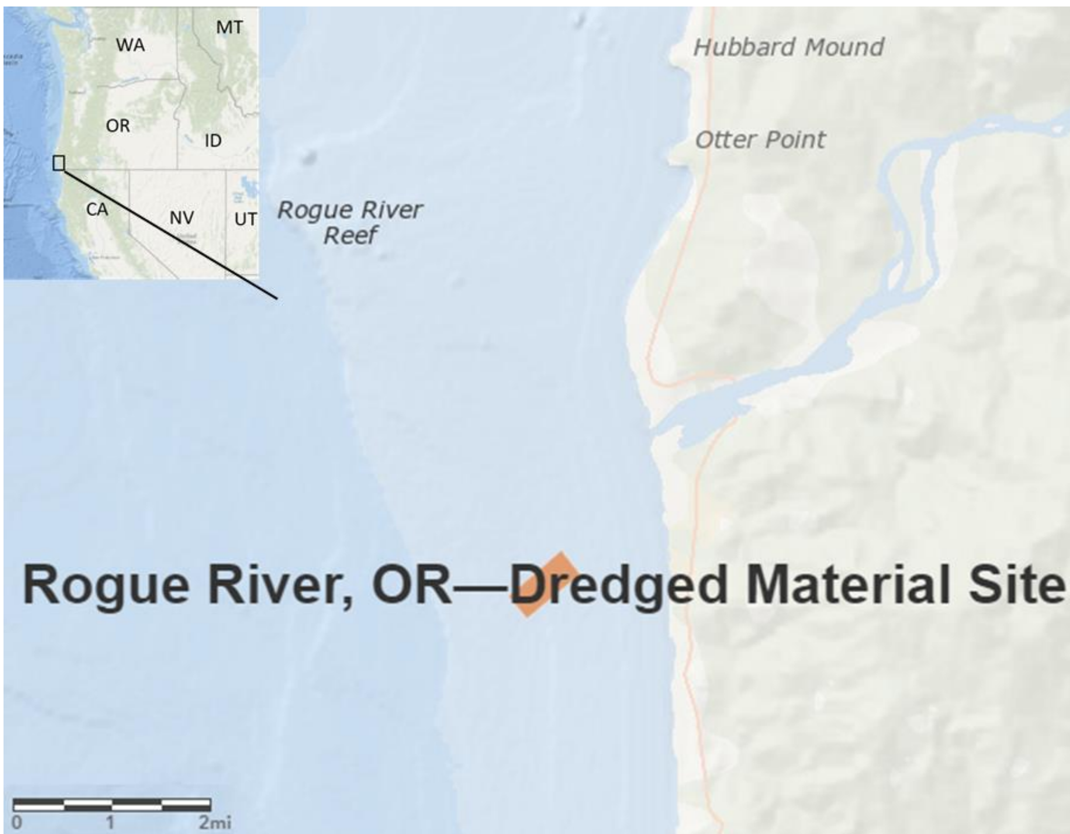


Figure 29. Location and boundary of Rogue River ODMDS.

3.4.2 Survey Objectives, Activities, and Findings

Region 10's survey objective was to collect physical, chemical, and biological data at the Rogue River ODMDS to inform a trend assessment evaluation of environmental effects at the site from the disposal of dredged material. The Region's monitoring effort was split into two parts: a hydroacoustic survey and a benthic and epibenthic sampling survey.

3.4.2.1 Hydroacoustic Survey

Region 10 conducted the hydroacoustic portion of this monitoring survey August 8 and 9, 2017, aboard the sailing vessel (S/V) *William R. Broughton*. The Region collected high-resolution multibeam sonar with backscatter over an area that included the entire ODMDS and a 500 ft (152 m) buffer (Figure 30).

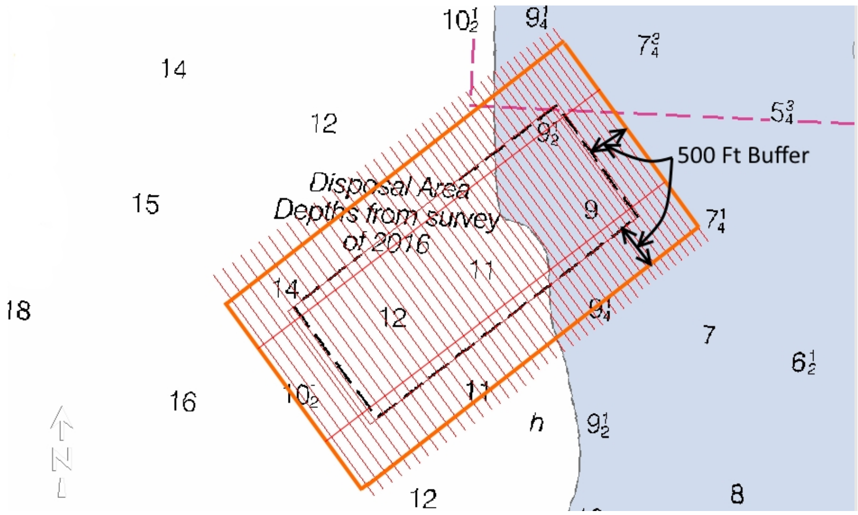


Figure 30. Hydroacoustic survey area with survey transect lines of the Rogue River ODMDS. Soundings shown are in fathoms below Mean Lower Low Water.

The hydroacoustic data provided a multi-dimensional visualization of the seafloor within and around the ODMDS which had not been observed before (Figure 31). The data showed coarse material, such as gravel, throughout the disposal site and rockier substrate and reefs at the deeper end of the ODMDS and near the offshore ODMDS boundary. Region 10 used knowledge of these geological substrate characteristics to modify the sampling plan for benthic grabs, benthic trawls, and video transects for the subsequent benthic and epibenthic sampling survey. Avoiding sampling locations in rocky substrates and aiming instead for sandier sediments allowed the Region to reduce safety hazards, protect valuable equipment from being damaged or lost, and provide the best chance for the successful collection of sediments and epibenthic organisms.

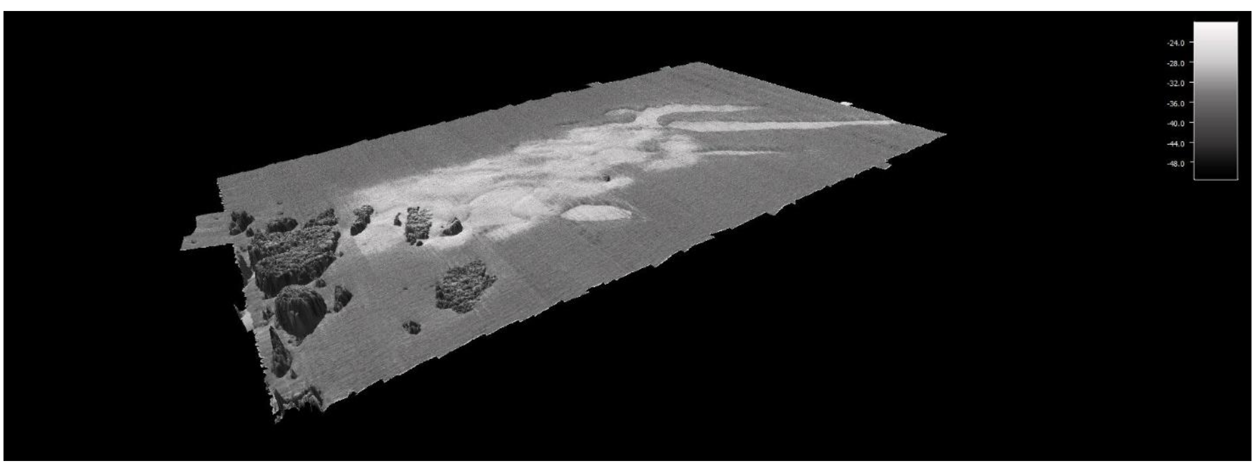


Figure 31. Hydroacoustic backscatter data of the Rogue River ODMDS and vicinity indicating harder substrate type, likely gravel cobbles, at the shallow-end of the site (right side of picture) in a fingerling-type formation and then a large area of high reflectance (light color) in the center of the ODMDS. Near the offshore boundary of the ODMDS, the seafloor has 10 to 15-foot rock relief structures.

3.4.2.2 Benthic and Epibenthic Sampling Survey

Region 10 conducted the benthic and epibenthic sampling survey from September 13-17 aboard Oregon State University's R/V *Pacific Storm*. During this survey, the Region collected sediment samples, conducted epibenthic trawls, and took benthic videos from within and outside of the ODMDS. Region 10 collected the sediment samples using a Grey-O'Hara modified box core and assessed them for grain size, contaminants of concern, and benthic infaunal community characteristics. The Region also collected trawl and video data using an otter trawl net and video sled, respectively, to assess epibenthic community characteristics and to conduct a comparison of the findings from the video sled with those collected using the otter trawl.

Results from the sediment grain size analyses showed that sediments outside of the boundaries of the ODMDS were primarily sand with a very small percentage (1-2%) of fine-grained material. Within the ODMDS, the sediments contained a much higher proportion of gravel. The coarser-grained sediments correlated with the dredged material permitted for disposal within the site from the Rogue River Federal Navigation Channel. Sediment results from the 2007 survey showed that the sediments within the ODMDS were mostly medium- to fine-grained marine sands with one sampling station showing coarser gravel. In comparison to the ambient sediments surrounding the ODMDS and the data collected from previous surveys, it appears that disposal operations have changed the sediment regime within the ODMDS from a coarse sand substrate to a gravel- and cobble-dominated seafloor.

Region 10 used the data collected from both the hydroacoustic survey and the benthic and epibenthic survey to create a surficial geological substrate map of the study area (Figure 32). This map identifies the predominant sediment types through the study area and will be used to inform future disposal activities and management of the site.

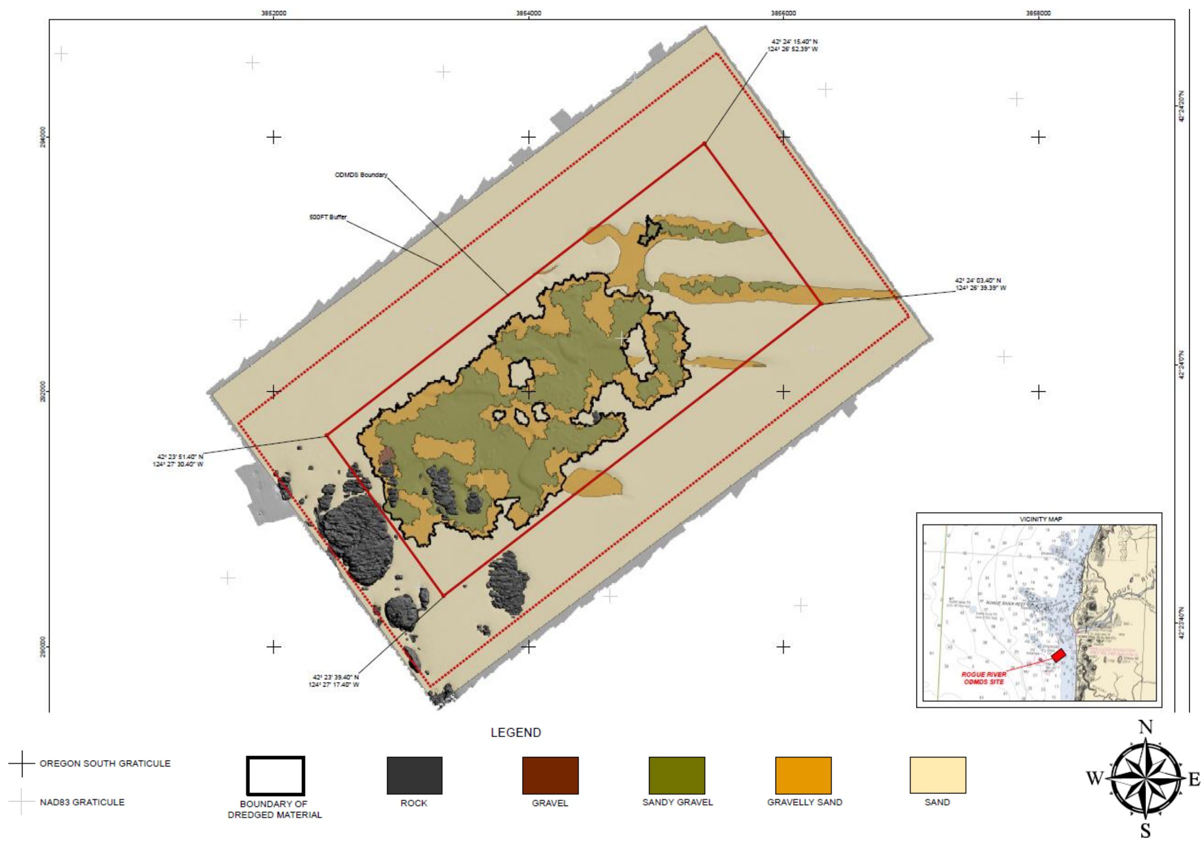


Figure 32. Surficial geologic substrate map of the Rogue River ODMDS based on hydroacoustic survey data and laboratory analysis of sediment samples. The green and mustard-colored area corresponds to the higher percentage of gravel found on the seafloor while also showing the area of sand (tan color) and the high-relief rock structures.

Region 10 collected sediment samples from nine locations within the ODMDS (Figure 33) and compared chemical analysis results to the 2018 Sediment Evaluation Framework for the Pacific Northwest marine screening levels. The Region analyzed sediments for antimony, arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver, zinc, and mercury. Region 10 also completed additional chemical analyses to detect the presence and concentrations of chemicals of concern including tributyltin, organic compounds (including chlorinated hydrocarbons), miscellaneous extractables (benzyl alcohol, benzoic acid, carbazole, dibenzofuran, hexachlorobutadiene, and n-nitrosodiphenylamine), phthalates, phenols (phenol, 2-methylphenol, 4-methylphenol, 2,4 dimethylphenol, and pentachlorophenol), and PAHs. Given the large grain size of the material, Region 10 did not expect to find any detectable levels of chemicals of concern in the sediments collected from the ODMDS; the chemical analyses confirmed this hypothesis.

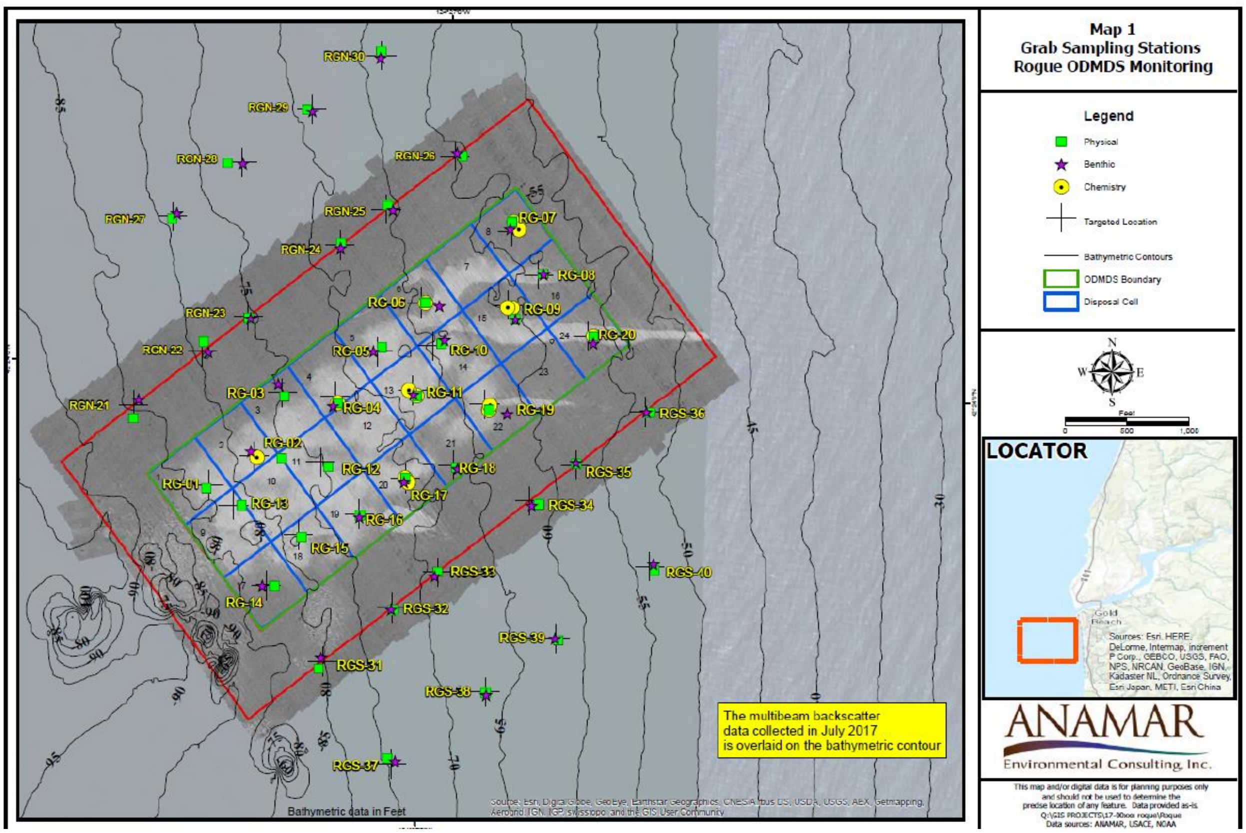


Figure 33. Station locations at the Rogue River ODMDS for the collection of sediment samples that were analyzed for physical and chemical properties and infaunal species.

Region 10 identified a total of 118 benthic invertebrate species from the infaunal grab samples. When comparing the infaunal data collected from within the ODMDS to those collected from outside of the boundaries of the ODMDS, analyses showed that infaunal species abundance, density, richness, and diversity were, in general, lower within the ODMDS. However, there was also a high species variability within the ODMDS. This higher variability in species is likely related to the greater variation in substrate types within the ODMDS (i.e., gravel and cobble) compared to the sand-dominated habitat found outside of the ODMDS boundaries. More variability in substrates offers more habitat types and therefore is often associated with higher variability in benthic community structure.

Region 10 conducted epifaunal trawls along three transects within the ODMDS and three transects outside and south of the ODMDS. The Region identified seven fish species and eight invertebrate species in varied abundances during each trawl, with higher abundances of each species measured in transects completed outside of the ODMDS. Despite this difference, the similarities in findings inside and outside of the ODMDS indicate that the benthic and epibenthic communities within the ODMDS can recover following the disturbances associated with disposal activities.

To compliment the data collected from the epifaunal trawl, the Region conducted video transects using a benthic sled outfitted with two cameras capturing both real-time and high-resolution video. Three video sled transects started outside of the southern boundary of the site and traveled across the site to the northern boundary of the ODMDS. Video transects provided visual documentation of the seafloor substrate and allowed for enumeration and identification of fish and invertebrates. The trawl data identified several minor trends: greater species density was found outside of the ODMDS, and greater richness, evenness, and diversity were seen inside the ODMDS (MTS, 2017). The results of the video sled recordings complemented the findings from the trawl data; however, Region 10 noted that the video sled footage allowed a broader visual perspective of the physical and biological conditions of the study area. The video footage confirmed a mixture of substrate types with gravel, cobble, and coarse sand being present inside the ODMDS. The high variability of substrates within the ODMDS indicated a greater potential for higher species richness. However, the community composition has likely been altered inside the ODMDS due to the disposal of dredged material which is dissimilar to the native substrate.

3.4.3 Conclusions and Recommended Management Actions

Region 10 accomplished all survey objectives. The data and information collected during the 2017 monitoring activities conducted at the Rogue River ODMDS provided new insight into the physical and biological parameters of the study area beyond what was learned from the 2007 survey. While EPA Region 10 and USACE were aware of the varied grain sizes within the ODMDS, 2017 monitoring activities provided a greater level of detail concerning substrate types, their expansiveness throughout the disposal site, and assumptions about how the substrate was influencing benthic and epibenthic communities. These survey findings have led to more conversations between the EPA and USACE about methods to more accurately characterize the physical nature of the dredged material removed from the Federal Navigation Channel and disposed of within the ODMDS. This will allow EPA to gain a clearer understanding of the grain size of material being disposed at the ODMDS to more accurately assess the potential changes to the seafloor habitat associated with disposal activities.

The various array of technologies employed during this survey highlighted numerous aspects of nearshore benthic and epibenthic community dynamics and will assist EPA and USACE in gaining a better understanding of the role that substrate type plays in benthic and epibenthic community dynamics. Collecting high-resolution data during future ODMDS monitoring activities would augment USACE's annual single-beam bathymetric data and offer higher resolution information about changes to the seafloor. Having regular access to higher resolution bathymetric data could inform EPA's management of ODMDSs and support future site designations.

4.0 Next Steps

EPA conducts oceanographic surveys to monitor the impacts of regulated dumping at ocean disposal sites and to inform management and monitoring decisions in accordance with EPA roles and responsibilities under the MPRSA and ocean dumping regulations. EPA monitors to ensure that dumping will not unreasonably degrade or endanger human health or the environment, to verify that unanticipated adverse effects are not occurring from past or continued use of the site, and to ensure that terms of ocean dumping permits are met.

Based on the results of these FY 2017 ocean disposal site surveys:

- Environmentally acceptable conditions were met at each of the surveyed ODMDSs. The data collected confirm that site management practices are working well and will inform site management as well as future updates of the SMMPs for each site. Permitted disposal of dredged material under the MPRSA can continue at these sites.
- Data and information collected from the Nawiliwili ODMDS identified hard-bottom habitat, including a volcanic escarpment marking an ancient shoreline, in the southeastern portion of the site. EPA is in the process of taking the steps necessary to change the location of the surface disposal zone to avoid future deposition of sediment on the hard-bottom habitat within this site.
- EPA also used the data collected during these surveys to:
    - Determine that portions of the Canaveral Harbor ODMDS are approaching capacity and the ODMDS will likely need increase in size to accommodate the disposal of the dredged material from any future expansion or deepening of Port Canaveral while ensuring protection of the marine environment, human health, and other resources and uses of the ocean;
    - Inform a modification of the Mobile ODMDS[5] to allow for the continued disposal of dredged material from the Mobile Harbor Federal navigation channel and provide additional disposal capacity for dredged material generated from the proposed Mobile Harbor Expansion Project;
    - Identify the need for additional data collection to determine the extent of the presence and concentration of dioxins and dioxin-like compounds at the Gulfport, MS, Pascagoula, MS, and Mobile, AL ODMDSs;
    - Better evaluate the efficacy of various survey methods for characterizing the dredged material disposed of at the Rogue River ODMDS so that EPA can accurately assess potential changes to the seafloor habitat due to disposal; and
    - Highlight the importance of collecting additional high-resolution multibeam or side-scan sonar data at the Rogue River ODMDS to enable the seafloor to be characterized more thoroughly and inform EPA management decisions to better protect human health and the marine environment.

5.0 Acknowledgements

This report is based on the monitoring surveys conducted, analyses performed, and conclusions drawn by EPA Regional offices 4, 9, and 10 during FY 2017. This report was developed with the support of Ocean Dumping Management Program staff from EPA Headquarters and all coastal Regional offices.

Cover art by Allie Redford.

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[5] The Final Rule for the Modification of an Ocean Dredged Material Disposal Site Offshore of Mobile, Alabama, was published in the Federal Register on May 20, 2020, with an effective date of June 20, 2020 (85 FR 47035). The EPA's *Final Environmental Assessment for Modification of the Ocean Dredged Material Disposal Site Mobile, Alabama, May 2020 (FEA),* provides an extensive evaluation of the criteria and other related factors for the modification of the Mobile ODMDS. The SMMP developed for the modified site is available at https://www.epa.gov/ocean-dumping/site-management-and-monitoring-plan-smmp-mobile-ocean-dredged-material-disposal-site.

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