FISH AND FISH HABITAT BASELINE STUDY

Prepared for

MOWI

Prepared by

LGL LIMITED
Est. 1971
environmental research associates

LGL Report No. FA0287D
April 2025

Fish and Fish Habitat Baseline Study

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List of Acronyms and Abbreviations

AAR	Aquaculture Activities Regulations
AERF	Aquatic Ecosystems Restoration Fund
AIS	Aquatic Invasive Species
AP	Aquaculture Policy
AVC	Atlantic Veterinary College
BAP	Best Aquaculture Practices
BMA	Bay Management Area
BOD	Biological Oxygen Demand
CFIA	Canadian Food Inspection Agency
COC	Code of Containment
DAV	Designated Aquaculture Veterinarian
DFLR	Department of Fisheries and Land Resources
DFO	Department of Fisheries and Oceans (Canada)
Div.	NAFO Divisions
DPS	Distinct Population Segment
DU	Designatable Units
EBSA	Ecologically and Biologically Significant Area
ECCC	Environment and Climate Change Canada
EEZ	Exclusive Economic Zone
EGSL	Estuary and Gulf of St. Lawrence
EHJV	Eastern Habitat Joint Venture
ERMA	Environment Resource Management Association
FFA	Department of Fisheries, Forestry and Agriculture
GOSLIM	Gulf of St. Lawrence Integrated Management
HDPE	High Density Polyethylene
IA	Important Area
IBA	Important Bird Area
IPMP	Integrated Pest Management Plan
KDE	Kernel density estimation
LOMA	Large Ocean Management Area
LRP	Limit Reference Point
MCE	Mowi Canada East
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MSP	Marine Spatial Planning
NAAHP	National Aquatic Animal Health Program
NAFO	Northwest Atlantic Fisheries Organization
NASCO	North Atlantic Salmon Conservation Organization
NL	Newfoundland and Labrador
NMCA	National Marine Conservation Area
OBIS	Ocean Biogeographic Information System

OPC	Opportunistic Polychaete Complex
PAV	Provincial Aquaculture Veterinarian
PBGB	Placentia Bay-Grand Banks
PEZ	Potential Exposure Zone
RV	Research Vessel
SAM	Stewardship Association of Municipalities
SAR	Species at Risk
SARA	*Species at Risk Act*
SBA	Sensitive Benthic Area
SFA	Salmon Fishing Area
SLDSS	Sea Lice Decision Support System
SSAC	Species Status Advisory Committee
SSC	Species Specialist Subcommittee
TAC	Total Allowable Catch
TBD	To be determined
TOC	Total Organic Carbon
USR	Upper Stock Reference Point
VEC	Valued Environmental Component
VME	Vulnerable Marine Ecosystem

1.0 Introduction

As part of the requirements stipulated in the Environmental Impact Statement (EIS) Guidelines for the Indian Head Hatchery Expansion Project (Registration Number 1975), this Fish and Fish Habitat Baseline Study was prepared. More specifically, this Baseline Study addresses Section 4.3.3 of the EIS Guidelines (see Appendix A of this document). Mowi Canada East (MCE), through the Indian Head Expansion Project (the Project), is proposing to increase the in-province production of Atlantic salmon (*Salmo salar*) smolt from the MCE established broodstock program in Atlantic Canada. These smolt will supply MCE's licensed sea farms located on the south coast of Newfoundland. This decreases reliance on smolt from out-of-province sources. As such, two key components of the Project are to increase the production capacity of farmed Atlantic salmon smolt and improve smolt quality at the MCE Indian Head Hatchery in Stephenville, NL (Hatchery). The Project involves upgrades to improve efficiency of the existing Hatchery facility, expansion of the Hatchery to increase production, and installation of supporting infrastructure such as freshwater and saltwater supply and effluent treatment and discharge. The Project also includes the transport, transfer, rearing and harvesting of the additional 2.2 million smolt in MCE's licensed sea farms, which are in Bay Management Areas (BMAs) established under an agreement with the Department of Fisheries, Forestry and Agriculture (FFA) and other salmon growers on the south coast of Newfoundland.

Key potential effects of Project activities on fish and fish habitat include those from: (1) deposition of organic matter from the sea cages (e.g., feces, feed, therapeutants) in the water column and on the sea floor; and (2) transfer of pathogens and parasites from farmed Atlantic salmon to wild fishes. The following sections discuss the existing fish and fish habitat in the Study Area on the south coast of Newfoundland with focus on the sea farms, the mitigation measures intended to minimize the potential effects of the Project on fish and fish habitat, and the follow-up monitoring intended to validate the effects conclusions in the EIS. For the purposes of the EIS, 'fish and fish habitat' is considered a Valued Environmental Component (VEC).

2.0 Study Area

The Study Area was selected to encompass the area where effects from Project activities on fish and fish habitat are reasonably expected to occur. The boundaries of the sea farm Study Area encompass most of the nearshore regions of the south coast of Newfoundland (west of Placentia Bay) with particular focus on Fortune Bay and Hermitage Bay (Figure 2.1). Within the Study Area, the geographic focus of this Baseline Study is the BMAs of the Project. MCE sea farms are located along the south coast of Newfoundland with many situated near coastal communities in Fortune Bay and Hermitage Bay. The 53 sea farms are located in 13 BMAs (Table 2.1) and divided into two primary areas: “Bays East” (Figure 2.2) and “Bays West” (Figure 2.3), which roughly correspond to Fortune Bay and Hermitage Bay, respectively.

The Hatchery Study Area (marine) near the MCE Hatchery in Stephenville, NL (St. George’s Bay) and the well boat transportation route between the Hatchery and sea farms (Figure 2.1) are briefly discussed primarily in relation to the potential for aquatic invasive species (AIS) and species at risk (SAR) to occur there.

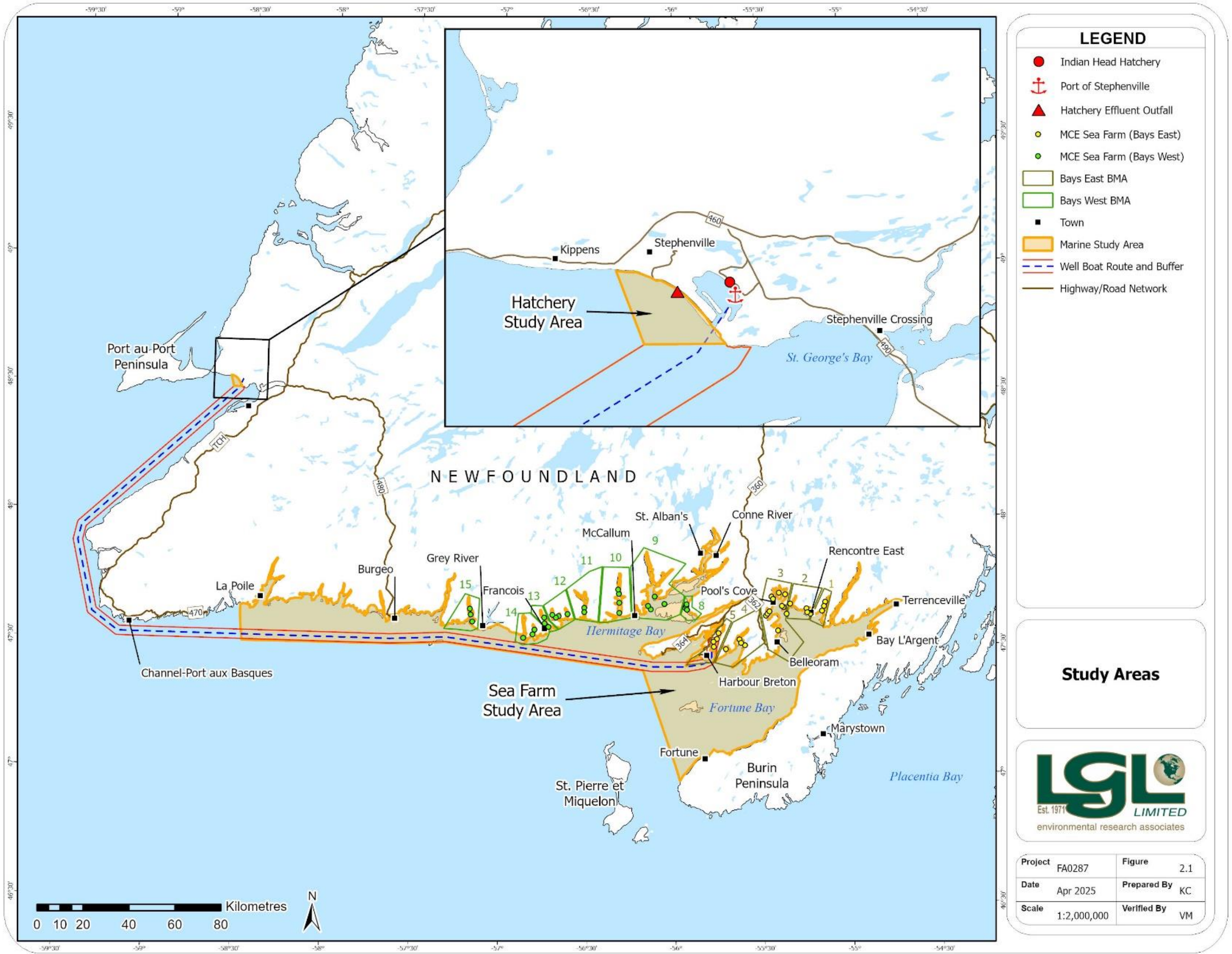


Figure 2.1. The locations of the Hatchery and Sea Farm Study Areas for MCE's Project.

Table 2.1. Summary of sea farms in Bays East and Bays West areas including BMA (name and number), AQ licence number, sea farm site coordinates, and construction status.

Area	BMA Name	BMA No.	Farm Site Name	AQ Licence No.	Site Coordinates		Construction Status
					Latitude (°N)	Longitude (°W)	
Bays East	Mal Bay	1	Benny's Cove	1084	47.67711	-55.13000	TBD
			Foshie's Cove	1085	47.66131	-55.13681	Pre-existing
			The Hobby	1086	47.64389	-55.14931	Pre-existing
	Rencontre East	2	Deep Water Point	1080	47.65319	-55.23769	Pre-existing
			Rencontre East Island	1081	47.63219	-55.21650	Pre-existing
			Old Woman's Cove	1082	47.67269	-55.33169	Pre-existing
			Little Burdock Cove	1083	47.63831	-55.23400	Pre-existing
	Fortune Bay West	3	Ironskull Point	865	47.56811	-55.40319	Pre-existing
			Spyglass Cove	881	47.62661	-55.47111	Pre-existing
			Spoon Cove	882	47.70131	-55.43819	Pre-existing
			Cinq Island Cove	883	47.63490	-55.46380	Pre-existing
			McGrath Cove South	885	47.65939	-55.36989	Pre-existing
			McGrath Cove North	886	47.66389	-55.37942	Pre-existing
			Belle Island	888	47.63350	-55.35389	TBD
			Tilt Point	976	47.64311	-55.45150	Pre-existing
			Hickman's Point	1002	47.71539	-55.39611	Pre-existing
			Steamers Head	1050	47.69150	-55.43150	Pre-existing
			South East Bight	1046	47.70950	-55.36119	TBD
	Great Bay de l'Eau	4	Salmonier Cove	1048	47.51297	-55.59531	Pre-existing
			Dog Cove	1049	47.53619	-55.62581	Pre-existing
			Red Cove	1065	47.52269	-55.61639	TBD
			Murphy Point	1088	47.49800	-55.70411	Pre-existing
	Harbour Breton Bay	5	Harvey Hill East	991	47.53850	-55.75619	Pre-existing
			Harvey Hill North	993	47.56081	-55.74733	Pre-existing
			Broad Cove	1045	47.50769	-55.77339	Pre-existing
			Harvey Hill South	1121	47.52800	-55.77631	Pre-existing
Bays West	Little Passage	8	Strickland Cove	127	47.66000	-55.93880	TBD
			Blackfish Cove	673	47.66690	-55.93140	Pre-existing
			Seal Nest Cove	781	47.65330	-55.92670	Pre-existing
			Deer Cove	1090	47.67390	-55.92910	TBD
	Outer Bay d'Espoir	9	Butter Cove	1128	47.67650	-56.05680	TBD
			Jervis Island	1129	47.65570	-56.13630	TBD
			Pass My Can	1130	47.66820	-56.15170	TBD
			Goblin Bay	1132	47.70570	-56.11280	TBD
	Facheux Bay	10	Wallace Cove	1123	47.71561	-56.31889	Pre-existing
			Dennis Arm	1131	47.68061	-56.31644	TBD
			Indian Tea Point	1126	47.73222	-56.32339	TBD
			Wild Cove	1127	47.64131	-56.31781	Scheduled 2025
	Hare Bay	11	Mare Cove South	1125	47.66189	-56.51969	TBD
			North Bob Locke Cove	1124	47.64431	-56.51889	Scheduled 2025
	Rencontre West	12	Devil Bay	1133	47.63681	-56.61489	Pre-existing
			Little Bay	1134	47.62950	-56.66600	Pre-existing
			Rencontre Bay	1136	47.62311	-56.68239	TBD
			The Gorge	1135	47.63311	-56.70269	Pre-existing
	Chaleur Bay	13	Chaleur Bay	1147	47.62211	-56.74839	Pre-existing
			Friar Cove	1148	47.60000	-56.74669	Pre-existing
			Shooter Point	1149	47.58610	-56.72356	TBD
	Aviron Bay and La Hune Bay	14	Aviron North	1165	47.57469	-56.80539	TBD
		14	Aviron South	1170	47.55756	-56.81553	Scheduled 2025
		14	Foots Cove	1169	47.54269	-56.86864	TBD
	Bay de Vieux	15	Denny Island	1166	47.60419	-57.16281	TBD
		15	Gnat Island	1167	47.63181	-57.17361	TBD
		15	Shoal Cove	1168	47.65503	-57.17856	TBD

Notes:

[a] Pre-existing refers to sea farms with pre-existing production. Sea farm system components are constructed by third parties. Installations are not permanent and are rotated between production and fallow periods, and to upgrade end-of-life construction materials.

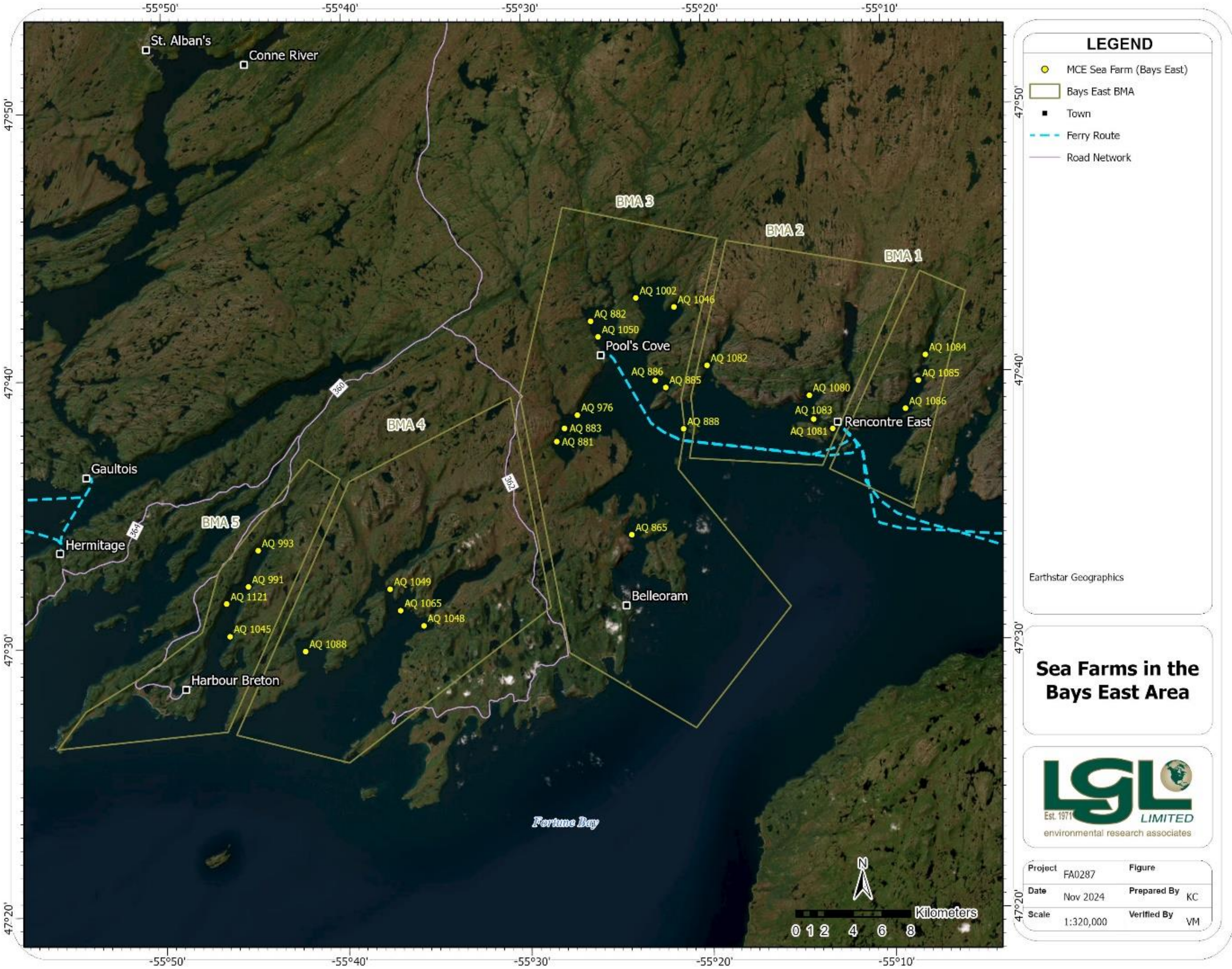


Figure 2.2. Locations of MCE sea farms and BMAs in the Bays East area.

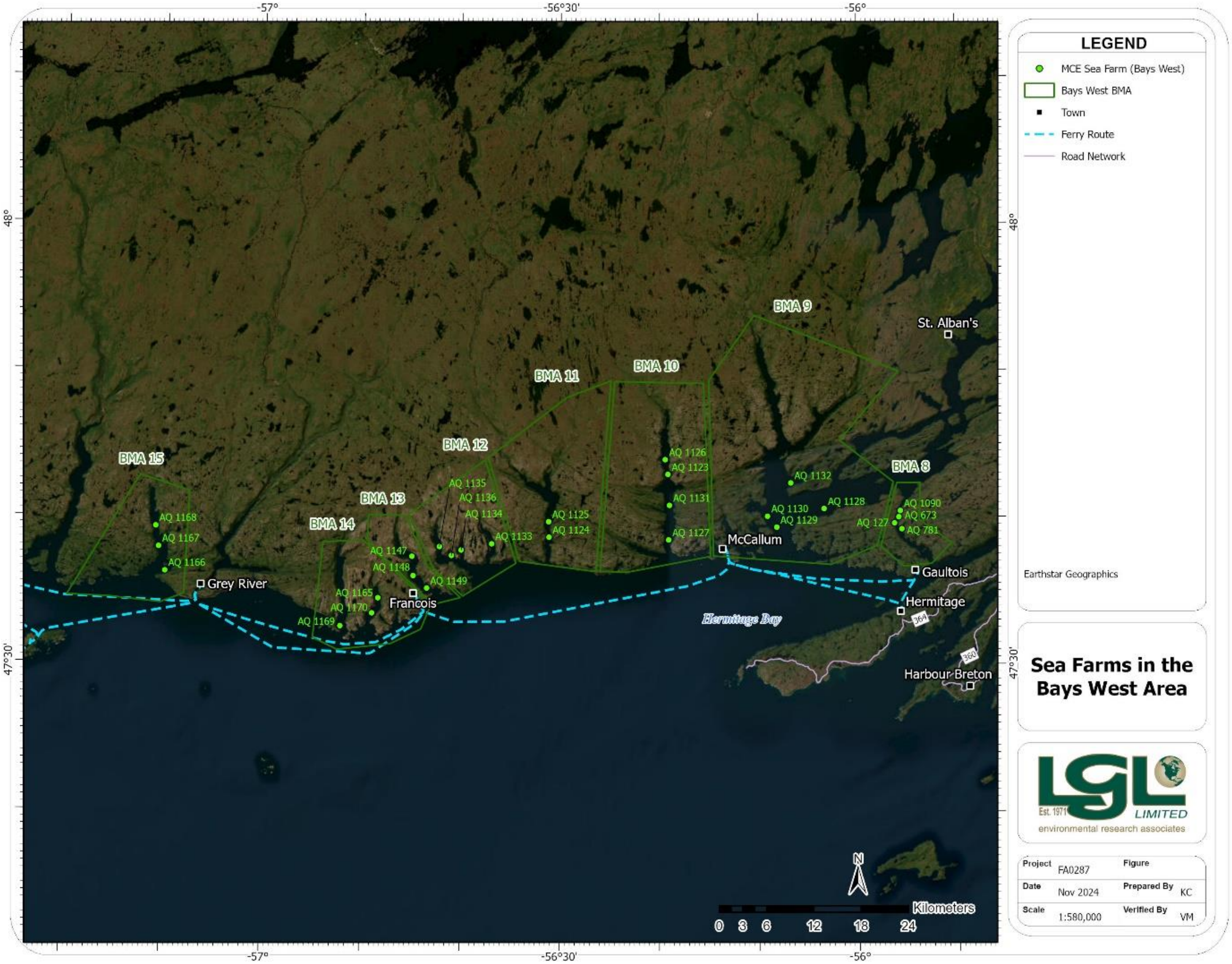


Figure 2.3. Locations of MCE sea farms and BMAs in the Bays West area.

3.0 Methodology

This Baseline Study is primarily a desktop review of available information used to address the EIS Guidelines (Table 3.1). The description of fish and fish habitat is presented from two perspectives: (1) an overview of fish and fish habitat in the Study Area (i.e., south coast of Newfoundland; see Figure 2.1); and (2) a more detailed description of fish and fish habitat in the marine Project Area (i.e., sea farms; see Figures 2.3 and 2.4). The components of "fish and fish habitat" discussed, which address the EIS Guidelines, include:

- Water quality parameters;
- Benthic characteristics;
- Fish and invertebrate species;
- Species at Risk;
- Aquatic Invasive Species;
- River overview;
- Aquatic dispersion modelling; and
- Sensitive areas.

Although marine mammals and sea turtles are not components of fish and fish habitat, the EIS Guidelines require some discussion of animal groups that have a reliance on invertebrates and fishes as prey, as well as their potential interactions with the MCE sea farms. Marine mammals and sea turtles are known to occur in Fortune and Hermitage Bay and surrounding areas and several species are considered at risk.

Table 3.1. Summary of the EIS Guideline requirements for the Fish and Fish Habitat Baseline Study and the approach taken to address the requirements.

EIS Guideline	Requirement	Approach	Data Sources
4.3.3a	Identify fish and fish habitat using benthic surveys, including identification of significant habitat, which may include invertebrates, crustaceans, corals and sponges, and eelgrass	• Reviewed available benthic surveys conducted on MCE sea farms as part of licensing process • Literature review	• Peer-reviewed scientific publications • Third-party consultant reports
4.3.3b	Identify fish and fish habitat, including species at risk, invasive species (both within and in close proximity to the study area), marine mammals, and those species that directly or indirectly support a fishery, such as cod, lobster, sea run trout, herring, sharks, scallops, crab, seals, mussels, and lumpfish	• Literature review • Analysis of data available from government and public sources • Consultation with government scientists	• Peer-reviewed scientific publications • Third-party consultant reports
4.3.3c	Water quality and benthic characteristics consistent with the baseline monitoring requirements of the provincial aquaculture licensing process	• Literature review • Analysis of data available from government and public modelling sites, and data collected by MCE and FFA	• Sea Farm Sites Baseline Study (LGL 2025a; see Volume 3)

EIS Guideline	Requirement	Approach	Data Sources
4.3.3d	Aquatic dispersion modelling for the deposition and accumulation of biochemical oxygen demanding (BOD) matter	• Literature review • Analysis of modelling reports as part of MCE sea farm licensing process.	• Peer-reviewed scientific publications • Third-party consultant reports
4.3.3e	Identify any Ecologically and Biologically Significant Areas (EBSA) within or adjacent to the BMAs associated with the Project	• Literature review • Review of information available from government sites	• Peer-reviewed scientific publications • Government research documents

4.0 Fish and Fish Habitat Overview

As noted in Section 2.0, the primary focus of this Baseline Study is Fortune Bay and Hermitage Bay as these areas encompass the majority of MCE's sea farms where Project activities are most likely to affect fish and fish habitat. The bathymetry of the sea farm Study Area is irregular with numerous banks and troughs. Water depths are typically less than 200 m; however, there are several deep channels where depths exceed 500 m (Donnet et al. 2022). Numerous rivers flow into the sea farm Study Area (see Figures 10.1 and 10.2 later) and result in seasonal changes from freshwater runoff. In addition to river run-off, wind force and temperature gradients have a strong influence and result in stratification of the waters in the sea farm Study Area (Donnet et al. 2022). Circulation patterns, such as upwelling and downwelling, along with water exchanges between inner and outer parts of the bays can lead to localized areas of high productivity (Donnet et al. 2022). As described in the sections below, the sea farm Study Area supports a wide variety of planktonic, benthic, and pelagic communities including numerous Species at Risk (SAR).

5.0 Water Quality at the MCE Sea Farms

A key aspect of the physical environment for determining the suitability of a site for growing farmed finfish, including Atlantic salmon, is the water quality. The EIS Guidelines (Section 4.3.3c) require a discussion of water quality data collected as part of the provincial aquaculture licensing requirements. The FFA licensing process in NL requires potential finfish cage culture operators to assess site suitability. As part of this assessment, water quality parameter data including water temperature (°C), dissolved oxygen (mg/L), and salinity (in parts per thousand, ppt, or ‰) were collected at MCE sea farms; these data are summarized below. Detailed water quality information (as well as current data) for sea farms are available in the Sea Farm Sites Baseline Study (see in LGL 2025a).

5.1 Water Quality

At MCE sea farms, water quality measurements were routinely collected with a handheld device such as a YSI with probes for temperature, dissolved oxygen, and salinity. Water quality data had also been collected in some areas in Bays West by FFA (formerly NL Department of Fisheries and Land Resources [DFLR]) and was used by MCE during license applications to describe the water quality of the area. The amount and temporal coverage of water quality data collected in the BMAs are variable. Summaries of available water quality data are provided here for the Bays East and Bays West areas (see Figure 2.1). To represent each BMA, one sea farm was selected to present detailed data in graphical and/or tabular formats. The selection of a representative sea farm for a BMA was based on an assessment of the available data and/or that which represented the most recent data. For each water quality parameter, data are provided from the upper 15 m of the water column as this is where farmed salmon predominantly occur in the sea cages. As noted above, detailed water quality information for each sea farm with available data is provided in the Sea Farm Baseline Study (see in LGL 2025a).

5.1.1 Bays East Sea Farms

Water quality data in the Bays East sea farms (see Figure 2.2) were collected periodically from 2013 (BMA 1) to 2024 (BMAs 2, 3, 4, and 5) and include water temperature, dissolved oxygen and salinity.

5.1.1.1 Mal Bay (BMA 1)

Mal Bay (BMA 1) has three licensed sea farms and water quality data (water temperature and dissolved oxygen) were collected during 2013–2018. Temporal coverage of water quality data collected in the Mal Bay BMA is variable and is available for two of the sea farms. The Foshie's Cove sea farm (AQ 1085; see Figure 2.2) was selected to present detailed water quality data for the Mal Bay BMA as it contained the most complete data sets (with focus on data collected at 5 m).

Water Temperature

Seasonal average water temperatures at 5 m water depth were the same across sea farms with available data (LGL 2025a). At the Foshie's Cove sea farm, mean water temperatures ranged from 1.6°C in winter to 14.6°C in summer. Maximum water temperature observed was 18.6°C in summer and minimum water temperatures were 0.3°C in winter at both sea farms with available data (LGL 2025a). Historical water temperature data collected during 2013–2018 at the Foshie's Cove sea farm showed an increase in water temperature from April–August and a general decrease thereafter (Figure 5.1). Average water temperatures peaked in August, while the lowest temperatures were recorded in March.

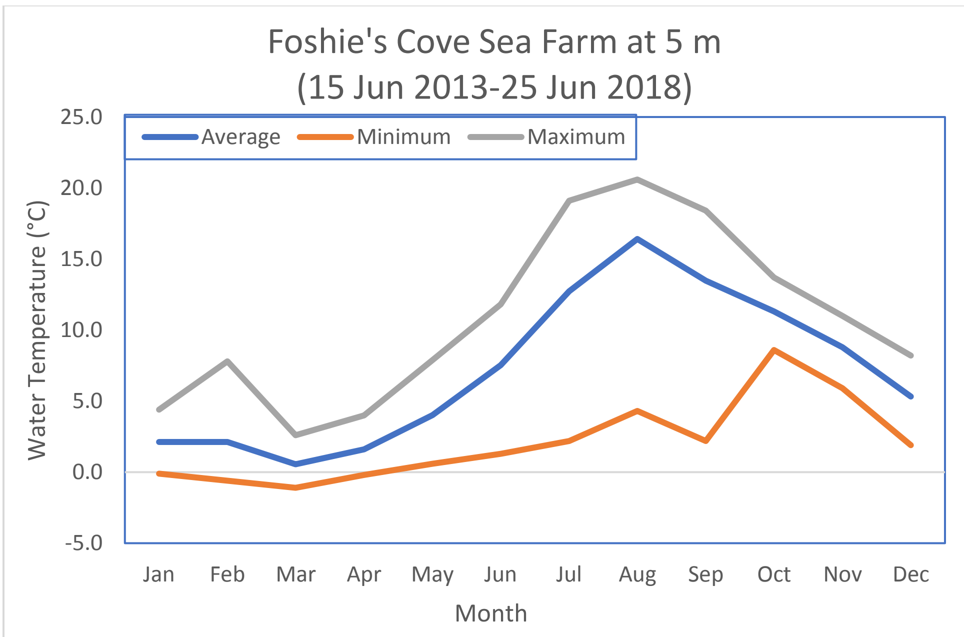


Figure 5.1. Historical water temperatures (°C) at 5 m depth for the Foshie's Cove sea farm considered representative of water temperatures in BMA 1.

Dissolved Oxygen

In BMA 1, dissolved oxygen levels were consistently lower in summer and fall than winter and spring, with the highest average dissolved oxygen levels observed in the Foshie's Cove sea farm (LGL 2025a). Mean dissolved oxygen ranged from 8.9 mg/L in summer to 13.1 mg/L in winter (LGL 2025a). The maximum observed dissolved oxygen level was 16.0 mg/L at The Hobby sea farm in spring, while minimum dissolved oxygen was 5.0 mg/L in summer at the Foshie's Cove sea farm (LGL 2025a). As represented by the Foshie's Cove sea farm, a general decrease in dissolved oxygen levels were observed from May–September, followed by an increase in the cooler months (Figure 5.2). Dissolved oxygen peaked between March and May while the lowest dissolved oxygen levels were recorded in September.

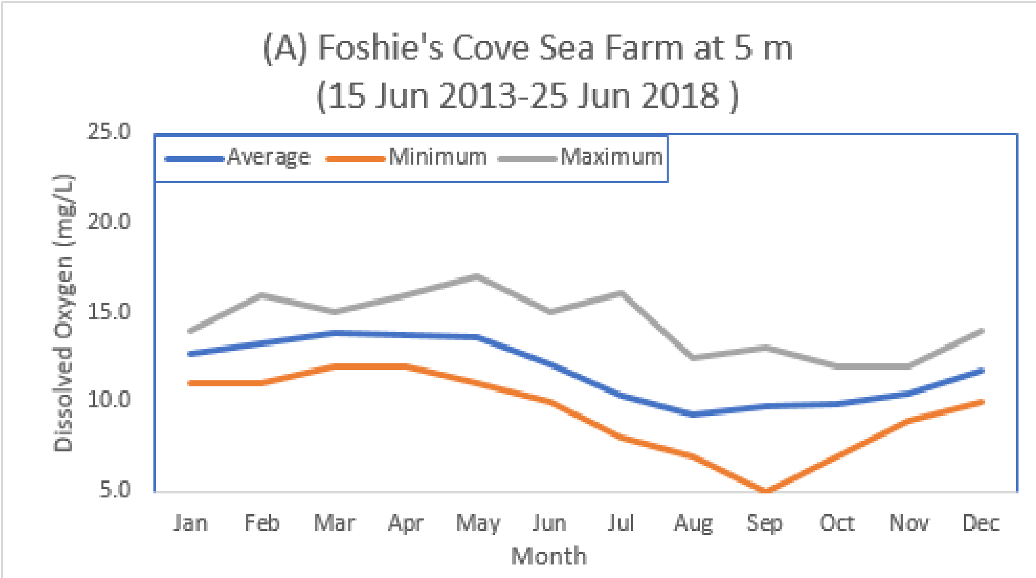


Figure 5.2. Historical dissolved oxygen (mg/L) levels at the Foshie's Cove sea farm at 5 m depth (June 2013–June 2018) considered representative of dissolved oxygen levels in BMA 1.

Salinity

There were no available data for salinity within the Mal Bay BMA.

5.1.1.2 Rencontre East (BMA 2)

Rencontre East (BMA 2) has four licensed sea farms and water quality data were collected periodically during 2019–2024. Temporal coverage of water quality data collected in the Rencontre East BMA are variable for all four sea farms. The Little Burdock Cove sea farm (AQ 1083; see Figure 2.2) was selected to represent the water quality for the Rencontre East BMA as it contained the most complete and recent data (2021–2024).

Water Temperature

Seasonal water temperatures were generally consistent across the sea farms with available data in the Rencontre East BMA, though the Rencontre East Island sea farm (AQ 1081; see Figure 2.2) had slightly lower water temperatures compared to the other sea farms in the BMA (LGL 2025a). At water depths 10 m and below, water temperatures were slightly warmer in winter but cooler during other seasons. In contrast, at water depths above 10 m, water temperatures were higher in spring, summer, and fall (LGL 2025a).

Mean water temperatures ranged from 1.1°C in winter at the Rencontre East Island sea farm (0.5 and 1 m depths) to 17.2°C in summer at the Little Burdock Cove sea farm (0.5 m depth; LGL 2025a). Maximum water temperatures at the sea farms were recorded at a depth of 0.5 m in summer, reaching 20.5°C. Minimum temperatures occurred in winter at the same depth, measuring 0.0°C. Lowest water temperatures were observed in March in all sea farms (LGL 2025a). In the Little Burdock Cove sea farm, average temperatures were highest in September, with steady increases from April–September, followed by decreasing water temperatures from October onwards (Figure 5.3).

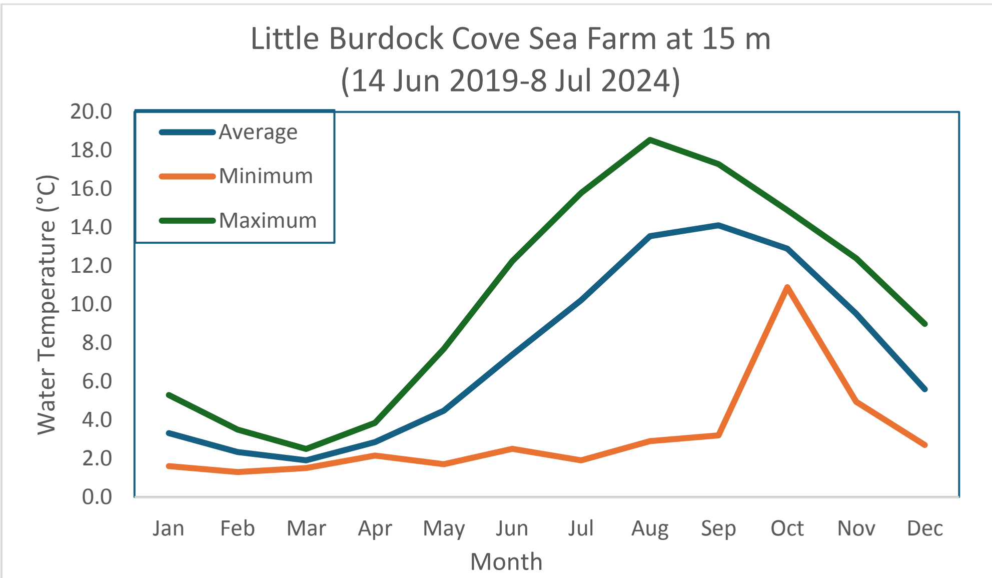


Figure 5.3. Historical water temperatures (°C) in the Little Burdock Cove sea farm at 15 m depth considered representative of water temperatures in BMA 2.

Dissolved Oxygen

In BMA 2, dissolved oxygen levels were consistently lower in summer and fall compared to winter and spring. Mean dissolved oxygen ranged from 7.7 mg/L in summer to 12.8 mg/L in winter at 0.5 m depth. Maximum observed dissolved oxygen was 16.0 mg/L, recorded at a depth of 0.5 m at the Little Burdock Cove sea farm in spring; minimum dissolved oxygen was 5.2 mg/L, measured at a depth of 1 m in fall at the Rencontre East Island sea farm (LGL 2025a). During 2019–2022 in the Little Burdock Cove sea farm, highest dissolved oxygen levels were recorded in May and the lowest were recorded in August; dissolved oxygen levels began increasing in November–December (Figure 5.4).

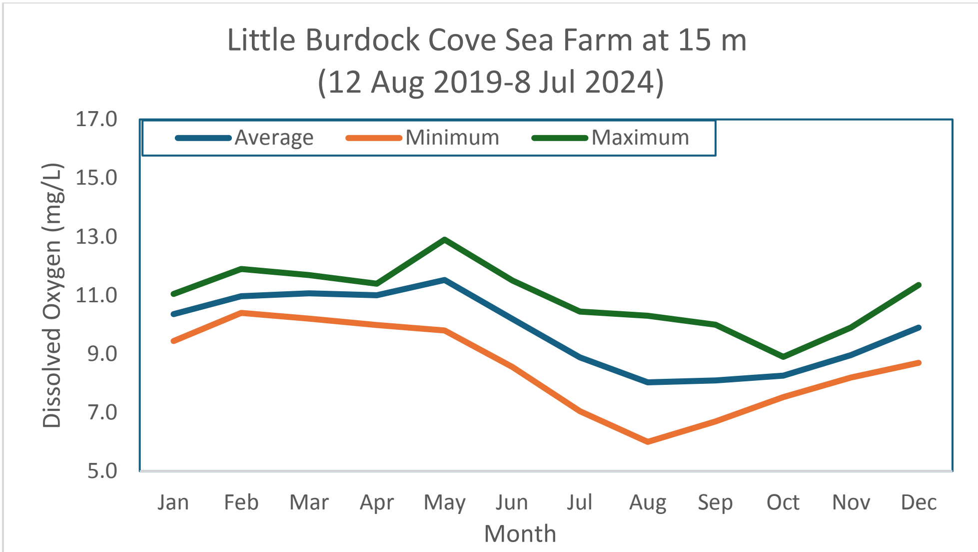


Figure 5.4. Historical dissolved oxygen (mg/L) levels in the Little Burdock Cove sea farms at 15 m depth considered representative of dissolved oxygen in BMA 2.

Salinity

Salinity was fairly consistent across sea farms and seasons in the Rencontre East BMA with averages ranging from 28.0–31.6 ppt. Results indicate a moderate freshwater influence near the surface that was more pronounced at the Rencontre East Island sea farm (LGL 2025a). Table 5.1 provides a summary of average salinities in the Little Burdock Cove sea farm.

Table 5.1. Average salinities (‰) in the Little Burdock Cove sea farm in the Rencontre East BMA (2022–2024).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Little Burdock Cove					
Surface	1 Jul 2022–8 Jul 2024	29.0	28.2	28.6	29.8
1 m	1 Jul 2022–8 Jul 2024	29.6	28.7	28.9	29.9
5 m	1 Jul 2022–8 Jul 2024	30.0	29.3	29.4	30.1
10 m	1 Jul 2022–8 Jul 2024	30.1	29.5	29.7	30.2
15 m	1 Jul 2022–8 Jul 2024	30.3	29.7	29.9	30.3
20 m	1 Jul 2022–8 Jul 2024	30.3	29.9	30.1	30.3
30 m	1 Jul 2022–8 Jul 2024	30.4	30.0	30.4	30.4

5.1.1.3 *Fortune Bay West (BMA 3)*

Fortune Bay West (BMA 3) has 11 licensed sea farms with water quality data available periodically during 2019–2024. Temporal coverage of water quality data collected in the Fortune Bay West BMA is variable for all 11 sea farms. The Cinq Island Cove sea farm (AQ 883;

see Figure 2.2) was selected to represent the water quality data for Fortune Bay West BMA as it contained one of the most complete and representative data sets of the 11 sea farms in the BMA.

Water Temperature

Seasonal water temperatures were generally consistent across sea farms with available data, as depths increase, water temperatures decreased except in winter (LGL 2025a). Mean water temperatures ranged from 1.3°C in winter at the Cinq Island Cove sea farm (0.5 m depth) to 18.3 C in summer at the McGrath Cove North sea farm (0.5 m depth) [LGL 2025a]. Maximum water temperatures were recorded at a depth of 0.5 m in summer, reaching 23.8°C and minimum temperatures occurred in winter at 1 m or above measuring 0.0°C (McGrath Cove North sea farm; LGL 2025a). Lowest water temperatures were observed in March in all sea farms. During 2020–2024 in the Cinq Island Cove sea farm, average and maximum water temperatures increased from May–August, while minimum temperatures increased from June–November (Figure 5.5).

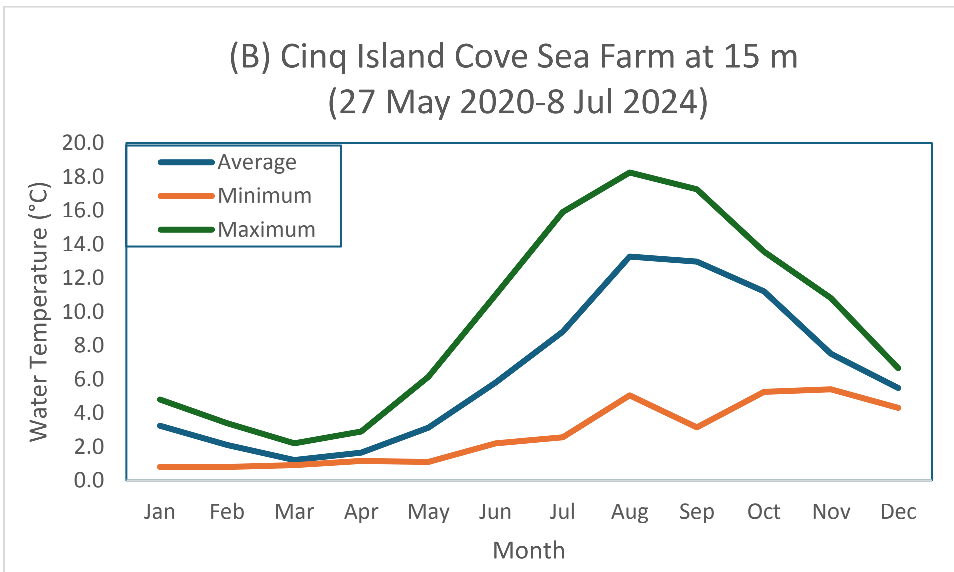


Figure 5.5. Historical water temperatures (°C) in the Cinq Island Cove sea farm at 15 m depth considered representative of water temperatures in BMA 3.

Dissolved Oxygen

Dissolved oxygen levels were consistently lower in summer and fall compared to winter and spring in sea farms in the Fortune Bay West BMA (LGL 2025a). Mean dissolved oxygen ranged from 8.0 mg/L in summer to 11.7 mg/L in winter at 0.5 m depth. Maximum observed dissolved oxygen was 15.6 mg/L, recorded at a depth of 1 m at the Ironskull Point sea farm (AQ 865; see Figure 2.2) in spring; minimum dissolved oxygen was 5.9 mg/L, measured at a depth of 1 m and 15 m in summer at the Cinq Island Cove sea farm (LGL 2025a). At the Cinq Island Cove sea farm, dissolved oxygen increased from October–May; average oxygen levels peaked in May whereas the lowest oxygen levels were observed in September (Figure 5.6).

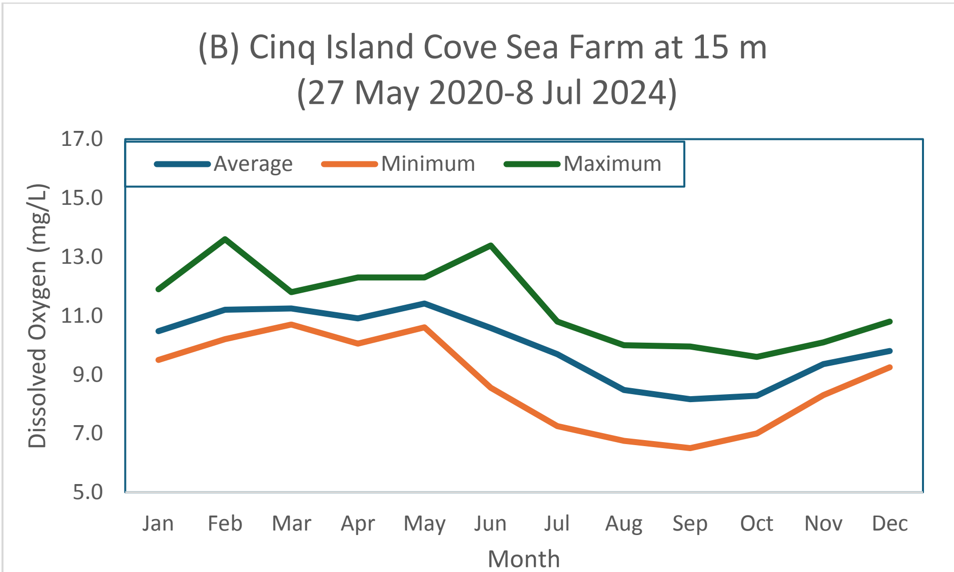


Figure 5.6. Historical dissolved oxygen (mg/L) levels in the Cinq Island Cove sea farm at 15 m depth considered representative of dissolved oxygen levels in BMA 3.

Salinity

Salinity was fairly consistent across sea farms and seasons in the Fortune Bay West BMA with averages ranging from 24.7–31.1 ppt (LGL 2025a). Results indicate a moderate freshwater influence near the surface that is more pronounced at Cinq Island Cove and Steamers Head sea farms. Table 5.2 provides a summary of average salinities in the Cinq Island Cove sea farm as representative of the Fortune Bay West BMA.

Table 5.2. Average salinities (‰) in the Cinq Island Cove sea farm in Fortune Bay West BMA (2023–2024).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Cinq Island Cove					
0.5 m	Jul 2023–Jun 2024	27.3	24.7	25.1	25.7
1 m	Jul 2023–Jun 2024	28.8	26.5	26.8	26.9
5 m	Jul 2023–Jun 2024	30.3	29.5	29.3	29.5
10 m	Jul 2023–Jun 2024	30.6	30.2	29.9	30.0
15 m	Jul 2023–Jun 2024	30.8	30.5	30.3	30.1
20 m	Jul 2023–Jun 2024	30.8	30.7	30.5	30.3
30 m	Jul 2023–Jun 2024	31.0	30.8	30.8	30.4

5.1.1.4 *Great Bay de l'Eau (BMA 4)*

Great Bay de l'Eau (BMA 4) has four licensed sea farms and water quality data were collected periodically during 2019–2024. Temporal coverage of water quality data collected in the Great Bay de l'Eau BMA are variable and are available for two of the sea farms. The Salmonier Cove sea farm (AQ 1048; see Figure 2.2) was selected to represent the water quality data for the Great Bay de l'Eau BMA as it contained the most recent data set (2022–2024) of the sea farms in the BMA.

Water Temperature

Seasonal water temperatures were generally consistent across the two sea farms with available data. At depths 10 m and below, water temperatures were slightly warmer in winter but cooler during other seasons. In contrast, at depths above 10 m water temperatures were higher in spring, summer and fall (LGL 2025a).

Mean water temperatures ranged from 1.5°C in winter (0.5 depth) to 17.0°C in summer (0.5 m depth) at the Salmonier Cove sea farm. Maximum water temperatures at the Salmonier Cove sea farm were recorded at a depth of 0.5 m in summer, reaching 20.9°C. The minimum water temperatures occurred in winter at the same depth, measuring -1.0°C. During 2022–2024, data collected at the Salmonier Cove sea farm indicated an increase in average and maximum temperatures from April–September, while minimum temperatures were highest in November (Figure 5.7).

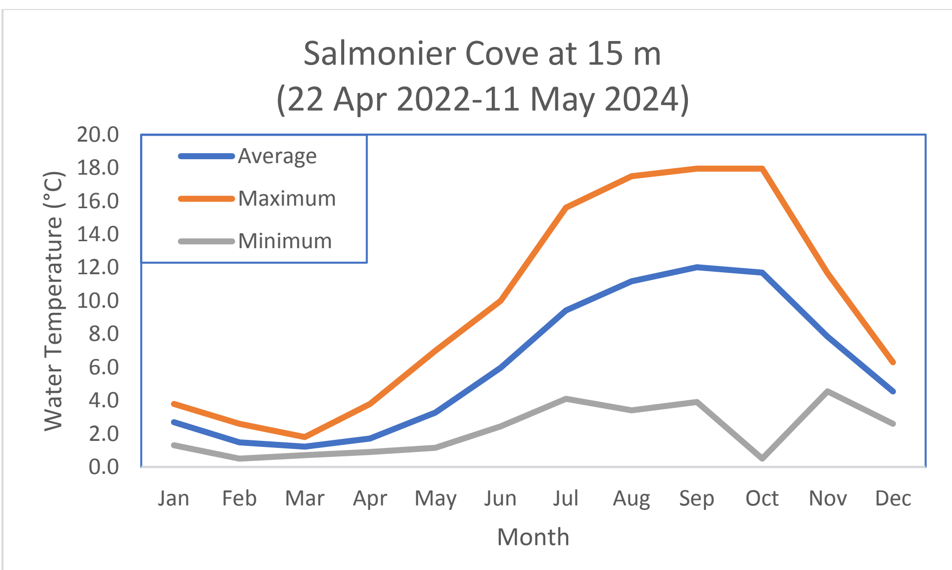


Figure 5.7. Historical water temperatures (°C) data in the Salmonier Cove sea farm at 15 m depth considered representative of water temperatures in BMA 4.

Dissolved Oxygen

Dissolved oxygen levels were consistently lower in summer compared to the other seasons (Figure 5.8). Mean dissolved oxygen levels ranged from 7.8 mg/L in summer (1.0 m depth at Salmonier Cove) to 12.4 mg/L in winter (0.5 m depth at Murphy Point sea farm [LGL 2025a). The maximum dissolved oxygen level was 15.9 mg/L, recorded at a depth of 1 m at the Murphy Point sea farm in winter, while the minimum dissolved oxygen level was 5.1 mg/L, measured at a depth of 0.5 m in summer at the Salmonier Cove sea farm (LGL 2025a).

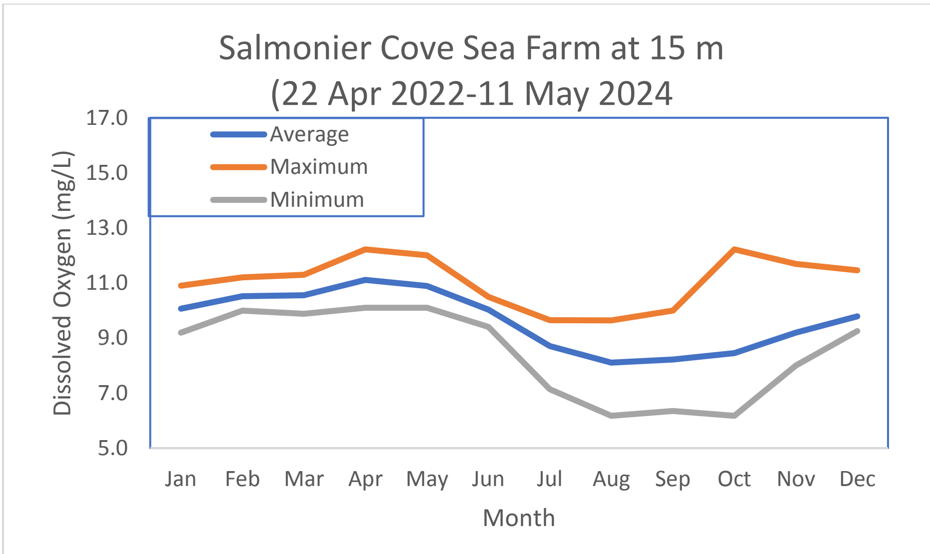


Figure 5.8. Historical dissolved oxygen (mg/L) levels at the Salmonier Cove sea farm at 15 m depth considered representative of dissolved oxygen levels in BMA 4.

Salinity

Salinity was generally consistent across sea farms and seasons with averages ranging from 27.05–31.01 ppt. Results indicate a moderate freshwater influence near the surface. Table 5.3 provides a summary of average salinities at the Salmonier Cove sea farm as representative of the Great Bay de l'Eau BMA.

Table 5.3. Average salinities (‰) in the Salmonier Cove sea farm in the Great Bay de l'Eau BMA (2022–2024).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Salmonier Cove					
0.5 m	22 Apr 2022–11 May 2024	28.46	28.75	27.05	28.20
1 m	22 Apr 2022–11 May 2024	29.81	29.74	28.56	29.25
5 m	22 Apr 2022–11 May 2024	30.51	30.64	29.94	30.13
10 m	22 Apr 2022–11 May 2024	30.96	30.79	30.41	30.21
15 m	22 Apr 2022–11 May 2024	30.99	30.85	30.66	30.46
20 m	22 Apr 2022–11 May 2024	30.64	30.90	30.81	30.59
30 m	22 Apr 2022–11 May 2024	30.61	30.96	30.85	30.66

5.1.1.5 Harbour Breton Bay (BMA 5)

Harbour Breton Bay (BMA 5) has four licensed sea farms and water quality data were periodically collected during 2019–2024. Temporal coverage of water quality data in the Harbour Breton Bay BMA are variable for the four sea farms. The Harvey Hill East sea farm (AQ 933; see Figure 2.2) was selected to represent the water quality data for Harbour Breton Bay BMA as it contained one of the most complete data sets of the four sea farms in the BMA.

Water Temperature

In BMA 5, the mean minimum water temperature was 2.1°C (winter in Broad Cove sea farm and the mean maximum was 15.7°C (summer in Harvey Hill East sea farm; LGL 2025a). The maximum water temperature observed was 20.2°C (at 0.5 m water depth) in the Harvey Hill East sea farm. The minimum water temperature observed was 0.08°C in the Broad Cove sea farm (<1 m). During the same period, the Harvey Hill East sea farm had a minimum temperature of 0.3°C. During 2019–2024 in the Harvey Hill East sea farm, average and maximum water temperatures increased from April–September, while minimum temperatures increased from August–October (Figure 5.9).

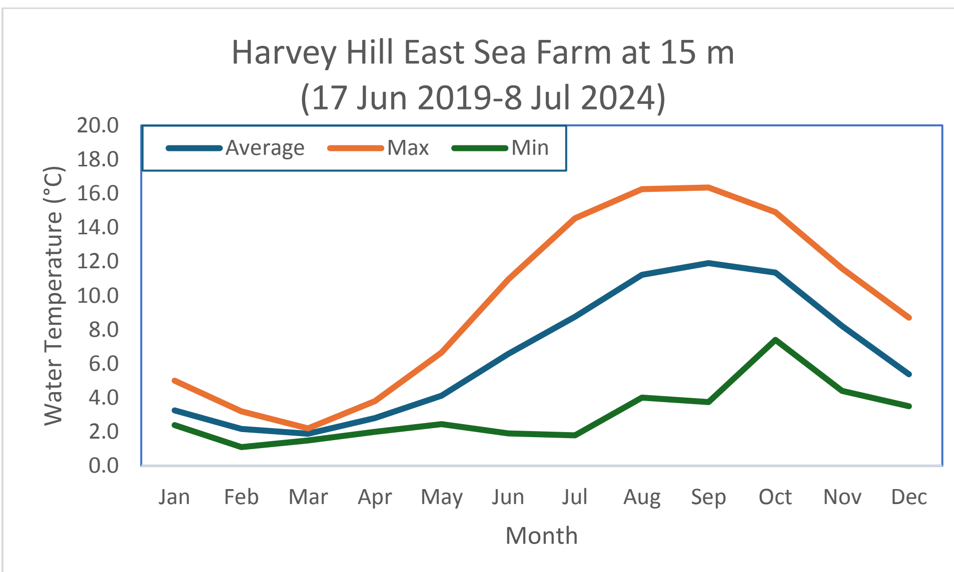


Figure 5.9. Historical water temperatures (°C) at 15 m depth in the Harvey Hill East sea farm considered representative of water temperatures in BMA 5.

Dissolved Oxygen

As in other BMAs, dissolved oxygen levels were consistently lower in summer and fall compared to winter and spring. Mean dissolved oxygen ranged from 8.2 mg/L in summer (1 m depth in Broad Cove sea farm to 11.6 mg/L in fall (10 m depth; Harvey Hill North sea farm LGL 2025a).

The maximum observed dissolved oxygen level was 13.8 mg/L, recorded at a depth of 15 m at the Harvey Hill North sea farm in summer; the minimum dissolved oxygen level was 5.5 mg/L, measured at a depth of 1 m in summer and fall at the Broad Cove sea farm (LGL 2025a). At the Harvey Hill East sea farm, dissolved oxygen levels increased from November–April; average oxygen levels peaked in April whereas the lowest oxygen levels were observed in July (Figure 5.10).

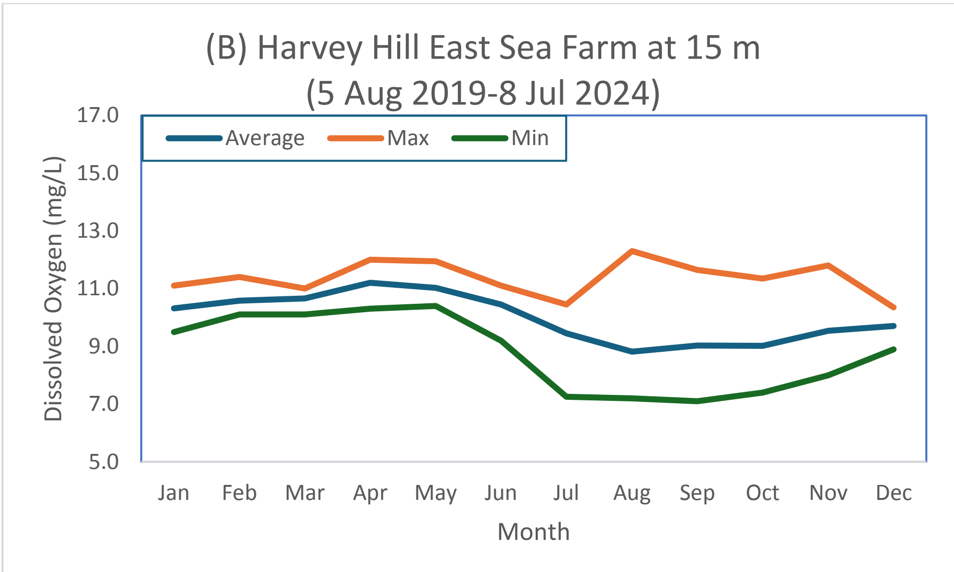


Figure 5.10. Historical dissolved oxygen (mg/L) levels in the Harvey Hill East sea farm at 15 m depth considered representative of dissolved oxygen levels in BMA 5.

Salinity

Salinity was fairly consistent across sea farms and seasons (where data were available) in the Harbour Breton Bay BMA with averages ranging from 27.6–30.8 ppt. Table 5.4 provides a summary of average salinities at the Harvey Hill East sea farm as representative of the Harbour Breton Bay BMA.

Table 5.4. Average salinities (‰) at the Harvey Hill East sea farm in the Harbour Breton Bay BMA (2021–2024).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Harvey Hill East					
0.5 m	26 May 2021–8 Jul 2024	29.49	29.61	29.30	29.60
1 m	26 May 2021–8 Jul 2024	29.80	29.79	29.44	29.80
5 m	25 May 2021–8 Jul 2024	30.11	30.32	29.90	30.18
10 m	26 May 2021–8 Jul 2024	30.22	30.49	30.19	30.28
15 m	26 May 2021–8 Jul 2024	30.29	30.52	30.37	30.33
20 m	26 May 2021–8 Jul 2024	30.33	30.61	30.46	30.38
30 m	26 May 2021–8 Jul 2024	30.39	30.77	30.55	30.44

5.1.2 Bays West Sea Farms

The Bays West area includes BMAs 8–15 (see Figure 2.3) and water quality data were collected by MCE periodically during 2019–2024 (in BMAs 10, 12, 13). The available water quality data in BMAs 10, 12, and 13 are representative of sea farms currently in active production and includes water temperature, dissolved oxygen and salinity data. Two BMAs (BMA 8 and BMA 9) are currently not used for production. These two BMAs are being actively used by another Atlantic salmon producer. In an effort to avoid interaction, there are no immediate plans to supply smolt to MCE's eight sea farms within these two BMAs. The provincial FFA (formerly DFLR) has collected water quality data in the Bays West area in the past. These historical data have been provided to MCE during their license application and where available are included in the summaries for BMAs 9, 11, 14 and 15.

5.1.2.1 Little Passage (BMA 8)

Little Passage (BMA 8) has four licensed sea farms. No recent water quality data have been collected (since last production in 2009) in sea farms in the Little Passage BMA. The area is actively farmed by other operators and at such a time MCE were to redevelop its sea farms in the area, daily measurements of biophysical data will be collected and reported quarterly as per its aquaculture license requirements.

5.1.2.2 Outer Bay d'Espoir (BMA 9)

Outer Bay d'Espoir (BMA 9) has four licensed sea farms. Data were collected by FFA (formerly DFLR) in the Outer Bay d'Espoir BMA (undated) and is representative of the general area. Water quality measurements for temperature and salinity are summarized. There are no dissolved oxygen data. At such time MCE were to redevelop its sea farms in the area, daily measurements of biophysical data will be collected and reported quarterly as per its aquaculture license requirements.

Water Temperature

Historical water temperature data were collected (undated) by FFA (formerly DFLR) at the Outer Bay d'Espoir BMA (Table 5.5). Average water temperatures at the surface ranged from 0°C in the winter to 17°C in the summer. Above 10 m water depth, water temperatures were the highest in summer and lowest in the winter. At 10 m depth, water temperatures are only slightly higher in summer and fall (4°C) compared to winter and spring (2°C).

Table 5.5. Historical water temperature (°C) profiles for the Outer Bay d'Espoir BMA collected by DFLR (undated).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Temperature (°C)			
BMA 9					
0 m	n/a	0	5	17	10
1 m	n/a	0.1	4	14	10
2 m	n/a	0.2	3	13	11
3 m	n/a	1	2	13	11
4 m	n/a	1	2	12	12
5 m	n/a	1	2	12	12
10 m	n/a	1	2	4	4

Notes:
Months were not defined for each season.

Dissolved Oxygen

There were no available data for dissolved oxygen within the Outer Bay d'Espoir BMA.

Salinity

Salinity was relatively consistent at 2 m water depth and below, with averages ranging from 25–30 ppt (Table 5.6). Results indicate a notable freshwater influence near the surface in the winter, spring and summer that is characteristic of Bay d'Espoir and the impact of the hydroelectric generation at the head of the bay. Above 2 m, salinity ranged from 15–17 ppt in spring and summer, and 30 ppt in fall (DFLR undated).

Table 5.6. Historical average salinity (‰) at the sea farms in the Outer Bay d'Espoir BMA (undated).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
BMA 9					
0 m	n/a	n/a	15	15	30
1 m	n/a	n/a	17	17	30
2 m	n/a	25	20	20	30
3 m	n/a	30	28	28	30
4 m	n/a	30	30	30	30
5 m	n/a	30	30	30	30
10 m	n/a	30	30	30	30

Notes:
Months were not defined for each season.

5.1.2.3 *Facheux Bay (BMA 10)*

Facheux Bay (BMA 10) has four licensed sea farms. Water quality data including water temperature, dissolved oxygen and salinity, were available for the Wallace Cove sea farm during 2019–2024 (AQ 1123; see Figure 2.3).

Water Temperature

In the Wallace Cove sea farm, mean water temperatures ranged from 1.6°C in winter to 16.9°C in summer (at 0.5 m water depth). Maximum water temperatures were recorded at 0.5 m in summer, reaching 22.9°C. Minimum temperatures occurred in winter at the same depth, measuring -0.8°C. During 2019–2024, water temperatures generally increased from April–September, with average temperatures peaking in September and decreasing thereafter. Maximum water temperatures peaked in August (Figure 5.11).

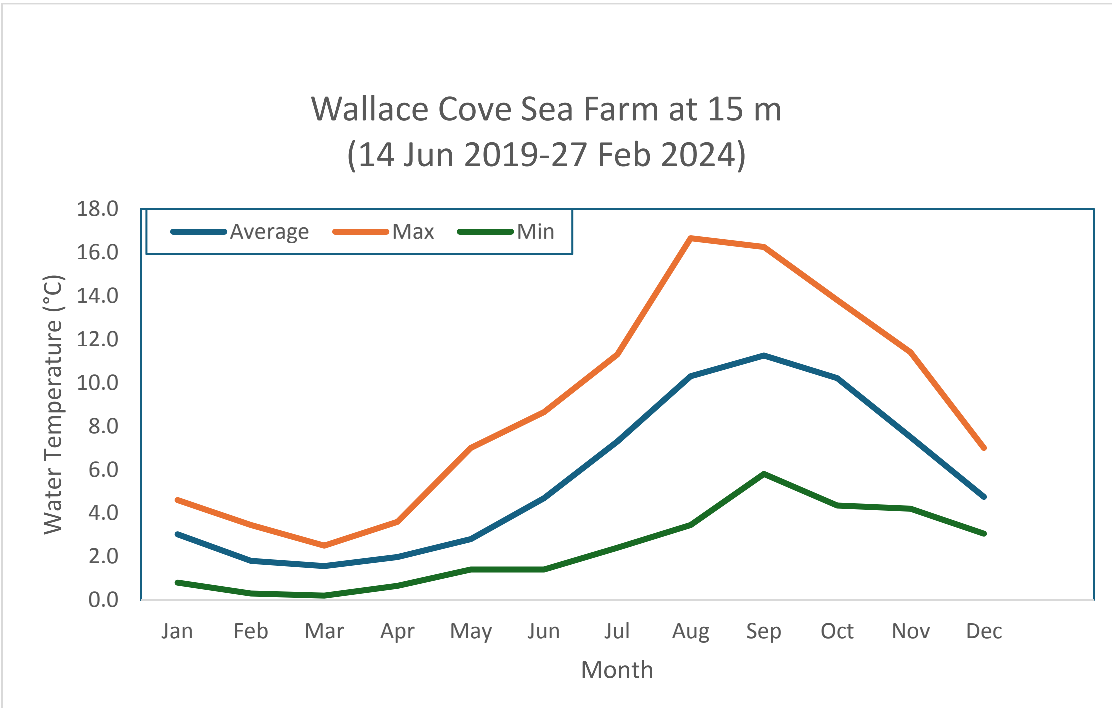


Figure 5.11. Historical water temperatures (°C) in the Wallace Cove sea farm at 15 m depth in BMA 10.

Dissolved Oxygen

Dissolved oxygen levels at the Wallace Cove sea farm were consistently lower in summer and fall compared to winter and spring. Mean dissolved oxygen levels ranged from 8.6 mg/L to 11.3 mg/L in winter (0.5–1.0 m water depth). The maximum dissolved oxygen level was 14.2 mg/L in winter (0.5 m water depth) and the minimum level was 4.1 mg/L in fall (at 1 m).

During 2019–2024 in the Wallace Cove sea farm, a general decrease in dissolved oxygen levels was recorded from June–October, followed by an increase in winter and spring. Average dissolved oxygen levels peaked in April, while the lowest levels were recorded in October. Maximum dissolved oxygen levels were highest in June while minimum dissolved oxygen levels were lowest in August (Figure 5.12).

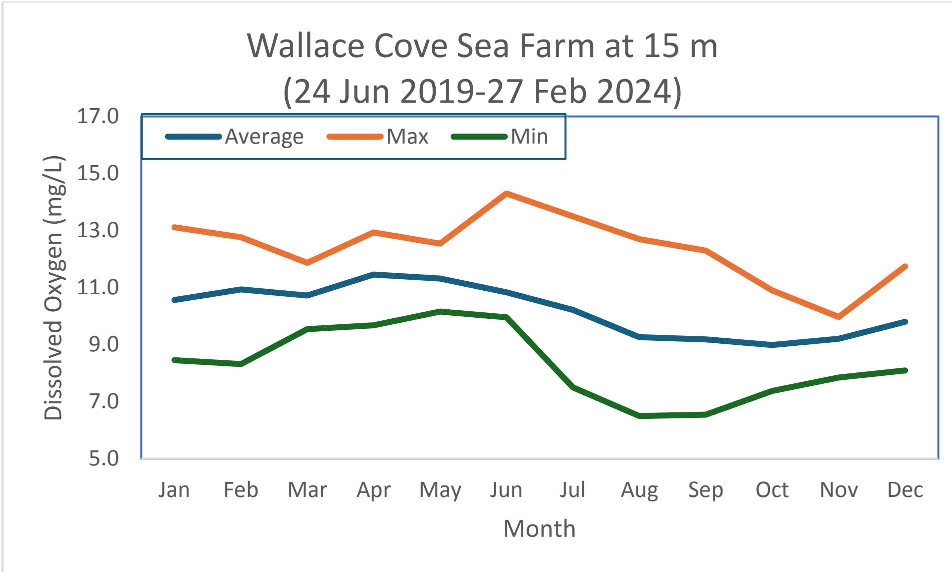


Figure 5.12. Historical dissolved oxygen (mg/L) levels in the Wallace Cove sea farm at 15 m depth in BMA 10.

Salinity

Salinities at the Wallace Cove sea farm was fairly consistent across the seasons with averages ranging from 24.3 (0.5 m) to 31.0 ppt (30 m) (Table 5.7). A moderate freshwater influence is observed near the surface that is more pronounced in the spring, summer and fall.

Table 5.7. Average salinities (‰) at the sea farms in the Facheux Bay BMA (2019–2024).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Wallace Cove					
0.5 m	4 Jul 2019–27 Feb 2024	28.70	24.32	24.42	25.52
1 m	11 Nov 2019–27 Feb 2024	29.06	25.42	24.69	26.76
5 m	21 Jun 2019–27 Feb 2024	30.13	28.49	28.32	29.70
10 m	11 Nov 2019–27 Feb 2024	30.57	29.43	29.64	30.25
15 m	4 Jul 2019–27 Feb 2024	30.70	29.77	30.02	30.60
20 m	11 Nov 2019–27 Feb 2024	30.80	29.91	30.29	30.76
30 m	11 Nov 2019–27 Feb 2024	31.01	30.02	30.35	30.94

5.1.2.4 Hare Bay (BMA 11)

Hare Bay (BMA 11) has two licensed sea farms. Salinity data were collected by FFA (formerly DFLR) during 1994–2003. There are no available water temperature or dissolved oxygen data for the Hare Bay BMA.

Salinity

Salinities were relatively consistent across seasons with averages ranging from 25.8–31.7 ppt (Table 5.8) in the Hare Bay BMA during 1994 and 2003. The results indicate a moderate freshwater influence near the surface that is more pronounced in the spring.

Table 5.8. Historical salinity (‰) profiles within Hare Bay BMA collected by DFLR (1994/5–2003).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Hare Bay					
0 m	1994/5–2003				
1 m	1994/5–2003	28.8	25.8	29	n/a
2 m	1994/5–2003	29.1	26.1	29	n/a
3 m	1994/5–2003	30.5	30.1	30	27
4 m	1994/5–2003	31.2	31.2	30	30
5 m	1994/5–2003	31.3	31.5	31	31.5
10 m	1994/5–2003	31.6	31.7	31	31.5

Notes:
Months were not defined for each season.

5.1.2.5 Rencontre West (BMA 12)

Rencontre West (BMA 12) has four licensed sea farms and water quality data were collected during 2020–2024 for three of the sea farms. Temporal coverage of water quality data are variable for all three sea farms. The Little Bay sea farm (AQ 1134; see Figure 2.3) was selected to represent the water quality data for Rencontre West BMA as it contained one of the most complete and representative data sets for the BMA.

Water Temperature

Seasonal water temperatures were generally consistent across sea farms with available data. Mean water temperatures ranged from 1.4°C in winter in the Devil Bay sea farm (5 m depth) to 15.1°C in summer at The Gorge sea farm (0.5 m depth; LGL 2025a). Maximum water temperatures were recorded at a depth of 0.5 m in summer, reaching 20.1°C (The Gorge) and minimum temperatures occurred in winter, measuring 0.20°C (Devil Bay). During 2020–2024 in the Little Bay sea farm average temperatures increased from April–September, while maximum temperatures increased from April–August (Figure 5.13).

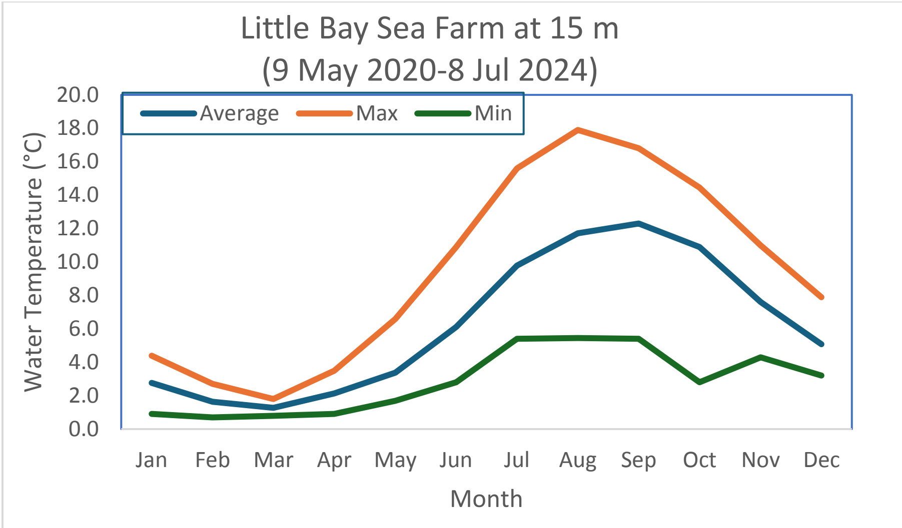


Figure 5.13. Historical water temperatures (°C) at 15 m depth in the Little Bay sea farm considered representative of water temperatures in BMA 12.

Dissolved Oxygen

Dissolved oxygen levels (average) were consistently lower in summer and fall compared to winter and spring (Figure 5.14 and LGL 2025a). Mean dissolved oxygen levels ranged from 7.8 mg/L in summer (Little Bay sea farm) to 11.5 mg/L in winter (Devil Bay sea farm) at 0.5 m depth. In the Little Bay sea farm, the maximum dissolved oxygen level was 15.0 mg/L (water depth of 0.5 m) in winter; the minimum dissolved oxygen level was 4.3 mg/L (water depth of 5 m) in summer.

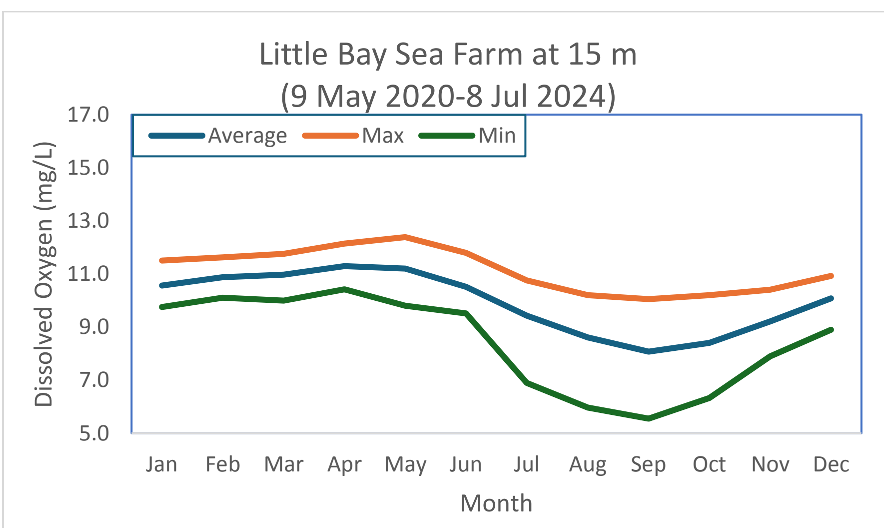


Figure 5.14. Historical dissolved oxygen (mg/L) levels in the Little Bay sea farm at 15 m depth considered representative of dissolved oxygen levels in BMA 12.

Salinity

Salinity was fairly consistent across sea farms and seasons with averages ranging from 27.9–31.0 ppt (LGL 2025a). Table 5.9 provides a summary of average salinities in the Little Bay sea farm as representative of the Rencontre West BMA. Near surface salinity concentrations indicate a moderate freshwater influence.

Table 5.9. Average salinity (‰) at the Little Bay sea farm in the Rencontre West BMA (2020–2024).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Little Bay					
0.5 m	9 May 2020–8 Jul 2024	29.39	28.66	28.91	28.83
1 m	9 May 2020–8 Jul 2024	29.57	29.18	29.16	29.00
5 m	9 May 2020–8 Jul 2024	29.93	29.89	29.86	29.48
10 m	9 May 2020–8 Jul 2024	30.04	30.26	30.35	29.79
15 m	9 May 2020–8 Jul 2024	30.10	30.37	30.62	29.91
20 m	9 May 2020–8 Jul 2024	30.03	30.50	30.80	29.99
30 m	9 May 2020–8 Jul 2024	30.15	30.68	30.89	30.01

5.1.2.6 *Chaleur Bay (BMA 13)*

Chaleur Bay (BMA 13) has three licensed sea farms and water quality data were collected during 2021–2024 for two of the sea farms. Temporal coverage of water quality data are variable for both sea farms. The Chaleur Bay sea farm (AQ 1147; see Figure 2.3) was selected to represent the water quality data for Chaleur Bay BMA as it contained the broadest temporal coverage.

Water Temperature

Seasonal water temperatures were generally consistent between both sea farms, with Chaleur Bay sea farm exhibiting slightly higher water temperatures compared to Friar Cove [LGL 2025a]. For the available data, mean water temperatures ranged from 2.1°C in winter at Chaleur Bay (0.5 m depth) to 15.6°C in summer at the same site and depth. Maximum water temperatures at both Friar Cove and Chaleur Bay sea farms were recorded at a depth of 0.5 m in summer, reaching 19.6°C and 21.6°C, respectively. Minimum temperatures occurred in winter at similar depths, measuring 0.8°C in Friar Cove and 0.4°C in Chaleur Bay. Water temperatures were the lowest in February at both sea farms (LGL 2025a). During 2021–2022 in the Chaleur Bay sea farm, average and maximum water temperatures increased from April–September, while minimum temperatures increased from May–October (Figure 5.15).

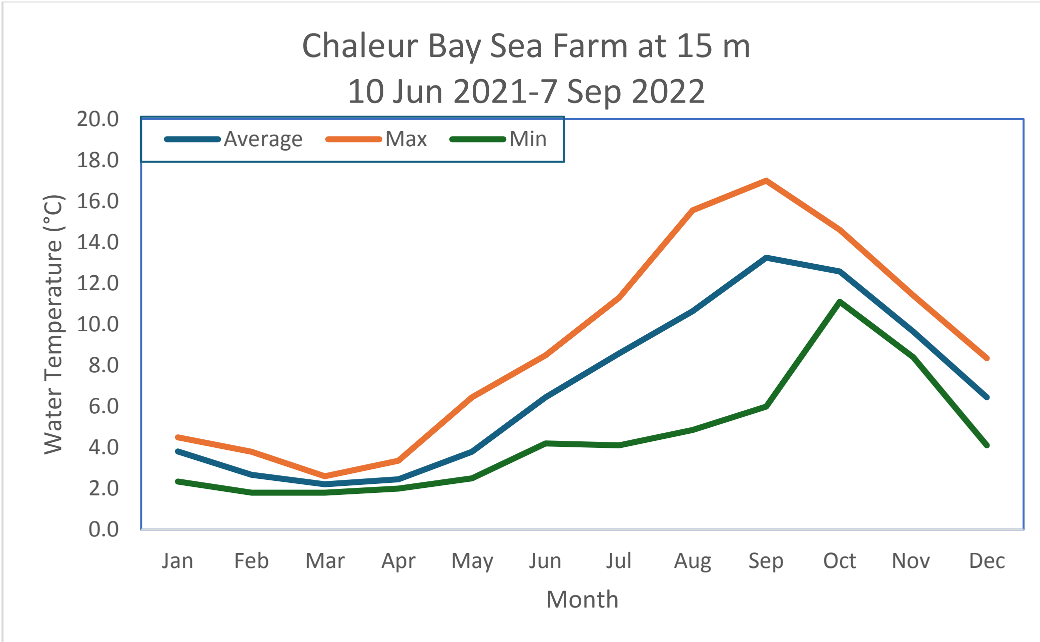


Figure 5.15. Historical water temperatures (°C) in the Chaleur Bay sea farm at 15 m depth considered representative of water temperatures in BMA 13.

Dissolved Oxygen

Mean dissolved oxygen levels ranged from 8.6 mg/L in summer to 11.0 mg/L in winter (at 0.5 m depth at Chaleur Bay). Based on the available data, the maximum dissolved oxygen level was 13.5 mg/L, recorded at 0.5 m depth at Chaleur Bay in spring, while the minimum dissolved oxygen level was 6.4 mg/L, measured at 1 m depth at Chaleur Bay in spring. Dissolved oxygen levels across all water depths showed a seasonal trend, with higher values in winter and spring, decreasing in summer and fall (LGL 2025a).

In the Chaleur Bay sea farm, dissolved oxygen levels increased from November–April; both average and maximum oxygen levels peaked in April whereas the lowest oxygen levels were observed in October (Figure 5.16).

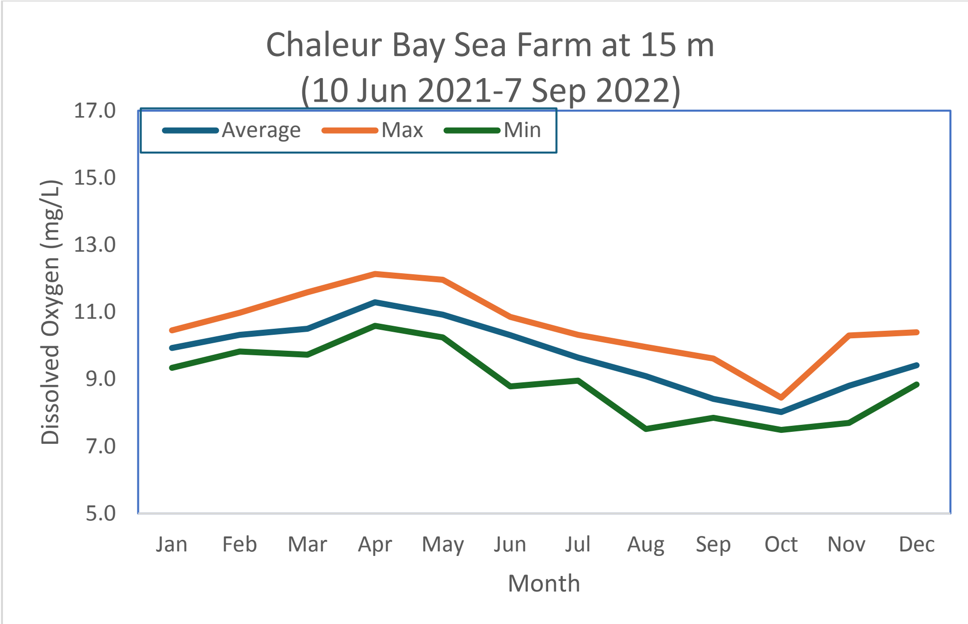


Figure 5.16. Historical dissolved oxygen (mg/L) levels in the Chaleur Bay sea farm at 15 m depth considered representative of dissolved oxygen levels in BMA 13.

Salinity

Salinity was fairly consistent across sea farms and seasons with averages ranging from 27.0 during summer at 0.5 m water depth in Chaleur Bay sea farm to 34.0 ppt in Friar Cove sea farm during winter at 30 m water depth (LGL 2025a). In the Chaleur Bay sea farm, salinity concentrations indicated a moderate freshwater influence near the surface in spring. Table 5.10 provides a summary of average salinities at the Chaleur Bay sea farm considered representative of BMA 13.

Table 5.10. Average salinities (‰) in the Chaleur Bay sea farm in BMA 13 (2021–2022).

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Chaleur Bay					
0.5 m	10 Jun 2021–7 Sep 2022	29.88	27.06	27.01	25.98
1 m	10 Jun 2021–7 Sep 2022	30.37	28.29	28.15	27.06
5 m	10 Jun 2021–7 Sep 2022	31.21	30.13	29.86	29.76
10 m	10 Jun 2021–7 Sep 2022	31.52	30.41	29.96	30.36
15 m	10 Jun 2021–7 Sep 2022	31.67	30.52	30.22	30.65
20 m	10 Jun 2021–7 Sep 2022	31.78	30.58	30.33	30.65
30 m	10 Jun 2021–7 Sep 2022	31.76	30.81	30.48	30.77

5.1.2.7 Aviron Bay and La Hune Bay (BMA 14) and Bay de Vieux (BMA 15)

Aviron Bay and La Hune Bay (BMA 14) and Bay de Vieux (BMA 15) each have three licensed sea farms. These six licenses were recently acquired by MCE in 2024. The available water quality data for both the Aviron Bay and La Hune Bay BMA and the Bay de Vieux BMA are a composite of information from several sources including historical data collected by DFLR (1994–1995; 2003–2004), a review of publications for the area, and data collected during production at nearby sea farms (L. Hiemstra, Owner, Mel Mor Science, pers. comm., 5 Dec 2024).

Water Temperature

Based on available data, seasonal average water temperatures were generally consistent across water depths in winter and spring (Table 5.11). Water depths 10 m and below are typically cooler than surface depths in the summer and fall. Mean water temperatures ranged from 3.0°C (10 m water depth) in spring to 12.5°C (0 m water depth) in summer.

Table 5.11. Seasonal temperature for Aviron Bay and La Hune Bay (BMA 14) and Bay de Vieux (BMA 15) based on a composite of data sources including those from FFA, literature, and MCE.

Water Depth	Sampling Period	Winter (Dec, Jan, Feb)	Spring (Mar, Apr, May)	Summer (Jun, Jul, Aug)	Fall (Sep, Oct, Nov)
		Temperature (°C)			
Aviron Bay and La Hune Bay and Bay de Vieux					
0 m	n/a	3.2	3.5	12.5	11.3
1 m	n/a	3.2	3.5	12.4	11.3
5 m	n/a	3.2	3.2	12.0	11.2
10 m	n/a	3.3	3.0	11.0	11.0
15 m	n/a	3.3	2.8	9.0	11.0
30 m	n/a	3.3	2.5	7.8	9.7

The FFA (formerly DFLR) collected data on water temperature in Aviron Bay (2003–2004) (Figure 5.17). Surface (3 m) temperatures peaked in August while water temperatures at 9–18 m depth were highest near the end of September. All water temperatures decreased in October, increasing again in April.

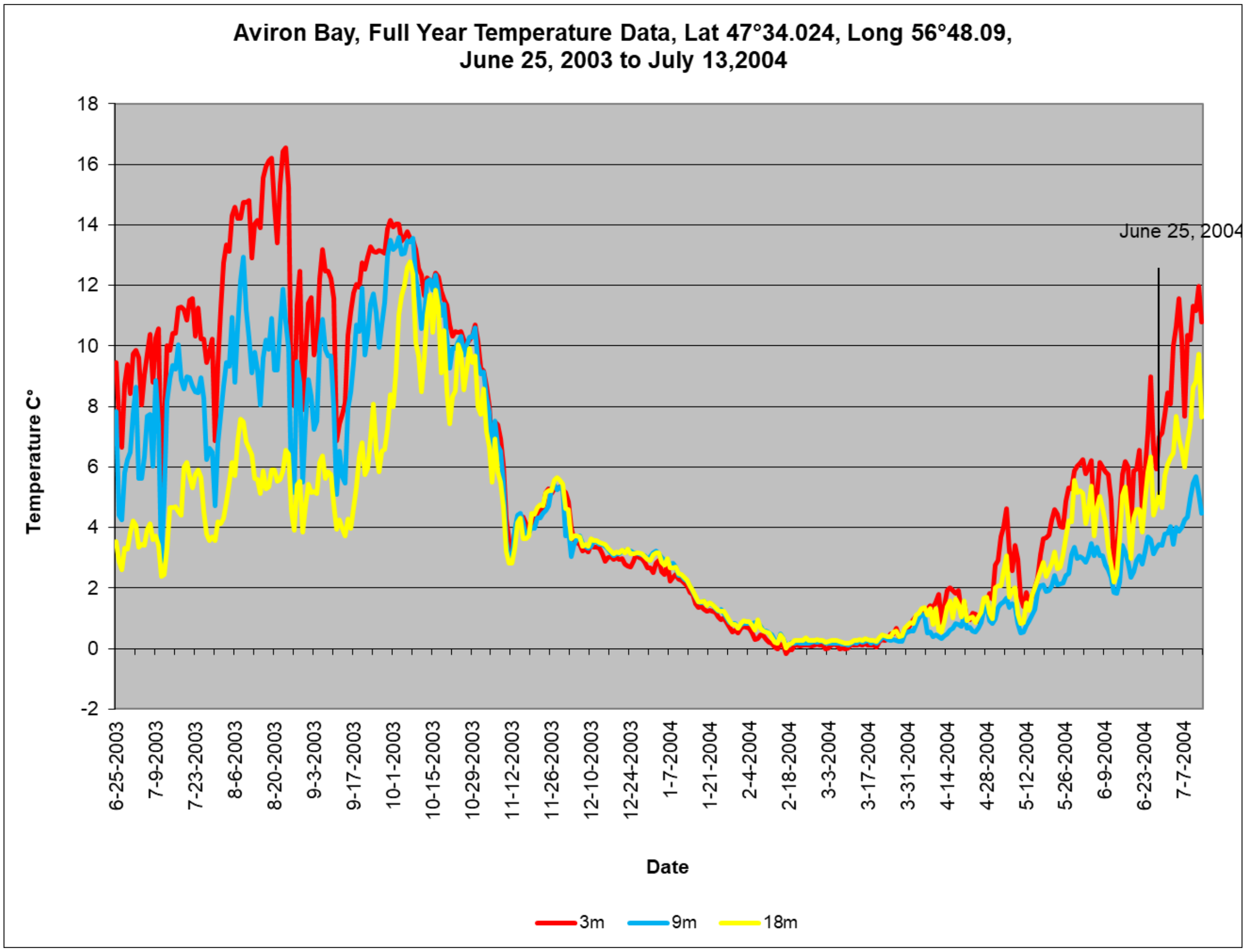


Figure 5.17. Historical water temperatures (°C) at 3, 9, and 18 m depths in Aviron Bay and La Hune Bay (June 2003–July 2004), collected by DFLR and considered representative of Bay de Vieux (BMA 15).

Dissolved Oxygen

There are no available dissolved oxygen data for the Aviron Bay and La Hune Bay BMA and Bay de Vieux BMA. See Section 5.1.2.5, BMA 12 (Little Bay [AQ 1134; see Figure 2.3]) for data from nearby sea farms that serve as a proxy for the Aviron Bay and La Hune Bay BMA as well as Bay de Vieux BMA.

Salinity

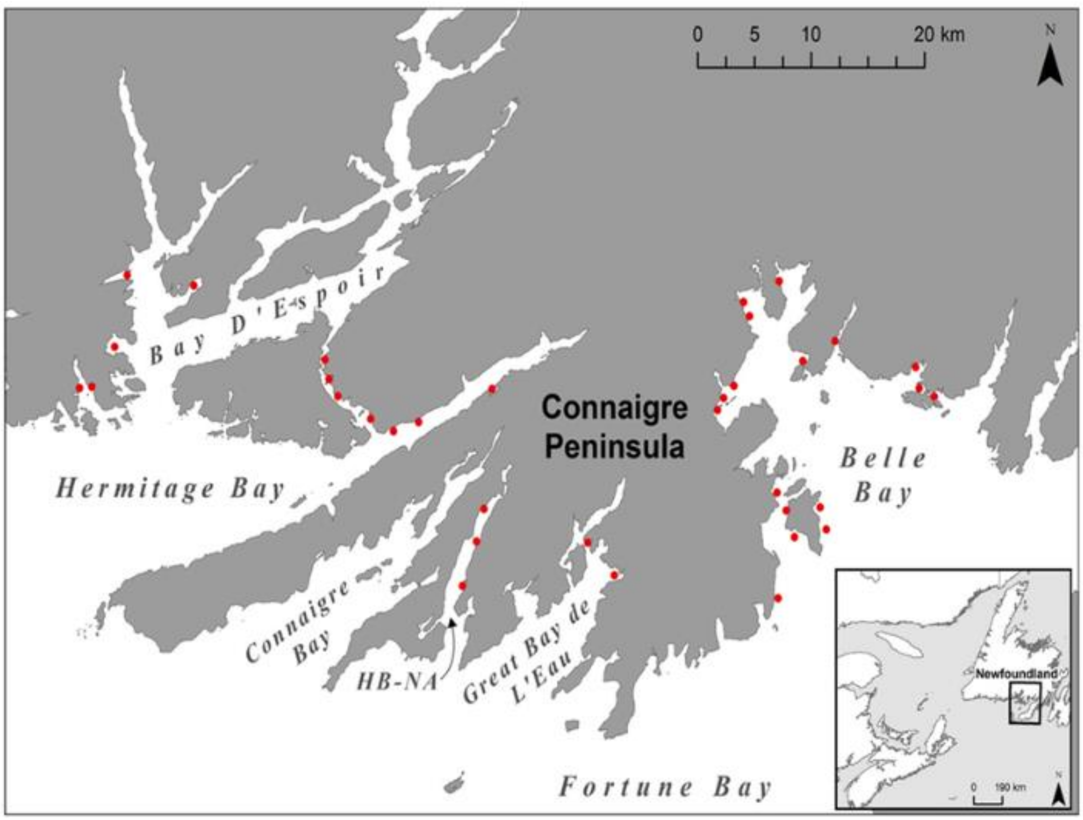
As noted above, available salinity data are a composite from several sources. As in other BMAs, salinities were fairly consistent across sea farms and seasons with averages ranging from 30–32 ppt (Table 5.12).

Table 5.12. Seasonal salinities for Aviron Bay and La Hune Bay (BMA 14) and Bay de Vieux (BMA 15) are based on a composite of data sources including those from DFLR, literature, and MCE.

Water Depth	Sampling Period	Winter	Spring	Summer	Fall
		Salinity (‰)			
Aviron Bay and La Hune Bay Area; Bay de Vieux					
0 m	n/a	30	30	30	30
1 m	n/a	30	30	30	30
5 m	n/a	30	31	30	30
10 m	n/a	30	31	31	30
15 m	n/a	30	32	31	30
30 m	n/a	31	32	31	30

6.0 Benthic Characteristics of MCE Sea Farms

Marine sediments provide habitat for infaunal and epibenthic biota, which in turn interact with non-benthic marine organisms. The composition of benthic biotic assemblages is dependent largely on sediment particle size and water depth. Bottom substrate types in the sea farm Study Area are variable, typically characterized by varying proportions of fine sediment (mud, sand, silt), medium sediment (gravel, pebble, cobble), coarse sediment (rubble, boulder), bedrock/ continuous rock, and rock wall/ vertical rock (Salvo et al. 2018; LGL 2025a). In addition to the sediment, some benthic invertebrates (i.e., corals and sponges) form structural colonies that are important habitats for other animals, including fish. The habitat formed by corals depends on how and where they grow, and different corals can provide a home for various marine animals during several life stages. Sea pens (Pennatulaceans) can grow individually or in assemblages and can typically be found growing on muddy sediment. Most sponges are found growing on rocky substrates. Salvo et al. (2018) recorded the presence of sponges and soft corals within the Bay d'Espoir, Hermitage Bay, Fortune Bay, and Belle Bay areas (see Figure 6.1 for sampling sites). *Gersemia* spp. was the most common soft coral, typically found growing on rocky substrates. Sponges were difficult to identify but were primarily attached to hard substrates.



Source: Hamoutene et al. (2016); Salvo et al. (2018).

Figure 6.1. Location of Bay d'Espoir, Hermitage Bay, Fortune Bay, and Belle Bay areas surveyed by Salvo et al. (2018).

Eelgrass (*Zostera marina*) is recognized as important nursery habitat for marine fish species, including Atlantic cod (see DFO 2009). Though there are instances of eelgrass in the sea farm Study Area (see Table 6.1 below; Rao et al. 2014), substantial areas have not been identified (K. Best, Fisheries Biologist, Marine Institute, pers. comm., 25 September 2024). The majority of habitat surveys of the south coast have been undertaken by aquaculture operators as part of the licensing process and by Salvo et al. (2018), and habitat surveys of other regions of the south coast are lacking. Kelp beds serve as essential habitat for a diverse array of marine species, offering both food and shelter to organisms such as crustaceans and fish.

6.1 Benthic Habitat Surveys

For aquaculture operators in Canada, the protection of benthic habitat falls under the mandate of DFO primarily through the Aquaculture Activities Regulations (AAR). Applicants are required to survey new aquaculture sites (and expansion of existing sites). Once operational, finfish aquaculture operators are required to conduct monitoring of the benthos during a period in the production cycle that is close to peak feeding for indicators of Biological Oxygen Demanding (BOD) matter. Benthic surveys for finfish aquaculture are typically conducted through video monitoring, often using drop cameras. The systematic surveys are conducted along transects based on the number of cages at the sea farm.

Salvo et al. (2018) released a photo guide based on images collected using a drop camera, of the natural benthic taxa and substrates as well as visual indicators of aquaculture deposition along the south coast of Newfoundland. At the time of Salvo's study, this area had established finfish aquaculture activities, particularly areas in the sea farm Study Area, i.e., Bay d'Espoir, Hermitage Bay, Fortune Bay, and Belle Bay (see Figure 6.1). Motile species such as fish, lobster, shrimp and planktonic species were not included in the study due to the potential influence of factors such as time of day, seasonal migrations, hiding, attraction, or deterrent behaviors. Salvo et al. (2018) observed many species that were also observed during MCE's monitoring for licensing purposes, including various echinoderms (sea star spp., green sea urchins), worm spp., sea scallops, blue mussels, anemones, soft corals (*Gersemia* spp.), porifera, kelp, and coralline algae.

Prior to 2018, research on benthic communities in the region of the south coast of Newfoundland was limited, with only a single study describing hard bottom benthic communities in this region using video (Salvo et al. 2018). The geographical location (i.e., bay level) is an important factor for determining the composition of natural benthic communities and benthic taxa may not always be affected by substrate type or depth, but rather by the interaction between the two factors, even if some organisms do exhibit depth and substrate preferences.

MCE, as part of its licensing process, has conducted marine benthic surveys in 12 of the 13 BMAs, at a total of 49 sea farms (of a total licensed 53 sea farms) using drop cameras. No benthic surveys have been conducted on sea farms in the Little Passage BMA (BMA 8; see Figure 2.3). MCE will collect baseline data as required prior to stocking farms in BMA 8. Various taxa and substrates were identified through the video assessments collected at MCE's 49 sea farms. Indicators of benthic changes due to aquaculture activities include the presence of Opportunistic Polychaete Complex (OPC), white *Beggiatoa*-like bacterial mats, and physical indicators such as flocculent matter, barren areas with no visible organisms, and off-gassing. *Beggiatoa*-like bacteria can also be observed where no aquaculture has been conducted, and when observed its prevalence and abundance are considerations in an assessment. Evidence of burrowing infauna, such as worms, clams, and other organisms, is often indicated by burrows in the substrate. Commonly observed benthic taxa include brown algae (*Phaeophyta*), such as sea colander and kelp; red algae (*Rhodophyta*), like coralline algae; sponges (Porifera); anemones; hydroids; jellyfish; corals (Cnidaria), including soft corals and fixed jellyfish; mussels, clams, scallops, whelks, and periwinkles (Mollusca, Bivalvia); segmented worms like marine bristle worms and leeches (Polychaeta); serpulid and calcareous tubeworms, fanworms, and plume worms; trumpet worms; and various echinoderms such as sea stars, brittle stars, basket stars, sea cucumbers, urchins, sand dollars, and feather stars (Echinodermata). Table 6.1 provides a summary of the taxa and substrate types observed in the 12 BMAs with data. Detailed information for each sea farm is available in the Sea Farm Sites Baseline Study (see LGL 2025a, Volume 3).

Table 6.1. Summary of the visual observations for substrate, flora and fauna in MCE's BMAs as part of its license application in the Bays East and Bays West areas of the south coast of Newfoundland.

		Presence											
		Bays East			Bays West								
Characteristic		BMA 1	BMA 2	BMA 3	BMA 4	BMA 5	BMA 9	BMA 10	BMA 11	BMA 12	BMA 13	BMA 14	BMA 15
Predominant Bottom Type	Hard	x	x	x	x	x	x	x	x	x	x	x	x
	Soft								x				
Substrate Type (% coverage when present)	Rockwall			<5–45	10–80	85	5–100	45–100	10–100	5–65	15–100	30–90	10–100
	Bedrock	50–100	40–90	<5–80	10–100	2–50	5–100	5–100	5–100	5–100	10–100	10–100	5–100
	Boulder	40–75	10–80	<5–100	<5–60	<5–30	5–95	5–95	5–100	10–100	5–80	5–100	5–100
	Rubble	10–60	20–60	<5–50	<5–85	<5–40	5–100	5–35	5–100	5–65	5–100	5–60	5–60
	Cobble	10–80	10–80	<5–80	<5–100	<5–75	5–100	5–65	5–75	5–80	5–100	5–100	5–100
	Gravel	10–60	5–90	<5–90	5–75	<5–80	5–100	5–95	5–100	5–100	5–100	5–100	5–100
	Sand	10–40	20–100	<5–95	10–100	10–100	5–100	5–100	10–100	5–100	15–100	10–100	5–100
	Silt/Mud	20–80	20–100	<5–100	5–95	5–100	10–100	5–100	5–100	20–100	5–100	15–100	5–100
	Organic			<5–15	<5–15								
	Floc			<5–10	5–30								
Depth (m) in Sea Farm Lease		2–215	3–115	0–230	6–185	10–160	1–<500	1–380	1–204	1–250	1–282	1–177	0–370
Important Habitat Features	Kelp beds		x	x	x	x	x	x	x	x	x	x	x
	Eelgrass			x									
	Macroalgae			x	x		x	x		x		x	x
Species At Risk	Wolffish spp.						x				x		
	Skate spp.			x	x		x				x		
Invasive species	Green Crab				x								
	Vase Tunicate			x						x			
Corals and Sponges	Soft Coral	x	x	x	x	x	x	x	x	x	x	x	x
	Sponge spp.	x	x	x	x	x	x	x	x	x	x	x	x
	Sea Pens						x			x		x	x
Beggiatoa-like bacteria							x	x	x	x	x	x	x
Crustaceans	Shrimp spp.			x	x	x	x	x	x	x	x	x	x
	Lobster			x			x		x			x	
	Crab spp.			x	x	x	x	x	x	x	x	x	x
Echinoderms	Urchin bed						x	x				x	
	Brittle star bed												x
	Feather Star Bed				x								x
	Sand Dollar bed										x	x	
Tube dwelling polychaete beds							x						
Snail sand collars												x	
Sea anemone beds							x	x		x	x	x	x
Mollusk	Blue Mussel			x	x	x	x	x	x	x	x	x	x
	Blue Mussel bed							x	x				
Infaunal Burrow				x	x	x							

6.2 Key Benthic Observations at MCE Sea Farms

Summaries of predominant species and key observations at sea farms in each BMA (see Figures 2.2 and 2.3) are provided below based on required benthic surveys for MCE's licensing process. Detailed information for each sea farm is available in the Sea Farm Sites Baseline Study (see LGL 2025a, Volume 3).

6.2.1 Mal Bay (BMA 1)

During benthic surveys at the three sea farms in the Mal Bay BMA, kelp was observed predominately in the photic zone, alongside various species such as coralline algae, anemones, cunners, and starfish. Soft coral were present at some sampling stations, while scallops, flounder, red algae, and unidentified tunicates were also recorded. Atlantic cod were recorded in low numbers and a striped wolffish, a SAR, were reported. There was significant kelp coverage that at times, impacted visibility. No AIS were detected.

6.2.2 Rencontre East (BMA 2)

During benthic surveys at the four sea farms in the Rencontre East BMA, kelp beds were observed near the shoreline, with three separate beds identified. The predominant species observed included seaweed, coralline algae, anemones, cunners, and scallops. Soft corals and Atlantic cod were recorded at some stations, and additional species such as red algae, starfish, lobster, flounder, brittle stars, and various infaunal burrows were also noted. No AIS were detected.

6.2.3 Fortune Bay West (BMA 3)

In the Fortune Bay West BMA, *Hormathia* anemones and encrusting coralline algae were among the most widespread organisms observed across all stations during benthic video surveys of the 11 sea farms. *Geodiid* sponges were also particularly abundant and soft corals were also commonly observed. Eelgrass was present, though in very small quantities. Kelp beds, primarily composed of *Laminariales*, *Saccharina* sp., and *Agarum* sp., were identified at several stations, with eight stations specifically classified as kelp beds. Scallops were recorded across multiple stations in moderate numbers, and Atlantic cod were seen in low numbers across several sites. Additionally, a single cluster of the invasive vase tunicate was documented. It should be noted that the observed kelp beds were outside the sea farm cage array, primarily near shore in shallower water.

6.2.4 Great Bay de l'Eau (BMA 4)

Benthic surveys were conducted at four sea farms in the Great Bay de l'Eau BMA. The most widespread organisms observed were sea stars (*Asterias* sp.) found at numerous stations, followed by green sea urchins, *Desmarestia* sp., and sand dollars. Infaunal burrows were common, though their inhabitants were not observed. Kelp species, particularly *Saccharina* sp. and *Agarum* sp., were present at several stations, with some classified as kelp beds or mixed macroalgal beds. Encrusting coralline algae were also widespread. Anemones (*Hormathia* sp.) were the most abundant fauna, with large numbers recorded across multiple stations. Other notable species included feather stars, geodiid sponges, and sand shrimp. Scallops were observed at a variety of stations, while shrimp (*Pandalus* sp.) and soft corals (*Gersemia* sp.) were less frequent. A single invasive green crab was recorded, along with a winter skate and a small feather star bed.

6.2.5 Harbour Breton Bay (BMA 5)

During the benthic surveys at four sea farms in the Harbour Breton Bay BMA, green sea urchins were the most widespread fauna observed at numerous stations, followed by arrow worms, brittle stars, and cerianthid anemones. Brittle stars were the most numerous, with large numbers of cerianthid anemones, northern shrimp, and green sea urchins also recorded. Other notable species included scallops, toad crabs, snow crabs, and Acadian redfish. Soft corals were rare, with only one recorded. Encrusting coralline algae were found at several stations, while kelp and unidentified red algae were also noted, though less frequently. No invasive species were detected.

6.2.6 Little Passage (BMA 8)

Benthic survey data were not available for the four sea farms in the Little Passage BMA.

6.2.7 Outer Bay d'Espoir (BMA 9)

In the four sea farms at the Outer Bay d'Espoir BMA, kelp beds were identified nearshore on several transects, primarily on rocky substrates between 2 m and 22 m depths. Red algae beds were also observed near shoals on bedrock substrates. *Beggiatoa*-like bacteria were recorded on multiple transects. Tube-dwelling polychaete beds and four beds of *Metridium* sea anemones were observed on rockwall substrates. A bed of feather stars was noted at two transects. Atlantic cod was observed in low numbers (individuals and small schools) on several transects. Additionally, one striped wolffish (*Anarhichas lupus*), a SAR, was observed at 74 m depth. Bubblegum coral (*Paragorgia arborea*), as well as encrusting and standalone sponges were observed, though not abundant enough to form complex habitats. Green sea urchin beds were observed in shallow areas on boulder and bedrock substrates along several transects.

6.2.8 Facheux Bay (BMA 10)

In the four sea farms in the Facheux Bay BMA, small kelp beds were observed nearshore on the east and west ends of most transects. These beds consisted of brown algae species (*Laminaria* sp. and *Agarum* sp.), forming fringing patches along the top rim of rock walls. Blue mussel (*Mytilus edulis*) beds were noted on two transects atop rock wall substrates. A bed of green sea urchins was observed near the shoreline directly below the water's surface. Encrusting and stand-alone sponges were present but not abundant enough to form complex habitats. Other sessile organisms, such as anemones, encrusting sponges, and calcareous tube worms, were the most abundant fauna. *Beggiatoa*-like bacteria and OPCs were recorded on five transects. Atlantic cod and scallops were also observed. No invasive species were detected.

6.2.9 Hare Bay (BMA 11)

In the Hare Bay BMA, which has two sea farms, minimal kelp beds (*Laminaria spp.*) were observed nearshore, forming fringing patches at depths of 2–4 m. Blue mussel beds were present in some areas. Brittle star and green sea urchin beds were observed at depths of 68 m and 4 m, respectively. A single sea anemone bed was documented between depths of 120–140 m. No eelgrass beds or sponge complexes were identified, although isolated sponges were present. *Beggiatoa*-like bacteria and OPCs, were noted. A small number of Atlantic cod were observed. No invasive species were detected.

6.2.10 Rencontre West (BMA 12)

The Rencontre West BMA has four sea farms that were surveyed by video camera and small kelp beds (*Agarum* sp. and *Laminaria* spp.) were observed nearshore, forming fringing patches along rock walls at depths of 0–35 m. Mixed macroalgae beds, including *Agarum* sp., *Ulva* sp., and red algae, were noted nearshore, while frilled anemone beds were also observed. A green sea urchin bed was identified in shallow water. Encrusting sponges were present but not abundant enough to form complexes. Observations included two schools and some individuals of Atlantic cod as well as five schools of Acadian redfish. Additionally, one Atlantic halibut was recorded. Small patches of *Beggiatoa*-like bacteria were observed. No invasive species were detected.

6.2.11 Chaleur Bay (BMA 13)

Kelp beds, composed of *Agarum* and *Laminaria* species, were observed nearshore, forming minimal fringing patches along rock walls in the three sea farms in the Chaleur Bay BMA. Notable observations included individual green sea urchins, sand dollar beds, and a single anemone bed (*Stomphia* sp.). One Atlantic wolffish was documented, while Atlantic cod were observed individually across the area, with no schools recorded. Acadian redfish were frequently noted, including schools of over 20 individuals. Snow crabs and individual scallops were also present but in small numbers. Minimal patches of *Beggiatoa*-like bacteria were observed. No invasive species were detected.

6.2.12 Aviron Bay and La Hune Bay (BMA 14)

In the Aviron Bay and La Hune Bay BMA, benthic surveys were conducted in the three sea farms. Kelp beds consisting of *Saccharina*, *Agarum*, and *Laminaria* species were observed nearshore, forming minimal fringing patches along bedrock and boulder substrates. Mixed brown algae beds, including *Desmarestia* and *Phylaiella* species, were also noted. Green sea urchin beds were identified in multiple areas outside the boundaries of the sea cage array. Sea anemone beds, along with invertebrate beds such as brittle stars and sand dollars, were recorded. A single sea pen was observed. Other species noted included lobster, snow crab, Acadian redfish, and sea scallops, though no large schools or beds were present. Small patches of *Beggiatoa*-like bacteria were observed. The presence of moon snail sand collars suggests potential nursery habitat. No invasive species were detected.

6.2.13 Bay de Vieux (BMA 15)

Kelp beds, primarily consisting of *Agarum* and other brown algae species, were observed nearshore, forming fringing patches along bedrock and boulder substrates in the three sea farms of the Bay de Vieux BMA. Sea anemone beds, feather stars, brittle stars, and green sea urchins were present, though none formed complex aggregations. Sea pens, potential nurseries for redfish, were recorded. Individual Acadian redfish were frequently observed, along with several schools of Atlantic cod and Atlantic pollock (*Pollachius virens)*. Snow crabs and sea scallops were also observed, though no significant beds or schools were identified. Patches of *Beggiatoa*-like bacteria were documented. No invasive species were detected.

7.0 Species Profiles

The EIS Guidelines (Section 4.3.3b) require a discussion of fish and invertebrate species that support a fishery in the Study Area, including but not limited to cod, lobster, sea-run trout, herring, sharks, scallops, crab, seals, mussels, and lumpfish. In this section, we present species profiles of commercial importance including groundfish, pelagic fish species, and invertebrates as well as sea-run trout and sharks. Fish SAR, including Atlantic cod, redfish, white hake, American plaice, lumpfish, and white, basking, porbeagle, and shortfin mako sharks, are presented in Section 8.0.

7.1 Species of Commercial Importance

This subsection provides summary information regarding the life histories, distribution, abundance, and recent fisheries data for fish and invertebrate species of commercial importance that occur in the sea farm Study Area. Commercial fisheries and/or scientific survey data are referenced to provide insight into species distribution in and near the sea farm Study Area.

7.1.1 Fish

The Northwest Atlantic Fisheries Organization (NAFO) regulates fisheries for groundfish, pelagic fish, and shrimp, including catch limitations, bycatch measures, recovery and conservation measures, fisheries monitoring, vessel and gear requirements, and protection of vulnerable marine ecosystems (VMEs). NAFO has developed a regulatory area map with divisions to assist in defining fishing footprints (Figure 7.1). These NAFO Divisions (Div.) are used to assist with the fish and fish habitat descriptions below. The sea farms are predominately located in Div. 3PSa and 3PSb while the Hatchery Study Area is in Div 4Rd. A detailed review of commercial, recreational, and Indigenous fisheries relative to the sea farm and Hatchery Study Areas is provided in Section 4.4.1 of LGL (2025b).

7.1.1.1 Groundfish

There are numerous species of groundfish that occur in and near the Study Areas. Of particular commercial importance in recent years are Atlantic cod (*Gadus morhua*) and Atlantic halibut (*Hippoglossus hippoglossus*) with other notable groundfish species including redfish (*Sebastes* spp.), white hake (*Urophycis tenuis)*, and Atlantic haddock (*Melanogrammus aeglefinus;* Table 7.1; see LGL 2025b; see also Section 8.0 for profiles of Atlantic cod, redfish, white hake, and American plaice). The DFO spring multispecies survey documents the distribution and abundance of groundfish in the Newfoundland region, including the south coast (DFO 2022a). This survey was conducted in Hermitage Bay adjacent to some of MCE sea farms but did not extend into the inshore bays (DFO 2022a). From 2000–2018, the survey of three adjacent strata recorded various commercial groundfish species; of the survey biomass, up to 20% of Atlantic cod, 16% of witch flounder (*Glyptocephalus cynoglossus*), 5% of Greenland halibut (*Reinhardtius hippogloissoides*), and 2% of American plaice *(Hippoglossoides platessoides*) were in Div. 3Ps (DFO 2022a).

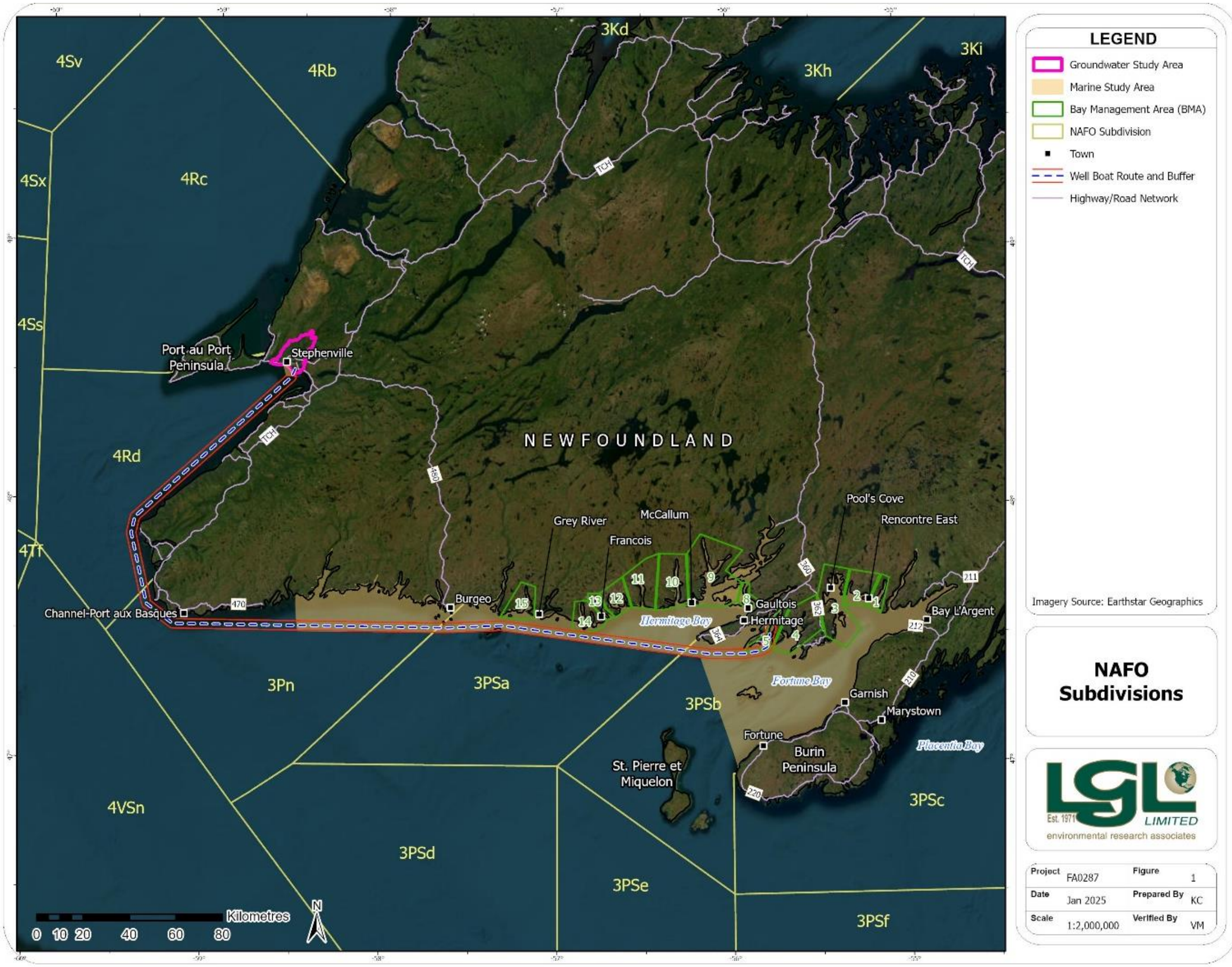


Figure 7.1. Study areas in relation to regional fisheries management areas (NAFO Divisions and Unit Areas).

Table 7.1. Groundfish species of note in the commercial fishery within and near the Study Areas.

Common Name	Scientific Name	Northwest Atlantic Distribution	Spawning
Atlantic cod	*Gadus morhua*	NL, Georges Bank, Bay of Fundy, Scotian Shelf. Gulf of St. Lawrence, and Nunavut [1]	NL: Variably between April and October; batch spawners; some spawn annually, others skip years depending on location and condition; eggs pelagic [1]
Atlantic halibut	*Hippoglossus hippoglossus*	New Jersey northwards to Greenland [2]	Continental slope & offshore banks (≤180 m depth); variably between early winter to spring (mostly November–December south of Newfoundland); batch spawners; eggs pelagic [2]
Redfish	*Sebastes spp.*	South of Newfoundland, Gulf of St. Lawrence, and Labrador Sea to eastern Baffin Island [3]	Breed September–December; females viviparous (carry young internally until released as larvae) [3]
White hake	*Urophycis tenuis*	Throughout Atlantic Canada and Gulf of St. Lawrence [4]	High fecundity; southern Newfoundland: deep offshore waters and shelf breaks in spring; eggs pelagic [4]
Atlantic haddock	*Melanogrammus aeglefinus*	Strait of Belle Isle south to New England [5]	Form spawning aggregations in spring; eggs pelagic [5]
Witch flounder	*Glyptocephalus cynoglossus*	NL south to North Carolina [6]	Overall: Spring-fall with peak in summer; Div. 3Ps: January–May with peak in January–March; eggs pelagic [6,7]
Greenland halibut	*Reinhardtius hippoglossoides*	Northern Greenland to eastern U.S. [8]	No clearly defined seasonality, but likely peaks during February–March; eggs pelagic [9]
American plaice	*Hippoglossoides platessoides*	Greenland and NL south to New England [10]	Div. 3Ps: widespread; eggs pelagic [11]

Source: [1] COSEWIC (2010a); [2] COSEWIC (2011a); [3] COSEWIC (2010b); [4] COSEWIC (2013a); [5] GC (2017a); [6] DFO (2016a); [7] DFO (2018a); [8] GC (2018a); [9] DFO (2022b); [10] DFO (2016b); [11] DFO (2020a).

There is no available information on the movement of groundfish species specifically within MCE's BMAs (DFO 2022a). However, Goodbrand et al. (2013) assessed the effects of the interaction between Atlantic salmon sea farm aquaculture and wild fish in terms of distribution at local and larger spatial scales in Fortune Bay (ranging from around Chapel Island to Pool's Cove and Rencontre East[1]). Each sea farm site consisted of round, 10-m diameter cages with

[1] Sea Farms: Hickman's Point, McGrath's Cove South, Cinq Isle-Tilt Cove, Ironskull Point, Old Woman's Cove, Deep Water Point, Little Burdock Cove, and Rencontre Island. Control sites: Bay du Nord (north of Pool's Cove), South East Bight, Corbin Bay, Hatcher Arm, and Doctor's Harbour (Goodbrand et al. 2013).

~20-m depths that contained salmon ranging from post smolts to market-size. Acoustic transect surveys were conducted in September 2011 at the farm sites and within the larger Fortune Bay area denoted above. Higher abundances of wild fish were detected below and adjacent to sea farms and within the larger sea farm bay environment compared to control sites (i.e., sites that did not have sea farms or did not have sea farms that had been active within the past three years). There were no noticeable effects on abundance relating to the number of cages or the amount of pelleted feed entering the environment. Rather, it is thought that the introduced presence of a stable (in space) and predictable (in time) food resource is preferential for wild fauna compared to natural environmental variability. There seems to be an energetic advantage in terms of reduced foraging effort, as evidenced by sea farm associating wild fish having higher total body fat and body condition compared to fish in control areas. This could in turn attract higher trophic level consumers and encourage lower trophic level movements between sea farms to avoid competition or predators. Combined, these three mechanisms may enhance overall biological activity within the greater bay ecosystem (Goodbrand et al. 2013).

Atlantic Halibut

In the Northwest Atlantic, Atlantic halibut ranges from the Arctic Circle to Virginia in the U.S. (DFO 2018b), and their abundance has been observed to have increased in recent years (French et al. 2018). French et al. (2018) predicted that 12% of Div. 3Ps is likely suitable habitat for Atlantic halibut, including portions of the sea farm Study Area.

As the world's largest flatfish, Atlantic halibut reach >2.5 m and >300 kg in length and weight, respectively (DFO 2018b). In Div. 3Ps, halibut are considered recruits to the fishery when they reach 81 cm in length (DFO 2018b). This species exhibits sexual dimorphism in that females are usually larger than males (DFO 2018b). Atlantic halibut are long-lived, with lifespans of at least 50 years, and age at sexual maturity may be around 6–7 years (Sigourney et al. 2006; NOAA 2025a). Spawning timing and locations are largely unknown in eastern Canada but are estimated to occur in deep waters (~300–700 m) between late fall and early spring in deep waters (DFO 2018b). It is presumed that Atlantic halibut rise abruptly in the water column (~50–100 m) as a component of spawning behaviour (Le Bris et al. 2017). Atlantic halibut spawn annually via batch spawning (NOAA 2025a). The pelagic eggs passively drift with surface currents where water temperatures are between 4.5–7ºC and salinity 33.8‰ and 35.0‰ (Haug et al. 1984; Armsworthy et al. 2014). Upon hatching, larvae remain pelagic and are capable of actively swimming, at least within several weeks from hatching (Pittman et al. 1990). Juveniles and adults are demersal, typically at water temperatures >2.5ºC and depths between 200–500 m, although larger individuals may inhabit deeper waters (DFO 2018b).

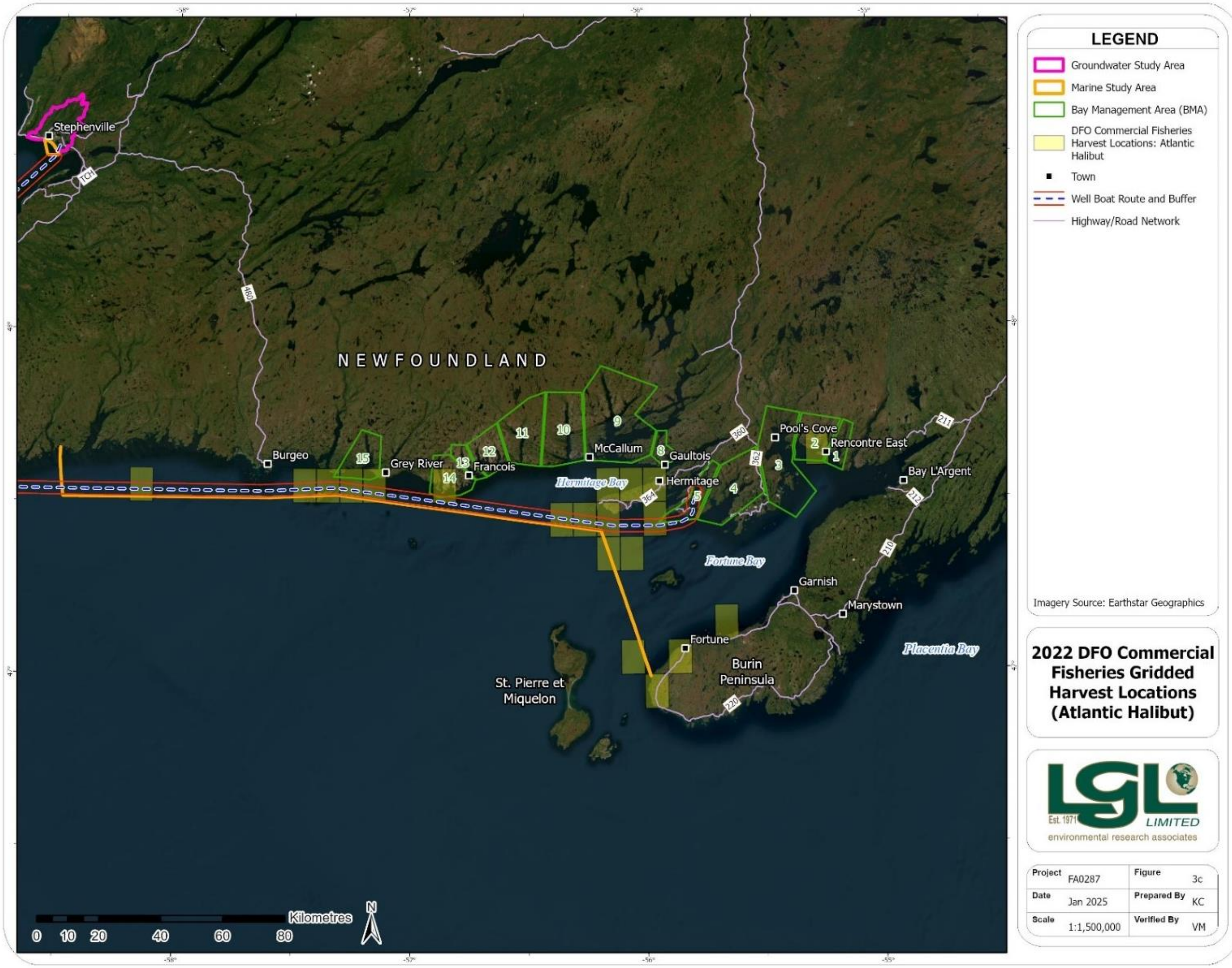
Some Atlantic halibut in eastern Canadian waters undertake seasonal migrations, from shallow (<37 m) waters in the summer to deeper waters in winter, while others exhibit depth residency (Scott and Scott 1988; Le Bris et al. 2017; Gauthier et al. 2024; Ransier et al. 2024). Tagging studies near the sea farm Study Area indicated Atlantic halibut there conduct shelf-channel migration to overwinter in the Laurentian Channel and occupy coastal waters (<200-m depth) in spring to fall (Rainsier et al. 2024).

There are few known natural predators of Atlantic halibut, namely including larger fish (e.g., Greenland shark, spiny dogfish) and seals (Cargnelli et al. 1999). Smaller/juvenile Atlantic halibut mainly prey on benthic invertebrates (e.g., hermit crabs, prawns, mysids), while larger, more mature individuals primarily consume fish (e.g., pollock, redfish, other flatfish species; DFO 2018b).

The DFO Commercial Landings Database indicates that, between 2018 and 2022, Atlantic halibut was the second-most important commercially-fished finfish species in the sea farm Study Area; however, within that timeframe catch quartile weights exhibited a year-over-year decline. In Div. 3Ps, the fishery is normally only authorised in waters >91.44-m (50-fathoms) depth west of Boxey Point in Fortune Bay; however, during the 2024–2025 season, fishing was also authorized in deeper waters east of Boxey Point (DFO 2024a). The timing of the commercial fishery in the sea farm Study Area changes between years but the DFO Commercial Landings Database (2018–2022) indicates that most of the harvest occurs in May and June, which coincides with observed seasonal migration behavior. The DFO Commercial Landings Database indicates that, during 2022, most of the Atlantic halibut catch locations within the sea farm Study Area occurred in Hermitage Bay and coastally between the communities of Burgeo and Francois, overlapping or near BMAs 8–10, and 12–15 (Figure 7.2). There was also at least one catch location that overlapped with BMAs 2 and 5 (Figure 7.2). There were no recorded catch locations in the Hatchery Study Area in the Database in 2022.

Atlantic Haddock

In the northwest Atlantic, Atlantic haddock are distributed from the Strait of Belle Isle southwards to New England, typically inhabiting depths of 50–250 m (GC 2017a). These bottom-dwelling fish can grow to a total length of ~100 cm and weigh up to 4 kg (GC 2017a). They feed on a variety of benthic invertebrates, such as mollusks, polychaetes, crustaceans, sea and brittle stars, sea urchins, sand dollars, and small fish or eggs (NOAA 2025b). Juvenile haddock inhabit shallower waters, while adults prefer deeper areas, migrating to shallower waters between mid winter to late spring (depending on location) to spawn after reaching maturation between 1–4 years of age (NOAA 2025b). Eggs are released and fertilized in batches at the seabed, after which the eggs are pelagic. Females typically produce ~850,000 eggs per year, up to 3 million for larger females (NOAA 2025b). Their primary predators include spiny dogfish, skates, groundfish species, and grey seal (NOAA 2025b).



Source: DFO Commercial Landings Database (2022).

Figure 7.2. Distribution of commercial harvest locations in the sea farm Study Area for Atlantic halibut, 2022.

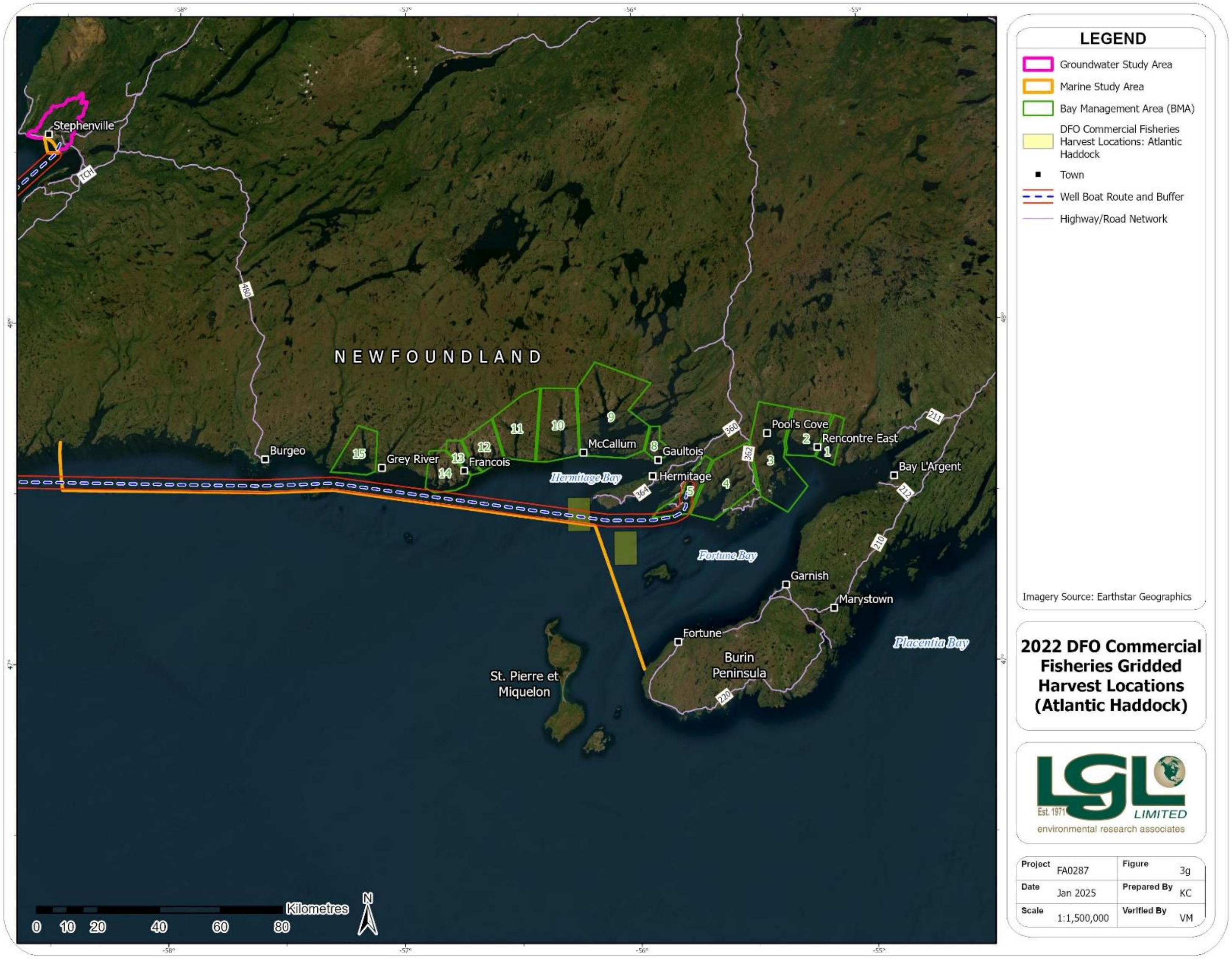
DFO RV surveys during 2014–2018 indicated that abundance and biomass indices were below the 1996–2018 series average (DFO 2019a). The stock is currently in the Critical Zone, which entails maintaining removals from all sources (including fisheries) at the lowest possible level until the stock improves (DFO 2019a). There is no targeted commercial fishery for Atlantic haddock that overlaps the sea farm or Hatchery Study Areas. This species has been under moratorium in Div. 3Ps since 1993 and any catches occur as bycatch, mainly in the Atlantic cod fishery (DFO 2019a). During 2022, the DFO Commercial Landings Database indicates there were at least two haddock catches within the sea farm Study Area, near the mouths of Hermitage and Fortune Bays; they did not overlap with any BMAs (Figure 7.3).

Witch Flounder

Witch flounder is a benthic flatfish species found in the North Atlantic, ranging from NL, the Grand Banks, and Gulf of St. Lawrence southwards to North Carolina (DFO 2016a). Inhabiting soft substates at depths typically between 100–500 m (but in some locations up to 900 m in Div. 3Ps), they mainly feed on polychaetes but also consume small crustaceans, molluscs, and echinoderms (DFO 2016a, 2018a). The inshore Div. 3Ps stock inhabits depths <250 m in the Fortune Bay and Hermitage Bay areas (DFO 2018a). In Div. 3Ps, the directed witch flounder fishery occurs in both the inshore and offshore, but this species is also caught as bycatch in other NL fisheries (e.g., Greenland halibut and redfish fisheries in Div. 2J3KL; DFO 2018a, 2024b).

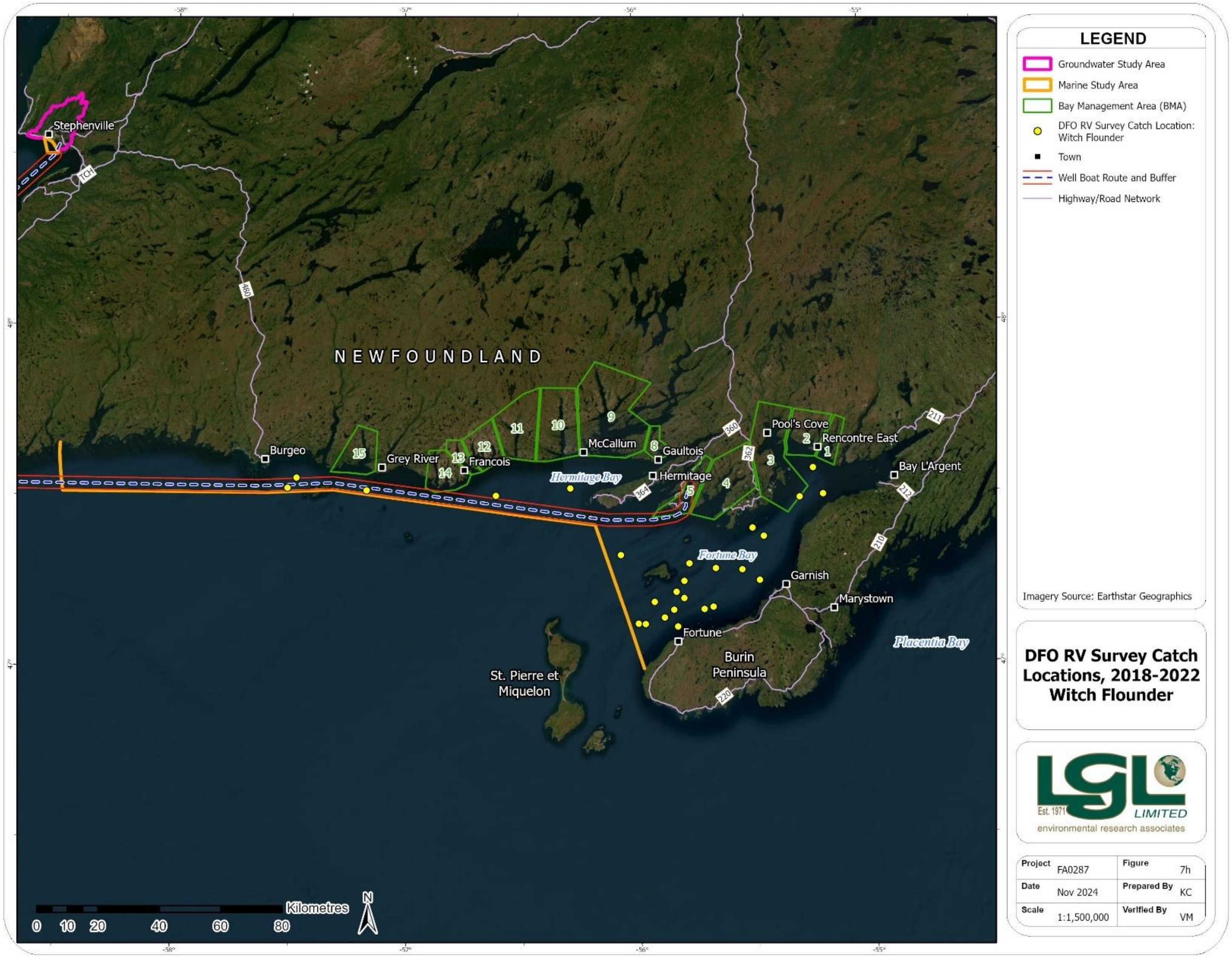
The maximum age for this long-lived species in Div. 3Ps declined from 22 years in the mid 1970s to 14 years during the 1980s (age data no longer available for Div. 3Ps as of 1994; DFO 2018a). Spawning in Div. 3Ps occurs in January–May with a peak during January–March, when dense spawning aggregations form (DFO 2018a). The eggs and larvae are pelagic and after a year-long pelagic post-larval phase, demersal juveniles are thought to inhabit greater depths than adults (DFO 2016a).

The 2024–2025 season for witch flounder in Div. 3Ps has set the Total Allowable Catch (TAC) for 650 t. Canada's share of this stock is 577 t (GC 2024a). Based upon DFO RV survey data (2018–2022) for the sea farm Study Area, witch flounder were primarily observed in Fortune Bay, south of the BMAs with one catch location occurring at the southern boundary of BMA 3 (Figure 7.4).



Source: DFO Commercial Landings Database (2022).

Figure 7.3. Distribution of commercial harvest locations in the sea farm Study Area for Atlantic haddock, 2022.



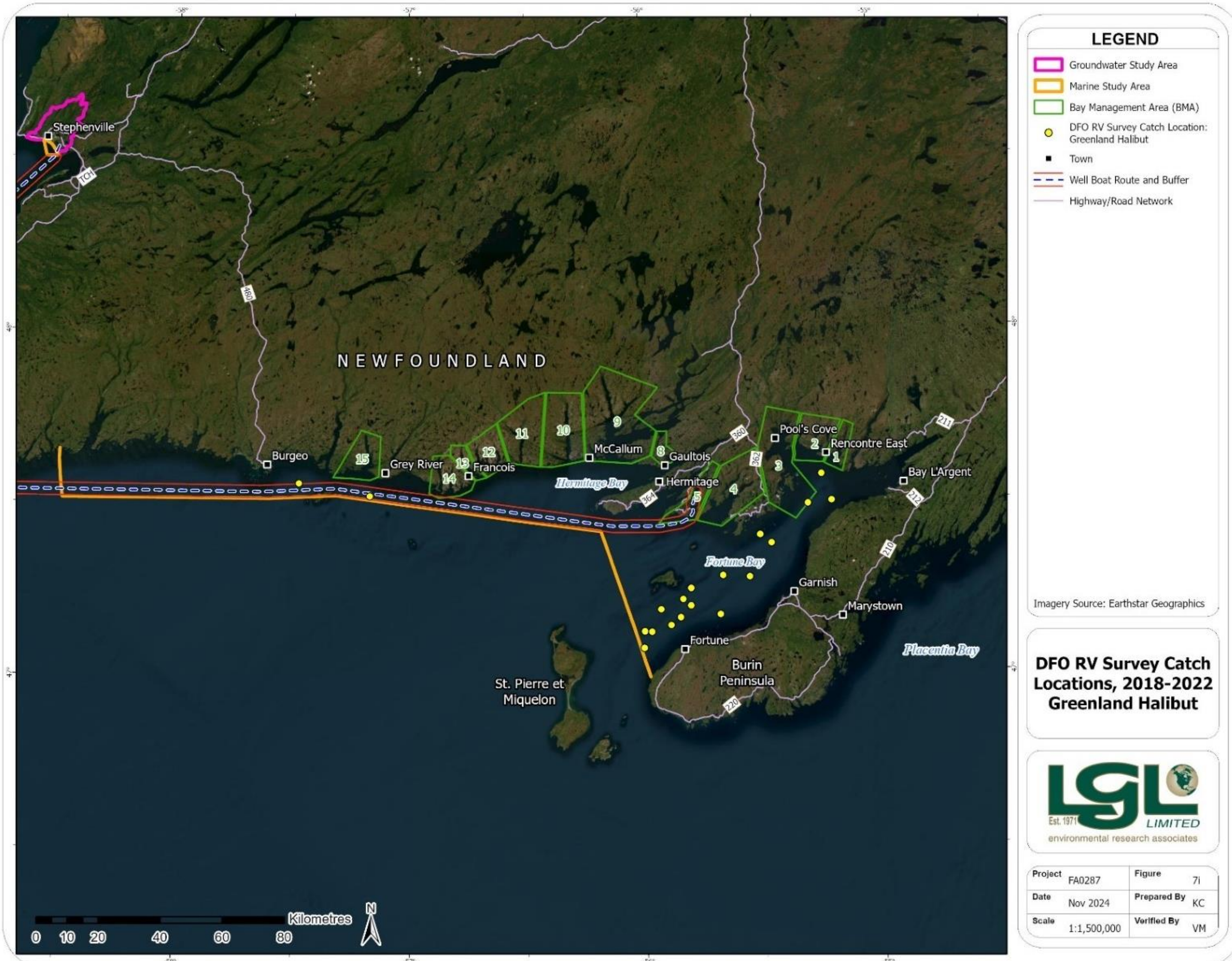
Source: DFO RV Survey Database (2018–2022).

Figure 7.4. Distribution of DFO RV survey catch locations of witch flounder in the sea farm Study Area, 2018–2022.

Greenland Halibut

Greenland halibut (turbot) is a deep-water flatfish species found from northern Greenland to the eastern U.S. in the Northwest Atlantic, with notable stocks in the Gulf of St. Lawrence and Grand Banks (GC 2018a). Although physically similar to Atlantic halibut, they can be distinguished by their lateral lines, with Greenland halibut's being straight and Atlantic halibut's arched (GC 2018a). Their diet varies based on body size, with smaller individuals (<20 cm) consuming zooplankton and small fish, and larger halibut shifting to mainly fish (especially capelin, redfish, and herring) and shrimp (DFO 2023a). Greenland halibut are important food sources for various seals (harp *Pagophilus groenlandicus*, hooded *Cystophora cristata*, and grey *Halichoerus grypus*) and Atlantic halibut (DFO 2023a).

Greenland halibut is a cold-water species that inhabits soft, muddy substrates (DFO 2018a). This relatively long-lived species (>20 years) can reach >1 m in length and >10 kg in weight (GC 2018a). The Gulf of St. Lawrence (Div. 4RST) stock spawn during January–March in the Laurentian Channel, southwest of NL (DFO 2023a). A low fecundity species, they release and fertilize their large eggs (nearly 5 mm diameter) near the seabed once per year; after 30 days in the water column, the eggs hatch within 50 m of the sea surface (DFO 2023a). Following up to four months at surface, the larvae metamorphose and become demersal (DFO 2023a). Based upon DFO RV survey data (2018–2022) for the sea farm Study Area, Greenland halibut were primarily observed in Fortune Bay, south of the BMAs with one catch location occurring at the southern boundary of BMA 3 (Figure 7.5).



Source: DFO RV Survey Database (2018–2022).

Figure 7.5. Distribution of DFO RV survey catch locations of Greenland halibut in the sea farm Study Area, 2018–2022.

7.1.1.2 *Pelagic Fish*

There are three pelagic fish species of commercial importance in the province, Atlantic herring (*Clupea harengus*), capelin (*Mallotus villosus*), and Atlantic mackerel (*Scomber scombrus*; Table 7.2). These three species of pelagic fish are also of great importance in the food chain and/or have recreational value in the province and are described in this section.

Table 7.2. Pelagic species of note in the commercial fishery within and near the Study Areas.

Common Name	Scientific Name	Northwest Atlantic Distribution	Spawning
Atlantic herring	*Clupea harengus*	Labrador to Nova Scotia [1]	Spring or fall; eggs demersal [2,3]
Capelin	*Mallotus villosus*	West Greenland and Hudson Bay to Maine [4]	Spring/summer, either deep offshore waters or inshore on beaches; eggs demersal [4,5]
Atlantic mackerel	*Scomber scombrus*	NL to North Carolina [6]	Northern (Canadian) spawning group: mainly southern Gulf of St. Lawrence in June–July; eggs pelagic [7]

Source: [1] DFO 2022c); [2] Bourne et al. (2023); [3] Scott and Scott (1988); [4] DFO (2017a); [5] Carscadden et al. (1989); [6] GC (2024b); [7] GC (2024c).

Atlantic Herring

Atlantic herring is a cold-water species whose Canadian range includes Labrador through Nova Scotia (DFO 2022c). In NL waters, Atlantic herring mainly occur in inshore areas (DFO 2022d). The East and South Coast stocks are designated into five stock complexes, including Fortune Bay and St. Mary's-Placentia Bay on Newfoundland's south coast and White Bay-Notre Dame, Bonavista-Trinity Bay, and Conception Bay-Southern Shore off northeastern Newfoundland (Bourne et al. 2023). At present, the "stock affinity" of other herring that occur off the southern coasts of NL is unknown (Bourne et al. 2023). These small "forage fish" are an important component of the North Atlantic ocean ecosystem, serving as prey for a variety of species, such as other fish (e.g., redfish, Atlantic cod), seals (harp, grey), cetaceans (DFO 2022c), and diving seabirds. Atlantic herring feed on zooplankton, namely copepods, euphausiids, and amphipods (DFO 2022c). In addition to the targeted fishery, Atlantic herring are also important as bait for other NL fisheries and are caught by bait gillnet fishers, who are mainly active during May–July. Atlantic herring are visual feeders and mainly consume plankton during daylight hours (Scott and Scott 1988).

There are both spring and fall spawners in the Northwest Atlantic. Historically, herring in NL stocks were predominantly spring spawners; while this remains the case for the Fortune Bay stock, other NL stocks shifted to 50–80% fall spawners by the 2010s in response to warming ocean conditions since the late 1990s (Bourne et al. 2023). However, poor fall spawner recruitment coupled with multiple strong spring spawner year classes in the early 2020s has recently resulted in increased proportions of spring spawners compared to the 2010s (Bourne et al. 2023). Spring spawners in NL stocks undertake inshore spawning migrations between April and July (Bourne et al. 2023), with migrations occurring later in the year for fall spawners. Sexual maturity is generally reached at age four years, but the Fortune Bay stock appear to begin spawning as early as the age of three years (DFO 2022c); Bourne et al. 2023). Demersal eggs are mainly laid on medium coastal substrate (gravel, rocks), although sand and bare rock have also been documented (Scott and Scott 1988). Spawning sites are typically associated with abundant seaweed or possibly eelgrass (Scott and Scott 1988). Hatched larvae are pelagic and undertake diel (night-to-day) vertical migrations in the water column; by the time they are juveniles and adults, they occupy deeper waters during the day, likely to avoid avian predation (Scott and Scott 1988). While travelling between their spawning (i.e., coastal waters), feeding, or over-wintering (i.e., deeper waters) areas, Atlantic herring occur in tight schools (DFO 2022c). They return to the same locations each year ("homing"), which is thought to be a learned behaviour within the population (DFO 2022c).

In Fortune Bay, commercial landings declined throughout the 2010s but saw an increase in 2018, with gillnet fishers observed declining abundance while bar seiners reporting perceived increases (Bourne et al. 2023). The stock status index showed a decline through the 2000s, with only a slight increase in 2017, and that a single year class is largely driving recent increased catch rates. Consequently, the stock status evaluation for Fortune Bay is negative (Bourne et al. 2023). The quota for 2023–2024 in Fortune Bay was 1,189 t (DFO 2024a).

Given the location of MCE sea farms, it is likely herring will move past or through the cages (DFO 2022a). The potential transmission of disease between Atlantic salmon and herring is a concern (DFO 2022a). The Infectious Salmon Anemia Virus (ISAv) can be carried by Atlantic herring and the presence of Viral *Haemorrhagic Septicaemia* Virus strain IVa (VHSV IVa) has been confirmed in wild herring harvested in Newfoundland waters (DFO 2022a).

Capelin

Capelin is one of the most ecologically important fish species in the region as it is a significant prey item for many species of fish, marine birds, and mammals. Capelin are circumpolar in Arctic and sub-Arctic regions, including from west Greenland and Hudson Bay through to Maine, with peak abundance in the Newfoundland region in the Northwest Atlantic (DFO 2017a). There are two capelin stocks that occur in eastern and southern NL: 2J3KL and 3Ps (DFO 2024c).

Some capelin only inhabit offshore areas and spawn in deep waters, such as the Southeast Shoal of the Grand Bank, while others move inshore to spawn on beaches during spring/summer (depending on water temperature; DFO 2010, 2017a). The capelin that survive post-spawning return to offshore waters in the fall (DFO 2010). Spawning preferentially occurs on inter- and subtidal gravel substrate ranging from moderately to fully exposed and sheltered beaches (Carscadden et al. 1989).

Upon hatching, capelin larvae are flushed from the gravel substrate by wave action, at which point they are pelagic and ultimately move to the offshore. Adult capelin undertake diel vertical migrations, occupying the lower water column during the day and moving upwards at night. During the fall, this pattern reverses (Scott and Scott 1988; Carscadden et al. 1989). When not spawning, capelin are planktivorous, feeding on copepods and amphipods (Scott and Scott 1988).

The total quota allocated for 3Ps the capelin fishery is 968 t (DFO 2024a). In addition to the commercial fishery in Div. 4RST (DFO 2024a), capelin are collected recreationally as they roll onto Newfoundland's shores annually to spawn, including at minimum near the Hatchery Study Area and portions of the vessel transit route around southwestern Newfoundland (eCapelin 2024). The recreational capelin fishery is open year-round with no bag limit (DFO 2023b). Fishers are permitted to use hook and line, angling gear, dip nets, or cast nets, and any incidental catches must be released in the least harmful manner possible (DFO 2023b). Based on Newfoundland's Capelin Calendar, they tend to roll around late June in the Stephenville/Port au Port, Cape Ray (southwestern Newfoundland), and eastern Burin Peninsula areas (Newfoundsander 2024). Newfoundland residents cooperatively track annual capelin movement/arrival through dedicated social media groups, such as the Capelin Rolling, Squid Catching, Whale Watching NL 2024 Facebook group (Facebook 2024).

Atlantic Mackerel

Atlantic mackerel are a pelagic species found on both sides of the Atlantic Ocean. In the Northwest Atlantic, their range extends from NL to Cape Hatteras, North Carolina (GC 2024b). This schooling species live in near surface waters (≥8ºC) close to shore (GC 2024b,c). Adults are typically 40–45 cm in length and up to 800 g in weight (DFO 2024b,c). While they generally live up to 15 years, some individuals exceed this lifespan (DFO 2024b). Atlantic mackerel lack a swim bladder, requiring them to continuously swim in order to breathe (GC 2024b).

Atlantic mackerel exhibit considerable variability in recruitment and spatial distribution, largely dependent upon temperature changes and prey availability (GC 2024c). There are two spawning groups in the Northwest Atlantic: southern (U.S.) and northern (Canadian; GC 2024c). The Canadian group mainly spawns in the southern Gulf of St. Lawrence in the summer (June–July; GC 2024c). A survey conducted in 2009 demonstrated that the South Coast of Newfoundland and the Scotian Shelf did not constitute a substantial portion of spawning area for Atlantic mackerel (Grégoire et al. 2013). Eggs are pelagic and quickly hatch within days; larvae feed on plankton before metamorphosing into juveniles after ~3 weeks (GC 2024c). Adults generally reach sexual maturity by 2–3 years of age, and older, larger spawners produce more, higher quality eggs relative to younger, smaller individuals (GC 2024c).

During 2018, a major portion of bycatch in the NL bait gillnet fishery consisted of Atlantic mackerel, along with "other fish" which were mainly flounders (Bourne et al. 2023). There is also an Atlantic mackerel personal-use bait fishery in the Atlantic Canadian and Quebec Regions, using either gillnets or handlines (GC 2024b). During 2024, this bait fishery had a total TAC of

470 t, released in two parts: 235 t were open to harvesters from 27 May–4 July and the remaining 235 t from 15–18 Aug (GC 2024a). The NL recreational mackerel fishery season is open from April through December (DFO 2023b). The daily possession limit is 20 fish per day and minimum retention size is 26.8 cm in length (DFO 2023b). The only authorized fishing gear for this fishery includes hook and line or angling gear, with the proviso of a maximum of five lines or a fishing line with up to six hooks attached (DFO 2023b).

7.1.2 Invertebrates

There are five commercially-important benthic invertebrate species that occur in the Study Area, including snow crab (*Chionoecetes opilio*), American lobster (*Homarus americanus)*, sea scallop (*Placopecten magellanicus*), blue mussel (*Mytilus edulis*), and northern shrimp (*Pandalus borealis*; Table 7.3). These species are profiled in this section.

Table 7.3. Invertebrate species of note in the commercial fishery within and near the Study Areas.

Common Name	Scientific Name	Northwest Atlantic Distribution	Reproduction
Snow crab	*Chionoecetes opilio*	Greenland to Nova Scotia [1]	Variable mating timing for first- vs. multi-time spawning females; possible spring/winter migration for mating, typically from deep to shallow habitats [1]
American lobster	*Homarus americanus*	NL: all inshore Newfoundland waters and Labrador coast in Strait of Belle Isle [2]	Mating variably occurs in summer (July–September) [2]
Sea scallop	*Placopecten magellanicus*	Gulf of St. Lawrence to Cape Hatteras [3]	NL: starts in July; timing varies with water temperature, prey availability, and current speed [3]
Blue mussel	*Mytilus edulis*	NW Atlantic: NL to South Carolina [4,5]	NL: June–July [6]
Northern shrimp	*Pandalus borealis*	NW Atlantic: Baffin Bay to Gulf of Maine [7]	Produce and carry eggs late summer-fall; eggs hatch in spring [7]

Source: [1] DFO (2023c); [2] DFO (2023d); [3] Coughlan et al. (2023); [4] DFO (2003); [5] Christian et al. (2010); [6] Toro et al. (2002); [7] DFO (2024d).

7.1.2.1 Snow Crab

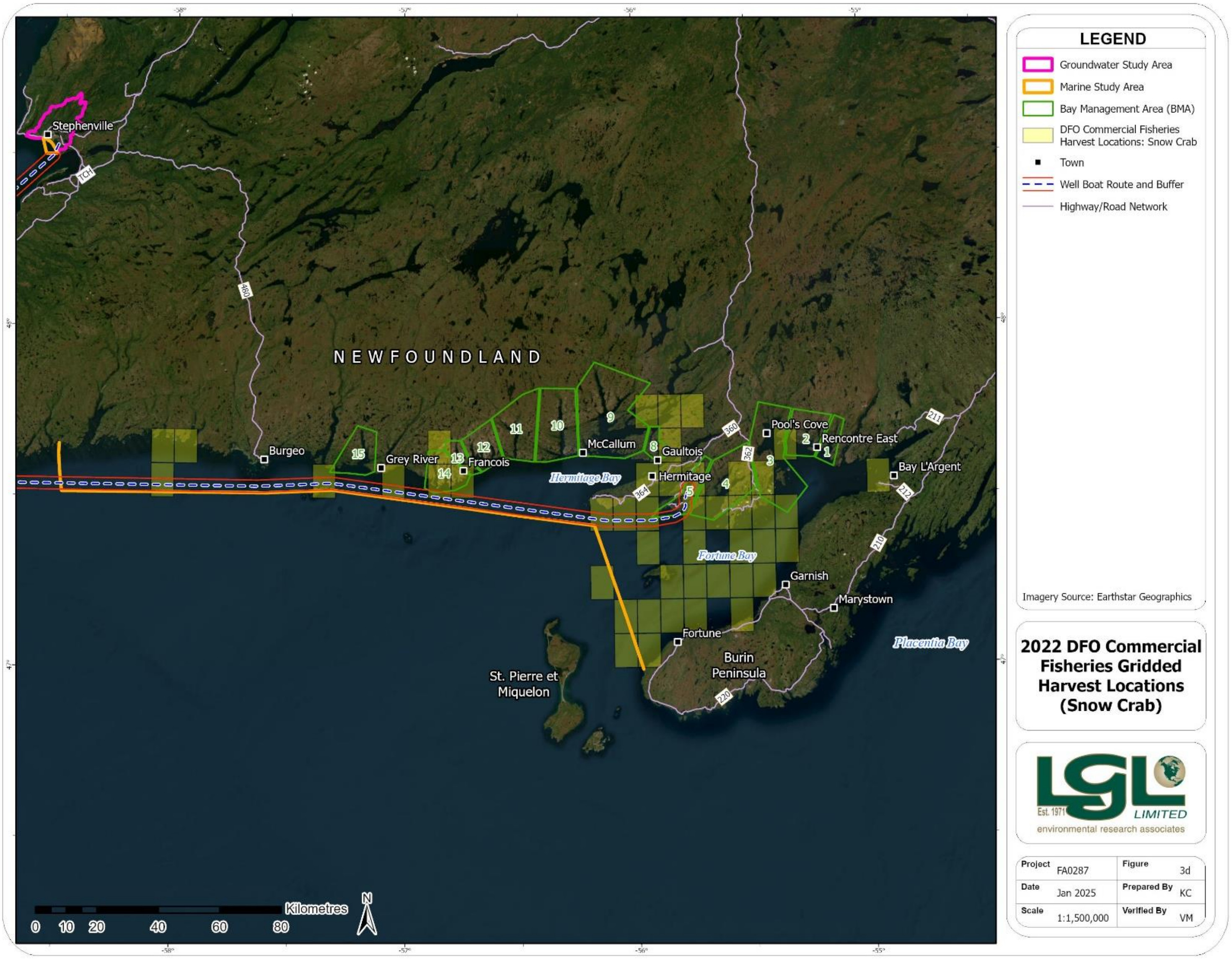
Following the cod fishery moratorium in 1992, snow crab became the prime economic species for many fishing enterprises (Mullowney et al. 2020). In the Northwest Atlantic, snow crab distribution ranges from Greenland to Nova Scotia; in Newfoundland waters, they typically inhabit water depths of 60–400 m on soft (mud) to medium (gravel) substrates (DFO 2023c).

During development, snow crab migrate from shallow, cold habitats with hard substrates when they are smaller in body size to warmer, deeper soft-substrate habitats (mud or mud/sand) when they are larger, particularly large males (DFO 2023c). Following multiple molting periods, snow crab tend to reach sexual maturity at ~4 years of age or ~40 mm in carapace width (DFO 2023c). After reaching sexual maturity, females no longer molt and are excluded from estimations of exploitable biomass (DFO 2023c). Adolescent males usually continue to molt annually until they reach terminal molt, at which time they are fully adult and possess enlarged claws; only adults that reach 95 mm carapace width are considered fishery recruits, likely at 8–10 years of age (DFO 2023c). Snow crab undertake winter and spring migrations for mating/molting purposes; little is known regarding these migrations other than there are correlations with mating periods (i.e., first-time vs. multiple-time) and travel occurs from deep to shallow habitats (DFO 2023c). After mating, females carry the egg clutches until they hatch in spring (DFO 2023c). The planktonic larvae may remain in the water column for months as they undergo several developmental stages before ultimately settling on the seabed to complete cycles of growth and late winter/spring molting as they mature from juveniles to adults (DFO 2023c). Once settled onto the benthic habitat, snow crab opportunistically feed on fish, bivalves, polychaetes, brittle stars, and crustaceans (including other snow crab; DFO 2023c). Natural mortality chiefly includes predation by groundfish, larger snow crab, and seals (DFO 2023c).

The targeted commercial fishery for snow crab has been lucrative since the groundfish moratorium in the early 1990s, but there was a downward turn in the stock/landings between 2000–2019, reaching time-series lows in 2016–2018/2019 (DFO 2023c; Belec 2025). In more recent years, the exploitable biomass index/landings have been increasing, and recruitment levels have been stabilizing (DFO 2023c). Projections indicate snow crab in Div. 3Ps and 3LNO are in the healthy zone, although those in Div. 2HJ and 3K remain in the cautious zone (Belec 2025). During 2022, the DFO Commercial Landings Database indicated that many of the catch locations within the sea farm Study Area overlapped or were near BMAs 3–5, 8–9, and 12–14 (Figure 7.6).

7.1.2.2 American Lobster

In NL waters, American lobster occurs in inshore habitats all around the island of Newfoundland and along the Labrador coast in the Strait of Belle Isle (DFO 2023d). Adults preferentially inhabit medium to coarse (i.e., rocky) substrates, but may also occur on soft substrates (sand, mud; DFO 2023d). Habitats and substrates identified in the baseline assessments of the proposed BMAs (i.e., bedrock, boulder, kelp; see Table 6.1 above) are considered suitable habitat for this species (DFO 2022a).

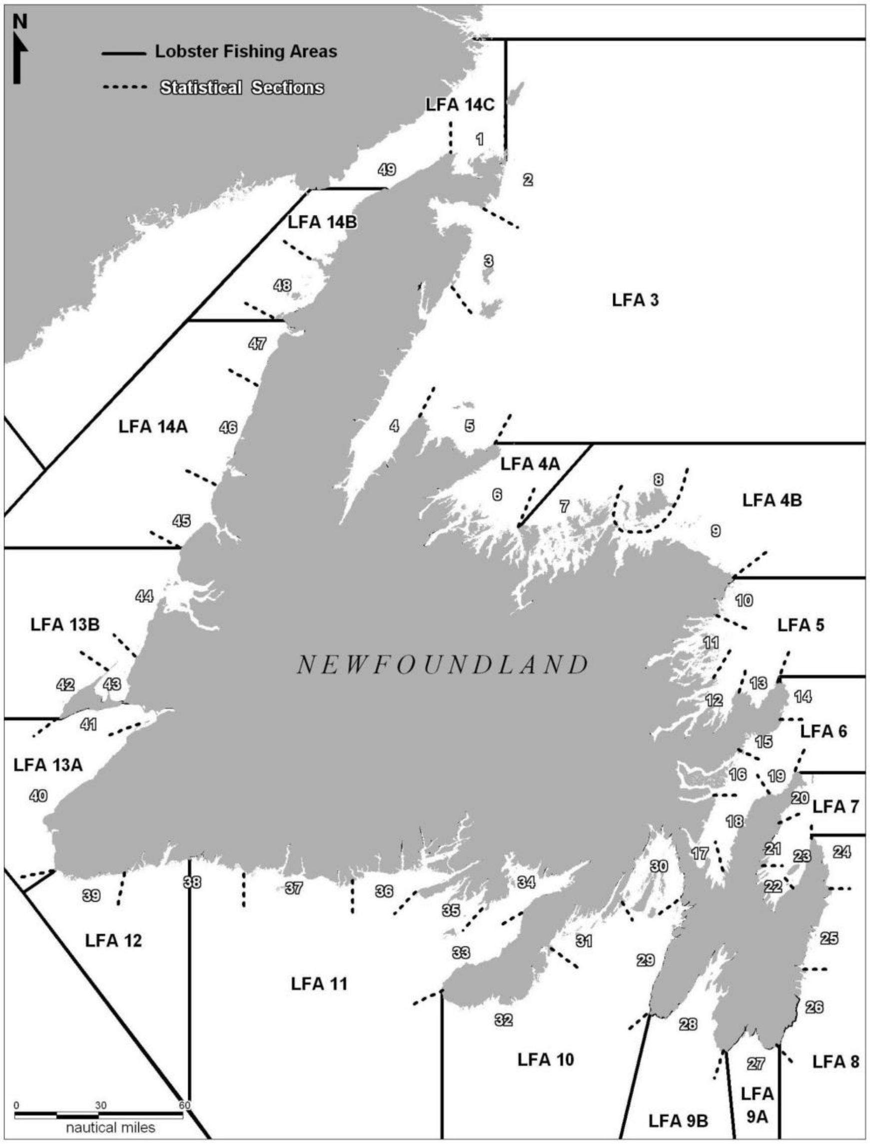


Source: DFO Commercial Landings Database (2022).

Figure 7.6. Distribution of commercial harvest locations in the sea farm Study Area for snow crab, 2022.

American lobsters can live 30+ years and in NL, typically reach minimum legal size for the fishery (82.5 mm carapace length) within ~8–10 years (DFO 2023d). This species grows through the molting process, the frequency of which is depending on age and water temperature; older lobsters have several years between consecutive molts, while younger individuals molt more frequently, and molting occurs more frequently in warmer versus colder waters (DFO 2023d). Smaller, mature females may molt and spawn within a single year, but larger females tend to follow a two-year molt-reproduction cycle and have increased fecundity and egg quality (DFO 2023d). Lobster molting and mating typically occurs during the summer months (July–September), with mating occurring ~1 year after a female extrudes her eggs (DFO 2023d). Fertilized eggs are carried by the female in clutches for 9–12 months on the underside of the tail (DFO 2023d). Hatching can occur between late May and September, with larger females tending to release larvae sooner than smaller individuals (DFO 2023d). Before the female releases the larvae, they undergo one molt, after which the planktonic larvae go through three more molts within 4–6 weeks before metamorphosing to benthic "miniature adults" and settling to the seabed (DFO 2023d). Natural predation is considered minimal, as this species has few predators; mortality is considered highest during the planktonic larval phase (DFO 2023d). American lobster is an opportunistic feeder and is known to consume a variety of prey, including crustaceans, echinoderms, molluscs, finfishes, and polychaetes (DFO 2023d).

American lobster commercial fishing activity has been ongoing on the south coast of Newfoundland since the mid-1970s and the NL lobster fishery is an effort-controlled fishery for which no TAC is assigned (DFO 2021a, 2022a). The sea farm Study Area overlaps lobster fishing areas 11 and 12 and the Hatchery Study Area is within area 13A (Figure 7.7; DFO 2021a). Since 2010, there has been cooperation between MCE (along with previous owners of its sea farms) and lobster fishers in and near the BMAs. Based upon a long-standing arrangement, lobster fishing is not restricted by farm infrastructure and local lobster fishers harvest within the lease boundaries. MCE policy is to allow lobster traps within the lease area and near the farm. This aligns with Aquaculture Policy (AP) 13 (FFA 2019). Likewise, recreational fishing for scallop (see Section 7.1.2.3), cod (see Section 8.1.1.1), trout (see Section 7.3), and mackerel (see Section 7.1.1.2.) occurs in and near MCE sea farms. During the aquaculture licensing process for sea farms, MCE organized public meetings and identified and discussed fishing areas to be considered in its farm planning. In addition, MCE issue a notice to mariners when sea farm installations are scheduled. For lobster fishing areas 3–14, the management strategy focuses on resource sustainability and includes measures such as a voluntary v-notching program, mandatory logbooks, closed areas for conservation, established trap limits and maximum number of fishing days, and minimum size retention limit (82.5 mm) (DFO 2024a). DFO intends to establish a working group of scallop and lobster fishers from Div. 3Ps with the goal of developing management strategies for the scallop fishery that will simultaneously protect lobster and their habitat (DFO 2024a).



Source: Appendix 5 in DFO (2021a).

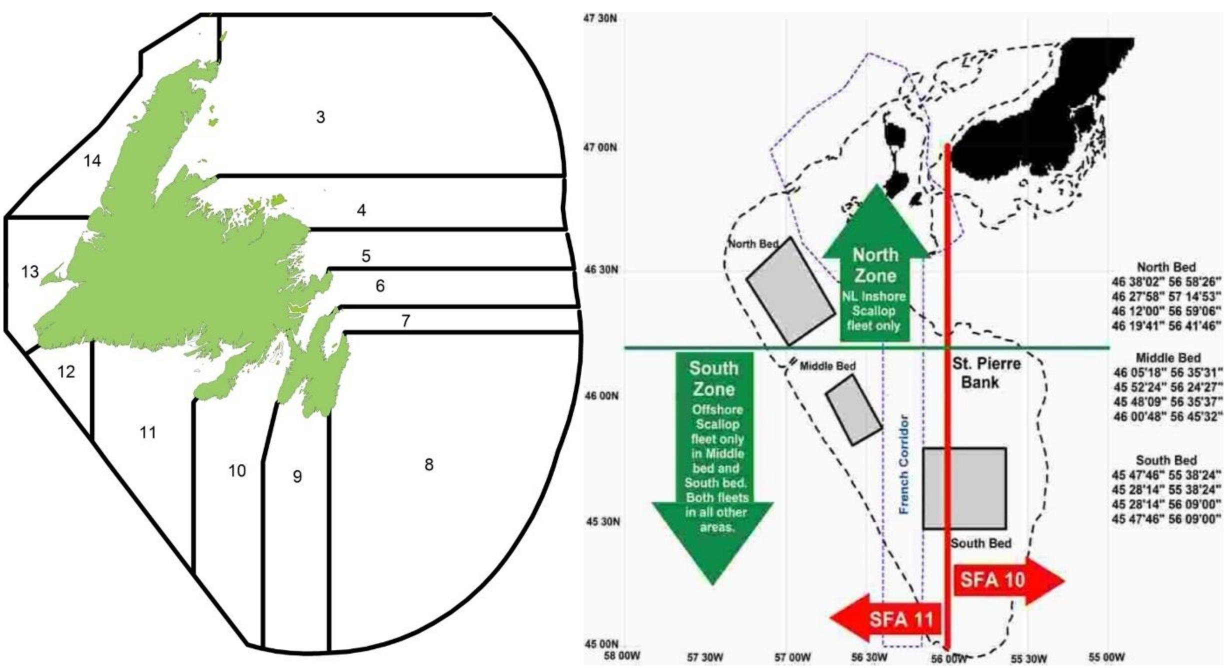
Figure 7.7. Lobster fishing areas in the NL Region.

7.1.2.3 Sea Scallop

Sea scallop only occur in the Northwest Atlantic, from the Gulf of St. Lawrence to Cape Hatteras; Newfoundland is the northernmost extent of their distribution (Coughlan et al. 2023). The St. Pierre Bank (Div. 3Ps, south of the Burin Peninsula) populations typically inhabit medium (gravel/cobble), soft (sand), and shell fragment substrates on three beds, North, Middle, and South, between 40 and 100-m depths (Coughlan et al. 2023).

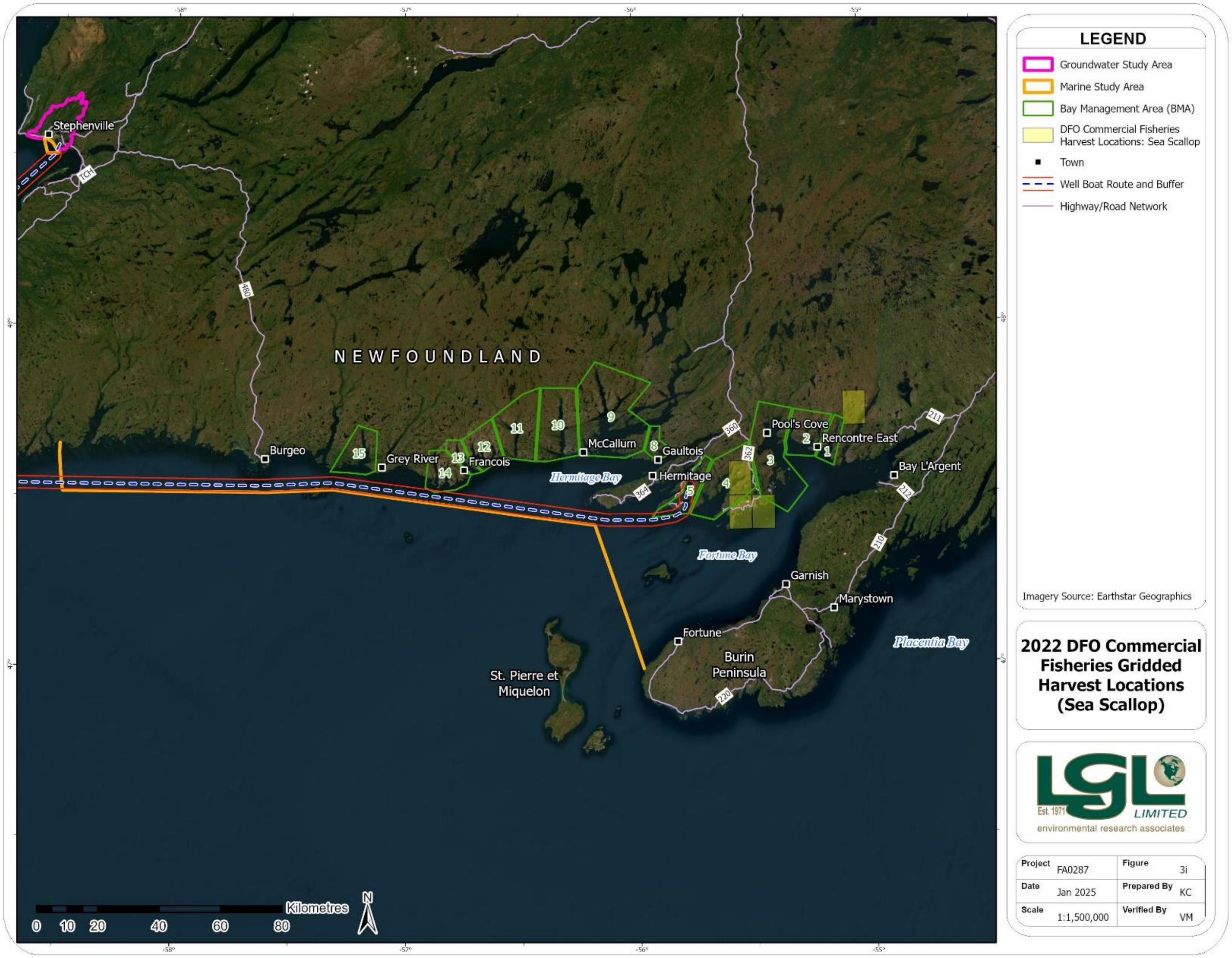
Sea scallop have lifespans of 21+ years and generally have shell heights of 100–150 mm, with some known to reach 200+ mm (Coughlan et al. 2023). They are considered recruits in the fishery when they reach ~90 mm in shell height, at ~4 years of age (Coughlan et al. 2023). Although most other commercial scallop species in Canadian waters are hermaphroditic, sea scallop have separate sexes (Coughlan et al. 2023). Sexual maturity can be reached by the age of 1 year, but their first spawning occurs when they have shell heights between 23–75 mm, during their second year (Coughlan et al. 2023). In NL, spawning timing is influenced by water temperature, food availability, and current speed, and typically starts in July (Coughlan et al. 2023). Fertilization is external and, after hatching, the planktonic larvae settle to the seabed within 1–1.5 months (Coughlan et al. 2023). Sea scallop have low natural mortality (0.02 in 2019), and filter feed on plankton and detritus in strong-current habitats (Coughlan et al. 2023).

There has been a targeted fishery for sea scallop on the St. Pierre Bank since the late 1970s (Coughlan et al. 2023). The sea farm Study Area overlaps scallop fishing areas 11 and 12, and the Hatchery Study Area is located within area 13 (Figure 7.8). More specifically, much of the sea farm Study Area is within the North Zone on the St. Pierre Bank (Figure 7.8; DFO 2021b). This fishery is a "pulse"-type, meaning the stocks are managed through alternating cycles of active fishing and fallow periods, and landings on St. Pierre Bank are correspondingly variable between years (Coughlan et al. 2023). Small scallop are currently abundant in the North bed, which is promising for short-term fishery projections (Coughlan et al. 2023). Within the sea farm Study Area, the DFO Commercial Landings Database indicates that sea scallop were harvested in Fortune Bay during 2022, in locations that overlapped or were near BMAs 3–4 (Figure 7.9).



Source: DFO (2019b, 2021b).

Figure 7.8. Sea scallop fishing areas in Newfoundland (left) and on the St. Pierre Bank (Div. 3Ps; right).



Source: DFO Commercial Landings Database (2022).

Figure 7.9. Distribution of commercial harvest locations in the sea farm Study Area for sea scallop, 2022.

7.1.2.4 Blue Mussel

Blue mussel occur in hard (e.g., bedrock/boulder, wharf pilings), intertidal and subtidal habitats ranging from the NL region to South Carolina in the Northwest Atlantic, and wild mussel beds are found in many Newfoundland coastal areas, typically in depths <20 m (DFO 2003; Christian et al. 2010; Thompson and Innes 2021). Although not commercially harvested from the wild, blue mussel are an important aquaculture species (GC 2017b), with most aquaculture facilities on the northeast coast of Newfoundland and one active farm, Connaigre Fish Farms, in the vicinity of MCE sea farms (between MCE BMA 5 and BMA 8). For this reason, blue mussel is included as part of this report's species profiles of commercially important species.

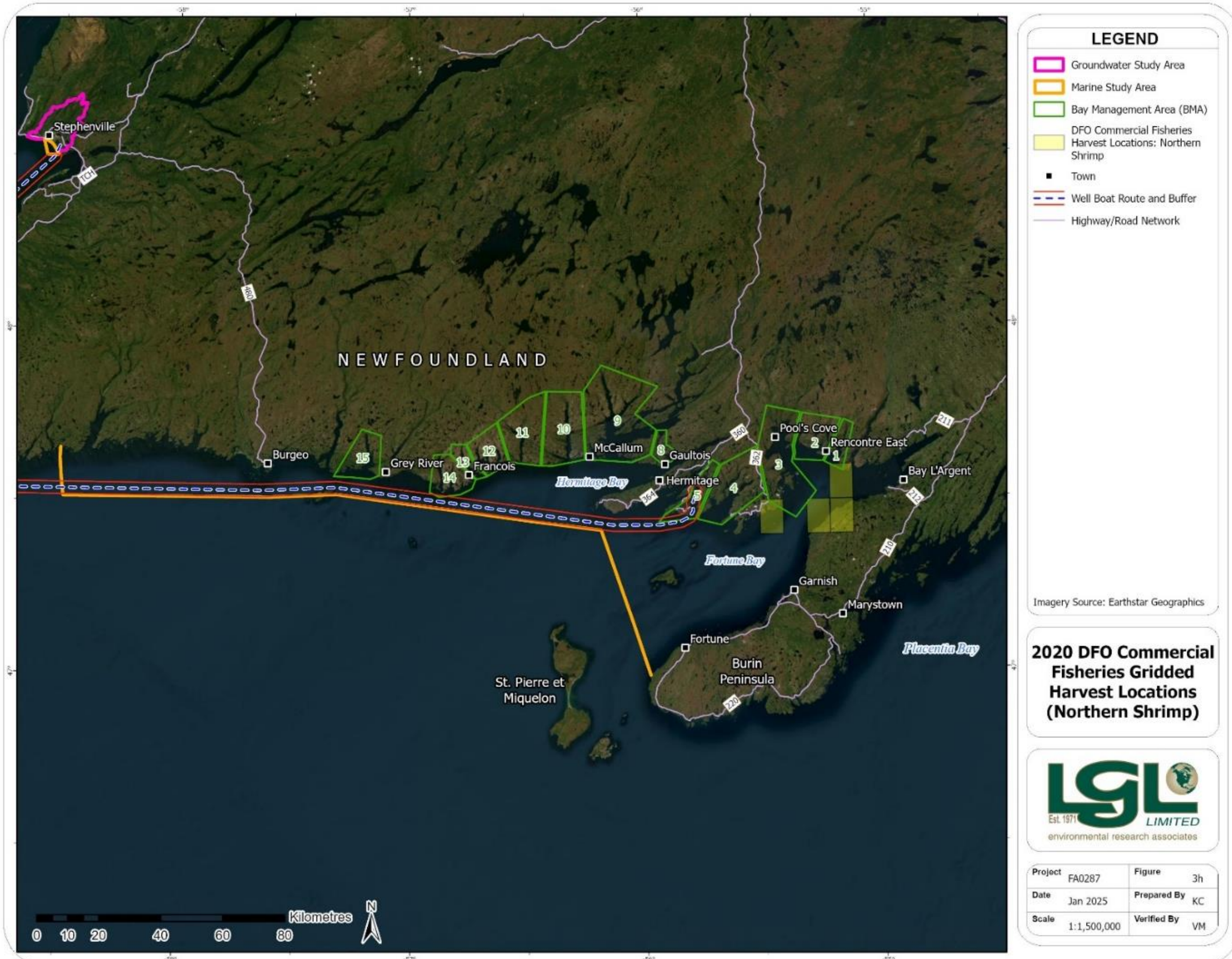
Adult blue mussel are typically ~5–10 cm in length but can grow up to ~20 cm (NOAA 2024). In Newfoundland, blue mussel reach sexual maturity at 12–15 mm shell length and spawn between June and July (Toro et al. 2002). The fertilized eggs are benthic, and, upon hatching, the larvae are free-swimming [vertically within the upper water column; they are carried by currents] and planktonic for 3–4 weeks before they settle on the seabed later in the summer as sessile spat to metamorphose into juveniles and mature into adults (Christian et al. 2010; Thompson and Innes 2021). Blue mussel attach to hard substrates using byssal threads, which have been found to have increased strength (tenacity) in winter versus summer, thought to be a response to seasonal flow fluctuations (Christian et al. 2010). Juveniles can detach and move to a new location, either via active crawling using their foot or passively flowing with the water current, but this becomes limited as a mussel grows and increases in body mass (DFO 2003; Christian et al. 2010). Blue mussel are important food sources for various fauna, with larvae preyed upon by zooplankton and small fish, and juveniles and adults by sea ducks (especially Common Eider *Somateria molissima*), sea stars, lobsters, and crabs, and they may be in competition for food with or suffocated by algae (e.g., invasive oyster thief *Codium fragile*) and anemones (DFO 2003; Christian et al. 2010). Other sources of natural mortality may include parasites, diseases, or environmental conditions beyond their wide range (DFO 2003). These filter feeders feed on plankton (living and dead) and detritus (Christian et al. 2010).

7.1.2.5 Northern Shrimp

In the Northwest Atlantic, northern shrimp are the predominant shrimp species and range from Baffin Bay to the Gulf of Maine (DFO 2024d). This cold-water species inhabits soft substrates (mud) where water temperatures are between 1–6°C, which, for NL, typically includes habitats with water depths ranging from 150–600 m (DFO 2024d). Northern shrimp undertake vertical diel migrations, resting or feeding on/near the seabed during the day and rising into the water column to feed at night.

Northern shrimp may live for ≥8 years and reach 15 cm in length, although the average body length is closer to ~7–8 cm (GC 2016a). They are considered part of fishable biomass when their carapace length is >17 mm (DFO 2024d). Individuals of this species are protandrous hermaphrodites, i.e., they are usually born and undergo maturation as males, then mate as males for one or several years before changing sex to spend the remainder of their lifespan as mature females (DFO 2024d). As a result, most of the fishable biomass consists of females (DFO 2024d). In late summer to fall, females produce and carry eggs until they hatch in spring, coincident with the spring phytoplankton bloom and peak food availability (GC 2016a; DFO 2024d). Larvae are transported by currents, potentially hundreds of kilometres from their hatching location, before settlement in any particular offshore area (DFO 2024d). Northern shrimp are an important component of offshore ecosystems, serving as prey for many fish species (e.g., Atlantic cod, Greenland halibut, redfish, skates, wolffish) and harp seal (DFO 2024d). Northern shrimp feed on zooplankton (DFO 2024d).

Northern shrimp population sizes are highly affected by water temperature (GC 2016a), along with food availability and natural mortality (i.e., predation pressure; GC 2024d). At the time of the collapse of groundfish stocks in the early 1990s, reduced predation pressures coupled with cold water temperatures led to a notable increase in shrimp populations in the NL region (GC 2016a). However, owing to rising water temperatures to record highs in recent years and increased commercial fishing pressure following the 1992 moratorium, current northern shrimp biomass estimates are at historical lows within all NL shrimp fishing areas (FFA 2023). Although the sea farm Study Area is not within a shrimp fishing area but rather between shrimp fishing areas 7 and 8, the Hatchery Study Area is within area 8 and the NL regional biomass decline is presumed to apply to both Study Areas. During 2018–2022, the DFO Commercial Landings Database indicates that northern shrimp catches within the sea farm Study Area declined considerably (65%) between 2019 and 2020 and there were no catches during 2021 or 2022; there were also no catches within the Hatchery Study Area. During this period, all commercial harvests in the sea farm Study Area occurred between June and November, with peak catches during July–September. During 2020, northern shrimp catches occurred in Fortune Bay, with catch locations overlapping or near BMAs 1 and 3 (Figure 7.10).



Source: DFO Commercial Landings Database (2020).

Figure 7.10. Distribution of commercial harvest locations in the sea farm Study Area for northern shrimp, 2020.

7.1.3 Marine Mammals

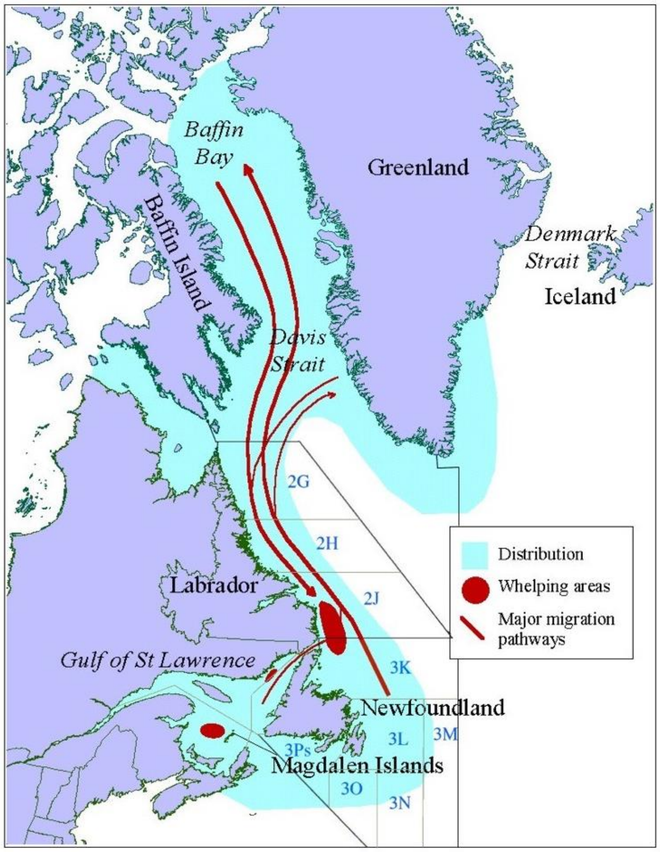
Seal harvesting in Atlantic Canada mainly includes harp and grey seals (DFO 2024e), with some harvesting of hooded seal. In recent years, DFO has not set a TAC for seals, but rather monitors landings and bycatch and relates the data to population assessments (Stenson and Upward 2020; DFO 2024e). To satisfy EIS Guideline requirements, brief summaries are provided for these species below, as their distribution does include Newfoundland. However, seal harvesting is not anticipated in or near the Study Areas and will not inform effects assessments for the EIS (see LGL 2025b). Harp seals are typically harvested off northeastern Newfoundland (Stenson and Upward 2020), grey seals nearer to Nova Scotia, and the commercial harvest for hooded seals is very limited (NAMMCO 2018).

7.1.3.1 Harp Seal

Harp seal is the predominant seal species in Canada in terms of abundance, and ranges from the Scotian Shelf to the Gulf of St. Lawrence, NL, Greenland, and Baffin Bay (Figure 7.11; DFO 2022e). They pup annually on stable ice in the Gulf of St. Lawrence and off the northeast coast of Newfoundland ("the Front"; Figure 7.11). In April/May, mature harp seals gather in large moulting aggregations near the southern boundary of the seasonal ice pack off southern Labrador and/or northeastern Newfoundland and in the northern Gulf of St. Lawrence (DFO 2020b). They later migrate northwards to summer feeding grounds in the Canadian Arctic and Greenland (DFO 2022e). The most recent population estimate (2019) for harp seal is 4.7 million individuals (DFO 2024e). A more recent harp seal survey was conducted in March 2022 and an updated population estimate is anticipated to be published in 2025 (DFO 2024e).

7.1.3.2 Grey Seal

There is one grey seal population in Canada that is subdivided into two herds, the Scotian Shelf and Gulf of St. Lawrence (DFO 2022f). This species is present year-round in the Gulf of St. Lawrence, Scotian Shelf, and NL (DFO 2022e). Most grey seal breeding occurs on Sable Island on the Scotian Shelf (DFO 2022e). The most recent population estimate (2021) totalled 366,400 individuals (DFO 2024e). Grey seals also occur on Saint-Pierre et Miquelon with a recent haul-out survey estimating 218 individuals (Godino Sanchez et al. 2024).

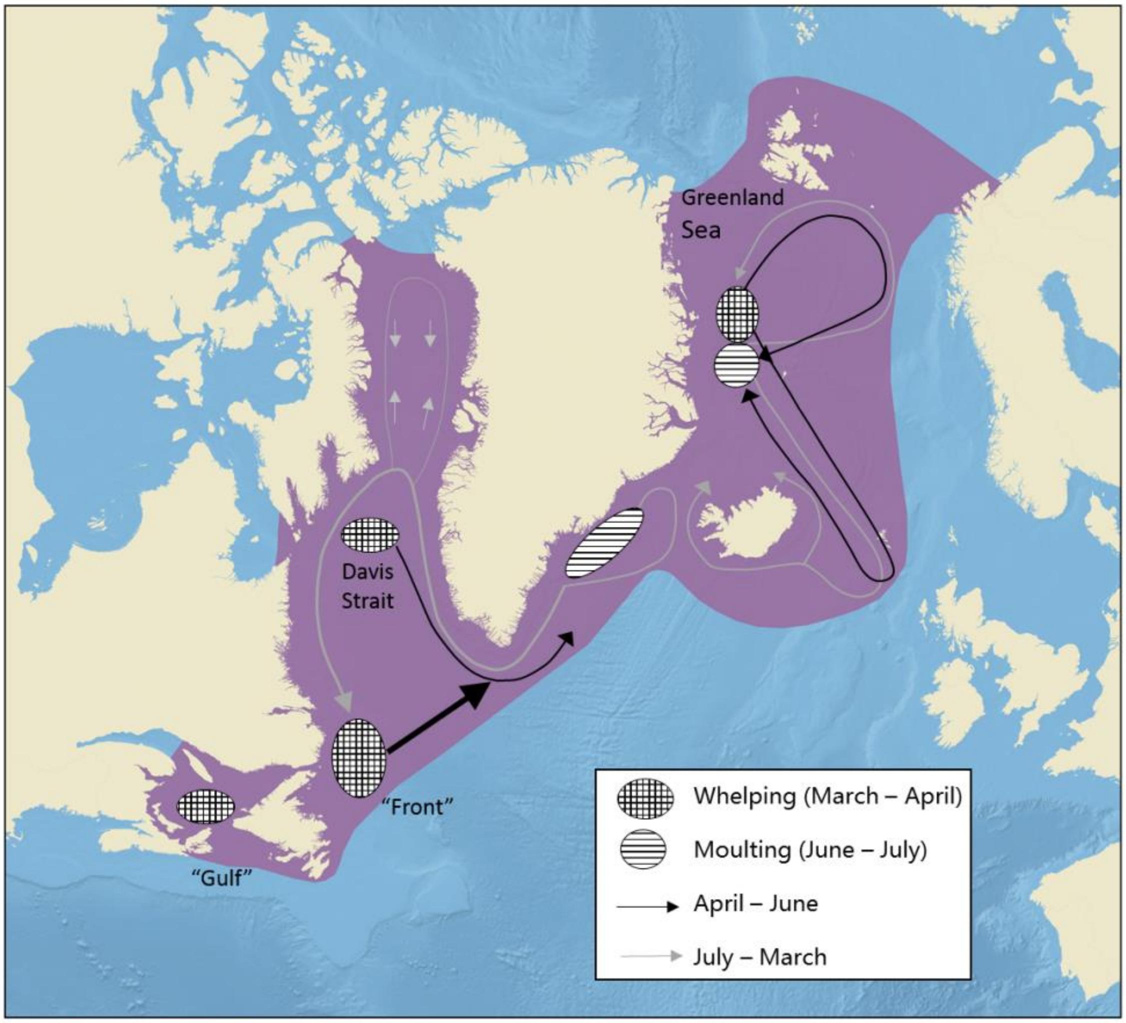


Source: Figure 1 in DFO (2022e).

Figure 7.11. Distribution, whelping areas, and major migration pathways of harp seal.

7.1.3.3 Hooded Seal

Hooded seal include southern Newfoundland, northern Nova Scotia, and the Gulf of St. Lawrence within the southernmost portion of their otherwise mainly Arctic distribution (Figure 7.12; NAMMCO 2018). Between March and April, hooded seal whelp in the Gulf of St. Lawrence, off northeastern Newfoundland ("the Front"), Davis Strait, and off eastern Greenland (Figure 7.12). Moulting occurs off southeastern Greenland in June and July, following northward migrations between April and June. In Canadian waters, southward migrations occur sometime between July and March. The Northwest Atlantic stock was estimated at ~600,000 individuals as of 2005, while the Greenland Sea stock is on a declining trend, from ~102,000 in 1997 to ~76,623 in 2018 (NAMMCO 2018).



Source: NAMMCO (2018).

Figure 7.12. North Atlantic hooded seal distribution range.

7.2 Sharks

Sharks have been identified as fish with the potential of causing damage to aquaculture sea cages. Various shark species have distribution ranges that occur in or near the Study Areas (Table 7.4). This subsection provides a brief summary of the occurrence of blue shark (*Prionace glauca*) in Newfoundland waters. See the subsection on species at risk for the profile of white (*Carcharodon carcharias*), basking (*Cetorhinus maximus*), porbeagle (*Lamna nasus),* and shortfin mako (*Isurus oxyrinchus*) sharks.

Table 7.4. Shark species within or near the Study Areas.

Common Name	Scientific Name	Northwest Atlantic Distribution	Reproduction
Blue shark	*Prionace glauca*	Global temperate/tropical oceans; Eastern Canada: Nova Scotia, NL, Gulf of St. Lawrence [1]	Spring/summer; locations not definitive given global distribution [1]
White shark	*Carcharodon carcharias*	Global 60ºN-60ºS; Northwest Atlantic: Newfoundland to northern Brazil [2]	Likely Mid Atlantic Bight [2]
Basking shark	*Cetorhinus maximus*	Northern Newfoundland to U.S. border [3]	Unknown, possibly Scotian Shelf in spring/early summer [4,5]
Porbeagle shark	*Lamna nasus*	Global 30–70ºN and 30–50ºS; NW Atlantic: NL, Gulf of St. Lawrence, Scotian Shelf & Bay of Fundy to New Jersey/South Carolina [6]	Grand Banks, off southern Newfoundland, at the entrance of the Gulf of St. Lawrence, and on Georges Bank [6]
Shortfin mako shark	*Isurus oxyrinchus*	Atlantic population: Quebec, New Brunswick, NL, Nova Scotia, Prince Edward Island, & Atlantic Ocean [7]	Late winter to mid summer; likely pup between 20–30ºN [7]

Source: [1] COSEWIC (2016); [2] COSEWIC (2021); [3] DFO (2022g); [4] Sims et al. (2000); [5] Campana et al. (2008); [6] COSEWIC (2014a); [7] COSEWIC (2019a).

7.2.1 Blue Shark

Blue shark is one of the most abundant and widespread shark species due to its relatively high fecundity and growth rate (COSEWIC 2016). Occurring in temperate and tropical oceanic and continental shelf waters, this pelagic species inhabits depths ranging from the surface to ≥600 m, generally in temperatures between 12–20°C (COSEWIC 2016). In Atlantic Canadian waters, blue shark mainly occurs in the Gulf Stream off the shelf, along with Nova Scotia, NL, and the Gulf of St. Lawrence (COSEWIC 2016). Blue shark in Atlantic Canada undertake seasonal migrations, from the continental shelf in summer to overwinter in waters beyond the shelf as of November (COSEWIC 2016). Individuals also undertake diel migrations within the oceanic water column, occurring in surface waters during nighttime to ~400-m depth in daylight hours (COSEWIC 2016).

The lifespan of blue shark is not well understood but may be between 15–30 years of age (COSEWIC 2016). Once reaching maturity at ~6–7 years, blue shark have on average a brood size of ~30 young, but broods can range from 4–135 (COSEWIC 2016). The gestation period is 9–12 months, with breeding occurring every 1–2 years, typically during spring or summer (COSEWIC 2016). Little is known regarding potential predators of blue shark, but they chiefly consume fishes, squids, and octopi (COSEWIC 2016).

While some blue shark may be caught in recreational fisheries, the main source of anthropogenic mortality in eastern Canadian waters is bycatch in longline fisheries for tuna and swordfish (GC 2025a). Internationally, blue shark is commonly caught for the shark fin trade (GC 2025a).

7.3 Sea-run Trout

Trout are a group of salmonids found in freshwater and marine environments across Canada. Sea-run trout are among the top ten recreationally fished groups in the province (Tipay et al. 2024). Trout fishing in coastal waters is open year-round and does not have any harvesting requirements (DFO 2023b). While some sea-run trout populations remain in freshwater for their entire lifecycle, sea-run trout populations spend a portion of their lives in the ocean. There are three trout species that have sea-run populations in Newfoundland, including speckled (brook; *Salvelinus fontinalis*), brown (*Salmo trutta*), and rainbow (*Salmo gairdneri*; DFO 2025). These three species have distributions that overlap the sea farm Study Area and are described in this section. The insular waters of Newfoundland are classified as trout angling zone 1 (DFO 2025). Specific season opening and closing dates may vary per water type (scheduled vs. non-scheduled) and trout species. Within zone 1, the recreational trout season dates for non-scheduled waters (for the 2025–2026 season) were from 1 February–15 April and 15 May–7 September (DFO 2025). The season for scheduled rainbow trout waters runs from 1 June–7 October. For brown trout, the season for scheduled and non-scheduled waters runs from 1 February–7 October. There are no scheduled waters for brook trout and season dates are as listed for trout non-scheduled waters.

7.3.1 Brook Trout

Brook trout (also known as speckled trout) are chars and are native to NL (Scott and Crossman 1964, 1998). This species can be non-anadromous (resident) or anadromous (sea-run), and is found in the province's lakes, rivers, and coastal areas (Grant and Lee 2004). Anadromous and non-anadromous brook trout have similar freshwater life histories (Scott and Crossman 1964).

In Newfoundland, adults of this species are typically between 0.9–2 kg but can exceed 3.6 kg in weight and 60 cm in length. Brook trout are short lived, typically living <4 years and rarely longer than 5–8 years (Scott and Crossman 1998). Sexual maturity occurs between 2–3 years (Portt et al. 1988; Scott and Crossman 1998). Spawning typically occurs between September and November (Bradbury et al. 1999; Grant and Lee 2004) in water temperatures between 4–10°C (Scott and Crossman 1964; Scruton 1986). Spawning substrate generally includes gravel in shallow headwater streams, the shoreline of lakes, areas of groundwater upwelling, or submerged woody debris (in lakes; Grant and Lee 2004). In streams, females will clear debris away and form a redd (i.e., nest made in gravel) to deposit eggs, which the male fertilizes by releasing sperm into the water column (Grant and Lee 2004). In Newfoundland, eggs incubate over winter in the redd and hatch between April and mid-June (Baggs 1989; Scruton et al. 1997). Fertilized eggs are typically in the upper 30 cm of the substrate and may succumb to freezing over winter if the redd is exposed (Curry et al. 1991; Snucins et al. 1992). Hatched trout (alevins) remain in the redd until their yolk sac is absorbed (Williams 1981; Ryan 1988; Scott and Scott 1988). After emergence, young-of-the-year trout remain in shallow waters with medium to hard substrates (e.g., gravel, cobble, rubble), slow currents (0.02–0.38 m/s, and temperatures between ~10–15ºC (McCormick et al. 1972; Peterson et al. 1979; Cunjak and Green 1983; Barton et al. 1985; Johnson et al. 1992; Meisner 1990; Ford et al. 1995). In Newfoundland, young-of-the-year and juvenile trout also prefer habitats with available cover (e.g., gravelly substrate or aquatic vegetation; Cunjak and Green 1983). Sea-run brook trout leave their natal streams for marine environments, typically by the age of ~3 years (MacMillan and LeBlanc 2002). Seward migration can occur year-round but typically peaks in Newfoundland in May and June (O'Connell 1982). Sea-run brook trout have been observed forming small schools within the vicinity of their natal streams (Scott and Scott 1988).

Temperature is a limiting factor for juvenile brook trout distribution (MacCrimmon and Campbell 1969), with suitable waters generally between 11–16°C (Jirka and Homa 1990). Juveniles inhabit a variety of substrates, from silt to large boulders (Grant and Lee 2004), and water depth varies with season (deeper waters in winter compared to summer), activity level/type, and fish size (Cunjak and Power 1986; Jirka and Homa 1990). Adults have a broader range for depth (~6–90 cm; Jirka and Homa 1990) and substrate type (mud, sand, silt, rocky, bedrock; Chisholm et al. 1987). The type of cover utilized by adults typically includes water surface turbidity and larger structures, such as undercut banks or submerged vegetation (Grant and Lee 2004).

Smaller sea-run brook trout mainly prey on invertebrates (e.g., insects, polychaetes, molluscs) and larger individuals primarily consume fish (e.g., rainbow smelt, small eels) in summer and invertebrates (e.g., crustaceans, polychaetes) in winter (Wiseman 1969; O'Connell 1982; Rikardsen et al. 2006). Natural mortality rates are likely highest within the first several weeks after seaward migration (Kristensen et al. 2019). Common predators of sea-run trout include marine mammals (e.g., seals), other fish (e.g., Atlantic salmon and sharks), and birds (e.g., cormorants; Trotter 1989; Jepsen et al. 2018). In terms of anthropogenic mortality, brook trout are fished in the freshwater recreational fishery, representing approximately half of the recreational catch in Newfoundland (DFO 2025; Tipay et al. 2024).

In the sea farm Study Area, brook trout presence has been reported in several rivers and brooks (Porter et al. 1974). Historically, brook trout have been present in Fortune Brook, Grand Bank Brook, Terrenceville Brook, Grand La Pierre River, Long Harbour River, Mal Bay Brook, Rencontre Brook, Belle Harbour River, Northeast Brook, Northwest Brook, Bay du Nord River, Salmon River (Cinq Island Bay), Southwest Brook (Cinq Island Bay), Old Bay Brook, Conne River (sea run and resident), Northwest Brook (Bay d'Espoir), Salmon River (Bay d'Espoir), Bottom Brook (sea run), and White Bear River (sea run and resident; Porter et al. 1974).

7.3.2 Brown Trout

Brown trout are native to western Asia, Europe, and North Africa (MacCrimmon et al. 1970). They were introduced to North America in the late 1800's (Scott and Crossman 1998) and introduced to St. John's, NL in 1884 from a hatchery in Scotland (Andrews 1965). Stocking efforts in local rivers across the island continued until the late 1930s but were eventually discontinued

(FFA n.d.). Today, brown trout are found across the island of Newfoundland and are an important part of the recreational fishery (DFO 2025; Tipay et al. 2024). Anadromous and non-anadromous (i.e., freshwater resident from) brown trout have similar freshwater life histories (Grant and Lee 2004).

The freshwater form of brown trout can grow to 140 cm in length, while the sea run-form is on average larger (Morris 2023). Life span can also differ, with resident trout living <10 years (Ryan 1988) and sea-run trout living to 11–13 years of age (Williams 1963; O'Connell 1982). In Newfoundland, brown trout have been observed reaching sexual maturity between 2–6 years (Liew 1969; Lee 1971; O'Connell 1982; MacKinnon 1998). While adults migrate to lakes, estuaries, or the ocean for their adult lives, all return to streams to spawn, although not necessarily to their natal rivers (Ryan 1988; Bradbury et al. 1999). Overall, this species typically prefers to spawn in shallow gravel sections in streams (Bradbury et al. 1999), with larger individuals spawning on coarser gravel and burying the eggs deeper than smaller fish (Fleming 1996). In Newfoundland, spawning begins in early October and can continue until early December (Kellett 1965; Liew 1969; Lee 1971; Wiseman 1972; O'Connell 1982; Scruton et al. 1997). Females create a redd in the substrate (typically near some form of cover) to deposit eggs in batches (Witzel and MacCrimmon 1983; Scott and Scott 1988; Haury et al. 1999). Once the eggs are fertilized, they are quickly covered with substrate (e.g., gravel; Scott and Scott 1988). Emergence typically occurs in early spring (Raleigh et al. 1986). Alevins remain in the vicinity of the spawning area to feed and, after several days to a week, move in-stream (Elliot 1966; Héland 1977, 1978; Mortensen 1977; Klemesten et al. 2003).

Young-of-the-year are mainly found over rocky substrates (e.g., gravel and cobble) at depths between 42.0–46.2 cm (Cunjak and Power 1986; Raleigh et al. 1986). Their first summer is spent within their natal stream before they overwinter in pools (Elliot 1986). Juveniles can utilize a wide a range of habitat types, inhabiting substrate sizes from gravel to bedrock (Grant and Lee 2004). Juveniles leave the spawning grounds and migrate to larger areas (e.g., larger rivers or lakes; Grant and Lee 2004) and become more pelagic as they grow (Jonsson 1981; Schei and Jonsson 1989; Hegge et al. 1993). In freshwater, adults spend the winter months upstream in deep waters with slow velocities and move downstream in the spring and summer (Clapp et al. 1990). By the age of ~3–4 years, smolts will migrate to estuaries or coastal areas to feed in fall/winter and migrate back to freshwater for spawning after spending between 2–4 months to several years at sea (Jensen 1968; Berg and Berg 1987; Jonsson and Jonsson 2002; MacMillan and LeBlanc 2002; Grant and Lee 2004). All age classes of this species seek areas with cover comparatively more than other trout species (Raleigh et al. 1986).

Dietary preferences can be habitat specific. In freshwater environments, brown trout consume invertebrates (e.g., winged insects, crustaceans, caddis larvae; Giller and Greenberg 2014). In marine environments, trout prey on marine fish and invertebrates (e.g., shrimp; Davidsen et al. 2023). Brown trout are preyed upon by larger fish, birds (e.g., cormorants, raptors), and mammals (e.g., otters).

Historically, sea-run brown trout have been observed in Garnish River (Porter et al. 1974), but a more recent study had no confirmed observations of brown trout in any rivers within the sea farm Study Area (Westley and Fleming 2011). However, brown trout are present in rivers that terminate in Placentia Bay (DFO 2025).

7.3.3 Rainbow Trout

Rainbow trout are native to the Pacific region, specifically northeast Asia and from Mexico to Alaska, including British Columbia (DFO 2016c). They were introduced to Newfoundland in 1887, into Long Pond on the Avalon Peninsula (Frost 1938; Scott and Crossman 1964; Porter 2000). At present, rainbow trout are found in waterways across Newfoundland and are recreationally fished (DFO 2025).

Freshwater residents are typically between 15–40 cm in length and weigh 1 kg (DFO 2016c). Sea-run rainbow trout (also known as steelhead) are larger, reaching lengths between 50–75 cm and weighing 4 kg (DFO 2016c). In Newfoundland, rainbow trout can reach sexual maturity between 3–4 years of age (Lee 1971). Whether adapted to streams, lakes, or marine environments, rainbow trout typically return to streams to spawn (Grant and Lee 2004). Preferred in-stream spawning locations are characterized by fine gravel in a riffle (i.e., shallow rocky area with fast-moving water flow) above a pool (Grant and Lee 2004). Females form a redd in gavel and deposit eggs, and after fertilization the eggs are covered (Scott and Scott 1988; Scott and Crossman 1998). Females do not deposit all their eggs at once and can repeat spawning with several males until spent (Scott and Scott 1988). Rainbow trout spawning timing is weather and location dependant, but typically occurs in the spring (e.g., March–May) in Newfoundland (Frost 1938, 1940; Scruton et al. 1997). Temperature is important for spawning, as sudden drops in water temperature could cease upstream migration (in sea-run trout) or delay ripening (Hanel 1971; Reiser and Bjornn 1979; Scott and Crossman 1998). Egg incubation and emergence timing is similarly location and weather dependent. In Newfoundland waters, incubation occurs from mid-April to late June, with the eggs hatching between mid-June and mid-August (Scruton et al. 1997; Scott and Crossman 1998). After hatching, young-of-the-year stay within the gravel substrates for ~14-days (Scott and Crossman 1998). Following emergence, they move to riffle areas. Sea-run rainbow trout typically spend 1–4 years in freshwater environments before migrating to marine environments, typically during the spring (Raleigh et al. 1984; Ryan 1988; Scott and Crossman 1998).

Water velocity, temperature, depth, and cover availability are important factors for juvenile and adult rainbow trout habitat, with larger fish occupying areas with higher water velocities (Grant and Lee 2004). Optimal temperatures for juvenile rainbow trout have been observed between 15–20°C and smoltification occurs in waters 7–10°C (Dickson and Kramer 1971; Wagner 1974; Adams et al. 1975). The preferred temperature for adult rainbow trout is estimated to be between 12°C to 18°C, and they have been observed to move to deeper waters during the winter months (Carlander 1969; Lewis 1969; Raleigh et al. 1984). Cover availability and percent coverage can influence the abundance and biomass of trout in streams, with adults requiring more coverage than juveniles (Boussu 1954; Raleigh et al. 1984). Juveniles and adults inhabit a wide range of substrate types, from fine (silt, sand) to medium/coarse (gravel, rubble; Grant and Lee 2004).

In freshwater environments, rainbow trout consume invertebrates (terrestrial and aquatic) and small fish. In marine environments, their diet is composed of small fish and crustaceans (Rikardsen and Sandring 2006). Larger fish, birds, and mammals prey on rainbow trout in both the marine and freshwater environments.

Historically, sea-run rainbow trout have been observed in streams in the Clarenville/Trinity Bay area and along the west coast of Newfoundland (Porter et al. 1974; Chadwick and Green 1985). In the sea farm Study Area, rainbow trout have been observed in rivers terminating in Bay d'Espoir (Conne River and Little River) since the 1990s (Dempson et al. 1999, 2000). Occurrences outside of Bay d'Espoir, sightings were first reported in Long Harbour River and Grand Bank Brook in 1998 (Porter 2000). Currently, rainbow trout are present in several rivers within salmon fishing area 11, including: Hughes Brook, First Brook, Salmon River (East Bay), Northwest Brook, Southeast Brook, and Little River (DFO 2025).

7.4 Marine Mammals (Non-commercial Species)

Marine mammals typically migrate to waters in the NL region between spring and early summer to feed until early fall, when they generally migrate south to overwinter. Other than harp, grey, and hooded seal harvests, Indigenous cultural practices, or authorized scientific, rescue, or rehabilitation exceptions, it is prohibited to disturb marine mammals in Canada under the *Fisheries Act* and Marine Mammal Regulations. Various non-commercial species of marine mammals, including cetaceans (whales, dolphins, and porpoises) and harbour seal (*Phoca vitulina concolor*) may occur within or near the Study Areas. Although not traditionally considered a component of fish and fish habitat, a brief summary of typical habitat use and relative occurrence of non-commercial marine mammals in the NL region is provided here to satisfy EIS Guideline requirements (Table 7.5). Marine mammal species at risk are described in Section 8.0.

Table 7.5. Non-commercial or at-risk species of marine mammals with reasonable likelihood of occurrence in or near the Study Areas.

Common Name	Scientific Name	Occurrence (NL Region)	Season (NL Region)	Habitat
Humpback whale (Western North Atlantic population)	*Megaptera novaeangliae*	Common	Potentially year-round, but mostly May–September	Coastal, shelf, & pelagic
Common minke whale (North Atlantic subspecies)	*Balaenoptera acutorostrata acutorostrata*	Common	Potentially year-round, but mostly May–October	Coastal, shelf, & banks
Sperm whale	*Physeter macrocephalus*	Common	Potentially year-round, but mostly summer	Slope, canyons, & pelagic
Long-finned pilot whale	*Globicephala melas*	Common	Potentially year-round, but mostly spring-fall	Shelf break, pelagic, & slope

Common Name	Scientific Name	Occurrence (NL Region)	Season (NL Region)	Habitat
Common dolphin	*Delphinus delphis*	Common	Summer	Shelf & pelagic
White-beaked dolphin	*Lagenorhynchus albirostris*	Common	Potentially year-round, but mostly June–September	Shelf & pelagic
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Common	Potentially year-round, but mostly summer–fall	Coastal & shelf
Harbour seal (Atlantic and Eastern Arctic subspecies)	*Phoca vitulina concolor*	Uncommon (but does occur in relatively high numbers on St. Pierre et Miquelon)	Potentially year-round	Coastal

Source: C-NLOPB (2010, 2014); LGL (2015, 2016, 2018); Godino Sanchez et al. (2024).

8.0 Species at Risk

For the purposes of this baseline study, SAR are those species listed/designated under the *Species at Risk Act* (SARA), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and/or Newfoundland and Labrador's *Endangered Species Act* (ESA).

SARA was adopted by the Canadian Federal Government in December 2002, with various provisions coming into effect in June 2003 (e.g., independent assessments of species by COSEWIC) and June 2004 (e.g., prohibitions against harming or harassing listed *Endangered* and *Threatened* species or damaging or destroying their critical habitat). Species are listed under SARA on Schedules 1–3. Schedule 1 is the official list of wildlife species at risk in Canada, and only those species designated as *Endangered, Threatened,* or *Extirpated* on Schedule 1 of SARA have immediate legal implications. Once a species/population is designated under SARA, protection and recovery measures are implemented. Schedules 2 and 3 of SARA identify those species listed by COSEWIC as 'at risk' prior to October 1999, which must be reassessed using revised criteria prior to consideration for Schedule 1 of SARA.

COSEWIC is "an independent advisory panel to the Minister of Environment and Climate Change Canada (ECCC) that meets twice a year to assess the status of wildlife species at risk of extinction. Members are wildlife biology experts from academia, government, non-government organizations and the private sector responsible for designating wildlife species in danger of disappearing from Canada" (COSEWIC 2025a). Species in Canada that have not yet been assessed by COSEWIC, but are suspected of being at risk, are identified by Species Specialist Sub-committees (SSCs) or by the Indigenous Knowledge [note: termed 'Aboriginal Traditional Knowledge' on COSEWIC (2025a)] sub-committee as candidate species for detailed status assessment. Candidate species may also include species that were previously assessed by COSEWIC as 'not at risk' or 'data deficient', for which newly available information suggests they may be 'at risk' in Canada (COSEWIC 2025a).

NL's ESA "provides special protection for plant and animal species considered to be *Endangered*, *Threatened*, or *Vulnerable* in the province, and fulfils the [provincial] commitment under the *National Accord for the Protection of Species at Risk*" (FFA 2025). The ESA includes provincial native species, subspecies, and populations, excluding marine fish, bacteria, and viruses. With few exceptions, the ESA is not applicable to introduced species. Status designation under the ESA follows recommendations by COSEWIC and/or the Species Status Advisory Committee (SSAC; an independent provincial committee of government and non-government scientists). The province's Wildlife Division "coordinates the assessment and listing of species at risk, and develops recovery and management plans, monitoring programs, and research projects to promote their conservation" (FFA 2025).

Aquatic species/populations that potentially occur in the sea farm and Hatchery Study Areas and are listed/designated under SARA, COSEWIC and/or ESA are described in this section (Table 8.1). Candidate species under consideration by COSEWIC or SSAC (ESA) are also provided in Table 8.1 but are not profiled in this section (other than those already designated as at-risk but are under consideration for reassessment/change by COSEWIC).

Table 8.1. At-risk aquatic species/populations that may occur in or near the Study Areas.

Common Name	Scientific Name	Status		
		SARA [1]	COSEWIC [1]	ESA [2]
Fish - Groundfish				
Atlantic cod (Laurentian North population)	*Gadus morhua*	UC	E	
Deepwater redfish (Gulf of St. Lawrence-Laurentian Channel population)	*Sebastes mentella*	UC	E	
Acadian redfish (Atlantic population)	*Sebastes fasciatus*	UC	T	
White hake (Atlantic and Northern Gulf of St. Lawrence population)	*Urophycis tenuis*	UC	T	
American plaice (NL population)	*Hippoglossoides platessoides*	UC	T	
Northern wolffish	*Anarhichas denticulatus*	T	T	
Spotted wolffish	*Anarhichas minor*	T	T	
Atlantic (striped) wolffish	*Anarhichas lupus*	SC	SC	
Lumpfish	*Cyclopterus lumpus*	UC	T	
Smooth skate (Laurentian-Scotian population)	*Malacoraja senta*	UC	SC	
Thorny skate	*Amblyraja radiata*	UC	SC	
Winter skate (Eastern Scotian Shelf-Newfoundland population)	*Leucoraja ocellata*	UC	E	
Spiny dogfish (Atlantic population)	*Squalus acanthias*	UC	SC	
Fish - Benthopelagic				
Banded killifish (Newfoundland populations)	*Fundulus diaphanus*	SC	SC	V
Fish - Pelagic				
White shark (Atlantic population)	*Carcharodon carcharias*	E	E	
Basking shark (Atlantic population)	*Cetorhinus maximus*	UC	SC	
Porbeagle shark	*Lamna nasus*	UC	E	
Shortfin mako shark (Atlantic population)	*Isurus oxyrinchus*	UC	E	
Atlantic bluefin tuna	*Thunnus thynnus*		E	
Fish - Anadromous				
American eel	*Anguilla rostrata*	UC	T	V
Atlantic salmon (South Newfoundland population)	*Salmo salar*	UC	T	
Marine Mammals				
Blue whale (Atlantic population)	*Balaenoptera musculus*	E	E	
North Atlantic right whale	*Eubalaena glacialis*	E	E	
Northern bottlenose whale (Scotian Shelf population) (Davis Strait-Baffin Bay-Labrador Sea population)	*Hyperoodon ampullatus*	E UC	E SC	
Fin whale (Atlantic population)	*Balaenoptera physalus*	SC	SC	
Sowerby's beaked whale	*Mesoplodon bidens*	SC	SC	
Sei whale (Atlantic population)	*Balaenoptera borealis*	UC	E	
Killer whale (Northwest Atlantic/Eastern Arctic population)	*Orcinus orca*	UC	SC	
Harbour porpoise (Northwest Atlantic population)	*Phocoena phocoena*		SC	
Sea Turtles				
Leatherback sea turtle (Atlantic population)	*Dermochelys coriacea*	E	E	
Loggerhead sea turtle	*Caretta caretta*	E	E	
Candidate Species [3]				
Brook trout	*Salvelinus fontinalis*		HPC	
Yellowtail flounder	*Limanda ferruginea*		HPC	
Deepwater redfish (Northern and Gulf of St. Lawrence-Laurentian Channel populations)	*Sebastes mentella*		HPC	
Acadian redfish (Atlantic and Bonne Bay populations)	*Sebastes fasciatus*		HPC	
Basking shark	*Cetorhinus maximus*		MPC	
Roundnose grenadier	*Coryphaenoides rupestris*		MPC	
Atlantic cod	*Gadus morhua*		MPC	
Spiny dogfish	*Squalus acanthias*		MPC	
Hooded seal	*Cystophora cristata*		LPC	
Harp seal	*Phoca groenlandica*		LPC	
Sperm whale	*Physeter macrocephalus*		LPC	

Source: [1] GC (2025a); [2] FFA (2025); [3] COSEWIC (2025a).

Note: E = Endangered; T = Threatened; SC = Special Concern; V = Vulnerable; UC = under consideration for addition to Schedule 1 of SARA; HPC = High Priority Candidate; MPC = Mid Priority Candidate; LPC = Low Priority Candidate.

8.1 Fish

There are 18 fish species listed under either Schedule 1 of SARA, under the ESA, and/or are designated at-risk by COSEWIC that could occur in or near the Study Area. These species are profiled below.

8.1.1 Groundfish

8.1.1.1 Atlantic Cod (Laurentian North Population)

Atlantic cod were originally assessed as a single population and designated as *Threatened* by COSEWIC in 2003 (GC 2025a). In 2010, Atlantic cod was split into four populations, Maritimes, NL, Arctic, and Laurentian North, and reassessed by COSEWIC. The Laurentian North population overlaps the sea farm Study Area and was designated as *Endangered* by COSEWIC in 2010; it is currently under consideration for addition to Schedule 1 of SARA (GC 2025a). In Div. 3Ps, the Atlantic cod stock structure is complex as there is mixing with other stocks, some cod from the stock undertake seasonal inshore migrations while others remain offshore year-round, and there are both inshore and offshore stock components (DFO 2024f). Recent assessment by DFO indicates the Div. 3Ps stock has remained in the Critical Zone since 2000 (DFO 2024f).

Atlantic cod can have lifespans of at least 20 years, but since the late 1980s, few cod in DFO RV surveys in Div. 3Ps have been aged ≥15 years and none have been >14 years since 2013 (Ings et al. 2024). During 2018, most Atlantic cod caught in commercial gillnet fisheries in Div. 3Ps were between 5–8 years of age (Ings et al. 2024). Cod in Div. 3Ps tend to reach maturity at ~5 years (Ings et al. 2024). Spawning in Div. 3Ps occurs nearshore, on Burgeo and St. Pierre Banks, and in the Halibut Channel, with timing variably taking place between March and August (DFO 2021c). Juvenile cod tend to inhabit coastal habitats that offer protection from predators, such as eelgrass beds, while adults do not exhibit preferential habitat types or depths (GC 2025a). Atlantic cod have high natural mortality rates, recently estimated at ~0.5 in Div. 3Ps, and overall, about one egg per million is expected to reach maturity (Ings et al. 2024; GC 2025a).

In June 2024, the GC announced the end of the Northern cod moratorium off the north and east coasts of NL (DFO 2024g). Within Div. 3Ps Area 11 (Fortune Bay), individual quotas for the 2023–2024 and 2024–2025 seasons for fleets <7.6 m, fleets 7.6 to <12.2 m, and fleets 12.2 to <19.8 m have been 2,355 kg, 3,766 kg, and 7,851 kg, respectively (DFO 2024a,g). DFO's *2024–25 Conservation Harvesting Plan for NAFO Sub-Division 3Ps* focuses on the sustainable management and conservation of groundfish resources (DFO 2024g,h). Key elements include mandatory at-sea observer programs, electronic logbook reporting for fish harvesters, and by-catch management with specific limits (DFO 2024g). Protected areas are designated based on ecological needs to safeguard spawning grounds and juvenile fish. The *Plan* stipulates that fishing by the mobile groundfishery fleet (<90 ft [<27.4 m]) is prohibited within a line drawn from Cape la Hune to Point Crewe within Fortune Bay. Commercial fishing is also not permitted within the Laurentian Channel Marine Protected Area (MPA); however, this MPA is well south of the sea farm Study Area (DFO 2024h).

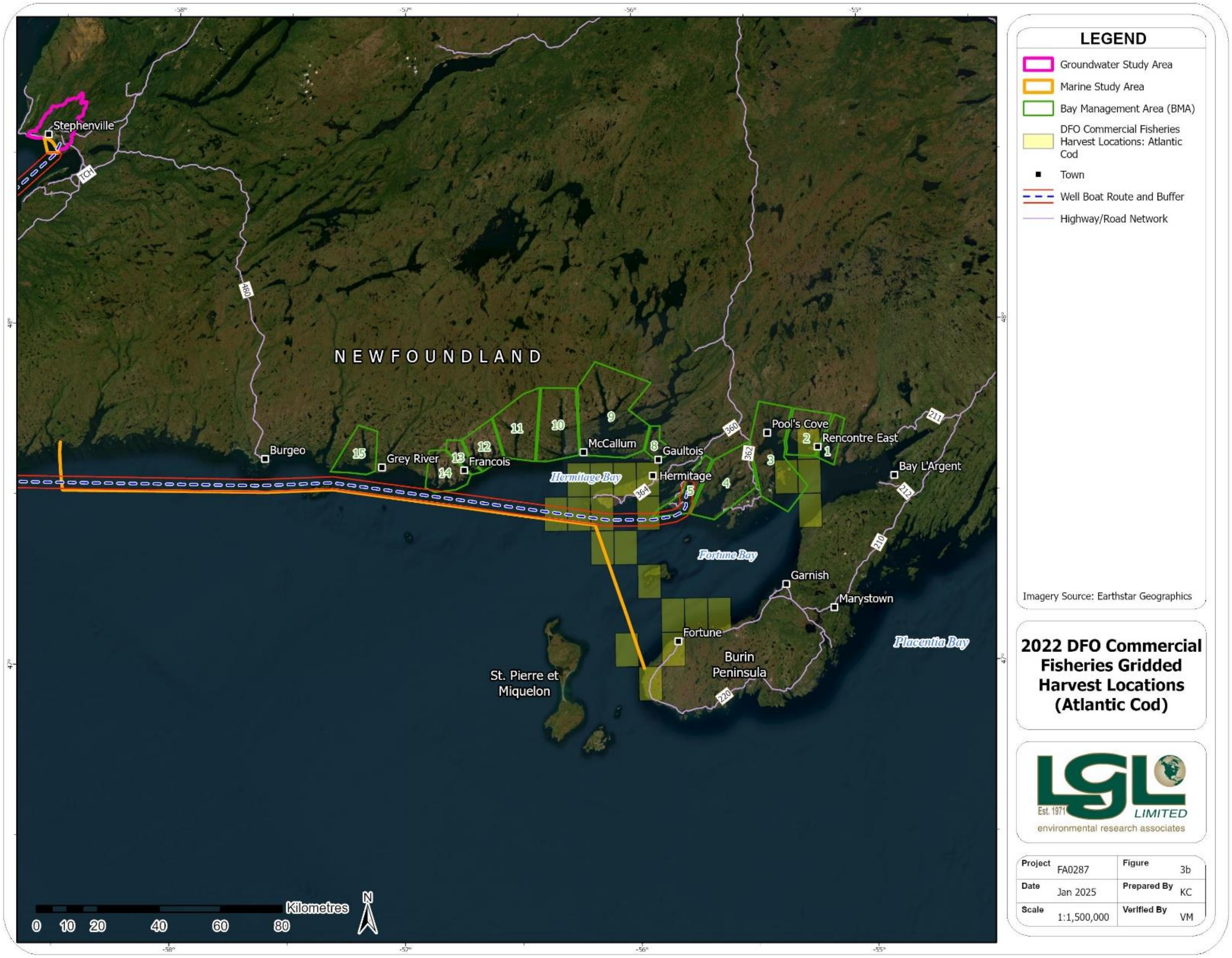
During a 1997 Atlantic cod acoustic survey in Fortune Bay, an abundance of cod was detected in Pool's Cove, representing approximately 60% of Fortune Bay's estimated biomass (Wheeler 1998). Anthropogenic information from local fishers indicated that cod typically gathered in the area during early winter (Wheeler 1998). There were no definitive environmental (e.g., water temperature) or behavioural (e.g., feeding activity) factors observed; most cod sampled were immature and not actively feeding (Wheeler 1998). As indicated by landings in 2022 in the DFO Commercial Landings Database, there is minimal overlap with MCE BMAs and commercial Atlantic cod harvest locations in the sea farm Study Area (Figure 8.1).

8.1.1.2 Redfish (Deepwater Redfish Gulf of St. Lawrence-Laurentian Channel Population; Acadian Redfish Atlantic population)

Redfish stocks that overlap the Study Areas belong to Units 1 and 2, which include both deepwater and Acadian redfish (DFO 2022h). Within Units 1 and 2, the Gulf of St. Lawrence-Laurentian Channel population of deepwater redfish and Atlantic population of Acadian redfish overlap the Study Areas (GC 2025a). The Gulf of St. Lawrence-Laurentian Channel deepwater redfish population is designated as *Endangered* under COSEWIC (GC 2025a). The Atlantic population of Acadian redfish is designated as *Threatened* under COSEWIC (GC 2025a). Both populations are presently under consideration for addition to Schedule 1 of SARA (GC 2025a).

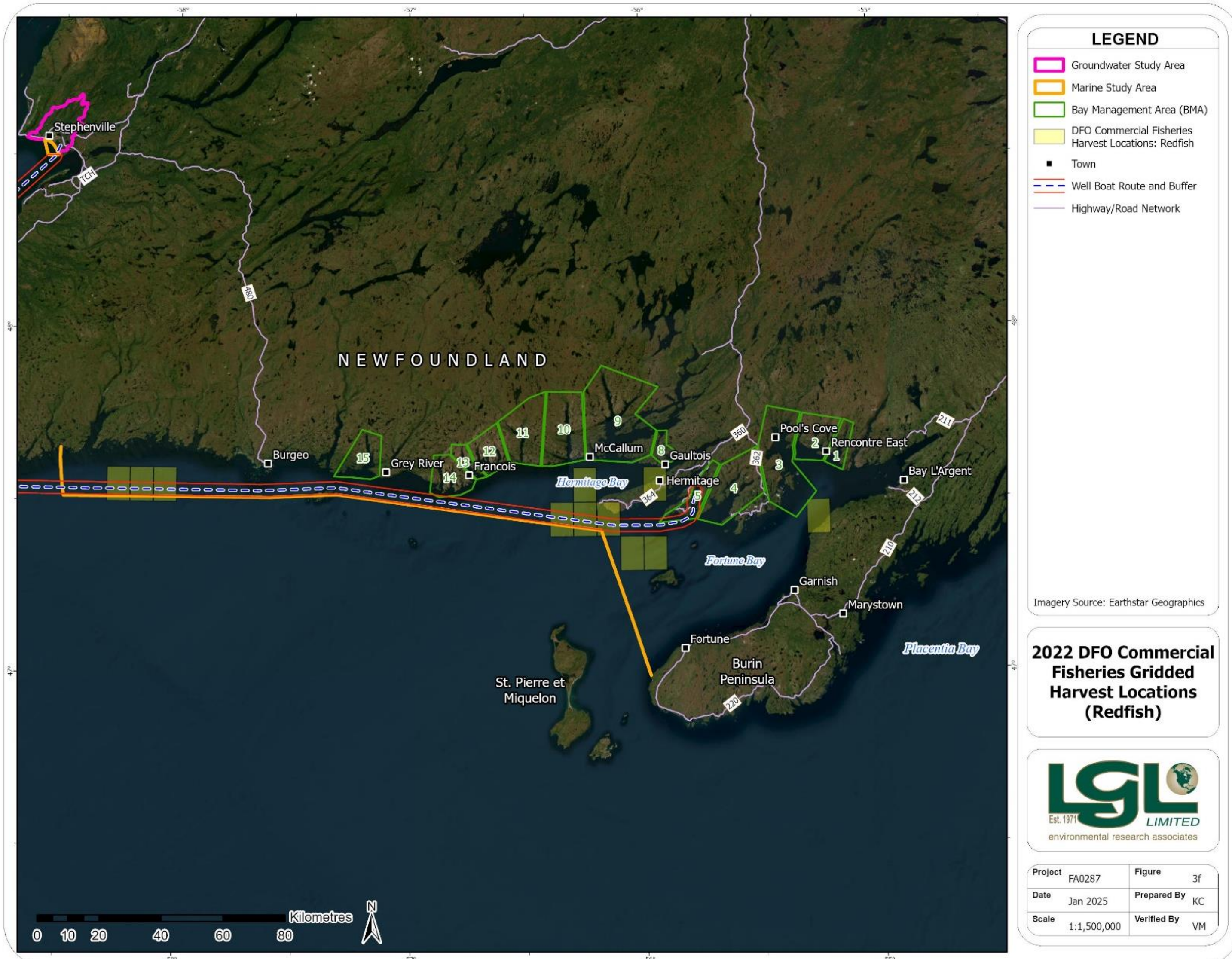
Deepwater redfish typically inhabit depths of 200–400 m, while Acadian redfish generally occurs in water depths <300 m (DFO 2022h). These demersal species conduct nocturnal vertical migrations in response to prey movements (DFO 2022h). Both species of redfish have slow growth rates and long lifespans (DFO 2022h). Mature redfish spawn in the fall (likely September–December); sometime between spring to early summer (April–July), females extrude larvae capable of swimming (DFO2022h). In the Gulf of St. Lawrence, deepwater redfish release larvae ~3–4 weeks earlier than Acadian redfish (DFO 2022h). Larval development occurs near the surface and juveniles descend deeper into the water column as they grow, before maturing into demersal adults (DFO 2022h). Redfish are food sources for seals (harp, hooded, grey) and large fish (e.g., Greenland halibut, dogfish, monkfish *Lophius americanus*, pollock, wolffish; COSEWIC 2010b). Smaller redfish prey on zooplankton, graduating to fish and shrimp once they reach 25 cm in length (DFO 2022h).

To provide a general indication of the relative abundance of redfish within the Study Areas in recent years, 2018–2022 data from the DFO Commercial Landings Database indicate there was a drastic decrease (~71%) in redfish harvest in the sea farm Study Area between the 2018 and 2019 fishing seasons and subsequent annual harvests, while variable, generally decreased between 2019 and 2022. In terms of distribution relative to the sea farm Study Area, during 2022, redfish commercial catches mainly occurred in the Hermitage Bay region, with catch locations overlapping or near BMAs 8–10; there was also at least one catch location southeast of BMA 3 (Figure 8.2). There were no catches recorded in DFO's Database within the Hatchery Study Area during 2018–2022.



Source: DFO Commercial Landings Database (2022).

Figure 8.1. Distribution of commercial harvest locations in the sea farm Study Area for Atlantic cod, 2022.



Source: DFO Commercial Landings Database (2022).

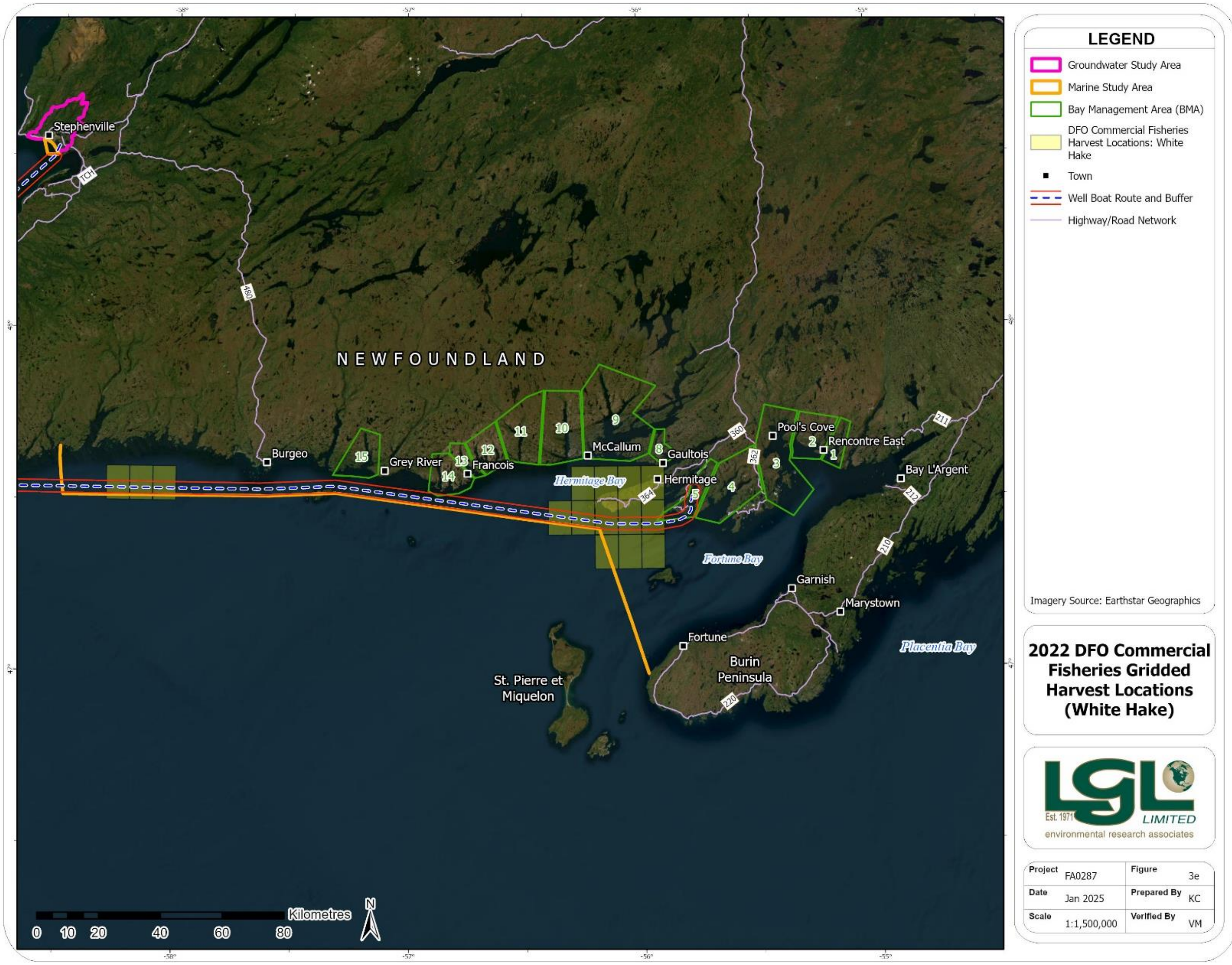
Figure 8.2. Distribution of commercial harvest locations in the sea farm Study Area for redfish (*Sebastes sp.*), 2022.

8.1.1.3 White Hake (Atlantic and Northern Gulf of St. Lawrence population)

In Canadian waters, the Atlantic and Northern Gulf of St. Lawrence population of white hake ranges from the Scotian Shelf (Div. 4VWX) to the Southern Gulf of St. Lawrence (waters >200 m depth in Div. 4T), Northern Gulf of St. Lawrence (Div. 4RS), and NL (Div. 3LNOP; GC 2025a). This population was designated as *Threatened* by COSEWIC in 2013 and is currently under consideration for addition to Schedule 1 of SARA (GC 2025a).

White hake in NL have lifespans of up to at least 13 years of age and generally reach maturity at body length sizes of 53 cm for females and 38 cm for males (Simpson and Miri 2021). This is a high-fecundity species that variably spawns in spring-summer (COSEWIC 2013a). Eggs and larvae are planktonic before juveniles ultimately settle to the seabed, with timing dependent on water temperature (COSEWIC 2013a). Recruitment was effectively nil in Div. 3NOPs between 2002–2020, but increased numbers of small (<27 cm) white hake were observed during the DFO spring 2019 and fall 2020 RV surveys (Sosebee et al. 2023). White hake inhabit soft substrates (sand, mud) in water depths from near surface to ~1,000 m, with larger individuals generally occupying greater depths than smaller fish or juveniles (GC 2025a). In Div. 3NO3Ps, white hake mainly associate with bottom water temperatures between 4–8°C and typically undertake seasonal migrations to inshore waters in summer and deeper waters in winter (Sosebee et al. 2023; GC 2025a). White hake have high natural mortality rates (GC 2025a). In Div. 3NOPs, the abundance of silver hake (*Merluccius bilinearis*) has "increased significantly" in DFO RV surveys since 2010 and this is a notable resource competitor with and predator of white hake, which may impede recovery of this species (Sosebee et al. 2023). Anthropogenic factors may also impact the recovery potential of white hake in the region, including the directed fishery and bycatch in other commercial fisheries (groundfish, lobster, scallop, northern shrimp; GC 2025a). White hake mainly prey on crustaceans and fish, with larger individuals consuming more fish than crustaceans (COSEWIC 2013a).

As an indicator of general abundance, the DFO Landings Database indicates that between 2018 and 2022, white hake catches within the sea farm Study Area decreased by ~67%. There were no catches within the Hatchery Study Area during this period. In terms of distribution relative to the sea farm Study Area, during 2022, white hake were mainly harvested in the Hermitage Bay region, with catch locations overlapping or near BMAs 5 and 8–10 (Figure 8.3).



Source: DFO Commercial Landings Database (2022).

Figure 8.3. Distribution of commercial harvest locations in the sea farm Study Area for white hake, 2022.

8.1.1.4 American Plaice (NL population)

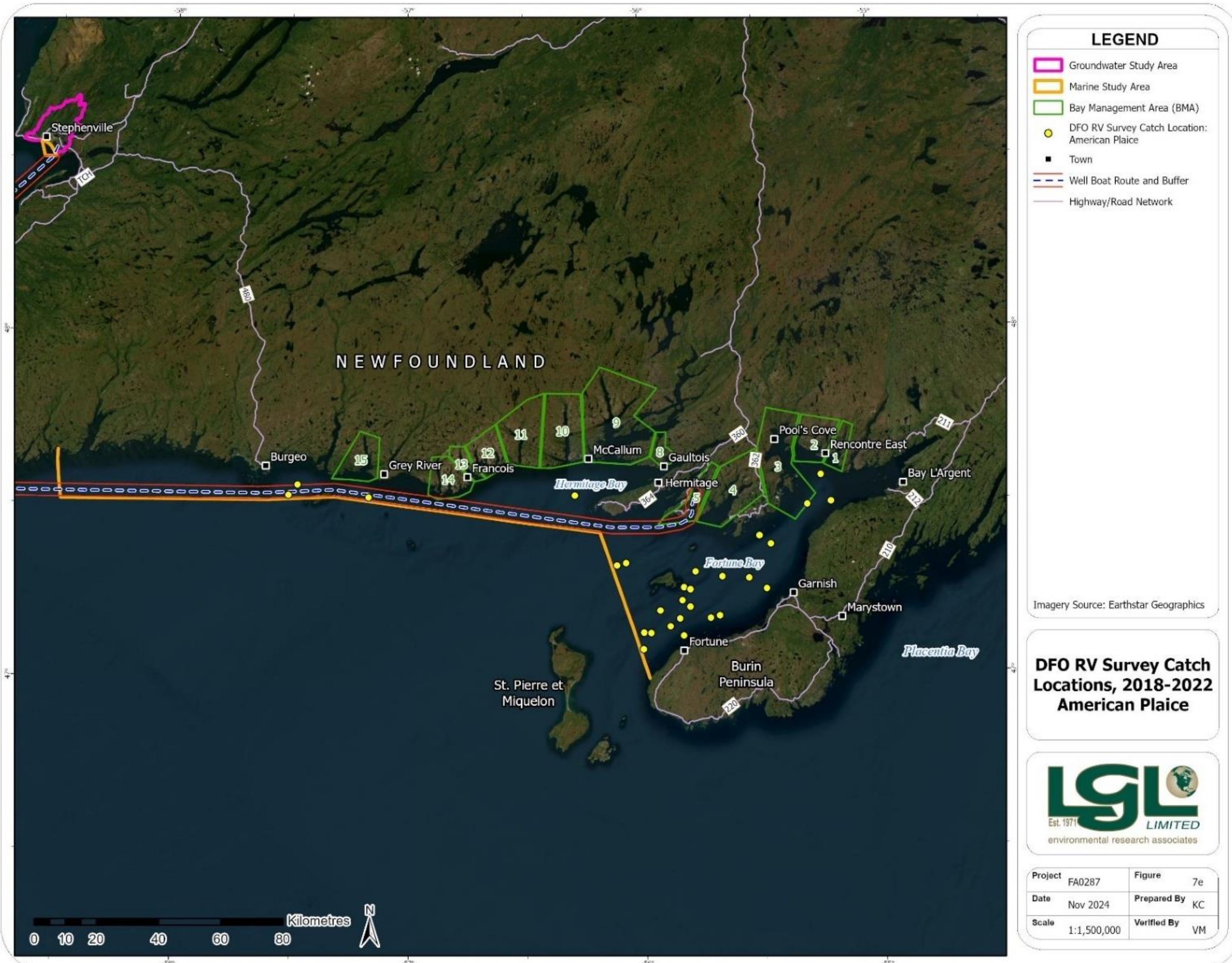
The NL population of American plaice ranges from eastern Canadian waters south of Hudson Strait to the eastern Grand Banks and southwestern tip of Newfoundland (i.e., Div. 2GHJ, 3KLNOPsPn; GC 2025a). This population was designated as *Threatened* under COSEWIC in 2009 and is currently under consideration for addition to Schedule 1 of SARA (GC 2025a).

American plaice have a lifespan of ~30 years (DFO 2020a). Although overall a slow-growing species, American plaice are sexually dimorphic whereby at all ages, females grow relatively faster and larger than males (DFO 2020a). Spawning occurs throughout Div. 3Ps, and the pelagic eggs and larvae passively drift with the current for several weeks before settling to the seabed as juveniles, typically on soft sediment that permits burrowing at depths ~100–300 m and water temperatures between -0.5 and 2.5ºC in NL (DFO 2020a; GC 2025a). American plaice are opportunistic predators with food types based on seasonal prey availability and prey size relative to their own body size at different stages of growth, including polychaetes, echinoderms, molluscs, crustaceans, and fish (DFO 2020a).

There has been a fishing moratorium on this stock since 1993 and catches since then occur as bycatch in other fisheries, particularly Atlantic cod or witch flounder (DFO 2020a). Based upon DFO RV survey data (2018–2022) for the sea farm Study Area, American plaice were primarily observed in Fortune Bay, south of the BMAs, with one catch location occurring at the southern boundary of BMA 3 (Figure 8.4).

8.1.1.5 Wolffish Species (Northern, Spotted, and Atlantic)

There are three wolffish species found from Davis Strait to Atlantic Canadian waters: northern, spotted, and Atlantic (formerly 'striped'). COSEWIC assessed Atlantic wolffish as *Special Concern* in 2000, and northern and spotted wolffish as *Threatened* in 2001 (GC 2025a). In 2003, all three species were listed on Schedule 1 of SARA with the same corresponding risk designations (GC 2025a). These at-risk designations remain unchanged (GC 2025a), although populations in Div. 2HJ and 3K (which host the highest abundances of northern and spotted wolffish) have increased somewhat since the late 1990s (DFO 2024i).



Source: DFO RV Survey Database (2018–2022).

Figure 8.4. Distribution of DFO RV survey catch locations of American plaice in the sea farm Study Area, 2018–2022.

Atlantic wolffish and spotted wolffish have longer lifespans (21–22 years) than northern wolffish (14 years; DFO 2024i). Wolffish of all three species reach sexual maturity by age 5–6 years and spawning occurs during fall or early winter (DFO 2024i; GC 2025a). Wolffish are low-fecundity species with internal egg fertilization, followed by demersal egg deposition in nests, which are usually guarded by an adult spawner (GC 2025a). Wolffish do not form schools or undertake migrations, and, although they are not limited by benthic substrate type and can inhabit depths of 1000–1500 m depending on species, their tendency for a somewhat sedentary and territorial lifestyle led to the definition of critical habitat in several locations off NL (DFO 2024i; GC 2025a). One component of the critical habitat overlaps a small portion of the westernmost boundary of the sea Farm Study Area (see Figure 12.1 in Section 12.0). Natural mortality sources for wolffish include predation by larger fish (e.g., Greenland shark *Somniosus microcephalus*, whiting *Merlangius merlangus*, and grey gurnard *Eutrigla gurnadus*) and marine mammals (e.g., harbour porpoise; DFO 2024i). Although the distribution of the three wolffish species have some overlap, they occupy someone different trophic niches; northern wolffish mainly prey on fish (pelagic and benthic) and shellfish, Atlantic wolffish on crabs and echinoderms, and spotted wolffish on shrimp and echinoderms (DFO 2024i).

Data from the Canadian At-Sea Fisheries Observer Program (1985–2021) did not have records of commercial fishery sets (mobile and fixed gears) with northern or spotted wolffish present within the sea farm Study Area (DFO 2024i). There were some records of Atlantic wolffish in fixed gear fisheries, namely in the western portion of the sea farm Study Area.

8.1.1.6 Lumpfish

Based on bottom trawl DFO RV surveys and commercial landings since the late 1990s and/or early 2000s, lumpfish abundance has declined considerably in the Atlantic and Arctic oceans (Simpson et al. 2024). As such, lumpfish were assessed as *Threatened* by COSEWIC in 2017 and are currently under consideration for addition to Schedule 1 of SARA (GC 2025a).

In the western Atlantic, lumpfish are distributed from southwestern Greenland/southeast Baffin Island to NL, the Flemish Cap, Gulf of St. Lawrence, and southwards as far as Chesapeake Bay (Simpson et al. 2024). Lumpfish are sexually dimorphic, whereby adult females are considerably larger than males (COSEWIC 2017). This species has an estimated lifespan of 13 years and generation time of 7 years, generally reaching sexual maturity at 4–7 years of age (Simpson et al. 2024; GC 2025a). Lumpfish demonstrate homing behaviour by returning annually to the same spawning areas (GC 2025a). In Newfoundland, lumpfish generally migrate inshore to spawn in spring (May–June), although there is speculation that some reproduction may occur offshore based on the presence of spawning adults in DFO RV surveys (Simpson et al. 2024). Batch spawning typically occurs in intertidal/subtidal habitats, after which lumpfish migrate back to deeper, offshore waters in late summer/early fall (Simpson et al. 2024). Eggs are laid in nests built by the males in structurally complex habitats (e.g., rocky crevices with macroalgal associations); females depart after external fertilization occurs and males remain to guard and maintain the eggs/nest (Simpson et al. 2024). In NL, larvae are pelagic and attach to flora (e.g., macroalgae, eelgrass, floating seaweeds in the offshore) or hard substrates using their ventral disc (COSEWIC 2017; Simpson et al. 2024). Although timing is variable depending on environmental conditions (e.g., temperature), larvae generally remain attached to flora/substrates for ~1 year before taking on a semi-pelagic lifestyle during their second year (COSEWIC 2017).

Lumpfish are important components in both nearshore and offshore ecosystems; their roe are consumed by fish (e.g., pouts, cunner *Tautogolabrus adspersus*, urchins, periwinkles), and juveniles/adults are preyed upon by marine mammals (e.g., grey and harp seals, sperm whale) and fish (e.g., Greenland and porbeagle sharks, wolffish, Atlantic cod, Greenland and Atlantic halibut, thorny skate, spiny dogfish; COSEWIC 2017; Simpson et al. 2024). Lumpfish are semi-pelagic as adults, undertaking diel vertical migrations in the water column (Simpson et al. 2024), likely in search of prey. Larval lumpfish feed on plankton, and older, larger lumpfish consume both benthic (e.g., polychaetes, sea squirts) and pelagic (e.g., medusa, ctenophores, euphausiids) fauna (COSEWIC 2017).

Lumpfish are targeted in the commercial fishery (particularly for their roe) and also caught as bycatch (Simpson et al. 2024). Coastal development that alters preferred spawning habitat and warming waters due to climate change may also impact lumpfish populations (Simpson et al. 2024). Lumpfish are subject to parasitic copepod, protozoan, and nematode infections, along with bacterial and viral infections (Simpson et al. 2024). They are also potentially under threat by invasive species that are destructive to eelgrass habitats, such as European green crab (*Carcinus maenas*), or other outcompeting/habitat-altering or invasives (Simpson et al. 2024).

8.1.1.7 Smooth Skate (Laurentian-Scotian population)

Smooth skate are endemic to the North American continental shelf (GC 2025a). In Eastern Canadian waters, smooth skate is delineated into several DUs, of which the Laurentian-Scotian population overlaps the Study Areas (COSEWIC 2012a). This population was assessed as *Special Concern* by COSEWIC in 2012 and is currently under consideration for addition under Schedule 1 of SARA (GC 2025a).

The distribution of the Laurentian-Scotian population of smooth skate includes the Gulf of St. Lawrence and southern Newfoundland to the Gulf of Maine (COSEWIC 2012a). Smooth skate are thought to have a generation time of 16 years, with adults reaching sexual maturity around age 11 years (COSEWIC 2012a). Reproduction is variable and occurs throughout their range; females deposit egg cases on the seabed which are presumed to hatch as fully formed juveniles within 1–2 years (COSEWIC 2012a). Records indicate smooth skate may occur between ~25–1440-m depth and -1.3 to ~16ºC water temperatures, with most occupying depths between 70–480 m and temperatures ~3–10ºC (COSEWIC 2012a). Substrate preferences are poorly understood, but seem to include fine (mud, silt, clay, sand), medium (gravel, pebbles), and shell substrates (COSEWIC 2012a). Natural mortality occurs in the form of predation of egg cases by fish (e.g., Atlantic halibut, goosefish *Lophius americanus*, Greenland shark) and gastropods, and of adults by marine mammals (e.g., grey seal) and possibly some of the same species that consume their egg cases (COSEWIC 2012a). Smooth skate appear to have a relatively selective diet, mainly eating small crustaceans and, at their largest body sizes, fish (COSEWIC 2012a).

Smooth skate is not a targeted commercial species but are caught as bycatch in other fisheries (COSEWIC 2012a). The Ocean Biogeographic Information System (OBIS) has numerous records (mostly from the 1970s to present) of smooth skate throughout most of the sea farm Study Area (OBIS 2025). However, there are few records in the Fortune Bay area (OBIS 2025).

8.1.1.8 Thorny Skate

Thorny skate occurs as a single population in the Northwest Atlantic. It was assessed by COSEWIC as *Special Concern* in 2012 and is currently under consideration for addition to Schedule 1 of SARA (GC 2025a). It has not yet been reassessed by COSEWIC.

In Canadian waters, thorny skate range from Baffin Bay and the Davis Strait to the Bay of Fundy and Georges Bank, in water depths between 18–1500+ m and water temperatures from -1.4° to ~6°C (DFO 2022i; GC 2025a). In Div. 3Ps, they occur on Burgeo, St. Pierre, and Green banks, and within deeper portions of the Laurentian, Hermitage, and Halibut channels (DFO 2022i). There is little information available regarding the lifespan of thorny skate in NL, but there is some indication they may live up to 20–30 years of age and mature at age 11 years (DFO 2022i; GC 2025a). It is known that their overall body size at maturity is greater in the southern portion of their distribution compared to northern latitudes, and that females have larger body sizes at maturation than males (DFO 2022i). Females lay egg cases on the seabed annually, possibly between summer and fall (DFO 2022i). Thorny skate appear to undertake seasonal migrations between the shelf edge during winter or spring and the banks within Div. 3Ps between mid summer and fall, likely for spawning purposes (DFO 2022i). This species inhabits various substrate types, include fine (sand, mud), medium (gravel), and shell substrates (GC 2025a).

A targeted commercial fishery has occurred in Canadian waters since the mid 1990s (DFO 2022i). Average annual landings in Div. 3Ps decreased by ~62% from the 1994–2008 period to 2009–2011, and by 40% from the 2009–2011 period to 2012–2017 (DFO 2022i). Thorny skate are also caught as bycatch in other groundfish fisheries (GC 2025a).

Thorny skate were caught in net tows each year within much of the sea farm Study Area during DFO spring RV surveys from 2015–2019 (DFO 2022i). There were typically 10–20+ thorny skate per tow within the sea farm Study Area.

8.1.1.9 Winter Skate (Eastern Scotian Shelf-Newfoundland population)

Winter skate are endemic to the Northwest Atlantic, where there are three active designated populations (DFO 2017b). Of these, the Eastern Scotian Shelf-Newfoundland population overlaps the Study Areas (DFO 2017b). This population was assessed as *Threatened* by COSEWIC in 2005 and then reassessed as *Endangered* in 2015 (GC 2025a). It is currently under consideration for addition to Schedule 1 of SARA (GC 2025a).

The geographic boundaries of the Eastern Scotian Shelf-Newfoundland population include sand and gravel sediment habitats generally at <100 m depth (although may be up to ~660 m) within Div. 3LNOPnPs and 4VnVsW (COSEWIC 2015; DFO 2017b; GC 2025a). Winter skate in this population reach sexual maturity at age 11 years for males and 13 years for females (~75 cm total length) and generation time is thought to be 18 years (COSEWIC 2015; DFO 2017b). Females deposit fertilized egg cases on the seabed annually, possibly between summer and fall (COSEWIC 2015; DFO 2017b). In-egg development may then take 18–22 months and larvae still have an egg yolk when they hatch (COSEWIC 2015; DFO 2017b). This species is slow growing and has low population increase rates (DFO 2017b). Natural mortality includes predation of hatched larvae by sharks, other skate species, and grey seal, and of juveniles/adults by large sharks (e.g., porbeagle) and grey seal (DFO 2017b).

There is no directed fishery for winter skate, although fish from this population are caught as bycatch in various fixed and mobile gear fisheries, such as groundfish, thorny skate (mainly Div. 3Ps), shrimp, scallop, and surf clam (DFO 2017b). Winter skate were variably caught in the sea farm Study Area in spring DFO RV surveys between 1996–2015, with no particular distribution or abundance pattern (DFO 2017b).

8.1.1.10 Spiny Dogfish (Atlantic population)

Spiny dogfish has a global distribution in temperate waters and there is a single population in the Atlantic Ocean which ranges from Labrador to Cape Hatteras, dubbed the Atlantic population (GC 2025a). This population was assessed by COSEWIC as *Special Concern* in 2010 and is currently under consideration for addition to Schedule 1 of SARA (GC 2025a). To date, it has not received reassessment by COSEWIC (GC 2025a).

Spiny dogfish is thought to have a lifespan between 30–40 years of age and late maturation, at age 10 years for males and ~16 years for females (DFO 2018c). Every second winter, spiny dogfish give birth to an average litter of 5–6 pups in relatively warm waters offshore Nova Scotia and the northeastern U.S. (DFO 2018c; GC 2025a). This 18- to 24-month long gestation period is the lengthiest known for a vertebrate species (GC 2025a). This species is among the most abundant of the demersal sharks and forms large, same sex and size schools between 100s to 1000s of individuals (DFO 2018c). This population tends to undertake seasonal migrations between inshore waters in the summer and offshore in winter, with “semi-resident aggregations” off southern Newfoundland, in the Gulf of St. Lawrence, and on the Scotian Shelf (DFO 2018c). Spiny dogfish have a wide tolerance for temperature and salinity levels and occur in water depths from 0–730 m (DFO 2018c). Natural mortality is generally low, as spiny dogfish have few predators (GC 2025a). They are opportunistic and omnivorous predators, consuming whatever fish (e.g., capelin, Atlantic cod, Atlantic haddock, mackerel, hakes, herring *Clupea harengus*, menhaden *Brevoortia tyrannus*, ratfish *Chimaera monstrosa*) or invertebrates (e.g., krill, crabs, polychaetes, jellyfish, ctenophores, amphipods, squids, octopi) are abundant at a given location/time (DFO 2018c).

There is a directed fishery for this species in Atlantic Canada (DFO 2018c). There are several records of spiny dogfish within Hermitage Bay in the OBIS database from the 1980s, and several others in or near the deeper portions of the sea farm Study Area (OBIS 2025). There are no records in the database of spiny dogfish in Fortune Bay (OBIS 2025).

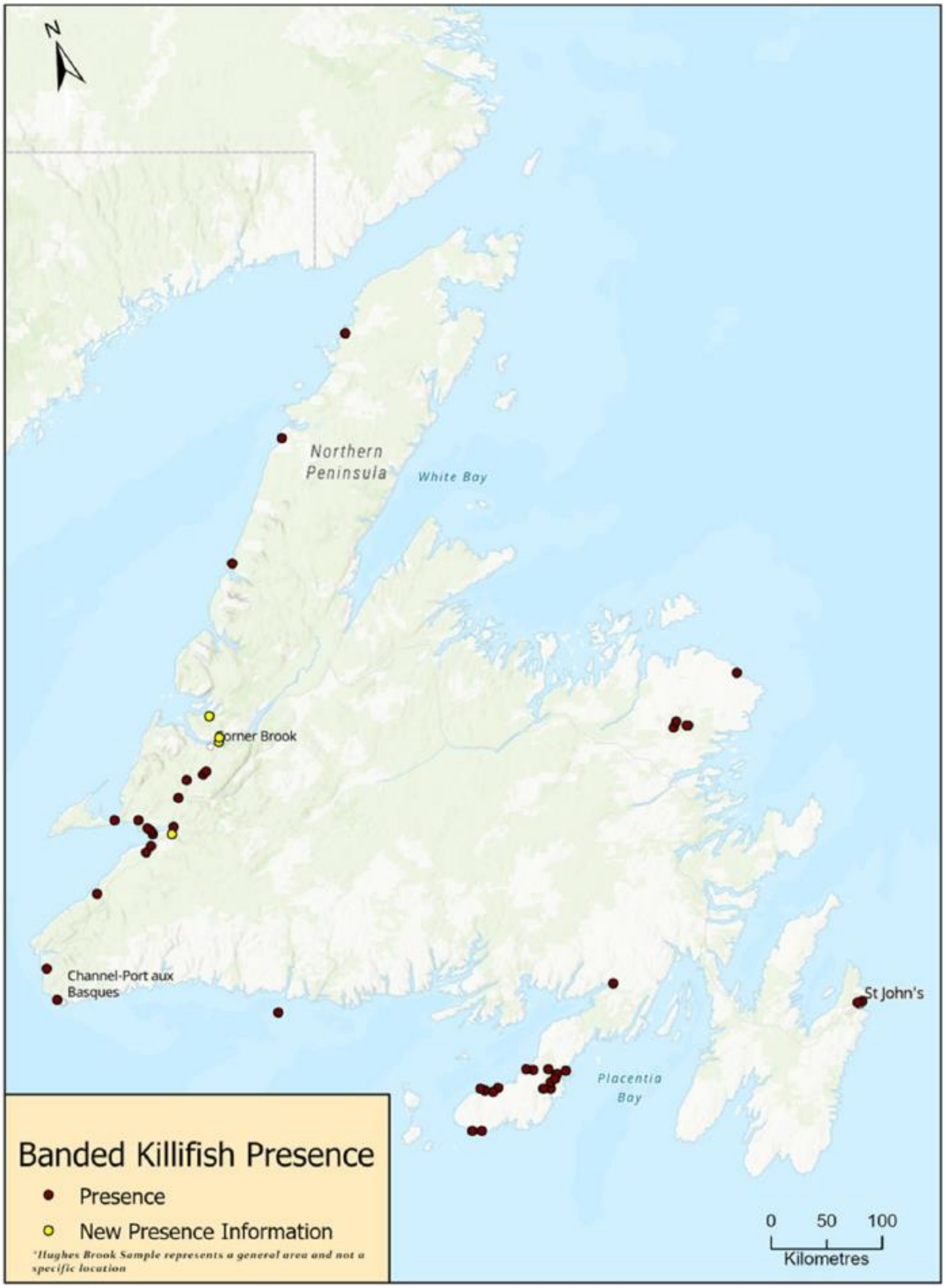
8.1.2 Benthopelagic Fish

8.1.2.1 Banded Killifish (Newfoundland populations)

In Canada, banded killifish ranges from the Atlantic provinces to Quebec and Lake Superior (GC 2025a). There are two Canadian DUs, Mainland and Newfoundland. The Newfoundland populations of banded killifish were assessed as *Special Concern* by COSEWIC in 1989 and maintained this designation following reassessments in 2003 and 2014 (GC 2025a). It was listed on Schedule 1 of SARA as *Special Concern* in 2005 (GC 2025a). It has been listed on the ESA as *Vulnerable* since 2003 (FFA 2025).

In Newfoundland, the maximum lifespan of banded killifish is 4 years, although it is thought most fish do not reach this age (COSEWIC 2014b). Sexual maturity is reached at 1 year of age and in Newfoundland, spawning occurs between late June and August, mainly on flora of the genus *Potamogeton* ('pondweed'; COSEWIC 2014b). The eggs are adhesive and do not receive care from spawning adults (COSEWIC 2014b). As habitat generalists, banded killifish in Newfoundland tend to inhabit shallow, clear waters with minimal current, fine (sand, mud) or medium (gravel, cobble) substrate, and flora (COSEWIC 2014b). Although they mainly occur in freshwater and are most active during the warmest summer months in Newfoundland, banded killifish have a high range of tolerance for salinity and temperature levels (COSEWIC 2014b). Predators likely include trout, but this is largely unknown (COSEWIC 2014b). Banded killifish have a varied diet, including marine invertebrates (e.g., cladocerans, copepods, ostracods, amphipods) and flying insects (COSEWIC 2014b).

The Newfoundland populations have a scattered distribution, including several sites within the sea farm Study Area (Figure 8.5).



Source: Figure 1 in DFO (2022j).

Figure 8.5. NL distribution of banded killifish as of 2021.

8.1.3 Pelagic Fish

8.1.3.1 White Shark (Atlantic population)

The Atlantic population of white shark was first designated as *Endangered* by COSEWIC in 2006 and listed as *Endangered* under Schedule 1 of SARA in 2011; it remained *Endangered* as of reassessment in 2021 (GC 2025a). Population size and abundance trend information is unavailable for the Atlantic Canadian population of white shark; however, the Northwest Atlantic population declined by >70% between the 1960s and 1990s owing to incidental mortality in the commercial fishery (COSEWIC 2021). Since the 1990s, the population seems to have stabilised, and it is anticipated it will either maintain the status quo or possibly experience a minor increase (COSEWIC 2021).

The species is especially vulnerable given its lengthy generation time (42 years) and low reproduction rate. Despite this species' high site fidelity, including for reproduction, there are no indications of genetic differences between Canadian and U.S. populations in the Northwest Atlantic and they are a single DU (COSEWIC 2021). White shark are relatively rare in Canadian waters, which represents the typical northern-most portion of their subtropical and temperate distribution, although they have been known to occur as far northwards as near Greenland (COSEWIC 2021). A highly mobile species, white shark individuals in Atlantic Canada are seasonal late summer and early fall migrants (COSEWIC 2021). This species occurs in both inshore and offshore waters, with juveniles more common nearshore before undertaking seasonal movements beyond the shelf as adults (COSEWIC 2021). White shark have a wide depth range, from near surface to near the seabed, up to ≥1,280-m depth but typically <50–500 m (COSEWIC 2021).

White shark lifespan has been estimated between 40–73 years and are presumed sexually mature by age ~26 years for males and ~33 years for females (COSEWIC 2021). Pupping likely occurs in the Mid-Atlantic Bight and the New York Bight has been identified as a nursing area (COSEWIC 2021). This ovoviviparous (i.e., eggs hatch within the female's body) species has average litters of seven pups after a ~10–20-month gestation period (COSEWIC 2021). Female reproductive timing is variable and largely unknown, but there could be two or more years between pregnancies to enable the rebuilding of energy stores (COSEWIC 2021). Natural mortality is low (0.06–0.13/year) and this apex predator preys on marine mammals (e.g., harbour porpoise, grey seal), fishes, and invertebrates (COSEWIC 2021).

In recent years, numerous white shark have been tagged in the Northwest Atlantic by OCEARCH, a non-profit organization conducting worldwide research on white and other shark species that provides open source, near-real time data (including satellite tracks) through their Global Shark Tracker (OCEARCH 2025). A juvenile male white shark, "Monomoy", originally tagged in August 2020 off Cape Cod, Massachusetts, occurred near the vessel transit route in the Port aux Basques area, on 15 August 2021 (OCEARCH 2025).

8.1.3.2 Basking Shark (Atlantic population)

Basking shark are circum-global, coastal-pelagic, and found in the temperate and tropical waters of the Atlantic and Pacific oceans, Mediterranean Sea, southern Australia, around New Zealand, and the Sea of Japan (DFO 2022g). In eastern Canada, basking shark ranges from off northern Newfoundland southwards to the U.S. border (DFO 2022g). In 2009, the Atlantic population of basking shark was assessed as *Special Concern* by COSEWIC (GC 2025a). It is currently under consideration for addition to Schedule 1 of SARA and has not yet received reassessment by COSEWIC (GC 2025a). The total global population is unknown, but a regional estimate suggests that ~10,000 individuals maybe present in eastern Canadian waters (Campana et al. 2008). Based on aerial surveys, Campana et al. (2008) estimated an abundance of 558 individuals in Newfoundland waters.

Basking shark is the second largest living fish, reaching lengths up to 12 m and weighing up to 4 t (DFO 2022g). In temperate waters, they are typically observed near the surface and can form large aggregations of ~30–1400 individuals (Crowe et al. 2018). This species is capable of diving to great depths and typically dive below the thermocline when in tropical and equatorial waters, during migrations, or while feeding (Shepard et al. 2006; Gore et al. 2008; Ebert et al. 2013; Witt et al. 2014; Dewar et al. 2018).

Much is unknown about the life history of basking shark, but they are believed to be long-lived (~50 years; Compagno 1984; Pauly 2002; Fowler 2005). Sexual maturation for females may occur between 16–20 years (Compagno 1984; Pauly 2002; Fowler 2005). Age for males is unknown but estimated lengths at maturity are 4.6–6.1 m (DFO 2022g). The reproductive behavior of this species is largely unknown. One study conducted in the North Sea observed what was presumed to be courtship behavior occurring along oceanographic fronts between May and July (Sims et al. 2000). In eastern Canadian waters, Emerald Basin on the Scotian Shelf has been suggested as a possible matting area (Campana et al. 2008). Basking shark birth live young after a gestation period of 12–36 months (Parker and Stott 1965, Pauly 1978, 2002; Compagno 1984). Once born, juveniles are believed to be pelagic. Knowledge gaps remain on the migration mechanisms of basking sharks; however, it is understood that they can undergo long migrations of several 1000 km (Sims et al. 2003; Skomal et al. 2009; Doherty et al. 2017). Transocean migrations have also been documented, with one shark tagged off the United Kingdom crossing the Atlantic Ocean and releasing its tag off Newfoundland (Gore et al. 2008).

These sharks travel the oceans filter-feeding plankton and small crustaceans from the water using gill rakers (DFO 2022g). They have also been documented using the ‘yo-yo diving’ foraging strategy (i.e., repeatedly diving to depth [>1000 m] from the surface) when prey distribution is patchy (Sims et al. 2003; Shepard et al. 2006; Gore et al. 2008; Witt et al. 2014). It is unknown whether there are species that regularly prey on basking sharks. Orcas have been observed hunting other large shark species, including white and whale sharks (Pancaldi et al. 2024; Towner et al. 2024), and it is possible that they could hunt basking sharks. While mortality rates are unknown, it is generally assumed that larger animals will prey on juveniles and subadult basking shark.

Commercial fishing pressure and human-interactions are the main threats to basking shark populations (Rigby et al. 2021). Basking sharks have been caught as bycatch off the coast of Newfoundland, the Scotian Shelf, and the Gulf of St. Lawrence (Campana et al. 2008). They are present along the south coast of Newfoundland but are rare (DFO 2008).

8.1.3.3 Porbeagle Shark

The abundance of porbeagle shark quickly declined following the initiation of a targeted commercial fishery in the 1960s (COSEWIC 2014a). In 2001, the species biomass hit a record low (~4400 t), representing a ~90% loss within a 40-year span (DFA 2003). As a result, the porbeagle shark was designated as *Endangered* by COSEWIC in May 2004 and reassessed as the same in 2014 (GC 2025a). It is currently under consideration for addition to Schedule 1 of SARA and the Canadian directed fishery was terminated in 2013 (COSEWIC 2014a; GC 2025a). Current evidence is indicative of a single population within the Northwest Atlantic, with individuals undertaking long, annual migrations between Canada and the U.S. (COSEWIC 2014a).

This large, cold temperate, coastal, and oceanic pelagic shark is distributed worldwide between 30–70ºN and 30–50ºS (COSEWIC 2014a). In the Northwest Atlantic, it occurs from the NL region to New Jersey and/or South Carolina (COSEWIC 2014a). Porbeagle shark typically occur on continental shelves but have also been observed farther offshore and nearshore (COSEWIC 2014a). This species has a life expectancy of ~26–40+ years, with males maturing at ~8 years of age and females at ~13 years (COSEWIC 2014a). Porbeagle shark in the Northwest Atlantic have mating grounds on the Grand Banks, off southern Newfoundland, at the entrance of the Gulf of St. Lawrence, and on Georges Bank (COSEWIC 2014a). Within Div. 3Ps, mating likely occurs annually during late summer/fall, and pups are released the following winter after an 8–9 month gestation period (Campana et al. 2001; COSEWIC 2014a). Porbeagle shark are opportunistic predators of various fish species and cephalopods, mainly including pelagics during spring and summer and groundfish in winter in accordance with their migration to deeper habitats in fall/winter (Campana et al. 2001; COSEWIC 2014a).

Natural mortality rates for this shark are low as it has no known predators (GC 2025a); fishing is the main cause of death. Slow growth, late maturation, and low reproductive rate renders porbeagle shark vulnerable to overfishing and limits its ability to recover (DFA 2003; COSEWIC 2014a).

8.1.3.4 Shortfin Mako Shark (Atlantic population)

The Atlantic population of shortfin mako shark was designated as *Threatened* by COSEWIC in 2006, reassessed as *Special Concern* in 2017, then reassessed again as *Endangered* in 2019 (GC 2025a). It is currently under consideration for addition to Schedule 1 of SARA (GC 2025a).

Modelling suggests a 50–60% population decline between 1950 and 2015, with a peak decline in the early 1980s (COSEWIC 2019a).

Shortfin mako are distributed circumglobally in all tropical and temperate seas (COSEWIC 2019a). Their Canadian range is estimated based on limited observations during commercial fisheries and at-sea monitoring programs but appears to range from inshore and offshore waters of the southernmost portion of Canada's Exclusive Economic Zone (EEZ) to 50ºN (COSEWIC 2019a). Their optimal water temperature range is 17–22°C and as such only migrationally occur in Canadian waters during summer and fall (COSEWIC 2019a). While seasonally present (~June–December) in Atlantic Canadian waters, shortfin mako may occur anywhere from surface waters to ~500-m depth (COSEWIC 2019a). A data gap exists regarding important habitat(s) for life functions of this species (COSEWIC 2019a).

Overall, shortfin mako have low growth and productivity rates and late sexually maturity age, with a generation time of about 25 years (COSEWIC 2019a). Males of this species are thought to mature at 8 years of age, while females likely mature at 18 years (COSEWIC 2019a). It is aplacental viviparous and likely breeds outside of Canadian waters, between 20–30ºN (COSEWIC 2019a). In the North Atlantic, a gestation period of 15–18 months has been estimated roughly every three years, with average litter sizes of 11 pups birthed anywhere between late winter and mid summer (COSEWIC 2019a).

In Canada, there is no directed fishery for shortfin mako, but they are caught as bycatch, including in the pelagic longline tuna and swordfish fisheries and, to a lesser extent, groundfish gillnet and otter trawl fisheries (COSEWIC 2019a; GC 2025a). Canadian recreational catches are "considered insignificant" (COSEWIC 2019a).

8.1.3.5 Atlantic Bluefin Tuna

Atlantic bluefin tuna was assessed as *Endangered* by COSEWIC in 2011 but it is not listed under Schedule 1 of SARA (GC 2025a). COSEWIC has not conducted reassessment to date (GC 2025a).

Atlantic bluefin tuna are highly migratory, endothermic (i.e., can regulate their body temperature), and occur in coastal and oceanic waters in both the western and eastern North Atlantic (COSEWIC 2011b). The International Commission for the Conservation of Atlantic Tunas manages Atlantic bluefin tuna as two stocks, western and eastern, with the western stock ranging from Newfoundland to the Caribbean Sea, Venezuela, and Brazil (COSEWIC 2011b; Ferter et al. 2024). It is unknown at what age Atlantic bluefin tuna reach sexual maturity, but fish from the western stock seem to mature by age 9 years and have a generation time of ~15–18 years (COSEWIC 2011b). The western stock spawns in the Gulf of Mexico in spring and the Slope Sea off the U.S. has recently been identified as a spawning area, but it is unclear which stock spawn there (Ferter et al. 2024). Atlantic bluefin tuna are oviparous (i.e., egg-laying) batch spawners and exhibit high site fidelity (COSEWIC 2011b; Ferter et al. 2024; Horton et al. 2024). Larvae may hatch within 2 days post-spawning; as they grow, both sexes have similar masses, although males generally have a longer body length (COSEWIC 2011b). Larger bluefin tuna of the western stock overwinter in warmer, southern waters and migrate to colder, Canadian waters to feed from July–December (Archambault et al. 2001; COSEWIC 2011b). Natural mortality is thought to be higher for smaller, younger Atlantic bluefin tuna compared to larger individuals, when they are most susceptible to predation by pelagic predators (e.g., killer whale, shortfin mako shark) and seabirds (COSEWIC 2011b). Atlantic bluefin tuna consume both pelagic and benthic fish, which in Canadian waters may include capelin, saury (*Scomberesox saurus*), herring, mackerel, lanternfishes (*Benthosema* sp.), barracudinas (*Paralepis* sp.), hakes, squids, and euphausiids (COSEWIC 2011b).

Atlantic bluefin tuna are fished both commercially and recreationally, with current conservation and management measures focused on the continued implementation of a 15-year rebuilding program that began in 2020 (ICCAT 2023).

8.1.4 Anadromous Fish

8.1.4.1 American Eel

American eel was assessed by COSEWIC as *Special Concern* in 2006 and reassessed as *Threatened* in 2012 (GC 2025a). It is currently under consideration for addition to Schedule 1 of SARA and has been listed as *Vulnerable* under the ESA since 2006 (FFA 2025; GC 2025a).

American eel is migratory and occurs in freshwater, estuaries, and coastal marine waters in the Northwest Atlantic, ranging from Greenland and Iceland southwards to Venezuela (COSEWIC 2012b). In Canadian waters, they may occur in these habitat types from the Ontario region to Nova Scotia, Newfoundland, and the mid-Labrador coast; juveniles migrating from and silver eels migrating to the Sargasso Sea spawning grounds also use the Canadian continental shelves (COSEWIC 2012b). Age estimation is difficult for American eel, but it is thought that, on average, generation time for those reared in Canadian freshwaters is ~22 years and those in saltwater possibly ~9 years (COSEWIC 2012b). Eel spawn once in their lifetime ('semelparous') and eggs likely hatch ~1 week following deposition, possibly between February–April or March–October (there is considerable uncertainty at present; COSEWIC 2012b). Upon hatching, American eel undergo several definitive life stages metamorphoses (COSEWIC 2012b):

1) leptocephalus (i.e., larval form; passively transported by surface currents towards coastlines [occurs in upper 350 m of oceanic waters]; likely last 7–12 months);
2) glass eel (i.e., juvenile form; unpigmented; occurs at mean age of 200 days and lasts for ~55 days; migrate [via nocturnal, surface swimming] to estuaries between mid-June and July);
3) elver (i.e., more pigmented forms that have entered freshwater tributaries and ultimately migrate upstream; lasts 3–12 months);
4) yellow eel (i.e., major growth and sexual differentiation stage; belly colouration yellowish/greenish/brownish and back is dark; may inhabit streams/tidal streams,

lakes, creeks, marshes, estuaries; movement patterns are varied [freshwater or saltwater residency or inter-habitat shifting]; may undertake seasonal migrations in spring [often from freshwater to forage in saltwater during the summer] and fall [back to freshwater to overwinter] and/or overwinter in "thermal refuge areas"; spend most of their time mostly submerged/hidden in the substrate [e.g., sand, vegetation, mud burrows]); and

5) silver eel (i.e., preparation phase for migration to spawning grounds in Sargasso Sea; initiation of sexual maturation; ultimately become spawning adults; greyish dorsal colouration and light ventral surface; for Canadian freshwater sites, mean age for female spawning migration start is ~18–19 years, and possibly ~7 years for estuarine sites [unknown for resident saltwater eels]).

Habitat use by American eel changes with life stage. Most of their lives are spent in benthic habitats (e.g., mud, sand, rock, woody debris, vegetation [e.g., eelgrass]) but they are pelagic during spawning migration and spawning, and the early, offshore life stages (COSEWIC 2012b; DFO 2014). Their prey types also vary as they undergo life stage changes, from zooplankton, detritus, and possibly dissolved organic carbon from the water column in the leptocephalus stage, to mainly insect larvae for the glass eel and elver stages, and benthos (e.g., fish, molluscs, crustaceans, insects/larvae, polychaetes, vegetation) for the yellow eel stage (COSEWIC 2012b). American eel either do not feed or have decreased food intake during the winter and do not feed leading up to spawning migration (COSEWIC 2012b).

Predators of American eel may include various larger fish species during the smaller, early life stages and birds during later stages (Wildlife Division 2010). American eel are caught in commercial, Indigenous, and recreational fisheries in eastern Canadian waters (COSEWIC 2012b). They can also be impacted by other anthropogenic factors, such as migration barriers (e.g., dams and their turbines) and habitat degradation (e.g., water contamination via chemicals, eelgrass or other vegetation removal; COSEWIC 2012b).

8.1.4.2 Atlantic Salmon (South Newfoundland population)

Sixteen DUs have been recognized by COSEWIC for Atlantic salmon in eastern Canada. DFO recently reassessed the Atlantic salmon stock and proposed various DU border revisions along with three additional DUs, for a new proposed total of 19 for the province (Lehnert et al. 2023). The sea farm and Hatchery Study Areas are located within COSEWIC DU 4 (now proposed to change to DU 6 South Newfoundland-East and DU 7 South Newfoundland-West) and DU 5 (now proposed to change to DU 8 Southwest Newfoundland), respectively (Lehnert et al. 2023). In 2010, the South Newfoundland population of Atlantic salmon was assessed by COSEWIC as *Threatened* and it is currently under consideration for addition to Schedule 1 of SARA (GC 2025a). A new assessment by COSEWIC is scheduled for November 2025 (COSEWIC 2025b).

The life history of Atlantic salmon is provided in Section 4.0 of LGL (2025c).

There have been no commercial salmon fisheries in Canada since 2000, and it is prohibited to retain or sell bycatch of salmon from commercial fisheries that target other species (ICES 2024). St. Pierre et Miquelon does authorize an "interceptor mixed-stock sea fishery using nets to target Atlantic salmon" (NASCO 2021). Catches there have been decreasing since 2014 as the number of professional licences issued per year decreased from 12 in 2014 to six in 2023 (NASCO 2021, 2024). A new framework for the professional fishery there was introduced in 2022 which allows fishers to diversity their catch (e.g., lobster, snow crab, scallop, and rod fishing for various species), which has led to reduced targeting of salmon (NASCO 2024).

The recreational Atlantic salmon fishery in NL is managed by DFO and the province has been divided into 15 Salmon Fishing Areas (SFAs; DFO 2025). The Hatchery Study Area is within SFA 13 and the sea farm Study Area within SFAs 11–12. Representative rivers monitored (via counting fences) in SFA 11 include Conne River (terminates into Bay d'Espoir) and Garnish River (on the Burin Peninsula; terminates into Fortune Bay; DFO 2024j). As of 2022, Atlantic salmon in Conne and Garnish rivers are in the Critical Zone (DFO 2024j). Atlantic salmon fishway count data (2022–September 2024) for Conne River and Garnish River and recreational fishery catch data (2022–2023) are presented in Section 4.1.3 of LGL (2025c).

In the NL Region, low marine survival is a primary contributor to poor returning adult abundance (DFO 2024j). In 2020, marine survival of adult salmon (return year) on the Conne and Garnish rivers was estimated at <1% (DFO 2022k). In 2022, survival rates increased somewhat, to 1.2% for Conne River and 3.9% for Garnish River (DFO 2024j).

8.2 Marine Mammals

Eight marine mammal species that may occur in or near the sea farm Study Area are listed as *Endangered* or *Special Concern* on Schedule 1 of *SARA*. These species/populations are described below. Other marine mammals that may occur in or in close proximity to the Study Areas (sea farm, Hatchery, and well boat route) are overviewed in Section 7.0 and Section 12.0.

8.2.1 Blue Whale (Atlantic Population)

Blue whale were originally considered a single population and assessed as *Special Concern* by COSEWIC in 1983. In 2002, the species was split into two populations, Atlantic and Pacific, and the Atlantic population was reassessed as *Endangered*, a status it retained following another reassessment in 2012. In 2005, the Atlantic population was listed as *Endangered* on Schedule 1 of SARA (GC 2025a). The population size of the Atlantic population is unknown, but it is thought to be "in the low hundreds" (Moors-Murphy et al. 2019).

In Canadian waters, the Atlantic population of blue whale occurs in the Gulf of St. Lawrence, off eastern Nova Scotia (Scotian Shelf) and southern Newfoundland, and in the Davis Strait (Moors-Murphy et al. 2019; GC 2025a). This migratory species typically occurs in Atlantic Canadian waters in the summer and migrates to equatorial latitudes to overwinter but may occur in eastern Canadian water spring through fall or even year-round (Moors-Murphy et al. 2019). Acoustic data from 2015–2017 indicated blue whale were present year-round in Newfoundland waters (Delarue et al. 2022). Suitable habitat in Canadian waters for this population include deep-waters along continental slopes (Scotian Shelf, Grand Banks [south of Newfoundland], the Laurentian Channel, and shallower shelf waters of the western Scotian Shelf and southern Newfoundland (Moors-Murphy et al. 2019). Lesage et al. (2018) also identified these areas as important for feeding and socializing. Important blue whale habitat is described in Section 12.0.

Blue whale may live up to 70–80 years and reproduce very 2–3 years, after reaching sexual maturity between 5–15 years of age (COSEWIC 2002). There are knowledge gaps regarding wintering and breeding areas, but acoustic and satellite tag data have indicated that at least some whales occur in fall and winter on the eastern portion of the Scotian Shelf (Moors-Murphy et al. 2019).

Threats to blue whale survival include ship strikes, disturbance due to whale watching activity, fishing gear entanglement, pollution, and climate change (COSEWIC 2002; GC 2025a).

There are two primary database sources for cetaceans in the sea farm Study Area: OBIS (2025) and DFO's Cetacean Sightings Database. There is one sighting record (1986) in the OBIS database of a blue whale near the sea farm Study Area (near St. Pierre; OBIS 2025). Based on the DFO Cetacean Sightings Database for 2005–2025, blue whales are rare in the sea farm Study Area, as they have been infrequently sighted; however, in 2018, there was one sighting ~20 km from Hermitage Bay (GC 2024d).

8.2.2 North Atlantic Right Whale

Prior to 1980, right whale was originally considered a single species. It was assessed as *Endangered* by COSEWIC in 1980 (reassessed as the same in 1985 and 1990), then split into two species (North Atlantic and North Pacific right whales) in 2003. COSEWIC designated North Atlantic right whale as *Endangered* during 2003 and 2023. North Atlantic right whale was listed under Schedule 1 of SARA as *Endangered* in 2005 and this status was maintained in 2013 (GC 2025a). The population estimate for North Atlantic right whale was ~370 individuals in 2019 and ~372 individuals in 2023 (NARWC 2024; IWC 2025).

North Atlantic right whales are variably distributed in both shallow (coastal) and deep (coastal, offshore) waters between Florida in the western Atlantic to Iceland and Norway in the eastern Atlantic (COSEWIC 2013b; DFO 2018d). In eastern Canadian waters, North Atlantic right whale occurs in the Gulf of St. Lawrence, Scotian Shelf, Bay of Fundy, and off Newfoundland (DFO 2018d). Between the early to mid 2010s, primary forage grounds in the Northwest Atlantic switched from the Gulf of Maine, Bay of Fundy, and western Scotian Shelf to the southern Gulf of St. Lawrence in response to decreased abundance of copepods (*Calanus* spp.) in the former locations and seasonal (spring-summer) abundance of three *Calanus* copepod species in the latter, which are North Atlantic right whale's preferred prey (Johnson et al. 2024). North Atlantic right whale is known to reside year-round in Canadian waters but is less prevalent during the winter (GC 2025a).

The lifespan of North Atlantic right whale is unknown, but they are a long-lived species and the oldest whale on record was ~70 years of age (COSEWIC 2013b). They're thought to reach sexual maturity at 10 years of age on average, but this may range between <5–21 years (COSEWIC 2013b). Breeding likely occurs in winter along the eastern U.S. coast between Florida and at least the Central Gulf of Maine (COSEWIC 2013b). Gestation is ~12 months-long and during November–April, pregnant and lactating females are typically present in shallow coastal waters within the southeastern U.S. portion of their range (COSEWIC 2013b). They remain there for 1–2 months before migrating northward to feeding grounds in March (COSEWIC 2013b). Calves suckle for the first year of life and sometimes into their second, and a lactating female will not become pregnant again until at least one year after her calf has weaned (COSEWIC 2013b).

Natural mortality can include calf predation by white shark and killer whale (COSEWIC 2013b). The main anthropogenic threats facing this species are ship strikes and entanglement in fishing gear (COSEWIC 2013b; Brillant et al. 2017; Daoust et al. 2018).

Acoustic data from 2015–2017 detected right whales in the Cabot Strait from May–December and in Placentia Bay during July (Durrette-Morin et al. 2022). In June 2022, there was a sighting in DFO's Cetacean Sightings Database of a single North Atlantic right whale within the sea farm Study Area, off of Fox Island in Hermitage Bay (GC 2024d). There are no North Atlantic right whale sightings within the sea farm Study Area recorded in the OBIS database (OBIS 2025). Right whale are considered rare in the Study Areas but considering the relatively recent visual sighting in the sea farm Study Area, it is possible this species may occur there again.

8.2.3 Northern Bottlenose Whale (Scotian Shelf and Davis Strait-Baffin Bay-Labrador Sea Populations)

Northern bottlenose whale was originally considered a single population that was assessed by COSEWIC as *Not At Risk* in 1993. In 1996, it was split into two populations, Scotian Shelf and Davis Strait-Baffin Bay-Labrador Sea. The Scotian Shelf population was designated *Special Concern* in 1996 and reassessed as *Endangered* in 2022, 2011, and 2024; it was listed as *Endangered* under Schedule 1 of SARA in 2006 and maintained this listing upon reassessment in 2011. The Davis Strait-Baffin Bay-Labrador Sea population was not assessed during 1996 but was designated *Special Concern* upon reassessment in 2011 and 2024; it is currently under consideration for addition to Schedule 1 of SARA (GC 2025a). It is estimated there are ~140 individuals in the Scotian Shelf population (DFO 2023e). There is no population estimate for the Davis Strait-Baffin Bay-Labrador Sea population (Moors-Murphy et al. 2024).

Northern bottlenose whale are endemic to the North Atlantic and mainly inhabit oceanic waters >500 m in depth (Moors-Murphy et al. 2024). The Scotian Shelf population occurs along the continental slope off Nova Scotia and southeastern Newfoundland (GC 2025a). The Davis

Strait-Baffin Bay-Labrador Sea population range in the more northerly waters that give the population its name (GC 2025a). Northern bottlenose whale also occur in the Cabot Strait, Gulf of St. Lawrence, the Flemish Cap, and offshore northeastern Newfoundland (see Figure 1 in Feyrer et al. 2024). For the Scotian Shelf population, the Gully MPA and proximal Shortland and Haldimand submarine canyons were identified as critical habitat for foraging and movement for northern bottlenose whale and Sowerby's beaked whale (see Section 8.2.5; Feyrer et al. 2024). Species distribution modelling also identified northeastern Newfoundland as a site for year-round presence of northern bottlenose whale (Feyrer et al. 2024).

Little is known regarding northern bottlenose life history (Feyrer et al. 2024). They may live for ≥37 years, with sexual maturity reached at 7–9 years of age for males and 8–13 years for females (GC 2025a). Generally, females will birth a single calf once every two years (GC 2025a). It would seem the Scotian Shelf population does not undertake migrations (COSEWIC 2011c). Satellite-tagged northern bottlenose whale in the Davis Strait generally remained near the tag deployment site and associated with commercial fishing vessels or moved southward to offshore Labrador, Newfoundland, or the Flemish Cap (Feyrer et al. 2024). Northern bottlenose whale can spend prolonged periods underwater (>60 min for a single dive) and are deep divers, preying on cephalopods (especially *Gonatus* sp. squid) and fish (epibenthic and mesopelagic; Feyrer et al. 2024; GC 2025a). Natural mortality may include predation by killer whale (COSEWIC 2011c).

The main threats to this species are climate change, ongoing effects from historic whaling, acoustic disturbance (military sonar, vessel noise, seismic airgun surveys, drilling operations, echosounders, low-level aircraft, or other chronic noise exposure), fisheries interactions (e.g., gear entanglement), vessel strikes, and environmental contaminants (e.g., persistent organic pollutants, toxic metals, plastics, oil spills; Moors-Murphy et al. 2024). Climate change is expected to result in a northward shift in their range (Moors-Murphy et al. 2024).

This beaked whale species is considered quite rare in the Study Areas. However, there have been a small number of stranded individuals at Stephenville Crossing, St. George's River, Fortune Bay, and Bay d'Espoir (McAlpine et al. 2023).

8.2.4 Fin Whale (Atlantic Population)

In 1987, fin whale was considered a single population and was assessed as *Special Concern* by COSEWIC. In 2005, this species was split into two populations, Atlantic and Pacific, and the Atlantic population remained designated as *Special Concern* following reassessment in 2005 and 2019. The Atlantic population was listed under Schedule 1 of SARA as *Special Concern* in 2006 and retained this designation in 2019 (GC 2025a). An estimated total of ~60,000 fin whale may occur in the entirety of the North Atlantic, of which at least 1664 whales are in Atlantic Canadian waters (COSEWIC 2019b).

Fin whale are distributed throughout the world's oceans but are most commonly found in temperate and polar waters (COSEWIC 2019b). In Canadian waters, they inhabit coastal, shelf, and beyond shelf waters (COSEWIC 2019b). Fin whale range from highly migratory to relatively sedentary throughout their global range; in the Northwest Atlantic, fin whale do not seem to undertake large-scale migrations and are known to occur year-round on the Scotian Shelf and around NL (COSEWIC 2019b; Moores-Murphy et al. 2018). Fin whale have also been detected in the Gulf of St. Lawrence during January–April and could remain there year-round (COSEWIC 2019b). Recent data suggest that a considerable portion of fin whale that summer in eastern Canadian waters tend to overwinter there, likely in response to prey distribution (COSEWIC 2019b).

Fin whale have long lifespans, possibly up to 100 years (COSEWIC 2019b). This species reaches sexual maturity at 5–15 years of age and is thought to reproduce and calve during the winter at low latitudes, possibly up to every two years (COSEWIC 2019b). Following an ~11–12-month gestation period, mother-calf pairs migrate to feeding grounds for the summer, where calves then wean (COSEWIC 2019b). Fin whale generation time is though to be 25 years (COSEWIC 2019b). Fin whale are preyed upon by killer whale and sharks may be predators of young individuals (COSEWIC 2019b). In Atlantic Canadian waters, fin whale mainly prey on euphausiids and small fish (e.g., herring, capelin; COSEWIC 2019b). Fin and blue whales (see Section 8.2.1) have globally overlapping niches in terms of distribution and diet; these whales are known to occur in mixed groups and form hybrids, and there is at least one confirmed record of a blue-fin whale hybrid in Atlantic Canadian waters (COSEWIC 2019b). Fin whale in Atlantic Canada are also known to forage in the same areas as humpback (see Section 7.4) and North Atlantic right whales (see Section 8.2.2; COSEWIC 2019b).

The main threats to this species may include acoustic disturbance (e.g., oil and gas exploration, shipping, military exercises, pile driving associated with offshore wind farm development) and entanglement in fishing gear (COSEWIC 2019b). Other threats include vessel strike, disease, and habitat degradation (COSEWIC 2019b).

There was one fin whale sighting within the sea farm Study Area recorded in the DFO Cetaceans Sighting Database between 2005–2025, in August 2023 off the western tip of the Burin Peninsula (GC 2024d). Three additional sightings occurred in August 2023 beyond the sea farm Study Area, between St. Pierre and Miquelon and the Burin Peninsula (GC 2024d). There were two sightings of individual fin whales within the sea farm Study Area in the OBIS database (OBIS 2025).

8.2.5 Sowerby’s Beaked Whale

Sowerby’s beaked whale was assessed by COSEWIC as *Special Concern* in 1989 and maintained this designation following reassessments in 2006 and 2019. It was listed as *Special Concern* under Schedule 1 of SARA in 2011 and kept this designation in 2020 (GC 2025a). There is no population estimate for Sowerby’s beaked whale, but relative sighting frequency compared to other beaked whales suggests a Canadian population numbering in the hundreds to low thousands (COSEWIC 2019c).

Sowerby's beaked whale is endemic to the North Atlantic; in the Northwestern Atlantic, sightings have occurred between 38–56°N (COSEWIC 2019c). Their Canadian range extends from the Canada-U.S. border to at least Labrador, and possibly farther north (COSEWIC 2019c). Sowerby's beaked whale life history is largely unknown. They seem to preferentially inhabit deep-waters (typically >1000 m), but they do occur in shallower, continental shelf edge and slope habitats (COSEWIC 2019c). The Gully MPA and Shortland and Haldimand submarine canyons were identified as critical habitat for both movement and foraging for Sowerby's beaked whale and northern bottlenose whale (see Section 8.2.3; Feyrer et al. 2024). Dispersal or migration habits of Sowerby's beaked whale are virtually unknown, but there has been some suggestion of site fidelity by other beaked whales (COSEWIC 2019c). A data gap exists regarding predators for this species, but they may include killer whale and large sharks (COSEWIC 2019c). Sowerby's beaked whale appear to feed on fish (mid- to deep-water) and, to a lesser extent, offshore squid (COSEWIC 2019c). They have been observed to form social aggregations with northern bottlenose whales (COSEWIC 2019c).

Anthropogenic threats to Sowerby's beaked whale may include acoustic disturbance (e.g., oil and gas drilling and seismic surveys, pile driving during offshore windfarm construction, military exercises), vessel strike (e.g., within shipping lanes), fisheries entanglement, and environmental pollution (COSEWIC 2019c).

Acoustic data (2015–2017) indicated eight detections of Sowerby's beaked whale off southwestern Newfoundland; detections also occurred off the Scotian Shelf, Grand Banks, Flemish Pass, and around the Orphan Basin (Delarue et al. 2024). There were 12 Sowerby's beaked whale sightings off southern Newfoundland during the Northwest Atlantic International Sightings Survey in 2016 (COSEWIC 2019c). There are no reported sightings of Sowerby's beaked whale in the Study Areas in the DFO Cetaceans Sighting Database from 2005–2025 (GC 2024d) and this species is considered rare in coastal waters of Newfoundland. Strandings of this species in Newfoundland have been limited to the northern coastline of the island (McAlpine et al. 2023).

8.2.6 Sei Whale (Atlantic Population)

The Atlantic population of sei whale was originally assessed by COSEWIC in 2003 and considered *Data Deficient*; it was later reassessed in 2019 and designated *Endangered*. It is currently under consideration for addition to Schedule 1 of SARA (GC 2025a). There are no reliable current or historic population estimates for sei whale in Atlantic Canada or for the species in general (DFO 2024k). There is some suggestion that there may be >10,000 individuals in the North Atlantic (NAMMCO 2020).

Sei whale have a global distribution, but they mainly occur in temperate waters (COSEWIC 2019d). In the Northwest Atlantic, sei whale range from Florida to between Baffin Island and Greenland (~68°N), with most sighting records between the mid/eastern U.S. and Newfoundland/southeastern Labrador; sei whale is rare in the Gulf of St. Lawrence (see Figure 6 in COSEWIC 2019d). In Newfoundland waters, it seems more abundant off the eastern portion of the island relative to the south coast (COSEWIC 2019d). In eastern Canadian waters, it is sighted nearshore (generally >40-m depth) through to the continental shelf outwards to [and beyond] the EEZ (COSEWIC 2019d). Sei whale generally associate with areas of high concentrations of prey, namely copepods, although a preference for open, pelagic waters versus inland seas/gulfs may supersede this tendency (COSEWIC 2019d). They are also known to associate with oceanographic fronts (major mixing zones and eddies), major ocean currents, and various topography (COSEWIC 2019d). It is thought that sei whale migrate between northern foraging areas (including NL) in higher latitudes to breeding areas at lower latitudes in winter (COSEWIC 2019d). Sei whale are most abundant in Canadian waters during summer-fall, but they are known to reside in the area year-round (COSEWIC 2019d).

Sei whale attain sexual maturity between 5–15 years of age and the North Atlantic population has a gestation period of ~11 months (COSEWIC 2019d). In the North Atlantic, reproduction peaks between November–December with females having a calving interval of 2–3 years (COSEWIC 2019d). Within ~6 months of birth, the calves are weaned at the foraging grounds, but it is not known where juveniles disperse once weaned (COSEWIC 2019d). Killer whale have been known to prey on sei whale in the southern hemisphere and North Pacific, but this has not been documented for the North Atlantic; however, given the distribution overlap and known predation on other cetaceans, killer whale are a likely predator for sei whale in Canadian waters (COSEWIC 2019d). Sei whale are considered opportunistic feeders but mainly consume copepods (namely *Calanus finmarchicus*) at night (COSEWIC 2019d).

Potential anthropogenic threats to sei whale may include underwater acoustic disturbance (oil and gas seismic exploration and drilling, shipping), ship strike, fishing gear entanglements, and noise/explosions from naval exercises (DFO 2024k).

There were no recorded sei whale sightings within the Study Areas between 2005–2025 in the DFO Cetacean Sightings Database (GC 2024d), and there are no strandings data available for NL (COSEWIC 2019d).

8.2.7 Killer Whale (Northwest Atlantic/Eastern Arctic Population)

The Northwest Atlantic/Eastern Arctic population of killer whale was assessed by COSEWIC as *Data Deficient* in 1999 and 2001 and reassessed as *Special Concern* in 2008 and 2023. It is currently under consideration for addition to Schedule 1 of SARA (GC 2025a). Although whole-genome genetic sequencing suggests genetic differences between killer whale individuals found in the Eastern Canadian Arctic and Canadian Atlantic waters, data are currently insufficient to allow further delineation into DUs (COSEWIC 2023). Killer whale is a social species, and the Northwest Atlantic/Eastern Arctic population is small, likely ranging between 250 to <1000 mature adults (COSEWIC 2023).

Reduced summer sea ice has led to a recent range expansion of this population into the Eastern Arctic, although their occurrence and abundance elsewhere within their range (i.e., Quebec, NL, New Brunswick, Nova Scotia, Prince Edward Island, Manitoba, Nunavut, and the Atlantic and Arctic Oceans) is largely unknown (COSEWIC 2023). Photographic identification catalogues for NL are in early development stages, but satellite telemetry has indicated summer southward migrations from the High Arctic (i.e., off northern Baffin Island) to at least northern Labrador by early October and, for one instance, the open North Atlantic south of Greenland by mid-November (COSEWIC 2023). Killer whale distribution is largely dictated by the distribution of and accessibility to prey throughout their range and the presence of sea ice in high latitudes, as they are tolerant of a wide variety of salinity, temperature, and turbidity levels and can inhabit or pass through both nearshore and pelagic habitats (COSEWIC 2023). Life history traits for this population are not known, but if they can be extrapolated from estimates for Resident populations in British Columbia, they may have lifespans of at least 80 years for females and 40–50 years for males, with females birthing their first calf between 12–17 years of age (COSEWIC 2023). They may produce a single calf once every five years and older females (>40 years) may have lengthy periods of declined reproductive success (i.e., reproductive senescence; COSEWIC 2023). The generation time for this population is estimated at 26–29 years (COSEWIC 2023). Stable isotope analyses suggest different ecotypes within this population with different diets and morphological features (Matthews et al. 2021a,b). For instance, high scarring rates on humpback whales off Newfoundland indicate preferential feeding on marine mammals in the region (McCordic et al. 2014), although they are also known to prey on fish (COSEWIC 2023).

Threats to this population include hunting, contaminants, and disturbance (acoustic, physical) from increased shipping traffic (COSEWIC 2023).

There are five records of killer whale south of the sea farm Study Area in the OBIS database, five records within or near the well boat transit route off southwestern Newfoundland, and one record south of the transit route in the same region (OBIS 2025).

8.2.8 Harbour Porpoise (Northwest Atlantic Population)

The Northwest Atlantic population of harbour porpoise was assessed by COSEWIC as *Threatened* in 1990 and 1991, and reassessed as *Special Concern* in 2003, 2006, and 2022. It is not currently listed on Schedule 1 of SARA (GC 2025a). Globally, there are >1 million harbour porpoise, of which an estimated 250,000 occur in Canadian waters between Labrador and the U.S. border (COSEWIC 2022a).

Harbour porpoise occur in the Northern Hemisphere, inhabiting nearshore, coastal, and continental shelf waters within cool-temperate to sub-arctic regions (COSEWIC 2022a). In the Northwest Atlantic, their distribution ranges from northwest Greenland to North Carolina, or occasionally as far as northern Florida; in eastern Canadian waters, harbour porpoise occur from the Bay of Fundy northwards to Baffin Island and have been observed all around Newfoundland (inshore and offshore) and coastal Labrador (COSEWIC 2022a). A relatively short-lived odontocete, harbour porpoise may live up to 24 years but rarely outlive their teen years

(COSEWIC 2022a). Females may become pregnant with a single calf once per year during late spring or summer, after reaching sexual maturity on average between 4–5 years of age, although estimates are closer to age 3 years for Newfoundland (COSEWIC 2022a). Following a 10–11-month gestation period, calves are weaned after a minimum of 8 months (COSEWIC 2022a). Foraging dives frequently include depths up to ~200 m, although there are records in the Northwest Atlantic of dives exceeding 400 m in depth (COSEWIC 2022a). They are generalists, but in eastern Canadian waters, mainly consume small, fatty fish (e.g., capelin, herring, mackerel, sand lance *Ammodytes americanus*), along with groundfish (e.g., Atlantic cod, hakes, redfish), bathypelagic fish (e.g., horned lanternfish *Ceratoscopelus maderensis*), and squid (e.g., *Illex illecebrosus*; COSEWIC 2022a). Natural mortality includes predation by white shark and killer whale, and it is suggested that juveniles may be targeted by grey seal (COSEWIC 2022a). South of the Gulf of Maine, bottlenose dolphin (*Tursiops truncatus*) have also been known to kill harbour porpoise (COSEWIC 2022a).

Anthropogenic threats for the Northwest Atlantic population may include bycatch in commercial fisheries (including longlines, seines, trawls, weirs, and various nets), acoustic disturbance (particularly from seismic airgun surveys due to their high sensitivity to noise; maybe from military sonar), habitat degradation (namely offshore oil and gas or wind farm development, or pollutants), or habitat exclusion (e.g., due to high-amplitude acoustic harassment devices that deter pinnipeds from aquaculture farms [used in the Bay of Fundy], i.e., "seal-scarers"; COSEWIC 2022a).

There are no records in the OBIS database of harbour porpoise within the Study Areas; however, there is one record from 2024 off northern Grande Miquelon and one from 2000 off eastern St. Pierre (OBIS 2025). There are also no records within the Study Areas in the DFO Cetacean Sightings Database for 2005–2025 (GC 2024d). There were no records of stranded harbour porpoise in Newfoundland in 2020, but there was one in Conception Bay in 2019 (Ledwell et al. 2020, 2021).

8.3 Sea Turtles

Two sea turtle species that are considered at-risk under Schedule 1 of SARA and by COSEWIC may occur within or near the sea farm Study Area, the Atlantic population of leatherback sea turtle and loggerhead sea turtle. These species/populations are summarized below.

8.3.1 Leatherback Sea Turtle (Atlantic Population)

Originally considered a single species, leatherback sea turtle was assessed as *Endangered* by COSEWIC in 1981 and 2001. In 2012, this species was split into two populations, Atlantic and Pacific. The Atlantic population was designated *Endangered* in 2012 and reassessed as the same in 2022. All leatherback were listed as *Endangered* under Schedule 1 of SARA in 2003, and after the population split was defined, the Atlantic population was listed as *Endangered* in 2012, which was reconfirmed in 2023 (GC 2025a). In the Northwest Atlantic, the leatherback population is estimated at 20,659 mature females and is exhibiting a decline in abundance (DFO 2022l).

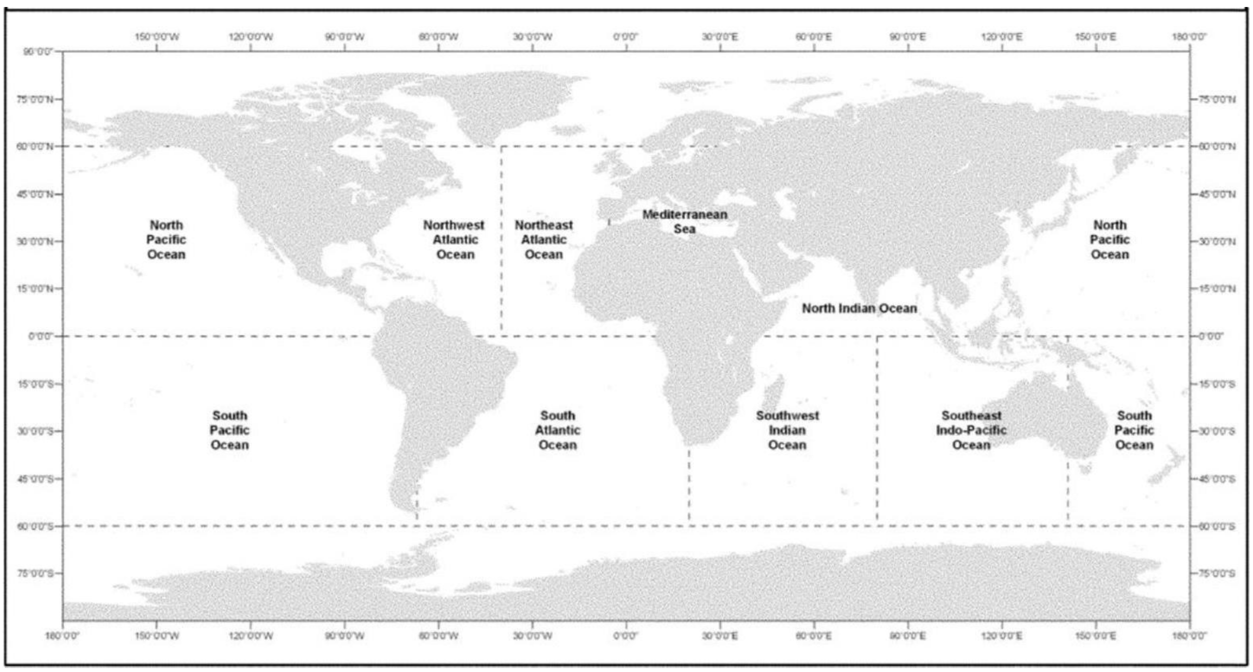
Members of the Atlantic population are seasonal migrants to eastern Canadian waters, occurring in temperate costal, shelf, slope, and offshore waters to forage between June and October (Mosnier et al. 2019; COSEWIC 2022b; GC 2025a). In Atlantic Canada, two areas have been identified as important foraging habitat: 1) the southeastern Gulf of St. Lawrence, eastern Cape Breton Island, and adjacent Laurentian Channel; and 2) south and east of the Burin Peninsula and portions of Placentia Bay (COSEWIC 2022b). Leatherbacks are estimated to reach sexual maturity between 17–19 years of age and have a generation time of 30 years (DFO 2022l). Leatherbacks can thermoregulate their body temperature (≤18°C above ambient temperature) and, although the majority of their lives are spent at sea, they undertake large-scale migrations from their northern foraging grounds to nest on land in southern latitudes (DFO 2022l) in fall/winter. Their average clutch size is ~80–90 eggs (DFO 2022l) and once laid, the eggs do not receive further care by adults. Long-term, multi-country data have indicated that this species has been experiencing a decrease in nesting female abundance and leatherbacks are known to have the lowest (~50%) hatch success rate of all sea turtles (DFO 2022l). The overall survival and life history of ocean-going hatchlings and juveniles are not known; however, survival from natural mortality is generally low for hatchlings and small juveniles and higher once they reach sub-adult to adult body size (DFO 2022l). Leatherbacks have a restricted diet that only consists of gelatinous zooplankton (DFO 2022l; e.g., jellyfish). Satellite telemetry and camera tag data have indicated that leatherbacks hunt entirely via visual means and foraging is restricted to daylight hours, mainly within the upper 30-m of the water column (C-NLOPB 2010).

In Atlantic Canada, the main threats for leatherbacks include negative impacts on food availability (e.g., distribution/seasonality changes resulting from climate change), migration disruption, or habitat pollution (DFO 2022l; includes ingestion of plastics). Leatherbacks also experience entanglements in fishing gear, and although underwater acoustic disturbance could potentially cause displacement from preferred habitats, impacts of underwater sound on leatherbacks are currently unknown (DFO 2022l). Leatherbacks are also subject to vessel strikes, which may cause serious injury or death (DFO 2022l).

DFO maintains a database of sea turtle sightings (mostly based on opportunistic reports) for NL, with data ranging from 1946–2024 (GC 2025b). Between 1981–2024, there are 43 recorded sightings of swimming leatherback throughout the sea farm Study Area, with the exception of Hermitage Bay (GC 2025b). However, in summer 2023, a female leatherback sea turtle, "Patricia", was recorded swimming through Belle Bay, Hermitage Bay, Connaigre, and along most of the island's south coast (OCEARCH 2025). From 1986–2016, there were nine leatherbacks found entrapped within the sea farm Study Area, including off Fortune (one alive trapped in a groundfish gillnet; one dead tangled with whelk pot); Garnish (two dead, one in a groundfish gillnet and the other not specified); Hermitage (one dead in a groundfish trawl); La Poile (one alive tangled in a herring gillnet); McCallum (two alive, one in a groundfish gillnet and the other unspecified); and St. Bernard's (one dead, unspecified; GC 2025b). There have been four recorded leatherback stranding events within the sea farm Study Area: 1) one in unknown condition stranded in Salmon Net Cove, Grand Bruit in 2001; 2) one alive in Sandyville, near Hermitage in 2008; 3) one dead in Grand Beach, Fortune Bay in 2010; and 4) one dead in Garnish in 2016 (GC 2025b). Leatherback sea turtles are considered common in the sea farm Study Area, albeit in relatively low numbers.

8.3.2 Loggerhead Sea Turtle

There are nine Distinct Population Segments (DPSs) of loggerhead sea turtle worldwide: 1) Northwest Atlantic Ocean; 2) Northeast Atlantic Ocean; 3) North Pacific Ocean; 4) South Pacific Ocean; 5) North Indian Ocean; 6) Southeast Indo-Pacific Ocean; 7) Southwest Indian Ocean; 8) Mediterranean Sea; and 9) South Atlantic Ocean (Figure 8.6; DFO 2020c). Those occurring in Atlantic Canadian waters are presumed to belong to the Northwest Atlantic Ocean DPS (DFO 2020c), but there is no separate population identified for risk assessment purposes. Loggerhead sea turtle was assessed by COSEWIC as *Endangered* in 2010, and it was listed under Schedule 1 of SARA as *Endangered* in 2017 (GC 2025a). There is no current population size estimate for the Northwest Atlantic Ocean DPS, but nest counts from 2001–2010 suggested an estimate of 38,334 adult females (Richards et al. 2011; DFO 2020c).



Source: Figure 2 in DFO (2020c).

Figure 8.6. Nine Distinct Population Segments of loggerhead sea turtle.

Loggerheads have five life stages, starting with year one (transition from terrestrial to oceanic habitats), followed by juvenile stages 1–3 (oceanic for stage 1, oceanic or neritic for stages 2–3) and adult (oceanic/neritic; DFO 2020c). For the Northwest Atlantic Ocean DPS, neritic juveniles (i.e., those that inhabit nearshore waters) tend to remain near their natal beaches, juveniles forage within the boundaries of this DPS along with the Northeast Atlantic and Mediterranean Sea DPSs, and adults only occur within the Northwest Atlantic Ocean DPS boundaries (DFO 2020c). In Atlantic Canadian waters, loggerhead are known to occur from Georges Bank to the southern Grand Banks in spring through fall, mostly in waters >200-m depth and with sea surface temperatures >20ºC (DFO 2020c).

Loggerheads have late sexual maturation (16–34 years of age or possibly ~22–42 years), and females have strong nesting area fidelity where they nest every 2–3 years (COSEWIC 2010d; DFO 2017g; 2020c). Females typically lay 3–4 clutches (with ~14 days between laying events), averaging ~112 eggs per clutch (COSEWIC 2010c). Nesting for Northwest Atlantic Ocean DPS loggerheads occurs in southern latitudes, mainly on Florida beaches, which are recognized as one of two of the most important nesting assemblages worldwide (DFO 2020c). Analyses during the late 2000s of long-term (20-year) data indicated a "significant declining trend in nesting in the Northwest Atlantic Ocean DPS" (DFO 2020c). However, more recently, there has been an increase in nest counts on index beaches (DFO 2020c). Juveniles are known to forage in Atlantic Canadian waters from summer-fall, mainly within the upper 5-m of the water column where they mostly prey on jellyfish, comb jellies, and salps (DFO 2020c, 2024l). Loggerheads are opportunistic, and have also been recorded feeding on gastropods, barnacles, crabs, amphipods, pteropods, fish, squid, and pelagic siphonophores (COSEWIC 2010c; DFO 2020c). Natural mortality includes egg and hatchling predation at nesting beaches by crabs, racoon (*Procyon lotor*), feral hog (*Sus scrofa*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyote (*Canis latrans*), armadillo (*Dasypus novemcinctus*), and red fire ants (*Solenopsis invicta*); juvenile oceanic predation by large fish or marine mammals; and juvenile and adult oceanic/neritic predation by large sharks and killer whale (COSEWIC 2010c). Neritic loggerheads have also experienced disease and death due to exposure to harmful algal blooms, like a red tide (COSEWIC 2010c).

Anthropogenic threats include bycatch (including in Atlantic Canadian pelagic longline fisheries), entanglement, acoustic disturbance, marine pollution, vessel strikes, harvesting (permitted in ~30% of countries within their Northwest Atlantic range; poaching also occurs, although not in Canada), habitat disturbance through coastal development, artificial light on nesting beaches (females only lay eggs at night and may abandon a nesting attempt in bright conditions; hatchlings may become disoriented; does not occur in Canada), and climate change (decreased suitable nesting sites due to rising sea levels, altered temperature-dependent sex determination; changed prey availability/distribution; DFO 2017c, 2024l).

No loggerhead sea turtles were reported in the Study Area in the OBIS or DFO sea turtle sightings databases (GC 2025b; OBIS 2025). There are also no records in Newfoundland waters for incidental bycatch on pelagic longlines (see Figure 3 in DFO 2024l). Loggerhead sea turtles are considered rare in the Study Areas.

9.0 Aquatic Invasive Species

The EIS Guidelines require a discussion of Aquatic Invasive Species (AIS) that occur in and near the Study Area (Section 4.3.3b). AIS include plants, animals, and micro-organisms that, when introduced beyond their native habitat, can outcompete native species (GC 2018b). AIS typically exhibit traits such as high fecundity, a lack of natural predators, and enhanced adaptability to diverse environments, making them difficult to control and contain (GC 2018b).

While some may be considered harmless, and even have commercial value, as invasive species proliferate and spread, they pose a significant, long-term threat to the health of aquatic ecosystems including native biodiversity, SAR, and the sustainability of aquaculture and fishing industries (GC 2018b).

A summary of AIS detected in the Study Area is provided in Table 9.1. Six species of marine invertebrate AIS and one plant AIS have been detected in and near the Study Area. Of direct relevance to the EIS are the AIS that are known to foul aquaculture equipment and vessels (i.e., tunicate species, bryozoan, and Japanese skeleton shrimp).

Table 9.1. Summary of Aquatic Invasive Species detected within and near the Hatchery and sea farm Study Areas.

Common Name	Scientific Name	Area First Detected	Year First Detected in NL	Locations Detected in the Study Area[a]	Detected during MCE Sea Cage Surveys
Vase Tunicate	*Ciona intestinalis*	Placentia Bay	2012	BMAs: Fortune Bay West, Great Bay de l'Eau, Harbour Breton Bay, Outer Bay d'Espoir, Facheux Bay, Hare Bay, Rencontre West, Chaleur Bay. Other: St. George's Bay.	Yes
Golden Star Tunicate	*Botryllus schlosseri*	Bonne Bay	1975	BMAs: Harbour Breton Bay, Facheux Bay. Other: St. George's Bay.	No
Violet Tunicate	*Botrylloides violaceus*	Belleoram	2007	BMA: Fortune Bay West. Other: St. George's Bay.	No
Coffin Box Bryozoan	*Membranipora membranacea*	NA	2002	BMAs: Fortune Bay West, Harbour Breton Bay, Outer Bay d'Espoir. Other: St. George's Bay.	No
European Green Crab	*Carcinus maenas*	South Coast	2007	BMAs: Fortune Bay West, Great Bay de l'Eau, Harbour Breton Bay, Outer Bay d'Espoir, Facheux Bay, Hare Bay, Chaleur Bay. Other: St. George's Bay.	Yes
Japanese Skeleton Shrimp	*Caprella mutica*	NA	~1990	BMAs: Fortune Bay West, Harbour Breton Bay.	No
Oyster Thief	*Codium fragile*	NA	2012	BMA: Fortune Bay West.	No

Source: DFO (2024m). [a] E. Corbett, DFO Aquatic Invasive Species Biologist, pers. comm, 11 March 2024.

9.1 Vase Tunicate

Vase tunicate is an invasive solitary tunicate first identified on September 19, 2012, in Placentia Bay (DFO 2024m). Vase tunicates have an elongate cylindrical, translucent soft and smooth body (often pale yellow, green or orange in color), and can grow up to 15 cm in length (DFO 2024m). Temperature and salinity play a major role in growth and reproduction; in shallower waters, vase tunicates have a shorter lifespan but can produce up to two generations a year (DFO 2024m).

Tunicates can be easily spread through movement of commercial and recreational boats, equipment and shellfish. Tunicates are known to add considerable weight to any structure or equipment on which it grows (DFO 2024m). This added weight may lead to increased maintenance costs, and their presence has been linked to water quality issues on finfish farms (DFO 2024m). Since the vase tunicate is a filter feeding animal, it is a natural competitor for other filter feeders (including mussels and other commercial bivalves; DFO 2024m).

Vase tunicates are the most widespread AIS in the Study Area, and have been identified by DFO in or within close proximity to eight of MCE's 13 BMAs including: Fortune Bay West, Great Bay de l'Eau, Harbour Breton Bay, Outer Bay d'Espoir, Facheux Bay, Hare Bay, Rencontre West, and Chaleur Bay as well as in the vicinity of the Hatchery Study Area in St. George's Bay (see Table 9.1).

9.2 Golden Star Tunicate

The golden star tunicate has a worldwide distribution, first reported in ~1975 in Bonne Bay on the west coast of Newfoundland. Since 1975, it has been confirmed at sites along the south coast of insular NL (DFO 2024m). It grows in colonies up to 10 cm in diameter and is distinguished from other types of tunicates by the star-shaped arrangement of individuals within a clear, firm, coat or tunic in typically a densely packed mat that covers the underlying surface (DFO 2024m). Common colours include black, brown, bright orange and green (DFO 2024m).

As a filter feeder, golden star tunicates compete for food with other filter feeders. It grows rapidly and may cover surrounding plants and animals, depriving them of sunlight or food (DFO 2024m). Golden star tunicate tunicates may even suffocate smaller organisms such as juvenile mollusks (DFO 2024m). Tunicates can spread through the movement of fishing gear, shellfish, and recreational and commercial vessels, and are known to cause increased maintenance costs to aquaculture productions (DFO 2024m).

Golden star tunicate has been identified by DFO in or within close proximity to the following BMAs: Harbour Breton Bay and Facheux Bay, and in the vicinity of the Hatchery Study Area in St. George's Bay (see Table 9.1).

9.3 Violet Tunicate

The violet tunicate was first identified in Belleoram in 2007 (DFO 2024m). It is a colonial tunicate, usually occurring as a single colour colony (purple, pink, yellow, white, or orange) of approximately 10 cm in diameter (DFO 2024m). It can tolerate a wide range of temperature, salinity, and nutrient availability (DFO 2024m).

Violet tunicates grow rapidly compared to other marine organisms. It may cover surrounding plants and animals and deprive them of sunlight or food, even suffocating smaller organisms (DFO 2024m).

Violet tunicate has been identified by DFO in or within close proximity to the Fortune Bay West BMA and the vicinity of the Hatchery Study Area in St. George's Bay (see Table 9.1).

9.4 Coffin Box Bryozoan

Coffin box bryozoan was first observed in NL in 2002 (DFO 2024m). It has become established as a prominent part of kelp beds throughout coastal areas of the island. A colonial animal, it forms circular, white-colored encrusting colonies of small rectangular shaped individuals of approximately 10 cm or more in width (DFO 2024m). This species can successfully invade new areas due to its short reproductive cycle, fast growth rates, and absence of predators and competitors.

In the fall, colonies of coffin box can entirely cover a blade of kelp, preventing it from absorbing nutrients, photosynthesizing, and reproducing; thereby, resulting in brittleness and eventually killing the kelp (DFO 2024m). Overall, these effects can decrease the abundance of kelp, potentially permanently altering kelp beds and affecting biodiversity (DFO 2024m).

Coffin box bryozoan has been identified by DFO in or within close proximity to the following BMAs: Fortune Bay West, Harbour Breton Bay, and Outer Bay d'Espoir, and also identified in the Hatchery Study Area (see Table 9.1).

9.5 European Green Crab

European green crab is a small coastal crustacean easily identified by its serrated, pentagon shaped shell (maximum width of 10 cm), with three spines between the eyes and five on each side and two different sized claws (DFO 2024m). It was first identified in southern NL in 2007; generally occurring on muddy, sandy or pebble bottoms or in vegetation (DFO 2024m). Two different types of green crabs have been found in eastern Canada with one type being more hardy and able to thrive in colder water (DFO 2024m).

C. maenas are aggressive, territorial, and pose a serious threat to estuarine and marine ecosystems as voracious predators (DFO 2024m). They are known to disrupt eelgrass beds, important nursery areas for many marine species, and compete directly with native crustaceans including American lobster (DFO 2024m). Life stages were likely brought to NL waters in bilge and ballast waters discharged by vessels (DFO 2024m).

European green crab has been identified by DFO in or within close proximity to the following BMAs: Fortune Bay West, Great Bay de l'Eau, Harbour Breton Bay, Outer Bay d'Espoir, Facheux Bay, Hare Bay, and Chaleur Bay and in the vicinity of the Hatchery Study Area (see Table 9.1).

9.6 Japanese Skeleton Shrimp

The Japanese skeleton shrimp can be identified by its long cylindrical body; the males also have a long two-segmented neck, and pale orange to red coloring (DFO 2024m). It was first reported in eastern Canada in the 1990s in the Bay of Fundy and has since spread to all Atlantic provinces (DFO 2024m). It can be found, often in abundance, on man-made structures such as ropes, buoys, artificial reefs, breakwaters and mussel aquaculture socks (DFO 2024m).

Like many invasive species, the Japanese skeleton shrimp reproduces rapidly, has a varied diet and tolerates a wide range of temperatures and salinities (DFO 2024m).

Japanese skeleton shrimp has been identified by DFO in or within close proximity to the Fortune Bay West and Harbour Breton Bay BMAs (see Table 9.1).

9.7 Oyster Thief

Discovered in NL waters in 2012, oyster thief plant grows on any hard surface including rocks, boulders, cobbles, wharves, boat hulls, and shellfish in both intertidal and subtidal zones (DFO 2024m). It is characterized by numerous dark green cylindrical branches that arise from its holdfast, which keeps the plant attached to the seabed (DFO 2024m). The plant can grow up to 90 cm with the branches described as soft and fuzzy in texture (DFO 2024m).

The ability to regenerate from fragments assists the oyster thief to outcompete native seagrasses and seaweeds, such as eelgrass and kelp (DFO 2024m). Dense meadows can restrict movement of many species (including lobster) that often live under and rely on kelp as habitat, food, and shelter from predation (DFO 2024m).

The oyster thief has been identified by DFO within the Fortune Bay West BMA (see Table 9.1).

10.0 Rivers in the Study Area

Rivers provide important habitat for freshwater fish but also for anadromous fish such as salmon and trout. Atlantic salmon mainly have an anadromous migratory behaviour where they are born in freshwater, migrate to the sea to grow (mature), and return to freshwater to reproduce. As discussed in Section 8.1.10, 16 DUs have been recognized by COSEWIC for Atlantic salmon in eastern Canada. In addition, the recreational Atlantic salmon fishery in NL (which is managed by DFO and the province) has been divided into 15 SFAs (DFO 2025). There are 104 known salmon rivers along the south coast of Newfoundland; 48 are scheduled salmon rivers (DFO 2022k; Lehnert et al. 2023) of which 24 (all Class 2, i.e., one retained fish/season and three catch and release fish/day; DFO 2023f) occur within the Study Area (Figure 10.1) on the south coast. Six of these scheduled salmon rivers occur in the Bays East area and nine are in the Bays West area. There are no scheduled salmon rivers in the Hatchery Study Area. There are also several non-scheduled salmon rivers (i.e., rivers with documented occurrences of Atlantic Salmon but not listed by name in the regulations) present in DU 4 (Figure 10.2). Additionally, some scheduled and non-scheduled rivers in the SFA 11 have historical documented occurrences of brook trout and/or sea trout (Porter et al. 1974). In Bay d’Espoir, Hughes Brook, First Brook, Salmon River (East Bay), Northwest Brook, Southeast Brook and Little River are open to rainbow trout fishing year-round (DFO 2025).

The Hatchery is located within DU 5 (Southwest Newfoundland) and SFA 13. There are 40 known salmon rivers in DU 5 (COSEWIC 2010c) of which four scheduled rivers (all Class 2; DFO 2023f) and five non-scheduled rivers (Reddin et al. 2010) terminate at St. George’s Bay near the port of Stephenville. The well boat will travel from the Hatchery to the sea cage sites traversing DU 4 and 5, and SFAs 11, 12, and 13. There are 24 scheduled salmon rivers within the vicinity of the Project sea farms (see Figure 10.1). Six of these rivers are in the Bays East area (Figure 10.3) and nine are in the vicinity of Bays West (Figure 10.4). These rivers all had a Class 2 designation for the 2023–2024 and 2024–2025 season (DFO 2023f, 2025). There are seven non-scheduled salmon rivers (i.e., rivers with documented occurrences of Atlantic Salmon but not listed by name in the regulations) near the sea farms in the Bays East (Figure 10.5) and eight non-scheduled salmon rivers in the Bays West (Figure 10.6) area. Proximity of sea farms to the closest salmon river range from 1 km to ~50 km considering all sea farms. Sea farms in BMAs 1, 5, 8, 12, 13, 14, and 15 are more than 20 km away from any listed scheduled salmon river. Sea farms in BMAs 3, 4, 9, 10, and 11 are all within 20 km of a scheduled salmon river. BMA 2 has four sea farms, of which three are within 20 km of a scheduled river. Of the 53 sea farm sites, 53% are within 20 km, and 15% are within 5 km. For non-scheduled salmon rivers, considering all BMAs, 45% of sea farms are within 20 km, and 28% are within 5 km.

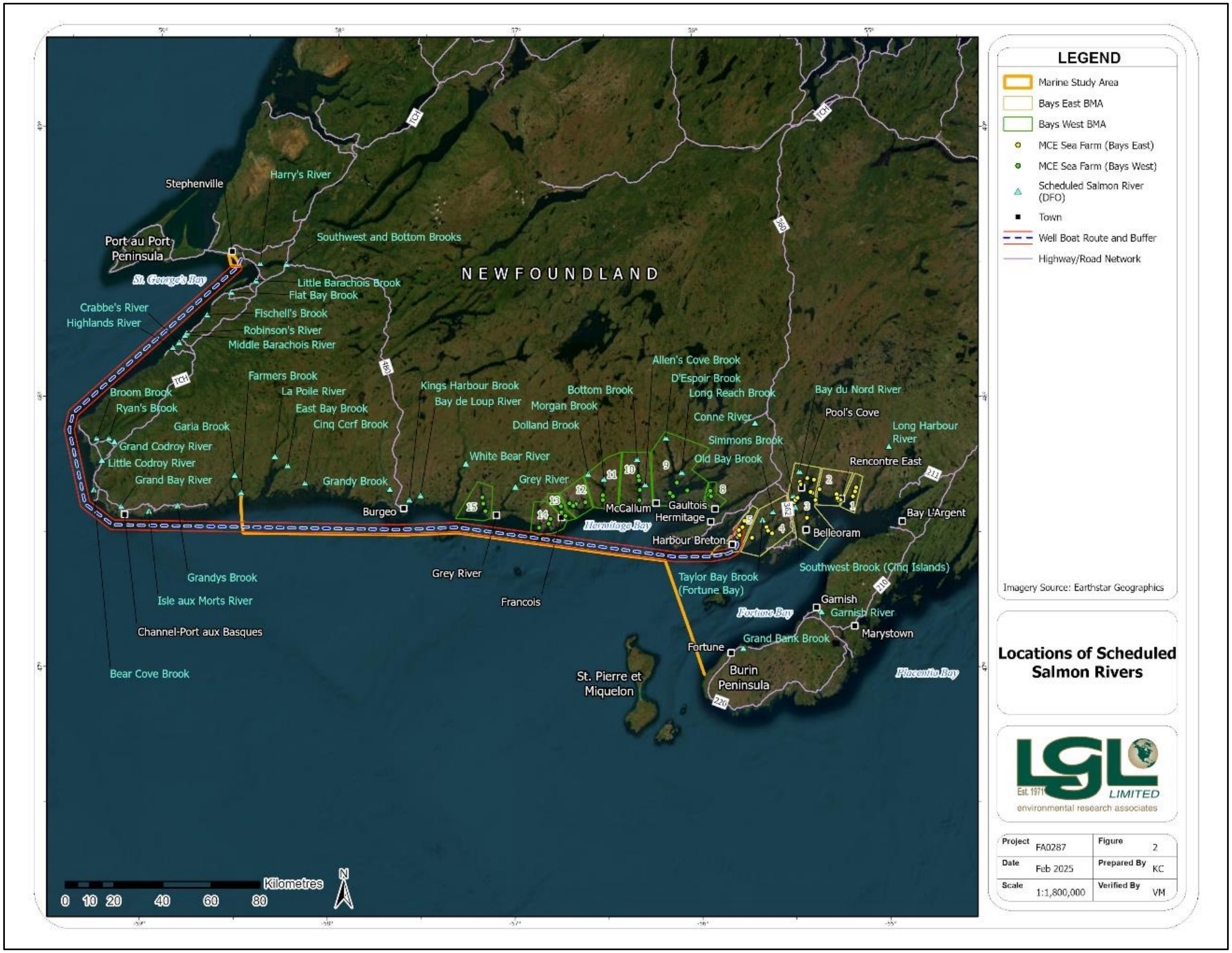


Figure 10.1. Locations of scheduled salmon rivers in the Hatchery and sea farm Study Areas.

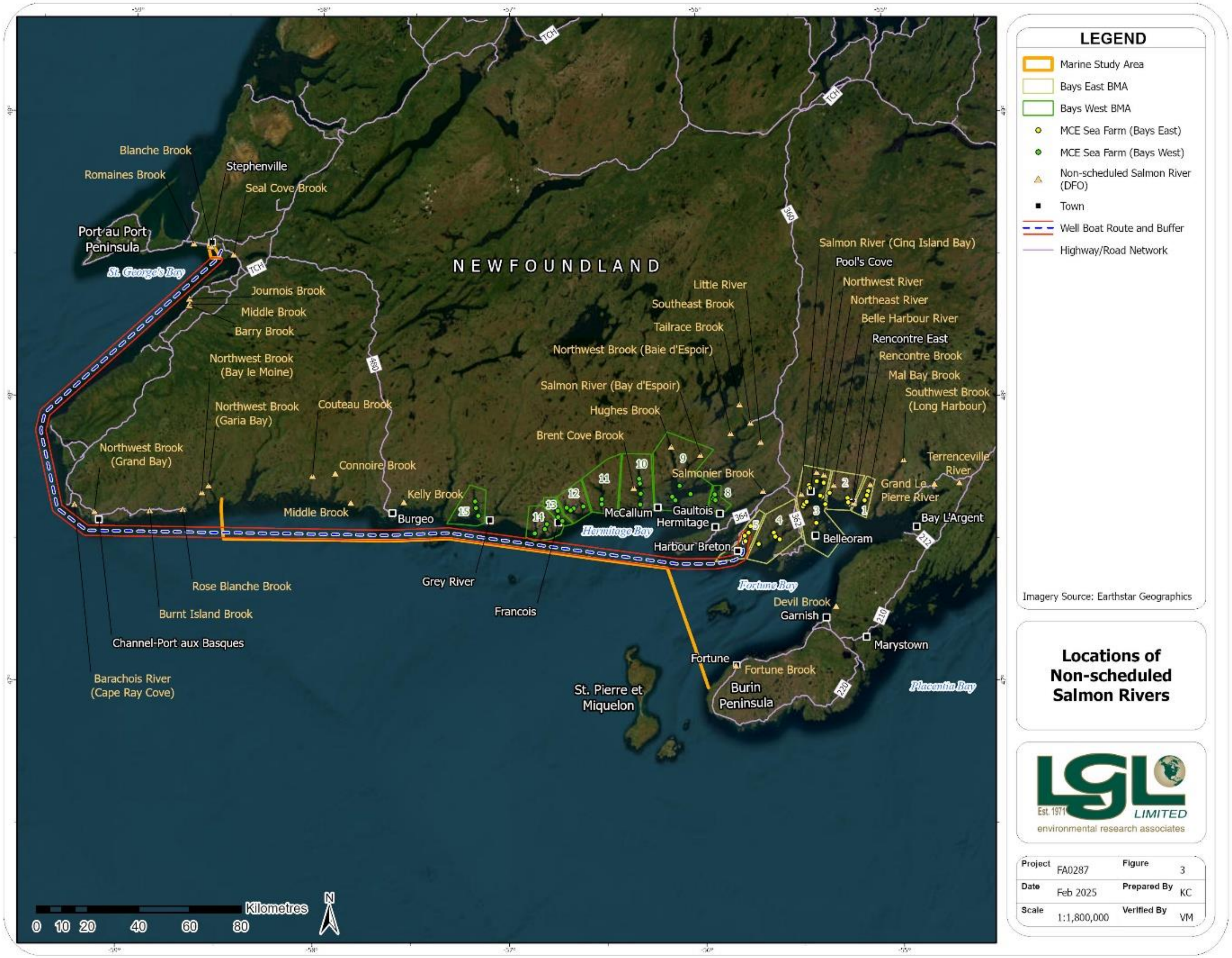


Figure 10.2. Locations of non-scheduled salmon rivers in the Hatchery and sea farm Study Areas.

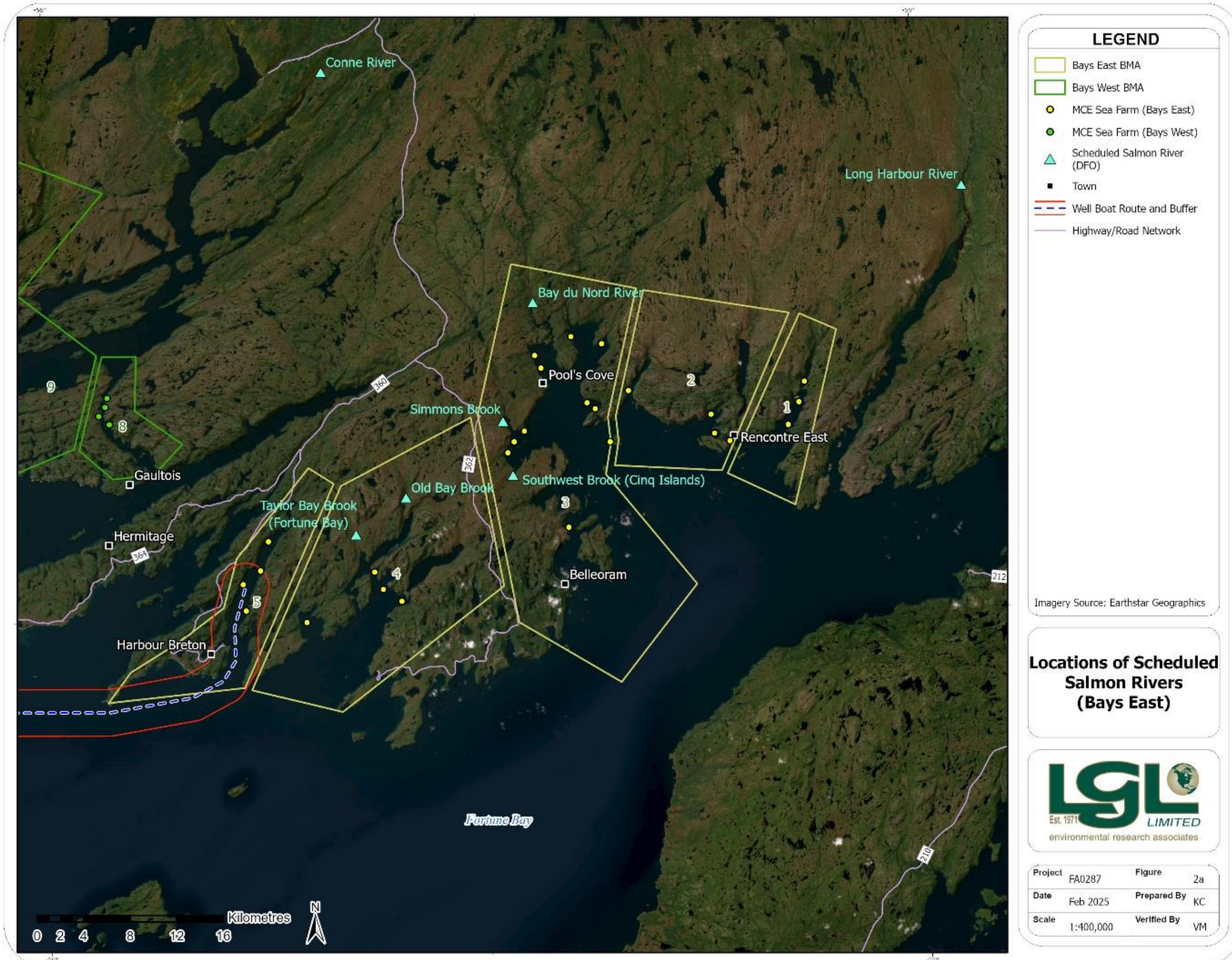


Figure 10.3. Locations of scheduled salmon rivers in the Bays East area in relation to MCE sea cages.

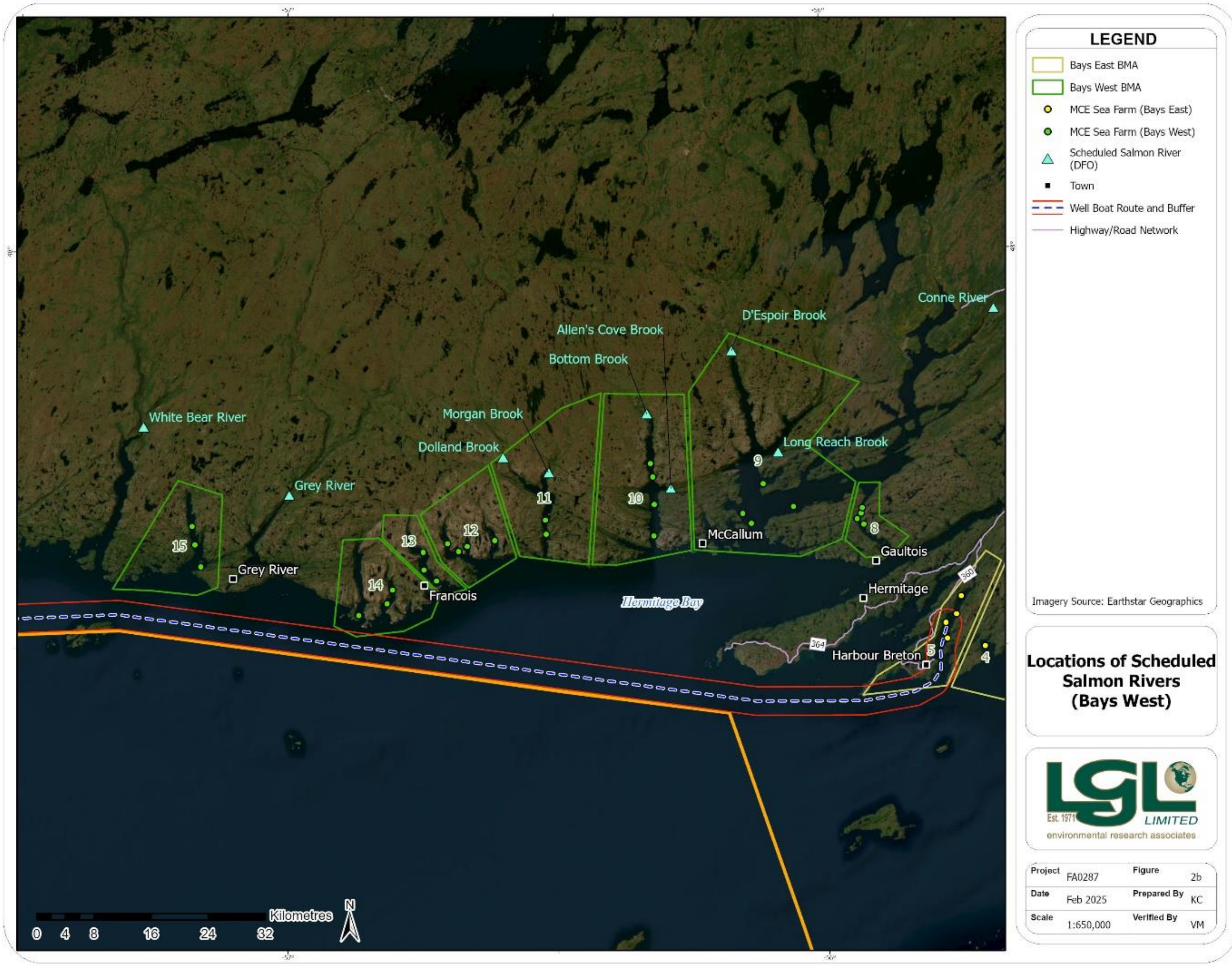


Figure 10.4. Locations of scheduled salmon rivers in the Bays West area in relation to MCE sea cages.

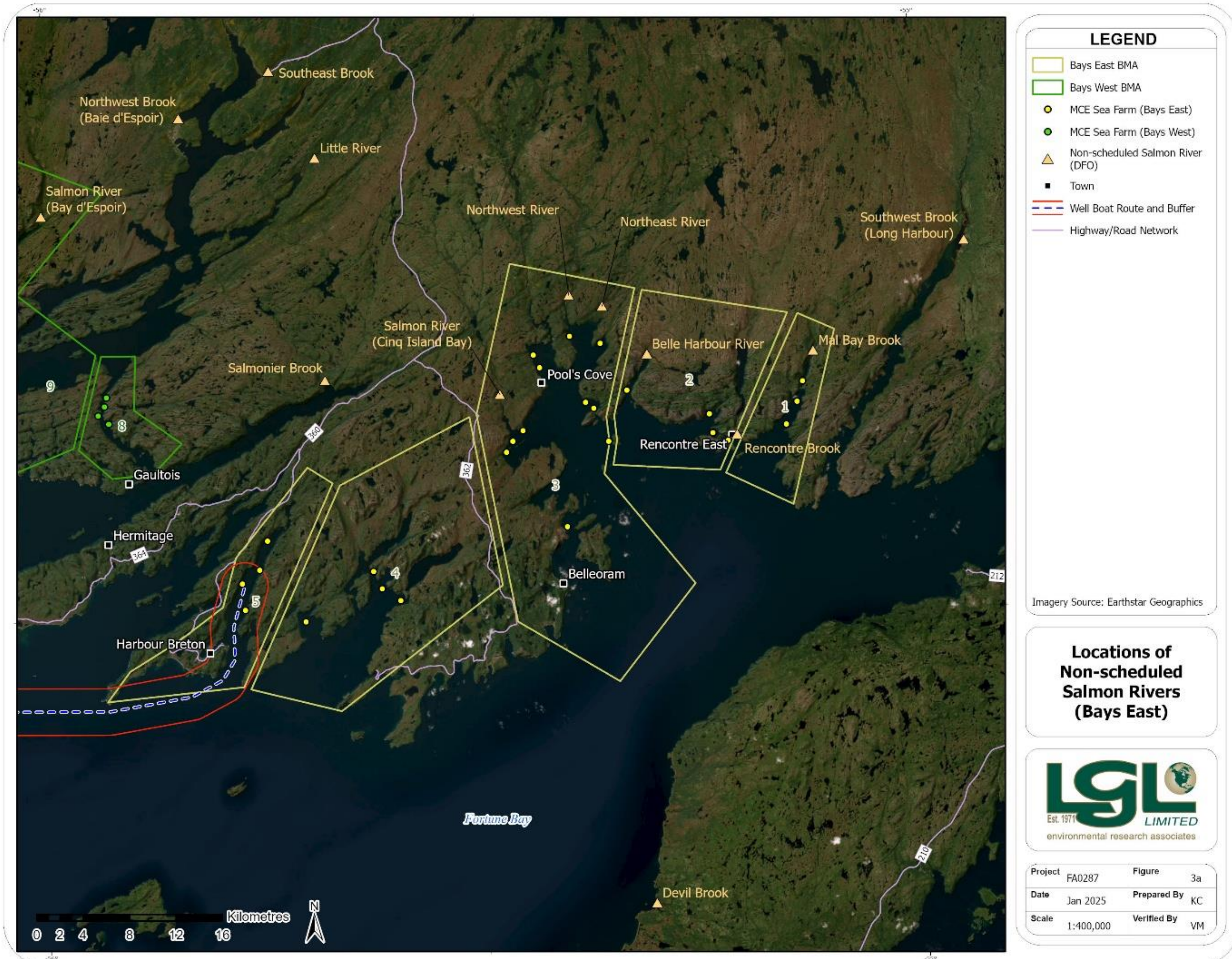


Figure 10.5. Locations of non-scheduled salmon rivers in the Bays East area in relation to MCE sea cages.

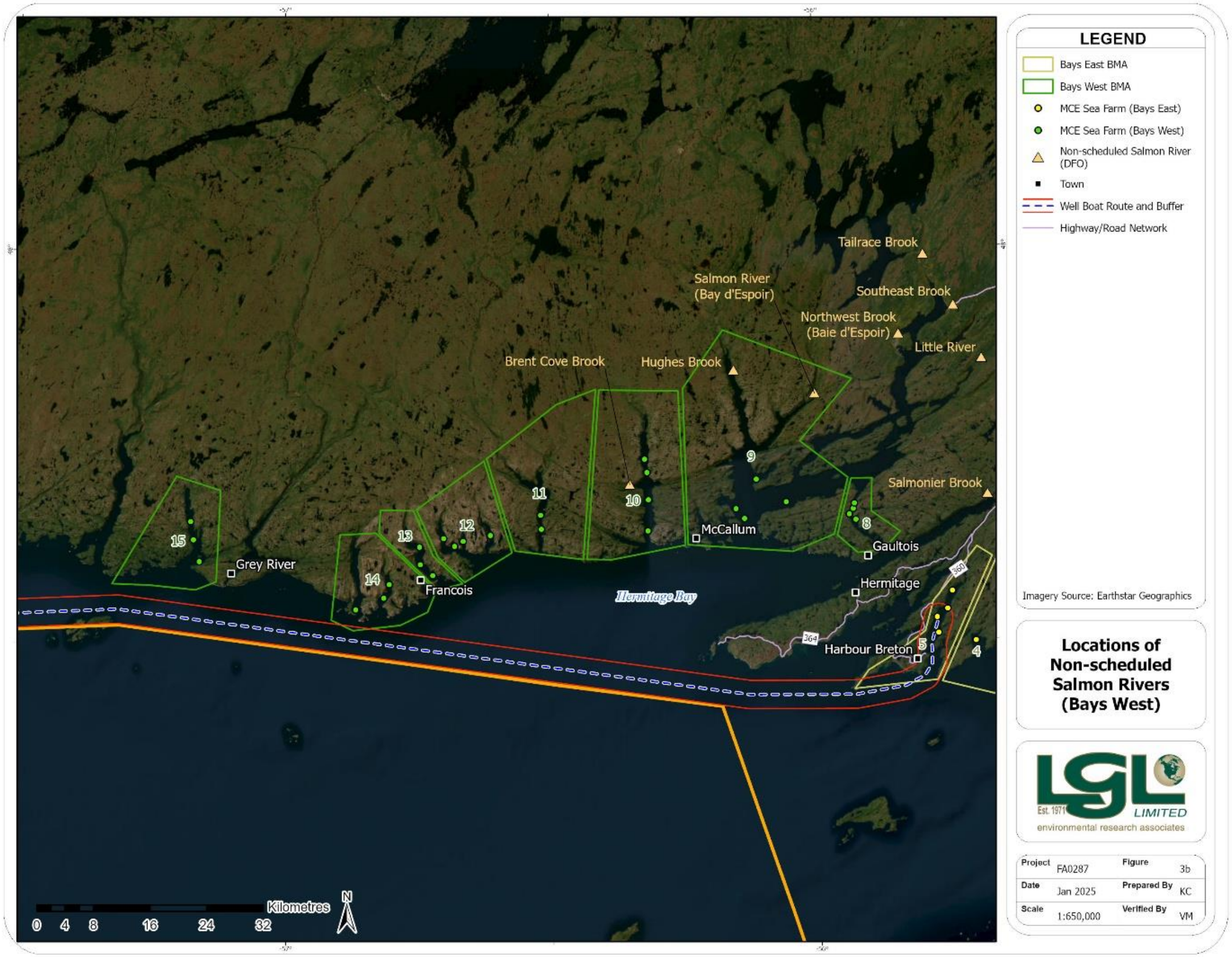


Figure 10.6. Locations of non-scheduled salmon rivers in the Bays West area in relation to MCE sea cages.

11.0 Aquatic Dispersion Modelling

The EIS Guidelines (Section 4.3.3d) require a discussion of aquatic dispersion modelling used to predict the deposition and accumulation of biochemical oxygen demanding (BOD) matter from the Project. A part of the fish farming process, nutrients are added to the surrounding waters from feed being provided to the fish and from feces being produced by the fish. These nutrient inputs can have an impact on the benthic environment below and near salmon cage aquaculture (Crawford et al. 2001; Hargrave 2010; Bannister et al. 2014) and are influenced by biomass levels (size and number of fish in a cage), environmental factors (water temperature and currents), and physical characteristics of the location (bathymetry and water depth; Wang and Olsen 2024). In 2015, as part of the implementation of the Aquaculture Activities Regulations (AAR), conditions were outlined to avoid, minimize, and mitigate potential effects on fish and fish habitat (DFO 2018e). To accomplish this, aquaculture operators submitting sea farm license applications must survey new sites (and expansion of existing sites), which includes modelling to predict depositional contours for carbon (C) per meter squared per day for 1, 5, and 10 g depositional levels (gC/m²/day). These contours must be calculated using the rate of deposition of BOD matter from the facility during maximum daily quantity of feed usage. To accomplish this, an aquaculture waste deposition model and site-specific oceanographic data are used, including characteristics of feed and fecal waste. Several simulation models are available that are accepted globally for these simulations including Delft 3D-Flow, AquaModel, and DEPOMOD. Recently, DFO has used a first order Potential Exposure Zone or PEZ model to predict areas for organic matter (see for example, Page et al. 2023). The main objective of any of these models is to predict the solids accumulation [total organic carbon (TOC)] and associated benthic effects from fish farms.

11.1 Modelling Methods

Two modelling programs, AquaModel and DEPOMOD, have been used by MCE to predict depositional contours for carbon (gC/m²/day) for 1, 5, and 10 g for its new, and expansion of its existing sea farms. AAR requires deposition of BOD matter calculations from the sea farm during maximum daily quantity of feed usage (peak feeding). MCE has also calculated at each sea farm the deposition of BOD matter during average daily quantity of feed usage (mean feeding).

11.1.1 AquaModel

AquaModel is a simulation model used by MCE for some of its Bays East farms. It has been adapted to simulate the water column and benthic effects of salmon aquaculture including salmon respiration (oxygen consumption) and nitrogen excretion (mostly ammonia and minor amounts of urea that both rapidly convert to nitrate in the environment). The model has interlinked sub-models, which account for hydrodynamics of the water column, solids dispersion, and fish physiology (Rensel et al. 2006). AquaModel simulates the growth and metabolic activity of fish in a cage along with the associated flow and transformation of nutrients and particulate waste in the adjacent waters and sediments.

AquaModel was used to predict the potential rate of TOC deposition at peak and mean feeding levels at two MCE sea farms in the Great Bay de l'Eau BMA (Salmonier Cove and Murphy Point). The inputs used for the AquaModel predictions are provided in Table 11.1.

Table 11.1. Summary of AquaModel inputs for the Great Bay de l'Eau (BMA 4) sea farms (Salmonier Cove and Murphy Point).

AquaModel Input	Great Bay de l'Eau (BMA 4)	
	Salmonier Cove	Murphy Point
Seafloor composition	rock and sandy silt	sandy silt
Number of sea cages	5	9
Sea cage type	circle	circle
Sea cage size (m)	140	140
Sea cage depth (m)	20	20
Introductory fish weight (g)	225	225
Starting fish density (kg/m^3)	0.7074	0.7074
Current data source	ADCP in 2010 (July 14–October 12)	ADCP in 2010 (July 14-October 12)
Mortality rate through production cycle (%)	15	15
Harvest start date	September 1 (2nd year)	November 1 (2nd year)
Harvest end date	October 31 (2nd year)	December 31 (2nd year)
# of harvests simulated	36 at 12,000 fish/harvest	39 at 20,000 fish/harvest
Waste feed rate (%)	2.5	2.5
Carbon fraction feed as dry weight (%)	57	57
Faecal settling rate (cm/s)	3	3
Bathymetry source	CHS[a]	CHS
Production cycle duration (days)	548	578
Dissolved oxygen level (mg/L)	8	8

Notes:
[a] CHS = Canadian Hydrographic Society.

11.1.2 DEPOMOD

DEPOMOD is a computer particle tracking model that predicts the accumulation of solids on a seabed arising from a fish farm and the associated changes in the benthic faunal community. Using inputs regarding site parameters, production biomass, and feeding rates, this model tracks particles of organic solids from source to its incorporation and degradation in sediments (Cromey et al. 2002).

DEPOMOD has been used by MCE for TOC contour predictions for its Bays West farms. More specifically, DEPOMOD was used to calculate and map the potential rate of deposition of BOD matter for carbon (gC/m^2/day) for 1, 5, and 10 grams originating from sea farms in BMAs 9 through 15.

DEPOMOD was utilized to predict the potential area of deposition based on the oceanographic conditions at each specific sea farm. Maps of predicted depositional contours during maximum feed input (peak feeding) and average (mean) feeding rate were produced. The predicted depositional contours depict TOC rate of deposition or sediment TOC rate. The inputs used for DEPOMOD modelling in BMAs 9, 10, 11, 12, 13, 14, and 15 are provided in Tables 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, and 11.8, respectively.

Table 11.2. Summary of DEPOMOD model inputs for the Outer Bay d'Espoir (BMA 9) sea farms (Butter Cove, Jervis Island, Pass My Can, and Goblin Bay).

DEPOMOD Model Input	Outer Bay d'Espoir (BMA 9)			
	Butter Cove	Jervis Island	Pass My Can	Goblin Bay
Number of sea cages	10	10	10	10
Sea cage grouping	2 rows of 5	2 rows of 5	2 rows of 5	2 rows of 5
Sea cage type	circle	circle	circle	circle
Sea cage size (m)	140	140	140	140
Sea cage depth (m)	25	25	25	25
Number of current velocity data sets	3	3	3	3
Water depths of current velocity data sets from the surface (m)	15, 33, 58	15.5, 35.5, 65.4	15, 24, 44	14.5, 52.6, 99.4
Water depth at current meter deployment location (m)	71	70	49	104
Current velocity record duration (days)	31	49	49	49
Sampling interval (minutes)	15	15	15	15
Time step of data	hourly average	hourly average	hourly average	hourly average
Number of time steps	751	1172	1170	1168
Bathymetry data source	CHS	CHS	CHS	CHS
Approximate farm production (MT)	6000	6000	6000	6000
Production cycle duration (days)	670	670	670	670
Feed input/cage at max. feed volume (kg/cage/day)	2722	2722	2722	2722
Feed input/cage at average feed volume (kg/cage/day)	1063	1063	1063	1063

Notes:

[a] CHS = Canadian Hydrographic Society.

Table 11.3. Summary of DEPOMOD model inputs for the Facheux Bay (BMA 10) sea farms (Wallace Cove, Dennis Arm, Indian Tea Point, and Wild Cove).

DEPOMOD Model Input	Facheux Bay (BMA 10)			
	Wallace Cove	Dennis Arm	Indian Tea Point	Wild Cove
Number of sea cages	10	10	10	10
Sea cage grouping	2 rows of 5	2 rows of 5	2 rows of 5	2 rows of 5
Sea cage type	circle	circle	circle	circle
Sea cage size (m)	140	140	140	140
Sea cage depth (m)	25	25	25	25
Number of current velocity data sets	3	5	3	3
Water depths of current velocity data sets from the surface (m)	15, 119, 338	6.7, 10.7, 14.7, 189.3, 375.0	15, 124, 243	13.3, 194, 385
Water depth at current meter deployment location (m)	345	380	248	380

DEPOMOD Model Input	Facheux Bay (BMA 10)			
	Wallace Cove	Dennis Arm	Indian Tea Point	Wild Cove
Current velocity record duration (days)	30	30	30	30
Sampling interval (minutes)	15	15	15	15
Time step of data	hourly average	hourly average	hourly average	hourly average
Number of time steps	721	720	722	722
Bathymetry data source	Olex	Marine Institute	Marine Institute	Marine Institute
Approximate farm production (MT)	6000	6000	6000	6000
Production cycle duration (days)	670	670	670	670
Feed input/cage at max. feed volume (kg/cage/day)	2722	2722	2722	2722
Feed input/cage at average feed volume (kg/cage/day)	1063	1063	1063	1063

Table 11.4. Summary of DEPOMOD model inputs for the Hare Bay (BMA 11) sea farms (Mare Cove South and North Bob Locke Cove).

DEPOMOD Model Input	Hare Bay (BMA 11)	
	Mare Cove South	North Bob Locke Cove
Number of sea cages	10	11
Sea cage grouping	2 rows of 5	3 rows of 5
Sea cage type	circle	circle
Sea cage size (m)	140	140
Sea cage depth (m)	25	25
Number of current velocity data sets	3	3
Water depths of current velocity data sets from the surface (m)	14, 100, 171	15, 79, 172
Water depth at current meter deployment location (m)	176	183
Current velocity record duration (days)	30	30
Sampling interval (minutes)	15	15
Time step of data	hourly average	hourly average
Number of time steps	720	720
Bathymetry data source	Marine Institute	Not specified
Approximate sea farm production (MT)	6000	6000
Production cycle duration (days)	670	670
Feed input/cage at max. feed volume (kg/cage/day)	2722	2722
Feed input/cage at average feed volume (kg/cage/day)	1063	1063

Table 11.5. Summary of DEPOMOD model inputs for the Rencontre West (BMA 12) sea farms (Devil Bay, Little Bay, Rencontre Bay, and The Gorge).

DEPOMOD Model Input	Rencontre West (BMA 12)			
	Devil Bay	Little Bay	Rencontre Bay	The Gorge
Number of sea cages	10	10	10	10
Sea cage grouping	2 rows of 5	2 rows of 5	2 rows of 5	2 rows of 5
Sea cage type	circle	circle	circle	circle
Sea cage size (m)	140	140	140	140
Sea cage depth (m)	25	25	25	25
Number of current velocity data sets	3	3	3	3

DEPOMOD Model Input	Rencontre West (BMA 12)			
	Devil Bay	Little Bay	Rencontre Bay	The Gorge
Water depths of current velocity data sets from the surface (m)	15, 55, 120	15, 109, 219	14, 91, 167	15.9, 73.8, 141
Water depth at current meter deployment location (m)	126	224	176	146
Current velocity record duration (days)	49	50	49	37
Sampling interval (minutes)	15	15	15	15
Time step of data	hourly average	hourly average	hourly average	hourly average
Number of time steps	1177	1179	1179	1179
Bathymetry data source	Marine Institute and MCE	Marine Institute and MCE	Marine Institute and MCE	Marine Institute and MCE
Approximate sea farm production (MT)	6000	6000	6000	6000
Production cycle duration(days)	670	670	670	670
Feed input/cage at max. feed volume (kg/cage/day)	2722	2722	2722	2722
Feed input/cage at average feed volume (kg/cage/day)	1063	1063	1063	1063

Table 11.6. Summary of DEPOMOD model inputs for the Chaleur Bay (BMA 13) sea farms (Chaleur Bay, Friar Cove, and Shooter Point).

DEPOMOD Model Input	Chaleur Bay (BMA 13)		
	Chaleur Bay	Friar Cove	Shooter Point
Number of sea cages	10	10	10
Sea cage grouping	2 rows of 5	2 rows of 5	2 rows of 5
Sea cage type	circle	circle	circle
Sea cage size (m)	140	140	140
Sea cage depth (m)	30	30	30
Number of current velocity data sets	3	3	3
Water depths of current velocity data sets from the surface (m)	15.7, 65.6, 126	15.7, 106.7, 240	14.1, 103.6, 201
Water depth at current meter deployment location (m)	131	225	206
Current velocity record duration (days)	34	34	33
Sampling interval (minutes)	15	15	15
Time step of data	hourly average	hourly average	hourly average
Number of time steps	820	817	805
Bathymetry data source	Marine Institute and MCE	Marine Institute and MCE	Marine Institute and MCE
Approximate sea farm production (MT)	6000	6000	6000
Production cycle duration (days)	670	670	670
Feed input/cage at max. feed volume (kg/cage/day)	2722	2722	2722
Feed input/cage at average feed volume (kg/cage/day)	1063	1063	1063

Table 11.7. Summary of DEPOMOD model inputs for the Aviron Bay and La Hune Bay (BMA 14) sea farms (Aviron North, Aviron South, and Foots Cove).

DEPOMOD Model Input	Aviron Bay and La Hune Bay (BMA 14)		
	Aviron North	Aviron South	Foots Cove
Number of sea cages	10	10	10
Sea cage grouping	2 rows of 5	2 rows of 5	2 rows of 5
Sea cage type	circle	circle	circle
Sea cage size (m)	140	140	140
Sea cage depth (m)	30	30	30
Number of current velocity data sets	3	3	3
Water depths of current velocity data sets from the surface (m)	16, 54.2, 105	15, 68.9, 130	14.5, 63.4, 124
Water depth at current meter deployment location (m)	110	135	129
Current velocity record duration (days)	35	35	34
Sampling interval (minutes)	15	15	15
Time step of data	hourly average	hourly average	hourly average
Number of time steps	837	837	825
Bathymetry data source	Marine Institute and MCE	Marine Institute and MCE	Marine Institute and MCE
Approximate sea farm production (MT)	6000	6000	6000
Production cycle duration (days)	670	670	670
Feed input/cage at max. feed volume (kg/cage/day)	2722	2722	2722
Feed input/cage at average feed volume (kg/cage/day)	1063	1063	1063

Table 11.8. Summary of DEPOMOD model inputs for the Bay de Vieux (BMA 15) sea farms (Denny Island, Gnat Island, and Shoal Cove).

DEPOMOD Model Input	Bay de Vieux (BMA 15)		
	Denny Island	Gnat Island	Shoal Cove
Number of sea cages	10	10	10
Sea cage grouping	2 rows of 5	2 rows of 5	2 rows of 5
Sea cage type	circle	circle	circle
Sea cage size (m)	140	140	140
Sea cage depth (m)	30	30	30
Number of current velocity data sets	3	3	3
Water depths of current velocity data sets from the surface (m)	14.7, 55.6, 105	15.7, 106.4, 210	15.2, 101.2, 198
Water depth at current meter deployment location (m)	110	215	203
Current velocity record duration (days)	38	38	37
Sampling interval (minutes)	15	15	15
Time step of data	hourly average	hourly average	hourly average
Number of time steps	913	914	892
Bathymetry data source	Marine Institute and MCE	Marine Institute and MCE	Marine Institute and MCE

DEPOMOD Model Input	Bay de Vieux (BMA 15)		
	Denny Island	Gnat Island	Shoal Cove
Approximate sea farm production (MT)	6000	6000	6000
Production cycle duration (days)	670	670	670
Feed input/cage at max. feed volume (kg/cage/day)	2722	2722	2722
Feed input/cage at average feed volume (kg/cage/day)	1063	1063	1063

11.1.3 Potential Exposure Zones (PEZ)

As part of the science review of proposed new finfish sites and expansion of finfish sites by MCE, DFO undertook PEZ modelling to estimate with the primary purpose to estimate the potential (first-order) zones of exposure for in-feed therapeutants associated with organic matter (feed and feces) that may be released from 14 sea farms in BMAs 9, 10, 11 and 12 (Page et al. 2023), three sea farms in BMA 13 (DFO 2022m), and at six sea farms in BMAs 14 and 15 (DFO 2024n). PEZ modelling uses simple calculations, based on assumptions, that give order of magnitude estimates of the sizes and locations of potential exposure zones that could be impacted by BOD deposits from sea farms. The zones represent areas organic matter may potentially disperse; however, the method is not a regulatory standard and does not predict the loading of BOD deposits from sea farms. Parameters including sea cage array, lease sites, water depths and current speeds from a single mooring in the vicinity of the proposed sea farm were used to estimate the radius and location of the zone of exposure for a sinking particle (feed and/or feces). Maximum and mean PEZ were calculated assuming an estimate of the maximum and mean currents. The exposure zone is assumed to have the shape of a circle centered over the center of the sea cage array. For some sea farms located in fjords or close to land, the PEZ area included land surface in which case, the areas calculated were inflated. There are two categories of benthic-PEZ; the zone potentially exposed to deposition of waste feed (feed-PEZ), and the zone potentially exposed to deposition of feces (fecal-PEZ). PEZ model inputs used information from MCE sea farm applications and reflected input parameters for sea cage array, currents, and bathymetry used for DEPOMOD. For the models in BMAs 9–12, low values for waste feed and fish feces sinking rates of 0.1 m/s and 0.02 m/s, respectively, were used to calculate maximum benthic PEZs. Typical values for waste feed and fish feces sinking rates of 0.12 m/s and 0.03 m/s, respectively, were used to calculate mean benthic PEZs (see Page et al. [2023] for details). For PEZ modelling in BMAs 13–15, a precautionary approach was taken using slow sinking rates (the slowest values obtained from the literature), fast water currents (the highest current speed measured at the location and within the layer where the particles will sink), and deep bottom topography (the greatest depth under the sea cage array). This ensured a maximum possible extent for the exposure zone (see DFO [2022m] and DFO [2024n] for details).

11.2 Great Bay de l'Eau (BMA 4) Modelling Results

In 2022, two sea farms (Salmonier Cove and Murphy Point) in BMA 4 had deposition modelling completed using AquaModel (see Table 11.1). Salmonier Cove was modelled with an assumed start date of 1 May 2022 with the first harvest occurring on 1 September 2023. Murphy Point was modelled with an assumed start date of 1 June 2022 with the first harvest occurring on 1 October 2023. PEZ modelling has not been conducted for BMA 4 sea farms.

11.2.1 Salmonier Cove Sea Farm

The AquaModel results for the Salmonier Cove sea farm indicate that the deposition is strongly influenced by the current flow. The 1 gC/m²/day contour for peak feeding is predicted to occur directly under the cage array with the distribution extending toward and just outside of the western boundary of the lease, as influenced by the current flow during this timestep (Figure 11.1). The 1 gC/m²/day contour for mean feed use is centered under and around the cages but does not extend beyond the lease boundary (Figure 11.2). Peak feed use contours have a wider spread and the mean feed use predictions result in a smaller footprint of the 10 gC/m²/day contour. The wider spread of the contours during peak feed use is due to the current flow at this timestep.

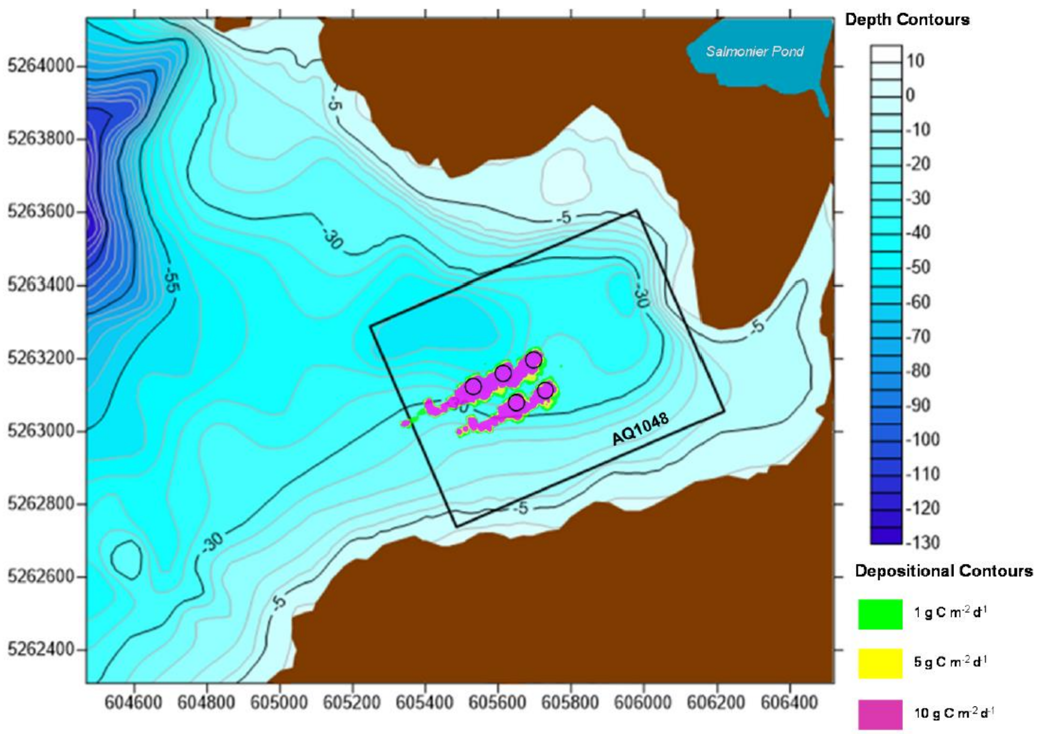


Figure 11.1. Predicted TOC rate of deposition for peak feed use (14 Aug 2023) at Salmonier Cove sea farm. Peak feeding date assumed the fish entry date to sea cages was 1 May 2022. Here, and elsewhere in this series of depositional maps, sea cage positions are represented by black circles.

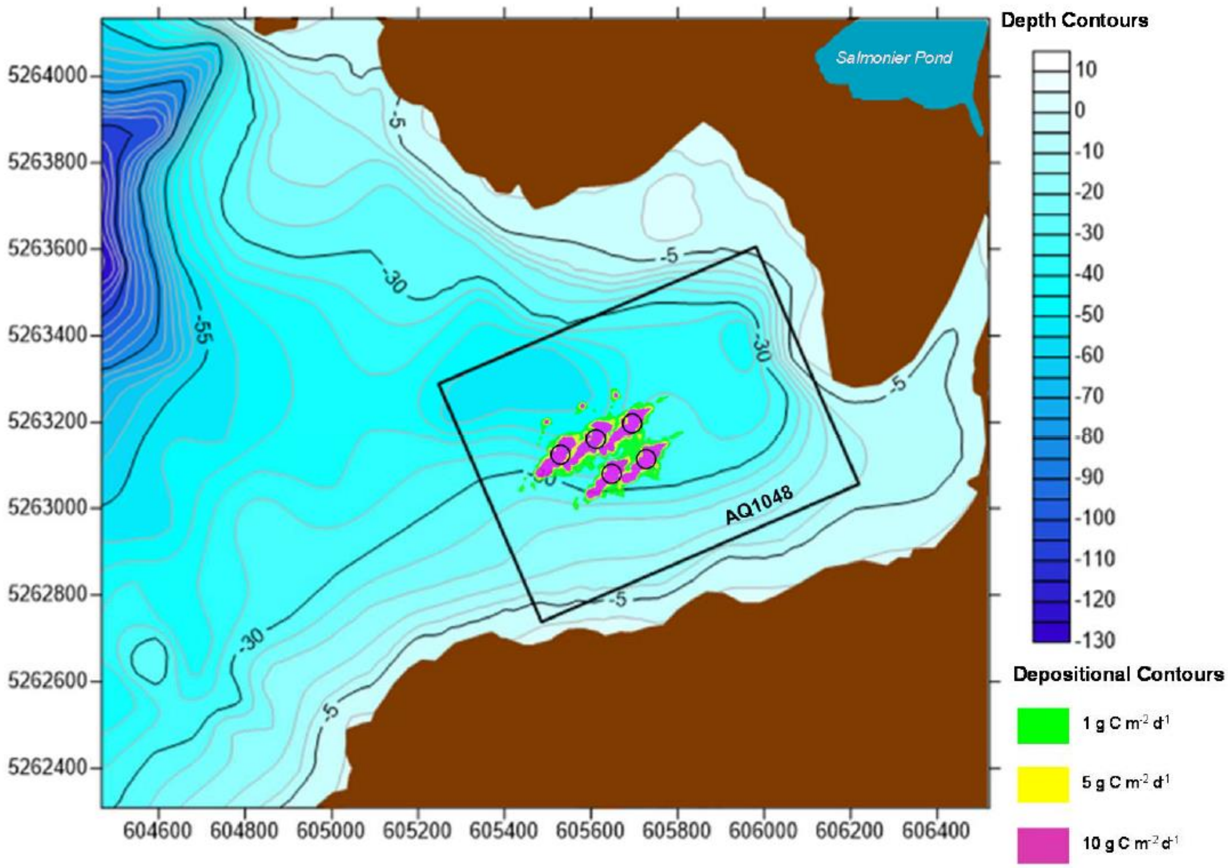


Figure 11.2. Predicted TOC rate of deposition for mean feed use (2 Aug 2022) at Salmonier Cove sea farm. Mean feeding date assumed the fish entry date to sea cages was 1 May 2022.

11.2.2 Murphy Point Sea Farm

The AquaModel results for the Murphy Point sea farm predict that the deposition will occur directly under the sea farm, with most deposition under the sea cages, and that it will not extend beyond the lease boundary for both peak and mean feeding inputs for all deposition contours (1, 5, 10 gC/m^2/day; Figures 11.3 and 11.4). The key differences in the depositional contours between peak feed use and mean feed use are the extension of the contours to the west and the separation of the contours into bands during mean feed use. These variations are largely due to differences in the currents at the timesteps representing peak feed and mean feed usage.

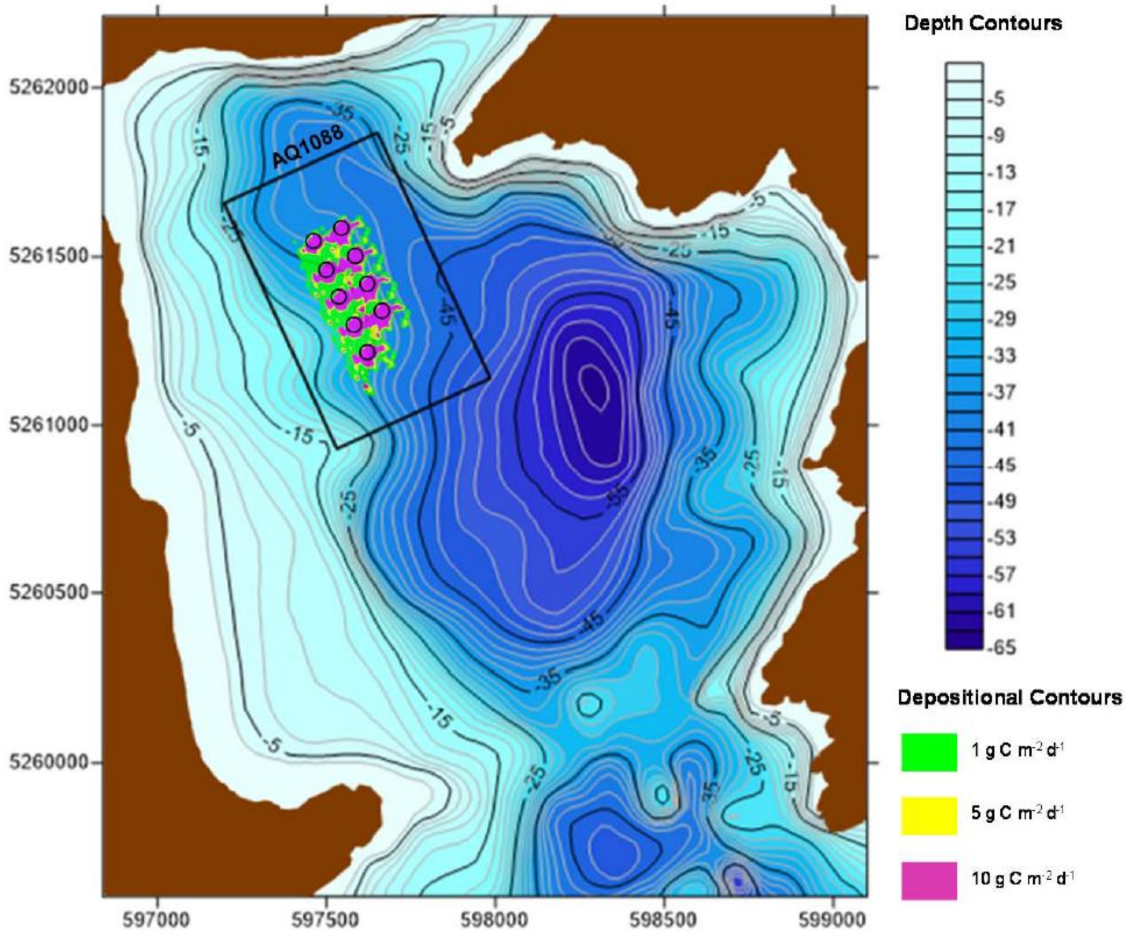


Figure 11.3. Predicted TOC rate of deposition for peak feeding (5 Nov 2023) at Murphy Point sea farm. Peak feeding date assumed the fish entry date to sea cages was 1 June 2022.

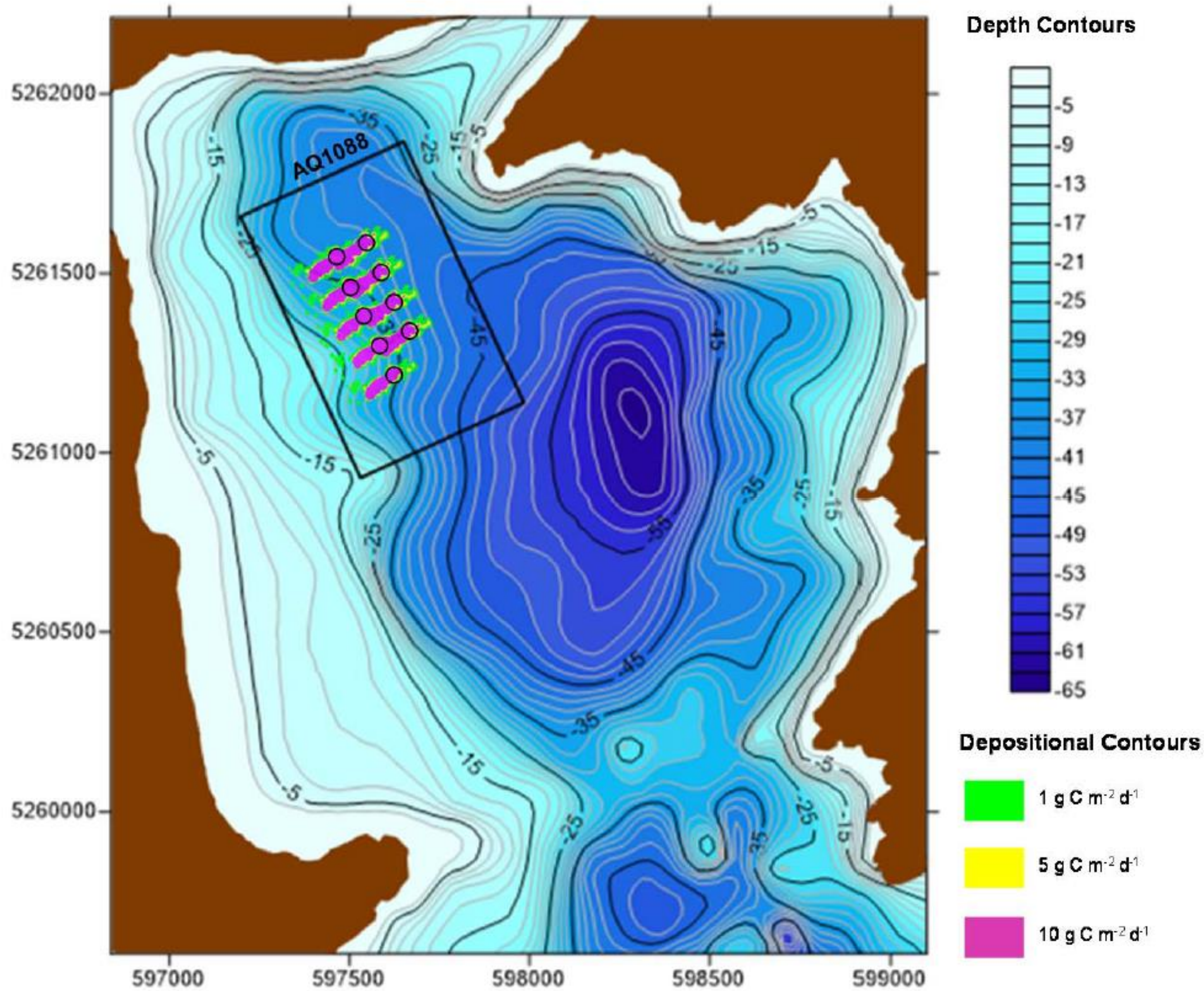


Figure 11.4. Predicted TOC rate of deposition for mean feed use (7 Jan 2023) at Murphy Point sea farm. Mean feeding date assumed the fish entry date to sea cages was 1 June 2022.

11.3 Outer Bay d'Espoir (BMA 9) Modelling Results

Depositional modelling was completed via DEPOMOD (Version 2.2) in 2018 by AMB Marine and Coastal Research for the four sea farms (Butter Cove, Jervis Island, Pass My Can, and Goblin Bay) in BMA 9. Modelling for all four sea farms assumed a 22-month production cycle for farmed salmon from sea entry (approximately September) to harvest (August of the second year). As noted previously, DFO conducted PEZ modelling for BMA 9 (Page et al. 2023).

11.3.1 Butter Cove Sea Farm

The DEPOMOD results for the Butter Cove sea farm indicated that at both peak feed and mean feed use, depositional footprints did not overlap with areas shallower than 30 m[2].

At peak feed rate, the 5 gC/m^2/day depositional footprint was predicted to extend slightly beyond the Butter Cove sea cage footprint. The 1 gC/m^2/day footprint is predicted to occur beneath and extend outside of the sea cage structure, particularly to the north and east and the 10 gC/m^2/day footprint was predicted to fall directly below the sea cage array (Figure 11.5).

At mean feed rate, the DEPOMOD model predicted that the 5 gC/m^2/day footprint would occur just below and between the sea cages. The 1 gC/m^2/day footprint was predicted to occur beneath and extend slightly outside of the sea cage structure, at depths ranging from 50–85 m (Figure 11.6).

11.3.2 Jervis Island Sea Farm

The DEPOMOD results for the Jervis Island sea farm indicated that at both peak feed and mean feed use, depositional footprints did not overlap with areas shallower than 30 m.

At peak feed rate, the 5 gC/m^2/day depositional footprint was predicted to occur beneath the sea cage structure and to extend beyond the sea cage array to the southeast (Figure 11.7). The 1 gC/m^2/day footprint was predicted to extend beyond the sea cage structure to the southeast and to a lesser extent to the northwest. The 10 gC/m^2/day footprint at peak feed rate was predicted to fall directly below the three southwestern sea cages and extend slightly past these sea cages.

At mean feed rate, the DEPOMOD modelling predicted a small 5 gC/m^2/day footprint, occurring below the southwestern edge of the sea cage array. The 1 gC/m^2/day footprint falls beneath the cage grid and extends beyond the cage structure to the southeast, from depths of 50 m to >150 m (Figure 11.8).

[2] Although there are no AAR requirements for deposition relative to water depth, productive habitat for seaweeds and kelp and sensitive habitat for other species is assumed to potentially occur in areas shallower than 30 m. However, the 30 m bathymetric contour is simply used as a general guide relative to sensitive habitat (Kendall, A., Senior Marine Environmental Biologist, SIMCorp Marine Environmental, pers. comm, 8 November 2024).

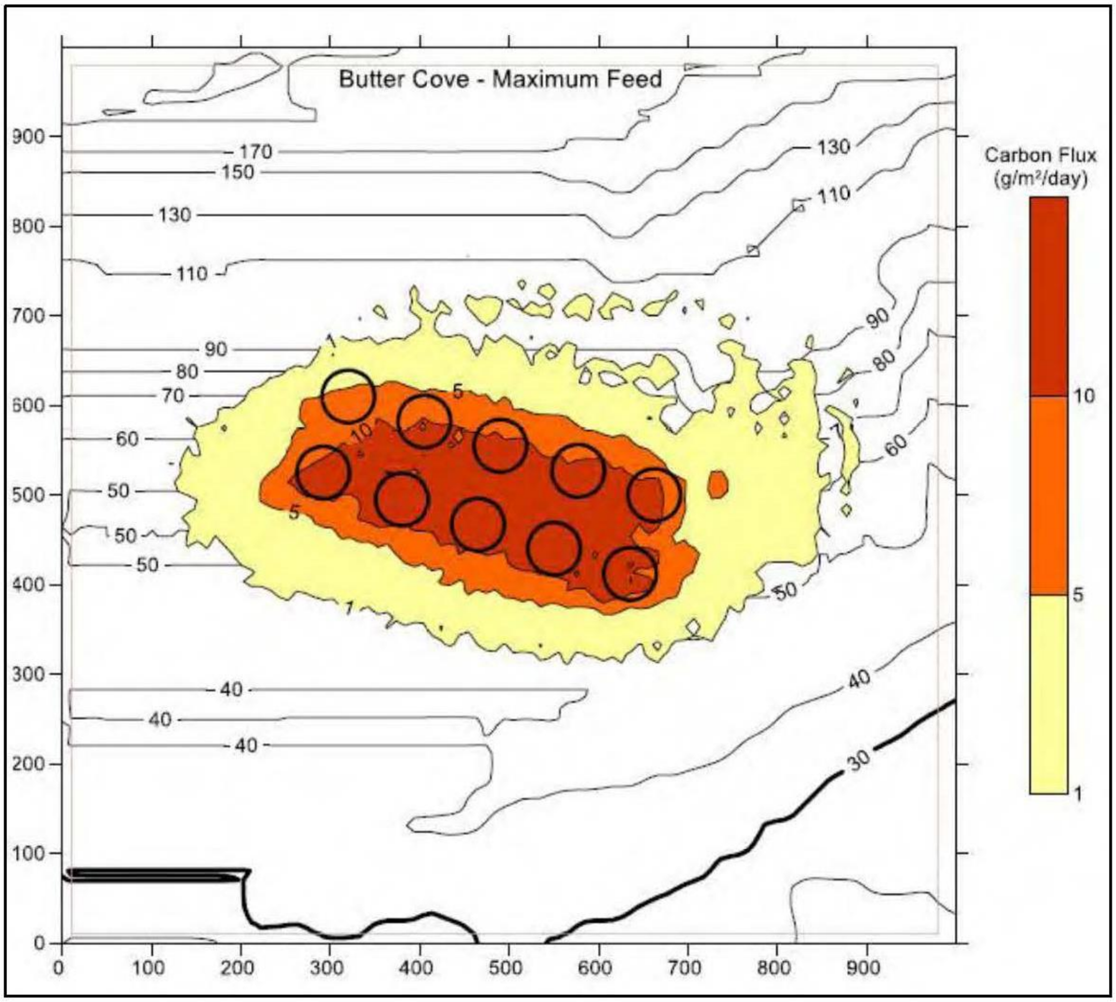


Figure 11.5. Predicted sediment TOC rate of deposition for peak feed use at Butter Cove sea farm. Here, and elsewhere in this series of DEPOMOD maps, the x- and y-axes and depth contours indicate metres.

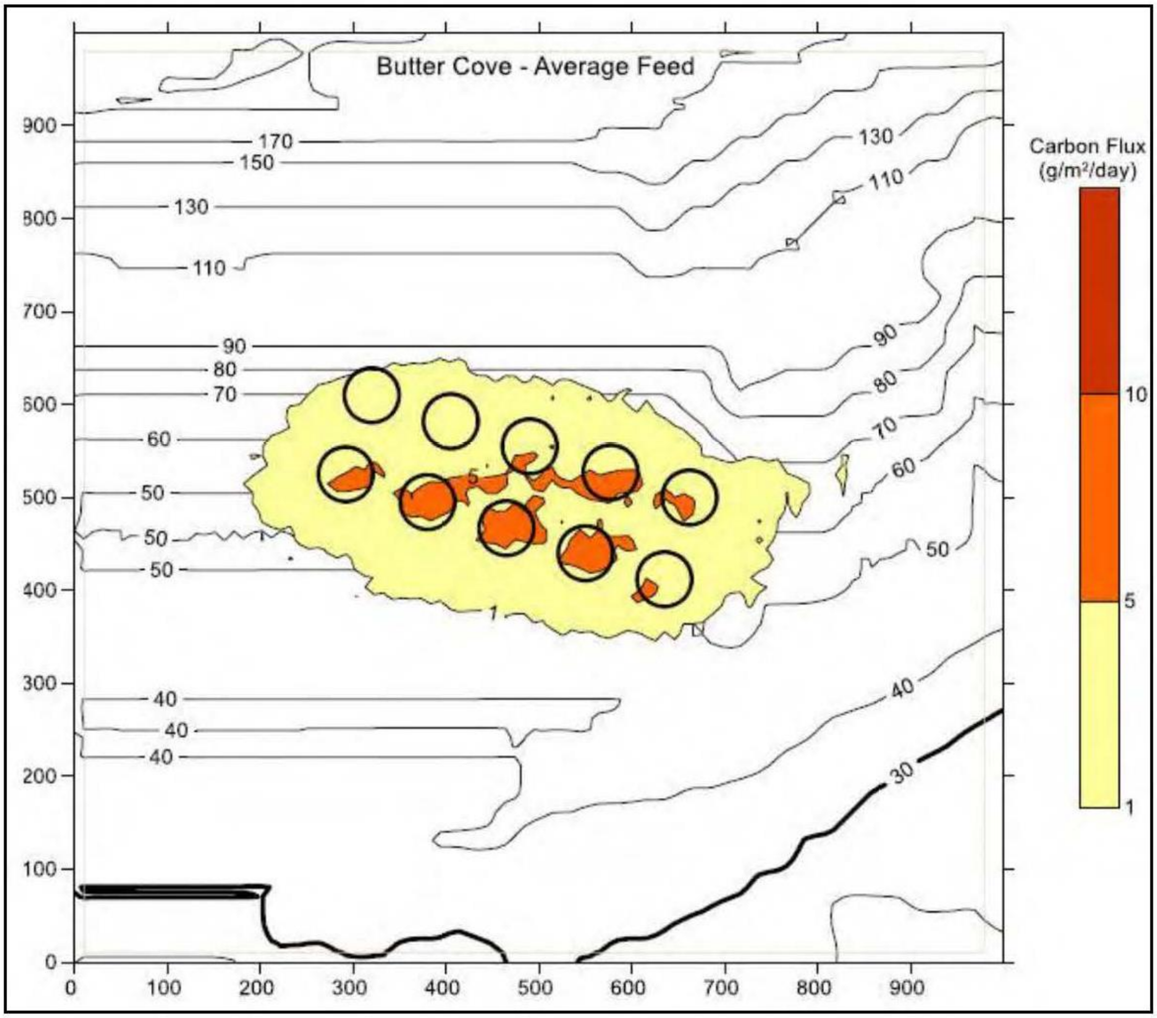


Figure 11.6. Predicted sediment TOC rate of deposition for mean feed use at Butter Cove sea farm.

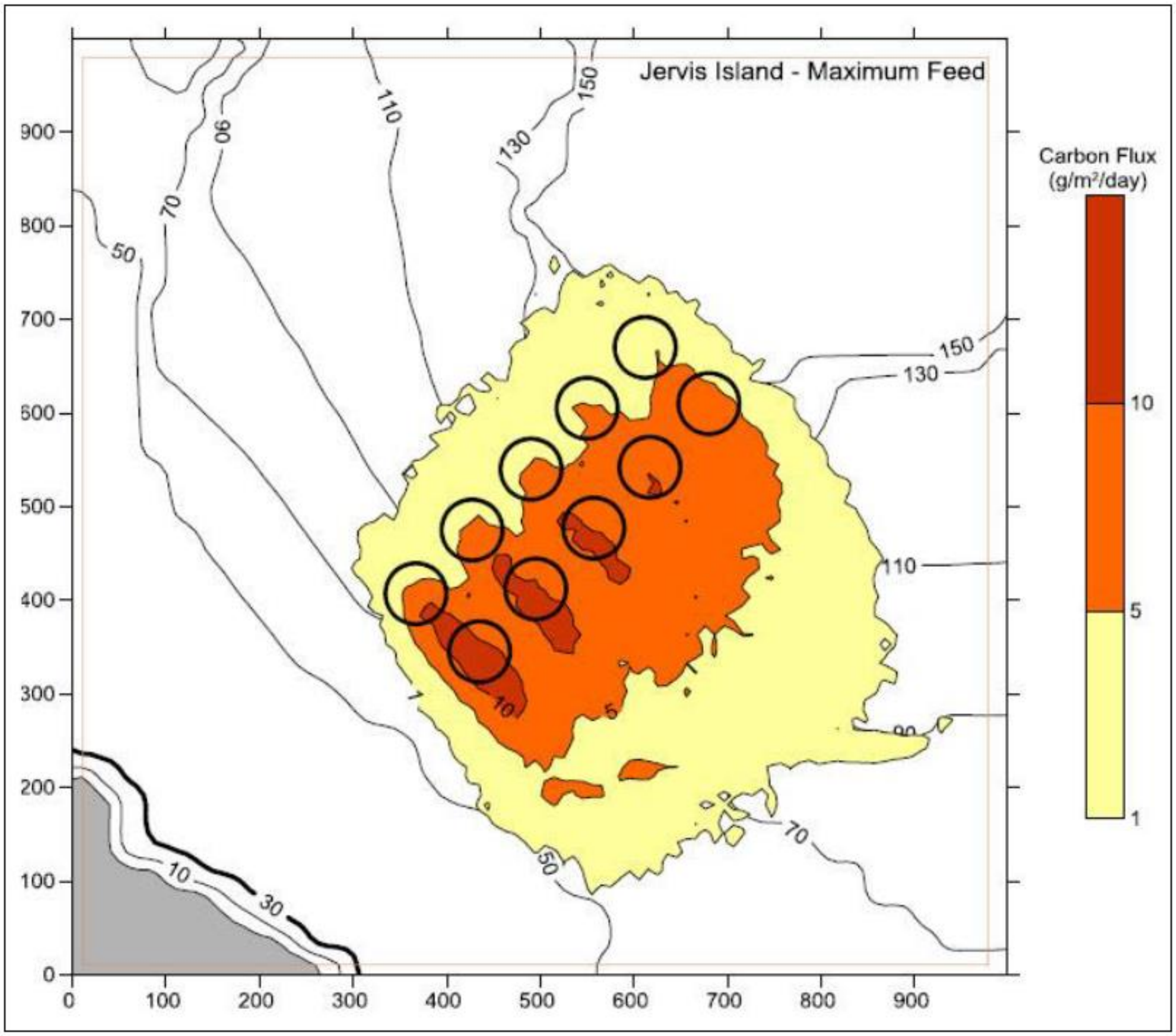


Figure 11.7. Predicted sediment TOC rate of deposition for peak feed use at Jervis Island sea farm.

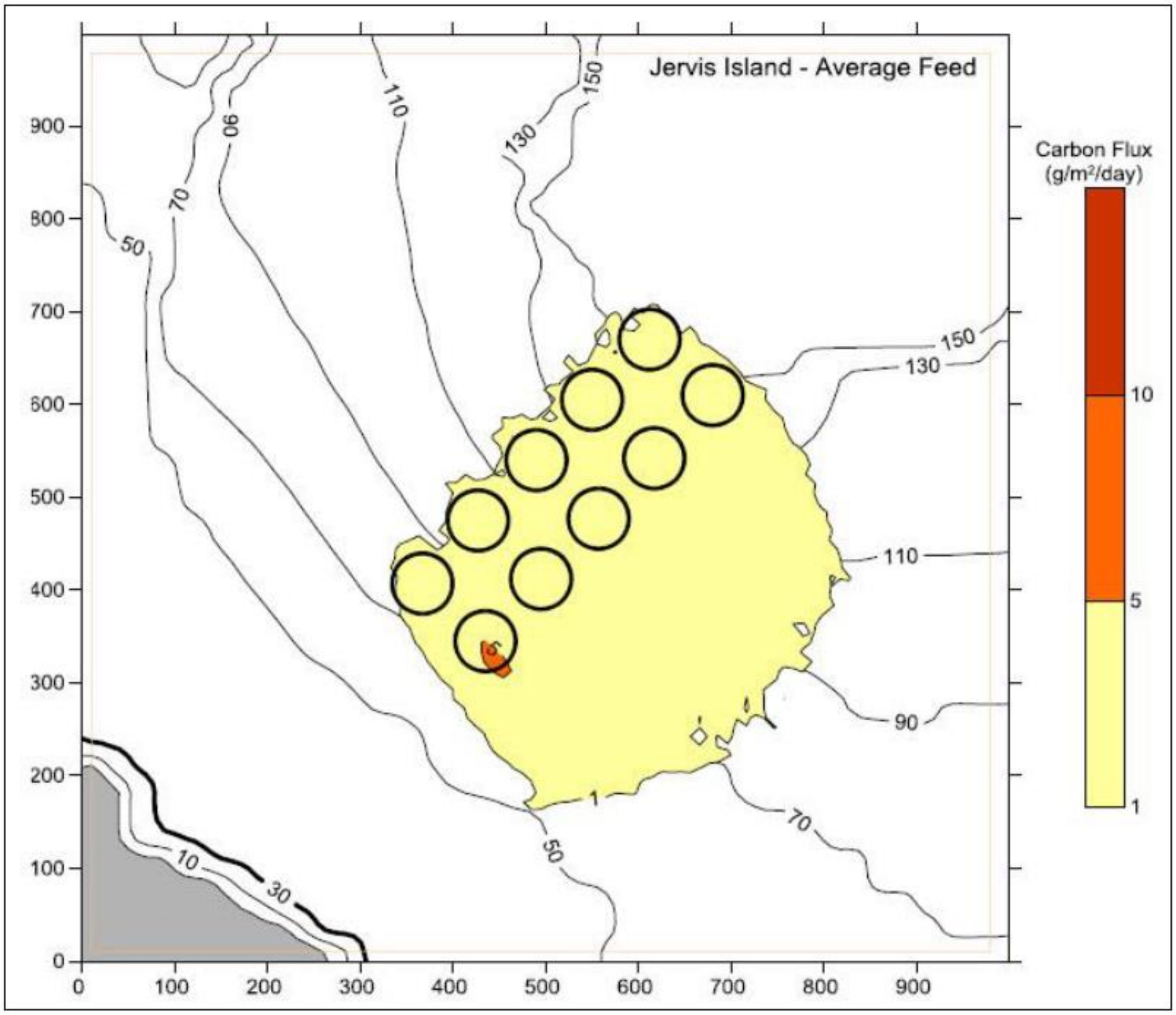


Figure 11.8. Predicted sediment TOC rate of deposition for mean feed use at Jervis Island sea farm.

11.3.3 Pass My Can Sea Farm

The DEPOMOD results for the Pass My Can sea farm indicated that at both peak feed and mean feed use, deposition footprints did not overlap with areas shallower than 30 m.

At peak feed rate, the 5 $gC/m^2/day$ depositional footprint was predicted to occur beneath the sea cage structure extending slightly beyond the cage array; the 1 $gC/m^2/day$ footprint was predicted to extend slightly further beyond the sea cage array. The 10 $gC/m^2/day$ footprint at peak feed rate was predicted to fall directly below and between the sea cages (Figure 11.9).

At mean feed rate, the DEPOMOD modelling for the Pass My Can sea farm predicted that the 5 $gC/m^2/day$ footprint would occur directly under each sea cage. The 1 $gC/m^2/day$ footprint falls beneath and extends about equally outside the sea cage structure, from depths of 60 m to >80 m (Figure 11.10).

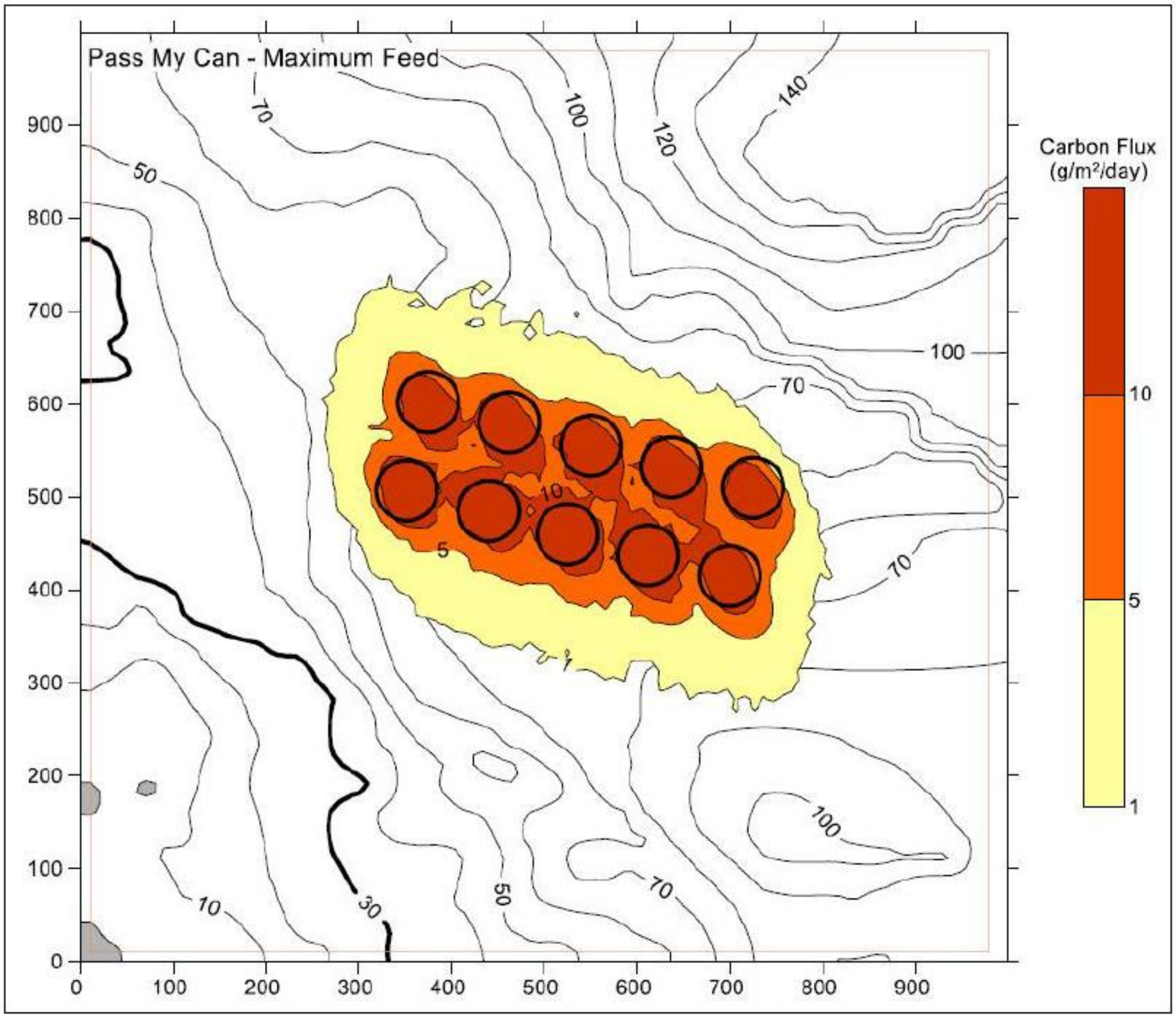


Figure 11.9. Predicted sediment TOC rate of deposition for peak feed use at Pass My Can sea farm.

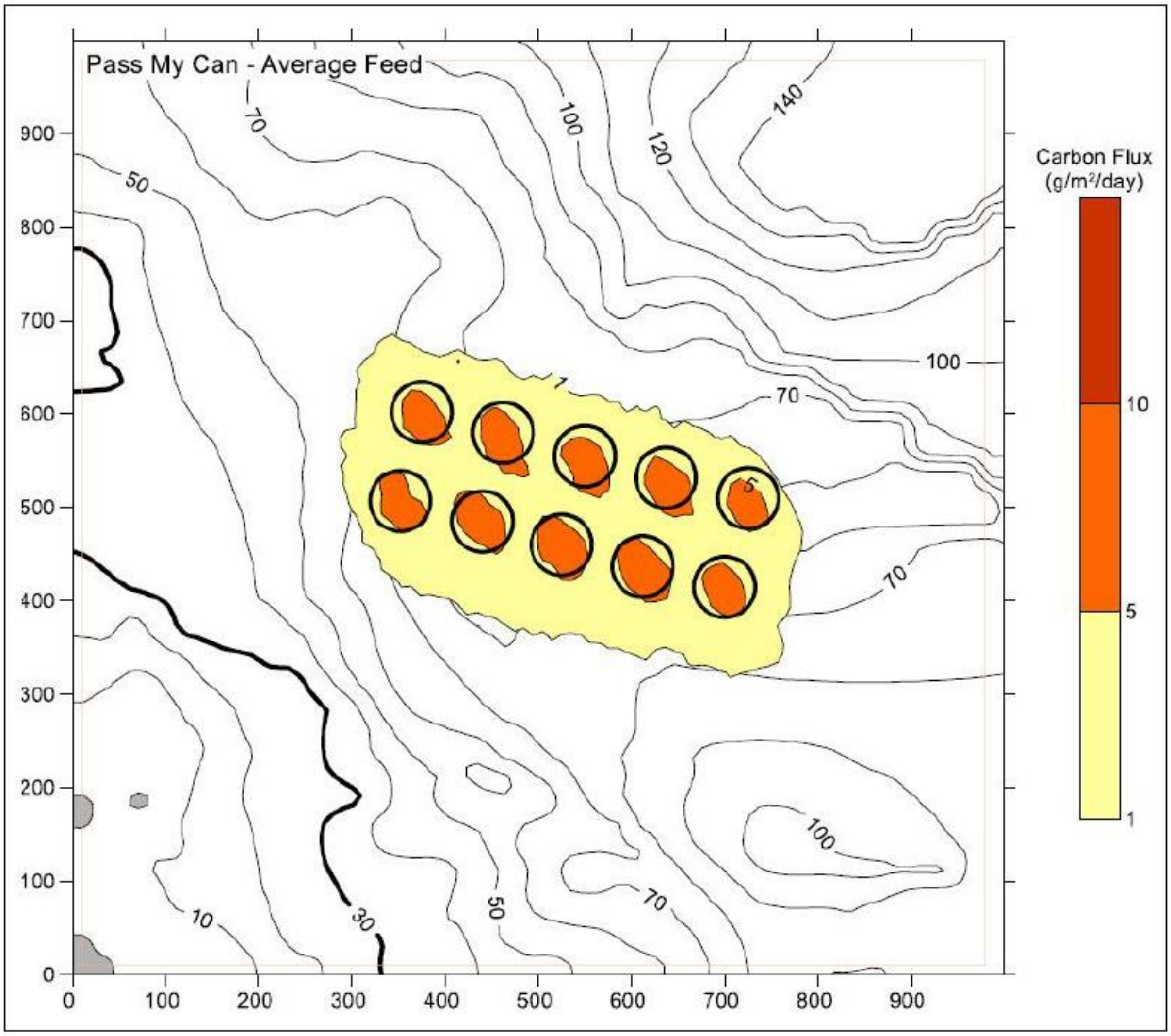


Figure 11.10. Predicted sediment TOC rate of deposition for mean feed use at Pass My Can sea farm.

11.3.4 Goblin Bay Sea Farm

The DEPOMOD results for the Goblin Bay sea farm indicated that at both peak feed and mean feed use, depositional footprints did not overlap with areas shallower than 30 m.

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to occur directly beneath the sea cage structure. The 5 gC/m²/day depositional footprint was predicted to occur in 50–130 m water depths beneath the sea cage structure extending slightly beyond the sea cages. The 1 gC/m²/day footprint was predicted to occur in water depths from 30 m to >150 m and occurs beneath the sea cage array and slightly to the northeast and southwest of the sea cage structure (Figure 11.11).

At mean feed rate, the 5 gC/m2/day depositional footprint was predicted to occur directly under each sea cage and the 10 gC/m2/day depositional footprint at the centre of the sea cages nearest the shore. The 1 gC/m2/day depositional footprint was predicted to extend outside the sea cage structure in water depths of 40–150 m (Figure 11.12).

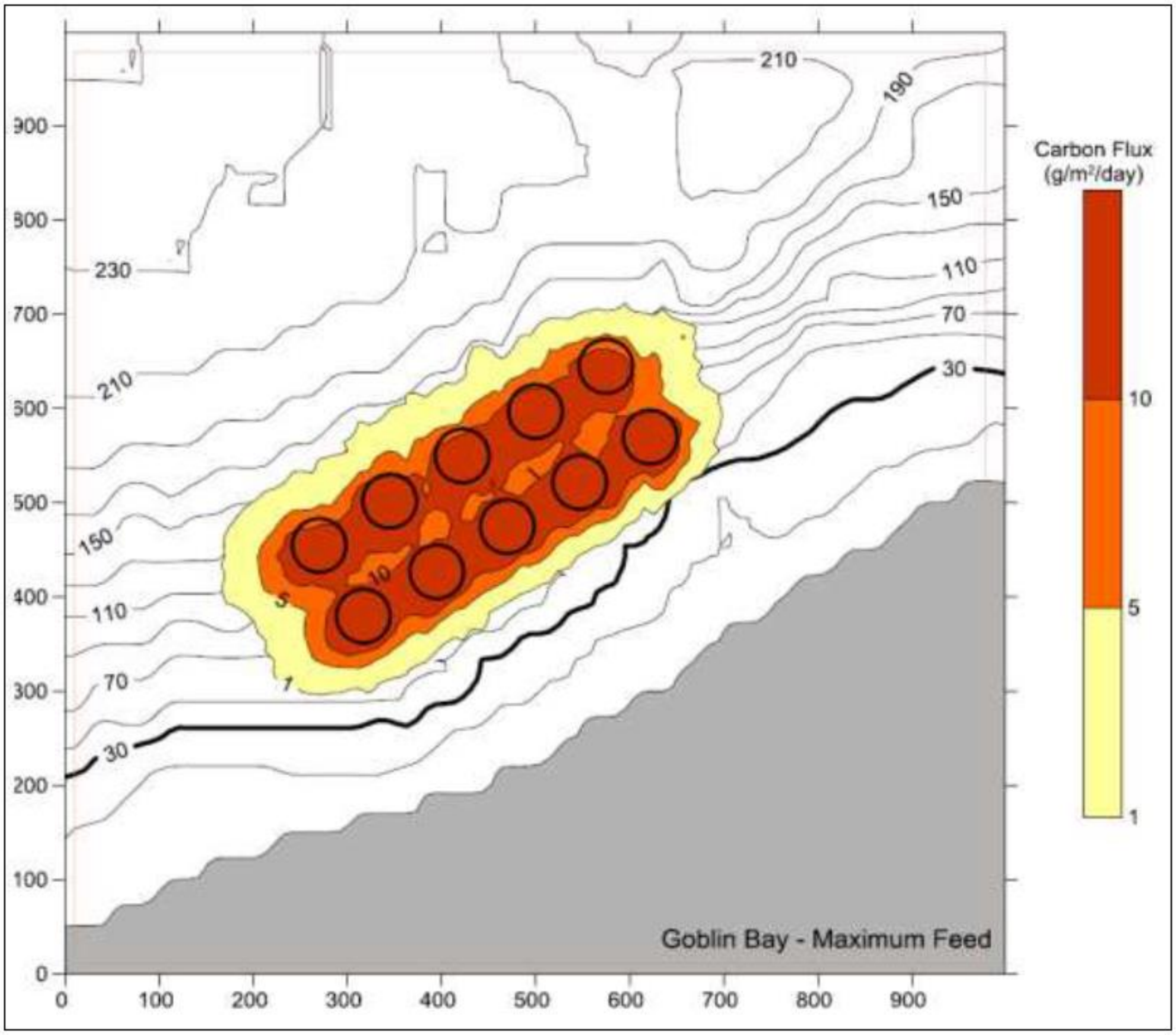


Figure 11.11. Predicted sediment TOC rate of deposition for peak feed use at Goblin Bay sea farm.

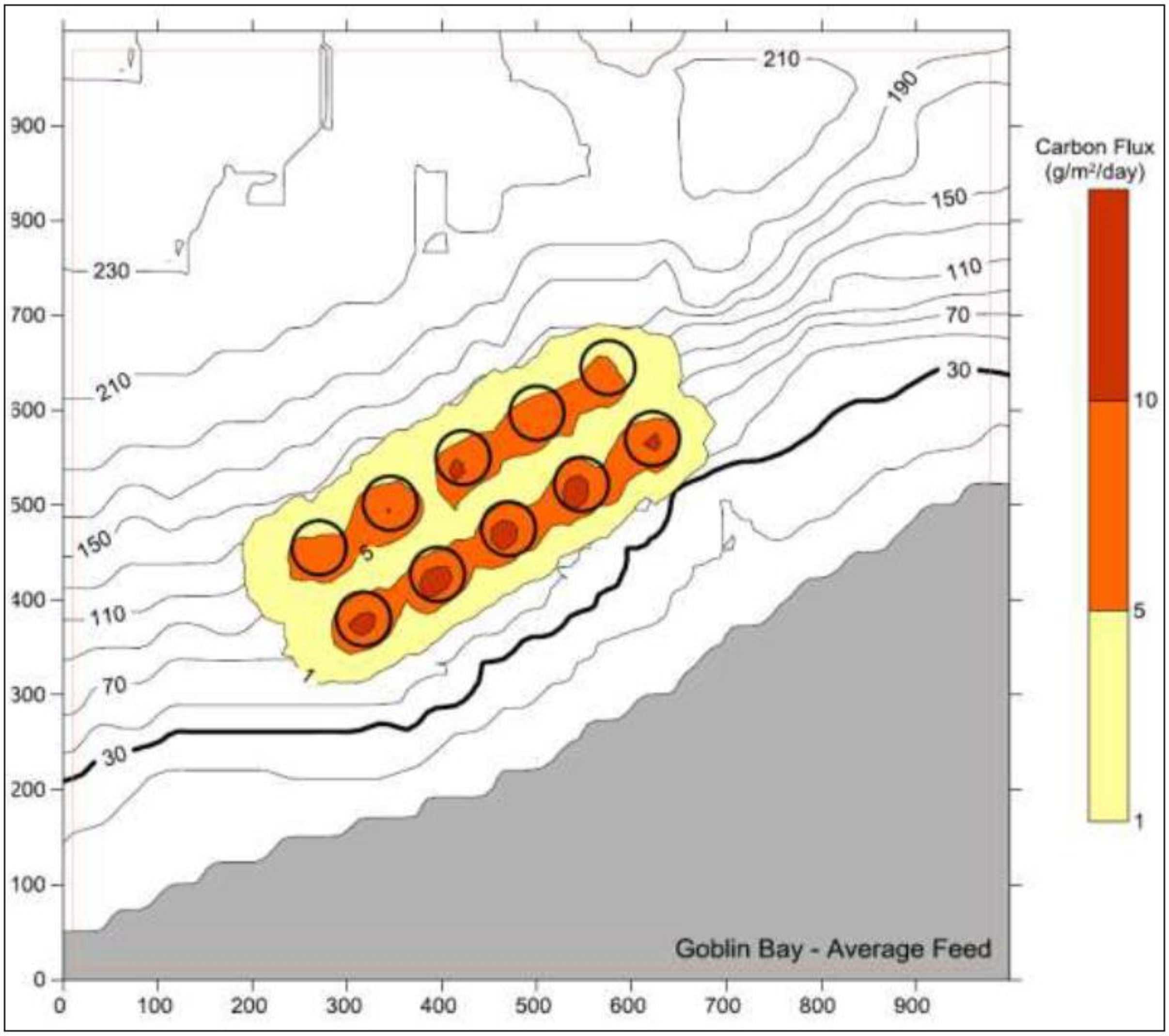


Figure 11.12. Predicted sediment TOC rate of deposition for mean feed use at Goblin Bay sea farm.

11.3.5 PEZ Modelling Results

The PEZ model was used to predict the maximum and mean benthic PEZs for organic matter at the four sea farms in BMA 9 (Page et al. 2023). Maximum feed and feces PEZs were predicted to overlap with stretches of coastline. The PEZs for fish feed are smaller than those for fish feces. The maximum feces PEZs have a more extensive overlap with the coastline; however, the interactions with the shallow shore may not be as extensive as those indicated by the PEZs because of the combination of the feed and feces sinking, a steeply sloped bathymetric regime, and the alignment of the current with the bathymetry. The Jervis Island sea farm had the largest estimated PEZ for feed (11.2 km^2) and feces (236.6 km^2) under maximum current speeds (Table 11.9). The smallest PEZ was estimated for the Goblin Bay sea farm.

Table 11.9. Summary of PEZ BOD area for feed and feces (km^2) under mean and maximum current speeds for BMA 9.

Sea Farm	Area of PEZ (km^2)			
	Mean Current Speed		Maximum Current Speed[a]	
	Feed	Feces	Feed	Feces
Butter Cove	0.17	0.32	3.13	55.73
Jervis Island	0.26	0.93	11.16	236.59
Pass My Can	0.21	0.55	3.54	62.44
Goblin Bay	0.17	0.32	1.60	23.93

Notes:

[a] Area represents an upper bound to the potential for exposure and should be interpreted as an order of magnitude acknowledging the complex full flow field in the area is not represented by a current measurement at a single location.

11.4 Facheux Bay (BMA 10) Modelling Results

Depositional modelling was completed via DEPOMOD (Version 2.2) in 2018 by AMB Marine and Coastal Research for the four sea farms (Wallace Cove, Dennis Arm, Indian Tea Point, and Wild Cove) in BMA 10. Modelling for all four sea farms assumed a 22-month production cycle for farmed salmon from sea entry (approximately September) to harvest (August of the second year). As noted previously, DFO conducted PEZ modelling for BMA 10 (Page et al. 2023).

11.4.1 Wallace Cove Sea Farm

The DEPOMOD results for the Wallice Cove sea farm indicated that at both peak feed and mean feed use, depositional footprints did not overlap with areas shallower than 30 m. Furthermore, the 10 gC/m²/day depositional rate/footprint was predicted to not occur under both feed use scenarios (Figures 11.13 and 11.14).

At peak feed rate, the model predicted that the 5 gC/m²/day depositional footprint would occur in water depths >300 m and directly beneath and slightly outside of the sea cage array, extending farther to the north and east (Figure 11.13). The 1 gC/m²/day depositional footprint is predicted to fall in greater than 150 m depth water.

At mean feed rate, the 5 and 10 gC/m²/day depositional rates/footprints were predicted to not occur, and the predicted 1 gC/m²/day footprint would occur in water depths >230 m (Figure 11.14).

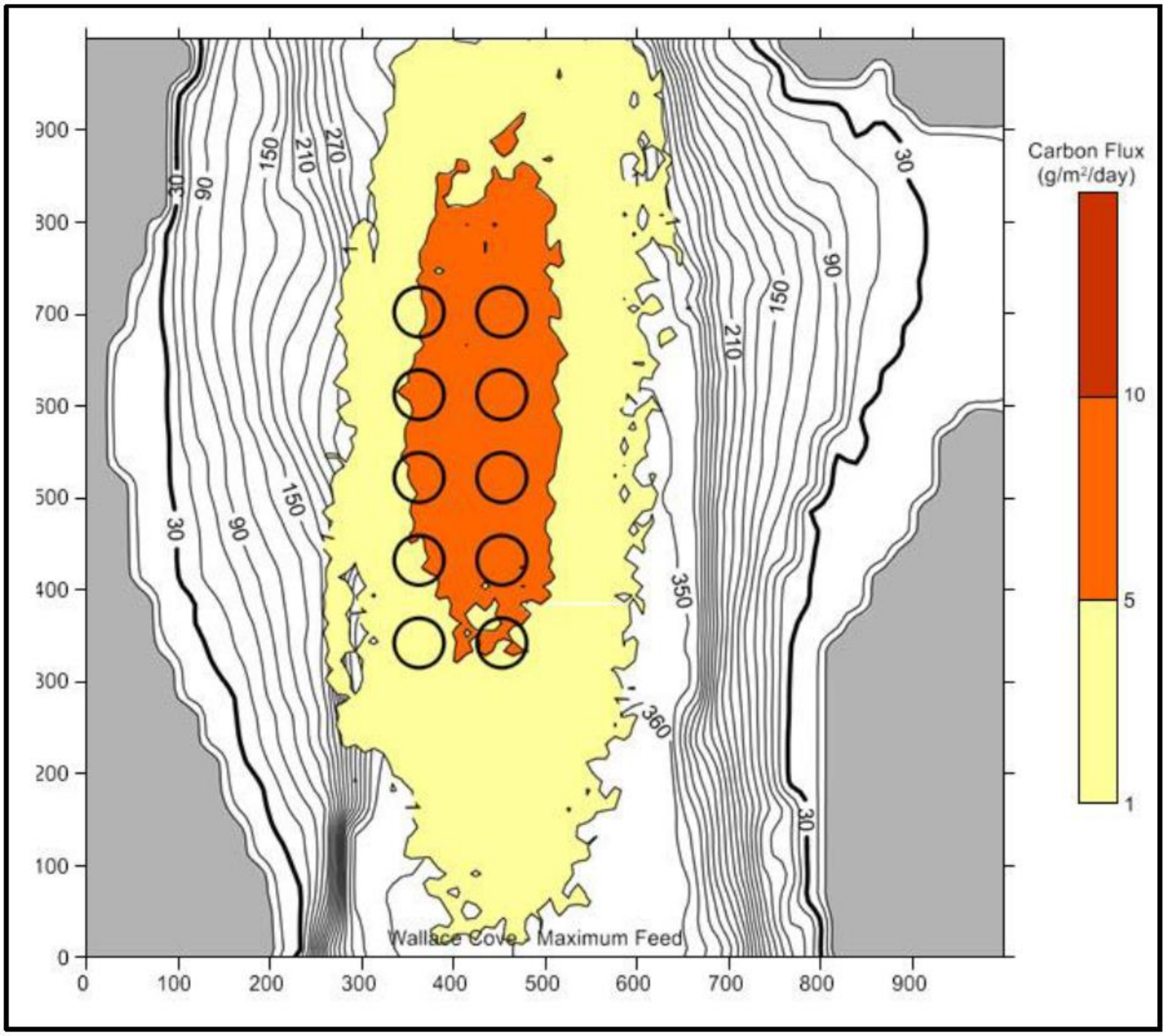


Figure 11.13. Predicted sediment TOC rate of deposition for peak feed use at Wallace Cove sea farm.

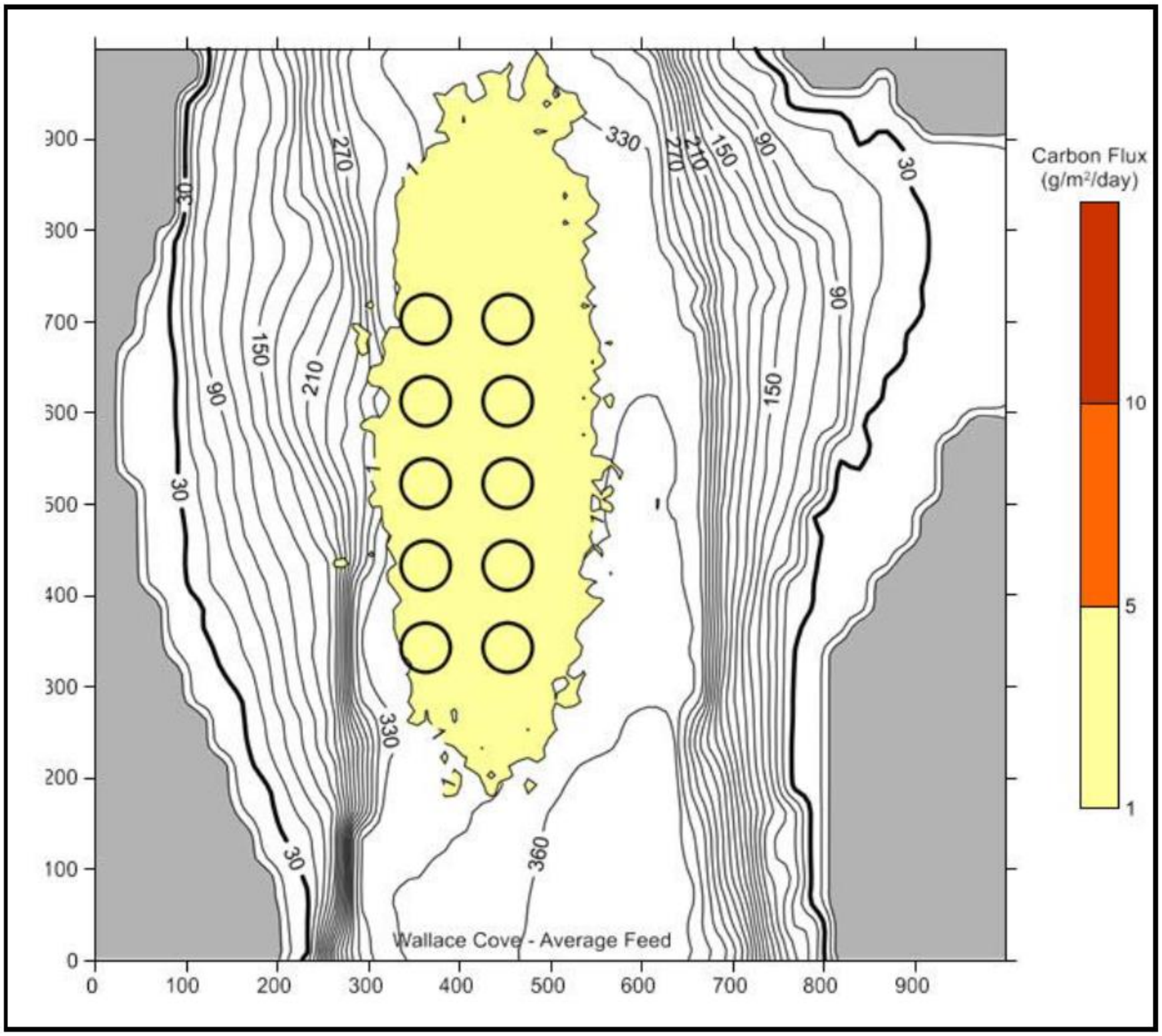


Figure 11.14. Predicted sediment TOC rate of deposition for mean feed use at Wallace Cove sea farm.

11.4.2 Dennis Arm Sea Farm

The DEPOMOD results for the Dennis Arm sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m.

At peak feed input, modelling predicted that the 10 gC/m^2/day depositional footprint is minimal and located in depths >150 m beneath the sea cage array and slightly outside of the array to the south (Figure 11.15). The 5 gC/m^2/day depositional footprint was predicted to occur in areas directly beneath and slightly outside of the sea cage array primarily to the south.

At mean feed input, the DEPOMOD predicted that the 1 gC/m2/day depositional footprint will occur in areas with >70 m water depth. A 10 gC/m2/day depositional footprint was not predicted considering mean feed use (Figure 11.16).

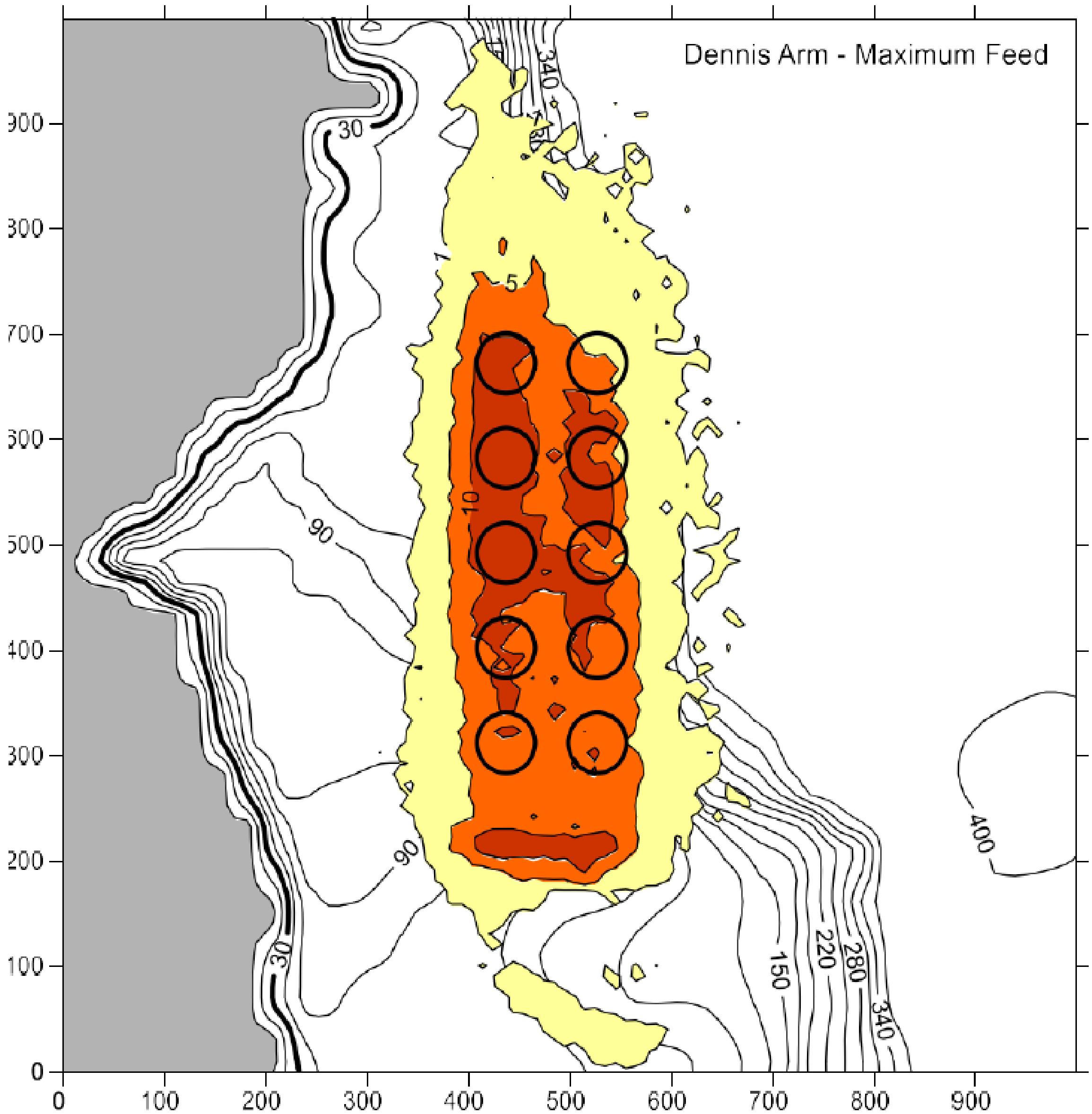


Figure 11.15. Predicted sediment TOC rate of deposition for peak feed use at Dennis Arm sea farm.

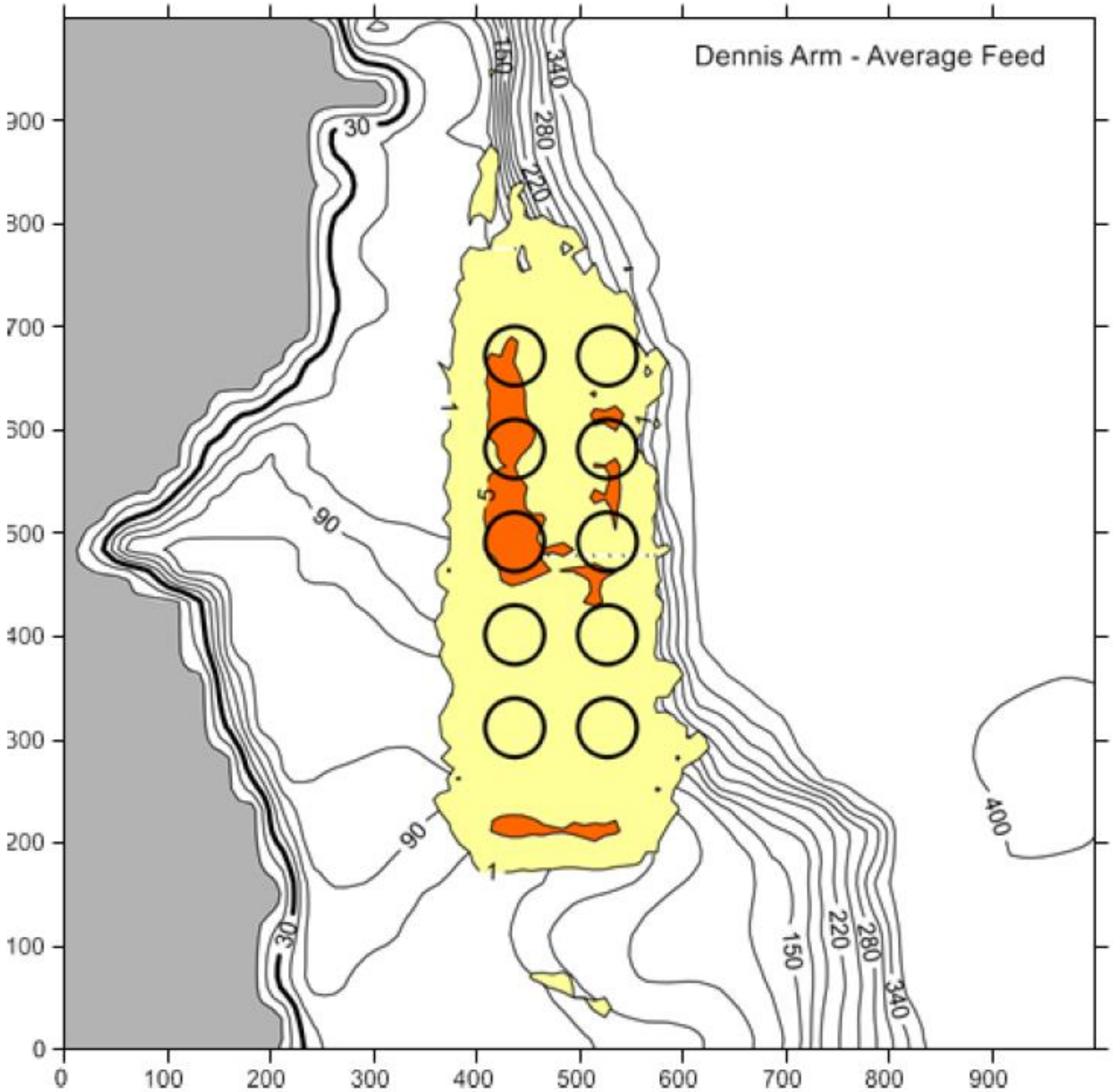


Figure 11.16. Predicted sediment TOC rate of deposition for mean feed use at Dennis Arm sea farm.

11.4.3 Indian Tea Point Sea Farm

The DEPOMOD results for the Indian Tea Point sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m.

At peak feed use, the DEPOMOD simulations predicted that the 10 gC/m²/day depositional footprint would fall beneath the sea cage array (Figure 11.17). The predicted 5 and 1 gC/m²/day depositional footprints were predicted to occur in areas >130 m and >100 m, respectively.

At mean feed use, the DEPOMOD simulations predicted that the 5 gC/m²/day footprint was present in small patches below the western sea cages, and the 1 gC/m²/day footprint would occur in waters >110 m (Figure 11.18).

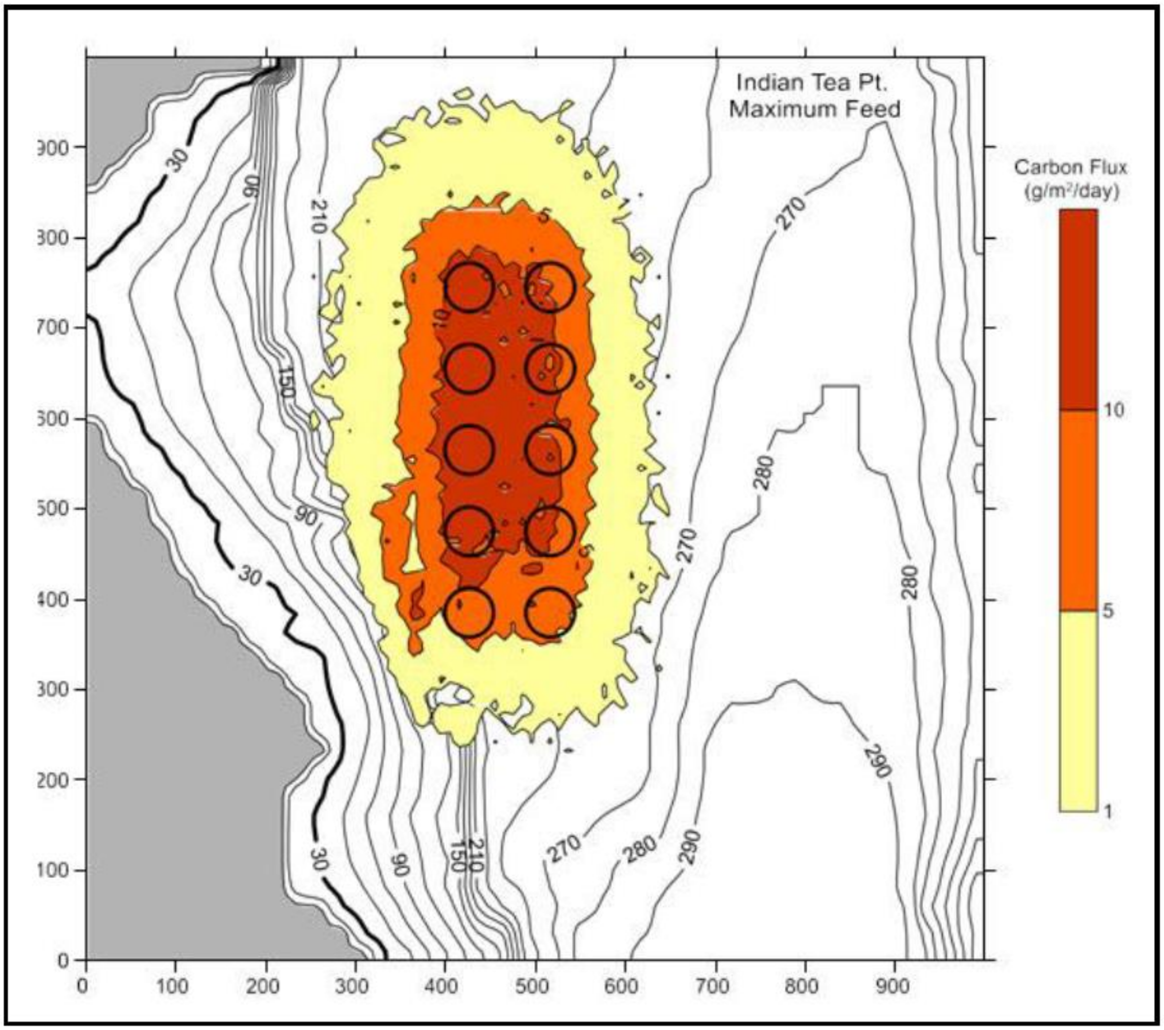


Figure 11.17. Predicted sediment TOC rate of deposition for peak feed use at Indian Tea Point sea farm.

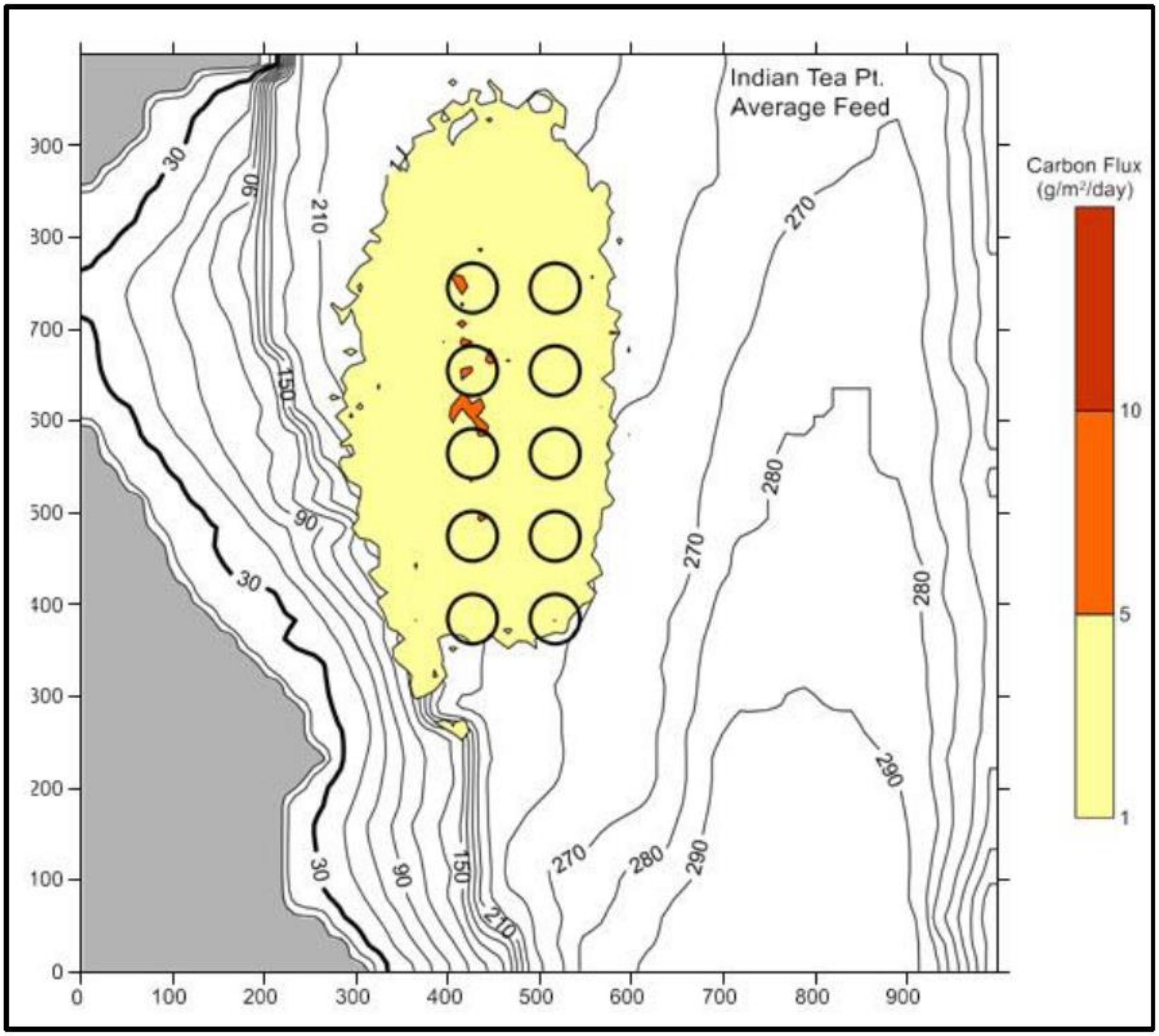


Figure 11.18. Predicted sediment TOC rate of deposition for mean feed use at Indian Tea Point sea farm.

11.4.4 Wild Cove Sea Farm

The DEPOMOD results for the Wild Cove sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m.

At peak feed use, modelling simulations predicted that the 5 gC/m²/day depositional footprint would occur beneath and slightly beyond the sea cage array in waters >200 m deep. The 1 gC/m²/day footprint was predicted to occur in areas with >90 m water depth. At peak feed use, a 10 gC/m²/day footprint was not predicted (Figure 11.19).

At the average feed use, modelling simulations predicted that there would be no 5 or 10 gC/m²/day depositional footprints and that the 1 gC/m²/day footprint would occur in waters >150 m (Figure 11.20).

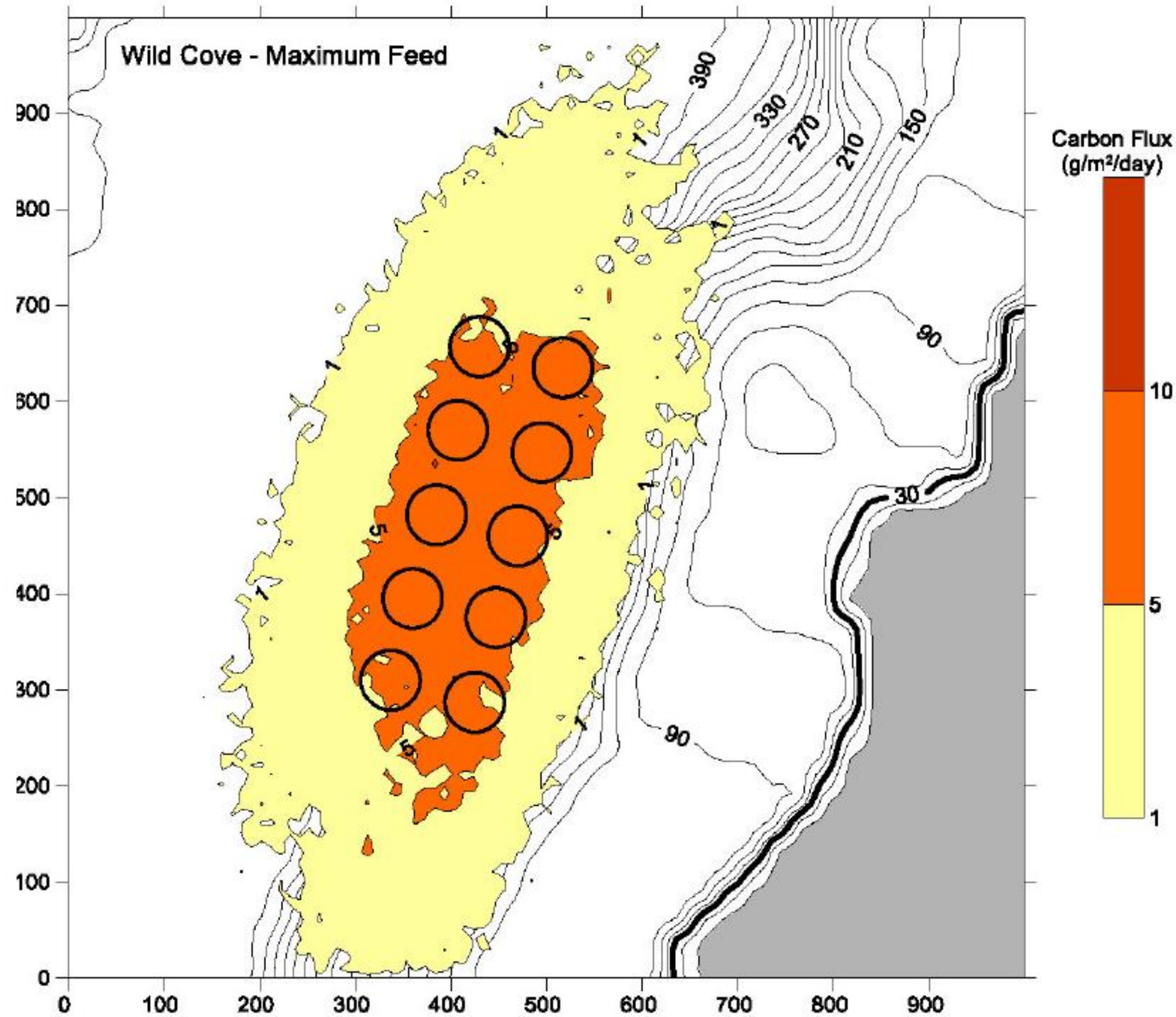


Figure 11.19. Predicted sediment TOC rate of deposition for peak feed use at Wild Cove sea farm.

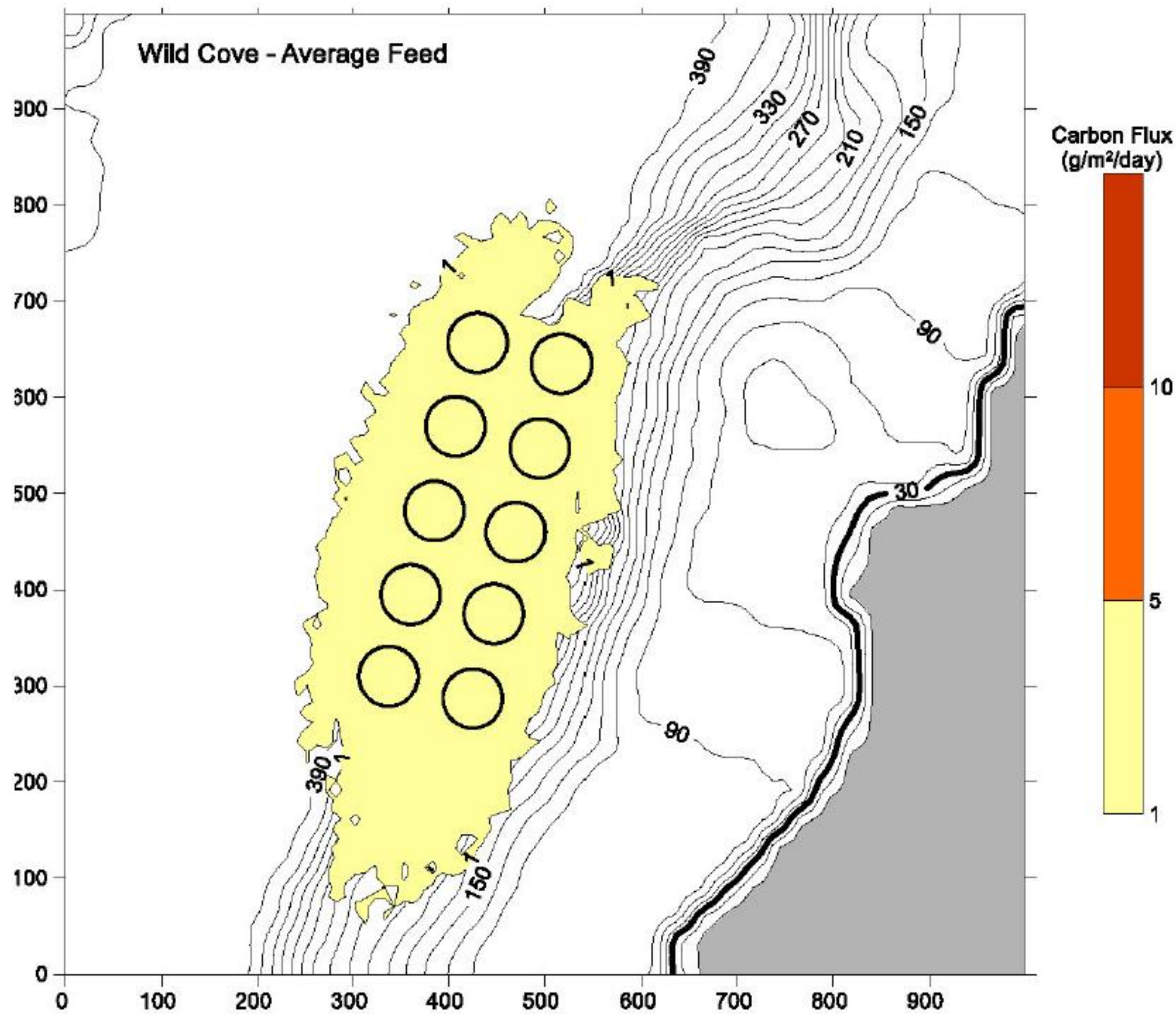


Figure 11.20. Predicted sediment TOC rate of deposition for mean feed use at Wild Cove sea farm.

11.4.5 PEZ Modelling Results

The PEZ model was used to predict the maximum and mean benthic PEZs for organic matter at the four sea farms in BMA 10 (Page et al. 2023). All maximum feed and feces PEZs and two mean feed and feces PEZs were predicted to overlap with the coastline. However, the interactions with the shallow shore may not be as extensive as those indicated by the PEZs because of the combination of the feed and feces sinking, a steeply sloped bathymetric regime, and the alignment of the current with the bathymetry. The Indian Tea Point sea farm had the largest estimated PEZ for feed (1.39 km^2) and feces (20.11 km^2) under maximum current speeds (Table 11.10). The smallest PEZ was estimated for the Dennis Arm sea farm.

Table 11.10. Summary of PEZ BOD area for feed and feces (km^2) under mean and maximum current speeds for BMA 10.

Sea Farm	Area of PEZ (km^2)			
	Mean Current Speed		Maximum Current Speed[a]	
	Feed	Feces	Feed	Feces
Wallace Cove	0.28	1.06	1.34	18.92
Dennis Arm	0.15	0.23	0.89	10.62
Indian Tea Point	0.24	0.81	1.39	20.11
Wild Cove	0.16	0.26	0.94	11.75

Notes:

[a] Area represents an upper bound to the potential for exposure and should be interpreted as an order of magnitude acknowledging the complex full flow field in the area is not represented by a current measurement at a single location.

11.5 Hare Bay (BMA 11) Modelling Results

Depositional modelling was completed via DEPOMOD (Version 2.2) in 2018 by AMB Marine and Coastal Research for the two sea farms (Mare Cove South and North Bob Locke Cove) in BMA 11. Modelling for both sea farms assumed a 22-month production cycle for farmed salmon from sea entry (approximately September) to harvest (August of the second year). As noted previously, DFO conducted PEZ modelling for BMA 11 (Page et al. 2023).

11.5.1 Mare Cove South Sea Farm

The DEPOMOD results for the Mare Cove South sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (indicated by blue contour line in Figures 11.21 and 11.22).

At peak feed rate, the 5 gC/m²/day depositional footprint was predicted to occur beneath the sea cage structure and to the east in water depths from 170–200 m (Figure 11.21). The 1 gC/m²/day footprint was predicted to occur in depths >160 m on the west side of the bay and >30–50 m on the east side.

At mean feed rate, the DEPOMOD modelling predicted an absence of depositional rates >5 gC/m²/day. The 1 gC/m²/day depositional footprint was predicted to occur at depths of 60–150 m. The extremely steep contours of the sea farm site do not allow for further precision of deposition at the shallowest depths on the east side of the bay (Figure 11.22).

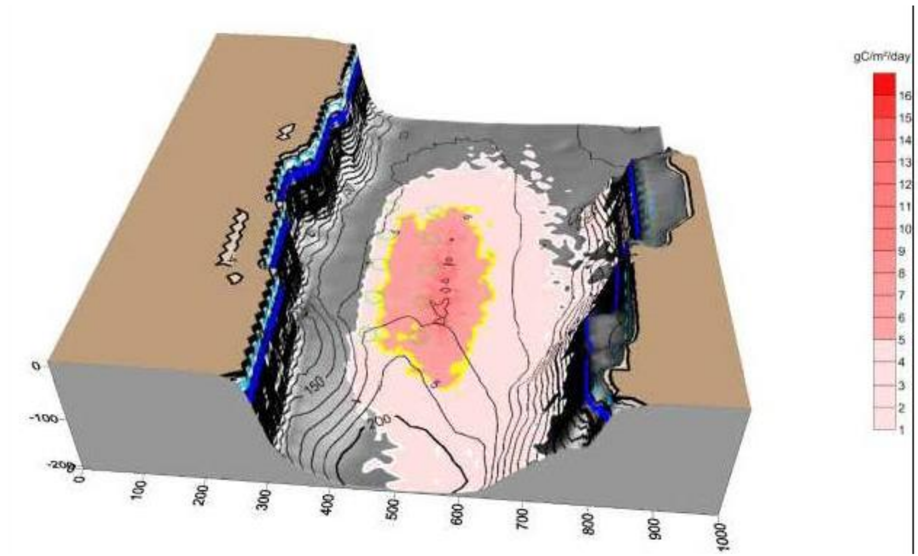


Figure 11.21. Predicted sediment TOC rate of deposition for peak feed use at Mare Cove South sea farm. Here, and in other figures for this BMA, the x-axis is distance in metres and the y-axis is water depth in metres; sea cage locations are indicated with green circles; the white line indicates the boundary of the 1 $gC/m^2/day$ contour; and the yellow line indicates the 5 $gC/m^2/day$ contour.

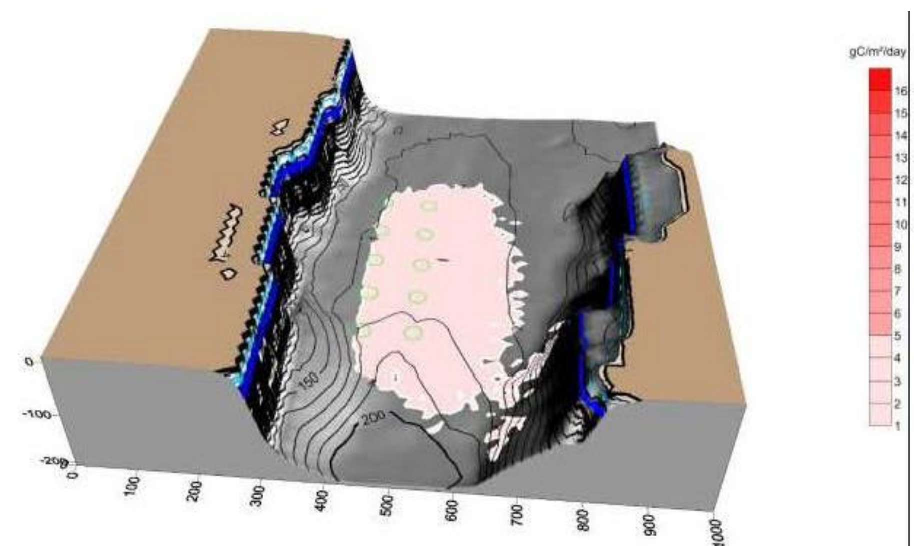


Figure 11.22. Predicted sediment TOC rate of deposition for mean feed use at Mare Cove South sea farm.

11.5.2 North Bob Locke Cove Sea Farm

The DEPOMOD modelling for the North Bob Locke Cove sea farm predicted that the 5 $gC/m^2/day$ depositional footprint did not overlap the 30 m depth contour at peak feed rate.

The 1 gC/m²/day contour was predicted to overlap a small portion of the 30 m depth contour along the eastern side of the lease during peak feed input.

At peak feed rate, the 5 gC/m²/day depositional footprint was predicted to occur in waters 50–180 m deep and beneath and slightly beyond the sea cage array, extending farther to the east and southeast (Figure 11.23).

At mean feed rate, the DEPOMOD modelling predicted that there is no 5 gC /m²/day footprint and the 1 gC/m²/day footprint would occur in waters 40–180 m deep (Figure 11.24).

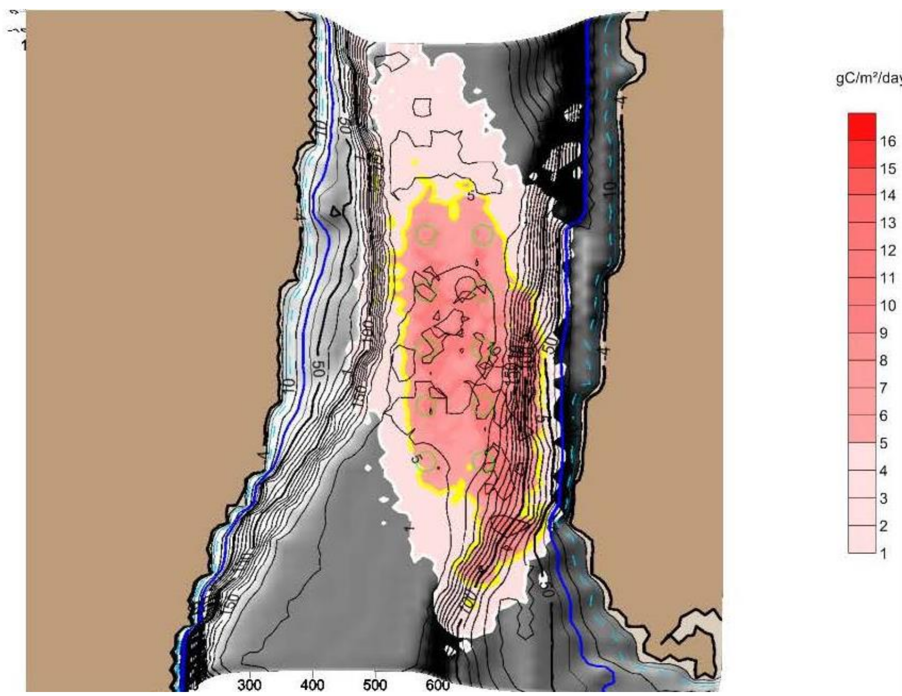


Figure 11.23. Predicted sediment TOC rate of deposition for peak feed use at North Bob Locke Cove sea farm.

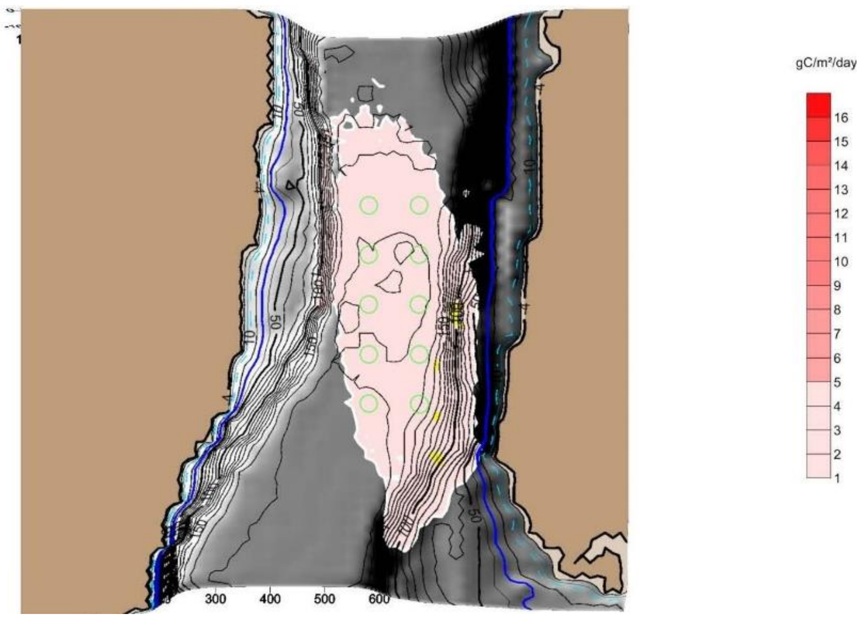


Figure 11.24. Predicted sediment TOC rate of deposition for mean feed use at North Bob Locke Cove sea farm.

11.5.3 PEZ Results

The PEZ model was used to predict the maximum and mean benthic PEZs for organic matter at the two sea farms in BMA 11 (Page et al. 2023). The maximum and mean feed and feces PEZs for both sea farms were predicted to overlap with stretches of coastline. However, the interactions with the shallow shoreline areas may not be as extensive as those indicated by the PEZs because of the combination of the feed and feces sinking, a steeply sloped bathymetric regime, and the alignment of the current with the bathymetry. The Mare Cove South sea farm had the largest estimated PEZ for feed (2.41 km^2) and feces (~40 km^2) under maximum current speeds (Table 11.11). The North Bob Locke Cove sea farm was predicted to have maximum PEZ areas of 1.82 km^2 (feed) and 28.98 km^2 (feces).

Table 11.11. Summary of PEZ BOD area for feed and feces (km^2) under mean and maximum current speeds for BMA 11.

Sea Farm	Area of PEZ (km^2)			
	Mean Current Speed		Maximum Current Speed[a]	
	Feed	Feces	Feed	Feces
Mare Cove South	0.21	0.60	2.41	39.99
North Bob Locke Cove	0.29	1.18	1.82	28.98

Notes:

[a] Area represents an upper bound to the potential for exposure and should be interpreted as an order of magnitude acknowledging the complex full flow field in the area is not represented by a current measurement at a single location.

11.6 Rencontre West (BMA 12) Modelling Results

Depositional modelling was completed via DEPOMOD (Version 2.2) in 2018 by AMB Marine and Coastal Research for the four sea farms (Devil Bay, Little Bay, Rencontre Bay, and The Gorge) in BMA 12. Modelling for the sea farms assumed a 22-month production cycle for farmed salmon from sea entry (approximately September) to harvest (August of the second year). As noted previously, DFO conducted PEZ modelling for BMA 12 (Page et al. 2023).

11.6.1 Devil Bay Sea Farm

The DEPOMOD results for the Devil Bay sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.25 and 11.26).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to occur in depths of 70–130 m directly beneath the sea cage structure. The 5 gC/m²/day depositional footprint was predicted to occur in 60–130 m depths beneath the cage structure and extending slightly beyond the edges of the sea cages. The 1 gC/m²/day depositional footprint was predicted to occur in water depths ranging from 40 m to >130 m extending beyond the sea cage array, slightly farther to the north and south (Figure 11.25).

At the average feed rate, the DEPOMOD modelling predicted that the 5 gC/m²/day footprint would occur under each sea cage and between the cages. The 1 gC/m²/day footprint was predicted to occur beneath the sea cage array and extend beyond the sea cage array in depths ranging from 50 m to >130 m (Figure 11.26).

11.6.2 Little Bay Sea Farm

The DEPOMOD results for the Little Bay sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.27 and 11.28).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to occur beneath the center of the sea cage array. The 5 gC/m²/day depositional footprint was predicted to occur below the sea cage array extending slightly beyond the edges of the sea cages. The 1 gC/m²/day footprint was predicted to occur at water depths ranging from 110 m to >230 m and would extend beyond the sea cage array, slightly farther to the north and south (Figure 11.27).

At average feed rate, the DEPOMOD modelling predicted depositional rates of 5 and 10 gC/m²/day would not be reached. The 1 gC/m²/day footprint was predicted to occur below the sea cage grid and extends beyond the sea cage array to areas slightly farther to the north and south (Figure 11.28).

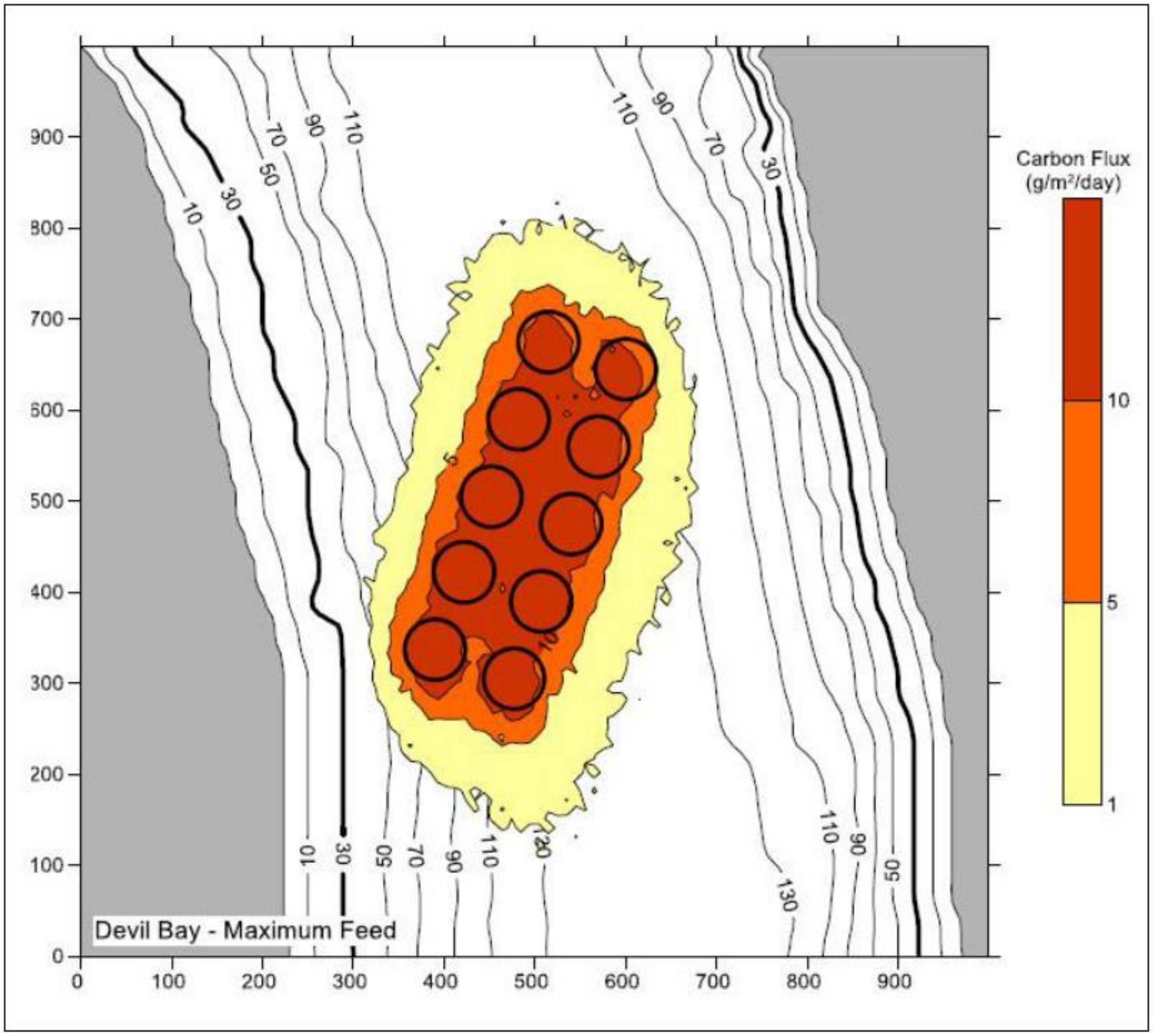


Figure 11.25. Predicted sediment TOC rate of deposition for peak feed use at Devil Bay sea farm.

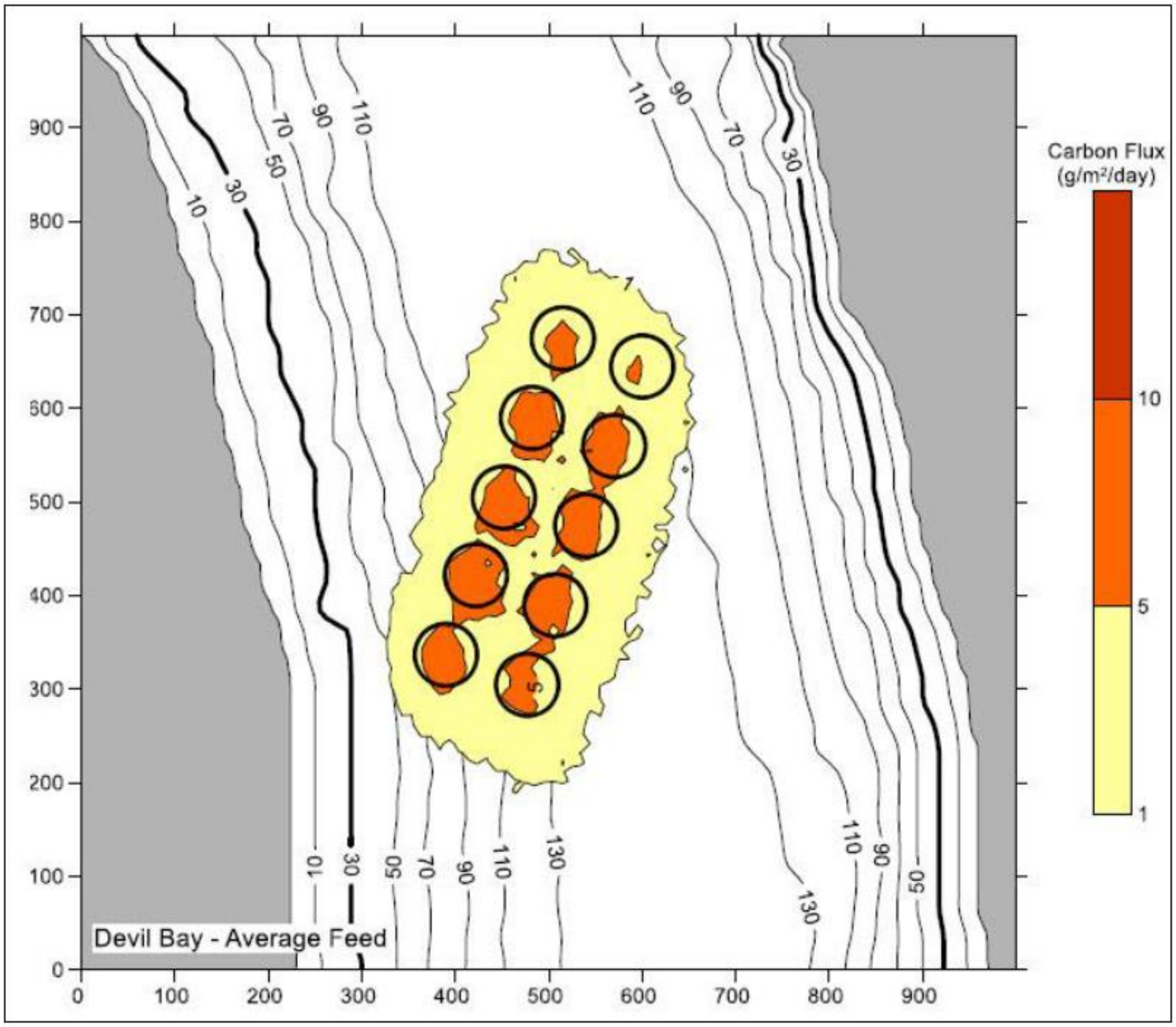


Figure 11.26. Predicted sediment TOC rate of deposition for mean feed use at Devil Bay sea farm.

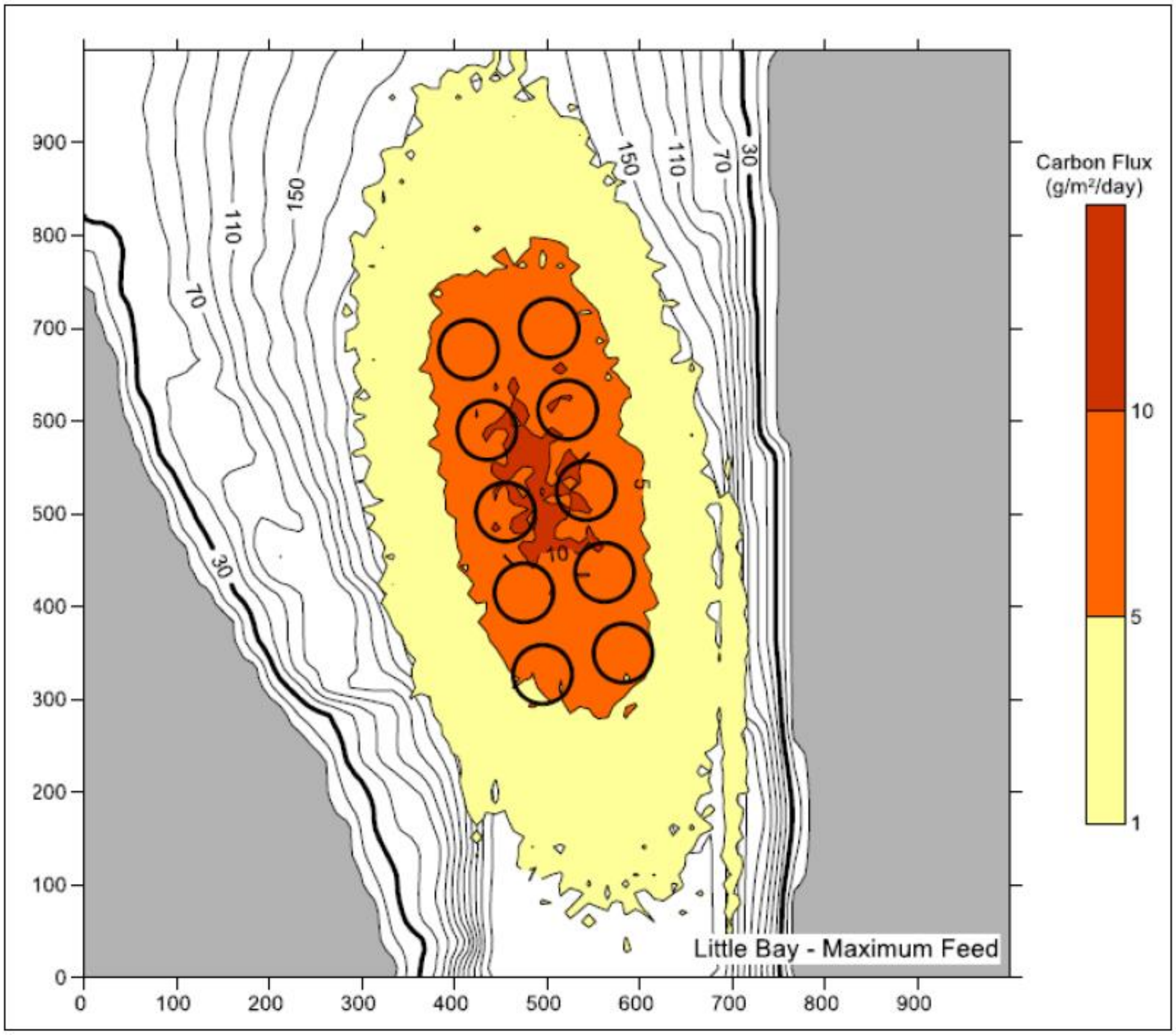


Figure 11.27. Predicted sediment TOC rate of deposition for peak feed use at Little Bay sea farm.

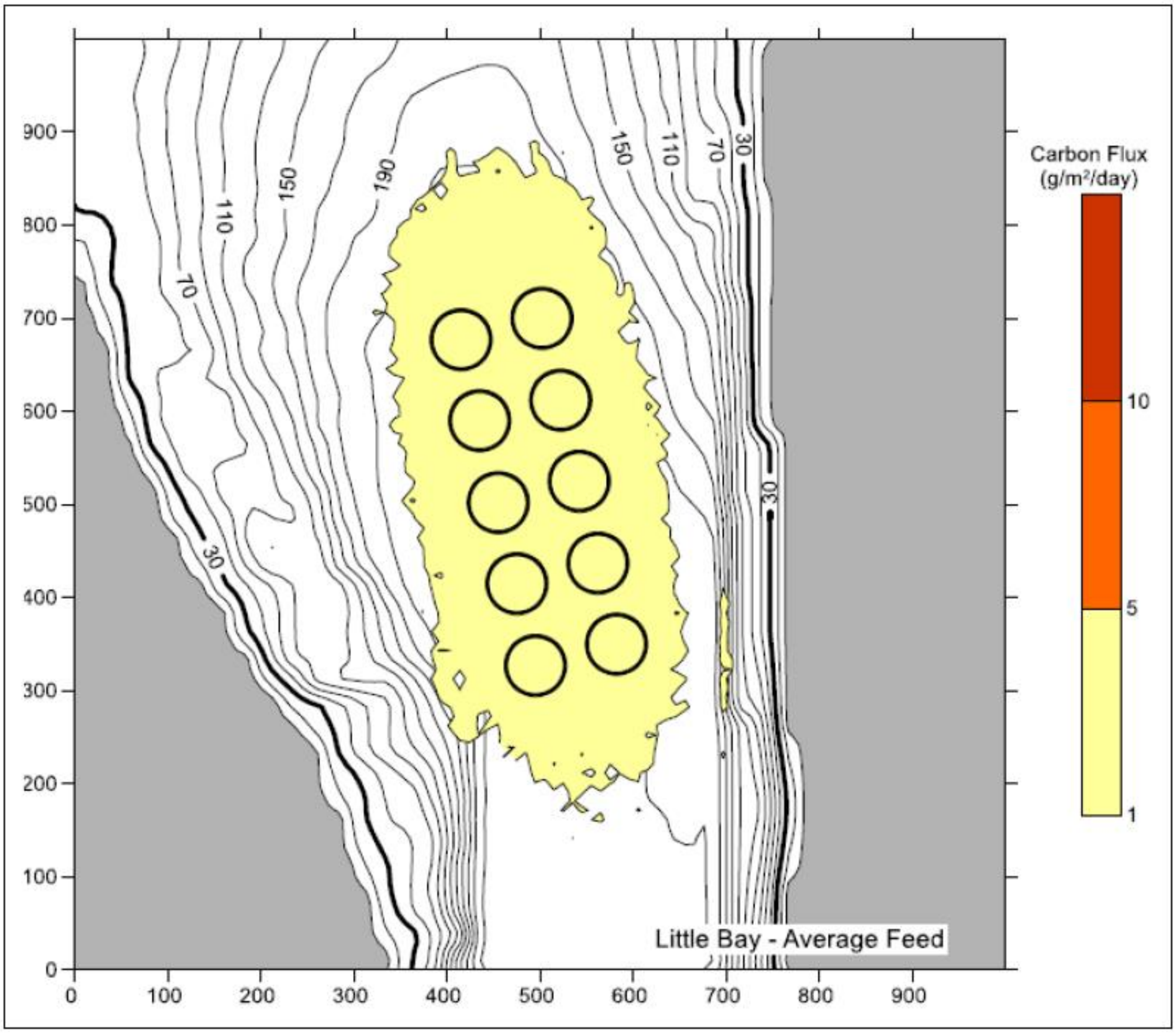


Figure 11.28. Predicted sediment TOC rate of deposition for mean feed use at Little Bay sea farm.

11.6.3 Rencontre Bay Sea Farm

The DEPOMOD results for the Rencontre Bay sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.29 and 11.30).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to occur below the sea cages in water depths ranging from 90–150 m. The 5 gC/m²/day depositional footprint was predicted to occur in 70–170 m depths below the sea cage array extending slightly beyond the edges of the sea cages. The 1 gC/m²/day footprint was predicted to occur at depths from 40 m to

>190 m and would extend beyond the sea cage array, slightly farther to the northwest (Figure 11.29).

At mean feed rate, the DEPOMOD modelling predicted there would be a small 5 gC/m²/day footprint under the sea cages located nearest to the shore. The 1 gC/m²/day footprint was predicted to occur below the sea cage array and in areas with water depths ranging from 60 m to >90 m (Figure 11.30).

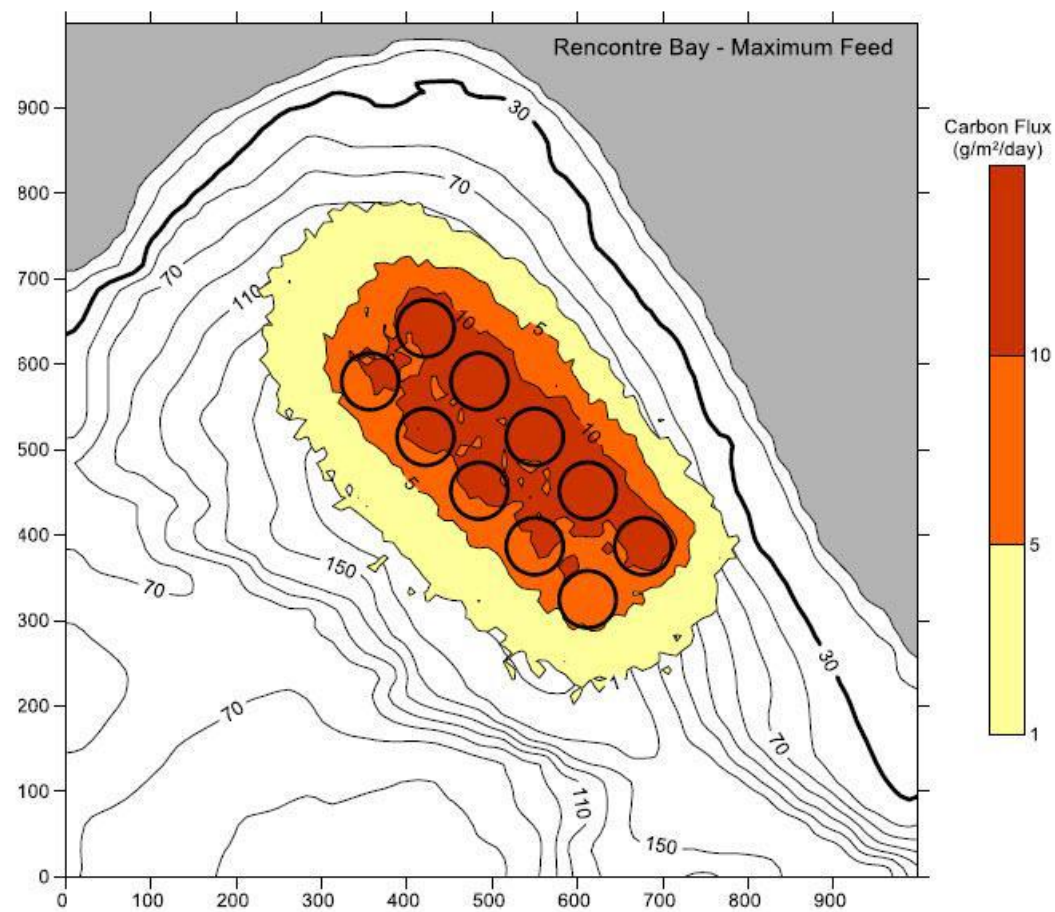


Figure 11.29. Predicted sediment TOC rate of deposition for peak feed use at Rencontre Bay sea farm.

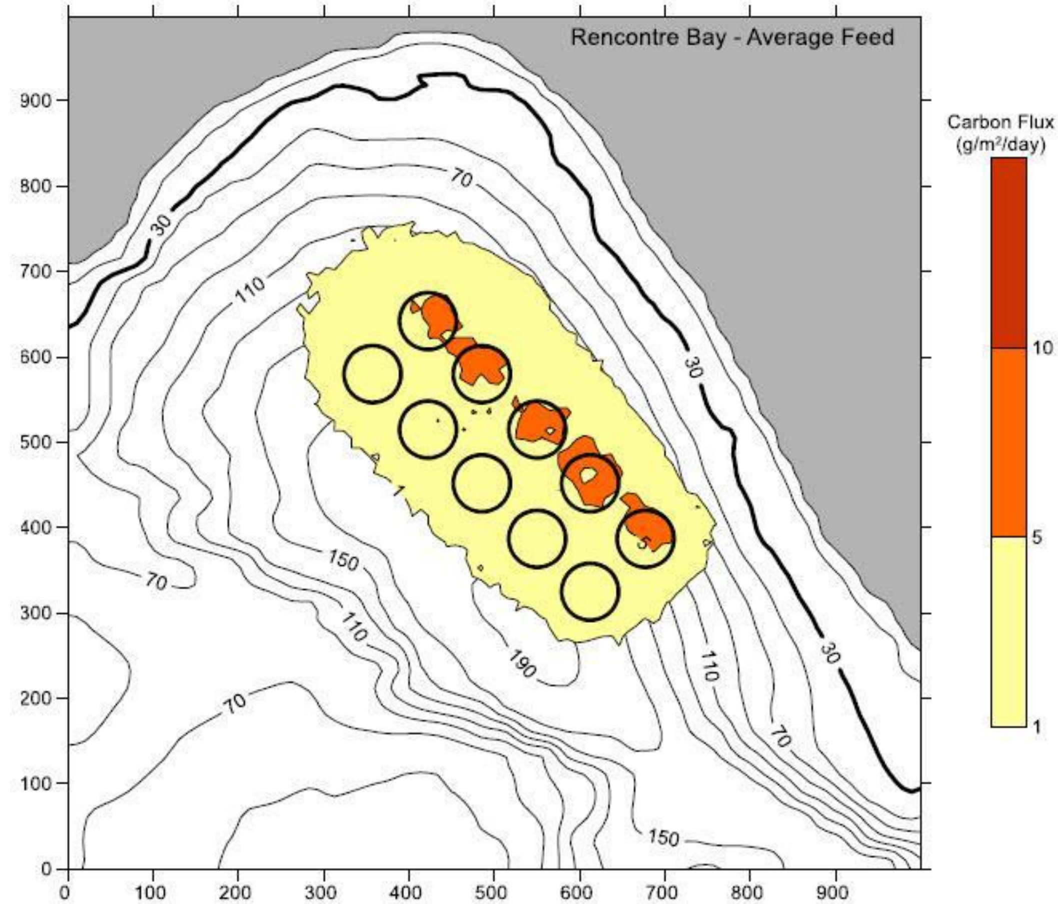


Figure 11.30. Predicted sediment TOC rate of deposition for mean feed use at Rencontre Bay sea farm.

11.6.4 The Gorge Sea Farm

The DEPOMOD results for The Gorge sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.31 and 11.32).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to occur in waters ranging from 130 m to >150 m below the sea cage structure. Both the 5 and 1 gC/m²/day depositional footprints would extend beyond the sea cage array with the lower depositional rate footprint extending further (Figure 11.31).

At mean feed rate, the DEPOMOD modelling predicted a 5 gC/m²/day footprint under each sea cage and between the sea cages. The 1 gC/m²/day footprint was predicted to extend beyond the sea cage array in water depths ranging from 110 m to >150 m (Figure 11.32).

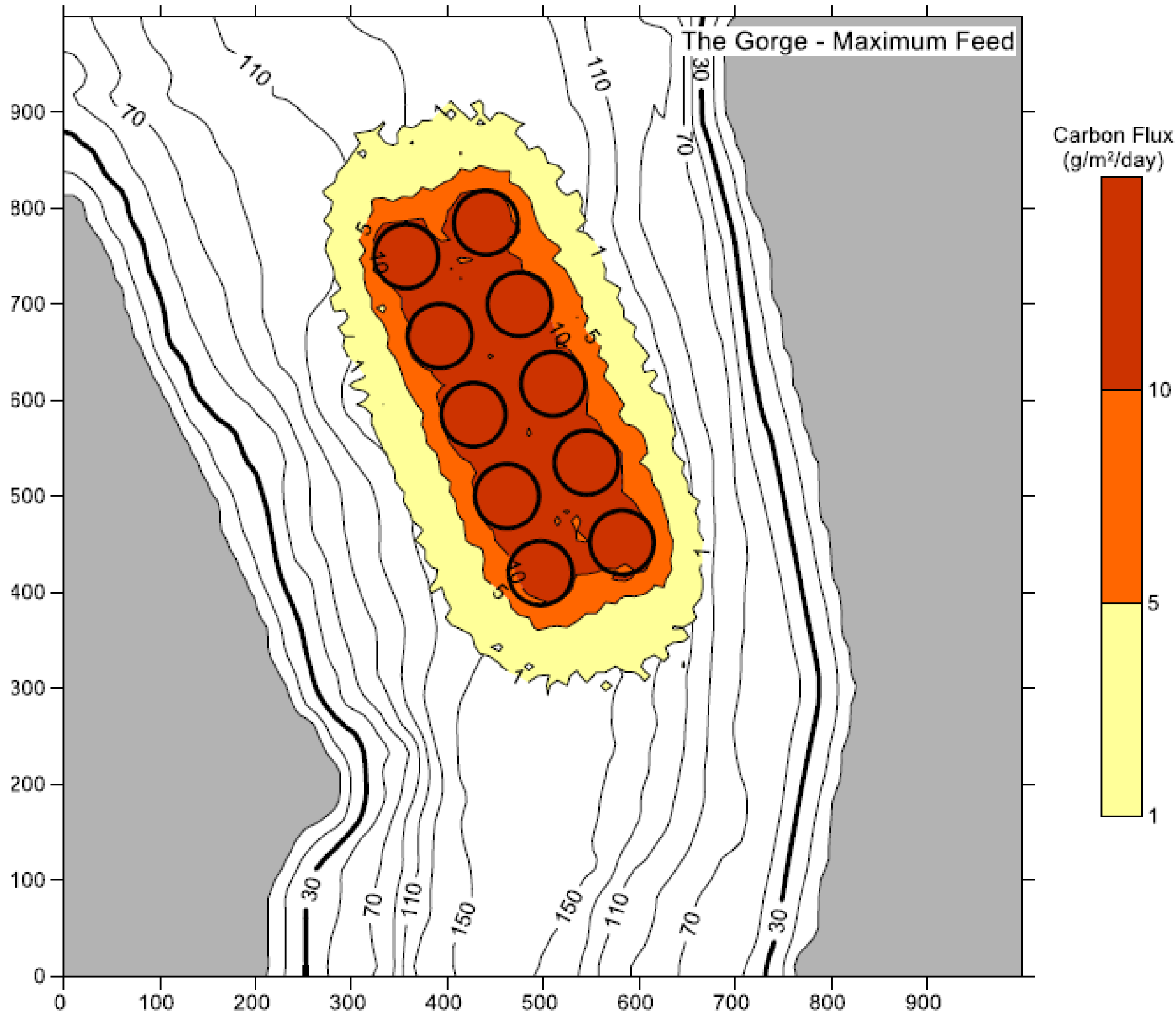


Figure 11.31. Predicted sediment TOC rate of deposition for peak feed use at The Gorge sea farm.

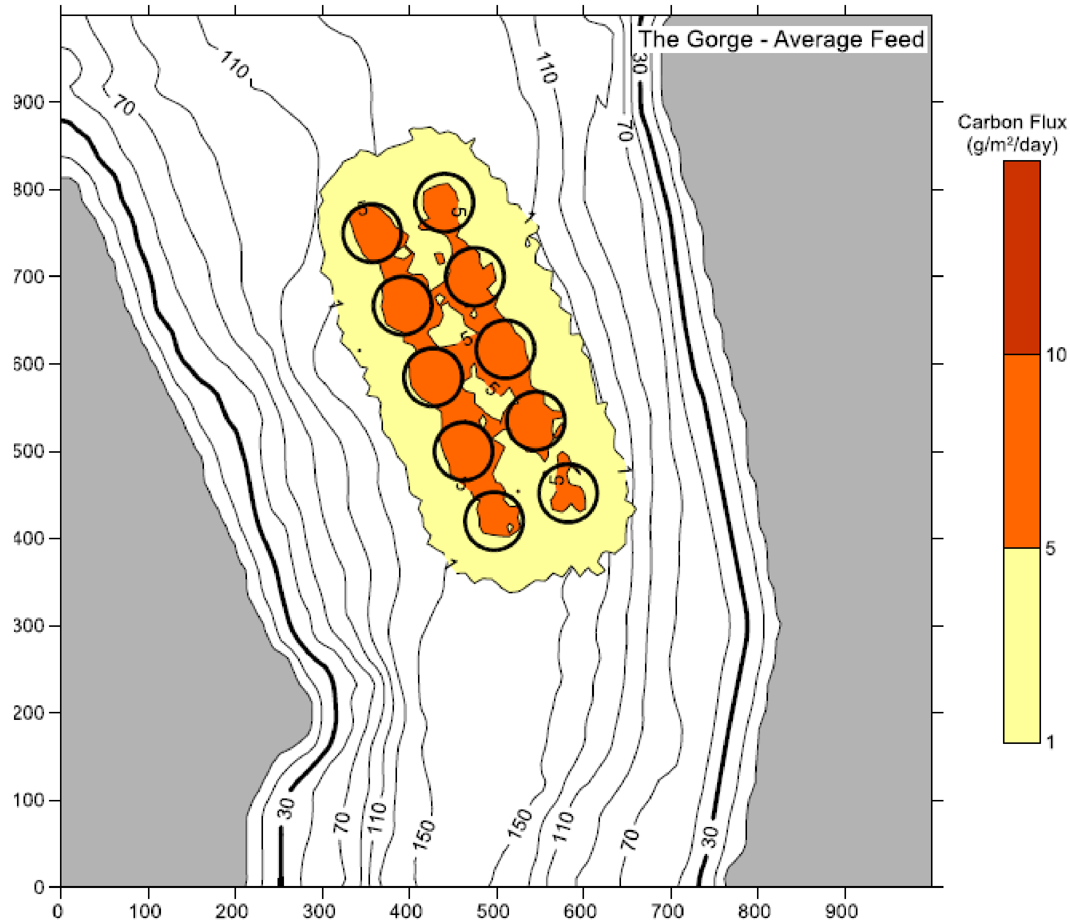


Figure 11.32. Predicted sediment TOC rate of deposition for mean feed use at The Gorge sea farm.

11.6.5 PEZ Results

The PEZ model was used to predict the maximum and mean benthic PEZs for organic matter at the four sea farms in BMA 12 (Page et al. 2023). The maximum feed and feces PEZs for all sea farms were predicted overlap with stretches of coastline. The Little Bay sea farm had the largest estimated PEZ for feed (1.76 km^2) and feces (27.51 km^2) under maximum current speeds (Table 11.12). The smallest PEZ was predicted for The Gorge sea farm.

Table 11.12. Summary of PEZ BOD area for feed and feces (km^2) under mean and maximum current speeds for BMA 12.

Sea Farm	Area of PEZ (km^2)			
	Mean Current Speed		Maximum Current Speed[a]	
	Feed	Feces	Feed	Feces
Devil Bay	0.17	0.34	0.52	4.57
Little Bay	0.27	1.01	1.76	27.51
Rencontre Bay	0.19	0.46	0.83	10.02
The Gorge	0.17	0.32	0.40	2.90

Notes:

[a] Area represents an upper bound to the potential for exposure and should be interpreted as an order of magnitude acknowledging the complex full flow field in the area is not represented by a current measurement at a single location.

11.7 Chaleur Bay Modelling Results (BMA 13)

Depositional modelling was completed via DEPOMOD (Version 2.2) in 2019 by AMB Marine and Coastal Research for the three sea farms (Chaleur Bay, Friar Cove, and Shooter Point) in BMA 13. Modelling for the sea farms assumed a 22-month production cycle for farmed salmon from sea entry (approximately September) to harvest (August of the second year). As noted previously, DFO conducted PEZ modelling for BMA 13 (DFO 2022m).

11.7.1 Chaleur Bay Sea Farm

The DEPOMOD results for the Chaleur Bay sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.33 and 11.34).

At peak feed rate, the 5 and 10 gC/m²/day depositional footprints were predicted to occur in depths ranging from 110 m to >130 m beneath the sea cage array with the 5 gC/m²/day footprint extending slightly beyond the sea cage array. The 1 gC/m²/day footprint was predicted to occur in water depths ranging from 90 m to >130 m extending from the sea cage array. particularly to the northwest and southeast (Figure 11.33).

At mean feed rate, the DEPOMOD modelling predicted that the 5 gC/ m²/day footprint would occur under and between the sea cages. The 1 gC/m²/day footprint was predicted to extend beyond the sea cage array in depths ranging from 110 m to >130 m (Figure 11.34).

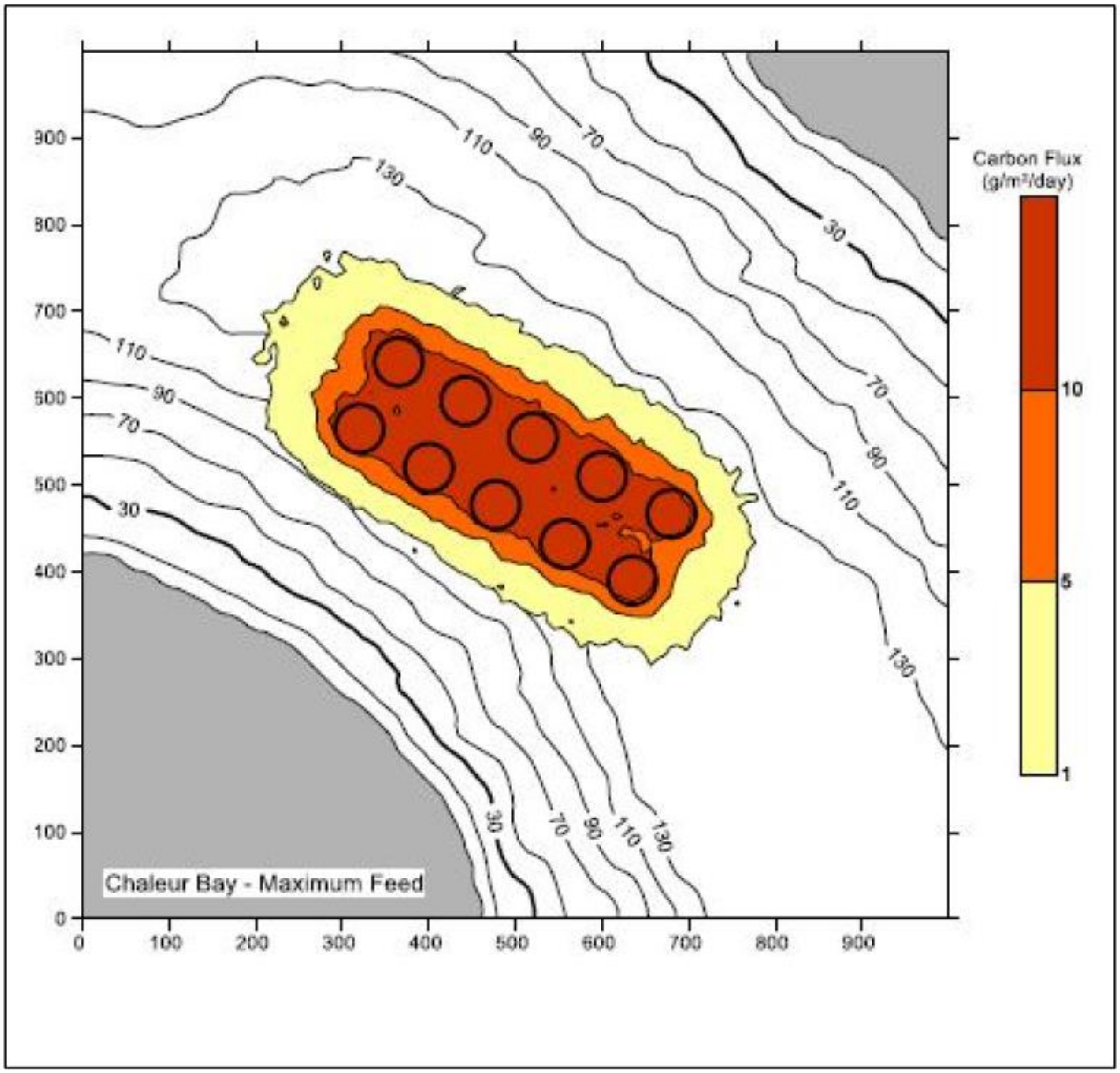


Figure 11.33. Predicted sediment TOC depositional rate for peak feed use at Chaleur Bay sea farm.

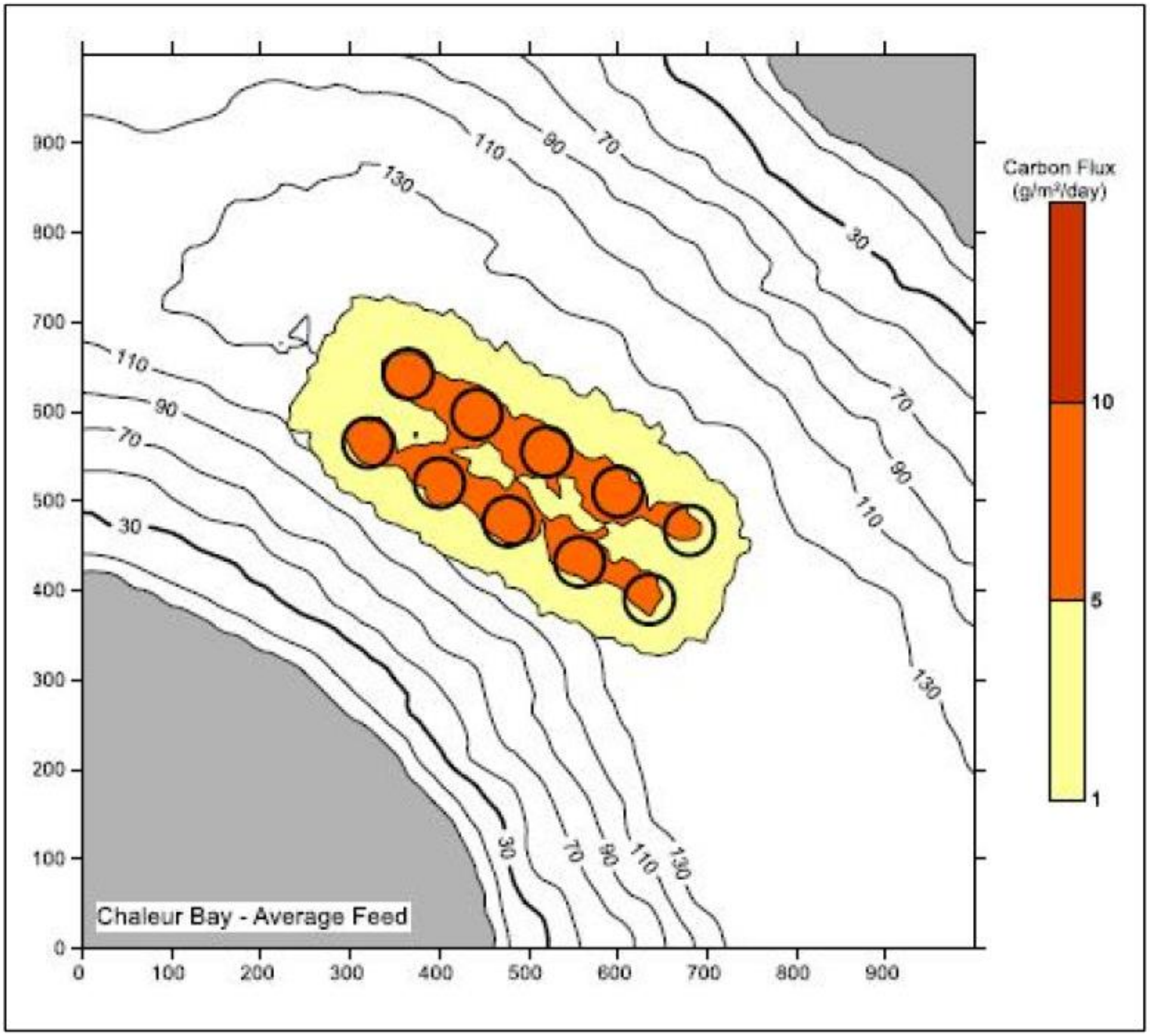


Figure 11.34. Predicted sediment TOC depositional rate for mean feed use at Chaleur Bay sea farm.

11.7.2 Friar Cove Sea Farm

The DEPOMOD results for the Friar Cove sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.35 and 11.36).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to occur in deep waters below most of the sea cage array. The 5 gC/m²/day depositional footprint was predicted to occur in waters ranging from 170 m to >250 m in an area slightly beyond the sea cage array. Likewise, the 1 gC/m²/day footprint was predicted to occur in deep waters extending even further beyond the sea cage array (Figure 11.35).

At mean feed rate, the DEPOMOD modelling predicted the patchy occurrence of the 5 gC/m²/day footprint under some sea cages. The 1 gC/m²/day footprint was predicted to occur below the sea cage array extending to depths of 150 m to >250 m (Figure 11.36).

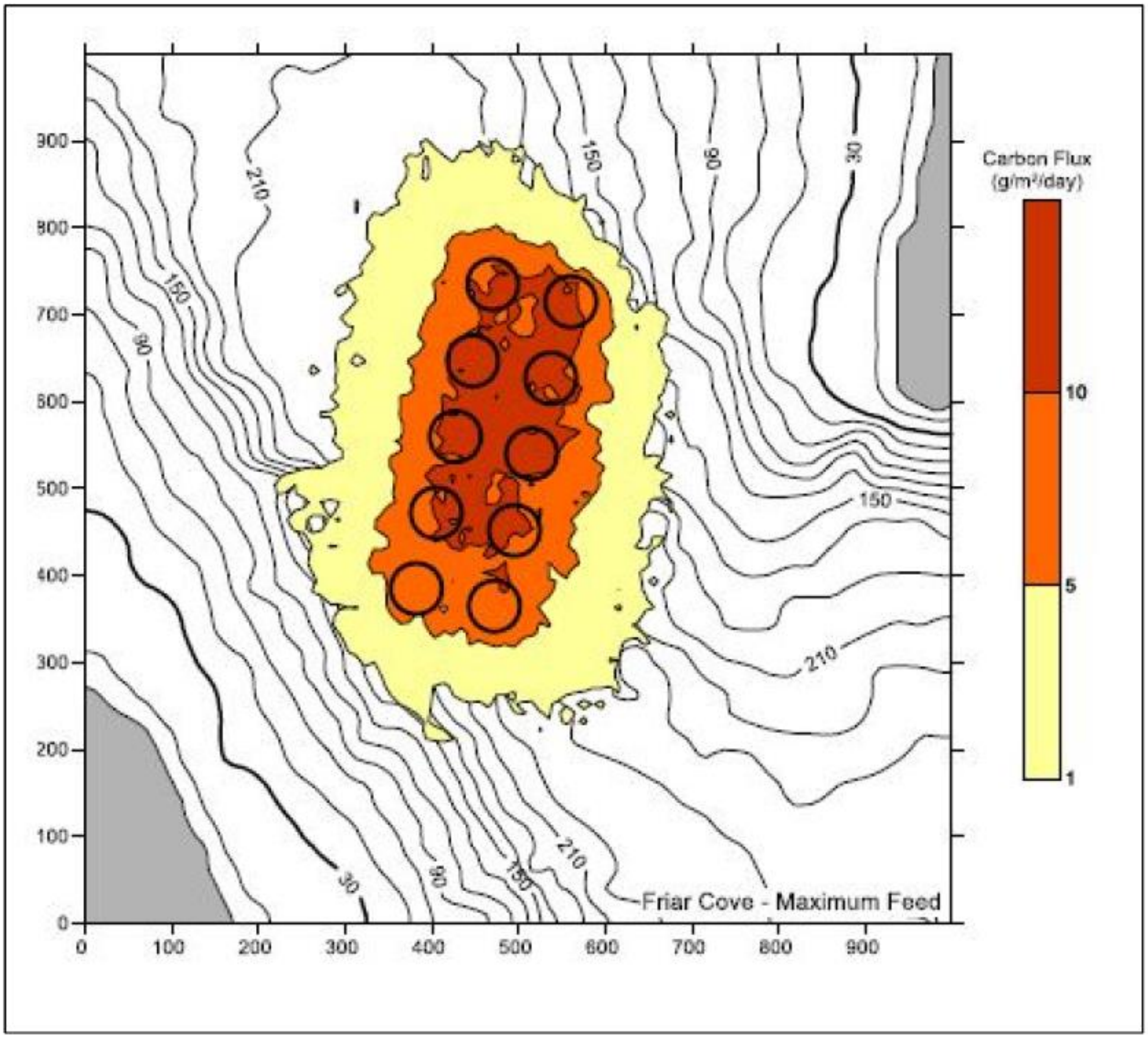


Figure 11.35. Predicted sediment TOC depositional rate for peak feed use at Friar Cove sea farm.

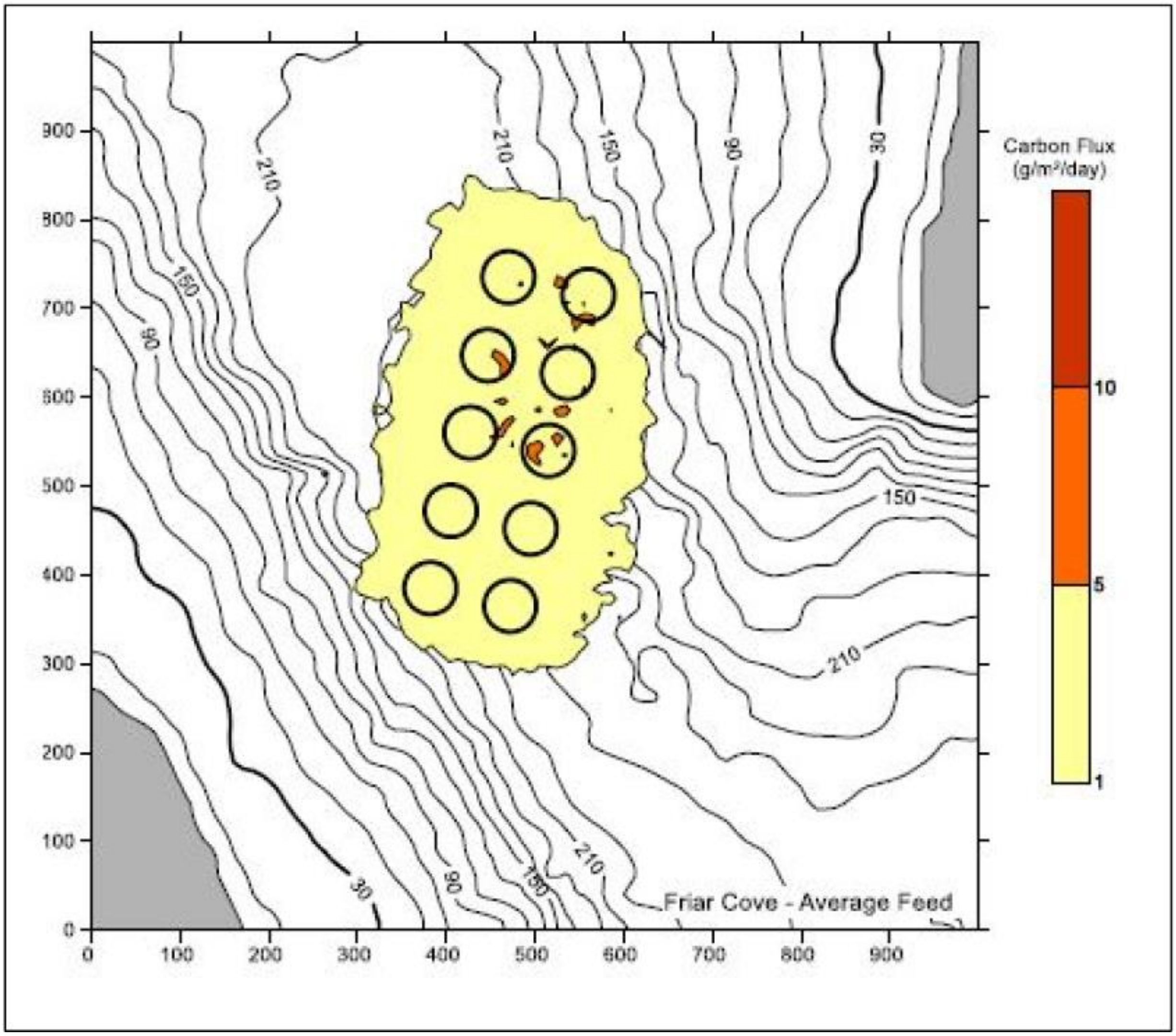


Figure 11.36. Predicted sediment TOC depositional rate for mean feed use at Friar Cove sea farm.

11.7.3 Shooter Point Sea Farm

The DEPOMOD results for the Shooter Point sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.37 and 11.38).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to have a patchy distribution under most of the sea cages (Figure 11.37). The 5 gC/m²/day depositional footprint was predicted to occur in water depths ranging from 130 m to >230 m depths below and slightly beyond the sea cage array footprint. The 1 gC/m²/day footprint was predicted to occur at depths ranging from about 30 m to >230 m and would extend beyond the sea cage array, slightly farther to the east.

At mean feed rate, the DEPOMOD modelling for the Shooter Point sea farm predicted a small, patchy 5 gC/m²/day footprint under/near several sea cages (Figure 11.38). The 1 gC/m²/day footprint was predicted to extend farther to the east and in depths ranging from 70 m to >230 m.

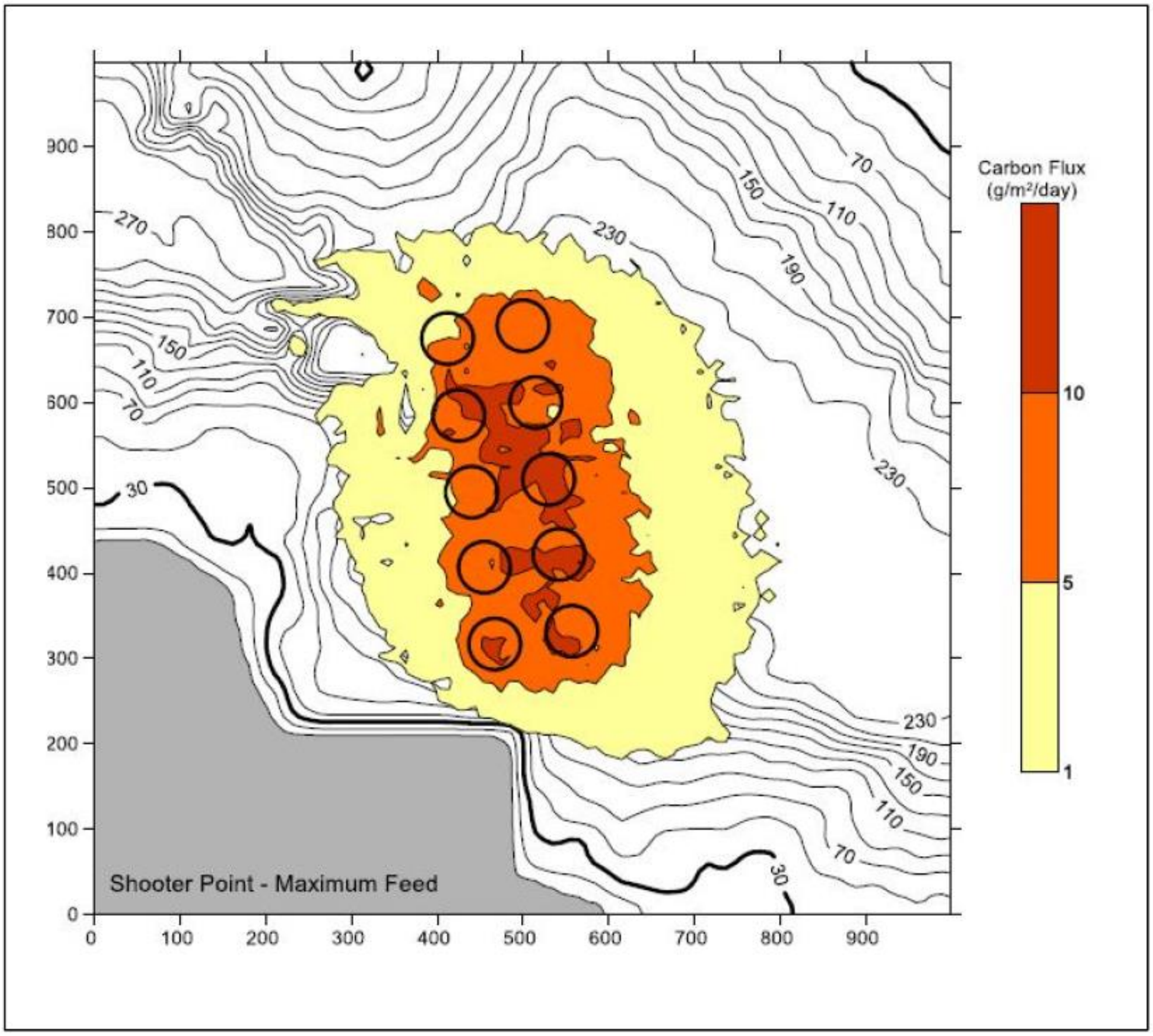


Figure 11.37. Predicted sediment TOC depositional rate for peak feed use at Shooter Point sea farm.

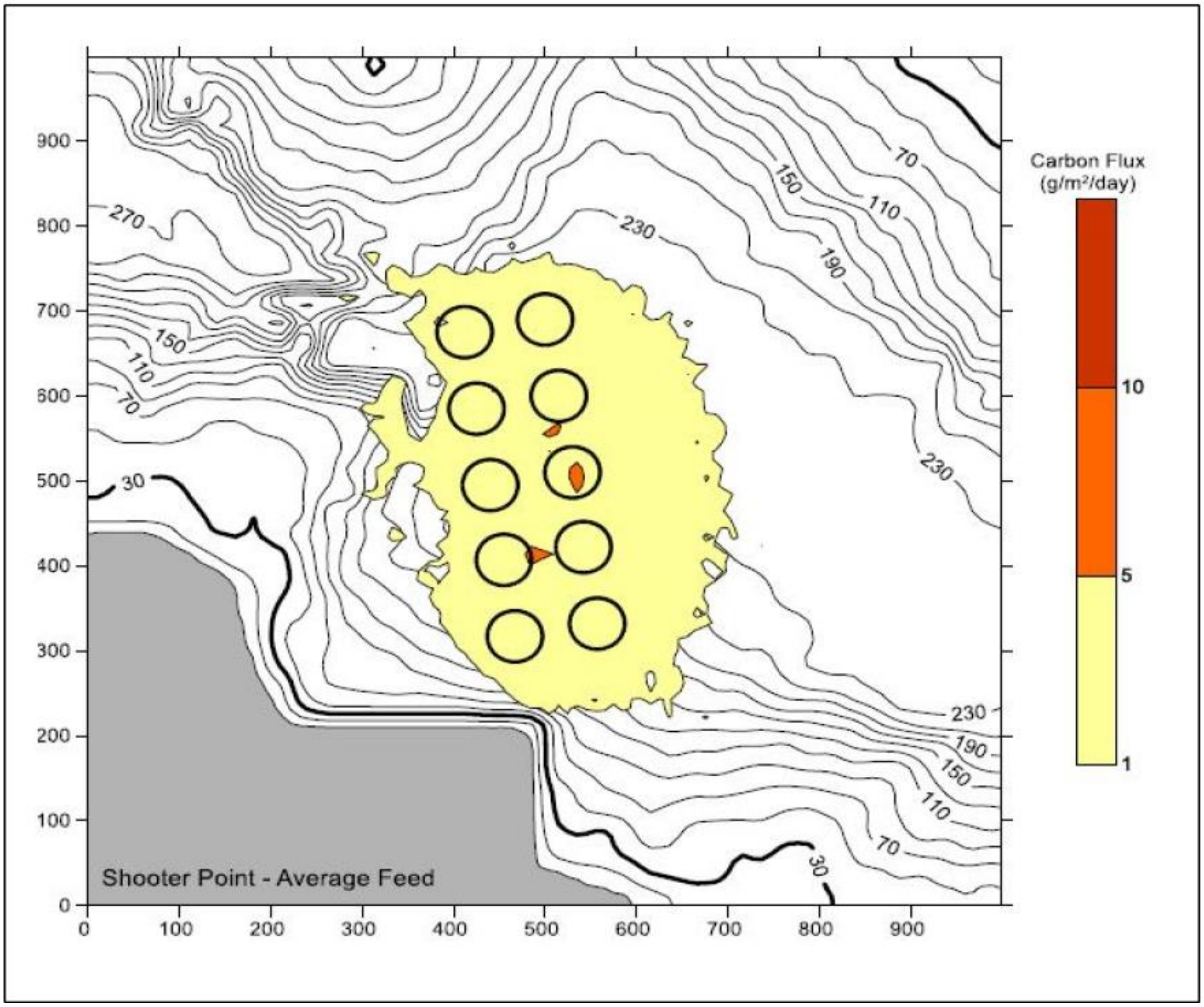


Figure 11.38. Predicted sediment TOC depositional rate for mean feed use at Shooter Point sea farm.

11.7.4 PEZ Results

Using the PEZ model, the maximum benthic PEZ for organic matter were calculated for the three sea farms in BMA 13 (DFO 2022m). The sea farms in BMA 13 are located in a long narrow fjord in Chaleur Bay. First-order estimations of the benthic-PEZ using waste feed particles indicated that there was potential overlap among the three farms and that much of the fjord is potentially exposed to waste (feed and feces) from the sea farms (Figure 11.39). The areas predicted for feces-based PEZ was larger than the predicted areas for the feed-based PEZ (Table 11.13). The largest estimated PEZ area for feed (13.85 km^2) and feces (3,524 km^2) under maximum current speeds was predicted to occur at the Shooter Point sea farm whereas the Chaleur Bay sea farm had the smallest areas (Table 11.13).

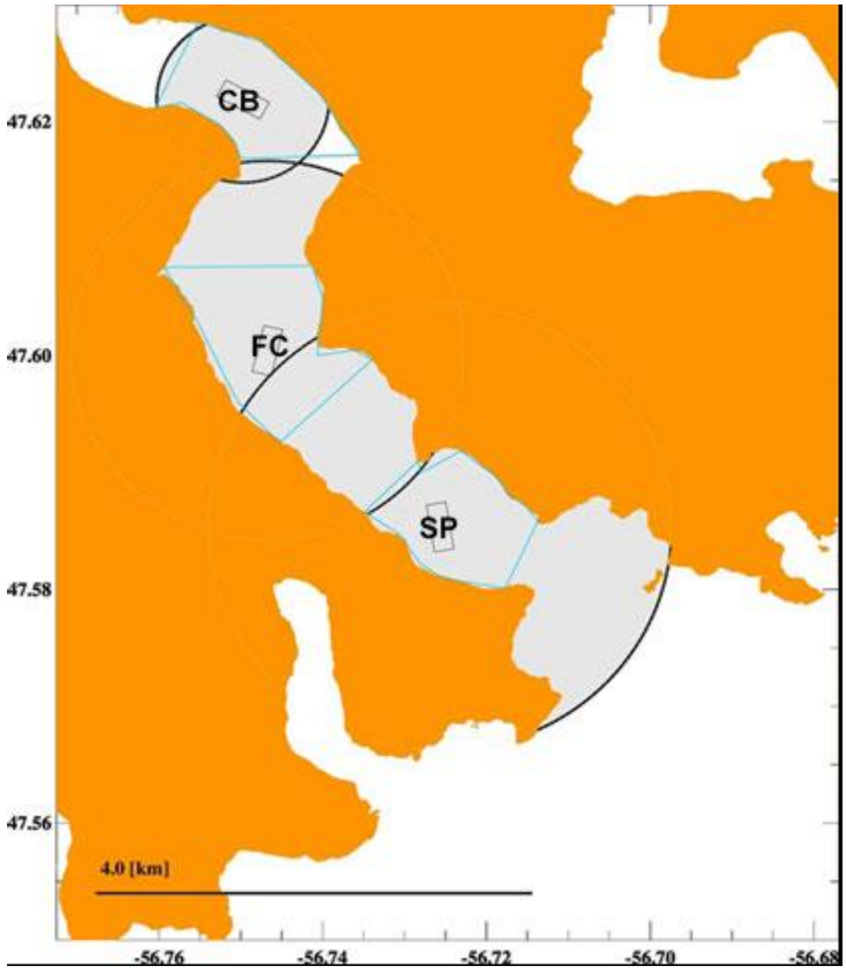


Figure 11.39. Benthic-PEZ (thick black lines) associated with feed particles under maximum current speed for BMA 13 sea farms (from DFO 2022m). Small black rectangles delimit the sea cage areas and light blue polygons the lease area for each sea farm (CB=Chaleur Bay, FC=Friar Cove, SP=Shooter Point).

Table 11.13. Summary of PEZ BOD area for feed and feces (km^2) under maximum current speeds for BMA 13.

Sea Farm	Area of PEZ (km^2)	
	Maximum Current Speed[a]	
	Feed	Feces
Chaleur Bay	2.01	308
Friar Cove	10.17	2,427
Shooter Point	13.85	3,524

Notes:

[a] Area represents an upper bound to the potential for exposure and should be interpreted as an order of magnitude acknowledging the complex full flow field in the area is not represented by a current measurement at a single location.

11.8 Aviron Bay and La Hune Bay (BMA 14) Modelling Results

Depositional modelling was completed via DEPOMOD (Version 2.2) in 2022 by AMB Marine and Coastal Research for the three sea farms (Aviron North, Aviron South, and Foots Cove) in BMA 14. Modelling for the sea farms assumed a 22-month production cycle for farmed salmon from sea entry (approximately September) to harvest (August of the second year). As noted previously, DFO conducted PEZ modelling for BMA 14 (DFO 2024n).

11.8.1 Aviron North Sea Farm

The DEPOMOD results for the Aviron North sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.40 and 11.41).

At peak feed rate, the 10 gC/m^2/day depositional footprint was predicted to occur below the sea cages and the 5 gC/m^2/day footprint was predicted to extend slightly beyond the edges of the sea cage array (Figure 11.40). The 1 gC/m^2/day footprint was predicted to occur beyond the sea cage array in depths ranging from 90 m to >120 m.

At average feed rate, the DEPOMOD modelling predicted similar results to the peak feed rate with the exception of smaller footprints for all three depositional rates (Figure 11.41).

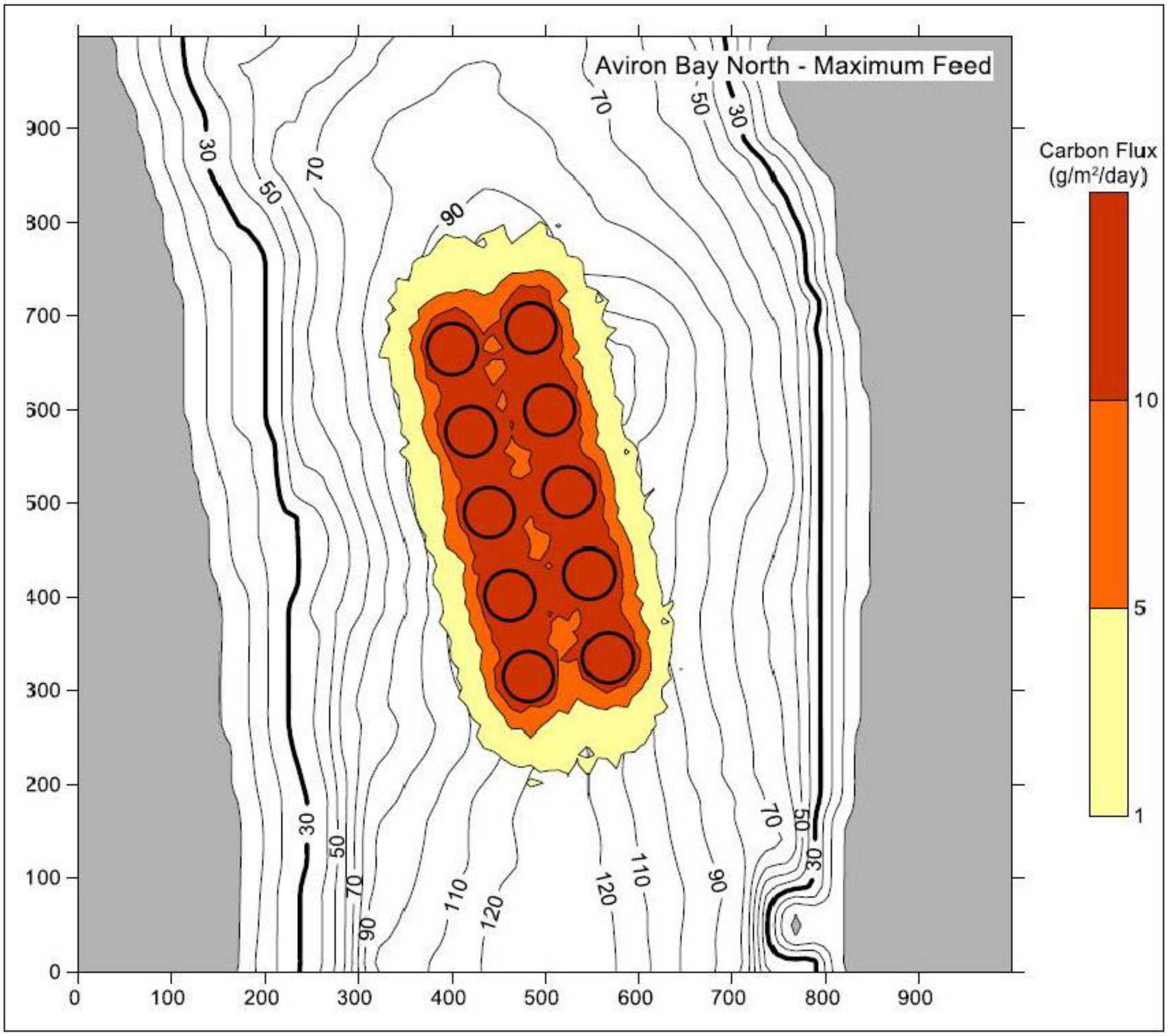


Figure 11.40. Predicted sediment TOC rate of deposition for peak feed use at Aviron North sea farm.

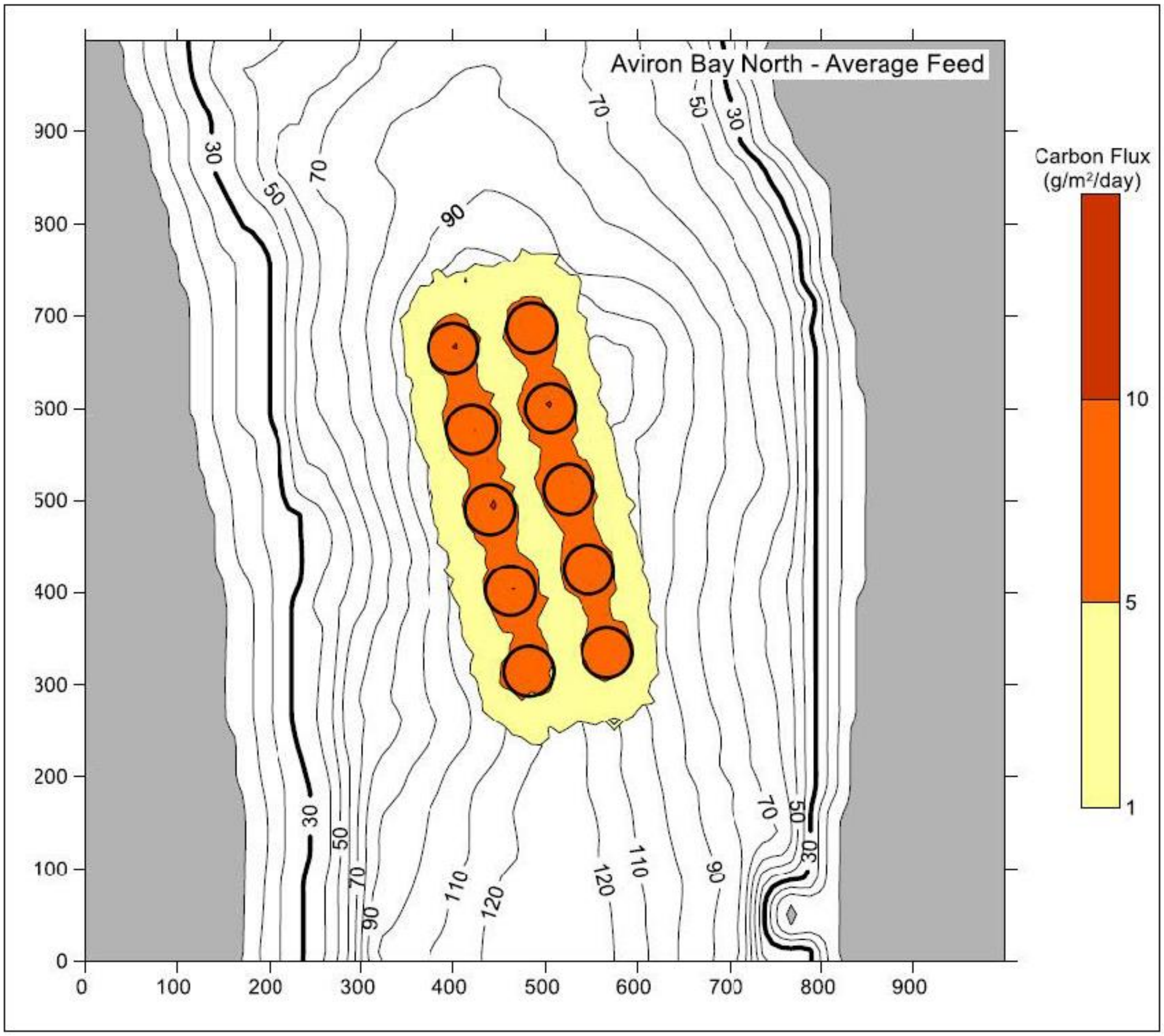


Figure 11.41. Predicted sediment TOC rate of deposition for mean feed use at Aviron North sea farm.

11.8.2 Aviron South Sea Farm

The DEPOMOD results for the Aviron South sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.42 and 11.43).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to occur in deep waters (>130 m) below the sea cage array (Figure 11.42). The 5 and 1 gC/m²/day depositional footprints were predicted to primarily occur in depths >130 m and to extend slightly beyond the edges of the sea cage array.

At mean feed rate, the DEPOMOD modelling predicted the occurrence of a 5 gC/m²/day footprint below the sea cages with the 1 gC/m²/day footprint predicted to extend beyond the sea cage array in depths ranging from 90 m to >130 m (Figure 11.43).

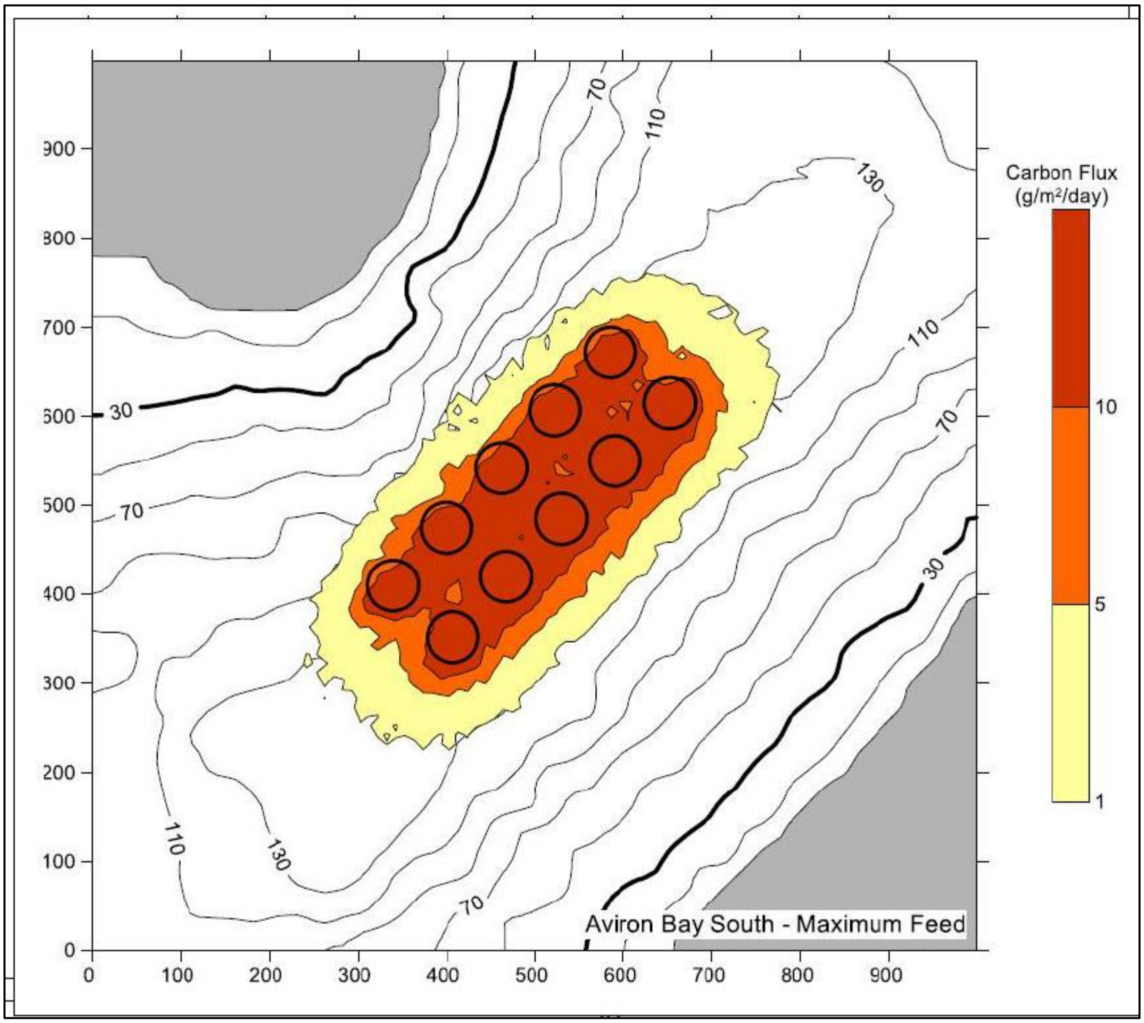


Figure 11.42. Predicted sediment TOC rate of deposition for peak feed use at Aviron South sea farm.

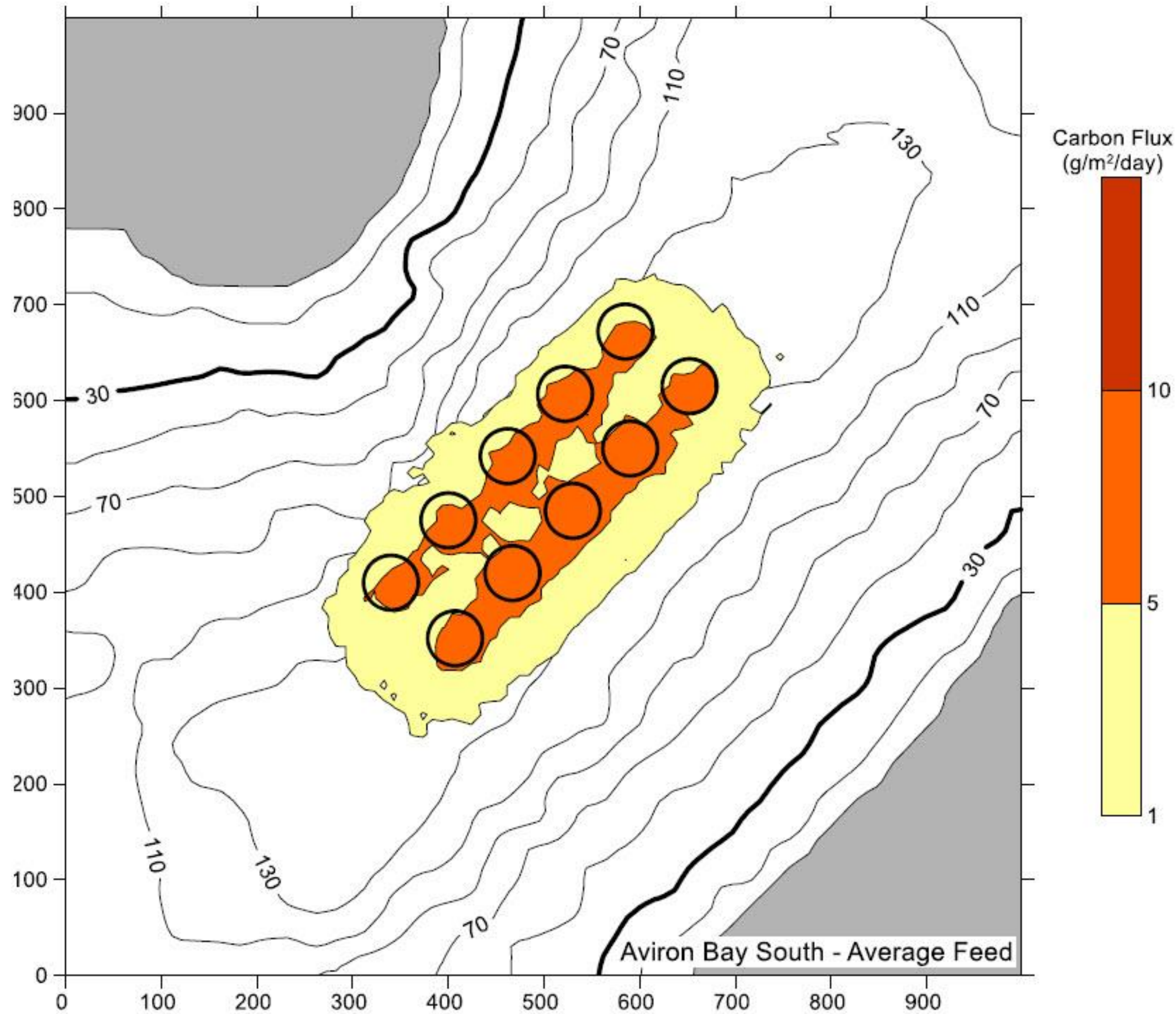


Figure 11.43. Predicted sediment TOC rate of deposition for mean feed use at Aviron South sea farm.

11.8.3 Foots Cove Sea Farm

The DEPOMOD results for the Foots Cove sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.44 and 11.45).

At peak feed rate, all three depositional footprints (1, 5, and 10 $gC/m^2/day$) were predicted to occur in water depths >90 m with the higher depositional rates having smaller footprints (Figure 11.44). The 1 $gC/m^2/day$ footprint was predicted to extend beyond the sea cage array, slightly farther to the southwest and southeast.

At mean feed rate, the DEPOMOD modelling predicted that the 5 gC/m²/day footprint would primarily occur below the sea cages and the 1 gC/m²/day footprint would extend beyond the sea cage array in water depths ranging from 90 m to >150 m (Figure 11.45).

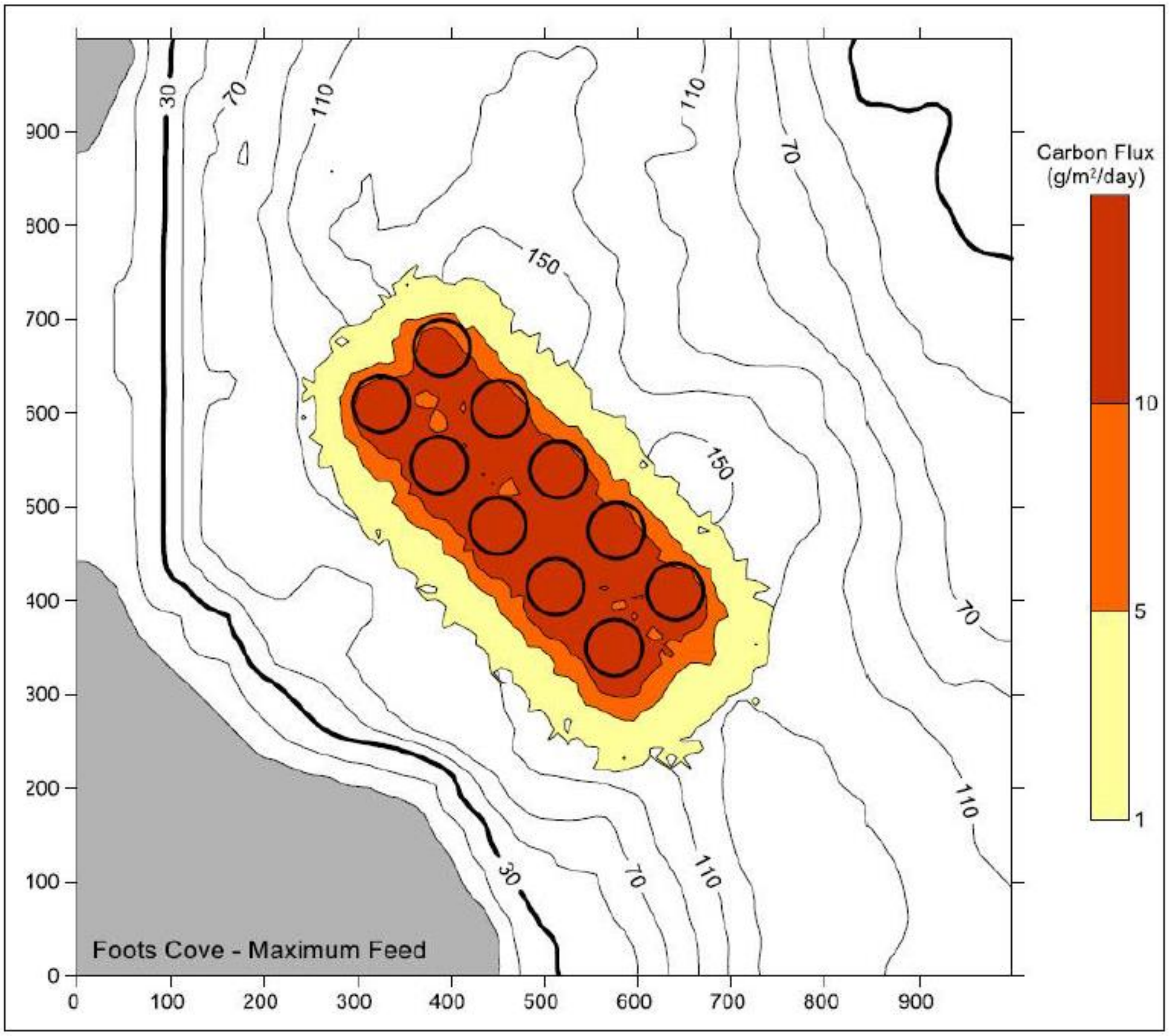


Figure 11.44. Predicted sediment TOC rate of deposition for peak feed use at Foots Cove sea farm.

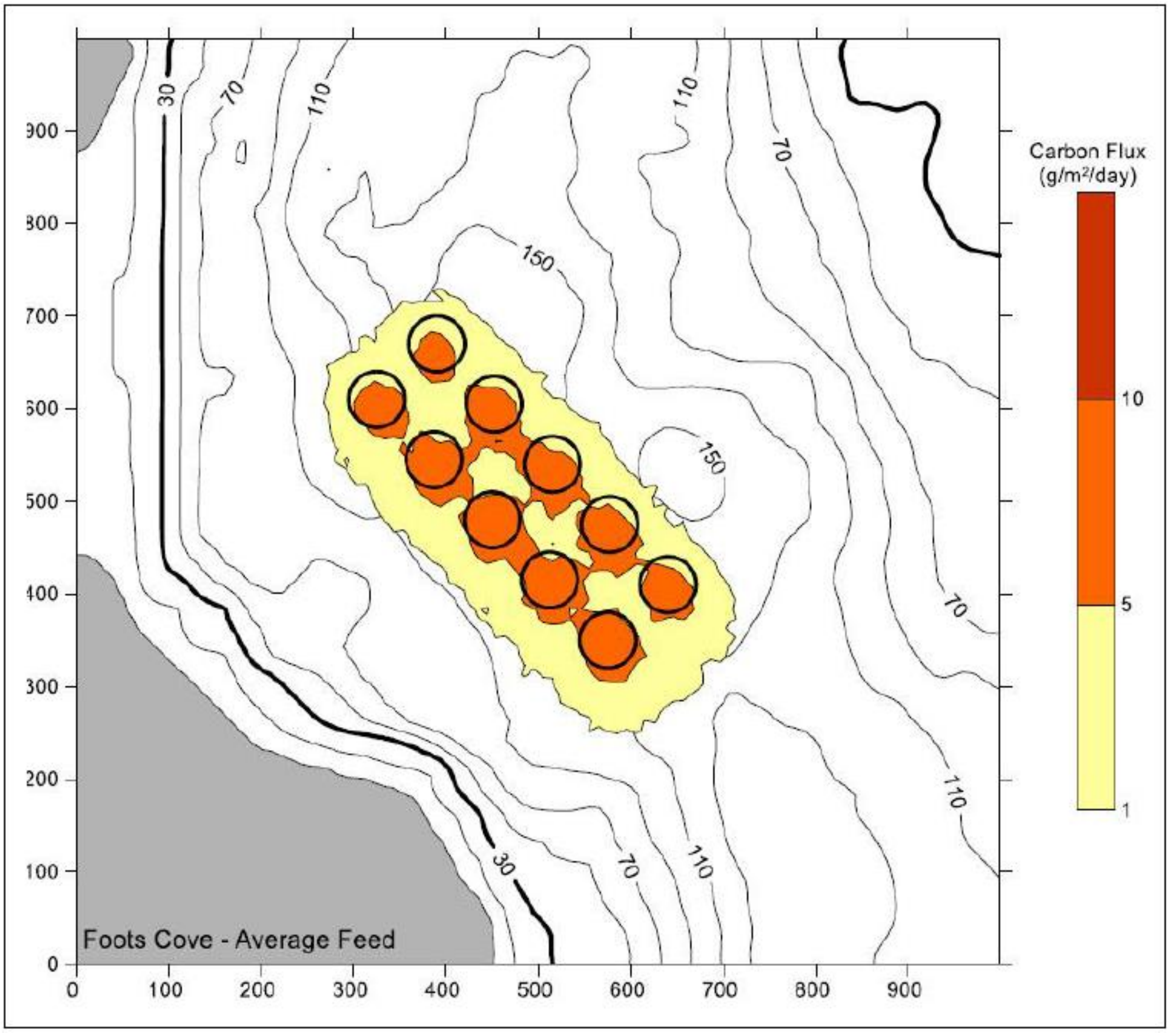


Figure 11.45. Predicted sediment TOC rate of deposition for mean feed use at Foots Cove sea farm.

11.8.4 PEZ Results

Using the PEZ model, the maximum benthic PEZ for organic matter were calculated for the three sea farms in BMA 14 (DFO 2024n). Two sea farms in BMA 14 (Aviron North and Aviron South) are located in a narrow fjord in Aviron Bay while the Foots Cove sea farm is located at the mouth of La Hune Bay, the adjacent fjord to the west. First-order estimations of the benthic feed-PEZ using waste feed particles indicated that there was no overlap among the three sea farms for feed (Figure 11.46) but overlaps were anticipated for the fecal-PEZ from sites within Aviron Bay. The areas predicted for feces-based PEZ were larger for all three sea farms than the feed-based PEZ (Table 11.14). The Aviron South and Foots Cove sea farms had the largest estimated PEZ areas for feed (1.13 km^2) and Aviron South had the largest estimated fecal-PEZ (38.47 km^2) under maximum current speeds (Table 11.14). The smallest PEZ were estimated for the Aviron North sea farm.

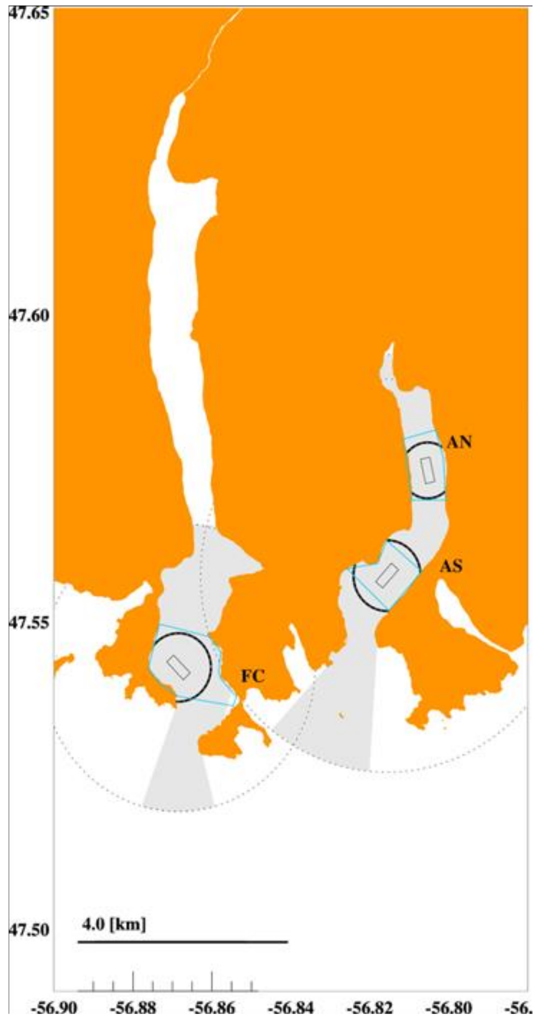


Figure 11.46. Benthic-PEZ (thick black lines) associated with feed particles under maximum current speed for BMA 14 sea farms (from DFO 2024n). Small black rectangles delimit the sea cage areas and light blue polygons the lease area for each sea farm (AN=Aviron North, AS=Aviron South, FC=Foots Cove).

Table 11.14. Summary of PEZ BOD area for feed and feces (km^2) under maximum current speeds for BMA 14.

Sea Farm	Area of PEZ (km^2)	
	Maximum Current Speed[a]	
	Feed	Feces
Aviron North	0.79	15.20
Aviron South	1.13	38.47
Foots Cove	1.13	21.23

Notes:

[a] Area represents an upper bound to the potential for exposure and should be interpreted as an order of magnitude acknowledging the complex full flow field in the area is not represented by a current measurement at a single location.

11.9 Bay de Vieux (BMA 15) Modelling Results

Depositional modelling was completed via DEPOMOD (Version 2.2) in 2022 by AMB Marine and Coastal Research for the three sea farms (Denny Island, Gnat Island, Shoal Cove) in BMA 15. Modelling for the sea farms assumed a 22-month production cycle for farmed salmon from sea entry (approximately September) to harvest (August of the second year). As noted previously, DFO conducted PEZ modelling for BMA 15 (DFO 2024n).

11.9.1 Denny Island Sea Farm

The DEPOMOD results for the Denny Island sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.47 and 11.48).

At peak feed rate, all three depositional footprints (1, 5, and 10 $gC/m^2/day$) were predicted to occur in water depths >50 m with the higher depositional rates having smaller footprints (Figure 11.47). The 1 $gC/m^2/day$ footprint was predicted to extend beyond the sea cage array, slightly farther to the west and east.

At mean feed rate, the modelling predicted that the 10 $gC/m^2/day$ footprint would occur in small patches under most sea cages (Figure 11.48). The 5 $gC/m^2/day$ footprint was predicted to occur below the sea cage array and the 1 $gC/m^2/day$ footprint was predicted to extend beyond the sea cage array in water depths ranging from 45 m to >110 m.

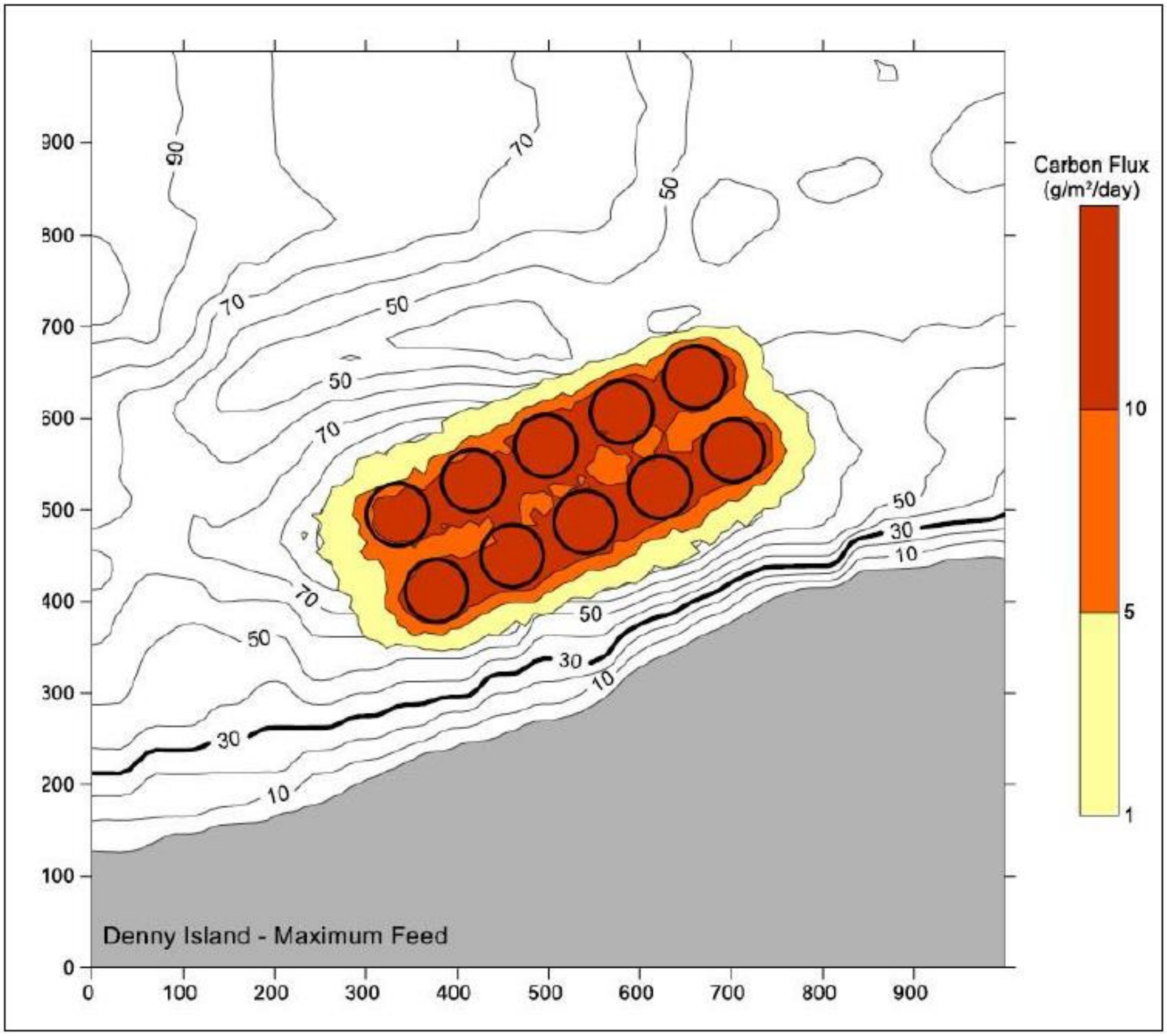


Figure 11.47. Predicted sediment TOC rate of deposition for peak feed use at Denny Island sea farm.

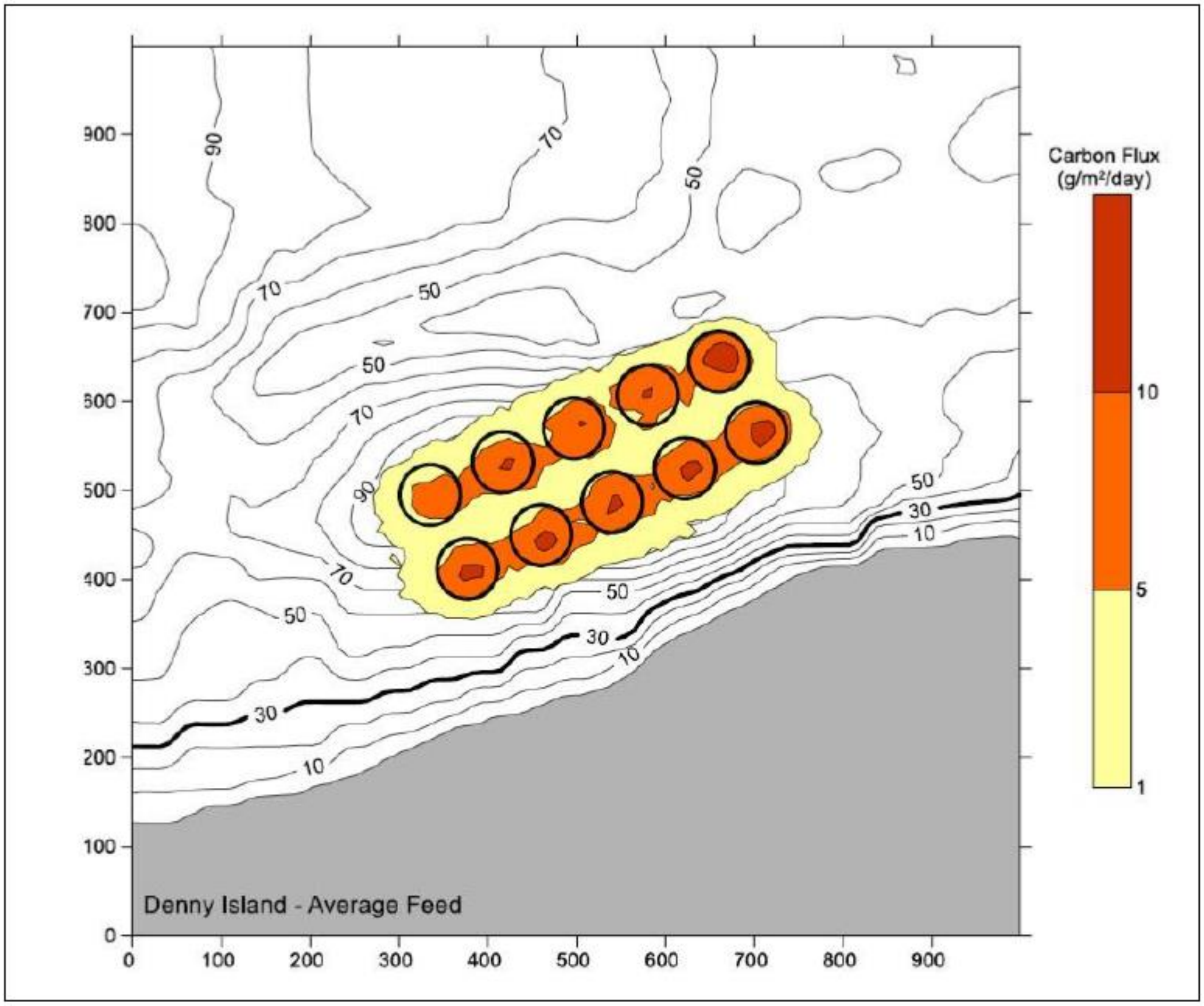


Figure 11.48. Predicted sediment TOC rate of deposition for mean feed use at Denny Island sea farm.

11.9.2 Gnat Island Sea Farm

The DEPOMOD results for the Gnat Island sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.49 and 11.50).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to occur in water depths ranging from 90–150 m below the sea cages and slightly to the west of the cage array (Figure 11.49). The 5 gC/m²/day footprint extended below most of the sea cage array and the 1 gC/m²/day footprint was predicted to extend farther to the north and south in depths ranging from 50–270 m.

At mean feed rate, the modelling predicted that the 5 gC/m2/day footprint would occur in small patches under the sea cages in the northwestern end of the sea cage array (Figure 11.50). The 1 gC/m2/day footprint was predicted to extend beyond the sea cage array in water depths ranging from 70–270 m.

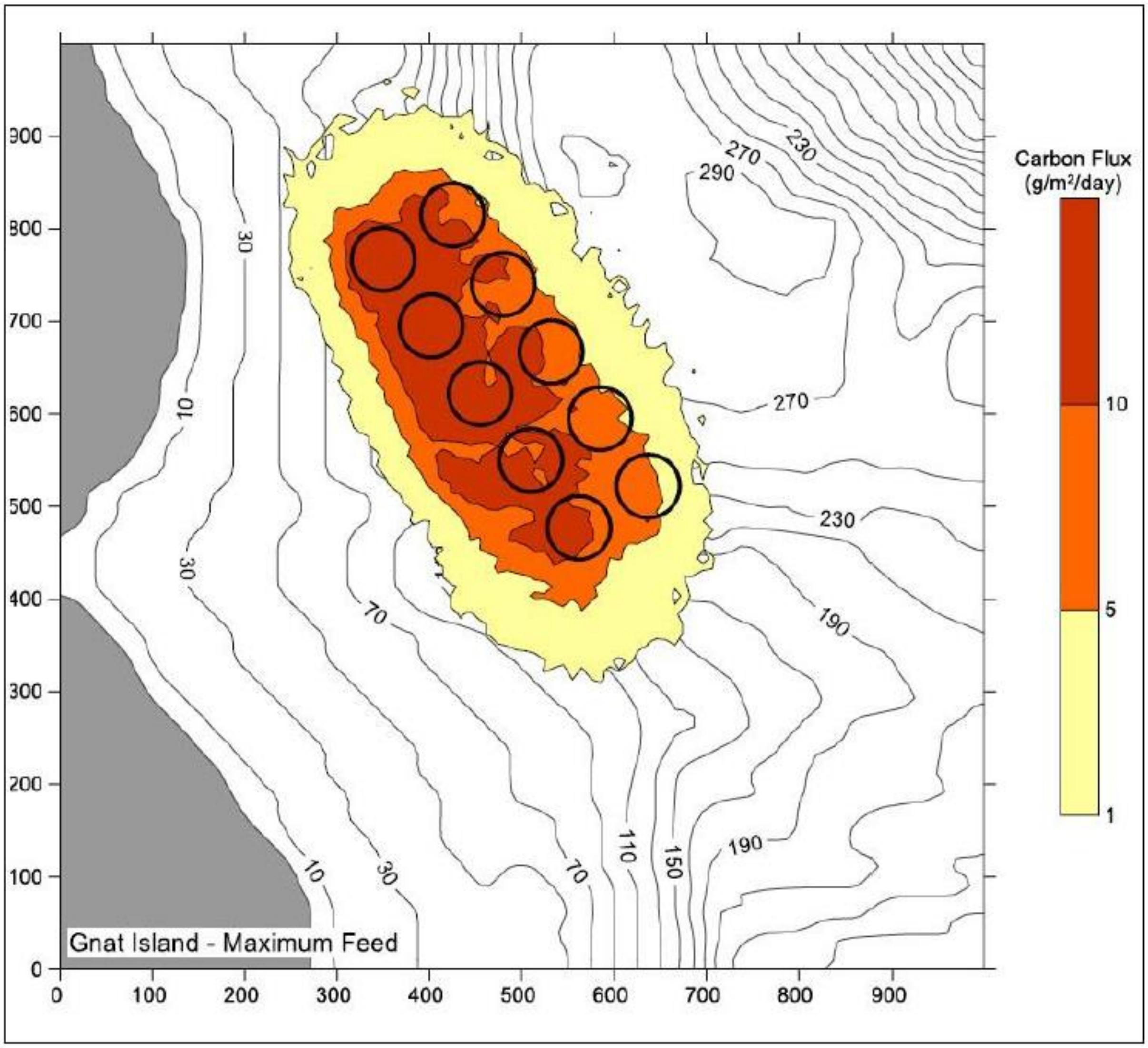


Figure 11.49. Predicted sediment TOC rate of deposition for peak feed use at Gnat Island sea farm.

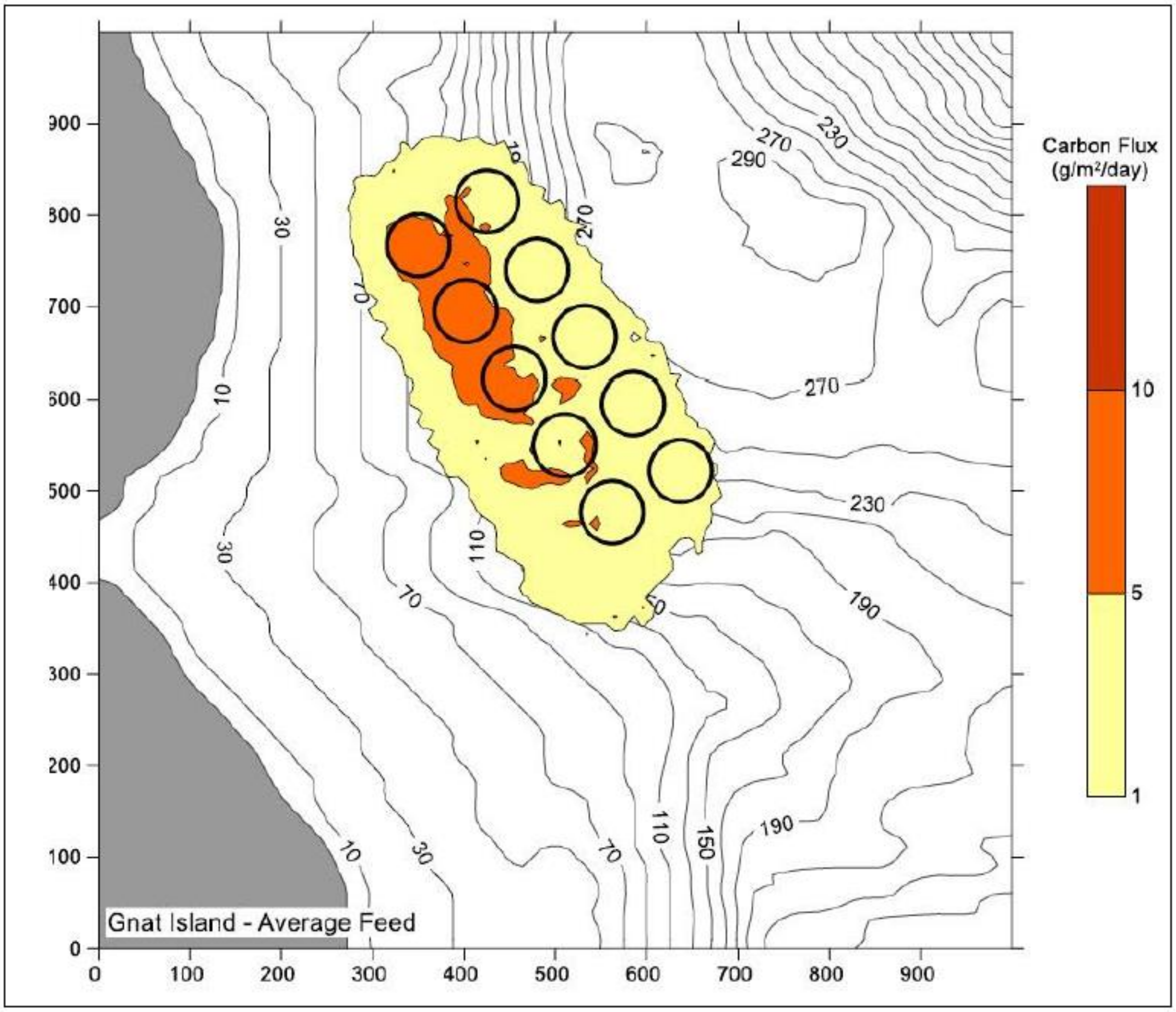


Figure 11.50. Predicted sediment TOC rate of deposition for mean feed use at Gnat Island sea farm.

11.9.3 Shoal Cove Sea Farm

The DEPOMOD results for the Shoal Cove sea farm indicated that at both peak and mean feed use, depositional footprints did not overlap with areas shallower than 30 m (Figures 11.51 and 11.52).

At peak feed rate, the 10 gC/m²/day depositional footprint was predicted to primarily occur under the sea cages in the eastern portion of the array (Figure 11.51). The 5 gC/m²/day depositional footprint was predicted to occur below and slightly beyond the sea cage array in water depths ranging from 90 m to >230 m. The 1 gC/m²/day footprint was predicted to occur in areas where water depths range from 70 m to >230 m.

At mean feed rate, the modelling predicted there is a 5 gC/m²/day footprint present directly under the eastern cages. The 1 gC/m²/day footprint extends beyond the sea cage array, slightly farther to the north, south and east, in water depths ranging from 90 m to >230 m (Figure 11.52).

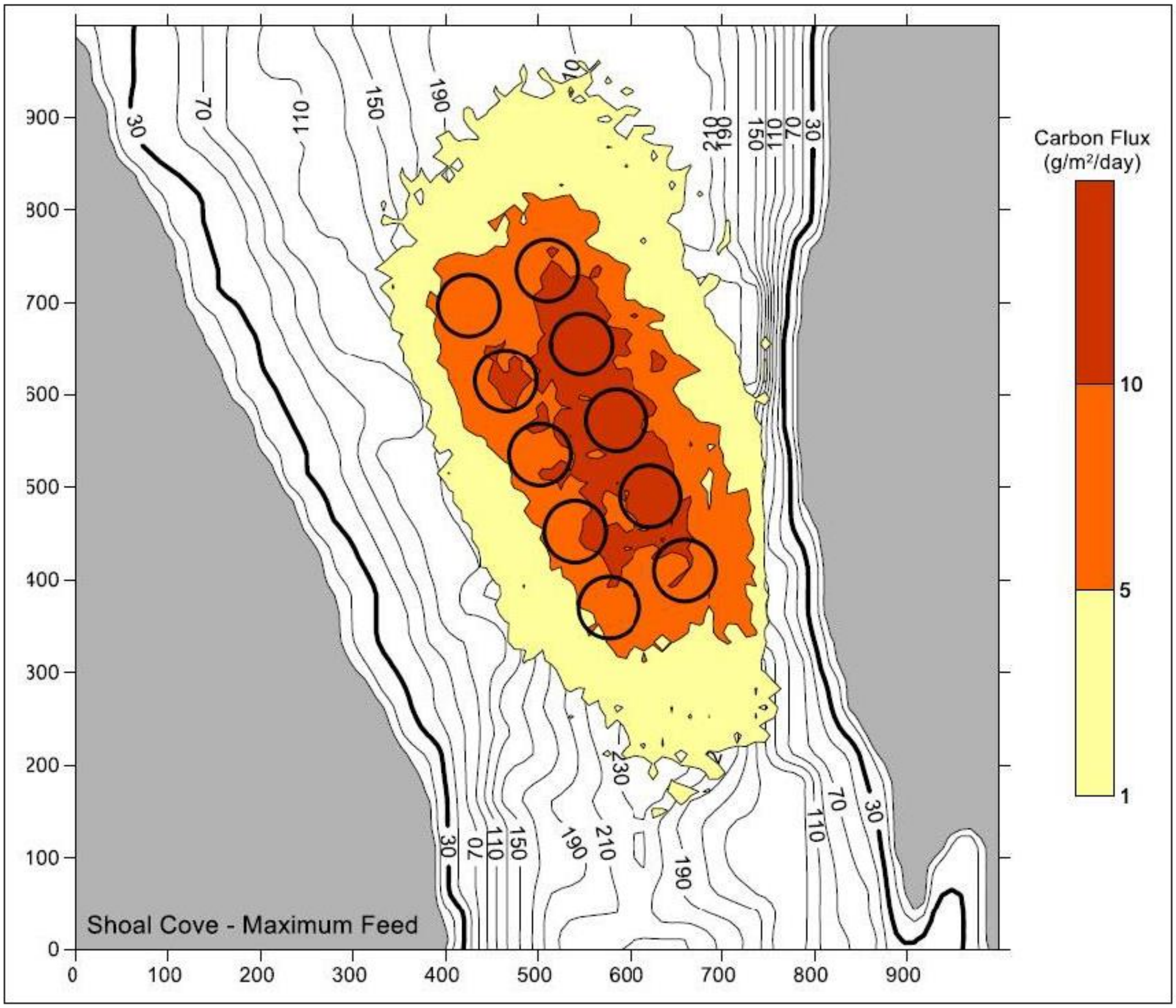


Figure 11.51. Predicted sediment TOC rate of deposition for peak feed use at Shoal Cove sea farm.

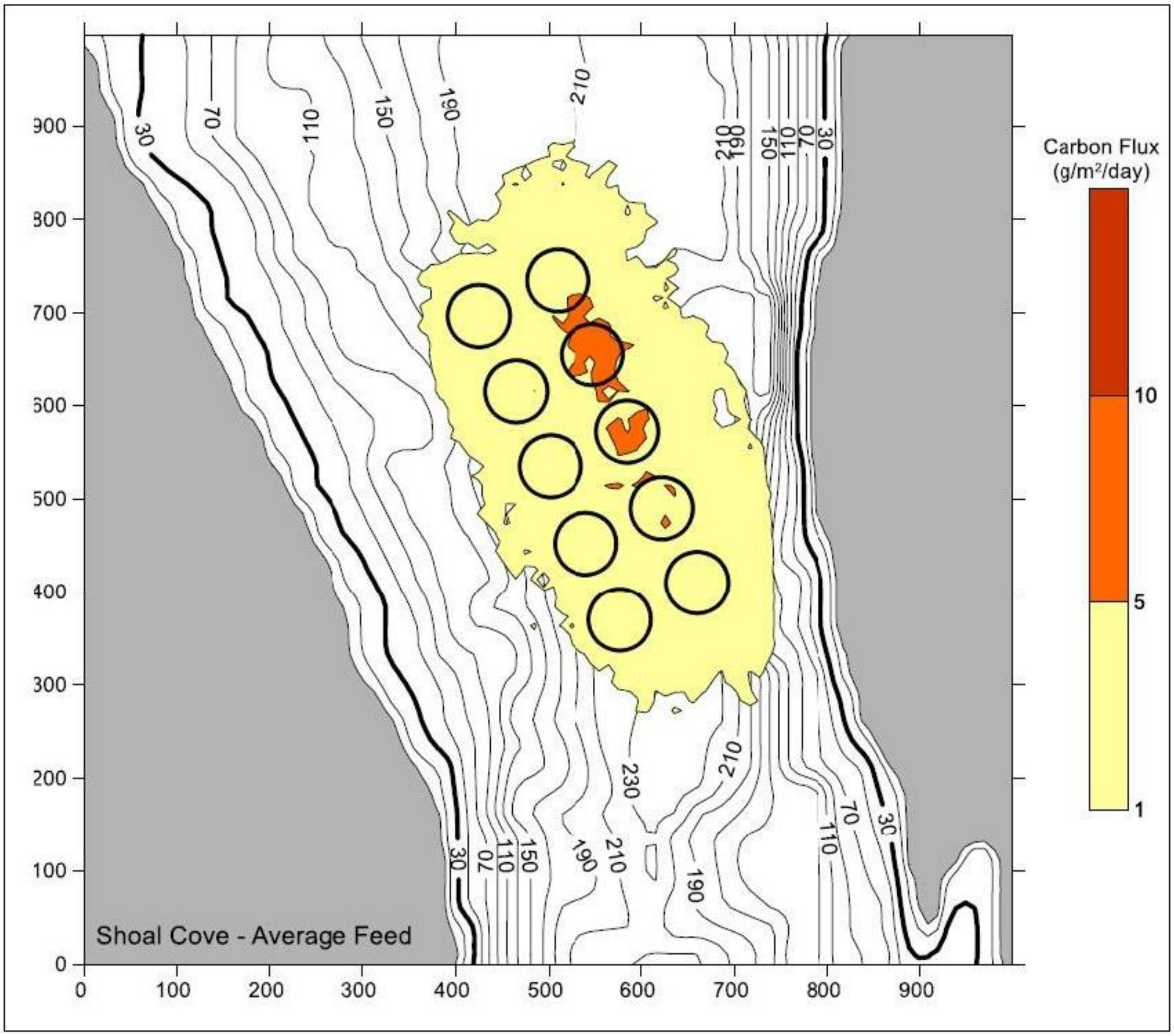


Figure 11.52. Predicted sediment TOC rate of deposition for mean feed use at Shoal Cove sea farm.

11.9.4 PEZ Results

Using the PEZ model, the maximum benthic PEZ for organic matter were calculated for the three sea farms in BMA 15 (DFO 2024n). First-order estimations of the benthic feed-PEZ indicates there is no overlap among the three sea farms (Figure 11.53) but overlap is anticipated for the fecal-PEZ (DFO 2024n). The Shoal Cove sea farm had the largest estimated PEZ area for feed (3.80 km^2) and feces (109.3 km^2) under maximum current speeds (Table 11.15). The smallest PEZ areas were estimated for the Denny Island sea farm.

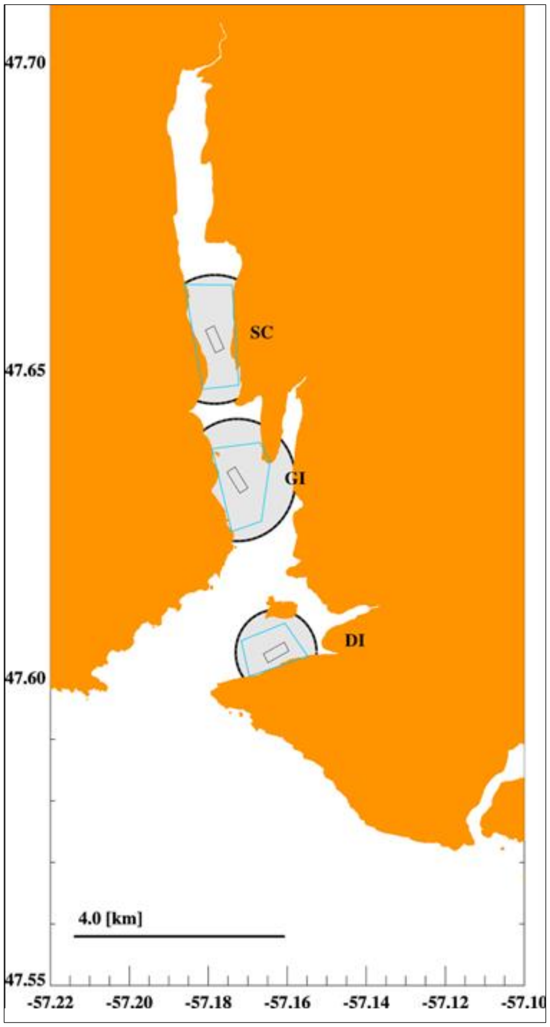


Figure 11.53. Benthic-PEZ (thick black “circles”) associated with feed particles under maximum current speeds for BMA 15 sea farms (DFO 2024n). Small black rectangles delimit the cage areas and light blue polygons the lease area for each sea farm (DI=Denny Island, GI=Gnat Island, SC=Shoal Cove).

Table 11.15. Summary of PEZ BOD area for feed and feces (km^2) under maximum current speeds for BMA 15.

Sea Farm	Area of PEZ (km^2)	
	Maximum Current Speed[a]	
	Feed	Feces
Denny Island	1.54	28.26
Gnat Island	3.14	63.59
Shoal Cove	3.80	109.3

Notes:

[a] Area represents an upper bound to the potential for exposure and should be interpreted as an order of magnitude acknowledging the complex full flow field in the area is not represented by a current measurement at a single location.

12.0 Sensitive Areas

Canada has developed an approach for marine spatial planning (MSP) that integrates science (data) and knowledge (including local and Indigenous) to produce accessible maps to identify zones and areas with ecological features and human activities to promote sustainable ocean development (GC 2025c). In NL, there are a variety of regulatory frameworks that administer management and protection in areas that are designated as a 'sensitive area' through this MSP process. In accordance with the Strategic Environmental Assessment (SEA) for southern Newfoundland (LGL 2010), a 'sensitive area' is defined as the following:

- an area that is afforded some level of protection under federal or provincial legislation;
- an area that may be under consideration for such legislative protection; or
- an area that is known to have particular ecological or cultural importance and is not captured under federal or provincial regulatory framework.

In the context of fish and fish habitat, DFO administers marine fisheries through the federal *Fisheries Act*, which also includes management of marine mammals under the *Marine Mammal Regulations* of the *Fisheries Act*. Species at risk and measures to protect them are administered under the *Species at Risk Act* (2002). Marine Protected Areas (MPAs) are established by DFO under the *Oceans Act* (1996) to protect and conserve important fish and marine mammal habitats, endangered marine species, unique features, and areas of high biological productivity or diversity. Other federal and provincial laws that are either directly or indirectly involved in ocean management of resources and activities include the *Aquaculture Act* (1990), *Canada Wildlife Act*, *Canada National Parks Act*, *Migratory Birds Convention Act*, and *Fishing and Recreational Harbours Act*, to name a few (GC 2025c).

Sensitive Areas which overlap or are in immediate proximity of the Hatchery Study Area, well boat route, and sea farm Study Area include two Ecologically and Biologically Sensitive Areas (EBSAs), as well as several designated Important Areas (IAs; blue whale), critical habitat (wolffish), and Sensitive Benthic Areas (SBAs) for deep-sea corals and sponges (Figure 12.1). In addition, there is a proposed National Marine Conservation Area (NMCA), a proposed Ecological Reserve and Transitional Reserve, a designated lobster closure area (Penguin Island), and a Habitat Enhancement Project that occurs within proximity to the sea farm Study Area.

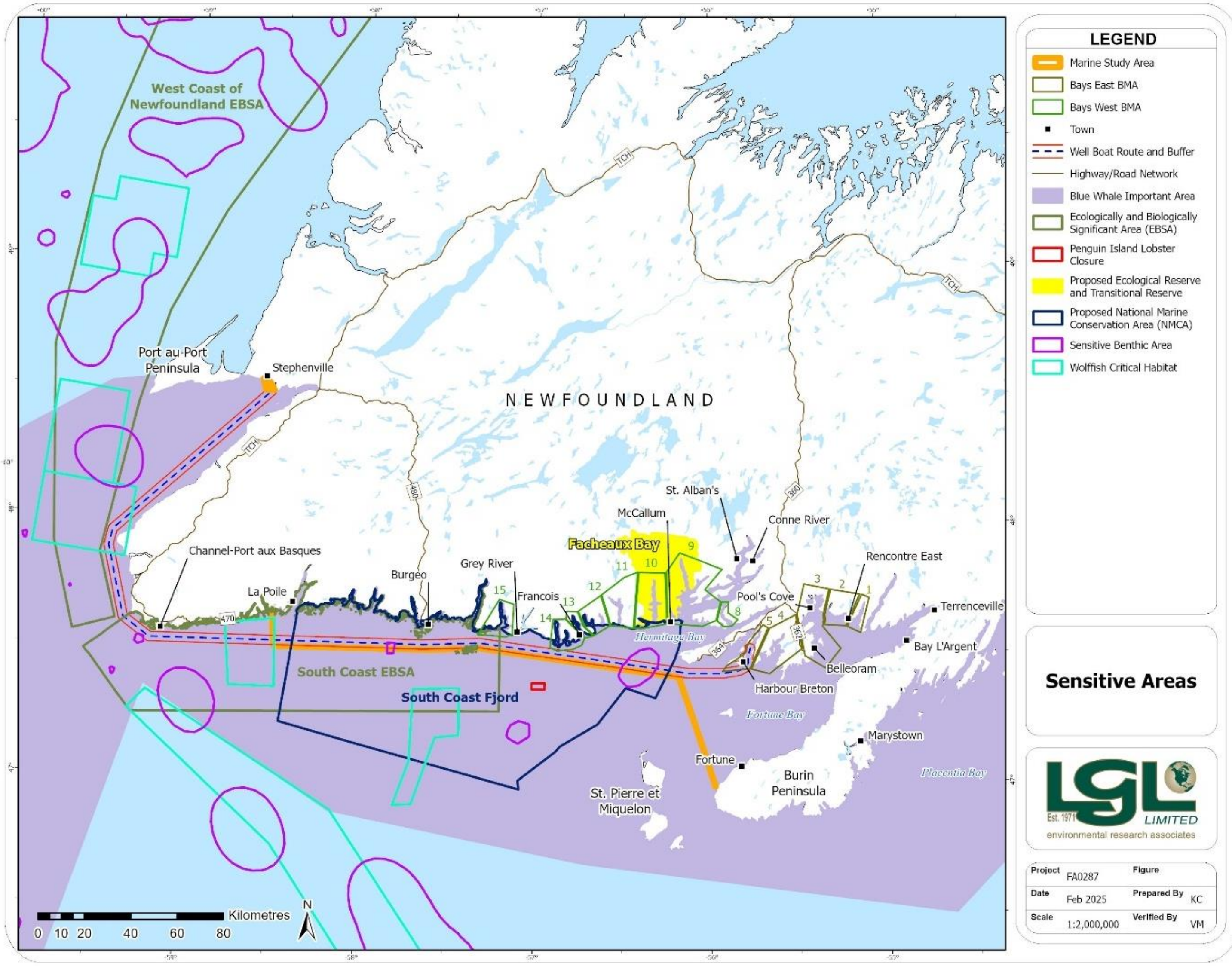


Figure 12.1. Protected and sensitive areas in or near the Study Area (Note: the boundaries for the proposed NMCA study area shown here are those that were initially proposed and are currently being changed).

12.1 Integrated Management Areas

Using *Canada's Oceans Act* as the framework, a national ocean management strategy has been developed to provide an integrated approach to ocean management (DFO 2002). Canada's Oceans Strategy provides the policy direction to ensure coordination of policies and programs from all governments (international, Canada, provincial/territorial, local, Indigenous) as well as interests from other stakeholders (including industry, environmental community groups and academia) while still maintaining an 'ecosystem approach' when assessing environments and managing Canada's ocean resources (DFO 2002). The *Oceans Act* provides the Minister of Fisheries and Oceans with a leadership role for the development and implementation of plans for the integrated management of federal MPAs, including the designation of EBSAs and other sensitive areas (GC 2024e, 2025c).

In 2007, DFO proposed a Large Ocean Management Area (LOMA) for the NL region, known as the Placentia Bay-Grand Banks (PBGB) area (Wells et al. 2019). At the time, this LOMA was one of five in Canada established to form the planning basis for DFO to implement integrated management plans. In 2016, a review of available geospatial information was undertaken by DFO Science for EBSA identification in the PBGB study area. This information underwent GIS analyses and candidate EBSAs were proposed with final EBSA delineations and descriptions determined through a scientific peer review meeting (Wells et al. 2019). In total, 14 EBSAs were identified and delineated in the PBGB study area, seven of which are located in coastal areas. One of these coastal EBSAs (South Coast Fjords) is in the vicinity of the MCE sea farm Study Area (Wells et al. 2019). In addition to the South Coast EBSA, the Placentia Bay EBSA was also delineated as a coastal EBSA and is also located on the south coast of Newfoundland, east of the MCE sea farms. The Placentia Bay EBSA was identified based on features including Atlantic salmon rivers, capelin spawning areas, eelgrass habitat, seabird colonies, as well as IAs for leatherback turtles, corals and sponges (Wells et al. 2019).

Another integrated management initiative is the Gulf of St. Lawrence Integrated Management (GOSLIM) area. As one of five priority LOMAs identified in 2005 by DFO for integrated management planning, a plan was developed for GOSLIM in 2013 (DFO 2013). According to the GOSLIM plan (DFO 2013), ten EBSAs have been identified in this area, including the West Coast of Newfoundland EBSA (DFO 2007).

12.1.1 Ecologically and Biologically Significant Areas (EBSAs)

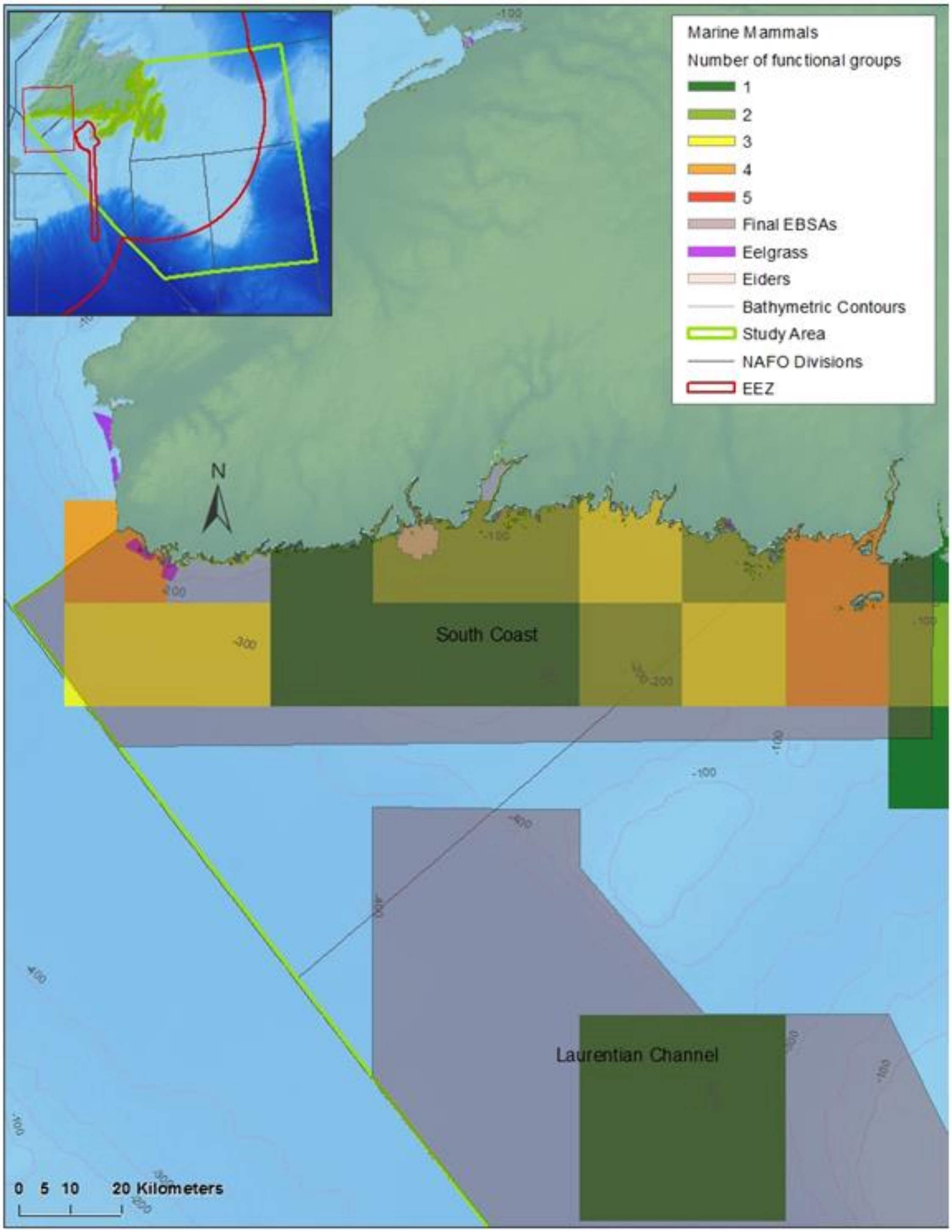
Through Canada's MSP approach for ocean management, EBSAs have been identified using the tools described above of scientific data and knowledge. These regions within Canada's oceans have been identified as having unique biological or ecological importance (GC 2025c). Assessments of an EBSA use nationally established criteria including uniqueness, aggregation, if the area is critical for the life history of a species, naturalness (pristine), and resilience (GC 2025c). These criteria use data and knowledge to assess factors such as biodiversity, rare species, critical habitats or vulnerability to disturbances. Designated EBSA areas usually justify special efforts for conservation and management compared to the surrounding areas and are a means to ensure ecosystems remain healthy and productive (GC 2025c).

There are two identified EBSA in the vicinity of the Project Study Area, the South Coast EBSA and the West Coast EBSA (see Figure 12.1). The South Coast EBSA does overlap with the well boat route and sea farm Study Area and is adjacent to BMA 15. The West Coast EBSA is in proximity to the well boat route (see Figure 12.1).

12.1.1.1 South Coast EBSA

The South Coast EBSA is located along the south coast of NL from Cape Ray to Grey River and overlap Div. 3Pn and 3Ps (see Figure 12.1). The eastern side of the South Coast EBSA boundary is in the vicinity of MCE BMA 15 just east of Ramea but does not extend into the fjord (Bay de Vieux) where the sea farms are located. The closest sea farm lease boundary (i.e., Denny Island) to the EBSA is 2.4 km

Using the criteria and guidance developed by DFO for EBSAs (aggregation, fitness consequences, uniqueness) to determine the boundaries of the South Coast EBSA, significant features of the South Coast EBSA were identified. The area is known to be important habitat for many marine mammals, including the *Endangered* blue whale (see Section 12.2) and two seal species (Wells et al. 2019). The South Coast EBSA also includes IAs for several groundfish and invertebrate species, such as Atlantic cod, redfish, black dogfish, smooth skate, and shrimp (Wells et al. 2019). It hosts sea pen and sponge SBAs (Wells et al. 2019). Eelgrass beds (see Section 12.2), common in coastal NL, are also present in the South Coast EBSA, with the largest beds in the far west portion of the EBSA near Cape Ray and Channel-Port aux Basque (Figure 12.2; Wells et al. 2019). There are two Important Bird Areas (IBAs) in this area: 1) Grand Bay West to Cheeseman Provincial Park; and 2) Big Barasway. The Big Barasway IBA supports a significant population of *Endangered* Piping Plover while Grand Bay West to Cheeseman Provincial Park IBA provides coastal dune Piping Plover nesting habitat (Wells et al. 2019). Although fairly small, with less than 30 individuals surveyed in each, two important Common Eider colonies were also identified in the South Coast EBSA (Figure 12.2; Wells et al. 2019). Table 12.1 outlines key features of the South Coast EBSA, the data source used for assessment, and the significance of each feature relative to the size of the area that was used to determine the ecological importance of species and habitats within the EBSA.



Source: Figure 16 in Wells et al. (2019).

Figure 12.2. Map of South Coast EBSA. Note locations of eelgrass habitat (purple) and eider colonies (peach) within and near the South Coast EBSA (grey).

Table 12.1. Principal features of the South Coast EBSA.

Important Features within the EBSA	Associated Data Source (Season/Years)	Description of Data Relative to EBSA Size
Planktivores (fish)	DFO RV Survey (spring 1996–2016)	Significant
Hooded Seal	Telemetry + expert advice	Significant
Grey Seal	Telemetry + expert advice	Significant
Smooth Skate	Peer reviewed	Significant
Blue Whale important habitat	Peer reviewed	Significant
Atlantic Cod	DFO RV Survey (spring 1996–2016)	Moderate
Redfish	DFO RV Survey (spring 1977–1995)	Moderate
Piscivores (fish)	DFO RV Survey (spring 1996–2016)	Moderate
Plankpiscivores (fish)	DFO RV Survey (spring 1977–1995)	Moderate
Planktivores (fish)	DFO RV Survey (spring 1977–1995)	Moderate
Surface, shallow-diving piscivores (seabirds)	Pelagic seabird surveys	Moderate
Blue Whale	Sightings data	Moderate
Common Eider colonies	Colony max counts	-
Shrimp	DFO RV Survey (spring 1996–2016)	Minor
Atlantic Cod	DFO RV Survey (spring 1977–1995)	Minor
Redfish	DFO RV Survey (spring 1996–2016)	Minor
Piscivores (fish)	DFO RV Survey (spring 1977–1995)	Minor
Plankpiscivores (fish)	DFO RV Survey (spring 1996–2016)	Minor
Surface, shallow-diving coastal piscivores (seabirds)	Pelagic seabird surveys	Minor
Sea pens	SBAs	Minor
Black Dogfish	Peer reviewed	Minor
Eelgrass Habitat	-	Insignificant
Sponges	SBAs	Insignificant

Source: Wells et al. (2019).

Marine Mammals and Sea Turtles

According to a 2007 large-scale aerial survey conducted in the PBGB area, the South coast of NL had the highest density and species diversity (in terms of abundance and distribution) of cetaceans and was also considered a "rich area" for leatherback sea turtle (DFO 2012). Historically, several SARA-listed species, including blue whale, North Atlantic right whale), and fin whale are known to occur off the south coast of NL (DFO 2012). While many cetaceans (e.g., humpback whale and harbour porpoise) and sea turtles (leatherback and loggerhead) are generally migratory and gather in the area from summer to early fall to feed, some seals (e.g., harbour and grey) and cetaceans (e.g., baleen whales and northern bottlenose whales) can be present in the Newfoundland region year-round (Bernier et al. 2023).

The identified important blue whale habitat within the South Coast EBSA (see Figure 12.1) is one of several areas in Atlantic Canada that are important for blue whale foraging and/or socializing (Bernier et al. 2023). The habitat's key features include aggregations of blue whale prey (primarily krill) that occur in the area (Bernier et al. 2023).

Fish

DFO has been conducting RV surveys of fish and shellfish since the early 1970s, and this information was considered during the peer review process of defining and describing the South Coast EBSA (Wells et al. 2019). Wells et al. (2019) listed Atlantic cod, redfish, Atlantic wolffish, and smooth skate as key fish species within the South coast EBSA; however, many other species are also present along/off the south coast Newfoundland, such as pelagic Atlantic herring, Atlantic mackerel, and capelin and benthic witch flounder, among others (see Sections 7.0 and 8.0; DFO 2024n). There are also several scheduled and non-scheduled salmon rivers within the boundaries of the South Coast EBSA (DFO 2025) and Atlantic salmon migrate along the south coast of NL (DFO 2024n). The most recent assessment of wild Atlantic salmon stocks in the *State of the Atlantic Ocean Synthesis Report* indicates that populations in eastern and western NL are stable or showing an increasing trend (Bernier et al. 2023).

12.1.1.2 West Coast of Newfoundland EBSA

The vessel route overlaps the southern portion of the West Coast EBSA (see Figure 12.1), which spans a total 18,238 km², and encompasses 7.1% of the Estuary and Gulf of St. Lawrence (EGSL; DFO 2007). This EBSA runs along Newfoundland's west coast, from the Cabot Strait in the south to the Esquiman Channel in the north, encompassing both coastal waters and deeper sections at the channel's head (DFO 2007). South of the area, Atlantic water enters the Gulf through the Cabot Strait (DFO 2007). Unlike the EGSL, water temperature in the west coast of NL area is slightly above freezing and the ice -cover period usually lasts less than 60 days (DFO 2007).

During the assessment period, the area was characterized for the role it plays for groundfish (maximum uniqueness, concentration, adaptive values), including hosting juvenile Atlantic cod, redfish, American plaice, and Atlantic wolfish concentrations (DFO 2007). In addition, entire populations (Atlantic cod, redfish, and others) use the Esquiman Channel (including Cabot Strait) as their principal migration corridor in the Gulf (DFO 2007).

The Cabot Strait channel serves as both a migration route and refuge for various pelagic fish species, including capelin and herring (DFO 2007). The Cabot Strait channel and the Esquiman Channel were identified as the only known critical refuges for these populations (DFO 2007). These areas are also important summer feeding grounds for many pelagic species, including Atlantic herring, capelin, ribbon barracudina (*Arctozenus risso*), spiny dogfish, silver hake, and pollock (DFO 2007). In addition to migration, refuge, and foraging, this area along the west coast of Newfoundland has been recognized as a primary spawning area for Atlantic cod from the

Northern Gulf of St. Lawrence stock; capelin and Atlantic herring larvae are also abundant in the region (DFO 2007).

With its nearly year-round ice-free waters, the West Coast EBSA (particularly St. George's Bay) is important for marine mammals, as many species (including blue whale) use this area as an important feeding ground (see Section 12.2; DFO 2007).

12.2 Habitats for Species at Risk and Ecologically Significant Species

Profiles are provided in Section 8.0 for aquatic SAR that are known to inhabit the Study Areas. In addition to SAR, a plant or animal that is considered a critical component in an ecosystem can be identified as an ecologically significant species, and their loss would have a greater ecological impact compared to other species associated with a community (DFO 2009). Several habitats for SAR and ecologically significant species have been identified in the vicinity of the MCE Study Areas, including an IA for blue whale, critical habitat for wolfish, SBAs for cold water corals and sponge communities, and ecologically significant eelgrass beds (see Figure 12.1).

12.2.1 Blue Whale Important Area

Endangered blue whales are migratory species found in all the oceans of the world including the North Atlantic (DFO 2018f). A recovery strategy was developed for blue whale in 2010. As part of this recovery strategy, DFO Science reviewed habitat requirements for blue whale, including feeding, reproduction, socializing, and migration corridors to identify areas with these properties as well as any potential activities that could impact the identified areas (DFO 2018f).

Habitat that is important to the survival and recovery of blue whale has been identified on the southwest of NL and within the sea farm Study Area (DFO 2018f). Although the habitat requirements of blue whale are not fully understood, the attributes of the south and west coast of Newfoundland (including the South Coast EBSA and portions of the West Coast EBSA), such as prey aggregations and access to transit corridors of suitable depth and water quality, contributed to this area being designated as a blue whale IA habitat (DFO 2018f). To meet their biological needs, blue whale most likely need to use several important habitats, which makes access to the productive waters of southern NL and corridors, such as the Gulf of St. Lawrence, equally important habitats for the population (DFO 2018f). MCEs sea farms are located within the designated blue whale IA (see Figure 12.1); however, MCE has mitigations and response plans in place for whale entanglements (see Section 13.6).

12.2.2 Wolfish Critical Habitat

Although the habitat for all three wolffish species in Atlantic Canada overlap, only northern and spotted wolffish have been assessed by COSEWIC as *Threatened* and listed as the same under Schedule 1 of SARA due to declines in abundance and biomass; therefore, critical habitat for these two species have been identified in a recovery strategy (see Figure 12.1; see also Section 8.0; DFO 2018g).

Wolffish are known to occupy deep waters over a variety of benthic substrates; however, given the vast area and extreme depths these fish can occupy, there are data gaps regarding their optimal habitat characteristics (Kulka et al. 2007). Wolffish are known to occupy depths ranging from 20 to >1500 m and water temperatures between 1.5–5°C, and they relocate when needed to maintain their thermal requirements (Kulka et al. 2007). Both northern and spotted wolffish inhabit a wide variety of benthic substrates, including mud, sand, pebble, small rocks, and hard bottom, where they have access to benthic invertebrate prey, such as echinoderms, crustaceans, and molluscs (Kulka et al. 2007). Although the habitats for northern and spotted wolffish may overlap, there are key differences between the species; northern wolffish regularly inhabit deep trenches or along the shelf slope whereas spotted wolffish rarely do, and northern wolffish can spend a considerable portion of time off bottom in the mid-water column (at least 200-m depth) to forage (Kulka et al. 2007).

DFO combined data gathered from remote sensing and bottom trawl surveys to relate wolffish observations with substrate-type and potential habitat areas (DFO 2018g). Using this information, along with data from other sources (i.e., SCUBA divers, groundfish survey data, bottom water temperatures research surveys), critical habitat maps were developed for northern and spotted wolfish in the NL region (see Figure 12.1; DFO 2018g). Wolffish critical habitat has not been identified near the sea farms, but the eastern boundary of one area overlaps the western boundary of the sea farm Study Area (see Figure 12.1). A single Atlantic wolffish was observed during benthic surveys in Jervis Island (BMA 9), Friar Cove (BMA 13,) and Gnat Island (BMA 15), which aligns with the fact that Atlantic wolfish are known to inhabit shallower depths than either northern or spotted wolffish (Kulka et al. 2007).

12.2.3 Sensitive Benthic Areas

SBAs have been defined by DFO as "significant areas of cold-water corals and sponge dominated communities" (GC 2025d). These areas are considered vulnerable to fishery activities and policies for fishing follow a process similar to EBSAs, i.e., using data and knowledge to assess risks, create maps, and determine management measures (GC 2009).

Cold-water corals and sponges provide structural habitat for marine organisms (e.g., for resting, feeding, spawning, and predator avoidance), including many marine species of commercial importance (DFO 2015). Edinger et al. (2009, in Edinger and Gilkinson 2009) found a significant correlation between coral biomass and fish biodiversity, suggesting that soft corals, sea pens, and small gorgonian corals are important to groundfish and invertebrate species in the region. Coral and sponge communities also contribute to species richness and biodiversity (DFO 2015). They are sessile, typically long-lived, and slow growing, which combined, render them particularly vulnerable to disturbance via anthropogenic activities (e.g., bottom contact fishing gear), smothering by sedimentation, climate change, and ocean acidification (DFO 2012, 2015). Given these factors, cold-water corals and sponges were identified as a primary conservation priority for the PBGB LOMA (DFO 2012). DFO has developed a *Coral and Sponge Conservation Strategy for Eastern Canada* to "facilitate the conservation and protection of cold-water coral and sponge species, communities, and their habitats in the Atlantic and Arctic Oceans of Eastern Canada" (DFO 2015).

Globally, more than 700 species of cold-water coral are known and many of these are common in Atlantic Canada (GC 2023a). These animals can be found in NL, ranging in depths from the intertidal zone to thousands of metres below the sea surface (DFO 2015a). Cold-water corals can be soft (e.g., sea fans and sea pens) or stony (e.g., cup corals) and be solitary or form colonies on both hard substrate and/or as soft sediments (GC 2023a). Extracting calcium carbonate from the surrounding sea water, both soft and stony corals create a skeleton and feed on particles (dead material and live animals) in the surrounding water column (GC 2023a). Sea pen ecology and distribution in the inshore region of the south coast of NL is unknown (DFO 2022a). During the past ~15–20 years, cold-water coral and sponge research in NL waters, conducted collaboratively between DFO Science, MUN, and industry, has increased (DFO 2012). Kenchington et al. (2016) used Kernel Density Estimation (KDE) to model the distribution of sponges, gorgonian corals, and sea pens and identify/delineate significant biomass concentrations, i.e., important ecological areas. Using spatial analysis from RV survey by-catch data, significant concentrations of sea pens were identified near Channel-Port aux Basques, Burgeo, and just outside of Hermitage Bay, as well as sponge concentrations within St. George's Bay and near Channel-Port aux Basques (Kenchington et al. 2016).

As part of the review of MCE's aquaculture siting baseline assessments, DFO reviewed seabed footage collected along the south coast of Newfoundland in MCE BMAs 9, 10, 11, and 12 (see Figure 12.1). The footage was used for benthic assessments, which included analyzing substrate types and identifying species and sensitive habitats within the cage array area (DFO 2022a). Cold-water corals, such as sea pens, soft corals, gorgonian corals, and sponges, were observed at multiple sites (DFO 2022a; see LGL 2025a). Two main sea pen species were identified: *Halipteris* sp. and *Pennatula aculeata*. *P. aculeata* colonies can reach heights of up to 31 cm and are known to live for decades (DFO 2022a). These sea pens play a critical ecological role, acting as nurseries for larval stages of species such as redfish, eelpout, and lantern fish (DFO 2022a). There were recorded instances of sea pens during MCE benthic surveys (see LGL 2025a) but none of these findings were significant or in immediate proximity to sea cages. The south coast of Newfoundland has not been studied to identify diversity, location, and density of cold-water corals and their potential for species associations; nor are data available regarding the connectivity between populations within defined BMAs and offshore populations (DFO 2022a).

During benthic surveys, the large gorgonian coral *Paragorgia arborea* (bubblegum coral) was found in five transects at MCE sea farm Jervis Island (in BMA 9), at depths between 148–280 m (DFO 2022a; LGL 2025a). The locations of the bubblegum corals at the Jervis Island sea farm were outside the sea cage array, south of the sea farm (see Section 10.0 in LGL 2025a for additional details).

There is limited knowledge regarding sponge diversity and distribution in coastal Newfoundland (DFO 2022a). During baseline assessments, sponge identifications from ROV footage included higher taxonomic levels, such as Phylum and Family. Sponge aggregations with over 20 individuals per video frame, including Geodiidae, finger sponges, branching sponges, and unidentified species, were frequently observed at Jervis Island, Little Bay, North Bob Locke Cove, Rencontre Bay, and the Gorge (DFO 2022a; LGL 2025a). There were also recorded instances of stand-alone sponges during MCE benthic surveys (see LGL 2025a) but none of these were significant or in immediate proximity to sea cages. Based on benthic survey data provided by MCE, there are no SBAs present in the immediate vicinity of MCE's BMAs. Based on Kenchington et al. (2016), there is one instance of a significant sea pen aggregation SBA within the sea farm Study Area, located just outside of Hermitage Bay (see Figure 12.1).

Previous studies on Newfoundland's south coast indicated that organic enrichment from aquaculture activities persisted even after more than 15 months of fallow periods (DFO 2022a). This suggests that recovery for long-lived, slow-growing species like corals could take over five years, which raises concerns for their long-term survival (DFO 2022a). Additionally, there is limited information on the biology, density, and distribution of sponges and cold-water corals in BMAs and the south coast of Newfoundland, which hinders a full understanding of the impacts of aquaculture on these ecosystems (DFO 2022a).

12.2.4 Eelgrass

Among the world's most productive environments for primary productivity, eelgrass beds "form extensive underwater networks providing a crucial habitat that reduces local currents, provides protection from predation, stabilizes the sediment, filters water, and increases habitat complexity" in sheltered photic environments (DFO 2012). Eelgrass has been shown to support increased fish species diversity and density compared to unvegetated seabed areas, serving as important nursery grounds for some benthic species in NL, including Atlantic cod (DFO 2012). The utilization of these areas also seems to result in improved growth rates for some fish species, including Atlantic cod (DFO 2012). Although distributed around NL, the south coast is known to have the province's highest abundance of eelgrass beds (DFO 2012).

Eelgrass can tolerate wide salinity (at least on the short-term) and temperature ranges of 5–35 ppt and 0–35°C, respectively, but grows best in a salinity range of 20–26 ppt and temperatures of 10–25°C (DFO 2009). Eelgrass bed habitat typically includes unconsolidated mud to cobble or a mixture, along with a current velocity ≥16 cm/s. In areas with high wave action, ice scour, desiccation, or sustained high current velocities, eelgrass beds may be limited or grow only in small patches (DFO 2009). Fluctuations in eelgrass structure occur in association with climatic events (e.g., temperature change and sea-ice cover) and the relatively recent arrival of the invasive species green crab impacts eelgrass habitats through its burrowing behaviour among the eelgrass root system (DFO 2012; Matheson et al. 2016). Instances of eelgrass were recorded during MCE benthic surveys (See LGL 2025a), but none of these findings were significant or in immediate proximity to the sea cages.

12.2.5 Other Important Habitats

The south coast of NL has numerous fjords with riverine input creating estuaries with scheduled and non-scheduled salmon rivers (DFO 2025). In particular, the Bay d'Espoir estuary and several Fortune Bay estuaries located along the south coast of NL are an important area for aquatic life, including trout and wild Atlantic salmon populations (see Sections 7.0 and 8.0, respectively, for species profiles). These estuaries are also a critical area for migratory birds, especially during breeding and nesting seasons, and estuaries provide nursery grounds for marine species, such as Atlantic herring and Atlantic cod (see Sections 7.0 and 8.0, respectively, for species profiles).

12.3 Other Sensitive Areas and Enhancement Projects

This subsection provides summary information regarding other sensitive areas that occur in or near the Hatchery and sea farm Study Areas, including lobster fishing closure zones, MPAs, proposed reserves, and habitat enhancement projects.

12.3.1 Lobster Fishing Closure Zone

The American lobster (see Section 7.0) plays a key role in NL habitats, contributing significantly to rocky, shallow, inshore ecosystems. Small lobsters serve as food sources for many species; therefore, protecting lobster spawning areas can contribute to the overall health of the inshore food web. Penguin Island, located ~20 km from the south coast of NL, has been closed for lobster fishing to enhance spawning and egg production (see Figure 12.1; GC 2019;). This closure was imposed in 2017 as part of several marine conservation initiatives (GC 2017c). The combination of this area-based fishery closure along with the prohibition of human activity that is incompatible with the conservation of the ecological components of the area, has created a marine refuge that is intended to contribute on the long-term to marine conservation effort (GC 2017c). Penguin Island is located beyond the sea farm Study Area.

12.3.2 Marine Protected Areas (MPAs), Ecological Reserves and Conservation Areas

A MPA is a "part of the ocean that is legally protected and managed to achieve the long-term conservation of nature" (GC 2023b). At the time of writing, there are no MPAs designated by DFO within or proximate to the Hatchery and sea farm Study Areas. There are, however, two proposed protected areas, the Facheux Bay Ecological Reserve and South Coast Fjord National Marine Conservation Area (NMCA; see also Sections 12.1.1 and 12.3.1), are located in the vicinity of the sea farm Study Area (see Figure 12.1).

12.3.2.1 Proposed Facheux Bay Ecological Reserve and Transitional Reserve

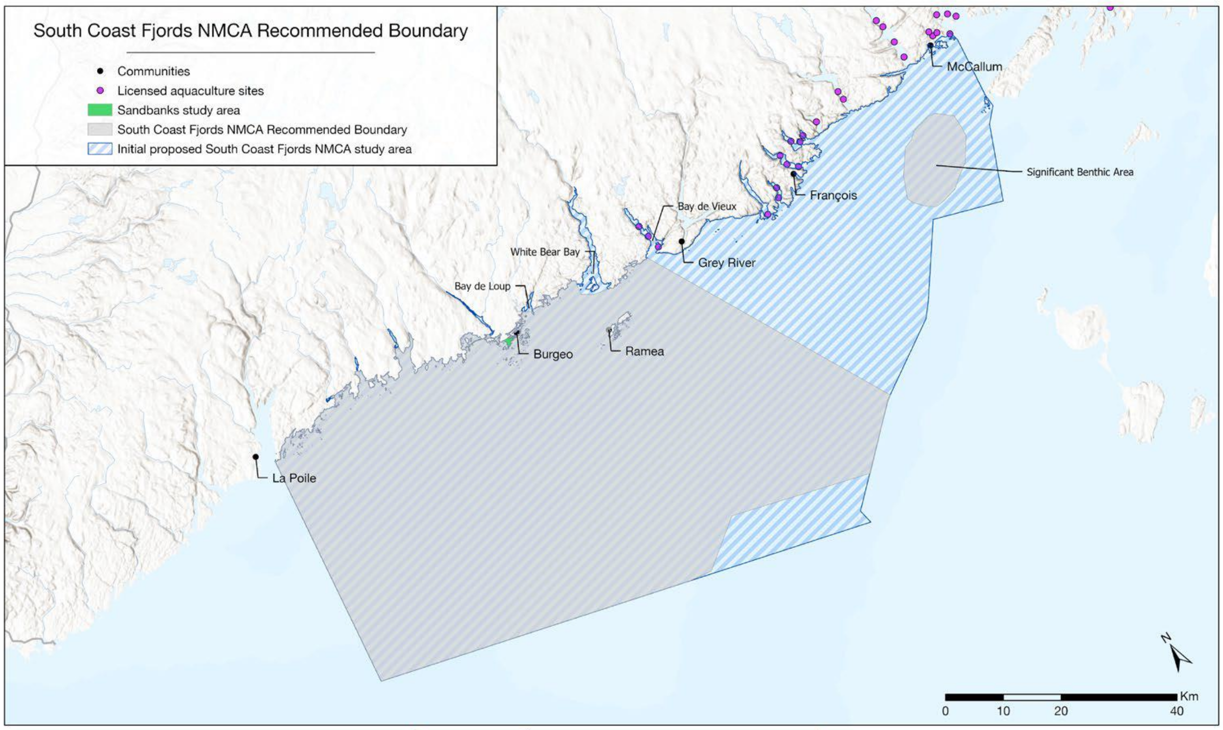
Facheux Bay has an area of ~900 km², with 762 km² proposed as an ecological reserve and 138 km² proposed as a transitional reserve under the NL *Wilderness and Ecological Reserves Act* (WERAC 2020). The area includes terrestrial wilderness and the coastlines of two deep fjords (but not the fjords themselves) and a range of vegetation typical of Newfoundland's south coast barrens (WERAC 2020). These fjords are in the vicinity of MCE's BMAs 9 and 10 (see Figure 12.1). The barrens and associated vegetation of the proposed Facheux Bay Reserve is represented of the Maritime Barrens. This areas' key features include shrub heaths, *Empetrum* (Blackberry) and *Kalmia* (sheep laurel, lambkill) as well as important habitat for the local caribou herds (WERAC 2020). There are two proposed protected area components in Facheux Bay, northern and southern. The northern section is remote with very little human disturbance and is important habitat for the Grey River Woodland caribou, particularly during the fall and winter (WERAC 2020). The southern portion is a more exposed coastal headland compared to the northern portion and is being proposed as a transitional reserve, permitting mineral exploration for a period of ten years, after which the intention is that the area will be protected as an ecological reserve (WERAC 2020).

12.3.2.2 Proposed South Coast Fjord National Marine Conservation Area

In June 2023, the Governments of Canada and NL, the Miawpukek First Nation, the Qalipu First Nation, and the Town of Burgeo signed a Memorandum of Understanding (MOU) to assess the feasibility of creating a NCMA in the South Coast Fjords area on the southwest coast of the island of Newfoundland (see Figure 12.1; note: originally proposed NMCA study area boundaries shown in figure – the proposed boundaries are currently being revised; Parks Canada 2025). It is of note that these partners are also investigating the possibility of redesignating Sandbanks Provincial Park as a national park in southwestern Newfoundland (Parks Canada 2025). The feasibility of the proposed NMCA is currently being assessed with an anticipated completion within two years of signing the MOU (Parks Canada 2025). Following the assessment, recommendations will be provided to leadership, including the Minister of Environment and Climate Change (Parks Canada 2025).

The study area initially proposed in October 2024 for the NMCA was approximately 9,114 km² and the Sandbanks study area (within the NMCA study area) spans 2.26 km² (Parks Canada 2025). In February 2025, Parks Canada indicated that adjustments were being made to the study areas based on input from stakeholders that identified important areas for finfish aquaculture and bottom-trawling fisheries within the initial proposed NMCA boundaries (Parks Canada 2025). A bulletin released by Parks Canada to stakeholders (not cited here as it has not yet been made public) indicates the revised proposed boundaries will have a study area of 6,491 km².

Species observed along the south coast of NL within the South Coast EBSA (see Section 12.1.1.1) are also present within the proposed boundaries of the South Coast NMCA, such as wild Atlantic salmon, Atlantic cod, sharks, lobster, whales (e.g., humpback, blue, fin), dolphins, porpoises, and leatherback sea turtles. The new proposed boundaries will still encompass habitat for these species as well as the Sandbanks Provincial Park with its sand dunes, marshes, and migratory shorebird habitat, including Piping Plover (Figure 12.3; note: information derived from a brochure provided to stakeholders by Parks Canada in February 2025; not cited here as it is not yet publicly available). An SBA has also been proposed to be retained within the boundaries in a known area of sea pen communities to protect this habitat and support marine biodiversity.



Source: Brochure provided to stakeholders by Parks Canada in February 2025 (not cited here as it is not yet publicly available).

Figure 12.3. Proposed updated South Coast Fjord NMCA boundary (February 2025).

12.3.3 Habitat Enhancement Projects

In 2016, Canada launched its Oceans Protection Plan in an effort to improve marine safety for shipping and also for response time to incidents (GC 2025e). More than 50 Projects have been initiated, strengthening the role of Indigenous people and improving shipping safety, training, and prevention of and response to marine incidents, as well as protection and restoration of important marine ecosystems. Funding programs, such as the Coastal Restoration Fund and Aquatic Ecosystems Restoration Fund, have been accessed as part of the Oceans Protection Plan by Indigenous groups, academia, and organizations for restoration projects in NL. One such restoration program, the Conne River Riverbank Restoration, was awarded funding through the Coastal Restoration Fund in 2017. This restoration project was located in the vicinity of the MCE sea farm Study Area and had a focus on wild Atlantic salmon habitat and improving their migration route and surrounding ecosystem.

12.3.3.1 The Coastal Restoration Fund and Aquatic Ecosystems Restoration Fund

The Costal Restoration Fund was introduced as part of Canada's National Oceans Protection Plan, which launched in May 2017 and concluded in March 2022 (DFO 2022n). Over this five-year period, the fund provided $75 million to support projects aimed at restoring coastal aquatic habitats (DFO 2022n). The purpose of these funds was to address threats to marine habitats and species located on Canada's coasts (DFO 2022n). The funds supported efforts that contributed to strategic planning, identifying and responding to restoration priorities, rehabilitating aquatic habitats, and long-term sustainability (DFO 2022n). The program encouraged collaboration with Indigenous and community groups, academics, and non-profit organizations to engage in restoration planning, capacity building, monitoring, and mitigating stressors affecting marine life (DFO 2022n).

The funds supported four initiatives in NL (DFO 2022n). These projects were located along the South Coast of Labrador, the South Coast of NL (Conne River; Miawpukek First Nation Riverbank Restoration Project), and in Placentia Bay (DFO 2022n). The restoration efforts sought to address past environmental damage and assist fish populations in recovering from key threats (DFO 2022n).

In July 2022, the initiative was renewed and expanded under the name Aquatic Ecosystems Restoration Fund (AERF; GC 2023c) with an additional $75 million over five years to support aquatic restoration (DFO 2022n). The AERF has allocated $1.2 million to the Environment Resources Management Association to support wild Atlantic salmon in NL (NTV 2024). This funding is directed towards the Exploits River Atlantic Salmon Collaborative Watershed Restoration Project, in partnership with Memorial University, which focuses on improving salmon productivity by enhancing spawning habitats, increasing food resources, and developing restoration strategies specific to the Exploits River watershed (NTV 2024).

Miawpukek First Nation Riverbank Restoration Project

In 2017, the Coastal Restoration Fund announced the allocation of $404,100 over two years to the Mi'kmaq Alsumk Mowimsikik Koqoey Association (MAMKA) for a project aimed at protecting the marine ecosystem in Conne River, NL (GC 2022).

With an additional $235,000 investment from the Miawpukek First Nation, the total project funding amounted to $639,100 (GC 2022). The investment aim was to improve the long-term health of the Bay d'Espoir Estuary and reduce stressors affecting marine life and habitats (GC 2022). It focused on stabilizing the McDonald's Family and Culture Area within the Miawpukek Reserve, along the banks of Conne River, an Atlantic salmon river which has been heavily impacted by erosion from recent extreme weather events as well as reduced winter ice cover (GC 2022). The McDonald's Family and Culture Area is culturally significant as the site of the Miawpukek First Nation's annual Powwow and the annual salmon run in the Conne River is vital for the Miawpukek First Nation's food, culture, and ceremonies. The project helped stabilize and protect coastal shorelines through preventing sediment, tree roots, and debris from entering the river (GC 2022). By restoring this area, Atlantic salmon will ultimately benefit from improved migration conditions and a healthier ecosystem (GC 2022).

With the investments, the project included the construction of a bio-remediation structure along Conne River to reduce further erosion at the clay bank site (GC 2022). This effort stabilized 1,240 m^2 of the riverbank (GC 2022).

13.0 Mitigation and Monitoring

There are several primary types of effects that may result from MCE Project activities at the sea farms, including effects on fish and fish habitat. Mitigation measures and monitoring intended to minimize the effects of Project activities on fish and fish habitat are described in this section. The planned and unplanned Project activities considered in this section include:

- Deposition of organic material (i.e., feed, feces) from the sea farms onto the seabed;
- Release of therapeutants and antibiotics into the marine environment;
- Attraction of naturally-occurring biota to the sea cages;
- Pathogen/parasite transfer between farmed salmon and wild fishes;
- Fish escapes; and
- Entanglement.

13.1 Deposition of Organic Material from the Sea Cages

Several mitigation measures and monitoring procedures are implemented to minimize the potential effects of the deposition of organic BOD matter (i.e., fish feces, uneaten fish feed, and naturally occurring biofouling material) on fish and fish habitat occurring beneath and in the immediate vicinity of the sea cages. These mitigation measures and monitoring procedures are discussed below.

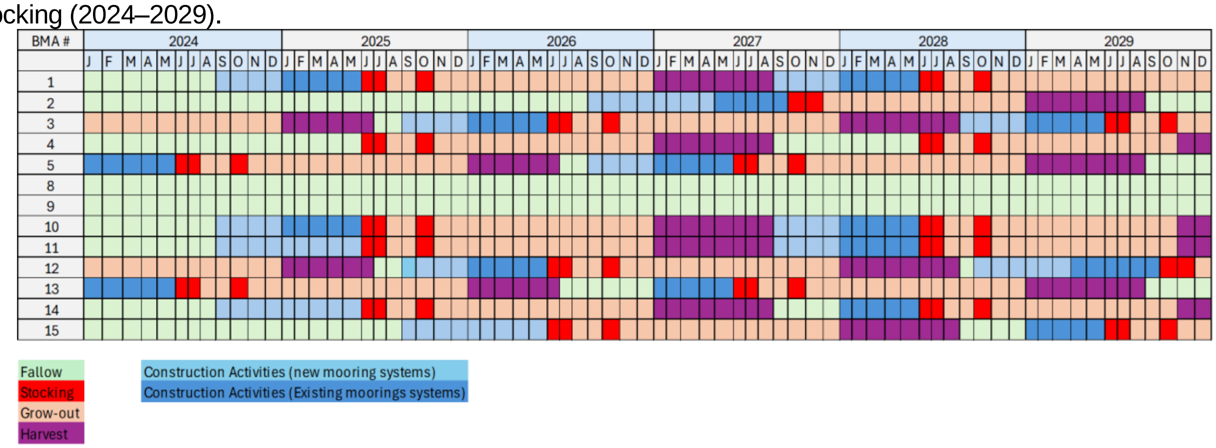
Sea Cage Site Selection

One of the first steps is to collect environmental baseline information for a sea farm location. The information supports the planning and the preparation of a Aquaculture Licence Application. Regarding the information that supports the assessment of organic deposition, the AAR information requirements must be met. Relative to effects on fish and fish habitat, proposed sea cage sites were selected based on adequate current speeds and current direction necessary to minimize depositional build-up and adequate water depth for sea cages. Sea farms were selected in areas that provide shelter, have suitable current conditions, and were predominantly ice free. The locations support the placement of sea cages over depths exceeding 30m. Sea cages systems were then oriented to minimize exposure to the prevailing winds and waves. Older aquaculture licences, licensed prior to the enactment of AAR in 2015 may not have comprehensive current measurements completed. This is not a regulatory requirement for these locations. However, MCE has committed to current profiling (that meets or exceeds the AAR 30-day requirements for BOD deposition) to support the upgrading of sea farm infrastructure and meet the FFA new third-party certified design and engineering requirements.

Fallowing

A primary mitigation measure that minimizes the likelihood that BOD matter will accumulate over successive production cycles is to fallow a sea farm at the end of each production cycle. Each BMA is required to fallow for no less than four months between stockings with farmed salmon. A fallow period is deemed to begin after the last fish have been harvested from the BMA. Individual sea farms are fallowed for at least seven months. A detailed fallowing schedule for each of MCE's sea farms is provided in Table 13.1. Follow-up monitoring to evaluate nutrification effects from deposition of BOD material is conducted at each of the sea farms as per regulations. MCE adheres to the regulations detailed in the BMA Agreement with FFA and AP 27 (FFA 2019). The *Monitoring Protocol for Hard Bottom Benthic Substrates under Marine Finfish Farms in Newfoundland and Labrador* (AAR, Annex 9; GC 2015) is followed. Additional details for fallowing and AAR monitoring for each sea farm are provided in the Sea Farm Sites Baseline Study (see LGL 2025a, Volume 3).

Table 13.1. MCE forecasted fallow periods based on production and construction schedules for salmon stocking (2024–2029).



Optimization of Feeding

Feed wastage is minimized via the use of established feeding tables/software used to determine feed type and amount, the monitoring of water temperatures, and an automatic feeding system, which integrates video monitoring in the sea cages. Salmon are monitored during feeding and once salmon have reached ~80% satiation, feed delivery is ceased. Cameras mounted in the sea cages provide staff (located in the control room on the feed barge, or at some sea farms, from a remote location) with a view of the feeding behaviour of fish and feed can be stopped when reduced feeding behaviour is noticed. This system reduces nutrient inputs into the environment by optimizing feeding.

Husbandry Practices to Minimize Biofouling on the Sea Cages

Husbandry practices designed to minimize biofouling also serve to mitigate effects on the marine environment. MCE schedules net cleaning of its sea cages to minimize and avoid the establishment of biofouling species, which otherwise can add to the depositional load of organic material. The cleaning schedule for cages and nets is developed based on environmental conditions as well as routine monitoring. Nets are cleaned via a ROV net cleaner equipped with an advanced camera system (e.g., FNC8 produced by AKVA group). Cages and nets are also cleaned after harvesting is completed and prior to cages being transferred to other BMAs. Routine checks of equipment utilizing underwater cameras (e.g., Orbit from Scale AQ), ROVs, surface inspections, and inspections by divers is used to confirm the cleaning schedule of the sea cages.

Sea Farm Stocking Density

MCE sea farm stocking density is 15 kg/m^3 (lower than the 18 kg/m^3 benchmark noted in provincial guidelines (FFA 2022). This density provides ample space for the salmon to move in the sea cage and not be crowded. This stocking density also assists with benthic impacts by lowering numbers of fish in cages and reducing the amount of feces that will be deposited in the area under each cage.

13.2 Release of Therapeutants and Antibiotics into the Marine Environment

Therapeutants and antibiotics will only be used based on the advice of health care professionals (private and provincial veterinarians) and in consideration of the health and welfare of the fish.

Optimization of Feeding

For therapeutants and antibiotics included in the feed, should their use be required, the optimization of feeding is the primary mitigation to minimize the potential effects on fish and fish habitat. Feed wastage is minimized via the use of established feeding tables/software used to determine feed type and amount and an automatic feeding system which integrates video monitoring in the sea cages. Salmon are monitored during feeding and once salmon have reached satiation feed delivery is ceased. Cameras mounted in the sea cages provide staff (located in the control room on the feed barge) with a view of the feeding behaviour of fish and feed can be stopped as soon as reduced feeding behaviour is noticed. This system reduces nutrient inputs into the environment by optimizing feeding.

Maintaining Fish Health

Maintaining fish health at a sea farm is the essential way to prevent health related impacts to fish and fish habitat. The key strategy to mitigate antibiotic use is good animal husbandry. These practices include an effective biosecurity program, vaccination against bacterial pathogens, and a comprehensive Fish Health Management Plan. Therapeutants and antibiotics are only used based on advice of health care professionals (private and provincial veterinarians). Antibiotics are only used to treat diagnosed bacterial disease and not as growth promoters. Of note, MCE has not used antibiotic medications at its sea farms in Newfoundland since 2021.

All smolt are vaccinated and health checked by CAV prior to transfer to sea cages to enhance their ability to resist diseases and ultimately the need for treatments. Should the need arise to use pesticides or chemotherapeutants, a prescription by a licensed veterinarian is required and the product must be approved and licensed for use in Canada by Health Canada.

Non-chemotherapeutant Options

MCE's *Salmonid Fish Health Management Plan* (see Appendix G in Volume 2 of LGL 2025b) has a variety of treatments that include non-chemotherapeutant options (i.e., mechanical equipment, and lice guards) reducing the need for repeated use of one treatment. MCE has available through a third-party service provider, the use of specialized mechanical equipment (e.g., Thermolicer®) that can assist with sea lice control.

13.3 Attraction of Naturally-occurring Biota to the Sea Farms

Several mitigation measures and monitoring procedures are implemented to minimize the potential effects of attraction of naturally-occurring biota to the sea farms. These mitigations also apply to marine fauna other than invertebrates and fishes such as marine birds, marine mammals and sea turtles. Marine fauna could be attracted to the sea farms for various reasons including the presence of concentrations of farmed Atlantic salmon, the potential build-up of biofouling on the sea farm infrastructure, and the accumulation of organic material, including unconsumed feed, on the seabed in the immediate vicinity of the sea farms.

Optimization of Feeding

The deposition of unconsumed feed from the sea farms is one reason that may attract naturally-occurring biota to the sea farms. Feed wastage is minimized via the use of established feeding tables/software used to determine feed type and amount and an automatic feeding system which integrates video monitoring in the sea cages. Salmon are monitored during feeding and once salmon have reached ~80% satiation, feed delivery is ceased. Cameras mounted in the sea cages provide staff (located in the control room on the feed barge, and for some sea farms, at a central off-farm location) with a view of the feeding behaviour of fish and feed is stopped when reduced feeding behaviour is noticed. This system reduces nutrient inputs into the environment by optimizing feeding.

Husbandry Practices to Minimize Biofouling on the Sea Cages

Another potential reason for the attraction of naturally-occurring biota to sea farms is the accumulation of biofouling on the sea cages. Husbandry practices designed to minimize biofouling also serve to mitigate effects on the marine environment. MCE schedules net cleaning of its sea cages to avoid and minimize the establishment of biofouling species, which can add to the depositional load of organic material. The cleaning schedule for nets is developed based on environmental conditions as well as routine monitoring. Nets are cleaned via an ROV net cleaner equipped with an advanced camera system. Cages and nets are also cleaned after harvesting is completed and prior to cages being transferred to other BMAs. Routine checks of equipment utilizing underwater cameras (e.g., Orbit Underwater Camera by Scale AQ), ROVs, and inspections by divers (as needed) is used to confirm the cleaning schedule of the sea cages.

Routine Removal of Dead Fish from the Sea Cages and Sea Farms

Mortalities are collected from sea cages daily. Any visible moribund fish or surface mortalities are also retrieved, and moribund fish are euthanized if required. By collecting mortalities daily this decreases predator attraction to the cages and minimizes disease risk. Once at the surface, the dead fish collected from the are transferred to a designated and approved container for ensilaging or disposal. The sea farms equipped with ensilaging equipment collect the dead fish in an ensilage tank and are ground into a slurry. The ensilage is transferred to shore for recovery at an approved facility. Fish mortalities are collected and removed weekly from the sea farms to avoid long term storage and minimize the attraction of seals, birds or other predators.

13.4 Pathogen and Parasite Transfer between Farmed Salmon and Wild Fishes, Including Atlantic Salmon

There is risk that disease and parasites may be transferred between farmed and wild Atlantic salmon (as well as other wild fish). There are two primary ways' of minimizing this risk.

1. Decrease the Potential for Interactions Between Farmed Salmon and Wild Fishes

MCE uses the following measures to decrease the potential for interaction between farmed salmon and wild fishes:

- Reducing the attraction of wild fishes to the sea farms by feed optimization
- Removal of biofouling from the sea cages to reduce habitat cover and food sources;

- Removing fish mortalities from the sea cages on a daily basis; and
- Fallowing of the sea farms to minimize the accumulation of organic material on the seabed.

2. Maintenance of Farmed Salmon Health

A number of aquatic disease-causing agents (pathogens) such as viruses and bacteria as well as parasites (i.e., sea lice), which occur naturally in the environment, can affect farmed fish. These pathogens can be spread from equipment used to transfer fish as well as through the water by animals releasing the pathogen. As part of the National Aquatic Animal Health Program (NAAHP), any finfish eggs or fish transfers in Canada must be sourced from and received by facilities where comprehensive biosecurity measures are followed, and which have been approved by regulatory agencies including DFO and FFA. The AAHD of FFA as per AP 12 (FFA 2019) will evaluate for disease risk and if all approvals have been met, issues a COHFT of live cultured finfish. The NL Introductions and Transfers Committee then issues the necessary Transfer and Transport permits. This program controls the spread of aquatic animal diseases within Canada. It not only protects farmed fish but also protects the health of all of Canada's aquatic resources including wild salmon.

A number of tools are implemented by MCE to eliminate or minimize the spread of disease and sea lice at the sea farms and the surrounding aquatic environment. MCE has developed and implemented a *Salmonid Fish Health Management Plan* (see Appendix G in Volume 2 of LGL 2025b) for its sea farms and all personnel are trained in its associated SOPs. The plan is reviewed and registered with FFA Aquatic Animal Health Division (AAHD) annually. In addition, MCE participates in FFAs AAHDs active and passive fish health surveillance program. Maintaining the health of its salmon is the primary means by which MCE prevents farmed based infection of wild fish. MCE practices are also evaluated under its Best Aquaculture Practices (BAP) certification. Under the program, an audit of sea farms is conducted every harvest year.

Mitigation measures and regular monitoring are in place to maintain fish health including (1) biosecurity measures, (2) routine husbandry practices, (3) health checks and procedures, (4) feeding procedures, (5) sea lice control procedures, (6) water quality monitoring, (7) vaccinations, and (8) removal and treatment of dead fish.

(1) Biosecurity Measures: MCE has entered into a BMA agreement with FFA and Cold Ocean Salmon to cooperatively enhance biosecurity. As outlined in Section 2.0, MCE has 13 separate BMAs (see Figures 2.2 and 2.3). BMAs enhance biosecurity by establishing discreet regions for

year class separation and are recognized as an effective approach to disease management, to mitigate pathogen presence and spread (Chang et al. 2007). The BMA delineations are nominal boundaries used by MCE to reduce risk of disease transmission and increase biosecurity. These boundaries are used to clearly define movements of personnel and equipment in a biosecure manner. The delineation of BMAs is based on an assessment of quantitative and qualitative environmental variables including detailed oceanographic data. FFA (2019) and earlier development policies set minimum distances between sea farms (AP 26) and minimum requirements for fallow periods between production cycles (AP 27). MCE has SOPs that detail the movement of personnel and equipment between and within BMAs. These SOP are designed to minimize the risk of disease introduction and spread.

FFA (2019) outlines numerous biosecurity measures including, but not limited to, those for vehicles, vessels and barges (AP 36), equipment (AP 37), wharves (AP 38), disposal of fish (AP 23) and disposal of harvest blood water (AP 39).

As noted previously, the NAAHP is designed to prevent the introduction and spread within Canada of reportable and emerging aquatic animal diseases. The program is consistent with international standards set by the World Organization for Animal Health (OIE). As part of this program, the Canadian Food Inspection Agency (CFIA) has a number of regulatory disease response tools including movement controls or "quarantine", a License to Transport of Animals or Things, and an Order to Dispose. MCE adheres to all CFIA requirements.

In a situation where a federally reportable disease is confirmed on one of MCE sea farms and CFIA does not consider the disease to be endemic to the region, domestic movement of farmed Atlantic salmon or farm equipment (including nets and cages), may require a Domestic Movement Permit Application to move Finfish and/or Things within Canada (CFIA/ACIA 5743). Whether a permit is required depends on the declarations of the reportable disease status of the areas being transferred from and to. The use of permits for these movements is a regulatory control measure that FFA initiates and oversees and is intended to contain certain diseases within areas of Canada where they are known to occur.

In the majority of situations, routine fish transfers are regulated by the FFA and DFO, under the National Code on Introductions and Transfers of Aquatic Organisms. An application to FFA and DFO addresses three main risks: genetics, ecosystem and disease prior to any transfer of the fish from the Hatchery to the sea farms for grow-out. MCE receives these approvals before fish are transferred from the Hatchery to its licensed sea farms.

MCEs licensed sea farms are based on suitable environmental conditions to grow Atlantic salmon. Details on the site characteristic are provided in the Sea Farm Baseline Study (LGL 2025a, Vol 3). Suitable water exchange and biophysical conditions in conjunction with farm systems, appropriate stocking densities, environmental monitoring, operational procedures that are responsive to changing conditions, and fallowing (AP 27), all contribute to fish welfare, fish husbandry, and biosecurity. Good management of fish health is the primary means of mitigating disease and parasite associated risks to the marine environment.

Other biosecurity measures MCE has implemented includes ensuring that feed is stored in secure silos on its feed barges, and mortalities are ensiled and stored or transferred to secure containers for storage. FFA oversees biosecurity through requiring approved plans for fish health and emergency response as well as routine audits (AP 35).

(2) Husbandry Practices: MCE employs standard husbandry practices designed to minimize the spread of disease at its sea farms. These practices include cleaning/disinfecting of equipment, vessels, and ROVs, and managing personnel and tasks to minimize health risks to fish. The cleaning schedule for cages and nets is developed based on environmental conditions at the sea farms as well as routine monitoring and can be as frequent as biweekly in the spring and summer periods when biofouling can grow quickly. Sea cage systems and nets are also cleaned after harvesting is completed and prior to sea cage systems being transferred to another BMA. MCE conducts routine checks of its sea cage systems and equipment using underwater cameras, ROVs, and divers (as needed). Sea farm personnel have dedicated gear for the specific sea farm. Visitors use designated gear, and where this is not possible visitor gear is cleaned and disinfected before use. Personnel gear is cleaned and disinfected on a routine schedule. MCE uses dedicated inflow (material to the sea farm) and outflow (material from the sea farm) wharves to transport farm equipment and supplies.

Salmon mortalities are removed daily from sea cages. When handling mortalities from the sea cages, personnel are required to wear rain gear, gloves, and boots which are disinfected after each collection. Once at the surface, the dead fish are ensiled on site in the Bays West Area, and stored whole in leak proof containers in the Bays East Area. Mortalities and silage are transferred to a designated wharf for collection by an approved transport company.

Mortalities (whole) and silage currently are sent to New World Dairy (St. David's, NL) to be disposed in their anaerobic digestor. Should New World Dairy be unable to accept the mortalities and waste products (e.g., fish waste and fish silage), mortalities can be sent to the Barry Group Inc. rendering facility (Burgeo, NL) or Cardwell Farms (Penobsquis, NB). The mortality vessel collects and transfers mortalities from a single BMA per trip. In addition, procedures are in place to collect, record, and process fish in the event of a mass mortality.

(3) Health Checks and Procedures: MCE personnel monitor fish health at the sea farms using procedures prescribed by the Aquatic Animal Health Division (AP 29, 32, 33, and 34; FFA 2019). Staff routinely monitor fish for physical changes such as signs of fin erosion, lesions, pigmentation problems, parasites and deformities, as well as behaviour changes. As part of MCEs *Salmonid Fish Health Management Plan* (see Appendix G in Volume 2 of LGL 2025b), an active and passive surveillance program is implemented in cooperation with the Designated Aquaculture Veterinarian (DAV) as well as the Provincial Aquaculture Veterinarian (PAV) (AP 29). MCE personnel are trained to identify and report any noticeable changes (physical and behavioural) to supervisors. Three of the most common types of pathogens that can cause issues with fish at the sea farms are viruses, bacteria and parasites (i.e., sea lice). Many of these pathogens are considered to be opportunistic and can create a serious health challenge, especially if the fish are exposed to stressful events or prolonged sub-optimal conditions. Care is taken throughout, to ensure the effects of necessary stressful activities are kept to a minimum, with sufficient recovery time allocated between activities. Proper husbandry practices are in place to ensure overall general hygiene is kept up to standard and proper disinfections procedures are in place. Routine parasite screening and diagnostic testing are performed at the sea farms. All routine parasite screening and active surveillance is conducted by MCE personnel on a schedule determined in consultation with the PAV and DAV that also considers fish health and

welfare. In addition to MCE active surveillance, PAV perform an active surveillance program along with diagnostic testing (AP 29). Knowledge or suspicion of a Reportable Disease is reported to the provincial Chief Aquaculture Veterinarian within 24 hours (AP 32).

MCE are using a sea cage net which extends >20 m below the water surface (AP 2). These nets have sufficient volume to allow fish freedom to swim to depths and avoid surface conditions during certain times of the year or during an extreme weather event (e.g., water temperature, and waves). The additional volume in the sea cages can decrease stress on the fish.

(4) Feeding Procedures: MCE maximizes feed intake and minimizes feed waste with the use of established feeding tables and software. Feed type and water temperatures are applied to determine the feed amount, and an automatic feeding system distributes the feed. An integrated video monitoring system in the sea cages is used to monitor the feeding and salmon behaviour. Once salmon have reached ~80% satiation, feed delivery is stopped. Cameras that are mounted in the sea cages provide staff with a view of the feeding behaviour of fish and feed can be stopped as soon as reduced feeding behaviour is noticed. This system optimizes feeding by providing only enough feed to satisfy the fish while reducing nutrient inputs into the environment.

(5) Sea Lice Control: MCE has developed and submitted to FFA an Integrated Pest Management Plan (IPMP) (AP 40). Included in this plan are MCEs prevention, monitoring and reporting strategies and procedures for mitigation and monitoring. Prevention is the first line of defense, and several strategies are in place to prevent infections from sea lice, which are summarised below.

- As part of the BMA Agreement with FFA and as per AP 24 requirements, sea farms are stocked with only a single year class. Preventing the mixing of younger fish with older fish when stocking sites reduces the risk of pathogen spread.
- Separating sea farms between operators (AP 26) and fallowing between production cycles (AP 27) are both strategies to reduce or eliminate pathogens. Creating distance between sea farms reduces the likelihood of transfer while allowing a site to remain fallow (empty of fish) following a production cycle can break the life

cycle of sea lice, thereby reducing or eliminating likelihood of re-occurrence.

- Maintaining good husbandry practices ensures fish are healthy and increase their ability to resist infection. Some examples of good husbandry include low stocking densities, good nutrition and feeding practices, predator control, hygiene and selective breeding (Gharbi et al. 2015; Noble et al. 2018; Santurtun et al. 2018; Laymann et al. 2024).
- MCE actively investigates the performance of new technologies and practices that can assist in sea lice prevention. For example, a sea lice skirt is currently being tested at the McGrath Cove sea farm. The sea lice skirt installed in a sea cage acts as a barrier in the top several meters of the water column where sea lice predominately occur. The mesh of the skirt is small enough to prevent the drifting sea lice life stages (nauplius and copepod) from entering the sea cage.
- Past performance trials of Cunners (*Tautogolabrus adspersus*) as cleaner fish in collaboration with MFN were conducted. Based on the findings of the trials, cunners are not currently used or being considered as cleaner fish on MCE sea farms.

To determine if the prevention strategies are working, constant monitoring is required. MCE conducts sea lice counts weekly on salmon starting in the spring and typically ending in the fall. In consideration of fish health and welfare, when water temperatures are below 5˚C, physical monitoring can be less frequent and is based on the advice of a veterinarian. As part of the monitoring process outlined in the IPMP, data are recorded and reported to the MCE Fish Health Unit, publicly as per AP 17 on the NAIA portal (https://aquacultureportal.ca/), and as part of the Sea Lice Decision Support System (SLDSS). MCE, along with other aquaculture industry members in NL and NB have been participating in the SLDSS for the collection and study of sea lice settlement and treatment data with the Centre for Aquatic Health Service at the Atlantic Veterinary College (AVC) in PEI. Developed in 2009 for New Brunswick aquaculture operators, the software-based SLDSS (known as Fish-iTrends) was first used in Newfoundland in 2010 to provide accurate reports to regulators and allow coordinated sea lice management and treatment strategies. Operators input data such as water temperatures, sea lice counts and treatment parameters into Fish-iTrends and AVC maintains the data for regulators to access reports. This cooperative effort is intended to lead to a better understanding of the efficacy of sea lice management and control tools.

Sea lice data collected during monitoring and reported to the MCE Fish Health Unit are used to determine if any intervention methods are required. Intervention is based on accurate and timely sea lice counts and only occurs under the direction of MCE's DAV, Production Director, and Health Director.

Intervention methods can include therapeutants or mechanical options. Therapeutants are administered in the fish feed (e.g., SLICE) or as a bath (e.g., Salmosan). The use of therapeutants is considered based on the advice from the DAV and PAV and the development stage of affected fish. The Mercatus Farmer software (by ScaleAQ) is an important tool in providing quantitative feedback on the efficacy of treatments. To avoid resistance, proper treatment rotation (not relying on just one treatment) and the proper dosage of each treatment is monitored and ensured. Depending on the size of the fish, it is also possible that the fish will be harvested early to minimize sea lice. Delousing efforts are balanced against fish welfare, avoiding resistance, and the effects on the environment. Continuous monitoring and response are important to early intervention and ensuring sea lice levels remain low.

Mechanical sea lice removal options include technologies such as a Thermolicer® or flusher. Both options are available to MCE via a third-party provider and involve pumping the fish from the sea cage into a machine (on a dedicated vessel) to separate the lice from the fish with increased temperature (Thermolicer®) or water sprays (flushers). The fish are then returned to the sea cage, and the sea lice are filtered out and disposed of at a licensed waste management facility (e.g., New World Dairy anaerobic digestor or composting).

(6) Water Quality Monitoring: A routine program is established for monitoring, measuring, and recording water quality at all active sea farms. In addition to biophysical parameters, sea farms are monitored for harmful algae blooms (HABs). Daily monitoring of water samples at each active sea farm commences in the spring and continues through late fall (mid-March to November). During, winter (December to mid-March), sampling is less frequent and is conducted as advised by MCE management in consultation with the DAV. MCE has contingency procedures in the event water quality deteriorates, and

procedures vary depending on the cause of the deterioration. Water quality monitoring is enhanced to determine the problem and to estimate how long the problem may persist. Cessation of feeding is immediate. Fish are monitored more closely for the duration of the event and fish handling is avoided until water quality is deemed acceptable. In addition, aeration devices are available for use at each sea farm that can be used to break up and move blooms of plankton (this is avoided for *Chaetocerous* species as this algae's spines are harmful to fish gills and when chains are broken apart, it can cause more harm).

(7) Vaccinations: As discussed above, prior to transfer to sea, MCE vaccinates all its salmon as per the specific recommendations of provincial veterinarians. Vaccines in NL must be approved by the CAV (FFA). Typical vaccinations include the standard bacterin with *Aeromonas salmonicida*, *Listonella anguillarum* and anguillarum type II, and *Vibrio salmonocida*. MCE includes the ISA vaccine based on consultations and recommendations with health authorities (FFA and DAV).

(8) Mortality Removal and Treatment: MCE is using LiftUp systems and ROVs to retrieve fish mortalities from sea cages daily. Any visible moribund fish or surface mortalities are retrieved, and moribund fish are euthanized if required. Collecting mortalities routinely decreases predator attraction to the sea cages and minimizes disease risk. The number of fish mortalities are recorded daily. When handling moribund fish from the sea cages, personnel are required to wear rain gear, gloves, and boots which are disinfected after each mortality disposal. Once at the surface, the dead fish are collected in a designated and approved container for transfer to a designated wharf for collection. Every effort is made to avoid transporting mortalities between sites and BMAs. If a mass mortality occurs, an emergency response plan (*Mass Mortality Contingency Plan*) details procedures for mortality removal and treatment.

13.5 Fish Escapes

MCE fish escape prevention measures include only using sea cage systems that exceed regulatory standards, the use of specialized equipment, and comprehensive personnel training and SOPs to minimize human error. These measures are essential to reducing the likelihood of fish escapes. MCE has implemented personnel training and SOPs for fish transfers. Additionally, MCE has mitigation measures and monitoring in place to manage interactions with predators, as well as ice on the sea cages, that could compromise the sea cage system. MCE has developed management strategies and maintained BAP accreditation, which audits MCE processes to minimize effects on the environment. Compliance is demonstrated through audits of procedures, inspections and staff training to control fish escapes.

13.5.1 Code of Containment (COC)

MCE has implemented practices that meet or exceed The Code of Containment (COC) in order to mitigate the risk of farm salmon escapes. The COC is based on internationally recognized principles that focus on procedures which minimize the potential for equipment failures and improve upon handling practices. There are five primary elements to the COC: (1) Equipment; (2) Handling Practices; (3) Inspections; (4) Documentation and Reporting; and (5) Mitigations. These elements and how they will be specifically applied to the Project are described below. MCE is continually adapting its methods in-step with the state-of-knowledge of the global salmon farming industry best practice (i.e., containment systems and their placement are being designed with the use of site-specific data and the engineering is now certified by a third-party).

(1) Equipment: As per the COC, all finfish containment systems (cage structures and nets) must be designed, constructed and installed to withstand local weather and ocean conditions including storms, water currents, and waves. Sea cage systems must also be maintained to control biofouling and ice accretion, which can compromise the system. Predator control measures are also important to minimize the risk of escapes (see below for more details). In addition to following the COC requirements for cage structure, nets and moorings, MCE utilizes cage systems, farm design and installation that has met a third-party engineering standard that exceeds the COC (AP 2). This standard covers specifications for collar material, net requirements, moorings, and environmental considerations. Factors such as material and load for Serviceability Limit State (SLS), Ultimate Limit State (ULS), Accidental Limit State (ALS), and Fatigue Limit State (FLS) are assessed during the certification process. The sea cage collars are constructed to allow flexibility without compromising on strength during strong sea conditions. The material and design consider moving and fixed ice as well as predicted 50-year storm intensities. HDPE (High Density Polyethylene) nets are commonly used. These nets provide high abrasion resistance. Staff are trained and tasked with removing ice build-up on nets and cage components. MCE will also use a ROV to assist with tasks such as net inspections, if required.

(2) Handling Practices: The COC details Handling Practices and includes appropriate precautions to prevent escapes during all stages of fish handling including transfers, counting, grading, sea lice counts, treatments, harvesting, net changing or cleaning. MCE seeks to minimize net handling to reduce abrasion and risk of weakening nets which may increase opportunities for escapes to occur. As a minimum, MCE adheres to the best practices in accordance with the approved Management Plans and SOPs on file with FFA for grading, weight sampling, sea lice counts, transportation, well boat treatments, and harvesting (e.g., catch net use and deployment SOP). A common

mitigation measure that reduces the likelihood of escapes during handling is the use of a drop net. Drop nets are placed under the work area and above the sea surface so that in the event a fish was 'dropped' during routine procedures that require handling of fish (e.g., sea lice counts). Prior to each use drop nets are inspected for holes, wear and any other damage (i.e., catch net use and deployment SOP). These secondary catch nets are secured at transfer hose joints, and between the well boat and sea cage (or docking location), and over any open areas where sampling or other handling events are occurring. All catch nets are secured by rope (e.g., no "draping") and remain in place for duration of activities involving fish handling. Drop nets are of sufficient size to cover the entire work area and the mesh size is small enough to contain the smallest fish being handled. During transfers, the transfer hose ends are always subsurface when in the cage and submerged in the fish hold to prevent escapes. This line remains submerged for a minimum of five minutes after the fish are transferred to the well boat to ensure there are no fish remaining in the transfer line. Before transferring fish, all pipe connections are wrapped with a containment net to ensure fish cannot escape as a result of failed connections. MCE uses well boats equipped with automatic counters and have cameras that can monitor the fish being loaded, held, and offloaded as an added security during handling. The fish are monitored (via video camera) and counted during transfer into the sea cages. Fish counters and video cameras used during fish transfers and harvesting monitor fish numbers and enable a quick response to potential issues. For fish handling events such as sampling/sea lice counting that are conducted on the deck of a vessel, all deck openings including scuppers are secured prior to fish sampling. MCE uses new HDPE generation nets that remain in place during the entire growth cycle. This eliminates the need to change nets with fish inside during a production cycle. This reduces the associated risk of fish escapes. All personnel receive appropriate training in fish handling, net handling and net maintenance procedures upon hire. MCE continues to investigate, through its global research and development teams, innovations in anti-fouling and pest management options to minimize the need for net cleaning and handling.

(3) Inspections: As part of the COC, once nets are over three years old, they are tested every 18 months by a third party. Nets are tested for strength (e.g., stress test with a tension scale instrument) and their condition is inspected for visible damage. In addition, as a minimum, nets are visually inspected at a minimum every 30 days by a qualified dive team or trained ROV operator (AP 2). Additional net checks may be conducted following any operational activity or event such as extreme weather conditions, smolt deliveries, predator attacks, vandalism or other operational activities that involves net handling and may increase the risk of net failure. Cages and surface mooring components are also inspected as per the COC. Surface components of mooring systems, cages, nets and ropes on each site are inspected once per week and recorded. Prior to system certification MCE is required to submit a "Mooring Maintenance/Replacement Plan" for each site that will be occupied with

fish on an annual basis. With implementation of third-party certification of the sea cage systems, inspections are now dictated by the engineering requirements. In addition, periodic audits of the cage system as specified in COC Procedures for Compliance are conducted and FFA will arrange for audits of net testing procedures. Audits by FFA are conducted at a minimum of twice yearly (one in the spring, after fish entry; one audit in fall/early winter). Any identified damaged equipment is repaired or replaced immediately. Table 13.2 summarizes sea cage system inspection and reporting requirements.

Table 13.2. Summary of sea cage system inspections and reporting requirements.

Responsible Party	Component	Method	Inspection Frequency	FFA Reporting Frequency
MCE	Components of mooring systems, cages, nets and ropes (surface)	Visual	Per week	Every 30 days
MCE	Net strength test (surface)	Manual (calibrated device)	18 months (if nets are >3 years old)	On request
MCE	Net inspections (Subsurface)	Diver or ROV	30 days	Every 30 days
MCE	Nets (subsurface)	ROV during in-situ net cleaning	Variable (per cleaning)	Every 30 days
MCE	Moorings	Mooring Maintenance/Replacement Plan	N/A	Annually
MCE	Salmon (farm inventory)	Fish counts	Per transfer	Annually
FFA	MCE site inspection records	Electronic	Twice yearly	Twice yearly
FFA	Surface components of mooring systems, cages, nets and ropes	Physical walk around	Twice yearly	Twice yearly

In addition to the COC, MCE complies with design standards outlined in the Norwegian Standard (NS) 9415 and the Scottish Standard to its sea farms. These standards are rigorous and were developed to address areas of technology failure in the past that had resulted in escapes. The provincial COC and AP 2 stipulate that all active farms will be designed and installed to a third-party engineered standard. In line with provincial government timelines, MCE is implementing this requirement on all sites as sea farms enter into production.

(4) Documentation and Reporting: Each net MCE owns has a clear inventory net number tag that is visible during operations. MCE maintains an accurate inventory of all nets in use indicating information such as manufacture date, type, size and testing dates. This inventory is submitted annually to FFA. After nets are removed from storage a net deployment visual inspection is completed to verify the nets condition and a report on the condition is submitted to FFA. Every 30 days, a submission of net inspections (diver or ROV) documenting status of the nets, including any holes or repairs, to FFA is conducted as per COC and AP 2. Net storage records are maintained and available

to FFA for auditing purposes. Net stress testing results are submitted every 18 months (for nets over three years old) and annual submission of inventory reconciliation including number of fish stocked, mortalities, removals and explanation of discrepancies is performed. As per AP 17, escape events that occur on a licensed aquaculture site will be reported publicly. All documentation will be maintained by MCE for inspection by FFA during their routine audits.

(5) Other Mitigation Measures: To prepare for a fish escape event, escape response drills are performed on site annually. All employees complete a training course and perform an escape response drill as part of their site orientation. Escape response drills include deploying weighted netting over a "mock" hole in the sea cage, reviewing kit contents, and reviewing SOPs. Should any escape be suspected or known to occur, the COC requires immediate reporting of escape incidents to both DFO and to the FFA (AP 17). MCE would initiate discussions with DFO within 24 hours of the incident to determine if recapture efforts should be initiated. Authorization of recapture is at the discretion of DFO in consultation with MCE and stakeholders as needed. Although all escapes are required to be reported, not all escapes incidents will trigger the requirement by Authorities for recapture efforts. Factors such as the life history stage of the escaped fish, the time of year, incident-specific factors and conservation objectives for wild fish populations are considered. DFO issues a license for recapture each year, and DFO directs whether MCE can commence recapture efforts. DFO, in consultation with MCE, may determine that captured salmon should be sampled to verify that they are from MCE's sea farms. Each BMA has an escape response kit, and all marine personnel are trained in its use. Once notification has been provided to DFO, and if a recapture response is authorized along with any necessary licenses, MCE will enact their recapture plan. If conditions permit, it will involve deployment of gill nets and/or dip nets near the sea farms where the escape has occurred. MCE will initiate a recapture response with DFO's approval and in accordance with recapture license and protocols. If a fish escape occurs or is suspected, MCE will submit a response plan to the authorities for approval. This response plan includes methods to complete an initial estimate of the number of escaped fish. The estimate of escaped fish would be confirmed during final harvest. In addition, at the end of each year, fish inventory reconciliations are performed and submitted to the FFA to ensure all fish have been accounted for at each sea farm. Of note, during a production cycle, if feeding trends do not align with the expected number of fish in a sea cage then a full count of the sea cage may be conducted via use of a well boat. The decision to conduct an immediate fish inventory count following an escape event would be directed by regulators; the scale of the event is the primary determinant.

13.5.2 Provincial Aquaculture Policy and Procedures (FFA)

As per AP 17 (FFA 2019), MCE immediately reports to FFA (Assistant Deputy Minister) any escape event. These events are also publicly reported within 24 hours. MCE response plans require review and approval by applicable agencies with jurisdictional authority (i.e., DFO for fish escapes) and FFA. Should an escape event occur, all treatment and health records are made available to the CAV with FFA upon request (AP 32). In addition, as per regulations (AP 2), MCE has developed and implemented an Incident Management System for reporting, analysis of escape events, and determining corrective action to prevent a reoccurrence.

13.5.3 MCE Plans and BAP Accreditation

Mowi ASA, parent company of MCE, has a global goal of zero escape incidents. MCE has incorporated this goal into their site and system design, gear used and operational practices. MCE draws upon Mowi's global experience and years of research into equipment as well as training and operational procedures developed from salmon farming in challenging environments in Norway and Scotland to prevent escapes. MCE fully supports the management strategies in the COC (FFA 2022). MCE has included all equipment standards, handling practices, reporting and audit requirements, inspections and mitigations in the COC in company policies and management practices. MCE has developed a multi-step approach that addresses all aspects of escape potential. In addition to the use of specialized engineered equipment, specific operational procedures and training for staff, MCE also assesses the suitability of a site's location and exposure for farm installation to reduce the risk of system failure and escapes.

MCE has achieved BAP accreditation (three-star), which is a voluntary program and administered by third-party certification bodies. Among the numerous BAP requirements include proof of certification of moorings, engineers' structural reports for cage system, escape risk analysis, predator deterrence and precautions related to handling procedures and inventory accounting. MCE must provide evidence of staff training records and interviews with staff are conducted by auditors to confirm this has occurred. This voluntary program adds another level of accountability that all MCE processes and documents are in order and meets regulatory requirements.

13.5.4 Predator Protection and Control

Methods to monitor, deter, and exclude marine predators from the sea farms are required because predators such as sharks and tuna can potentially create holes in nets which may contribute to escapement. In addition, birds may attempt to take fish from the sea cages. Several mitigation measures and monitoring tools are in place to minimize interactions with predators. MCE practices passive predatory deterrence including prompt removal of fish mortalities to reduce attraction of predators. Waste is not held at alternative storage locations near the sea farms and is regularly removed from the sea farms to avoid long term storage and minimize the attraction of seals, birds or other predators. Fish mortalities are removed daily from the sea cages and typically mortalities are collected and removed weekly from the sea farms. Feed is contained in silos on feed barges and not accessible to predators or pests.

Each sea cage has bird nets, which cover the entire top of the cage and prevent birds from taking fish. The bird net and support structures (i.e., poles) are part of the sea cage system and are designed to provide sufficient tension to eliminate net sagging. High-quality protective netting is installed on top of the cages using the support structure to protect the fish from bird and mammalian predation. Bird nets are deployed ensuring mesh size is sufficient to deter predators but minimize the risk of entanglement, nor sag under the weight of preying birds. Bird nets are inspected for damage after a storm event. Note that to date, proper installation and maintenance have ensured no incidents of birds becoming entangled in the bird nets at the MCE sea cages. If a bird does become entangled MCE will contact ECCC-CWS to determine appropriate procedures to release the bird given the particular situation. The MCE incident management system is followed to address unforeseen or unprecedented incidences, and would be followed to determine reporting requirements, determine the cause, implement corrective actions, and determine how to avoid a repeat occurrence.

For waterborne predators several techniques will be used. As previously noted, HDPE nets with steel core are commonly used in production. This material is stronger and more resistant to tears and “bites” from predators providing additional protection for escapes. The fish behaviour in sea cages will be monitored by personnel on the feed/accommodation barge for indications (i.e., crowding in bottom of net, skittish behaviour, change in feeding) that a predator may be nearby. If fish behaviour indicates the presence of a predator and/or a predator is directly observed (via the video or by personnel at the sea cage), the net will be inspected immediately for holes. There are trade-offs with using an anti-predator net—the primary drawback is that it makes cleaning the primary net much more difficult, which can result in water flow issues and subsequent health risks to the fish. The use of anti-predator nets is determined on a site-by-site basis. Regular removal of mortalities from sea cages (daily) and sea farms (weekly) minimizes the attraction of predators like sharks and seals.

It is possible that seals and river otters may be attracted to the sea cages, but it is unlikely they would gain access to fish from the top of the sea cage. The fencing (and bird netting) on the inside of the gangway would make it difficult for these animals to gain access to the fish. Like sharks, it is possible that seals and perhaps river otters may attempt to enter through nets. As described above, the containment system and monitoring minimize this risk.

Keeping the sea farms free of waste (including food scraps) and mortalities during operations reduces the attraction of opportunistic birds and other wildlife. MCE methods to deter predatory and nuisance species are summarized in Table 13.3. No acoustic harassment devises are used by MCE below the water level. Sea farm personnel are familiar with the provisions of the MCE plan for environmental management of wild species and instructed to record on the Daily Site Report (DSR) the species and numbers of all avian and mammalian predator mortalities, even if accidental.

Table 13.3. Deterrence control methods used for predatory and nuisance species at MCE sea farms.

Predator	Control Method	Description
Birds: Osprey, Eagles, Gull species	Equipment: Top net poles or bird stands and top net No mortalities or refuse exposed in open containers. Mortalities are ensiled on site or contained in a closed designated container for removal off-site. This practice eliminates odours and visual attractants.	Poles or bird stand with a top net of HDPE 38 mm[a] with 1.6 mm twine[b] or a nylon net. Installation of bird netting is to the top of the grower net and secured to the handrail. Handrails are marked with 10 cm x 60 cm yellow reflective tape in four locations of the top rail, equidistant apart. Ensilage equipment is present on some barges. Those without ensilage equipment use covered xactic boxes. Mortalities are routinely removed from sea farms for disposal at an approved location.
Marine Mammals: Seal, Mink, Otter, Orca whales	Equipment: Single net system – HDPE main net with Ultracore stainless steel woven into mesh on the bottom. The use of live traps for otters and mink may be considered as permitted by FFA. No mortalities or refuse exposed in open containers. Mortalities are ensiled on site or contained in a closed designated container for removal off-site. This practice eliminates odours and visual attractants.	38 mm[a] HDPE Ultracore net with 3.1 mm[b] twine on the walls of the net. There is also a predation prevention net on the bottom (cone of the net) made from 4.2 mm[b] HDPE Ultracore. The Ultracore contains stainless steel wiring woven into the bottom mesh which improves strength, abrasion and predation resistance. This has proven effective against large sea lions and other marine predators in British Columbia. If the sea farm has a nylon grower net (instead of HDPE), an additional predator net may be employed (a second net surrounding main net). Ensilage equipment is present on some barges. Those without ensilage equipment use covered xactic boxes. Mortalities are routinely removed from sea farms for disposal at an approved location.
Fish: Shark, Tuna, Dogfish	Equipment: Single net system – HDPE main net with Ultracore stainless steel woven into mesh on the bottom. No mortalities or refuse exposed in open containers. Mortalities are ensiled on site or contained in a closed designated container for removal off-site. This practice eliminates odours and visual attractants.	38 mm[a] HDPE Ultracore net with 3.1 mm[b] twine on the walls of the net. There is also a predation prevention net on the bottom (cone of the net) made from 4.2 mm[b] HDPE Ultracore. The Ultracore contains stainless steel wiring woven into the bottom mesh which improves strength, abrasion and predation resistance. This has proven effective against large sea lions and other marine predators in British Columbia. If the sea farm has a nylon grower net (instead of HDPE), an additional predator net may be employed (a second net surrounding main net). Ensilage equipment is present on some barges. Those without ensilage equipment use covered xactic boxes. Mortalities are routinely removed from sea farms for disposal at an approved location.

Notes:

[a] Mesh square size.

[b] Twine thickness.

13.5.5 Other Mitigation Measures

In addition to the measures in the COC, Aquaculture Policy and Procedures, BAP, and predator protection and control, there are other mitigation measures in place to further minimize the likelihood of fish escapes. For example, sea farms are selected in areas that provide shelter, have suitable current conditions, and are predominantly ice free. Sea cages are then oriented to minimize exposure to the prevailing winds and waves. Additionally, husbandry practices such as maintaining clean nets and continuous monitoring of fish and nets also serve to minimize the risk of fish escapes.

13.6 Entanglement

It is possible that marine mammals, sea turtles, river otters, wild fish, and birds may become entangled in the sea cage nets and in the case of some animals in the associated mooring and buoy lines. MCE practices passive predatory deterrence to reduce the risk of entanglement. Storing feed in silos on the feed barges, and keeping nets clear of fish mortalities are designed to reduce the attraction of seals, birds or other predators to sea farms. Sea cage mooring and buoy lines are kept tensioned and there are no loose ropes in the water. The MCE incident management system is followed to address unforeseen or unprecedented incidences such as a bird entanglement, and would be followed for reporting requirements, to determine the cause, implementation of corrective actions, and determine how to avoid a repeat occurrence. MCE has not experienced entanglement of marine mammals, otters, wild fish, and sea turtles, but would report any incident to DFO as per conditions of license and action will be taken, in consultation with DFO (and the Whale Release and Strandings Group), to free or remove the animal. In an extreme scenario where there is risk to personnel safety, or the animal cannot be released without serious suffering or risk to its life, lethal measures would be considered in consultation with DFO.

13.7 Monitoring Plans

As indicated in Section 7.2.3 of the EIS Guidelines, MCE will prepare and submit Environmental Effects Monitoring Plans (EEMP) subsequent to the completion of the EIS but prior to initiation of Project construction. The Benthic EEMP will provide the details of the follow-up monitoring of most relevance to fish and fish habitat. Key follow-up monitoring and activities that will be implemented to validate predictions regarding the residual effects of planned Project activities on fish and fish habitat include:

- Underwater camera surveys (i.e., drop camera, ROV) of benthic habitat in and near sea farms will continue to be undertaken to assess the degree of deposition of organics from the sea farms during routine operations as per AAR requirements;
- Collection and analysis of samples for various parameters (e.g., sulfide levels) of the deposited organic material as per AAR requirements

- Following the use of pesticides reporting of fish morbidity or mortality outside the aquaculture facility as per the AAR requirements; and
- Development of a response plan, consistent with AAR and associated Aquaculture Monitoring Standard, that describes mitigation measures that will be implemented if regulatory thresholds for BOD are exceeded.

An EEMP for AIS will also be developed that includes the mitigation measures and monitoring employed to prevent AIS introduction, transport, and spread as stipulated in Section 7.2.3.4 of the EIS Guidelines. As noted previously, AIS can directly affect fish and fish habitat.

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List of Appendices

Appendix A: Final EIS Guidelines (Section 4.3 and 4.3.3)

4.3 Baseline Studies

Baseline studies shall provide a description of existing conditions in biophysical and socio-economic environments that could be affected by the Project, both in the immediate vicinity and beyond. This shall include the components of the existing environment and environmental processes, their interrelations and interactions, as well as their variability over time scales appropriate to the effects analysis. The level of detail shall be sufficient to:

- identify and assess any adverse environmental effects that may be caused by the Project;
- identify and characterize the beneficial effects of the Project; and
- provide the data necessary to enable effective follow-up.

The boundaries of the study area shall be defined for each baseline study and the rational for the boundaries shall be provided. Methodology for each baseline study shall be proposed by the proponent, in consultation with resource agencies, as appropriate, and shall be summarized in the EIS.

Where appropriate and possible to do so, the EIS shall present a time series of data and sufficient information to establish the averages, trends, and extremes of the data that are necessary for the evaluation of potential environmental effects. For key environmental and social components, the Proponent should consider how far back in time and how far into the future the study should be conducted. Rationale for the temporal boundaries chosen should be provided.

Baseline Studies shall be prepared for at least the following components:

- Wild Atlantic Salmon
- Sea Farm Sites
- Fish and Fish Habitat

4.3.3 Fish and Fish Habitat

The baseline study shall characterize fish and fish habitat in the study area, mitigative measures that will be undertaken to protect and conserve these components from the potential effects of the Project, and follow-up monitoring that will be conducted to determine the effectiveness of mitigative measures and residual effects. The baseline study shall include, but not be limited to, a discussion of the following features:

a) identify fish and fish habitat using benthic surveys, including identification of significant habitat, which may include invertebrates, crustaceans, corals and sponges, and eelgrass;

b) identify fish and fish habitat, including species at risk, invasive species (both within and in close proximity to the study area), marine mammals, and those species that directly or indirectly support a fishery, such as: cod, lobster, sea-run trout, herring, sharks, scallops, crab, seals, mussels, and lumpfish;
c) water quality and benthic characteristics consistent with the baseline monitoring requirements of the provincial aquaculture licensing process;
d) aquatic dispersion modelling for the deposition and accumulation of biochemical oxygen demanding (BOD) matter; and
e) identify any Ecologically and Biologically Significant Areas (EBSA) within or adjacent to the BMAs associated with the Project.

Appendix B: MCE's *Salmonid Fish Health Management Plan*

MOWI

Salmonid Fish Health Management Plan
Mowi Canada East
Version 8.2

Doc. ID #	Revision	Date	Responsibility
SFHMP – V 8.2		March 2025	Fish Health and Welfare Division

Change Log

SECTION	PAGE	DATE	UPDATE
Fish Health Management Plan 1.1	5	2022-12-19	Added note about vacancy of the Fish Health & Welfare Director
1.2	6	2024-01-26	Moved Information from section 8.2; updated vet email address
		2024-11-17	Update veterinarian information
1.3	6	2024-01-06	Moved Information from section 8.2; updated staff information
2.1, 2.4	9-10	2025-02-07	Added reference to NFACC
2.6	7	2022-05-06	Added reference to Canadian Code of Practice for the care and handling of Farmed Salmonids
2.9	7	2022-05-06	Updated language to include all escape situations and not just from the cage.
3.6	11	2022-05-06	Added bullet for new DO probes.
		2023-05-02	Updated description of probes on active sites
	12	2024-03-05	Updated monthly fish health sampling requirements
3.7	12	2022-05-06	Added bullet regarding COHFT
	12	2024-02-02	Updated freshwater testing procedures
3.9	13	2022-05-06	Added salinity
4.1	14	2022-05-06	Added disinfection when leaving site
4.3	15	2022-05-06	Added reference to SOP
	18	2025-02-27	Added reference to specific land-based net washing SOPs
4.4	16	2022-05-06	Added that tub lids need to be secured
4.5	17	2022-05-06	Added secured tub lids
	20	2025-02-07	Amended description of mortality transport
8.1	21	2023-05-02	Updated production/ponding sites
	21	2024-01-26	Removed specific information as it is provided in other gov. submission.
8.2	21	2022-12-19	Update veterinarian contact information
	21	2024-01-26	Deleted section, moved information to Section 1.2&1.3
Appendix 1 - IPMP 2.5.2	7	2022-05-06	Removed cleanerfish
Appendix 1 – IPMP	7	2022-12-02	Section 2.5.2 – Cleanerfish added for 2023 Trial
2.5.2	33	2025-02-27	Amended to state MCE does not currently employ cleanerfish
3.1	8	2022-05-11	Updated temperature info Added rationale and temperature depth for when sea lice counts occur
	8	2023-01-24	Changed temperature when counting is discontinued to be in line with industry standards for fish welfare
4.2	10-12	2022-05-06	Added temperature data for various therapeutants
		2022-05-11	Addition of sea lice treatment options for all BMAs
		2023-02-10	Updates to Therapeutant descriptions
4.2.2	11	2023-05-02	Updated the withdrawal period for Emamectin benzoate and CFIA ref.
4.2.4	11	2022-05-11	Updated maximum temperature for Azamethiphos use

		2023-05-02	Updated the temperature range for Azamethiphos use
	12	2024-01-24	Updated the maximum number of treatments for Azamethiphos
4.4	13	2022-05-06	Added info about euthanizing
		2022-05-11	Added reference to The NFACC Code of Practice for the Care and Handling of Farmed Salmonids (salmon, trout, charr)
6.1	13	2023-05-02	Updated progress on cage rigging
6.2	14	2023-05-02	Update on training for staff
6.3	14	2023-05-02	Update on efficient mortality removal – lift-up systems, mortality removal vessel
	14	2024-02-02	Update on efficient mortality removal – cones, foovers, vessels
6.4	15	2024-02-02	Update on bioassays. Not routinely completed. Done as required
6.5	14	2023-05-02	Update on new treatments in 2023 and future years
	15	2024-02-02	Removed project for Bays East to draw freshwater from local pond.
Appendix 2 – Biosecurity Plan	28	2022-05-06	Added Cleaning and Disinfection Protocols
1.1	45	2025-02-27	Updated language for predator control
1.3	46	2025-02-27	Added bullet on large vessels entering province adherence to AP 36
1.3	46	2025-02-27	Added reference to specific land-based net washing SOPs
1.4	48	2025-02-27	Removed reference to mortality specific gear and divers
1.6	49	2025-03-13	Amended description of mortality transport, added reference to Fish Disposal Plan
2.1	52	2025-02-27	Added information on effluent treatment during a quarantine order
Appendix 3	16	2023-05-02	Revised SOP for ATP Swab Test
Appendix 4	22	2023-05-02	Hatchery policy on water flow updated with new effluent treatment
Appendix 3 – Fish Disposal Plan – Appendix 1 Standard Operating Procedures – Ensilage on a Marine Site	16	2022-05-11	Added pH of 4 or lower. Added pH measurement to records.
Fish Disposal Plan – 3.3	77-78	2025-02-07	Added section on quarantine protocols
FDP – 2.3 Mortality Disposal	83-84	2025-03-13	Amended description of mortality transport for trucking and ensiling, provided more detail of C&D procedures
Mortality Removal Using Lift Up Devices Marine Sites	22	2023-05-02	Added use of catch nets to SOP
Appendix 2: Mass Mortality Contingency Plan 3.0	27	2022-12-08 2024-11-17	Updated contact information for the Emergency Management Team Updated contact information for Government Officials
2.0	26	2023-05-02	Updated number of active sites in 2023
	26	2024-01-26	Removed specific information as it is provided in other gov. submission.
3.0	26	2024-02-02	Updated contact for ADM for NL Depart of FFA
5.0	30	2023-05-02	Update on service provider for fat/debris containment
	30	2024-02-12	Update on skimmer technology in lieu of vacuum pump
6.12	34-35	2022-05-06 2022-05-13	Updated info on mortality retrieval Updated capacity of New World Dairy
6.22	40	2022-05-06	Updated info on mortality retrieval processes
6.22	40	2022-05-11	Updated reference for Fish Disposal Plan – Appendix 3
7.0	42	2022-05-06	Updated language on various sections within section 7.0
Appendix 1	48	2022-05-06	Updated 2022 maps
	47	2023-05-02	Updated 2023 maps
	47	2024-01-26	Removed maps and renumbered appendices
	47	2024-01-26	Renamed Service providers
Appendix 2	48	2022-05-06	Updated service providers
	51	2024-01-26	Renamed SOPs
Appendix 3	52	2024-01-26	Renamed Biosecurity
Appendix 4	56	2024-01-26	Renamed Disposal Guidance ECCM
Appendix 5	63	2024-01-26	Renamed Migratory Bird Response Plan
Appendix 4	155	2022-05-06	Added Plankton Monitoring Response Plan
	156	2024-02-02	Updated Harmful Plankton Response Chart
	161	2024-02-02	Updated lethal concentration for Chaetoceros
	170	2024-02-02	Updated lethal concentration for Pseudochattonella

	176	2024-02-02	Updated lethal concentration for Pseudo-Nitzchia
	180	2024-02-02	Updated lethal concentration for Alexandrium
	183	2024-02-02	Updated lethal concentration for Rhizosolenia

Salmonid Fish Health Management Plan

The Salmonid Fish Health Management plan (SFHMP) serves three purposes:

1) To outline good health conditions for cultured finfish raised By Mowi Canada East (MCE).
2) To reflect a commitment by MCE 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;
3) To be used by MCE 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 Fish Health Unit, who makes decisions related to fish health.

The content located within this document pertains to Salmonids only. A separate document, the Cleanerfish Health and Welfare Plan, contains policies and procedures specific to cleanerfish.

These guidelines, along with the associated Biosecurity Audit Plan, Integrated Pest Management Plan, and Cleanerfish Health and Welfare Management Plan, will be reviewed by the Fish Health Unit on an annual basis.

Table of Contents

MOWI

1.0 Personnel Duties and Responsibilities

1.1 Fish Health and Welfare Director

The Fish Health and Welfare Director acts as a team leader for the Fish Health Unit. The Fish Health and Welfare Director is responsible for giving direction to the Fish Health Unit, for approving fish health policies and procedures, and for prioritizing any fish health research/projects for the Fish Health Unit. Any fish health reporting that is required by Fisheries, Forestry and Agriculture (FFA), Fisheries and Oceans Canada (DFO), or other government agency will be done by the Fish Health and Welfare Director and/or the Development and Environmental Compliance Director only. Furthermore, the Fish Health and Welfare Director will provide comments relating to fish health to the Development and Environmental Compliance Director for any public reporting that is required.

The position of Fish Health and Welfare Director is currently vacant. Fish health management will temporarily be the responsibility of the attending veterinarian, contracted by MCE, until such time as the Director's position is filled. The contract veterinarian will report directly to the Managing Director. Contact information for this person is listed in Section 8.2.

1.2 Veterinarian

The attending Veterinarian (either staff or contract veterinarian), in conjunction with fish health staff, has agreed to be responsible in overseeing matters of fish health management for MCE. The Veterinarian is licensed in Canada and fosters a lawful Veterinarian-Client-Patient relationship with the company. The Veterinarian is responsible for disease diagnoses, interpretations, 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.

Veterinarians	Dr. XXXXX XXXXX M: XXX-XXX-XXXX E:

1.3 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 MCE. This "Fish Health Unit" refers to those persons, including the Veterinarian, who are responsible for major fish health decisions. The Fish Health Unit is responsible for identifying and managing risks to maximize fish health.

Fish Health Manager	XXXXX XXXXXX
Fish Health Specialist	XXXXX XXXXXX
Laboratories	XXXXX XXXXXX

1.4 Facility Staff Play a Role

As per conditions of license, all facility staff have read and abide by this FHMP and relevant operational procedures, 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.

1.5 Contact Names and Numbers

Contact names and numbers for key fish health personnel are posted in readily accessible location(s) at each facility.

2.0 Fish Handling Techniques

2.1 Routine Handling Techniques

MCE's fish handling procedures – including types of equipment used and equipment maintenance – are designed to minimize stress, injury, escape and 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. During all crowding events, staff will be continually assessing the population for Fish welfare or stress indicators as identified by NFACC Farmed Salmonids Code of Practice .

2.2 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.

- Proper disposal and disinfection methods for equipment, waste and blood water will be used.
- Proper blood water containment, disinfection and disposal during fish harvesting must be observed to minimize environmental impact and negative effects upon fish health.
- As much as possible, blood water from harvesting operations will be contained and returned with harvested fish to contracted processing facilities where it is subject to blood water treatment.
- All equipment and/or waste resulting from or used for the harvest of farm stock will be cleaned, disinfected, treated and/or disposed of, using only approved chemical agents and in a manner which complies with all existing legislation, regulations, and guidelines, and which minimizes environmental impact, ensures farm stock health, and promotes food safety.

For specific diseases of concern (e.g. ISAv infections), specific harvest procedures apply.

2.3 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 always monitored closely. Adequate water quality of the anaesthetic bath, in particular available oxygen, is maintained.

2.4 Sea Lice Monitoring

Sea lice abundance (i.e. counts) requires monitoring to make effective control and management decisions. Monitoring will be conducted as per Mowi's procedures, or upon instruction by the Veterinarian, the Fish Health Management Team, the FFA Aquatic Animal Health Division or the aquaculture license requirements. For more specific policies and procedures surrounding sea lice management, **please see the "Integrated Pest Management Plan", Appendix 1.**
During lice counts, staff will be monitoring the population for Fish Welfare Indicators. These can be found at Farmed Salmonids Code of Practice . Any concerns will be raised to the Fish Health and Welfare Director.

2.5 Vaccinating Fish

Vaccines are biologic substances that are stored (refrigerated), handled, and applied as per manufacturer's instructions. MCE staff and contract vaccinators are appropriately trained prior to undertaking a vaccination procedure. Vaccines are administered at the hatchery site and occasionally at sea sites and form part of an integrated fish health management program. The type of vaccine administered will be decided by the Fish Health and Welfare Director, in conjunction with the Freshwater Production Director.

2.6 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. All policies and procedures surrounding euthanasia will be written and approved by the Veterinarian. All methods of euthanasia will be in compliance with the Canadian Code of Practice for the Care and Handling of Farmed Salmonids (salmon, trout, charr) (acceptable methods accessible at: https://www.nfacc.ca/farmed-salmonids-code-of-practice#appI)

2.7 Fish Disease Outbreaks/Emergencies

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, record keeping, 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 of 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 Unit, and/or regulatory authority.

Once an outbreak/emergency has been recognized, specific steps are followed, depending on the type of outbreak/emergency. In the case of an infectious event, the objective is to keep the pathogen concentration (or load) as low as possible and to prevent the spread of the problem within or off the facility. Biosecurity is enhanced. **Please see the Mass Mortality Contingency Plan (included in the Fish Disposal Plan) for associated practices and reporting in the event of a disease outbreak/emergency.**

2.8 Escaped Medicated Fish

In the unlikely event of fish escaping, MCE's facility staff will immediately put into place notification and escape mitigation procedures as outlined in the Escape Prevention and Response Plan. In the specific case of medicated fish escaping, information on the medication and the stage of treatment will be reported with the escape information.

3.0 Fish Health Management

Prevention, Surveillance/Monitoring, Diagnosis and Disinfection are a mainstay of Fish Health and are essential in the prevention and control of disease.

3.1 Keeping Fish Healthy

- Fish will be routinely monitored for signs of normal health and disease. All staff should be 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.
- 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. MCE will follow mitigation procedures striving toward minimal predator interaction with the cultured fish.
- MCE will have healthy, hygienic delivery of feed to fish. Proper storage of feed is essential to maintaining its nutritional value. 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.

3.2 Fish Ponding (FW)

MCE believes that the cornerstone to fish health is prevention. It is easier and more efficient to prevent any fish health issues from appearing then to try and manage an issue once it occurs. As such, the following protocols are in place:

- Fish will only be stocked in areas that are suitable for the species of fish being stocked.
- Only healthy fish will be reared at hatchery sites as per Federal and Provincial Transfer licenses, permits and approvals.

- Reduction of stress on the fish is an important factor in fish health and, as such, all consideration will be given to reducing stress to the fish during normal operations.
- Mortality numbers from any movement of fish/eggs will be monitored and used to evaluate the efficiency of the movement method, with the goal to continually improve the process.
- As operationally practicable, fish will be stocked at densities no greater than 75 kg/m^3

3.3 Fish Ponding (SW)

MCE believes that the cornerstone to fish health is prevention. It is easier and more efficient to prevent any fish health issues from appearing than to try and manage an issue once it occurs. As such, the following protocols are in place:

- Fish will only be stocked in areas that are conducive to the species of fish being stocked.
- Only healthy, vaccinated, tested, and approved smolt will be placed into the marine farm as per Federal and Provincial Transfer licenses, permits and approvals.
- Reduction of stress on the fish is an important factor in fish health and, as such, all consideration will be given to reducing stress to the fish during normal operations.
- Farm staff shall perform any function as may be required to ensure that transport and delivery of smolt to sea water is timely, to reduce stress on the fish.
- Mortality numbers from any fish transfers will be monitored and used to evaluate the efficiency of the transport method, with the goal to continually improve the transportation process.
- For bio-security purposes, farm staff should not board the delivery vessel and hatchery staff should not board the cages. If contact is required, full disinfection of gear and equipment will be performed.
- A member of the fish health unit will be present to monitor ponding at every site.
- Sites will only be stocked with a single year class of fish and in accordance with Bay Management Areas (BMAs).
- As operationally practicable, fish will be stocked as to have a density of less than 15 kg/m^3 at time of harvest.

3.4 Identifying Concerns

All staff are aware of any distinguishing signs of potential health problems. Any observed changes must be reported to both the site manager and fish health immediately:

- Physical Changes- skin darkening, scale loss, fungal or ulcerative lesions, gasping, obvious eye injuries or protrusions.
- Behavioral Changes- changes in swimming behavior, flashing, lethargy, reduced feeding response, gasping at the surface.

Below is a list of diseases of concern:

- Infectious Pancreatic Necrosis, IPN
- Infectious Salmon Anemia, ISA (including the non-pathogenic HPR0)
- Viral Hemorrhagic Septicemia, VHS4a
- Enteric Redmouth Disease, ERM
- Bacterial Kidney Disease, BKD
- Furunculosis
- Saprolegnia
- Vibrio species

Any diagnosis of the above diseases will be made by the licensed Veterinarian.

3.5 Pre-Transfer Testing

Pre-Transfer testing will include, at minimum:

- 20 fish per population
    - BKD IFATs
    - Kidney plated on SKDM, BA, and TSA
    - Cell culture (pools of 5 – heart, kidney, spleen, and gill); plated on ASK, CHSE, and EPC
    - Kidney PCR for ISAv
- Pre-Transfer testing may be increased depending on requirements from Provincial or Federal regulatory agencies.
    - All requirements that are set out in the Certificate of Health for Transfer (COHFT) will be followed for all transfers between the Atlantic provinces.
- The Fish Health and Welfare Director must review and approve all health testing results prior to the transfer of fish to a sea site.

3.6 Surveillance/Monitoring (SW)

Monitoring of fish and their environment is crucial in the fish rearing process since identifying any abnormalities can be the first step in identifying any fish health concerns. In general, the sooner an abnormality is detected, the sooner mitigation strategies can be put in place, minimizing any potential impacts on the fish.

- Every marine site will be visited a minimum of once per month by the company veterinarian or their designate to collect samples (as appropriate) for disease testing to sample and screen fish for the presence of bacteria, viruses, parasites, or other factors that may contribute to a decline in fish health. Elevated mortality or suspected disease will be reported to the Fish Health and Welfare Director immediately and will trigger additional visits and sampling, depending on suspected cause.

- The schedule for veterinarian visits may increase as determined by management or as required by the Newfoundland & Labrador Fish Health Surveillance Program.
- At minimum, the following samples will be collected monthly:
    - Virology - pool of organs from a minimum of five moribund fish per site.
        - Organs to be included: kidney, heart, spleen, gill
        - Cell lines: Chinook Salmon Embryo, Epithelioma Papulosum Cyprini and Atlantic Salmon Kidney
    - Pathogen specific testing
        - Kidney samples for molecular testing using polymerase chain reaction for Infectious Salmon Anaemia virus. Submitted in duplicate.
        - Kidney impression sides for test Infectious Salmon Anaemia virus using Immunofluorescent Antibody Testing. Submitted in duplicate
        - Kidney samples for archive at minus 80 degrees Celsius.
- Should cleanerfish be present on site, the Newfoundland & Labrador Cleanerfish Health Surveillance Program will be followed.
- All farm staff will observe fish behavior and appearance during normal feeding operations and communicate these observations to the site manager daily. Observations of abnormal behavior or appearance are to be recorded on the Daily Site Report (DSR) and reported to the Fish Health Unit.
- Farm staff will observe and record water temperatures, dissolved oxygen levels and environmental conditions daily into Mercatus Farmer.
- Probes have been installed on all active site that will measure dissolved oxygen and temperature at predetermined intervals and relay the information to the farm staff. This information is available through a real time monitoring network that is accessible remotely via star link internet that has been installed at our farms.
- Weekly dive information, as regards to mortality numbers and divers' observations will be recorded and communicated to Management through Mercatus Farmer.
- Where possible, mortalities should be classified as to the cause according to the mortality worksheet. This may require dissection over secured and leak-proof containers.
- Feed records for each cage will be entered into the database and examined regularly by site management, to observe feeding patterns, which may indicate fish health problems.
- At minimum yearly, the veterinarian or designate will conduct an audit of biosecurity and disinfection practices at each farm site (**see Biosecurity Audit Plan, Appendix 2**).

MCE will work in cooperation with all government agencies to be in compliance with regulations set forth by these government groups.

3.7 Surveillance/Monitoring (FW)

- Every freshwater site will be visited a minimum of once every 2 months by the company veterinarian or their designate to collect samples (as appropriate) for disease testing to sample and screen fish for the presence of bacteria, viruses, parasites, or other factors that may contribute to a decline in fish health. Elevated mortality or suspected disease will be reported to the Fish Health and Welfare Director immediately and will trigger additional visits and sampling, depending on suspected cause.
- The schedule for veterinarian visits may increase as determined by management or as required by the Newfoundland & Labrador Fish Health Surveillance Program.
- Diagnostic testing is completed routinely. The following tests are ordered upon the direction of fish health staff
    - Kidney tissue plated on SKDM, TSA, BA, and Cytophaga agars
    - Pooled organ sample (pools of 5 fish - kidney, spleen, heart, gill) for cell culture, plated on ASK, EPC, and CHSE
- All farm staff will observe fish behavior and appearance during normal feeding operations and communicate these observations to the site manager daily. Observations of abnormal behavior or appearance are to be recorded on the Daily Site Report (DSR) and reported to the Fish Health Unit.
- Where possible, mortalities should be classified as to the cause according to the mortality worksheet.
- Feed records for each tank will be entered into the database and examined regularly by site management, to observe feeding patterns, which may indicate fish health problems.
- At minimum yearly, the veterinarian or designate will conduct an audit of biosecurity and disinfection practices at each farm site (**see Biosecurity Audit Plan, Appendix 2**).
- Additionally, any testing required by the Certificate of Health for Transfer (COHFT) will be performed by the designated veterinarian.

MCE will work in cooperation with all government agencies to be in compliance with regulations set forth by these government groups.

3.8 Diagnosis and Treatment

- Diagnosis of any health issues will be made by a licensed veterinarian
- The veterinarian will keep a health record for each site, which will include all results from the surveillance visits, as well as results for any additional diagnostic testing that has occurred due to a fish health concern.
- Any drug treatments will only be given after a prescription from the licensed veterinarian has been received.

- Therapeutants will be from credible and responsible sources and will only be used when it is necessary for proper fish health. **All therapeutants will be approved by the Fish Health and Welfare Director prior to administration.**
- MCE will ensure that all therapeutants used will be in compliance with existing regulations, that any therapeutant residues in fish for human consumption are below the maximum reside limits set by the receiving country, that the environmental impact is reduced as much as possible, and that animal health is promoted through husbandry practices and judicial use of approved therapeutants.
- Treatment records for all therapeutants will be recorded in the fish health records, and will include the date, compound used, reason for use, dose, withdrawal period and harvest date.
- Prior to harvest, appropriate residue testing will be performed by an accredited laboratory facility (e.g. XXXXX XXXXX) and clearance declarations will be obtained from the prescribing veterinarian.

3.9 Monitoring Water Quality

MCE will routinely monitor and record water quality parameters at all sites to ensure optimal fish health. Minimal monitoring requirements of a saltwater site includes-– dissolved oxygen, water clarity, salinity, and temperature. Minimal daily monitoring requirements for a Freshwater Facility include- temperature, dissolved oxygen, pH, TAN, and Nitrite. Additional parameters vary depending on location and hydrographic specifics of the local environment.

In addition to water chemistry, saltwater sites should monitor for harmful algae blooms (HABs). At minimum, plankton/algae will be assessed once per week per site during the spring; with increased frequency occurring during high-risk periods (August through September, see Mowi Canada East's Plankton Monitoring and Response Plan – Appendix 5).

MCE 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. Additional mitigation measures to address adverse environmental conditions, such as aeration are listed in Table 2 and Appendix A (Operational Environmental Mitigation Plan) of the Environmental Management and Waste Management Plan. Details on the inventory of aeration systems, operation, maintenance and reporting as per FFA guidance is provided in an annual report. This report will be submitted to FFA during the aquaculture licence validation process. This submission will ensure information is current with MCE sea farm production planning.

3.10 Fish Health Records

Many records are computerized and form part of the integrated MCE record-keeping system. Backups are maintained. MCE provides adequate system training and documentation to authorized facility personnel, including data entry and report creation. Record-keeping, storage, reporting and MCE's Fish Health Unit review is followed as per MCE's policies and conditions of license.

All fish health records are compliant with province-specific veterinary clinic standards.

4.0 Biosecurity Policy and Practices - SW

Biosecurity is the ongoing process of identifying, evaluating and addressing actions or events in order to reduce the risk of disease transmission, to or from marine sites. ***These biosecurity practices may require modification with new information and technologies.***

4.1 General Daily Biosecurity Practices

- All feed boats and rafts are to be cleaned, scrubbed (with Greenworks or similar detergent) and disinfected (with Iodor or similar sanitizer) at the start and at the end of every day.
- Foot Baths are to be located for easy access and to be used by anyone boarding site vessels or work barges
- Footbaths are to be refreshed daily (Water should look like weak tea)
    - Iodor or any iodophor should be mixed at 100 to 200 mg/L with a ten-minute contact time. This contact time may be achieved through exposure to proper disinfectant concentration without rinsing with fresh seawater.
- As much as practicable, all site gear and personal gear should remain on site. All site gear, equipment or personal gear should be disinfected prior to leaving and before returning to the site.
- Any site gear, equipment or personal gear that is moved between sites MUST be cleaned and disinfected before leaving one site AND again upon arrival at another site.
- Inflow wharves (Pool's Cove, Hermitage, Hr. Breton, Milltown) are to be used for all 'clean' material being transported to farm sites. Vessels using inflow wharves will be cleaned and disinfected prior to use at these wharves, according to operational agreement with FFA for use of those facilities.
- At other mixed-use wharves or facilities, vessels and vehicles will be cleaned and disinfected to reduce transmission of pathogens.
- All site staff are required to clean and disinfect their personal gear at the end of every day prior to leaving the site.

Site biosecurity practices will be reviewed monthly by the Veterinarian or designate during their routine visit, as per the Biosecurity Audit Plan.

4.2 Farm Access

Vehicles, vessels, and visitors can be agents of contamination and can transmit disease from one farm to another.

- Access to farm sites will be controlled to provide a break between those outside influences such as predators, non-essential personnel, and vehicular traffic which may negatively affect the health of fish.
- The most efficient layout of farm sites will be used to facilitate the development and maintenance of controlled access zones.
- Exclusive 'in-flow' or 'clean' wharf facilities at Pool's Cove, and Hr. Breton will be used as per the Wharf User Agreements.
- No outside visitors will be allowed on site without prior approval from the Salt Water Production Director and/or the Fish Health and Welfare Director.

4.3 Large Equipment Cleaning and Disinfection

- For maximum efficacy of disinfection, all objects must be thoroughly cleaned and free of all organic material prior to disinfection, using either a detergent like Greenworks or a pressure washer.
- As operationally practicable, vessels and feed rafts will be site specific. If necessary to move between sites, they will be cleaned and disinfected before.
- Dirty nets being transported to shore will be transported in a manner to minimize loss or spillage of organic matter and only to designated outflow wharves. Pickup of dirty nets will be done in a manner to reduce risk of contamination with clean areas, using contained transport vehicles and containers. Transport vehicles or containers that are used to transport dirty nets will be cleaned and disinfected at the end of each day.
- Nets will be cleaned of all organic material before disinfecting. Disinfection will be done on land, as per government policies. Land-based net washing will be performed as per MCE SOP SW-008 NL C&D of Nets and Newfoundland Aqua Services (NAS) Standard Operating Procedure. In the event of ISA, NAS will follow NAS SOP for Sites Under a Quarantine Order due to ISA.
- To move vessels or large equipment from one BMA to another, prior approval is required from the Fish Health and Welfare Director (see Appendix 3: Biosecurity Plan).
- Vessels or large equipment can be moved from one site to another within the same BMA without prior approval, provided that the vessel is thoroughly scrubbed clean with Greenworks prior to disinfection with Iodor (250ppm for 10-minute contact time).
- For specifics, please see "Large Vessel Biosecurity Protocols" SOP in the Biosecurity Management Plan
- Transport trucks will be designated to haul dirty OR clean loads – NEVER both, unless they have had a thorough cleaning and disinfection which has been verified by Mowi staff.
    - Examples of dirty loads include:
        - Used site equipment – nets, weight balls, compensator buoys, etc.
        - Fish (harvest or processed)
        - Mortalities or Offal
        - Used pallets

    - Garbage
  - Examples of clean loads include:
    - Feed
    - Clean or new site equipment

4.4 Mortality Collection

- Daily mortality collection is done through the use of a Liftup system or ROV.
- At minimum, mortality is removed from the sea farms on a weekly basis.
- Alternative methods of mortality collection are used as needed.
- Divers will be accompanied or met on site-by-site management personnel.
- Divers should maintain separate dive suits and gear for each site or ensure thorough disinfection between sites where this is not possible. If dive gear is to be used on multiple sites, prior approval from the Fish Health and Welfare Director must be granted.
- Site crew should ensure that the dive vessels, personal apparel, and equipment of the divers is properly cleaned and disinfected before and after the dive at their site.
- Any gear not necessary for the mort dive should be removed from the dive vessel. All drains and scuppers in boats should be plugged for the duration of the dive to contain any spillage unless boat is equipped with flap-type scuppers. In this case, efforts will be made to contain any spillage and disinfect prior to discharge.
- Divers should be disinfected in between cages as soon as the diver exits the cage (to allow contact time between cages).
- The vessel and all gear and equipment onboard must be thoroughly cleaned and disinfected immediately **after** the mortalities have been removed from the vessel. If morts must be transported to a wharf, the vessel will be cleaned and disinfected after the dive (prior to leaving site) and then again after morts are removed.
- Mort totes or tubs
  - Must be in good condition (no cracks or breaks).
  - Mort totes should not be filled more than ¾ and not overfilled. Fish totes should be leak proof, free from damage and if drain stoppers are present, they should be sealed. The totes should be covered and secured before movement from the dive boat to a barge or transport vessel.
  - Mort totes should be clearly marked with company name
- No morts or moribund fish are to be released to the sea.
- Divers’ suits and all dive gear must be disinfected upon completion of the dive.
- Cages with elevated mortality or known health issues will be dove last.
- If more than one site is to be dove per day, older sites or sites with known fish health issues will be dove last.

4.5 Mortality Disposal

- Following the dive, mort tubs will be taken to the wharf where they will be held for storage (a layer of clean sawdust may be added as a bulking and odour control agent if morts are destined for composting) or transferred to large, sealed containers for eventual transport to the designated mort disposal facility.

- NO material other than mortalities (i.e. kelp, plastic wrap, mussel or other shells) are to be mixed with morts that are destined to be ensiled.
- All mort totes or boxes MUST be thoroughly cleaned and disinfected before being returned to the site. In addition, any mort tubs that are damaged or cracked will be taken out of rotation and disposed of. Only undamaged, fully intact tubs will be used for mortality collection.
- Every effort should be made to avoid transporting mortalities from one BMA to another. If mortalities must be moved, they should only move from a younger BMA to an older BMA, not vice versa. Furthermore, mortalities should be stored in a separate area away from other wharf activities. Any mortalities that are being transported should be in leak-proof containers that have lids that can be secured. Every effort should be made to ensure that mortalities are contained during transport.
- Under normal circumstance, no mortalities should be moved from one site to another. It is the responsibility of each site crew to bring their own mortalities back to the wharf for disposal.
- In the event of ensiler breakdown at remote sites where daily mortality removal to a wharf is not feasible, mortalities may be transported to a neighboring site within the same BMA for immediate processing.
- For greater detail, **please see The Fish Disposal Plan, Appendix 3.**

4.6 Harvest Disinfection Protocols

- Deck and equipment of all harvest vessels will be cleaned and disinfected prior to loading the harvest tubs. Top holes must be used when strapping full tubs.
- All harvest tubs will be disinfected and inspected for cracks or missing plugs prior to use.
- All harvest tubs will only be partially filled (see Harvest Protocols) to prevent spillage during transport. Plastic wrap will be used to prevent spillage during transport to processing facilities.
- A disinfectant hose or sprayer will be kept on hand to treat any spillage.
- All operations will be carried out in a manner to avoid any spillage or leakage of blood, slime, or scales.
- Prior to site departure after a harvest, all harvest tubs, harvest equipment, rain gear, gloves, boots, free deck, and side of boat under the dewatering box will be cleaned and disinfected.
- After offloading, the deck and other gear will again be disinfected, as well as the surface of the harvest wharf.
- Fresh water (not seawater) will be used to wash equipment where contact with saltwater should be minimized (vehicles, forklifts etc.).
- Blood water will normally be contained in tubs with the fish, transported & disposed of in an approved manner at Harbour Breton processing plants.
- If harvesting via wellboat, the vessel will do a topside cleaning and disinfection after loading harvest fish, but before leaving site.

- If harvesting from a site with a known disease, the wellboat will use moving bulkheads to dewater back into the holds so the water can be disinfected with ozone prior to releasing into the sea.

4.7 Biosecurity Audits

Biosecurity audits will be conducted by the Fish Health Unit to ensure that proper biosecurity protocols are being followed by all MCE staff members. Specific procedures and frequency of audits are outlined in the Appendix 2 (MCE Biosecurity Plan).

4.8 Response Plan for a Biosecurity Breach

A biosecurity breach is any incident in which a pathogen is brought into a facility despite efforts to prevent as such. The movement of people, equipment and fish all have the potential to introduce pathogens. Mowi Canada East has strong procedures to prevent the introduction or movement of pathogens in facilities. MCE has implemented an Incident and Crisis Management System (Doc ID# SCP-v4.1).A biosecurity breach can be identified through routine surveillance sampling or increased sampling in response to a change in fish behavior or mortality levels. The identification of a fish pathogen or the identification of biosecurity procedures not being followed are reported through the Incident and Crisis Management System. Where biosecurity procedures were not followed, but did not result in cross-contamination of a fish pathogen, the incident is a near miss.

The following key information is reported through the Incident and Crisis Management System:

1. What happened?
2. How did it happen?
3. Why did it happen?
4. Other relevant information/development of the incident
5. Corrective actions

In the event that fish are infected as a results of a biosecurity breach, the response is the implementation of increased fish health surveillance, treatment, and reporting for the disease. Any affected units will undergo full C&D before being restocked. Also a review of the contamination source in order to implement corrective measures that will avoid a reoccurrence.

In the event of a procedural error or gap related to biosecurity practices, the response is a review of the biosecurity procedures, communications and training. If a gap or need for improvement is identified, the response will be to update procedures, communications or training as needed to prevent a reoccurrence.

5.0 Biosecurity Policy and Practices - FW

Biosecurity is the ongoing process of identifying, evaluating, and addressing actions or events in order to reduce the risk of disease transmission, to or from different systems or tanks. ***These biosecurity practices may require modification with new information and technologies.***

5.1 General Daily Biosecurity Practices

- Foot Baths and hand sanitizers are to be located at all entry points into a building and easily accessible for use by all site personnel.
    - Footbaths and hand sanitizers are to be checked daily to ensure that they are filled and at proper concentrations.
    - Virkon aquatic solutions should be mixed at 10 g/L with a ten-minute contact time.
- As much as practicable, all site gear should remain on site. All site gear, equipment, or personal gear that leaves site should be disinfected before leaving and before returning to site.

Site biosecurity practices will be reviewed monthly by the Veterinarian or designate during their routine visit, as per the Biosecurity Audit Plan.

5.2 Farm Access

Vehicles and visitors can be agents of contamination and can transmit disease from one farm to another.

- There will be limited access points to the facility where all staff, visitors and/or vehicles requiring entry onto site will undergo a disinfection process prior to entry.
    - Pedestrian access will be through limited, specific biosecurity checkpoints with foot dips and hand sanitizers
    - Vehicle access will be granted only after the vehicle undercarriage and tires have been sprayed with disinfectant.
- No outside visitors will be allowed on site without prior approval from both the Fresh Water Production Director and/or the Fish Health and Welfare Director.

5.3 Equipment Cleaning and Disinfection

- Water systems are to be separated by biosecurity barriers (footbaths, hand wash stations, and building specific PPE for staff).
    - Staff are required to go through a biosecurity barrier when moving from one system to another.
    - Whenever possible, staff should be assigned to a specific system so that movement from one system to another is limited.
- Each system will have designated equipment for use in that system only.
- Equipment must not be shared between systems to reduce the risk of cross contamination between fish groups.

- All equipment, including nets and brushes, must be disinfected with a 1% Virkon solution before and after every use.

5.4 Mortality Collection

- Mortality removal from tanks will be conducted daily, at minimum.
- Mortalities will be collected in system-specific buckets that are not used for any other purpose.
- At the end of every day, mortality buckets will be brought to the on-site holding tub for further removal.
    - Once emptied, mortality buckets will be cleaned with a detergent (ex. Greenworks or Mr. Clean), rinsed, and then disinfected with a 1% Virkon solution
- Mort buckets must be in good condition (no cracks or breaks).
- Mort buckets should be clearly marked.
- No mortalities or moribund fish are to be released into the environment.

5.5 Mortality Disposal

- At the end of the day, all mortalities will be placed in holding tubs located on site for eventual transport to the designated mort disposal facility.
- No material other than morts shall be placed in mortality collection tubs.
- All mort tubs MUST be thoroughly cleaned and disinfected before being returned to site. In addition, any mortality tubs that are damaged or cracked will be taken out of rotation and disposed of. Only undamaged, fully intact tubs will be used for mort collection.

5.6 Biosecurity Audits

Biosecurity audits will be conducted by the Fish Health Unit to ensure that proper biosecurity protocols are being followed by all MCE staff members. Specific procedures and frequency of audits are outlined in Appendix 2 (MCE Biosecurity Plan).

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A biosecurity breach is any incident in which a pathogen is brought into a facility despite efforts to prevent as such. The movement of people, equipment and fish all have the potential to introduce pathogens. Mowi Canada East has strong procedures to prevent the introduction or movement of pathogens in facilities. MCE has implemented an Incident and Crisis Management System (Doc ID# SCP-v4.1).A biosecurity breach can be identified through routine surveillance sampling or increased sampling in response to a change in fish behavior or mortality levels. The identification of a fish pathogen or the identification of biosecurity procedures not being followed are reported through the Incident and Crisis Management System. Where biosecurity procedures were not followed, but did not result in cross-contamination of a fish pathogen, the incident is a near miss.

The following key information is reported through the Incident and Crisis Management System:
1.What happened?

2. How did it happen?
3. Why did it happen?
4. Other relevant information/development of the incident
5. Corrective actions

In the event that fish are infected as a results of a biosecurity breach, the response is the implementation of increased fish health surveillance, treatment, and reporting for the disease. Any affected units will undergo full C&D before being restocked. Also a review of the contamination source in order to implement corrective measures that will avoid a reoccurrence.

In the event of a procedural error or gap related to biosecurity practices, the response is a review of the biosecurity procedures, communications and training. If a gap or need for improvement is identified, the response will be to update procedures, communications or training as needed to prevent a reoccurrence.

6.0 Travel Between Different Areas

There may be times when staff are required to travel from one area of the business unit to another. From a fish health perspective, different areas include (with proper numerical designation):

1. Broodstock
2. Freshwater
3. Saltwater
4. Quarantined site for FH reason (Freshwater or Saltwater)
5. Processing Plant

- Staff that are required to move from one area to another should have a separate set of work gear for each area. Under no circumstances should any uncovered clothing or PPE be brought from one area to another.
- Staff can move from one area to an area with a higher number designation without any restrictions (for example there is no restriction to go from a FW site to a SW site).
- If staff need to move from one area to an area with a lower number designation (for example moving from a processing plant to a saltwater site), a site-free period of 72 hours must be observed prior moving to the second area.
- Vehicles (personal or work-related) should be used for salt water OR freshwater; never both
    - If staff are required to travel between two different areas of production, rental cars should be utilized for one of the areas.
- In addition to the numerical areas set above, an off-site period of 72 hours should be observed if staff are moving from a site in one province to a site in another (regardless of their numerical designations).
- If there are any questions as to whether a 72-hour off-site period must be observed, staff are instructed to consult with a member of the Fish Health Unit for advice.

- Exceptions to this rule will be on a case-by-case basis and MUST be approved by the Managing Director OR the Fish Health and Welfare Director AND either the Freshwater Production Director or the Saltwater Production Director.

7.0 Handling Drugs and Chemicals

Fish health and survival is sometimes optimized with judicious use of veterinary prescribed therapeutants. The Veterinarian attending MCE maintains a veterinarian-client-patient relationship to facilitate diagnosis and prescription treatments. These decisions are taken considering both the welfare of fish and the ecosystem.

7.1 Medicated Feed Storage, Administration, and Inventory

Medicated feed, if used, is stored in clearly marked container, easily distinguishable from non-medicated feed. The prescription number for the medicated feed will be marked on each container. The medicated feed is inventoried and recorded daily as the feed is offered to the fish according to a prescription. A Safety Data Sheet (SDS) for all medications used at the facility will be on-site and readily accessible. MCE ensures that all chemicals are handled safely and appropriately by trained staff, taking suitable precautions.

7.2 Treatment Records

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. MCE does not harvest fish until they have cleared the withdrawal period prescribed by the Veterinarian. As per regulations and license conditions, when fish are delivered to a processing plant, a harvest release written by the attending Veterinarian will accompany fish to ensure seafood safety and wholesomeness.

7.3 Chemicals and Biologicals

Disinfectants and chemicals are stored in clearly marked containers. An SDS for each chemical at the facility is on-site and readily accessible. MCE ensures that all chemicals are handled safely by appropriately trained staff, taking suitable precautions.

All chemical therapeutants are used as directed by the attending Veterinarian and are handled safely by appropriately trained staff, taking suitable precautions.

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

8.0 Production Plan

8.1 Production/Ponding Plans

Three-year Site Stocking and Production Plans are submitted annually to FFA as part of the license validation process. Active sites and planned wharf usage for the current cycle are provided in that plan. All feed is sourced from Skretting feed mill and stored in onsite barges.

Appendix 1 – Integrated Pest Management Plan

Integrated Pest Management Plan
Mowi Canada East
Version 7.1

Doc. ID #	Revision	Date	Responsibility
IPMP V-7.1		Feb 2024	Fish Health and Welfare Division

Table of Contents

1.0 Introduction

1.1 Components of the Plan

An effective integrated pest management plan consists of three key components: prevention, intervention and research and development. It is important to recognize that an integrated pest management plan should be constructed in a way that maximizes the utilization of prevention techniques and minimizes the emphasis on intervention therapies and maximizes the utilization of prevention techniques. The sea lice life cycle (section 1.2) exists in such a way that, without intervention, can become out of control in a short period of time. Therefore, every effort should be made to prevent the parasite from ever attaching to the host, thus stopping the life cycle before it even begins. In this fashion, prevention becomes the cornerstone to any pest management plan.

Constant monitoring is required to determine if sea lice prevention strategies are working. When prevention methods become overwhelmed, there may be a need to introduce intervention methods, but only as a last resort. Assessments should be made as to whether strategies (both preventative and therapeutic) are being effective. Anytime there is a determination that efforts are not being effective, changes should be made to try and improve success.

Finally, a pest management plan should include some avenue for research and development to ensure that methods are constantly being updated to the most new and effective means of control.

Thus, the major components of the plan become prevention, monitoring, intervention and research and development. Whenever there is a discrepancy between this plan and local Aquaculture Acts or Regulations, the local Acts and Regulations will take precedence and will be strictly adhered to.

1.2 Sea Lice Life Cycle

There are several species of sea lice, however on the east coast of Canada where Mowi Canada East operates, the main species of concern is *Lepeoptheirus salmonis*. Occasionally *Caligus sp*. can be found on salmon, but they are not found to be in great numbers, and do not appear to cause any damage. Care should be taken to include *Caligus sp*. in the monitoring program (section 3.0), if that this trend changes and the dynamics of these two species starts to change. Any mention of sea lice in this document will be in reference to *Lepeoptheirus salmonis.*

For the time being, only the life cycle of *Lepeoptheirus salmonis* will be presented (Figure 1). It is important to have a working knowledge of the life cycle of the parasite, as some therapies only target certain stages of the life cycle and will be completely ineffective on the non-target life stages.

There are 2 stages of nauplii. These two stages make up the planktonic stages of the life cycle. At these stages, the sea lice are free floating in the ocean; they can vary their depths in the water column but cannot choose the direction of travel as they must go with the water current.

The copepodid stage is next and is the stage of the life cycle that first attaches to the fish. From this stage, the louse will moult into the first chalimus stage of the louse.

The chalimus stages of the louse are attached to the fish by a frontal filament. Once the louse moults through all the chalimus stages, it becomes a pre-adult, and then an adult louse.

The pre-adult and adult stages of the life cycle are both mobile stages – meaning the louse can freely move around on the fish – and are the stages that result in the damage to the fish as the parasite feeds off the fish.

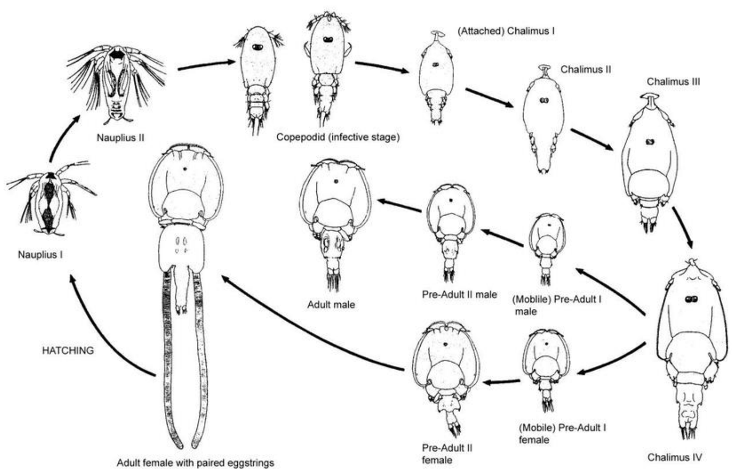


Figure 1:Life cycle of *Lepeoptheirus salmonis* *https://www.researchgate.net/figure/The-stages-in-the-life-cycle-of-the-sea-louse-Lepeophtheirus-salmonis-The-Nauplius-I_fig1_266489278*

In addition to recognizing the stages of the life cycle, it is also important to realize how much the effect of water temperature has on how quickly the louse progresses through its life cycle (Table 1). The lifespan of the louse is not known yet, but females have been known to live up to 210 days.

	5°C	15°C
Duration of egg stage	17.5 days	5.5 days
Duration of nauplius I stage	52 hours	9 hours
Time from attachment to sexual maturity	106 days	32 days

Table 1: Effects of temperature on life cycle (www.marine.ie)

1.3 Responsibilities

The Fish Health and Welfare Director is responsible for working with the Salt Water Production Director to ensure that the Integrated Pest Management Plan (IPMP) is implemented properly; to ensure that the IPMP is reviewed annually to keep strategies current; and to ensure that the Fish Health Unit (FHU) is properly trained and has the proper resources to fulfill their duties.

The FHU is responsible for providing direction to Mowi Canada East staff on any procedures relating to the IPMP. The FHU is responsible for assessing the IPMP and making decisions on how well therapies are working; deciding when an intervention therapy is required; scheduling of intervention therapies; and monitoring fish welfare during the lice season. The FHU is also responsible for ensuring all appropriate acts and regulations are followed.

The designated veterinarian plays a lead role in monitoring fish health and welfare of the fish at all times, including sea lice season. They are also responsible for monitoring lice levels and recommending intervention strategies to the FHU and area/site manager, should they be required.

The Development and Environmental Compliance Director is responsible for ensuring all appropriate site permits and licenses are in place.

The Freshwater Production Director is responsible for ensuring that high quality smolt are produced; for working with the Fish Health and Welfare Director to ensure that any freshwater facilities are properly set up for any intervention therapies that must be given during the freshwater phase; and for ensuring that freshwater staff are available to assist with any freshwater therapies, should there be a need.

The Saltwater Production Director is responsible for working with the Fish Health and Welfare Director to ensure that the IPMP is implemented properly and to ensure that saltwater staff have the proper training and resources to complete their responsibilities. They are also responsible for scheduling of vessels and resources required for treatments.

The regional manager is responsible for installing and maintaining any site equipment that may be required.

Each salt water area manager is responsible for ensuring saltwater staff have the proper training for sea lice monitoring. They are also responsible for ensuring all site managers in their area have a valid pesticide applicators license should the need for a pesticide intervention therapy arise.

Each site manager will be responsible for monitoring sea lice numbers and reporting these to the FHU. They are also responsible for monitoring and reporting any damage from sea lice on their fish.

Site staff are responsible for monitoring fish behavior and reporting anything of concern to their site manager.

2.0 Prevention

Prevention of sea lice settlements is always the main goal of the IPMP. Preventing infections from occurring results in healthier, stronger fish which in turn results in less need for intervention therapies. This is good for Mowi and good for the environment.

2.1 Location of Sites

Care will be taken to avoid siting any saltwater cage sites close to known wild salmon runs to avoid interaction of sea lice to/from wild fish.

2.2 Year Class Separation

All salmonid sites in NB and NL are subject to Bay Management Area (BMA) agreements. As part of these agreements, all sites will be stocked with one year-class only. Single year class sites assist in sea lice management by strengthening fish health, and easily allows for implementation of fallow periods (section 2.3). Healthy and strong fish are less susceptible to sea lice infections.

2.3 Fallowing

Fallowing refers to allowing a site to sit vacant of fish for a specified period. This allows for a break in the sea lice life cycle, thereby reducing the sea lice infection pressure in the area.

2.4 Husbandry

Good husbandry practices have a huge impact on fish health, and therefore can impact on the ability for fish to resist sea lice infection pressure. As such, Mowi Canada East will constantly strive to ensure that the best husbandry practices are instigated on their saltwater sites.

Examples of husbandry practices that can contribute to fish health include (but are not limited to) selective breeding, proper stocking densities, good nutrition and feeding practices, proper hygiene, and predator control.

2.5 Technology

Wherever possible, Mowi Canada East will invest in new technologies which aim to prevent sea lice settlements from occurring. Mowi will investigate new technologies as they become available to see if they are a fit for the IPMP (see section 5.0 Research and Development).

2.5.1 Lice Guards

Lice guards are a type of cage skirt that are designed to prevent the copepodid stage of lice from entering the sea cage, thus preventing them from attaching to the fish. This specialized piece of equipment has a mesh size that is small enough to prevent the free-flowing life stages (i.e. nauplius and copepodid) of lice from flowing through it.

Lice shields show no preference on which side they block the lice from (i.e. lice are blocked from flowing either direction). Care must be taken to time the installment of lice guards properly so as to install when there are no lice inside the cage (i.e. on the fish). If used improperly, the lice guard can prevent nauplii or copepodids produced by lice inside the cage from exiting, thus creating a situation that amplifies the self-infection pressure within the cage.

2.5.2 Cleanerfish

The term cleanerfish refers to any species of fish that shows an affinity for removing ectoparasites (in this case, sea lice) from another fish. When choosing a species of cleanerfish, it is important to consider how well the cleanerfish reduces sea lice numbers, and how the pathogen profile of the cleanerfish overlaps with Atlantic salmon to ensure that there is minimal potential for pathogen transfer from cleanerfish to salmon.

Mowi Canada East is not currently employing the use of cleanerfish.

2.5.3 Mechanical "Treatments"

The term "Mechanical treatments" refers to any fish handling event where lice are removed from the fish by some type of mechanical equipment, rather than a chemotherapeutant. Examples of this type of technology include thermolicers, flushers, etc. The basic principle of these types of devices is that fish are pumped out of the cage and into the machine, the lice are separated from the fish, and then the fish are pumped back into the cage. In all of these types of equipment, lice are retained by some type of filter and disposed of on land (either composting facilities or biogenerator at New World Dairies). The mechanical treatments that Mowi Canada East utilizes are:

Thermolicer – the water that the fish enter inside the equipment is heated to a point where the fish can handle it but is lethal to the sea lice. It is important to realize that in thermolicers, it is not the water temperature itself that matters; rather, it is the change in temperature from ambient sea temperature to the heated water. In general, the change in water temperature should be 12 degrees Celsius or higher.

Flusher – the fish are pumped into a pipe that has water sprayers positioned all around the circumference of the pipe. These sprayers are pointed so that the spray is directed at the fish as it swims through the pipe. In essence, the sprayers act as a pressure washer to knock the lice off the fish.

3.0 Monitoring

3.1 Sampling Protocols

- Site Managers, with assistance from site workers, will normally conduct weekly (or as designated) sea lice counts.
- For counts, the fish will be anesthetized (TMS) to allow careful count detection of larval stages. Recognition of early life stages is essential for timely implementation of mitigation strategies.

- Ten fish from each cage will be sampled. These fish will be removed from the water and examined for lice and overall fish condition.
- Counts and observations as to life stages will be recorded and communicated to site management and the company veterinarian on the standard Sea Lice worksheet. The following categories will be counted and recorded for each fish:
    - Chalimus
    - Pre-Adult + Adult Males (PAAM)
    - Adult females (AF)
    - Caligus
- Water temperatures will be measured at 5 m below the surface to determine if counts can be performed.
- Minimum counts will be performed as follows, unless otherwise instructed by the FHU:
    - Lower than 5°C, counts will not be done to maintain the welfare of the fish during cold water temperatures (eliminate handling during high-risk period)
    - Higher than 5°C, counts will be done weekly
- In cold periods, handling fish to conduct sea lice counts can disturb the skin, scale and mucous layers of the fish being handled and lead to winter sores and secondary infections from *moritella* spp., *tenacibaculum* spp., etc.
- In periods of extremely high temperatures, handling of fish can cause excessive stress and mortality. In general terms, however, periods of extremely high temperatures tend to be short-lived and will only disrupt sea lice counting for brief periods of time.
- Given the importance of close monitoring of sea lice levels, we will generally err on the side of counting.
- Site staff will receive yearly training on identification of species, life stages and management strategies. Such training authority examples include (but are not limited to) government authorities, the Atlantic Veterinary College (AVC), and Mowi Canada East FHU (in house).

3.2 Data Reporting

Information regarding sea lice will be recorded as per the standard Sea Lice worksheet. This information will be used by the FHU to decide if any intervention methods are required.

Mowi Canada East participates in the Decision Support System (DSS) for the collection and study of sea lice settlement and treatment data with the Centre for Aquatic Health Services at the Atlantic Veterinary College (AVC) and other industry members both in NB and NL. This cooperative effort is intended to lead to a better understanding of the efficacy of sea lice management and control tools.

As part of this effort:

- Staff from AVC may visit from time to time to assist in sea lice counts.
    - All counts (completed by either AVC staff or site staff) will be submitted to the site management, the FHU and to the DSS system.
    - Site staff will provide transport to the site and give assistance to AVC staff, as necessary, to complete the counts
- Lice treatment data: date, method of treatment, compound used, and amount of compound used will be submitted to the DSS as the system develops.

Reporting will be done as per the Acts and Regulations in effect in the jurisdiction of the sites.

3.3 Count Audits

Any analysis of the IPMP is based solely on sea lice counts, thus it is critical that the sea lice counts are performed accurately. In addition to the sea lice count audits that the Atlantic Veterinary College may do, the FHU will perform sea lice count audits as well.

Annually, the FHU will perform a minimum of one sea lice count audit on every site. These audits will be entered into the DSS and any Mowi Canada East staff member who fails an audit will be required to undergo additional training prior to being allowed to conduct further sea lice counts. The type and amount of training required will be decided by the Fish Health and Welfare Director. As well, the Fish Health and Welfare Director has the final call as to when the staff member will be allowed to regain their role of performing sea lice counts again.

4.0 Intervention

The need for intervention will be based on accurate and timely lice counts and will only be under the direction of a company veterinarian.

4.1 Action Levels

Thresholds for control strategies will aim at preventing the development of gravid females.

Mowi Canada East will attempt to implement an intervention strategy if any of the following conditions is met:

- The average number of gravid females in a cage is 0.5 or higher
- The average number of mobile lice (PAAM + AF) is 3 or higher

Interventions will be made on a cage level, not a site level, and may be made sooner than the above situations if the FHU thinks it is necessary.

It is important to notice what different interventions are available for each BMA when choosing an intervention. For NL, the intervention strategies are as follows:

4.2 Therapeutants

Mowi Canada East will only use therapeutants that are authorized for use on food animal fish in the jurisdiction in which it is operating. Under no circumstances will a non-approved therapeutant be used. Furthermore, all withdrawal periods will be strictly adhered to. Under no circumstances will fish be sent for human consumption until all withdrawal periods have been met to ensure all seafood produced by Mowi Canada East is healthy and safe to consume.

Emamectin, salmosan, thermolicer and flushers are available in all BMAs. Generally, the thermolicer and flushers (described as mechanical treatments in Section 2.5.3) cannot work when air temperatures are significantly below freezing. Peroxide treatments are possible during Spring and Fall when sea water temperatures are between 8 and 12 degrees Celsius.

Any intervention therapy will be chosen by a licensed veterinarian, in consultation with the Fish Health and Welfare Director.

4.2.1 Lufeneron

Trade name: Imvixa®

Method of Action: Binds chitin synthase 1 in terrestrial arthropods causing inhibition of chitin biosynthesis of target louse; acts by preventing the louse from moulting to the next life stage. Effective against all moulting stages.

Method of administration: In-feed treatment fed at the freshwater stage for 7 days. It is severely toxic to aquatic life, so any solids excreted during the 1 week of treatment and the 1 week following treatment must be collected and disposed of properly.

Duration of action: ~9 months

Withdrawal period: 350 days

Special notes: Lufeneron is currently not approved for use in Canada. Available under Emergency Drug Release (EDR) from the Veterinary Drug Directorate (Health Canada).

4.2.2 Emamectin benzoate (EMB)

Trade name: SLICE®

Method of Action: It disrupts chloride ion movement and, hence, transmission of nerve impulses. The parasite stops feeding, becomes paralyzed and dies.

Method of administration: In-feed treatment fed at the saltwater stage for 7 days.

Timing of treatment: As needed throughout the lice season.

Duration of action: ~30 days (or less)

Withdrawal period: If used according to label directions, there is no withdrawal period in Canada. To ensure tissue residues do not exceed the maximum residue limit, Atlantic salmon should not be treated more than once in the 60 days prior to the first fish being harvested for human consumption (https://inspection.canada.ca/animal-health/livestock-feeds/medicating-ingredients/emamectin-benzoate/eng/1521217897188/1521217949734).

Special Notes: Sea lice have shown resistance to emamectin benzoate, thus if used, it is often used at doses higher than label instructions. Because of this, caution must be used when determining withdrawal periods; lengthening the withdrawal period is recommended, as well as testing tissue samples prior to slaughter to ensure EMB residues are below MRLs.

4.2.3 Hydrogen Peroxide

Trade name: Interox® Paramove® 50, Aquaparox 50

Method of Action: Reactive oxidizer – Oxygen bubbles form within sealice causing temporary paralysis in lice. Does not kill lice, but rather dislodges motile stages of lice only. Also reduces egg string viability.

Method of administration: Bath treatment for 20-30 minutes; well boat or tarpaulin.

Timing of treatment: Spring and fall cleanup.

Duration of action: No residual effect. Re-infestation can occur immediately.

Withdrawal period: None

Special Notes: Hydrogen peroxide is hard on gill health; it should not be used if the gill health of the fish is already compromised. In addition, hydrogen peroxide should not be used if water temperatures are under 3°C or over 13°C. A pesticide applicators license is required.

4.2.4 Azamethiphos

Trade name: Salmosan®

Method of Action: Organophosphate that blocks acetylcholinesterase, causing paralysis and death.

Method of administration: Fully enclosed bath treatment recommended for 60 minutes (up to a maximum of 180 minutes); well boat or tarpaulin.

Timing of treatment: As needed throughout the lice season. Effective against motile preadult and adult lice only. Juveniles that may be present with the pre-adult and adult stages will develop in 10 to 20 days, when another population count should be performed to show whether a second treatment is necessary.

Duration of action: No residual effect.

Withdrawal period: 48 hours.

Special Notes: This product should be used as part of a rotational strategy in the medicinal treatment of sea lice to avoid development of resistance. Maximum 10 applications may be applied to a fish population per year, with a minimum 7 day reapplication interval between treatments.. A pesticide applicators license is required. "Azamethiphos should not be used under 5°C or over 17°C unless directed by a veterinarian. Use under 5°C should only be done in exceptional circumstances based on feedback from divers and general observations of fish behavior that lead to lice counts."Azamethiphos should be applied to salmon suffering from infestations with pre-adult and adult sea lice, before the stage at which serious skin damage is evident. Careful management and monitoring of oxygen levels is critical during treatment.

4.2.5 Therapeutant assessment

The FHU will assess the efficacy of each intervention treatment. Any treatment that results in clearance of over 75% of targeted life stages will be considered an effective treatment.

Any treatments that have resulted in less than a 75% clearance of targeted life stages will trigger an investigation as to why the clearance levels are less than expected. There are a variety of reasons why a treatment may have resulted in sub-optimal clearance:

- Incorrect dose
- Incorrect mode of administration
- Incorrect water temperature
- Spoiled product – incorrect storage or expired product
- Incorrect therapeutant choice for the targeted life stage
- Inaccurate lice count – Pre or post treatment
- Resistance

Note that resistance cannot be proven by any single treatment. Rather, resistance is shown by tracking trends of treatments over time. Therefore, the DSS becomes a valuable tool for assessing effectiveness of treatments. To avoid resistance, proper treatment rotation should be utilized (instead of relying on one single treatment), and the proper effective dose of each therapeutant should be used.

4.3 Harvest

Mowi Canada East will always place top priority on the welfare of the fish under its care. If ever the FHU determines that the lice levels on a given cage have increased to the point that the welfare of the fish is in jeopardy, and none of the available treatments are able to decrease the lice load to an acceptable level, then an early harvest is warranted. The decision to harvest a cage of fish early will be made by both the Salt Water Production Director and the Fish Health and Welfare Manager, with the final decision resting with the Fish Health and Welfare Director.

4.4 Euthanasia

In the extremely rare circumstance that the lice levels in a cage are high enough that the welfare of the fish is jeopardized, and no treatments can bring the lice levels down to a reasonable level, but the fish are not cleared for harvest because they have not met all withdrawal periods of their treatments, then the fish will be humanely euthanized. If a large-scale euthanasia event is warranted, it will be conducted in as humane a manner as possible, facilitating a rapid and irreversible loss of consciousness. All policies and procedures surrounding euthanasia will be written and approved by the Veterinarian. Although the method of euthanasia may vary depending on the circumstances, all methods of euthanasia used will be in compliance with the Canadian Code of Practice for the care and handling of Farmed Salmonids:

Table I.1 – Methods that are Acceptable or Unacceptable at Different Weight Classes

Primary Method	Secondary Step Required?	Fish Weight[1]		
		≤1 g	1g–500g	>500g
Maceration	No	Acceptable	Unacceptable	Unacceptable
Intentional overdose via immersion in anesthetic bath	Conditional[2]	Acceptable	Acceptable	Acceptable
Blunt force trauma to the head	Yes[3]	Unacceptable	Acceptable	Acceptable
Percussive stunning device	Conditional[4]	Unacceptable	Unacceptable[5]	Acceptable
Electrical stunning	Conditional[4]	Acceptable	Acceptable	Acceptable
Pithing	No	Unacceptable	Acceptable	Acceptable
Secondary Steps	pithing, exsanguination, decapitation, cervical transection, immersion in ice slurry			

The NFACC Code of Practice for the Care and Handling of Farmed Salmonids (salmon, trout, charr) will determine the indices for depopulation due to animal welfare concerns.

5.0 Research and Development

Mowi Canada East places a high priority on research and development. It is understood that the more tools that are used in the treatment rotation in the IPMP, the less likely that sea lice will develop resistance to any single treatment. Mowi Canada East will work with research partners in both academia and government to better understand sea lice dynamics and management tools. As with the rest of the IPMP, an emphasis will be placed on research into preventative methods rather than intervention methods.

6.0 Additional Operational Procedures

With the increase in water temperatures that the South coast of Newfoundland has been experiencing in the last few years, there has been a noticeable increase in the lice pressures at sea sites. For this reason, changes must be made to both operational and treatment strategies to counteract this growing pressure.

6.1 Cage Rigging

All cages, regardless of size, have been rigged to allow the deployment of tarp treatments on the cage. **Redacted – Commercially sensitive strategic procedural details that are registered with FFA.**

6.2 Training for Operational Staff

In line with 6.1 Cage Rigging, Mowi Canada East staff have received hands-on operational training. **Redacted – Commercially sensitive procedural details that are registered with FFA.** .

6.3 More Efficient Mortality Removal

To treat an entire pen and ensure that every last fish has been treated, a pen must be corked. This process cannot be completed if there is mortality collecting at the bottom of the net pen, as it weighs down the net and causes issues with the corkline. Thus, a delay in mortality removal also causes a delay in lice treatments. Strategies that will allow for more efficient mortality removal include:

- All nets have been modified with 15m cone, to allow for more efficient mortality removal in the bottom of the cone.
- All nets have been installed as to allow for diverless mortality removal systems.
- Lift-up systems have been modified to function properly, efficiently and reliable. This was accomplished through input with Mowi colleagues in other Business Units. Additional farms have access to ROV Foover systems for mortality removal as needed.
- A new mortality-specific vessel Equipped with large wells, totaling 108T capacity was brought under contract in 2023 (for period of 5 years), to be used in addition to other vessels in the event of a mass mortality incident.
-

6.4 In-house Bioassay Program

The FHU has underwent special training so that they can start doing in-house bioassays. This will allow the unit to do bioassays in the future, as required. In turn, this will better inform treatment selection decisions as more options become available to the industry.

6.5 Deployment of New Treatments

There are a few new treatments that MCE is exploring and hoping to trial in the 2023 season and future years:

- Freshwater treatments **– Redacted - Commercially sensitive procedural details that are registered with FFA.**
- Extended salmosan treatments – **Redacted - Commercially sensitive procedural details that are registered with FFA.**

Appendix 2 – Biosecurity Plan

Salmonid Biosecurity Management Plan

Mowi Canada East

Version 4.1

Doc. ID #	Revision	Date	Responsibility
SBMP – V 4.1		May 2023	Fish Health and Welfare Division

Table of Contents

1.0 Biosecurity Policy and Practices - SW

Biosecurity is the ongoing process of identifying, evaluating and addressing actions or events in order to reduce the risk of disease transmission, to or from marine sites. ***These biosecurity practices may require modification with new information and technologies.***

1.1 General Daily Biosecurity Practices

- All site vessels are to be cleaned, scrubbed (with Greenworks or similar detergent) and disinfected (with Iodor or similar sanitizer) at the start and at the end of every day.
- Foot Baths are to be located for easy access and to be used by anyone boarding site vessels or work barges
- Footbaths are to be refreshed daily (Water should look like weak tea)
    - Iodor or any iodophor should be mixed at 100 to 200 mg/L with a ten-minute contact time. This contact time may be achieved through exposure to proper disinfectant concentration without rinsing with fresh seawater.
- As much as practicable, all site gear and personal gear should remain on site. All site gear, equipment or personal gear that leaves the site should be disinfected before returning to the site.
- Any site gear, equipment or personal gear that is moved between sites MUST be cleaned and disinfected before leaving one site AND again upon arrival at another site.
- Inflow wharves (Pool's Cove, Hermitage, Hr. Breton, Milltown) are to be used for all 'clean' material being transported to farm sites. Vessels using inflow wharves will be cleaned and disinfected prior to use at these wharves, according to operation agreement with FFA of use of those facilities.
- At other mixed-use wharves or facilities, vessels and vehicles will be cleaned and disinfected to reduce transmission of pathogens.
- All site staff are required to clean and disinfect their personal gear at the end of every day prior to leaving site.
- All feed will be stored in the proper wells on sites that have Steinsvik feed barge (or similar). On sites that do not have feed barges, feed must be stored in a cool, dry place and must be contained and always covered when not being administered to the fish.
- Predator control must be in place at all sites. In the marine environment this would include engineering controls (e.g. reinforced containment nets) and bird nets on the top of the cage.

Site biosecurity practices will be reviewed monthly by the Veterinarian or designate during their routine visit, as per the Biosecurity Audit Plan.

1.2 Farm Access

Vehicles, vessels, and visitors can be agents of contamination and can transmit disease from one farm to another.

- Access to farm sites will be controlled to provide a break between those outside influences such as predators, non-essential personnel, and vehicular traffic which may negatively affect the health of fish.
- A login sheet will be used at all sites to document any visitors (ie. non-site staff) to the site. This includes any Mowi Canada East employees who are not regular workers on site. See Appendix 4.1 for the SW Visitor Orientation and Sign in sheet.
- Any transport vessels coming to site will tie up at a designated spot (on sites with a feeding barge, vessels will tie up to the barge), and then use site specific vessels to access the site.
- Staff will be designated to a BMA. In the event that relief staff are required (ex. Sick leave, vacation coverage, etc), relief staff can only work in their designated BMA.
- The most efficient layout of farm sites will be used to facilitate the development and maintenance of controlled access zones.
- Exclusive 'in-flow' or 'clean' wharf facilities at Pool's Cove, Hermitage, Hr. Breton, and Milltown will be used as per the Wharf User Agreements.
    - BMA 1,2, and 3 will be serviced by Pools Cove Wharves
    - BMA 4 will be serviced from Wreck Cove and Harbour Breton
    - BMA 5 will be serviced from Harbour Breton
    - BMA 10, 11, and 12 will be serviced from Seal Cove or Harbour Breton
- No outside visitors will be allowed on site without prior approval from both the Saltwater Production Director and the Fish Health and Welfare Director. This includes service vessels such as wellboats.

1.3 Large Equipment Cleaning and Disinfection

- For maximum efficacy of disinfection, all objects must be thoroughly cleaned and free of all organic material prior to disinfection, using a detergent like Greenworks.
- As operationally practicable, vessels and feed rafts will be site specific. If necessary to move between sites, they will be disinfected before and after leaving the site.
- Dirty nets being transported to shore will be transported in a manner to minimize loss or spillage of organic matter and only to designated outflow wharves. Pickup of dirty nets will be done in a manner to reduce risk of contamination with clean areas, using contained transport vehicles and containers. Transport vehicles or containers that are used to transport dirty nets will be cleaned and disinfected at the end of each day.
- Nets will be cleaned of all organic material before disinfecting, either by a manual net cleaner on site, or by a Remote Operated Net Cleaner (RONC). Disinfection will be done at a facility using approved methods, presently at Newfoundland Aqua Services in Head, Bay d'Espoir. Land-based net washing will be performed as per MCE SOP SW-008 NL C&D of Nets and Newfoundland Aqua Services (NAS) Standard Operating Procedure. In the event of ISA, NAS will follow NAS SOP for Sites Under a Quarantine Order due to ISA.
- Large vessels entering from other provinces/countries will receive C&D prior to use in operations in NL. C&D and notifications will be performed, as required by AP-36 – Aquaculture Motor Vehicle, Vessel, Boat and Barge Biosecurity. Further guidance for third party vessels is provided in Appendix Biosecurity: Large Vessel Biosecurity Protocols (SW).

- To move vessels or large equipment from one BMA to another, prior approval is required from the Fish Health and Welfare Director.
- Vessels or large equipment can be moved from one site to another within the same BMA without prior approval, provided that the topside of the vessel is thoroughly scrubbed clean with Greenworks prior to disinfection with Iodor (250ppm for 10-minute contact time).
- Alternative products for cleaning and disinfection can be found in Table 1. If other products outside of the table are to be used, prior approval from the Fish Health and Welfare Director MUST be granted.
- Transport trucks will be designated to haul dirty OR clean loads – NEVER both.
    - Examples of dirty loads include:
        - Used site equipment – nets, weight balls, compensator buoys, etc.
        - Fish (harvest or processed)
        - Mortalities or Offal
        - Used pallets
        - Garbage
    - Examples of clean loads include:
        - Feed
        - Clean or new site equipment
- At the end of every production cycle, all the equipment on a site will be properly cleaned and disinfected:
    - Cages will be steam cleaned
    - Vessels and barges will be cleaned as vessels (see section 2. Travel Between Areas if the vessel or barge is to be moved to a different BMA)
    - All equipment will be cleaned and disinfected prior to be moved off of site, even if the equipment is just to be moved into storage until the next production cycle at the same site.
- All Cleaning and Disinfection processes are subject to biosecurity audits by the Fish Health Unit (FHU) – see section 1.7 Biosecurity Audits.

Table 2: Cleaning and Disinfection products

Disinfectant	**Strength**	**Dilution**	**Contact time**
Iodor, Premise, Wescodyne etc	250ppm	300mls/20liters	10 mins
Javex (cannot be used at marine site)	1,000 ppm	500mls/20liters	10 minutes
Virkon (can only be used with fresh water)	1%	250 grams/25liters (freshwater only)	10 minutes
Oxygerm (hydrogen peroxide/acetic acid/peracetic acid)	0.4%		5 minutes
Cleaning	**Strength**	**Dilution**	**Contact time**

Detergents	Green Works, Mr. Clean or similar	Strong	Use prior to disinfecting
Hot water & High Pressure	>65°C	N/A	>10 minutes

1.4 Fish Transfers

- Prior to transferring any fish, a pre-transfer health assessment must be completed and signed off by the designated veterinarian for the site. If fish are to cross a provincial border, then a Certificate of Health for Transfer is required.
- Transfer permits must accompany every lot of fish and be available for inspection.
- If trucks are to be used during the transfer, they must be thoroughly cleaned and disinfected prior to the transfer, between different sources of fish (ie. between different hatcheries), and after all transfers are over. See Appendix 4.2 for the SOP for Truck Tanker Disinfection.

1.5 Mortality Collection

- Daily mortality collection is done through the use of a Liftup system or ROV.
- At minimum, mortality is removed from the sea farms on a weekly basis.
- Alternative methods of mortality collection are used as needed.
- If divers are used, they will be accompanied or met on site-by-site management personnel.
- Site crew must wear site specific PPE. These items must be cleaned and disinfected at the end of mortality removal and stored on site. See Table 1 for cleaning and disinfection products.
- If divers are used, all associated equipment will be cleaned and disinfected prior to and after completion of their assigned tasks.
- Site crew should ensure that the collection vessels, personal apparel, and equipment used during the mortality collection is properly cleaned and sanitized before and after completion.
- Any gear not necessary for the mort collection should be removed from the collection vessel. All drains and scuppers in boats should be plugged for the duration of the collection to contain any spillage unless boat is equipped with flap-type scuppers. In this case, efforts will be made to contain any spillage and disinfect prior to discharge.
- If divers are used, divers should be disinfected in between cages as soon as the diver exits the cage (to allow contact time between cages).
- The vessel and all gear and equipment onboard must be thoroughly cleaned and disinfected immediately **after** the mortalities have been removed.
- Mort totes or tubs
    - Must be in good condition (no cracks or breaks).
    - Mort totes should not be filled more than ¾ full and the bungs are to be checked for tightness (or sealed by spot-welding) and proper fit to prevent spillage.
    - Mort totes should be clearly marked with company name

- No morts or moribund fish are to be released to the sea.
- Divers' suits and all dive gear must be disinfected upon completion of the dive.
- Cages with elevated mortality or known health issues will be dove last.
- If that more than one site is to be dove per day, older sites or sites with known fish health issues will be dove last.
- For specific information and SOPs on mortality collection, **please see the Fish Disposal Plan**

1.6 Mortality Disposal

- Following the collection, mortalities will be taken to the wharf (either as whole fish or as silage) where they will be held for storage (a layer of clean sawdust may be added as a bulking and odour control agent if morts are destined for composting) or transferred to large, sealed containers for eventual transport to the designated mort disposal facility.
- NO material other than mortalities (i.e. kelp, plastic wrap, mussel or other shells) are to be mixed with morts that are destined to be ensiled.
- All mort totes or boxes MUST be thoroughly cleaned and disinfected before being returned to the site. In addition, any mort tubs that are damaged or cracked will be taken out of rotation and disposed of. Only undamaged, fully intact tubs will be used for mortality collection.
- Every effort should be made to avoid transporting mortalities from one BMA to another. Mortalities should be stored in a separate area away from other wharf activities. Any mortalities that are being transported should be in leak-proof containers that have lids. Every effort should be made to ensure that mortalities are contained during transport.
- Under normal circumstance, no mortalities should be moved from one site to another. It is the responsibility of each site crew to bring their own mortalities back to the wharf for disposal.
- In the event of ensiler breakdown at remote sites where daily mortality removal to a wharf is not feasible, mortalities may be transported to a neighboring site within the same BMA for immediate processing.
- For greater detail, **please see The Fish Disposal Plan, Appendix 3.**

1.7 Bath Treatments

- Staff must recognize that bath treatments, and associated equipment, pose a potential risk of pathogen transfer.
- Wherever possible, equipment should be BMA specific (tarps, oxygen lines, etc).
- When not possible, equipment should be thoroughly cleaned and disinfected when moving from one site to another.
    - Well boats must be topside Cleaned and Disinfected. All wells must be cleaned, disinfected, and rinsed. Note that well boats are a vessel and as such, are subject to Section 2. Movement Between Areas

1.8 Harvest Disinfection Protocols

- Deck and equipment of all harvest vessels will be cleaned and disinfected prior to loading the fish.
- All harvest tubs will be disinfected and inspected for cracks or missing plugs prior to use.
- All harvest tubs will only be partially filled (see Harvest Protocols) to prevent spillage during transport. Plastic wrap will be used to prevent spillage during transport to processing facilities.
- A disinfectant hose or sprayer will be kept on hand to treat any spillage.
- All operations will be carried out in a manner to avoid any spillage or leakage of blood, slime, or scales.
- Prior to site departure after a harvest, all harvest tubs, harvest equipment, rain gear, gloves, boots, free deck, and side of boat under the dewatering box will be cleaned and disinfected.
- After offloading, the deck and other gear will again be disinfected, as well as the surface of the harvest wharf.
- Fresh water (not seawater) will be used to wash equipment where contact with saltwater should be minimized (vehicles, forklifts etc.).
- Blood water will normally be contained in tubs with the fish, transported & disposed of in an approved manner at St. Alban's or Harbour Breton processing plants.

1.9 Biosecurity Audits

Biosecurity audits will be conducted by the Fish Health Unit to ensure that proper biosecurity protocols are being followed by all Mowi Canada East staff members.

- All marine sites will have a thorough Biosecurity Audit once per calendar year. This includes:
    - Site inspection for cleanliness and adherence to procedures
    - Tracing of everything coming into site – staff, feed, treatments, etc
    - Tracing of everything leaving site – staff, mortalities, garbage, etc
    - Analyzing traffic patterns listed above to identify any potential cross track and mitigation measures for when cross track cannot be prevented.
- All major equipment moving between BMAs must be approved by the Fish Health and Welfare Director prior to movement. In order for this to occur, an Application to Move must be submitted to, and subsequently signed by, the Fish Health and Welfare Director. See Appendix 4.3 for the SOP for ATP Swabs.
- All sites are subject to the FFA Biosecurity Audit Plan. Visits for audits will be arranged through the Fish Health and Welfare Director.

1.10 Response Plan for a Biosecurity Breach

A biosecurity breach is any incident in which a pathogen is brought into a facility despite efforts to prevent as such. The movement of people, equipment and fish all have the potential to introduce pathogens. Mowi Canada East has strong procedures to prevent the introduction or movement of pathogens in facilities. MCE has implemented an

Incident and Crisis Management System (Doc ID# SCP-v4.1).A biosecurity breach can be identified through routine surveillance sampling or increased sampling in response to a change in fish behavior or mortality levels. The identification of a fish pathogen or the identification of biosecurity procedures not being followed are reported through the Incident and Crisis Management System. Where biosecurity procedures were not followed, but did not result in cross-contamination of a fish pathogen, the incident is a near miss.

The following key information is reported through the Incident and Crisis Management System:

1. What happened?
2. How did it happen?
3. Why did it happen?
4. Other relevant information/development of the incident
5. Corrective actions

In the event that fish are infected as a results of a biosecurity breach, the response is the implementation of increased fish health surveillance, treatment, and reporting for the disease. Any affected units will undergo full C&D before being restocked. Also a review of the contamination source in order to implement corrective measures that will avoid a reoccurrence.

In the event of a procedural error or gap related to biosecurity practices, the response is a review of the biosecurity procedures, communications and training. If a gap or need for improvement is identified, the response will be to update procedures, communications or training as needed to prevent a reoccurrence.

2.0 Biosecurity Policy and Practices – FW

Bio-security is the ongoing process of identifying, evaluating and addressing actions or events in order to reduce the risk of disease transmission, to or from different systems or tanks. ***These biosecurity practices may require modification with new information and technologies.***

2.1 General Daily Biosecurity Practices

- Foot Baths and hand sanitizers are to be located at all entry points into a building and easily accessible for use by all site personnel.
    - Footbaths and hand sanitizers are to be checked daily to ensure that they are filled and at proper concentrations.
    - Virkon aquatic solutions should be mixed at 10 g/L with a ten-minute contact time.
- As much as practicable, all site gear should remain on site. All site gear, equipment, or personal gear that leaves site should be disinfected before returning to site (see Table 1).

- Each system will have system-specific colour-coded gear. As much as possible, each tank within a system will have tank-specific nets. Separate nets should be used for mortality collection and live fish handling.
- A third-party contractor will look after pest control for every building on site. This contractor, as with every contractor, will be subject to guest protocols as outlined in Section 2.2 Farm Access
- No moist food will be permitted on site. All food will be dry, pelleted food that is contained small lot bags. Every effort will be made to store food in the system that it is destined for.
- All incoming well water will be degassed and all outgoing effluent water will have solids separated prior to release (see Appendix 4.4 for Stephenville's Policy on Water Flow)
- In the case of a quarantine order, a Licence to Move will be obtained prior to solid waste removal by a third party contractor. Specific protocols will be provided in the LTM application for approval before commencing removal of the material.

Site biosecurity practices will be reviewed monthly by the Veterinarian or designate during their routine visit, as per the Biosecurity Audit Plan.

2.2 Farm Access

Vehicles and visitors can be agents of contamination and can transmit disease from one farm to another.

- There will be limited access points to the facility where all staff, visitors and/or vehicles requiring entry onto site will undergo a disinfection process prior to entry.
- A sign will be posted at the entrance which notifies visitors that the site is a Biosecure Area and that visitors will be received by appointment only.
    - Pedestrian access will be through a biosecurity building with foot dips and hand sanitizers
    - Visitors will be given site specific guest boots and guest lab coat to be worn while on the property
    - Vehicle access will be granted only after the vehicle undercarriage and tires have been sprayed with disinfectant.
- No outside visitors will be allowed on site without prior approval from both the Fresh Water Production Director and/or the Fish Health and Welfare Director.
- A sign in sheet will be used to document all people entering the site (see Appendix 4.5 for the Land Based Sign in Sheet)
- All staff will change into site specific footwear upon entrance to the facility.
- Staff will all enter the facility through the same entrance, change into their site-specific gear and proceed to their designated system.
    - Lunch will be taken in designated lunch areas only
        - Fry, Smolt 1 and Smolt 2 facilities will use the lunchroom in the Fry building
        - Smolt 3 staff will use the lunchroom in Smolt 3
        - Post smolt staff will use the lunchroom in the Post smolt building

2.3 Equipment Cleaning and Disinfection

- Water systems are to be separated by biosecurity barriers (footbaths and hand wash stations).
    - Staff are required to go through a biosecurity barrier when moving from one system to another.
    - Whenever possible, staff should be assigned to a specific system so that movement from one system to another is limited.
- Each system will have designated equipment for use in that system only.
- Equipment must not be shared between systems to reduce the risk of cross contamination between fish groups.
- All equipment, including nets and brushes, must be disinfected with a 1% Virkon solution before and after every use.
- Once a system is emptied of all its fish, it will undergo a thorough cleaning and disinfection process:
    - All tanks and accessible equipment will be pressure washed
    - Caustic soda will be added to the system until the pH is 12.
    - The caustic soda solution will be allowed to run through the system (including biofilter) for a minimum of 24 hours prior to emptying into wastewater system
    - The system will be pressure washed again to remove any residuals
    - The system will be disinfected with Virkon
    - Once this process has been finished, it must pass an ATP swab test prior to new fish being ponded into the system (see Appendix 4.3 for SOP on ATP Swabs)
- Every effort should be made to avoid moving used equipment into the facility.
    - If it is required to do so, the equipment must be thoroughly cleaned, disinfected prior to entry into the site (see Table 1). Prior to installation into a system, it must have completed and passed an ATP swab test.

2.4 Fish Transfers

- Prior to transferring any fish, a pre-transfer health assessment must be completed and signed off by the designated veterinarian for the site. If fish are to cross a provincial border, then a Certificate of Health for Transfer is required.
- Transfer permits must accompany every lot of fish and be available for inspection.
- If trucks are to be used during the transfer, they must be thoroughly cleaned and disinfected prior to the transfer, between different sources of fish (ie. between different hatcheries), and after all transfers are over. See Appendix 4.2 for the SOP on Tanker Truck Disinfection.
- Fish movements through the facility must always be in the following order:
    - Incubation room
    - Fry systems
    - Smolt systems
    - Pumped onto transport trucks
- See Appendix 4.6 for the Stephenville Facility Site Plan

- Any hoses or pumps that are used for transferring fish from one system to the other (or from one system onto a transport truck) must be cleaned and disinfected between different lots of fish (see Table 1).

2.5 Mortality Collection

- Mortality removal from tanks will be conducted on daily.
- Mortalities will be collected in system-specific buckets that are not used for any other purpose.
- At the end of every day, mortality buckets will be brought to the on-site holding tub for further removal.
    - Once emptied, mortality buckets will be cleaned with a detergent (ex. Greenworks or Mr. Clean), rinsed, and then disinfected with a 1% Virkon solution
- Mort buckets must be in good condition (no cracks or breaks).
- Mort buckets should be clearly marked.
- No mortalities or moribund fish are to be released into the environment.

2.6 Mortality Disposal

- At the end of the day, all mortalities will be placed in holding tubs located on site for eventual transport to the designated mort disposal facility.
- No material other than morts shall be placed in mortality collection tubs.
- All mort tubs MUST be thoroughly cleaned and disinfected before being returned to site (see Table 1). In addition, any mortality tubs that are damaged or cracked will be taken out of rotation and disposed of. Only undamaged, fully intact tubs will be used for mort collection.
- For more details, **please see the Fish Disposal Plan, Appendix 3.**

2.7 Biosecurity Audits

Biosecurity audits will be conducted by the Fish Health Unit to ensure that proper biosecurity protocols are being followed by all Mowi Canada East staff members.

- All land-based sites will have a thorough Biosecurity Audit once per calendar year. This includes:
    - Site inspection for cleanliness and adherence to procedures.
    - Tracing of everything coming into site – staff, feed, treatments, etc.
    - Tracing of everything leaving site – staff, mortalities, garbage, etc.
    - Analyzing traffic patterns listed above to identify any potential cross track and mitigation measures for when cross track cannot be prevented.
- All sites are subject to the FFA Biosecurity Audit Plan. Visits for audits will be arranged through the Fish Health and Welfare Director.

2.8 Response Plan for a Biosecurity Breach

A biosecurity breach is any incident in which a pathogen is brought into a facility despite efforts to prevent as such. The movement of people, equipment and fish all have the potential to introduce pathogens. Mowi Canada East has strong procedures to prevent the introduction or movement of pathogens in facilities. MCE has implemented an Incident and Crisis Management System (Doc ID# SCP-v4.1).A biosecurity breach can be identified through routine surveillance sampling or increased sampling in response to a change in fish behavior or mortality levels. The identification of a fish pathogen or the identification of biosecurity procedures not being followed are reported through the Incident and Crisis Management System. Where biosecurity procedures were not followed, but did not result in cross-contamination of a fish pathogen, the incident is a near miss.

The following key information is reported through the Incident and Crisis Management System:

1. What happened?
2. How did it happen?
3. Why did it happen?
4. Other relevant information/development of the incident
5. Corrective actions

In the event that fish are infected as a results of a biosecurity breach, the response is the implementation of increased fish health surveillance, treatment, and reporting for the disease. Any affected units will undergo full C&D before being restocked. Also a review of the contamination source in order to implement corrective measures that will avoid a reoccurrence.

In the event of a procedural error or gap related to biosecurity practices, the response is a review of the biosecurity procedures, communications and training. If a gap or need for improvement is identified, the response will be to update procedures, communications or training as needed to prevent a reoccurrence.

3.0 Travel Between Different Areas

There may be times when staff are required to travel from one area of the business unit to another. From a fish health perspective, different areas include (with proper numerical designation):

6. Broodstock
7. Freshwater
8. Saltwater
9. Saltwater (quarantined for FH reason)
10. Processing Plant

- Staff that are required to move from one area to another should have a separate set of work gear for each area. Under no circumstances should any uncovered clothing or PPE be brought from one area to another.

- Staff can move from one area to an area with a higher number designation without any restrictions (for example there is no restriction to go from a FW site to a SW site).
- If staff need to move from one area to an area with a lower number designation (for example moving from a processing plant to a saltwater site), a site-free period of 72 hours must be observed prior moving to the second area.
- Vehicles (personal or work-related) should be used for salt water OR freshwater; never both
    - If staff are required to travel between two different areas of production, rental cars should be utilized for one of the areas.
- In addition to the numerical areas set above, an off-site period of 72 hours should be observed if staff are moving from a site in one province to a site in another (regardless of their numerical designations).
- If there are any questions as to whether a 72-hour off-site period must be observed, staff are instructed to consult with a member of the Fish Health Unit for advice.
- Exceptions to this rule will be on a case-by-case basis and MUST be approved by the Fish Health and Welfare Director and either the Freshwater Production Director or the Saltwater Production Director.

Appendix Biosecurity: SW Visitor Orientation and Sign in Sheet

All visitors must be made aware of the following 4 categories.
Complete the checklist as individuals are presented with all necessary information.

1. PERSONAL PROTECTIVE EQUIPMENT (MANDATORY while on site) (√)

Personal Flotation Device (PFD)	
Hard Hat	
CSA Approved Safety Boots	

2. BIOSECURITY

Use of foot dip **immediately upon entering vessel** and as directed by NHSF staff	
Notification of any Aquaculture site(s) visited in previous 72 hrs **If yes to the above, please list site(s) by signature below.**	

3. LOCATION OF SAFETY EQUIPMENT

Life Raft	
Fire Extinguisher	
First Aid Kit	

Emergency Flares	
Eye Wash Station	
Washroom Facility	

4. LOCATION OF EMERGENCY INFORMATION BINDERS

Material Safety Data Sheets (MSDS/SDS)	
MCE (NHSF NL Ltd./MHAC Inc.) Policies and Procedures	

By signing below, all parties acknowledge and understand the boat ________________________ orientation
(Vessel name)

that was presented at __________________________ on ______________________________ by
(Site) **(Date)**

____
(Employee Name, please print)

Appendix Biosecurity: SOP for Transport Tankers Disinfection

Transport Tankers Disinfection

Rationale
This procedure is used to disinfect tankers/box holds prior to fish transfers between freshwater sites and also prior to transfers between hatcheries and saltwater/well boats.

Responsibility
All staff preparing tankers/box holds for fish transfers will be responsible for the following procedure.

Description
Advance preparation
- Use a transport company dedicated to MCE transports.
- Use trailers and smolt transfer tanks dedicated to MCE transports only.
- Tractor unit is to be washed and disinfected prior to arrival at freshwater shipping station.
- The complete disinfection process is to be repeated for each individual freshwater facility or location (ex. Northampton, Cardigan, Dover, Stephenville NH Smolt ect.).
- The plan for transport personnel responsible for loading fish is to remain at originating site and separate personnel at receiving site.
- Designated 'clean' raingear, gloves and boots are to be worn by transport personnel.

Procedure (Tanker/Box holds and lines)
- Using a dosatron system and a 1% J-12 solution spray all exterior surfaces of the Truck and Tanker/box holds.
- Mix a 1% J-12 solution (i.e. 100ml J-12 in 9L water) in a portable sprayer.
- Spray all interior holding surfaces with the 1% J-12 solution while using a brush to scrub away any residue. Let sit for 10 minutes.
- Rinse interior surfaces with well water at the transport site.
- Over fill tanker with well water allowing all air lines and diffusers to be fully submerged. Add enough J-12 to reach a 1% solution and mix thoroughly allowing solution to overflow the overflow outlet valves and the inlet valves. Let sit for 1 hour.
- Drain and rinse the J-12 solution from tanker by filling with well water at the transport site.
- Isolate and fill lines/pipes with a 1% J-12 solution (i.e.100mL J-12 in 9L water). Let sit for ten minutes minimum, drain and flush with well water at transport site.

Procedure (Additional Items/Locations)
- After cleaning tanker holds, use a 1% J-12 solution and scrub brush to clean the 6" outlet tubes from both top and bottom.
- Use a brush and scrubbie with the 1% J-12 solution to clean the aluminum camlock caps.
- Test sterility level with ATP swabs and meter. Any test area reading >500RLU must be re-cleaned, disinfected and tested again.

Equipment
- New brushes, cleaning tools
- PPE including proper gloves (butyl rubber or nitrile), eye protection, clean raingear.
- Suitable chemical sprayer with clearly marked liter levels.
- Measuring cup
- ATP swabs and meter

Recordkeeping
- Disinfection logs with a place for a check mark verifying that each step has been done- then signed off at the bottom.
- Safety Data Sheets for products used.
- Chemical mixing directions.

Appendix Biosecurity: ATP Swab Test

Mowi Canada East

Standard Operating Procedure

ATP Swab Test

Date Effective: April 2023

Purpose

This Standard Operating Procedure (SOP) must be followed when completing an ATP Swab test on any equipment (boat, truck, tanks, barge, grader, counter, net etc.) that will be moved from one site or year class to another or coming in from external. The swab test will be done after cleaning and after disinfection.

Biosecurity internal and external/ risk of spreading pathogenic biological matter/ spread of disease: *Equipment should be site/year class specific, and movements should be avoided. Movements should only occur where absolutely necessary, at a high standard of biosecurity control.*

Accompanying Documents: "Application to Move Equipment" form

See Appendix A, this document must be partially completed online prior to the ATP Swab Test. It must be filled out by the manager of the location sending the equipment. Once the ATP testing has been carried out and passed by a trained member of staff and the results added to the application, the item is cleared for movement. The document must be emailed to the relevant parties detailed below. This document can and will be used to confirm the results of the test and will be kept as reference.

Responsibilities

- Site Managers must submit the Application to Move Equipment form and send completed document to relevant parties including but not limited to: Receiving Site Manager, All Health Team, Production Director (seawater and/or freshwater)
- Trained staff to perform the swabs and complete the Application to Move Equipment form

Health and Safety

Mowi Canada East is a strong advocate and supporter for safety in the workplace, therefore, the protocol for personal protective equipment is extensive. You should identify which items are required for the circumstance and speak to your manager if you are unsure.

- Hard hat
- Steel toe/ composite rubber work boots
- Personal flotation device with crotch strap (if vessel is in water)
- VHF handheld radio (working over water)
- Winter suit/Waterproof rain gear
- Gloves (if necessary)

Description

BEFORE GOING TO THE SITE

This process is started when a Site Manager submits an "Application to Move Equipment" form. Once the form is submitted, a trained member of staff will schedule a swab test.

Prepare a test kit to bring to the site

a. Place an ice pack into the bottom of a small cooler
b. Place several paper towels over the ice pack
c. Lay a pack of hygiena UltraSnap ATP Surface Test swabs on top of the layer of paper towel.
d. Bring the Hygiene SystemSure Plus.
e. Bring the Application to Move Equipment Form that was submitted by production staff

AFTER ARRIVING AT THE SITE

1. Review photos in Appendix 1 for guidance on SystemSure Plus
2. Locate the piece(s) of equipment that needs to be tested.
3. Give the equipment a thorough look over
   a. Make notes of the overall cleanliness on Part B of the "Application to Move Equipment" form
4. Turn on the Hygiena SystemSure Plus by pressing the red power button on the top left corner
5. A MINIMUM of FOUR swab test must be completed with each piece of equipment after cleaning and again after disinfecting
6. Choose 2 areas on the outside of the equipment and 2 areas on the inside of the equipment of perform the test
   a. Particular attention should be paid to areas of high traffic, e.g. handling, contact with fish (pipes, chutes)
   b. These areas should be spaced out over the equipment
   c. These areas may be in places that the person performing the test believe are hard to clean

7. Open a swab and rub the cotton tip along the surface being tested, only for a few seconds. Adequate pressure must be used to ensure thorough contact between the swab and the equipment surface. An area of 4 inch by 4 inch or 10cm x 10cm should be swabbed. Please see the instruction manual of the Hygiena SystemSure Plus for further instructions.
8. Put the swab back into the plastic casing and crack the top of the swab (opposite end of the cotton tip) where the solvent is held; squeezing the bulb several times to ensure ALL the solvent goes into the bottom with the tip of the swab
9. Gently shake the swab for TEN seconds
10. Place the swab, in the plastic casing, into the top of the Hygiena SystemSure Plus, close the top and press the OK button in the center
11. After 15 seconds the Hygiena SystemSure Plus will give a reading. Record this reading on the result page of the "Application to move equipment" file.

AFTER CLEANING:

- A reading **BELOW 40** is automatic PASS
- A reading **ABOVE 40** is automatic FAIL

AFTER DISINFECTANT

- A reading **BELOW 10** is automatic PASS
- A reading **ABOVE 30** is automatic FAIL

A reading between **11 and 29** is subject to approval from the Health Team, based on type of equipment and the area the equipment is moving from/to.

12. Complete steps 7-11 with at least other three swabs
13. Once the "Application to Move Equipment" form has been completely filled, send it to the relevant parties outlined above.

If the item passes the swab test, it is cleared for movement.

Notes:

If there is ANY DOUBT about whether an item should pass based on its physical condition, visible cleanliness or swab results, speak to a member of the Health Team

If there is ANY DOUBT regarding sampling locations, speak to ether Site Manager or a member of the Health Team

If the equipment fails the swab test, notify the manager that it did fail and that the whole equipment must be cleaned and disinfected again before another swab test can be performed.

Review photos below for guidance on ATP swab use

Records: Application to Move Equipment form

Appendix 1

Step 1 – Turn on machine
and locate swab

Step 2 – Remove swab from tube
and swab a 4x4inch area applying gentle pressure.

Step 3 – Replace swab in tube and
bend the bulb over to release the liquid

Step 4 – Swirl the liquid around the swab for 10seconds

Step 5 – Insert swab into device

Step 6 – Press 'OK' and system will count down from 15 to give a reading

Appendix Biosecurity: Stephenville Policy on Water Flow

Northern Harvest Smolt Ltd.
Stephenville Hatchery

Policy Name: Flow of Water from Well to Effluent
Policy Number: 034
Date: 2016-09-30
Date Reviewed or Revised: 2024-11-17
References: Andrew Skanes

Policy Statement: Northern Harvest Smolt Ltd. (NHS) Stephenville hatchery uses well water as regulated by the provincial Government of Newfoundland and Labrador issued Water Use Licenses WUL-23-13191. NHS hatchery is a 98% recirculating system.

Purpose and Scope: The purpose of this standard operating procedure is to describe the flow of water from the well through the systems and finally to the effluent building.

Definitions and Clarifications: N/A

Procedure: Northern Harvest Smolt Ltd. (NHS) uses three separate wells to access water in an aquifer. Each well contains a pump which can be activated using a variable speed drive control located in a central well house.

Once pumped from the well the water continues gravity fed to the facility. Each of the three buildings has a well water line which is separated into each of the 8 isolated systems. The water is introduced into the reservoir of each system. From the reservoir the water is then pumped to a degassing chamber. The unwanted gas e.g. carbon dioxide has been removed from the water oxygen is then gravity fed to the water with a low head oxygenator (LHO). From the LHO the water is gravity fed separately to each of the system tanks. The water exits each tank through the swirl separator then to a drum filter. From the drum filter (Fairvre) the water is channeled through a moving bed bio-filter where ammonia is removed before returning to the reservoir. In addition to the filtration mentioned above each reservoir has installed in a side stream configuration, a bead filter (Aquaculture Engineering) which filters water, treats it with Ultra Violet (ETS) light and returns it to the reservoir.

All waste water or excess water is shed from each system via an overflow pipe in the reservoir or the bottom drain on each swirl separator. This water travels through underground pipe to the waste water building at the rear of the property. In the waste water building, the water is filtered through a 80µM micron drum filter. After filtration through the primary waste water building, the water is piped underground a second time to a secondary waste water building for polishing. The water is filtered through a 37µM micron drum filter and UV disinfected before travelling through a discharge pipe into Bay St. George. The waste gathered by the drum filters are stored in 2 3785 litre storage tanks which are pumped out by Gales Septic Cleaning Ltd as needed or on a quarterly basis. The waste from each storage tank is taken to Gales own facility where it is prepared and disposed of as per local regulations. Gales introduce certain additives to the lagoon in order to bread down any waste. The remaining waste material is not removed from their site.

Authority: Aaron Bennett **Signature:**

Appendix Biosecurity: Land Based Sign-In Sheet

Biosecurity Sign In Sheet

Date: ____________

Name	Company	Reason For Visit	Time In	Time Out	Radio #	Radio Returned

Northern Harvest Smolt Ltd.
P.O. Box 39, 15 Connecticut Dr., Stephenville, NL, A2N-2Y7
[redacted]

Appendix Biosecurity : Large Vessel Biosecurity Protocols (SW)

Large Vessel Biosecurity Protocols (SW)

This document has been drafted to provide third party suppliers a guide on what Mowi Canada East expects from you when visiting our marine sites. If anything is unclear, do not hesitate to reach out to our Fish Health and Welfare Director to clarify any questions you may have.

1. Prior to Accessing Site

The following items are required to be complete prior to entering our site boundaries:

- Allow 72 hours between visiting a different aquaculture company and a Mowi site.
- Ensure that your vessel is cleaned and disinfected according to Section 2: Vessel Protocols prior to entering site boundary.
- Mowi specific personal gear is to be worn on any of our sites. Personal gear refers to personal flotation device, rubber boots, hard hat and rain gear (if required). If items have been worn on a different company's site, they should not be brought onto site with you, even if you will not be wearing them.
  - Furthermore, if your staff will be working directly with fish, then BMA specific gear should be worn.
  - All personal gear should be clean and free of debris before starting each day. If handling fish, then it should be cleaned and disinfected at the end of the day (if you are unsure, please ask the site manager).
- Be aware that if you are accessing our site with your own vessel or gear, Mowi reserves the right to do a biosecurity audit of your vessel or gear. This may include taking swabs to verify cleanliness of the item prior to arriving on our sites.

Upon entering site, you will need to fill out a Visitor's Orientation.

2. Vessel Protocols

Depending on the Operational Circumstance, various levels of cleaning / disinfection will be required on your vessel, as outlined below:

OPERATIONAL CIRCUMSTANCE	Stage 1	Stage 2	Stage 3
Arrival and departure from Canadian waters	√	√	√
Within BMA – Operating on a site / between cages	√		
Within BMA – Moving between sites	√	√	
Between BMA's – Moving from one BMA to another	√	√	
Moving between provinces	√	√	√

Stage 1:

- Brush / clean solids from all surfaces.
- Use either a mild detergent solution (Greenworks or Dawn) or a hot-water pressure clean (greater than 2000 psi at a temperature greater than 60ºC with detergent/degreaser) to remove organic material from the following areas:

- deck and railings
- wells and pumps (if applicable)
- equipment

- After cleaning, spray the above items with a disinfectant (see approved list below) and either leave on permanently, or wait 10 minutes prior to rinsing off.
- Clean and Disinfect personal gear
- Complete the checklist

Stage 2: Complete Stage 1 and carry out the following additional tasks:

- Internally inspect, clean, and disinfect any fish pumps or fish lines, being sure to clean all organic material from it before carrying out the normal disinfection procedure.
- Disinfectant is recycled through pump for a contact time of 10 minutes
- Steam clean and disinfect the deck, well and hull above the waterline.
- Deck lines are submerged in disinfectant for >10 minutes
- Complete the checklist
- Sign the checklist with copies to be retained/distributed as follows:
  - Retained In the vessel disinfection log and kept on board at all times
  - Copied to site manager and Fish Health and Welfare Director for auditing

Stage 3: Complete all of Stages 1 and 2 plus the following additional tasks:

- Slip the vessel, clean and disinfect the hull below the waterline.

Other Requirements:

- If a disease is detected on a site, the Fish Health and Welfare Director will provide instructions on how your vessel may or may not interact with that site. Any special biosecurity protocols will be given at that time.
- The Fish Health and Welfare Director must be given as much notice as possible when a Stage 3 cleaning is anticipated so that a biosecurity audit can be arranged.
- Approval must be granted from the Fish Health and Welfare Director prior to the vessel moving between provinces and/or countries.

Approved Disinfectants

- Iodophor (ex. Wescodyne, Iodor) at minimum of 100ppm
- Peroxide/Peracetic Acid (ex Oxygerm) at a minimum of 0.5%
- Sodium hypochlorite (ex Javex) at a minimum of 100ppm
  - Note – cannot dispose of this disinfectant at sea; only use on land or if disinfectant can be contained and brought back to land
- Potassium Peroxymonosulfate (Virkon Aquatic) at a minimum of 1%
  - Note – can only be mixed with freshwater. Cannot be mixed with saltwater

3. Checklist (if you have your own vessel specific checklist, this can be used as well)

Stage I	Sign	Stage II & III	Sign
Cleaning		**Disinfection**	
MSDS sheets present and crew have been informed		MSDS sheets present and crew have been informed	
Hull below waterline		Hull below waterline	
Hull above waterline		Hull above waterline	
Wells		Wells	
Grid plates		Grid plates	
Pumps (including vacuum pump)		Pumps (including vacuum pump)	
Bilge pumps		Bilge pumps	
Sea valves		Sea valves	
Deck		Deck	
Railings		Railings	
Bulkhead/casing		Bulkhead/casing	
Hatches and covers		Hatches and covers	
Derrick		Derrick	
Crane		Crane	
Ladders		Ladders	
Counting table		Counting table	
Ballast tanks		Ballast tanks	
Other equipment (specify): O_2 Monitoring Systems		Other equipment (specify): O_2 Monitoring Systems	
COUNTERS		COUNTERS	
Water temperature used: **Disinfectant used:** **Disinfectant concentration measured:**		**Detergent used:** **Contact Time:** **How measured:**	

***If stage III see veterinary report and verification from shipyard.**

I, …………..................…………………………. (Name & Signature) Skipper of the vessel:…………………………….., have overseen the Cleaning and Disinfection procedures outlined above:

SIGNED :..(Person responsible for cleaning)

NAME: …………………………………… (Printed)

DATE : ……………

Appendix Biosecurity: Cleaning and Disinfection Protocols

CLEANING AND DISINFECTION PROTOCOLS

I. Purpose

The purpose of these protocols is to minimize the risk of spreading disease both within the site itself and minimize the risk of spreading infectious disease between sites within the same geographical area.

II. Process

Clean the item with either a steam pressure washer or a detergent based solution (as listed in Table 1).

After all of the organic materials have been removed from the item, disinfect the item with a disinfectant as listed in Table 1.

For specific instructions on items, please see Table 2.

Table 1: Disinfectant / Cleaning alternatives

Disinfectant	**Strength**	**Dilution**	**Contact time**
Iodor, Premise, etc	250ppm	300mls/20liters	10 mins
Javex (cannot be used at marine site)	1,000 ppm	500mls/20liters	10 minutes
Virkon (can only be used with fresh water)	1%	250 grams/25liters (freshwater only)	10 minutes
Cleaning	**Strength**	**Dilution**	**Contact time**
Detergents	Green Works	Strong	Use prior to disinfecting
Hot water & High Pressure	>65°C	N/A	>10 minutes

Table 2: Disinfection Process

Procedure	
Disinfection of PPE	Clean with detergent. Rinse. Spray down with Iodor (250ppm) and let soak for 10 minutes
Disinfection of Deck and Gunwales of vessel	Clean with detergent. Rinse. Spray with Iodor(250ppm) then scrub in with brush and let soak for 10 minutes
Foot Dips	Step in with both feet (Iodor bath at 250ppm), stop for 10 seconds then step out of bath
Disinfection of mort bag (between cages)	Soak in an Iodor (250ppm). Alternate bags for each cage so each bag soaks for 10 minutes between uses.
Mask, fins and dive tank disinfection	Clean with detergent. Rinse. Submerse in Iodor (250ppm) bath for 10 minutes
Mort pans	Clean with detergent. Rinse. Spray with Iodor (250ppm) and brush around and let soak for 10 minutes

Appendix 3 – Fish Disposal Plan

Fish Disposal Plan
Mowi Canada East
Version 4.1

Doc. ID #	Revision	Date	Responsibility
FDP – V 4.1		May 2023	Fish Health and Welfare Division

Table of Contents

1.0 Introduction

This Fish Disposal Plan includes all options available to Mowi Canada East for mortality disposal. The standard practice for mortality disposal at MCE sites in BMA's 1, 2,3,4 and 5 is to ensile mortalities and then transport silage to New World Dairy.

2.0 Fish Disposal – Normal Activities

Mortalities from normal activities will be disposed of at New World Dairies (NWD) anerobic digestor. NWD can accommodate 170 mt of material per week and accepts silage and whole fish. NWD has a Certificate of Approval from the Department of Municipal Affairs and Environment to accept waste from aquaculture facilities.

2.1 Mortality Collection (Freshwater)

- Mortality collection will be conducted at least once each day. Every effort will be made to collect mortalities from tanks twice or more per day, as time allows.
- Nets and equipment used for mortality collection should be system-specific
- Nets and equipment used for mortality collection should be disinfected between each tank
- Unless approved by the site manager, staff will be designated to a specific system, and therefore only retrieve mortalities from their own designated system.
- The gear and equipment must be thoroughly cleaned and disinfected immediately **after** the mortalities have been removed.
- Mort totes or tubs
    - Must be in good condition (no cracks or breaks).
    - Mort totes should not be filled more than ¾ full and the bungs are to be checked for tightness (or sealed by spot-welding) and proper fit to prevent spillage.
    - Mort totes should be clearly marked as "Mortalities Only"
- Care should be taken to ensure that all mortalities are placed into the mortality collection tubs, and not onto the floor surrounding the mortality collection tub.

Tanks with elevated mortality or known health issues will be collected last.

2.2 Mortality Collection (Saltwater)

Diving

- Daily mortality collection is done through the use of a Liftup system or ROV.
- At minimum, mortality is removed from the sea farms on a weekly basis.
- Alternative methods of mortality collection are used as needed.
- Mortality dives will be conducted at least once each week, provided weather, water temperature and other environmental conditions are suitable. Every effort will be made to dive all sites twice a week, logistics depending. Diving SOP can be found in Appendix 1.
- Divers will be accompanied or met on site-by-site management personnel.

- Divers should maintain separate dive suits and gear for each site or ensure thorough disinfection between sites where this is not possible. At minimum, a separate dive suit per BMA is required.
- Site crew should ensure that the dive vessels, personal apparel, and equipment of the divers is properly cleaned and sanitized before and after the dive at their site.
- Any gear not necessary for the mort dive should be removed from the dive vessel. All drains and scuppers in boats should be plugged for the duration of the dive to contain any spillage unless boat is equipped with flap-type scuppers. In this case, efforts will be made to contain any spillage and disinfect prior to discharge.
- Divers should be disinfected in between cages as soon as the diver exits the cage (to allow contact time between cages).
- The vessel and all gear and equipment onboard must be thoroughly cleaned and disinfected immediately **after** the mortalities have been removed.
- Mort totes or tubs
    - Must be in good condition (no cracks or breaks).
    - Mort totes should not be filled more than ¾ full and the bungs are to be checked for tightness (or sealed by spot-welding) and proper fit to prevent spillage.
    - Mort totes should be clearly marked with company name
- No morts or moribund fish are to be released to the sea.
- Divers' suits and all dive gear must be disinfected upon completion of the dive.
- Cages with elevated mortality or known health issues will be dove last.
- If more than one site is to be dove per day, older sites or sites with known fish health issues will be dove last.

Lift-up systems

- Mortality collections will be conducted at least twice each week, provided weather, water temperature and other environmental conditions are suitable. Every effort will be made to collect mortalities daily, logistics depending. Lift-up System SOP can be found in Appendix 1.
- Site crew should ensure that the mortality collection vessels, personal apparel, and equipment used for mortality collection is properly cleaned and sanitized before and after the dive at their site (see Biosecurity Plan).
- Any gear not necessary for the mort collection should be removed from the vessel. All drains and scuppers in boats should be plugged for the duration of the collection to contain any spillage unless boat is equipped with flap-type scuppers. In this case, efforts will be made to contain any spillage and disinfect prior to discharge.
- The vessel and all gear and equipment onboard must be thoroughly cleaned and disinfected immediately **after** the mortalities have been removed.
- Mortality totes or tubs
    - Must be in good condition (no cracks or breaks).

    - Mort totes should not be filled more than ¾ full and the bungs are to be checked for tightness (or sealed by spot-welding) and proper fit to prevent spillage.
    - Mort totes should be clearly marked with company name
- No mortalities or moribund fish are to be released to the sea.
- Cages with elevated mortality or known health issues will be collected last.

2.3 Mortality Disposal

Trucking

- Following collection, mortalities collected in tubs will be taken to a collection area where they will be held for storage (a layer of clean sawdust may be added as a bulking and odour control agent if morts are destined for composting) or transferred to large, sealed containers for eventual transport to the designated mort disposal facility. Trucking SOP can be found in Appendix 1.
- All mort totes or boxes MUST be thoroughly cleaned and disinfected before being returned to the site. In addition, any mort tubs that are damaged or cracked will be taken out of rotation and disposed of. Only undamaged, fully intact tubs will be used for mortality collection.
- Every effort should be made to avoid transporting mortalities from one BMA to another. If mortalities must be moved, they should only move from a younger BMA to an older BMA, not vice versa. Furthermore, mortalities should be stored in a separate area away from other activities. Any mortalities that are being transported should be in leak-proof containers that have lids. Every effort should be made to ensure that mortalities are contained during transport.
- Within one BMA, for efficient use of resources, a single vessel may be used to collect mortalities from all sites for delivery to the wharf. If this is required, the vessel will not perform any other operations other than mortality transport. Once mortalities have been offloaded to the wharf, the vessel will perform a full C&D before returning to site.
- Once enough mortality tubs have been collected to constitute a full truck load, a third-party transport truck will be loaded with mortality tubs via a forklift.
- The truck will travel to the disposal site for dumping.
- Once mortalities are dumped, the truck and all mortality tubs will be cleaned and disinfected prior to returning to the wharf.

Ensiling

- Following collection, mortalities collected in tubs will be taken to the ensilage location where they will be immediately ensiled according to the site's Ensiling SOP, Appendix 1.
- NO material other than mortalities (i.e. kelp, plastic wrap, mussel or other shells) are to be mixed with morts that are destined to be ensiled.
- All mort totes or boxes MUST be thoroughly cleaned and disinfected before being returned to the site. In addition, any mort tubs that are damaged or cracked will

be taken out of rotation and disposed of. Only undamaged, fully intact tubs will be used for mortality collection.

- Every effort should be made to avoid transporting mortalities from one BMA to another. If mortalities must be moved, they should only move from a younger BMA to an older BMA, not vice versa. Furthermore, mortalities should be stored in a separate area away from other activities. Any mortalities that are being transported should be in leak-proof containers that have lids. Every effort should be made to ensure that mortalities are contained during transport.
- Under normal circumstance, no mortalities should be moved from one site to another. It is the responsibility of each site crew to bring their own mortalities back to the wharf for disposal.
- In the event of ensiler breakdown at remote sites where daily mortality removal to a wharf is not feasible, mortalities may be transported to a neighboring site within the same BMA for immediate processing. If this is necessary, the mortality transport containers will be subject to C&D before entering the neighboring site for ensiling. While the mortalities are entering the ensiler, the deck of the transport vessel will be C&D. Once the containers are empty and all mortalities have been ensiled, they will be C&D and moved back onto the transport vessel to return to the original site.
- Once mortalities have been ensiled, the ensilage will be transported via trucking in IBCs to the mortality disposal site.

3.0 Fish Disposal – Reportable Disease Events

3.1 Reporting

- For a list of Federally Reportable Diseases, please see: https://inspection.gc.ca/animal-health/aquatic-animals/diseases/reportable-diseases/eng/1322940971192/1322941111904
- As soon as a reportable disease is suspected, both the Canadian Food Inspection Agency and the Chief Aquaculture Veterinarian will be notified.

3.2 Self Quarantine

- The designated site veterinarian should institute self-quarantine procedures until the suspected disease is either confirmed or disproven.
- If a site is confirmed to have the suspected disease, then SOPs will be submitted to the province for approval by the Chief Aquaculture Veterinarian.
    - SOPs will change depending on the disease suspected/confirmed and will vary by site and life stage of the fish diagnosed.

3.3 Official Quarantine

- Depending on the disease diagnosed, either the CFIA or the FFA will place a quarantine on the site.
- All SOPs and protocols that have been approved by the regulating body will be strictly followed at all times.

- No staff or equipment will move to/from the site without approval from the Fish Health and Welfare Director
    - Approvals will be only granted once a License to Move has been received from the regulating body

- Mortality removal under quarantine conditions will be subject to a site-specific approved SOP but will adhere to the following basic principles:
    - Lowest mortality cages morted first
    - Equipment that has contact with cage or it's contents (divers, ROV, dip nets etc) will be disinfected between cages
    - Mortality storage containers will have secure lids/closure during storage and be subject to full C&D.
    - Transport to the wharf will only occur upon receipt of an LTM.
    - During transport of mortalities to the wharf, containers will be full C&D once on the transport vessel. After offload, the vessel deck and topside will be subject to full C&D.

    - If mass mortality removal is required during a quarantine situation, then the general process in Fish Disposal: Mass Mortality Contingency Plan, section 6.12 will be followed but with disinfection of any equipment between cages and starting at the lowest mortality cage first.
    - If, under quarantine conditions, a large-scale euthanasia event is warranted, it will be conducted in as humane a manner as possible, facilitating a rapid and irreversible loss of consciousness. All policies and procedures surrounding euthanasia will be written and approved by the Veterinarian. Although the method of euthanasia may vary depending on the circumstances, all methods of euthanasia used will be in compliance with the Canadian Code of Practice for the care and handling of Farmed Salmonids. Farmed Salmonids Code of Practice. All equipment used during a cull under quarantine conditions will be subject to full C&D between cages and will include but is not limited to: dip nets, seine and exactics. When task is completed, the topside of vessel and all equipment used will be fully C&D.

Appendix Fish Disposal: Standard Operating Procedures

Mortality Removal by Divers Marine Sites

Purpose

The purpose of these protocols are to remove mortalities by the means of diving at a marine site in a manner that promotes biosecurity.

Responsibility and Authority

- The Fish Health and Welfare Director will review these procedures annually and make changes if necessary.
- Site managers are responsible for ensuring mortality removal is conducted at least once per week as per the Fish health Management Plan and that the following procedures are followed.
- Site staff must brief the dive team on any known hazards or special instructions prior to commencing the dive. The Dive Leader must ensure that the divers are following all provincial regulations.

Personal Equipment

In addition to standard safety equipment required for all MOWI employees the additional equipment is required for mortality removal:

- Rubber pants and rubber jacket
- Rubber gloves

Description

Preparing for the dive

- The divers are contacted the day before via email by the dive coordinator to schedule the dive.
- The divers arrive at the site and tie up to the feed barge and wait for the vessel they are diving from to pick them up
- The site crew must have on all the PPE listed above before starting the mortality dive.
- Any equipment that is not required for the dive will either be removed (ideal) from the dive vessel or covered (if it cannot be removed).
- The dive gear is transferred from the transport vessel to the dive vessel.
- The weight belts and fins are placed in a tote box filled ¾ full of an Iodor solution consistent with strong tea.
- Two tote boxes are filled ¾ full of an Iodor solution consistent with strong tea.
- In each of the totes with the Iodor solution, a mortality retrieval bag is placed for disinfecting. The purpose of two is so that they can be rotated between cages giving each one more contact time in the Iodor solution.
- The divers will don their gear in preparation for the dive.

During the Dive

- The dive vessel ties up to the cage they are going to dive on.
- The site crew unties and pulls back the bird net.
- The fish net is untied and left hooked on to the hooks on the rail of the cage.
- Before the diver enters the cage he is disinfected with an Iodor solution (250 ppm).
- The site crew now lowers the fish net down to allow the diver to enter the cage.
- The diver is handed one of the mort retrieval bags from the tote containing the water and Iodor solution.
- Once the diver is in the cage, the fish net is then raised and hooked to the rail of the cage.
- When the diver resurfaces the fish net is lowered and the site crew take the mort retrieval bag containing the mortalities and place them in a tote box. This is done either by hand or by using the crane depending on the number of mortalities.
- The mortality retrieval bag is placed back in the tote containing the Iodor solution.
- The diver then exits the cage and gets back in the boat where he or she is again disinfected with an Iodor solution.
- The site crew ties the fish net and the bird net to the rail of the cage.
- The vessel is untied and moved to the next cage to be dove on.
- While the diver is diving in the next cage, the mortalities are classified by the site manager (or trained designate) and recorded on a mortality classification sheet. They are then placed in a mortality tub that has no cracks and a tight fitting bung so that there are no leaks.
- These steps are repeated until all cages have been dove and the dive is complete.

Finishing the Dive

- The dive is now complete.
- The outside of all of the mortality totes is scrubbed with a mild detergent showered with Iodor solution using the watering can and carried back to the wharf.
- The divers scrub their gear with a mild detergent (such as Green works) and then are disinfected with an Iodor solution.
- They remove their dive gear and place it in a tote that contains a water and Iodor solution.
- After a 10-minute contact time, the gear is removed from the iodor solution and placed in transport containers.
- The site staff scrubs their gear with a mild detergent (such as Green Works) and then are disinfected with a Iodor solution (250 ppm).
- The staff scrubs all equipment used for the dive, (mort bags, totes, deck of the boat) with a mild detergent (such as Green Works) and then are disinfected with a Iodor solution (250 ppm).
- The outside of the containers are scrubbed with a mild detergent (Greenworks) and disinfected with an Iodor solution (250 ppm) and placed into a transport vessel.
- Any Iodor solution is neutralized with sodium thiosulfate prior to dumping:
    - Add sodium thiosulfate to the Iodor solution. Once the solution turns colour from brown to clear/white, the titration is complete and the solution is neutralized.

- The dive supervisor fills out the dive sheet and it is signed by him or her and signed by the site manager or designate.
- The divers and the mortality tubs are transported back to a designated wharf.
- At the wharf, the totes containing the mortalities are transported using forklift by a certified forklift driver to a designated holding spot until such a time they can be picked up and transported to a disposal facility.
- The forklift is then steam cleaned and disinfected with a Iodor solution (250 ppm).
- The fork lift operator cleans his PPE with a mild detergent (such as Green Works) and disinfects with a Iodor solution (250 ppm).
- The transport vessel is then scrubbed with a mild detergent (such as Green Works) and disinfects with a Iodor solution (250 ppm).
- Once back on land, the site manager will enter the mortality data into Mercatus.

Records

- Mortality Dive Worksheet
- Dive Company Dive Reports
- The number of mortality tubs filled will be recorded on the Daily Site Records (DSR).

Approved by FLR Jan 31, 2020

Mortality Removal Using Lift Up Devices Marine Sites

Purpose

The purpose of these protocols are to remove mortalities in a biosecure manner by means of a lift up at a marine site.

Responsibility and Authority

- The Fish Health and Welfare Director will review these procedures annually and make changes if necessary.
- Site managers are responsible for ensuring mortality removal is conducted at least once per week as per the Fish health Management Plan and that the following procedures are followed.

Personal Equipment

In addition to standard safety equipment required for all MOWI employees the additional equipment is required for mortality removal:

- Rubber pants and rubber jacket
- Rubber gloves

Description

Preparing for mortality removal

- The site crew must have all the PPE listed above before starting the mortality collection.
- The vessel that is to be used for the mortality collection must have any gear removed (ideal) or covered (if it cannot be removed) that is not being used for the mortality removal

Removing the mortalities

- The vessel ties up to the cage where the lift up hose is located.
- The compressor on the boat is started.
- The dewatering table is placed in position.
- The lift up hose is attached to the dewatering table.
- The air hose from the compressor is attached to the air hose on the cage.
- The valve on the compressor supplying the air is turned on.
- The water and mortalities start to flow in the dewatering table.
- The water flow continues for 5 minutes to ensure all mortality is removed.
- The mortalities are now classified by the site manager (or trained designate) and put in totes.
- The air supply valve is shut off.
- The lift up hose and the air supply hose is detached from the dewatering table.
- The dewatering table, lift up hose and air supply hose is now showered with a Iodor solution (250 ppm) consistent with strong tea.
- The boat is untied and moved to the next cage and the process is repeated.

- After each cage, Green Works detergent is sprayed in and around the dewatering table, deck, and rain cloths. There is also a doser connected to a garden hose. The doser is drawing iodore and is sprayed in the same manner. If the doser/hose is frozen, a bucket is used to mix the iodore and pour it is poured in a watering can and sprayed around the area.
- Once the collection is over, the collection boat and all associated collection equipment is scrubbed clean with a mild detergent and disinfected with an iodor solution (250 ppm).
- Tubs containing the mortalities are then securely fastened closed and transported to the feed barge for disposal in the ensile located on the stern of the barge.If there is a spill on the barge, the mortalities or silage will be cleaned up and put back in the ensiler. The are will then be cleaned with a mild detergent and disinfected with an iodor solution (250 ppm).
- The site crew scrubs their PPE with a mild detergent (such as Green Works) and then disinfects with an Iodor solution.
- The site crew scrubs all equipment as well as the boat that was used in the mortality retrieval.
- Once all clean up is complete, the site manager will enter the mortality data into Mercatus.

Records

- MHAC Mortality Dive Worksheet
- The number of tubs collected and brought to the wharf will be recorded on the Daily Site Record (DSR).

Transporting Mortalities By Truck - Newfoundland Marine Sites

Purpose
The purpose of these protocols is to ensure biosecurity during truck transport of mortalities to designated sites for disposal.

Responsibility and Authority

- The Fish Health and Welfare Manager will review procedures annually and update if necessary.
- The Operations Manager or designate schedules the activities and ensures procedures are being followed.

Health and Safety
In addition to standard safety equipment required for all MOWI employees the additional equipment is required for loading mortalities onto trucks:

- Rubber pants and rubber jacket
- Rubber gloves

Description
Transporting the Mortalities in an Enclosed Trailer

- The truck with an enclosed trailer is backed into a loading ramp and the doors opened.
- The safety chains on the ramp are fastened to the truck to prevent the ramp from moving away from the truck.
- A certified forklift operator begins by unloading the empty mortality tubs from the truck and placing them in a designated clean area.
- Once unloaded, he begins to load the tubs containing the mortalities by placing them side by side and double stacked in the trailer.
    - Note that tubs with mortalities can mean either whole fish in xactic tubs, or ensiled fish in IBC tubs.
- When the truck is loaded the chains on the ramp are unfastened from truck.
- The Operations Manager or designate signs a way bill that is provided by the truck driver representing the trucking company verifying the load.
- The truck closes its doors and proceeds to the disposal site.
- The ramp and fork lift are then steam cleaned and disinfected with a Iodor solution (250 ppm).
- The fork lift operator cleans his PPE with a mild detergent (such as Green Works) and disinfects with a Iodor solution (250 ppm).

Transporting mortalities on an Open Deck Trailer

- The truck is parked on a level area.

- A certified forklift operator begins by unloading the empty mortality tubs from the truck and placing them in a designated area.
- Once unloaded he begins to load the tubs containing the mortalities which are placed side by side and double stacked on the trailer.
    - Note that tubs with mortalities can mean either whole fish in xactic tubs, or ensiled fish in IBC tubs.
- The driver of the truck fastens the tubs down using straps that are located on the side of the trailer.
- The operations manager or designate signs a way bill that is provided by the truck driver representing the trucking company verifying the load.
- The truck proceeds to the disposal site.
- The forklift is then steam cleaned and disinfected with a Iodor solution.
- The fork lift operator cleans his PPE with a mild detergent (such as Green Works) and disinfects with a Iodor solution.

Records

- The number of tubs, and what site each tub came from will be documented
- The way bill for the truck will be kept that indicates how many tubs on the load were shipped, and where they were shipped to.

Approved by FLR Jan31, 2020

Ensilage on a Marine Site

Purpose

The purpose of these protocols are to ensile mortalities on a marine site using biosecure protocols.

Responsibility and Authority

- The Fish Health and Welfare Director will review annually and make changes if necessary.
- Site managers must ensure procedures are followed.
- The Operations Manager must ensure that silage containers (IBC) are picked up and sent to the disposal site in a timely manner. Mortalities will not be returned to the Seal Cove wharf – only ensiled material will leave the site.

Health and Safety

In addition to standard safety equipment required for all MOWI employees the additional equipment is required for ensiling mortality includes:

- Rubber pants and rubber jacket
- Rubber gloves

Description

- When the mortality collection is complete, the mortalities are taken to the feed barge where they will be ensiled.
- Containers with mortalities will be lifted onto the tank area via crane.
- Lift the ensiling tank cover open.
- Dump all mortalities into the ensiling tank.
- If there is a spill, the mortalities/silage will be picked up and placed in the ensiler. The area will then be cleaned with a mild detergent (such as Green Works) and then disinfected with an Iodor solution (250 ppm).
- Place the covers back down.
- Ensure that the pump valves are set as follows:
  - The "Recirculating" valve is set to ON
  - The "Removal" valve is set to OFF
- Press the start button for the Chopper Pump
- Set timer for ~27 minutes
- Acid will be added automatically to maintain a ph of 4, so do not do anything else with the system while it is running
  - Ph is measured weekly and will be recorded.
- If the ensiling tank is less than ¾ full, proceed to the "Cleanup" steps
- If the ensiling tank is ~3/4 full or higher, proceed to the "Pumping Steps"
- Emptying of the silage tanks occurs every 3-4 months.

Pumping

- Once the ensiling tank is ¾ full, it will need to be pumped off.
- The ensiled mortalities are pumped in 1 cubic metre IBC containers.
- Ensure that the pump valves are set as follows:
    - The "Recirculating" valve is set to OFF
    - The "Removal" valve is set to ON
- Hook the pumping hose onto the coupling, located immediately next to the valves
- Place the end of the hose into one of the IBC containers
- Turn the Chopper pump ON
- Once the IBC is almost full, turn the Chopper pump to OFF
- If there is still material in the ensiling tank, fill other IBCs in the same manner until the ensiling tank is empty.
- Once full, the containers are scrubbed with a mild detergent (such as Green Works) and then disinfected with an Iodor solution (250 ppm).
- Filled containers are transported to the Seal Cove wharf.
    - Note that this may not take place immediately after ensiling. It will be done when logistically efficient.
- Once at the wharf, a certified forklift driver will move the containers via forklift to a truck that will deliver the containers to Pools Cove where they will be held until adequate quantities of mortalities/silage to ship to NWD.
- The forklift is then steam cleaned and disinfected with a Iodor solution.
- The fork lift operator cleans his PPE with a mild detergent (such as Green Works) and disinfects with a Iodor solution (250 ppm).
- The transport vessel is then scrubbed with a mild detergent (such as Green Works) and disinfects with a Iodor solution (250 ppm).

Clean Up

- Once mortalities have been ensiled, the Ensiling barge and all associated equipment (including the mortality collection containers) will be scrubbed clean with a mild detergent (such as Greenworks) and disinfected with an Iodor solution (250 ppm).
- The site staff will then clean their rubber gear with a mild detergent (such as Greenworks) before disinfecting with a 250ppm Iodor solution

Records

- The date, amount of IBCs and the site name will be recorded. Ph of silage will be recorded.

Mass Mortality Removal with Seiners Marine Sites

Application & Purpose

- To ensure a quick and effective response/removal of a mass mortality event using a seiner
- To maintain compliance with regulatory authorities AP 23- Fish Disposal.

Responsibility and Authority

Mass Mortality removal operations will be managed under the MCE/MCE Incident and Crisis Management System and through collaboration with regulators through the external emergency management team. The efficient and effective removal of mass mortalities via seiner is the responsibility of site and operations management, as well as third party seiner companies, with oversight by the MCE/MCE internal Emergency Management Team (EMT).
Communication of progress to the EMT is the responsibility of the Area and Site Manager.

Description

<u>Support</u>

- Regional manager will contact Barry group Inc and arrange seiner boat(s)
- Arrange for divers
- Arrange for disposal at rendering site

<u>Procedure</u>

- Seiner will be instructed which cage to tie up to and will secure the vessel to the side of the cage. Divers' vessel must also be tied to the affected cage.
- In the event of fat and debris on the water during pumping, a 36" boom will be deployed around the seiner and area of the cage being pumped.
- The 10' hose, provided by the seiner and used for pumping the mortalities, will be deployed by the crew into the cage
- Once the hose is inside the cage, the diver(s) will enter the cage and secure the end of the hose and suction bell to the bottom of the cage
- The diver confirms with the seiner Captain that the hose and bell are secured via communication device. The diver remains at the bottom of the cage with the suction bell.
- The seiner Captain controls the pump from the vessel wheelhouse, starting and stopping as needed through instruction provided by diver in cage
- Depending on the condition of the mortalities, the diver may have to maneuver/reposition the hose and suction bell to ensure effective pumping of all mortalities
- The mortalities are sucked up through the hose, across a dewatering table, and directly into the containment hole of the vessel
- The seiner and divers will continue this procedure until the seiner reaches compacity

- Once capacity is reached, the seiner will do a top side cleaning and disinfection, as per protocols outlined in the MCE Salmonid Biosecurity Management Plan and leave site. The seiners will maximize distance from other aquaculture sites on route to Burgeo, weather dependent.

- All mortalities are sent to Burgeo Rendering Facility for further processing. The seiner will then follow the Biosecurity Protocols for the facility.

Records

Records of all necessary information (seiner vessel, dive company (divers), number tubs removed, start/stop times, etc.) will be maintained on site and submitted to the EMT by site management for reporting as per the Mass Mortality Contingency Plan.

Mass Mortality Removal with Portable Air Lift System Marine Sites

Application & Purpose

- To ensure a quick and effective response/removal of a mass mortality event using a portable air lift system.
- To maintain compliance with regulatory authorities, specifically AP 23 – Fish Disposal, Mass Mortality Plan

Responsibility and Authority

Mass Mortality removal operations will be managed under the MCE/MCE Incident and Crisis Management System and through collaboration with regulators through the external emergency management team. The efficient and effective removal of mass mortalities via seiner is the responsibility of site and operations management, as well as third party seiner companies, with oversight by the MCE/MCE internal Emergency Management Team.
Communication of progress to the EMT is the responsibility of the Site Manager.

Description

Important considerations prior to removal

- Ensure all necessary air lift equipment is available and properly functioning
  - Dewatering table
  - Air compressor
  - Rigid hose
  - Lay flat hose with suction bell
  - Air supply hose
- Ensure divers are scheduled to assist and necessary transport is provided
- Confirm that the necessary number of xactic tubs are available and on site for storage and containment of mortalities
- Ensure the required number of transport vessels are scheduled to move full tubs to the designated wharf for pick up.
- All gear that is non-essential to the mortality collection must be removed
- Required amount of disinfectant solution is on site to facilitate proper cleaning and disinfection of all gear, according to protocols outlined in the MCE Salmonid Biosecurity Management Plan.

Air Lift Set-up

- Utility barge, or other vessel with required capacity, transports all required air lift equipment to site and ties up to affected cage. Divers' vessel must also be tied to the affected cage.
- Divers enter cage and install lay flat hose and suction bell to bottom of the cage.

- On the deck of the vessel, the rigid hose is connected to the dewatering table. The hose is then secured to a point close to the cage (handrail, gunnal) and is connected to the lay flat hose via camlock fitting

- The air supply hose is connected to the air compressor and the diver takes the end of the hose to the bottom of the cage where it is attached to the suction bell.

<u>Removing the mortalities</u>

- Empty xactic tubs are placed by the dewatering table. Transport vessels are put in place to receive full tubs.
- The compressor is turned on, as well as the compressor valve, to supply the diver with suction for vacuuming the mortalities
- Using the valve on the suction bell, the diver within the cage controls the amount of air (via air supply hose) required to suction the mortalities
- Mortalities are received on the dewatering table and counted, if possible, with consideration of the condition of the mortalities, prior to entering the xactic tub.
- Once a xactic tub is full, it is sealed and moved to the transport vessel. An empty xactic tub is then put in place in the system.
- Transport vessels rotate as they are filled.

<u>Disassembly and disinfection of system</u>

- Once all mortalities are moved from a cage, the air supply valve is shut off.
- The airlift hose and the air supply hose are detached from the dewatering table.
- The diver detaches the lay flat hose from the net and removes the hose as well as the suction bell.
- The dewatering table, airlift hose and air supply hose are cleaned and disinfected, according to protocols, prior to moving to next cage.
- Process is repeated at each cage until all mortalities at the site are removed.
- At end of day, all gear, including PPE, vessels, and air lift equipment, is cleaned, and disinfected according to protocol.
- Prior to leaving site, transport vessels disinfect full xactic tubs using Iodor and according to procedures outlined in above mentioned protocols.
- Full, sealed xactic tubs are then transported to the wharf to be ensiled or transported to rendering plant.

Records

Records of all necessary information (dive company (divers), number tubs removed, start/stop times, etc) will be maintained on site and submitted to the EMT by site management for reporting as per the Mass Mortality Contingency Plan.

Mass Mortality Removal with Wellboats – NL Marine Sites

Application & Purpose

- To ensure a quick and effective response/removal of a mass mortality event using a Wellboat
- To maintain compliance with regulatory authorities AP 23- Fish Disposal.

Responsibility and Authority

Mass Mortality removal operations will be managed under the MCE/MCE Incident and Crisis Management System and through collaboration with regulators through the external emergency management team. The efficient and effective removal of mass mortalities via wellboat is the responsibility of site and operations management, as well as third party wellboat companies, with oversight by the MCE/MCE internal Emergency Management Team (EMT).
Communication of progress to the EMT is the responsibility of the Area and Site Manager.

Description

Support

- Arrange for divers
- Arrange for disposal at rendering site

Procedure

- Wellboat will be instructed which cage to tie up to and will secure the vessel to the side of the cage. Divers' vessel must also be tied to the affected cage.
- In the event of fat and debris on the water during pumping, a 36" boom will be deployed around the wellboat and area of the cage being pumped.
- See SOP Mass Mortality Removal with Portable Air Lift System Marine Sites.
- Once the hose is inside the cage, the diver(s) will enter the cage and secure the end of the hose and suction bell to the bottom of the cage
- The diver confirms with the wellboat Captain that the hose and bell are secured via communication device. The diver remains at the bottom of the cage with the suction bell.
- The wellboat Captain controls the pump from the vessel wheelhouse, starting and stopping as needed through instruction provided by diver in cage
- Depending on the condition of the mortalities, the diver may have to maneuver/reposition the hose and suction bell to ensure effective pumping of all mortalities
- The mortalities are sucked up through the hose, across a dewatering table, and directly into the containment hole of the vessel
- The wellboat and divers will continue this procedure until the wellboat reaches compacity
- Once capacity is reached, the wellboat will do a top side cleaning and disinfection, as per protocols outlined in the MCE Salmonid Biosecurity Management Plan and leave site. The

wellboats will maximize distance from other aquaculture sites on route to Burgeo, weather dependent.

- All mortalities are sent to Burgeo Rendering Facility for further processing. The wellboat will then follow the Biosecurity Protocols for the facility.

Records

Records of all necessary information (wellboat vessel, dive company (divers), number tubs removed, start/stop times, etc) will be maintained on site and submitted to the EMT by site management for reporting as per the Mass Mortality Contingency Plan.

Freshwater Mortality Removal SOP

Rationale

This procedure is used for mortality removal of a routine or mass-mortality scale at the Stephenville Hatchery location.

In the event of a mass mortality, this SOP is applied in conjunction with MCE Incident and Crisis Management System to support an effective response, and includes practices that are consistent with procedures approved in the past for mortality and quarantine events.

In the event of a mass mortality or large depopulation event the removal of mortalities can take several weeks depending on the scale of the event.

Responsibility

Freshwater production staff are responsible for the removal of mortalities from all tanks on a daily basis.

Fish Health personnel are responsible for fish welfare and ensuring biosecurity protocols are followed at all times.

Advance preparation (i.e., in the event of a quarantine)

- Ensure a valid License to Move has been granted for all mortalities leaving the quarantine zone.
- Temporary hot zones will be created to accommodate mortalities – one will be for smolt and post smolt mortalities. No fry mortalities will be disposed of in the smolt or post smolt mortality area nor will any smolts be disposed of in the fry mortality area.
- The location of the areas will be set up in the yard according to Figure 1.
- Each area will be clearly marked with high visibility tape
- A Rubbermaid tote will be placed inside each area which contains:
  - Disposable gloves
  - A Tyvek lab coat
  - A small garbage bag for used gloves

- A roll of pallet wrap

- A bucket of gentle detergent and a bucket of disinfectant will be placed just inside the collection area – each with a scrub brush. For list of detergents and disinfectants, please see approved SOP – Biosecurity: Cleaning and Disinfection Protocols.

- A foot dip filled with Virkon will placed at the entrance of each area

- Holding containers will be placed inside each area
    - Containers will be leakproof and free from any damage
    - Appropriate lids will be available – also free from damage with rubber hold downs in place at each of the 4 corners

- Outside each area will be a holding area for clean attire (e.g. coat rack)

- For each water system holding fish, a "Morts only" mortality transport container will be provided
    - Container will have a tight-fitting, leak proof lid available
    - Container will be leakproof and free from damage
    - The container will either be colour coded to match the system it belongs to, or it will be labelled with the system name to ensure transport containers always return to the same water system

Procedure

1. **Mortality Collection**

- Remove mortalities from the tank using a system specific dip net (6m/7m) or uplifting system (12m and 18m)
- Place mortalities in tank specific 'Mort Only' buckets/containers. Containers should contain a TMS solution to humanely euthanize any moribund fish removed from the tank.
- Remove mortalities from the TMS solution one fish at a time and place into the 'mort only' transport container
    - Remove one fish from the TMS solution
    - Record it on the mortality record sheet
    - Place the fish into the transport container
    - Repeat until all fish are removed from the TMS solution
- Count and record total mortalities per tank.
- Repeat as necessary throughout the day with a minimum of one picking in the morning and one in the afternoon.
- At the end of the day, the lid should be securely fastened onto the mortality transport container to prevent spillage of material.

- A designated staff member will exit the building with the transport container through the staging area according to the most recent approved MCE Biosecurity Plan.

2. Entering Mortality Collection Areas

- Staff will then walk the transport container to the designated mortality collection area
    - If mortalities are post-smolts, proceed to the post-smolt ensiling area
    - If mortalities are smolts, proceed to the smolt ensiling area
    - If mortalities are fry, proceed to the fry mortality collection area
- Once at the area, but prior to entry, staff will remove any clean outer clothing
- Immediately staff will put on the Tyvek lab coat from the Rubbermaid container and a fresh pair of disposable gloves.

3. Transferring Mortalities into Holding Containers

- Staff will carefully open the lids of both the holding container and then the transport container
- They will slowly dump mortalities from the transport container into the holding container.
    - Care will be taken to ensure all mortalities and fluids wind up in the holding container.
    - If any mortalities spill onto ground, the mortalities will be picked up and placed into the holding container. Afterwards, the affected ground will be sprayed with disinfectant using the garden sprayer.
- Lids of both the transport container and the holding container will be replaced and fastened.

4. Exiting the Mortality Collection Areas

- If any equipment was brought into the area, for example a transport container, staff will scrub the exterior with a mild detergent solution. Afterwards they will cover the equipment with disinfectant.
- Once any equipment have been cleaned and disinfected, staff will remove their gloves and place into the garbage bag within the Rubbermaid container. They will remove the Tyvek lab coat and carefully place inside the Rubbermaid container. They will then step inside the foot dip, taking care to slosh solution to ensure the solution covers the entire top of the boot.
- Once 10 minutes has passed, staff will step out of the foot dip and back into the clean area of the yard. They will then put on any of their clean PPE and return the transport container (if applicable) to the appropriate staging area for its designated water system.
    - The transport container will remain in the staging area, unopened, until the next shift where staff will collect it and bring through the staging area back into the hot zone.

5. **Mortality Disposal**

- When the holding containers are full, or at least once a week, the holding containers will be removed and sent to the disposal facility.
- To start the process, a designated staff will enter each mortality collection area (as per Procedure 2: Entering the Collection Area) to prepare the holding container
  - The lid will be checked to make sure it is securely fastened at each corner
  - Pallet wrap will be wrapped around the container where the lid meets the container to create a seal
  - Using a garden sprayer, the outside of the xactic will be sprayed with disinfectant and the appropriate contact time will be observed prior to removal from the area
- Once the holding containers are ready for transport, a loader with forks previously cleaned and disinfected will drive up to the collection area.
- Only the forks of the loader will enter the mortality collection area; the body of the loader will remain on the clean side.
- Using the forks, the loader will pick up the xactic full of mortalities.
- Mortalities will then go to their designated disposal area:
  - If the facility is not under quarantine, post smolt or smolt will go to New World Dairies as whole fish – see "Trucking of Mortalities" below
  - If the facility is under quarantine, post-smolt or smolt will go to the ensiler for ensiling – see "Silage on a Quarantine Site – Tanker" SOP
  - Fry (will go to New World Dairies as whole fish – see "Trucking of Mortalities" below

6. **Trucking of Mortalities**

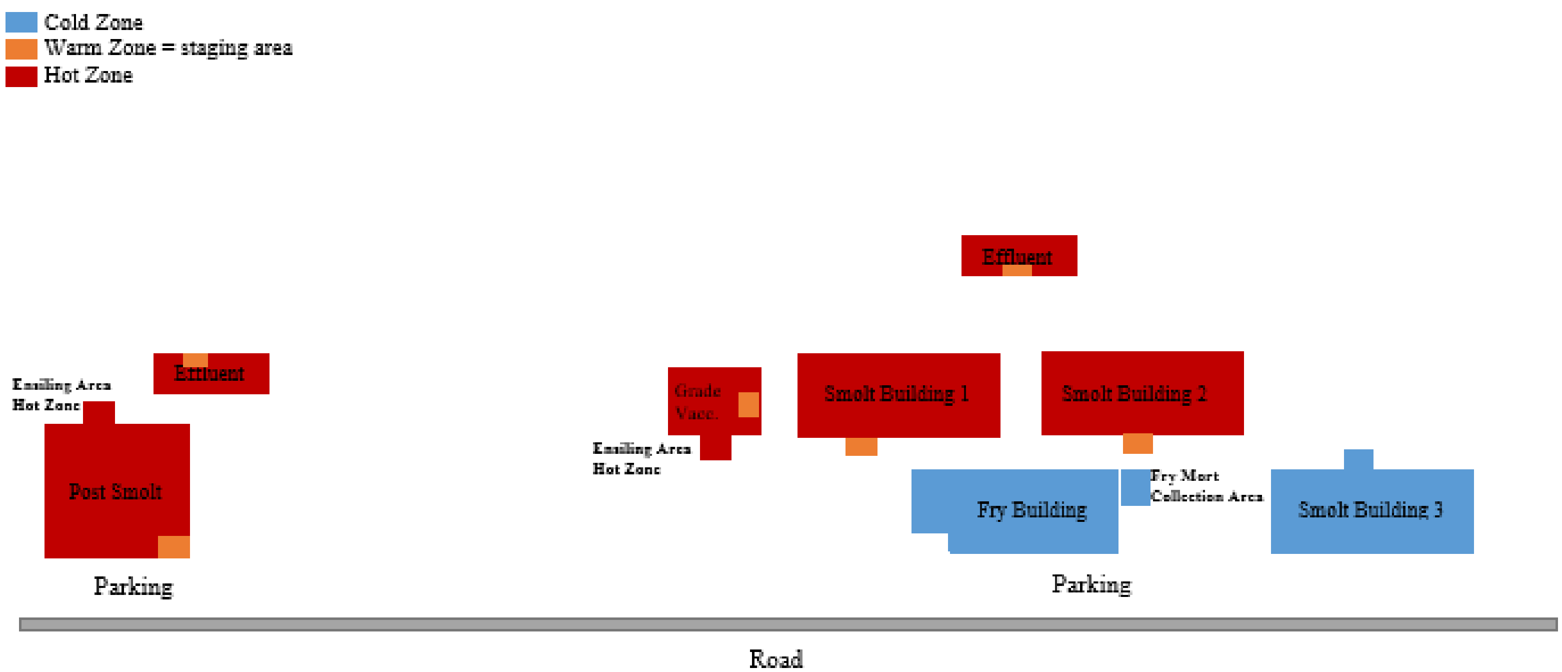
- The loader will drive to the edge of the yard and place the xactic onto a transportation truck.
- These steps will be completed until all mortalities to be shipped are loaded onto the truck
- Once completed, the staff inside the mortality collection areas will exit the collection areas (as per Procedure 4: Exiting the Collection Areas) and the forks of the loader will be sprayed with J-12 or Virkon solution and a contact time of 10 minutes will be observed.
- The truck will then drive to the disposal facility (New World Dairies).
- At the disposal facility, the xactics will be removed from the truck one at a time and dumped directly into the biodigester.
- Once all xactics have been removed from the truck, the inside of the container will be sprayed with a J-12 solution and a contact time of 10 minutes will be observed before any clean xactics are placed back into the truck.
- In the meantime, while the truck is observing it's contact time, staff from the New World Dairies facility will steam pressure wash the xactic tubs so they are cleaned prior to returning to the Stephenville hatchery.
- Once the contact time of the truck has been observed, the clean xactics will be loaded back onto the truck and transported back to the Stephenville facility.
- The truck will not enter the Stephenville property. It will offload the xactic tubs just outside of the facility gate.

- A hatchery staff member will then spray the outside of the xactics with an OxyGerm (peroxyacetic acid) solution and a contact time of 10 minutes will be observed prior to the xactics entering the facility.
- Once the contact time is up, the loader will load the clean xactics onto the forks and drive to the mortality collection areas.
- With the help of a designated staff member inside the collection area (who entered via Procedure 2: Entering the Mortality Collection Areas), the loader will place the clean xactics back into the mortality collection area.
    - Again, the body of the loader will stay on the clean side; only the forks of the loader will enter the mortality collection area.
- Once the xactics are placed into the mortality collection area, the forks of the loader will be sprayed with J-12 or Virkon and let sit for 10 minutes.
- The staff member inside the mortality collection area will exit the area.

Recordkeeping

- Record mortality numbers per tank/classification on the Daily Worksheets.

Figure 1: Location of Mortality Collection Areas (i.e., in a quarantine event)



Appendix Fish Disposal: Mass Mortality Contingency Plan (SW)

Mass Mortality Contingency Plan (SW)

Prepared By:

Mowi Canada East

Doc. ID #	Revision	Date	Responsibility
MMCP V-6.1		Nov 2024	Environment and Development Division

Table of Contents

1.0 Objective

The Mass Mortality Contingency Plan (MMCP) describes Mowi Canada East (MCE) plan to address high/mass mortality events at the marine sites. The objective of this plan is to have a plan in place that can be executed quickly and in a biosecure manner by MCE in conjunction with regulatory agencies with jurisdiction in aquaculture management. This plan addresses high or mass mortality events resulting from environmental events as well as disease events, including handling, transportation of fish products and environmental management of removal activities. This plan will be reviewed and updated annually at minimum and more frequently as necessary.

2.0 Scope and Authority

This plan applies to all active sea site operations of MCE. Three-year Site Stocking and Production Plans are submitted annually to FFA as part of the license validation process. Active sites for the current year are provided in that plan.

This plan is responsive to policy requirements and conditions of aquaculture licenses enabled under the province of Newfoundland and Labradors *Aquaculture Act*. Specifically, Aquaculture Policy (AP) 2 – Aquaculture Requirements, AP17 – Public Reporting, AP 23 – Fish Disposal, AP 23 – Fish Health Reporting and AP33 - Aquatic Animal Health Contingency Plan.

3.0 The Emergency Management Team (EMT)

All mass mortality events will trigger MCE Incident and Crisis Management System (ICMS – as per AP 2 and 17)). ICMS requires both internal and external reporting and the establishment of a crisis or emergency management team. The internal Emergency Management Team is comprised of Senior Management Team members of MCE including:

Managing Director
Fish Health Director
Saltwater Director
Fresh Water Director
Development and Environmental Compliance Director
Processing Director

Depending upon the level of the event, government representatives may be invited to participate on an external emergency management team. Participation is at the discretion of the government agencies invited. Participation of government agencies in collaboration with industry will allow for a comprehensive response that includes permitting and regulatory controls and smooth flow of information between industry, government, and the public. In the event of a mass mortality response, the following will be invited to join the external EMT:

- Aquatic Animal Health (AAHD) and Aquaculture Development Divisions (ADD), Fisheries, Forestry and Agriculture, Government of Newfoundland and Labrador
- Ecosystem Management Division, Fisheries and Oceans Canada (DFO)
- National Environmental Emergencies Centre, Environmental Protection Operations Directorate
- Environment and Climate Change Canada (ECC)
- Canadian Wildlife Service, Environment and Climate Change Canada (CWS)
- The Canadian Food Inspection Agency (CFIA)

A representative of the Newfoundland Aquaculture Industry Association (NAIA) may also be invited to take part in the external EMT.

MCE Emergency Management Team Contact Number:

Position	Name	Cell Phone Number
Managing Director (Team Leader)		**Private contacts redacted**
Development & Environmental Compliance Director		**Private contacts redacted**
Processing Manager		**Private contacts redacted**
Fish Health and Welfare Director		**Private contacts redacted**
Saltwater Production Director		**Private contacts redacted**
Freshwater Production Director		**Private contacts redacted**

Regulatory Authorities/External Management Team Contacts:

Position	Name	Phone Number
Assistant Deputy Minister FFA		709-729-3765 (office)
Aquaculture Development Division Director, FFA		709-538-3725
Aquatic Animal Health Division Director, FFA		709-729-6872
Regional Aquaculture Coordinator, DFO		709-772-6674
District Veterinarian, Canadian Food Inspection Agency		709-687-9012
Senior Officer, Preparedness Environment and Climate Change Canada		709-772-4285
Emergency Response Coordinator, Canadian Wildlife Services		902-426-6405
NAIA		
Spill Response Line	N/A	1-800-563-9089

4.0 Identification of Event

The response to an event will be determined by the magnitude, the expected quantity of mortalities, and the cause. The cause of the event will be the primary decision factor in determining the response to the event. The following definitions are provided as a guide to determining the magnitude of expected losses due to a mass mortality event. The approximate time to clean up will depend on the scale of the loss, time frames given are meant as a guide. Actual clean up time will depend on the resources mobilized to address the event.

Level	Item	Scope	Clean up time frame
1	Cage	Event affecting 1-3 cages at a single site.	1-2 weeks
2	Farm	Event affecting majority of cages within a farm site.	2-4 weeks
3	Multiple-Farm	Multiple-Farm sites affected in a BMA.	4-8 weeks
4	Multi -Regional	Multiple farms in more than one BMA affected.	8 weeks +

5.0 Preparation of mortality events

The most important part of preparing for mortality events is preventing them. Please see Environmental Event Mitigation Plan and Fish Health Management Plan for details on prevention of mortality events and maintaining fish health to avoid events.
In the event a loss occurs, priority will be on removing mortalities as quickly as possible. Resources will be mobilized to clean up the event in the least amount of time before decomposition has a chance to occur. MCE will catalogue a list of equipment and resources it will have available to assist in a mortality event. In addition to this, MCE will maintain a contact list of service providers who have the capacity to assist in the event of a mass mortality event. A seasonal listing of available service providers and their timelines to travel to the south coast region will be assembled to draw upon if needed.

Equipment:

MCE will store equipment necessary to enact rapid removal of mortalities should they occur in Pools Cove and Hermitage. This equipment includes:

- All pens on site are fitted with individual airlift mortality systems (Lift-Up). These are connected to central compressors stationed on the feed barge,.
-
- Large independent mortality airlift system available, can be installed on any large work boat or well-boat currently on long term contract1 m^3 fish totes (Harbour Breton and Pools Cove)
- Containment Boom: Oil Containment Boom. Three hundred feet of 36' round with 12" skirt, will be stored in Pools Cove and three hundred feet will be stored in Harbour Breton.
- Sweeper boom: A sweeper boom will be rigged to existing vessels to enable collection and retention of any fat that may escape the primary containment boom.
- Skimmer Technology (see Fat/Debris Containment, below)
- Vessels: MCE have a several vessels that can participate in a mass mortality event. The list below does not include a variety of small outboard vessels and small barges, approximately 20 in total.

Vessel Name	Type	Length
FSV Multi-Ocean	Commercial Work Boat	15m M
Victoria Viking	Well Boat	1050 m^3
360 Contender	Well Boat	24m
Atlantic Harvester 360 Handler	Work Boat (Crane) Work Boat	19.5 M 24m
Northern harvester 1 – 65' x 28' vessel with 40'x 26' of deck space	65' x 28' vessel with 40'x 26' of deck space	19.5 M
Ben Lea	Long Liner Crane	12 M
Cage N Queen	Long Liner Crane	12 M

Adriana and Tanya	Utility Barge Crane	17.5 x 6.5 M
Northern Dawn	Utility Barge Crane	19 x 7.5 M

Figure 1. Containment boom for containing any drifting debris resulting from removal activities.

Figure 2. Examples of Sweeper Booms

Fat/debris Containment: Should mortality removal not be completed before decomposition occurs and fat and debris start to surface, MCE will notify the Spill Response Line, FFA and DFO (past event this was 7 to 10 days after fish death). Primary containment booms will be deployed to surround the seiner vessels and areas being pumped when there is evidence of floating material. Material contained within the booms will be removed by site staff and contained in 1 m3 fish totes. Should material float free of the booms, MCE will have a crew dedicated to collecting fat via small vessel with dip nets and 1 m3 fish totes, or with Sweeper Booms to collect and contain material for dipping out into fish totes. Clean up Crews will visit shorelines daily and will use absorbent pads to collect any fat/debris that may have gone to shore. Effectiveness of clean up will be monitored by the Environmental control Officer (see section 6.12 & 6.22) and/or environmental monitoring agencies (see section 8.0).

Note: Manual dipping of fat off the water is an accepted and effective practice, but it is time consuming and difficult. MCE is exploring the use of skimmer technology to suction fat and oil off the water. This is an efficient and effective way of removing oil from the waters surface and has been used in the oil and gas sector. MCE will be purchasing skimmer technology and storing in Harbour Breton by the end of the second quarter of 2024.

Figure 3. Example of a skimmer technology.

Service Providers:

MCE will compile a list of service providers than can assist in rapid removal of mortalities should they occur. Prior to entering the winter season, the service providers on the list will be contacted to make a calendar of availability. Another availability calendar will be made prior to entering the warm water season. The list of service providers can be found in Appendix 1 and includes:

- Contracted seiners (40-90 mt capacity; 150-170 MT capacity)
- Diving contractors
- Boom/ oil absorbent suppliers
- Rendering facilities
- Anaerobic Digestor

Note: In addition to resources available in Newfoundland, MCE will engage Transport Canada in discussion on mechanisms to enable rapid approval for well boats to come to NL to assist in removal activities as necessary. Currently, approval process for allowing well boats from other countries, such as Norway and Scotland, take months to obtain.

Shore-based facilities that will support mortality removal depending upon location of the event are included in the table below. It encompasses operating areas and supporting facilities located in the regions, and others located outside of the region but are relevant to this plan. This plan will focus on existing outflow infrastructure that is available immediately.

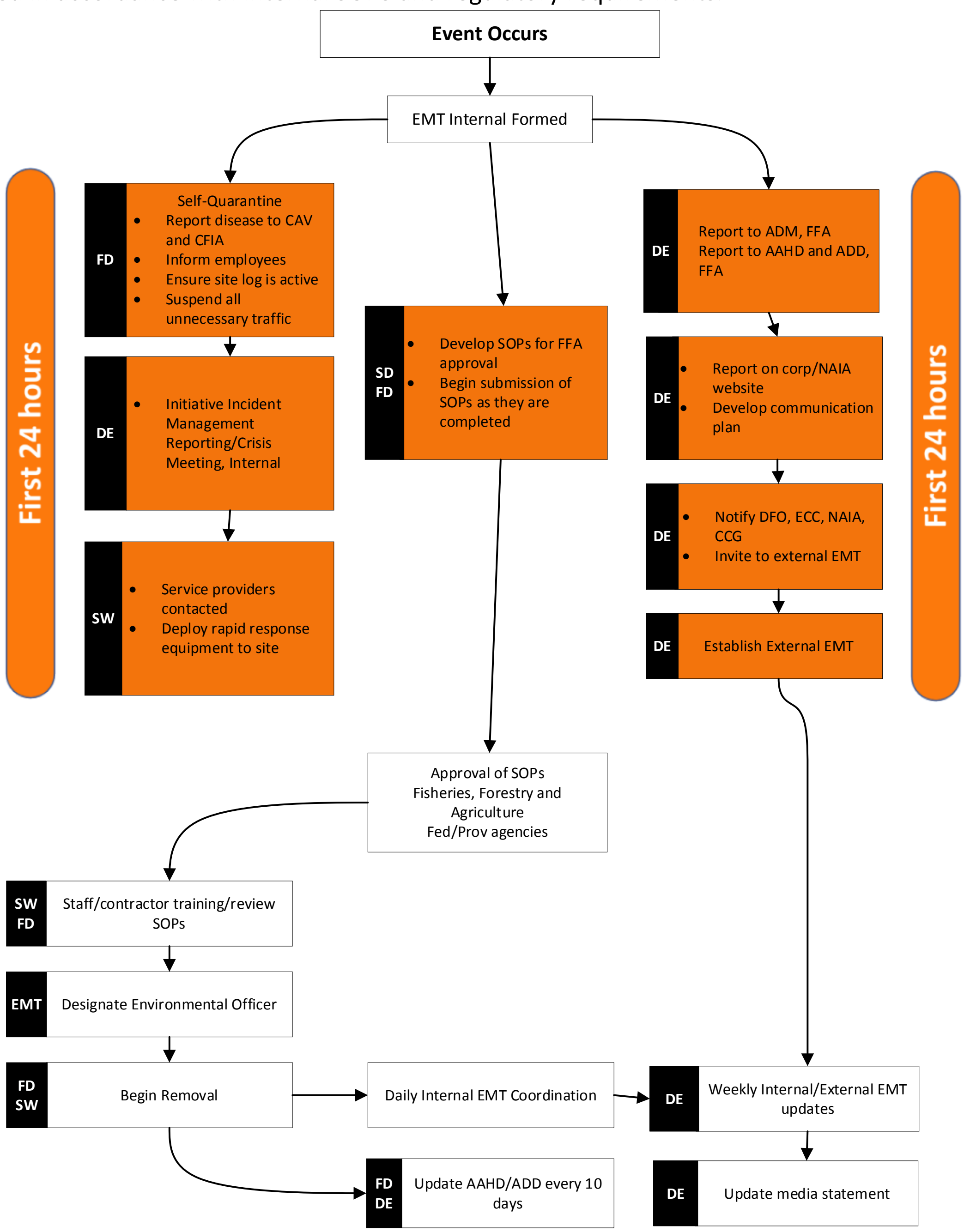
Community	Facility
Harbour Breton	Fish Plant Wharf
Hermitage	Ferry Wharf
Belleoram	Fishing Wharf
Pool’s Cove	Ferry Wharf
Wreck Cove/Coombs Cove	Fishing Wharf
Burgeo	Processing/Meal Plant Wharf

Should additional booms be required, they will be obtained from Hi-Point Industries in Botwood with a delivery time of two weeks. Hi-Point is also able to provide oil absorbent material (Oclansorb Oil Absorbent) within a day of order.

6.0 Response Plan

6.1 General Process: Reportable Disease/Disease event.

In the event of a mass mortality or depopulation event the following general process shall be followed in accordance with Internal SOPS and regulatory requirements.



SW – Saltwater Director
FD – Fish Health Director
DE – Development and Environmental Compliance Director
EMT – Emergency Response Team

6.11 Mass Mortality Detection

Detection of a mass mortality event will occur through daily site activities, daily/weekly mortality removal, and fish health surveillance activities. If an event is detected where a reportable disease is the cause or suspected to be the cause, the following steps will be taken.

1. Assemble internal EMT
    a. Items i. to v occur concurrent with 2 to 4 below:
        i. Contact service providers (Appendix 1)
        ii. Deploy rapid response mortality removal equipment (see Sections 6.12 &6.22 and 7.0).
        iii. Initiate Incident and Crisis Management System (ICMS) with Incident Report.
        iv. Develop Communications Plan
        v. Self-Quarantine site(s)
            a. Inform employees of the situation.
            b. Initiate staging area for site access.
            c. Ensure visitor log is active.
            d. Suspend all unnecessary traffic.
2. Notify the following agencies Immediately (within 24 hours) as per AP 17, Public Reporting and AP 32, Fish Health Reporting:
    a. Assistant Deputy Minister, Fisheries and Aquaculture 729-1725
    b. Director of Aquatic Animal Health, Aquatic Animal Health, Fisheries, Forestry and Agriculture, 729-6872
    c. Director of Aquaculture Development, Aquaculture Development Division, Fisheries, Forestry and Agriculture, 538-3725
    d. District Veterinarian, Canadian Food Inspection Agency, 687-9012

3. Notify Fisheries and Oceans Canada, Environment and Climate Change Canada, and the Newfoundland Aquaculture Industry Association.
    a. If an Emergency Drug Release has been authorized for the site, also notify Health Canada
    b. Invite provincial and federal representatives and NAIA to participate in external EMT
    c. Notify Canadian Coast Guard, Spill Response Line, 1-800-563-9089 of mass fish mortalities.

4. If an official Quarantine Order or Order to Depopulate is given, then the following must occur as per AP33, Aquatic Animal Health Contingency Plan:
    a. A list of items on the site must be provided to the CAV. This list is to include:
        1. Fish numbers
        2. Fish cages/tanks with cage/tank identification numbers
        3. Fish nets with net identification numbers
        4. Vessels
        5. Barges
        6. Trucks
        7. Equipment
        8. Buoys
        9. Lines
        10. Trays/cages/tanks/socks or other applicable holding units
        11. Other items/equipment contained within the quarantine area

    b) Ensure a License to Move is obtained prior to removal of anything from site, including fish.

    c) If an Order to Depopulate is given, preparations to depopulate must begin within 24 hours.

d) Participate in enhanced surveillance program
e) Follow any other direction given from the CAV within the following authorities:
    a. Diagnostic testing
    b. Epidemiological investigation
    c. Treatment of the fish
    d. Vaccination of the fish
    e. Fish movement
    f. Enhanced biosecurity

5. Report Quarantine/Depopulation and abnormal mortality event on corporate/industry association website (within 24 hours), as per AP 17 Public reporting.

6. Submit SOPs for quarantine. Once SOPS area approved, and a License to Move has been granted, begin removal process (see section 6.13).

7. Conduct daily internal EMT calls to coordinate activities. Provide daily updates as per Section 8.0.

8. Conduct weekly external EMT calls to update agencies and coordinate activities. Provide weekly summary of operations as per Section 8.0.

9. Update AAHD and AD every ten days in accordance with conditions of license and AP17 Public Reporting. This will be accomplished more frequently, via daily and weekly updates.

10. Provide daily media updates that transition to weekly media statement on progress of mortality removal.

6.12 Mortality Retrieval Process

Initial Response:
The focus will be on fast response to enable quick removal of mortalities before they have a chance to spread disease to other sites, or decay and contribute to debris in the water. Mobilization of seiners or well boats to engage in mass mortality removal may take several days to a week depending on where they are located at the time of the event. Mortality will be retrieved via lift-up systems (on 140m cages), Servi-Pump diverless mort retrieval systems and airlift systems until seiners and well boats arrive. Once a seiner is in place, the net will be shallowed and the vessel pump utilized. Divers will be used to remove mortality as a last resort. Should mortality retrieval extend beyond a Class 1 or 2 event; the Migratory Birds Response Plan will be initiated in conjunction with the MMCP (see Appendix 5).

Environmental Control:
A staff member on each shift at each site will be designated as the “Environmental Control Officer” and will ensure that materials and debris are contained within the site lease area via monitoring of removal activities and the use of containment booms. Booms will be deployed when there is evidence of floating material. Material contained within the booms will be removed by site staff and disposed of in 1 m3 fish totes . Environmental monitoring services will be engaged in class 3-4 events.

Mortality Retrieval:
All teams and vessels involved in mortality removal will adhere to strict biosecurity and sanitation procedures including quarantine orders if required. Specific measures are described below.

Fish tote Removal:
Mortalities will be retained in fish totes which have been double lined with plastic bags that have been zip tied shut before being secured shut with the cover latched down once the dive is complete. Fish totes will be stored securely latched down in a biosecure area of the outflow wharf until there is enough to complete a full truck load. Fish totes will be transported to NWD or to the Barry Group meal plant in Burgeo under approved SOPs for transport (see section 6.13).

Seiner Removal:
Mortalities will be retained in a seiner vessel which has large holds below the deck. Seiners allow for removal of larger quantities of mortalities compared to fish totes. This results in fewer return trips to the final destination, and in turn results in a quicker removal process. Mortalities will be pumped directly into the seiner and once full, seiner boats will steam to the rendering facility in Burgeo. Dewatering outlets will flow through a screen or sock to retain as much debris as possible. Should removal be delayed, and decomposition of mortalities is present, a boom will be deployed around the seiner to contain and remove any floating debris. Mortalities will be pumped directly into the rendering plant, and if necessary, the seiner will steam back to site for another load.

Wellboat Removal:
If wellboats are available for removal, they will be used in conjunction with the Air Lift pumps. The same providers for seiners will b followed as, above.

Trucking
MCE will co-coordinating with the local transport companies to ensure that fish mortalities are removed to the service provider as rapidly as possible. Local trucking companies are listed in Appendix 1. Transport services with the essential SOPS for bio-securely transporting fish mortalities. These SOPS shall be approved as per FFA policy prior to engagement.

Containers
MCE will ensure that there is a sufficient number of containers or other means of storing the mortalities for the rapid disposal of fish to the service provider. Containers will be free from damage and leak proof.

Disposal Sites:
Mortalities will be disposed of at two locations. Location of disposal will depend on the scale of the event. Scale 1 events may be managed via disposal at New World Dairies anerobic digestor. Higher scale event may also use NWD, especially in early stage of removal when lift up pumps are used. NWD can accommodate **[redacted (3rd party); details registered with FFA]** mt of material per week. NWD has a Certificate of Approval from the Department of Municipal Affairs and Environment to accept waste from aquaculture facilities.

High volume removal will require removal by seiners. Seiners come in various sizes and can remove from 40mt to 170 mt. Seiners will transport material to the Burgeo meal plant. The meal plant is can take **[redacted (3rd party); details registered with FFA]** mt raw material per 24 hours seven days a week. The meal plant is permitted to accept fish from aquaculture operations.

6.13 Transport from Affected Farm Site(s)

Transport to Wharves

All mortalities that will be trucked shall be contained in an industry standard container-1 m^3 fish totes boxes and shall be transported in a bio secure manner to designated “Outflow” wharves. Bio secure handling and transportation is designed to circumvent spillage and entails:

- The covering of containers with lids, followed by strap securement
- Using containers that are leak proof and free from damage
- Double lining the container with plastic bags (which will be zip tied closed after full)
- The sealing of drain stoppers
- The availability of approved, industry-standard disinfectant and empty double-lined, leak-proof mortality totes with which to mitigate accidental spills. Decontamination protocols are outlined in section 6.14.

Outflow wharves are located at the following locations:

- Hermitage
- Belleoram
- Pool’s Cove
- Hr. Breton
- St. Alban’s
- Conne River

MCE will ensure that adequate numbers of vessels are provided to ensure a fast and efficient removal of all mortalities from the farm.

Transport Via Road to Disposal Site

Mortalities transport via road to disposal sites will be completed with no opportunity for spillage or leakage as per approved SOP’s and in accordance with government policy regarding transportation of fish (see Appendix 2).

Transport Via Seiner to Disposal Site

Seiners will sail to the Burgeo meal plant utilizing a route that maximizes distance between the seiner and aquaculture sites while maintaining crew and vessel safety given prevailing weather conditions. Seiner holds will be sealed with no opportunity for leakage while on route to the meal plant. Seiners will be off loaded in accordance with approved SOP’s that address biosecure transfer of material into the meal plant and cleaning and disinfection of vessel and wharf facilities at the disposal point.

6.14 Decontamination

The MCE shall be responsible for the decontamination and disinfection of all the wharves, company vessels, containers and all other equipment used in the collection, removal and transport of mortalities.

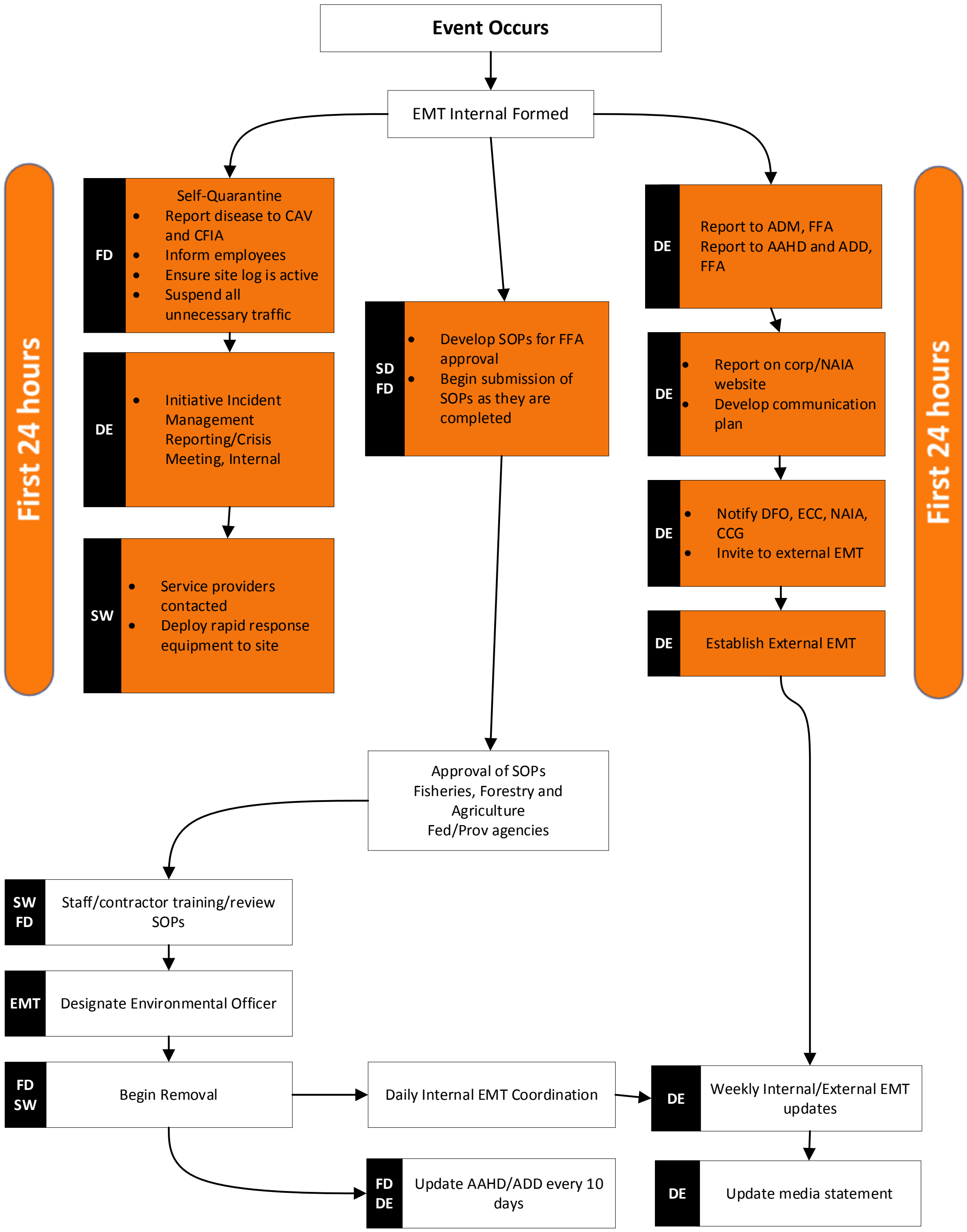
All disinfectants shall conform to industry and relevant environmental standards. The choice of disinfectant will depend on weather conditions and the disease which is present on the site.

Disinfectant	**Strength**	**Dilution**	**Contact time**
Iodor, Premise, etc.	250ppm	300mls/20liters	10 mins
Javex (cannot be used at marine site)	1,000 ppm	500mls/20liters	10 minutes
Virkon (can only be used with fresh water)	1%	250 grams/25liters (freshwater only)	10 minutes
Cleaning	**Strength**	**Dilution**	**Contact time**
Detergents	Ex. Green Works	Strong	Use prior to disinfecting
Hot water & High Pressure	>65°C	N/A	>10 minutes

All disinfection, sterilization and decontamination protocols shall be submitted and approved by the AAHD and/or CFIA prior to initialization.

6.2 General Process: Mass Mortality Non Disease.

In the event of a mass mortality or depopulation event the following general process shall be followed in accordance with Internal SOPS and regulatory requirements.



SW – Saltwater Director
FD – Fish Health Director
DE – Development and Environmental Compliance Director
EMT – Emergency Response Team

6.21 Mass Mortality Detection

Detection of a mass mortality event will occur through daily site activities, daily/weekly mortality removal, and fish health surveillance activities. If an event is detected, the following steps will be taken.

1. Assemble internal EMT
    a. Items i. to v occur concurrent with 2 to 4 below:
        i. Contact service providers (Appendix 1)
        ii. Deploy rapid response mortality removal equipment.
        iii. Initiate Incident Management System with Incident Report.
        iv. Develop Communications Plan
            a. Inform employees of the situation.
            b. Ensure visitor log is active.
            c. Suspend all unnecessary traffic.

2. Notify the following agencies Immediately (within 24 hours) as per AP 17, Public Reporting:
    a. Assistant Deputy Minister, Fisheries and Aquaculture 729-1725
    b. Director of Aquatic Animal Health, Fisheries, Forestry and Agriculture, 729-6872
    c. Director of Aquaculture Development, Aquaculture Development Division, Fisheries, Forestry and Agriculture, 292-4111

3. Notify Fisheries and Oceans Canada, Environment and Climate Change Canada, the Canadian food Inspection Agency and the Newfoundland Aquaculture Industry Association.
    a. If an Emergency Drug Release has been authorized for the site, also notify Health Canada
    b. Invite provincial and federal representatives and NAIA to participate in external EMT
    c. Notify Canadian Coast Guard, Environmental Response, 1-800-563-9089 of mass fish mortalities.

4. Report abnormal mortality event on corporate/industry association website (within 24 hours), as per AP 17 Public reporting.

5. Submit SOPs for people/equipment movement, mortality removal and disposal, cleaning and disinfection to AAHD and AD, Fisheries, Forestry and Agriculture for approval (SOPs will vary depending on location of event, size of event and time of year – see attached listing of SOPs anticipated for a Mass Mortality Event in Appendix 3).
    a. Submit SOPs to other agencies for review and approval.

6. Once SOPS area approved, begin removal process (see section 6.22).

7. Conduct daily internal EMT calls to coordinate activities. Provide daily updates as per Section 8.0.

8. Conduct weekly external EMT calls to update agencies and coordinate activities. Provide weekly summary of operations as per Section 8.0.

9. Update AAHD and AD every ten days in accordance with conditions of license and AP17 Public Reporting. This will be accomplished more frequently, via daily and weekly updates.

10. Provide daily updates that transition to weekly media statement on progress of mortality removal.

6.22 Mortality Retrieval Process

Initial Response:
The focus will be on fast response to enable quick removal of mortalities before they have a chance to spread disease to other sites, or decay and contribute to debris in the water. Mobilization of seiners or well boats to engage in mass mortality removal may take several days to a week depending on where they are located at the time of the event. Mortality will be retrieved via lift-up systems (on 140m/160m cages), Servi-Pump diverless mort retrieval systems and airlift systems until seiners and well boats arrive. Once a seiner is in place, the net will be shallowed and the vessel pump utilized. Divers will be used to remove mortality as a last resort. . Should mortality retrieval extend beyond a Class 1 or 2 event, the Migratory Birds Response Plan will be initiated in conjunction with the MMCP (see Appendix 4).
Should the event be class 3 or 4, additional booms will be ordered or rented from suppliers (see Appendix 1).

Environmental Control:
A staff member on each shift at each site will be designated as the "Environmental Control Officer" and will ensure that materials and debris are contained within the site lease area via monitoring of removal activities and the use of containment booms. Booms will be deployed when there is evidence of floating material. Material contained within the booms will be removed by site staff and disposed of in 1 m3 fish totes. Environmental monitoring services will be engaged in class 3-4 events.

Mortality Retrieval:
Details of mortality retrieval, and transport will be conducted in accordance with the Fish Disposal Plan (App 3 in the FHMP) as required by AP 23- Fish Disposal.

All teams and vessels involved in mortality removal will adhere to strict biosecurity and sanitation procedures including quarantine orders if required. Specific measures are described below.

Fish tote Removal:
Mortalities will be retained in fish totes which will be secured shut with cover latched down once the dive is complete. Fish totes will be stored securely latched down in a biosecure area of the outflow wharf until there is enough to complete a full truck load. Fish totes will be transported to NWD or to the Barry Group meal plant in Burgeo.

Seiner Removal:
Mortalities will be retained in a seiner vessel which has large holds below the deck. Seiners allow for removal of larger quantities of mortalities compared to fish totes. This results in fewer return trips to the final destination, and in turn results in a quicker removal process. Mortalities will be pumped directly into the seiner and once full, seiner boats will steam to the rendering facility in Burgeo. Dewatering outlets will flow through a screen or sock to retain as much debris as possible. Should removal be delayed, and decomposition of mortalities is present, a boom will be deployed around the seiner to contain and remove any floating debris. Mortalities will be pumped directly into the rendering plant, and if necessary, the seiner will steam back to site for another load.

Wellboat Removal:
If wellboats are available for removal, they will be used in conjunction with the Air Lift pumps. The same providers for seiners will b followed as, above.
Trucking

MCE will co-coordinating with the local transport companies to ensure that fish mortalities are removed to the service provider as rapidly as possible. Local trucking companies are listed in Appendix 1. Transport services will be conducted in according to SOPs for bio-securely transporting fish mortalities.

Containers
MCE will ensure that there is a sufficient number of containers or other means of storing the mortalities for the rapid disposal of fish to the service provider.

Disposal Sites:
Mortalities will be disposed of at two locations. Location of disposal will depend on the scale of the event. Scale 1 events may be managed via disposal at New World Dairies anerobic digestor. Higher scale event may also use NWD, especially in early stage of removal when lift up pumps are used. NWD can accommodate **[redacted (3rd party); detail registered with FFA]** of material per week. NWD has a Certificate of Approval from the Department of Municipal Affairs and Environment to accept waste from aquaculture facilities.

High volume removal will require removal by seiners. Seiners come in various sizes and can remove from 40mt to 170 mt. Seiners will transport material to the Burgeo meal plant. The meal plant can take **[redacted (3rd party); detail registered with FFA]** raw material per 24 hours seven days a week. The meal plant is a licensed processing facility through FFA and is permitted to accept fish from aquaculture operations.

Fish transport will be in accordance with FFA policy 'AP – 23 Fish Disposal'

6.23 Transport from Affected Farm Site(s)

Transport to Wharves

All mortalities that will be trucked shall be contained in an industry standard container-1 m3 fish totes boxes and shall be transported in a bio secure manner to designated "Outflow" wharves. Bio secure handling and transportation is designed to circumvent spillage and entails:

- The covering of containers with lids, followed by strap securement
- The sealing of drain stoppers
- The availability of approved, industry-standard disinfectant and empty double-lined, leak-proof mortality totes with which to mitigate accidental spills. Decontamination protocols are outlined in section 6.24.

Outflow wharves are located at the following locations:

- Hermitage
- Belleoram
- Pool's Cove
- Hr. Breton
- St. Alban's
- Conne River

MCE will ensure that adequate numbers of vessels are provided to ensure a fast and efficient removal of all mortalities from the farm.

Transport Via Road to Disposal Site
Mortalities transport via road to disposal sites will be completely continued with no opportunity for spillage or leakage as per approved SOP's and in accordance with government policy regarding transportation of fish – see Appendix: Disposal Guidance.

Transport Via Seiner to Disposal Site

Seiners will sail to the Burgeo meal plant utilizing a route that maximizes distance between the seiner and aquaculture sites while maintaining crew and vessel safety given prevailing weather conditions. Seiner holds will be sealed with no opportunity for leakage while on route to the meal plant. Seiners will be off load in accordance with approved SOP's that address biosecure transfer of material into the meal plant and cleaning and disinfection of vessel and wharf facilities at the disposal point.

6.24 Decontamination

The MCE shall be responsible for the decontamination and disinfection of all the wharves, company vessels, containers and all other equipment used in the collection, removal, and transport of mortalities.

All disinfectants shall conform to industry and relevant environmental standards.

Disinfectant	**Strength**	**Dilution**	**Contact time**
Iodor, Premise, etc.	250ppm	300mls/20liters	10 mins
Javex (cannot be used at marine site)	1,000 ppm	500mls/20liters	10 minutes
Virkon (can only be used with fresh water)	1%	250 grams/25liters (freshwater only)	10 minutes
Cleaning	**Strength**	**Dilution**	**Contact time**
Detergents	Ex. Green Works	Strong	Use prior to disinfecting
Hot water & High Pressure	>65°C	N/A	>10 minutes

In the situation that the mass mortality event was caused by a reportable disease, all disinfection, sterilization and decontamination protocols shall be submitted and approved by the AAHD and/or CFIA prior to initialization.

7.0 Mobilization Plan

7.1 Class 1-2 Event: One site only; 1-3 cages on a site or a whole site

Once notification is completed and SOPs are approved, MCE will mobilization people and equipment to site. Focus will be to remove mortalities prior to decomposition (within 7-10 days). In the event of a disease related event, all activities would occur in accordance with established and approved SOPs for quarantine actives and health related events. Timelines for mobilization will be dependent on location of site affected and prevailing weather conditions that may affect the time it takes to access the site.

Day 1: Concurrent with notification and SOP development as in Section 6.1 & 6.2.

- Coordination meeting with EMT, Salt water Manager, Fish Health Director, Development and Environmental Compliance Director, Regional manager, Site Managers, site staff.
    - Brief on event and plan to removal activities
    - Identify cages to start first and sequence of removal.
    - Identify roles and responsibilities (i.e who does what in terms of set up).
    - Notify disposal sites.

  - Identify ECO for site operations and monitoring.
  - Determine availability of wellboats
  - Identify potential challenges (i.e weather, distance to sites, etc., and mitigations to address challenges.
- Regional manager coordinate with site manager to deliver and set up Air Lifts at sites.
  - Identify vessels for transport of equipment and people. Identify vessels for holding and moving fish totes.
  - Arrange for 1m cube totes to be on site
  - Ensure transport is arrange for mortalities
  - Contact Dive companies to arrange divers (1-2 days for travel)
- SW Director will contact seiners to come to site. Determine time for arrival (if in Burgeo, one - two days for travel). If possible, well boats will be diverted to site.
- FH Director/SW Director – direct set up biosecure staging area if necessary
- Update regulatory authorities on activities.

Day 2: Begin Air Lift mort retrieval. Should seiners arrive on site, mortality removal will start with seiners. If wellboats are available, initiate removal with Air Lifts into wellboats.

- Begin mortality removal with Air Lifts, Lift-Up Systems or Servi-Pump units (see Fish Disposal Plan SOP's). Continue retrieval with these systems until seiners and/or well boats arrive.
- If wellboats are available, utilize Air Lifts, Lift-Up Systems or Servi-Pump units to pump into wellboats.
- Mortalities retrieved by Air Lifts, Lift-Up Systems or Servi-Pump units will be transported to NWD by truck.
- If seiners/wellboats arrive, begin mort retrieval with seiners.
- Seiners will transport mortalities to Burgeo meal plant.
- Record volumes of mortalities retrieved, and cages completed daily and report back to EMT.
- Provide daily updates to regulatory authorities on progress.

Day 3 until completion. Continue with mortality removal until complete.

- If removal continue beyond 7 days, deploy booms to site.
- ECO to report to Spill Response, FFA and DFO if fat and debris begins to surface.
- Clean up crews deployed to site to collect fat/debris
- Initiate Migratory Bird response Plan (see Appendix 5)
- Provide daily Update to regulatory authorities. Provide weekly review of activities to external EMT, including regulatory authorities.

7.2 Class 3-4 Event: Multiple sites in a BMA to multiple sites in multiple BMA's

Once notification is completed and SOPs are approved, MCE will mobilize people and equipment to sites. Focus will be to remove mortalities as quickly as possible. It is expected that some site will have floating fat/debris. In the event of a disease related event, all activities would occur in accordance with established and approved SOPs for quarantine actives and health related events. Timelines for mobilization will be dependent on location of site affected and prevailing weather conditions that may affect the time it takes to access the site.

Day 1: Concurrent with notification and SOP development as in Section 6.1 & 6.2.

- Coordination meeting with EMT, Salt water Manager, Fish Health Director, Development and Environmental Compliance Director, Regional manager, Site Managers, site staff.
  - Identify an Operations Coordinator responsible for overall vessel, equipment, and staff co-

ordination.
    - Brief on event and plan to removal activities
    - Identify sites affected and order of priority for removal.
        - Identify cages to start removal and sequence of removal within each site.
        - Identify roles and responsibilities (i.e who do**es** what in terms of set up).
    - Notify disposal sites.
    - Identify ECO for each site operations and monitoring.
    - Identify clean up crews for each site
    - Identify environmental monitoring team for each site.
    - Contact Environmental Monitoring companies to initiate monitoring services.
    - Determine availability of wellboats
    - Identify vessels for transport of equipment, personnel and moving fish totes and which sites they will be assigned to.
    - Identify potential challenges (i.e weather, distance to sites, etc., and mitigations to address challenges.
    - Initiate Migratory Bird Response Plan.
    - Order/rent additional booms
    - Order absorbent pads
    - Develop biosecurity plan for movement of equipment and people from site to site and BMA to BMA.
- Operations Coordinator to coordinate with site manager to deliver and set up Air Lifts to priority sites.
    - Identify vessels for transport of equipment and people. Ident**i**fy vessels for holding and moving fish totes.
    - Arrange for 1m cube totes to be on site
    - Ensure transport is arrange for mortalities
    - Contact Dive companies to arrange divers (1-2 days for travel) and determine numbers available.
- SW Director will contact seiners to determine how many are available to come to site**s**. Determine time for arrival (if in Burgeo, one - two days for travel). Determine if wellboats are capable of participating.
- FH Director/SW Director – direct set up biosecure staging areas if necessary
- Compile a Response Plan that addresses:
    - Sequence of sites to depopulate
    - Vessel's equipment and people available and where they will be assigned.
    - Verification of resource availability
    - Biosecurity plan
    - Reporting mechanisms (daily, weekly)
- Update regulatory authorities and external EMT on Response Plan.

Day 2: Begin Air Lifts, Lift-Up Systems or Servi-Pump units mort retrieval on priority site. Should seiners arrive on site, mortality removal will start with seiners. If wellboats are available, initiate removal with Air Lifts into wellboats.

- Begin mortality removal with Air Lifts, Lift-up Systems or Servi-Pump units. Continue until seiners/wellboats arrive.
- If wellboats are available, utilize Air Lifts, Lift-up Systems or Servi-Pump units to pump into wellboats.
- Mortalities retrieved by Air Lifts, Lift-up Systems or Servi-Pump units will be transported to NWD by truck.

- If seiners/well boats arrive, begin mort retrieval with seiners.
- Seiners/well boats will transport mortalities to Burgeo meal plant.
- Record volumes of mortalities retrieved, and cages completed daily and report back to EMT.
- Provide daily updates to regulatory authorities on progress.

Day 3 until completion. Continue with mortality removal until complete.

- Deploy booms to sites.
- ECO to report to Spill Response, FFA and DFO if fat and debris begins to surface.
- Clean up crews deployed to site to collect fat/debris.
- Initiate Migratory Bird response Plan (see Appendix 5)
- Provide daily Update to regulatory authorities. Provide weekly review of activities to external EMT, including regulatory authorities.

8.0 Monitoring and Reporting

MCE will utilize internal staff for environmental monitoring of Class 1 and 2 mortality events. MCE employs several qualified staff who will be responsible for working with the site staff to ensure fat/debris, should it occur, is immediately addressed before it leaves site. Staff will also implement the Migratory Bird Response Plan (Appendix 5) if necessary. See Mobilization section 7.0.

In the event of a Class 3 or above event, external environmental monitoring agencies will be hired to work with the ECO to monitor floating debris, effectiveness of clean up, address shoreline impacts if they occur and participate in the Bird Response Plan. The agencies listed below can provide monitoring services in the event of a mass mortality event:

- MAMKA
- TBD

Regulatory agencies will be advised if fat/debris is present and if it leaves the site. MCE will collaborate with authorities on appropriate removal techniques and monitoring of impacts and seek permission where required. Daily reports will be compiled on removal activities and reported to regulatory authorities and external EMT. These reports will include:

- Location of operations
- Removal methods utilized
- Number of cages completed
- Whether floating debris is present/absent
- Amount of fat/debris removed and removal method.
- Report on shoreline impacts if any and clean up if it occurs.
- Report on any bird effects as per Migratory Bird Response Plan.
- Any issues or challenges encountered

A weekly summary report will be compiled that will report on the following:

- How many sites/cages completed
- Total mortalities removed
- Total fat/debris removed
- Location of any affected beaches and current status
- Total affected birds, if any.
- How many cages/sites are left for removal
- Any issues or challenges encountered

The weekly report will be shared with the external EMT, including regulatory agencies. Both the daily and weekly report will be submitted to FFA in accordance with AP17, clause 8, requirement to report every 10 days.

9.0 Communications

In addition to reporting requirements required by the Department of Fisheries, Forestry and Agriculture policy and license conditions, MCE will conduct daily meetings of the internal EMT and weekly meetings of the external EMT. The internal EMT will provide a daily update to regulatory authorities and a written update every 10 days as per AP 17. MCE will also provide at minimum, weekly updates on the progress of any mass mortality clean up on the corporate or NAIA website.

For Class 1-2 events, MCE will verbally inform local communities (mayors) and fishers (through the FFAW) of the event and estimate time for clean up. For class 3-4 events MCE will initiate meetings with local stakeholders, including communities, local fishers, and FFAW representatives. These meetings will be held at regular intervals through out the response to keep stakeholders informed of progress.
All communications will be coordinated through MCE's Communications Director through collaboration with the internal and external EMT.

10.0 Training and Maintenance

MCE will ensure that each service provider shall ensure that staff involved in handling fish mortality are trained according to the SOPS and other protocols provided by MCE.
MCE staff will receive annual training on the Mass Mortality Plan. Training will include:

- Equipment set up, maintenance and deployment (i.e. Air lifts/booms)
- Review of Quarantine procedures
- Review of notification procedures
- Review of Migratory Bird Response Plan
- Review of all applicable SOP's.
- Tabletop mortality event exercise.

Should the plan be updated, amendments will be communicated immediately to all site staff. All new hires of site personnel will be briefed on this plan.

11.0 Post Event Analysis

Priority during events will be on containment and clean up, however, post event, each event will be evaluated through MCE Incident and Crisis Management System (ICMS) to determine the following:

- Cause of the event
- Effectiveness of response system
- Issues/bottleneck during clean up
- Description of future mitigations to prevent similar events
- Description of improvement to made in the response to and clean up of the event clean up of the event.

This evaluation will be shared with external EMT members and those with legislative and regulatory mandate regarding aquaculture and oceans environments.

Appendix Mass Mortality: Service Providers

Dive Contractors:

Private names, and contacts of 3rd party dive contractors are redacted. Details are registered with the FFA. MCE has 5 dive companies shortlisted.

Trucking Companies

Private names, and contacts of 3rd trucking companies are redacted. Details are registered with the FFA. MCE has 5 trucking companies shortlisted.

Seiners: Are all available August to November also February and March. All other times may only get one or two of them.

Private names, contacts and vessel capacity of 3rd party vessel owners are redacted. Details are registered with the FFA. MCE has multiple vessels shortlisted with a total hold capacity of approximately 885MT.

Mortality Disposal Facilities

Primary material recovery operators are public knowledge. Specific details of 3rd party capacity are redacted but are registered with FFA. Total capacity of companies exceeds 1,150 MT per week.

Name	Barry Group Inc.
Type	Rendering
Contact	
Phone	
Address	

Name	New World Dairy
Type	Anaerobic Digestor
Contact	
Phone	
Address	

Cleaning and Disinfections Materials Providers

Private names, and contacts of 3rd party suppliers are redacted. Details are registered with the FFA.

Booms, Absorbent Material

Private names, and contacts of 3rd party suppliers are redacted. Details are registered with the FFA.

Air Compressor Rental

Private names, and contacts of 3rd party suppliers are redacted. Details are registered with the FFA.

Appendix Mass Mortality: SOP's

Standard Operating Procedures will be developed for all mass mortality operations. These must be approved by FFA in accordance with policy and conditions of license prior to engaging in mortality removal and will be prepared to be specific to the site, region and time of year when the event occurs. Other provincial and federal agencies who have a jurisdictional mandate regarding aquaculture and mortality transfer will also be asked to review and approve SOP's. Below is a listing of anticipated SOPS that will be developed for approval. Should the event be disease specific SOP's will be developed with enhanced biosecurity. The Fish Disposal Plan (FHMP, Appendix 3) will be followed with adaptations to site, region and time of year.

- General Biosecurity Protocols
- Mortality Removal
    - Seiner set up and retrieval
    - Air lift set up and retrieval
    - Boom deployment and environmental monitoring
- Mortality Transport
    - Transport via truck
    - Transport via Seiner
- Equipment Cleaning and Disinfection
- Vessel Cleaning and Disinfection
- Mortality Disposal
- Vehicle Cleaning and Disinfection
- Any other SOPs relevant to the planned activities
- or as requested by FFA

Appendix Mass Mortality: Biosecurity
Biosecurity Protocols for a Quarantined Site

I. Purpose
The purpose of these protocols is to minimize the risk of spreading disease both within the site itself (i.e. from cage to cage) and minimize the risk of spreading infectious disease between sites within the same geographical area.

II. General
1. All personnel that are involved with the quarantined site are required to read and abide by these protocols. This includes staff working on site, visitors to site, transporting workers to site, etc.).
2. Traffic to and from the site is **restricted** and must be authorized by both the Department of Fisheries, Forestry and Agriculture (FFA) and through the Fish Health and Welfare Director (*currently vacant*) or designate. **No unauthorized entry to the site will be tolerated.**
3. Access to the site will be via FFA-approved SOPs ONLY.
4. Footbaths (Table 1) with scrub brushes will be present on the wharf and in boats and will be checked and refreshed daily or any time they appear dirty.
5. Equipment is **NOT** to be moved off site without a License to Move.
6. Farm staff and visitors are to wear proper PPE (see Table 3) to ensure all clothing can be disinfected to prevent disease transfer.

III. Site Set-Up
1. An aluminum barge will be used as a staging area.
2. The barge will be split into 3 areas:
    a. A "Clean" area will be the furthest away from the site
    b. A "Dirty area will be the closest to the site
    c. A "Buffer" area will be in between the "Clean" and "Dirty" areas
    d. A berm will be placed between the dirty and buffer zone to contain any fluid from cleaning and disinfection activities.
3. The areas on the barge will be clearly labelled and lines will be drawn to delineate the associated areas.
4. There will be a plastic storage shed on the dirty area so that site PPE can be stored in a dry area.

IV. Site Access

Entering Site
1. All visitors must follow the same protocols as staff. All staff and equipment must enter the site via the staging area. A transport vessel will be used to get from the designated wharf to the staging area.
2. Staff are required to disinfect their boots using a foot dip (see Tables 1 and 2) at the wharf before boarding the transport vessel and again on the transport vessel directly after boarding. This transport vessel is used to deliver staff and equipment to the staging area of the quarantined site.
3. **Transport vessels should ensure their route of travel is as far away from other sites as is feasible and safe.**

4. Upon arrival, the transport vessel will tie up to the designated clean side of the staging area.
5. Staff and equipment will exit the transport vessel and step onto the clean side of the staging area.
6. Staff and equipment will then proceed across the staging area through the designated buffer zone and onto the dirty side of the staging area.
7. Once staff or equipment leaves the clean side of the staging area, they cannot return to the clean side without proper cleaning and disinfection (see “Exiting Site” below).
8. Staff and equipment will board the site vessel from the dirty side of the staging area.
9. The staff can now access the site and attend to their designated duties.
10. **All equipment and staff must exit the site as per “Section IV: Site Access - Exiting the Site”.**

Exiting Site

1. Once staff are ready to exit the site, they will steam from the site to the staging area in the site vessel.
2. The site vessel will be tied up to the “Dirty” side of the staging area.
3. All staff and equipment that is to leave site will exit the boat and land on the “Dirty” area of the staging area.
4. Staff will scrub themselves and any equipment with a detergent (see Table 1) and then rinse with clean water.
5. Once clean, equipment and staff be sprayed with disinfectant (See Table 1). Care must be taken to ensure disinfectant contacts every appropriate surface.
6. Once sprayed with disinfectant, staff and equipment will move to the “Buffer” area of the staging area. Staff (PPE) and equipment will and allowed to sit for the appropriate contact time.
7. Once the appropriate contact time has passed, equipment and staff can move to the “Clean” area of the staging area and board the transport vessel. If anything or anyone moves back into the dirty area, then the exiting protocols must be re-applied.
8. All transport vessels will be completely cleaned and disinfected above the waterline prior to departure from the staging area.

V. Personal Protective Equipment

1. PPE is to be worn at all times, according to Table 3.
2. When staff arrives at the transfer area, they remove their life vests before leaving the transfer vessel and entering the staging area. Once on the staging area on aluminum storage barge they proceed to the PPE storage area and put on their life vest and rain gear that are left on the farm.
3. At the end of the day, site rain gear is disinfected as per “Section IV: Site Access” and stored on the storage barge along with their life vest. Staff will then leave the transfer area and board the transfer vessel, where they put on their transfer vessel life vests.

VI. Feed Delivery

1. Feed will be brought to the staging area via a transport vessel on an as-needed basis.
2. Feed will be transferred from the transport vessel to the staging area.
3. Feed will then be transferred from the staging area to the feed barges on the dirty side.
4. All protocols outlined in “Section IV: Site Access” apply.

VII. Mortality Dives

1. SCUBA divers are used to retrieve mortalities as needed. Increased diving frequency will be employed if there are disease concerns on site or if mortality increases.
2. Divers will access the site as per Section IV: Site Access
3. Divers will dive the farm in order of cages with lowest mortality to highest mortality.
4. Divers will be disinfected between cages using an iodine bath of 250ppm
5. Mortalities will be collected into site specific mort bags that are rinsed in disinfectant after use and kept on the site vessel. (See Table 1).
6. All mortalities will be put into double lined xactic tubs and removed from site as per the "Mortality Removal from a Quarantined Site" SOP.
7. The vessel used for the mortality dives will be cleaned and disinfected before and after each dive. (See Table 1 and 2).
8. Diving equipment will be disinfected following the dive and all equipment will remain on site (except mask, fins, and tanks). This equipment will not be used at any other marine farms. Mask, fins, and tanks will exit the site as equipment following the protocols outlined in "Section IV Site Access".

VIII. Disease surveillance

1. A veterinarian or veterinary technician will visit the farm a minimum of every 2 weeks. A representative sample of dead and moribund fish will be examined for signs of disease. Appropriate samples will be collected for disease surveillance (including but not limited to ISA testing) and will only be permitted to be removed from the site under a FFA license to move.
2. The farm manager will report any unusual findings on the mortality dive to management as soon as possible.

Table 1: Disinfectant / Cleaning alternatives

Disinfectant	**Strength**	**Dilution**	**Contact time**
Iodor, Premise, etc.	250ppm	300mls/20liters	10 mins
Javex (cannot be used at marine site)	1,000 ppm	500mls/20liters	10 minutes
Virkon (can only be used with fresh water)	1%	250 grams/25liters (freshwater only)	10 minutes
Cleaning	**Strength**	**Dilution**	**Contact time**
Detergents	Green Works	Strong	Use prior to disinfecting
Hot water & High Pressure	>65°C	N/A	>10 minutes

Table 2: Disinfection Process

Procedure	
Disinfection of PPE	Clean with detergent. Rinse. Spray down with Iodor (250ppm) and let soak for 10 minutes
Disinfection of Deck and Gunwales of vessel	Clean with detergent. Rinse. Spray with Iodor(250ppm) then scrub in with brush and let soak for 10 minutes

Foot Dips	Step in with both feet (Iodor bath at 250ppm), stop for 10 seconds then step out of bath
Disinfection of mort bag (between cages)	Soak in an Iodor (250ppm). Alternate bags for each cage so each bag soaks for 10 minutes between uses.
Mask, fins and dive tank disinfection	Clean with detergent. Rinse. Submerse in Iodor (250ppm) bath for 10 minutes
Mort pans	Clean with detergent. Rinse. Spray with Iodor (250ppm) and brush around and let soak for 10 minutes

Table 3: Personal Protective Equipment

Rain Gear	To be worn on site
Rubber Boots	To be worn at all times
Rubber Gloves	To be worn when on the cages
Life vest	To be worn at all times

Appendix Mass Mortality: Disposal Guidance ECCM

GOVERNMENT OF
NEWFOUNDLAND AND LABRADOR

Department of Environment and Conservation
Pollution Prevention Division

Guidance Document

Title: Disposal of Fish, Shellfish and Fish Offal

Revision Date: November 07, 2004

Revised By: Joe Ashley, Environmental Co-ordinator

Approved By: Derrick Maddocks, Director

Disposal of Fish, Shellfish and Fish Offal
GD-PPD - 04rev. 1

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1.0 INTRODUCTION

Fish, shellfish and fish offal wastes generated by fisher persons and fish plants have, on occasion, caused health and environmental concerns due to improper/poor storage, handling and/or disposal practices. Some of the problems created include water pollution, fouled beaches, insect/rodent infestations and noxious odors. In some cases, traffic hazards have been created due to spillage onto roadways from overloaded offal transport trucks. Also, contaminated liquids leaking from containers on transport vehicles or the tailgate of dump trucks create slippery road conditions and threaten public and domestic water supplies along the route.

These guidelines provide environmentally acceptable alternatives for the storage, transport and disposal of fish, shellfish and fish offal in the Province and are intended for internal use by Departmental agents at the Government Services Center. The guidelines may also be used as environmental guidelines for the general public.

These guidelines apply to fish , shellfish and fish offal as wastes generated within the Province. Importation of such waste is restricted except as may be authorized by an environmental Certificate of Approval.

2.0 LEGISLATION

Applicable legislation:

- *Environmental Protection Act, SNL 2002 and Regulations*
- *Water Resources Act, SNL 2002 and Regulations*

The following is a list of additional legislation, (and appropriate mandated agencies), which may be applicable when dealing with the storage, transport and disposal of fish, shellfish and fish offal.

- *Canadian Environmental Protection Act, Part VI* (Environment Canada)
  - *Ocean Dumping Regulations, 1998*
- *Fisheries Act* (Fisheries and Oceans Canada)
- *Fish Inspection Act and Fish Inspection Regulations* (Canadian Food Inspection Agency)
- *Load and Drugs Act and Sanitation Regulations* (Department of Health and Community Services)
- *Highways Traffic Act* and the *Load Security Regulations* section 3(5)(h), (Royal Newfoundland Constabulary, Royal Canadian Mounted Police, Department of Government Services and/or respective Municipal By-Laws).

3.0 DEFINITIONS

Approval	Approval means a Certificate of Approval issued under provisions of the Environmental Protection Act or Water Resources Act.
Department	Newfoundland Department of Environment and Conservation
GSC	Government Service Center, Department of Government Services

Offal	All parts of an animal which are removed from the carcass when it is dressed for food, e.g. entrails, heart, liver, head, tail.
Owner/Operator	A person that owns or is responsible for or has the charge, management or control of the operation of a waste management system. A person includes a council, firm, committee or franchise holder.
Waste	Waste includes rubbish, offal, slime, tailings, effluent, sludge, sewage, garbage, refuse, scrap, litter or other substances or waste products that would or could cause an adverse effect.
Waste Disposal Site	A site designated for handling, storage, processing, treatment, and/or disposal of waste and for which a certificate of approval has been issued under the provisions of the *Environmental Protection Act, May 22, 2002.*

4.0 EXEMPTION

4.1 Individual fisher persons splitting/filleting fish on a beach or on a stage head may only deviate from these guidelines to dispose of fish offal in traditional ways; disposal in the water or for use as fertilizer on fisher person's residential garden(s).

5.0 STORAGE REQUIREMENTS

5.1 All fish, shellfish and fish offal waste shall be loaded into leak-proof containers.(e.g. fish bins) Note: A dump truck with **a proper liner or proper gasket on the tailgate** can serve as a leak-proof container.

5.2 These containers shall be covered (tarpaulin or equivalent cover) at the completion of loading operations to minimize flies and odours.

6.0 TRANSPORTATION REQUIREMENTS

6.1 Waste shall be transported in leak-proof covered containers.

6.2 These wastes shall be transported to an authorized site within 24 hours after loading operations are completed. In cases where transportation of the waste may be delayed, refrigeration or ice cover shall be used as necessary to reduce the rate of decomposition and to minimize noxious odours and fly infestation of these wastes.

6.3 Fish, shellfish and fish offal transport trucks shall not be overloaded. Consideration shall be given for steep inclines along the route to an offloading or disposal site. Spillage from transport vehicles is prohibited.

7.0 DISPOSAL OPTIONS

7.1 Disposal of wastes shall be to predetermined/authorized sites.
Environmentally acceptable alternatives for the disposal of fish, shellfish and fish offal are listed in order of priority and not limited to:

Option 1: Delivery to a Fish Waste/Meal Processing Plant

Offal shall be transported to a fish waste/meal processing plant daily between May and October and at least every other day between November and April. Plants utilized for chitin production, sauce production, crafts and ornaments (cod skin leather, earrings, scallop shell items, etc.), are considered processing plants and are acceptable alternatives for fish, shellfish and fish offal disposal.

Option 2: Disposal as a Compost or Fertilizer

Fish, shellfish and fish offal used as fertilizer or compost is an acceptable alternative under certain circumstances.[1] The potential for noxious odors, flies and rodent infestation shall be considered. Watercourses, private and public water supplies and environmentally sensitive sites shall be avoided.

(a) Written approval of the GSC (for the Department) is required prior to commercial composting or land disposal of shellfish, fish and/or fish offal.

(b) Fish and offal stored for compost or fertilizer shall be covered to control flies and odour problems.

(c) Drainage from waste storage areas shall be directed to an approved discharge site/system. Discharge to a watercourse is prohibited.

(d) The use of offal as a fertilizer should be done after an assessment has been completed on the land where the offal is to be spread. Soil assay testing is recommended before any extensive quantity of offal is applied in a spreading program. The quantity of offal applied to land in a given period of time should meet only the soil requirement for beneficial use and therefore have least adverse impact on the environment.

(e) Fish offal may not be spread within **thirty** meters of a watercourse/body of water. Distance requirements may be greater as local conditions vary, i.e. slope of land, soil conditions, etc.

(f) Fish offal may not be spread within **ninety** meters of any well or public water supply and may not be spread on the watershed of any community water supply system.

(g) Consideration shall be given to neighbouring properties and land use. Noxious odours generated from decaying fish, shellfish and fish offal wastes may adversely affect land use on such neighbouring properties.

(h) Fish offal shall not be applied to snow covered and/or frozen ground.

Option 3: Ocean Disposal

A permit is required from Environment Canada for the disposal of any fish, shellfish and/or fish offal in marine waters (using a barge, vessel, netting, etc.)[2]

Option 4: Disposal at a Land Based Waste Disposal Site

Written approval must be obtained from the owner/operator of an approved waste disposal site and the appropriate regional GSC office prior to any offal disposal. All offal deposited at a waste disposal site must be into a prepared excavation. Liming prior to backfill is required (to control rodent/fly infestation and/or noxious odour problems associated with decaying wastes.)[3]

Note: Disposal in a waste disposal site is not permitted unless the generator of the offal demonstrates that meal, composting/fertilizer and ocean dumping options are either unavailable or economically prohibitive.

7.2 Unacceptable Disposal Methods

Methods of disposal of fish, fish offal, and shellfish waste which are **not acceptable** and are in violation of one or more of the previously mentioned Acts include;

- Over the wharf dumping.
- Dumping on a beach.
- Dumping at sea in an area other than a designated gurry ground for which the operator has an Ocean Dumping Permit from Environment Canada[2].
- Dumping on land that is not part of an approved composting/land fertilization program "or" at any location other than an approved Waste Disposal Site (with the permission of the owner/operator).

8.0 SPILLS

In the event of spillage from a waste container or transport truck, the proponent must immediately notify the GSC via the environmental emergency phone number (772-2083 or 1-800-563-9089) and take all necessary steps to clean the affected area and restore the environment to the satisfaction of the Department.

All waste, damaged materials and debris generated at the spill site must be disposed in an approved waste disposal site. Authorization of the site owner/operator and the appropriate regional office of the GSC is required prior to disposal. Special disposal requirements and/or user fees may be applied by the disposal site owner/operator.

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APPENDIX A

Endnotes:

1. Guidelines for Compost Quality have been developed by CCME(Canadian Council Ministers of Environment); ref. 1996-CCME-SWMTG-106, #ISBN 1-895925-6. (Available from CCME at a cost of $3./copy.) Composting activities may require a certificate of approval from the Department of Environment and Conservation. Contact should be made with the Department prior to conducting any composting activities.

2. Disposal at Sea: Offal loaded for the purpose of disposal at sea requires a permit issued by Environment Canada pursuant to the Canadian Environmental Protection Act (Ocean Dumping Regulations, 1998).

3. A minimum of 0.6 m of fill material is required for the backfilling of offal wastes. Backfill material shall be compacted at the end of the disposal operations. Lime refers to hydrate of lime (not to be confused with "dolomite" lime used as a soil conditioner/fertilizer). Liming will assist in disinfection/decomposition as well as suppress odour, flies and rodent infestation.

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APPENDIX B

For further information on the disposal of fish, shellfish and fish offal, contact any Regional Office of the GSC, Department of Government Services or the Department of Environment and Conservation, Pollution Prevention Division.

Regional Government Service Centre Offices

St. John's
5 Mews Place
P.O. Box 8700
St. John's, NL
A1B 4J6
Tel: (709) 729-3699
Fax: (709) 729-2071

Corner Brook
Noton Building
1 Riverside Drive, P.O. Box 2006
Corner Brook, NL
A2H 6J8
Tel: (709) 637-2204
Fax: (709) 637-2681

Clarenville
2 Masonic Terrace
P.O. Box 1148
Clarenville, NL
A0E 1J0
Tel: (709) 466-4060
Fax: (709) 466-4070

Happy Valley-Goose Bay
Thomas Building
13 Churchill St.,
P.O. Box 3014, Stn B
Goose Bay, NL
A0P 1S0
Tel: (709) 896-2661
Fax: (709) 896-4340

Gander
McCurdy Complex
P.O. Box 2222
Gander, NL
A1V 2N9
Tel: (709) 256-1420
Fax: (709) 256-1438

Grand Falls-Windsor (field office)
9 Queensway
Grand Falls-Windsor, NL
A2A 1W9
Tel: (709) 292-4206
Fax: (709) 292-4528

Appendix 4: Migratory Bird Response Plan

Migratory Birds Response Plan

Prepared By:

Mowi Canada East

Doc. ID #	Revision	Date	Responsibility
MBRP V-3.0		February 2023	Environment and Development Division

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1.0 Objective

The objective of this document is to outline actions and procedures to prevent and monitor potential impacts on migratory birds, in the event of a mass mortality event that results in fish fat floating on the surface of sea cage sites.

Application: This plan applies to all active sea sites of Mowi Canada East (MCE) on the south coast of Newfoundland (See maps, Appendix 1, Mass Mortality Contingency Plan (MMCP)).

Authority: The Canadian Wildlife Service (CWS) is responsible for the management and conservation of migratory birds wherever they occur in Canada under the Migratory Bird Convention Act (MBCA) and Species at Risk under Environment and Climate Change's jurisdiction (SARA). CWS oversees all aspects of impacts to wildlife during an environmental emergency, including:

- Authorizing activities affecting Wildlife (i.e. permits)
- Acting as a Resource Agency to advise during emergencies.

This plan forms part of the Mass Mortality Plan as required by the Department of Fisheries, Forestry and Agriculture under Aquaculture Policy (AP) 2, 17 and 23 under the authority of the provincial *Aquaculture Act.*

2.0 Species and Risk Assessment

Avian species most at risk of encountering sea cage sites are sea birds. A listing of migratory birds covered under the MBCA can be found in Appendix 1.

In 2019 a mass mortality event at seas sites in Newfoundland resulted in floating fat on the surface of the water because of fish removal operations. Most of the fat was retained and collected, however, some fat drifted to nearby shorelines. Observers, including, site staff, fishers, environmental technicians (MAMKA technicians who conducted systematic inspections of beaches near the affected sites) and CWS officers did not report any impacted bird species during or after the event. The areas affected by the mass mortality event was limited to waters immediately around the cage structures and shorelines immediately adjacent to the sea sites (See MAMKA, Interim report, attached.). Should another event occur, it is expected that the area affected will be within the site boundaries directly around the cage structures (approximately area of 180m x 450m for Bays West and approximate area of 120m x 500m for Bays East).

Sea bird species may be at potential risk of encountering floating salmon fat on the water during mass mortality depopulation events. Fish fat/oil has the potential of harming birds by impacting the structure and waterproofing of bird feathers. MCE have undertaken environmental mitigation measures to prevent mass mortality from occurring again. However, should an event occur, a Mass Mortality Plan has been developed and includes measure to contain and minimize salmon fat on the water's surface. Should salmon fat be apparent on the water, MCE will take to steps to prevent birds from encountering the fat, collect the fat as quickly as possible while preventing it from leaving the sites, and monitor shorelines and the waters around the sites for impacted birds.

Note: Birds not covered under the MBCA that may be in the vicinity of sites include corvids (crows), raptors and kingfishers. These birds fall under provincial wildlife jurisdiction. Standard protocol on farms sites is to call the Wildlife Division if a bird is injured on site. Discussion with Wildlife Division officials indicate that the protocol for these birds if injured, is to notify Wildlife Division through local Conservation Officers at the Milltown Forestry office, 709-882-2200 or the Wildlife Division Head office in Corner Brook, 709-637-2025 for direction on actions to take.

3.0 Notification, Prevention, Monitoring and Permitting

The Avian response plan will be initiated upon identification of a mass mortality event.

3.1 Notification

The Mass Mortality Plan lists the notification process which included notification to ECCC/CWS (see Section 2.0, MMCP). Procedures for mortality removal and fat containment are outlined in the MMCP(Section 6.0)). The Spill Response Line will be notified of the mass Mortality event (1-800-563-9089). The Spill Response Line will be called if impacted birds are found.

3.2 Prevention

Preventing birds from coming into contact with salmon fat will be a priority during a mass mortality event. MCE will employ number of strategies to prevent birds from being impacted.

Bird nets:

Salmon farms employ bird nets to prevent birds from accessing the water surface inside the cage collars (Figure 1). Much of the salmon fat is retained within the cage collar during an event. The cage collar acts a boom, containing the fat. Sites affected will leave the bird nets on the cages during removal activities to prevent bird access to the fat. Should nets need to be removed, they will be replaced as soon as the activity requiring removal is completed.

Figure1: Sea cage with bird net in place.

Hazing:

Hazing is a technique used to deter birds away from impacted sites to prevent them from coming into contact with fat. Hazing techniques include auditory scare devices (pyrotechnic

devices, propane cannons), visual devices (i.e. artificial hawks kites) and hazing by personnel via vessel, aircraft or vehicle.
All the sites have personnel on site at all times during daylight hours. The activity of the mortality removal and clean up was sufficient to keep birds away from site activity during the 2019 event. The staff designated "Environmental Control Officer" (ECO, see MMCP, section 6.12 & 6.22) will monitor for the presence of birds and will direct site staff to "haze" birds via small boat activity should birds get too close to removal activity or if fat becomes free floating. Hazing will continue until fat can be contained or removed.
Habituation to scare devices can occur. Should hazing by scare devices or vessels vessel scare devices or vessels be ineffective, alternative means of hazing via acoustic deterrents will be sought through consultation with CWS and appropriate permits will be obtained prior to initiating hazing (See Section 3.4)

Containment:
The Mass Mortality Plan details efforts to contain fat and not allow it to drift from site or to shorelines. Should that occur the plan also lists actions to be taken to contain the fat and removed it from the shoreline.

3.3 Monitoring
MCE will monitor all activities during mortality removal to identify when birds are present. The designated site ECO will be responsible for coordinating monitoring activities and deciding when birds may be getting too close to removal activities.

3.31 Surveillance During Operations on site
Sites affected by a mortality event will be monitored for bird presence on an ongoing basis during fish removal operations. The ECO will direct site staff to conduct hazing operations in the event that birds get too close to removal activities as described in the MMCP.

3.32 Beach Sweeps
MCE site staff regularly do shoreline beach sweeps and clean ups as a regular part of farming activities. This would continue during a mortality event. MCE staff will begin to record when they see dead or distressed birds and will document the presence /absence of birds (a picture will be taken where possible), the beach location and the date of the sweep as part of their regular beach sweeps to form a baseline of knowledge on bird mortality in the areas near the site. This information will be made available to CWS. The shoreline survey form provided in the Adopt-A-Beach Program a Beached Bird Survey Guide, Environment Canada's Canadian Wildlife Service (EC-CWS) (Appendix 2) will be used to record any birds discovered.

During a removal procedures during a mortality event at a sea site, beach sweeps will be performed once a day on beaches in close proximity to the sites (within 1km of the center of the site). Once weekly, shoreline surveys within 2 km of the site will be conducted. This will continue until removal and cleanup activities are completed.

3.33 Bird Collection

Should oiled birds be discovered on site or on beaches, the Spill Line will be called. MCE will seek permits (see Section 3.4) to collect birds, both dead and alive, from CWS and will follow protocol outlined in ECCC's "Protocol for Collecting Birds During an Oil Spill Response" (Appendix 3).

Bird Collection kits will be assembled and distributed to affected sites. These kits will include:

- Dip net
- Tin foil
- Large plastic collection bags for dead birds
- Labels, sharpies
- Gloves
- Chain of custody form
- Cardboard boxes for holding live birds

MCE employs a licensed veterinarian on staff. The veterinarian wil, under permits from CWS and through consultation with CWS, decide if live affected birds need to be euthanized or if rehabilitation is possible. Should rehabilitation be possible, MCE will seek advice on options for rehabilitation, possibly the Suncor Rehabilitation Center (currently in discussions). Should birds need to be euthanized, it will be done by the veterinarian or under the supervision of our veterinarian. Dead birds will be delivered to CWS/ECCC for assessment.

3.4 Permitting

MCE will seek all required permit to enable responses to impacted birds. The MBCA requires permits for the possession, transportation, rehabilitation, and deterrence/dispersal of birds. CWS Atlantic Region permits officer will be contacted for permits should an event occur. It is understood that a Scientific Permit Application for Migratory Bird Emergency Response will be required for bird collection (application in Appendix 4). It is understood stood that we do not require a permit for hazing via the use of small vessels, however, if additional hazing methods are required, permits will be necessary.

3.5 Training

MCE are all trained in Occupational health and Safety protocols specific to operation onboard vessels and at sea sites. All site staff have MED A3 and First Aid. All small vessel operators have Small Vessel Operators Proficiency (SVOP) training. Site visitors are briefed on OH&S protocols. Safety equipment includes steel toes boots, hard hats, and rubber gear. This will be required equipment during hazing, beach sweeps and bird collection activities.

Site staff involved in hazing, beach sweep and bird collection will be briefed on prevention and monitoring techniques as discussed in section 3.0. Specific training will be given on bird collection techniques.

4.0 Mobilization

Experience indicates that fat as a result of salmon decomposition post mass mortality event begins to surface about 7 to 10 post mortality. This allows time for coordination of the Migratory Bird Response Plan. Upon identification of a mass mortality event, the following steps will be followed:

1. Identification of an event: Notification of regulatory authorities, including Spill Response Line, as per Section 2.0 of the MMCP.
2. Depending on the class of the event, the Migratory Bird Response Plan will be Initiated. Events classed as 1 or 2, with the ability to clean up within a week, will not trigger the MBRP. Response that are anticipated to take longer than one week will trigger the response plan.
3. Upon and Class 3 event or higher, the Migratory Bird Response Plan is initiated.
4. Obtain permits for bird collection in the event birds are encountered (this can be done in advance on a yearly basis).
5. Compile the bird collection kits and beach survey sheets and distribute to affected sites (Day 1).
6. Refresh staff training on techniques for preventing bird encounters and in shoreline surveys and collection techniques (Day 1).
7. Appoint an ECO at each site responsible for bird monitoring, prevention, survey, and collection activity (Day 1).
8. Ensure response kits, staff training, ECO and permits/notification are in place prior to mortality removal efforts (Day1-2).
9. Each morning before removal starts, staff meetings on site will be held to review activities related to birds and response success. Changes to methods will be made as necessary and through consultation with CWS.
    a. Review hazing effectiveness
    b. Review effectiveness of bird covers
    c. Review beach surveys and bird observations
10. Report all birds found to CWS through Spill Response Line.
11. Once removal activities are complete, review effectiveness of bird response plan and adjust for the future.

5.0 Reporting

Results of the Bird Monitoring Program will be reported daily/weekly along with the MMCP updates as per section 8.0 of the MMCP.

Appendix Bird Response: Migratory Birds

Migratory Game Birds:
(a)Anatidae or waterfowl, including brant, wild ducks, geese, and swans;
(b) Gruidae or cranes, including little brown, sandhill, and whooping cranes;
(c) Rallidae or rails, including coots, gallinules and sora and other rails;
(d) Limicolae or shorebirds, including avocets, curlew, dowitchers, godwits, knots, oyster catchers, phalaropes, plovers, sandpipers, snipe, stilts, surf birds, turnstones, willet, woodcock, and yellowlegs;
(e) Columbidae or pigeons, including doves and wild pigeons.

Migratory Insectivorous Birds: Bobolinks, catbirds, chickadees, cuckoos, flickers, flycatchers, grosbeaks, humming birds, kinglets, martins, meadowlarks, nighthawks or bull bats, nuthatches, orioles, robins, shrikes, swallows, swifts,
tanagers, titmice, thrushes, vireos, warblers, waxwings, whippoorwills, woodpeckers, and wrens, and all other perching birds which feed entirely or chiefly on insects.

Other Migratory Nongame Birds: Auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns.

Appendix Bird Response: Shoreline Survey

NEWFOUNDLAND AND LABRADOR
ADOPT-A-BEACH PROGRAM

Time start:
Time end:

Did you find birds (Yes/No)?
- No, please remember to still submit your results
- Yes, please fill out form and submit your results

Beach	Surveyor	Day	Month	Year

Species	No.	**Dead birds on beach**			
		Age (U, J, A)	Sex (U, M, F)	Is > 50% of carcass intact? (Y/N)	Oiling code (0, 1, 2, 3)

Live birds in area

Species No.	Oil Code	

Beach condition code (0, 1, 2, 3) or % covered

Oil	Snow/ice	Seaweed

.AB

Notes:

ADOPT-A-BEACH PROGRAM

Degree of oiling:

0. No oil.
1. Slight oiling – smudges of oil that do not totally penetrate the breast feathers or coat the wings.
2. Moderate oiling – oil penetrates to base of feathers or saturates wings; < 25% body affected.
3. Heavy oiling – oil penetrates to base of feathers; > 25% of body affected.

Beach codes for oil:

0. Clean.
1. Slightly oiled – few small patches or tar-balls (<1 per 50 m).
2. Moderately oiled – several large patches of oil or many small ones; wrack line speckled with oil.
3. Heavily oiled – water line and wrack line extensively covered with oil.

Beach codes for snow/ice or seaweed:

0. Covers 5% of beach or less.
1. Covers up to 30% of beach.
2. Covers 30-60% of beach.
3. Covers >60% of beach.

Appendix Bird Response: Protocol for Bird Collection

PROTOCOL FOR COLLECTING BIRDS DURING AN OIL SPILL RESPONSE

Anyone collecting migratory birds must be a nominee on an existing federal salvage permit

Collection of dead birds

1) Every time a beach is swept, select *two oiled birds* to be retained as possible evidence, preferably from different parts of the beach. For each of these two birds:
    - Individually wrap the bird in aluminum foil,
    - Place the wrapped bird in its own evidence bag,
    - Completely fill out a chain of custody form,
    - Write on the bag (or on data form/label) the collector, date, time, coordinates/location, species (if known at time),
    - Place label, chain of custody form, and bagged bird carcass into a second bag,
    - Place evidence bag in a secure place until retrieved by appropriate Environment Canada personnel.

2) To avoid cross-contamination, it is vital that:
    - Clean gloves are used prior to handling each bird, and
    - Birds are wrapped in foil as soon as they are found.

3) Place each remaining bird found on the beach in its own generic plastic bag, and:
    - Write on the bag (or on data form/label) the collector, date, time, coordinates/location, and record that the bird was found dead,
    - Record on the bag weather the bird was OILED or NOT OILED, and
    - Treat bird parts the same as whole birds.

4) If it is not feasible to individually bag all birds found on the beach:
    - Put remaining oiled birds in one of more large bags,
    - Put remaining un-oiled birds in a separate large bag(s) from oiled birds,
    - Write on the bag (or on data form/label) the collector, date, time, coordinates/location, and record that birds were found dead,
    - Record on the bags contain OILED or NOT OILED birds, and
    - Keep birds from different beaches in separate bags.

5) Make arrangements to retrieve all oiled and un-oiled birds with:
    - CWS personnel if oiled wildlife rehabilitation response is NOT in place, or
    - Wildlife rehabilitator if oiled wildlife rehabilitation response is in place.

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Collection of live birds

A. If oiled wildlife response is NOT in place:
   1. If you are permitted to humanely euthanize the oiled bird, do so following the standard protocol and:
      - Individually wrap two euthanized birds in aluminum foil,
      - Place the wrapped birds in individual evidence bags,
      - Completely fill out a chain of custody form,
      - Write on the bag (or on data form/label) the collector, date, time, coordinates/location, species (if known at time), and record that bird was found alive and
      - Place evidence bag, label, and chain of custody form in second bag.
      - Store in secure place until retrieved by appropriate Environment and Climate Change Canada personnel
   2. Record and bag remainder of the euthanized oiled birds as outlined in points 3, 4, and 5 on reverse side of this form.
   3. If you are not permitted to euthanize oiled birds, do not feel comfortable doing so, or have found a bird listed under COSEWIC or SARA (e.g. Harlequin Duck, Ivory Gull):
      - Place oiled bird in a cardboard box
      - Label box with the collector, date, time, and location where bird was recovered, and
      - Place in warm, quiet area until handed over to CWS personnel for euthanasia or rehabilitation

B. If oiled wildlife response is in place:
   1. Place the oiled bird in a cardboard box,
   2. Label box with the collector, date, time, and location where bird was recovered, and
   3. Place in warm, quiet area until handed over to wildlife rehabilitator for rehabilitation or euthanasia.

Important information when catching and placing birds in box:
- Handle birds with gloves, preferably disposable ones, and
- Lid and walls of box must have sufficient holes to allow proper ventilation.

Place only one murre, seaduck, or other large bird per box

Two dovekies may be placed together in box if both are only slightly oiled (i.e. <25% of body covered)

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Appendix Bird Response: Permit Application

SCIENTIFIC PERMIT APPLICATION for Migratory Bird Emergency Response
Canadian Wildlife Service – Atlantic Region

SECTION 1: Applicant Information		
1.1 Type of request □ New project. □ Continuing project for which a permit has expired. Permit number: ______________		
1.2 Previous permits Do you currently have or have you previously held a permit issued under the *Migratory Birds Regulations*? Yes □ No If so, provide the most recent permit number: ______________ Has a report been submitted for this (previous) permit? □ Yes □ No □N/A		
1.3 Contact information		
Applicant surname:	Applicant given name:	
Position/title (e.g. Environmental Planner):		
Name of the organization you are affiliated with:		
Mailing address of **applicant**		
Street:		
City:	Province/Territory:	Postal Code:
Work Telephone:	Fax (if available):	
Cellular:	Email:	
Mailing address of **organization** (if different from above)		
Street:		
City:	Province/Territory:	Postal Code:

SECTION 2: Project Information	
2.1 Project title	
2.2 Project duration (anticipated): Start______________ (*yyyy/mm/dd*)	End______________(*yyyy/mm/dd*)
2.3 Project summary	

2.4 Applicant qualifications relevant to the project (or CV attached ▫)

2.5 Location of activities

Address/UTM/geo-location or proximity to nearest identifiable town or city. Provide the location(s) where the activities will be conducted. If the migratory birds are to be held in captivity, the address of the facility where they will be held must be included. If birds are to be released in a location other than at the point of capture, please provide the location of release.

SECTION 3: Activities/Methods

3.1 Target species (indicate the species expected to be affected)

3.2 Methods or protocol followed for disturbance, hazing, handling or release

3.3 Proposed disposition of dead birds

3.4 Shipment/transport
If samples or specimens will be shipped, transported, imported or exported, describe these and provide the name and address where they will be shipped (to/from):

Section 4: Nominees

4.1 Nominees (other participants)
Name all individuals disturbing or handling birds, if this is impossible at time of application, a detailed position title is required.

Name	Organization	Position/Title

SECTION 5: Individuals Recommending the Permit (letters must be included with the application unless this is a permit renewal application)

1) Name:	Work Telephone Number:
Title/Position & Organization:	
2) Name:	Work Telephone Number:
Title/Position & Organization:	

SECTION 6: Signature of Applicant

I, ____(print name) attest that I have the ability and knowledge to accurately identify the species and conduct the permitted activities and certify that:

- I am 18 years of age or older;
- all information submitted in this application is accurate and has been completed to the best of my knowledge;
- I may not commence work before a valid permit is in my possession;
- I understand that, in order to legally conduct the activities authorized by my permit, I may need to obtain in advance additional federal, provincial, territorial and/or municipal permits or authorizations.

SIGNATURE OF APPLICANT: ______________________________	**DATE:**____________________
(electronic signatures are accepted for email submissions)	*(yyyy/mm/dd)*

Return to your Regional Canadian Wildlife Service Office

Newfoundland and Labrador, Prince Edward Island, Nova Scotia, and New Brunswick
Permits Section
17 Waterfowl Lane, P.O. Box 6227
Sackville, NB
E4L 1G6

Telephone: 506-364-5068
Fax: 506-364-5062
Email: ec.scfatlpermis-cwsatlpermits.ec@canada.ca

Appendix 5 – Plankton Monitoring and Response Plan

MCE Plankton Monitoring and Response Plan contains specific operating procedures and methods that are highly confidential and commercially sensitive. The details are registered with the FFA. Disclosure of this information can harm significantly the competitive position of MCE. To meeting the EIS information needs, a more generalized description is provided in the Saltwater Environmental and Waste Management Plan V 6.2, Appendix A, Operational Environmental Mitigation Plan.

MOWI Canada East
Standard Operating Procedure

Consider Printed
Copies Uncontrolled
Document #: Approved

MOWI Canada East Plankton Monitoring and Response Plan

1. Overview of Plankton monitoring at sites
2. Phytoplankton Response Plan

Appendix I: Phytoplankton Identification Guide

Appendix II: Standard operating procedure for taking water samples

Appendix III: Standard operating procedure for counting and identifying phytoplankton with a microscope

Appendix IV: Plankton Recording Form

Appendix V: Sampling locations

1. Overview of Plankton Monitoring at Sites

Application and Purpose
The purpose of this document is to demonstrate the importance of phytoplankton monitoring at MOWI Canada East sites. This section provides a quick look into phytoplankton sampling, analysis and mitigation practices.

Responsibility and Authority
Site Managers will be responsible for collection and monitoring phytoplankton samples at their sites and remote sampling stations near their sites.
Fish Health will provide training for site managers. Fish Health will also provide remote assistance when it is appropriate to do so.

Description

[redacted]

1