

NPDES Permit Closure Sampling and Analysis Plan

Final Version 12.06.23

Net-pen Sites	NPDES Permit Numbers
<i>Hope Island Site 4</i>	WA-003159-3
<i>Clam Bay</i>	WA-003152-6
<i>Fort Ward</i>	WA-003153-4
<i>Orchard Rocks</i>	WA-003154-2
Deepwater Bay Site 1	WA-003156-9
Deepwater Bay Site 3	WA-003158-5
Port Angeles Harbor	WA-004089-4

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Recommended citation of this sampling and analysis plan report:

Rensel, J.E. 2019. NPDES Permit Sampling and Analysis Plan for Puget Sound Floating Net Pens 2019. Prepared for Washington Department of Ecology, Olympia, Washington and Cooke Aquaculture Pacific, LLC. Anacortes, Washington. Permits WA0031593, WA0031526, WA0031534 and WA0031542. Prepared by Rensel Associates, Arlington Washington. 53 pp. and appendices.

Note herein the acronym RPD herein refers to relative percent difference, a statistical analysis term.

The acronym aRPD refers to apparent redox potential discontinuity, a feature of some sediments in marine waters described here.

1. Introduction and Objectives

The objective of this sampling event is to ensure that sediment parameters in the area where the Sediment Impact Zone (SIZ) was previously established are meeting the sediment management standards established by the State of Washington Baseline conditions prior to the operation of the net pens or a level akin to background conditions in Puget Sound will be used for comparison of the SIZ closure stations. Exceedance will be evaluated in the following ways: TOC will be compared to the Puget Sound Reference TOC Values in Table 1 of SMS WAC 173-204-412. Zinc and Copper will be compared to the performance criteria which are the sediment clean up objective levels stated in WAC 173-204-562, 410mg/kg dw and 390 mg/kg dw respectively. The goal of closure monitoring is to demonstrate the sediment quality is at or returning to baseline conditions. If the TOC, copper and/or zinc levels at any closure monitoring station within the SIZ area exceed the SMS criteria established in WAC 173-204-412 and WAC 173-204-562, a benthic faunal analysis will be performed on the failed sampling station. Benthic infaunal samples will be collected, preserved, and held until exceedance evaluation is complete and Ecology has approved the Closure Monitoring reports for each site. Visual inspection and a description of the sediment characteristics from the grab sampling process and videoing of benthic imagery at all sampling stations (five per net pen site) will be conducted.

Reference site data will be collected near each pen at locations that have been sampled at in the NPDES yearly monitoring program. These reference sites were chosen and have been sampled for numerous years as they have a similar depth, sediment type and current to the net pen site. Each reference location is upstream of the prevailing currents at the net pens eliminating the possibility of cross-contamination. Sediment sampling at the net pen sites has occurred for over 25 years and reference stations for each net pen location have been established (See Section 5 below). Past data from each of these reference stations has been included in the previous benthic reports provided to Ecology. The SIZ Closure Monitoring report will include a description of the reference area physical parameters for comparability to those same parameters within the SIZ. The reference locations will be sampled at the same time as the closure monitoring and utilized in consideration of the requirements and statistical analysis.

If the site sediment levels of the mentioned parameters are in exceedance, additional testing and monitoring may be needed in the future as determined by Ecology. Benthic infauna samples will be screened and collected to archive in the event exceedances occur. This testing and monitoring will be decided by Ecology after all sampling information is received and based upon which samples are above the reference/background levels. If there are no exceedances, this sampling will fulfill Ecology's sediment sampling requirements for site closure.

2. Background

Cooke Aquaculture will be closing all its net pens in the Puget Sound. Closure of the pens requires sampling to be conducted for the Washington Department of Ecology (herein: “Ecology”) and Cooke Aquaculture Pacific (Cooke), the net-pen permit holder, for the four sets of floating salmon net pens located at the Hope Island Site 4, Clam Bay, Fort Ward, and Orchard Rocks as designated in Table 1.

Table 1: Cooke Aquaculture Pacific Sites

Site Name	NPDES Permit Number	Location Code	Type of Monitoring
<i>Hope Island Site 4</i>	<i>WA-003159-3</i>	<i>S4</i>	<i>Site closure</i>
<i>Clam Bay</i>	<i>WA-003152-6</i>	<i>CB</i>	<i>Site closure</i>
<i>Fort Ward</i>	<i>WA-003153-4</i>	<i>FW</i>	<i>Site closure</i>
<i>Orchard Rocks</i>	<i>WA-003154-2</i>	<i>OR</i>	<i>Site closure</i>
<i>Deep Water Bay site 1</i>	<i>WA-003156-9</i>	<i>DW1</i>	<i>Site closure</i>
<i>Deep Water Bay site 3</i>	<i>WA-003158-5</i>	<i>DW3</i>	<i>Site closure</i>
<i>Port Angeles</i>	<i>WA-004089-4</i>	<i>PA east and west</i>	<i>Site closure</i>

Closure monitoring is required in the NPDES permits when fish culture is no longer practiced, ensuring that the permitted area is returned to background conditions. A difficulty with this is that most Puget Sound fish farms have been in place for decades, and some facilities were in place prior to established routine monitoring parameters or baseline data collection. The locations and stations of the net pen facilities involved in this 2023 SAP have been monitored by independent qualified contractors in Washington State since the 1980’s as a requirement first of their aquatic lands lease and later by the first marine net pen NPDES permits administered by Ecology in the mid-90’s.

3 Project Team and Responsibilities and Scheduling

Project Manager: Kevin Bright, Cooke Aquaculture Pacific

Responsibilities: Oversight of the routine and special monitoring to comply with the NPDES requirements. He acts as the primary liaison for Cooke Aquaculture Pacific and the Department of Ecology.

Principal Investigator: Shawn Hinz, Gravity Consulting LLC

Responsibilities: Coordination and planning of field sampling, overseeing and participating in sample collection and handling, assists research vessel skipper in health and safety choices,

primary liaison with the certified laboratory or other analysts such as invertebrate taxonomists, inspects every bit of data for possible problems or errors, conducts statistical tests as needed, writes technical reports, assist the project manager as directed. QA/QC coordinator responsible for preparing the quality assurance project plan, interactions with the analytical laboratories, and data validation activities. Coordinates with Ecology staff as needed and directed.

Sampling Vessel Contractor: Gravity

Sampling Vessel Skipper: John Schafer, Licensed Master Mariner or other available experienced Gravity Marine Inc. staff as needed.

Responsibilities: Vessel captain, navigates and positions vessel and operates computerized positioning and depth measuring data collection. Captain is also the primary health and safety officer, responsible for overseeing vessel maintenance and first aid if necessary. Prior to sampling, Captain communicates with Principal Investigator regarding scheduling, tides, weather and other conditions that could affect the vessel and its crew.

Other sampling vessel crew: Two deckhands from Gravity Marine or Cooke Aquaculture Pacific or one from each.

3.1 Schedule

Final closure sampling will be conducted at the pen sites within 12-months of Cooke Aquaculture Pacific's formal request to Ecology for NPDES permit termination of each individual NPDES permit. The seven (7) net pen NPDES permits are Deepwater Bay 1, Deepwater Bay 3, Hope Island, Clam Bay, Orchard Rocks, Fort Ward, and Port Angeles. Upon approval of the Closure Monitoring SAP by Ecology, Cooke estimates a permit termination request will occur by the end of this year. The subsequent SIZ Closure monitoring for each permit requested to be terminated could then be potentially carried out during spring of 2024 (March-June). The Closure Monitoring report would be submitted to Ecology within 60 days of each site closure sampling event. The timing of the report submittal is dependent upon having no unforeseen delays during the lab analysis of sediment samples. Cooke and Gravity will notify Ecology of the field work schedule prior to carrying out the sampling events and whether additional report preparation time becomes necessary.

The project manager for Cooke Aquaculture Pacific will provide such notification for monitoring schedules beyond what is known and indicated above.

4. Performance Standards: Sediment Zinc and Copper

Sediment Zinc Standard: maximum of 410 mg/kg

Within the Department of Ecology regulations and WAC rules the applicable sediment zinc standard is a maximum concentration of 410 mg kg⁻¹. Sample results have not been adjusted for TOC content as the pertinent permit for net pens does not specify that it be done. Whether it is done or not is inconsequential as there has only been one violation of this standard in 2021 which was re-sampled in 2022 and did not exceed criteria.

The zinc standard “corresponds to a sediment quality that will result in no adverse effects, including no acute or chronic adverse effects on biological resources and no significant health risk to humans” (Washington Administrative Code: WAC 173-204).

Copper was monitored at Puget Sound net pens in the past during the period when a water-based copper antifoulant paint was being applied to the new fish rearing nets by the net manufacturers to prevent biofouling. By 2014, commercial net pens in Washington phased out the use of copper on the nets to address public perception and customer concern. Copper concentrations in sediments near net pens never exceeded the regulatory limits during this period and were routinely much lower than the maximum allowable concentrations. Zinc is a heavy metal that in a concentrated form is harmful to plant and animal life, however, it is also an essential dietary trace element that is required by both humans and other animals. Zinc is an added constituent in commercial salmon feeds in trace amounts to meet the dietary requirements of the fish. It also occurs naturally in sea water and ocean sediments. Zinc levels around the Puget Sound net pen facilities are monitored in the sediments and have historically remained very low and well below the sediment performance standards.

If an elevated concentration is detected in our sampling, the responsible laboratory will re-digest the remaining homogenized sample replicate or for retesting of a single or multiple replicates of any subject station. That has happened a few times in the past, where a single replicate had a high number, and without exception the re-analysis showed a much lower zinc concentration that was below the performance standard. Those results may indicate that the single high sample had possibly a particle of dislodged galvanized metal from a boat, nearby anchor chains, or the fish pen walkways themselves which are made of galvanized steel. Zinc is also a common byproduct of our modern society from non-point run off and point sources like domestic sewers and may occur at higher concentrations in industrial areas harbors and waterways. Zinc tends to bind with sediments rich in silt and clay.

Sediment Copper Standard: maximum of 390 mg/kg

Within the Department of Ecology regulations and WAC rules the applicable sediment copper standard is a maximum concentration of 390 mg kg. Although Cooke has not tested for copper for the past number of years the closure monitoring will include this analysis. Copper is commonly associated with vessel anti-fouling paints; particularly older vessels built before the 1970s. No current operations are point sources for Copper at the Cooke net pen facilities.

5. Summary of Methods

SIZ sampling locations

Five sediment samples will be collected from within each net pen SIZ area, one in the pen center, one down current at 50' and 100', and one sample from each outer edge of the fish pen footprint at the mid-way point from the pen center and the end of the pens as shown in the figures in section 2. The five samples will be pooled replicates for the data analysis and statistical comparisons to the SMS criteria.

Comparable silt-clay categories for the five sampling locations within the SIZ.

Historic sediment silt/clay data from the sites will be reviewed for comparison to the five SIZ stations at each net pen site for potential locations that may be in different silt/clay categories from the rest because of a spatial difference. Because the five SIZ stations are within close proximity to each other, it is unlikely the silt/clay characteristics will vary considerably. If a SIZ sample location is potentially going to end up in a different category, five individual replicates will be collected for that location and preserved for later analysis if necessary.

The following is an overview of tasks required prior to sampling for preparation followed by a list of tasks to be conducted during sampling. Subsequent chapters provide details of sample collection, equipment used, and other details.

Reference sampling locations

Reference locations will be sampled near each net pen using previously identified locations that have similar sediment, depth and currents to the SIZ sample locations. Five replicate samples will be collected at each reference area to be pooled for comparison against the SIZ pooled sample. Table 2 provides depth and position data on these locations.

Table 2. Reference Locations

Location	Station	Latitude	Longitude	Depth (ft.)
Hope Island	S4REF	48.40685856 N	122.55973050 W	68
Port Angeles	REF1	48.13890145 N	123.42511594 W	175
Orchard Rocks	ORREF	47.57357425 N	122.52833236 W	100
Fort Ward	FWREF	47.57565475 N	122.52587158 W	44
Clam Bay	CBREF	47.57050653 N	122.53799486 W	127
Deepwater Bay Site 1 and 3	DBREF	48.55756610 N	122.68301811 W	80

5.1 Sampling Preparation and Subsequent Follow Up

Tasks involved for preparation by the principal investigator include:

- Inspect tide table to identify daylight hours when tidal exchange is less to much less than average to allow for proper sampling.
- Arrange for research vessel contract to conduct field work. Inform research vessel contractor regarding required grab sampling and other equipment and biosecurity requirements.
- Prepare sampling equipment, containers, sample container labeling, coolers and ice for sample storage while in the field and notify laboratory of the impending delivery of samples.

- Arrange for crew housing while in the field and scheduling.
- Examine weather forecasts as the date of sampling approaches and adapt plans to deal with inclement or potentially-dangerous storms.
- Research vessel contractors will conduct safety inspections of the sampling vessel equipment including propulsion, electronics, and safety equipment.

5.2 Overview of Each Field Sampling Task

The following is a general description of a typical routine sampling event organized sequentially in a task list:

- **Immediately Prior to Sampling:** Contact site manager regarding any new or unusual conditions such submerged obstructions that could influence the grab sampler or CTD. Discuss current and expected weather conditions that could influence the success and safety of the field data collection. Request general information relating to fish rearing, facility cleaning, or fish biomass loading that may influence results.
- **Check Research Vessel GPS Positioning System:** Upon arrival at the site, the research vessel skipper will run a QA/QC analysis of the computerized positioning system to ensure accuracy of GPS positioning and the computerized recording system. The skipper will note the GPS readings for accuracy before, during, and after sampling. See separate section of this report regarding positioning equipment and practices used for the sampling events.
- **Check Grab Sampler, Connector, and Wire Cable to Power Winch.** The vessel captain will inspect these items for condition prior to the first deployment looking for impediments to normal operation such as the jaws of the grab sampler being misaligned, the cable having frayed, and the cable to grab sampler connector showing signs of possible problems.
- **Grab Sampling Sediment Chemistry and Physical Properties:** The sampling vessel will reoccupy the same stations identified above for grab sampling for attempted collection of a single replicate sample for TOC, zinc, and sediment grain size. A full-sized VanVeen grab sampler will be lowered to the sea floor at a rate most suitable for the sea bottom type and recovered to the surface and inspected. By permit requirements, fullness of the grab sampler should exceed 4 to 5 cm deep as measured in the center of the unit.
- Grab samples will be carefully inspected to see the sea bottom surface is not disturbed by the sampling or by repeated sampling of the exact same location. In either case, those samples will be discarded.
- One sample is collected at each of the five stations for each of the net pen sites addressed in this SAP. Additional samples may also be taken as needed if a station has the potential to be in a different silt/clay category from the others.
- A subsample from each grab of sufficient volume for the TOC, sediment grain size, and zinc analyses will be collected from the top two centimeters exactly. All prior sampling has been from this depth interval in compliance with this widely used depth metric that defines “surficial” sediment depths.

- A subsample will be screened and preserved as an archive for potential Benthic Infauna analysis if chemistry exceeds criteria.
- Visual and olfactory information will be recorded to categorize the surface and subsurface of every sediment grab sample of sufficient volume. Although not required by permit, photographs of the surface of each grab sample will be collected to help analyze the results of laboratory testing.
- **Underwater Video Use:** Commence with video and photographic work for each station to confirm the types of sea bottoms and provide documentation of stations where grab sampling will not be possible. The camera will be lowered to 3 to 7 feet above sea floor as required by the NPDES permit for recording.
- The contractor will inventory samples again completely to ensure proper and complete labeling and that the chain of custody forms are accurate and account for each recorded sample and station. Contractor will store samples appropriately and transport them quickly to an Ecology-certified commercial laboratory with a chain of custody form to be signed and copied upon delivery.
- Shortly after sampling and while awaiting laboratory results, Contractor will inspect field data forms and make separate notes regarding any information needing clarification or correction. Contractor will not erase anything, but rather cross out mistakes.
- The contractor will compose tables of qualitative results for each station, replicate using notes, and refer to photographs of the undisturbed surface of each grab sample.
- After receiving the laboratory data, Contractor will inspect the data. Contractor will identify potential exceedances of the sediment TOC, zinc, and copper results and compare to reference site results.
- If there are exceedances of the sediment TOC, copper, or zinc results at any sampling location, Contractor will then perform a benthic faunal analysis at these locations.
- Contractor will assemble and assess the quality control results of the laboratory reports using standard techniques discussed in this SAP.

5.3 Overview of Reporting Tasks

- The contractor will submit the final report no later than 60 days after sediment sample analysis has been completed by the laboratory. Contractor will prepare and submit the digital sampling result data electronically to the Ecology EIM database digitally no later than 60 days after sediment sample analysis has been completed by the laboratory and will report numerical results and required details to the Department of Ecology EIM database.
- Contractor will prepare and distribute a final report regarding closure monitoring and SIZ condition to Department of Ecology. Contractor will submit data to the Ecology EIM database prior to the same deadline and refer to that submission date in the final report.
- Contractor will include recommendations and add best professional judgement when necessary.

5.4 Sampling Locations

The following Figures indicate the sampling locations as required in the permit and shown in Appendix C of the NPDES permits. These figures are diagrammatic only and not drawn to scale; compass direction arrows are approximate. Geographic centers are listed on the cover of each NPDES permit. These sites have not varied in location or configuration during the past decade or more. The type of anchoring used maintains the facilities within a few meters' location and is readily visible in Google Earth satellite photograph imagery from prior years. The red dots indicate the approximate location of the required sampling stations.

Each net pen location is to be sampled at five stations in the SIZ:

- A) one at 100' from perimeter location on downstream end of SIZ
- B) one at 50' from perimeter location on downstream end of SIZ
- C) one at center of pens (GPS coordinates are contained in the original NPDES permits from Ecology)
- D) two stations on outside edge of net pen array at mid-distance from center and the end of the net pen array.
- E) at each reference location (5 replicates)

Figure 1: Hope Island (S4) Sampling Locations

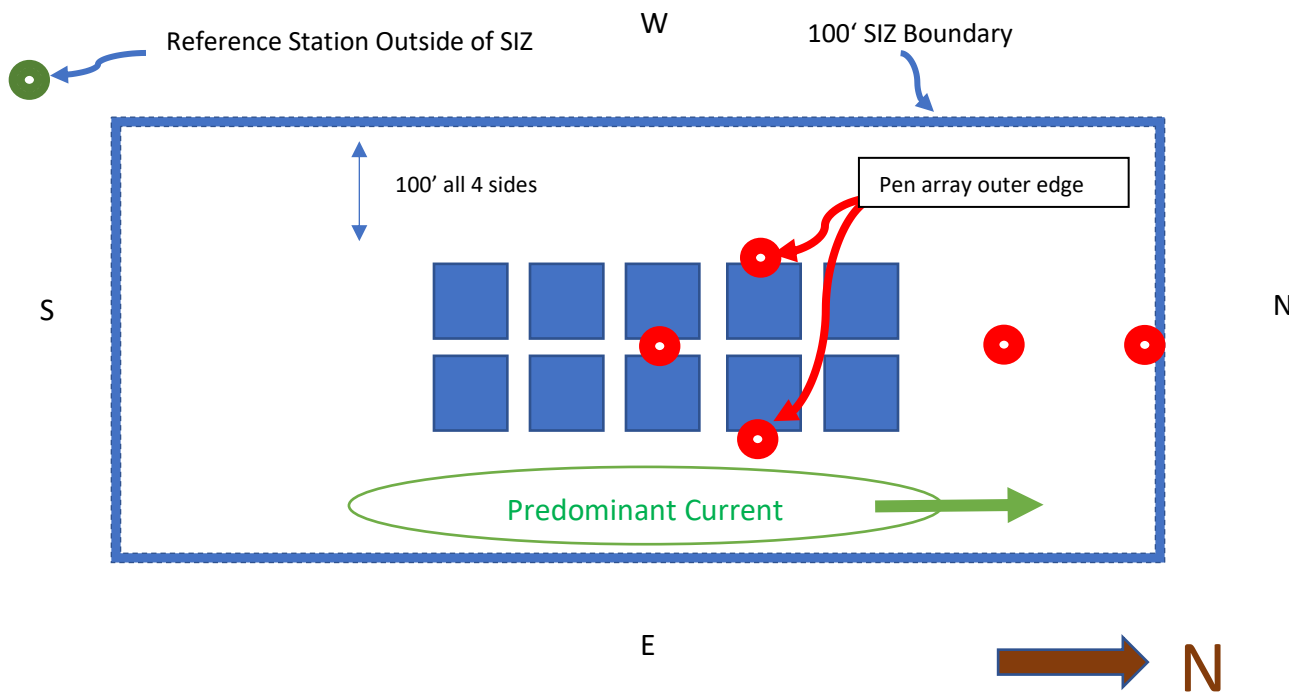


Figure 2: Clam Bay Sampling Locations

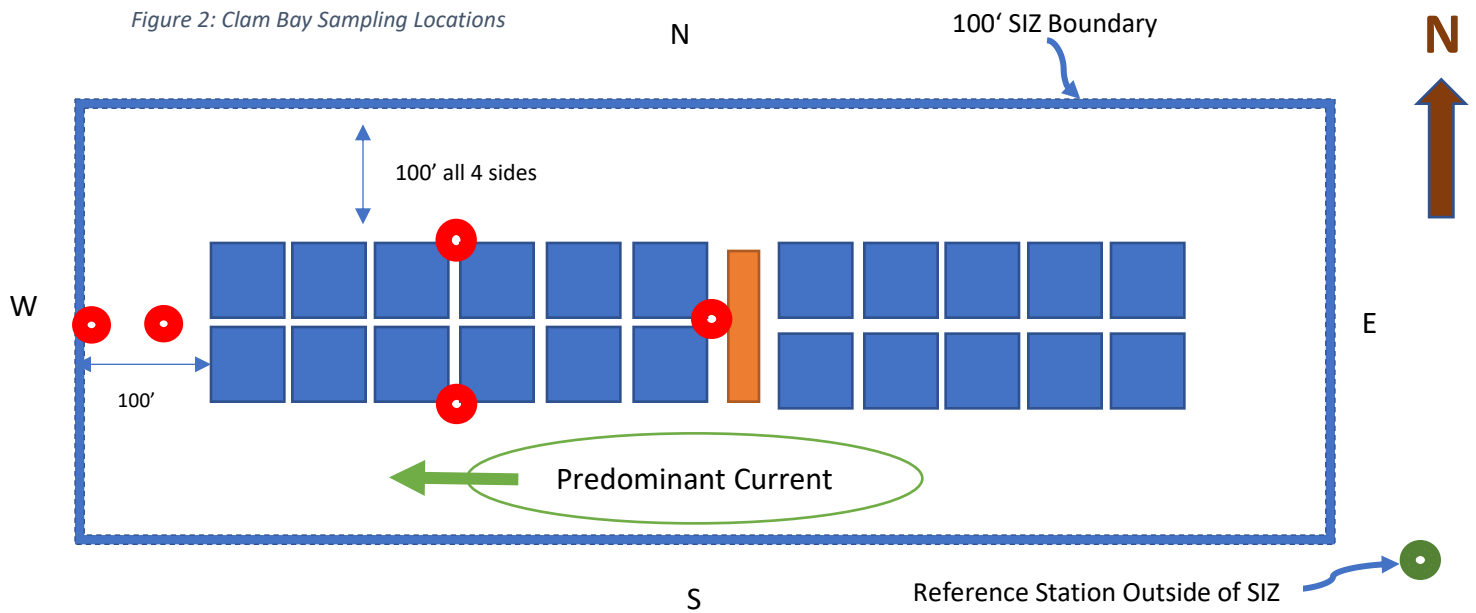


Figure 3: Fort Ward Sampling Locations

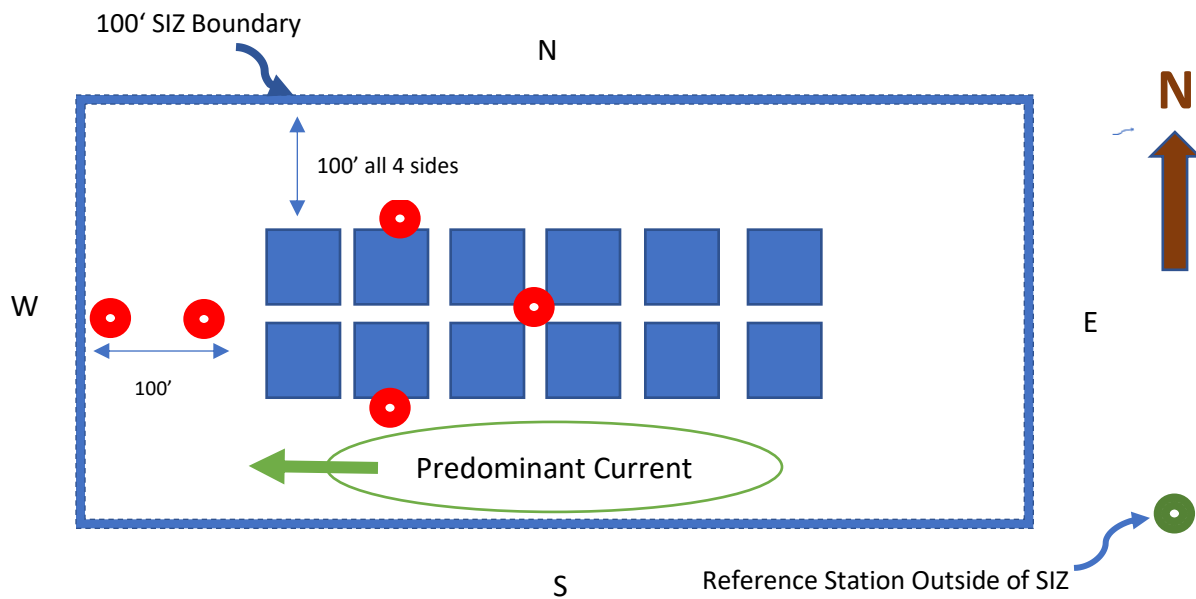


Figure 4: Orchard Rocks Sampling Locations

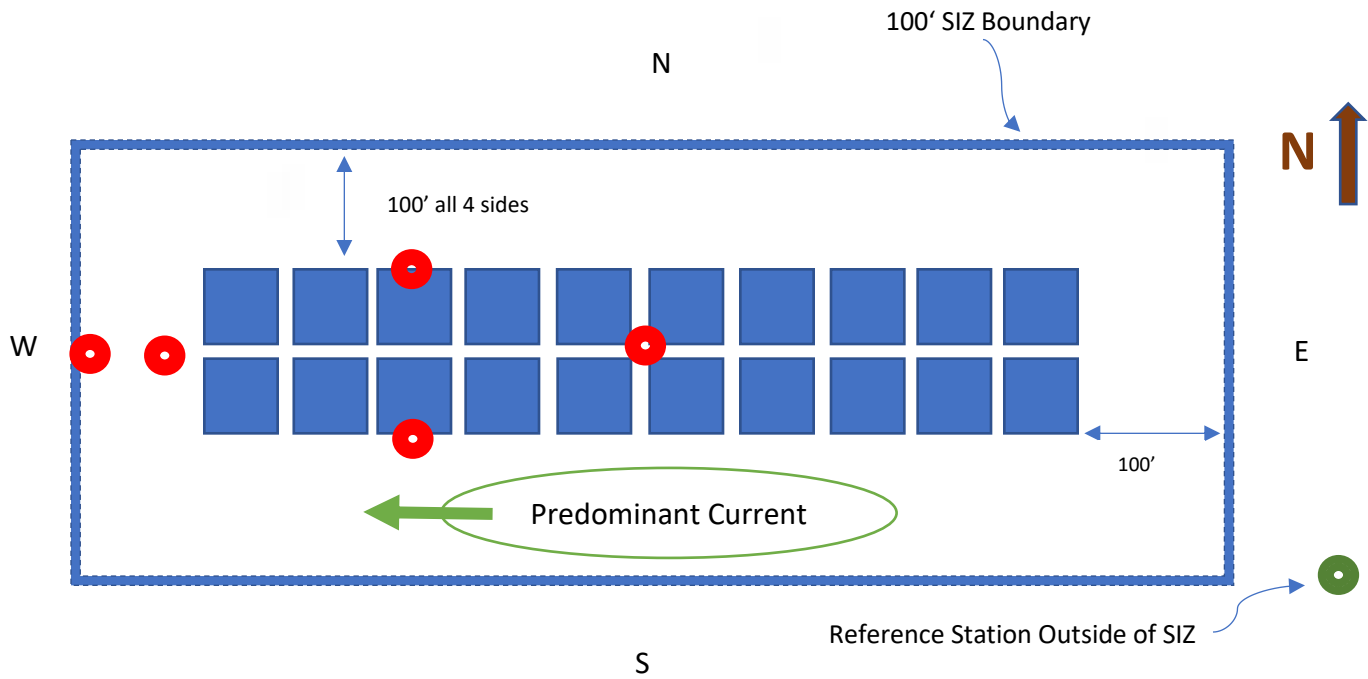


Figure 5: Deepwater Site 1

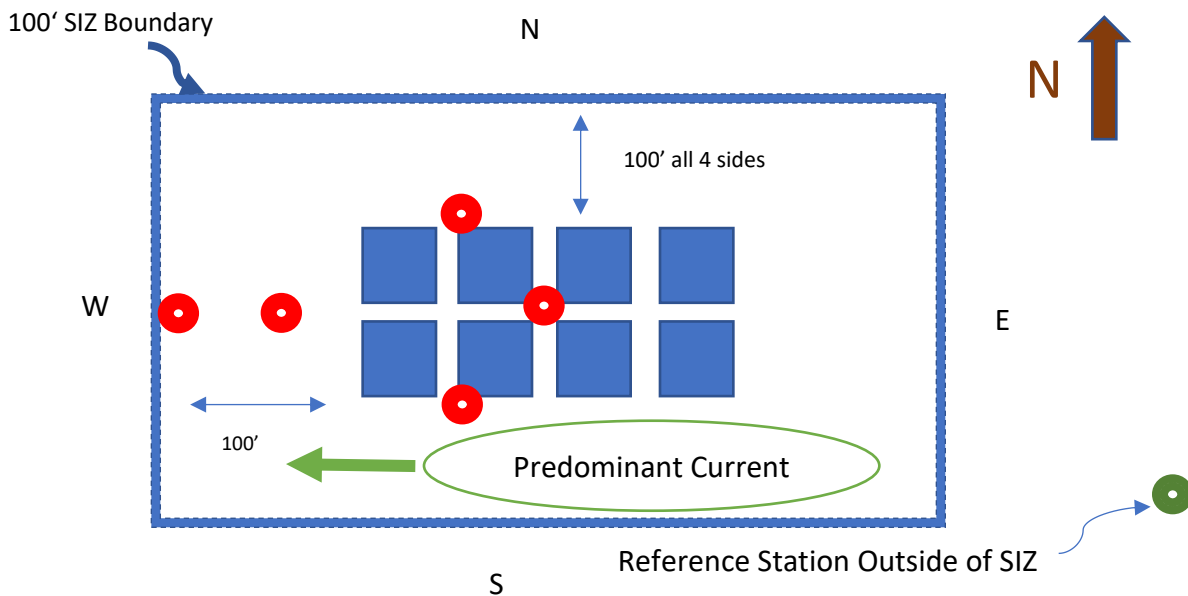


Figure 6: Deepwater Site 3

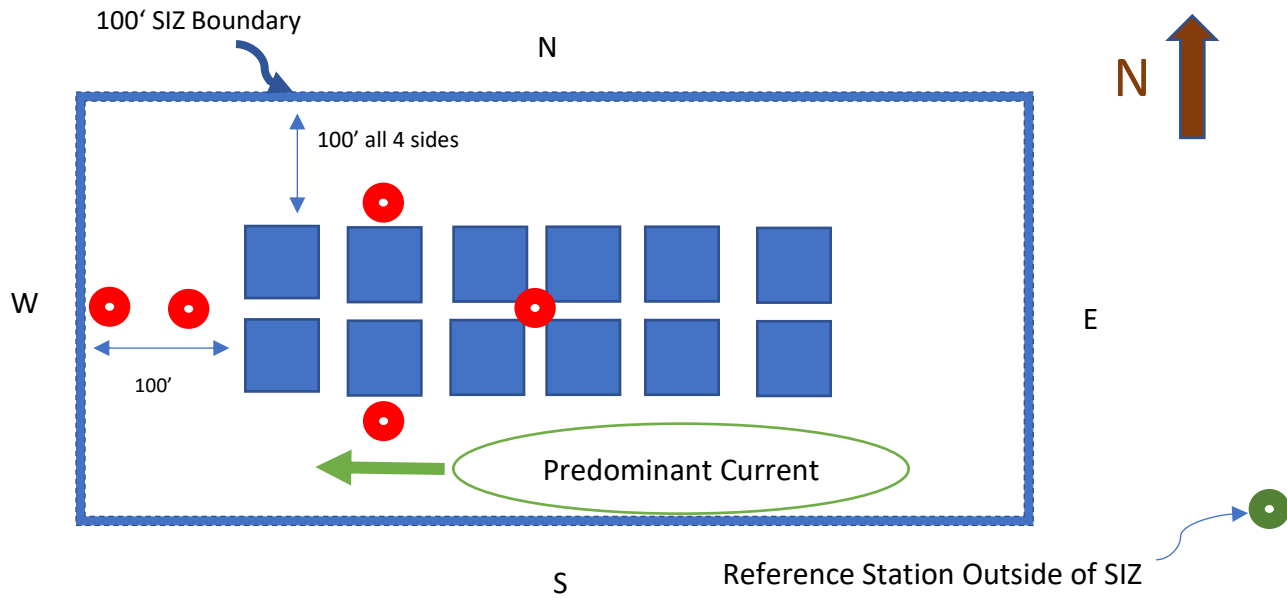


Figure 7: Port Angeles Site

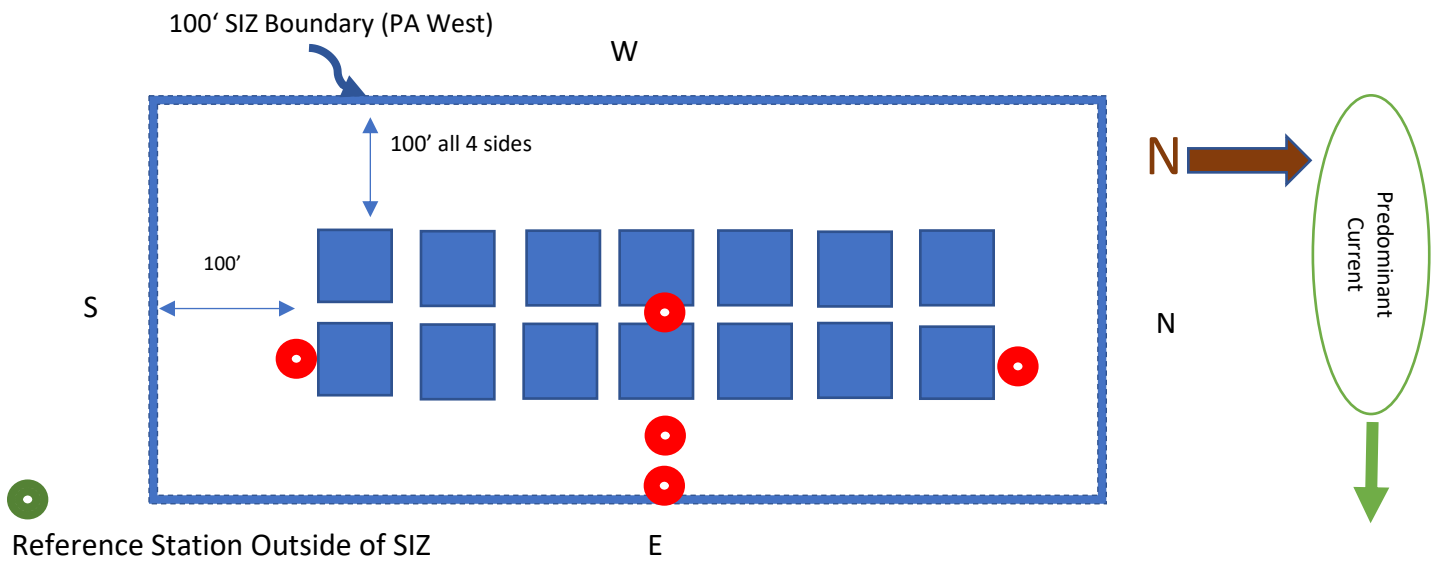
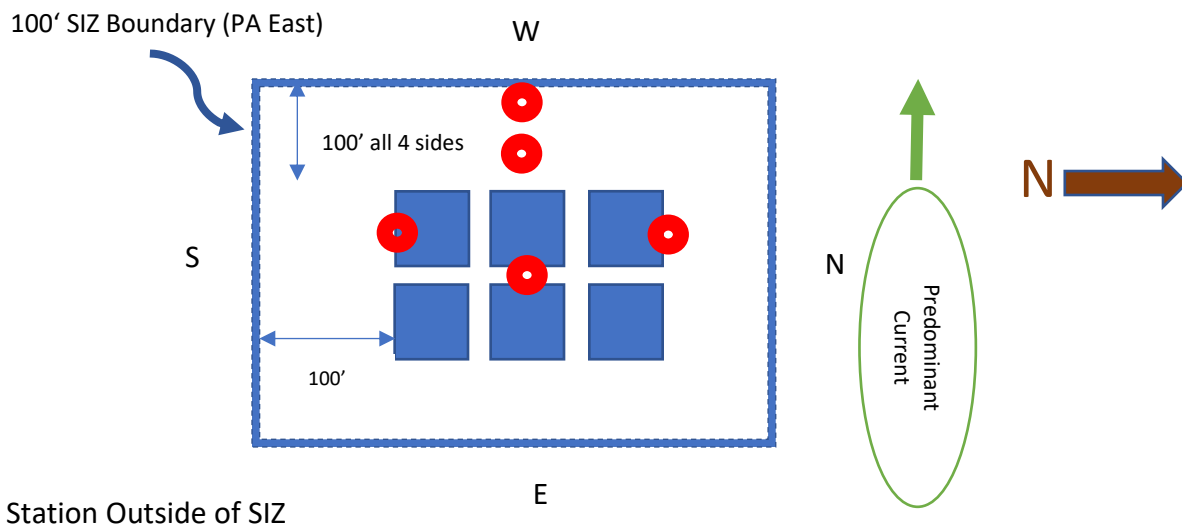


Figure 8: Port Angeles East Site



6. Summary of Parameters to be Measured

Table 2 provides an overview of the sample types to be collected for the monitoring covered by this SAP based on permit requirements at each sampling location around each net pen facility. SIZ samples will be collected and homogenized to be compared to both criteria and reference samples collected.

Table 3. Summary of types of samples to be collected.

Parameter	Sample
Sediment Total Organic Carbon	X*
Sediment Grain Size	X
Sediment Zinc	X*
Sediment Copper	X*
Benthic Infauna	X (archive)

*Note: if TOC, copper or zinc levels exceed the limits, a benthic infaunal analysis will be conducted

7. Field Sampling Methods

7.1 Station Positioning and Recording Methods

All site infrastructure will be removed prior to sampling. Original pen locations will be utilized from the 2022 NPDES sampling to locate the locations at each pen.

Sampling vessels will utilize DGPS locations recorded at all stations using a survey-grade heading and GPS recording system. A sampling vessel owned by Gravity Marine Consultants (RV Mazama) is outfitted with a Trimble SPS461 modular GPS heading receiver with a WAAS correction package. The Trimble SPS461 collects satellite and ground corrections to provide a DGPS horizontal position accuracy of 20 cm. The dual-antenna heading receiver also has an accuracy of 0.05-degrees for vessel heading and course calculations.

Navigation and vessel positioning is performed using Hypack 2023 survey software which combines positioning with vessel dimensions, A-frame point location, and heading data. GPS and heading data are fed from the SPS461 receiver via serial connection, and input into the vessel's survey computer. The Hypack navigation software is used to receive the vessel's heading and position data on a real time basis. Vessel specifications are input into the Hypack software to both accurately reflect the dimensions of the vessel, the center of rotation, and the inclusion of an offset tracking point to collect corrected GPS data over the data acquisition

point. This allows the navigation software to reflect in real-time both the heading of the vessel and the course over ground. Offsets are used to correct GPS data from the location of the installed antenna to the location of the acquired sample.

Station locations are digitally recorded at least once to the on-board computer during sampling and repeatedly checked by the sampling vessel's skipper as he maintains the vessel on station with a highly-controllable jet drive propulsion system. Station location code, time of sampling, depth and QAQC notes are recorded digitally by the sampling vessel's skipper and by the chief scientist on board in a written field log on write-in-the-rain paper with pencil with no erasing.

The above-mentioned DGPS unit was routinely monitored to ensure the differential corrections were being received by the DGPS system. The system is also used to collect station depth data by linkage to the on-board chart plotter-depth finder system. The sampling vessel's software systems are updated on a regular basis as revised programs are made available by the manufacturer.

7.2 Benthic Grab Sampling and Coring Methodology

A specialized, jet-drive sampling vessel with high resolution GPS, depth sounder, and winch-davit will be positioned and maintained within 20 cm of the intended sampling location as described herein at *Station Positioning*.

A custom Van Veen style sampler with specialized frame and triggering mechanism will be used for sediment penetration (Figure 16). A hydraulically-actuated grab sampler is also available that is used if the sea bottom is either too soft or too hard to successfully trigger and close the jaws of other samplers.

Figure 9: Custom-built stainless-steel Van Veen style grab sampler used in some cases for net pen monitoring.



The degree of sample disturbance, unevenness of sample surface and leakage from the grab sampler will be noted if the principal investigator or crew believes that specific samples are compromised. The principal investigator will judge the degree of disturbance and decide if the grab sample is suitable or not for coring as per Puget Sound Estuary Protocol requirements (WA Department of Ecology, USEPA, and Puget Sound Water Quality Authority 2015). If accepted, and after siphoning off trapped surface water if required, sample characteristics such as surface color, presence of visible biota, presence of rock, gravel, shell, shell hash, and other material will be documented in a photograph and on field notes. Then sample depth will be measured in the center of the sample with a stainless-steel ruler and recorded in the field notes.

Prior to grab sampling, the sea bottom at every sampling station is first inspected and recorded using a cabled underwater video camera with surface display for the presence of obstructions or debris that could possibly interfere with sampling or jeopardize recovery of the sampler. In the case of perimeter SIZ stations that have the same locations as prior routine sampling events, we have advanced knowledge of the sea bottom's suitability for sampling.

A Nalgene or similar material core will then be used to collect sediment from the grab sample in the top two (2) cm for sediment TOC, copper, and zinc. A translucent core is necessary to assure the correct depth penetration of the core. A clean stainless-steel spoon will be inserted under the core to retain the sediment to remove the sample sediment. The deck crew will smell the sample for the presence of sulfur. If there is any doubt, a second staff member, usually the principal investigator will also smell the core to decide and judge if there was no smell, mild, moderate, or a strong hydrogen sulfide smell.

At the same time, the color of the bottom of the core and in the impression left in the grab sample will be inspected for evidence and coloration of a redox potential discontinuity depth mark (i.e., transition from grey or brown to darker or black color). The core being retained by the stainless-steel spoon is then discharged by shaking into a pre-numbered whirl Pac bag that is just slightly larger in diameter than the core. The sample bag number will then be noted in the field notes. The sample will be mixed by flattening the bag, then the top rolled over and sealed with the built-in retainer. The sample bag will be placed on ice within an ice cooler with ice but within a Ziplock freezer bag for other replicate samples of a single station only.

To collect sediment for grain size analysis, a stainless-steel spoon will be used to remove approximately 150 grams of the top 2 cm of the sample and placed in a pre-numbered Ziplock freezer bag for storage with ice in another cooler, but it will only be refrigerated, not frozen. When this is completed the deck crew will then probe the sample to further depth looking for the presence of an apparent redox potential discontinuity (aRPD) layer interface and recording information as it was acquired. If found, the depth of the aRPD will be noted in the field log, and additional photographs may be taken.

After the above process, the remaining excess sample in the grab sampler will be removed by locking the grab sampler open and rinsing the grab sampler up and down in ambient seawater. The grab sampler will be re-inspected to be sure it is clean after each cleaning, and if there are sticky mud deposits, a brush and seawater spray hose will be used to further clean the grab sampler after every sample at each station. In the past sticky mud has not been seen at any of the four net pen sites targeted in this SAP.

Prior to first use at a net pen facility, the grab sampler will be washed with laboratory grade soap (Alconox) using a brush and warm water and thoroughly rinsed with tap water. All reusable equipment (e.g., sampling cores, spoons, and tubes used as siphons) will be washed similarly and brushed down, particularly in the corners and edges of the sampler, and rinsed thoroughly with seawater after each discrete grab collection to prevent cross-contamination among sampling station samples. After decontamination, sampling equipment will be protected from recontamination by placement in plastic containers treated to the same methods described above. Any sampling equipment suspected of recontamination will be decontaminated again or rejected. Biosecurity procedures instituted by Cooke Aquaculture Pacific will also be followed, e.g., stepping into boot/shoe treatment baths if the sampling vessel crew needs to walk onto a net pen site.

Chain of custody documentation will be provided to the Ecology-certified analytical laboratory to accompany sample shipment. Analytical Resources of Seattle, WA will conduct the laboratory analyses, and it is an Ecology-accredited laboratory.

7.3 Sample Containers and Labels

All sediment chemistry samples will be placed in plastic containers that are labeled with a pen with a matching write in the rain paper tag inserted within and inscribed with pencil. Sediment grain size samples will be placed in quart-sized freezer bags and labeled the same. The laboratory will be instructed to confirm that both labels match in every case and to report any discrepancy.

7.4 Field Documentation Procedures

As noted in Ecology (2003) a standardized field log will be used to record the names of the field crew, arrival and departure dates and times, weather, and other miscellaneous observations in addition to the information discussed in other sections of this plan.

Each gear deployment event will be recorded on a station log sheet. One or more station/sample log sheets may be completed for each station where sediment sampling is conducted. The station name, date, time, gear and cast number, water depth, and location coordinates should be recorded on each log sheet. Penetration depth, sediment type, sediment color, sediment odor, presence of any organisms, and obvious evidence of contamination (e.g., sheen, wood waste, oil droplets, sandblast grit, paint chips) will also be recorded, as well as the sample type, sample identifier, and unique sample number. If any materials, such as woody debris, shells, or rocks, are removed prior to homogenizing the sample, the type of material and approximate quantity will be noted. Any deviations from the sampling and analysis plan that were necessitated by field conditions will also be noted on the station/sample log sheet.

Each set of samples sent to a laboratory will be accompanied by a sample analysis request form that identifies the samples by their unique identification number. This form should identify any preservative or other sample pretreatment applied and the analyses to be conducted by referencing a list of specific analytes or the statement of work for the laboratory.

7.5 Procedures for Disposal of Contaminated Sediments

Although not expected and applicable for this sampling plan, a contingency for sediment with visible evidence of contamination, such as oily droplets, sheen, or paint chips is provided. Visibly contaminated sediment will be stored in a watertight drum onboard for appropriate disposal onshore and noted in the field notes along with the specific GPS coordinates. The project lead and chef scientist will be alerted.

7.6 Sediment Physicochemical Sampling Procedures

Grab samples must meet the minimum fullness and undisturbed standards specified in the NPDES permit (section S2.D, 4 to 5 cm of depth). The sampler also should not be over-filled with sample so that the sediment surface is pressed against the top, that overlying water is present (indicates minimal leakage), that the overlying water is not excessively turbid (indicates minimal sample disturbance), and that the sediment surface is relatively flat (indicates minimal disturbance or winnowing).

Multiple attempts will be made at each station to fulfill this requirement, but all of the stations have previously been sampled in prior permit cycles and Contractor are fully aware of the locations that will not allow grab sample penetration.

After retrieving a closed grab sampler, the top end, sliding covers will be removed to inspect the contents and measure depth of penetration. Samples compromised with shell or rock sticking in the jaws of the sampler that cause significant leakage of water or water/sediment mixtures will be rejected. Overlying water will be decanted slowly and discarded (in the case of physicochemical samples but screened if it is a benthic sample described in the next section). At that point a careful inspection of the entire surface of the sample will be conducted to ensure that it was not disturbed and represents a continuous section of the sea bottom sediments.

Approximately 150 grams of the remaining undisturbed surface sediment to a depth of 2 cm in each grab will be collected using a stainless-steel spoon for the grain size analysis from the top two centimeters of each acceptable grab sample. These samples will also be placed in Whirl Pac bags or zip lock freezer bags.

Characteristics of the grab sample, including date, project name, weather, station location, time, water depth, depth grab sample penetration, sediment type, color and smell of sediment, estimated grain size, personnel names, vessel name, latitude/longitude and accept/reject status, will be recorded on field logs composed of write-in-the-rain paper and held on clipboards for each sample prior to collection of any additional samples.

Sample bags are to be labeled inside with write-in-the-rain paper noting the project name, station location or number and sample number, sampling date and time, sampling personnel, and

number. The same information will also be written with felt pen indelible ink pen on the outside of the whirl pack or freezer bags too.

7.7 Benthic Infauna Abundance

The benthic infaunal abundance sampling, preservation, and analysis will follow Puget Sound Estuary Protocols (PSEP, 1987). When an acceptable grab sample is obtained and sediment for the other analytes are removed, the remaining contents will be sieved through a 1-mm sieve box on the vessel as samples are collected. The sieve box will be checked for damage and wear before each use. A mount will be installed on a side of the vessel that will allow the excess water and sediment to be disposed of directly overboard. When being sieved, sediments will be gently sprayed with water from above, gently agitated by hand in a washtub of water (in an up-and-down, not swirling, motion), or washed using a combination of these techniques. The sample will be washed gently to minimize specimen damage. Once sieving is complete, the screen box will be held at an angle and the remaining material gently washed into one corner. The sample will then be transferred to a container for relaxation, staining, and immediate fixation, using as little water as possible. After the screen has been checked for remaining animals and sample removal is complete, back-wash the screen with a high- pressure spray to dislodge any sediment grains that may be caught in the mesh and to prep for the next sample.

A 10% formalin solution buffered with borax and created with seawater will be used to fix the samples. The formalin solution will be prepared by adding 4 oz of borax to each gallon of concentrated formalin (i.e., a 40-percent solution of formaldehyde in water). When in the field, the solution will be diluted to a ratio of one-part concentrated formalin to nine parts seawater. Seawater will also buffer the solution and act as an isotonic solution reducing swelling and infauna breakage. Samples will be stained with liquid rose bengal with a concentration of 4 g/L and relaxed with a magnesium chloride solution that is isotonic with seawater. The magnesium chloride solution will be prepared by dissolving 73g of hydrated magnesium chloride ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$) per liter of tap water.

Samples will be put into 1- or 2-quart jars provided by the lab. If the sample volume is greater than one half of the container volume, more than one container will be used. The volume of formalin will be at least twice the volume of the sample and will be added to the container until it is completely full. The jar will be immediately inverted multiple times to ensure the sample is well-mixed. After about an hour, the sample will be inverted again several times. These samples will be stored in an empty cooler, so that they will not be in direct sunlight or extreme temperatures.

Lab Processing

The benthic infaunal samples will remain in the buffered formalin-seawater solution for 1 – 7 days. Ideally, the sample will be removed as soon as possible after the initial 1 day. Once removed from the formalin the samples will be washed on a sieve with mesh 0.5mm or smaller.

One of the acceptable rinsing methods is to flush the sample with large quantities of fresh water from a low-pressure faucet or hose, being careful not to splash or spray out any of the sample. The second method is to partly immerse the sieve in a plastic tub filled with fresh water, moving the sieve in an up and down motion, not letting the water rise above the sieve. T

Once the sample is rinsed with fresh water, the sample will be rinsed with a solution of 70% ethanol from a squirt bottle. The sample will then be carefully washed into to a sample jar by, filling it no fuller than three-quarters. The last bit of material on the sieve will be rinsed into the jar by using the squirt bottle with the 70% ethanol solution. The jar will then be filled to the top with 70% alcohol solution and then be inverted multiple times for proper mixing.

An internal label will be placed inside the jar with a waterproof, 100% rag paper filled out with pencil. One external label will be placed on the outside of the jar and the other on the lid. The samples will be stored in an upright position at a cool temperature, away from direct sunlight. These samples will be archived at the lab for future identification if needed.

Sample Sorting

Organisms will be sorted by one of two potential methods. The first and most common approach includes placing a small amount of sample into a petri dish and using forceps to remove each organism in the sample systematically. The sample will be viewed through a 10-power dissecting microscope or magnifying lamp. Enough liquid must be in the dish to ensure that there are no distortions from the water/air interface. Each dish of material will be sorted through twice. The second approach is a floating method, where the sample is washed with fresh water in a large flat tray and the less dense material floats to the top. The less dense material includes organic material, arthropods, and most soft-bodied organisms. The floating material is then carefully poured into a sieve and is sorted using the standard technique above. The denser material is then sorted through with a 5-power illuminated hand lens. The denser material usually includes molluscs and some tube-dwelling or encrusting organisms. All the molluscs and polychaete tube fragments must be removed for closer inspection. These fragments must then be viewed under a 10-power dissecting microscope to remove any organisms from tubes and to ensure that the molluscs were alive when collected.

Each sample will only be sorted by one person. Organisms will be sorted into these major groups at a minimum: Annelida (polychaete worms), Arthropoda (crustaceans), Mollusca (bivalves, gastropods, aplacophorans), Echinodermata (asteroids, ophiuroids, echinoids, and holothuroids), and miscellaneous phyla (combined). All organisms should be placed in large vials containing 70-percent alcohol solution, other than Ophiuroidea which requires air drying for identification. Special handling of Ophiuroidea should be conducted by experienced sorters. Each vial containing a major taxonomic group should have an internal label listing the survey name, station designation, water depth, date sampled, and field screen size. All vials from the same sample should be stored in a common container and immersed in the 70-percent alcohol solution. To reduce evaporation of alcohol, vials and container lids can be sealed with plastic tape.

Taxonomic Identification

Taxonomists will identify the organism to the species level. Binocular dissecting and/or compound microscope will be used for identification. If a specimen is incomplete, only the anterior or posterior ends will be counted. If possible, two pieces of literature should be used for each species identification. The taxonomist will record notes and identification in a notebook, and then transfer the data to datasheets.

Following the identification, all organisms will be placed into vials with 70%-ethanol for long term storage. Each vial will have a label containing the project name, sampling site, sample number, collection gear, water depth, and date. All the organisms from a sample will be placed into common containers and immersed in 70% ethanol as well.

Quality Assurance and Quality Checks

The analytical balance used for biomass measurements will be calibrated on a weekly basis at a minimum. All microscopes and balances used for this project are required to be serviced at regular intervals. In most cases, an annual service and inspection fulfills the manufacturers' requirements.

Taxonomic identifications need to be consistent within the laboratory and with other regional labs. If a permanent reference collection is available at the lab, the samples will be confirmed against them. If a reference collection is not available, at least three individuals of each taxon will be verified by recognized experts. Once these samples have been verified, the samples should be stored to start a reference collection. Additional details on proper reference collection storage can be found in the PSEP document (PSEP 1987).

At least 20% of each sample should be resorted for QA/QC purposes. After initially removing the organisms, a representative 20% of the remnants will be reassessed with a dissecting microscope capable of 25-power. The re-sort will be completed by someone other than the person who initially sorted the sample. A sample sorting efficiency of 95% is considered acceptable. In other words, no more than 5% of the organisms in each sample are missed by the sorter. If the 95%-criterion is not met, resorting is required.

To ensure that identifications are accurate, 5% of all samples identified by one taxonomist will be reidentified by another qualified taxonomist. The senior taxonomist is the ultimate decider on the proper identification. Accurate identification of 95% of the total number of species is considered acceptable. If a taxonomic error is found, all the work of the taxonomist should be reviewed to identify the specific error or inconsistency in other samples.

Performance Standards and Objectives

When the benthic infaunal samples have been sorted and identified, the average organism abundance at the reference site and net pen sites will be compared. The marine sediment objectives and cleanup screening levels determined by the Sediment Management Standards (SMS) will be used as the performance standards for this project (Table 1). The replicate abundances will be averaged for the taxa class Crustacea, phylum Mollusca, and class Polychaeta of the entire sampling site for comparison purposes. If the site of interest has a taxa organism abundance greater than 50% of the abundance of the same group at the reference site, the site meets the performance standard. The results from this analysis will be provided to Washington Department of Ecology (Ecology) in a report with clear pass or failure of the performance standard.

Table 4. Performance standards for the benthic infaunal abundance sampling at the net pen sites that are required to pass.

Sediment Cleanup Objective for each biological test	Cleanup Screening Level for each Biological Test
$A_T / A_R > 0.50$ For any one of three major taxa Class Crustacea, Phylum Mollusca, or Class Polychaeta	$A_T / A_R > 0.50$ For any two of three major taxa Class Crustacea, Phylum Mollusca, or Class Polychaeta

A = Site average Abundance
 T = Test
 R = Reference

7.9 Sample Handling, Storage, and Delivery Procedures

Sample storage and handling procedures will comply with the 2019 NPDES requirements PSEP protocols for storage, chain of custody, shipping, and delivery. Specifically, all TOC/zinc and grain size samples will be kept in ice chests with bags of ice or blue ice on the day of collection. As soon as the sampling is completed and the crew returns to their base, TOC/zinc samples will be frozen and sediment grain samples refrigerated in a 4 °C refrigerator if the samples cannot be delivered to the laboratory the next day. Under no circumstances will the sediment grain size samples be frozen. Chain of custody forms provided by the laboratory and attached notes will be maintained and used, and copies signed and copied at the laboratory during the delivery process. Shipping of samples by common carrier or courier will not be conducted. Samples will be delivered by one of the consultants conducting the fieldwork. The laboratory will inspect and enumerate the samples during the delivery process, record the temperature of the samples and provides copies of the signed and dated chain of custody forms to the delivery staff.

8. Laboratory Analytical Methods

All laboratory analyses will be performed by a Washington State Department of Ecology Certified Laboratory known as EHI Laboratories in Seattle, a laboratory with extensive

experience with the methodology. Methodologies, detection limits and quality control measures are as follows:

8.1 Solids Analysis

Dry weight must first be determined for the sediment samples using a procedure to dry the sediment without combusting it. The procedure is specified as EPA method 160.3 that has a stated *detection limit of 1%*, but usually is much better. The wet sample will be mixed thoroughly and weighed and dried in a laboratory oven at 103 to 105°C. The sample will then be cooled in a desiccator to avoid re-hydrating and then promptly reweighed to calculate the total residue. The sample will then be ready for other analyses.

8.2 TOC Analysis

A critical sample preparatory step in the laboratory process is inorganic carbon removal through acid fuming that is particularly important in samples with shell and shell hash. Accordingly, sediment samples for total organic carbon (TOC) will be homogenized, as per the above solids analysis description and treated with weak HCL acid to remove inorganic carbonates, e.g., shell and shell hash particles. This is to be done in a careful manner so as not to oxidize organic material but to be sure that all carbonates are removed. The pre-treatment is complete when visible effervescent reaction of the sample is no longer visible, after stirring the sample and acid treatment. The laboratory uses a Shimadzu TOC-V Combustion system with infrared detection to perform EPA method 9060 to estimate TOC concentrations of sediment samples after homogenizing them. EPA method 9060 can involve many different analytical processes, some not as accurate and precise as the above cited combustion system. The associated quality control (QC) check for TOC is essentially an LCS (laboratory control sample). A reference material, in this case Buffalo River Sediment 8704, which has a known value of 3.35%, will be used in this process. The internal laboratory QC goal is 90-110%. At least 5% of the samples are split and run in duplicates with an RPD goal of <20%. For Puget Sound net pens, the results are usually in the range of 1% to 15%. Sample blanks have also been analyzed for quality control and routinely indicated < 0.01% TOC or no detection. The 0.01% concentration is the detection limit for the method, but Puget Sound sediments are typically significantly above that limit.

8.3 Particle Size Analysis

Particle size samples will be conducted to estimate the percent fine (silt and clay) to classify the associated TOC samples into one of the four regulatory performance categories. Grain size analysis defines the frequency distribution of the size ranges of the particles that make up the sediment. The general size classes of gravel, sand, silt, and clay are the most useful in describing the samples, but for the purposes of the sampling the focus is on silt and clay combined, known as “fines”. The method used for analysis will be ASTM D422. This method remains widely used but was formerly withdrawn by ASTM on account of the hydrometer testing of silts versus clays. That is not an issue with the method’s use in this case, as that component is not needed nor utilized.

The grain size distribution and percentage fines will be analyzed, and frequency distribution of all particle sizes determined using wet or dried samples passed through a set of precision standard sieve screens. Usually this is conducted through wet sieving. The application of this

method does not include pipette analysis as there is no need to differentiate between silt versus clay.

Quality control measures for fines particle size analysis focus on laboratory splits for duplicate analysis. No published target RPD or other metrics are available, but the method is highly susceptible to the presence or absence of shell and shell hash that increases RPD, especially if a sampling location has relatively heterogeneous distributions of these materials. Soft bottom samples from mud and sands generally produce relatively low RPD results. These factors have to be accounted for when evaluating results and judging quality assessment. The chain of custody documentation will specify that the laboratory performs a specific percentage of laboratory splits for determination of precision if observations during sampling indicate highly variable sediment grain size distributions. In such cases, additional analysis of the data by plotting and statistical analysis may be required.

8.4 Sediment Zinc Analysis

Metals analyses for sediment zinc will be performed using EPA method 6010B /3051, known as inductively coupled plasma - atomic emission spectrometry. The detection limit for this analysis is 0.1 mg/kg. QC checks will be conducted by the laboratory for the sediment zinc analysis. QC checks will be conducted with zinc spikes as outlined in the methodology.

8.5 Quality Assurance and Quality Control

QA/QC procedures will comply with the PSEP and ASTM protocols. Quality assurance objectives and measurements are detailed throughout this plan. The laboratories performing the analytical work will assess laboratory quality assurance for analytical methods as per this plan and the Puget Sound Protocols.

8.6 QA/QC specifics for chemical analyses

The laboratory identified for this project (Analytical Resources Inc Laboratories) is part of a large multinational company certified in Washington State by Ecology to perform all the analyses utilized for this project. Accreditation requires submission of an acceptable Quality Assessment (QA) manual, documentation of Quality Control (QC) procedures required by specific methods, success in analyzing samples as part of proficiency testing and success in passing an on-site audit by Ecology or another recognized accrediting authority and several ongoing accreditation maintenance requirements.

The certified laboratory will flag any samples that exceed the hold time, are damaged or leaking or otherwise do not meet normal quality assurance standards. Data are often transmitted to clients by email using spreadsheets where methods, detection limits, raw data for each sample, and QC information are included for each batch of samples submitted along with a statement regarding the general acceptability of the samples that were provided.

The net pen NPDES monitoring project QA/QC will consider the standard benchmarks including qualitative (e.g., completeness, representativeness, defensibility, accuracy) and quantitative (numerical objectives for precision and lack of bias) objectives. These topics have already been addressed specifically for the net pen NPDES monitoring SAP above in “*Laboratory Analytical Methods*” and are here discussed in more general terms.

Completeness. The developed data sets are to be assessed to assure the sample and analysis plan and meets the goals and objectives of the study. Samples will be collected and assayed for TOC, sediment grain size, and zinc for all assigned stations that have sufficiently soft sea bottoms to allow grab sample collection of undisturbed sediments. Improvements in grab sampling equipment and the vessel(s) used to deploy the gear over the years have allow sampling to occur, where in the past wash-out of sediment from partially-closed samplers negated efforts at many more stations than occurs at present. All samples collected and recorded in field notes and the on-board computer system will be accounted for in the resulting analytical laboratory processes. If any samples were lost or mishandled in the collection, storage, transport or analysis phases of this project they will be identified and explained.

Representativeness. Net pen sampling in past decades has always been conducted in summer for reasons previously explained herein. Sampling will be conducted in the spring of 2024, so it is possible to compare among years for this time period if necessary. No major changes in sea bottom conditions are expected from summer to winter as sediment conditions reflect and integrate long periods of overlying water column conditions and productivity. It is possible and even probable that TOC conditions will have declined due to the fallow period, as the organic matter from fish wastes will be rapidly assimilated by benthic, epibenthic, and above interacting food webs. The key objective is to be sure that the sample collection and analysis

provides adequate representativeness of the conditions so that the performance standards can be applied.

Defensibility

Specific requirements for laboratory analyses defensibility are presented in Ecology's (2010) procedure manual for environment laboratory accreditation. These procedures are not repeated here but provide detailed instructions for recording and documenting analytical records and focus strongly on QA procedures mentioned above. Defensibility also is the realm of the field work, both in planning and execution of the sampling by using the best available techniques, equipment and sample extraction and handling procedures that are all documented and recorded.

Comparability. Sediment samples and dissolved oxygen measurements will be collected and analyzed using identical protocols and standard methods discussed in the sampling and analysis plan for this project that represents the most appropriate methodology. The same analyst will enter the laboratory data into spreadsheets, double check the entries on a separate day and inspect results for unreasonable entries or outcomes. Statistical tests are to be conducted twice on separate days for these samples and the outcomes compared using a statistical software program known to be valid and error free. Therefore, these data may be compared to similarly collected data in the past and possibly the future if the same protocols and types of analytical equipment are used.

Comparisons made among samples within the data set are therefore also valid, but not expected to be similar as site and station-specific habitat characteristics can vary considerably over small spatial and temporal scales.

Each grab sample that is judged in the field to be of adequate volume and have suitable grab sampler closure to prevent washout will have a unique and matching sample number in order to easily compare results among parameters. Upon receipt of the laboratory data, the spreadsheets will be checked for completeness by comparing the chain of custody and also the field logs, if necessary. As described in the statistical analysis section of this SAP, the principal investigator will calculate average and standard deviation for each set of replicates/samples from the net stations and evaluate potential non-normal distribution or potential outlier occurrence. Re-testing of the remaining sample that was mixed initially can then be requested from the laboratory, if necessary. ARI Laboratory retains all remaining samples in the appropriate storage conditions until advised that the technical analysis is completed, and the final report completed and submitted.

If retesting is done, both the initial data and subsequent analysis of the same sample will be reported and possible explanations for variation listed. For TOC the most common cause is usually wood chips, but none of the four net pens included in this SAP have had that occurrence in the past. For zinc, the possibility of rusted steel net pens was suggested when a single value out of many dozen to hundreds of samples indicated a high value. This should occur upon closure as Cooke Aquaculture Pacific has had an aggressive cage maintenance program that the prior ownership did not pursue.

For analysis of the laboratory reported QAQC results, the final report appendices will include the original reported QAQC data in association with the original data. These QAQC data will be combined into tables in the body of the final report where they can be summarized, compared, and contrasted.

Data quality assurance review reporting

Laboratory reports, QA worksheets (when applicable), and chain-of-custody records will be included in appendices to the NPDES monitoring project reports. Any problems and associated corrective actions taken will be reported, interpreted, and suggestions provided to deal with a specific problem at hand.

Normally, the laboratory will detect analytical problems prior to producing written results and would contact the client whether solutions are readily available or not. However, through correspondence and discussion, the laboratory and the project chief scientist and project manager can help expedite solutions as needed.

Specific QA information that will be noted in the project NPDES final report include the following:

- Changes in the monitoring and QA project plan
- Results of performance and systems audits
- Significant QA problems and recommended solutions
- Data quality assessment in terms of precision, accuracy, representativeness, completeness, comparability, and detection limits
- Sample estimates and rejections
- Discussion of whether the QA objectives were met, and the resulting impact on decision-making.
- Limitations on use of the measurement data
- If routine QA/QC measurement or recommendations were conducted, and what the results of the measurements met the requirements.
- Transmission of specific laboratory objectives to the support laboratory

Although care is required, this project does not include difficult planning or field work, and the types of analyses to be conducted are routine and have been conducted repeatedly over past decades. The Ecology certified laboratory responsible for project laboratory analyses should be contacted for any other information such as bench sheets or computer records of intermediate calculations or results. These data are not under normal circumstances provided to Cooke Aquaculture Pacific or their designated field sampling consultants or consulting chief scientist.

9. Data Analysis, Record Keeping, and Reporting

9.1 Statistical Analysis of Data

Sediment chemistry data from the laboratory and field notes are arrayed in tables for inspection using Excel spreadsheets that include statistical average and standard deviation of each

monitoring station using all available samples for sediment TOC, sediment silt and clay, and sediment zinc.

A summary table with raw and transformed raw data, means, and threshold performance targets, in both raw and transformed format are prepared. These tables will include all pertinent ancillary sample identification data discussed elsewhere in this plan along bold font indicating if performance standards of mean values are exceeded. If any retesting of the samples (i.e., additional laboratory splits) were evaluated to confirm high or low values of individual or groups of samples, these are reported in separate columns that are appropriately labeled.

9.2 Record Keeping Procedures

Provisions will be included in all sediment sampling and analysis plans for record keeping in accordance with the requirements of the 2019 net pen NPDES permits. All sampling and analysis and log sheets or records (including field logs) will be retained for a minimum of three years, in accordance with S3.C of the permits. Contractors working for Cooke Aquaculture Pacific may elect to retain their records for that period or transfer such records to the company in the future should they not be contracted for further studies. At that point it will be the responsibility of Cooke Aquaculture Pacific LLC to retain such records in accordance with the permits.

9.3 Reporting Procedures and Timing

Laboratory results of NPDES closure monitoring will be reported to Ecology using the EIM on-line reporting system. The results will be filed in advance of the due dates of the written sediment monitoring reports and the date of submittal to the EIM system will be noted in the written reports.

Final NPDES closure project reports will be filed using Ecology's Water Quality Permitting Portal by the project manager.

Sediment data must be submitted in both dry weight and total organic carbon normalized units and compared to SMS criteria. The data report must note if Exceedance and/or Enhanced Monitoring will be required.

10. Health and Safety

A separate Health and Safety Plan for Gravity Marine, the contractor responsible for sampling vessel operation will be provided. Cooke Aquaculture Pacific, the fish farm facility owner, has previously submitted an Accident Prevention Plan to Ecology. These plans will be shared between the companies and reviewed by managers and the sampling vessel skipper and staff prior to conducting the work outlined in this document.

The best weather conditions occur in June, and the weather affects all human endeavors when it is harsh. Limited daylight hours, persistent rain and wind conditions, wind and snowstorms, electrical storms and especially foggy conditions present serious health and safety sampling in the waterways of Puget Sound that experience continually expanding vessel traffic year-round.

As the professional research vessel charter company Gravity Marine has to be contracted well in advance for specific sampling events and places, plans will also have to include alternative, backup sampling days if conditions pose an unacceptable risk to field staff or others that could be affected. The project manager and chief scientist along with the operations manager will need to utilize NOAA weather forecasts to approve sampling previously planned in advance and arrange for possible alternative re-scheduling.

It is the practice of Gravity Marine that the skipper of the sampling vessel review the safety procedures such as use of approved hard hats on deck during grab sampling winch operation, locations and use of fire extinguishers, VHF radio emergency operation, storage location for marine flares and other signaling devices and rules regarding personal floatation devices prior to commencement of work at a project site.

Literature Cited

See also Appendix A for recent net pen NPDES reports not duplicated in this literature cited section.

Collias E. E., and T. H. Benttinen. 1967. A study of water circulation in Clam Bay, WA. U.S. Public Health Service, Division of Buildings and Facilities, Design and Construction Branch. 202 Willste Bldg. Silver Spring, MD. No. D-874043-7. 13 p.

Ecology. 2019a. National Pollutant Discharge Elimination System Waste Discharge Permits for WA0031593, WA0031526, WA0031534 and WA0031542. Prepared by State of Washington Department of Ecology, Southwest Region Office, Olympia WA. Addressing Cooke Aquaculture Pacific, LLC sites. Issued July 11, 2019. Effective Date: August 10, 2019, to August 9, 2024.

Ecology. 2019b. Appendix A. Sampling Guidance for NPDES Permits under the Sediment Management Standards. In: Washington Department of Ecology's Sediment Cleanup User's Manual (SCUM) Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC May 2019 Revised Draft for 60 Day Review and Comment Publication No. 12-09-057 Original publication March 2015, First Revision December 2017, Second Revision draft May 2019.

McGary, N. and J.H. Lincoln. 1977. Tide Prints. Surface tidal currents in Puget Sound. Washington Sea Grant Publication. University of Washington Press, Seattle.

Rensel, J.E. 2006. Biological evaluation and biological assessment: Addition of four pens to existing North Skagit Bay net-pen structure. Prepared for American Gold Seafoods LLC by Rensel Associates for National Marine Fisheries Service review. 98 pp. See also 11-page addendum, Endangered Species Biological Evaluation Reference No. 200501468.

Rensel, J.E. 2007. NPDES Sampling and Analysis Plan 2007: Puget Sound Floating Net Pens. Prepared for American Gold Seafoods, LLC. Seattle WA. 30pp.

Rensel, J.E. 2010. NPDES Sampling and Analysis Plan for Puget Sound Floating Net Pens, 2010 Sampling. Prepared for Icicle Acquisition Subsidiary, LLC. DBA: American Gold Seafoods. 49 pp. and appendices. Submitted to Washington Department of Ecology. Olympia, Washington.

SAIC. 1986. Recommended interim guidelines for the management of salmon net pen culture in Puget Sound. Science Applications International Corporation for Washington Department of Ecology. WDOE Publication 87-05. Ecology contract No. C-0087110. Olympia, Washington.

Washington State Department of Fisheries. 1990. Programmatic Environmental Impact Statement: Fish culture in floating net-pens. Prepared by Parametrix, Battelle Northwest Laboratories and Rensel Associates for and with the Washington State Department of Fisheries. 161 pp.

Zar, J.H. 2010. Biostatistical Analysis. Third Edition. Prentice-Hall, Inc. 662 p. and appendices.

Appendix A. Prior Puget Sound Net Pen NPDES Monitoring Reports

The following are annual and other sampling reports plus prior sampling and analysis plan citations from the past 10 years. These reports should be available from the Washington Department of Ecology upon request or be available online:

Rensel, J.E., 2008. NPDES sampling during 2007: American Gold Seafoods Net-pen sites in Puget Sound. Prepared for Washington Dept. of Ecology and American Gold Seafoods LLC by Rensel Associates, Arlington WA.

Rensel, J.E. 2009. NPDES Sampling during 2008: Exceedance Monitoring at American Gold Seafoods Net-Pen Sites in Puget Sound, Site 1 Deepwater Bay, NPDES Permit WA-003156-9 and Site 2 Deepwater Bay, NPDES Permit WA-003157-7. Prepared by Rensel Associates Aquatic Sciences for American Gold Seafoods and the Washington Department of Ecology. 96 pp.

Rensel, J.E. 2010. Draft NPDES sampling and analysis plan 2010. Puget Sound floating net pens. Prepared for Washington Dept. of Ecology and American Gold Seafoods LLC by Rensel Associates, Arlington WA. (Provided as a draft on January 30, 2010, to Dept. of Ecology).

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Appendix B. Gravity Marine Health and Safety Plan

Same as previously submitted plans