

FINFISH AQUACULTURE SITE AQUACULTURE STEWARDSHIP COUNCIL REPORT

WILLIAMSON PASSAGE, MUCHALAT INLET, BC

SITE LICENSE: AQ1705

SURVEY TYPE: ASC

SURVEY DATE: MARCH 29, 2022

REPORT DATE: JUNE 1, 2022

PREPARED FOR:

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Summary

This document presents the qualitative and quantitative assessment of sediment obtained during the survey completed at the Williamson Passage finfish aquaculture site operated by Grieg Seafood BC Ltd. in Muchalat Inlet, BC, on March 29 and 30, 2022. 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 and C was greater than the ASC Salmon Standard acceptable lower limit of 0 mV. Redox potential measured in sediment obtained outside the AZE on Transect B was less 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 was below detectable limits in all collected samples except for in one Reference 1 sample which had a concentration of Emamectin Benzoate of 1.2 µg/g. Subsequent samples were collected from the Reference 1 location on May 13, 2022, at the request of Grieg Seafood BC Ltd, and these two samples were found to be below the laboratory's detectable limit.

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/>

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1.0 Introduction

This document presents the marine sediment data collected as part of a benthic study completed at the Williamson Passage finfish aquaculture site operated by Grieg Seafood BC Ltd. (Campbell River, BC). The Williamson Passage 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 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).

2.0 Methods

The substrate at the designated sampling locations at the Williamson Passage finfish aquaculture site had been previously identified to consist of “soft” sediment. Therefore, the field activities involved the collection of sediment samples for physical and chemical analysis.

2.1 Field Sampling

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

Individual sediment sampling stations were located along three transects (Transects A, B, and C). Stations within the AZE were located 5 m inside the 1 g DEPOMOD contour (Figure 2) for Transects B and C and at the perimeter of the containment system for Transects A and B. During a previous ASC benthic assessment in January 2020 sediment could not be successfully obtained at the station located inside the AZE on Transect A². Therefore, attempts to obtain sediment from this location were not made during this survey.

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 was collected using a Petite Ponar sampler. Two sediment samples were collected at each station.

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)³, 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.

² Mainstream Biological Consulting. 2020. Finfish Aquaculture Site Aquaculture Stewardship Council report, Williamson Passage, Muchalat Inlet, BC. An unpublished report prepared for Grieg Seafood BC Ltd.

³ 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.

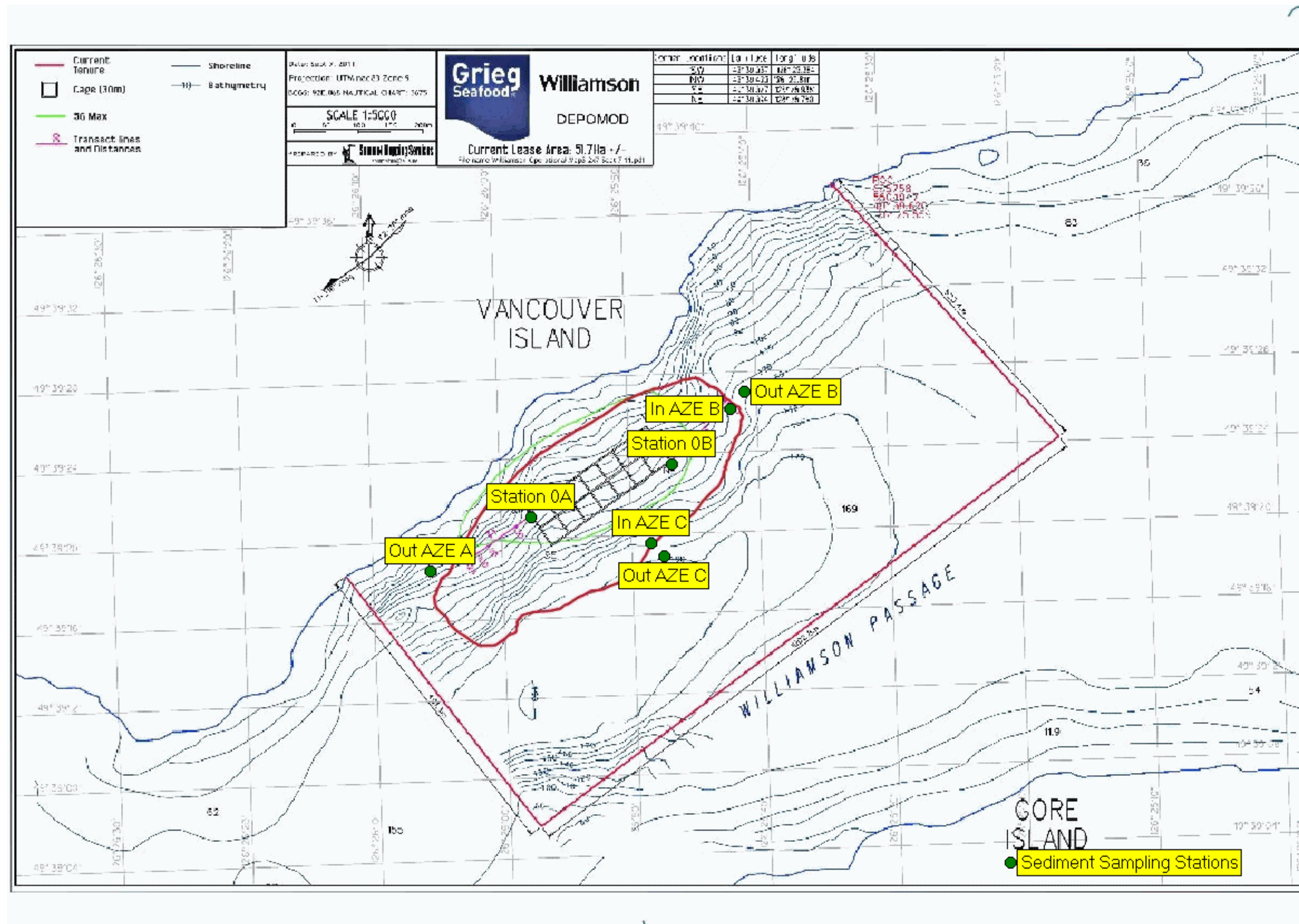


Figure 2: The locations of the sampling stations for the ASC survey at the Williamson Passage finfish aquaculture site in relation to the pen system and surrounding area on March 29 and 30, 2022.

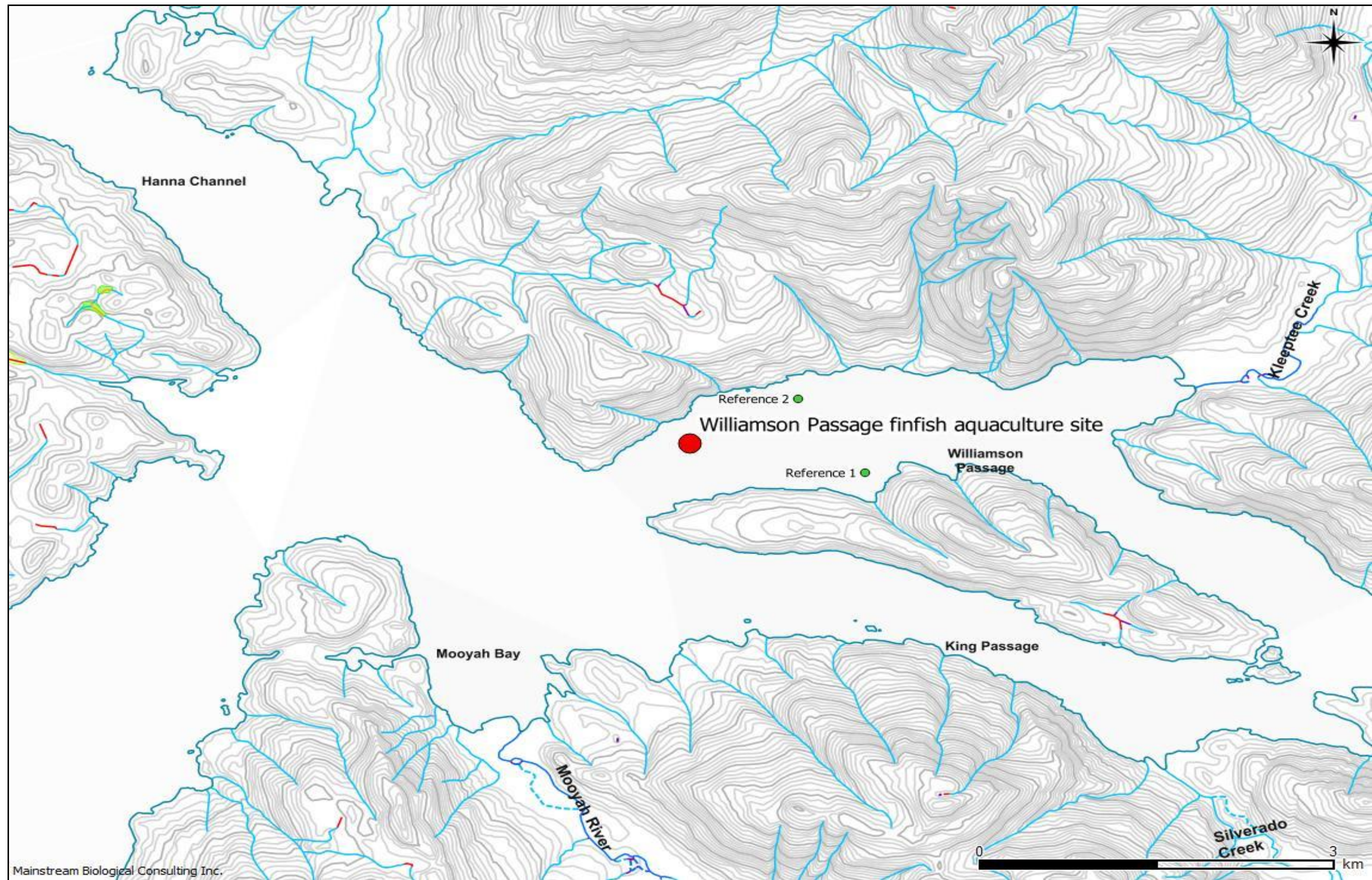


Figure 3: The locations of the reference stations for the ASC survey at the Williamson Passage finfish aquaculture site in relation to the site and surrounding area on March 29 and 30, 2022.

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.

2.2 Data Analysis

To evaluate if the benthic conditions at and near the Williamson Passage 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 Williamson Passage 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 Williamson Passage sampling stations typically consisted of grey or brown mud with shell hash.

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 Williamson Passage 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 (68.0 µM, 660 µM and 33.8 µM respectively) on March 29 and 30, 2022 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 and C (243.5 mV and 335.4 mV respectively) were greater than the 0 mV minimum requirement cited in Criterion 2.1.1 of the ASC Salmon Standard. Mean redox potential in sediment collected at the station outside the AZE on Transect B (-44.0 mV) was less 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 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, except for one Reference 1 sample which had a concentration of Emamectin Benzoate of 1.2 µg/g. Subsequent samples were collected from the Reference 1 location on May 13, 2022, at the request of Grieg Seafood BC Ltd, and these two samples were both found to be below the laboratory's 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 Williamson Passage finfish aquaculture site on March 29, 30 and May 13, 2022.

Station Name	Sample Number	Emamectin Benzoate (µg/g)
Detection Limit		1.0
Outside AZE A	1	<1.0
Outside AZE A	2	<1.0
Outside AZE B	1	<1.0
Outside AZE B	2	<1.0
Outside AZE C	1	<1.0
Outside AZE C	2	<1.0
Reference 1	1	1.2 (March 30/22) / <1.0 (May 13/22)
Reference 1	2	<1.0 (March 30/22) / <1.0 (May 13/22)
Reference 2	1	<1.0
Reference 2	2	<1.0

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 Williamson Passage site on March 29, 2022.



Photo 2

Sediment sample collected at the station outside the AZE on Transect A at the Williamson Passage site on March 29, 2022.



Photo 3

Sediment sample collected at the 0B station at the Williamson Passage site on March 30, 2022.



Photo 4

Sediment sample collected at the station inside the AZE on Transect B at the Williamson Passage site on March 29, 2022.



Photo 6

Sediment sample collected at the station outside the AZE on Transect B at the Williamson Passage site on March 29, 2022.



Photo 7

Sediment sample collected at the station inside the AZE on Transect C at the Williamson Passage site on March 30, 2022.



Photo 8

Sediment sample collected at the station outside the AZE on Transect C at the Williamson Passage site on March 30, 2022.



Photo 9

Sediment sample collected at the Reference 1 at the Williamson Passage site on March 30, 2022.



Photo 10

Sediment sample collected at the Reference 2 at the Williamson Passage site on March 30, 2022.

Appendix 2 – Williamson Passage Field Data

Reference Information:	
Farm site:	Williamson Passage
Aquaculture Company:	Grieg Seafood BC Ltd.
Site Reference #:	AQ1705
Geographic Region:	Muchalat Inlet, BC
Field Crew:	E Cicon, M Easton
Field Investigator:	Mainstream Biological Consulting Inc.
Laboratory:	SGS Canada Inc

<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	0m	1	227	N	0	Petite Ponar	0.02			2022-03-29	14:07	49	39.3524	126	25.9607	Post-process Corrected	96.9	10
A	0m	1	227	N	0	Petite Ponar	0.02	Y	Duplicate	2022-03-29	14:07	49	39.3524	126	25.9607	Post-process Corrected	96.9	10
A	0m	1	227	N	0	Petite Ponar	0.02	Y	Triplicate	2022-03-29	14:07	49	39.3524	126	25.9607	Post-process Corrected	96.9	10
A	0m	2	227	N	0	Petite Ponar	0.02			2022-03-29	14:15	49	39.3524	126	25.9608	Post-process Corrected	97.1	5
A	25m	1	227	N	170	Petite Ponar	0.02			2022-03-29	14:34	49	39.3110	126	26.0910	Post-process Corrected	59.8	5
A	25m	2	227	N	170	Petite Ponar	0.02			2022-03-29	14:42	49	39.3114	126	26.0912	Post-process Corrected	60.2	5
B	0m	1	32	N	0	Petite Ponar	0.02			2022-03-30	15:23	49	39.3910	126	25.7791	Post-process Corrected	101	5
B	0m	2	32	N	0	Petite Ponar	0.02			2022-03-30	15:44	49	39.3911	126	25.7792	Post-process Corrected	101	5
B	5m	1	32	N	120	Petite Ponar	0.02			2022-03-29	10:47	49	39.4357	126	25.7013	Post-process Corrected	146	9
B	5m	2	32	N	120	Petite Ponar	0.02			2022-03-29	10:54	49	39.4354	126	25.7009	Post-process Corrected	146	8
B	25m	1	32	N	150	Petite Ponar	0.02			2022-03-29	15:51	49	39.4494	126	25.6831	Post-process Corrected	141	7
B	25m	2	32	N	150	Petite Ponar	0.02			2022-03-29	16:04	49	39.4507	126	25.6836	Post-process Corrected	143	6
C	5m	1	121	N	80	Petite Ponar	0.02			2022-03-30	09:54	49	39.3260	126	25.8099	Post-process Corrected	157	8
C	5m	2	121	N	80	Petite Ponar	0.02			2022-03-30	10:02	49	39.3259	126	25.8101	Post-process Corrected	157	6
C	25m	1	121	N	110	Petite Ponar	0.02			2022-03-30	10:06	49	39.3144	126	25.7938	Post-process Corrected	162	5
C	25m	2	121	N	110	Petite Ponar	0.02			2022-03-30	10:32	49	39.3143	126	25.7939	Post-process Corrected	162	5
REF	Ref 1	1		Y	1560	Petite Ponar	0.02			2022-03-30	11:08	49	39.5982	126	25.0097	Post-process Corrected	106	10
REF	Ref 1	2		Y	1560	Petite Ponar	0.02			2022-03-30	11:15	49	39.6007	126	25.0077	Post-process Corrected	106	9
REF	Ref 2	1		Y	1000	Petite Ponar	0.02			2022-03-30	11:38	49	39.2239	126	24.4946	Post-process Corrected	117	10
REF	Ref 2	2		Y	1000	Petite Ponar	0.02			2022-03-30	11:44	49	39.2246	126	24.4988	Post-process Corrected	116	10

<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	0m	1	15300	8.4	-294.5	-78.5								Y	N	N	N	4	N	Y
A	0m	1	13500	8.4	-312.9	-96.9								Y	N	N	N	4	N	Y
A	0m	1		8.4	-320.9	-104.9								Y	N	N	N	4	N	Y
A	0m	2	9700	8.4	-332.5	-116.5								Y	N	N	N	4	N	N
A	25m	1	56.6	8.2	26.4	242.4								N	N	N	N	0	N	N
A	25m	2	79.4	8.1	28.5	244.5								N	N	N	N	0	N	N
B	0m	1	565	7.6	-190.5	25.5								N	N	N	N	2	N	N
B	0m	2	736	7.7	-252.1	-36.1								N	N	N	N	3	N	N
B	5m	1	560	8.0	-200.1	15.9								N	N	N	N	2	N	N
B	5m	2	908	8.1	-245.8	-29.8								N	N	N	N	3	N	N
B	25m	1	692	8.3	-255.3	-39.3								N	N	N	N	2	N	N
B	25m	2	627	8.3	-264.9	-48.9								N	N	N	N	2	N	N
C	5m	1	41.2	7.4	267.5	484.5								N	N	N	N	0	N	N
C	5m	2	42.9	7.4	205.3	422.3								N	N	N	N	0	N	N
C	25m	1	39.8	7.6	124.8	340.8								N	N	N	N	0	N	N
C	25m	2	27.7	7.5	114.0	330.0								N	N	N	N	0	N	N
REF	Ref 1	1	25.8	6.9	-35.5	180.5								N	N	N	N	0	N	N
REF	Ref 1	2	29.3	7.4	-18.2	198.8								N	N	N	N	0	N	N
REF	Ref 2	1	35.9	7.6	20.2	236.2								N	N	N	N	0	N	N
REF	Ref 2	2	26.1	7.4	-83.9	133.1								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	0m	1	Y	N	Y	N	N	N	Dark Brown	Mud	
A	0m	1	Y	N	Y	N	N	N	Dark Brown	Mud	
A	0m	1	Y	N	Y	N	N	N	Dark Brown	Mud	
A	0m	2	N	Y	Y	N	N	N	Dark Brown	Mud	
A	25m	1	N	Y	N	N	N	Y	Grey	Sand	Tubeworm
A	25m	2	N	Y	N	N	N	N	Grey	Sand	Abundant shell hash
B	0m	1	N	Y	Y	N	N	N	Grey	Mud	Mussel shells, sticks
B	0m	2	N	Y	Y	N	N	N	Grey	Mud	
B	5m	1	N	Y	N	N	N	N	Brown	Mud	
B	5m	2	N	Y	Y	N	N	N	Brown	Mud	Bark, trace shell hash
B	25m	1	N	Y	Y	N	N	N	Brown	Mud	Twig
B	25m	2	N	Y	N	N	N	Y	Brown	Mud	Worms
C	5m	1	N	Y	N	N	N	Y	Brown	Mud	Tubeworms
C	5m	2	N	Y	N	N	N	Y	Brown	Mud	Worms, trace gravel
C	25m	1	N	Y	N	N	N	Y	Brown	Mud	Tubeworms, squat lobster, dead sponge
C	25m	2	N	N	N	N	N	Y	Brown	Mud	Tubeworms, brittle star, some gravel
REF	Ref 1	1	N	Y	N	N	N	N	Brown	Mud	Trace shell hash
REF	Ref 1	2	N	Y	N	N	N	N	Brown	Mud	Trace shell hash
REF	Ref 2	1	N	N	N	N	N	N	Brown	Mud	
REF	Ref 2	2	N	N	N	N	N	N	Brown	Mud	

Appendix 3 – Williamson Passage ASC Survey Summary

Company:	Grieg Seafood BC Ltd	Sample date:	March 29 and 30, 2022
Farm Site:	Williamson Passage	Field crew:	E Cicon, M Easton
Site License #:	AQ1705	Analytical:	SGS Canada Inc
Site Location	Muchalat Inlet, BC		

SULPHIDES Indicator 2.1.1 Requirement ≤ 1500 (μm)					
Station	Rep 1	Rep 2	n	Mean	ASC Criteria Met
0m A	15300	9700	2	12500	
Outside AZE A	56.6	79.4	2	68.0	Yes
0m B	565	736	2	651	
Inside AZE B	560	908	2	734	
Outside AZE B	692	627	2	660	Yes
Inside AZE C	41.2	42.9	2	42.1	
Outside AZE C	39.8	27.7	2	33.8	Yes
Reference 1	25.8	29.3	2	27.6	
Reference 2	35.9	26.1	2	31.0	

REDOX POTENTIAL Indicator 2.1.1 Requirement > 0 mV					
Station	Rep 1	Rep 2	N	Mean	ASC Criteria Met
0m A	-78.5	-116.5	2	-98.0	
Outside AZE A	242.4	244.5	2	243.5	Yes
0m B	25.5	-36.1	2	-5.0	
Inside AZE B	15.9	-29.8	2	-7.0	
Outside AZE B	-39.3	-48.9	2	-44.0	No
Inside AZE C	484.5	422.3	2	453.4	
Outside AZE C	340.8	330	2	335.4	Yes
Reference 1	180.5	198.8	2	189.7	
Reference 2	236.2	133.1	2	184.7	