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**2023** **NSARB-2023-001**

**Nova Scotia Aquaculture Review Board**

**IN THE MATTER OF:** Applications made by **KELLY COVE SALMON LTD.** for a **BOUNDARY AMENDMENT** and **TWO NEW MARINE FINFISH AQUACULTURE LICENSES** and **LEASES** for the cultivation of **ATLANTIC SALMON (Salmo salar) - AQ#1205x, AQ#1432, AQ#1433** in **LIVERPOOL BAY, QUEENS COUNTY.**

**Kelly Cove Salmon Ltd.**

APPLICANT

-and-

**Minister of Fisheries and Aquaculture**

PARTY

-and-

**Kwilmu'kw Maw-Klusuaqn Negotiation Office (KMKNO)**

INTERVENOR

-and-

**Queens Recreational Boating Association (Brooklyn Marina)**

INTERVENOR

**22 Fishermen of Liverpool Bay**

INTERVENOR

**Region of Queens Municipality**

INTERVENOR

**Protect Liverpool Bay Association**

INTERVENOR

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**Affidavit of Jessica Feindel**

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I, Jessica Feindel, of Shelburne, Nova Scotia, affirm and give evidence as follows:

1. I am the Manager of Aquaculture Operations in the provincial Department of Fisheries and Aquaculture (the Department). As part of this position, I am responsible for the Farm Management Plan Program, the Environmental Monitoring Program and the management of the Department's marine equipment. I started this position on November 7, 2017. I have been employed with the Department since 2013. Attached to this Affidavit as **Exhibit A** is a copy of my resume.

2. I have personal knowledge of the evidence affirmed to in this affidavit except where otherwise stated to be based on information or belief.

3. I state, in this affidavit, the source of any information that is not based on my own personal knowledge, and I state my belief of the source.

Review Team

4. My Team and I participated in the evaluation of the boundary amendment application brought by Kelly Cove for lease AQ #1205x as well as the applications for new aquaculture sites AQ#1432 and AQ#1433. We assisted in evaluating the operational aspects of these applications. This included assessing various aspects of the Development Plans from the Department's Operations Unit perspective, including the Production Plan, Oceanographic Environment, baseline environmental monitoring, and interactions with other aquaculture operations.

Farm Management Plan Program

5. As the Manager of Aquaculture Operations, one of the programs I am responsible for is the Farm Management Plan Program.

6. Under the *Aquaculture Management Regulations* (AMRs), all aquaculture licence holders must prepare a Farm Management Plan (FMP) that includes detailed information and procedures on:

    - fish health management,
    - containment management,
    - environmental monitoring, and
    - farm operations.

7. An FMP is a comprehensive document prepared by the aquaculture licence holder and is kept at the licence holder's place of business.

8. The AMRs outline in detail the information and procedures the Department requires in an FMP. The Department has established minimum compliance requirements for the procedures contained in FMPs. Attached to this Affidavit as **Exhibit B**, is a chart outlining the minimum compliance requirements for marine finfish aquaculture operations in Nova Scotia that must be described in the FMP.

9. FMP templates were created by the Department to assist licence holders with organizing information on their farm operations, procedures, and records to document that they operate in a way that is compliant with the AMRs.

10. FMPs are reviewed by the Department to ensure that the information is complete, and the aquaculture licence holder's described inputs and procedures comply with the AMRs. If the licence holder's described inputs and procedures comply with the AMRs, the Department approves the FMP for implementation.

11. A licence holder must have an approved FMP prior to stocking their site.

12. Licence holders are required to adhere to the procedures contained in their FMP. Records must be maintained:

    (a) To verify adherence to procedures,

    (b) To indicate an amendment to the FMP, and

    (c) Verify that effective action was taken at a critical control point(s).

13. The Department may audit the implementation of a licence holder's FMP, or request records and information contained in the FMP, at any time to assess compliance with the FMP requirements.

Section 3 Factors

14. The parts of applications that my team and I evaluated are relevant to several of the factors listed in s. 3 of the *Aquaculture Lease and Licence Regulations*. This affidavit is organized by the s. 3 factor most relevant to the Development Plan sections evaluated by my team.

**Section 3(b) Contribution of the Proposed Operation to Community and Provincial Economic Development**

Environmental Monitoring Program

15. The Environmental Monitoring Program (EMP) is an important monitoring and regulatory tool that is used to maintain balance between the aquaculture operation and the environment it operates within. The function of the EMP is to monitor the effects of an aquaculture operation on the marine environment and respond if balance is disrupted.

16. The EMP was established in 2002 and monitoring was carried out by the Department until 2008. The responsibility to conduct monitoring as part of the EMP was transferred to the industry beginning in 2009.

17. Environmental monitoring takes place at stations located directly within the lease boundaries and at a reference station(s) that is located outside of the lease boundaries.

18. The EMP uses a risk-based approach to monitoring that recognizes that increased risk requires increased monitoring. This approach can be consistently applied to the diverse nature of the aquaculture industry in the province. The EMP framework includes a variety of environmental indicators and variables to define environmental performance. Over time these site-specific data can be used to identify how each aquaculture lease interacts with the surrounding marine benthic environment. Attached to this Affidavit as **Exhibit C**, is the Environmental Monitoring Program Framework for Marine Aquaculture in Nova Scotia which describes the EMP in more detail.

19. One of the primary concerns regarding a marine finfish aquaculture operation is the potential for impacts on the surrounding marine benthic environment through organic loading.

20. Significant organic deposition can result in increased Biological Oxygen Demand (BOD) in benthic sediments.

21. The primary objective of the EMP is to ensure that the marine environment where aquaculture operations occur maintain oxic sediment conditions. Oxic conditions result when the BOD is *less than* the oxygen available.

22. Hypoxic or Anoxic sediment conditions result when BOD is *greater* than the oxygen available. Hypoxic or anoxic sediment conditions have the potential to negatively impact localized fish habitat by decreasing the abundance and diversity of faunal populations.

23. The EMP monitors impacts to benthic environments in two ways. First, impacts are monitored by conducting geochemical analysis of sediments (ex. sulfide concentration). Second, benthic impacts are monitored by assessing visual indicators of benthic health.

24. All marine finfish aquaculture leases that currently have production are subject to the EMP. Since the EMP is a risk-based program, sites of potential concern are subject to increased scrutiny, including additional sampling and, if it is required, remediation and mitigative actions will be required.

Production Plan

Maximum Site Biomass

25. All three sites, AQ#1205x, AQ#1432 and AQ#1433 propose twenty 100m cages, with 33,000 salmon per cage (total of 660,000 per site). The salmon will be harvested at 5.5 kg, and with 660,000 salmon on site the maximum biomass should be 3,630,000 kg.

26. DFO's Letters of Advice indicate that these production levels could result in the exceedance of the 3000 µM sulfide threshold (exceedance would temporarily prevent restocking under AARs) at one or more of these sites. (NSARB Exhibit 004, p. 255, 262, 269)

27. Environmental monitoring plays an important role in evaluating maximum site biomass. These leases will be assessed annually through the EMP, and should environmental results exceed the regulatory thresholds, the program is designed to further determine the spatial

degree of impact and mitigations and fallowing periods may be required to return the site to oxic conditions prior to restocking.

28. Actual monitoring at AQ#1205 since 2011 indicates this site has achieved acceptable environmental performance in accordance with the EMP, with the site's current maximum biomass (440,000 fish) which is less than what is being proposed (660,000).

29. The proposed maximum number of fish of 660,000 per lease site (estimated biomass of 3,630,000 kg) is a reasonable proposal, but site performance will dictate the maximum biomass approved by the Department for each production cycle.

Baseline Assessment

30. Baseline assessments of the benthic environments were required for the two new proposed sites, as well as AQ#1205x, since the boundary amendment for that site covers an expanded area that has not been previously approved.

31. AQ#1205x - A baseline monitoring event was conducted on the boundary expansion area on January 15th and 16th, 2019. At that time AQ#1205 was stocked with fish. The fallow period started April 2019. This monitoring event consisted of four corners (one had to be re-done the following day, January 16th, due to video recording issues), a center station and a reference station. One corner station was hard bottom, the rest were soft bottom. The center station was within the current active lease, and feed was identified in the video. The average sulfide of the four soft bottom stations was 189 µM, and the hard bottom corner passed the assessment of visual indicators of benthic health. The reference station had an average sulfide of 0 µM. The data presented by Kelly Cove falls within Oxic conditions.

32. AQ#1432 - A baseline monitoring event was conducted on this proposed lease on January 16th, 2019. This monitoring showed that 3 out of 4 corners were hard bottom, as well as the center station. The reference station was soft bottom. The single soft bottom corner had an average sulfide of 0 µM, and the hard bottom corners and center all passed the assessment of visual indicators of benthic health. The reference station had an average sulfide of 23 µM. The sulfide data presented by Kelly Cove falls within Oxic conditions.

33. AQ#1433 - Baseline monitoring took place on February 6th, 2019. Two corners were soft bottom stations, with an average sulfide of 0 µM, and the other two corners as well as the center station were hard bottom stations. The first reference station was hard bottom, a second reference station was used and was soft bottom with an average sulfide of 1.47 µM. Hard bottom stations all passed the assessment of visual indicators of benthic health. The sulfide data presented by Kelly Cove falls within Oxic conditions.

34. In summary, the baseline assessments for all three sites presented with oxic conditions for sulfide analysis and a pass as per the hard bottom protocol. Kelly Cove's consultant followed the sampling methodology required by the Department at that time.

BOD Modelling

35. These baseline assessments also inform the modelling DFO requires under the federal *Aquaculture Activities Regulations* (AAR). The modelling is done to predict BOD impacts from the aquaculture site's proposed operation. As mentioned above, the modelling done by DFO for these three sites predicted that the site's production level could result in the site mean exceeding the 3000 µM sulfide threshold. (NSARB Exhibit 004, p. 255, 262, 269)

36. The 3000 µM sulfide threshold is a regulatory threshold used by DFO for allowable BOD impacts on the benthic environment. If the sulfide site mean exceeds this threshold there can be no restocking of the site until the mean sulfide concentration has dropped below the 3000 µM threshold.

Past Performance of AQ #1205

37. A historical review of the EMP results for site AQ#1205, shows that this site design and biomass has achieved acceptable environmental performance in accordance with the environmental regulatory requirements.

38. AQ#1205 has been in operation by Kelly Cove since 2011 (it was formally acquired by the company in 2012). Attached to this Affidavit as **Exhibit D** is a document showing a summary of the environmental monitoring results at this site from 2011 to present. This data is available on the Province's Open Data portal.

39. The list below defines the Department's oxic classification thresholds related to sulfide concentrations as follows:

    Oxic A: 0-749 µM sulfide

    Oxic B: 750-1499 µM sulfide

    Hypoxic A: 1500-2999 µM sulfide

    Hypoxic B: 3000-5999 µM sulfide

    Anoxic: 6000+ µM sulfide

40. The AMRs require certain mitigation and/or steps to be taken if particular thresholds are exceeded. Steps could include mitigative actions regarding overstocking of fish, fish feces settlement, net biofouling, overfeeding, and improper feeding technique.

41. If the mitigative actions do not succeed in bringing down the sulfide average, the Minister may order specific actions be taken such as expediting the harvest program, extending fallowing periods, limiting approved stocking levels or adjusting the site layout.

42. As a result of the historical review of the environmental performance of AQ#1205, the current baseline information for all three sites, and the Department's regulatory framework

of programs, my team is satisfied that the maximum proposed biomass is reasonable. As stated above, ultimately site performance will dictate the maximum biomass approved by the Department each production cycle.

**Section 3(d): Oceanographic and Biophysical Characteristics**

Engineer's Approval of Site Design

43. As outlined in Section 15 (g) of the AMRs, operators of marine finfish sites are required to provide proof of a professional engineer's approval of the design of the structures in place for containment management. The Containment Management Framework, which is a policy document developed by the Department, outlines what is required for professional engineer approval. Attached to this Affidavit as **Exhibit E**, is the Containment Management Framework. The professional engineer must take into consideration the prevailing oceanographic and meteorological conditions at the site such as wind, waves, currents, depth and tidal range. Proof of professional engineer's approval is required prior to stocking at any new, or existing, sites.

44. The engineer's approval must be tailored to the operation. In the case of these applications, the Aquaculture Review Board (ARB) must decide whether to approve the proposed boundary amendment and two new additional sites. If the applications are approved by the ARB, Kelly Cove will be required to obtain proof of a professional engineer's approval of each approved site.

45. Kelly Cove obtained an engineer's approval for AQ#1205 prior to the most recent stocking at the site. A new engineer's approval will be required if the ARB approves the expanded operation AQ#1205x.

46. As a result, although the Review Team assessed the oceanographic environment, the final determination of the suitability of the infrastructure for the marine environment for the boundary amendment and new sites will be assessed by a professional engineer.

Wind

47. Kelly Cove provided a summary of Environment Canada Weather Station (Western Head) wind records from between 2012 and 2018. Data from this station is likely representative of conditions at the proposed lease areas as it is in relatively close proximity to the three lease sites:

    (i) AQ#1205x - ~6km

    (ii) AQ#1432 - ~6km

    (iii) AQ#1433 - ~4km

48. The observed data also suggests wind is most frequent from the SSW, from which these areas are reasonably well sheltered.

49. The most significant exposures for these sites are as follows:

    (i) AQ#1205x – S and SSE

    (ii) AQ#1432 – S and SE

    (iii) AQ#1433 – E and SE

    These most significant exposures for these three sites are from the directions in which the winds are least frequent. However, they are also among the directions from which the strongest winds are reported (110-180 degrees).

50. The proximity of the weather station to these lease areas should be sufficient to inform the Engineer who does the site assessment.

Current Speed and Direction

51. The Department deployed an Acoustic Doppler Current Profiler (ADCP) at AQ#1205 between September 2 and October 4, 2010. The mean current speed recorded during this deployment was 5.07 cm/s.

52. Kelly Cove conducted its own ADCP deployment at AQ#1432 and AQ#1433. The ADCP deployment at AQ#1432 took place between January 14, 2019, and February 19, 2019. The mean current speed recorded during this deployment was 5.1 cm/s.

53. The ADCP deployment at AQ#1433 took place between September 17, 2012, and October 24, 2012. The mean current speed recorded during this deployment was 5.4 cm/s.

54. These ADCP deployments met the Department's requirements.

Wave Height

55. Wave data presented by Kelly Cove is generalized data for the whole of the Nova Scotia coastline. It is not representative of the specific area of the applications and is unlikely to be a sufficient basis for a professional engineering assessment. Kelly Cove's wave height statistics were obtained from the Wind and Wave Climate Atlas and from the Northeastern Regional Association of Coastal and Ocean Observing Systems website. Additional wave height data was obtained from the Northeast Channel buoy, however located in open ocean approximately 215 km southwest of Liverpool Bay. The highest wave height measured from this buoy was 13.0 m in November 2007.

56. Local wave height data are available from ADCP deployments conducted by the Department near site AQ#1205 in 2008 and 2010. Significant wave heights from these deployments averaged approximately 0.6m, with maximums of approximately 4 to 4.5m, respectively. Waves of this height could potentially pose a risk to structural integrity of an aquaculture site. Around 75% of waves recorded during these deployments were from between 140 and 170 degrees; directions from which the proposed lease areas would be significantly exposed. It is worth noting that the ADCP deployments in 2008 and 2010

would include higher than normal wave heights due to the impact of Hurricane Kyle (2008) and Hurricane Earl (2010) while the devices were deployed.

57. Wave data will be considered by the professional engineer when assessing the site and signing off on approval of the infrastructure to be added to the site. The engineer also confirms that the site infrastructure has been constructed and installed in accordance with their original engineer's assessment.

58. In the Spring of 2023, a professional engineer approved the construction and installation of the infrastructure for AQ#1205, in accordance with the original professional engineer's assessment. As per the Containment Management Framework, a reassessment by the engineer would be required prior to stocking AQ#1205x again due to the change in infrastructure and/or equipment.

**Section 3(g): The Sustainability of Wild Salmon**

Containment Management

59. Containment Management is one of the Department's programs used to mitigate potential impacts on the sustainability of wild salmon. My team oversees most of the Containment Management program, with the exception of the traceability component which is administered by the Development section. All other components of the Containment Management program are under my team. These components involve all aspects of a marine finfish farm operation including infrastructure, operating procedures, and reporting procedures for suspected or confirmed breaches.

60. Containment management is principally addressed in the AMRs. Section 15 of the AMRs proscribe the following minimum requirements of containment management that must be addressed in the Operator's FMP:

- operating procedures that limit the risk of a breach;
- processes for installing and maintaining infrastructure in place to limit the risk of a breach;
- responses to breaches;
- areas of potential impact if a breach occurs;
- management of the site if unusual events or severe weather occurs;
- schedules for reporting breaches:
    - initial farm stocking;
    - inventory levels during production;
    - audits of the containment management system;

- proof of a professional engineer's approval of the design of the structures in place for containment management; and

- marking of fish in such a manner that it can be traced to the licensed grower of the said fish.

61. These minimum requirements are explained in more detail in the Containment Management Framework (Exhibit E) and the FMP minimum compliance requirements chart for marine finfish (Exhibit B).

62. To mitigate against escapes, operators must conduct a Hazard Analysis of Critical Control Points (HACCP) process as part of their FMP. HACCP is a tool, or process, in which the whole farm operation is analyzed to identify critical control points for risks to containment.

63. Kelly Cove's HACCP for containment is outlined in their Development Plan. (NSARB Exhibit 005, p. 253) This table is a summary of the measures outlined more fully in the FMP. It outlines the risks from Kelly Cove's specific operational procedures that could result in a breach, and identifies how the risks will be mitigated. These containment measures have been approved for implementation by the Department.

64. The goal of this process is to reduce and minimize the potential for fish to be released as a result of the farming operation.

65. Section 33 of the AMRs proscribe the minimum requirements for containment management monitoring that must be addressed in the operator's FMP. Third party audits of the containment management sections of an operator's FMP are required to identify sources of confirmed breaches and identify corrective actions to mitigate against those risks in the future.

Past Performance at AQ#1205

66. Since Kelly Cove took over operation of AQ#1205, there has been one suspected breach event reported which took place in June 2021. The Department requested information from Kelly Cove regarding inventory control and reporting sections of the FMP for that production cycle. The information was provided to the Department and deemed satisfactory. The Department did not require any additional actions. Kelly Cove has complied with the criteria set out in the Containment Management Framework.

**Section 3(h): The Number and productivity of Other Aquaculture Sites in the Public Waters Surrounding the Proposed Aquacultural Operation**

67. There is only one current aquaculture site in Liverpool Bay and that is the existing AQ#1205. If AQ#1205x is approved these applications propose that AQ#1205 will be expanded and two new leases, AQ#1432 and AQ#1433, will be added to Liverpool Bay.

It is noted in the applications that organic matter depositional contours did not extend beyond the lease boundaries, with the majority of the deposition falling directly under the cages.

68. The current lease AQ#1205 has performed well environmentally in the past, suggesting the oceanographic conditions in the area are tolerable for the current production of Atlantic Salmon. DFO noted that sediment sulfide concentrations at the existing AQ#1205 have exceeded Oxic categories at some sampling stations, but not at a lease level.

69. If one of the sites is determined not to be Oxic, mitigation will be required. As discussed above, if the mitigative actions do not succeed in bringing down the sulfide average, the Minister may order specific actions be taken such as expediting the harvest program, extending fallowing periods, limiting approved stocking levels or adjusting the site layout.

70. I was not physically present before Ms. Campbell when I affirmed this affidavit. I was linked with Ms. Campbell using video conferencing technology.

Affirmed before me by videoconference from Shelburne, Nova Scotia (location of affiant) to Halifax, Nova Scotia (location of lawyer taking oath) on the 19th day of January 2024.

[redacted]

Alison W. Campbell
A Barrister of the Supreme Court
of Nova Scotia

[redacted]

**Jessica Feindel**

# TAB A

2023 NSARB-2023-001

This is Exhibit "A" referred to in the
Affidavit of Jessica Feindel
affirmed before me by videoconference
on January 19, 2024

[redacted]

Signature
ALISON W CAMPBELL
A Barrister of the Supreme Court of Nova Scotia

# JESSICA
# FEINDEL, M.Sc.

[redacted] NS
[redacted]
[redacted]

## EDUCATION

### Master of Science - Biology | University of New Brunswick, Fredericton, NB
**2009 – 2012**

Thesis: *Ovarian development and sex ratios of gynogenetic Atlantic cod (Gadus morhua)*

***Publication***: Whitehead, J.A., Benfey, T.J., and Martin-Robichaud, D.J. 2011. Ovarian development and sex ratio of gynogenetic Atlantic cod (*Gadus morhua*). Aquaculture:324-325, 174-181.

### Bachelor of Science (Honours) – Marine Biology | University of New Brunswick, Saint John, NB
**2004 – 2008**

## EXPERIENCE

### Manager, Aquaculture Operations | NS Dept. Fisheries and Aquaculture, Shelburne, NS
**2017 – PRESENT**

- Manages the day-to-day administration of the Environmental Monitoring and Farm Management Plan Programs to ensure policies and procedures are followed.
- Supervises a working unit to ensure services and projects are accomplished efficiently and effectively.
- Ensures a risk-based management strategy is applied to respective aquaculture programs, while promoting sustainability.
- Conducts comprehensive reviews and assessments of Farm Management Plans (FMPs) to ensure operations reflect strong and sustainable management practices.
- Evaluates environmental suitability of new sites and performance of existing sites using data and modelling results.
- Plans and coordinates inter-related field work efforts, including the maintenance, operation and scheduling of all marine field equipment.
- Represents the department on federal and provincial committees, forums and at meetings to collaborate on the development of environmental and operational aquaculture programs, policies, and regulations.
- Interacts with industry, communities, municipalities, and special interest groups/individuals on aquaculture operational and environmental management matters.

### Environmental Monitoring Program Supervisor | NS Dept. Fisheries and Aquaculture, Shelburne, NS
**2013 – 2017**

- Led the implementation of provincial environmental management and compliance practices for aquaculture.
- Planned and coordinated the ongoing development and implementation of a risk-based environmental monitoring program for aquaculture.
- Reviewed program submissions and conducted data analysis to ensure standards of quality were met.
- Conducted data interpretation to evaluate environmental suitability of new sites and performance of existing sites.
- Conducted internal and external audits to ensure field and laboratory operations followed program standard operating procedures.
- Represented the department on federal and provincial committees, forums, and meetings to collaborate on the development of standard operating procedures, guidelines, and protocols for the environmental management of aquaculture.

- Provided consultative and specialized expertise to senior department staff on aquaculture environmental management.
- Interacted with industry, communities, municipalities, and special interest groups/individuals on all aquaculture environmental management matters.
- Responsible for maintenance and safe storage of laboratory equipment, supplies and resources.
- Responsible for accurate calibration of laboratory equipment and ensures technical requirements meet ISO standards.
- Deployed Acoustic Doppler Current Profilers and temperature loggers to inform oceanographic research related to aquaculture siting.
- Policy development.
- Familiarity with Hazard Analysis Critical Control Point system.

### Marine Environmental Biologist | Sweeney International marine Corp., St. Stephen, NB

**2011 – 2013**

- Conduct environmental monitoring of marine aquaculture farms in NB, NS and NL with a field team.
- Adhere to field sampling and sediment analysis SOPs.
- Experience with Ekman, Ponar and Hunter Simpson sediment grabs.
- Familiar with underwater drop cameras with top side units and amphibico diver-held cameras.
- Perform sulphide and redox analysis on marine sediments.
- Extensive experience of Windows and Microsoft Office.
- Experience writing Environmental Monitoring, Baseline, Environmental Assessment (CEAA), current meter an temperature profile reports.
- Perform current meter deployments.
- Analyze sulphide, redox, water current and temperature data.
- Initiation and development of R&D projects.
- Writing funding applications (NRC-IRAP, ACOA, NB TACP, ACRDP).
- Knowledge of MapSource, GPS devices and formats.
- 3D visualization, contouring and surface modeling of side scan sonar data.
- Conduct third party audits of farms with poor environmental ratings.

### Teacher's Assistant, Aquaculture in Canada Course | University of New Brunswick, Fredericton, NB

**2011**

- Supervised and provided academic support to students during labs and field trips.
- Graded and provided constructive feedback toward reports and presentations.

### Lab Assistant, Biological Effects Study | Dept. of Fisheries and Oceans, St. Andrews, NB

**2011**

- Assisted with biological effects studies related to oil and gas program.
- Responsible for daily collection of Atlantic cod gametes.
- Prepared chemical solutions.
- Exposed gametes and cod larvae to produced water, chemical dispersants, and oil.
- Assessed fertilization rates, hatching success and lethality of chemicals acting upon larvae.

### Lab Assistant, Fish Physiology | Dept. of Fisheries and Oceans, St. Andrews, NB

**2011**

- Executed care for diploid and triploid Atlantic cod larvae.
- Conducted routine tank husbandry.
- Measured and recorded water quality parameters.
- Administered hand feedings.
- Observed and recorded fish behaviour.

## Master of Science - Biology | University of New Brunswick, Fredericton, NB & Dept. Fisheries and Oceans, St. Andrews, NB

**2009 – 2012**

- Handled Atlantic cod broodstock:
    - Familiar with finfish anaesthesia; applied spawning techniques for gamete collection; constructed and used catheters for milt collection.
- Implemented UV treatments for DNA inactivation.
- Performed artificial fertilization procedure.
- Operated hydrostatic pressure shocker for ploidy manipulation.
- Prepared samples for genotyping (fin clips and embryos).
- Experience rearing embryos via flow-through incubation systems.
- Participated in rotifer culture practices.
- Practiced with larval tank set-up and larval rearing.
- Programmed and operated "AMD" feeding systems.
- Conducted histology on ovarian tissue.
- Experience writing scientific documents:
    - Master's thesis, Aquaculture Journal manuscript, AAC Bulletin article, Animal Use Protocol, ACRDP project update
- Presented scientific research.
- Well versed with Microsoft Office (Excel, Powerpoint, Word, Outlook).
- Familiar with both ImagePro Plus and ImageJ.
- Analyzed data with SPSS, SigmaPlot, MS Excel and Minitab.
- Utilized SigmaPlot for graph design.
- Demonstrated effective experimental design.

## Aquaculture Research Technician | Huntsman Marine Science Center, St. Andrews, NB

**2008 – 2009**

- Handled Atlantic cod Broodstock:
    - Familiar with finfish anaesthesia and sedation; performed weight, length measurements and data entry; administered injections: Ovaplant, antibiotic, floy tags; practiced with spawning techniques.
- Knowledgeable of recirculation systems (backwashing, pump changes, flows).
- Performed sea cage assessments (length, weight, external morphologies).
- Participated in fish quality assessments at fish processing plant.
- Implemented artificial fertilization procedures.
- Practiced in fertilization rates and photo capture.
- Prepared biological samples.
- Utilized "Image J" for egg diameter analysis.
- Familiar with ozonating procedures for sterilization.
- Acquainted with incubation systems.
- Performed larval tank set-up and administered larval care.
- Contributed and performed live feed culture (algae, rotifers and artemia).
- Conducted submersion vaccinations of juveniles.
- Demonstrated effective pit-tagging skills and deformity recognition.
- Performed water quality analysis via spectrophotometry.

# TAB B

2023 NSARB-2023-001

This is Exhibit “B” referred to in the
Affidavit of Jessica Feindel
affirmed before me by videoconference
on January 19, 2024

[redacted]

Signature
ALISON W CAMPBELL
A Barrister of the Supreme Court of Nova Scotia

## Marine Finfish Farm Management Plan Minimum Compliance Requirements

The following document outlines the minimum compliance requirements for marine finfish aquaculture operations in Nova Scotia. The minimum compliance requirements are organized by Farm Management Plan (FMP) section.

### *Section 2.0: Stocking Level*

Before initial stocking or restocking of an aquaculture site, the population number to be stocked must be reported and approved. This section outlines the stocking plan for the site for the time period covered within the FMP and provides information required to assess the stocking level. This section includes a production plan, site diagram, fallowing plan, and production reporting information.

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 2.1 Production plan | *All finfish* | • Production plan must be provided |
| 2.1 Species and year class | *Atlantic salmon* | • One year-class stocking |
| | *Rainbow Trout* | • Up to a maximum of two year-classes stocked |
| | *Other species* | • Subject to review by Chief Aquatic Animal Health Veterinarian or Veterinary Administrator |
| 2.2 Site plan | *All finfish* | • Scaled site diagram must be provided |
| 2.3 Historical environmental monitoring and production information | *Atlantic salmon* | • Historical production levels and environmental monitoring results (two previous production cycles minimum) provided upon stocking request |
| | *Rainbow Trout* | • Historical production levels and environmental monitoring results (four previous years minimum) provided upon stocking request |
| | *Other species* | • Historical production levels and environmental monitoring results provided according to request by NSDFA |
| 2.4 Aquaculture Management Area (if AMA is established) | *All finfish* | • Written AMA agreements with other licence holders if required by the Minister |
| 2.5 Fallowing plan (for sites NOT within an AMA) | *Atlantic salmon* | • Maximum of 36 months continuous stocking<br>• Fallowing period according to stocking cycle length, as described |
| | *Rainbow Trout* | • Maximum of two consecutive year class stockings before fallowing<br>• Fallowing period according to stocking cycle length, as described |
| | *Other species* | • Subject to review by Chief Aquatic Animal Health Veterinarian or Veterinary Administrator |
| 2.5 Fallowing plan (for sites within an AMA) | *Atlantic salmon* | • Fallowing according to AMA agreement |
| | *Rainbow Trout* | • Fallowing according to AMA agreement |
| | *Other species* | • Fallowing according to AMA agreement |
| 2.6 Inventory control and reporting | *All finfish* | • Reporting of stocking level upon request |

### *Section 5.0: Description of Inputs*

This section describes the physical components and material elements of the farm. These inputs affect all components covered within the FMP, including Fish Health Management, Containment Management, Farm Operations, and Environmental Monitoring.

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 5.1 Site, infrastructure and holding system | *All finfish* | • Provide technical specifications of containment equipment and infrastructure<br>• Describe installation processes for containment equipment and infrastructure<br>• The design of the structures in place for containment management follow requirements as defined in AMR 15(g) |
| 5.4 Veterinary service provider | *All finfish* | • Provide name of veterinary service provider |

### *Section 6.0: Procedures for Fish Health Management and Containment Management*

This section defines the procedures and plans required for meeting compliance requirements common for all operations (as defined by species) to ensure they meet the AMR requirements for Fish Health Management and Containment Management. Topics affecting fish health are often relevant for containment management and vice versa, so that the procedures relevant to these aspects have been combined within this template plan.

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 6.1 Bird deterrence | *All finfish* | • Bird deterrent strategies described |
| 6.2 Predator management | *All finfish* | • Predator deterrent strategies described |
| 6.3 Equipment maintenance | *All finfish* | • Removal of nets from the water after each production cycle for cleaning, disinfection, and testing<br>• Up to date net inventory records<br>• Up to date net history records<br>• Up to date net testing records<br>• Net biofouling control strategy(ies) described<br>• On-site net repair kit<br>• Net repair procedure described<br>• Up to date net inspection records<br>• Net mesh sizing strategy described<br>• Net changing procedure described<br>• Records to support application of net changing SOP<br>• Minimum weekly bird net inspections<br>• Up to date inspection and history records for bird nets<br>• Biannual mooring and anchor inspection<br>• Up to date inspection and repair records (moorings and anchors)<br>• Biannual grid system inspection<br>• Inspection and repair records (grid system) |
| 6.4 Equipment inspection | *All finfish* | • Weekly surface inspections<br>• Up to date surface inspection records (to include enclosure nets, bird nets, predator nets, moorings and anchors, and grid)<br>• Below-water net inspection (every 60 days)<br>• Up to date below-water net inspection records (to include enclosure nets, predator nets)<br>• Biannual below-water infrastructure inspection<br>• Up to date below-water infrastructure inspection records (to include moorings and anchors, and grid) |

***Section 6.0: Procedures for Fish Health Management and Containment Management***

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 6.5 Response to a breach of containment | *All finfish* | • Areas of potential impact of a breach described<br>• Procedures to respond to a breach described<br>• Immediate notification of knowledge or suspicion of a breach |
| 6.6 Unusual event and severe weather response | *All finfish* | • Strategy for responding to unusual events described<br>• Strategy for responding to severe weather described |
| 6.7 Biosecurity | *All finfish* | • Wharf usage biosecurity SOP described<br>• Up to date records demonstrating application of wharf usage biosecurity SOP<br>• Cleaning and disinfection standard operating procedures described<br>• Up to date records demonstrating application of cleaning and disinfection SOP<br>• Staff and visitor cleaning and disinfection standard operating procedures described<br>• Up to date records demonstrating application of staff and visitor cleaning and disinfection SOP |
| 6.8 Feeding | *All finfish* | • Structured monthly feeding schedule<br>• Recorded feed consumption and up to date calculated feeding rate records |
| 6.9 Pest management | *All finfish* | • Pest management strategy described<br>• Pest management records |
| 6.10 Waste management | *All finfish* | • Strategy to manage waste described<br>• Blood water and offal containment and treatment strategy that assures the killing or rendering of pathogens of concern inert |
| 6.11 Water quality | *All finfish* | • Up to date daily and monthly water quality monitoring and recording of oxygen and temperature<br>• Described algae monitoring regime and up to date records of algae monitoring according to regime<br>• Strategies for responding to low oxygen, low and high temperatures, and suspected algae effects on fish health described |
| 6.12 Mortality collection | *All finfish* | • Described mortality collection procedures that include all aspects of storage and disposal<br>• Records supporting application of mortality collection SOP<br>• Described mortality collection schedule- a minimum of one mortality dive for each of the stocked cages per week is mandatory<br>• Up to date mortality collection records<br>• Classification of all mortalities<br>• Up to date records of mortality classification |

***Section 6.0: Procedures for Fish Health Management and Containment Management***

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 6.13 Fish handling | *All finfish* | • Euthanasia method(s) described<br>• Anesthesia method described<br>• List anesthetics<br>• Described mean weight determination procedure<br>• Records supporting application of mean weight determination SOP<br>• Described grading or splitting procedure (if applicable)<br>• Records supporting application of grading or splitting procedure<br>• Described harvesting procedure<br>• Records supporting application of harvesting procedure |
| 6.14 Transport | *All finfish* | • Defined live transport procedure<br>• Certificate of Health for Transfer (COHFT) permit for all live transfers (refer to Section 6.19.5)<br>• All pertinent Federal transfer permits<br>• Records supporting application of live transport procedure<br>• Defined dead fish transport procedure<br>• Fish transport biosecurity procedures described<br>• Records supporting application of fish transport biosecurity procedures |
| 6.15 Broodstock | *All finfish* | • Described method for egg and milt collection<br>• Described egg disinfection procedures<br>• Up to date egg disinfection records<br>• Egg and milt records to identify parentage or batch |
| 6.16 Vaccination | *All finfish* | • Vaccination status described |
| 6.17 Stock treatment | *All finfish* | • Up to date stock treatment records<br>• Reporting of antibiotic use to the Province<br>• Reporting of products to treat sea lice to the Province |
| 6.18 Sea lice management | *Atlantic salmon and Rainbow trout* | • At a minimum, weekly sea lice counts from April 1 to January 15th of each year<br>• Personnel to perform sea lice counts must be trained and records of training kept<br>• Sea lice counts records kept on file and made available for review within 7 days of count<br>• If weekly sea lice count is not complete an explanation for the omission must be recorded in the sea lice count record<br>• Site access for auditors during sea lice counting, if requested<br>• Sea lice treatments applied according to Farm Management Plan (unless deviations from this schedule were approved)<br>• Sea lice treatment plans approved by Chief Aquatic Animal Health Veterinarian<br>• Record of sea lice treatment<br>• Sea lice biosecurity procedures described |

***Section 6.0: Procedures for Fish Health Management and Containment Management***

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 6.19 Disease surveillance | *All finfish* | • Adherence to and documentation of routine surveillance<br>• Adherence to minimum sampling and testing requirements for fish transfers from a marine site (if applicable)<br>• Adherence to the Health Policy for the Transfer of Live Cultured Fish in Atlantic Canada<br>• Possession of a Certificate of Fish Health for Transfer permit during and post transport<br>• Use of an approved laboratory for testing<br>• Possession of health records for current stock |
| 6.19.9 Mandatory reporting | *All finfish* | • Reporting of provincially reportable diseases<br>• Reporting of mass mortality events<br>• Reporting of significant mortality events of unknown etiology |
| 6.19.10 Managing disease outbreaks | *All finfish* | • Adherence to authority requests during disease outbreak (if applicable)<br>• Adherence to a Quarantine Order (if ordered)<br>• Disease management measures approved by Chief Aquatic Animal Health Veterinarian |

### *Section 7.0: Hazard Assessment for Fish Health Management and Containment Management*

This section allows the completion of hazard analyses to define procedures that have critical control points necessary for effective Fish Health and Containment Management. These supplement the procedures described in Section 7 by ensuring that operation specific hazards are accounted for in the FMP.

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 7.1 Hazard analysis for Fish Health Management | *All finfish* | • A hazard analysis of the production process must be completed for Fish Health Management<br>• Each procedure contained in a Farm Management Plan must include any of the following that apply to with respect to that procedure:<br>a) Critical control points<br>b) Critical control limits<br>c) Details about how the procedure is monitored<br>d) Details about corrective actions to be taken |
| 7.2 Hazard analysis for Containment Management | *All finfish* | • A hazard analysis of the production process must be completed for Containment Management<br>• Each procedure contained in a Farm Management Plan must include any of the following that apply to with respect to that procedure:<br>a) Critical control points<br>b) Critical control limits<br>c) Details about how the procedure is monitored<br>d) Details about corrective actions to be taken |

### *Section 8.0: Farm Operations*

This section describes aspects that demonstrate responsible operation of a marine shellfish operation. The FMP must include information and procedures that are consistent with industry best practices relating to the following:

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 8.1 Supply storage | *All finfish* | • Strategy for the storage and disposal of fuel described<br>• Strategy for the storage and disposal of lubricants and chemicals described |
| 8.2 Accumulated refuse and decommissioned farm supplies and equipment | *All finfish* | • Strategy to deal with accumulated refuse and decommissioned farm supplies and equipment described<br>• Immediate reporting to NSDFA and DFO regarding equipment dropped to the bottom |
| 8.3 Retrieving loose gear | *All finfish* | • Strategy for retrieval of loose gear or debris described |
| 8.4 Maintaining the site in good order | *All finfish* | • Strategy to maintain the site in good order described |
| 8.5 Noise | *All finfish* | • Strategy to minimize noise disruption described |

### *Section 9.0: Environmental Monitoring*

This section defines the procedures and plans required for effective environmental monitoring of a marine finfish operation. A hazard analysis defines those procedures that can be put into place in the event that poor environmental performance is indicated by monitoring.

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 9.1.2, 9.1.3 Benthic monitoring, Level I | *All finfish* | • Annual Level I benthic monitoring for active sites<br>• Electronic site diagram (kg fish/cage and number and location of proposed monitoring locations) submitted at least two weeks prior to monitoring<br>• Anticipated monitoring date submitted at least two weeks prior to monitoring<br>• Monitoring method submitted at least two weeks prior to monitoring |
| 9.1.4 Benthic monitoring, Level II | *All finfish* | • Level II benthic monitoring for Hypoxic B and Anoxic sites<br>• Electronic site diagram (kg fish/cage and number and location of proposed monitoring stations submitted within one week of monitoring<br>• Monitoring to occur no later than 35 days after the date of the Level I monitoring event |
| 9.1.5 Benthic monitoring, Level III | *All finfish* | • Level III monitoring for sites that consistently fail to meet oxic conditions<br>• Compliance with enhanced monitoring regimen determined by AESMC in discussion with the site operator |
| 9.1.7 Benthic monitoring procedures | *All finfish* | • Procedures for collection of samples for benthic monitoring provided |
| 9.1.8 Video recording | *All finfish* | • Video recording procedures for benthic monitoring provided |
| 9.1.9 Field observations | *All finfish* | • Recording of field observations during benthic monitoring |
| 9.1.10 Analysis of sediment samples | *All finfish* | • List of chemicals and equipment to be used for EMP approved by NSDFA prior to monitoring season<br>• Procedures for sediment sample analysis provided |
| 9.1.11 Benthic monitoring reporting | *All finfish* | • For Level I monitoring, field observations, coordinate table, redox and sulfide analysis results reporting within 14 days of sediment collection<br>• For Level I monitoring, all remaining sample analyses results (porosity and organic matter), video and grab log sheets, and photos and video recordings reporting within 21 days of sediment collection<br>• For Level II monitoring, all reporting must be within 14 days of sample collection |

***Section 9.0: Environmental Monitoring***

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 9.2 Mitigation plan | *All finfish* | • A hazard analysis of the production process must be completed for Environmental Impact to determine mitigation plan options to address poor environmental performance<br>• Each mitigation procedure must include any of the following that apply to with respect to that procedure:<br>a) Critical control points<br>b) Critical control limits<br>c) Details about how the procedure is monitored<br>d) Details about corrective actions to be taken |
| 9.3 Oxic condition remediation, for change from Oxic to Hypoxic A site classification | *All finfish* | • Mitigation plan and timeline for implementation described<br>• Updated mitigation plan described |
| 9.3 Oxic condition remediation, for change to Hypoxic B, or Anoxic site classifications | *All finfish* | • Level II monitoring conducted no later than 35 days after the Level I monitoring event<br>• Results of Level II monitoring submitted no later than 14 days following monitoring<br>• Updated mitigation plan submitted no later than 14 days following Level II monitoring<br>• Compliance with additional directives from NSDFA to reduce environmental impact, if applicable. |

### *Section 10.0: Record Keeping*

This summarizes the minimum record keeping requirements for the operation, as determined by compliance requirements, procedures, and critical control points established within the risk analyses.

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 10.1 Compliance record requirements | *All species* | • Records must be kept to verify adherence to the procedures and to demonstrate that effective action was taken at critical control points, when applicable.<br>• Records must be kept for at least seven years from the date the record is created or updated<br>• Records must be available when requested |

### *Section 13.0: Record of Amendments*

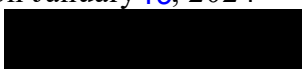
Once the FMP is approved, records must be kept by the aquaculture licence holder of any amendments to the FMP.

| Subject | Species | Minimum compliance requirement |
|---|---|---|
| 13.0 Record of Amendments | *All species* | • Records must be kept of any amendments to the FMP |

# TAB C

2023 NSARB-2023-001

This is Exhibit “C” referred to in the
Affidavit of Jessica Feindel
affirmed before me by videoconference
on January 19, 2024



Signature
ALISON W CAMPBELL
A Barrister of the Supreme Court of Nova Scotia

# ENVIRONMENTAL MONITORING PROGRAM FRAMEWORK FOR MARINE AQUACULTURE IN NOVA SCOTIA


Fisheries and Aquaculture

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# Environmental Monitoring Program Framework for Marine Aquaculture in Nova Scotia

## 1. INTRODUCTION

The Nova Scotia Aquaculture Environmental Monitoring Program (EMP) began in the fall of 2002 when the Aquaculture Association of Nova Scotia (AANS) produced a draft plan recommending that the Province implement and regulate an EMP for the marine aquaculture industry. This draft plan originated from the document *Design of the Environmental Monitoring Program for the Marine Aquaculture Industry in Nova Scotia* (Smith et al., 2002). The Aquaculture Division of the Nova Scotia Department of Fisheries & Aquaculture (NSDFA) accepted the lead role and began implementing the EMP.

The EMP examines the relationship between an aquaculture operation and the surrounding benthic marine environment. Environmental monitoring takes place at stations located directly within the lease boundaries and at a reference station(s) that is located outside of the lease boundaries.

The EMP applies to all active and inactive, marine finfish and shellfish aquaculture leases in Nova Scotia. As of March 2021, there were a total of 206 licensed marine aquaculture sites in Nova Scotia (164 shellfish, 35 finfish, and 7 shellfish/marine plant sites). Species grown at marine aquaculture leases in Nova Scotia include: salmon, trout, mussels, scallops, clams, quahogs and oysters.

The regulatory provisions for the EMP are referenced in the Aquaculture Management Regulations (S.10-11 and S.30-32) created pursuant to the Fisheries and Coastal Resources Act (S.64). Each operator is responsible to include all information and procedures related to the EMP in their site-specific Farm Management Plan. In addition, a Memorandum of Understanding (MOU) has been signed by both the NSDFA and Fisheries and Oceans Canada (DFO) stating responsibilities of each party:

*"The Parties will co-operate in the development of an industry wide environmental effects monitoring program. Nova Scotia will be responsible for the implementation of the environmental effects monitoring program and the implementation of a follow-up program, where applicable, and will report to Canada in a manner that is mutually agreeable to the Parties."*

The EMP uses a risk-based approach to monitoring that recognizes that increased risk requires increased monitoring. This risk-based approach is based on almost two decades of empirical data that has been collected across the spectrum of Nova Scotia aquaculture activities and environmental conditions. This approach can be consistently applied to the diverse nature of the aquaculture industry in the province. The dataset includes a variety of environmental indicators and variables to define environmental performance. Over time these site-specific datasets can be used to identify how each aquaculture lease interacts with the surrounding marine benthic environment.

All marine aquaculture leases that currently have production are assessed as part of the EMP. Active marine finfish sites are required to conduct monitoring at least once annually. Additional monitoring, remediation and mitigative actions may be required based on results from annual

monitoring. Active shellfish sites may be required to conduct monitoring if deemed necessary by NSDFA or DFO. It should be recognized that shellfish culture is different with respect to environmental interactions, and that the monitoring and management practices reflect this difference.

Environmental monitoring is a critical part of the management of a marine resource industry. NSDFA believes that the growing body of data that has been and will continue to be collected, helps to ensure that the aquaculture industry in Nova Scotia remains environmentally sustainable.

This document is designed as a companion paper to the *Standard Operating Procedures for the Environmental Monitoring of Marine Aquaculture in Nova Scotia* (NS EMP SOP; PNS 2021B). These documents are intended to be used as a framework and protocol for environmental monitoring of the Nova Scotia aquaculture industry. These documents will be reviewed and adjusted as needed.

The objective of this document is to detail key components of the NS EMP. These are:

- **Environmental Management Framework –** this section describes the rationale for the regulatory framework and determining appropriate levels of monitoring;
- **Site Management Responses** – this section describes site management responses based on the environmental quality classification reported from a sample location with reference to industry Best Management Practices (BMP);
- **Committees for Regulation and Development of Environmental Management Outcomes** – this section describes the role and responsibilities of the committee to make recommendations on the conduct of the EMP;
- **Annual Schedules** – this section describes the timing deadlines for monitoring and mitigation; and
- **Auditing and Reporting** – this section describes the types of auditing that will be performed by NSDFA as well as the reporting requirements for Industry self-monitoring.

# 2. ENVIRONMENTAL MANAGEMENT FRAMEWORK

The NS EMP lays out a series of principles and criteria to guide the management process and to determine the level of monitoring required for each aquaculture lease. Depending on the monitoring results, the EMP also provides guidance on the level of mitigation required for an aquaculture lease.

## 2.1. Monitoring Principles

The information obtained from the monitoring program is valuable both to government regulators and the aquaculture industry. Monitoring is carried out to:

- Ensure compliance with conditions of a site approval;
- Ensure environmental quality objectives (EQOs) and other standards are met;
- Assess the effects of an operation on the environment;
- Verify and validate mathematical models (if any);
- Determine mitigative action to be taken (if any); and
- Audit the results of self-monitoring.

One of the primary concerns regarding a marine aquaculture operation is the potential for negative impact on the surrounding marine benthic environment through organic loading. Significant organic deposition can result in increased Biological Oxygen Demand (BOD) in benthic sediments. If BOD is greater than the incoming supply of oxygen, hypoxic or anoxic sediment conditions will result, potentially impacting localized fish habitat and decreasing the abundance and diversity of macrofauna populations.

The EMP aims to monitor such impacts in benthic communities through both geochemical analysis of sediments and the assessment of visual indicators of hypoxic conditions. These assessments are used to classify the environmental performance of an aquaculture lease based on established relationships between the collected parameters and benthic community health. In instances where site classification indicates compromised benthic conditions as a result of organic loading, the EMP dictates increasing levels of monitoring to improve understanding of the scope and severity of the impacts as well as mandatory management responses to be undertaken by the facility operator.

The primary EQO for the marine environment where an aquaculture operation occurs is to maintain oxic sediment conditions. If oxic sediment conditions cannot be maintained within a lease, operators must comply with the regulatory process that identifies steps required to improve onsite environmental conditions.

## 2.2. Station and Site Classifications

In July of 2015, the Aquaculture Activities Regulations (AARs) were introduced by the Department of Fisheries and Oceans Canada (DFO), resulting in the creation of federal monitoring requirements which aquaculture site operators must comply with in addition to the provincial program. The AAR's inclusion of assessment requirements for stations where sediments can not be collected has since led to the incorporation of similar considerations within the Nova Scotia Environmental Monitoring Program for assessing and classifying stations and leases (AAR 2021). While previous iterations of the EMP relied solely on measurements of sediment sulfide ion concentration to determine environmental impacts, the inclusion of hard bottom monitoring methodologies has required the consideration of additional benthic health indicators and classification metrics for the assessment of the environmental performance of aquaculture operations.

### 2.2.1. Determination of Monitoring Station Type

All monitoring events conducted under the Environmental Monitoring Program consist of the assessment of a series of individual monitoring stations. The means by which these stations are assessed and how the results are used in the classification of the environmental performance of an aquaculture lease as a whole is dependant on the representative bottom types present. Within the context of the EMP, monitoring stations can be considered hard bottom or soft bottom stations. A monitoring location is considered to be a soft bottom station only when a sufficient number of sediment samples can be collected which satisfy the methodology and quality criteria presented in Section 5 of the NS EMP SOP (PNS 2021B). Where the composition or consolidation of the benthic substrate is such that sufficient, acceptable samples can not be collected, a monitoring location will be considered a hard bottom station for the purposes of that monitoring event.

### 2.2.2. Environmental Indicators and Definitions

The NS EMP focuses on benthic marine habitat directly underneath the aquaculture site. The objectives of the environmental parameters assessed for soft and hard bottom stations are to:

- Maximize habitat information by providing scientific confidence in the parameters and methods of monitoring and analysis used to describe changes to the benthic community structure;
- Provide long-term record of habitat quality with variables that are sensitive to the potential organic enrichment effects of aquaculture;
- Provide repeatability and consistency in monitoring and analysis;
- Provide clear specification of spatial and temporal bounds; and
- Optimize logistics and field efforts while ensuring cost effectiveness.

Several additional, well-established, environmental indicators allow for the classification of sediment conditions into oxic, hypoxic and anoxic categories based on the following Environmental Quality Definitions (EQD). These indicators may be used, in addition to environmental performance classification metrics (Section 2.2.3) in determining specific site management response requirements resulting from the monitoring and classification of aquaculture leases.

**Table 1**. Environmental Quality Definitions

| | **Sediment Classification** | | |
|---|---|---|---|
| **Measurement** | **Oxic** | **Hypoxic** | **Anoxic** |
| Sediment colour | Tan to depth > 0.5 cm | Tan to < 0.5 cm with some black sediments at surface | Surface sediments black |
| Microbial presence | No *Beggiatoa*-like bacteria present | Patchy *Beggiatoa*-like bacteria | Widespread *Beggiatoa*-like bacterial mats |
| Macrofaunal Assemblage | Wide array of infauna and epifauna | Mixed group of mostly small infauna | Small infauna only |
| **Sulfide, µM** | **≤ 749 (A)<br>750 to 1499 (B)** | **1500 to 2999 (A)<br>3000 to 5999 (B)** | **≥ 6000** |
| Redox (Eh), $mV_{NHE}$ | >100 (A)<br>100 to -50 (B) | -50 to -100 (A)<br>-100 to -150 (B) | < -150 |
| Organic matter, % | <= reference* | 1.5 to 2X ref. | > 2X reference |
| Porosity, % | <= reference* | 1 to 10X ref. | > 10X reference |

Modified from the *Design of the Environmental Monitoring Program for the Marine Aquaculture Industry in Nova Scotia* (Smith et al 2002) and *Towards a Classification of Organic Enrichment in Marine Aquaculture* (Hargrave et al. 2008a)

#### 2.2.2.1. Soft Bottom Environmental Indicators

The primary environmental indicator used to assess the benthic health at a soft bottom monitoring station is the mean concentration of free sulfide in the sediment. The use of mean sediment sulfide to classify the environmental quality of a soft bottom aquaculture station or lease is based on recommendations made by Wildish et al. (1999) in the paper, *A recommended method for monitoring sediments to detect organic enrichment from mariculture in the Bay of Fundy*. Sediment is generally considered to be hypoxic when sulfide levels reach 1500 micromoles per litre (µM).

Additional environmental indicators are assessed at soft bottom stations as a means of validating mean sediment sulfide results. These include oxidation-reduction potential (redox), porosity and organic matter prevalence in sediment. These indicators are incorporated into the calculation of a Benthic Enrichment Index (BEI), which provides a multi-variate measure of sediment organic enrichment. The index is correlated with total 'free' sulfides and biological indicators such as macrofauna biodiversity indices that can be altered by increased organic matter sedimentation, and the formation of hypoxic or anoxic conditions in sediment. It serves as an internal check by applying more than one method for quality control in monitoring programs using geochemical methods to measure benthic organic enrichment (Hargrave 1994, Shaw 1998, Holmer et al. 2005, Hargrave et al. 2008a, b). The index can, therefore, be used to verify the degree of benthic organic enrichment in marine sediment based on measures of sulfide (Hargrave, 2009).

Comparison of the relative sensitivity of variables for detecting sediment organic enrichment due to aquaculture, has shown that porosity and organic matter are not as good indicators of differences between farm and reference sites as redox. However, when combined with measures of redox to calculate the BEI, detection of differences between farm and reference site sediments using BEI, approaches levels obtained using sulfide (Hargrave et al., 1997).

Measurements of porosity and organic matter therefore serve more than one purpose. Primarily, these parameters allow inference of sediment texture to ensure that the depositional-erosional characteristics at farm and reference sites are comparable. In addition, they provide an internal check on data quality. Sediments with high porosity typically have higher levels of organic content. Over time, as data is collected from the same location, a database can be developed to identify temporal trends in organic matter to be detected independent of the effect of grain size inferred from porosity measurements. Finally, porosity must be known if the absolute mass of organic matter in surface sediments is to be calculated on a dry weight basis (Hargrave 2009). This is required not only for comparisons of organic matter in sediments from farm and reference locations, but to ensure that organic content inventories are being compared on the same basis between locations where porosity differs (Hargrave 2009).

Sulfate reduction and the production of sulfide are closely related to redox potential. While the relationship weakens somewhat for oxic sediments, redox acts as a quality control measure for sulfide measurements and vice versa (Grant 2010).

Detailed instruction for collecting and analyzing sediment and video for the assessment of soft bottom environmental indicators can be found within the NS EMP SOP (PNS 2021B).

#### 2.2.2.2. Hard Bottom Environmental Indicators

The inability to collect sufficient acceptable sediment samples characterizes a monitoring station as hard bottom. For hard bottom stations, the primary environmental indicators used to assess benthic health result from visual observation of the seafloor at and nearby the monitoring station. The three (3) hard-bottom environmental indicators include: the abundance of *Beggiatoa*-like bacterial species, opportunistic polychaete complexes, and barrenness. The decision to use these indicators to asses the benthic health of hard bottom stations is based on recommendations made by DFO.

Methodology for assessing these indicators is explained by the Aquaculture Activity Regulations (AAR 2021) and supporting documents, found on DFO's website (Aquaculture Activities Regulations (dfo-mpo.gc.ca)) and in the NS EMP SOP (PNS 2021B) document, found on NSDFA's website (Aquaculture Management - Government of Nova Scotia, Canada).

### 2.2.3. Environmental Performance Classification of Sites

The metrics by which an aquaculture site's environmental performance is classified will depend on the proportion of monitoring stations which are determined to be soft and hard bottom during a given monitoring event. The Environmental Performance Classification of an aquaculture lease resulting from an annual Level I monitoring event will determine the required site management response, if any (Section 3). If an analytical or independent audit is conducted on a monitoring event, the results indicating a higher level of impact will be used to determine site management responses.

#### 2.2.3.1. Predominantly Soft Bottom Sites

At sites where 75% or more of non-reference monitoring stations are determined to be soft bottom, the site's environmental performance classification will be determined using the mean sulfide ion concentration of sediment samples collected from these stations (Table 2). Monitoring locations which are determined to be soft bottom stations are subject to monitoring as described in the NS EMP SOP (PNS 2021B).

**Table 2.** Environmental performance classification levels and associated mean sediment sulfide concentrations for predominantly soft bottom sites

| Site Classification | Sediment Sulfide Concentrations |
|---|---|
| Oxic A | ≤ 749 µM |
| Oxic B | 750 - 1499 µM |
| Hypoxic A | 1500 - 2999 µM |
| Hypoxic B | 3000 - 5999 µM |
| Anoxic | ≥ 6000 µM |

#### 2.2.3.2. Predominantly Hard Bottom Sites

At sites where less than 25% of non-reference monitoring stations are determined to be soft bottom, the site's environmental performance classification will be determined using the proportion of stations which pass or fail visual assessment of benthic impacts. Monitoring locations which are determined to be hard bottom stations are subject to spatially expanded visual assessments consisting of multiple video collection locations, as described in the EMP SOP Section 4.2.2. If during these assessments, evidence of hard bottom indicators (Section 2.2.2.2) are observed at 70% or more of the video collection locations along a video transect, the monitoring station will be considered as having failed to meet the Environmental Quality Objectives of the EMP (PNS 2021B). If the number of stations which pass this visual assessment is greater than the number of stations which fail, the site will be classified as having passed. If the number of stations which fail is greater than or equal to the number of stations which pass this visual inspection, the site will be classified as having failed.

#### 2.2.3.3. Mixed Bottom Sites

At sites where the number of stations determined to be soft bottom is between 25% and 74%, environmental performance classification will be determined using a combination of average sulfide ion concentrations from soft bottom stations and visual assessment results from hard bottom stations. Monitoring locations which have been determined to be hard bottom stations will be assessed as having passed or failed visual assessment, as described in Section 2.2.3.2. Soft bottom stations will be considered as having passed or failed based on the mean sulfide ion concentration of sediments collected from that monitoring location. Where mean sulfide concentrations are found to be $\geq$ 3,000 µM, the station will be considered as having failed. If the number of stations which pass is greater than the number of stations which fail, the site will be classified as having passed. If the number of stations which fail is greater than or equal to the number of stations which pass, the site will be classified as having failed.

### 2.3. Levels of Monitoring

A risk-based approach is required to address the variety of potential impacts on the marine benthic environment. The risk-based approach is based on the interaction of site conditions, culture methods and culture intensities that vary greatly among finfish and shellfish marine aquaculture operations in Nova Scotia. Sites are subject to baseline environmental monitoring. For more information on baseline requirements, please refer to Section 2 of the NS EMP SOP (PNS 2021B).

Up to three levels of monitoring events may be required in the annual assessment of a given aquaculture lease. Detailed methodology for conducting the required monitoring associated with each of these events is presented in the NS EMP SOP (PNS 2021B).

**Level I** –Level I monitoring is required annually on all active finfish sites. The site is classified on the results from the Level I monitoring unless further monitoring is required. Level I monitoring procedures are described in the NS EMP SOP (PNS 2021B).

**Level II** – Additional monitoring is required when the results of annual Level I monitoring classify a lease as Hypoxic B, Anoxic, having failed based on the mixed or hard bottom classification, , or as determined to be required through an audit. (Section 2.2.3). The additional information gathered during a Level II monitoring event is used to better define the outer limits of the affected area and

more effectively define the zone of influence. Level II monitoring procedures are described in the NS EMP SOP (PNS 2021B).

**Level III** – Monitoring is required when a site consistently fails to meet oxic conditions, when the results of annual Level I monitoring classify a lease as Anoxic or otherwise severely impacted, or at the discretion of NSDFA. This monitoring is used to capture seasonal variation on a lease and is used to closely monitor affected areas within the lease boundaries through increased temporal monitoring intensity. Additional requirements may be imposed at the discretion of NSDFA in order to better assess the environmental impacts and ongoing sustainability of an aquaculture operation. These may include, but are not limited to:

- The addition of more monitoring stations;
- The addition of seasonal monitoring events;
- Sediment profiling;
- Collection of oceanographic data, such as current profiles;
- Development of oceanographic models (e.g. flushing, carrying capacity, depositional); and/or
- Collection of additional water quality parameters.

Details and specific conditions of all follow-up monitoring are to be determined by NSDFA and DFO in discussion with the operator.

# 3. SITE MANAGEMENT RESPONSES

In order to meet the EQO of oxic sediment conditions, it is important to define a suite of measures that could be implemented to achieve the goal. These measures include BMP that are determined by industry and are deemed to be effective in mitigating potential environmental effects. If, after monitoring, there is evidence of organic enrichment on the site, then enhanced BMP's are to be implemented on the lease.

Potential site mitigation responses, as outlined in Appendix B of this document, will be based on results of annual Level I monitoring events, or results from an audit. Other parameters and information, such as redox, porosity, organic matter and video/visual observations will continue to be included as part of the weight-of-evidence approach for the overall site assessment and classification. These other parameters will aid in determining cause-effect relationships and appropriate management responses.

The following are management responses based on site classification of marine finfish aquaculture sites in Nova Scotia. Responses within the shellfish sector will be similar but more prescribed to the differences between shellfish and finfish growing operations (infrastructure, growing environments, etc.).

## 3.1. Oxic Site Responses

Sites classified as Oxic A or Oxic B are considered to have low environmental effects on the marine sediments. The operator will continue to follow the site's operational BMP's and will continue to complete annual Level I monitoring. If a site remains 100% oxic for two production cycles, and there is no significant stocking increase, they may apply to conduct EMP monitoring every 2 years instead of annually.

## 3.2. Hypoxic A Site Responses

Sites classified as Hypoxic A, or sites indicating audit results with a site sulfide mean between 1500-2999 µM, may be causing adverse environmental effects on marine sediments. In addition to following the sites BMP's for the lease, the operator will submit an updated mitigation plan to NSDFA for approval and must identify which predetermined risk control plans from their Farm Management Plan (FMP) are appropriate to address the sub-optimal environmental performance. The updated mitigation plan must be implemented in a timeframe determined by the Minister. The operator will be required to conduct Level I monitoring for the next monitoring season.

## 3.3. Hypoxic B Site Responses

Sites classified as Hypoxic B, or sites indicating audit results with a site sulfide mean between 3000-5999 µM, are likely causing adverse environmental effects on the marine sediments. Level II monitoring will be required at sites receiving this classification or as required due to audit results. In addition to following operational BMP's, the operator must submit an updated mitigation plan to NSDFA for approval and must identify which predetermined risk control plans from their FMP are appropriate to address the lease's poor environmental performance. The updated mitigation plan must be implemented in a timeframe determined by the Minister. The operator must also provide a strong rationale for maintaining or increasing production levels.

### 3.4. Anoxic Site Responses

Sites classified as Anoxic, or sites indicating audit results with a site sulfide mean ≥ 6000 μM, are considered to be causing adverse environmental effects on the surrounding marine sediments. Large portions of the site are likely affected due to the excessive accumulation of organic material. The operator must conduct both Level II and Level III monitoring on the site. The operator will work closely with regulators to resolve the situation. In addition to following the sites BMP's for the lease, the operator will submit an updated mitigation plan to NSDFA for approval and must identify which predetermined risk control plans from their Farm Management Plan (FMP) are appropriate to address the sub-optimal environmental performance. The updated mitigation plan must be implemented in a timeframe determined by the Minister.

### 3.5. Mitigation plans

When poor environmental performance (Hypoxic A, B, Anoxic, or Fail) has been determined through a Level I monitoring event (or an audit), the aquaculture operator must implement appropriate enhanced mitigation strategies. All enhanced mitigation measures to be implemented on an aquaculture lease must be submitted to NSDFA within **14 days** of receiving a **Hypoxic A site classification, within 14 days of a Level II monitoring event for Hypoxic B or Anoxic site classification, if the site is classified with a "fail" under the mixed and hard bottom protocol, or as required by NSDFA due to audit results**. The mitigation plan must specify the timelines in which the mitigation measures will be implemented and explain how the measures will reduce any environmental impacts caused by the operation , in addition to how each measure will be monitored to prevent recurrence. Additionally, the known production history of the site along with historical EMP performance and site characteristics will be important in determining mitigation and must be incorporated into an operator's updated mitigation plan.

Appendix A highlights the standard BMPs that all marine aquaculture operators are expected to implement as part of their daily operations. In addition to these BMPs, aquaculture operators are also required to determine enhanced mitigation strategies that can be implemented on a lease when poor environmental performance has been identified. Examples of enhanced mitigation measures that can be implemented by the operator when poor environmental performance has been identified are detailed in Appendix B. If the operator identifies that the recommended enhanced mitigation measures listed below are unsuitable for addressing the cause of the environmental impact(s), alternative mitigation strategies may be submitted. These alternate mitigation strategies must be approved by NSDFA prior to implementation.

# 4. COMMITTEES FOR REGULATION AND DEVELOPMENT OF ENVIRONMENTAL MANAGEMENT OUTCOMES

On an ongoing basis NSDFA consults with the Nova Scotia Aquaculture Environmental Coordinating Committee (NSAECC) which is co-chaired by NSDFA and DFO through the Canada-Nova Scotia MOU.

The NSAECC will provide a mechanism for both industry and regulators to provide input into the NS EMP processes. Any program revisions will be vetted through this committee. It has representatives from all aquaculture related regulatory agencies such as NSDFA, DFO, and representatives of the finfish and shellfish industry through the AANS. This body has no regulatory authority to make site specific decisions but is a means of exchanging ideas and making recommendations on the conduct of the EMP.

Under the MOU, NSDFA also takes the lead role in the management of the NS EMP through a Nova Scotia Aquaculture Environmental Site Management Committee (NSAESMC) which is co-chaired by NSDFA and DFO.

The NSAESMC provides a review on site-specific results of the NS EMP. This committee interprets the results of the NS EMP monitoring events and provides site-specific recommendations for any remedial action required. This approach provides a method of integrating the regulatory requirements of both agencies with respect to environmental management.

In summary:

- NSDFA and DFO co-chair the NSAECC;
- NSAECC has representation from NSDFA, Nova Scotia Environment and Climate Change (NSECC), DFO, AANS and other provincial and federal government agencies, as needed;
- NSAECC will be the advisory body and forum for information exchange with Industry on EMP matters;
- NSAESMC will be co-chaired by NSDFA and DFO. The committee will review EMP data and make remediation/mitigation recommendations based on EQOs and a risk-based approach; and
- NSDFA will perform the lead role on EMP management and will perform the audit function of the EMP, however regulators on the NSAESMC can make any determinations and actions on their own based on their respective legislation and regulations.

# 5. ANNUAL SCHEDULES

The optimal time for conducting environmental monitoring on a lease is when feeding and waste production (i.e., organic deposition) are at a peak for both marine finfish and shellfish operations. It is also important to complete monitoring when seasonal storm potential is limited.

Annual Level I monitoring of Nova Scotia marine aquaculture sites will be conducted from July 1st to October 31st. Level II monitoring will also be conducted between July 1st to October 31st. Dependent on when Level I monitoring occurs, Level II monitoring can also take place during the month of November. Level III monitoring will occur between March 1st and May 31st when the weather permits and prior to restocking a site with fish. Site operators are expected to comply with the schedules in Table 3 for the submission of data, materials, and, if necessary, updated mitigation plans. Only complete, final copies of reports, results, coordinates, log sheets and video are to be submitted. An electronic copy of the monitoring event and corresponding video files can be sent to Aquaculture Operations via the secure file transfer system upon request. Requests can be made by email to EMPSupervisor@novascotia.ca.

**OR**

A physical copy of the monitoring event and video files can be sent to the attention of Aquaculture Operations at the following mailing address:

Aquaculture Operations
Nova Scotia Department of Fisheries and Aquaculture, Aquaculture Division
1575 Lake Road
Shelburne, Nova Scotia
B0T 1W0

Incomplete reports and partial submissions are considered late. Any delays to these timelines require approval by the EMP Supervisor via email or telephone (902-875-7436).

The deadlines for each type of monitoring and mitigation response are as follows:

**Table 3.** Monitoring Deadlines for the Operator and NSDFA

| **Requirement** | **Deadline for Industry** | **Deadline for NSDFA** |
|---|---|---|
| Annual Level I EMP Monitoring | Must be completed between **July 1st to October 31st** | |
| All submissions for Level I monitoring event | Must be submitted within **14 days** of the completion of Level I monitoring event. | |
| Level I Follow-up (Site Classification and QA/QC Audit Results) | | Letter provided within **28 days** of Level I monitoring |
| Updated Mitigation Plan | Hypoxic A classification or as required due to audit results: updated mitigation plan must be submitted **14 days** after site classification notification. | Response provided to Industry within **14 days** of receipt of updated mitigation plan |
| Level II monitoring (Hypoxic B, Anoxic site classification, or as required due to audit results) | Must be completed within **35 days** of the Level I monitoring event. | |
| Updated Mitigation Plan and all submissions for Level II monitoring event | Must be submitted within **14** days of the completion of the Level II monitoring event. | |
| Level II Monitoring Follow-up (final site classification, mitigation plan status) | | Letter provided within **28 days** of Level II monitoring |
| Level III EMP Monitoring | Must be completed between **March 1st and May 31st** of the following year and prior to stocking the site. | |
| All submissions for Level III monitoring event | Must be submitted within **14** days of the completion of the Level III monitoring event. | |
| Level III Follow-up (QA/QC Audit Results) | | Letter provided within **28 days** of Level III monitoring |

# 6. AUDITING AND REPORTING

Auditing will be conducted by NSDFA on an annual basis. All monitoring events (I, II and III) are eligible to be assessed via a NSDFA audit. The purpose of an audit is to ensure that the information submitted to NSDFA is accurate, consistent, and reliable. Access to accurate, consistent and reliable data ensures that government agencies and operators make sound management decisions. Audits are also used to ensure that the proper monitoring methodology is being followed. Detailed information regarding audit types and determination can be found within the Environmental Monitoring Program Audit Policy for Marine Aquaculture in Nova Scotia (PNS 2021A).

The principles of transparency and collaboration are tenets of responsible environmental management and described in the original 2002 EMP document (Smith et al. 2002); therefore, one goal of the NS EMP is to release information regarding the monitoring results to the public. NS EMP monitoring results can be accessed through the province's open data portal: https://data.novascotia.ca/.

# APPENDIX A: Associated Best Management Practices for Marine Finfish Aquaculture - provided by Aquaculture Association of Nova Scotia (AANS)

These Best Management Practices are extracted from the New Brunswick Environmental Management Program for the Marine Finfish Cage Aquaculture Industry in New Brunswick (July 2006) as requested by industry representatives within the AANS.

The following Operational Best Management Practices are designed to minimize the organic and inorganic loading from marine finfish cage aquaculture sites and are a requirement of all marine finfish cage aquaculture operators.

**Waste Management**

- Cage site operators are required to develop and comply with site-specific waste management plans as required by provincial and federal regulators. The aim of the plan is to ensure proper disposal of all waste materials generated at the facility. Categories of waste include, but are not limited to operational debris, hazardous waste, human waste, bio-fouling, fish mortalities, fish feed, waste products from harvesting, etc.

**Record Keeping and Reporting**

- Marine finfish cage aquaculture site operators are required to maintain production records and report information as required by provincial and federal regulators; and
- Environmental monitoring data will be reported to NSDFA within timelines set out above in *Section 5: Annual Schedules.*

**Equipment Cleaning (nets, cages, mooring, and other equipment)**

- It is recommended that no net washing be conducted on-site, and that farmers monitor nets for biofouling organisms during routine mortality dives;
- In some circumstances, maintenance washing of lightly fouled nets still attached to cage structures is allowed on-site. However once nets are removed, they must be brought to shore for cleaning;
- Washing of lightly fouled equipment or nets with washing systems at the site will be conducted only under conditions that maximize dispersal of the dislodged materials away from the site and neighboring sites (e.g. strongest currents);
- Nets will be replaced at least at the beginning of each production cycle, and more often as required;
- No nets or other equipment shall be dropped to the bottom for the purpose of storage or cleaning. In the event of emergency circumstances such as worker safety or fish survival, any nets or equipment dropped to the bottom must be within lease boundaries and must be reported to NSDFA and DFO immediately; and
- Sites classified as Hypoxic B or Anoxic will not conduct any on-site net cleaning.

**Equipment Disinfection (nets, cages, mooring, and other equipment)**

- Steam is the only disinfectant to be used on-site to clean cages and equipment;
- The cages will be cleaned on the aquaculture site prior to transport to the off-site location where the disinfection will take place;
- Only the following disinfecting agents will be used to clean cages at a location other than on the aquaculture site: steam, chlorine-based solutions, iodophor-based solutions, and hydrogen peroxide-based solutions;
- Environment Canada (EC) has suggested maximum discharge concentrations for each of the indicated disinfectants so that runoff from the disinfection process should not be deleterious to fish. The release of disinfectant solutions to waters frequented by fish could be considered a violation of Section 36(3) of the federal *Fisheries Act* at concentrations above the following maximum values:
    - Chlorine = 0.02 ppm
    - Iodine = 0.1 ppm
    - Hydrogen peroxide = 0.5 ppm
- During disinfection, the disinfectants will be stored such that any spill is contained and not released into the environment. All reasonable precaution will be taken to avoid releases due to spills;
- Disinfection of cages will only take place during sunny days, especially with chlorine-based solutions. Bright sunshine will aid in decreasing the concentration of chlorine and speed up the evaporation of other disinfectant solutions;
- Care will be taken to ensure that disinfectant is not applied in excess. Direct discharge of disinfectants other than steam to waters of the province, including marine waters, is a violation of Section 36(3) of the federal *Fisheries Act*
- Disinfectant solutions will be directed only at cage structures, with care taken to avoid over-spraying onto the beach;
- Ample drying time will be allotted to ensure that all disinfectant has completely dried prior to inundation with the next high tide;
- The disinfection of the cages will be spread out over a number of days to reduce the potential for impacts from the disinfectant residues;
- Disinfectant storage will occur in an area not in danger of being inundated by tidal waters or any other water source; and
- To whatever extent possible, disinfection events will be coordinated with other growers within the same bay/harbour to spread it out over time and space.

**Feed Handling and Storage**

- Site staff and feed delivery personnel will take all reasonable precautions to reduce spills during delivery of feed to the site;
- Should a spill of feed occur, immediate cleanup is required to minimize the loss of feed into the ocean;
- Accurate records will be maintained detailing the amount of feed delivered to the site, stored at the site, fed to the fish, spilled and/or returned unused to the manufacturer. These records will provide a mass balance of feed use at the site;
- The amount of feed on site at any one time will be limited to an amount that can be safely and properly stored at the site;

- Feed will be stored, as much as practically possible, at the site in covered areas including hoppers, bins, or buildings so that spills and spoilage are minimized;
- Bags or open containers of feed will not be left exposed or uncovered at the site; and
- Any feed that is unusable will be removed from the site as new feed is delivered and disposed of at an approved site.

**Feeding Practices**

- Amounts of feed given to stock will be based on biomass contained in the pen and environmental conditions present;
- Feeding will be reduced or stopped if conditions such as low temperature, low dissolved oxygen, high tide currents, or heavy weather suggest that utilization of feed by the stock will be affected;
- Site staff will monitor all feeding operations at the facility. Feeding equipment must be regularly monitored during operations. Staff will closely observe fish feeding behavior;
- The use of underwater video cameras to monitor the feeding activity is recommended for all sites and will be used when available or when required;
- Feeding rates should be reduced or stopped when staff observes changes in fish activity indicating a reduction in appetite and/or if uneaten feed is detected passing through the bottom of the cage nets;
- Feeding will be temporarily reduced or suspended at times of strong currents flowing through the net pens that impact the ability of the fish to efficiently eat the feed;
- Hand feeding will be conducted in a manner to ensure an even distribution and reduce the amount of waste feed. Feeding will be slowed or paused if staff observes a reduction in feeding activity;
- Feeding performed with feed blowers will be conducted in a manner to ensure minimum loss of uneaten fish feed. Feeding will be slowed or paused if staff observes a reduction in feeding activity;
- Feeding equipment must be properly maintained to minimize crushing of the feed pellets which can result in fine feed dust that will not be eaten by the fish. The operator must establish a schedule for the regular maintenance of mechanical feed blowers;
- Mechanical feed blower nozzles must be carefully aimed and controlled to ensure that the feed is being evenly distributed across the surface of the net pen and that no feed is missing the net pen entirely;
- Computer-controlled feeding systems require that a qualified operator be on duty at all times when feed is being administered;
- Detailed records will be maintained for each cage of feed type and amount, fish numbers, total fish biomass, water temperature, and growth rates to ensure optimal feed conversion rates are being achieved at the site, minimizing feed losses;
- Feeding of moist feed will be conducted slowly to ensure that the fish have adequate time to consume the feed being distributed in the net pens;
- Feeding will be timed to coincide with the times of the day that the fish are eating well.
- Continual evaluation of the size of the pellets being used to feed the fish to ensure that the proper size pellets are being utilized; and
- All staff must be trained in the above practices. Detailed records of training must be maintained for each employee including training received and dates of training.

# APPENDIX B: Examples of Mitigation Plans and Submissions

## Environmental Impact: Stocking of Cages

Overstocking of the site or specific areas within the site, can lead to increased organic loading on certain parts of the site.

*Enhanced Mitigation Measures*

- A cage stocking strategy that helps to ensure oxic conditions based on the results of the environmental monitoring;
- Adjustment of the on-site cage stocking levels based on the environmental monitoring results; and
- Adjustment of the cage position based on the environmental monitoring results.
- How this will be monitored to prevent recurrence

## Environmental Impact: Increased Faecal Matter

The settlement of faecal matter on the bottom of the lease can result in increased organic loading and impact the condition of the bottom sediment.

*Enhanced Mitigation Measures*

- Completion of a tidal current study through the deployment of a current meter on the lease for thirty-five days. The operator should evaluate the tidal patterns on both the overall site and at the individual cages using modelling. The use of the current meter and modelling studies will allow the operator to fully understand the dispersion of organic matter that is released from the farm operation;
- Adjustment in cage stocking levels based on the monitoring results;
- Adjustment in cage stocking levels based on the evaluation of tidal current patterns and modelling study;
- Adjustment in the cage positions on the lease according to monitoring results;
- Adjustment in the cage positions on the lease based on the tidal current study and modelling study during the grow out period;
- Modification to the harvest schedule to reduce biomass on the lease over those areas of the lease with greatest amount of degradation;
- Readjustment of the cages during the subsequent production cycles to avoid further impacts to areas showing adverse environmental conditions;
- Increase in the fallow period of the site to allow the site to recover; and
- Conduct an audit of site operations in addition to any regular scheduled auditing. This audit should be completed by an internal site manager working for the same operator at a different farm location. The auditor will examine the waste management practices employed on the site. A written report identifying any deficiencies observed as well as any recommendations to improve waste management practices is to be submitted to NSDFA by the auditor.
- How this will be monitored to prevent recurrence

**Environmental Impact: Net Cleaning**

When net cleaning occurs on a lease it can lead to a large release of biofouling from the nets which can settle on the bottom.

*Enhanced Mitigation Measures*

- Increase frequency of site cleaning practices to reduce amount of biofouling;
- Monitor and record the amount and frequency of biofouling over a set period and adjust net cleaning procedures to address biofouling accumulation;
- Evaluate site staff in terms of experience, qualification and awareness of site policies and procedures- increase staff training if necessary;
- Ensure all net cleaning equipment is maintained and remains in good working order. Ensure records are kept of the equipment maintenance schedules;
- Use of alternative methods on site to reduce the amount of biofouling that occurs;
- Creation and implementation of a standard operating procedure regarding the level of biofouling that is acceptable on a net cage and when net cleaning must occur;
- More frequent net changes when net washing is not feasible; and
- Conduct an audit of site operations in addition to any regular scheduled auditing. This audit should be completed by an internal site manager who works for the same operator at a different farm location. The auditor will examine the net cleaning practices used on the lease. A written report identifying any deficiencies observed as well as any recommendations to improve net cleaning practices is to be submitted to NSDFA by the auditor.
- How this will be monitored to prevent recurrence

**Environmental Impact: Feeding**

Improper feeding techniques can lead to the settlement of feed on the bottom of the lease, can lead to increased organic loading on the site.

*Enhanced Mitigation Measures*

- Evaluation of the site staff in terms of experience, qualifications and awareness of site policies and procedures;
- Update staff training on feeding methods when necessary;
- Compare feeding activities of the fish, feed conversion rates, and feed usage per cage for cages fed moist feed and dry feed to determine if the switch can be made earlier;
- Evaluate feed records to confirm the switch to dry feed is being made at the correct time according to the critical limit defined by the operator;
- Implementation of an equipment maintenance schedule if not in place;
- Implementation of a weekly maintenance schedule of on- site feed equipment. Ensure that all equipment used for feeding is kept in good working order;
- Increase record keeping from weekly records to daily records;
- Review the camera settings on site;
- Calibration of the feeding equipment; and

- Conduct an audit of site operations in addition to any regular scheduled auditing. This audit should be completed by an internal site manager who works for the same operator at a different farm location. The auditor will examine feeding practices used on the lease. A written report identifying any deficiencies observed as well as any recommendations to improve feeding is to be submitted to NSDFA by the auditor.
- How this will be monitored to prevent recurrence

**Environmental Impact: Overfeeding**

Overfeeding of fish can lead to the settlement of uneaten feed on the bottom of the aquaculture site.

*Enhanced Mitigation Measures*

- Calculate the weekly anticipated feed rate;
- Increased record keeping on the lease to monitor the weekly feed rate- compare to the calculated weekly feed rate;
- Adjust weekly feed rates to ensure it is not over the weekly feed rate;
- Increase staff training; and
- Conduct an audit of site operations in addition to any regular scheduled auditing. This audit should be completed by an internal site manager who works for the same operator at a different farm location. The auditor will examine feeding practices used on the lease. A written report identifying any deficiencies observed as well as any recommendations to improve feeding is to be submitted to NSDFA by the auditor.
- How this will be monitored to prevent recurrence

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# TAB D

2023 NSARB-2023-001

This is Exhibit “D” referred to in the
Affidavit of Jessica Feindel
affirmed before me by videoconference
on January 19, 2024

[redacted]

Signature
ALISON W CAMPBELL
A Barrister of the Supreme Court of Nova Scotia

***Figure 1: Environmental Monitoring Program sulfide decision thresholds for 2002-2015.***

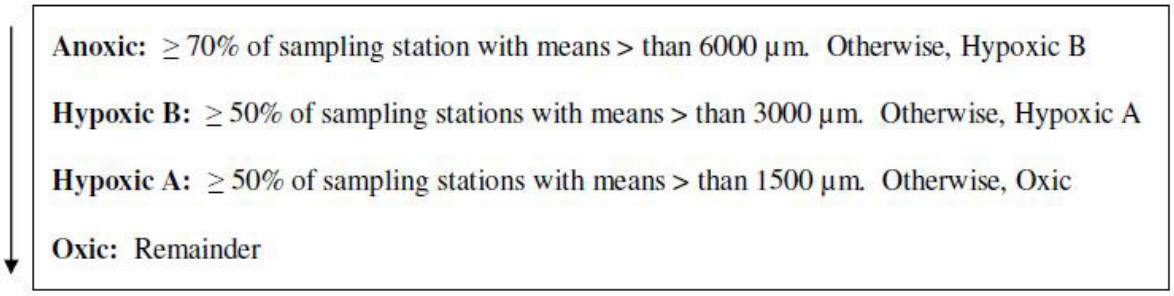


***Table 1: Environmental Monitoring Program site classifications for AQ1205, 2011 to present.***

| | Monitoring Event | Classification | Sulfide average (µM) | Notes |
|---|---|---|---|---|
| Jul-2011 | Level I | Hypoxic A | n/a | 2/3 stations were < 3000 µM |
| Jul-2012 | Level I | Oxic | | 3/4 stations were Oxic |
| Jun-2013 | Level I | Oxic | | 3/3 stations were Oxic |
| Jul-2014 | Level I | Oxic | | 5/5 stations were Oxic |
| Jul-2015 | Level I | Oxic | | 3/5 stations were Oxic |

***Figure 2: Environmental Monitoring Program sulfide classification thresholds for 2016-present.***

| Site Classification | Sediment Sulfide Concentrations |
|---|---|
| Oxic A | ≤ 749 µM |
| Oxic B | 750 - 1499 µM |
| Hypoxic A | 1500 - 2999 µM |
| Hypoxic B | 3000 - 5999 µM |
| Anoxic | ≥ 6000 µM |

***Table 2: Environmental Monitoring Program site classifications for AQ1205, 2016 to present.***

| | Monitoring Event | Classification | Sulfide average (µM) | Notes |
|---|---|---|---|---|
| Jul-2016 | Level I | Pass | Hard bottom protocol | Lease evaluated as hard bottom as grab samples did not meet the quality criteria for soft bottom<br>4 stations |
| Oct-2017 | Level I | Oxic A | 351 | 6 stations |
| Jul-2018 | Level I | Oxic B | 864 | 4 stations |
| Jul-2019 | Level I | Oxic A | 73 | 4 stations |
| Jul-2020 | Level I | Oxic A | 253 | 5 stations |
| Jul-2021 | Level I | Oxic A | 277 | 5 stations |
| Aug-2022 | Level I | Oxic B | 1171 | 5 stations |
| Jul-2023 | Level I | Oxic A | 396 | 4 stations |

# TAB E

2023 NSARB-2023-001

This is Exhibit “E” referred to in the
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on January 19, 2024

[redacted]

Signature
ALISON W CAMPBELL
A Barrister of the Supreme Court of Nova Scotia

**Containment Management Framework**
**Nova Scotia Department of Fisheries and Aquaculture**
**2021**

## Introduction

Containment management is an important function of comprehensive and effective management of marine finfish farming. Proper containment is crucial to address environmental sustainability from wild fish genetics, ecological and fish health perspectives and it makes good business sense to maintain a valuable crop.

A solid governance regime has an integral role in effective containment management, which, in the province of Nova Scotia is led by the establishment of the **Aquaculture Management Regulations (AMRs)** made under Section 64 of the *Fisheries and Coastal Resources Act* (2015). These Regulations provide the regulatory tools that are used to support a responsible approach to aquaculture. The Containment Management content of these Regulations provide the basis for the Containment Management Framework for the aquaculture industry in Nova Scotia.

## Principles

Reducing and minimizing the chance of any fish being released or escaping from a marine finfish site are the primary goals of containment management measures.

The Containment Management Framework concentrates on two elements:

- farm infrastructure and operating procedures; and
- traceability of escaped fish

Subsequently, it addresses:

1) minimum infrastructure and cage array design/construction requirements;
2) site operational procedures;
3) mandatory reporting of suspected or confirmed escapes or breaches of containment;
4) provisions for recapture plans;
5) techniques/procedures that enable traceability of escaped fish (marking plan); and
6) an auditing regime to ensure application of the Containment Management components of the Farm Management Plan (FMP).

## Farm Management Plan Requirements

While the core of the Containment Management Framework is the AMRs, it is augmented by the contents of the FMP, which by Regulation, focus on: the infrastructure and procedures needed for containment management; reporting procedures for suspected or confirmed breaches of containment; and the marking specifics used to effectively identify the ownership of any farmed fish detected outside of a farmed fish enclosure.

Specifically, the FMP must include any information required by the Minister that pertains to:

- operating procedures that limit the risk of a breach;
- processes for installing and maintaining infrastructure in place to limit the risk of a breach;
- responses to breaches;
- areas of potential impact if a breach occurs;
- management of the site if unusual events or severe weather occurs;
- schedules for reporting:
    - initial farm stocking;
    - inventory levels during production;
- proof of a professional engineer's approval of the design of the structures in place for containment management; and
- marking of fish in such a manner that it can be traced to the licensed grower of the said fish.

It is also important to note, that as per the AMRs, the containment management sections of the FMP must be audited by a third-party auditor approved by the Minster, during time periods specified in the AMRs. The FMP Containment Management Audit Framework outlines the conformity requirements, assessment guidelines, and scoring criteria that auditors must use during an audit. Auditors must contact the Aquaculture Operations Manager at the Nova Scotia Department of Fisheries and Aquaculture (NSDFA) prior to the commencement of any audit to outline and discuss all requirements associated with each individual audit.

1) Farm Infrastructure

Prior to the initial stocking or re-stocking of an aquaculture site, an aquaculture licence holder must be in possession of an approved FMP, which includes approved/certified engineering documentation pertaining to the integrity of the site's infrastructure. In essence, the site infrastructure design and construction must have been deemed as being satisfactory to reasonably withstand the prevailing oceanographic and meteorological conditions (e.g., weather, currents, ice flow, etc.) at the site's location to ensure the fish stay contained.

The engineering documentation referenced above must be submitted to the NSDFA and must include a professional engineer's assessment of the design of the structure in place for the fish farm operation. If the assessment does not contain technical specifications for all materials utilized in the mooring systems (i.e. anchors, ropes, chains, buoys, thimbles, shackles, etc.), it is the responsibility of the farm operator to include such information in their FMP. In addition, any auxiliary equipment, barges, rafts or secondary working vessels must also be included in the engineer's assessment or described in the FMP.

Professional engineers must be licensed to practice in Nova Scotia. They must do a risk analysis using recognized standards/best practices that apply to the design and construction of a marine

finfish net pen array and its supporting infrastructure. Any standards/best practice utilized by the professional engineer must be identified in the risk analysis. It is important to acknowledge that technology and associated standards are constantly evolving. Therefore, mandating explicit standards or best practices may in fact hinder efficient operations versus allowing professional engineers to use a standard or best practice that would be appropriate for their client's operating environment.

All marine finfish sites will require a professional engineer's comprehensive assessment prior to stocking fish on the site and the first such assessment will be known as an original assessment.

Documentation to be included in the original assessment is as follows:

- details from a site survey/assessment outlining the oceanographic and meteorological conditions of the site, to support a risk analysis;
- a risk analysis assessing whether the infrastructure in place, or to be installed, is able to withstand prevailing oceanographic and meteorological conditions (including any safety margins required) at the site;
- a statement from the engineer indicating his/her assessment of the site infrastructure and that the site infrastructure is constructed and installed appropriately, using undamaged parts, for the prevailing oceanographic and meteorological conditions at the site; and
- a drawing of the site infrastructure stamped with the professional engineer's seal.

After an original assessment, and prior to re-stocking, a third-party audit is required which must include one of two sets of documents:

- a statement from an auditor or engineer that there have been no changes in the design or components of the site infrastructure and equipment and no change in the prevailing oceanographic and meteorological conditions at the site that would compromise the integrity of the site infrastructure and equipment since the last professional engineer assessment; **or**
- if it has been determined by an auditor or an engineer that, since the last professional engineer assessment, the site infrastructure and/or equipment integrity have been compromised, the Operator has changed or altered the infrastructure, as described below, or a change in the prevailing oceanographic and meteorological conditions have compromised the site infrastructure and/or equipment integrity, the farm operator will be required to have a reassessment of the site. Upon completion of the re-assessment, the farm operator must provide a statement from a professional engineer indicating that appropriate adjustments have been made and that, as per his/her assessment, the site infrastructure and equipment remains constructed and installed appropriately for the prevailing oceanographic and meteorological conditions at the site.

Although general triggers that would flag compromised site infrastructure and equipment integrity are listed below, the onus is upon the site operator to seek the expertise of an engineer to determine that since the last professional engineer assessment, the site infrastructure or equipment integrity has not been compromised.

- Removal of mooring lines
- Major change in anchor location
- Reduction in mooring line length
- Reduction in mooring line strength
- Addition of net pens or expansion of the system within the approved lease area
- Addition of feed barge
- Change in site orientation (i.e. anchor positions change)
- Change in net half mesh size of netting, change of net size affecting drag, or net and weighting system design
- Change in floater high-density polyethylene (HDPE) rings
- Any substantive change which will affect the loads (including any increase in stocking density above the maximum planned density previously approved), or any reduction in the specification of minimum break strength (MBS) of a component
- Any substantive change in materials used or in the system design

In addition to the engineering documentation discussed above, other infrastructure requirements in the FMP include:

- tagging of specific equipment so that components that have gone adrift can be traced back to the fish farm;
- manufacturer and equipment technical/life cycle specifications;
- breaking strengths, where applicable;
- maintenance records;
- installation/removal procedures; and
- inspection schedules/procedures.

2) Breaches of Containment

With regards to containment management, the FMP must describe:

- procedures that limit the risk of a breach, including fish leakage/losses during farm operations such as fish transfers, counting, grading, harvesting, net cleaning/changes and net pen re-positioning;
- processes for installing and maintaining infrastructure in place to limit the risk of a breach;
- responses to breaches;
- areas of potential impact if a breach occurs; and

- management of the site if unusual events or severe weather occurs.

There are also mandatory notification requirements in the event that a breach occurs or is suspected. Aquaculture licence holders for marine finfish or any personnel of their aquacultural operation who know or suspect a breach must immediately[1] notify the NSDFA by phone with an e-mail follow up of the initial notification.

Information included in the notification includes details pertaining to:

- contact information of the party making the report;
- date and time of the event;
- location of the event;
- attributes of the fish that escaped (e.g. species, number of fish, age, size, year stocked, weight, health status);
- the freshwater place of origin of the fish that escaped;
- cause of the breach; and
- mitigation efforts and/or corrective actions to prevent further escapes.

Experience has indicated that immediate recovery or recapture activities of escaped salmon in the immediate area of the accountable farm, has resulted in minimum success and has caused harm to other marine life. A more efficient endeavour to prevent escaped salmon from interacting with wild fish may be an enhanced river monitoring program that is triggered once a breach of farmed fish has been detected. The NSDFA will be assessing the effectiveness of an enhanced monitoring program by developing such a program in partnership with the aquaculture industry, organizations devoted to the conservation of wild Atlantic salmon as well as other provincial and federal government organizations. Once developed, all marine finfish farmers operating within Nova Scotia are expected to be a participant in the enhanced river monitoring program.

Information and experience concerning recapture of escaped trout is very minimal. Therefore, recapture plans of escaped trout will be developed through discussions with the NSDFA and each individual trout farm operator. Both on-site and off lease recapturing efforts will be developed.

3) Marking

Growers may use the marking plan of their choice, but it must be approved by the Minister and meet the following criteria:

[1] The term “immediately” means as soon as it is safe, or it is possible to do so. This is expected to be within an hour of the determination of a known or suspected breach.

- Any marking (e.g., fin clipping that is unique to the farm operator, coded wire tags (CWTs), genotyping, branding, etc.) must be auditable. Where genetic markers are used, the Minister reserves the right to have access to the genetic information for auditing purposes.
- The mark must identify the fish as originating from a Nova Scotian marine fish grower.
- Fish must be marked prior to stocking.
- The marking scheme must take fish welfare into consideration and be a generally accepted industry practice.

While a marking plan is not a new concept, the implementation of a marking plan can require an extensive timeframe. Therefore, marking plans will be implemented in phases as per discussions between the licensed grower and the NSDFA. During the implementation process, the origin of any species of suspected farmed fish found in the wild, will be determined by the standby method. This method involves the collection of fish from farms in the area where the suspected farmed fish was detected and are of the same species and comparable year class. The data collected from testing these fish is then compared to the suspected escaped fish.

Containment Management Framework Revisions

The Containment Management Framework will be reviewed and updated by the NSDFA, as required, but at a minimum, on an annual basis by March 31 of each calendar year.