Marine Fish Farm: Stulaigh South

Fish Production Plan

Mowi Scotland Limited

January 2023

Fish Production Plan

Stulaigh South Marine Pen Fish Farm, South Uist

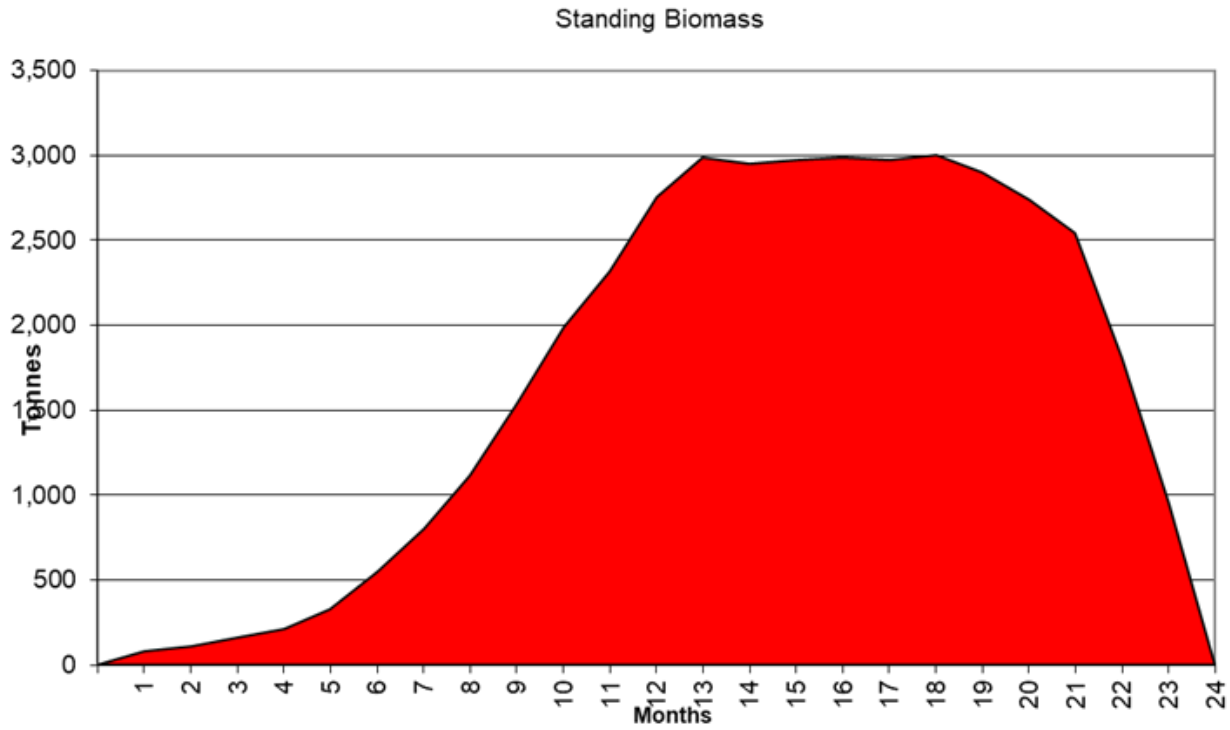
Scope

This document outlines information requirements requested by SEPA in their standardized application form "Application for a new Permit FORM C-2". The Form advises that a Fish Production Plan (FPP) as a minimum should include:

a) Stocking plan for each production cycle;
b) Projected monthly biomass figures;
c) Anticipated time for which maximum biomass will be held during the production cycle;
d) Feeding plan stating:
    i) the quantity of feed to be used;
    ii) the proposed feeding method;
    iii) the expected feed conversion ratio in kg of fish production (wet weight) against kg of food (wet weight);
    iv) the phosphorous content of the feed;
    v) the nitrogen content of the feed and;
    vi) the carbon content of the feed; and
e) The means by which discharge of uneaten feed and fish faeces will be minimised.

Nutrient enhancement budgets are calculated to provide a relative representation of the volume of dissolved nutrients released from salmon fish farming. These are provided in Appendix A together with Equilibrium Enhancement Calculations (ECE).

a) Stocking plan for each production cycle, b) Projected monthly biomass figures, and c) Anticipated time for which maximum biomass will be held during the production cycle



d) Feeding plan

i) the quantity of feed to be used
4,684 (t/yr)

ii) the proposed feeding method
Automated Feed Barge. Feed at Mowi sites has, until recently, been distributed at the pen via a rotor on the surface of the water. However the company has started to utilise subsea feeding systems to allow the fish to be fed at depth; feed is delivered to a small structure at the centre of the pen. Water is then added to the feed and passed down through a pipe to a dispersion unit suspended in the net. The proposal seeks permission to feed the fish at the pens using a surface rotor or a subsea feeding system. With the installation of a surface rotor system expected in the first instance due to site conditions.

iii) the expected feed conversion ratio in kg of fish production (wet weight) against kg of food (wet weight)
The amount of particulate deposition as a result of faecal waste is determined by the digestibility of the feed. Modern feeds are easily assimilated and provide good feed conversion ratios (FCR). The lowering of FCRs has led to reduced waste inputs to the environment per unit production. The FCR for the farm will be budgeted at 1.07:1, where 1.07 kg of feed is required to produce 1 kg of harvested fish.

iv) the phosphorous content of the feed
Phosphorus 1.5-2%

v) the nitrogen content of the feed
Nitrogen 6-7%

vi) the carbon content of the feed
49%

c) The means by which discharge of uneaten feed and fish faeces will be minimised.
Accurate feed management is the main control over the amount of food waste that reaches the seabed. In brief, measures to minimize the discharge of uneaten feed and fish faeces include:

- the use of an automated monitoring equipment;
- select feed composition with reduced feed conversion ratios (FCR)
- feed forecasting and management
- daily monitoring on site
- staff training
- and company targets.

In order to reduce potential interactions, a range of mitigation measures have been developed to remove or reduce the range of impacts associated with the operation of the proposed site. Mitigation measures are summarised in Table xxx below. These are proposed to remove, avoid, reduce and where possible offset any impacts which could, either by themselves or in combination with others, have a significant adverse effect.

Table 1 Mitigation measures

Title	Description
Site Selection General	The site was selected on the basis of its well flushed and open water characteristics. These energetic hydrodynamics, typical of these locations, assist dispersion of fish farm wastes demonstrating a higher assimilative capacity than lower energy sites. Preliminary modelling exercises and stocking density calculations were completed at an early stage to determine an appropriate maximum standing biomass for the site in line with current legislation and constraints. This process gives a good indication early in the design process that the site will will comply with SEPA CAR licence EQS. Prior to a detailed modelling assessment, a risk assessment by SEPA confirmed the proposed site is in an area of high dispersion and initial modelling indicated that the relative influence of Stulaigh South is likely to be lower than other sites for a similar tonnage.
Site Location Detailed	Public data was reviewed and baseline field date collected early in the process. This information was used to locate the equipment away from likely areas of features of ecological value. The proposal has been positioned away from known important ecological features such as PMFs to minimise potential impacts; this was a primary consideration that was reviewed throughout the design and assessment process, and if required the proposal modified.
Site Design	Embedded mitigation in the proposal purposefully uses fewer, larger pens than traditionally proposed in Scotland; the benefits from which include reducing the extent of seabed impacts, supporting feeding monitoring and management, and maintaining low stocking densities.

Control of food and faecal waste	Accurate feed management is the main control over the amount of food waste that reaches the seabed. Feeding is controlled by automated monitoring equipment and the waste generated is consequently relatively low at 3%. • Feed composition: the amount of particulate deposition as a result of faecal waste is determined by the digestibility of the feed. Modern feeds are easily assimilated and provide good feed conversion ratios (FCR). The lowering of FCRs has led to reduced waste inputs to the environment per unit production. The FCR for the farm will be budgeted at 1.07:1, where 1.07 kg of feed is required to produce 1 kg of harvested fish. • Management: feed is ordered by support staff based on forecasts which are predicted using bespoke software packages. These systems use parameters including the number of fish stocked at a site and the size of the fish to determine the appropriate feed rate for any given time of year and the production cycle. • Surveillance: feed to each pen at the farm is delivered from the feed barge via pipes. Cameras installed within the pens allow employees to monitor and respond to the appetite of the fish; and • Training: the company ensures that all farm staff undertake a high standard of training to reduce feed waste. Efficient use is a Key Performance Indicator (KPI) incorporated within individual appraisal targets.
Fallowing	Fallowing is standard practice following a production cycle to provide an opportunity for decomposition of organic matter on the seabed and to allow benthic community recovery. Faunal community alterations arising from accumulation of carbon deposition during the growing cycle are expected to be temporary and reversible. The pens will be left fallow for a period of at least 6 weeks at the end of each production cycle.
Licencing and Enforcement under the Controlled Activities Regulations (Regulations) 2005 (CAR)	Potential benthic impacts are regulated by the Scottish Environmental Protection Agency (SEPA) under the Controlled Activities Regulations (Regulations) 2005 (CAR) and are advised by Marine Scotland's Locational Guidelines. NatureScot (NS) also provides guidance if a site is located within a protected area of conservational importance. Regular Environmental Audits are carried out as part of the compliance monitoring set out by SEPA. SEPA is implementing a revised regulatory framework that seeks to strengthen the protection of the marine environment. The changes primarily introduce: a tighter standard for the organic waste; a voluntary pre-application screening process, more powerful modelling using the best available science; enhanced environmental monitoring; and a new Enforcement Unit. This will apply to the proposed new site. Whilst a worst-case scenario, SEPA has extensive enforcement powers to decrease site biomass if the site is deemed to continually not comply with benthic EQS. Enforcement is a final, but an available option should sites not meet required criteria. Marine modelling has been used to assess benthic impacts and compliance with SEPA's EQS Standards, with consideration of relevant habitats and species to ensure these will not be adversely affected by the proposed development
Monitoring	Suitable transects and sampling stations to monitor benthic and in feed compliance monitoring have been suggested in the Environmental Monitoring Plan (EMP). SEPA will determine the finalised EMP and this will be attached as a enforceable condition to a future CAR Licence.

Husbandry	Fish are tended to under conditions that satisfy their biological needs for food, clean water and space, and it is ensured that the fish obtain the necessary nutrients for good health throughout production. The fish are stocked at densities that balance welfare and enhance performance. Coordinated fallowing and synchronised production are integral components of Mowi's farming practices, which reduce biological risk. While the farm shares regional resources with other Mowi farms, the site is able to operate under its own veterinary health plan and follows its own production cycle.

Appendix A Nutrient Enhancement Budget & Equilibrium Enhancement Calculations (ECE)

Nutrient enhancement budgets are calculated to provide a relative representation of the volume of dissolved nutrients released from salmon fish farming. The volume of particulate and soluble nutrients can be determined based on a calculation of feed manufacturer's value for nutrient content and the relative nutrient content in fish. A summary of the nutrient enhancement budget summary is provided in Table 1A.

Table 1A. Nutrient enhancement budget summary for the development site, cumulative sites in the Rubha Roiseal to Sgeir a Mhill coastal water body, and precautionary sites in LochBoisdale and Loch Eynort.

Parameter	Definition / Source	Proposed Stulaigh South	Active Stulaigh	Active Marulaig	Active An Camus	Inactive Rigsay (Note)
Maximum Standing Biomass (T)	Proposed project biomass	3,000	2,850	2,400	1,471	20
Stocking Density (kg/m^3)	Proposed project stocking density	9.81	13.6	14.5	15.4	unknown
Annual Production (T/yr)	Production calculation	4,377	4,158	3,502	2,146	29
Feed Conversion Ratio (FCR)	Current figures relating to feed efficiency	1.07	1.07	1.07	1.07	1.07
Total feed input (T/yr)	Calculated based on proposed biomass and FCR	4,684	4,450	3,747	2,297	31.2
Total N Input (T/Yr)	Calculated based on conversion of crude protein to nitrogen, Mowi Feed (approximately 6.5%)	306.8	283.0	238.3	146.0	2
Total N in Fish (T)	Calculated at 3.4% of fish	148.818	141.372	119.1	72.97	0.99

	mass					
N Lost to the Environment (T/Yr)	Calculated as Total N Input minus Total N in Fish	158.0	141.6	119.2	73.1	1
Note. Rigsay is owned by another operator and so figures are assumed based on principles applied at a Mowi site.						

The standard ECE Model is a simple box model which estimates the level of enhancement of dissolved nitrogen above background levels. The standard model is used mainly to rank sea lochs and other semi enclosed bodies of water by their nutrient load. The development site is not located in a locational guideline water body, subsequently an alternative 'open water' model for ECE was adopted. The model uses current data from hydrographic surveys to calculate the rate of water exchange (Q). Using a source rate of nitrogen per tonne of farmed fish, the simple calculation estimates the enhancement of dissolved nitrogen above background levels due to farming activity. Data inputs to the open water ECE model and the outputs are shown in Table 2A and Figures below.

Table 2A. Data inputs to the Open Water ECE model for the proposed biomass at the development site, and cumulative sites in the Rubha Roiseal to Sgeir a Mhill coastal water body and wider area.

Parameter	Proposed Stulaigh South	Active Stulaigh	Active Marulaig	Active An Camus
Depth of water at the site (m)	41	30	23	23
Diffusion Coefficient ($m^2 s^{-1}$)	0.1	0.1	0.1	0.1
Along shore residual velocity ($m s^{-1}$)	0.009	0.020	0.021	0.028
Normal residual velocity ($m s^{-1}$)	-0.027	-0.020	0.007	0.011
Along shore tidal current amplitude ($m s^{-1}$)	0.115	0.067	0.067	0.072
Normal tidal current amplitude ($m s^{-1}$)	0.091	0.037	0.040	0.052
Tidal current phase (degrees)	0	0	0	0
Number of pens	6*200s	14*120s	12*120s	7*120s
Maximum biomass (tonnes)	3,000	2,850	2,400	1,471
Total pen area (m^2)	19098.59316	16042.81826	13750.98708	8021.40913
Distance from head of grid (km)	1.634386	0.957564	0.95134519	1.027924866
Distance of pens from shore (km)	0.353	0.315	0.2	0.26
Note. The input values used for the ECE model are unknown for Rigsay as the CAR Licence is owned by another operator. The site is long term dormant, is distant from the site, and for a low tonnage. Therefore, it is reasonable to conclude it would have a small contribution to cumulative results and the associated risk is low/insignficant.				

The methodology to assess the level of change follows the UKTAG procedure to assess coastal waters using the winter mean of dissolved inorganic nitrogen. Assessment levels define a level of natural variability in the water plus a 'slight' disturbance (defined as background level,

increased by 50%). UKTAG uses this methodology to define reference conditions for the Water Framework Directive. Reference values for coastal waters (at salinity 32) at the 'high to good' boundary for dissolved inorganic nitrogen is 168 µg/l or 12 µmol/l.

The Water Framework Directive classifies water bodies 'Bad', 'Poor', 'Moderate', 'Good' or 'High' status for a variety of water quality parameters. The region of Rubha Roiseal to Sgeir a Mhill was given High status for Dissolved Inorganic Nitrogen. High status corresponds to mean of 12 µmol/L (168 µg/L) during the period 1st December – 28th February, the period when Dissolved Inorganic Nitrogen is expected to be highest and is assumed to be the background. The inputs from aquaculture are assessed against current UKTAG background levels. The calculated ECE is added onto the background level and the result is then assessed as to whether it breaches the threshold, which is 50% above the background value.

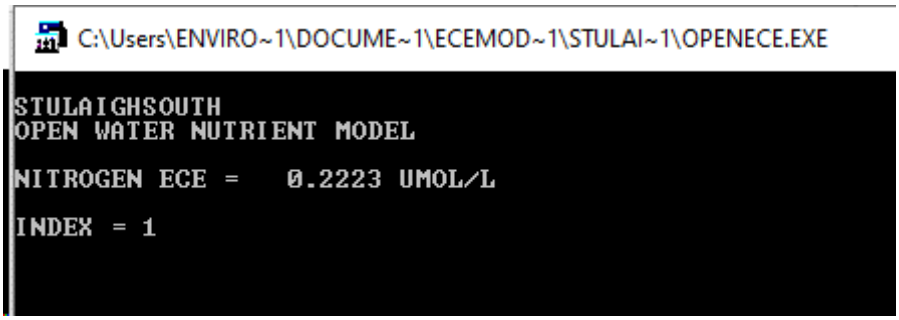


Figure 1A Results from OPENECE model run for the development site

The ECE value for the proposed farm based on a maximum standing biomass of 3,000 tonnes was calculated as 0.2223 µmol/L or 3.11368941 µg/l and Index 1 . The calculated value represents 1.85% of the background and does not exceed the 150% value trigger specific in UKTAG procedures. The nutrient contributions from the site are therefore assessed as having a very low magnitude of impact on the water column. Based on the very low sensitivity of the water column as a receptor, the overall significance of the impact is assessed as negligible (not significant).

Cumulative impacts between the proposed development, Stulaigh Fish Farm, and Marulaig were also assessed. Stulaigh and Marulaig are the only finfish farms in operation within the Rubha Roiseal to Sgeir a Mhill coastal water body at the time of writing. The associated baseline biomasses for these sites are summarised in Tables 1216.1a&b. The large area of well-flushed sea between the development site and Marulaig, together with the dispersive nature of the waters surrounding the site reduce the likelihood of significant adverse cumulative impacts generated from the sites in combination.

To calculate the cumulative ECE from all farms, the open water ECE model outlined by Gillibrand et al (2002) was used for each farm separately, then the ECE values added together to generate the cumulative values.

Figure 1B. Results from OPENECE model runs: Marulaig, Stulaigh, and An Camus

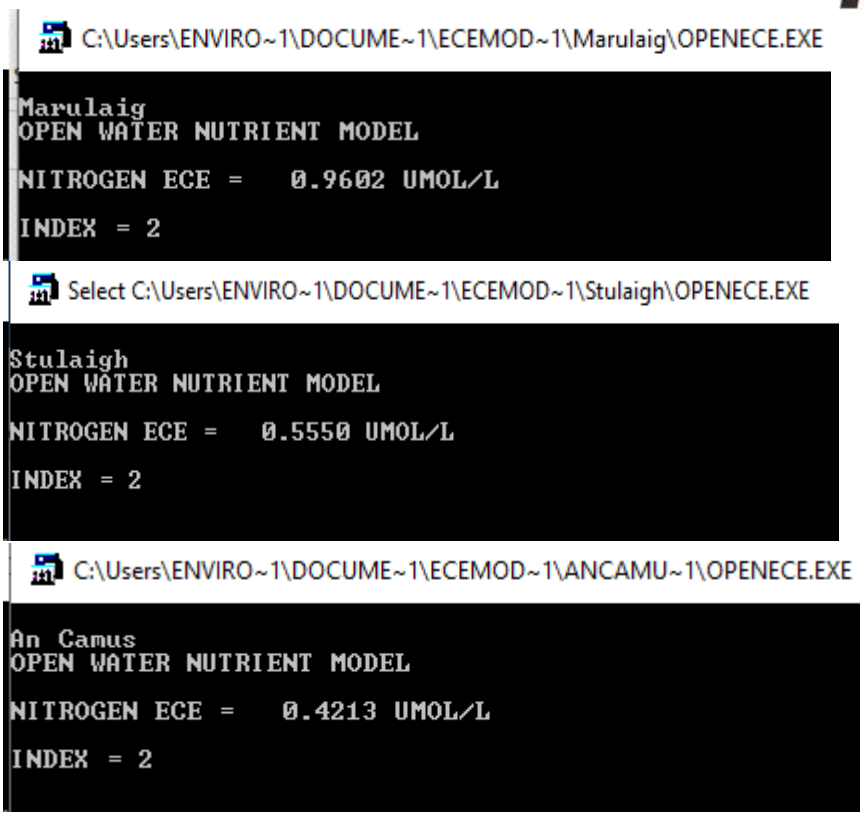


Table 3B. Data inputs to the cumulative ECE calculation and results. Note. all of the results are less than the regulatory thresholds.

Name	MSB (tonnes)	ECE (µmol/L)	ECE (µg/L)	168 µg/l +ECE Result	12 µmol/l +ECE Result
Existing Stulaigh (Active)	2,850	0.9602	13.44923334	12.9602	181.4492333
Existing Marulaig (Active)	2,400	0.5550	7.7737185	12.555	175.7737185
Existing Total (Stulaigh & Marulaig)	5,250	2	21	14	189
Proposed Stulaigh South	3,000	0.2223	3.11368941	12.2223	171.1136894
Proposed Total Rubha Roiseal to Sgeir a Mhill coastal water body (Stulaigh, Marulaig, and Stulaigh South)	8,250	2.2223	24.11368941	14.2223	192.1136894
Existing An Camus (Active)	1,471	0.4213	5.90102271	12.4213	173.9010227
Existing Rigsay (Inactive)	20	Undetermined Scoped Out due to distance, low biomass, and inactivity			
Existing Total (Stulaigh & Marulaig & An Camus)	6,721	1.9365	27.12397455	13.9365	195.1239746
Proposed Total Rubha Roiseal to Sgeir a Mhill coastal water body & wider area(Stulaigh, Marulaig, Stulaigh South, and An Camus)	9,721	2.1588	30.23766396	14.1588	198.237664

The Rubha Roiseal to Sgeir a Mhill coastal water body is located within a well flushed area of open sea therefore it can be expected that any nutrient discharges from the sites will be dispersed quickly. The total cumulative enhancement levels were calculated as 2.3µg/l or 24.12 µmol/L for this water body (Table 11.6.1c). When added to the High status mean value (168 µg/l

or 12 µmol/l), it yields a value of 192.2µg/L or 14.3 µmol/L. The calculated value represents a fraction the background and does not exceed the 150% value trigger specific in UKTAG procedures.

Due to the low level above background, the high level of flushing in this open coastal region; the cumulative enhancement levels are assessed to have a low magnitude of impact on the water column. Based on the very low sensitivity of the water column as a receptor, the overall significance of the impact is assessed as negligible (not significant).