TRIDENT SEAFOODS CORPORATION

5303 Shilshole Ave. NW, Seattle, WA 98107-4000
(206) 783-3818 • Fax: (206) 782-7195

Mr. Christian Gebhardt
U.S. Environmental Protection Agency – Region 10
1200 Sixth Avenue, Suite 900, OCE – 101
Seattle, WA 98101

July 18, 2018

Subject: Sand Point Waste Remediation Work Plan
Consent Decree (DJ #90-5-1-1-11200)
Trident Seafoods Corporation Sand Point Seafood Processing Facility
Sand Point, Alaska

Dear Mr. Gebhardt,

Please find attached the final version of the Sand Point Waste Remediation Work Plan, which was written to satisfy the requirements listed under Section VI of the Consent Decree (Civil Action No. 2: 18-cv-00210). Trident has revised this work plan to reflect the comments that EPA provided on July 16, 2018. Trident respectfully requests that you formally approve this document.

If you have any questions regarding this document, please do not hesitate to contact me at (206) 783-3818.

Sincerely,

Thomas J. Moore
Treasurer

Attachment: Sand Point Waste Remediation Work Plan

TRIDENT SEAFOODS CORPORATION

5303 Shilshole Ave. NW, Seattle, WA 98107-4000
(206) 783-3818 • Fax: (206) 782-7195

CERTIFICATION OF TRUTH, ACCURACY, AND COMPLETENESS

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

[signature]	7-19-18
Signature of Responsible Official	Date
Thomas J. Moore	Treasurer
Printed Name	Title

Waste Remediation Work Plan

Trident Seafoods – Sand Point Facility

Popof Island, AK

Prepared for:

Trident Seafoods Corporation

5303 Shilshole Ave. NW

Seattle, WA 98107

Submitted by:

Dalton, Olmsted & Fuglevand, Inc.

10827 NE 68th Street, Suite B

Kirkland, Washington

DOF DALTON OLMSTED FUGLEVAND

and

INSPIRE Environmental

88 Silva Lane, Suite 4

Middletown, RI, 02842

INSPIRE ENVIRONMENTAL

Revised July 18, 2018

TABLE OF CONTENTS

Page

ATTACHMENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF ACRONYMS AND ABBREVIATIONS

ADNR	Alaska Department of Natural Resources
ARCS	Assessment & Remediation of Contaminated Sediments
CERCLA	Resource Environmental Response, Compensation, and Liability Act
Consent Decree	Pre-Final Consent Decree, January 10, 2018
DGPS	Differential global positioning system
DOF	Dalton, Olmsted & Fuglevand, Inc.
DQO	Data Quality Objectives
EPA/USEPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
G&A	Germano & Associates, Inc.
INSPIRE	INSPIRE Environmental
NWP	Nationwide Permit (USACE)
PCN	Pre-Construction Notice
QAPP	Quality Assurance Project Plan
Sand Point	Trident Seafoods Sand Point Facility
SOW	Scope of Work
SPI	Sediment Profile Imaging
Trident	Trident Seafoods Corporation
USACE	U.S. Army Corps of Engineers
U.S. DOJ	U.S. Department of Justice
VRS	Virtual Satellite Reference
Work Plan	Sand Point Waste Remediation Work Plan
ZOD	Zone of Deposit

1.0 INTRODUCTION

This Sand Point Waste Remediation Work Plan (Work Plan) was prepared by Dalton, Olmsted & Fuglevand, Inc. (DOF) and INSPIRE Environmental (INSPIRE) for Trident Seafoods Corporation (Trident). The work plan is prepared in accordance with the Consent Decree of May 9, 2018, US District Court, Western District of Washington (U.S. DOJ 2018). The Consent Decree requires Trident to reduce the Sand Point outfall area zone of deposit (ZOD) to 1.0 acres or less.

The Consent Decree specifies that the Work Plan include both field sampling plan (FSP) and quality assurance project plan (QAPP) components. FSPs and QAPPs are typically associated with field sampling programs. The seafood waste remediation project is an in-water construction project. Within this Work Plan, the FSP is renamed as the “Removal Activity Plan” and the QAPP is renamed as the “Construction Quality Assurance Plan”. These analogous titles are applied within this Work Plan in order to more accurately describe the work to be performed and the quality assurance methods and protocols to be followed. This re-naming protocol was deemed appropriate for the Akutan Pilot Removal Remediation Work Plan (DOF & Germano 2015) conducted in accordance with 2012 Consent Decree (U.S. DOJ 2012).

To ensure that project goals, informational inputs, analytical approach, and other components are well-considered and clearly described, a Sand Point remediation monitoring Data Quality Objectives (DQO) table is provided in Attachment A. The DQO table was developed in accordance with U.S. EPA Guidance on Systematic Planning Using the Data Quality Objectives Process (U.S. EPA 2006) and describes the rationale and key elements of the monitoring program. The DQO table provides links to this Work Plan and QAPP methods used for evaluating other seafloor seafood waste deposits throughout Alaska (i.e. the QAPP for Seafood Waste Pile Benthic Impact Assessment for Akutan (G&A 2013a)).

The Trident Seafoods Sand Point Facility (“Sand Point”) is located on Popof Island in Alaska’s Aleutian Island chain (Figure 1). As set forth in the Consent Decree, Trident will conduct removal and disposal of seafood waste, conduct construction oversight, and conduct a set of confirmatory seafloor visual surveys and turbidity monitoring surveys, as part of the Sand Point remediation project.

1.1 Objective

The objective of this Work Plan is to describe the methods for removal and disposal of the Sand Point seafood waste deposit adjacent to the Trident facility outfall, as shown in Figure 2, and the associated quality assurance (QA) oversight, monitoring and reporting procedures.

The objective of the Sand Point seafood waste remediation project is to remove seafood waste from the Sand Point outfall area such that the NPDES-permitted ZOD does not exceed 1.0 acre. The Sand Point individual NPDES permit #AK-005278-7 (USEPA 1999) and associated seafloor monitoring reports (e.g., Coho & Enviro-Tech 2016) define the ZOD as the seafloor area covered with a continuous layer of seafood waste of measurable thickness (>0.5 inches).

1.2 Work Plan Organization

This Work Plan is organized into the following sections:

2.0 REMOVAL ACTIVITY PLAN

2.1 Seafood Waste Pile Removal

2.1.1 Removal Area

The expected removal area covers approximately 3.5 acres and is shown in Figure 2. This removal area was established in coordination with United States Environmental Protection Agency (EPA) (U.S. DOJ 2018). Prior to commencement of removal activities, a seafloor visual survey will be conducted to obtain an updated seafloor waste coverage map. The removal area may be adjusted based on the findings of the pre-removal visual seafloor survey, as well as on conditions encountered during the removal activity.

2.1.2 Removal Method

A dredge will be utilized for the removal of the seafood waste. The dredge will consist of either a crane on a barge or a derrick, depending on the marine construction contractor's equipment availability. The seafood waste will be mechanically removed with an enclosed clamshell bucket deployed from the dredge. The dredge will be held in place on anchors and anchor wires or spuds[i], depending on the marine contractor's equipment. The seafood waste recovered from the seafloor will include incidental quantities of seafloor materials associated with normal removal practices. It will be placed into material barges for delivery to the project at-sea discharge area.

2.1.3 Positioning of Equipment

The location of the dredge and of each placement of the dredge bucket will be established with global positioning system (GPS) electronic equipment and software. For a conventional clamshell dredge, the GPS antenna will be located on the tip of the boom of the crane or derrick, directly over the cable attached to the bucket. The positioning system will record the location of the bucket each time material is removed from the seafloor.

2.1.4 Removal Depth.

The recovery of seafood waste will continue until native sediment is observed in the bucket as it is placed in a material barge, as described in Section 3.2.

The existing seafood waste thickness at the site was estimated based on the results of sediment cores, videoprobes, and sediment profile images collected in 2014 and 2016 (e.g., Germano 2015), as shown in Figure 3. The thickness measurements will be combined with the results of a 2016 hydrographic survey of the seafloor to establish a site map of the estimated elevation of the bottom of the seafood waste.

As a guide to the dredge operator, the map of the estimated bottom elevation of the seafood waste will be loaded into the electronic positioning system of the dredge. This will serve as a

---

[i] Spud, n-steel columns that are extend through wells in the barge to the seabed that are used to hold the barge in position.

guide for removal, with the actual depth of removal adjusted as needed until native material is observed in the bucket.

The equipment operator’s control of the vertical placement of the bucket will be achieved with one of multiple approaches: 1-foot paint markings on lifting line, pore pressure transducer attached to the bucket, a spool counter on the lifting line, or other methods depending on the marine contractor’s equipment. Typical bucket cuts are expected to be on the order of two feet deep, with deeper cuts possible when removing thick deposits of seafood waste.

The removal area has two different topographic characteristics:

> Mound Areas: The removal area includes five topographic mounds (Figure 3), each estimated to have several feet of seafood waste, based on the 2014 and 2016 investigations.

> Valley Areas: The areas between and around the Mound Areas have flatter topography and are typically estimated to have thinner seafood waste deposits.

The dredge equipment and methods may be configured differently depending on site conditions. For example, deeper removal is expected in the Mound Areas where deeper seafood waste is expected and shallower removal is expected in the Valley Areas where thinner seafood wastes are expected.

In either case the removal operations will also capture an incidental component of underlying native sediment, associated with “allowable overdepth” removal. Allowable overdepth is the removal of material below the required depth due to normal and accepted inaccuracies in standard dredging practices. The allowable overdepth for removal operations can range from one to three feet depending on site conditions and equipment.

2.1.5 Removal Quantity

An estimated 25,000 CY to 30,000 CY of material is to be recovered from seafloor removal area, based on estimated seafood waste thickness and coverage area (Figure 3), plus one to two feet of allowable overdepth material. The actual recovered quantity will be a function of the actual thickness of seafood waste encountered across the site and on the actual overdepth removal.

2.1.6 Removal Duration

The on-site removal and disposal of 25,000 to 30,000 CY of recovered seafood waste is estimated to take approximately 45 days to complete, based on the marine construction contractor working 10 hours per day, seven days per week at production rates similar to those of the Akutan pilot seafood waste removal project in 2015. Depending on where the marine contractor’s equipment is located, project mobilization could take an additional two to three weeks.

2.1.7 Post-Removal Conditions

The removal and monitoring methods set forth in the Work Plan are intended to achieve the objective of reducing the ZOD to less than one acre, as set forth in the Consent Decree (U.S. DOJ 2018). Due to the inherent nature of removal operations, the post-removal surface will be composed, to some degree, of a discontinuous mixture of seafood waste (primarily old fish bones and shells) and native sand, commonly referred to as dredging residuals.

Dredging residuals refer to target materials (such as seafood waste in this case) found following dredging of target material at the post-removal surface. Numerous studies have investigated the nature and character of dredging residuals. The National Research Council 2006 report titled Sediment Dredging at Superfund Megasites concluded “*residuals will occur if dredging is performed*” (NRC 2007).

A USACE report (USACE 2008) stated that one of the more significant limitations currently associated with predicting the effectiveness of environmental dredging is the uncertainty associated with estimating the nature and extent of residual contamination following removal. The document also provided the following definitions of residuals:

> Undisturbed Residuals. Target material found at the post-removal sediment surface that have been uncovered by the removal action but not fully removed (missed target material).
>
> Generated Residuals. Target material found in in the post-removal surface sediments that are dislodged or suspended by the removal operation and are subsequently redeposited on the bottom of the water body. Generated residuals typically occur as a thin veneer (½ to 4 inches thick).

The removal program and associated monitoring program described in this Work Plan is intended to greatly limit the potential for an “undisturbed residuals” outcome following removal. It includes monitoring for the presence of native sediment in the dredge buckets as they are emptied in the material barge, in combination with seafloor visual surveys of the bed (described in Section 3 below).

The generated residual layer is generally represented by a depth-averaged mixture of vertical profile of the material removed. For example, removal of a foot of target material and a foot of native sediment would result in a generated residual layer with a 50-50 mix of target material and native sediment (i.e., a blend of 1 ft. target and 1 ft. native sediment). In removing both the seafood waste layer and some native sediment (normal allowable overdepth dredging) at Sand Point, it is expected that the generated residual layer will not be continuous seafood waste, but rather a mix of native sediment and seafood waste.

There is some uncertainty regarding the nature and character of a post-removal “generated residuals” seafood waste layer. While most sediment removal projects involve soft fine-grained sediment that can flow with disturbance and remolding in water, the Sand Point target material is mainly bone material that is mixed with and underlain by sand. Because of the inherent strength of sand material, as comparable to soft fine-grained sediment, it is expected that the generated residuals from Sand Point will be less prominent that those associated with typical sediment removal sites. It is likely that generated residuals layer following the seafood waste removal will typically vary from between 10% to 50% seafood waste in some areas. Visual surveys conducted throughout the removal process (and described in Section 3) will quantify remaining seafood waste and inform decision-making regarding completion.

2.2 At-Sea Discharge

2.2.1 Material Barges

The recovered material will be loaded onto barges for transport to the at-sea discharge site. If flat-deck barges are used for transport of recovered material, they will have containment walls to prevent loss of recovered material. Barges will not be filled to a point where the freeboard along the edges of the barge is less than one foot.

Controls will be implemented as necessary to drain dredge water from barges and ensure that water quality standards are not violated. Control methods can include, but are not limited to, placement of filter media (such as straw bales, filter fabric) at the scuppers of binned flat deck barges.

2.2.2 Discharge Location

The recovered seafood waste along with incidental seafloor materials will be transported to an offshore discharge area in Popof Strait shown on Figure 4 (“Popof Strait Placement Site”). The closest point of the at-sea discharge site is located 8.2 nautical miles (NM) southeast of Sand Point at a location less than 3 miles offshore and within Alaska State Waters. The placement site is roughly “L”-shaped and is 3.3 NM long along the northwest-southeast axis and 2.3 NM long along the northeast-southwest axis, with center coordinates at approximately 55.214977 °N, 160.366115 °W. An acoustic survey conducted in 2016 found that depths at the at-sea discharge site ranged from 210 to 705 feet (65 to 215 meters) with an average depth of approximately 550 feet (166 m).

2.2.3 Discharge Methods

Barges of recovered material will be towed to the discharge site. Once at the Popof Strait Placement Site, the barge will be towed at a speed of at least 3 knots while seafood waste is being discharged, to the extent such speed can be safely maintained based on conditions at sea and along a heading that is compatible with the sea conditions at the time. In the event that a speed of 3 knots cannot be safely maintained, Trident shall maintain the maximum safe speed and the reasons for not maintaining a minimum speed of 3 knots shall be recorded and included in the removal report. Trident contractor team personnel will communicate using standard VHF (marine) short-wave radios with standard channel protocols to coordinate start and end of disposal events, as well as other operations activities.

Each disposal event will occur along a different prescribed track line within the disposal area. During each disposal event, a Trident representative will record the date, start time and end time, length of track line during disposal events, average vessel speed, estimated quantity discharged, weather conditions, visual surface observations, and sea life observations. Disposal event logs will be included in the remediation report, as described in Section 5.

3.0 CONSTRUCTION QUALITY ASSURANCE PLAN

The following quality assurance components will be established to monitor construction activities throughout the removal project. Trident will have full-time representatives at the site during the removal project to monitor the removal work and at-sea disposal operations. Trident representatives will document completion of the work, in accordance with the approved work plan.

3.1 Area Coverage of Removal Action

The coordinates and location of the removal area will be entered into the marine contractor's on-board electronic navigation and bucket-positioning system on the dredge (several commercial systems are available such as Dredge Pack, WinOPS and Cable Arm). The near real-time display from the system will show the position of the boom tip, assumed to be over the bucket, to the equipment operator, and to guide the operator to achieve overlapping bucket placement (Figure 5). The system will electronically record each bucket placement on the bed and generate an output file with a graphical plot of the bucket placements in the removal area. The operator will utilize this information to verify full coverage of the removal area.

> Measurement and Response Action. The Trident representative will daily review the marine contractor's bucket positioning data and plot of bucket placements to verify and document that overlapping bucket placement was achieved once native material was observed. If overlapping bucket coverage was not achieved then the contractor will be directed to re-dredge areas, as needed, to achieve overlapping bucket placement into the native sediment. The Trident representative will also review the contractor's bucket positioning data to verify full coverage of the removal area. If missed areas are disclosed by the review, the contractor will be directed to return to such areas to complete the removal action.

3.2 Removal Depth

The depth of removal is intended to recover the full thickness of continuous seafood waste across the site. Achieving the desired removal will be monitored as follows:

Dredge Positioning Software. The marine contractor will be provided a map of the expected elevation of the bottom of the seafood waste deposit ("target elevation") based on the results of 2014 and 2016 investigations (e.g., Germano 2015). The contractor's dredge positioning software will display the target elevation for each placement of the bucket to guide the operator's positioning of the bucket with respect to the target elevation.

> Measurement and Response Action. The Trident representative will daily monitor the closing elevation of the buckets as compared to the target elevation as presented on the display of the dredge positioning software. The Trident representative will consult with the contractor to determine what adjustments, if any, are appropriate for achieving the desired digging elevations for the dredging operations.

Bucket Content Inspection. Because the target elevation is an estimate that may differ from the actual elevation of the bottom of the seafood waste, the Trident representative will observe and log material placed into the material barge as:

Table 1. Bucket Content Categories

A. Predominant Seafood Waste
B. Mixed Seafood Waste and Native Sediment
C. Predominant Native Sediment

Measurement and Response. The Trident representative will maintain contact with the dredge operator. If native material has not been observed in the bucket (Category A) at the expected elevation of removal, the dredge operator will be directed to continuing digging at that location. When sufficient native material is observed in the bucket (such as Category C) the operator will be informed that the removal depth has been achieved and to discontinue removal activities at that location.

3.3 Confirmatory Seafloor Visual Surveys

Confirmatory seafloor visual surveys will be conducted at a minimum of four stages during the removal project. Seafloor visual surveys will be conducted prior to commencement of removal activities (baseline or 0% complete survey), at approximately 25% complete, at approximately 50% complete, and at 100% complete. The goal of the visual seafloor surveys is to ensure that the removal construction activity is conducted such that the Sand Point seafood waste ZOD is reduced to not greater than 1.0 acre. Conducting seafloor visual surveys throughout the removal activity will provide the information inputs required to inform construction modifications needed to improve the removal process and to confirm removal success.

Each visual seafloor survey will consist of lowering a plan-view camera to near the seafloor and taking high-resolution photographs of the seafloor at a set of locations throughout the seafood waste deposit area. Three plan-view camera deployments will be collected at each sampling location. Plan-view images will be analyzed and percent seafood waste coverage in each image will be estimated. For the 100% complete seafloor visual survey, seafood waste thickness will be measured at each sampling location using a sediment profile imaging camera.

The methods used for all four Sand Point plan-view visual seafloor surveys and for the sediment-profile imaging (SPI) camera during the 100% completion survey are provided in the QAPP for Seafood Waste Pile Benthic Impact Assessment for Akutan (G&A 2013a). These methods have been successfully applied to conduct seafood waste deposit benthic assessments and surficial seafood waste coverage assessments at several locations throughout Alaska in recent years, following QAPPs for Akutan, Cordova, and Ketchikan (G&A

2013a, G&A 2013b). At 100% completion, the Sand Point ZOD will be delineated using the plan-view and sediment-profile images following methods described in “Delineating Surficial Seafood Waste Zones of Deposit” (INSPIRE 2017, Attachment B).

The Sand Point seafloor visual surveys and seafloor image analysis will be conducted by Dave Browning and/or Marisa Guarinello. Mr. Browning and Ms. Guarinello are experts in benthic assessment and have conducted seafloor visual surveys of seafood waste deposits at Akutan, Ketchikan, and Cordova in recent years. Resumes for Mr. Browning and Ms. Guarinello are provided in Attachment C.

A Sand Point seafood waste remediation monitoring data quality objectives (DQO) table was developed to clearly describe the rationale and key components of the project. The DQO table is provided in Attachment A and the Sand Point sampling and analysis plan for the seafloor visual surveys is provided below.

<u>Baseline (0% Complete) Seafloor Visual Survey</u>

A baseline Sand Point visual seafloor survey will be conducted prior to the beginning of the removal project. The baseline seafloor visual surveys will feature collection of seafloor images at approximately 168 stations on a grid with approximately 50-foot by 50-foot spacing, as shown in Figure 6. Three plan-view images will be collected at each sampling location.

Immediately following seafloor visual survey data collection and quality control, each plan-view image will be analyzed for percent cover of seafood waste. Based on previously conducted surveys, seafood waste deposits at Sand Point are known to consist of coarse bone and fin fragments that vary in size, with typical sizes up to 5 cm, with distributions ranging from thick matrices and piles to fragments mixed across and into the sandy sediment found across the area.

Percent seafood waste coverage will be efficiently estimated due to project time constraints (the marine construction contractor will be standing-by). The intermingled nature of fish bone and sand at Sand Point make this assessment challenging. Rapid and accurate analysis will be achieved by visually estimating the total percent cover in each plan-view image and assigning it a coverage category. The analysis method used is based on convex hull theory (de Berg et al. 2000) and involves visually consolidating all indications of seafood waste into an area, e.g., quadrant, of the image to make a reasonable estimation of percent cover. The categories used are: continuous (100%), greater than 75%, 50 to 75%, 25 to 50%, 10 to 25%, Trace (2 to 10%), and less than 2%. These categories provide sufficient information and will assist Trident in making decisions regarding removal actions throughout the project.

Results of the baseline (0% complete) seafloor visual survey will be compared to the Consent Decree-required seafood waste removal area and the removal area will be expanded, if needed, to ensure that the entire seafood waste deposit area is included in the removal action.

25% and 50% Complete Seafloor Visual Surveys

The 25% and 50% completion seafloor visual surveys will be conducted at approximately 25% and 50% of project completion. These surveys will cover roughly 25% and 50% of the removal area with proportional numbers or sampling locations (e.g., approximately 42 sampling locations for the 25% survey and 84 locations for the 50% survey). The 25% and 50% completion surveys will be conducted following the same methods as those described above.

Results from the 25% and 50% complete seafloor visual survey will provide percent seafood waste coverage at each sampling location within the active portion of the removal area. These results will be evaluated by Trident personnel prior to continuing with additional removal activities. If continuous (100%) seafood waste deposits are identified, then Trident will likely require that the marine construction contractor return to selected locations and continue removal activities. Seafood waste observations from the visual seafloor surveys will be compared to expectations based on construction oversight activities and modifications to the removal process will be adapted, as needed.

100% Complete Seafloor Visual Survey

The 100% complete seafloor visual survey will be different from the other seafloor visual surveys because it will include seafood waste thickness measurements. The 100% complete survey will feature use of a plan-view camera for surficial seafood waste characterization and a sediment profile imaging (SPI) camera for seafood waste thickness characterization. The 100% complete seafood waste survey will include plan-view and SPI measurements at approximately 168 sampling locations, as shown in Figure 6.

The 100% complete seafloor survey will follow the methods described above for estimation of percent seafood waste coverage. In addition, three SPI deployments will be completed at each sampling location to measure seafood waste thickness. The SPI camera typically reaches a surficial sediment depth of 15 to 20 cm and varies depending on the hardness of seafloor materials. The thickness of SPI camera penetration will be recorded for each image. The ZOD measurement method requires determination of whether greater than 0.5 inches (1.3 cm) of seafood waste thickness is present. Thus, the SPI penetration depth (typically 15 to 20 cm) is more than sufficient to support the ZOD method requirements (greater than 1.3 cm) of the Sand Point project. The methods used for all four Sand Point plan-view visual seafloor surveys and for the 100% SPI camera survey are provided in the QAPP for Seafood Waste Pile Benthic Impact Assessment for Akutan (G&A 2013a).

At 100% complete, the Sand Point ZOD will be delineated using the plan-view and sediment profile images following methods described in “Delineating Surficial Seafood Waste Zones of Deposit” (INSPIRE 2017, Attachment B). The ZOD delineation methods described in Attachment B are consistent with the requirements of the 2018 Consent Decree.

Results from the 100% seafloor visual seafloor survey will provide both percent seafood waste coverage and seafood waste thickness measurements using the plan-view and SPI cameras at each sampling locations in the seafood waste removal area. These results will be evaluated by

Trident personnel prior to allowing the construction contractor to demobilize and depart the project site. Trident will assess the percent seafood waste coverage at each station and the size of the seafood waste deposit ZOD at 100% completion. Trident will ensure that the seafood waste ZOD does not exceed 1.0 acre in size before the project is completed.

3.4 Turbidity Monitoring

Turbidity monitoring will consist of in-situ turbidity measurements and visual observations in the area of the Sand Point removal operations, in accordance with the Consent Decree (U.S. DOJ 2018). In-situ turbidity measurement will be collected and recorded throughout the water column prior to, and throughout, the removal project. Turbid plume visual observations will also be recorded throughout the duration of removal project.

Turbidity resulting from removal activities is expected to consist of primarily inert sands and small aged fish bone material, based on the Sand Point seafloor investigations conducted in 2014, 2015, and 2016 (e.g., G&A 2015). The Akutan QAPP (G&A 2014) describes the methods that will be used to conduct in-situ turbidity monitoring.

The in-situ turbidity measurements will be conducted:

- At three stations situated approximately 600 feet to the north, west, and south of the removal area, as shown in Figure 7.
- Using a continuously-recording turbidity and pressure sensor (an OBS-3Plus Particle Sensor or similar) configured with a dive weight suspended 2-feet below the sensor. The sensor and weight will be lowered through the water column until the weight rests on the bottom in order to collect water column and near-bottom measurements.
- Prior to commencement of the removal project, two turbidity monitoring events will be conducted at the three turbidity stations during one day.
- Once removal activities are initiated, two turbidity monitoring events will be conducted at the three turbidity stations each day for the first three days of removal activities and one day per week thereafter.

In addition, Trident's representative will watch for, observe, and record persistent (1 hour or longer) visible turbid plumes of 100-foot diameter or larger, throughout the duration of removal activities at Sand Point. Monitoring results and observations will be compiled and included in the removal report.

3.5 At-Sea Disposal

Barges of recovered material will be delivered to the designated at-sea disposal location (Figure 4). The barge will be equipped with Global Positioning System (GPS)-based electronic position monitoring equipment to measure, record, and plot the track lines of the vessel while the material is being discharged while in tow. The beginning and ending times for the discharge of material will be recorded. Each disposal event will occur along a different track line within the disposal area, orientated on a heading that corresponds to sea conditions at the time. To the extent practical, the track line of each disposal event will be offset on the order of 100 feet or more from prior track lines, recognizing that due to varying sea conditions the track lines may at times cross or overlap.

> Measurement and Response. The position of the barge will be monitored and discharge will be terminated prior to exiting the disposal area. During disposal, the track line of the barge will be monitored with respect to prior track lines of disposal. The vessel captain will be informed if a track line is encroaching on the desired 100 ft. buffer between track lines, and the orientation of the tow adjusted to the degree that can be safely accomplished consistent with existing sea conditions.

A written log will be maintained of the disposal events and included in the removal report. The following information will be included in the log:

- Date, start and end time of discharge, estimated quantity of material discharged, nature of material discharged, and average vessel speed for each event.
- Sea life or activity at the time of disposal, in accordance with Section I.B.2.c of the Sand Point Permit (USEPA 1999).
- Weather conditions at the time of disposal.
- Visual surface observations at the time of disposal

GPS-based plots will be generated for each discharge event showing the track line of the barge during discharge, indicating disposal start and stop locations.

4.0 PERMITTING AND CONTRACTING

4.1 Permitting Requirements

The EPA has authorized the removal and at-sea disposal of the Sand Point seafood waste pile under the existing NPDES Permit AK-005278-7 (USEPA 1999). No additional permitting applications are being submitted based on direction from the EPA.

4.2 Contracting

Marine construction contracting for the Sand Point removal project is based on the assumption that the removal project will be completed during the summer of 2018, contingent on timely approval of the Work Plan and lodging of the Consent Decree. Trident has identified Western Marine Construction (WMC) to conduct the work in 2018 as they will already be working in the Aleutian Islands of Alaska. WMC was the Trident marine construction contractor for the Akutan pilot removal and capping project in 2015. Trident may select another marine contractor if the work is shifted to 2019.

5.0 REPORTING

A Sand Point seafood waste removal report will be submitted to EPA within 120 days of completion of the removal project. The report will be prepared in accordance with the Consent Decree (U.S. DOJ 2018) and will include the following components:

Bottom Surveys

- A description of seafloor visual confirmation surveys (i.e., bottom surveys) conducted at 0%, 25%, 50%, and 100% completion (at a minimum) including a summary of finding and seafood waste coverage maps associated with each survey. The bottom survey report will also include a post-removal visual survey (100%) ZOD size and coverage area map. In addition, the report will provide a description and example images of each type of seafood waste (e.g., aged bone or fine organic seafood waste) observed.

Dewatering and Removal

- A description of seafood waste removal activities including a summary and photographs of equipment and methods employed for the removal project, including controls as necessary to not violate water quality standards. The removal activity summary will include plots graphically showing bucket placements for recovery of seafood waste, a site plan showing the actual extent of the removal area and a tabulation of the observations of the class of materials being placed into the material barge, per Table 1 - Bucket Content Categories.

- A description of turbidity monitoring activities including presentation of water column and near-bottom turbidity measurements and descriptions of observed turbidity plume events.

Disposal and Monitoring

- A description of seafood waste disposal activities including a log of discharge events with time, date, amount, nature, and location of discharges. The vessel speed, disposal site start, stop, and intermediate positions will also be logged and reported. Observations of sea life will be monitored and reported. Weather conditions will also be reported.

Variations and Corrective Actions

- An explanation of variations from the approved work plan

- A summary of corrective actions, if any, required as a result of construction quality assurance monitoring results.

The Sand Point remediation report will describe each component above in a clear and straightforward manner and will include illustrative figures and tables.

6.0 SCHEDULE

The Sand Point seafood water removal project schedule is currently based on the assumption that the work will be completed during the summer of 2018, contingent on timely approval of the Work Plan and lodging of the Consent Decree. Trident may shift the work to 2019 depending on EPA approvals and marine contractor availability. The following tentative schedule is provided for reference.

Table 2. Tentative Schedule for Sand Point Removal Project

Tasks	Anticipated Timeframe
Lodging of Sand Point Consent Decree	May 2018
EPA approval of Work Plan	July 2018
Contractor mobilize equipment to Sand Point	July 2018
Contractor complete removal project	September 2018
Submit Construction Report (120 days after completing work)	January/February 2019

7.0 REFERENCES

Battelle. 2016. Quality Assurance Project Plan (QAPP) for the Alaska Fish Waste Ocean Disposal Site Survey. Submitted to: Tim Mayers, Work Assignment Manager, U.S. Environmental Protection Agency, Region 10, Anchorage, AK. Submitted by: Battelle, Norwell, MA. EPA Contract Number EP-C-14-017. September 19, 2016.

Coho & EnviroTech. 2016. Seafloor Monitoring Report: 2016 Season. Trident Plant, Sand Point, AK. APDES #AK0052787. Prepared for: Trident Seafoods, Seattle, WA. For submittal to: Alaska Department of Environmental Conservation, Anchorage, AK. Prepared by: Coho Environmental, LLC, Seattle, WA and EnviroTech Diving, Inc, Stanwood, WA. Draft Report submitted July 25, 2016.

Dalton, Olmsted & Fuglevand, Inc. and Germano & Associates, Inc. 2015. Work Plan for Removal Pilot Remediation Project in Akutan Harbor. Prepared for Trident Seafoods Corporation, Seattle WA. Prepared by Dalton, Olmsted & Fuglevand, Inc., Kirkland, WA and Germano & Associates, Bellevue, WA. April 2015.

de Berg, M., M. van Krevald, M. Overmars, and O. Schwarzkopf. 2000. Computational geometry: Algorithms and applications. Springer Science + Media, Dordrecht, The Netherlands.

Germano & Associates, Inc. 2013a. Quality Assurance Project Plan for Seafood Waste Pile Benthic Impact Assessment for Akutan. Prepared for U.S. EPA Region 10, Seattle, WA. Prepared by Germano & Associates, Inc., Bellevue, WA. November 4, 2013.

Germano & Associates, Inc. 2013b. Quality Assurance Project Plan for Seafood Waste Pile Benthic Impact Assessment for Ketchikan and Cordova. Prepared for U.S. EPA Region 10, Seattle, WA. Prepared by Germano & Associates, Inc., Bellevue, WA. December 2013.

Germano & Associates, Inc. 2014. Addendum 1 to Quality Assurance Project Plan for Seafood Waste Pile Benthic Impact Assessment for Akutan. Final. Prepared for U.S. EPA Region 10, Office of Environmental Assessment, Seattle, WA. Prepared by Germano & Associates, Bellevue, WA. May 2014.

Germano & Associates, Inc. 2015. Sand Point 2014 Seafloor Investigation Report. Prepared for Trident Seafoods Corporation, Seattle, WA. Prepared by Germano & Associates, Inc., Bellevue, WA. Submitted July 2015.

INSPIRE Environmental. 2017. Akutan Harbor Seafloor Monitoring and Remediation, 2014-2016, Synthesis Report, Revised Draft. Prepared for Trident Seafoods Corporation, Seattle, WA. Prepared by INSPIRE Environmental, Newport, RI. Revised Draft submitted January 11, 2017.

National Research Council (NRC). 2007. Sediment Dredging at Superfund Megasites: Assessing the Effectiveness. The National Academies Press, Washington, D.C.

USACE. 2008. The Four Rs of Environmental Dredging: Resuspension, Release, Residual, and Risk. United States Army Corps of Engineers, EDRC/EL TR-08-4. January 2008.

U.S. DOJ. 2012. United States District Court: Western District of Washington. U.S.A., Plaintiff v. Trident Seafoods Corporation, Defendant. No. Civ. No. 11-1616 Amended Consent Decree. June 18, 2012. Frederick Phillips, Environmental Enforcement Section, Environmental & Natural Resources Division, U.S. Dept. of Justice, Washington, D.C.

U.S. DOJ. 2018. United States District Court: Western District of Washington. U.S.A., Plaintiff v. Trident Seafoods Corporation, Defendant. No. Civ. No. 2:18-cv-00210, Consent Decree. May 9, 2018. Frederick Phillips, Senior Trial Attorney, Environmental Enforcement Section, Environmental & Natural Resources Division, U.S. Dept. of Justice, Washington, D.C.

U.S. EPA. 1999. Authorization to Discharge under the National Pollutant Discharge Elimination System. NPDES Permit AK-005278-7, Trident Seafoods Corporation (the “permittee”), Trident Seafoods – Sand Point Facility (the “facility”). United States Environmental Protection Agency. August 10, 1999

U.S. EPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4, United States Environmental Protection Agency, Office of Environmental Information, Washington, DC. EPA/240/B-06/001. February 2006.

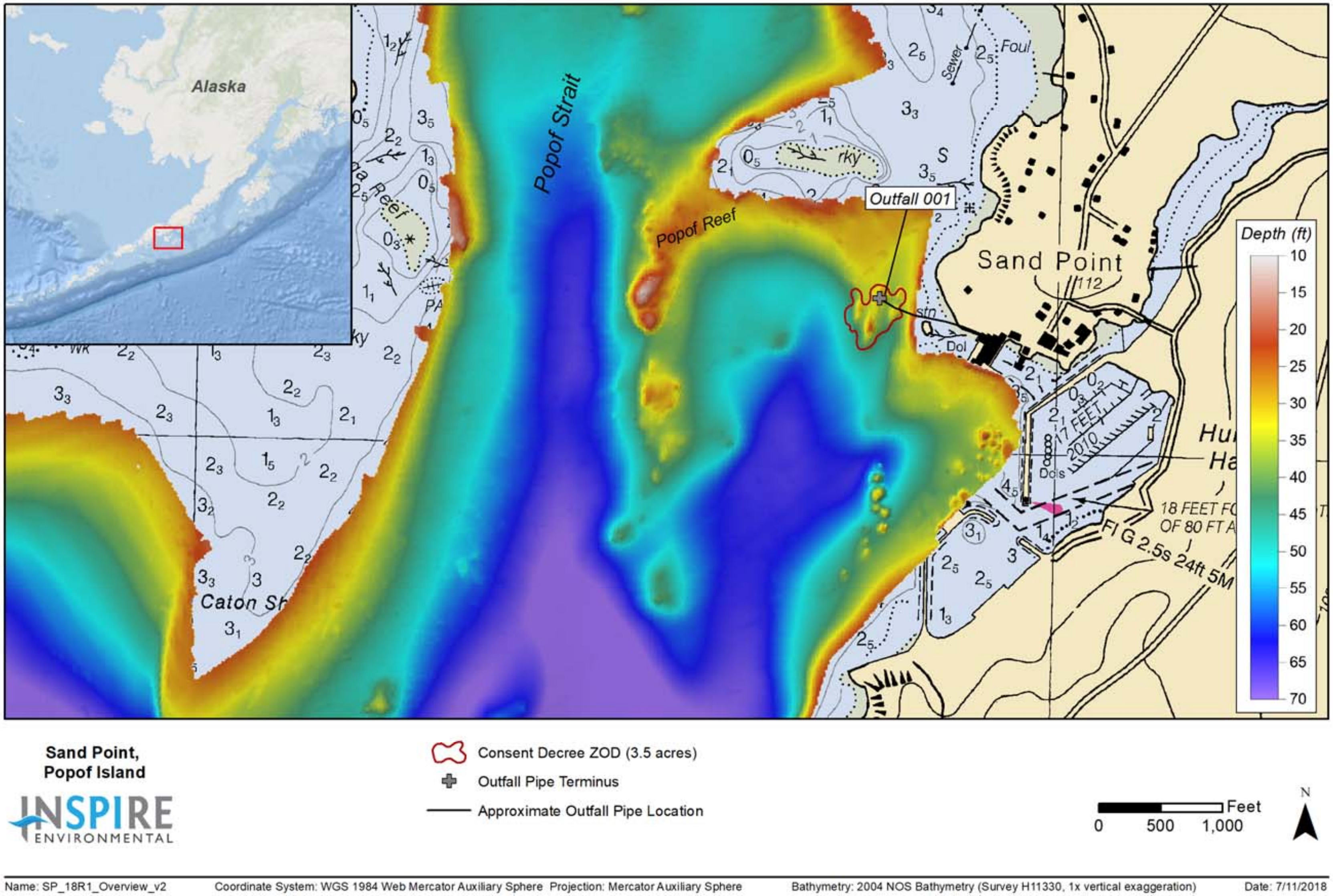


Figure 1. Trident Sand Point facility and surrounding area

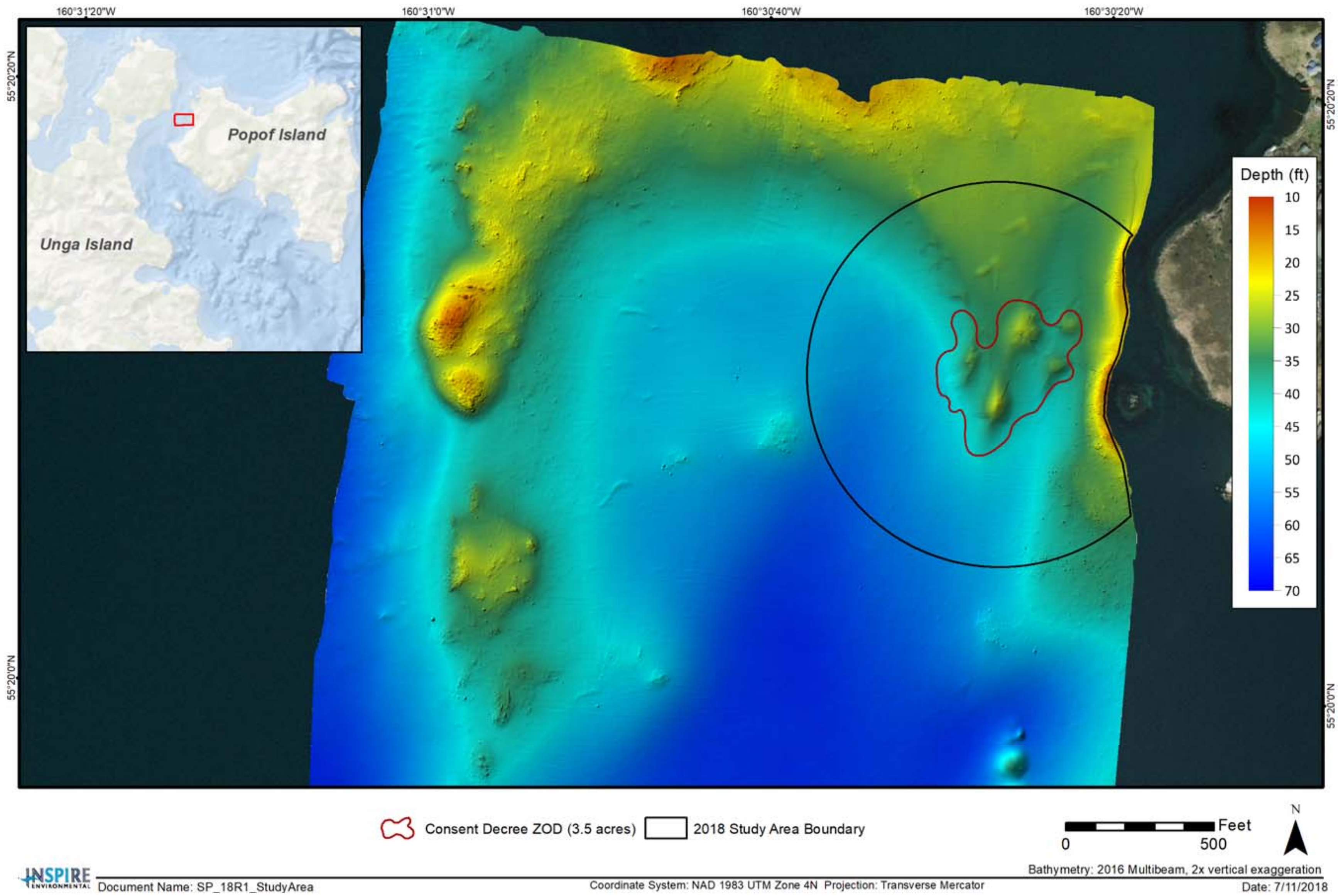


Figure 2. Sand Point Seafood Waste removal area

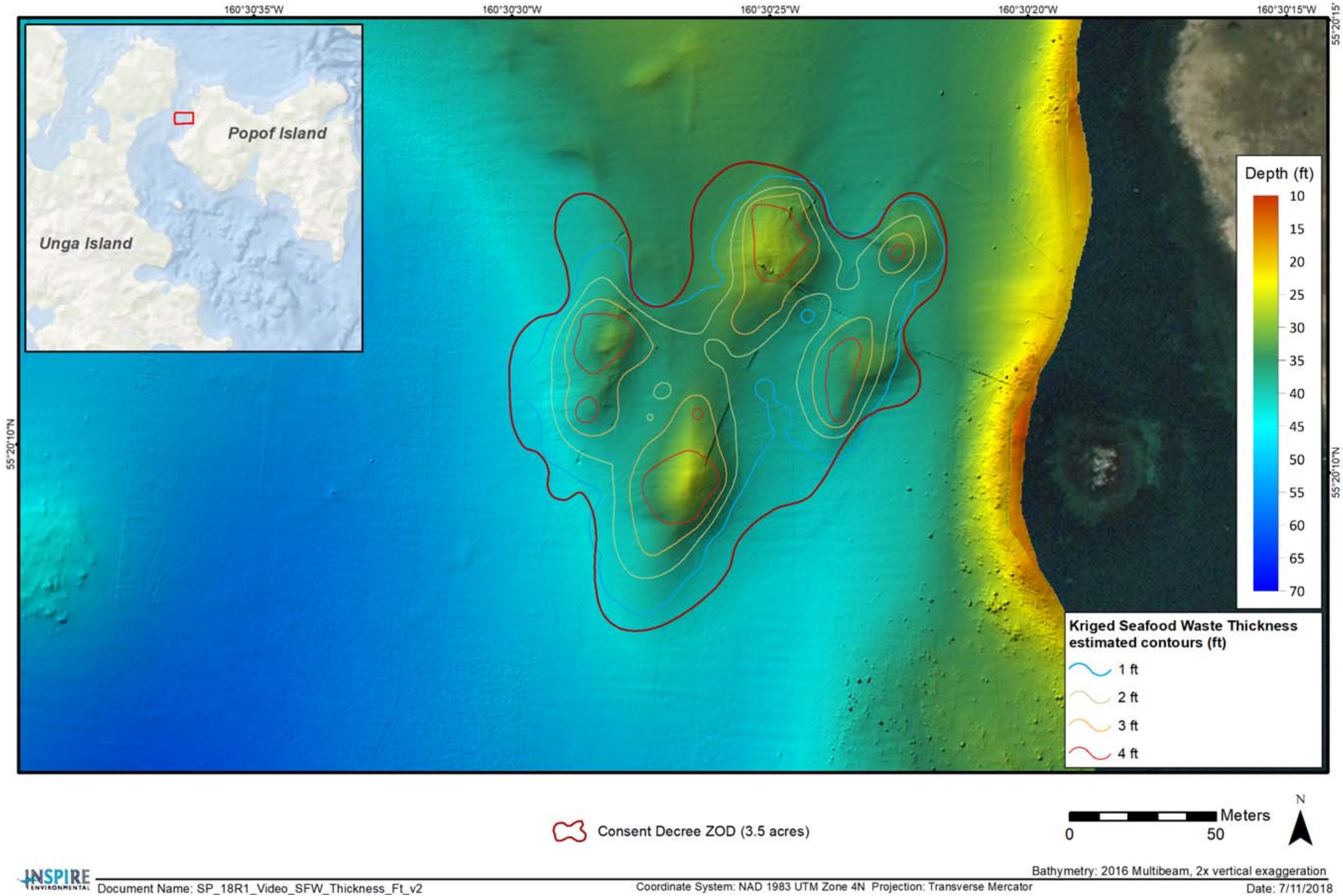


Figure 3. Sand Point Seafood Waste removal area with estimated thickness contours

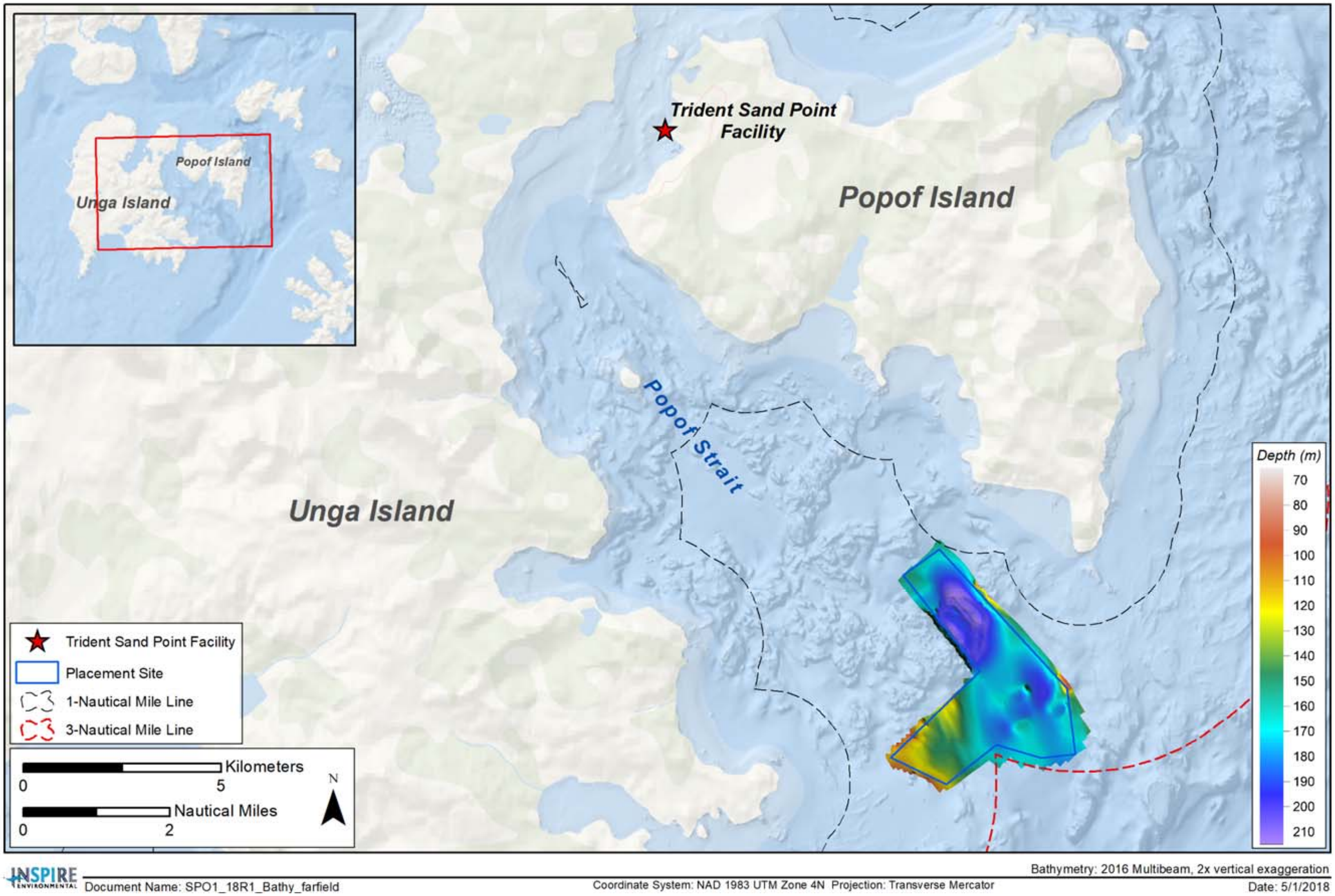


Figure 4. Popof Strait Placement Site

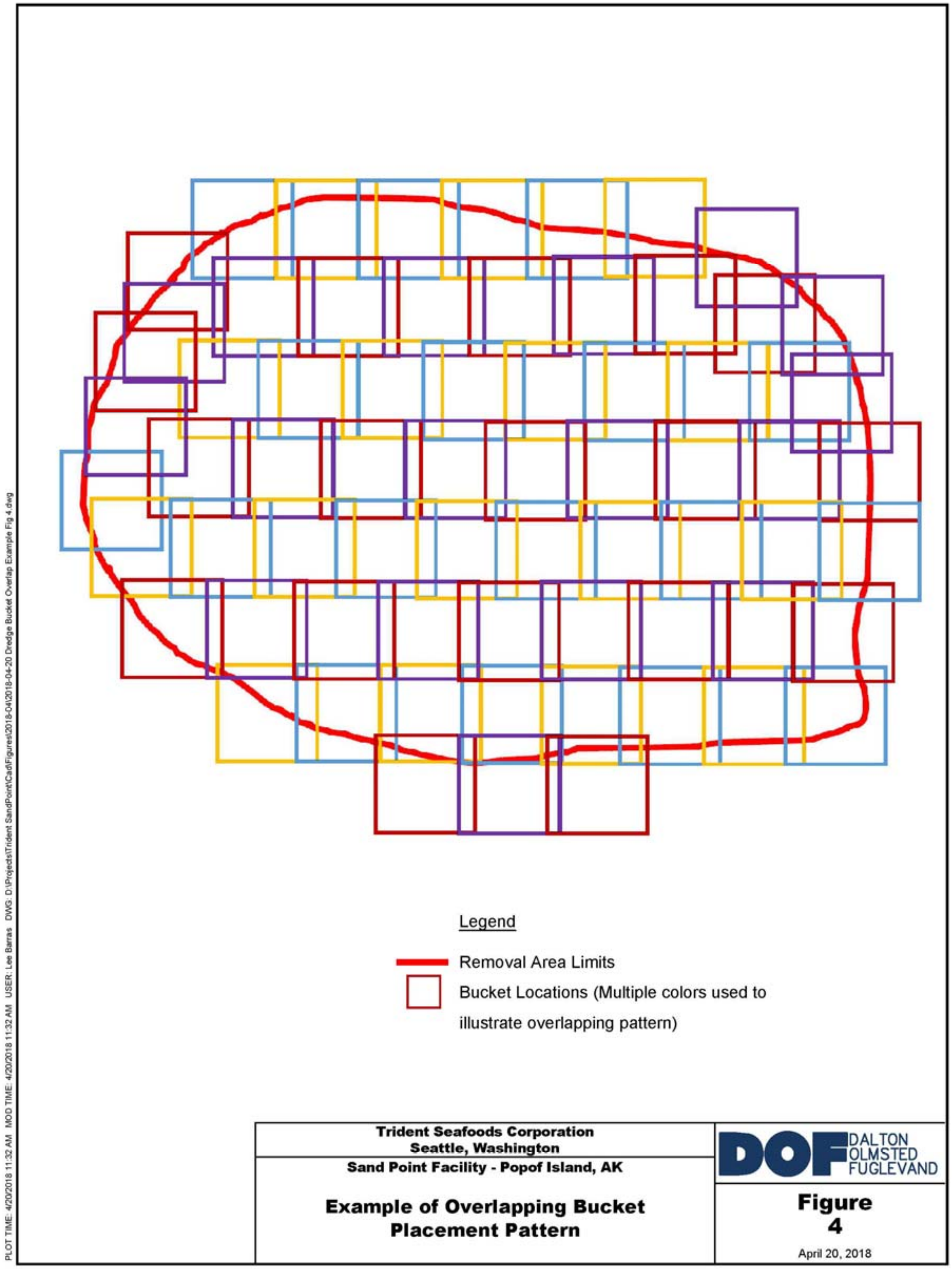


Figure 5. Example Overlapping Bucket Placement Pattern

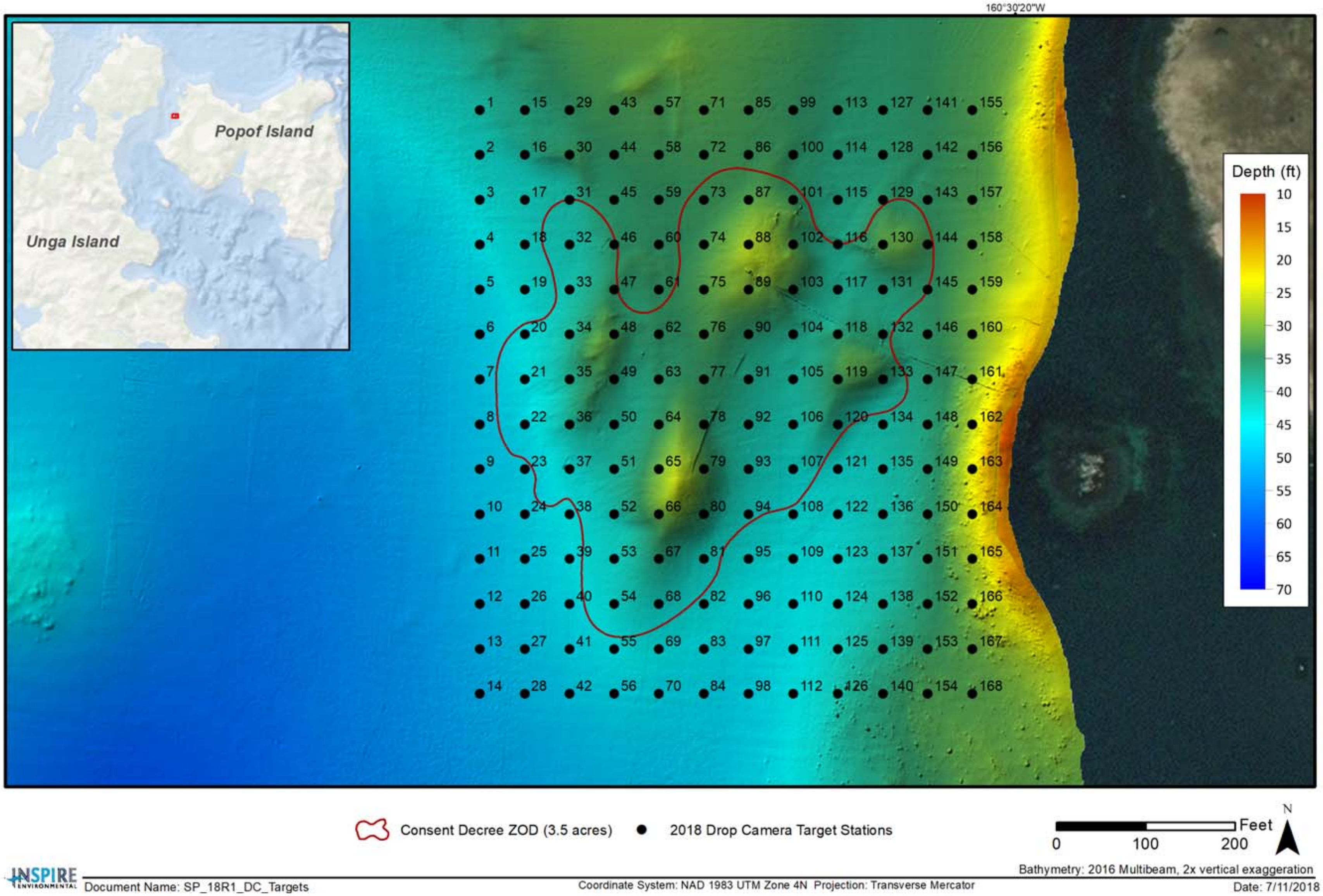


Figure 6. Seafloor visual survey sampling locations

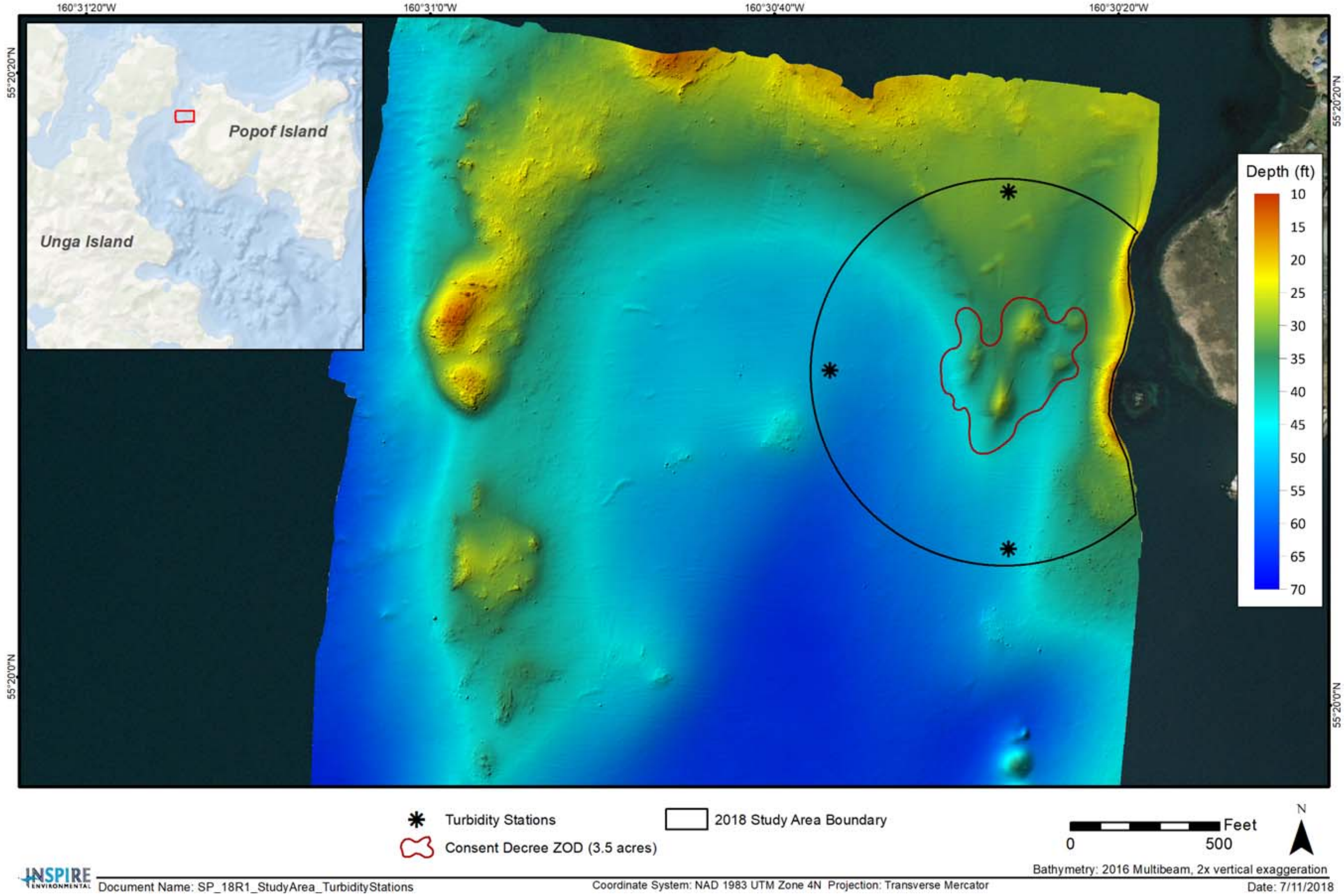


Figure 7. Sand Point removal area with turbidity monitoring stations indicated

ATTACHMENTS

Attachment A: Sand Point Remediation Monitoring Data Quality Objectives Table

Data Quality Objectives for the Sand Point Waste Remediation
Step 1: State the Problem Sand Point seafood waste deposit covers an area of over 3.5 acres, exceeding the area allowed under the 2018 Consent Decree and must be reduced to not greater than 1.0 acres to ensure Consent Decree compliance. This is not an ecological restoration project. It is a project focused on removal of aged and degraded fish bones. Extensive scientific investigations of the Sand Point seafood waste deposit area have been conducted over the past five years, including a benthic habitat assessment survey in 2014 (G&A 2015), a sediment coring survey in 2014 (G&A, 2015), a seafloor videoprobe survey in 2016, and an acoustic survey in 2016. The investigations found that Sand Point seafloor materials consist primarily of a mix of inert materials including aged and degraded fish bones (typically over 20 years old) and sand. Evidence of impairment was limited to observations of *Beggiatoa*, a bacteria indicative of anoxic conditions, in an area of less than 1.0 acre in size. Excess organic loading, often observed in active seafood waste deposit areas, was not observed in the Sand Point seafood waste deposit. Rather, an abundant seafloor habitat with an equilibrium condition benthic infaunal community characterized largely by bivalves and tube-building polychaetes was found. Additionally, diatoms were prevalent on the sediment surface and provided food for bottom feeders as well as benthic grazers including sea stars, flounders, sculpin, and other fish (G&A 2015). The Sand Point waste remediation problem is to remove aged and degraded fish bones from the outfall area in order to reduce the size of the continuous seafood waste deposit, known as the Zone of Deposit (ZOD), to not greater than 1.0 acres. The aged and degraded fish bones will be removed using construction equipment, transported via barge, and released at an at-sea disposal site located 8.2 nautical miles away.
Step 2: Identify the Goals of the Study The goals of the study are (1) to ensure that the removal construction activity is conducted such that the Sand Point seafood waste ZOD is reduced to not greater than 1.0 acre and (2) to conduct monitoring to ensure that the removal action does not cause excess turbidity in the vicinity of the removal activity.
Step 3: Identify Information Inputs A set of at least four visual seafloor surveys will be conducted to assess achievement of the goal to reduce the seafood waste ZOD to not greater than 1.0 acres in size. These surveys will be conducted at four prescribed times; prior to the beginning of removal activities (a baseline or 0% complete survey), at approximately 25% complete, at approximately 50% complete, and at 100% complete. Conducting seafloor visual surveys

Data Quality Objectives for the Sand Point Waste Remediation
throughout the removal activity will provide the information inputs necessary to inform construction modifications to improve the removal process and to confirm removal success. Each visual seafloor survey will consist of lowering a plan-view camera to near the seafloor and taking high-resolution photographs of the seafloor at a set of locations throughout the seafood waste deposit area. The baseline seafloor visual survey will extend across the footprint of the seafood waste pile and feature collection of seafloor image at approximately 168 stations on a grid with approximately 50-foot by 50-foot spacing (Work Plan Figure 5). For the 100% completion survey, both a sediment profile imaging (SPI) camera and a plan view imaging camera will be deployed at the same sampling locations to evaluate surficial seafood waste coverage (from plan-view images) and seafood waste thickness (from SPI images). The methods used to deploy the plan--view camera (for all four visual surveys) and the SPI camera (for the 100% completion survey) are provided in the Quality Assurance Project Plan for Seafood Waste Pile Benthic Impact Assessment for Akutan (G&A 2013a). The Akutan QAPP describes the methods used to conduct seafloor surveys in Alaska seafood waste deposit areas. These methods have been successfully applied to conduct seafood waste deposit benthic assessments and surficial seafood waste coverage assessments at several locations throughout Alaska in recent years, following QAPPs for Akutan, Cordova, and Ketchikan (G&A 2013a, G&A 2013b). At 100% completion, the Sand Point ZOD will be delineated using the plan view and sediment profile images following methods described in “Delineating Surficial Seafood Waste Zones of Deposits” (INSPIRE and DOF 2017, Attachment B). The ZOD delineation methods described in Attachment B are consistent with the requirements of the 2018 Consent Decree. The site-specific components of the Sand Point seafloor visual seafloor data collection and analysis are described Section 3.3 of the attached Work Plan. To achieve the second goal of conducting monitoring to ensure that the removal action does not cause excess turbidity in the vicinity of removal activities, in-situ turbidity monitoring will be conducted prior to, and throughout, the remediation project. In-situ turbidity measurements will be collected throughout the water column at three locations to the north, west, and south of the removal area. Turbidity resulting from removal activities is expected to consist of primarily of inert fine sand and small aged fish bone material, based on the Sand Point seafloor investigations conducted in 2014, 2015, and 2016. The Akutan QAPP (G&A 2013a) describes the methods that will be used to conduct in-situ turbidity monitoring. The site-specific components of the Sand Point turbidity monitoring program are described in Section 3.4 of the attached Work Plan.

Data Quality Objectives for the Sand Point Waste Remediation
Step 4: Define the Study Boundaries The study area boundary surrounds the seafood waste deposit area and covers an approximately 1050 feet by 1300 feet area. The study area boundary is provided in Figure 6 of the attached work plan. The expected temporal boundary or schedule for the Sand Point removal project is July through September 2018.
Step 5: Develop Analytical Approach Results of the baseline (0% complete) seafloor visual survey will be compared to the Consent Decree-required seafood waste removal area and, if needed, the removal area will be expanded to ensure that the entire seafood waste deposit area is included in the removal action. Results from the 25% complete seafloor visual survey will provide percent seafood waste coverage at each sampling location within the 25% removal area (approximately 42 sampling locations). These results will be evaluated by Trident personnel and will guide additional removal activities, as needed. If 100% seafood waste coverage is observed at any of the sampling stations, they may be revisited and additional removal activities may be conducted to ensure that the continuous seafood waste deposit is removed. The same analytical approach will be applied for conducting the 50% completion survey. Results from the 100% seafloor visual seafloor survey will provide both percent seafood waste coverage and seafood waste thickness measurements using the plan-view and SPI cameras at each sampling location in the seafood waste removal area (approximately 168 sampling locations, as shown in Figure 5). These results will be evaluated by Trident personnel prior to allowing the construction contractor to demobilize and depart the project site. Trident will assess the percent seafood waste coverage at each station and the size of the seafood waste deposit ZOD at 100% completion. If the ZOD size does not exceed 1.0 acres, then Trident may decide to end the removal activity.

Data Quality Objectives for the Sand Point Waste Remediation
Step 6: Specify Performance Criteria Sampling error for this study will be reduced by collecting a sufficient number of samples (3 samples at each of up to 168 sampling locations) to ensure adequate characterization of the study area and surrounding areas. For example, the plan-view camera will be lowered to the seafloor and images will be collected three times at each sampling location. Measurement error will be minimized by use of accepted field collection and laboratory quality assurance protocols and the use of trained personnel to perform sample collection and analyses. A detailed description of performance criteria for seafloor visual surveys and turbidity monitoring activities is provided in the Akutan QAPP (G&A 2013a).
Step 7: Develop Plan for Obtaining the Data The plan for collecting seafloor visual survey data is described in Section 3.3 of the attached Work Plan. The plan includes collecting seafloor visual survey data throughout a grid of approximately 168 sampling stations on an approximately 50-foot by 50-foot grid, as shown in Figure 5. Data collection will follow the methods described in the Akutan QAPP (G&A 2013a) and the ZOD delineation memo (Attachment B). The plan for collecting turbidity measurements is provided in Section 3.4 of the attached Work Plan and the sampling locations are shown in Figure 6. Data collection will follow the methods described in the in the Akutan QAPP (G&A 2013a).

Attachment B: Technical Memorandum: Delineating Surficial Seafood Waste Zones of Deposit Using Plan-View and Sediment-Profile Imaging (INSPIRE 2017)

Delineating Surficial Seafood Waste Zones of Deposit Using Plan-View and Sediment-Profile Imaging

This memorandum describes a recently developed method for analyzing seafood waste presence and delineating Zone of Deposit (ZOD) areas using plan-view (PV) and sediment-profile imaging (SPI) benthic assessment techniques. Seafood waste ZOD areas are visual estimates of the extent of seafood waste residuals on the seafloor near seafood processing outfalls. Seafood waste ZODs delineate the size of seafood waste deposits on the seafloor and have been the regulatory standard for evaluating seafood waste deposits in Alaska for decades; historically, seafood waste ZODs have been based on the results of dive surveys.

A new SPI-based ZOD method has been developed in response to requirements associated with a 2012 Consent Decree agreement between the U.S. EPA and Trident Seafoods Corporation (US DOJ 2012). The CD required that benthic assessment surveys be conducted and that Zones of Impact (ZOI) and ZODs be delineated in Ketchikan and Cordova outfall areas based on these surveys. The ZOI provides a delineation of the seafloor benthic habitat area that has been adversely affected by seafood waste. The ZOD provides delineation of the extent of surficial seafood waste presence, but does not provide an assessment of adverse effects to benthic habitats.

The CD specified that a method for delineating ZOIs be developed and approved by EPA. As a result, the Index of Fish Waste Impact (IFWI) method was developed and approved by EPA for use in the context of the 2012 CD (G&A 2012). The CD did not specify a method for delineating a ZOD using benthic assessment survey data. Developing a SPI-based method for delineating a ZOD proved a challenging task. As described below, the different types of seafood waste found on the seafloor and different existing methods for delineating ZODs provided a myriad of potentially suitable approaches. The SPI-based ZOD method described herein provides a ZOD that includes different types of seafood waste and provides maps of surficial and buried seafood waste.

This technical memorandum provides brief descriptions of the following:

- Types of seafood waste observed on the seafloor
- Existing dive survey methods for delineating ZODs
- Benthic assessment SPI and PV images
- Categorizing and presenting observations of seafood waste presence
- Calculating and delineating the surficial SPI ZOD
- Example application of the SPI ZOD method: Akutan Harbor 2016

These brief descriptions provide essential background and contextual information used to support development of the SPI ZOD method.

Types of Seafood Waste Observed on the Seafloor

Scientific investigations conducted from 2010 through 2016 in Akutan, Ketchikan, and Cordova have consistently resulted in observations of two different types of seafood waste present on the seafloor near seafood processing facility outfalls, as follows:

Aged, Coarse Fish Bones and Crab consists primarily of coarse fish bones and fin rays, varying in size with typical sizes up to 5 cm. Crab waste is less commonly observed and consists of coarse pieces of crab exoskeleton and carapace. Aged, coarse fish bones and crab waste are observed on and beneath the seafloor surface, forming a thick bone matrix at some locations, and as individual, scattered bone fragments in other locations. Aged, coarse fish bones and crab are typically relatively inert and are expected to persist on the seafloor for extended periods of time.

Fine Organic Seafood Waste consists of relatively small particles of seafood waste with high organic content. Fine seafood waste particles are typically distinguished from native sediment by distinct texture and optical reflectance, visible in SPI images with a low reflectance as mottled gray. Fine organic seafood waste is observed in layers on and beneath the sediment surface and have typically been deposited on the seafloor in recent years. Recent deposits of fine seafood processing wastes can appear as a surface layer with high water content (i.e., appears fluffy) that sits atop the native sediment column. If present in limited quantities, benthic infauna can utilize these fine organic seafood waste deposits as food and can, over time, process seafood waste deposits fully into the native sediment matrix. If present in high quantities, fine organic seafood waste can overload the benthic system with organic input, resulting in impaired conditions in which benthic communities are not able to thrive.

These two types of seafood waste have been observed separately and comingled in seafloor study areas and have different characteristics and effects on the benthic community. Aged, coarse material is generally inert, relatively old, and likely to persist for extended periods of time. Fine organic material is smaller, deposited recently, and, in limited quantities, can be biologically processed and incorporated into native sediments over time.

Existing Dive Survey Methods for Delineating ZODs

Dive surveys have been conducted to delineate the size of ZODs for several decades beginning when seafood waste primarily consisted of coarse material. The ZOD has historically been delineated through diver observations of seafood waste presence on the surface of the seafloor at a set of fixed locations. In brief, a diver swims to a set of prescribed seafloor locations, looks at the seafloor, and makes a visual determination of whether seafood waste is present on the seafloor surface at that location. The diver also visually estimates the percentage of a seafloor area that is covered by seafood waste and, in some cases, estimates the thickness of the seafood waste by probing the seafloor with a rod. Following the dive survey, visual observations at each fixed location are combined to delineate the ZOD.

Dive survey ZOD delineation methods vary from location to location. Specifically, percent surficial coverage of seafood waste and seafood waste thickness thresholds differ. The dive survey ZOD method for Trident's Ketchikan and Cordova outfall areas is relatively stringent and was established through the CD and associated work plans (e.g., Coho & Enviro-Tech 2016). This dive survey ZOD threshold specifies that locations with greater than 2% (trace) of the surface area covered with seafood waste and seafood waste thickness of at least ½ inch (1.3 cm) should be included in the ZOD.

Dive surveys do not accurately measure seafood waste thickness or the presence of buried seafood waste. A push-probe is used to get a rough estimate of whether seafood waste persists below the surface of the seafloor, but is not a reliable method of measurement. As a result, dive survey ZOD methods delineate surficial ZODs and provide supplemental rough estimates of buried seafood waste.

The dive survey ZOD method detects and delineates surficial coarse seafood waste, but cannot reliably detect fine organic seafood waste. The optical qualities of fine organic seafood waste (fine gray, brown and black materials) are typically too similar to the surrounding seafloor to be seen in plan-view by divers. As a result, dive survey ZODs typically result in coarse seafood waste ZODs. In summary, dive survey ZODs typically include surficial, coarse seafood waste, but typically exclude most or all fine organic seafood waste.

Benthic Assessment SPI and PV Images

Benthic assessment investigations result in characterization of the sediment type and benthic habitat condition of seafloor sediments and mapping of the presence of seafood waste accumulation in the study area. SPI/PV camera operation (Figure 1) involves deploying an underwater camera system to capture photographic images of the seafloor surface (PV) and cross-sectional images (SPI) at each sampling location. PV images typically provide a 1 square meter aerial view of the seafloor and SPI images typically show a 15 to 20 cm deep cross-section of the seafloor. The photographic images acquired by these techniques may be stored and analyzed to support seafloor characterization. At each sampling location, three sets of PV and SPI images (replicates) are collected and analyzed to ensure that representative sampling is conducted.

The SPI camera obtains high-resolution images that allow particles as small as 0.063 mm diameter to be observed. SPI and PV images are capable of identifying coarse seafood waste on and beneath the seafloor. PV images are aerial images similar to a diver's view and are similarly not capable of reliably identifying fine organic seafood waste due to optimal similarity to surrounding sediments. Fine organic seafood waste is, however, readily identifiable in SPI images on and beneath the seafloor surface in high resolution cross-sectional images. As a result, a combination of PV and SPI image analysis is conducted to identify and categorize the presence of aged coarse seafood waste and fine organic seafood waste on and beneath the seafloor surface. PV and SPI images are used to extend the ZOD determination to include fine seafood waste deposits and to identify layers of seafood waste, both aged coarse and fine organic, found up to maximum penetration depth (21 cm).

Categorizing and Presenting Observations of Seafood Waste Presence

Using the SPI camera, coarse and fine organic seafood waste may be observed on the seafloor surface and buried below the seafloor surface. The following categories of seafood waste observations may be observed:

1. ***Coarse seafood waste in a surficial layer*** *(PV and SPI)*
2. ***Fine organic seafood waste in a surficial layer*** *(SPI)*
3. ***Coarse seafood waste in a buried layer*** *(SPI)*
4. ***Fine organic seafood waste in a buried layer*** *(SPI)*
5. ***Coarse seafood waste – scattered on surface or buried*** *(PV and SPI)*

For surficial coarse seafood waste (category 1), the dive survey criteria of at least 2% seafood waste coverage and at least 1.3 cm thickness is applied as part of the SPI ZOD method. Buried coarse seafood waste layers (category 3) were detected through SPI analysis (i.e., viewing the sediment cross-section). Scattered coarse seafood waste (category 5) represents surficial coarse seafood waste that does not meet the 2% coverage (PV) as well as buried scattered seafood waste (SPI).

SPI analysis is used to detect fine organic seafood waste because fine organic seafood waste cannot be reliably detected in PV (as discussed above). Surficial fine organic seafood waste (category 2) represents layers of fine seafood waste that are in contact with the sediment-water interface. Buried fine organic seafood waste layers (category 4) represent fine seafood waste layers beneath the surface. Fine organic seafood waste was observed exclusively in layers. As a result, a scattered fine organic seafood waste category was not created. If scattered fine organic seafood waste is observed in the future, this category may be added.

To support categorization, the three replicate sets of PV and SPI images are analyzed. These three sets represent three camera “drops” on the seafloor within each sampling location. As a result, three sets of images (or samples) are collected at each location. To be conservative, observation of any of the five seafood waste categories in any of the three replicate image sets qualifies that sampling location as having observable seafood waste present. As a result, several categories of seafood waste may be observed at a single sampling location.

The SPI survey technique captures an extensive set of SPI and PV images. The SPI ZOD method features analysis and interpretation of the SPI data to delineate available seafood waste data into each of the 5 categories identified. Upon completion of analysis, the 5 seafood waste categories are compiled into data tables and presented in seafood waste presence maps prior to delineation of the SPI ZOD. In contrast, the dive survey ZOD delineation methods detect only seafood waste category 1 (and the scattered surficial component of category 5) of the seafood waste observation categories captured by the SPI ZOD method. As a result, the SPI ZOD method provides a more extensive characterization of seafood waste presence.

Calculating and Delineating the Surficial SPI ZOD

The SPI ZOD provides delineation of the seafloor surface where coarse and fine seafood waste is present. Like the dive survey ZOD, the SPI ZOD is a surficial ZOD meaning that it does not include buried seafood waste. The SPI ZOD method represents an improvement relative to the dive survey ZOD method because it ensures that surficial coarse and fine organic seafood waste are included in the ZOD. In addition, the SPI ZOD method provides mapping of the presence of buried coarse and fine organic seafood waste resulting in an enhanced characterization of seafood waste deposits.

Once the seafood waste categorization analysis is complete, a summary table is compiled that contains sampling stations and associated seafood waste categories (1 through 5). Next, seafood waste categories that meet the criteria for inclusion in the SPI ZOD (1 and 2) are identified and used to support delineation of the ZOD. Buried and scattered seafood waste categories (3, 4, and 5) are also identified and use to map buried and scattered seafood waste.

To delineate the ZOD, station-based data are interpolated using indicator kriging. Indicator kriging is also the interpolation method used as part of the Index of Fish Waste Impact to delineate the ZOI at Akutan Harbor (G&A 2012). Indicator kriging uses a similar model to ordinary kriging with the exception that it uses binary rather than continuous data. The kriged value is an estimate of the probability of meeting the ZOD criteria. The ZOD boundary represents a line where there is a 50% probability that the stations are within the visual deposit area.

Example Application of the SPI ZOD method: Akutan Harbor 2016

A benthic assessment survey was conducted in Akutan Harbor in June 2016 that included sampling at the locations shown in Figure 2. A full set of sampling locations, data analysis tables, and results are provided in the 2016 benthic assessment report (INSPIRE 2017 – Appendix C). Three replicate sets of SPI and PV images collected at each sampling location were analyzed following the methods described above. Five seafood waste categories, as listed below, were observed in the SPI and PV images and were tabulated.

1. *Coarse seafood waste in a surficial layer*
2. *Fine organic seafood waste in a surficial layer*
3. *Coarse seafood waste in a buried layer*
4. *Fine organic seafood waste in a buried layer*
5. *Coarse seafood waste – scattered on surface or buried*

Seafood waste observation categories were then mapped at each sampling location (Figure 3). The five boxes shown at each station in Figure 3 represent the five seafood waste categories in a color-coded, matrix format. The surficial categories are represented in the top two boxes, above the buried and scattered categories. The new SPI ZOD analysis method resulted in categorization and mapping of each seafood waste observation obtained during the benthic assessment survey (Figure 3). Once categorization and mapping of seafood waste observations was complete, the surficial seafood waste ZOD was delineated using indicator kriging. The surficial ZOD included sampling locations with surficial coarse and fine organic seafood waste (Figure 4) and covered an area of 8.5 acres. The coarse seafood waste ZOD was also delineated and covered an area of 2.3 acres situated entirely within the total ZOD (Figure 4).

The new SPI ZOD method resulted in mapping of each seafood waste observation obtained during the benthic assessment survey and delineation of a surficial ZOD that includes coarse and fine organic seafood waste.

References

Coho Environmental and EnviroTech Diving 2016. Seafloor Monitoring Plan: Cordova North Plant, Cordova, AK, APDES #AKG520493. Prepared for: Trident Seafoods, Seattle, WA. Prepared by: Coho Environmental LLC, Seattle, WA and Enviro-Tech Diving Inc., Stanwood, WA. For submittal to: US Environmental Protection Agency, Region 10 and Alaska Department of Environmental Conservation, Anchorage, AK. July 22, 2016

Germano & Associates, Inc. 2012. Summary of Analyses to Develop an Index of Fish Waste Impact to Determine a Zone of Impact in Akutan Harbor. June 8, 2012.

INSPIRE Environmental. 2017. Akutan Harbor Seafloor Monitoring and Remediation, 2014 – 2016. Synthesis Report. Appendix C: Akutan Harbor 2016 Benthic Assessment Survey Report. Prepared for Trident Seafoods Corporation, Seattle, WA. Prepared by INSPIRE Environmental, Newport, RI. January 2017

U.S. Department of Justice. 2012. United States District Court: Western District of Washington. U.S.A., Plaintiff v. Trident Seafoods Corporation, Defendant. No. Civ. No. 11-1616 Amended Consent Decree. June 18, 2012. Frederick Phillips, Environmental Enforcement Section, Environmental & Natural Resources Division, U.S. Dept. of Justice, Washington, D.C.

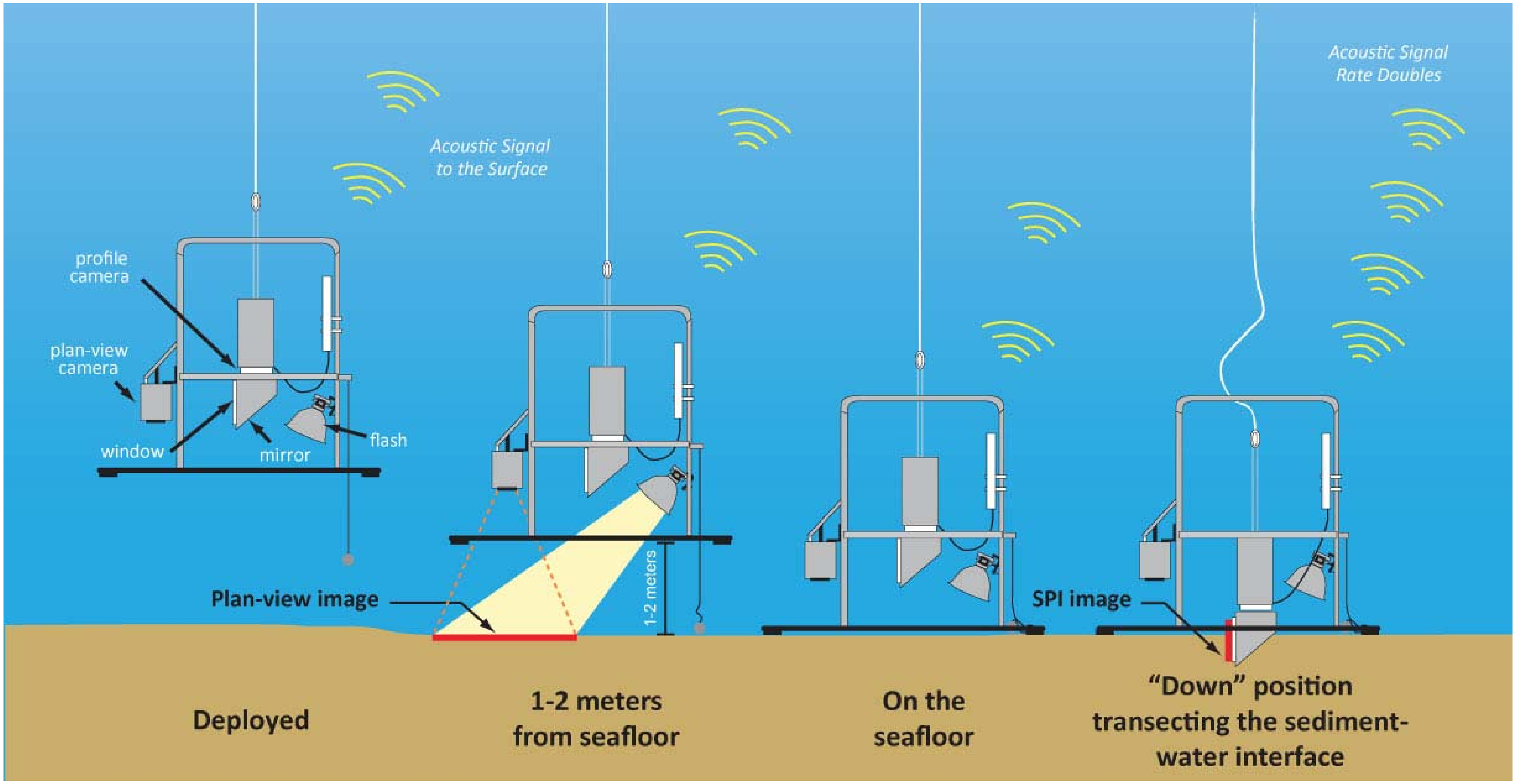


Figure 1. Schematic diagram of the SPI/PV camera deployment

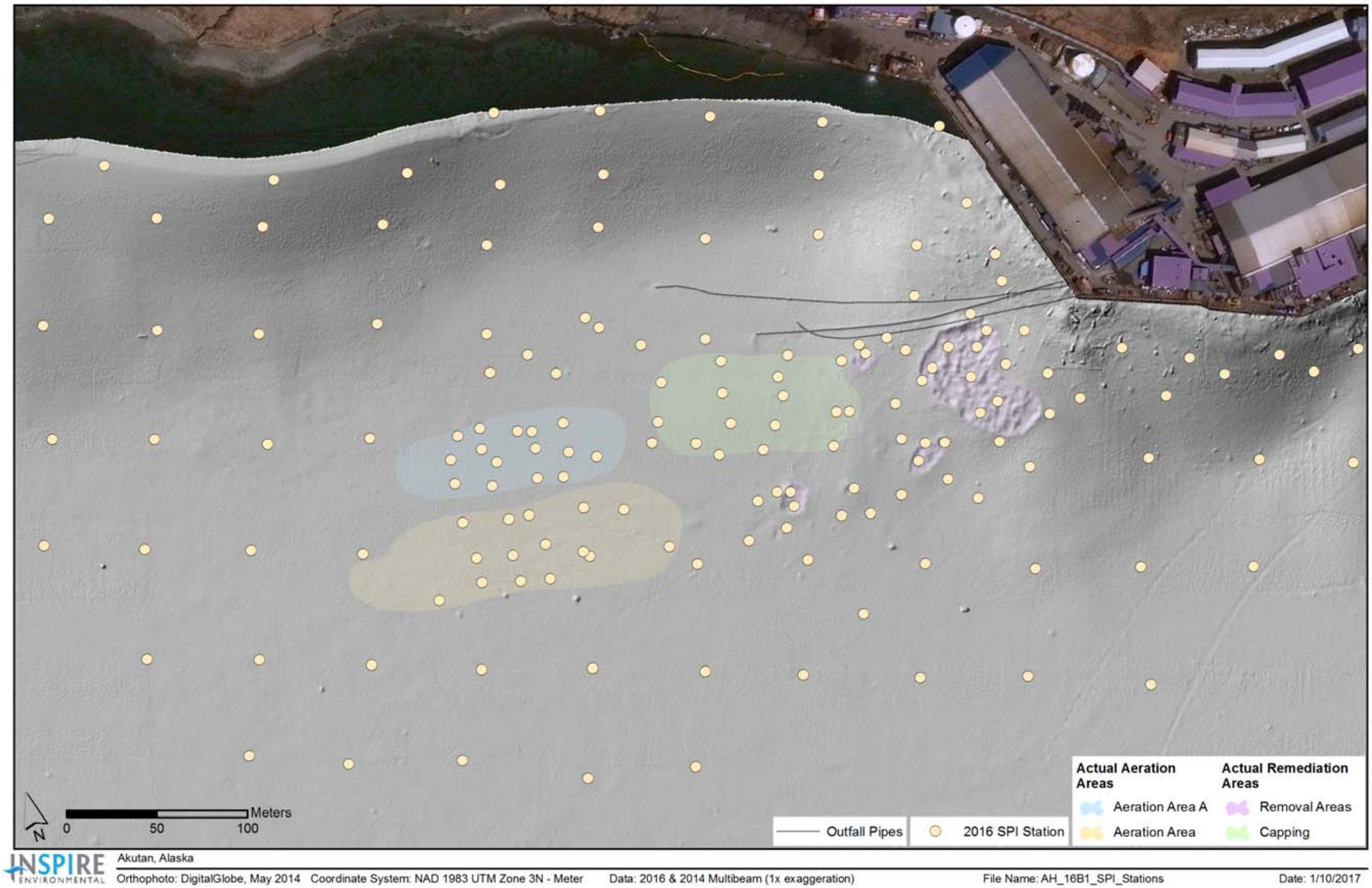


Figure 2. Akutan Harbor 2016 Near-field benthic assessment sampling locations

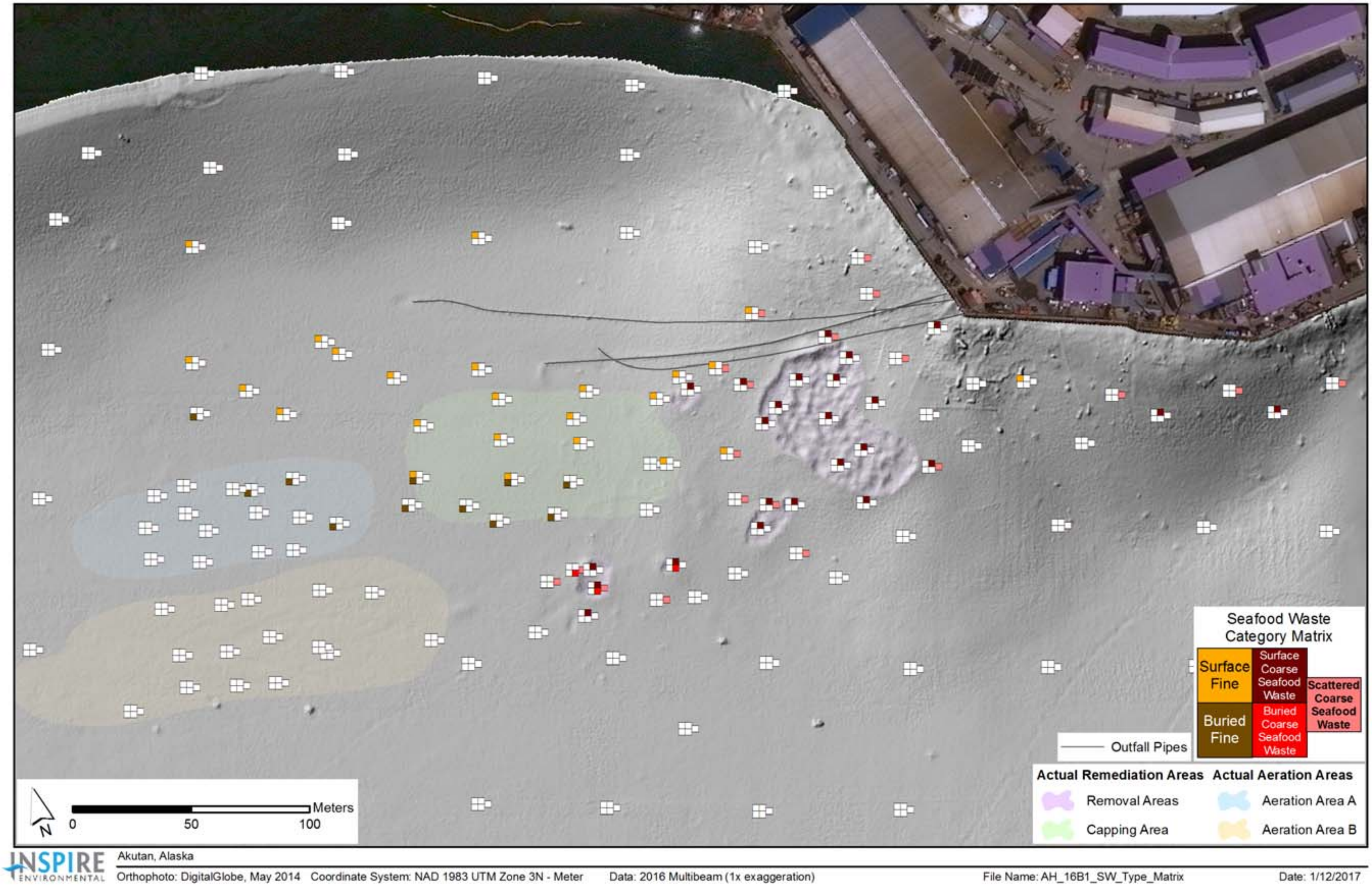


Figure 3. Akutan Harbor 2016 seafood waste presence by category

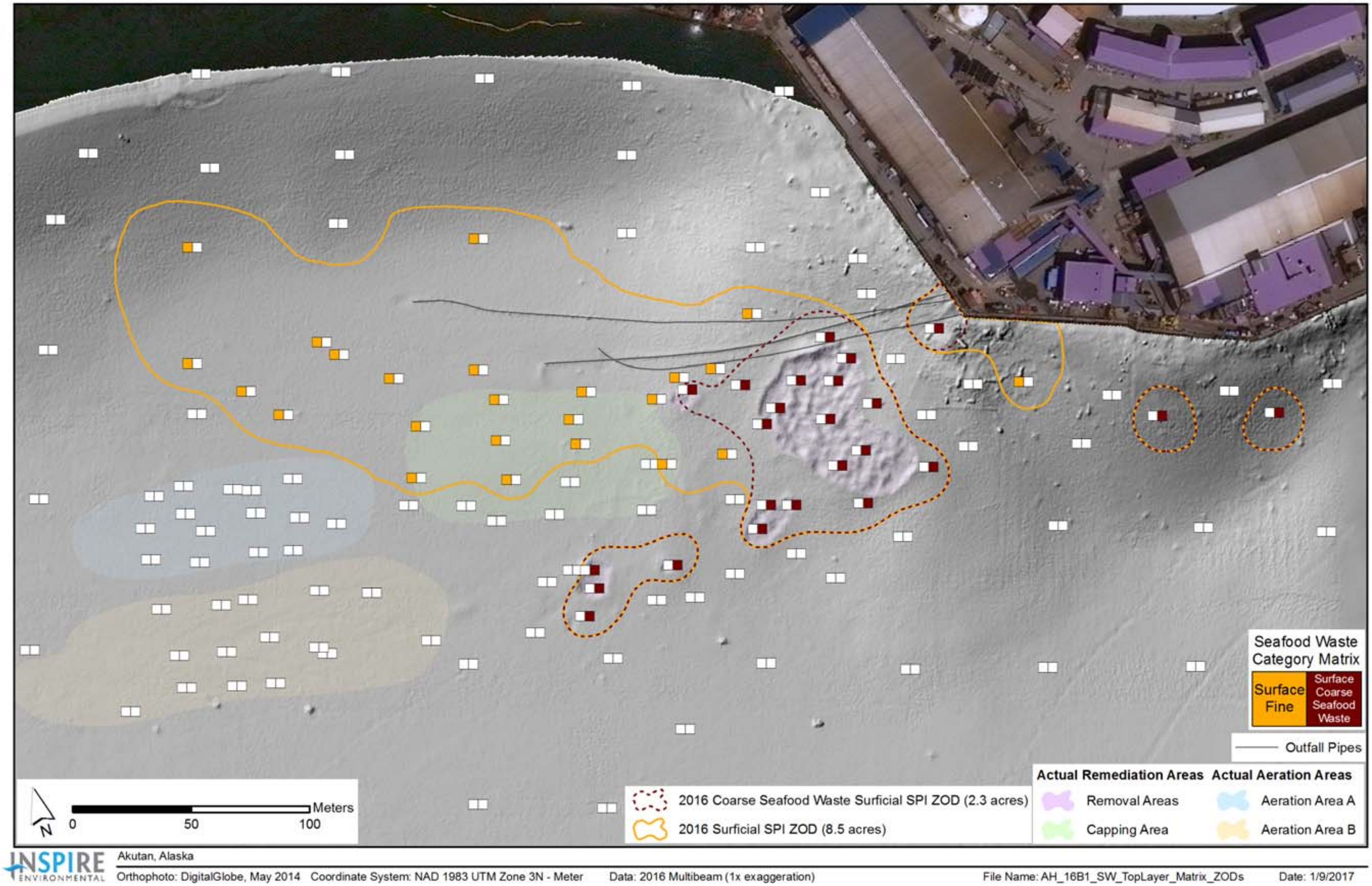
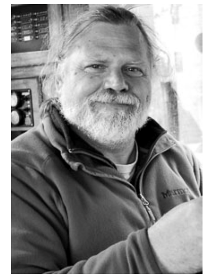


Figure 4. Akutan Harbor 2016 coarse and total surficial ZOD with surficial seafood waste categories

Attachment C: Resumes of Sand Point Seafloor Visual Seafloor Image Analysts

88 Silva Lane, Suite 4 | Middletown, RI 02842 | (401) 849-9236
dave@INSPIREenvironmental.com



DAVID G. BROWNING | Senior Scientist

Education

B.A, Earth & Environmental Science, Wesleyan University, 1985

Graduate Study, Marine Geology & Geophysics, University of Rhode Island, 1987-1988

Areas of Specialization

Sediment-Profile Imaging

Marine Environmental Sampling

Marine Geology & Geophysics

Side Scan Sonar & Hydrographic Survey Techniques

Employment History

2015-present – Senior Scientist, INSPIRE Environmental, LLC, Olympia, WA

2001 - 2015 – Senior Scientist, Germano & Associates, Inc., Olympia, WA

2000 - 2013: Browning Environmental, Olympia, WA

1995 - 2000: Scientist, Striplin Environmental Associates, Olympia, WA

1988 - 1995: Scientist, Science Applications International Corporation, Bothell, WA

1985 - 1988: Research Assistant, Graduate School of Oceanography, University of Rhode Island, Kingston, RI

EXPERIENCE SUMMARY

Mr. Browning has more than 20 years of experience in the collection, analysis and interpretation of marine environmental and geophysical data supporting monitoring and engineering studies. He is an expert in the use of sediment-profile imaging (SPI) for mapping dredged material deposits, physical benthic habitats and physical processes/disturbances. He has led, managed or supported dozens of SPI surveys throughout the West Coast, Alaska, and Asia and has analyzed and interpreted thousands of SPI images from diverse benthic environments as well as presented several papers on the use of SPI for assessing benthic habitats and physical processes affecting the marine seafloor.

Mr. Browning has also served as principal investigator on numerous projects investigating sediment quality, water quality and habitat quality issues in support of dredging, capping and environmental clean-up projects. He is well versed in the methods of sediment acquisition ranging from hollow-stem augering to boxcoring along with the sediment analyses and interpretive criteria required for different regulatory programs throughout the country. He is highly experienced in biological collection ranging from benthic infauna to crabs and finfish.

PROFESSIONAL EXPERIENCE

Sediment Profile Imaging Surveys in Support of Multi-Client Environmental Baseline Studies for ERM-Mexico. Mr. Browining, Senior Field Lead, led two sequential Sediment Profile Imaging surveys in support of multi-client Environmental Baseline Surveys for ERM confidential clients; shallow-water Mexican Gulf of Mexico, 2018.

Sediment Profile Imaging surveys in support of Offshore Wind Development Site Investigations for Deepwater Wind's South Fork Development. In 2017 Mr. Browning was Senior Scientist on this Sediment Profile Imaging study for Fugro offshore NY, RI, and MA, 2017.

Seabed Mapping and Sediment Profile Imaging surveys for NYSERDA. Mr. Browning was Principal Scientist in support of locating additional areas for future offshore wind development in New York State; offshore NY, 2017.

Environmental Baseline and Monitoring Surveys, Jubilee Field, Ghana. In 2011 and 2015, conducted SPI and plan-view imaging surveys of the Jubilee oil field as part of a baseline environmental assessment and subsequent follow-on monitoring related to development and production of the field. The oil field is located in 1400 m of water 60 miles off the coast of Ghana. SPI and PV images were evaluated for the presence of drilling and production related materials as well as benthic community dynamics. The surveys were adjusted in real time to account for the features observed during the SPI/PV portion of the survey to best characterize the region.

Deepwater Horizon Deepwater Benthic Assessments, Gulf of Mexico. From 2011 to 2014, was either field lead or co-PI on three SPI and plan-view imaging surveys of the Deepwater Horizon well area. The area surveyed covered over 100 square km at water depths ranging from 900 to 1600 m. Mr. Browning was responsible for the image analysis of the 2011 images as well as conducting real-time data review of SPI and PV images in the field.

EIA and Benthic Survey, Natural Gas Production, Gulf of Thailand. In 2013, conducted a SPI and PV survey of benthic conditions at and around a serious of natural gas wells in the Gulf of Thailand for Tetra Tech Inc. and Chevron. SPI/PV data were used to assess benthic infaunal processes in an area of methyl mercury bearing sediments.

City of Portland, OR Downtown Portland Sediment Characterization. For separate studies in 2008 and 2009, Mr. Browning was a subcontractor to Groundwater Solutions Inc., charged with the collection and processing of surface sediment samples and vibracores from the downtown reach of the Willamette River. Mr. Browning was responsible for the geologic logging and core processing of over 100 cores during both surveys.

Lower Willamette Remedial Investigation, Portland, Oregon. From 2004-2008, Mr. Browning was a subcontractor to Integral Consulting responsible for the collection of over 400 vibracores from the Lower Willamette River. Mr. Browning oversaw collections and contributed to the processing and logging of collected cores.

Port of Olympia Post-Dredging/Interim Cap SPI Survey, Olympia, WA. In March 2009, Mr. Browning assisted in the collection of SPI images from a recently dredged area that had an interim cap placed over exposed sediment that had elevated chemical constituents. Mr. Browning was responsible for the analysis of the SPI images to determine cap thickness, mixing between underlying sediments and cap sediments as well as deposition subsequent to cap placement.

Lago Maggiore/Fiume Toce SPI and Plan-View Surveys, Toce/Pallanza, Italy, 2008-2009. Collection and analysis of over 300 SPI and plan-view sampling stations within Pallanza Bay of the alpine lake Lago Maggiore, the montane river Fiume Toce, and the montane lake Lago Mergozzo. Analysis with special detail paid to depositional and fluvial processes throughout the distinct environments.

San Francisco Deep Water Disposal Site Monitoring, 1992 – 2007. Mr. Browning has extensive experience at SF-DODS, starting with the site designation studies in 1992 while he was at SAIC and continuing as a subcontractor to Tetra Tech and ENSR/AECOM in subsequent years. His duties included box coring, sediment sample processing for chemistry and benthic analyses, and watch leader in charge of SPI sampling at SF DODS during 7 different cruises.

Augusta Bay SPI Survey, Augusta, Sicily, Italy. During 2008, Mr. Browning assisted in the collection of sediment profile images from Augusta Bay, Sicily in support of a RI/FS. Mr. Browning analyzed all SPI images collected during this study. Images were analyzed for standard and supplemental SPI parameters with special detail paid to depositional processes and post-depositional mixing due to anthropogenic factors (vessel induced resuspension).

Woodard Bay Videoprobe Survey, Woodard Bay, Olympia, WA. As a subcontractor to SAIC in 2008, Mr. Browning conducted a videoprobe survey of a former log storage area in Woodard Bay. The videoprobe collected in-situ profiles of the top 6 feet of the sediment column. Mr. Browning was responsible for the analysis of the video probe data to determine the presence and depth of buried logs and changes in sediment lithology.

Saginaw River RI/FS, Saginaw, MI. In 2007 to present, Mr. Browning collected and analyzed sediment profile images from 14 miles of combined river of the Saginaw, Shiawassee and Tittabawassee Rivers in support of a RCRA investigation. Over 800 stations were sampled and 1400 SPI images collected.

Confined Aquatic Disposal Monitoring, Sinclair Inlet, Puget Sound. During the summer of 2002, Mr. Browning performed a sediment profile imaging survey of the confined aquatic disposal borrow pit adjacent to the Puget Sound Naval Shipyard in Bremerton, WA. The survey was performed for the US EPA to investigate the cause of elevated contaminant concentrations found in sediment samples from the nearby seafloor taken after capping operations were completed. The SPI survey showed that the dredged material apron extended over 200 meters beyond the designated CAD pit boundary.

Post-Drilling EIA Monitoring, Caspian Sea. In September 2002, Mr. Browning participated in a comprehensive mapping survey to delineate the footprint of drilling muds/cuttings surrounding three former oil well sites in the Caspian Sea off the coast of Azerbaijan. The sediment profile imaging survey documented the lateral extent of drilling muds on the seafloor in depths from 70 – 500 meters; SPI technology was used at all three sites to map the footprint of the muds. The film was developed immediately on-board following completion of the reconnaissance SPI survey, and the results were used to plan the location of the grab samples taken for sediment chemical and biological analyses.

Wood Waste Investigations, Puget Sound. Mr. Browning assisted in data collection and analyzed all images in SPI surveys at Port Gamble and in the Hylebos waterway for industrial clients to both characterize the extent of wood waste at former log rafting/transfer sites and assess the status of benthic recovery in these areas. The results from the SPI surveys were used to delineate the extent of wood waste impacts and provide a rapid characterization of the status of the benthic community.

Thorne Bay Bark and Benthic Assessment. Mr. Browning assisted in data collection and analyzed all images for the benthic and sediment profile imaging survey at a former log transfer facility in Thorne Bay, Alaska. As a subcontractor to Tetra Tech for TMDL support to the Alaska Department of Environmental Conservation, Germano & Associates performed all water and sediment sampling in addition to sediment profile and plan-view imaging in June, 2005, to assess the nature and extent of impacts associated with wood waste on the seafloor.

Evaluation of Sediment and Benthos Characteristics at a Proposed LNG Deep Water Port. Mr. Browning assisted in data collection and analyzed all images for a comprehensive sediment profile imaging survey as part of a permit application baseline study for a proposed pipeline route and deepwater port associated with an LNG offloading terminal for a facility on the east coast of the United States. A total of 160 stations were surveyed in July 2005 in a range of water depths between 200-300 feet, and a complete report and interpretation of all profile images was submitted to the client within 30 days following completion of the field survey.

Habitat Restoration Project, Woodard Bay, Puget Sound. Mr. Browning assisted in data collection and analyzed all images for a combination SPI/plan-view survey of a former log storage area in Puget Sound that was scheduled to undergo a restoration for oyster habitat by the Nature Conservancy. The proposed area was surveyed in one day of field work, and the results of the SPI and plan-view camera analysis to determine whether or not the proposed area was suitable for oyster habitat were submitted to the client within 2 weeks of completion of the field work.

Wyckoff 2002 Operations Maintenance and Monitoring Plan (OMMP), Eagle Harbor, WA. Mr. Browning provided input to the Corps of Engineers, Seattle District regarding chemical and biological monitoring of the Wyckoff/Eagle Harbor East Harbor operable unit. The OMMP Addendum was developed by the Seattle district and input/recommendations were provided to match biological and chemical monitoring (surface and subsurface sediments) to project goals and regulatory requirements.

Capping Demonstration Project, Los Angeles Harbor. As part of a comprehensive capping demonstration project in Los Angeles Harbor being carried out for the US Army Corps of Engineers, Los Angeles District in coordination with the Contaminated Sediments Task Force, Mr. Browning participated in the post-capping monitoring surveys using Sediment Profile Imaging technology in the fall of 2001. Approximately 40 stations were monitored in this time-series to study the effectiveness and impacts of confined aquatic disposal as a management tool for contaminated sediments.

Sediment Profile Imaging Survey, Lower Willamette River. As part of a multi-disciplinary RI/FS investigation of the Lower Willamette River, Mr. Browning analyzed and helped collect the sediment profile images for a baseline characterization of the lower 15.7 miles of the river using sediment profile imaging technology. The report produced from this study was a required deliverable under the Stipulated Agreement for Portland Harbor which was incorporated by reference into the Administrative Order on Consent for the Portland Harbor CERCLA Site. The SPI results provided reconnaissance information on the physical and biological features of surface sediments in the Willamette River from Ross Island to the Columbia River. A total of 514 stations were sampled between November 26 and December 10, 2001.

PSDDA Disposal Site Monitoring. Mr. Browning participated in all SPI monitoring and analyzed the images from the Commencement Bay and Elliott Bay Disposal Sites in 2001 and 2002. Between 50-70 sediment profile imaging stations were sampled at each site, with maps of the dredged material footprint submitted to the client within 24 hours of the field sampling; a comprehensive report on the profile imaging results was submitted within 4 weeks of completion of the field work at each site. Mr. Browning also provided sediment and biological sampling expertise during the 2002, 2001, 1995, 1992 and 1990 monitoring events.

Comprehensive Environmental Impact Baseline Survey, People's Republic of China. Mr. Browning participated in a comprehensive SPI survey in the fall of 2001 as part of a multi-disciplinary environmental impact study for an industrial client in the People's Republic of China. A baseline characterization of an entire bay over 650 km² in area was surveyed using Sediment Profile Imaging as a requirement for building a large industrial coastal facility. Field work was completed within one week, and Mr. Browning analyzed all images within 2 weeks of completion of all field activities.

RCRA Investigation, Soda Lake, WY. Mr. Browning served as task manager for sediment studies for a RCRA facilities investigation of Soda Lake, Wyoming. He collected, analyzed, and reported SPI and water column profile data and provided extensive support for surface sediment sampling, sediment coring and biological collections within the lake.

Responsible for reporting sediment quality results in final documents and provided input in developing a conceptual model of the physical and biological dynamics of the lake that was utilized in the Risk Assessment.

SPAWARS PRISM Project: Field Verification of Bioturbation Depths. The Navy is in the process of identifying, assessing, and remediating a large number of coastal facilities with contaminated sediments; as part of this effort, the PRISM project is developing a set of diagnostic tools for characterizing and quantifying in-place contaminant pathways to aid in the effective selection, permitting and monitoring of in-situ sediment management strategies. Mr. Browning participated in all sediment profile imaging surveys and performed all image analysis as part of this multidisciplinary, comprehensive program development carried out in San Diego Harbor, CA and Pearl Harbor, Hawaii in 2001-2002.

Ecological Impacts of Potential New Jersey Sand Mining Operations, Minerals Management Service. Mr. Browning performed all image analysis and field collection for the Sediment Profile Imaging (SPI) surveys in 2001 that were done as part of baseline ecological assessment of potential sand resource mining areas off the coast of New Jersey.

Post-Disposal Monitoring, Coos Bay, OR. Mr. Browning performed a SPI and plan-view video study to map the extent of a newly placed dredged material deposit (<8 hours after disposal) at three disposal sites at the mouth of Coos Bay, WA. Plan-view video was affixed to SPI frame and the sampling grid was adjusted real-time using real-time information provided by the video. 1999 – 2000.

Wyckoff Superfund Site Monitoring, Eagle Harbor, WA. In 1999-2000, Mr. Browning was Project Manager and principal investigator for Year 5 monitoring of the sediment cap placed at the Wyckoff/Eagle Harbor Superfund Site. Year 5 monitoring included SPI, towed video, sediment core sampling, and surface sediment sampling for benthos and sediment chemistry. In 1994-1995, Mr. Browning was Project Manager for the development of a 10-year monitoring plan to determine the efficacy of the sediment cap placed at the Wyckoff/Eagle Harbor Superfund Site. The plan was prepared under both CERCLA and COE guidance. Elements of long-term monitoring included: bathymetry, subbottom sonar profiling, SPI, towed video, and sediment sampling. After the monitoring plan was accepted, Mr. Browning was also the Principal Investigator for all physical monitoring during the cap construction at the creosote-contaminated Wyckoff/Eagle Harbor Superfund Site, East Harbor Operable Unit. Physical monitoring included pre-, syn-, and post-placement bathymetry, sediment profile imaging, water quality monitoring, towed underwater video, gravity coring and subbottom sonar profiling.

SPI Survey, Red Dog Mine, AK. In 1998, Mr. Browning was the Project Manager for an SPI survey of proposed dredged material disposal sites in support of Port Facility Expansion at Cominco's Red Dog Mine, Alaska. The SPI survey provided information the benthic resources at the site, aided in the interpretation of benthic infaunal community analysis and served as a pre-dredging and disposal baseline.

Wood Waste Evaluation, Tacoma, WA. In 1998-1999, Mr. Browning evaluated wood waste issues in the Hylebos Waterway, Tacoma, WA by looking at potential toxicity of wood-derived chemicals and estimating the volume percentages of wood waste in areas to be remediated using sediment profile images. SPI wood waste data were ground-truthed to true wood waste volumes and conventional chemistry parameters (e.g. total volatile solids). Estimated percent cover of wood waste throughout the Hylebos using plan-view affixed to the SPI camera frame.

Sediment Characterization and Deposit Study, Fox River, WI. Mr. Browning was responsible for the physical demarcation of sediment deposits in the stretch of the Fox River extending from Little Lake Butte de Morts to DePere. Sediment deposits were identified and measured for lateral extent and thickness using subbottom profiling sonar, dual frequency hydrographic surveying and poling. The data were synthesized and processed to produce isopach maps of deposit thickness. These data were then used to determine the locations of sediment collection to best characterize the deposit in terms of chemical burdens.

Confined Aquatic Disposal Monitoring, US Army Corps of Engineers, Los Angeles District. In 1994 – 1995, Mr. Browning conducted SPI surveys prior to and immediately after the placement of 800,000 CY of contaminated dredged material in a confined aquatic disposal site immediately inside the San Pedro breakwater. Mapped the distribution of construction-related sediments, contaminated sediments, and pertinent physical and biological features at the study area.

Wood Waste Evaluation, Lake Washington, WA. In 1996-1997, Mr. Browning conducted a sediment profile imaging survey of a wood waste and coal tar contaminated site in Lake Washington. Analyzed all SPI images and developed wood waste volume estimation method for SPI images.

Sediment Characterization Investigation, Bellingham, WA. In 1996-1997, Mr. Browning assisted in the collection of sediment samples (vibracore) and compositing of 4 to 16 ft sediment cores for a PSDDA pre-dredge sediment characterization for the Port of Bellingham and U.S. Oil.

Bay Farm Borrow Area (BFBA) Investigations, US Army Corps of Engineers, San Francisco District. Between 1991-1994, Mr. Browning was the task manager for a multi-disciplinary environmental survey for U.S. Army Corps of Engineers to determine the suitability of the BFBA as an open water dredged material disposal site pursuant to Section 404 of the Clean Water Act. He was responsible for the coordination and conductance of all sampling surveys and reporting activities. Elements of the seasonal BFBA surveys included precision navigation, sediment profile imaging to determine benthic conditions, collection of sediments for conventional and contaminant chemicals analyses to determine nature and extent of substrate chemical properties, collection of infauna to assess the benthic community structure, in-situ profiling of the water column to determine seasonal temperature, salinity and dissolved oxygen conditions, characterization of epibenthic, demersal and pelagic faunal populations using gill-nets and otter trawls, measurement of near-bottom tidal currents and passing wave trains, and observations of avian and mammalian fauna throughout the surveys.

Hong Kong Coastal REMOTS® Survey. Between 1996-1997, Mr. Browning participated in a series of Sediment Profile Imaging (SPI) surveys of Hong Kong coastal waters for the Geotechnical Engineering Office (GEO) of the Hong Kong Government's Civil Engineering Department. Mr. Browning evaluated SPI images for the presence of dredged material as well as other biological and geological features.

Biological Monitoring, Grays Harbor, WA. Mr. Browning participated in the collection, identification and enumeration of crabs and fishes in Grays Harbor and Willapa Bay, WA during 1994-1996. He was responsible for preparation of all weekly and synthesis data reports.

PUBLICATIONS/REPORTS

Germano, J.G., and D.G. Browning. 2006. Marine Log Transfer Facilities and Wood Waste: When Dredging Is Not Your Final Answer. In prep. Proceedings of the Pacific Chapter of the Western Dredging Association, San Diego, CA. June 2006.

Browning, D.G., and E.C. Revelas. 2004. A SPI-based technique for determining wood waste volumes and effects in marine sediments. Presentation at the SPICE (Sediment Profile Imaging Colloquium of Experts) Conference, University of Galway, March 4-5, 2004. Galway, Ireland.

Browning, D.G., E.C. Revelas, R.A. Hollar, and A. Risko. 1996. Confined Disposal and Capping of Dredged Material in the Long Beach Borrow Area. Abstract. Proceedings of the Pacific Chapter of the Western Dredging Association, Honolulu, HI. Nov. 1996.

Browning, D.G. and E.C. Revelas. 1996. Development and Application of the Physical Disturbance Index (PDI) for Sediment Profile Images. Abstract. PERS, Pacific Northwest Chapter Proceedings, Olympia, WA.

Browning, D., P. Cagney and E. Nelson. 1995. Physical Monitoring of Subtidal Cap Construction at the Wyckoff/Eagle Harbor Superfund Site. Puget Sound Research 1995 Proceedings.

Browning D., D.A. Kendall and E.C. Revelas. 1993. Delineation and Biogenic Reworking of a Dredged Material Deposit Placed at a Deep Water Disposal Site. Abstract. Proc. PNWCSETAC Proceedings May 1993.

Sichel, S.A., D. Browning and H. Sigurdsson. 1988. Pseudopicritic MORBs from the Southern Mid-Atlantic Ridge. American Geophysical Union. EOS Transaction. Abs.

Sigurdsson H., J. Palais and D. Browning. 1986. Petrologic Evidence of Volcanic Degassing, Proceedings of the Norman D. Watkins Symposium on the Environmental Impact of Volcanism. University of Rhode Island, Graduate School of Oceanography, 1986.

Browning D. 1985. The Petrology of a Suite of Mafic and Ultramafic Nodules from the Pinacate Volcanic Field, Sonora, Mexico. Honors Thesis, Wesleyan University, Middletown, Ct. 76 pp.

INSPIRE ENVIRONMENTAL

88 Silva Lane, Suite 4 | Middletown, RI 02842 | (401) 608-2670
marisa@INSPIREenvironmental.com

MARISA L. GUARINELLO | Project Scientist

Education
M.S. Oceanography, University of Rhode Island, 2009

B.S., *magna cum laude,* Biology & Env. Sci., The College of William & Mary, 2002

Areas of Specialization
Sediment Profile Imaging
Benthic Ecology/Organism-Sediment Relationships
Habitat Classification and Mapping
Spatial Analysis
Data Analysis & Synthesis
Data Management

Professional Memberships
Coastal and Estuarine Research Federation

Employment History
2016 - present – Scientist, INSPIRE Environmental, LLC, Newport, RI

2011 - 2016: Associate Scientist & Image Analyst, under contract to Germano & Associates, Bellevue, WA & CoastalVision, LLC, Newport RI

2014 - 2016: Environmental Data Manager, Northwest Knowledge Network, University of Idaho, Moscow, ID

2013 - 2014: Spatial Analyst, The Nature Conservancy in Arizona, Tucson, AZ

2011 - 2013: Scientist & GIS Analyst, under contract to Pacific Islands Region, NOAA, Honolulu, HI

2009 - 2010: Faculty Research Assistant, Arctic Benthic Ecology Lab, Chesapeake Biological Laboratories, University of Maryland Center for Environmental Sciences, Solomons, MD

2003 - 2008: Environmental Protection Specialist, Superfund Program, EPA, Washington DC & Boston, MA

WORK EXPERIENCE SUMMARY

Ms. Guarinello is a marine scientist with expertise conducting benthic assessments across habitat and disturbance types and in classifying seascapes for benthic assessments & marine spatial planning. She has over 12 years of analytical experience with sediment profile imagery (SPI) and has conducted additional research in places as diverse as the Arctic and American Samoa. At INSPIRE, Marisa manages projects, directs and assists with sampling design, data analysis, and reporting. She also leads development of analysis methodologies and use of habitat classification for benthic assessments for offshore wind installations.

PROFESSIONAL EXPERIENCE

Benthic Habitat Assessment for Off-Shore Wind Installations

Ms. Guarinello has lead data analysis efforts of sediment profile imagery, plan view imagery, and video footage for the purposes of assessing benthic habitats for off-shore wind development and construction. Specific projects include assessment of construction-related effects on hard bottom habitat at the Block Island Wind Farm for Deepwater Wind and pre-siting assessments of the New York offshore study area for the New York State Energy Research and Development Authority. For these projects, she optimized use of the national habitat classification standard, the Coastal and Marine Ecological Classification Standard (CMECS), recommended by BOEM for benthic habitat assessments to address the specific concerns of developers, resource agencies, and stakeholders. She has been involved with the testing and use of CMECS since the standard was in development.

Habitat Mapping

As an Associate Scientist with CoastalVision, Ms. Guarinello led an assessment of habitat classification schemes for the Northeast Regional Ocean Council (NROC). The project resulted in a consensus by the region to utilize the national marine habitat classification standard, the Coastal and Marine Ecological Classification Standard (CMECS), for regional marine spatial planning. Ms. Guarinello also used habitat mapping and classification techniques to conduct an assessment of benthic habitats in Narragansett Bay using SPI images.

Sediment Profile Image Analysis & Interpretation
Ms. Guarinello is responsible for oversight of data interpretation of SPI/PV images for benthic assessments of the seafloor related to dredged material disposal sites and seafood processing waste disposal sites, among others. At INSPIRE, she leads development of image analysis standards, protocols, and development of training materials. Ms. Guarinello developed her expertise in field surveys and Sediment-Profile Image analysis working on multiple coastal and marine assessment projects while an Associate Scientist with Germano & Associates, building off her early experience as a graduate student.

GIS Analyst and Scientist
While on contract to the Pacific Islands Fisheries Science Center (NOAA/NMFS), Ms. Guarinello was responsible for development of a publically available web mapping application for marine spatial planning, specifically site-selection and evaluation for off-shore aquaculture in the Main Hawaiian Islands. In addition to designing the application interface and writing the GIS site-selection model, she was responsible for identifying, compiling and creating the geospatial data used. On a separate contract to the same office (on sub-contract to SRGII), Ms. Guarinello conducted a coastal and marine spatial planning data gap analysis for the Main Hawaiian Islands, American Samoa, Guam, and the Northern Marianas Islands.

Environmental-based Management Review of Proposed Western Pacific Region Fisheries Management Actions for the Pacific Islands Regional Office of the National Marine Fisheries Service (on sub-contract to SRGII). Ms. Guarinello reviewed the Pelagic Fisheries Ecosystem Plan (FEP) and two draft amendments to this FEP: 1) Bigeye Tuna (BET) Catch Limits and Responsible Fisheries Development for the U.S. Pacific Territories and 2) Proposed Modifications of the Hawaii Deep-Set Tuna Longline Fishery Swordfish (SWF) Retention Limit to Reduce Regulatory Discards. She evaluated each document to determine how well it utilized the principles of ecosystem-based fisheries management and provided recommendations for improvement.

Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science
As a Faculty Research Assistant Ms. Guarinello participated in research cruises to the Bering and Chukchi Seas, conducted GIS and statistical analysis for habitat characterization, processed and analyzed underwater video footage, and processed sediment and faunal samples.

Environmental Protection Specialist, Superfund Program
While in the headquarters office, Ms. Guarinello supported two EPA Regions (Regions 2 and 6) on program initiatives and site-specific topics. She collaborated on nationwide post-remediation policy guidance documents, conducted trainings, and organized workshops. Her part-time work in Region 1 included implementation of institutional controls at several sites and assistance with outreach for fishery advisories at the New Bedford Harbor site.

WORKSHOPS

Developer and Instructor, Solve Problems, Save Time: Making Data Management Work for You (2hr), Northwest Knowledge Network, University of Idaho, Fall 2015

Participant, Spatial-temporal lesson planning hackathon (3 days), National Ecological Observation Network, Boulder, CO, October 2015

Developer and Instructor, Spatial Inquiry & Analysis using ArcGIS, The Nature Conservancy in Arizona (2hr), Spring 2014

Developer and Instructor, Basic GIS Skills using ArcGIS, The Nature Conservancy in Arizona (1/2 day), Fall 2013

PROFESSIONAL SKILLS & DEVELOPMENT

Certifications: 40-hr HAZWOPER; Boating Safety

Technical Skills: ArcGIS, PrimerE v6, R, GitHub, Marxan, Python, Adobe Creative Suite, ISO 19115 metadata

Professional Development Trainings:

Re:Think Innovation Workshop (2017, 2 day in-person)
The Human Element (2017, 1 week in-person)
Mindfulness-Based Stress Reduction (2015, 8-week online course, *palousemindfulness.com*)
Working with Personality Types (2014, 1 day in-person, *TNC-Arizona*)
Team Member Training (2013, 4 days in-person, *TNC-Arizona*)
Interaction Styles (2103, 1 day in-person, *TNC-Arizona*)

PUBLICATIONS AND REPORTS

Peer-reviewed

Shumchenia EJ, **Guarinello ML**, King JW. (2016) A re-assessment of Narragansett Bay benthic habitat quality between 1988 and 2008. Estuaries and Coasts. DOI 10.1007/s12237-016-0095-z

Shumchenia EJ, **Guarinello ML**, Carey DA, Lipsky A, Greene J, Mayer L, Nixon ME, Weber J (2015) Inventory and comparative evaluation of seabed mapping, classification and modeling activities in the Northwest Atlantic, USA to support regional ocean planning. Journal of Sea Research 100, 133-140 doi:10.1016/j.seares.2014.09.010

Cunning R, Yost D, **Guarinello M**, Putnam H, Gates R (2015) Variability of Symbiodinium communities in waters, sediments, and corals of thermally distinct reef pools in American Samoa. PLOS ONE 10(12): e0145099 doi:10.1371/journal.pone.0145099

Cooper LW, Janout M, Frey KE, Pirtle-Levy R, **Guarinello ML**, Grebmeier JM, and Lovvorn JR (2012) The relationship between sea ice break-up, water mass variation, chlorophyll biomass, and sedimentation in the northern Bering Sea. Deep-Sea Research II. http://dx.doi.org/10.1016/j.dsr2.2012.02.002

Stolt M, Bradley M, Turenne J, Payne M, Scherer E, Cicchetti G, Shumchenia E, **Guarinello M,** King J, Boothroyd J, Oakley B, Thornber C, August P (2011) Mapping Shallow Coastal Ecosystems: A Case Study of a Rhode Island Lagoon. Journal of Coastal Research. DOI: 10.2112/JCOASTRES-D-11-00002.1

Guarinello ML, Shumchenia EJ, King JW (2010) Marine habitat classification for ecosystem-based management: A proposed hierarchical framework. Environmental Management 45: 793-806. DOI 10.1007/s00267-010-9430-5

Technical Reports

Guarinello ML, Carey DA, Read LB (2016) Hard Bottom Baseline and Post-Construction Survey, Year 0 Report, Block Island Wind Farm. Prepared for Deepwater Wind, LLC.

Guarinello ML, Carey DA, Wright C (2016) Data Summary Report for the Isles of Shoals Disposal Site North September 2015 Monitoring Survey. U.S. Army Corps of Engineers, New England District, Concord, MA

Guarinello ML, Carey DA, Hickey K (2015) Monitoring Survey at the Western Long Island Sound Disposal Site August 2014. DAMOS Contribution No. 198. U.S. Army Corps of Engineers, New England District, Concord, MA

Shumchenia EJ, **Guarinello ML**, Carey DA, Lipsky A, Greene J, Mayer L, Nixon ME, Weber J (2013) Review of marine habitat classification, characterization, and modeling activities in the Northeast U.S. Prepared by CoastalVision and SeaPlan for the Northeast Regional Ocean Council

Guarinello M, Duin K (2011) Coastal and Marine Spatial Planning Geodata Gap Analysis for the Pacific Islands Region. Prepared by SRGII for NOAA-Pacific Islands Regional Office

Guarinello M, Duin K (2011) An Ecosystem-Based Fisheries Management Review of Two Proposed Modifications to the Management of Pelagic Fisheries in the Western Pacific. Prepared by SRGII for NOAA-Pacific Islands Regional Office

Grebmeier J, Cooper L, **Guarinello M** (2011) Epibenthos Survey of the Bering Sea (Version 1.0) doi:10.5065/D6F18WQH

Maps

Guarinello ML, Robles MR, Turner DS, Marshall RM (2015) "Using the Condition of Arizona's Landscapes to Inform Conservation & Mitigation Priorities" in Esri Map Book, Volume 30. Esri Press, Redlands, CA.