

# FINFISH AQUACULTURE SITE AQUACULTURE STEWARDSHIP COUNCIL REPORT ATREVIDA POINT, MUCHALAT INLET, BC

*SITE LICENSE: AQ1738*

*SURVEY TYPE: ASC*

*SURVEY DATE: FEBRUARY 25 AND 26, 2020*

*REPORT DATE: MARCH 17, 2020*

***PREPARED FOR:***

*GRIEG SEAFOOD BC, LTD*

*#106 3001 IRONWOOD STREET*

*CAMPBELL RIVER, BC*

*V9W 5P7*



1310 Marwalk Cres  
Campbell River, BC.  
V9W 5X1  
phone: (250) 287-2462  
fax: (250) 287-2452  
email: [info@mainstreambio.ca](mailto:info@mainstreambio.ca)  
[www.mainstreambio.ca](http://www.mainstreambio.ca)



## Summary

This document presents the qualitative and quantitative assessment of sediment obtained during the survey completed at the Atrevida Point finfish aquaculture site operated by Greig Seafood BC Ltd in Clayoquot Sound, BC, on February 25 and 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 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 and C was greater than the ASC Salmon Standard acceptable lower limit of 0 mV. Sediment could not be obtained at the station outside the AZE on Transect B to complete any analysis.

As required by Criterion 5.2 of the ASC monitoring for parasiticide residue was completed at the station outside the AZE on Transects A 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)<sup>1</sup>.

---

<sup>1</sup> <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

<b>Summary.....</b>	<b>ii</b>
<b>Table of Contents.....</b>	<b>iii</b>
<b>1.0 Introduction.....</b>	<b>1</b>
<b>2.0 Methods.....</b>	<b>3</b>
2.1 Field Sampling.....	3
2.2 Data Analysis.....	6
<b>3.0 Results and Discussion .....</b>	<b>7</b>
3.1 Redox Potential and Sulphide Levels.....	7
3.2 Parasiticide Residue .....	7
<b>4.0 References .....</b>	<b>9</b>
<b>Appendix 1 – Sample Photographs .....</b>	<b>I</b>
<b>Appendix 2 – Atrevida Point Field Data .....</b>	<b>VI</b>
<b>Appendix 3 – Atrevida Point ASC Survey Summary.....</b>	<b>VIII</b>

## 1.0 Introduction

This document presents the marine sediment data collected as part of a benthic study completed at the Atrevida Point finfish aquaculture site operated by Greig Seafood BC Ltd (Campbell River, BC). The Atrevida Point site is located in Muchalat 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 copper concentration and 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).

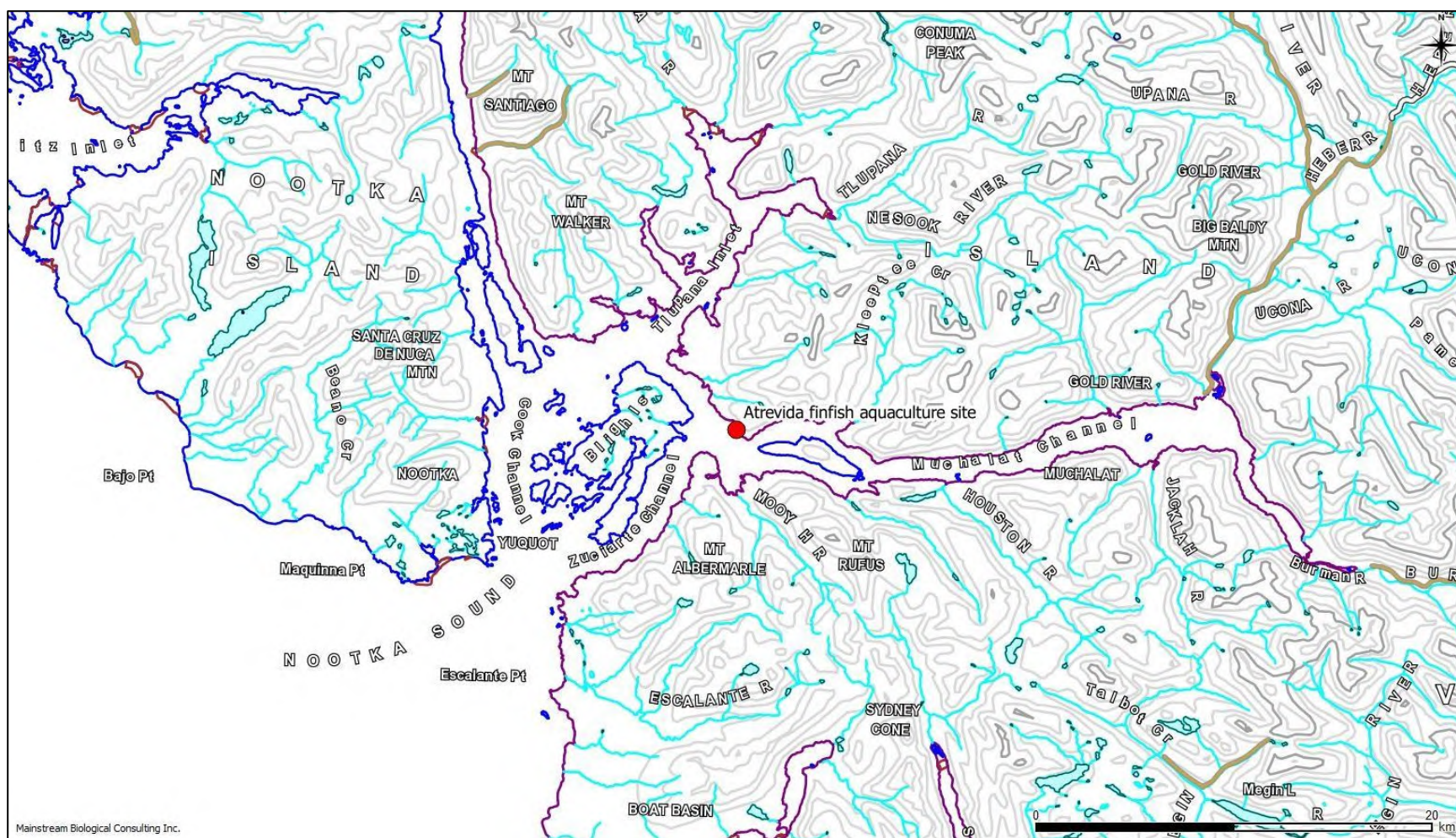


Figure 1: An overview map showing the approximate location of the Atrevida Point finfish aquaculture farm site (red dot) in Muchalat Inlet, BC.

## 2.0 Methods

The substrate at the designated sampling locations at the Atrevida Point finfish aquaculture site had not previously been sampled for ASC. Therefore, the field activities involved attempted grabs at each location and the collection of sediment samples for physical and chemical analysis at stations at which successful grabs were obtained.

### 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, B and C. 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).

On Transect B the 0m sample station and the inside the AZE sample station were located at the same position at the edge of the containment array.

Sediment was collected using a Petite Ponar sampler. Two sediment samples were collected at each station except for stations located on Transect B where grabs were unsuccessful.

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)<sup>2</sup>, 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 Ucluelet base station (UCLA).

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.

---

<sup>2</sup> 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.



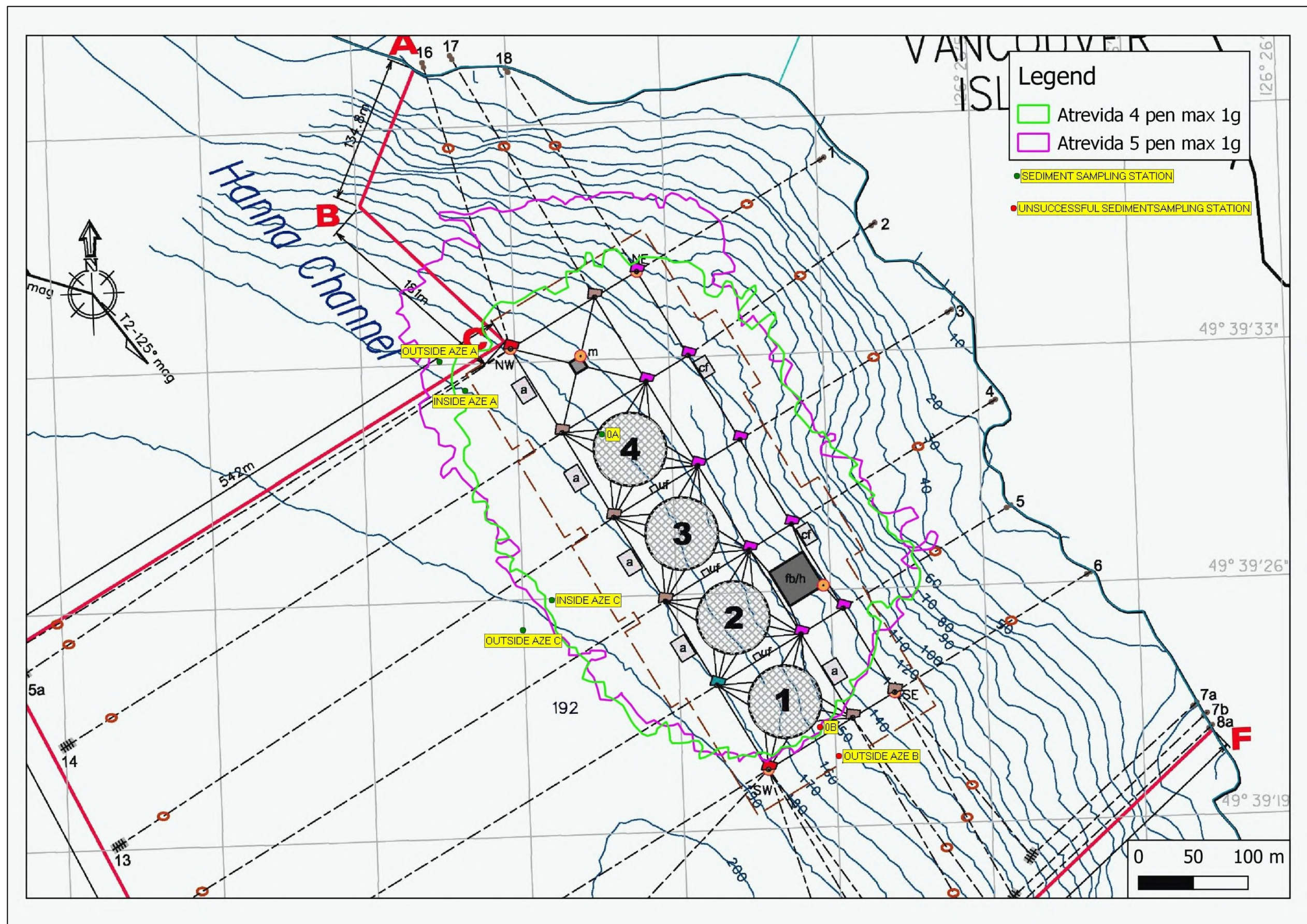


Figure 2: The locations of the sampling stations for the ASC survey at the Atrevida Point finfish aquaculture site in relation to the pen system and surrounding area on February 25 and 26, 2020.



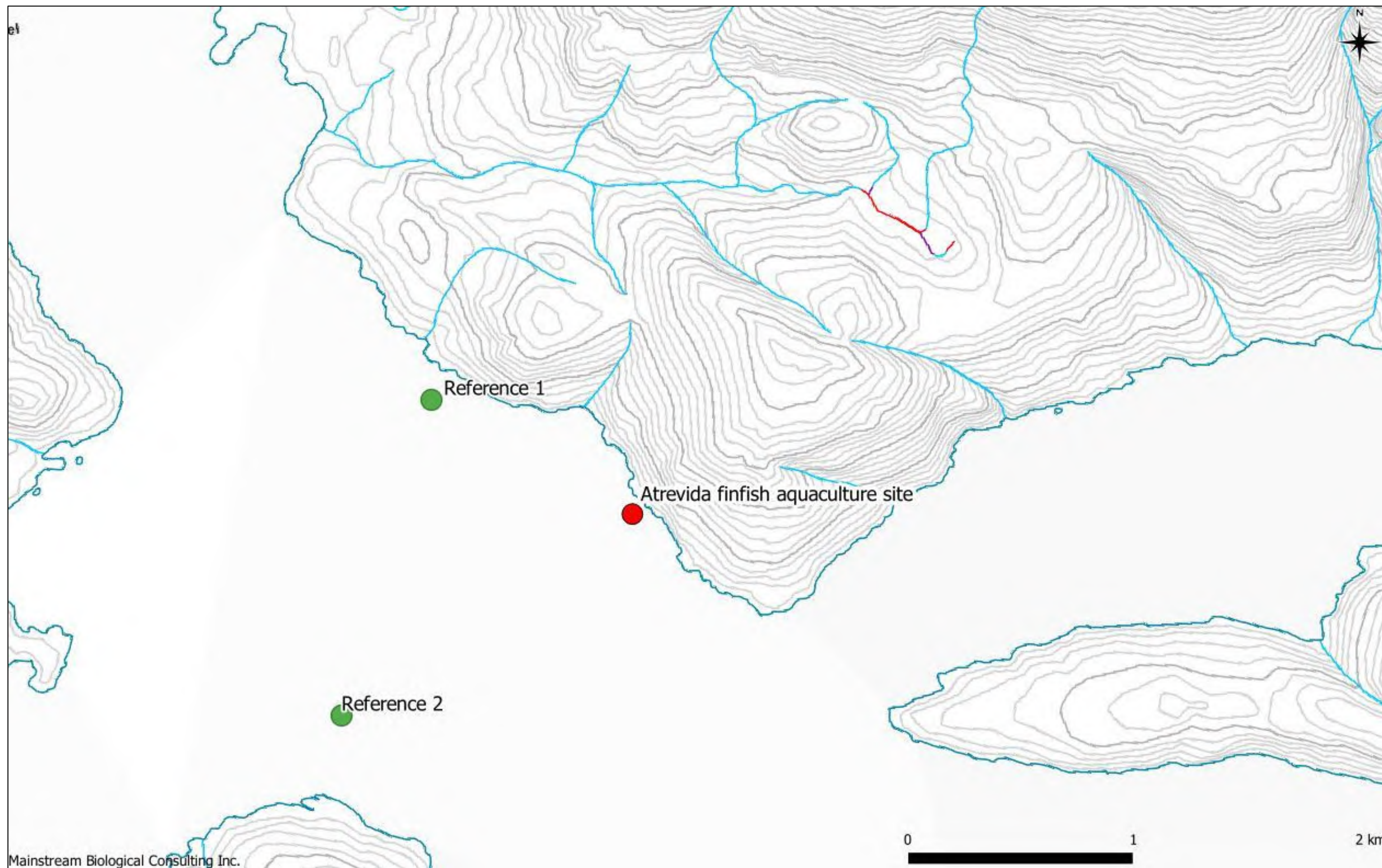


Figure 3: The locations of the reference stations (green dots) for the ASC survey at the Atrevida Point finfish aquaculture site in relation to the site (red dot) and surrounding area on February 25 and 26, 2020



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 and C as well as the reference stations were retained for analysis. Grab samples were not successful at the station outside AZE on Transect B. 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 Atrevida Point 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 Atrevida Point 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 <sup>1</sup> .	>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 Atrevida Point sampling stations typically consisted of green mud. Station 0B and the station inside AZE B are at the same location.

Table 2: The location and results of each unsuccessful grab attempt on Transect B at the Atrevida Point finfish aquaculture site on February 25-26, 2020

Station	Latitude	Longitude	Sampling Device	Comments
Station 0Bm	49 39.3626	126 27.0761	Petite ponar	Shell hash + gravel
Station 0Bm	49 39.3614	126 27.0769	Petite ponar	Shell hash
Station 0Bm	49 39.3621	126 27.0769	Petite ponar	4 mussel shells
Station 0Bm	49 39.3631	126 27.0773	Petite ponar	Shell hash
Outside AZE B	49 39.3482	126 27.0624	Petite ponar	1 cm sand
Outside AZE B	49 39.3465	126 27.0678	Petite ponar	Sand
Outside AZE B	49 39.3486	126 27.0628	Petite ponar	Stick, shell
Outside AZE B	49 39.4840	126 27.0648	Petite ponar	shell
Outside AZE B	49 39.3487	126 27.0633	Petite ponar	

#### 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 stations outside the AZE were analyzed to help evaluate if the Atrevida Point facility was meeting the certification requirements (Appendix 3).

The mean sulphide level in sediment collected at the stations outside AZE on Transects A and C (41.5  $\mu\text{M}$  and 149  $\mu\text{M}$  respectively) on February 25 and 26, 2020 were less than the ASC Salmon Standard sulphide upper limit of 1500  $\mu\text{M}$ .

Mean redox potential in sediment collected at the stations outside the AZE on Transect A and C (56.6 mV and 130 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 and C and the two reference stations for emamectin benzoate and florfenicol are shown in Table 4. 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, C and the two reference stations at the Atrevida Point finfish aquaculture site on February 25 and 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 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

## 4.0 References

- Aquaculture Stewardship Council. 2012. ASC Salmon Standard Version 1.3. Available online: [www.asc-aqua.org](http://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 Atrevida Point site on February 25, 2020.



**Photo 2**

Sediment sample collected at the station inside the AZE on Transect A at the Atrevida Point site on February 25, 2020.



**Photo 3**

Sediment sample collected at the station outside the AZE on Transect A at the Atrevida Point site on February 25, 2020.



**Photo 4**

A typical missed grab attempts at the 0B station (also the inside AZE B station) at the Atrevida Point site on February 25, 2020.





**Photo 5**

A skiff of sediment collected in an unusable grab attempt at the outside AZE station on Transect B at the Atrevida Point site on February 25, 2020



**Photo 6**

Sediment sample collected at the station inside the AZE on Transect C at the Atrevida Point site on February 26, 2020.



**Photo 7**

Sediment sample collected at the station outside the AZE on Transect C at the Atrevida Point site on February 26, 2020.



**Photo 8**

Sediment sample collected at the Reference 1 at the Atrevida Point site on February 26, 2020.



**Photo 9**

Sediment sample collected at the Reference 2 at the Atrevida Point site on February 26, 2020



Appendix 2 – Atrevida Point Field Data

Reference Information:

<b>Farm site:</b>	Atrevida Point	<b>Field Crew:</b>	L. Stewardson, E. Cicon, E. Weiss
<b>Aquaculture Company:</b>	Greig Seafood BC Ltd	<b>Field Investigator:</b>	Mainstream Biological Consulting Inc.
<b>Site Reference #:</b>	AQ1738	<b>Laboratory:</b>	SGS Canada Inc
<b>Geographic Region:</b>	Muchalat Inlet, BC		

<i><b>Transect A, B, C Name</b></i>	<i><b>Sampling Station Name</b></i>	<i><b>Replicate Number</b></i>	<i><b>Transect A, B, C Bearing (Magnetic)</b></i>	<i><b>Reference Station (Y/N)</b></i>	<i><b>Distance from Pens (m)</b></i>	<i><b>Sampling Device Type</b></i>	<i><b>Sampling Device Capacity (m2)</b></i>	<i><b>Quality Control Replicate (Y/N)</b></i>	<i><b>Replicate Analysis Type</b></i>	<i><b>Sample Date (YYYY-MM-DD)</b></i>	<i><b>Sample Time (24HH:MM)</b></i>	<i><b>Sample Latitude (Degrees)</b></i>	<i><b>Sample Latitude (Minutes)</b></i>	<i><b>Sample Longitude (Degrees)</b></i>	<i><b>Sample Longitude (Minutes)</b></i>	<i><b>GPS Correction Status</b></i>	<i><b>Ocean Depth (m)</b></i>	<i><b>Sample Depth (cm)</b></i>
A	0m	1	272		0	petit ponar	0.02			2020-02-26	10:29	49	39.5117	126	27.2350	Post-process corrected	129	10
A	0m	1	272		0	petit ponar	0.02	Y	Duplicate	2020-02-26	10:29	49	39.5117	126	27.2350	Post-process corrected	129	10
A	0m	1	272		0	petit ponar	0.02	Y	Triplicate	2020-02-26	10:29	49	39.5117	126	27.2350	Post-process corrected	129	10
A	0m	2	272		0	petit ponar	0.02			2020-02-26	10:37	49	39.5123	126	27.2347	Post-process corrected	129	10
A	5m	1	272		125	petit ponar	0.02			2020-02-25	11:45	49	39.5353	126	27.3376	Post-process corrected	133	9
A	5m	2	272		125	petit ponar	0.02			2020-02-25	11:53	49	39.5335	126	27.3390	Post-process corrected	133	10
A	25m	1	272		161	petit ponar	0.02			2020-02-26	12:50	49	39.5503	126	27.3563	Post-process corrected	133	10
A	25m	2	272		161	petit ponar	0.02			2020-02-26	12:56	49	39.5360	126	27.3650	Post-process corrected	133	9
C	5m	1			113	petit ponar	0.02			2020-02-26	09:22	49	39.4290	126	27.2766	Post-process corrected	179	9
C	5m	2			113	petit ponar	0.02			2020-02-26	09:32	49	39.4240	126	27.2737	Post-process corrected	179	10
C	25m	1			144	petit ponar	0.02			2020-02-26	09:52	49	39.4144	126	27.2986	Post-process corrected	180	10
C	25m	2			144	petit ponar	0.02			2020-02-26	10:01	49	39.4259	126	27.3057	Post-process corrected	180	9
Ref 1	Ref 1	1		Y	650	petit ponar	0.02			2020-02-26	11:57	49	39.7215	126	27.6707	Post-process corrected	135	10
Ref 1	Ref 1	2		Y	650	petit ponar	0.02			2020-02-26	13:07	49	39.7134	126	27.6712	Post-process corrected	135	10
Ref 2	Ref 2	1		Y	1340	petit ponar	0.02			2020-02-26	12:30	49	38.9698	126	28.0359	Post-process corrected	147	10
Ref 2	Ref 2	2		Y	1340	petit ponar	0.02			2020-02-26	12:40	49	38.9698	126	28.0097	Post-process corrected	147	10

<i><b>Transect A, B, C Name</b></i>	<i><b>Sampling Station Name</b></i>	<i><b>Replicate Number</b></i>	<i><b>Free Sulphide (micromolar)</b></i>	<i><b>Sediment Temperature (deg C)</b></i>	<i><b>Eh Uncorrected (mV)</b></i>	<i><b>Eh Corrected (mV)</b></i>	<i><b>Cu (micro-g/g)</b></i>	<i><b>Zn (micro-g/g)</b></i>	<i><b>Li (micro-g/g)</b></i>	<i><b>Gravel Percent</b></i>	<i><b>Sand Percent</b></i>	<i><b>Mud Percent</b></i>	<i><b>TVS Percent</b></i>	<i><b>Beggiatoa Observed (Y/N)</b></i>	<i><b>OPC Observed (Y/N)</b></i>	<i><b>Fish Feed Observed (Y/N)</b></i>	<i><b>Fish Feces Observed (Y/N)</b></i>	<i><b>Odour Rating</b></i>	<i><b>Black Sediment Observed (Y/N)</b></i>	<i><b>Gas Bubbles Observed (Y/N)</b></i>
A	0m	1	10900	7.4	-326.8	-109.8									N	N	Y	Y	4	Y
A	0m	1	8910	7.4	-335	-118									N	N	Y	Y	4	Y
A	0m	1		7.4	-337.1	-120.1									N	N	Y	Y	4	Y
A	0m	2	10200	7.4	-344.9	-127.9									N	N	Y	Y	4	Y
A	5m	1	341	7.7	-265.7	-49.7									N	N	N	N	1	N
A	5m	2	143	7.6	-259.9	-43.9									N	N	N	N	1	N
A	25m	1	37.9	7.6	-160.3	55.7									N	N	N	N	0	N
A	25m	2	45	7.6	-158.6	57.4									N	N	N	N	0	N
C	5m	1	201	7.8	-83.9	132.1									N	N	N	N	0	N
C	5m	2	101	7.9	-86.4	129.6									N	N	N	N	0	N
C	25m	1	112	8.1	-81.9	134.1									N	N	N	N	0	N
C	25m	2	185	8.2	-89.9	126.1									N	N	N	N	0	N
Ref 1	Ref 1	1	145	8.1	-164.6	51.4									N	N	N	N	0	N
Ref 1	Ref 1	2	100	8.2	-134.1	81.9									N	N	N	N	0	N
Ref 2	Ref 2	1	135	8.3	-133.2	82.8									N	N	N	N	0	N
Ref 2	Ref 2	2	106	8	-145.8	70.2									N	N	N	N	0	N

Table note:

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



<i><b>Transect A, B, C Name</b></i>	<i><b>Sampling Station Name</b></i>	<i><b>Replicate Number</b></i>	<i><b>Flocculent Organic Material Observed (Y/N)</b></i>	<i><b>Shell Hash Observed (Y/N)</b></i>	<i><b>Terrigenous Material Observed (Y/N)</b></i>	<i><b>Farm Litter Observed (Y/N)</b></i>	<i><b>Macrophytes Observed (Y/N)</b></i>	<i><b>Megafauna Observed (Y/N)</b></i>	<i><b>Sediment Colour Observations</b></i>	<i><b>Sediment Texture Observations</b></i>	<i><b>Other Sample Observations (Comments)</b></i>
A	0m	1	Y	N	N	N	N	N	black	mud	off gassing black
A	0m	1	Y	N	N	N	N	N	black	mud	off gassing black
A	0m	1	Y	N	N	N	N	N	black	mud	off gassing black
A	0m	2	Y	N	N	N	N	N	black	mud	off gassing black
A	5m	1	N	N	N	N	N	Y	green	mud	tube worm
A	5m	2	N	Y	Y	N	N	N	green	mud	
A	25m	1	N	N	Y	N	N	N	green	mud	stick and leaf
A	25m	2	N	Y	Y	N	N	N	green	mud	cedar needles
C	5m	1	N	N	Y	N	N	Y	green	mud	1-piece wood, mussel shell
C	5m	2	N	N	Y	N	N	Y	green	mud	worm, small stick
C	25m	1	N	Y	Y	N	N	Y	green	mud	sticks, tubeworms
C	25m	2	N	N	Y	N	N	Y	green	mud	1 mussel shell
Ref 1	Ref 1	1	N	N	N	N	N	N	green	mud	
Ref 1	Ref 1	2	N	Y	N	N	N	N	green	mud	few flecks shell hash
Ref 2	Ref 2	1	N	N	N	N	N	N	green	mud	
Ref 2	Ref 2	2	N	N	N	N	N	N	green	mud	

## Appendix 3 – Atrevida Point ASC Survey Summary

<b>Company:</b>	Greig Seafood BC Ltd	<b>Sample date:</b>	February 25 and 26, 2020
<b>Farm Site:</b>	Atrevida Point	<b>Field crew:</b>	L. Stewardson, E. Cicon, E. Weiss
<b>Site License #:</b>	AQ1738	<b>Analytical:</b>	SGS Canada Inc
<b>Site Location</b>	Muchalat Inlet, BC		

SULPHIDES Indicator 2.1.1 Requirement $\leq 1500$ ( $\mu\text{m}$ )					
Station	Rep 1	Rep 2	n	Mean	ASC Criteria Met
0m A	10900	10200	3	10550	
Inside AZE A	341	143	2	242	
Outside AZE A	37.9	45	2	41.5	Yes
Inside AZE C	201	101	2	151	
Outside AZE C	112	185	2	149	Yes
Reference 1	145	100	2	123	
Reference 2	135	106	2	121	

REDOX POTENTIAL Indicator 2.1.1 Requirement $> 0$ mV					
Station	Rep 1	Rep 2	N	Mean	ASC Criteria Met
0m A	-109.8	-128	4	-118.9	
Inside AZE A	-49.7	-43.9	2	-46.8	
Outside AZE A	55.7	57.4	2	56.6	Yes
Inside AZE C	132.1	129.6	2	130.9	
Outside AZE C	134.1	126.1	2	130.1	Yes
Reference 1	51.4	81.9	2	66.7	
Reference 2	82.8	70.2	2	76.5	