

FINFISH AQUACULTURE SITE AQUACULTURE STEWARDSHIP COUNCIL REPORT MUCHALAT NORTH, MUCHALAT INLET, BC

SITE LICENSE: AQ1849

SURVEY TYPE: ASC

SURVEY DATE: MARCH 1, 2022

REPORT DATE: MARCH 22, 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 Muchalat North finfish aquaculture site operated by Grieg Seafood BC Ltd in Muchalat Inlet, BC, on March 1, 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 station outside the Allowable Zone of Effect (AZE) on Transect C had a mean sulphide level less than the ASC Salmon Standard acceptable limit of 1500 µm. Redox potential measured in sediment obtained outside the AZE on Transect 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 Transect C and at two reference stations. Emamectin benzoate 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/>

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1.0 Introduction

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

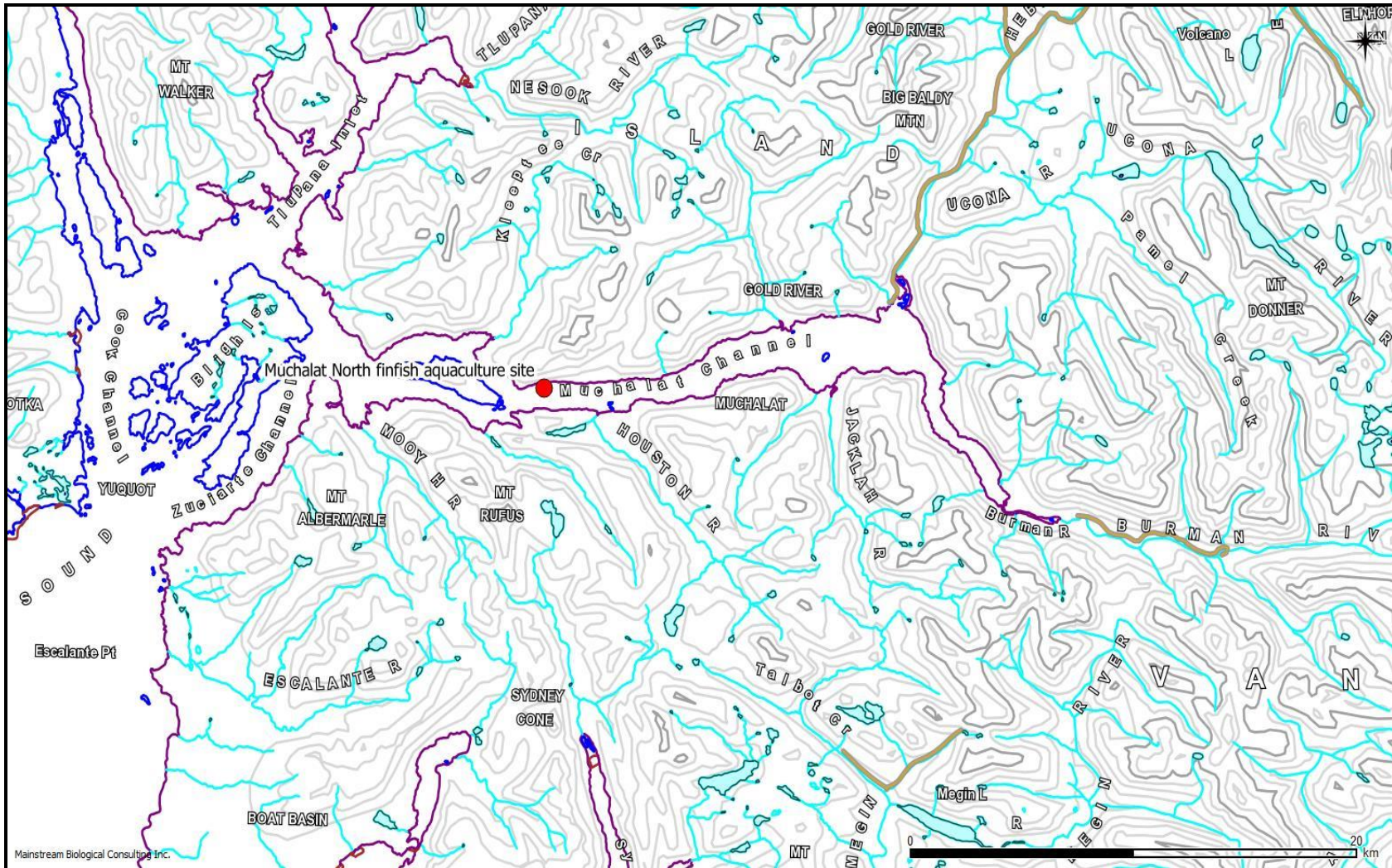


Figure 1: An overview map showing the approximate location of the Muchalat North finfish aquaculture farm site (red dot) in Muchalat Inlet, BC.

2.0 Methods

The substrate at the designated sampling locations at the Muchalat North 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. Only sample stations where sediment was successfully obtained during previous ASC surveys were sampled during this survey.

2.1 Field Sampling

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

Individual sediment sampling stations were located along one transect (Transect C). The station within the AZE was located 5 m inside the 1 g DEPOMOD contour (Figure 2). The station outside the AZE was located 25 m outside of the 1 g DEPOMOD contour. Additional stations were established at two reference sites within the range of 1700 m to 3300 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)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 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 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.

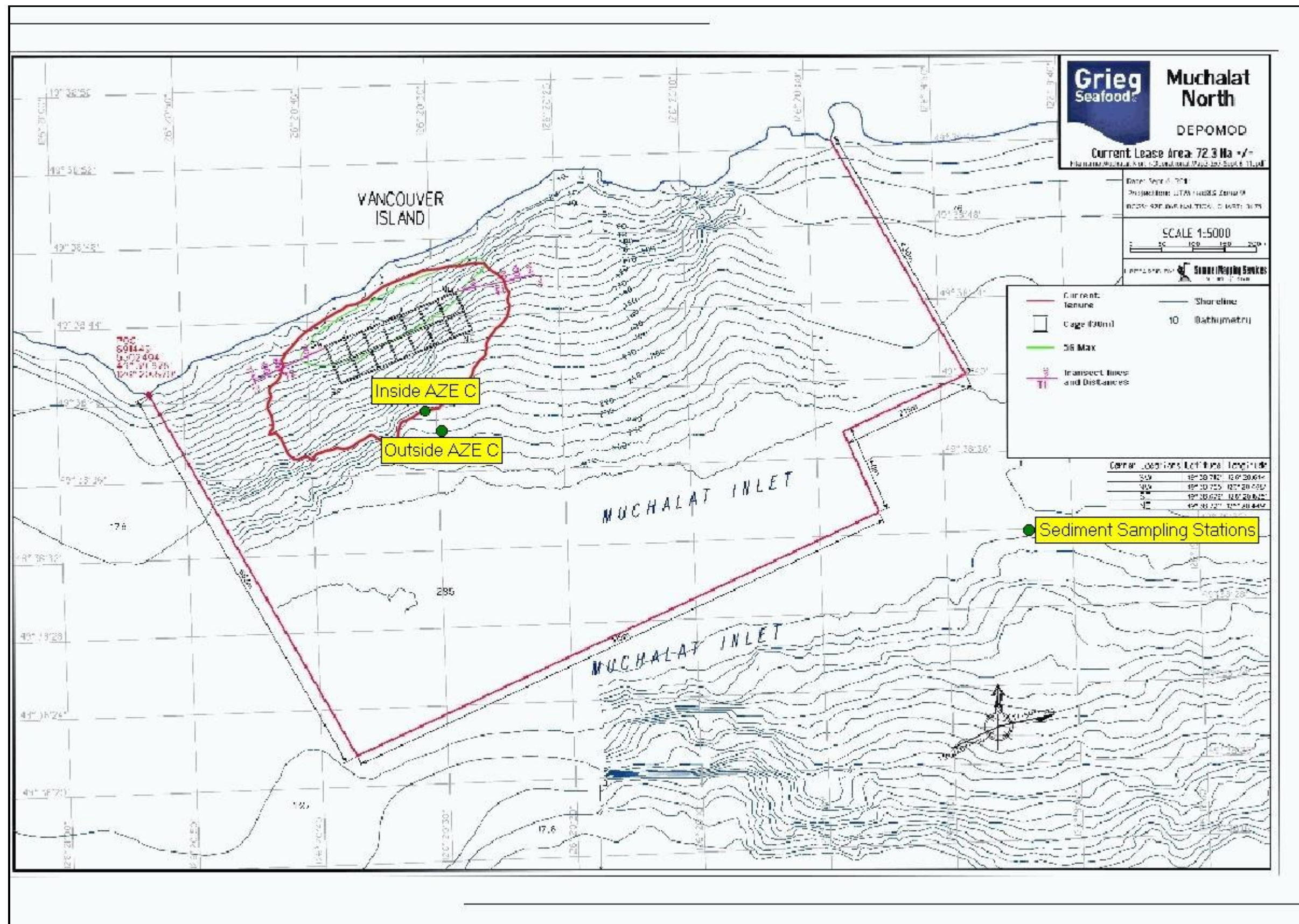


Figure 2: The locations of the sampling stations for the ASC survey at the Muchalat North finfish aquaculture site in relation to the pen system and surrounding area on March 1, 2022.

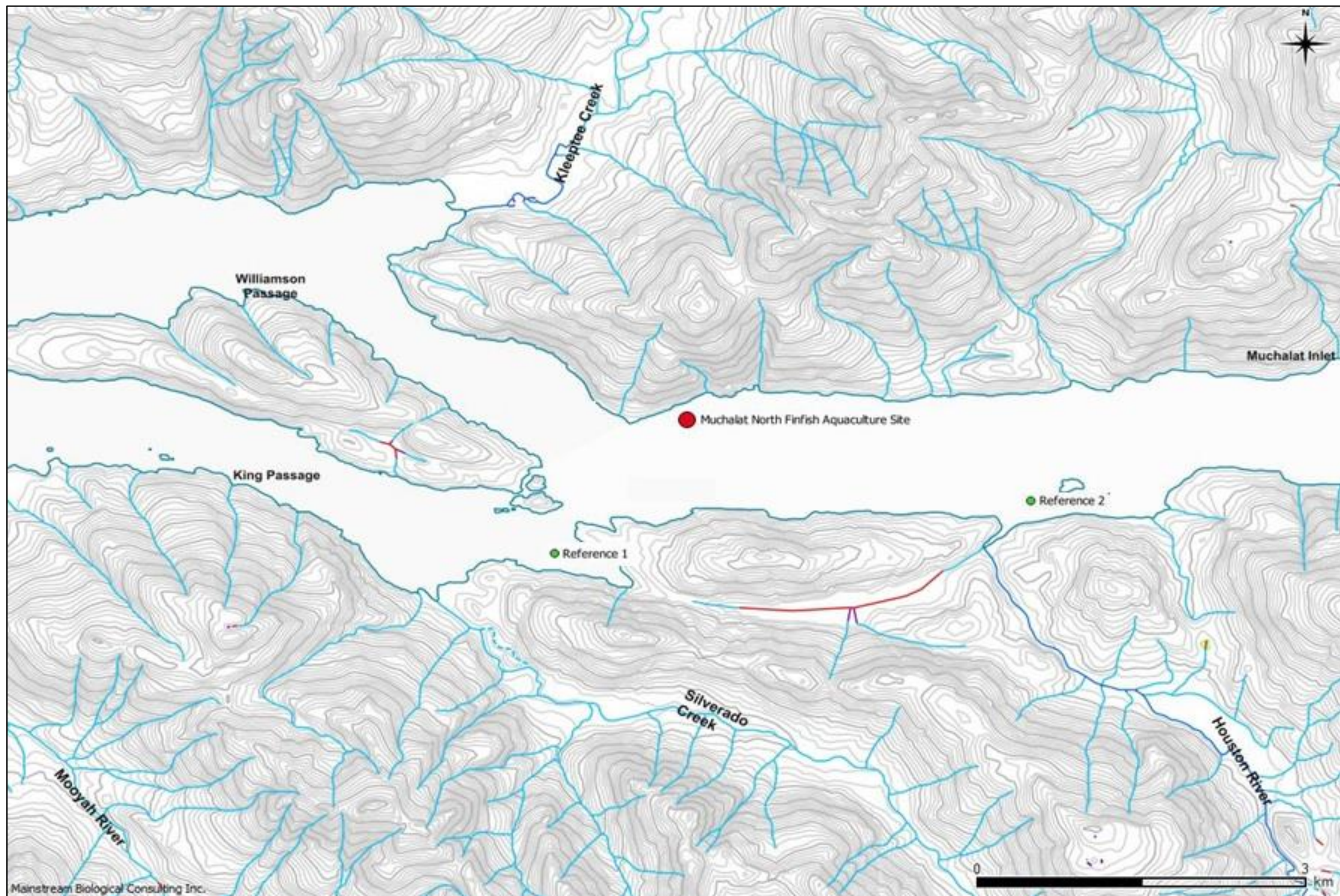


Figure 3: The locations of the reference stations for the ASC survey at the Muchalat North finfish aquaculture site in relation to the site and surrounding area on March 1, 2022.

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 station outside the AZE on Transect 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 near the Muchalat North 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 Muchalat North 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 Muchalat North sampling stations typically consisted of brown mud.

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 was analyzed to help evaluate if the Muchalat North facility was meeting the certification requirements (Appendix 3).

The mean sulphide level in sediment collected at the station outside AZE on Transect C (79.1 μM) on March 1, 2022, was less than the ASC Salmon Standard sulphide upper limit of 1500 μM .

Mean redox potential in sediment collected at the station outside the AZE on Transect C (291.3 mV) was 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 station outside the AZE on Transect 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.

Table 3: The parasiticide residue concentration of collected sediment at the station outside the AZE on Transect C and the two reference stations at the Muchalat North finfish aquaculture site on March 1, 2022.

Station Name	Sample Number	Emamectin Benzoate (ppm)
Detection Limit		1.0
Outside AZE C	1	<1.0
Outside AZE C	2	<1.0
Reference 1	1	<1.0
Reference 1	2	<1.0
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 station inside the AZE on Transect C at the Muchalat North site on March 1, 2022.



Photo 2

Sediment sample collected at the station outside the AZE on Transect C at the Muchalat North site on March 1, 2022.



Photo 3

Sediment sample collected at the Reference 1 at the Muchalat North site on March 1, 2022.



Photo 4

Sediment sample collected at the Reference 2 at the Muchalat North site on March 1, 2022.

Appendix 2 – Muchalat North Field Data

Reference Information:			
Farm site:	Muchalat North	Field Crew:	E. Cicon and M. Easton
Aquaculture Company:	Grieg Seafood BC Ltd	Field Investigator:	Mainstream Biological Consulting Inc.
Site Reference #:	AQ1849	Laboratory:	SGS Canada Inc
Geographic Region:	Muchalat 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>
C	5m	1	126	N	88	Petite ponar	0.02	N		2022-03-01	14:35	49	38.6524	126	20.5182	Post-process Corrected	150	10
C	5m	1	126	N	88	Petite ponar	0.02	Y	Duplicate	2022-03-01	14:35	49	38.6524	126	20.5182	Post-process Corrected	150	10
C	5m	1	126	N	88	Petite ponar	0.02	Y	Triplicate	2022-03-01	14:35	49	38.6524	126	20.5182	Post-process Corrected	150	10
C	5m	2	126	N	88	Petite ponar	0.02	N		2022-03-01	14:49	49	38.6528	126	20.5147	Post-process Corrected	150	10
C	25m	1	126	N	113	Petite ponar	0.02	N		2022-03-01	16:02	49	38.6348	126	20.5003	Post-process Corrected	174	10
C	25m	2	126	N	113	Petite ponar	0.02	N		2022-03-01	16:25	49	38.6356	126	20.4990	Post-process Corrected	173	10
REF	Ref 1	1		Y	1740	Petite ponar	0.02	N		2022-03-01	16:38	49	38.0154	126	21.5342	Post-process Corrected	79.1	5
REF	Ref 1	2		Y	1740	Petite ponar	0.02	N		2022-03-01	16:46	49	38.0198	126	21.5391	Post-process Corrected	78.3	6
REF	Ref 2	1		Y	3250	Petite ponar	0.02	N		2022-03-01	17:03	49	38.3651	126	17.8876	Post-process Corrected	96.7	5
REF	Ref 2	2		Y	3250	Petite ponar	0.02	N		2022-03-01	17:10	49	38.3773	126	17.8920	Post-process Corrected	96.9	5

<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>
C	5m	1	691	8.1	-158.1	57.9								N	N	N	N	2	N	N
C	5m	1	597	8.1	-178.4	37.6								N	N	N	N	2	N	N
C	5m	1		8.1	-229.3	-13.3								N	N	N	N	2	N	N
C	5m	2	709	8.1	-242.6	-26.6								N	N	N	N	2	N	N
C	25m	1	52.2	7.9	80.4	296.4								N	N	N	N	0	N	N
C	25m	2	106	7.9	70.1	286.1								N	N	N	N	0	N	N
REF	Ref 1	1	25.2	8.2	41.9	257.9								N	N	N	N	0	N	N
REF	Ref 1	2	16.2	8.1	58.8	274.8								N	N	N	N	0	N	N
REF	Ref 2	1	17.9	8.1	129.3	345.3								N	N	N	N	0	N	N
REF	Ref 2	2	20.8	7.8	134.9	350.9								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>
C	5m	1	N	N	Y	N	N	N	Brown	Mud	Needles
C	5m	1	N	N	Y	N	N	N	Brown	Mud	Needles
C	5m	1	N	N	Y	N	N	N	Brown	Mud	Needles
C	5m	2	N	N	Y	N	N	N	Brown	Mud	Cedar needles
C	25m	1	N	Y	N	N	N	N	Brown	Mud	Flecks of shell hash
C	25m	2	N	N	N	N	N	N	Brown	Mud	
REF	Ref 1	1	N	Y	Y	N	N	Y	Brown	Mud	Tubeworms, snails
REF	Ref 1	2	N	Y	Y	N	N	Y	Brown	Mud	
REF	Ref 2	1	N	N	Y	N	N	Y	Brown	Sandy mud	Worm
REF	Ref 2	2	N	N	Y	N	N	Y	Brown	Sandy mud	Abundant bark

Appendix 3 – Muchalat North ASC Survey Summary

Company:	Grieg Seafood BC, Ltd	Sample date:	March 1, 2022
Farm Site:	Muchalat North	Field crew:	E. Cicon and M. Easton
Site License #:	AQ1849	Analytical:	SGS Canada Inc
Site Location	Muchalat North, BC		

SULPHIDES Indicator 2.1.1 Requirement ≤ 1500 (μm)					
Station	Rep 1	Rep 2	n	Mean	ASC Criteria Met
Inside AZE C	691	709	2	700	
Outside AZE C	52.2	106	2	79.1	Yes
Reference 1	25.2	16.2	2	20.7	
Reference 2	17.9	20.8	2	19.4	

REDOX POTENTIAL Indicator 2.1.1 Requirement > 0 mV					
Station	Rep 1	Rep 2	N	Mean	ASC Criteria Met
Inside AZE C	57.9	-26.6	2	15.7	
Outside AZE C	296.4	286.1	2	291.3	Yes
Reference 1	257.9	274.8	2	266.4	
Reference 2	345.3	350.9	2	348.1	