

FINFISH AQUACULTURE SITE AQUACULTURE STEWARDSHIP COUNCIL REPORT SALTEN, SECHELT INLET, BC

SITE LICENSE: AQ332

SURVEY TYPE: ASC

SURVEY DATE: MAY 26, 2020

REPORT DATE: JUNE 16, 2020

PREPARED FOR:

GRIEG SEAFOOD BC LTD.

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Summary

This document presents the qualitative and quantitative assessment of sediment obtained during the survey completed at the Salten finfish aquaculture site operated by Grieg Seafood BC Ltd in Sechart Inlet, BC, on May 26, 2020. Sediment was collected and the data analyzed according to the *Aquaculture Activities Regulations* (AAR) and adapted to address Criterion 2.1 and 5.2 of the Aquaculture Stewardship Council (ASC) Salmon Standard.

The measured and observed characteristics of the sediment collected during the sampling confirmed that the stations outside the Allowable Zone of Effect (AZE) on Transects A, B and C had mean sulphide levels less than the ASC Salmon Standard acceptable limit of 1500 µm. Redox potential measured in sediment obtained outside the AZE on Transect A, B and C was greater than the ASC Salmon Standard acceptable lower limit of 0 mV.

As required by Criterion 5.2 of the ASC monitoring for parasiticide residue was completed at the station outside the AZE on Transects A, B and C and at two reference stations. Emamectin benzoate and florfenicol was below detectable limits in all collected samples.

An assessment and identification of the benthic organisms present in the sediment was not completed to evaluate for potential impacts to habitat, as BC salmon farms have been granted a variance to Indicators 2.1.2 and 2.1.3 and instead rely on the scientifically proven and federally regulated sulfide surrogates (ASC VR224)¹.

¹ <http://variance-requests.asc-aqua.org/questions/vr-224-benthic-biodiversity-and-benthic-effects-salmon-v1-0-2-1-2-2-1-3/>

Table of Contents

Summary.....	ii
Table of Contents.....	iii
1.0 Introduction.....	1
2.0 Methods.....	3
2.1 Field Sampling	3
2.2 Data Analysis.....	6
3.0 Results and Discussion	8
3.1 Redox Potential and Sulphide Levels.....	8
3.2 Parasiticide Residue	8
4.0 References	11
Appendix 1 – Sample Photographs	I
Appendix 2 – Salten Field Data	V
Appendix 3 – Salten ASC Survey Summary	VII

1.0 Introduction

This document presents the marine sediment data collected as part of a benthic study completed at the Salten finfish aquaculture site operated by Greig Seafood BC Ltd (Campbell River, BC). The Salten site is located in Sechelt Inlet, BC (Figure 1).

The study was completed by adapting the methodology required for operational monitoring of waste dispersion required under *Aquaculture Activities Regulations* (AAR) and comparing the results with the indicators listed in Criterion 2.1 of the Aquaculture Stewardship Council (ASC) Salmon Standard. Additional analysis of the collected sediment was also completed to address Criterion 5.2 of the ASC.

The purpose of the ASC Salmon Standard is to evaluate concerns of potential environmental impact related to salmon farming. The Standard is based on a combination of requirements and performance levels that must be reached in order to determine if potential impacts are being addressed. Principle 2 of the Standard addresses the “*potential impacts from salmon farms on natural habitat, local biodiversity and ecosystem function*” (ASC, 2012).

This survey was specifically designed to address Criterion 2.1 within Principle 2 of the ASC Salmon Standard which involved the collection of sediment within and outside of the Allowable Zone of Effect (AZE). Sediment was analyzed for redox potential and sulphide levels to evaluate benthic habitat conditions. In addition, testing for parasiticide residue in sediment collected at the two reference stations and at the stations outside the AZE was completed to address Criterion 5.2.1 of the ASC.

An assessment and identification of the benthic organisms present in the sediment was not completed to evaluate for potential impacts to habitat, biodiversity and ecosystem function, as BC salmon farms have been granted a variance to Indicators 2.1.2 and 2.1.3 and instead rely on the scientifically proven and federally regulated sulfide surrogates (ASC VR224).

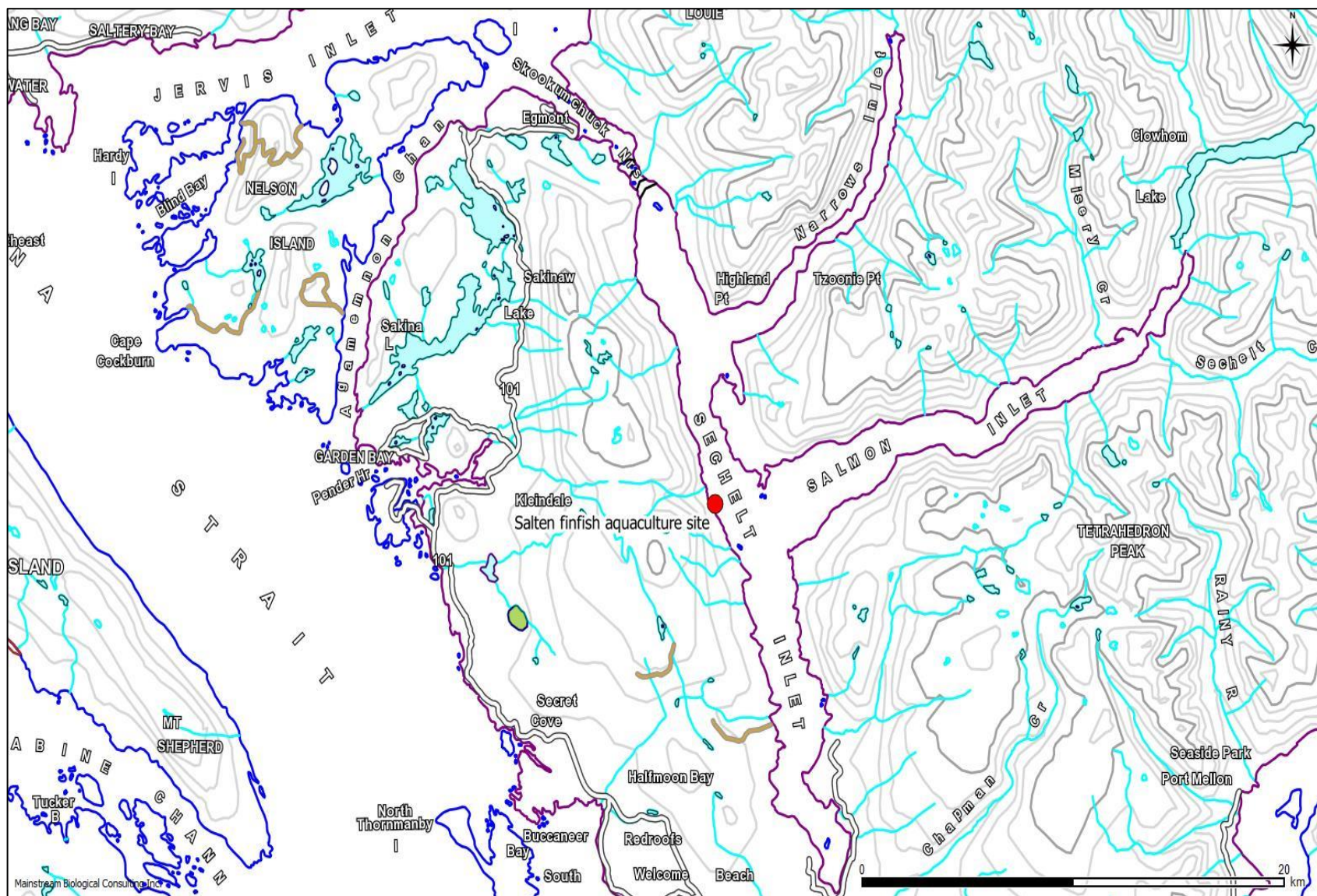


Figure 1: An overview map showing the approximate location of the Salten finfish aquaculture farm site (red dot) in Sechart Inlet, BC.

2.0 Methods

The substrate at the designated sampling locations at the Salten finfish aquaculture site had not been previously identified to consist of “soft” sediment. Therefore, the field activities involved the attempted collection of sediment samples for physical and chemical analysis.

2.1 Field Sampling

The locations of sediment sampling stations were provided by Greig Seafood BC Ltd.

Individual sediment sampling stations were located along three Transects A, B, and C. Stations within the AZE were located 5 m inside the 1 g DEPOMOD contour (Figure 2) for all three transects and also at the perimeter of the containment system for Transects A and B. Stations outside the AZE were located 25 m outside of the 1 g DEPOMOD contour. Additional stations were established at two reference sites within the range of 500 m to 1000 m from the aquaculture containment system as outlined in the ASC Salmon Standard (Figure 3).

Sediment collection was attempted using a Petite Ponar sampler. Three grab attempts were made at each station, with the exception of the 0B station which could not be accessed due to the presence of a float house. Two sediment samples were collected at each station if sediment could be successfully obtained.

The coordinates of the sample locations were recorded using a Trimble GeoExplorer GeoXT (Firmware v1.05) using TerraSync 3.30 software and equipped with an external Hurricane antenna.

Data filters were set to standards recommended by the Resource Inventory Standards Committee (RISC)², with at least 15 fixes taken per location, using satellites greater than 15 % above the horizon with signal to noise ratios (SNR) greater than 40 and a horizontal dilution of precision (HDOP) of five. The GPS data was corrected post-mission with Pathfinder Office v5.40 software using data from the Nanoose base station (NANO).

The Trimble antenna was attached to the grab davit and positional fixes were obtained while the grab was completing the estimated bottom third of its descent. Positional fixes were completed when the grab was on the bottom and the drop line was as close vertical as possible.

² Integrated Land Management Bureau. 2008. Province of British Columbia Standards, Specifications and Guidelines for Resource Surveys Using Global Positioning System (GPS) Technology. Release 4.0d.

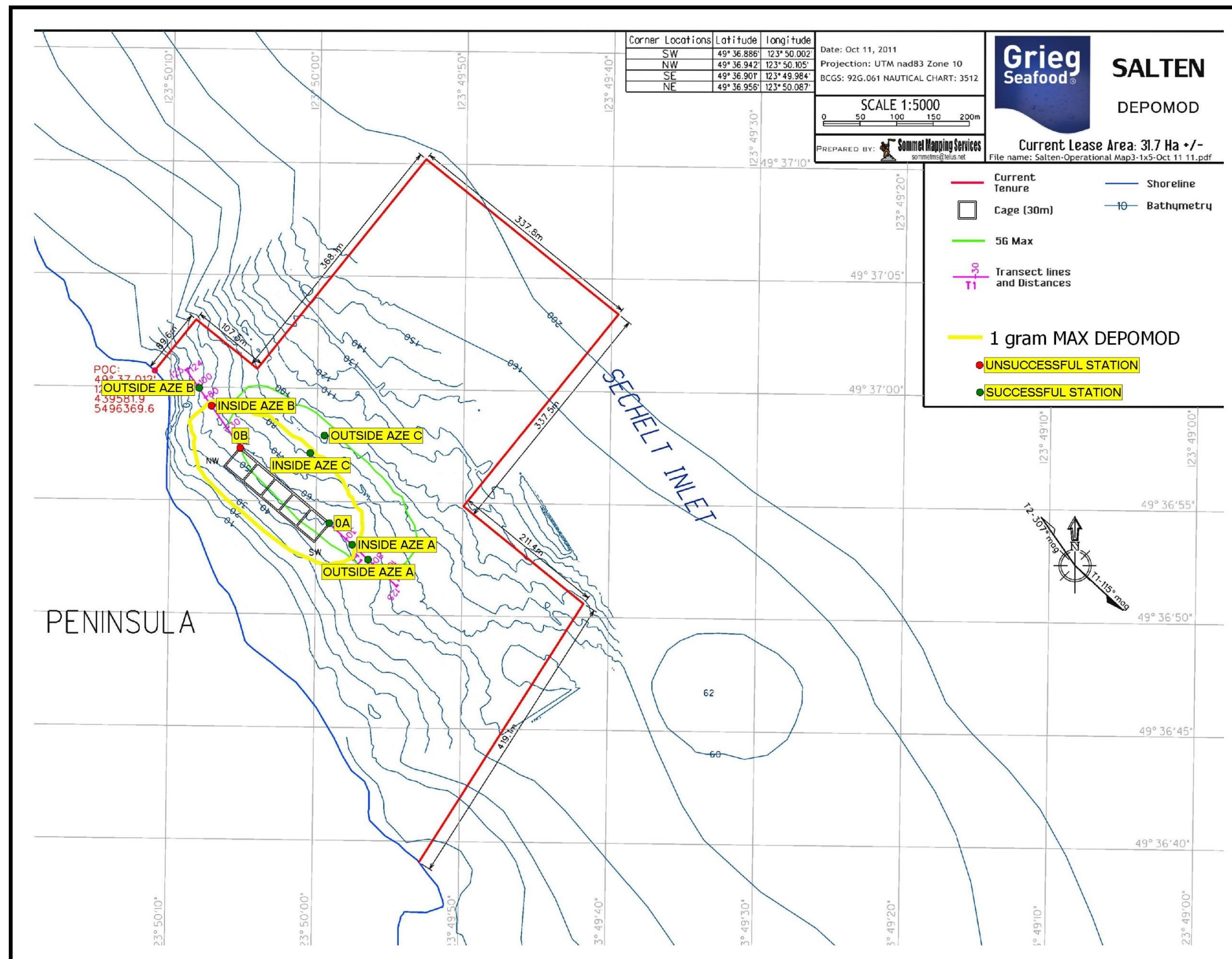


Figure 2: The locations of the sampling stations for the ASC survey at the Salten finfish aquaculture site in relation to the pen system and surrounding area on May 26, 2020.

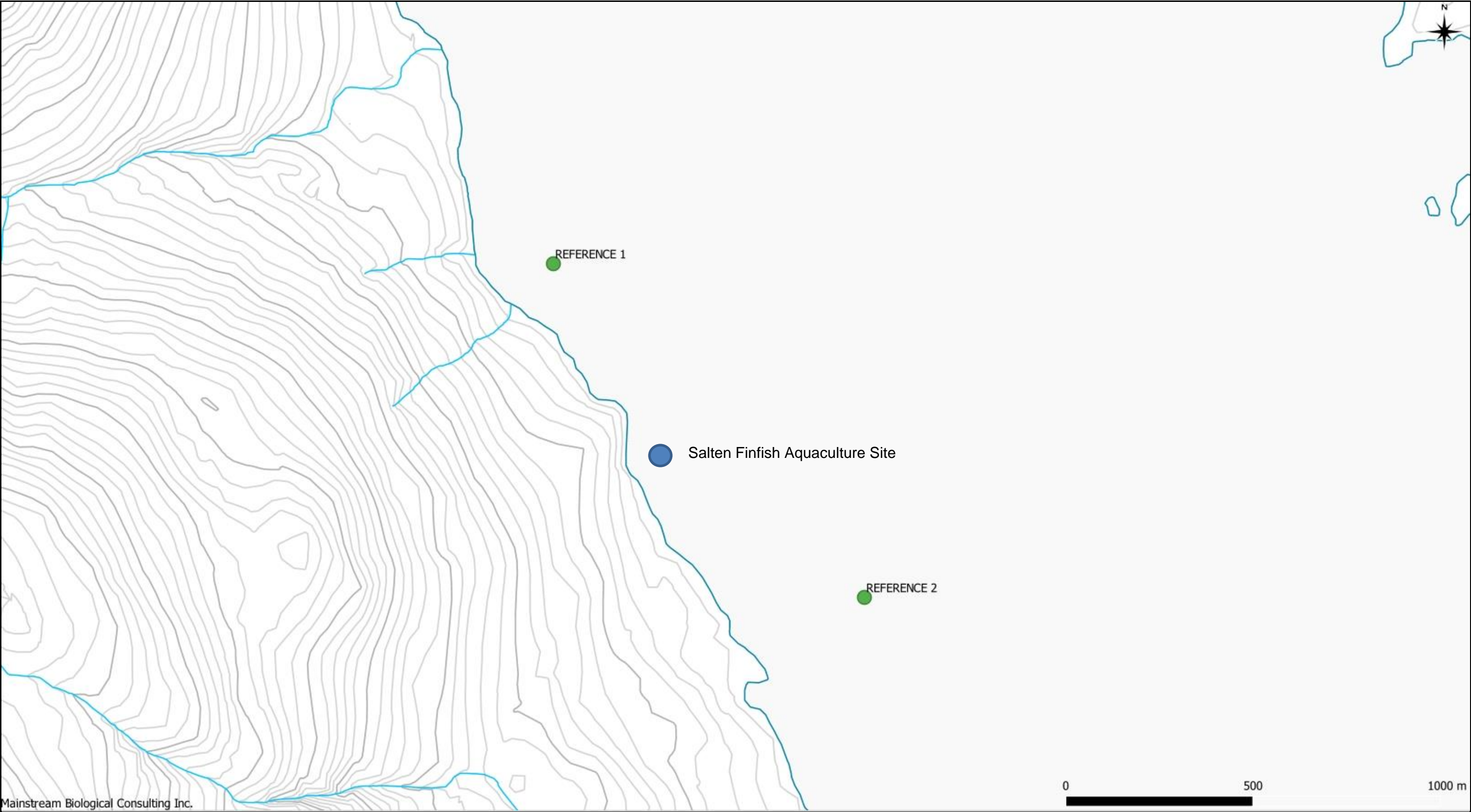


Figure 3: The locations of the reference stations for the ASC survey at the Salten finfish aquaculture site in relation to the site and surrounding area on May 26, 2020

The time at which each sample was successfully obtained and physical characteristics of the collected sediment were recorded. A digital photograph of each sample was also taken. As per Indicator 2.1.1, levels of free sulphides and redox potential of each sediment sample were measured in the field using an Orion A324 meter and the appropriate ISE probes. A digital thermometer was used to measure the temperature of the sediment.

As per Indicator 5.2.1, portions of the grab samples collected at the stations outside the AZE on Transects A, B and C as well as the reference stations were retained for analysis. Retained samples were stored at 4° Celsius and transported to SGS Canada Inc for analysis for emamectin benzoate and florfenicol.

2.2 Data Analysis

In order to evaluate if the benthic conditions at and near the Salten site met the requirements of Criterion 2.1 of the ASC Salmon Standard, the data collected was compared to required levels for indicators of potential finfish farm impacts. These indicators represent a combination of chemical and biodiversity measurements to evaluate the status of benthic health, biodiversity and ecosystem function and to detect potential impacts related to the salmon farm operation. The indicators considered for this assessment are summarized below in Table 1.

Additional analysis of parasiticide residue was completed to fulfill the requirement for monitoring of these chemicals but there is no required level presented in the ASC to compare these results to.

Table 1: Summary of indicators of benthic health, biodiversity and ecosystem function that were considered during the evaluation of the Salten finfish aquaculture site. The indicators have been adopted from Criterion 2.1 of the ASC Salmon Standard.

Criterion Number	Indicator	ASC Salmon Standard Requirement
2.1.1	Redox potential in sediment outside the AZE ¹ .	>0 millivolts (mV)
2.1.1	Sulphide levels in sediment outside the AZE.	≤1500 microMoles / L (µM)

1: AZE = Allowable Zone of Effect

3.0 Results and Discussion

Representative photographs of sediment obtained at each sampling station are presented in Appendix 1. Raw data obtained from sediment sampled in the field is presented in Appendix 2 and the summarized data is presented in Appendix 3.

The sediment successfully collected at the Salten sampling stations typically consisted of dark brown mud with sponge spicules. Sediment could not be successfully obtained from the station inside the AZE on Transect B (Table 4).

3.1 Redox Potential and Sulphide Levels

Following Criterion 2.1.1 of the ASC Salmon Standard, the results of redox potential and sulphide testing at the station outside the AZE were analyzed to help evaluate if the Salten facility was meeting the certification requirements (Appendix 3).

The mean sulphide level in sediment collected at the stations outside AZE on Transects A, B and C (15.7 μM , 12.4 μM and 9.25 μM respectively) on May 26, 2020 were less than the ASC Salmon Standard sulphide upper limit of 1500 μM .

Mean redox potential in sediment collected at the stations outside the AZE on Transect A, B and C (57.3 mV, 259.2 mV and 254.8 mV respectively) were greater than the 0 mV minimum requirement cited in Criterion 2.1.1 of the ASC Salmon Standard.

3.2 Parasiticide Residue

Analysis of the sediment collected from the stations outside the AZE on Transects A, B, C and the two reference stations for emamectin benzoate and florfenicol are shown in Table 3. The analysis was completed to fulfill the requirement of the ASC Salmon Standard Criterion number 5.2.1. All of the collected sediment samples analyzed had parasiticide residue concentrations less than the laboratory detectable limit.

Table 3: The parasiticide residue concentration of collected sediment at the stations outside the AZE on Transects A, B, C and the two reference stations at the Salten finfish aquaculture site on May 26, 2020.

Station Name	Sample Number	Emamectin Benzoate (ppm)	Florfenicol (ng/g)	Florfenicol Amine (ng/g)
Detection Limit		1.0	2.00	5.00
Outside AZE A	1	<1.0	<2.00	<5.00
Outside AZE A	2	<1.0	<2.00	<5.00
Outside AZE B	1	<1.0	<2.00	<5.00
Outside AZE B	2	<1.0	<2.00	<5.00
Outside AZE C	1	<1.0	<2.00	<5.00
Outside AZE C	2	<1.0	<2.00	<5.00
Reference 1	1	<1.0	<2.00	<5.00
Reference 1	2	<1.0	<2.00	<5.00
Reference 2	1	<1.0	<2.00	<5.00
Reference 2	2	<1.0	<2.00	<5.00
Reference 3	1	<1.0	<2.00	<5.00
Reference 3	2	<1.0	<2.00	<5.00

Table 4: The location and result of each unsuccessful attempted grab at the Salten site during the ASC survey completed on May 26, 2020.

Station	Grab Attempt	Latitude	Longitude	Depth (m)	Distance from Site (m)	Comment
B-5m	1	49 36.9875	123 50.1169	51.2	66.4	1cm of sand
B-5m	2	49 36.9871	123 50.1193	51.2	66.4	2cm gravelly sand and shell hash
B-5m	3	49 36.9873	123 50.1183	51.2	66.4	<1cm skiff of sand, mud, gravel and cobble

4.0 References

- Aquaculture Stewardship Council. 2012. ASC Salmon Standard Version 1.3. Available online: www.asc-aqua.org.
- Salas, F., Patrício, J. and Marques, J.C. 2006. Ecological Indicators in Coastal and Estuarine Environmental Quality Assessment - A user friendly guide for practitioners. Imprensa da Universidade de Coimbra.

Appendix 1 – Sample Photographs



Photo 1

Sediment sample collected at the 0m station on Transect A at the Salten site on Survey May 26, 2020.



Photo 2

Sediment sample collected at the station inside the AZE on Transect A at the Salten site on Survey May 26, 2020.



Photo 3

Sediment sample collected at the station outside the AZE on Transect A at the Salten site on Survey May 26, 2020.



Photo 4

Sediment sample collected at the station outside the AZE on Transect B at the Salten site on Survey May 26, 2020.



Photo 5

Sediment sample collected at the station inside the AZE on Transect C at the Salten site on Survey May 26, 2020.



Photo 6

Sediment sample collected at the station outside the AZE on Transect C at the Salten site on Survey May 26, 2020.



Photo 7

Sediment sample collected at the Reference 1 at the Salten site on May 26, 2020.



Photo 8

Sediment sample collected at the Reference 2 at the Salten site on May 26, 2020.

Appendix 2 – Salten Field Data

Reference Information:

Farm site:	Salten	Field Crew:	E. Weiss, N. Delange
Aquaculture Company:	Greig Seafood BC Ltd	Field Investigator:	Mainstream Biological Consulting Inc.
Site Reference #:	AQ332	Laboratory:	SGS Canada Inc
Geographic Region:	Sechelt Inlet, BC		

<i>Transect A, B, C Name</i>	<i>Sampling Station Name</i>	<i>Replicate Number</i>	<i>Transect A, B, C Bearing (Magnetic)</i>	<i>Reference Station (Y/N)</i>	<i>Distance from Pens (m)</i>	<i>Sampling Device Type</i>	<i>Sampling Device Capacity (m2)</i>	<i>Quality Control Replicate (Y/N)</i>	<i>Replicate Analysis Type</i>	<i>Sample Date (YYYY-MM-DD)</i>	<i>Sample Time (24HH:MM)</i>	<i>Sample Latitude (Degrees)</i>	<i>Sample Latitude (Minutes)</i>	<i>Sample Longitude (Degrees)</i>	<i>Sample Longitude (Minutes)</i>	<i>GPS Correction Status</i>	<i>Ocean Depth (m)</i>	<i>Sample Depth (cm)</i>
A	A-0M	1			0	Petite Ponar	0.02			2020-05-26	11:22	49	36.9001	123	49.9857	Post Process Corrected	48.9	8
A	A-0M	1			0	Petite Ponar	0.02	Y	duplicate	2020-05-26	11:22	49	36.9001	123	49.9857	Post Process Corrected	48.9	8
A	A-0M	2			0	Petite Ponar	0.02			2020-05-26	11:27	49	36.9000	123	49.9858	Post Process Corrected	48.9	8
A	A-5M	1			47	Petite Ponar	0.02			2020-05-26	11:59	49	36.8822	123	49.9562	Post Process Corrected	50	6
A	A-5M	2			47	Petite Ponar	0.02			2020-05-26	12:01	49	36.8818	123	49.9566	Post Process Corrected	50	6
A	A+25M	1			78	Petite Ponar	0.02			2020-05-26	12:11	49	36.8716	123	49.9369	Post Process Corrected	49.5	10
A	A+25M	2			78	Petite Ponar	0.02			2020-05-26	12:13	49	36.8722	123	49.9363	Post Process Corrected	49.5	8
B	B+25M	1			95.2	Petite Ponar	0.02			2020-05-26	13:33	49	36.9994	123	50.1308	Post Process Corrected	42	9
B	B+25M	2			95.2	Petite Ponar	0.02			2020-05-26	13:37	49	36.9990	123	50.1324	Post Process Corrected	42	6
C	C-5M	1			50	Petite Ponar	0.02			2020-05-26	14:30	49	36.9513	123	50.0044	Post Process Corrected	75.2	8
C	C-5M	2			50	Petite Ponar	0.02			2020-05-26	14:37	49	36.9520	123	50.0056	Post Process Corrected	75.2	8
C	C+25M	1			78	Petite Ponar	0.02			2020-05-26	14:49	49	36.9648	123	49.9913	Post Process Corrected	82.6	6
C	C+25M	2			78	Petite Ponar	0.02			2020-05-26	14:54	49	36.9649	123	49.9915	Post Process Corrected	82.6	5
REF 1	REF 1	1			560	Petite Ponar	0.02			2020-05-26	15:13	49	37.2148	123	50.3352	Post Process Corrected	71	7
REF 1	REF 1	2			560	Petite Ponar	0.02			2020-05-26	15:20	49	37.2155	123	50.3361	Post Process Corrected	71	9
REF 2	REF 2	1			1550	Petite Ponar	0.02			2020-05-26	15:34	49	36.7388	123	49.6374	Post Process Corrected	78.3	10
REF 2	REF 2	2			1550	Petite Ponar	0.02			2020-05-26	15:44	49	36.7393	123	49.6382	Post Process Corrected	78.3	9

<i>Transect A, B, C Name</i>	<i>Sampling Station Name</i>	<i>Replicate Number</i>	<i>Free Sulphide (micromolar)</i>	<i>Sediment Temperature (deg C)</i>	<i>Eh Uncorrected (mV)</i>	<i>Eh Corrected (mV)</i>	<i>Cu (micro-g/g)</i>	<i>Zn (micro-g/g)</i>	<i>Li (micro-g/g)</i>	<i>Gravel Percent</i>	<i>Sand Percent</i>	<i>Mud Percent</i>	<i>TVS Percent</i>	<i>Beggiatoa Observed (Y/N)</i>	<i>OPC Observed (Y/N)</i>	<i>Fish Feed Observed (Y/N)</i>	<i>Fish Feces Observed (Y/N)</i>	<i>Odour Rating</i>	<i>Black Sediment Observed (Y/N)</i>	<i>Gas Bubbles Observed (Y/N)</i>
A	A-0M	1	1280	12.5	-302.6	-91.6								N	N	N	N	3	N	N
A	A-0M	1	828	12.5	-324	-113								N	N	N	N	3	N	N
A	A-0M	2	1440	11.3	-341.3	-128.3								N	N	N	N	3	N	N
A	A-5M	1	13.6	11.3	-190.4	22.6								N	N	N	N	0	N	N
A	A-5M	2	4.07	10.7	-241.9	-28.9								N	N	N	N	0	N	N
A	A+25M	1	4.53	11.6	-163	49								N	N	N	N	0	N	N
A	A+25M	2	26.8	11.3	-147.5	65.5								N	N	N	N	0	N	N
B	B+25M	1	5.81	10.9	54.8	267.8								N	N	N	N	0	N	N
B	B+25M	2	18.9	11.1	37.6	250.6								N	N	N	N	0	N	N
C	C-5M	1	19.3	10.3	78.2	292.2								N	N	N	N	0	N	N
C	C-5M	2	32.4	11.1	56.8	269.8								N	N	N	N	0	N	N
C	C+25M	1	5	10.5	58.3	271.3								N	N	N	N	0	N	N
C	C+25M	2	13.5	10.3	24.2	238.2								N	N	N	N	0	N	N
REF 1	REF 1	1	2.77	11.5	53.9	265.9								N	N	N	N	0	N	N
REF 1	REF 1	2	2.29	12.4	37.4	251.4								N	N	N	N	0	N	N
REF 2	REF 2	1	19.7	10.9	-7.9	205.1								N	N	N	N	0	N	N
REF 2	REF 2	2	12	11.3	-68.7	144.3								N	N	N	N	0	N	N

Table note:

- Odour rating: ranked on a scale of 0 (no odour) to 4 (very strong sulphide odour)

<i>Transect A, B, C Name</i>	<i>Sampling Station Name</i>	<i>Replicate Number</i>	<i>Flocculent Organic Material Observed (Y/N)</i>	<i>Shell Hash Observed (Y/N)</i>	<i>Terrigenous Material Observed (Y/N)</i>	<i>Farm Litter Observed (Y/N)</i>	<i>Macrophytes Observed (Y/N)</i>	<i>Megafauna Observed (Y/N)</i>	<i>Sediment Colour Observations</i>	<i>Sediment Texture Observations</i>	<i>Other Sample Observations (Comments)</i>
A	A-0M	1	N	Y	Y	N	N	N	Green/brown	Mud	Alder leaf
A	A-0M	1	N	Y	Y	N	N	N	Green/brown	Mud	Alder leaf
A	A-0M	2	N	Y	N	N	N	N	Green/brown	Mud	
A	A-5M	1	N	Y	Y	N	N	N	Dark brown	Mud	Cedar needle, sponge spicules
A	A-5M	2	N	Y	Y	N	N	N	Dark brown	Mud	Pine needle, sponge spicules
A	A+25M	1	N	N	Y	N	N	Y	Dark brown	Mud	Sponge spicules, kelp, pine needle
A	A+25M	2	N	N	Y	N	N	N	Dark brown	Mud	Pine needle, twig
B	B+25M	1	N	Y	Y	N	N	N	Dark brown	Mud	Pine needle, sticks, sponge spicule
B	B+25M	2	N	Y	N	N	N	N	Dark brown	Mud	Sponge spicules
C	C-5M	1	N	N	N	N	N	Y	Dark brown	Mud	Worm tubes, sponge
C	C-5M	2	N	Y	N	N	N	Y	Dark brown	Mud	Sponge, brittle stars, worm tubes
C	C+25M	1	N	N	N	N	N	N	Dark brown	Mud	Sponge, worm tubes
C	C+25M	2	N	N	N	N	N	N	Dark brown	Mud	Sponge spicules, worm tubes
REF 1	REF 1	1	N	N	N	N	N	N	Dark brown	Mud	Sponge, worm tubes
REF 1	REF 1	2	N	N	N	N	N	N	Dark brown	Mud	Sponge, worm tubes
REF 2	REF 2	1	N	N	N	N	N	N	Dark brown	Mud	Sponge spicules
REF 2	REF 2	2	N	N	N	N	N	N	Dark brown	Mud	Sponge spicules

Appendix 3 – Salten ASC Survey Summary

Company:	Greig Seafood Ltd	Sample date:	May 26, 2020
Farm Site:	Salten	Field crew:	E. Weiss, N. Delange
Site License #:	AQ332	Analytical:	SGS Canada Inc
Site Location	Sechelt Inlet, BC		

SULPHIDES Indicator 2.1.1 Requirement ≤ 1500 (μm)					
Station	Rep 1	Rep 2	n	Mean	ASC Criteria Met
0m A	1280	1440	2	1360	
Inside AZE A	13.6	4.07	2	8.84	
Outside AZE A	4.53	26.8	2	15.7	Yes
Outside AZE B	5.81	18.9	2	12.4	Yes
Inside AZE C	19.3	32.4	2	25.9	
Outside AZE C	5.00	13.5	2	9.25	Yes
Reference 1	2.77	2.29	2	2.53	
Reference 2	19.7	12.0	2	15.9	

REDOX POTENTIAL Indicator 2.1.1 Requirement > 0 mV					
Station	Rep 1	Rep 2	N	Mean	ASC Criteria Met
0m A	-91.6	-128.3	2	-110.0	
Inside AZE A	22.6	-28.9	2	-3.2	
Outside AZE A	49.0	65.5	2	57.3	Yes
Outside AZE B	267.8	250.6	2	259.2	Yes
Inside AZE C	292.2	269.8	2	281.0	
Outside AZE C	271.3	238.2	2	254.8	Yes
Reference 1	265.9	251.4	2	258.7	
Reference 2	205.1	144.3	2	174.7	