Finfish Aquaculture Licence under the Pacific Aquaculture Regulations

Licensed for: Aquaculture Date Issued: «DATE_ISSUED»

LICENCE No. «DFO_Prefix» «DFO_Lic_No» «YEAR» Expiry Date: «EXPIRY_DATE»

ISSUED TO:
«LICENCE_HOLDER» «CORPORATION_ADDRESS»

This licence is issued under the authority of the *Fisheries Act* and confers, subject to provisions of the *Fisheries Act* and Regulations made there under, the authority to carry out aquaculture activities including cultivation and harvest of fish and prescribed activities under the conditions included herein and/or attached hereto.

It is the responsibility of the licence holder to obtain all other forms of authorization from federal or provincial agencies that may have jurisdiction for marine finfish aquaculture facilities. As well, it is the licence holder's responsibility to be informed of, and comply with, the *Fisheries Act* and the regulations made there under, in addition to these conditions.

The above licence holder is authorized by this licence to carry on the business of aquaculture at the following location and for the following species:

<table>
<thead>
<tr>
<th>Facility Reference Number</th>
<th>Location and Legal Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>«REFERENCENUMBER»</td>
<td>«SITECOMMONNAME»</td>
</tr>
<tr>
<td></td>
<td>«LEGALDESCRIPTION»</td>
</tr>
<tr>
<td></td>
<td>«LANDFILENUMBER»</td>
</tr>
<tr>
<td></td>
<td>«PFMA»</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Licensed Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 «SPECIES_1»</td>
</tr>
<tr>
<td>2 «SPECIES_2»</td>
</tr>
<tr>
<td>3 «SPECIES_3»</td>
</tr>
<tr>
<td>4 «SPECIES_4»</td>
</tr>
<tr>
<td>5 «SPECIES_5»</td>
</tr>
<tr>
<td>6 «SPECIES_6»</td>
</tr>
<tr>
<td>7 «SPECIES_7»</td>
</tr>
</tbody>
</table>

Combined Peak Biomass (tonnes):
Site specific conditions:

«Section_B_Comment_1»

**Required Record Keeping and Reporting:** Details are contained within the attached conditions of this licence.

**Compliance Advisory:** No person carrying out any activity under the authority of this licence shall contravene or fail to comply with any condition of this licence.

*This licence includes further conditions that are included herein and/or attached hereto. These conditions form part of the licence and may not be removed.*
# Table of Contents

**PART A. Definitions** ......................................................................................................... 5

**PART B. Licence Conditions** ............................................................................................ 9

1. Application and Licensed Species ................................................................................. 9
2. Production Plan (Peak Biomass) ................................................................................... 9
3. Transfer of Fish .............................................................................................................. 9
4. Containment Array Requirements ................................................................................ 10
5. Fish Health .................................................................................................................... 11
6. Fish Health Record ....................................................................................................... 13
7. Sea Lice Monitoring ..................................................................................................... 13
8. Sea Lice, Health and Mortality Reporting .................................................................... 15
9. Escape Prevention, Reporting and Response ............................................................ 15
11. Management of Marine Mammal Interactions ............................................................ 17
12. Protection of Fish Habitat ........................................................................................... 19
13. Boat Operations .......................................................................................................... 24
15. Use of Lights ............................................................................................................... 24
16. Administrative matters ............................................................................................... 24

**CONTAINMENT ARRAY PLAN** ................................................................................... 26

**APPENDICES**

APPENDIX I-A(i). Inventory Plan .................................................................................. 27
APPENDIX I-A(ii). Details of Monthly Stock Transfers ..................................................... 28
APPENDIX I-B. Population Harvest Declaration Form ..................................................... 29
APPENDIX II. Map of Salmonid Transfer Zones ............................................................... 30
APPENDIX III. Diseases of Regional, National or International Concern ....................... 31
APPENDIX IV. Veterinarian Attestation Form .................................................................. 32
APPENDIX V. Health Management Plan ......................................................................... 33
APPENDIX V-A. Carcass Management Plan ................................................................. 45
APPENDIX VI. Map of Fish Health Zones ..................................................................... 46
APPENDIX VII. Sea Lice Monitoring ............................................................................... 50
APPENDIX VII-A. Sea Lice Report .................................................................................. 51
APPENDIX VII-B. Environmental Record ...................................................................... 52
APPENDIX VIII-A. Stocking and Fish Health Activity ...................................................... 53
APPENDIX VIII-B. Use of Therapeutants, Pest Control Products and Anaesthetics ....... 54
APPENDIX VIII-C. Mortality by Category ....................................................................... 55
APPENDIX VIII-D. Urgent Notification & Follow-Up Report of Mortality or Environmental Spill Event .................................................................................................... 56
APPENDIX IX. Escape Prevention Through Maintenance of Cage and Net Integrity ... 57
APPENDIX X. Escape Notification Form ........................................................................ 68
PART A. Definitions

“Absolute lice inventory” means the calculated total number of lice within a farm determined by multiplying fish number on the farm by the average lice count per fish;

“Attestation” means a declaration made by a qualified individual who bears witness to, confirms or authenticates;

“Acoustical Deterrent” means a device that is used underwater and is intended to generate an aversive response in marine mammals and for the purpose of this licence includes, but are not limited to, explosives, incendiary devices, and electronic sound recordings;

“Baseline survey” means the gathering of environmental information typically conducted prior to a facility becoming operational;

“Beggiatoa-like species” means species of bacteria that form visible mats on the seabed surface in areas of organic enrichment which may be in the genus Beggiatoa, but may also include those found in different genera;

“Benthic” means on or in the seabed;

“Biofouling” means the organisms that attach and/or live on nets and other structures (excluding herring spawn);

“Broodstock” means fish used to generate gametes;

“CCME PEL” means Canadian Council of Ministers of the Environment probable effects level;

“Compliance station” means a geographical location relating to the containment structure as measured at high water referenced to chart datum;

“Containment structures” means net pens, bag cages, tanks and similar structures used to contain finfish for the purposes of aquaculture;

“Containment structure array” means a group of containment structures physically attached to each other, or in the case of circular structures, up to a maximum of 60 m apart;

“Department” means the Department of Fisheries and Oceans;

“Disease” means an abnormality of form or function and can be caused by a suite of infectious, non-infectious and inherent factors. Specifically:
“Clinical Disease” is a stage of the disease continuum that reflects anatomic or physiologic changes that are sufficient to produce recognizable signs and symptoms of a disease; 

“Infectious disease” means a disease caused by the invasion and growth of a microorganism in or on a fish in such a way that it affects the form or function of that fish; and

“Infectious outbreak” means an occurrence of disease in a population as determined by the attending veterinarian with the indicating morbidity or mortality rate substantially higher than its normal level;

“Domestic sewage” means human excrement, water-borne human excretion or the water-carried wastes from liquid or non-liquid culinary uses, washing, cleansing and laundering generated at staff quarters where the treated effluent is discharged to the facility tenure;

“Evidence of escape” means any visual or physical evidence that demonstrates a release of fish from containment including, but not limited to, cultivated fish observed leaving a pen or outside a pen, a significant decline in feed demand or observed significant reduction in stocking density within a pen;

“Facility” means the collective structures used for the purposes of aquaculture, including but not limited to, net pens, walkways, barges, floats and living accommodations plus associated lines and anchors;

“Finfish” means fish of the class Osteichthyes;

“Fish Habitat” means spawning grounds and any other area, including nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes;

“Fish Health Event (FHE)” means an active disease occurrence or a suspected infectious event on a farm that triggers an action, such as laboratory work-up, recommendation/report, husbandry change, veterinary diagnosis or prescription medication, further investigation, etc. where such action is intended to reduce or mitigate impact and risk associated with that occurrence or event. FHEs do not include routine sea lice monitoring activity or routine fish health sampling and surveillance activities;

“Fish Health Staff” means the designated personnel, with veterinary oversight, responsible for: identifying, managing, and minimizing the impact of risk factors; making health-related decisions; and routine monitoring of health, lice and disease parameters;

“Free sulphide” means sulphide ions not chemically bound to any other chemical constituent;

“Hard ocean substrate” means a seabed type that cannot be sampled using sediment grab devices;
“Harvest” means removal of live fish for market or in response to a Fish Health Event;

“Harvest/transfer pens” means pens that are temporarily secured to the main cage array for the purpose of feeding, handling, holding, harvesting or moving fish;

“High slack tide” means that point in time in any give location where the water depth has reached its maximum height (above chart datum) and any water movement has ceased, up until the current reverses direction;

“Incidental catch” means any wild fish from within the facility caught during harvest, movement of fish between or within facilities, or net removal;

“Licence holder” means the person, individual or corporation operating the facility;

“Marine mammal” includes cetaceans, pinnipeds and sea otters;

“Mortality event” means:
(a) fish mortalities equivalent to 4000 kg or more, or losses reaching 2% of the current facility inventory, within a 24 hour period; or
(b) fish mortalities equivalent to 10,000 kg or more, or losses reaching 5%, within a five day period;

“Mortalities” means fish that have died within the containment structure array during a production cycle but does not include mortalities associated with harvest activities;

“Opportunistic polychaete complexes (OPC)” means specific classes/genus of infaunal marine worms, including *Capitella*, found in organically enriched environments;

“Pathogen” means a microorganism causing damage (pathology) in or on a fish. These include parasites, bacteria, rickettsia and viruses many of which are common and naturally present in the ecosystem;

“Peak biomass event” means the maximum biomass of finfish within a facility during a production cycle;

“Production cycle” means
(a) the period of time from stocking the containment structures to the time of harvest or removal of all finfish, prior to the facility being restocked; or
(b) for facilities containing broodstock, from the period of time immediately after a peak biomass event up to and including the next peak biomass event;

“Qualified Individual” means an individual employed by or contracted by an aquaculture corporation who possesses a combination of knowledge, expertise and experience necessary to complete the task and who can provide an attestation to the integrity of new or amended facilities;
“Reference station” means a sampling station
(a) typically within 0.5 – 2.0 km from the facility unless otherwise specified by the Department;
(b) having the same types of habitats and similar hydrographic, physical and morphological characteristics as the facility sampling stations; and
(c) representing background conditions;

“Remotely Operated Vehicle (ROV)” means a vehicle which is used for video monitoring at an aquaculture facility;

“Soft ocean substrate” means a seabed type that can be sampled using sediment grab devices;

“Time unit” means a 20 second long video clip equating to a linear 4 m distance across the seafloor based on a maximum ROV speed of 0.2 m per second;

“Tonnes (t)” means 1000 kg;

“Transfer” means the movement of live fish to or from a licensed facility or hatchery;

“Year class” means the grouping of fish based on their time spent within the marine environment. Year class 1 represents a juvenile fish group that shares an approximate sea water entry date (e.g. within 4 months) plus the subsequent 12 months. Year class 2 refers to the fish group which remains in the sea water after the initial 12 month rearing period, but does not include broodstock;

“Zone of compliance” is a location where hard ocean substrates must be monitored by video. This is comprised of a 24 m linear strip of seabed divided into six equal segments with the beginning of the zone located at 100 m from the containment array edge.
PART B. Licence Conditions

Finfish Condition of Licence

1. Application and Licensed Species

1.1 This licence authorizes the licence holder to cultivate and harvest the species listed as part of the “Species” section on the face of this licence.

1.2 A copy of this licence must be kept at this facility and available for inspection by a Fishery Officer or Fishery Guardian.

2. Production Plan (Peak Biomass)

2.1 The combined peak biomass of cultivated fish at this facility must not exceed that set out on the face of this licence.

2.2 The licence holder must submit to the Department by January 15 and monthly thereafter:

   (a) a seven month rolling inventory plan for all licensed species using the template set out in Appendix I-A(i), including biomass, number of fish, age class and harvest activities at this facility. One month of the plan must reflect the calculated inventory at this facility for the previous month and the remaining six months must be the projected inventory. This plan will include data when no production is occurring; and

   (b) calculated transfers to and from this facility for the previous month using the template set out in Appendix I-A(ii). This report is required only if transfers occurred.

2.3 The licence holder must complete the Population Harvest Declaration Form in Appendix I-B which must accompany the harvested fish and be provided to the processor.

3. Transfer of Fish

3.1 The licence holder may transfer fish to this facility from another facility possessing a valid aquaculture licence issued pursuant to section 3 of the Pacific Aquaculture Regulations provided that the following conditions are met:

   (a) the fish are live Atlantic or Pacific salmonids;

   (b) the species of live salmonid are the same as those listed on the face of this licence;
(c) transfers occur within the same Salmonid Transfer Zone as described in Appendix II; and

(d) the licence holder has obtained written and signed confirmation, executed by the source facility’s veterinarian, fish health staff, or facility manager, that, in their professional judgement:

(i) mortalities, excluding eggs, in any stock reared at the source facility have not exceeded 1% per day due to any infectious diseases, for any four consecutive day period during the rearing period;

(ii) the stock to be moved from the source facility shows no signs of clinical disease; and

(iii) no stock at the source facility is known to have had any diseases listed in Appendix III.

3.2 Where any or all conditions set in paragraph 3.1 (d) (i), (ii), (iii) cannot be met, transfer may still occur if the facility’s veterinarian:

a) has conducted a risk assessment considering facility fish health records, diagnostic reports, an evaluation of stock compartmentalization and related biosecurity measures, and deemed the transfer to be low risk to fish; and

b) submits, to the Department, an attestation that the transfer is low risk, not later than 48 hours following the transfer using the template in Appendix IV.

3.3 The original or a copy of the written and signed confirmation, described in section 3.1(d) or 3.2 must:

(a) be kept at this facility and available for inspection by the Department; and

(b) accompany all shipments of fish to and from this facility, except for movement of harvested fish.

3.4 For transfers of fish to this facility that are not authorized pursuant to sections 3.1 and 3.2, the licence holder must possess a valid licence issued pursuant to section 56 of the Fishery (General) Regulations. To obtain such a licence, the licence holder must communicate with the BC Introductions and Transfers Committee, which will liaise with the appropriate Department licensing officials.

4. Containment Array Requirements

4.1 The licence holder must comply with the Containment Array Plan(s) attached to this licence with respect to location and infrastructure. Infrastructure at the facility may be less than that in the Containment Array Plan(s), but must not exceed it.
4.2 If the containment structure array is anchored for the first time or re-anchored in the same or alternate approved location the licence holder must, prior to transferring fish to this facility, submit to the Department:

(a) a written attestation completed by a qualified individual(s) confirming that the facility infrastructure is installed in such a way and using such equipment as to withstand the prevailing oceanographic and/or meteorological conditions of the licensed location; and

(b) an accurate Containment Array Plan including locational information (+/- 10 m) for each corner of the containment structure array at high slack tide, cage number, and anticipated monitoring stations as per the marine finfish harmonized application guide.

4.3 Written attestations referred to in subsection 4.2(a) must be kept at the head office of the licence holder and a copy kept at this facility and available for inspection by the Department.

4.4 The licence holder must notify the Department when planning to change from one approved containment structure array to another 10 days prior to transferring fish to this facility.

5. Fish Health

5.1 The licence holder culturing salmonids must comply with the Health Management Plan (HMP) attached as Appendix V. Any proposed amendments to the HMP will be considered a request for licence amendment by the licence holder to the Department.

5.2 The licence holder culturing salmonids must submit to the Department, for its considered response, all amendments to facility-specific proprietary Health Management Standard Operating Procedures (HMSOPs), or indicate no changes to HMSOPs, annually by October 15.

5.3 The licence holder must comply with carcass management (including mortality events as defined in Part A) as described in its salmonid HMP or, in the case of non-salmonid licence holders, as described in a separate Carcass Management Plan (CMP) attached as Appendix V-A. Any proposed amendments to the CMP will be considered a request for licence amendment by the licence holder to the Department.

5.4 The salmonid HMP or the non-salmonid CMP must include procedures for the following measures:

(a) collection, categorizing, recording, storage and disposal of normal operational levels of fish carcasses, including:

(i) the regular removal of carcasses to carcass storage containers;
(ii) reporting to the Department as per sections 8.4 and 8.6;
(iii) bio-security protocols or direction provided by Fish Health Staff;
(iv) the secure location of stored carcasses while awaiting transfer to land-based facilities;
(v) the procedures to prevent contents from leaking into receiving waters;
(vi) the secure transfer of stored carcasses to land-based facilities; and
(vii) the methods used to sanitize carcass storage containers, equipment and other handling facilities or vessels.

(b) procedures to record, report, contain and dispose of dead wild finfish, as per sections 8.4 and 8.6; and
(c) a mortality event procedure, which will include:

(i) notification to the Department of an initial mortality event defined in Part A “Mortality Event” not later than 24 hours after discovery, providing as much detail as is known using Appendix VIII-D, or reasonable facsimile;

(ii) not later than 10 calendar days after the initial mortality notification, submission to the Department of a summary report of the cumulative carcass biomass (kg), the number of fish that died, the proportion (percent) of the inventory that this represents, and the probable cause of the mortality event, with subsequent update reports every 10 days thereafter if the specific mortality continues;

(iii) actions required to handle the additional biomass associated with a mortality event of the magnitude defined in Part A of the licence; and

(iv) identification of vessels that will be used to collect and transport mortalities to on-land facilities in the case of elevated mortality events.

5.5 Should a Fish Health Event occur, the licence holder must;

(a) take immediate action to manage the event by implementing a response procedure to minimise the potential spread of pathogens if an infectious disease is suspected or diagnosed;

(b) undertake follow up measures to evaluate the Fish Health Event and the efficacy of the mitigation measures taken;

(c) store records of the specific event and make them available at this facility for the Department's review; and
(d) submit the therapeutic management measures as per Appendix VIII-C.

6. Fish Health Record

6.1 The licence holder must keep at this facility, unless otherwise indicated, complete, up-to-date and accurate written or electronic records of stocking and fish health activity for the facility. Records must include the following:

(a) stocking and fish health activity for the facility as listed in Appendix VIII-A; and

(b) the use of all therapeutants, pest control products and anaesthetics as listed in Appendix VIII-B.

6.2 The licence holder must provide training to Fish Health Staff to support accurate and consistent observations and record-keeping of fish health information outlined in this facility’s HMP. Documentation of this training must be kept as records held at the head office or at the fish health professional's office and be made available to the Department upon request.

6.3 The licence holder must ensure that Fish Health Events and carcass assessment records, in written or electronic form, are reviewed by the licence holder’s veterinarian and/or Fish Health Staff to assess patterns in fish health and to facilitate quarterly reporting of "Mortality by Category" as per section 8.4. These assessments must be documented and stored at an accessible office and be made available to the Department upon request.

7. Sea Lice Monitoring

7.1 The licence holder must follow a sea lice monitoring program in accordance with the monitoring protocols described in Appendix VII as set out in sections 7.2, 7.3, 7.4 and 7.5.

7.2 Sampling at each facility cultivating Atlantic salmon and trout must be conducted in a minimum of three containment structures except if:

(a) during harvest, a facility that normally has four or more containment structures of fish reduces its inventory to fewer than four containment structures; or

(b) fish transferred to this facility reside in fewer than three fully stocked containment structures, or fewer than 30 calendar days have passed since the completion of fish transfer to the third containment structure; or

(c) the facility, when fully stocked, consists of five or fewer containment structures. In such a case, the fish of at least one containment structure must undergo lice abundance assessment.
7.3 During the period from March 1 to June 30 inclusive, the licence holder cultivating Atlantic salmon and trout must carry out a sea lice abundance assessment every two weeks, at minimum, for fish held in containment structures for more than 30 calendar days, and where the abundance threshold of three motile *Lepeophtheirus* spp. has been exceeded, the licence holder must:

(a) initiate action within 15 calendar days of the discovery to reduce the absolute lice inventory at this facility over subsequent weeks; and

(b) notify the Department as per section 8.3.

7.4 During the period from July 1 to February 28 inclusive, the licence holder cultivating Atlantic salmon and trout must carry out a sea lice abundance assessment once every month, at a minimum, for fish held in containment structures for more than 30 calendar days, and where the abundance threshold of three motile *Lepeophtheirus* spp. has been exceeded, the licence holder must:

(a) increase monitoring to at least once every two weeks;

(b) initiate action within 30 calendar days of the discovery to manage motile *Lepeophtheirus* spp. on Atlantic salmon and trout; and

(c) notify the Department as per section 8.1.

7.5 The licence holder must follow the sea lice monitoring program at the intervals set out in sections 7.3 and 7.4 except when:

(a) the lice monitoring activity and anaesthetic withdrawal time would delay the current rate of harvest of a facility;

(b) fish have been medicated for sea lice within the previous 21 days;

(c) fish are being medicated or otherwise managed for a fish health event; or

(d) an ongoing environmental issue would lead to additional fish stress or harm if handled.

7.6 Sea lice monitoring must resume at the interval set out in either section 7.3 or 7.4 as applicable, as soon as practicable following an event set out in section 7.5.

7.7 The licence holder must ensure that sea lice monitoring are conducted on cultivated Pacific salmon at the facility during routine observations and handlings of fish (live or dead), or at a minimum, quarterly, during a harvest or fish sorting event. Sea lice abundance must be documented and available for review by the Department upon request. Should the average motile *Lepeophtheirus* spp. abundance reach or exceed three lice per cultivated Pacific salmon, the licence holder must notify the Department as per section 8.3.

7.8 The licence holder must provide training to Fish Health Staff to support accurate and consistent protocols, observations and record-keeping of lice abundance as verified by Departmental lice audits. This training must be documented and
records kept, at a minimum, at the licence holder’s head office or at the fish health professional’s office. Records must be made available upon request of the Department.

8. Sea Lice, Health and Mortality Reporting

8.1 The licence holder, cultivating Atlantic Salmon and trout, must submit to the Department monthly reports on the results of sea lice monitoring as set out in section 7, using the template in Appendix VII-A, not later than the 15th calendar day of the following month.

8.2 Environmental data associated with the facility, as set out in Appendix VII-B, must be maintained at this facility and made available to the Department upon request.

8.3 From March 1 to June 30 inclusive, should the average sea lice abundance reach or exceed three motile Lepeophtheirus spp. per cultivated salmonid, the licence holder must report to the Department not later than seven calendar days after the discovery:

(a) the abundance results of the sea lice monitoring; and

(b) the actions and management response to be initiated within 15 calendar days of the discovery.

8.4 The licence holder must submit to the Department reports, not later than April 15 and quarterly thereafter, summarizing "Mortality by Category", including: nil reports and any use of therapeutants and anaesthetics as outlined in Appendix VIII-C.

8.5 The licence holder must notify the Department and submit detailed information using Appendix VIII-D, or reasonable facsimile, within 24 hours of veterinary diagnosis or laboratory confirmation of diseases listed in Appendix III.

8.6 The licence holder must maintain and submit to the Department not later than April 15 and quarterly thereafter, records of all wild fish mortalities collected during routine carcass recovery, following the template set out in Appendix XI.

9. Escape Prevention, Reporting and Response

9.1 The licence holder must take all reasonable measures to prevent the escape of cultivated fish and must comply with all the requirements of Appendix IX.

9.2 The licence holder culturing finfish must have in place an Escape Prevention and Response Plan including elements of Appendix IX and ensure that it is readily available at this facility and that all site staff are familiar with it.
9.3 The licence holder must take immediate corrective action to control, mitigate, remedy and confine an escape or a suspected escape, of fish from the containment structure array.

9.4 The licence holder must ensure that any escape, or evidence of escape, of cultivated fish from this facility is reported upon discovery to the Department as per Appendix X. The licence holder must provide as much detail of the incident as possible including the record of therapeutants administered, if still within the withdrawal period.

9.5 The licence holder must submit to the Department a follow-up report, as per Appendix X, of any escape, or evidence of escape, reported in section 9.4 not later than seven calendar days after the escape, or suspected escape.

10. Incidental Catch

10.1 The licence holder must use reasonable care in designing and using nets and other gear or equipment in a way that reduces the risk of incidental catch, and causes the least amount of harm to incidental catch.

10.2 Unless otherwise directed by the Department, the licence holder must ensure that any live incidental catch are immediately returned to waters outside the aquaculture facility in a manner that causes it the least harm.

10.3 The licence holder must take reasonable measures to retain all dead incidental catch and dispose of them in the same manner that cultivated stock carcasses are disposed of, as set out in section 5.4.

10.4 The licence holder must maintain records of incidental catch, following the template provided in Appendix XI, including:
   (a) all dead incidental catch;
   (b) estimates of all live incidental catch caught during harvest and transfer activities or end of production cycle net removal; and
   (c) herring spawn observed on infrastructure.

10.5 The licence holder must submit to the Department incidental catch data required under section 10.4 in the following manner:
   (a) for facilities that have fish continuously present, a report which includes all recorded incidental catch data for the previous 12 month period must be submitted annually, not later than January 15; or
   (b) for all other facilities, a report must be submitted within 15 calendar days of the final date of harvest that includes all recorded incidental
catch data from transfer and harvest events during the production cycle. The licence holder must submit a follow-up report if more incidental catch is discovered after all containment nets are removed.

11. Management of Marine Mammal Interactions

11.1 The licence holder must have in place a Marine Mammal Interaction Management Plan that includes all the elements of Appendix XII and ensure that it is readily available at this facility and that all facility staff are familiar with it.

11.2 The licence holder must ensure that all reasonable methods are used to deter marine mammals from coming into conflict with the aquaculture facility operation, but must not use acoustical deterrents.

11.3 The licence holder must report, any marine mammal drowning mortality to the Department not later than 24 hours after its discovery. The report is to contain as much information as available at the time of the reporting, as specified in Appendix XIII-A.

11.4 Not later than seven calendar days after the initial notification pursuant to section 11.3 the licence holder must submit to the Department, using Appendix XIII-A, a complete follow-up report of discovery of any marine mammal drowning mortality.

11.5 Upon discovery of a live entangled marine mammal, the licence holder must make all reasonable attempts to free the animal without harm and report to the Department. The report must include as much of the information as available at the time of the reporting, as specified in Appendix XIII-A.

11.6 Not later than seven calendar days after the initial notification pursuant to section 11.5 the licence holder must submit to the Department a complete follow-up report of the entanglement using Appendix XIII-A, including those situations where the animal is released alive.

11.7 The licence holder must keep a record of all instances where an animal is confined, but not entangled, within the facility infrastructure (including within anti-predation netting) but is released or leaves on its own and must provide this record to the Department upon request.

11.8 If the confined or entangled California sea lion or harbour seal cannot be released, the licence holder must dispatch the animal in accordance with sections 11.9 through 11.16 of this licence.

11.9 In the event that deterrence efforts referred to in section 11.2 fail, the licence holder is authorized to kill only harbour seals and California sea lions which are
no farther than 30 m from the edge of any net pen associated with the containment structure array, and that:

(a) are within or attempting to get within the containment structure array; and

(b) represent an imminent danger to the equipment used in the operation of an aquaculture facility (infrastructure), the safety of persons in the facility or the fish cultivated in the facility.

11.10 Only employees and/or agents of the licence holder who meet all of the following qualifications may kill harbour seals or California sea lions pursuant to section 11.9;

(a) possess a valid Federal Possession and Acquisition Licence (PAL) issued under the *Firearms Act* and are able to produce it upon demand by a Fishery Officer or Guardian; and

(b) carry, in the case of an employee of the licence holder, photo identification and current contact information, and additionally, in the case of an agent, the name of the business, business owner, business licence number and current contact information for the business and produce it upon request by a Fishery Officer or Guardian.

11.11 All firearms used to kill harbour seals or California sea lions must have a muzzle velocity of not less than 1,800 feet per second, and a muzzle energy of not less than 1,100 foot pounds. Ammunition must be factory produced and the box available for inspection. The use of hand loads is not permitted under the authority of this licence.

11.12 If a harbour seal or a California sea lion is shot under the authority of this licence, every reasonable attempt must be made to retrieve it and ensure that it is dead.

11.13 As soon as it is practical, the licence holder must make all reasonable efforts to recover every marine mammal killed under the authority of this licence and must, for every marine mammal that is retrieved, dispose of the carcass in accordance with applicable Federal, Provincial, and Municipal legislation.

11.14 If a harbour seal or a California sea lion is shot under the authority of this licence and is not retrieved, the licence holder must record all retrieval efforts made and report such efforts to the Department in the form of Appendix XIII-B. Retrieval efforts must be reported to the Department in conjunction with the report required under Section 11.15.

11.15 The licence holder must ensure that the shooting or killing of any marine mammal is reported immediately to the Department. The report must include as much of the detail in Appendix XIII-B as possible.
11.16 The licence holder must submit to the Department a complete follow-up report of the marine mammal shot or killed under section 11.9, in the form of Appendix XIII-B, not later than seven calendar days after the shooting or killing.

12. Protection of Fish Habitat

12.1 The licence holder must maintain records at this facility of in-water net cleaning for the purposes of biofouling removal, as set out in Appendix XIV.

12.2 The licence holder must ensure that no washing of copper-treated nets will occur at this facility once nets are removed from the containment structure array. Copper-treated nets must be washed at authorized land-based facilities.

12.3 The licence holder must comply with the requirements set out in the Benthic Monitoring Program, including the frequency of submission of reports to the Department as set out in Appendix XV. These reports, including DVD video data may be stored at the head office, rather than at this facility, and in addition must be submitted as set out in section 16.2.

12.4 Subject to the requirements in section 12.3, the licence holder must obtain benthic sediment samples using a grab when possible and follow the procedures set out in Appendix XV to determine when the alternate protocols for video surveys must be followed.

12.5 The licence holder must conduct benthic monitoring at peak biomass, as set out in Appendix XV and report on:

(a) for soft ocean substrates;
   (i) free sulphides, redox potential, metals package (only reporting copper, zinc and lithium), and total volatile solids (TVS) at the zero-metre sampling stations;
   (ii) free sulphides, redox potential, sediment grain size (SGS) and/or moisture content and TVS at the 30 m compliance sampling stations; and
   (iii) free sulphides, redox potential and TVS at the 125 m compliance sampling stations;
(b) for hard ocean substrates;
   (i) percent cover of *Beggiatoa*-like species and/or OPC in each required time unit; and
   (ii) other abiotic and biotic parameters as set out in Appendix XV.

12.6 Prior to re-entering fish to this facility, the licence holder must ensure that:

(a) for soft ocean substrates, the mean free sulphide concentration:
(i) must not exceed 1300 µM at or beyond the 30 m compliance sampling stations; and
(ii) must not exceed 700 µM at or beyond the 125 m compliance sampling stations;

(b) for hard ocean substrates, the coverage of Beggiatoa-like species and/or OPC:

(i) must not exceed 10% in four or more of the segments in the zone of compliance; and
(ii) must not exceed 10% in any two contiguous segments in the post-compliance zone (124 – 140 m from the containment structure array edge) if the coverage exceeds 10% in both of the last two segments of the zone of compliance.

12.7 The licence holder must not restock fish at this facility until the Department has confirmed that benthic monitoring results meet the standards set out in section 12.6 of all soft or hard ocean substrate compliance sampling stations.

12.8 For any soft ocean substrate compliance station at or beyond 30 m where benthic monitoring results at peak biomass show a mean free sulphide concentration statistically greater than 1,300 µM and less than 4,500 µM, the licence holder must:

(a) notify the Department not later than 14 calendar days after the sampling event;

(b) conduct additional monitoring until mean free sulphides are shown to be less than 1,300 µM at the 30 m compliance sampling station where 1,300 µM was exceeded and corresponding 125 m compliance sampling station, reporting on free sulphides and redox potential; and

(c) submit results to the Department prior to planned fish entry to this facility.

12.9 For any soft ocean substrate compliance station that exceeded the standard in section 12.6(a) at peak biomass copper or zinc exceeded the CCME PEL guidelines of 108 µg/g or 271 µg/g respectively at the corresponding zero metre sampling station, the licence holder must:

(a) conduct additional monitoring comprised of a metals package at the zero metre sampling station that exceeded the guidelines, and at the corresponding 30 m and 125 m compliance sampling stations; and

(b) submit results to the Department prior to planned fish entry to this facility.

12.10 For any soft ocean substrate compliance station at or beyond 30 m where benthic monitoring results at peak biomass show a mean free sulphide concentration statistically greater than 4,500 µM, the licence holder must:
(a) notify the Department not later than 14 calendar days after the sampling event;

(b) conduct additional monitoring until mean free sulphides are shown to be less than 1,300 µM at the 30 m compliance sampling station where 4,500 µM was exceeded, reporting on:

(i) free sulphides, redox potential, TVS, SGS and/or moisture content and metals package at the 30 m compliance sampling station;

(ii) free sulphides, redox potential and TVS at the corresponding 125 m compliance sampling station; and

(iii) free sulphides, redox potential, TVS, SGS and/or moisture content at two reference stations; and

(c) submit chemical results to the Department prior to planned fish entry to this facility.

12.11 For any soft ocean substrate compliance station at or beyond 125 m where benthic monitoring results at peak biomass show a mean free sulphide concentration statistically greater than 700 µM, the licence holder must:

(a) notify the Department not later than 14 calendar days after the sampling event;

(b) not later than 30 calendar days after the initial sampling event, conduct additional monitoring at the 125 m compliance station where 700 µM was exceeded, and two reference stations, reporting on:

(i) free sulphides, redox potential, TVS, SGS and/or moisture content, and metals package; and

(ii) biological monitoring including taxonomic identification;

(c) if required, conduct additional monitoring at the 125 m compliance sampling station where 700 µM was exceeded until mean free sulphides are shown to be less than 700 µM, reporting on:

(i) free sulphides and redox potential; and

(d) submit chemical results to the Department prior to planned fish entry to this facility.

12.12 For any hard ocean substrate transect at or beyond the zone of compliance where benthic monitoring results at peak biomass show the coverage of *Beggiatoa*-like species and/or OPC exceeds the standards in section 12.6(b), the licence holder must:

(a) notify the Department not later than 14 calendar days after the sampling event;
(b) conduct additional monitoring beginning at 80 m from the containment structure array at the transect(s) where the pre-stocking standards were exceeded until monitoring shows *Beggiatoa*-like species and/or OPC do not exceed 10% coverage in any time unit within or beyond the zone of compliance; and

(c) submit results to the Department prior to planned fish entry at this facility.

12.13 Where the licence holder has multiple containment structure arrays, the licence holder must ensure that the standards set out in section 12.6 are attained at all compliance stations associated with the most recently used containment structure array prior to transferring fish to this facility.

12.14 Should the Department determine that the monitoring stations set out in section 4.2(b) for gathering data required under sections 12.6 and 12.8 to 12.12 may not be representative of worst-case conditions, the Department may prescribe additional or alternate monitoring locations.

12.15 For proposed amendments where production or infrastructure changes will increase or cause new areas of benthic impact, prior to transfer of fish to this facility, the licence holder must:

(a) submit an application to amend the licence;

(b) collect baseline survey data if required by the Department;

(c) provide habitat compensation as approved by the Department; and

(d) undertake measures to mitigate the loss of productivity to the seabed.

12.16 Harvest/transfer pens may be used in the same location for up to 90 calendar days. The licence holder must ensure that:

(a) harvest/transfer pens must remain empty or in an alternate location for the equivalent time that they are in operation; and

(b) facility records of harvest and transfer pen usage are maintained and available upon request to the Department. These records must include location, start and end dates of harvest/transfer pen use.

12.17 The licence holder must ensure that the only infrastructure contacting the sea bed is anchoring equipment.

12.18 The licence holder must prepare, implement, and produce on the request of the Department a Chemical and Other Substances Management Plan including the management, control and spill response of therapeutants, disinfectants, pesticides, anti-fouling agents, hydrocarbons and blood.

12.19 The licence holder must collect and retain, with minimal leakage, blood generated during harvest and dispose of it at a licensed processing facility.
12.20 The licence holder must ensure all debris generated or used at this facility is collected or treated and disposed of in accordance with applicable Federal, Provincial, and Municipal legislation.

12.21 The licence holder must ensure employees take immediate action to stop, contain and clean up any spill of fuel or lubricants. All such spills must be reported to the Canadian Coast Guard at 1-800-889-8852.

12.22 The licence holder must ensure that when therapeutants bound to feed pellets are utilized, they are prepared at the feed mill and not at this facility with the exception that if less than one tonne of feed is required at this facility, hand-mixing is acceptable.

12.23 The licence holder must ensure that spent disinfectants from footbaths are added to the mortality storage totes, and disposed of along with the fish carcasses at on-land facilities.

12.24 Not later than January 15, the licence holder must submit to the Department, a report summarizing the following information for the previous calendar year:

(a) the monthly total dry weight of feed, including weight or concentration of zinc and copper formulations. All other feed information must be made available for inspection by the Department; and

(b) the names of all materials that are directly or indirectly released into the water during the reporting period including disinfectants, anti-fouling agents and for all pesticides;

(i) the names, volumes and concentrations used.

12.25 The licence holder must ensure that domestic sewage produced from the facility and discharged to the marine environment complies with the following requirements:

(a) the maximum daily discharge rate does not exceed 2.5 m$^3$/day; and

(b) the domestic sewage is treated by:

(i) a septic tank designed with a retention time of not less than two days prior to discharge, or

(ii) a device other than a septic tank with the concentration of total suspended solids in the effluent not exceeding 130 mg/L; and

(c) the location of the sewage discharge point to the environment is at a depth not less than 15 m below the surface of the water; and

(d) all records related to the construction, operation and maintenance of sewage treatment and disposal works are retained for inspection by the Department.
13. Boat Operations

13.1 The licence holder must post moorage signs and visitor protocols at designated docking stations.

13.2 The licence holder must post restricted use signs in those areas where boats not involved in the cultivation of fish are not permitted access.


14.1 Not later than January 25 annually, the licence holder must complete and submit to the Department the Annual Aquaculture Statistical Report (Appendix XVI) for the previous calendar year to the following e-mail address:

fishstats@dfo-mpo.gc.ca

15. Use of Lights

15.1 The licence holder may use lights to promote fish growth and alter fish physiology and must record the following:

(a) type of lights used;
(b) the intensity of lights used;
(c) the number of lights used; and
(d) dates and times when the lights are used (period of day; season).

15.2 Not later than February 15, the licence holder must submit to the Department annual light use reports summarizing results from section 15.1 for the previous calendar year.

16. Administrative matters

16.1 Unless otherwise noted under specific conditions of this licence, the licence holder must keep all records required by these conditions in the following manner:

(a) with respect to duration:
   (i) at this facility for the duration of the production cycle; and
   (ii) in a suitable location, at this facility, in a corporate office, or other accessible storage off-site for a minimum of four additional years;
(b) accessible, legible and protected from damage; and
(c) in either electronic or paper versions.

16.2 Unless otherwise noted in specific licence conditions, all other reports and submissions required by this licence must be submitted as follows:

(a) to the respective email addresses:

   AQFF.General@dfo-mpo.gc.ca for reports required from sections 2, 4, 10, 12, and 15 of this licence;
   AQFF.FishHealth@dfo-mpo.gc.ca for all reports required from sections 3, 5, 6, 7 and 8 of this licence;
   AQFF.FishEscapes@dfo-mpo.gc.ca for all reports required from section 9 of this licence;
   AQFF.MarineMammals@dfo-mpo.gc.ca for all reports required from section 11 of this licence; or

(b) to the Departmental aquaculture database as directed; and

(c) for DVD video data only, deliver to the following address:

   Aquaculture Environmental Operations
   Pacific Region, Fisheries and Oceans Canada
   1520 Tamarac Street
   Campbell River, BC V9W 3M5
### APPENDIX I-A(i) INVENTORY PLAN

#### LEGEND (Colour Indicates Status and Year Class)
- Yellow: Harvest
- Green: Fallow
- Orange: Year 2
- Blue: Brood

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>1234</td>
<td>Biomass (T)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Population</td>
<td>2042</td>
<td>961</td>
<td>0</td>
<td>0</td>
<td>47</td>
<td>66</td>
<td>66</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Notes:

- Fishes and Oceans
- Pêches et Océans
- Canada
APPENDIX I - A(ii) DETAIL OF MONTHLY STOCK TRANSFERS

Company Name: 
Month/Year: 

<table>
<thead>
<tr>
<th>Species</th>
<th>Date(s) of Transfer</th>
<th># Fish Transferred</th>
<th>Facility Name</th>
<th>Facility Reference #</th>
<th>Fish Health zone (see map App. VI)</th>
<th>Source</th>
<th>Facility Name</th>
<th>Facility Reference #</th>
<th>Fish Health zone (see map App. VI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: 

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
APPENDIX I-B  POPULATION HARVEST DECLARATION FORM

PART A.

<table>
<thead>
<tr>
<th>Company Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
</tr>
<tr>
<td>Phone number:</td>
</tr>
</tbody>
</table>

Aquaculture Facility Number:

<table>
<thead>
<tr>
<th>Fish ID or Lot #</th>
<th>Date of Harvest</th>
<th>Fish Species and Common Names</th>
<th>Quantity Shipped (pieces)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Name of Market Venue, Distributor, Next Grower, or Processor:

PART B. Details of Drug/Chemical Treatment While Fish in this Lot Held at the Licence Facility

<table>
<thead>
<tr>
<th>Details of Last Drug/Chemical Treatment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Name of Drug and Prescription No.</td>
</tr>
<tr>
<td>(if any)</td>
</tr>
<tr>
<td>2. Date Treatment Commenced</td>
</tr>
<tr>
<td>3. Date Treatment Ended</td>
</tr>
<tr>
<td>4. Treatment Information (withdrawal time prescribed, how applied to animals (in-feed or bath), amount per Kg of feed, etc.)</td>
</tr>
</tbody>
</table>

Treatment file and details are available at rearing site: Yes No

5. Name of Prescribing Veterinarian

<table>
<thead>
<tr>
<th>Name of Person Responsible for Administering the Treatment</th>
<th>Signature of Person Responsible for the information of this declaration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date:</td>
</tr>
</tbody>
</table>

This form may be used by a licence holder or their agent to satisfy the information requirements specified in licence condition 2.3 concerning shipping of fish/seafood to a market venue or processing plant. This form must accompany the fish/seafood and must be retained by the market or processing licensee for a period of one year. Please note that this form must be submitted even if there has been no drug treatment of the animals in the shipment.
APPENDIX II  MAP OF SALMONID TRANSFER ZONES

Figure 1
Salmonid Transfer Zones for British Columbia

1. Trans Boundary
2. Liard
3. Peace
4. Skeena
5. Central Coast
6. Queen Charlotte Islands
7. Southern Coast
8. Fraser
9. Columbia
APPENDIX III  DISEASES OF REGIONAL, NATIONAL OR INTERNATIONAL CONCERN

The diseases and pathogens listed below are considered either exotic to British Columbia (BC) or, such as IHN that is known to exist in BC, have the potential to emerge from the ecosystem in the Pacific region. These diseases can severely impact fisheries and affect regional and national trade so they warrant urgent notification and immediate attention.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious Hematopoietic Necrosis (IHN)</td>
<td>Infectious hematopoietic necrosis virus (rhabdovirus)</td>
</tr>
<tr>
<td>Infectious Pancreatic Necrosis (IPN)</td>
<td>Infectious pancreatic necrosis virus (birnavirus)</td>
</tr>
<tr>
<td>Viral Hemorrhagic Septicemia (VHS) – other than the endemic VHS Genotype IVa</td>
<td>Viral hemorrhagic septicemia virus (rhabdovirus)</td>
</tr>
<tr>
<td>Infectious Salmon Anemia (ISA)</td>
<td>Infectious salmon anemia virus (orthomyxovirus)</td>
</tr>
<tr>
<td><em>Oncorhynchus masou</em> Virus Disease (OMV)</td>
<td><em>Oncorhynchus masou</em> virus (herpes virus)</td>
</tr>
<tr>
<td>Any other filterable replicating agent causing cytopathic effects in cell lines specified by the Minister or is causative of identifiable clinical disease in fish</td>
<td></td>
</tr>
<tr>
<td>Whirling Disease</td>
<td><em>Myxobolus cerebralis</em></td>
</tr>
<tr>
<td>Cold Water Vibriosis (Hitra disease)</td>
<td><em>Vibrio salmonicida</em></td>
</tr>
</tbody>
</table>


APPENDIX IV-TRANSFER OF FISH VETERINARIAN ATTESTATION FORM

Company Name: 

Receiving Site Name: 

Receiving Site Facility Reference #: 

Source: (include intermediate sites if applicable) 

Date of Transfer: ____________ Species: ________________

Life Stage: ____________ Number of fish: __________________

Section 3.2:

For facility veterinarian:
I hereby attest that in my professional judgement, a risk assessment was conducted considering:

[ ] Facility fish health records, diagnostic reports, an evaluation of stock compartmentalization and related biosecurity measures, and deemed the transfer to be low risk.

Comments/Rationale:

Facility Veterinarian __________________ Signature __________________ Date of Attestation __________________
Salmonid Health Management Plan (HMP)
of [corporate entity name]

serves as Appendix V of the
Marine Finfish Aquaculture Facility Numbers:
- AQFF ...
- AQFF ...
- or see table below

[NB. This template is designed to facilitate the principles of HMPs applicable to a number of cultured finfish types or facilities - aspects common to: salmonids, non-salmonids (eg. sablefish), marine open-water netpens, fresh open-water netpens, marine solid-wall arrays].

To complete, the Licence Holder will please:
1. fill-in names/items highlighted in blue,
2. in some paragraphs, select or delete the applicable item in blue,
3. complete this title page and assign the licence(s) to which this HMP (and SOPs herein) apply,
4. remove the “Template” watermark,
5. remove all yellow highlights, and
6. adjust the footer (pages 2 to 12) to reflect the latest update.

Template updated November 2012. Fisheries and Oceans Canada, Aquaculture Management Division (DFO-AMD) of British Columbia
1 OBJECTIVES, PERSONNEL & EXECUTIVE SUMMARY

The Health Management Plan (HMP) submitted to Fisheries and Oceans Canada as part of both the Marine and Freshwater/Land-based Finfish Aquaculture Licences serves three purposes: i) to outline good health conditions for cultured finfish raised by [corporate entity name] within the [marine] [freshwater/land-based] ecosystem; ii) to reflect a commitment by [corporate entity name] to comply with the principles, concepts, and required elements of fish health management when culturing finfish or gametes thereof in, or destined for, the marine environment, unless otherwise depicted by site-specific conditions of licence (i.e. culturing finfish in any open-water ecosystem) and; iii) to be used by [corporate entity name]’s facility staff for training and for day-to-day interaction with the fish, and by other fish health staff who are responsible for maintaining and monitoring good health status of the fish, and by the Licence Holder’s Health Management Team who makes decisions related to fish health.

This document forms one of two components of [corporate entity name]’s overall Health Management Plan (HMP): i) concepts; and ii) proprietary Standard Operating Procedures (SOPs). This HMP document forms [Appendix V (SW)] [Appendix III (FW/LB)] of the current Finfish Aquaculture Licence under the Pacific Aquaculture Regulations (PAR, 2010). As an appendix of the Finfish Aquaculture Licence, this document is the publicly available component and commits [corporate entity name] to ensure and maintain the health and wholesomeness of its cultured finfish. It also commits [corporate entity name] to abide by four key principles of the management of health:

1. Characterizing the health status of the animal population
2. Identifying and managing risks
3. Reducing exposure to disease-causing agents
4. Judicious application of chemicals and drugs

Functionally, this document applies to [corporate entity name]’s open-water containment arrays (net pens or solid wall) [and to open-water body broodstock-rearing facilities, when present]. A number of health concepts herein may refer to an SOP that coincides with other health concepts (eg. both biosecurity and fish handling may refer to the same net changing SOP (eg. SOPs of sections 3 and 7), common to both concepts). In addition, SOPs may be identified as either site-specific or practiced at all Licence Holder’s facilities.

The proprietary SOPs cited in this HMP document are initially submitted in their entirety to Fisheries and Oceans Canada’s Aquaculture Management Division (DFO-AMD) for review and response. Thereafter, amendments to the SOPs will be submitted annually for Departmental review and response.

[Yellow highlights in this template depict tangible indicators of each concept easily verified and inspected].

Health Management Plan (HMP) - updated November 2012
1.1 Personnel Duties and Responsibilities

1.1.1 Veterinarian

[Corporate entity name]’s attending Veterinarian (either staff or private contract vet), in conjunction with fish health staff, has agreed to be responsible in overseeing matters of fish health management for [corporate entity name]. The Veterinarian is licensed in BC and fosters a lawful Veterinarian-client-patient relationship with the Licence Holder. The Veterinarian is responsible for disease diagnoses, interpretations, and writing prescriptions and is expected to exercise good medical judgment in matters of fish health. Veterinary contact information is posted and available to on-site fish health staff.

1.1.2 Fish health manager / technicians / team

Job descriptions for the Fish Health Manager, Fish Health Technicians, Fish Health Biologist and other positions are available at the Head Office of [corporate entity name]. This “Fish Health Management Team” refers to those persons, including the Veterinarian, who are responsible for major fish health decisions. The Team is responsible for identifying and managing risks in an attempt to maximize fish health.

1.1.3 Facility staff play a role

As per conditions of licence, all facility staff have read and abide by this HMP and relevant operational SOPs, signed-off, and practice appropriate hygienic procedures supportive of fish health. General farm staff may be assigned specific fish health duties from time to time.

1.1.4 Contact names and numbers

Contact names and numbers for key fish health personnel, including emergency numbers for regulatory authorities and services, are posted in readily accessible location(s) at each facility.

2 HEALTH CONCEPTS & REQUIRED ELEMENTS

2.1 Biosecurity

Disease-causing agents (pathogens) may be spread by sick fish (wild or cultured) through the water, on shared equipment, other animals, or inadvertently by personnel, visitors or their personal gear. Entrance of potential pathogens is minimized by supporting an effective biosecurity “barrier” at each facility. Biosecurity measures apply to all personnel, visitors, divers, suppliers, regulators, vessels, and all equipment. Biosecurity has three main goals: keeping fish healthy, keeping pathogens out, and keeping disease from spreading. See the heading below: “Keeping Pathogens Out” for operational SOPs.

2.2 Keeping Fish Healthy

Keeping fish as healthy as possible is critical in preventing disease from arising at the containment facility, and/or from spreading within a facility.
2.2.1 Single year-class farms
Containment arrays (i.e., production farms, not including broodstock holding facilities) ideally contain a single year-class of finfish livestock to minimize the transmission of pathogens between age classes of fish. In other words, an ‘all stock in; all stock out’ approach is encouraged. However, due to siting or production limitations [corporate entity’s name] is acknowledged by the Department to raise multi-year-class fish at this specific location.

2.2.2 Suitable rearing environment and security
[Corporate entity name] is responsible for ensuring a suitable rearing environment for the fish so they remain healthy. Requirements related to materials used in the construction and maintenance of rearing units provide security and minimize risk of potential escape or harm to fish. Facilities are staffed 24-hours daily or are locked, alarmed, secured or otherwise monitored to control entry and deter vandalism.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.2.3 Normal fish behaviour is observed
Fish are routinely monitored for signs of normal health and disease. All staff are familiar with normal fish appearance and behaviour. Early detection of altered activity is key to maintaining health and disease management so changes in behaviour and physical condition are logged and reported to facility managers upon discovery. To minimize stress and mortality, fish are held at cost-effective, species-specific densities.

2.2.4 Predator control
Predators include birds, other fish, and mammals. Reasonable, due diligent attempts are made to exclude predators from the facility and from interacting with the fish. As detailed and required in the conditions of licence [corporate entity name] follows mitigation procedures striving toward minimal predator interaction with the cultured fish.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.2.5 Feed and nutrition
The objective of good nutrition is to optimize fish health and growth so fish receive sufficient quantity and quality of feed. [Corporate entity name] has procedures in place for healthy, hygienic delivery of feed to fish. Proper storage of feed is essential to maintaining its nutritional quality. Feed is stored in structures designed to minimize spillage, spoilage, and wildlife’s access to feed. Feed is also protected from extremes of heat, sunlight and moisture.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.
2.3 Fish Handling Techniques

2.3.1 Routine handling techniques

[Corporate entity name]’s fish handling procedures - including types of equipment used and equipment maintenance - are designed to minimize stress, injury, escape and predisposing fish to disease. Observing fish during handling, and for a period after handling, ensures any negative effects are noted and steps are taken to mitigate impact. Staff minimize the time fish are exposed to stressful events such as crowding and out-of-water events (i.e. moving, counting, grading, tagging, injecting, etc.). Each handling event is logged.

Refer to proprietary SOPs in Section(s) ___ of [corporate entity name’s] SOP manual or Best Management Practices.

2.3.2 Harvesting

If fish are being live-hauled to a processing plant measures are taken to minimize their stress during handling and transport. If fish are stunned and bled at the containment array they are stunned using humane procedures. Stress reduction is practiced to as great a degree as possible. [Corporate entity name]’s specific slaughter objectives and conditions vary yet specific harvest procedures (i.e. seine, brail, pump, etc.) are detailed in the SOP. Blood water is contained to the best of [corporate entity name]’s ability to minimize leakage. For specific diseases of concern, e.g. IHN viral infections, special harvest SOPs apply.

Refer to proprietary SOPs in Section(s) ___ of [corporate entity name’s] SOP manual or Best Management Practices.

2.4 Monitoring Water Quality

[Corporate entity name] routinely monitors and records water quality parameters at its facilities to ensure optimal fish health. Monitoring varies between specific licence holdings depending on location and hydrographic specifics of the local environment yet dissolved oxygen, water clarity, and temperature monitoring are minimal requirements.

2.4.1 Contingency plans

[Corporate entity name] maintains a contingency of procedures in the event of deterioration of water quality and procedures vary depending on cause. Cessation of feeding is immediate. Water quality monitoring is enhanced to determine the problem and to estimate how long the problem may persist. Fish are monitored more closely for the duration of the event and will not be handled until water quality is deemed acceptable. Records of these events, findings and actions are kept.

Refer to proprietary SOPs in Section(s) ___ of [corporate entity name’s] SOP manual or Best Management Practices.

2.5 Keeping Pathogens Out

Reasonable and necessary precautions are taken to mitigate infections at the facility. Often pathogens indigenous to the ecosystem are difficult to exclude from open or semi-open ecosystems but the development of disease can be minimised or prevented.

Health Management Plan (HMP) - updated November 2012 5
2.5.1 Personnel / Visitor / Diver / Supplier movement

Where possible, personnel and visitors avoid travel between [corporate entity name]’s containment arrays. If such travel is unavoidable, personnel and visitors adhere to all biosecurity procedures at each facility. Procedures are posted or explained to all visitors as part of the [visitor log-in] event. Suppliers are advised of containment array procedures and delivery-order in advance. Suppliers attending multiple facilities may be denied access. Staff will notify suppliers [and divers] if any specific disease of concern arises.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.5.2 Equipment / Vehicle movement

Where possible, [corporate entity name] equipment is not shared between containment arrays. This includes fish handling equipment, vehicles, feeding, monitoring and other equipment. Equipment is kept as clean as possible at all times to prevent possible spread of pathogens; it is cleaned and disinfected after each use and re-stored to its proper location. Equipment drying is also practiced when possible. Items which must be used at more than one facility are subject to biosecurity and disinfection measures.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.5.3 Moving fish between facilities

Transferring fish between culture facilities is minimized; however, due to siting or production objectives [corporate entity’s name] may relocate fish provided all required permits are obtained in advance, carried during transport, and filed at both source and receiving facilities. Particular care is taken to avoid undue fish stress, transmission of pathogens, or the possibility of escape. [Where well-boats are used, water quality is closely maintained and monitored to minimize stress during transport.]

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.6 Monitoring Fish Health and Disease

[Corporate entity name]’s fish are monitored at least once daily for any unusual behaviour, visible lesions or other signs of illness. Changes in behaviour and physical condition are reported to management or fish health staff. Water quality is also routinely monitored (as above).

2.6.1 Carcass collection

Mortality is natural in all populations. All efforts are made by [corporate entity name] to minimize infection and disease within a containment array. Optimal hygiene, disinfection, and carcass collection helps to maintain population health. Carcasses are collected, classified and recorded on a routine and frequent basis to minimize the potential spread of pathogens and to minimize the attraction of predators. If mass mortality arises, it is managed according to licence conditions and its specific SOP.
Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.6.2 Carcass classification

Carcasses are examined for obvious cause(s) of mortality and/or signs of disease. As detailed and required in the conditions of licence, [corporate entity name] records and reports the classifications of mortality at least as follows, and the Fish Health Management Team of [corporate entity name] is notified of any unusual counts or types of lesions / mortality:

- Environmental (oxygen, water quality, storms, entrapment, nutritional)
- Fresh “silvers”
- Handling or transport damage (trauma)
- Maturation
- Old (decomposed)
- Poor performers
- Predator attack
- Dead wild finfish carcasses (number and type, eg. herring-like, rockfish-like, etc.)

Diagnostic sampling is conducted as per [corporate entity name]’s procedures, or upon instruction by the Veterinarian, the Fish Health Management Team, or the Department (DFO-AMD), and recorded and reported as per licence.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.6.3 Specific fish health procedures

2.6.3.1 Anaesthetizing and sedating fish

A variety of fish health procedures require that fish be sedated or anaesthetized for welfare and to minimize stress. Registered anaesthetics are obtained through a veterinarian. Anaesthetized fish are monitored closely at all times. Adequate water quality of the anaesthetic bath, in particular available dissolved oxygen, is maintained.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.6.3.2 Sea lice monitoring (Marine licences only)

Sea lice abundance (i.e. counts) requires monitoring to make effective control and management decisions. Requirements are detailed in conditions of licence.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

2.6.3.3 Vaccinating fish

Vaccines are administered occasionally at containment arrays and form part of an integrated fish health management program. Vaccines are biologic substances that are stored (refrigerated), handled, and applied as per manufacturer’s instructions. [Corporate entity name] staff are appropriately trained prior to undertaking a vaccination procedure.

Health Management Plan (HMP) - updated November 2012
2.6.3.4 **Euthanasia**

In the uncommon event where numerous fish are euthanized (e.g., to facilitate specific fish measurements, sampling, mercy-killing, or culling), it is recorded and conducted in as humane a manner as possible, facilitating a rapid and irreversible loss of consciousness.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

---

2.7 **Fish Health Records**

Many records are computerized and form part of the integrated licence holder record-keeping system. Backups are maintained. [Corporate entity name] provides adequate system training and documentation to authorized facility personnel, including data entry and report creation. Record-keeping, storage, reporting and [corporate entity name]’s Fish Health Management Team review is followed as per conditions of licence.

2.8 **Fish Disease Outbreaks / Emergency**

A fish health emergency is any situation where the health of a fish population is suddenly at risk. This may be due to disease-causing agents (such as a pathogenic virus) or to abrupt water quality changes (such as plankton blooms, a toxin, or a sudden, severe decline in dissolved oxygen). **Vigilant monitoring, recording and early detection** is key to good management of health emergencies.

An outbreak is defined as an unexpected occurrence of mortality or disease. Not all outbreaks are infectious or fish health emergencies. Infectious diseases may differ in how contagious they are and therefore how easy or difficult they are to control. Rapid response is essential but will be determined on a case-by-case basis in conjunction with the Veterinarian, the Fish Health Management Team, and/or by regulatory authority. Once an outbreak / emergency has been recognized, specific steps are followed. The objective is to keep the pathogen concentration (or load) as low as possible and to prevent spread of the problem within or off the facility. Biosecurity is enhanced.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

---

2.9 **Escaped Medicated Fish**

The requirements and procedures related to fish escapes are **conditions of licence**. In the unlikely event of large, medicated, cultured fish escaping from the containment array (i.e., those with drug residues), [corporate entity name]’s facility staff will immediately inform their Veterinarian and Fish Health Management Team who, in turn, will contact the Department Veterinarian(s) of DFO-AMD as soon as possible to facilitate the potential need of a general fisheries advisory and/or closure.
2.10 Handling Drugs and Chemicals

Fish health and survival is sometimes optimized with judicious use of veterinary prescribed therapeutics. The Veterinarian attending [corporate entity name] maintains a veterinarian-client-patient relationship to facilitate diagnoses and prescription treatments. These decisions are taken considering both the welfare of fish and the ecosystem.

2.10.1 Medicated feed storage, administration and inventory

Medicated feed, if used, is stored in clearly marked bags, easily distinguishable from non-medicated feed. The medicated feed is inventoried and recorded daily as the feed is offered to the fish according to prescription. A Material Safety Data Sheet (MSDS) for all medications used at the facility is on-site and readily accessible. [Corporate entity name] ensures that all chemicals are handled safely by appropriately trained staff, taking suitable precautions.

2.10.2 Treatment records

As per conditions of licence specific and detailed records of medicated feed administration are kept on-site for the entire time the fish are present. In combination with inventory records, the fish groups that were treated are readily identifiable through treatment and withdrawal times. A copy of the treatment history will accompany the target fish to another containment array if the fish are subsequently moved. [Corporate entity name] does not harvest fish until they have cleared the withdrawal period prescribed by the Veterinarian. As per regulations and licence, when fish are delivered to a processing plant a Population Harvest Declaration accompanies harvest fish to ensure seafood safety and wholesomeness.

2.10.3 Chemicals and Biologicals

2.10.3.1 Disinfectants, chemicals, and biologicals

Disinfectants and chemicals are stored in clearly marked containers. An MSDS for each disinfectant at the facility is on-site and readily accessible. [Corporate entity name] ensures that all chemicals are handled safely by appropriately trained staff, taking suitable precautions.

Biologics include vaccines. Where applicable, these products are stored refrigerator and handled as per manufacturer’s instructions. A product insert for each vaccine at the facility is on-site and readily accessible.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.
3 BROODSTOCK – SPECIAL CONSIDERATIONS

Broodstock may be held at marine, brackish, or freshwater facilities. All fish health aspects of this HMP appendix apply (e.g., biosecurity, routine monitoring, treatments, emergencies, records) though they differ between saltwater and freshwater facilities. For example, water quality monitoring and contingency planning will differ between marine and freshwater broodstock sites.

3.1 Suitable Rearing Environment

[Corporate entity name] is responsible to provide a suitable, safe and secure rearing environment. Escape and predation prevention is essential.

3.2 Feed and Nutrition

Broodstock often require specially formulated diets to meet their nutritional requirements prior to full maturation. Broodstock feeding strategies differ from those of production fish, particularly as they begin to mature and stop feeding. Proper storage of these diets is essential to maintaining their nutritional value; feed is stored in structures designed to minimize spillage, spoilage, and wildlife’s access to feed; feed is also be protected from extremes of heat, sunlight and moisture.

3.3 Biosecurity

[Corporate entity name] raises mature broodstock for a period of time longer than production fish. Where possible, designated staff and equipment are selected to interact with broodstock. Strict disinfection and hygiene procedures are in place. At freshwater facilities shared by other fish year-classes, biosecurity is particularly vital to prevent the transfer of pathogens from the mature fish to susceptible young fry.

To minimize two-way transmission of disease, mature broodstock are held at a designated facility or in a portion of a facility, removed from production or hatchery fish. Broodstock in freshwater may use a separate water supply.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

3.4 Selection and Handling

Broodstock are handled individually at least once. Aquaculture facility personnel select broodstock for specific traits, and all broodstock are sorted by sex and for “ripeness”, i.e. whether or not they are fully mature. Handling individual brood fish is be done with care and with minimal stress to prevent negative effects on gametes (eggs and milt). Anaesthesia and sedation is used to minimize time and exposure to anaesthetic compounds, and to provide gentle handling and recovery.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.
3.5 Medications
Broodstock are medicated preventatively for specific infections prior to maturation, particularly for those infectious pathogens that may be transmitted “vertically”, i.e. from parent to egg. The type and timing of applied medications is determined by [corporate entity name]’s Veterinarian and Fish Health Management Team. The medications are used according to prescription and are inventoried and recorded daily. A Material Safety Data Sheet (MSDS) for all medications used at the facility is on-site and readily accessible. [Corporate entity name] ensures that all medications are handled safely by appropriately trained staff, taking suitable precautions.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

3.6 Egg and Milt Collection
Egg and milt collection is conducted in as hygienic a manner as possible to prevent transmission of pathogens to other broodstock or progeny. Brood fish are anaesthetized and gametes are harvested. Females are euthanised in a humane manner. Males, if used for multiple egg takes, are monitored for recovery from anaesthesia and returned to holding unit(s). Proper hygiene and disinfection is practiced.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

3.7 Disease Screening
Disease screening procedures are conducted at the time of spawning to mitigate risk of vertical transmission of pathogens to progeny. Tests performed are at the discretion of the Veterinarian but may include screening for BKD (female broodstock) [and viral screening]. Additional testing may be performed at the discretion of the Veterinarian. Samples for disease screening are collected using aseptic technique. The location of progeny from sampled fish is tracked until such time the screening results are received and reviewed by the Veterinarian and/or Fish Health Management Team.

3.8 Egg Disinfection
Eggs are safely disinfected following fertilization and water hardening. This disinfection is conducted either at the Broodstock facility or once the gametes enter the hatchery.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

3.9 Egg (and/or Milt) Transportation
Pre-arranged permits are required when eggs or milt are transported and permits must accompany the gametes during transport. Transport occurs in clean, labelled containers with secure lids. Strict disinfection and biosecurity procedures are followed to prevent transmission of pathogens from the broodstock facility to the hatchery.
3.10 Identifying Progeny
Female brood are labelled and corresponding eggs are clearly labelled to match (by date and parents or batch of parents).

3.11 Records
Records are kept for egg-take and broodstock pathogen screening. Records accompany each shipment of eggs from the broodstock facility to the hatchery receiving the eggs, whether destined for on-site or off-site incubation.
APPENDIX V-A  CARCASS MANAGEMENT PLAN (for marine non-salmonids)

Monitoring Fish Health, Disease and Mortality

[Corporate entity name]’s live fish are monitored at least once daily for any unusual behaviour, visible lesions or other signs of illness. Changes in behaviour and physical condition are reported to management or fish health staff. Water quality is also routinely monitored as per Standard Operating Procedure (SOP).

Carcass collection

Mortality is natural in all populations. All efforts are made by [corporate entity name] to minimize infection and disease within a containment array. Optimal hygiene, disinfection, carcass collection and containment helps to maintain population health. Carcasses are collected, classified, and recorded on a routine and frequent basis to minimize the potential spread of pathogens and to minimize the attraction of predators. If mass mortality arises, it is managed according to licence conditions and its specific SOP.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.

Carcass classification

Carcasses are examined for obvious cause(s) of mortality and/or signs of disease. Presumed classifications of mortality are assigned and recorded as follows, and the Fish Health Management Team of [corporate entity name] is notified of any unusual counts or types of lesions / mortality:

- Environmental (oxygen, water quality, storms, entrapment, nutritional)
- Fresh “silvers”
- Handling or transport damage (trauma)
- Maturation
- Old (decomposed)
- Poor performers
- Predator attack
- Dead wild finfish carcasses (number and type, eg. herring-like, rockfish-like, etc.)

Diagnostic sampling is conducted as per [corporate entity name]’s procedures, or upon instruction by the Veterinarian, the Fish Health Management Team, or the Department (DFO-AMD), and recorded and reported as per licence.

Refer to proprietary SOPs in Section(s) ____ of [corporate entity name’s] SOP manual or Best Management Practices.
APPENDIX VI MAP OF FISH HEALTH ZONES
APPENDIX VII  SEA LICE MONITORING PROTOCOLS

Definitions

Lice life stages

*Lepeophtheirus salmonis* (Leps)

- **Adult female**: Includes adult female lice, with egg strings (i.e. gravid) or without egg strings
- **Motile Lice**: Includes all 'not permanently attached' free-moving life stages:
  - Adult females (as above)
  - Adult males
  - Pre-adult male and female lice

*Caligus* sp.

- **Total numbers of motile Caligus species**

Both of the above

- **Chalimus**: Attached early stages of both *Caligus* and *Lepeophtheirus* species. Both species are categorized simply as chalimus since louse identification at these early life stages is not practical at the facility.

Year class 1 and 2 – see definitions in Part A of this licence.

**Broodstock**

Broodstock may initially enter saltwater directly into designated broodstock pens, or be entered to a production farm and later become designated broodstock populations, yet remain at the production farm or be relocated to broodstock facilities.

1. Sea Lice Sampling Protocols – Production Year classes 1 and 2

1.1. Other than the exemptions of COL s.7.1 sampling at each facility shall be conducted in a minimum of three containment structures, i.e. pens. Pens chosen for sampling shall include:

(a) one “reference” or “index” pen (i.e. first pen entered in the system, or the pen with the highest probability of having lice burden based on historical facility information). The fish from this pen are assessed EVERY sampling event; and

(b) two additional pens selected at random for each sampling event.

(c) not withstanding COL s. 7.2 (a), efforts should be made to restrict the “3 pen sampling event” to a 5-calendar-day period, that is the time between conducting sampling from the 1st pen to the 3rd.

1.2. In order to ensure a random sample of fish are collected from the pen:

(a) numerous fish shall be initially captured using a seine net (or alternate method provided it ensures a crowding and representative collection of the pen’s entire population).
(b) a minimum sub-sample of 20 live fish (i.e. 5 groups of 4 fish) shall be randomly collected using a dip net.

1.3. Fish shall then be placed in an anaesthetic bath (i.e. ‘tote’) or humanely euthanized (e.g. in cases where biological sampling is lethal).

1.4. Physical handling shall be minimized to protect the fish and avoid dislodging lice.

1.5. All sampled fish shall be examined for the presence of lice regardless of the health status or size (i.e. robust, moribund or runt).

1.6. Sea lice on each selected fish shall be discriminated, counted and recorded for reporting in the following four categories:

- Adult Lep females (with or without egg strings)
- Other motile Leps (including adult males, and preadults)
- Chalimus (non-motiles, regardless of species), and
- *Caligus* (combined totals of adults and preadults)

1.7. When sampling of each pen is completed, water in the anaesthetic tote shall be examined for detached sea lice. Lice dislodged and found within the handling totes must also be counted and categorized in the manner above, recorded as the ‘tote count,’ and included in the calculation of the total lice number (per pen) and average abundance (per fish).

2. **Sea Lice Sampling Protocols for Broodstock**

2.1. Broodstock shall be sampled in the same manner as production fish until their second winter at sea (i.e. the broodstock pens may be selected in the normal course of selecting three pens on the farm during the month for sampling including bi-weekly counts). If a broodstock pen is randomly selected, 20 fish shall be sampled.

2.2. In January/February of their second and subsequent winters at sea:
   a) a broodstock population on broodstock facilities shall be selected for sampling. Twenty broodstock from one pen shall be assessed.
   b) a broodstock population at production facilities, that are of a different year class than the production fish at that same location, shall be selected for sampling. Twenty broodstock from one pen shall be assessed.

2.3. After January/February of the year in which those brood are anticipated to spawn as two-winter brood, and to reduce handling-related injuries and stress on broodstock:
   (a) all sea lice monitoring shall be conducted opportunistically (or via other husbandry sampling). In other words, all sea lice monitoring shall be
coordinated with other routine broodstock handling procedures, such as sorting, moving or medicating.

(b) broodstock shall be subject to a visual inspection twice per month for the presence of sea lice and any associated grazing blemishes and observations recorded.

3. **Licence Holder Recording and Reporting Requirements**

3.1 Licence holder’s records shall contain the following information for reporting as per Condition of Licence, Section 8 and Appendix VI-A. The records shall contain the:

- a) date and details of the most recent use of anti-sea louse products;
- b) sampling date of each pen count;
- c) year class of the sampled fish;
- d) unique pen identifier;
- e) number of fish sampled for each pen for each sampling event;
- f) sampling method used;
- g) total number of lice counted, per pen (including the detached lice in the anaesthetic bath);
- h) lice counts separated into four categories as described above (at a minimum); and
- i) action taken if calculated trigger abundances are reached.

3.2 Calculated Pen averages, Sampling Event averages, and Farm Abundance records shall be stored at the facility and made available upon request by the Department.

3.3 Reporting “null” (0) in Appendix VI-A and an explanation is required if no lice monitoring was undertaken at an active production facility.
## APPENDIX VII-A SEA LICE MONITORING

<table>
<thead>
<tr>
<th>Fish Health Zone (see map App. V)</th>
<th>Facility Reference #</th>
<th>Company name</th>
<th>Facility name</th>
<th>Reference pen (Y/N)</th>
<th>Final sea water entry date</th>
<th>Pen ID</th>
<th># of sample events this month</th>
<th>If no sampling, explain</th>
<th>Sampling event start date</th>
<th>Number of fish sampled</th>
<th>Sampling method</th>
<th>Adult females L. salmonis</th>
<th>Motile L. salmonis</th>
<th>chalimus</th>
<th>Motile Caligus</th>
<th>Total Lice Numbers Counted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>drop down</td>
<td>drop down</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes (i.e. Explanation for missing counts):**

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

No sample list:
- Harvest ongoing
- Fish < 4 pens
- Fallow
- Recent transfer
- Emamectin <21 d
- H2O2
- Meds ongoing
- Environmental
- Pathogen threat
- Other - explain

Sampling method list:
- Box seine
- Full seine
- Dipnet-feed
- Weights
- Harvest
- Brood sort
- Visual estimate
- Fresh carcass
- Cull/Mort event
- Other - explain
<table>
<thead>
<tr>
<th>Action taken</th>
<th>Start date (if Rx or PC approval)</th>
<th>Calculated Pen Average (per fish)</th>
<th>Sampling Event Average (per fish)</th>
<th>Average Farm Abundance (per fish)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Adult females L. salmonis</td>
<td>Motile L. salmonis</td>
<td>chalimus</td>
</tr>
<tr>
<td>drop down</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Action taken list:**
- None required
- Bi-weekly counts
- Harvest
- Treatment
- Cull
- Other - explain

**Aquaculture Management**
Ensuring Sustainable Fisheries
## APPENDIX VII-B ENVIRONMENTAL RECORD

<table>
<thead>
<tr>
<th>Sampling Date (yr/mo/da)</th>
<th>Fish Health Zone (eg. 2.0 or 3.4)</th>
<th>Facility Reference #</th>
<th>Company Name</th>
<th>Facility Name</th>
<th>Temperature 0-1m degC</th>
<th>Temperature 5m degC</th>
<th>D.O. 5m ppm</th>
<th>Salinity 0-1m ppt</th>
<th>Salinity 5m ppt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes (i.e. Occurrence of harmful algal blooms):

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

AQUACULTURE MANAGEMENT
Ensuring Sustainable Fisheries
APPENDIX VIII-A  STOCKING AND FISH HEALTH ACTIVITY

Further to the definition of “Fish Health Staff” in Part A, the designated staff are considered qualified for this role if they have adequate post-secondary or on-the-job training and experience in the recognition of disease signs. Veterinarians are the only professionals qualified to make diagnoses and prescribe treatment of fish diseases.

Records of stocking and fish health activity shall include the following:

(a) inventory records (including source, number, pen/container number and lot of fish at the facility);
(b) daily feed consumption and growth rate;
(c) mortality records including: collection dates, carcass classification and documentation of morbidity;
(d) signs of increased morbidity;
(e) fish health and stress monitoring observations during handling or otherwise when noteworthy activities occur such as: predation, strong currents, influx of wild fish to the facility;
(f) biosecurity-related records including: visitor log, equipment cleaning, moving, and disinfection, footbath or equipment changes;
(g) records of fish health-related activity including: medications, lice counts, sorts, splits, fish health or veterinary inspection dates;
(h) records of mortality events, infectious outbreaks, urgent health-reporting;
(i) daily water quality records;
(j) records of non-therapeutic mitigative actions taken to prevent or mitigate disease such as: withholding feed due to blooms, deploying tarps and diffusers, the use of nutritional supplements, reducing densities, net changes or cleaning;
(k) records of samples collected for surveillance and diagnostic laboratory analyses related to fish health (record may reside at headquarter office);
(l) all veterinarian or fish health staff reports (at headquarter office); and
(m) records of reporting fish health information to Federal authorities (at headquarter office).
APPENDIX VIII-B USE OF THERAPEUTANTS, PEST CONTROL PRODUCTS and ANAESTHETICS

Records of the use of all therapeutants, pest control products and anaesthetics shall include the following:

(a) the facility reference number and the name of licence holder;
(b) the species of finfish cultivated at the facility;
(c) the name of the prescribing veterinarian;
(d) a log naming all therapeutants, pest control products and anaesthetics administered and when;
(e) how therapeutants and pest control products were administered and the dosage;
(f) the therapeutic schedule including the date treatment commenced;
(g) the final date of treatment or anaesthesia;
(h) the veterinarian's name and signature responsible for each therapeutant, pest control product and anaesthetic used;
(i) the detailed records of in-feed medication or pest control product administered;
(j) with the exception of source hatchery records (to be held at head office), traceability records and copies of previous medication from smolt entry facilities shall accompany all fish groups both within and off-site, and shall include:

   (i) therapeutant records of the previous 90 days;
   (ii) anaesthetic records for the previous 21 days;
   (iii) pest control product records for the previous 21 days.

(k) any accidental mixing of treated fish and non-treated fish must be recorded; thereafter the mixed group will be considered tainted until the withdrawal period is reached.
<table>
<thead>
<tr>
<th>Quarterly (year mo)</th>
<th>Fish Health zone</th>
<th>Facility Reference #</th>
<th>Company name</th>
<th>Facility name</th>
<th>Fish type cultured</th>
<th>Fish production category</th>
<th>Environmental</th>
<th>Fresh / silver</th>
<th>Handling / transport</th>
<th>Maturation</th>
<th>Old (decomposed)</th>
<th>Poor performer / cull</th>
<th>Predator attack</th>
<th>Mortality Total</th>
<th>Therapeutant, pest control product used (Y/N &amp; completed)</th>
<th>Weight or volume of active therapeutant(s) used (kg or L)</th>
<th>Anaesthetic used (Y/N) &amp; type if not TMS</th>
<th>Notes, particularly if a Nil report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- If a Nil report, Therapeutant used: Nil
- Anaesthetic used: Nil

**Fish type and category:**
- Atlantic: Production <500g
- Chinook: Production >500g
- Coho: Brood
- Sablefish: Other - explain
- Other: Other - explain

**Therapeutants:**
- Florfenicol
- Erythromycin
- Emamectin Benzoate
- H2O2
- Other

**Anaesthetics:**
- Oxytet
- Metomidate
- Clove oil
- Other - explain

**Weight or volume of active therapeutants used:**
- kg or L

**Anaesthetic used:**
- Yes or No
## APPENDIX VIII-D: URGENT NOTIFICATION (& FOLLOW-UP REPORTS) OF MORTALITY EVENTS OR DISEASES OF CONCERN

<table>
<thead>
<tr>
<th>Discovery date of event mm/dd/yyyy</th>
<th>Fish Health zone</th>
<th>Company name</th>
<th>Facility name</th>
<th>Fish type cultured</th>
<th>Fish production category</th>
<th>Suspected No. of fish dead or affected</th>
<th>Suspected proportion affected (%)</th>
<th>Suspected carcass biomass (kg)</th>
<th>Event type</th>
<th>Probable cause or diagnosis</th>
<th>Action taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/14/2014</td>
<td>3.3</td>
<td>Hemlock</td>
<td>Atlantic</td>
<td>Smolts</td>
<td>30,000</td>
<td>6,000</td>
<td>Cull event</td>
<td>Poor smolt</td>
<td>None required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Yew</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Alder</td>
<td>Sablefish</td>
<td>Production</td>
<td>As yet unknown</td>
<td></td>
<td></td>
<td>Non-inf. Mortality</td>
<td>Low D.O.</td>
<td>Ongoing monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chinook</td>
<td>Smolts</td>
<td>2,140</td>
<td>4%</td>
<td>200</td>
<td>Infectious outbreak</td>
<td>Bacterial</td>
<td>Carcass removal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coho</td>
<td>Brood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sablefish</td>
<td>Other-explain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other-explain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data in table for example only.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fish type**: Atlantic, Chinook, Coho, Sablefish, Other-explain  
**Fish category**: Production, Smolts, Brood, Other-explain  
**Event type**: Mortality Event, Disease of App.III, Infectious outbreak, Non-inf. Outbreak, Cull event, Toxic spill, 10-day follow report, Summary report, Other - explain  
**Probable cause**: Low D.O., Algae bloom, Poor smolt, Excess crowding, Transport, Bathing, Viral, Predation, As yet unknown, Other - explain  
**Action taken**: None required, Resolved, Ongoing correction, Ongoing monitoring, Harvest, Treatment, Carcass removal, Cull, Other - explain, Ensuring Sustainable Fisheries
APPENDIX IX  ESCAPE PREVENTION THROUGH MAINTENANCE OF CAGE AND NET INTEGRITY

A – General Equipment Design, Use and Maintenance

1. All equipment, materials and structures employed at a marine finfish aquaculture facility shall be designed, constructed, installed, inspected and maintained in a manner that prevents escapes, including escapes caused by damage, holes or tears to net cages or containment structures through entanglements with other equipment.

2. The facility operator shall monitor, evaluate and maintain containment structures, including cage support systems and net cages, in order to prevent escapes and to detect and respond to any escapes once detected or suspected.

B – Containment Structures and Cage Support Systems

3. The requirements for containment structures are as follows:
   a. Licence holders shall ensure that equipment used at the aquaculture facility is designed and constructed to meet generally accepted standards prevalent in the aquaculture industry;
   b. Licence holders shall evaluate new or experimental containment structure system designs through:
      i. field trials,
      ii. consultation with other aquaculture producers who have used the design,
      iii. comprehensive analysis of the manufacturer's performance trials, or
      iv. review by a professional engineer,
      to ensure compatibility with conditions at the proposed location of the marine finfish aquaculture facility and with containment requirements;
   c. Licence holders shall ensure that containment structures are installed by a person who knows the risks of finfish escapement from the containment structures and the measures needed to minimize these risks;
   d. Licence holders shall ensure that containment structures are repaired or replaced with materials that meet or exceed the accepted standards prevalent in the aquaculture industry and of the standards required to meet all Licence Conditions and in particular Section 3.

4. The requirements for cage support systems are as follows:
   a. all cage support system weights and other equipment shall be designed, constructed and installed with the aim of preventing entanglement and chafing with containment nets, predator nets and shark guard nets;
   b. all cage support system weights, anchoring equipment, and other equipment that has the potential to come into physical contact with the net cage shall be maintained to prevent catching or abrading nets;
   c. daily above-water visual inspections of active cage support systems including, anchoring-line buoy orientation and the general integrity of the anchoring system shall be conducted at all marine finfish aquaculture facilities;
d. any irregularity noted in paragraph (c) that increases the risk of escape shall be corrected or repaired immediately;
e. a record of the daily visual inspection and any repairs under this section shall be made and a copy of the record retained at the marine finfish aquaculture facility for one year.

5. The requirements for anchoring equipment are as follows:
   a. anchoring equipment design shall be compatible with the containment structure equipment and biophysical conditions of the location;
   b. anchoring equipment shall be repaired or replaced with materials that meet or exceed the standards prevalent in the aquaculture industry and of the standards required to meet all Licence Conditions and in particular Section 3.

C – Net Cages
I – Design, Installation and Maintenance

6. All net cages that do not have a permanently attached mesh top shall be attached by the water line rope of the net cage to the cage support system as a primary point of attachment. Any attachment of net cages to the cage support system railing shall be for support of the jump net only.

7. Jump nets extending at least one metre above the surface of the water shall be installed at the top of any net cage that does not have a permanently attached mesh top or similar barrier.

8. Sufficient weight or pressure shall be used to produce tension on net cage panels with the aim of maintaining a taut net.

9. Net cages shall be weighted at a sufficient number of points to ensure the tension or weight is distributed evenly.

10. Netting mesh size shall be small enough to contain the smallest fish to be placed in the net cage.

11. Net cages shall be stored in a manner that minimizes deterioration of the net material.

12. The licence holder shall ensure that all tears found while handling or inspecting net cages in use or intended for use at any time are repaired immediately.

II – Net Cage Mesh Strength

13. According to the dimension classification identified in Table 1, the mesh of any part of a net cage, including any repairs, shall meet the minimum breaking strength standards established in Tables 2 through 6.

14. Tests to determine the net cage mesh breaking strengths of a net cage's mesh as established in section 13 of this Appendix shall be conducted in accordance with the protocol set out in Section IV of this Appendix - Net Cage Mesh Strength Testing Procedure.

15. At the request of the Department, licence holders shall demonstrate that net cage mesh meets minimum breaking strengths established in section 13 of this Appendix, within a period of time determined by the Department.
16. Net cages with mesh that does not pass the breaking strength test requirements established in section 13 of this Appendix shall be repaired or retired as soon as possible.

III - Inspections and Record Keeping

17. The requirements for complete out-of-water servicing and inspection of net cages are as follows:
   a. servicing and inspections shall be carried out by a person who knows the risks of finfish escapement from the net cages and the measures needed to minimize these risks;
   b. a complete visual inspection of the entire net cage shall be completed for signs of abrasions, tears or holes;
   c. any damage to the net cage shall be repaired as needed;
   d. the net cage mesh shall be tested in accordance with the protocol in section 14 of this Appendix;
   e. a record of testing shall be completed in accordance with the protocol in section 14 of this Appendix;
   f. the record of testing shall be signed by the person who carried out the inspection.

18. The licence holder shall ensure that complete inspection and repair of active net cages and any similar structure that contains fish at their marine finfish aquaculture facilities takes place as follows:
   a. an underwater inspection, by divers or other comparable method\(^1\), shall be conducted on any net cages or any similar structure used to contain fish prior to the initial introduction of a new group of fish;
   b. active net cages and similar structures used to contain fish shall be inspected every 60 days by divers or another comparable method;
   c. despite paragraph (b), active net cages and any similar structure used to contain fish shall be inspected as soon as is practicable by divers or another comparable method after any operational activity or event that increases risk of net failure, including extreme environmental conditions, net cage changes, fish delivery, recurring predator attacks, vandalism to net cages or equipment or towing of active containment structures;
   d. despite paragraph (b), active net cages and any similar structure used to contain fish shall be inspected by divers or another comparable method as soon as is practicable after any event that occurs during routine harvesting, grading or any other routine activity which leads a holder or person acting on their behalf to suspect there is a material increase in the risk of net failure.

19. Each net cage shall be marked with an inventory control number that is permanently marked on a permanent tag attached at the top of the net cage within one metre of a corner down line or a main down line of a circular net cage.

\(^1\) In this section, “other comparable methods” means a method of inspection designated in writing by the manager to be equivalent to inspection by divers for purposes of this section
20. At the marine finfish aquaculture facility where the net cage is deployed, the licence holder shall ensure that a written maintenance record for each net cage is maintained, that includes:
   a. the inventory control number referred to in section 19 of this Appendix,
   b. the dimensions of each net cage,
   c. the mesh size,
   d. a record of the most recent complete out-of-water servicing and inspection under section 18 of this Appendix,
   e. the accumulated time-in-water since the most recent complete out-of-water servicing and inspection under section 18 of this Appendix,
   f. a description and the dates of each inspection under section 18 of this Appendix since most recent complete out-of-water servicing and inspection under section 17 of this Appendix, and
   g. a description and the dates of all repairs, including reasons for repairs, made to the net cage since the most recent complete out-of-water servicing and inspection under section 17 of this Appendix.

21. Records required to be kept under section 18 and 20 of this Appendix that were recorded prior to the last out-of-water servicing and inspection under section 17 of this Appendix shall be retained for six months after that out-of-water servicing and inspection.

22. The licence holder shall ensure that written records are maintained for each net cage that includes:
   a. the inventory control number in section 19 of this Appendix,
   b. the manufacturer's name,
   c. the year produced,
   d. the dates and records of all complete out-of-water servicings and inspections since October 31, 2000, under section 17 of this Appendix, and
   e. if applicable, the date of retirement.

23. Records for each net cage under section 22 of this Appendix shall be retained for 1 year following retirement of the net cage.

IV – Net Cage Mesh Strength Testing Procedure

24. This procedure specifies the method that shall be used for the purpose of determining the tensile (breaking) strength of mesh used for the containment of farmed fish.

25. This procedure is intended for use with nets commonly used in the British Columbia finfish aquaculture industry. These nets are generally made with knotless nylon mesh with published breaking strengths of between 50 and 400 lbs. This procedure may not be suitable for other types of nets.

26. Principle – a mesh is extended until it ruptures under the applied load. The test is performed using a suitable apparatus that records or indicates the load at the point of rupture. The testing machine is operated at a rate of elongation which is both constant and within prescribed limits.

27. APPARATUS
a. Testing Machine
   The machine used for testing shall meet the following criteria
   i. Machine shall include a digital load cell or dynamometer providing
direct measurement (in units of force) of the load applied to the mesh.
The load cell or dynamometer shall be accurate to within 2.5 lbs
(11 N), or 1.0% of the mesh breaking strength, whichever is greater.
   ii. The load cell or dynamometer shall have an accurate means of
recording the peak load applied prior to failure of the mesh.
   iii. Machine shall apply load to a single mesh at a constant rate of
elongation equal to 10 inches per minute (25 cm per minute), plus or
minus 10%.
   iv. For testing machines which apply force in discrete steps (such as by
way of a hydraulic cylinder with a hand pump), the rate of elongation,
per (iii) above, shall be the average rate of elongation. During each
step, the rate of elongation shall be as close as possible to the average
rate required, that is the steps must be consistently applied at a given
rate. The maximum mesh elongation for each step shall be 0.20 inches
(5 mm). Testing machines of this nature shall be designed such that the
user can readily apply the load at a rate that will meet these
requirements.
   v. The machine shall engage a single mesh for testing with steel pins or
hooks formed from round material with a diameter of 0.1875 inches (5
mm). The pins or hooks shall be so mounted as to remain in direct line
with the applied load in order to provide a true reading on the load cell
or dynamometer. The pins or hooks shall be smooth and free of any
sharp edges or roughness.

b. Calibration and Maintenance
   i. The dynamometer or load cell from each testing machine shall be
calibrated annually in accordance with the manufacturer’s
recommendations. Testing machines shall also be calibrated annually
to ensure that the specified elongation rate is maintained. The owner of
the machine shall keep calibration certificates on file, with a copy kept
with the machine.
   ii. The testing machine shall be properly maintained in order to continue
to provide accurate results and to meet the requirements above. This
will include replacement of the testing hooks as necessary due to wear,
corrosion or roughness.

28. TESTING REQUIREMENTS.
   a. A net cage shall be tested according to the testing protocol in Section 29 of
this document at the following locations:
      i. two locations separated by greater than 10 meters on the underwater
portion of the net; and
      ii. one location on the jump net.
   b. For each location tested on a net cage, the reported result shall be the average
of 5 breaks.
c. Test locations shall be representative of the mesh making up the whole net, and shall not be located in a previously repaired area. If a net has large areas of repair or is fabricated from different sources of mesh, the test procedure (Section 29) shall be performed on each different mesh type or age of mesh, and the reported result must be the average of 5 breaks.

d. Testing may be done on mesh remaining in the net or on a sample cut from a net. Cut samples shall be large enough to accommodate the required number of breaks within a single sample.

e. Testing done on mesh remaining in the net shall be performed by pulling the net slack around the area to be tested, such that no outside forces are acting upon the mesh being tested, and maintaining such slack for the duration of the test.

f. Testing may be performed on dry or wet mesh. Temperature shall be within normal ambient temperatures for the B.C. coast. Tests shall not be conducted on frozen mesh.

*NOTE:* - ‘Mesh size’ refers to the distance between the centers of two opposite joints (or knots) in the same mesh when fully stretched; this information should be obtained from the original tagging on the net cage.

29. TEST PROCEDURE

a. Testing shall be performed on a single mesh, oriented so that the pillars (bars) of the mesh are engaged over the pins or hooks, not the knots or joints of the mesh.

b. Mount the mesh over the pins or hooks, and take up the slack.

c. Apply load at a steady rate of elongation, as defined in 3.1, until the mesh breaks. Record the peak load indicated.

d. Repeat for a total of five breaks at the location being tested.

e. Average the five results to get the recorded breaking strength for that location

Example: 200 lbs, 210 lbs, 230 lbs, 195 lbs, 185 lbs  
Record breaking strength of \((200+210+230+195+185)/5 = 204 \text{ lbs}\)

f. Record breaking strength to the nearest pound force.

30. REPORTING

Test results shall be recorded on a form that also includes information about the net. Information recorded shall include:

a. Owner of net and net identification number.

b. Mesh manufacturer and manufacturer’s published mesh-breaking strength.

c. Net fabricator and date of net fabrication.

d. Accumulated in-water service time.

e. Size and gauge of mesh and dimensions of net cage.

f. Date and location of testing, company and name of person doing test.

g. Information on antifoulant treatment of net, if any.

h. Whether net was tested wet or dry.
i. Approximate ambient temperature at test.

j. Breaking strength test results for each prescribed location, and pass/fail grades per requirements of the section 13 of this appendix.

k. General comments and notes on overall condition of net.

l. Signature of tester.
<table>
<thead>
<tr>
<th>Perimeter</th>
<th>Up to 50 m (164 ft.)</th>
<th>&gt; 50 m to 60 m (197 ft.)</th>
<th>&gt; 60 m to 70 m (230 ft.)</th>
<th>&gt; 70 m to 80 m (262 ft.)</th>
<th>&gt; 80 m to 90 m (295 ft.)</th>
<th>&gt; 90 m to 110 m (361 ft.)</th>
<th>&gt; 110 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 5 m (16 ft.)</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>&gt;5 m to 10 m (33 ft.)</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>&gt;10 m to 15 m (49 ft.)</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>&gt;15 m to 20 m (66 ft.)</td>
<td>B</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>&gt;20 m to 30 m (98 ft.)</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>&gt;30 m</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
</tbody>
</table>

A to E establishes net cage dimension classification. Depth is from waterline rope to net cage bottom. Perimeter refers to the line bounding the top of the net cage.
## Table 2: Dimension Classification A

<table>
<thead>
<tr>
<th>Mesh Size</th>
<th>Minimum Required Mesh Breaking Strength (below surface of water)</th>
<th>Minimum Required Mesh Breaking Strength (jump netting, above surface of water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 22 mm (7/8&quot;)</td>
<td>20 kg (44 lbs)</td>
<td>18 kg (41 lbs)</td>
</tr>
<tr>
<td>&gt; 22 mm (7/8&quot;) to &lt; 38 mm (1-1/2&quot;)</td>
<td>26 kg (58 lbs)</td>
<td>24 kg (52 lbs)</td>
</tr>
<tr>
<td>38 mm (1-1/2&quot;)</td>
<td>31 kg (68 lbs)</td>
<td>28 kg (62 lbs)</td>
</tr>
<tr>
<td>&gt; 38 mm (1-1/2&quot;)</td>
<td>41 kg (90 lbs)</td>
<td>38 kg (83 lbs)</td>
</tr>
</tbody>
</table>

## Table 3: Dimension Classification B

<table>
<thead>
<tr>
<th>Mesh Size</th>
<th>Minimum Required Mesh Breaking Strength (below surface of water)</th>
<th>Minimum Required Mesh Breaking Strength (jump netting, above surface of water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 22 mm (7/8&quot;)</td>
<td>25 kg (56 lbs)</td>
<td>24 kg (52 lbs)</td>
</tr>
<tr>
<td>&gt; 22 mm (7/8&quot;) to &lt; 38 mm (1-1/2&quot;)</td>
<td>31 kg (68 lbs)</td>
<td>28 kg (62 lbs)</td>
</tr>
<tr>
<td>38 mm (1-1/2&quot;)</td>
<td>41 kg (90 lbs)</td>
<td>38 kg (83 lbs)</td>
</tr>
<tr>
<td>&gt; 38 mm (1-1/2&quot;)</td>
<td>46 kg (102 lbs)</td>
<td>43 kg (94 lbs)</td>
</tr>
</tbody>
</table>

## Table 4: Dimension Classification C

<table>
<thead>
<tr>
<th>Mesh Size</th>
<th>Minimum Required Mesh Breaking Strength (below surface of water)</th>
<th>Minimum Required Mesh Breaking Strength (jump netting, above surface of water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 38 mm (1-1/2&quot;)</td>
<td>36 kg (79 lbs)</td>
<td>33 kg (73 lbs)</td>
</tr>
<tr>
<td>38 mm (1-1/2&quot;)</td>
<td>46 kg (102 lbs)</td>
<td>43 kg (94 lbs)</td>
</tr>
<tr>
<td>&gt; 38 mm (1-1/2&quot;)</td>
<td>51 kg (113 lbs)</td>
<td>47 kg (104 lbs)</td>
</tr>
</tbody>
</table>
### Table 5: Dimension Classification D

<table>
<thead>
<tr>
<th>Mesh Size</th>
<th>Minimum Required Mesh Breaking Strength (below surface of water)</th>
<th>Minimum Required Mesh Breaking Strength (jump netting, above surface of water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 38 mm (1-1/2&quot;)</td>
<td>41 kg (90 lbs)</td>
<td>38 kg (83 lbs)</td>
</tr>
<tr>
<td>38 mm (1-1/2&quot;)</td>
<td>51 kg (113 lbs)</td>
<td>47 kg (104 lbs)</td>
</tr>
<tr>
<td>&gt; 38 mm (1-1/2&quot;)</td>
<td>62 kg (136 lbs)</td>
<td>57 kg (125 lbs)</td>
</tr>
</tbody>
</table>

### Table 6: Dimension Class E

<table>
<thead>
<tr>
<th>Mesh Size</th>
<th>Minimum Required Mesh Breaking Strength (below surface of water)</th>
<th>Minimum Required Mesh Breaking Strength (jump netting, above surface of water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 38 mm (1-1/2&quot;)</td>
<td>46 kg (102 lbs)</td>
<td>43 kg (94 lbs)</td>
</tr>
<tr>
<td>38 mm (1-1/2&quot;)</td>
<td>62 kg (136 lbs)</td>
<td>57 kg (125 lbs)</td>
</tr>
<tr>
<td>&gt; 38 mm (1-1/2&quot;)</td>
<td>77 kg (169 lbs)</td>
<td>71 kg (156 lbs)</td>
</tr>
</tbody>
</table>
# Example Net Cage Testing Reporting Form

## Net Cage Testing Record

<table>
<thead>
<tr>
<th>Date of Testing</th>
<th>Net ID</th>
<th>Job Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner of Net (Company)</td>
<td>Name of Company performing testing:</td>
<td></td>
</tr>
<tr>
<td>Name of Contact</td>
<td>Location of Testing</td>
<td>Name of Tester</td>
</tr>
<tr>
<td>Mesh Manufacturer</td>
<td>Dimensions: (ft) or (m)?</td>
<td>Deep</td>
</tr>
<tr>
<td>Net Fabricator</td>
<td>Mesh Size (mid knot to mid knot): (in) (mm)</td>
<td></td>
</tr>
<tr>
<td>Date of Net Fabrication</td>
<td>Accumulated in-water service time:</td>
<td></td>
</tr>
<tr>
<td>Mesh Manufacturer Breaking Strength (lbs):</td>
<td>Tested: Water or Dry?</td>
<td></td>
</tr>
<tr>
<td>Required Strength (lbs or kg?):</td>
<td>BELOW WATERLINE: JUMP:</td>
<td></td>
</tr>
</tbody>
</table>

### Breaking Strength (lbs or Kg?)

<table>
<thead>
<tr>
<th>Dipped?</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Test 5</th>
<th>Average</th>
<th>Pass/Fail</th>
<th>Initials of Tester</th>
</tr>
</thead>
<tbody>
<tr>
<td>BELOW WATERLINE 1</td>
<td>Yes ☐ No ☐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELOW WATERLINE 2</td>
<td>Yes ☐ No ☐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JUMPNET</td>
<td>Yes ☐ No ☐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Details of Complete Visual Inspection:

Repairs Completed:

Comments:

Signature of Tester:
# APPENDIX X ESCAPE NOTIFICATION FORM

**PLEASE REPORT ALL ESCAPES UPON DISCOVERY**

<table>
<thead>
<tr>
<th>Company Information</th>
<th>File Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company:</td>
<td>Facility Name:</td>
</tr>
<tr>
<td>Facility Name:</td>
<td>Facility Reference#:</td>
</tr>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>Contact name:</td>
<td>Phone #:</td>
</tr>
<tr>
<td>Email:</td>
<td>Report date:</td>
</tr>
</tbody>
</table>

## Report of Escape Incident

<table>
<thead>
<tr>
<th>Suspected escape (date/time):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Species of finfish:</td>
<td></td>
</tr>
<tr>
<td>Date Stocked:</td>
<td></td>
</tr>
<tr>
<td>Estimated number of escaped fish:</td>
<td></td>
</tr>
<tr>
<td>Average weight of escaped fish:</td>
<td></td>
</tr>
<tr>
<td>Name of facility where fish were produced:</td>
<td></td>
</tr>
</tbody>
</table>

List any therapeutants (still within the prescribed withdrawal period) administered to these finfish:

<table>
<thead>
<tr>
<th>Name of drug(s):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Period of administration, including dates of commencement and completion of drug treatment:</td>
<td></td>
</tr>
<tr>
<td>Name of prescribing veterinarian:</td>
<td></td>
</tr>
<tr>
<td>The prescribed withdrawal period:</td>
<td></td>
</tr>
<tr>
<td>Identification of the groups/pen #s of finfish treated:</td>
<td></td>
</tr>
</tbody>
</table>

## Description of Event

Describe in detail the cause or suspected cause of incident:

Describe in detail measures that will be implemented to prevent future incidents:

## Additional comments:

Submitted by:

<table>
<thead>
<tr>
<th>Signature</th>
<th>Please Print Name</th>
<th>Date:</th>
</tr>
</thead>
</table>

SUBMIT the completed form to Fisheries & Oceans Canada inbox: AQFF.FishEscapes@dfo-mpo.gc.ca
## Appendix XI  Incidental Catch and Wild Mortalities Log

Aquaculture Site Name: ____________________________  Date: ____________________________
Facility Reference #: ____________________________  Cultured Species: ____________________________
Site Contact Person: ____________________________  Telephone Number: ____________________________

Record type (please circle one)  Carcass Recovery  Transfer  Harvest  Net Observation  Escape  Recapture  Vessel Name: ____________________________

<table>
<thead>
<tr>
<th>Species Caught</th>
<th>Number of Pieces</th>
<th>Observed Herring Spawn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scientific Name</td>
<td>Released (Section 10.4) Mortalities (Section 8.6 and 10.4) Average weight per piece (g) (Section 10.4) Average Percent Cover in 1m² (%) (Section 10.4) Number of 1m² Covered (Section 10.4)</td>
</tr>
<tr>
<td></td>
<td>Common Name</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: ____________________________________________________________________________
APPENDIX XII - MARINE MAMMAL INTERACTION MANAGEMENT PLAN

<table>
<thead>
<tr>
<th>Company</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td></td>
</tr>
<tr>
<td>Facility Ref. #</td>
<td></td>
</tr>
<tr>
<td>Date of Submission</td>
<td></td>
</tr>
</tbody>
</table>

The Marine Mammal Interaction Management Plan is intended to describe policies, procedures, infrastructure, and other measures aimed at mitigating conflict with marine mammals at marine finfish aquaculture facilities including those resulting from entanglements and where lethal control methods are required. The following document is to be completed for each site and must include completed entries for each of the sections listed. Licence holders may submit a plan for multiple facilities provided mitigation measures are identical for all those facilities. The list of these facilities should be provided on the first page of the plan.

Outline:

1. Mitigation
   a. Infrastructure
      i. Anti-Predator Nets, type, height, depth, location, etc (Diagram)
         1. Mesh size, material
         2. Maintenance schedule
            a. Inspection
            b. Repair
      ii. Perimeter Fencing
         1. Type and distribution
         2. Maintenance Schedule
            a. Inspection
            b. Repair
   b. Non-Lethal Deterrents
      i. Approved Devices
         1. Procedures
         2. Staff Training
   c. Interaction Recording Standard Operating Procedures
      i. Templates/Forms
         1. Procedures
         2. Staff training
      ii. Photos/Video
         1. Procedures
         2. Staff Training
2. Lethal Control
   a. Company/Site Policy and Standard Operating Procedures
      i. Procedure
         1. Detailed Circumstances
      ii. Qualified Personnel
         1. Qualification Process
            a. Training/testing/Marine Mammal Identification
            b. Ongoing Training
      2. Credentials and Personal Identification Information
         a. Identification Procedures
         b. Credential Verification Procedures
         c. Contact Information

3. Site Specific Recommendations
   a. Company Policy
   b. Site Policy
APPENDIX XIII-A MARINE MAMMAL INCIDENT REPORT FORM

PLEASE REPORT ALL INCIDENTS WITHIN 24 HOURS OF DISCOVERY

<table>
<thead>
<tr>
<th>Company information</th>
<th>Dates</th>
<th>Fish data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company: ___________</td>
<td>Reported to DFO</td>
<td>Fish species on site: __________</td>
</tr>
<tr>
<td>Facility Ref. #: ______</td>
<td>Date/time: _<em><strong><strong><strong><strong>/</strong></strong></strong></strong></em></td>
<td>No. fish on site: __________</td>
</tr>
<tr>
<td>Site Name: ___________</td>
<td>Discovery</td>
<td>Avg. size of fish: __________ g</td>
</tr>
<tr>
<td>Contact name: ___________</td>
<td>Date/time: _<em><strong><strong><strong><strong>/</strong></strong></strong></strong></em></td>
<td></td>
</tr>
<tr>
<td>Address: ___________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone: ___________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email: ___________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fish data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. size of fish: __________ g</td>
</tr>
</tbody>
</table>

Incident Details
- Harbour seal
- California sea lion
- Other, please specify: __________

<table>
<thead>
<tr>
<th>Animal condition</th>
<th>Incident type</th>
<th>System Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh or Adv-mod decomposition</td>
<td>Drowning / Entanglement</td>
<td>Containment net, predator net, shark guard, other (please specify)</td>
</tr>
</tbody>
</table>

Mitigation Measures

Describe in detail the mitigation measures in place at this facility to prevent drowning and/or entanglement (these can include infrastructure and/or procedures).

Describe in detail the circumstances that led to the failure of these mitigation measures.

Describe in detail what corrective measures are being undertaken to prevent recurrence of this event. (Please include procedural and/or infrastructural modifications.)

Actions taken with Marine Mammal:
- Collected, stored until DFO advises further
- Photograph of tooth dentition pattern with date stamp
- Released

**DFO requests all dolphins & porpoises are collected and stored on ice until arrangements can be made for their collection & necropsy**

Comments: __________________________________________________________________________________________

SUBMIT the completed form to Fisheries & Oceans Canada inbox
AQFF.MarineMammals@dfo-mpo.gc.ca

Ensuring Sustainable Fisheries
# APPENDIX XIII-B  MARINE MAMMAL AUTHORIZED KILL REPORT FORM

**PLEASE REPORT ALL KILLS IMMEDIATELY**

<table>
<thead>
<tr>
<th>Company information</th>
<th>Dates</th>
<th>Fish data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company: _________</td>
<td>Reported to DFO</td>
<td>Fish on site _________</td>
</tr>
<tr>
<td>Facility Ref.#: __________</td>
<td>Date/time: <em><strong><strong><strong>/</strong></strong></strong></em>__</td>
<td>No. fish on site ________</td>
</tr>
<tr>
<td>Site Name: __________</td>
<td>Date/time of kill: <em><strong><strong><strong>/</strong></strong></strong></em>__</td>
<td>Avg. size of fish: _______g</td>
</tr>
<tr>
<td>Contact name: __________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone: _______________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email: _______________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Conflict History

- Harbour seal
- California sea lion

<table>
<thead>
<tr>
<th>Date</th>
<th>Action(s)</th>
<th>Conflict Behaviour (evidence of imminent danger)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Mitigation Measures

Describe in detail the mitigation measures in place at this facility. *(Include procedures and/or infrastructure)*

Describe in detail the circumstances that led to the failure of these mitigation measures.

Describe in detail what corrective measures are taking place to prevent recurrence of this event. *(Include procedures and/or infrastructure)*

Describe in detail what retrieval methods were employed to recover and sample the animal. *(If you fail to recover the animal, explain why)*

Submit the completed form to Fisheries & Oceans Canada inbox: AQFF.MarineMammals@dfo-mpo.gc.ca
APPENDIX XIV - BIOFOULING REMOVAL REPORT

Aquaculture Site Name: ________________________________
Facility Reference #: ________________________________
Site Contact Person: ________________________________
Cultured Species: ________________________________

<table>
<thead>
<tr>
<th>Date</th>
<th>Cleaning Equipment/Procedure</th>
<th>Nets/Infrastructure</th>
<th>Anti-foulant Type</th>
<th>Date of Application</th>
<th>Average Size of Mussels &gt;2cm</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Type</td>
<td>Number</td>
<td>Cumulative Area (m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Fisheries and Oceans Canada
Pêches et Océans Canada

AQUACULTURE MANAGEMENT
Ensuring Sustainable Fisheries
APPENDIX XV BENTHIC MONITORING PROGRAM PROTOCOLS FOR MARINE ENVIRONMENTAL MONITORING

ACRONYMS, ABBREVIATIONS, & DEFINITIONS

ANOVA: analysis of variance

*Beggiatoa*-like species: species of bacteria that form visible mats on the seabed surface in areas of organic enrichment which may be in the genus *Beggiatoa*, but may also include those found in different genera

**Benthic Monitoring**: sediment sampling and video surveys conducted during operation of a finfish aquaculture facility and as outlined by the Conditions of Licence. This includes operational monitoring as well as prescribed follow-up and pre-stock monitoring.

**CoL**: Condition of Licence

**Cu**: copper concentration (expressed in μg/g dry sediment)

**dGPS**: differential Global Positioning System

**DI**: de-ionized

**EDTA**: Ethylenediaminetetraacetic Acid Disodium Salt Dihydrate

**Eh**: redox potential (expressed in millivolts, mV)

**Epifauna**: animals that live on top of the substratum

**HA**: alternate hypothesis

**HO**: null hypothesis

**High slack tide**: is that point in time in any given location where the water depth has reached its maximum height (above chart datum) and any water movement has ceased, up until the current reverses direction. Official tide tables are to be used to determine the predicted time for maximum height of the nearest tidal station and then extrapolate for the specific aquaculture facility location.

**Infauna**: animals that live within the substratum.

**Li**: lithium concentration (expressed in μg/g dry sediment)

**M**: median

**μM**: micromolar; unit of measure used to express sulphide concentrations

**Macrofauna**: animals with body sizes on the scale of millimetres

**Megafauna**: animals with body sizes on the scale of centimetres

**n**: sample size

**NAD**: North American Datum

**OPC**: Opportunistic Polychaete Complexes

**Post Processed (PP)**: GPS positions are corrected for satellite and propagation errors after the observations are made.

**QA/QC**: Quality Assurance / Quality Control

**Real Time (RT)**: GPS positions are corrected for satellite and propagation errors as the observations are made. The reference receiver sends corrections and/or observations to the roving receiver.

**ROV**: Remotely Operated Vehicle

**S**: free sulfide concentration (expressed in micromolar; μM)

**SAOB**: Sulphide Anti-Oxidant Buffer

**SD**: Standard Deviation

**SGS**: Sediment Grain Size

**TVS**: Total Volatile Solids (expressed as a percentage)
\( x \): sample mean  
\( Zn \): zinc concentration (expressed in \( \mu g/g \) dry sediment)

1. **COMPLIANCE SAMPLING LOCATIONS**

1.1 Selecting compliance sampling stations or zones:

(a) Use a differential Global Positioning System (dGPS) to obtain readings from each corner of the containment structure array at high slack tide, and ensure this is consistent with the approved location of the array. Note that only corrected dGPS coordinates will be accepted, unless otherwise directed by the Department;

(b) Use electronic mapping procedures to establish the compliance sampling stations or zones as required for soft or hard ocean bottom substrate sites;

(c) Locate the compliance sampling stations or zones in areas where the greatest concentration of farm derived organic material is expected taking into consideration the following factors:
   (i) most recent peak biomass sampling and monitoring data;
   (ii) historic sampling and monitoring data;
   (iii) company internal in-cycle monitoring data;
   (iv) DFO audit data;
   (v) modeling data;
   (vi) observed localized current direction; and
   (vii) other direction by the Department;

(d) Locate the compliance sampling stations or zones along transects in the directions of the dominant and subdominant currents, unless otherwise directed by the Department. A minimum of two transects per containment structure array must be sampled;

(e) If the containment structure array is perpendicular to the dominant current direction and is greater than 200 metres in length, the following is required:
   (i) an additional two transects for every 200 metre increment;
   (ii) transects must be a minimum of 50 metres apart; and
   (iii) the location of the secondary transects shall be based on modeling or other assessment methods indicating the location of the 5 g C/m\(^2\)/day contour as follows:
      - if the 5 g C/m\(^2\)/day contour extends beyond 30 metres from the containment structure array on the shoreward end of the array, the transects shall be located such that they transit the contour at its furthest extent; and
      - if the 5 g C/m\(^2\)/day contour does not extend beyond 30 metres from the containment structure array on the shoreward end, the transects shall be located on the seaward end of the array;

(f) If adjacent containment structures or containment structure arrays are less than 60 metres apart they will be considered to be a single array when transects are located; and

(g) Compliance stations or zones are to be identified as follows:
   (i) transects located along the dominant current direction shall be labelled A and C; and
   (ii) transects located along the subdominant current direction shall be labelled B and D; or
   (iii) as otherwise directed by the Department.

1.2 Selecting Reference Stations

(a) Locate stations 0.5 – 2.0 kilometres from the nearest containment structure associated with the facility;
(b) Reference stations must be a minimum of 0.5 kilometres apart;
(c) Ensure mean depth is within 25% of the mean depth of all facility stations. This may require additional reference stations if there is significant variability in the depth associated with the facility stations;
(d) Ensure that characteristics such as topography, seabed type, current and tidal regimes, amount of freshwater run-off and other applicable characteristics are similar to those at facility stations;
(e) Ensure that the reference stations have similar effects if facility stations appear to have been influenced by anthropogenic activity (e.g. log dumps); and
(f) For soft ocean bottom substrate sites, ensure the silt/clay fraction of Sediment Grain Size (SGS) is within 15% of the facility station’s silt/clay fraction. This may require additional reference stations if there is significant variability in the silt/clay fractions associated with the facility stations.

Note: For baseline surveys, reference stations require both sediment analysis and at least 100 m of video data collection. For more information, see application guidance document.

2. BENTHIC MONITORING AND REPORTING REQUIREMENTS

2.1 Monitoring Frequency and Timing

(a) “Peak biomass” monitoring must be conducted:
   (i) within 30 days either side of peak biomass for farms that have a production cycle ending in the complete removal of all fish; or
   (ii) at the end of every 24 month period if the production cycle is longer than 24 months; or
   (iii) every 24 months for brood stock farms and/or with finfish continuously on site.
(b) Prior to fish entry, pre-stock monitoring must also be conducted:
   (i) if required for compliance with the Conditions of Licence; and
   (ii) as otherwise directed by the Department.

2.2 Monitoring Method

(a) Collect sediment samples following the procedures outlined in Section 4. Sediment Sampling except when:
   (i) Acceptable grab samples as described below in Section 4.4 (c, d, and e) cannot be obtained at the 0 or 30 m station(s). In this case, report the latitude/longitudes of the locations of the attempted grabs and submit a photo(s) of any sediment within the grab at the failed sampling location(s) to confirm the hard bottom nature of the station(s); or
   (ii) Acceptable grab samples as described below in Section 4.4 (c, d, and e cannot be obtained at the 125 m station(s). In this case, report the number and locations of the attempted grabs and conduct video surveys following the protocol outlined in Section 3. Video Surveys; or
   (iii) Any station is confirmed by the Department as having hard ocean bottom substrate. In this case, grabs do not need to be attempted at that station in the future.

2.3 Report Frequency and Timing

(a) Benthic monitoring reports shall be submitted:
within 30 days of sediment sampling for soft ocean substrate sites;
(ii) within 60 days of video surveys for hard ocean substrate and mixed ocean substrate sites.

(b) Biological monitoring reports shall be submitted:
(i) within 6 months of collecting samples submitted for taxonomic identification; and
(ii) within 14 days of receipt of the results from the taxonomist.

(c) All of the above reports shall also be submitted a minimum of 14 days prior to planned fish re-entry on site.

2.4 Report Content and Format

(a) Reports must be submitted in a format acceptable to the Department and include completed data templates where provided by the Department;
(b) Maps at a scale of 1:5000 must be submitted showing the number and location of containment structures and indicating which pens were stocked during the production cycle. Any harvest pens or transfer pens on-site should be included;
(c) Maps must show the start and endpoints of both sections of each video transect and their associated dGPS coordinates, all compliance sampling stations, the corners of the containment structure array, the associated anchor line locations, dominant current direction, and 10m depth contours;
(d) Peak biomass (in tonnes) must be reported;
(e) For hard ocean bottom substrate sites, high resolution DVDs are to be submitted with video data and the survey data associated with the classification database;
(f) For soft ocean bottom substrate sites, all raw data recorded during sampling and associated chemical analysis must be submitted in the sediment chemistry data template provided by the Department; and
(g) A written summary report, including any required statistical analysis, must also be submitted for all benthic monitoring.

3. VIDEO SURVEYS

The focus of these protocols is to describe the accepted method of performing continuous video surveys using a remotely operated vehicle (ROV). Standard deployment and positional methods as well as equipment specifications are detailed.

3.1 Monitoring Design

(a) Each transect must start at the edge of the containment structure and extend:
   (i) 140 metres from the containment structure array; or
   (ii) 24 metres or six time segments (see Section 3.7 (c)) beyond where Beggiatoa-like species or OPC was last observed to exceed 10% cover, whichever is the greatest distance.
(b) Each transect will consist of two sections described as follows:
   (i) 0 – 80 metres; and
   (ii) 80 metres – to transect termination point as described in (a) above.

3.2 ROV Minimum Requirements

(a) Horizontal and vertical thrusters. A lateral thruster is recommended;
(b) A minimum of biannual calibration of:
(i) ROV compass to the accuracy of ±3°. Surveys shall be recorded in accordance to the calibrated bearing.
(ii) depth gauge accurate to ±2 % full scale calibration using a minimum of three depths between 10 metres and 100 metres.
(c) Paired auxiliary lights:
   (i) positioned laterally and on the same plane as camera to provide uniform illumination of a minimum 0.5 metres in width for at least 75% of the field of view; and
   (ii) illumination intensity is to be balanced with the light sensitivity of camera; and
   (iii) light diffusers used to reduce backscatter and shadowing as necessary;
(d) Paired laser lights:
   (i) should be used to provide a horizontal scale and estimate of the field of view; and
   (ii) the distance between lights should be recorded as it can differ between units.

3.3 Camera and Recording Minimum Requirements

   (a) Resolution and illumination of the video quality must be such that biota 1-2 centimetres in size may be distinguished and identified within a 0.5 metre horizontal field of view;
   (b) Real time video display with time, depth and compass bearing;
   (c) Transect should be identified; and
   (d) Original video must be transferable to digital-format storage media (i.e. no post survey video compression).

3.4 Positioning Equipment Requirements

   (a) A GPS field unit that facilitates both real-time (RT) differential corrections and post-processed (PP) differential corrections;
   (b) GPS positioning software capable of PP differential corrections of the field unit data. If this is not available, report alternate positional methodology and identify whenever uncorrected positions are used; and
   (c) An acoustic positioning system for mapping the ROV transect is recommended. If an acoustic positioning system is not available, marker buoys may be used to navigate to transect section start points.

3.5 Conditions and Requirements

   (a) Operate ROV during slack tide and/or minimal current conditions to minimize drifting;
   (b) Video transects are to begin at edge of containment structure array;
   (c) Each transect is to be comprised of two sections: 0 – 80 metres and 80 – 140 metres (minimum);
   (d) If required for clarity, observed compliance factors such as Beggiatoa-like species, OPC, fish feed or feces should be magnified to facilitate identification;
   (e) Optimum ROV speed over seabed is 0.2m/sec. The acceptable range of speed is between 0.15 – 0.25m/sec; and
   (f) Maximum variance from planned transect is +/- 10% of planned transect length and +/- 20% of planned transect bearing.

3.6 Deployment
(a) Deploy weighted line with marker buoy adjacent to containment structure array at point where transect is to start;
(b) Deploy second weighted line with marker buoy on projected transect bearing 80 metres from first line using navigational aids such as GPS and navigational software and range finder to confirm distance;
(c) Fly ROV from moored vessel to ocean floor following weighted line adjacent to containment structure array;
(d) Use pre-determined compass bearing to fly ROV toward 80 metre weighted line. Estimate distance using time and deployed tether length. Bring ROV to surface and calculate variances for length and width; and
(e) Use predetermined compass bearing fly ROV along transect an additional 60 metres (140 metres from containment structure array). Bring ROV to surface and calculate variances for length and width.

Note: The length of the second section of transect will depend on compliance with OPC and Beggiatoa-like species standards.

3.7 Video Assessment

(a) Classification and video assessment must be based on Hard Seabed Aquaculture Video Monitoring Classification Tutorial DVD June 30, 2009 (Revised February, 2011);
(b) The following information must be included in raw data tables for both peak biomass and pre-stocking monitoring reports:
   (i) Abiotic parameters
      - Substrate using Wentworth scale indicating habitat type
      - Location and type of farm litter and debris
   (ii) Biotic parameters
      - Percent cover of compliance indicators: Beggiatoa-like species and OPC. All observed Beggiatoa-like species and aggregated polychaetes must be reported.
      - Percent cover of fish waste and feces
   (iii) Presence and relative abundance of sensitive, opportunistic and resource/conservation taxa;
(c) Classify the video imagery into 20 second time segments, assuming speed over ground to be 0.2 m/s unless otherwise specified. A segment length of 20 seconds equates to a linear distance of 4 metres; if ROV speed of 0.2 m/sec cannot be maintained, the time of each segment should be adjusted such that each segment represents 4 linear metres. A table of stoppages may be included to justify segment length if consistent speed cannot be maintained, or to include ROV ascents/descents. Divide each 20 second segment into 5 second intervals to improve accuracy of the segment classification. Ensure no “overlap” of 20 second video segment classification occurs;
(d) Calculate length of video transects using the time at start and end points, subtracting all camera stoppages of more than 3 seconds and report temporal length that encompasses the zone of compliance;
(e) Assess and record only the bottom 2/3 of the screen. The area considered to be “near field”;
    and
(f) Input data into the Hard Seabed Aquaculture Classification Database Version 2.2 June 30, 2009 (Revised February, 2011); use the report generating function in the database and the report templates to submit the data.
4. SEDIMENT SAMPLING

For the purposes of this protocol, sediment sampling is primarily used for compliance purposes. The regression approach is used such that data are collected at stations along transects extending outward from the facility along prevailing current directions. This section describes the protocols on how to choose a sample station, obtain and handle samples, use electrodes and generate physical and chemical data.

4.1 Monitoring Design

(a) The following compliance sampling stations must be sampled along each transect:
   (i) At the edge of the containment structure array (0 m station); and
   (ii) 30 metres from the edge of the containment structure array; and
   (iii) 125 metres from the edge of the containment structure array.

   i. For 30 m and 125 m compliance sampling stations not already predetermined by way
      points, use range finder to locate stations. (It is recommended that the vessel is tied
      off to the containment structure array to maintain position).

(b) Two reference stations must be sampled if required by licence conditions;

(c) A minimum of three replicate samples shall be taken at each required compliance sampling
    station;

(d) The samples reported shall be the first samples that meet quality standards (See Section 4.5);

(e) If the free sulphide concentration in any of the three samples exceeds the threshold for that
    station, an additional two samples shall be taken and analyzed for free sulphides and redox
    potential; and

(f) Best survey practices include sampling during slack tide and in low wind conditions to
    minimize drift and facilitate accurate sampling of predetermined compliance sampling station
    locations.

4.2 Equipment Requirements

(a) Acceptable soft sediment sampling devices for physical, chemical and biological variables
    include those where multiple samples can be taken from a single grab: including the Ponar,
    Smith-MacIntyre, Van Veen;

(b) Meters and electrodes to measure sulphide (‘S’) and redox (Pt). See Section 6 for
    standardization and calibration procedures; and

(c) An independently powered davit system is recommended.

4.3 Sampling Preparation and Information

(a) Prepare the ‘S’ stock solution (10⁻² M Na₂S) and SAOB (EDTA/NaOH) solutions in advance
    (See Section 6);

(b) Add L-Ascorbic acid to the SAOB solution just prior to calibration of silver/sulphide (Ag⁺/S⁻)
    electrode;

(c) If the Ag⁺/S⁻ electrode requires the filling solution to be topped up, ensure the solution is
    added at least 30 minutes prior to electrode use to ensure stability of electrode; and

(d) Calibrate Ag⁺/S⁻ electrode and standardize redox (Eh) electrode just prior to sampling, using
    protocols outlined in Section 6.
4.4 Sample Collection and Description

(a) Decrease descent speed when approaching the seafloor and retrieve the sampling device at sufficiently slow speeds to preserve the intact sediment surface structure in the sample;
(b) Record the following and include in the raw data table template submitted with monitoring reports:
   (i) latitude/longitude of sample locations using corrected dGPS;
   (ii) Magnetic and true-north bearings of transects (should be based on moving away from farm);
   (iii) ocean depth; and
   (iv) time that sample was successfully obtained;
(c) If the sample appears compromised by a previous grab (i.e., was collected in a divot formed by previous sampling), discard this sample and try again;
(d) Ensure excess sediment from grabs is disposed of in a manner such that it will not compromise subsequent grabs;
(e) Check for indicators of an acceptable grab sample:
   (i) overlying water present – indicating minimal leakage and associated disturbance;
   (ii) overlying water not excessively turbid - indicating minimal sediment disturbance;
   (iii) sediment surface relatively flat – indicating minimal sediment loss due to wash-out; and
   (iv) minimum penetration depth of 5 centimetres for surficial sediments is achieved;
(f) If sampling device is overfilled, remove some or all of the detachable weights and/or reduce deployment rate;
(g) Do not make more than 4 attempts to obtain a suitable sample grab at any sampling station location. If unsuccessful:
   (i) Move vessel over 1 – 3 metres and attempt to obtain sample. If unsuccessful after one attempt;
   (ii) Move vessel in opposite direction from original location and attempt to obtain sample; and
   (iii) When a sediment sample cannot be taken, refer to Section 2.2;
(h) If samples for macrofauna analysis are to be collected, siphon the overlying water from the sample and retain for sieving;
(i) Record the following information and include in the raw data table template submitted with the monitoring report:
   (i) depth of sediment in centimetres;
   (ii) sediment texture;
   (iii) sediment colour and presence of black sediment;
   (iv) odour on a scale of 0 – 4, with 4 being the strongest;
   (v) presence of gas bubbles;
   (vi) presence of *Beggiatoa*-like species;
   (vii) presence of Opportunistic Polychaete Complexes (OPC);
   (viii) presence of fish feed;
   (ix) presence of fish feces;
   (x) presence of flocculent organic material;
   (xi) macrophytes;
   (xii) megafauna;
   (xiii) terrigenous material; and
   (xiv) farm litter; and
(j) Take a colour photo of the sample and include it in the monitoring report.
4.5 Preparing Sediment Subsamples

Perform Eh and ‘S’ analyses within 5 minutes after sample collection by completing the following steps:
(a) Collect duplicate subsamples from the top 2 centimetres of sediment from the centre of each side of the grab using a plastic spatula, shallow spoon, or cut-off plastic syringes if sediment texture permits. A minimum volume of 25 mL is required for each Eh and ‘S’ analysis;
(b) Place both sub-samples in a suitable container and remove all unrepresentative material (e.g. large shell fragments, megafauna, wood waste, rock). Then homogenize the subsamples by gently mixing the sediment; and
(c) Remove the sediment needed for Eh and ‘S’ analyses. The remaining sediments are to be placed in whirl packs or tissue cups for lab analysis. TVS and percent moisture (water content) analysis can be done on the same sample. SGS and metals require separate subsamples for analysis. All storage containers must be kept cool and be air-tight to prevent desiccation and exposure to excess air.

4.6 Measurement of ‘S’

(a) In order to measure ‘S’ a 1:1 volume ratio of SAOB to sediment is required;
(b) Place 10 mL of SAOB in a small plastic or glass graduated container and then add sediment from section 4.6 (c) until the meniscus is at the 20 mL gradation. (Always add SAOB first);
(c) Briefly stir the mixture and then insert the Ag⁺/S²⁻ electrode into the sample. Ensure the tip of the electrode is fully covered by the SAOB/sediment slurry;
(d) Gently move the electrode in the slurry until electrode stabilizes. Depending on electrode a “Ready” message appears on the meter screen and/or a beep is heard (typically 1 – 4 minutes). Note: Solid phase metal-‘S’ complexes may be solubilised under alkaline conditions and prolonged exposure of sediment to SAOB before the electrode potential is recorded should be avoided;
(e) Gently wipe the electrode and remove all sediment prior to insertion into the next sample;
(f) Any oily residue on the electrode must be removed prior to further use; and
(g) If potentials recorded with the Ag⁺/S²⁻ electrode in a sediment sample do not stabilize in 1 – 2 minutes, performance can be assessed without a full recalibration. The ‘S’ concentration can be measured in one of the dilute ‘S’ standards if it has been stored in a dark cooled container with a minimum head space. Do not attempt to correct the data for drift if deviations are less than 10 – 20% of expected standard values. If measured values have a greater deviation than the expected value a full recalibration should be performed following protocols in Section 6.

4.7 Measurement of Eh

(a) After the subsample for ‘S’ is removed for the analysis in Section 4.6, place the redox electrode in the remaining subsample, ensuring that Pt tip is in contact with the sediments. The electrode should be held in one position without movement. Drift will occur as a rest potential is achieved. This occurs when a relatively stable value (drift <10 mV/min) is achieved (usually within 3 minutes);
(b) Record the Eh value and temperature at the same time;
(c) Correct Eh value using temperature correction factors supplied by manufacturer. Some electrodes may not require correction or the associated meter has a setting to account for correction internally. (Check with manufacturer);
(d) Gently wipe the electrode and remove all sediment prior to insertion into the next sample; and
(e) Any oily residue on the electrode must be removed prior to further use.

**Note:** Measured Eh potentials are converted to be relative to the normal hydrogen electrode (NHE) by addition of a potential characteristic for the filling solution used and the sample temperature. For example, the correction factor applied to a potential measured at 20°C with a 4M KCl in saturated Ag/AgCl reference solution is +204 mV. This value is added to the measured Eh potential (irrespective of whether the potential is positive or negative) to calculate the Eh\textsubscript{NHE} potential. Correction factors for different filling solutions are usually provided by a manufacturer in the electrode instruction manual.

### 4.8 Biological Sampling

(a) All sediment should be scraped and rinsed from the grab into pre-cleaned containers when collecting samples for analysis of benthic macrofauna. Save the rinse water as part of the infaunal sample.

**Note:** Rinse water must be filtered through a minimum 250 µm screen to remove ambient fauna prior to use;

(b) When sieving biological samples in the field:
   (i) sieve each sediment sample, associated overlying water and rinse water through a 1.0 mm screen. Care must be taken when sieving that fauna is not damaged by abrasion or water pressure. Depending on the volume of the sample, sieving it in batches should be considered;
   (ii) count, identify, photograph and record megafauna then return to the ocean causing it the least amount of harm;
   (iii) retain all coarse gravel and cobble less than 2.5 centimetres in diameter. Remove attached epifauna and include with infauna separated in the sieved sample;
   (iv) fix the faunal sample in 10% buffered formalin; and
   (v) after four days, rinse the preserved fauna samples on a 0.5 millimetre screen to remove formalin and then preserve in 70% isopropyl alcohol or ethyl alcohol.

**Note:** Formalin/rinse water mixture must be contained and appropriately treated prior to disposal; and

(c) All biological samples shall be:  
   (i) counted and taxonomically identified to at least the level of family with all major taxa identified to species; and
   (ii) properly maintained, stored and archived for at least five years after processing.

### 5. QUALITY ASSURANCE/QUALITY CONTROL OF SEDIMENT SAMPLES

Quality assurance and quality control are essential components of a sampling and monitoring program. Quality assurance can be described as “all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality”.

10
Quality control can be described as “the operational techniques and activities that are used to fulfill requirements for quality” or “a well documented plan that ensures results are within a consistent level of error.”

There is both a field and lab component to QA/QC. Commercial labs are required to obtain certification from the Canadian Association for Environmental Analytical Laboratories (CAEAL) which requires them to participate in a proficiency testing interlaboratory program. Not all parameters associated with marine sediment analysis are part of this program, and for those, labs must follow a standard quality assurance plan that includes the use of blanks, duplicate samples and reference standards.

5.1 Physical and Chemical QA/QC

(a) Redox Potential
   (i) ensure the Pt electrode is prepared with filling solution and standardize using recommended redox standards (Section 6);
   (ii) obtain a triplicate measurement of Eh once every 20 samples, or once per batch if fewer than 20 samples are taken; and
   (iii) if potentials do not stabilize (drift >10 mV/min) select a standard wait time (3 minutes recommended) and record values after this period. Note the lack of stabilization and the standard time at which readings were taken.

(b) Total Free Sulphides (‘S’) in SAOB
   (i) ensure filling solution is added to the Ag+/S²⁻ electrode several hours prior to calibration;
   (ii) calibrate electrode using standards and protocols outlined in Section 6; and
   (iii) obtain an additional ‘S’ measurement from a sample once every 20 samples or once per batch if fewer than 20 samples are analyzed;

(c) Laboratory Analyses
   (i) obtain one additional sediment sub-sample after every batch of 20 samples or once per batch if fewer than 20 samples are taken, for duplicate analyses of TVS, SGS, metals, % moisture (water content) and other applicable parameters;
   (ii) ensure sub-sample is representative of the composite sample, properly homogenized, and large enough all intended analysis; and
   (iii) upon receiving lab data confirm that:
       - 35% Relative Standard Difference for SGS has not been exceeded;
       - 20% Relative Standard Difference for TVS has not been exceeded; and
       - 40% Relative Standard Difference for metals has not been exceeded.

5.2 Biological QA/QC

There are two options for QA/QC on biological samples:

(a) Submit QA samples to an expert contract taxonomist. The taxonomist’s lab must have its own QA/QC program;
(b) Have certified facility *staff complete the sampling for macrofauna on site by completing the following steps:
   (i) for every 10 grabs, one additional grab should be collected, split into two equal parts, screened and fauna from both parts preserved. Macrofauna should be enumerated and identified from one half of the sample by facility staff while the other half is submitted to a recognized contract laboratory for similar analysis; and
(ii) the results obtained by facility staff and the recognized taxonomy lab should be comparable at a similarity level of at least 70%. Results from the contract lab must be reported directly to the Department.

**Note:** *Staff must be certified by an educational institute recognized for expertise in taxonomic identification of macrofauna to the family level.*

### 6. CALIBRATING THE SULPHIDE (Ag⁺/S⁻) ELECTRODE

Ag⁺/S⁻ electrodes are used to measure free sulphide ions (S⁻ or ‘S’) in sediment samples treated with an antioxidant buffer solution (SAOB). Exposure of sediments to alkaline conditions created by the buffer (pH 12 and greater) may solubilise some fraction of solid phase ‘S’ (pyrite and other metal complexes) in a sample. ‘S’ is therefore operationally defined as total free ‘S’ ions measured in sediment samples buffered with SAOB. Ag⁺/S⁻ electrodes must be calibrated before the start of each sampling event, and recalibrated a minimum of every 3 hours during an analytical session.

The following protocols are generic to the Ag⁺/S⁻ electrode. Specific models may have slightly different specific requirements and the operator must be familiar with the model prior to calibrating the electrode. If routinely used Ag⁺/S⁻ combination electrodes should be replaced every couple of years as they tend to become less accurate due to wear and tear.

### 6.1 Materials and Equipment

(a) Ag⁺/S⁻ combination electrodes should be used with an appropriate multimeter for measuring electrode potentials. Any millivolt meter with connectors suitable for the electrode can be used; and

(b) The choice of filling solution affects electrode potentials (e.g. if an Orion 96-16BNWP Sure-flow combination electrode is used, Optimum Results A Orion 900061 filling solution is the appropriate reference filling solution). The level of the electrode filling solution should always be maintained just below the filler hole in the barrel.

### 6.2 Summary Table of Required Solutions

<table>
<thead>
<tr>
<th>Solutions</th>
<th>Expiration Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphide Anti-oxidant Buffer (SAOB)</td>
<td>3 hours</td>
</tr>
<tr>
<td>Sulphide Anti-oxidant Buffer excluding L-ascorbic acid</td>
<td>7 days</td>
</tr>
<tr>
<td>Stock S⁻ solution, 10,000 μM (10⁻² M Na₂S)*</td>
<td>48 hours (cool, dark and air excluded)</td>
</tr>
<tr>
<td>Standard S⁻ solution, 1,000 μM (10⁻³ M Na₂S)*</td>
<td>3 hours</td>
</tr>
<tr>
<td>Standard S⁻ solution, 100 μM (10⁻⁴ M Na₂S)*</td>
<td>3 hours</td>
</tr>
</tbody>
</table>

**Note:** The three standards (*) in the table are recommended for the 3-point calibration. If samples are expected or found to have ‘S’ concentrations below 100 μM then a 10 μM standard should be prepared to create a 3-point calibration series consisting of 10 μM, 100 μM and 1,000 μM. ‘S’ solutions below 100 μM are unstable and these values are also at the minimum sensitivity of most commercially available Ag⁺/S⁻ combination electrodes.

### 6.3 Solution Preparation
(a) Sulphide Anti-Oxidant Buffer (SAOB)
   (i) Materials
      - 20.0 g NaOH (sodium hydroxide crystals);
      - 17.9 g EDTA (ethylenediaminetetraacetic acid disodium salt dehydrate);
      - 8.75 g L-ascorbic acid; and
      - de-aerated de-ionized (DI) water
   (ii) Procedure
      - dissolve the NaOH crystals in 250 ml of de-aerated DI water (use a volumetric-type flask);
      - add EDTA to NaOH solution and swirl until dissolved;
      - place solution in plastic screw top jar. Larger volumes can be prepared as necessary provided ratio of reagents is maintained;
      - add L-ascorbic acid just prior to the calibration process or analyses of samples. Store in the dark at 4°C; and
      - de-aerated DI water must be at similar temperature as that of the sediment to be sampled.

(b) Stock S\(^{=}\) solution 10,000 μM
   (i) Materials
      - 0.2402 g Na\(_2\)S·9H\(_2\)O (10,000 μM) (pre-weighed and stored in ampoules under nitrogen, argon or helium); and
      - de-aerated DI water
   (ii) Procedure
      - working in a fume-hood or well ventilated area, add the 0.2402 g Na\(_2\)S·9H\(_2\)O to a volumetric flask containing 100 mL of de-aerated DI water. Swirl until dissolved. Store refrigerated in dark, air-tight bottle with minimum head space;
      - prepare a serial dilution (10,000 μM, 1,000 μM, 100 μM and 10 μM (if required)) of ‘S’ standards immediately before calibrating the Ag\(^+\)/S\(^{=}\) combination electrode by transferring 10 mL of the 10,000 μM Na\(_2\)S stock solution into a volumetric flask and diluting with 90 mL of the de-aerated DI water. This procedure is repeated sequentially using 10 mL of each successive standard and diluting with 90 mL of de-aerated DI water; and
      - de-aerated DI water must be at similar temperature as that of the sediment to be sampled.

6.4 Calibration Procedures

(a) Frequency and Handling
   (i) the Ag\(^+\)/S\(^{=}\) combination electrode must be recalibrated a minimum of once every 3 hours and each time sampling is initiated at a new farm;
   (ii) the tip of the electrode should be gently cleaned using an abrasive strip or detergent solution before each calibration. If difficulty is experienced in obtaining the expected slope for the relationship between mV potential and log ‘S’ concentrations (see subsection (b) below) cleaning may be necessary to remove coatings formed on the electrode tip; and
   (iii) the level of the filling solution should also be checked and either topped up or replaced with fresh electrolyte (if the latter option is chosen wait at least 30 minutes for electrode to stabilize prior to using it);

(b) Electrode Calibration
(i) calibration of the Ag⁺/S⁻ combination electrode is to be carried out by working from the lowest to highest concentration in a standard 3-point series. A fixed volume of a standard is diluted with an equal volume of SAOB (1:1 by volume) immediately before each potential is measured;
(ii) the range of standards used for the 3-point calibration should bracket the range of ‘S’ concentration expected in the sediment samples;
(iii) mV potentials are stored by the multimeter after they become stable (usually between 1 – 3 minutes depending on the make of the meter);
(iv) upon completing the measurement of the third standard instruct the meter to calculate the slope of the concentrations. The theoretical slope is -28 mV for each 10-fold increase in the ‘S’ concentration but because of temperature sensitivities and differences in electrodes the accepted range of values for the slope is between -27 to -33. If the slope is outside this range repeat the calibration using fresh standards (also check cleanliness of probe, filling solution level, battery function, etc. prior to recalibrating);
(v) following calibration, rinse the electrode with DI water and blot dry before measuring the first sample; and
(vi) upon completion of sediment measurements rinse the electrode and drain filling solution (unless electrode will be used within week).

7. STANDARDIZING THE REDOX (Pt) ELECTRODE

The Pt electrode is used to measure Eh_{NHE} potentials to indicate oxidation/reduction potentials in sediment samples. The measurements do not specify what thermodynamic reactions are involved in forming the potentials measured.

The following protocols are generic to the redox (Pt) electrode. Specific models may have slightly different specific requirements and the operator must be familiar with the model prior to standardizing the electrode.

7.1 Materials and Equipment

(a) Any commercially available ion specific electrode (ISE) meter or mV meter with connectors suitable for a combination Pt electrode can be used for Eh_{NHE} (redox) measurements;
(b) Redox combination (internal reference) electrodes are refillable or gel-filled and have a BNC connector to allow connection to a mV meter with a similar connector. The refillable option is recommended. It is also recommended that the electrode have a thin disc of Pt (surface area ~1 cm²) rather than a pin at the end of the electrode;
(c) If using a refillable electrode it must be filled with a reference solution. A solution with 4 M KCl saturated with Ag/AgCl is recommended for marine samples;
(d) At least one redox reference solution is required for Pt electrode standardization. These can be purchased from the manufacturer of the electrode; and
(e) Abrasive cleaning strips can be used for cleaning (polishing) the Pt tip of the electrode if coatings are formed during use. A fine powdered detergent can also be used.

7.2 Procedures

(a) The Pt electrode must be rechecked against the standard a minimum of once every three hours and each time sampling is initiated at a new farm;
(b) If using a refillable Pt electrode add filling solution (4 M KCl with saturated Ag/AgCl) at least 24 hours before use;
(c) The reference chamber of the electrode must be completely filled. Check that filling solution is present around the reference junction;
(d) Calibrate the electrode by placing it in a standard solution with a temperature close to that expected in the sediment samples. Record the actual temperature immediately prior to measurements. The mV readings should stabilize rapidly (<30 sec) due to strong oxidation-reduction coupled reactions in a standard solution. Record the potential for comparison with the expected standard value of +220 mV (the potential for a triiodide/iodide redox couple standard at 20°C). The measured value should not exceed ± 5 mV. If so, recalibrate electrode following instructions in applicable manual; and
(e) Upon completion of sediment measurements rinse the refillable electrode and drain filling solution (unless electrode will be used within week).

8. PERFORMING STATISTICAL ANALYSES

For soft sediment sites, statistical analyses are performed for compliance purposes to determine if there are significant differences ($p < 0.05$) between observed mean sediment total free sulphide ('$S$') and designated compliance standards. Nonparametric tests may be used to assess between-station differences in median values of ‘$S$’ at facility stations and reference stations.

8.1 Statistical Methods to Determine if Requirements Have Been Met

The following study designs and statistical tests are to be used to determine whether facilities are meeting chemical and biological requirements.

**Note:** Different statistical software may produce slightly different results. The following are examples only, and were produced using the open-source statistical computing environment, R (http://www.r-project.org).

**Example Dataset**

*Table 1. Mean free sulphide concentrations (μM) at facility and reference stations.*

<table>
<thead>
<tr>
<th>Station</th>
<th>Rep 1</th>
<th>Rep 2</th>
<th>Rep 3</th>
<th>Rep 4</th>
<th>Rep 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 m</td>
<td>1200</td>
<td>1500</td>
<td>3000</td>
<td>1900</td>
<td>800</td>
</tr>
<tr>
<td>125 m</td>
<td>900</td>
<td>700</td>
<td>1000</td>
<td>600</td>
<td>800</td>
</tr>
<tr>
<td>Ref 1</td>
<td>100</td>
<td>150</td>
<td>175</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ref 2</td>
<td>200</td>
<td>300</td>
<td>250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 m post-fallow</td>
<td>800</td>
<td>650</td>
<td>1100</td>
<td>540</td>
<td>200</td>
</tr>
</tbody>
</table>

(a) Descriptive Statistics *(required)*

These descriptive statistics provide a summary of the data from each station.
(i) Calculate summary statistics including sample number, mean, median and standard deviation for all stations.

*Table 2. Summary Statistics.*
### Table

<table>
<thead>
<tr>
<th>Station</th>
<th>number</th>
<th>mean</th>
<th>median</th>
<th>standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 m</td>
<td>5</td>
<td>1680</td>
<td>1500</td>
<td>841</td>
</tr>
<tr>
<td>125 m</td>
<td>5</td>
<td>800</td>
<td>800</td>
<td>158</td>
</tr>
<tr>
<td>Ref 1</td>
<td>3</td>
<td>142</td>
<td>150</td>
<td>38</td>
</tr>
<tr>
<td>Ref 2</td>
<td>3</td>
<td>250</td>
<td>250</td>
<td>50</td>
</tr>
</tbody>
</table>

(ii) Draw a box-and-whisker plot showing all stations. The box-and-whisker plots show the median value (centre of the box), the 25\textsuperscript{th} and 75\textsuperscript{th} percentiles (edges of the box), the minimum and maximum values (end of whiskers) and outliers (dots).

![Box-and-whisker plot](image)

**Figure 1. Box-and-whisker plot**

Statistical Test to Determine Compliance (required)
The one-sample t-test is a parametric test to compare measurements from a single station to a single value threshold. It is recognized that with only three to five data points per station, there is not enough information to determine whether all assumptions of the t-test have been met. However, a non-parametric equivalent to this test does not exist. As such, the t-test will be used as the primary method for assessing compliance. The null hypothesis is rejected if the p-value is less than the accepted significance level ($\alpha = 0.05$).

(i) Perform a one-sample one-tailed t-test to determine if the mean total free sulphide at the 30 m compliance sampling station is statistically greater than 1300 $\mu$M or 4500 $\mu$M.

Example:
$H_0 = \text{the true mean is equal to 1300 } \mu\text{M}$
\( HA = \text{the true mean is greater than 1300 \(\mu\)M} \)

Results:
\( t = 1.011, \ df = 4, \ p\text{-value} = 0.185 \)

There is no evidence that the mean free sulphide concentration at the 30 m station is significantly greater than the standard of 1300 \(\mu\)M \((p > 0.05)\).

(ii) Perform a one-sample one-tailed t-test to determine if the mean total free sulphide at the 125 m compliance sampling station is statistically greater than 700 \(\mu\)M.

Example:
\( H_0 = \text{the true mean is equal to 700 \(\mu\)M} \)
\( HA = \text{the true mean is greater than 700 \(\mu\)M} \)

Results:
\( t = 1.414, \ df = 4, \ p\text{-value} = 0.115 \)

There is no evidence that the mean free sulphide concentration at the 125 m station is significantly greater than the standard of 700 \(\mu\)M \((p > 0.05)\).
# Annual Aquaculture Statistical Report

Once completed, this document is confidential within the provisions of the Access to Information and Privacy Act.

For Internal Use Only

<table>
<thead>
<tr>
<th>Reporting Year</th>
<th>Facility Reference Number</th>
<th>Licence Holder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Landfile #</th>
<th>Tenure Size (ha)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species1:</th>
<th>Species2:</th>
<th>Species3:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species4:</th>
<th>Species5:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Introduction

In British Columbia, Fisheries and Oceans Canada is the lead authority responsible for regulating the aquaculture industry. Production statistics collected through this form may be used for analytical and operational purposes and will be shared with other government partners for statistical use. These organizations agree to take appropriate steps to protect all sensitive personal and commercial information, and to release data only in aggregated form.

In compliance with licenses issued under the Pacific Aquaculture Regulations, all aquaculture licence holders are required to complete the Annual Aquaculture Statistical Report (AASR) under Section 61 of the Federal Fisheries Act. The completed forms for each calendar year are due no later than January 25 of the following year.

## Instructions for Completing the AASR

- This form is for use by shellfish, marine finfish and freshwater/land-based aquaculture licence holders.
- Complete all sections of this form, unless otherwise indicated.
- This form must be completed and submitted via email to fishstats@dfo-mpo.gc.ca or mailed to the address provided. To request an electronic spreadsheet version of this form, email fishstats@dfo-mpo.gc.ca.
- Provide weights and measures using metric (e.g., kg, cm) unless other units are indicated.

## Section 1 - Harvest for Food Market Sales

<table>
<thead>
<tr>
<th>Species</th>
<th>Weight (kg)</th>
<th>Quantity (For Shellfish Only)</th>
<th>Quantity Unit of Measure (For Shellfish use Lbs, Dozens or Gallons)</th>
<th>Value ($)</th>
<th>Product Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Round, Live, Fresh Dressed Head On, Fresh Dressed Head Off, Frozen Dressed Head Off, Fresh Fillets, Frozen Fillets, or Other (specify)</td>
</tr>
</tbody>
</table>

Were any fish or shellfish sold for Food Market Sales?  
Yes ☐ No ☐

## Section 2 - "U-Catch-Em" Sales

Note: Section 2 only applies to Freshwater/Land Based facilities.

<table>
<thead>
<tr>
<th>Species</th>
<th>Average Length</th>
<th>Total Number</th>
<th>Total Weight (kg)</th>
<th>Total Value $</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Were there any U-Catch-Em Sales?  
Yes ☐ No ☐

## Section 3 - Processing Information

Were any fish or shellfish processed?  
Yes ☐ No ☐

- Who processed your fish or shellfish?  
- Did you own the fish or shellfish after processing and sell to market (i.e. have your fish self- or custom-processed)?
- No ☐ Yes, all of it ☐ Yes, a portion of it ☐ Provide details (e.g., species, quantity, value):  

![](aquaculture_management.png)
Section 4 - Sales for Restocking or Ongrowing Purposes
Were any fish or shellfish sold for restocking or ongrowing?  
Yes ☐ No ☐

Note: Include Sales only, not purchases or acquisitions

<table>
<thead>
<tr>
<th>Species</th>
<th>Life Stage (Eggs, Fry/Fingerlings, Juveniles/Smolts, Adults or Seed, Larvae)</th>
<th>Cultch Type (Shellfish Only)</th>
<th>Number Sold in BC (not exported)</th>
<th>Number exported</th>
<th>Total Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section 5 – In-Zone Introductions & Transfers Information
Note: Section 5 does not apply to any species on a marine finfish licence, geoduck, sea cucumber, sea urchin, white sturgeon, Nile tilapia, barramundi and signal crayfish. Transfers of these species are represented via other reporting mechanisms.

Was any stock brought on site during the reporting year?  
Yes ☐ No ☐

If Yes, fill in the information below only for in-zone transfers that did not require a separate Introductions & Transfers Licence.

Please provide one line per species (i.e. all transfer data for each species should be aggregated and reported on a single line)

<table>
<thead>
<tr>
<th>Species Brought on Site</th>
<th>Source (provide aquaculture facility reference number or commercial licence number)</th>
<th>Total Number of Fish Transferred</th>
<th>Total Number of Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section 6 - Stock on Hand and Future Plans
Note: Section 6 only applies to Freshwater/Land Based and Shellfish facilities.

- Will this site be actively culturing during the next reporting year?  
  Yes ☐ No ☐

- If this site had any stock on hand as of December 31, please list all species:
  
<table>
<thead>
<tr>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Annual Aquaculture Statistical Report (cont’d)

Section 7 - Subtidal Shellfish (on/in bottom) Seeding Activities
Note: Section 7 only applies to facilities licensed for subtidal culture

7a. If you purchased geoduck (Panopea generosa) and/or horseclam (Tresus) seed this year, please attach your proof of purchase. If submitting electronically, please ensure that an electronic copy of your proof of purchase is attached.

7b. Did you conduct subtidal shellfish seeding activities for any species this year? Yes □ No □

If Yes, list:

<table>
<thead>
<tr>
<th>Species</th>
<th>Total Area Seeded (m²)</th>
<th>Month Seeding Activities Commenced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section 8 - Declaration

DECLARATION: I have read all information contained on this report and it is true to the best of my knowledge and belief.

<table>
<thead>
<tr>
<th>Name (please print)</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Position in Company</th>
<th>Email address</th>
<th>Phone #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>