BAKKAFROST

ESTABLISHED 1968

The Finest Salmon from
SCOTLAND

Sea Lice Management Statement

North Gravir, Isle of Lewis

Date	**January 2025**
Revision No.	**A1**
Author	**Michael Hill**
Reviewed By	**Kim McKinnell**
Approved By	**Penny Hawdon**

Table of Contents

Table of Tables

Table of Figures

Glossary of Abbreviations

Term	Definition
AF	Adult Female Sea Lice (*Lepeophtheirus salmonis*)
AGD	Amoebic Gill Disease
APB	Aquaculture Production Business
Application	The Planning Application for the Proposed Development
BFS	Bakkafrost Scotland Ltd.
CAR	The Water Environment (Controlled Activities) (Scotland) Regulations 2011
CoGP	Code of Good Practice for Scottish Fish Aquaculture
EmBz	Emamectin Benzoate
EQS	Environmental Quality Standard
FHI	Marine Directorate Fish Health Inspectorate
FMA	Farm Management Area
FS	Site Identification Number
g	Gram
ISLM	Integrated Sea Lice Management
kg	Kilogram
m^3	Cubic Metre
MD	Marine Directorate
MMQ	Maximum Modelled Quantity
NTS	National Treatment Strategy
Proposed Development	The North Gravir Fish Farm Proposal
RO	Reverse Osmosis
SLAP	Sea Lice Action Plan
SLMS	Sea Lice Management Strategy
T	Tonne
VMD	Veterinary Medicines Directorate

1. Introduction

This Sea Lice Management Statement has been prepared by Bakkafrost Scotland Limited ('BFS') to support the submission of a planning application (the 'Application') under the Town and Country Planning (Scotland) Act 1997 (as amended) for a new Atlantic salmon marine fish farm. North Gravir (the 'Proposed Development'), is located off the east coast of the Isle of Lewis. This document details the capability of BFS to control sea lice, including the capacity in which BFS has to undertake medicinal, mechanical, biological and freshwater interventions.

2. Regulation and Compliance

BFS operates all of its farms in line with the Code of Good Practice (CoGP) for Scottish Finfish Aquaculture, which incorporates the National Treatment Strategy (NTS) for the control of sea lice. This strategy's main objective is to achieve zero adult female lice on farmed fish during the wild salmonid smolt migratory period (peaking April to May, inclusive), through the coordination of Aquaculture Production Business (APB) operations within respective Farm Management Areas (FMAs), in addition to the implementation of specific sea lice intervention criteria detailed in **Table 2.1**.

In addition to CoGP, sea lice levels on farmed fish are regulated by the Marine Directorate Fish Health Inspectorate (FHI) under the Aquaculture and Fisheries Scotland Act 2013 (as amended). This Act gives Scottish Ministers legal powers to undertake inspections, review sea lice records and management measures, and ultimately the capacity to serve enforcement notices requiring interventions to be undertaken to ensure the prevention, reduction or control of sea lice. The specific reporting and intervention criteria defined by the Aquaculture and Fisheries Scotland Act 2013 are also detailed in **Table 2.1**.

Table 2.1: Sea lice thresholds defined through regulatory and legislative mechanisms.

Regime	Intervention Criteria	Action Required
Code of Good Practice / National Treatment Strategy	0.5 adult female (AF) lice/fish (01 February – 30 June inclusive)	Farm Intervention Suggested
	1 AF lice/fish (01 July – 31 January inclusive)	Farm Intervention Suggested
Aquaculture and Fisheries Scotland Act (2013)	2 AF lice/fish	Report to FHI/ Farm Intervention Required
	6 AF lice/fish	FHI Intervention/enforcement

To facilitate more effective sea lice treatment at all of its farms, BFS operates to the lowest of these intervention criteria, i.e. 0.5 adult female (AF) lice and does so throughout the entire year.

3. Sea Lice Attestation

The following attestation is based on cumulative sea lice and intervention data from the existing BFS farms operated as a single unit (Gravir FS0242) with regard to lice, Gravir Outer and Gravir West, in Loch Odhairn.. This attestation is provided to demonstrate the current ability of BFS to control sea lice on its Sites, and to aid an assessment of the risk associated with the Proposed Development.

The information below is provided in the format recommended by Marine Directorate (MD) and is based on the most recent production cycle at Gravir (FS0242).

Dates of information provided	22Q3
Are there any breaks in weekly counts? Yes/ No	No
If so, is a reasonable explanation given (e.g. severe weather conditions)? Yes/ No	
Are bioassays of lice carried out at least yearly for the treatments utilised? Yes/ No	No – The current availability of, and investment in, a variety of control measures significantly diminishes the risk of resistance. The rotational use of various medicines and non-medicinal interventions is fundamental to the principals of Integrated Sea Lice Management (ISLM) which are adopted within BFS's Sea Lice Management Strategy (SLMS) in order to prevent the tendency of parasites to develop medicine resistance. Bioassays can be helpful indicators of sensitivity, but historically have limited accuracy. Protocols have evolved and PCR-bioassays are now more accurate but there is limited comparable historical data. The opportunity to conduct bioassays is limited when sea lice numbers are very low (a statistically relevant number of lice needs to be collected for assessment). It is therefore inherently difficult to obtain sensitivity information prior to an escalation of sea lice numbers and the speed of action required to control an escalation often precludes waiting for results. Therefore, the use of bioassays is to give broad indication of trends in sea lice sensitivity at a macro-level over the long-term and are complementary to the more useful weekly analysis of sea lice clearance levels observed per treatment/intervention on a site-level. The intention is to conduct medicine bioassays once per generation within a region to help guide appropriate medicinal choices (especially if faced with observed reduction in sensitivity) and to determine the trend over the long-term.
Have any strategic treatments been carried out in the management area (even if levels are below CoGP suggested criteria for treatment)? Yes/ No	Yes – BFS treats sites strategically, pro-actively and according to a regionally coordinated plan at levels below those stipulated in the CoGP, as part of the National Treatment Strategy and operates to the most sensitive intervention criteria (0.5AF/fish) for further reactive treatments throughout the year.
Have you adopted the CoGP suggested criteria for treatment? Yes/No	Yes – BFS adopts the CoGP lowest sea lice treatment criteria i.e., 0.5 AF/fish, but does so for the full year rather than limiting this to the wild smolt migration period. The ongoing use of this lower criteria during warmer months of the year allows more time to plan treatments and allocate resource in the face of more rapid sea lice life-cycles and the potential for quicker re-settlement of juvenile sea lice. In addition to this, BFS operates within the MD guidelines of reporting and monitoring lower and upper limits.

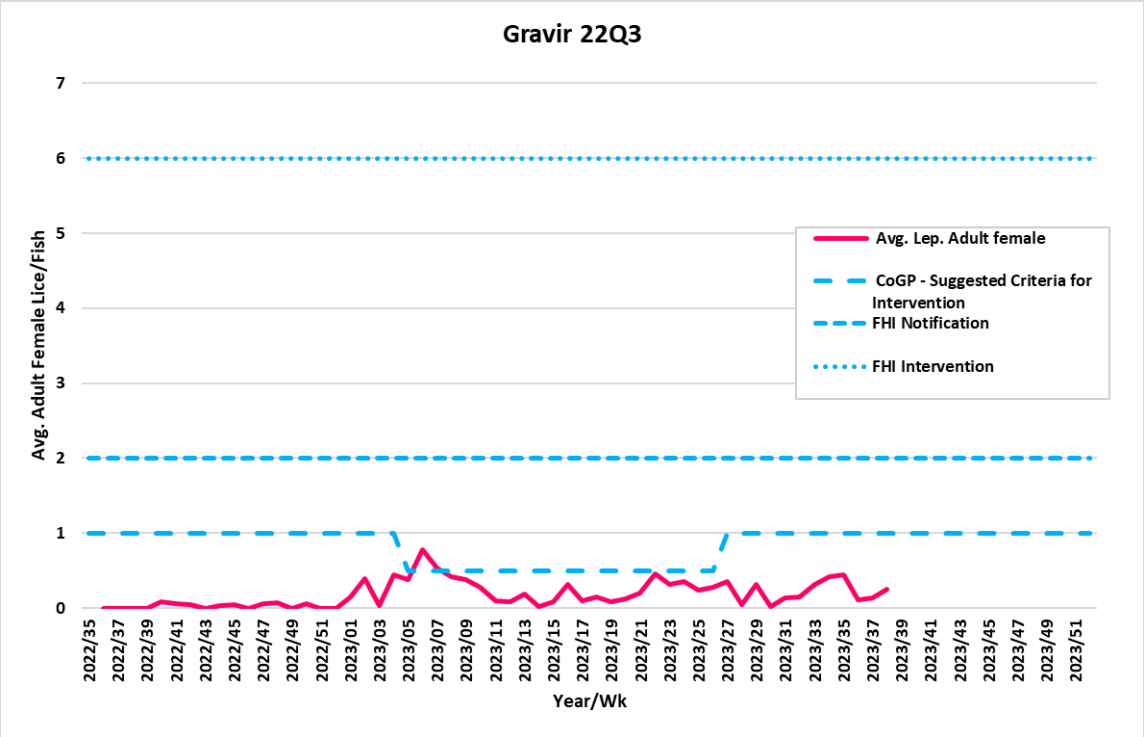
If no, to what criteria for treatment of lice do you work to?	See above
Is treatment carried out when the criteria for treatment of lice is reached? Yes/ No	Strategic interventions will already have been undertaken prior to reaching the agreed criteria for treatment and further interventions are assessed and instigated at this point. Other aspects of lice control are taken into consideration, such as whether there is an active cleanerfish population as well as any health challenges on site. Freshwater combined with FLS delousing systems, FLS only & bath treatments can be explored in the event that treatment criteria is reached. Changes to harvest plan are an additional consideration.
Are alternating methods of treatment utilised? Yes/ No	Treatment methods are determined by many factors, such as the health of the fish, species of cleanerfish present, lice burden and results of bioassays, and the resource available for treatment at any given time, relative to the priority of treatment requirements across the business. The existing Gravir farm has a Sea Lice Action Plan (SLAP) which is a live, working documents designed to enable real time analysis of intervention requirements and success.
Are treatments successful i.e., drop to below criteria for treatment levels? Yes/ No	Yes – The observed reduction of sea lice numbers is a function of clearance rate and resettlement rate. The expected clearance rate of any intervention is likely to be >80%, but this success may be masked or rapidly followed by high levels of resettlement. BFS considers the outcomes of all interventions and instigates further interventions if the lower of the CoGP criteria has not been achieved.
If no, are unsuccessful treatments a regular occurrence? Yes/ No	No – Occasionally sea lice interventions may not achieve expected clearance levels. For example, this may be due to a technical failure of a physical delousing system, an adverse reaction in the fish that requires the intervention to be abandoned or, rarely, a pharmacological resistance issue in the case of medicinal treatments. Where a lower clearance is seen, or where the lice level is not brought down below company thresholds, further alternative interventions will be instigated in accordance with the SLAP.
Are treatments successful i.e., drop to a stated target level? Yes/ No	Yes - Although ultimately the target for sea lice control is to have zero lice present on fish, sea lice are naturally present in the wild, which results in settlement of juvenile sea lice on farmed fish at varying levels. This is due to complex environmental factors that influence sea lice population dynamics (e.g., temperature, salinity, predation, hydrodynamics and availability of hosts). The target of the BFS sea lice intervention strategy is to remain below the lower CoGP criteria and/or to return to below these levels swiftly if exceeded.
If no, is this a regular occurrence? Yes/ No	N/A

3.1 Recent production cycle, lice and fish health review

Lice levels in the previous cycle (22Q3) were maintained at levels well below the Marine Directorate criteria, and consistently below the CoGP suggested criteria for intervention. CoGP was exceeded in weeks 6 and 7 of 2023 at 0.78 and 0.53 average AF respectively, representing 2 weeks of a 57 week production cycle. BFS current sea lice management strategy is considered pivotal in this success, as it has been generally across all BFS sites.

During the cycle, in-feed medicines were used in compliance with the quantities permitted under CAR, in addition to the use of cleanerfish (farmed lumpfish), freshwater bathing, and combined freshwater bathing and FLS delousing. All interventions were considered successful, which is evident in the low average lice numbers throughout the production cycle.
The weekly average (adult female) lice count trends for the previous cycle is shown in **Figure 1**.

Figure 1: Average Monthly Adult Female Lice from Gravir.



4. Efficacy Statement

NewDEPOMOD, BathAuto, and three dimensional marine modelling have been carried out for the Proposed Development. In addition to the BathAuto modelling to determine bath medicine quantities, BFS has undertaken detailed three dimensional marine modelling to better determine allowable bath medicine amounts.

Based on the outputs of the NewDEPOMOD and marine model outputs, an application to SEPA to obtain a Controlled Activities Regulations (CAR) licence, under 'The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) was submitted by BFS, with SEPA receiving this application on 10/05/2024. SEPA issued the CAR Licence (**Appendix U**) for the Proposed Development on 05/11/2024. The biomass and medicine quantities detailed in the CAR Licence are summarised within **Table 2**, below.

Table 2: Summary of SEPA CAR Licence amounts for the Proposed Development.

Pen Type & Number	Circular 200 m (circumference)	5 pens
Nets	15 m	
Pen Volume & Site Total (m^3)	47,746.52	238,732.59
Max Allowable Density (kg/m^3) & Biomass (T)	19.60	4,680
Slice Consent (Maximum Environmental Quantity) (g)	26.70 g	
Alphamax (deltamethrin) Consent - per 3 hours	43.4 g	
Salmosan (azamethiphos) Consent – per 24 hours	318.7 g	

* The medicine quantities outlined in the above table are per pen.

4.1 In-Feed Treatment: SLICE

SLICE is an in-feed sea lice treatment, with the active ingredient Emamectin Benzoate (EmBz). This is fed to the fish, usually over a week, and is usually given to the fish on a routine basis even if very low numbers of lice are present, in order to prevent escalation. Once smolts are transferred into marine pens SLICE will be fed from as soon as the fish are fully feeding and lice are present, giving ample protection to the salmon during this vulnerable phase of the growing cycle, if consent is available to use the medicine. Where limited medicinal consent is available, partial site treatment may be applied, or the farm will be treated with freshwater baths in combination with delousing systems to treat for sea lice if required. Biological control (wrasse) may also be stocked earlier to offer some protection from sea lice infection while the fish are smaller and more vulnerable.

BFS's strategic SLICE treatments are intended to occur early in the marine phase of the cycle when the fish are small and biomass low.

The consented amount for EmBz (SLICE) is 26.70 g (Maximum Modelled Quantity) as defined under the updated SEPA interim EmBz Environmental Quality Standard (EQS)[1].

The SLICE consent does not allow a full farm treatment at first stocking but may allow a partial treatment. Assessment would be made at the point of stocking to determine whether there are pens or stocks that are more vulnerable due to pre-transfer health and would benefit from SLICE coverage.

[1] SEPA. Interim Emamectin Benzoate (EmBz) EQS Position Statement. March 2023. [Online] Available at: https://www.sepa.org.uk/media/594684/position_statement_embz-march-2023-approved.pdf

4.2 Topical Bath Treatments: Alphamax & Salmosan

Bath treatments are undertaken in either full enclosure tarpaulins (either wedge or cone) or wellboats. Bath treatments may be alternated to minimise the risk of resistance developing.

All bath treatments adhere to BFS procedures and medicines are prescribed by the BFS veterinarian, taking health and lice trends into consideration.

The consented limits for Alphamax (Deltamethrin) and Salmosan (Azamethiphos) are:
Deltamethrin: (3 hour value) 43.4 g
Azamethiphos: (24 hour value) 318.7 g

The SEPA approved marine modelling identified sufficient amounts of Alphamax and Salmosan for use as efficacious and practical treatment substances for control of sea lice. Assuming typical tarpaulin size, the consented amount of Azamethiphos allows for 1 pen per 3 hour period and 3 pens within a 24 hour period to be treated, therefore the whole farm could be treated within 2 days. The consented amount of Deltamethrin allows for treatment of the whole farm within 1 to 2 days. Logistically however, it is more likely that a maximum of 3 pens per day will be treated with either medicine, therefore treatment will take 2 days. These amounts enable satisfactory treatment under the SLMS.

The approved treatment amounts of SLICE (EmBz), Alphamax (Deltamethrin) and Salmosan/Azasure (Azamethiphos) give sufficient medicines for an efficacious treatment strategy to be applied at the Proposed Development.

Biological (e.g., cleanerfish), mechanical (e.g., FLS) and freshwater intervention options will also be available at the Proposed Development, and form part of the Integrated Sea Lice Management Strategy (ISLMS). Further information on these interventions are detailed in **Section 5**.

5. Sea Lice Management Strategy

5.1 Biological Intervention

The salmon louse (*Lepeophtheirus salmonis*) is the most common parasite of farmed salmon and is one of the biggest challenges facing the aquaculture industry, alongside the other seasonal louse species observed, *Caligus elongatus*. Cleanerfish are an effective biological method for the removal of sea lice. This means that delousing can potentially be carried out without the use of medicants, reducing the use of chemicals, and reducing the likelihood of resistance developing to delousing medications.

The Proposed Development may be stocked with ballan wrasse (*Labrus bergylta*). To ensure that the ballan wrasse act as an effective sea lice control measure, their stocking density in relation to the stocked salmon will range from 3 to 6 %. The ballan wrasse will be stocked ahead of the first summer to ensure effective acclimatisation before the sea lice burden may potentially develop, from experience this has proven to be an effective stocking strategy.

The ballan wrasse to be stocked at the Proposed Development will come from farmed and wild origin, with the potential of having both origins stocked concurrently. BFS works with wild wrasse suppliers to ensure sustainable levels of wild capture. In line with the Marine Directorate mandatory criteria, all wrasse fishermen must have a wild wrasse fishing letter of derogation.

Through experience with freshwater treatments and wrasse stocking, BFS have assessed the risk of 3-hour exposure to freshwater as low and such exposures also have a benefit to control gill parasites in the wrasse. Where a longer exposure is expected, wrasse will be removed prior to the treatment using a variety of catching methods, including using creels, hand netting out of the crowd sweep and dewatering bars on the freshwater wellboat.

5.2 Physical Intervention Systems

BFS utilise a number of non-chemical interventions in order to reduce reliance on medicinal sea lice interventions. Mechanical interventions are a novel technology which are constantly being improved for

better sea lice clearance, better fish welfare, and better environmental impact. There are several technologies currently used for the physical removal of sea lice, some of which BFS implement extensively, whilst others are used on a more ad-hoc basis.
The mechanical treatments currently in use include:

- **FLS/Hydrolicer systems:** Use low pressure water jets to remove sea lice from the salmon. This system reduces the sea lice burden without the need for chemical intervention (which has environmental benefits). Sea lice are filtered out via sea lice bags attached to the discharge pipework and/or drum filtration and disposed of. The sea lice do not re-enter the water column, thereby reducing the potential for resettlement post treatment. BFS currently has three mechanical treatment vessels, one dedicated mechanical vessel and two wellboats with an FLS system installed. BFS also has the option to hire additional resource from third parties, if required. Generally, FLS treatment operations result in a clearance percentage of at least 85%, while combined FW & FLS are achieving clearances of >95%;
- **Thermolicer system:** Thermolicer systems utilise warm water to remove sea lice from salmon. Sea lice have a low tolerance to sudden thermal shifts in temperature. Fish are pumped into the thermolicer system, where they are then passed through the treatment system and bathed in lukewarm water. This process kills the sea lice, which fall off the salmon and are collected. The salmon are then returned to their pen post-treatment. Thermolicer treatments conducted by BFS have resulted in 85% clearance;
- **Optilicer system:** Optilicer systems are very similar to thermolicer systems. They too rely on warm water to thermally shock sea lice; and
- **SkaMik:** The SkaMik system utilises a combination of water jets and brushes to physically dislodge sea lice. The system is highly effective at removing all sea lice stages from salmon, with a documented clearance rate of 97 %. The system also has a large capacity, with the potential to treat up to 100 T per hour. The SkaMik system works by pumping the salmon from the pen through a drainage chamber, a flushing chamber, a brush chamber, and then a final flush chamber, with the whole process taking 1.5 seconds. All sea lice are collected in a filter system and destroyed.

5.3 Freshwater Treatment Systems

Freshwater treatments are rapidly evolving as a highly effective and environmentally neutral treatment option, not only for lice but also for Amoebic Gill Disease (AGD).

Attached lice have low tolerance for low saline conditions and will detach from host salmonids when exposed to freshwater contained in a wellboat. This treatment mimics the process which would occur naturally in the wild when adult salmon transition from marine to freshwater environments on their return to natal rivers.

Recent investment and advances have been made in reverse osmosis (RO) technology, enabling the conversion of saltwater into freshwater. This reduces the reliance on freshwater abstractions to supply freshwater for treatment purposes, in addition to optimising the resource capacity required to provide treatment by reducing time and resource spent replenishing freshwater supplies.

Freshwater interventions have proven to be a valuable tool for both gill health and sea lice control. The freshwater interventions currently utilised by BFS include:

- **Freshwater treatment:** For treatments targeting only AGD, a freshwater treatment for a minimum of 3 hours is sufficient. For treatments targeting both AGD and sea lice, freshwater treatment may be extended up to 12 hours. Cleanerfish, in particular wrasse, can be sensitive to FW treatments. Wrasse will tolerate an exposure of approximately 3 hours. Prior to FW treatments, efforts are taken to remove the cleanerfish from the pens using creels. Site operatives are present at the crowding event to hand net wrasse over the sweep net. These efforts combined reduce the risk of wrasse entering the wells. The wellboats also have cleanerfish dewatering capacity on board, which allows the wrasse to be separated from the salmon during loading, and these can then be returned to the pen without exposure to FW.
- **Freshwater & FLS (mechanical):** The addition of FLS systems to the FW vessels gives the option of delousing via FLS on discharge from the wellboat. Lice are collected via drum filtration. Early trials of FW (3 hours) and FLS on discharge has resulted in >95% lice clearance. This delousing option reduces the risk of having to administer long exposure FW treatments to the

salmon populations, thereby further reducing the risk that wrasse will be exposed to FW for longer than 3 hours.; and

- **Freshwater and chemical treatment**: Medicines can be used in conjunction with freshwater treatments to optimise treatment effectiveness. BFS has developed protocols to ensure optimal combinations and treatment times are used. Treatment strategies are developed and led by the company veterinarian.

5.4 Resource Availability

Recent additional vessel resource has been added to the BFS fleet. BFS has internal access to intervention vessels that are equipped with FLS delousing systems. These vessels will be available for deployment at the Proposed Development. FLS capacity per vessel allows for the treatment of up to 50 T of salmon per hour, with vessels equipped with up to four lines. Therefore, at maximum capacity the individual vessels can treat up to 200 T of salmon per hour.

BFS also has internal access to several wellboats that are equipped with freshwater and FLS intervention capacity. Individual vessel capacity allows for the treatment of up to 300 T of salmon per hour.

All of these internal intervention vessels, FLS and freshwater, will be available for deployment at the Proposed Development, should it be necessary. Additional intervention resource may be procured as and when demand requires, such as in the event of an unforeseen fish health challenge where existing resource is not available immediately.

BFS have developed a treatment programme which allocates the necessary treatment resource to farms at an appropriate level to accommodate peaks in biomass and anticipated lice/disease challenges, as well as allowing proactive strategic, co-ordinated treatments in advance. This process allows the forecasting of resource availability and maximises the efficiency in which existing resource is used. The programme maintains flexibility to accommodate unforeseen challenges, however, sets the foundations for additional resource to be sourced where necessary.

Health monitoring occurs routinely (monthly during the winter months, fortnightly during the summer months), and BFS also conducts enhanced surveillance where applicable, with weekly sampling conducted when a specific population requires more attention. All disease results are collated and reviewed twice weekly, with a triage system implemented during higher risk periods. The primary aim of this health monitoring strategy is to intervene at the pre-clinical stage and mitigate clinical disease. BFS implements a rolling freshwater treatment strategy as a means to maintain good gill health, aiming to treat all farms every 4-6 weeks, thereby keeping AGD at very low levels. However, depending on the specific health status of individual fish farms, some farms may be treated more frequently and other farms less frequently.

5.5 Bath Intervention Efficacy

The observed reduction of sea lice numbers is a function of clearance rate and resettlement rate. The expected clearance rate of any intervention is likely to be >80 %, but this success may be masked or rapidly followed by high levels of resettlement. Bath treatments are determined to be successful if they achieve at least 50 % observed reduction of the target life stage. If a treatment is determined not to be successful, the Biology Department are notified in the first instance, who will determine appropriate action. If the failure is suspected to be of a pharmacological nature, the Veterinary Medicines Directorate (VMD) is also notified.

Treatments are administered taking fish health and welfare into account. If treatments are unsuccessful, and health suggests that fish would tolerate further treatment, then the next option in the Sea Lice Action Plan (SLAP) would be instigated (e.g., mechanical, stocking of cleaner fish). If no further options are available, or fish health suggests that handling will not be tolerated well, depopulation of biomass may occur. The efficacy of sea lice treatments is monitored during the production cycle, by conducting sea lice counts routinely, and pre/post treatment and may be supplemented by laboratory bioassays if appropriate. These assessments inform future treatment decisions and facilitate the adaptive management of sea lice.

Bioassays give broad indication of trends in sea lice sensitivity at a macro-level and are complementary to the analysis of sea lice clearance levels observed per treatment on a site-level. The intention is to

conduct bioassays once per generation within a region to help guide appropriate medicinal choices on sites within the region (especially if faced with observed reduction in sensitivity) and to determine the trend in sensitivity over the long-term. The very low sea lice levels present on fish in Year 1 generally preclude bioassays being carried out until Year 2.