

**CODE OF CONTAINMENT FOR
CULTURE OF ATLANTIC SALMON IN MARINE NET PENS
IN NEW BRUNSWICK**

Prepared By

**New Brunswick Salmon Growers' Association
107 Mt. Pleasant Road
P.O. Box 1054
St. George NB
E5C 3K5**

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1.0 BACKGROUND

The New Brunswick Salmon Grower's Association (NBSGA) has worked in collaboration with the New Brunswick Department of Agriculture and Aquaculture (NB DAA) and Department of Fisheries and Oceans (DFO) to develop Codes of Containment for marine finfish farms in New Brunswick. This Code of Containment has been prepared specifically for Atlantic salmon farming in New Brunswick.

Proper containment of valuable crops of fish makes good sense and is an underlying tenet of good fish farm husbandry and management. As such, it is recognized by both industry and regulators that a code is required that addresses issues associated with ensuring fish are contained within net pen structures, as well as to establish contingencies to be followed in the event of escape.

In developing this Code, examples prepared for other jurisdictions including Scotland, British Columbia, State of Maine USA, and Newfoundland and Labrador were reviewed to ensure that best practices from elsewhere were considered in developing New Brunswick's Code. The Code of Containment for New Brunswick is consistent with provincial and federal legislation; it meets international commitments made by the Province of New Brunswick and the Government of Canada, especially in terms of the North Atlantic Salmon Conservation Organization's (NASCO) resolution regarding the need to minimize farmed salmon escapes and to establish design standards for finfish cage systems. Further, it is intended that New Brunswick's Code be consistent, in so far as possible, with those of other jurisdictions. This Code of Containment will also assist NBSGA members and industry, in general, in their ability to meet international commitments to environmental stewardship and provide information to regulators in a concise, timely and meaningful fashion.

2.0 PRINCIPLES

The Code of Containment is founded on the following principles:

- It is recognized by farming companies that it is to their advantage to ensure their stocks of salmon are contained within structures which are properly designed and constructed to meet the anticipated rigours of the marine environment in which they will be deployed. As such, it is the responsibility of industry when planning, constructing and maintaining net pen sites to:
 - utilize their local knowledge and experience to ensure the proposed net pen design and deployment plan are developed with proper cognizance of risk assessment and management principles, and that all structures are fully adequate for the intended site
 - consult with, and engage recognized specialists when designing, constructing and deploying net pen structures
 - adhere to the provisions of the elements of the Code of Containment presented in subsequent sections
 - consult with their insurance underwriter, as necessary, to confirm proposed structures will meet with requirements established by underwriters

- Farming companies will take appropriate precautions and make every effort to ensure the integrity of the structures they deploy on their sites, and that their stocks of fish are adequately contained.
- Farming companies will take adequate precautionary measures to prevent escapes during transfers, counting, grading, harvesting, net cleaning and changing, and net pen repositioning.
- Salmon farming areas are characterized by a diversity of sites ranging from the very protected to the very exposed and, as such, containment structures will be designed and constructed with particular attention paid to the site-specific rigours of the marine environment in the location where they will be deployed.
- Even with all reasonable precautions taken in the design, construction and maintenance of containment structures, unforeseen events such as vandalism, predator attacks, and weather events may result in the loss of fish from net pens. If such events do occur, contingency plans are required for reporting the breach of containment and for efforts related to recovering lost stocks.
- In the event of a breach of containment, farm operators will work with federal and provincial regulators to recover stock in a timely manner in accordance with established protocols as described in the Code.

3.0 ELEMENTS OF THE CODE

The elements of the Code may be considered in the following broad topics which flow from the Code's Principles:

Net Pen Site Location and Infrastructure including:

- Recognition of the physical rigours of the marine environment in which the site will be located
- Containment system design
- Review of proposed net pen site locations and systems design
- Consultation, as necessary, with insurance underwriters
- Qualifications of equipment manufacturers and suppliers
- Mooring systems
- Net pen structures
- Netting components
- Predator control
- Site markers

Inspection, Maintenance and Auditing including:

- Equipment inspection, maintenance schedules and checklists
- Reporting requirements
- Auditing of inspection and maintenance procedures

Stock Loss and Recovery Contingency Planning including:

- Reporting requirements
- Stock recovery procedures

4.0 ROLES AND RESPONSIBILITIES

The marine grow-out phase of Atlantic salmon farming in New Brunswick is conducted on sites leased from the Crown. Given this use of common property resources by private operators, industry, the Province of New Brunswick and the Government of Canada each have roles and responsibilities with respect to the Code of Containment. In summary, the respective roles of the parties are:

Industry

- to commit to the provisions of this Code
- to make every reasonable effort, through regular monitoring and maintenance, to prevent breach of containment
- to undertake regular internal inspections, audits and other reporting as required
- to report a breach of containment and launch stock recovery actions in a timely manner
- to cooperate with provincial and federal regulators

NBSGA

- to coordinate bi-annual reviews of the Code
- to assist with coordination of storage and access of stock recovery gear
- to promote and support innovative research and development initiatives directed at improving containment technology

New Brunswick Department of Agriculture and Aquaculture

- to utilize existing regulations and licence approval processes to monitor and enforce those provisions of the Code which intersect with NBDAA regulatory responsibilities
- to provide timely responses to industry in the event of breaches of containment
- to provide and update DAA contact information (names and telephone numbers) for reporting in the event of a breach of containment

Fisheries and Oceans Canada

- to assist industry in the development and implementation of workable stock recovery plans to be initiated in the event of a breach of containment
- to issue licenses permitting recovery of lost stock
- to provide timely responses to industry in the event of breaches of containment
- to provide and update DFO contact information (names and telephone numbers) for reporting and to activate pre-approved Recovery Plans as available

5.0 CONFORMANCE, COMPLIANCE AND ENFORCEMENT

To be an effective industry management tool, farming companies will make all reasonable efforts to conform to the principles and provisions of the Code. As such, primary responsibility for enforcement of the Code resides with the companies themselves. Specifically, company management will ensure that, through inspections, reporting and auditing, their staff conform to the Code's provisions, and where weaknesses occur, they will be addressed and corrected in a timely manner.

Clearly, there are some provisions of the Code for which government regulators have authority, and in these cases, it is expected they will use their regulatory powers to enforce such provisions.

6.0 PROVISIONS OF THE CODE

This Section presents specific provisions embodied within the Elements of the Code of Containment.

6.1 Net Pen Site Location and Infrastructure

Net Pen Design and Location:

Depending on their location, net pen sites in New Brunswick experience a broad range of tidal currents, wave action, storm surges, and wind exposure. This continuum from low energy protected sites to high energy exposed sites translates into varying requirements in terms of robustness of net pen materials and construction methods required to endure the rigours imposed by the surrounding environment. The quality of materials, as well as construction standards and methods utilized by manufacturers and suppliers to the industry, together with their level of staff supervision and overall previous experience, are all key elements in ensuring the integrity of containment structures. The combined experience and knowledge of site operators and reputable equipment manufacturers and suppliers represents the optimal resource for determining the equipment requirements for any given site. Ultimately, however, the responsibility for equipment selection and installation procedures resides with the site operator.

Accordingly, salmon farmers are expected to:

- ensure the design of all components of the net pen installations (individually and as a system) take into account site conditions and established practices in the area
- ensure that the strengths of materials of individual components are known and balanced within the design
- have available detailed specifications for all materials utilized in mooring systems, net pen structures, netting, and any other structures (eg. shelters, feed storage facilities, etc)
- ensure the system considers an adequate built-in structural safety margin
- ensure that materials and construction methods utilized will result in a net pen system fully capable of withstanding anticipated rigours of the site in which it will be deployed
- consult with manufacturers, suppliers and experienced specialists, as appropriate to review their site plan and design specifications

Mooring Systems:

As the system component which maintains the operation in position, special attention is required to ensure system integrity is maintained. The following need to be taken into consideration when designing and constructing mooring systems:

- All mooring materials and components will be of known composition and strength.
- Specifications will be available for all anchors, ropes, chains, compensator buoys, thimbles and shackles used in constructing the mooring structure.

- Moorings will be designed to present a progressive strain as load is placed on the system. As an example, this may be achieved through the use of compensator buoys, heavy chain along the bottom or multiple mooring blocks.
- Rope will not be used for mooring lines that may come in contact with the ocean bottom or other system elements.
- Anchors will be compatible with the characteristics of the bottom on which they are located.
- Rope thimbles will be lashed in place to prevent overturning or closed thimbles will be used.
- Shackle pins will be additionally secured by suitable means.
- Moorings and lines are to be properly set and tensioned at the time of installation. Manufacturers' recommendations will be considered.
- Permanent floating structures such as accommodation and storage barges are to be moored separately from the net pen system, but within the site boundary.
- Large service vessels and barges are not to be moored to the net pen system except for brief periods for specific activities such as feeding, service or harvest. Such activities are to be carried out in calm weather and supervised by qualified staff.

Net Pen Systems:

The net pen system works, with the mooring equipment, to maintain the shape and integrity of the stock containment nets. Net pen systems must be consistent with the design provisions of the Code:

- All new system designs will have a written statement from the manufacturer describing construction materials, strength of the system, and information regarding the environment in which the system has been successfully deployed. This information will be provided prior to new fish entry to these systems.
- Each new net pen will be marked with an inventory control number (coded to identify the owner) and all maintenance or work done on specific net pens will be recorded in a net pen maintenance log.
- All net pens will meet or exceed the conditions (tidal current velocities, wind exposure, sea surges, depth and sea bottom type, etc.) of the site on which they will be deployed.
- It is the farmer's responsibility to consult with manufacturers regarding net pens best suited for their site conditions.
- Materials used in the manufacture of net pen components will be of known composition and strength.
- Materials and construction specifications will be documented.
- Net pen structural components will be designed to avoid fatigue, stress concentration, or corrosion.
- All metal structural steel components will be protected from galvanic corrosion.
- Structural components will be matched in strength. Connecting components will be of equal strength.
- Dependence will not be placed solely on bolted joints. Bolted joints will have locking pins.
- Welding, of either plastic or steel, will be carried out in accordance with established procedures, subject to inspection, testing and quality control.
- Field repaired components will be subject to increased inspection by the site operator or replaced as soon as conditions permit.

Net Structures:

Nets provide the basic barrier for containment; as such, close attention needs to be paid to ensure they are properly constructed, installed and maintained. Accordingly, the following will be taken into consideration:

- All nets will be obtained from a manufacturer who will also provide specific instructions regarding installation procedures.
- All netting materials used will be of known composition and strength.
- According to the dimension classification identified in Table 1 (Appendix 1), the mesh of any part of a net pen, including any repairs, must meet the minimum breaking strength standards established in Tables 2 through 6 (Appendix 1).
- Primary containment nets will have a strength and abrasion resistance consistent with established practice in the area (Appendix 1).
- Nets will be installed so as to avoid chafing and concentrated loads.
- As indicated in the following table¹, the proper/adequate net mesh size will be used according to fish size to prevent fish escape.

Maximum Inside Mesh Size (inches)	Minimum Fish Size
1 $\frac{1}{8}$	35 g
1 $\frac{3}{8}$	45 g
1 $\frac{1}{2}$	60 g
2 $\frac{1}{4}$	500 g

- All netting, net pen weights and other equipment will be designed, constructed and installed with the objective of preventing entanglement and chafing of containment nets and predator nets.
- All net pen weights, anchoring equipment, and other equipment that has the potential to come into physical contact with the net pen will have a smooth exterior that cannot catch or abrade nets. Efforts will also be made to remove mussels, barnacles, and other abrasive marine growth.
- Where practical, propeller guards will be installed on boats operated regularly in close proximity to net structures.
- Nets stored on dry land will be stored in a manner that prevents exposure to ultraviolet light.
- Net pens will be monitored on a daily basis for floating debris which could cause damage to netting. Such debris will be removed and disposed of in an approved manner as set out in the site's Waste Management Plan.
- Provision will be made to maintain the shape of the primary net, (such as through the use of weights, sand rings or tension lines).
- Nets will be installed in such a manner that the strain is borne by the main structural components of the system, not ancillary structures such as handrails.
- All nets are to be marked with an inventory control number.
- Maintenance/repair records will be maintained for each net used.

¹ Extracted from BC Fisheries Act, Aquaculture Regulation, B.C. Reg. 78/2002, Deposited April 19, 2002

- A schedule relating frequency for testing net integrity to site energy will be established and followed. Manufacturers in New Brunswick perform a four point break test for each net brought in for repairs or for a newly manufactured net. Guidelines are already established for what is considered to be a failed net.
- Prescribed minimum breaking strengths for each mesh size will be established in consultation with net manufacturers. This will apply to predator and bird nets, as well as containment nets.
- Nets not passing break tests are to be taken out of service immediately.
- Documentation of test results will be maintained by the site operator.
- In addition to break tests, all nets will be inspected for imperfections prior to re-use. Such inspections will include visual inspection for holes, broken or damaged ropes, chafing, and fouling. All holes will be repaired prior to re-entry.

Predator Control:

Damage to nets by predators is a potential means of stock loss. Accordingly, salmon farmers will have considered and implemented provisions to minimize loss of stock due to predator damage. Such considerations will include, but are not limited to the following:

- The primary containment net will be protected from damage by predators, for example by use of a predator control net as needed.
- The predator net mesh size will be consistent with that utilized in the area for controlling access by predators, and will recognize that not all sites are habitually prone to predator attacks.
- Provision will be made to avoid bird predation with the use of a top bird net.

Site Markings:

Site markings are required to minimize site equipment damage due to vessel traffic. All salmon farms in New Brunswick will be marked with aids to navigation as required by the Transport Canada and the provisions of Navigable Waters Protection Act (NWPA) permits. In addition, the NWPA specifies conditions for the maintenance and upkeep of site marking equipment.

6.2 Inspection, Maintenance and Auditing

Regular inspections and maintenance of all components of net pen site systems, together with auditing of the processes involved, are key elements in ensuring sustainability of containment systems. Inspections refer to physical examinations of the components of the net pen systems which may be undertaken by company staff, or by a knowledgeable and competent contractor acting on behalf of the company. Inspections are documented in company records which describe what work was undertaken, when it was undertaken, the name of the inspector, and the nature and schedule of any follow-up actions required.

An audit process will be applied to examine company records associated with operations and inspections to ensure consistency with the Code of Containment. Auditing may be carried out by company staff and/or contractors proficient in quality management auditing.

Accordingly, the Code addresses the following:

Inspection:

- *Initial Inspection:* All elements of the net pen, mooring and netting structures will be inspected to ensure they are properly installed in accordance with design specifications. Inspectors will also compare prepared specifications of materials and construction methods to those actually used in establishing the site. The results of the initial inspection will be documented for the company and will include a description of the installation, details of design, description of work carried out, findings and recommendations.
- *Semi-annual Inspections:* Semi-annual inspections of surface components will be carried out with the results to be recorded, signed by the operator, dated, and kept on file to be reviewed during an audit, or by regulatory officials in the event of a stock loss event. (Appendix 2 provides an example of a basic checklist and reporting form to be used in documenting this and all other inspections. Individual companies may adapt this form to their specific situations so long as the basic elements are retained.) Additional inspections will be carried out immediately following a major storm event, with results being documented, signed and dated for future reference. Similarly, semi-annual underwater inspections of mooring and other below water structures will be carried out and documented.
- *Biannual or Prior to Restocking Inspections:* Biannually or prior to restocking, an additional underwater inspection will be carried out to inspect components of the mooring system, net pen structures, netting, predator control systems, and site markings.
- *Responses to Inspections:* Inspections resulting in the repair or upgrading of critical components, net changes/washes, system adjustments, net pen additions, etc. will also be documented with dates and signatures for future reference. Repairs and/or replacements will be undertaken as needed

Preventative Maintenance:

The underlying principle of preventative maintenance is a commitment to continuous improvement in procedures relating to maintaining equipment in prime working condition. While the primary onus for this is on the salmon farmer, manufacturers and suppliers also need to commit to continually improving their equipment to remain competitive in terms of capital and operating costs. Specifically, the following need to be taken into account:

- All salmon farming companies will prepare an itemized list of components at the time of system installation. Critical components will form part of a regular inspection checklist.
- Records are to be kept of the dates of replacement of individual components.
- The degree of maintenance required on containment systems can be reduced by exercising care during operations including feeding, transferring, counting, harvesting fish, and general vessel operations in the vicinity of the structures.
- A training program will be developed by salmon farmers focusing on preventative maintenance and inspection procedures. Training records will be maintained for each employee to demonstrate competence.

Containment System Auditing:

Salmon farms will develop a program of regular audits to demonstrate that the site's operations, inspection and maintenance programs are being undertaken as prescribed in the Code. The audit program will focus not only on spot visual inspections, but also on documentation supporting all operational, inspection and maintenance programs. The audit program will include an examination of, in the event of a recent breach, documentation related to the failure analysis and corrective actions implemented to prevent future occurrences.

6.3 Stock Loss and Recapture Contingency Planning

The Provisions of this Code have been developed to ensure that the potential for stock loss from a salmon farm will be minimized. Nevertheless, salmon farms will have a contingency plan to deal with the unlikely event of stock loss. The plan will include provision for stock recovery developed in concert with DFO and DAA.

The company's contingency plan will address the following topics:

- ***Suspected Breach of Containment Event:*** An event is defined as a breach of the containment system which could be triggered by one or more of the following:
 - A severe weather event
 - A readily observable hole in the containment net
 - Vessel collision
 - Human error
 - Abnormal feeding behaviour
 - The presence of predators
 - Results of a regular inspection
 - Malicious damage
- ***Confirmation of Breach of the Containment System:*** The suspected breach will result in an immediate above and/or below water inspection to confirm whether or not the containment system was breached. If a breach is confirmed, the farm will undertake an immediate assessment of the damage to the net pen and mooring systems, and initiate repairs to ensure the containment system is stabilized, thus preventing any further stock losses.
- ***Reporting:*** Within 24 hours of the confirmation of the breach of containment event, designated officials at DFO, NBDAA and NBSGA, will be notified. The decision to activate a pre-approved recovery plan will be made during discussions with DFO and NBDAA.
- ***Activation of Recovery Plan:*** The stock recovery plan will address recapture activities both on and off site, including location, vessels and company personnel involved, wharf usage, and recapture gear to be utilized. The plan will also address:
 - Specific company individuals will be designated to conduct recapture activity. Following a breach event these individuals will have as their primary responsibility the recapture of stock. This responsibility will not be subordinate to other duties.
 - NBSGA will be notified. The NBSGA has responsibility for maintaining a repository of nets and other gear to be utilized for recovering stock

- The disposal procedure for recaptured fish
- **Follow-Up:** Follow-up actions will include:
 - An inventory reconciliation to assess the numbers of fish lost during the breach of containment
 - An assessment of the numbers of fish recaptured during the recovery process
 - A failure analysis to determine the reason for the breach, together with proposed corrective actions to prevent future occurrences
 - Within 14 days of completion of the recovery plan, written notice of the breach event, prepared on the form provided in Appendix 3 will be sent to both NB DAA and DFO, with a copy to NBSGA.

APPENDIX 1 MINIMUM NET BREAKING STRENGTHS²

Table 1: Net Pen Dimension Classification

Perimeter	Up to 50 m (164 ft.)	> 50 m to 60 m (197 ft.)	> 60 m to 70 m (230 ft.)	> 70 m to 80 m (262 ft.)	> 80 m to 90 m (295 ft.)	> 90 m to 110 m (361 ft.)	> 110 m
Depth							
Up to 5 m (16 ft.)	A	A	B	C	D	D	E
>5 m to 10 m (33 ft.)	A	A	B	C	D	D	E
>10 m to 15 m (49 ft.)	A	B	B	C	D	D	E
>15 m to 20 m (66 ft.)	B	B	C	D	D	D	E
>20 m to 30 m (98 ft.)	D	D	D	D	D	E	E
>30 m	E	E	E	E	E	E	E

A to E establishes net pen dimension classification. Depth is from waterline rope to net pen bottom. Perimeter refers to the line bounding the top of the net pen.

Table 2: Dimension Classification A

Mesh Size	Minimum Required Mesh Breaking Strength (below surface of water)	Minimum Required Mesh Breaking Strength (jump netting, above surface of water)
< 22 mm (7/8")	20 kg (44 lbs)	18 kg (41 lbs)
> 22 mm (7/8") to < 38 mm (1-1/2")	26 kg (58 lbs)	24 kg (52 lbs)
38 mm (1-1/2")	31 kg (68 lbs)	28 kg (62 lbs)
> 38 mm (1-1/2")	41 kg (90 lbs)	38 kg (83 lbs)

²Extracted from BC Fisheries Act, Aquaculture Regulation, B.C. Reg. 78/2002, Deposited April 19, 2002

Table 3: Dimension Classification B

Mesh Size	Minimum Required Mesh Breaking Strength (below surface of water)	Minimum Required Mesh Breaking Strength (jump netting, above surface of water)
< 22 mm (7/8")	25 kg (56 lbs)	24 kg (52 lbs)
> 22 mm (7/8") to < 38 mm (1-1/2")	31 kg (68 lbs)	28 kg (62 lbs)
38 mm (1-1/2")	41 kg (90 lbs)	38 kg (83 lbs)
> 38 mm (1-1/2")	46 kg (102 lbs)	43 kg (94 lbs)

Table 4: Dimension Classification C

Mesh Size	Minimum Required Mesh Breaking Strength (below surface of water)	Minimum Required Mesh Breaking Strength (jump netting, above surface of water)
< 38 mm (1-1/2")	36 kg (79 lbs)	33 kg (73 lbs)
38 mm (1-1/2")	46 kg (102 lbs)	43 kg (94 lbs)
> 38 mm (1-1/2")	51 kg (113 lbs)	47 kg (104 lbs)

Table 5: Dimension Classification D

Mesh Size	Minimum Required Mesh Breaking Strength (below surface of water)	Minimum Required Mesh Breaking Strength (jump netting, above surface of water)
< 38 mm (1-1/2")	41 kg (90 lbs)	38 kg (83 lbs)
38 mm (1-1/2")	51 kg (113 lbs)	47 kg (104 lbs)
> 38 mm (1-1/2")	62 kg (136 lbs)	57 kg (125 lbs)

Table 6: Dimension Class E

Mesh Size	Minimum Required Mesh Breaking Strength (below surface of water)	Minimum Required Mesh Breaking Strength (jump netting, above surface of water)
< 38 mm (1-1/2")	46 kg (102 lbs)	43 kg (94 lbs)
38 mm (1-1/2")	62 kg (136 lbs)	57 kg (125 lbs)
> 38 mm (1-1/2")	77 kg (169 lbs)	71 kg (156 lbs)

**APPENDIX 2
BASIC INSPECTION CHECKLIST & REPORT FORM**

DATE:	INSPECTOR:		SIGNATURE:
Type of Inspection:	Initial	Semi-Annual	Biannual/Restocking
System Component	Location	Status	Action Required
<u>Mooring System:</u>			
Anchors			
Chains			
Ropes			
Compensator Buoys			
Thimbles			
Shackles			
<u>Net pen Systems</u>			
Structural Components			
Stanchions			
Welds			
Joints			
Decking			
Handrails			
Net and mooring attachment points			
<u>Netting</u>			
Primary Containment			
Predator Net			
Ropes			
Tensors			
<u>Site Markings</u>			
Marker location			
Radar reflectors			
If work required, date of completion:			
If work required, date of follow-up inspection:			

APPENDIX 3³

BREACH OF CONTAINMENT REPORTING FORM

This report is to be completed and faxed to _____ within 14 days of reporting of the breach of containment.

Aquaculture Site Licence #: _____

Company Name: _____

Telephone: _____ Fax: _____

Email: _____

Date & Time of Occurrence: _____

Accident Site/Location: _____

Assessment of Cause of Breach: _____

Estimated Numbers of Fish Lost Due to Breach: _____

Life stage of Stock (circle):

Smolt Post Smolt Premarket Market Broodstock

Was Recovery Plan Activated? (If Not Why Not?): _____

(If yes, what was the outcome?) _____

Number of Net Pens Affected: _____

Company Representative Signature: _____

Company Representative Name (Please Print): _____

³ Based on "Escapement Report", Code of Containment for the Culture of Salmonids in Newfoundland and Labrador, February 2005, Annex 1