Tabhaigh East, Isle of Lewis

Waste Solids Deposition Modelling Report

Mowi Scotland Ltd.

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QUALITY ASSURANCE

Mowi Scotland maintains a Quality Manual which defines the Quality and Environmental Policy of Mowi Scotland Farming Limited and includes an overview of its processes and acts as a signpost to key elements of its Quality Management System according to the requirements of BS EN ISO 9001, BS EN ISO 14001, GLOBALG.A.P. and British Retail Consortium Global Standard Food. Note the BRC standard is relevant to Blar Mhor processing plant only.

EXECUTIVE SUMMARY

Model simulations have been performed to assess the likely deposition of waste solids at a proposed salmon farm site at Tabhaigh East, at the mouth of Loch Erisort on the Isle of Lewis. This report explains the application of the NewDepomod model to describe the deposition of waste solids beneath the pens and in the surrounding environment. The modelling procedure followed as far as possible guidance presented by the Scottish Environment Protection Agency (SEPA) in January 2024 (SEPA, 2024).

Results indicated that deposition at Tabhaigh East will be moderate, with a maximum deposition of 2,316.1 g m^{-2} (Table 1). The footprint area, where the deposition exceeded the critical deposition rate of 250 g m^{-2}, was 0.21 km^2. The wave exposure index at this site is 3.4, giving an allowable mixing zone of 212,830 m^2 (120% of the 100 m zone). The intensity of deposition, 557.8 g m^{-2}, was less than the critical value of 4,000 g m^{-2} for this exposed site.

Cumulative solids modelling is not required at this site and hence will not be undertaken (SEPA 2024b).

These results indicate that the proposed farm at Tabhaigh East will meet pertinent Environmental Quality Standards for salmon farm waste solids.

Table 1. Site details & summary of results

Site Details	
Site Name:	Tabhaigh East
Site Location:	Loch Erisort
Peak Biomass (T):	2,075
Feed Load (T/year):	5,302
Pen Details	
Number of Pens:	8
Pen Dimensions:	160m Circumference
Working Depth (m):	15 & 20
Configuration:	2x4, 100m matrix
NewDepomod Results	
Allowable Mixing Zone (m^2):	212,830
Maximum Deposition (g m^{-2}):	2,316.1
Modelled Footprint Area (m^2):	210,000
Mean Footprint Deposition (g m^{-2}):	557.8

1. INTRODUCTION

This report has been prepared by Mowi Scotland Ltd. to describe the deposition of waste solids from a proposed marine salmon farm at Tabhaigh East, at the mouth of Loch Erisort on the Isle of Lewis (Figure 1). The proposed site incorporates 8 x 160 m pens, the southern string with 15 m deep nets and the northern string with 20 m deep nets. The report describes the application of the NewDepomod model to describe the deposition of waste solids beneath the pens and in the surrounding environment. The modelling procedure followed as far as possible guidance presented by the Scottish Environment Protection Agency (SEPA) in April 2023 (SEPA, 2023).

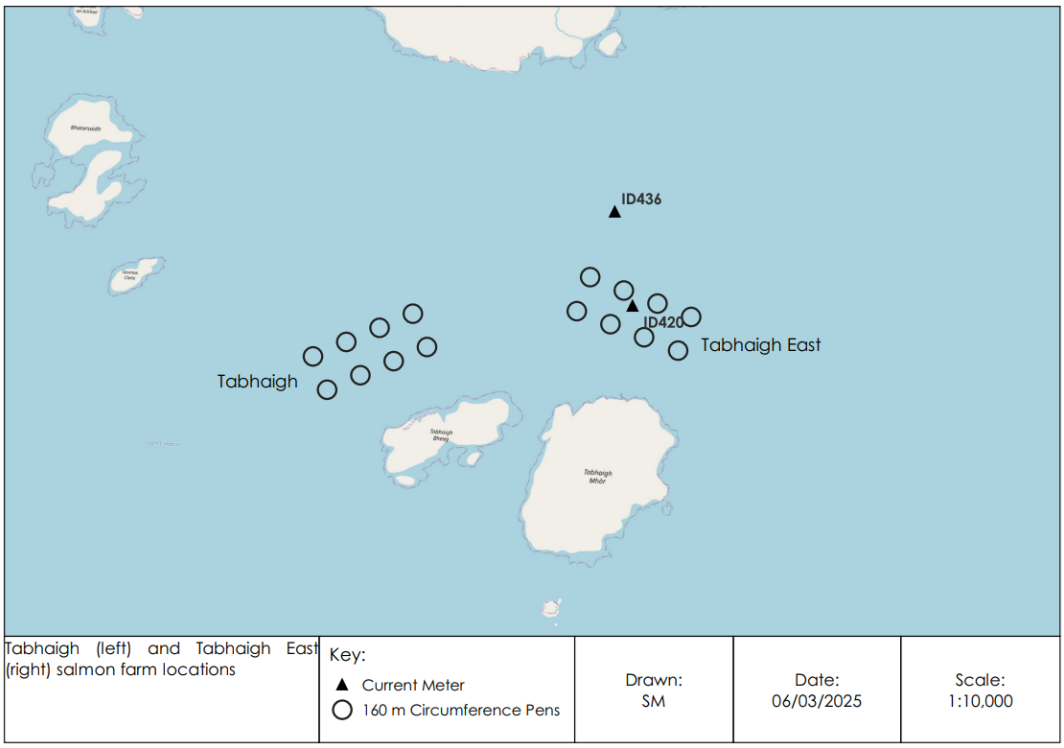

Figure 1. Pen locations (○) for the existing Tabhaigh site (left) and proposed new Tabhaigh East site (right). Current meter deployment locations are marked (▲).

1.1 Site Details

The proposed site is situated East of the existing Tabhaigh salmon farm (Figure 1). The proposed pen centre locations are given in Table 2; these locations were used in the computer modelling (Section 2). Details of the site and hydrographic summary are provided in Table 3. Hydrographic data were collected over two deployments in 2023 and 2024 (ID420 and ID436, Figure 1). The receiving water is defined as open water.

The proposed location at Tabhaigh East is sited in a high wave exposure location (wave exposure index = 3.4); as such, the deposition intensity limit within the modelled footprint will be set at 4,000 g m^2 and the footprint area must be less than 120% of the 100 m mixing zone (SEPA, 2024).

Table 2. Details of the proposed 8 x160 m pen centre locations and net depths used in the modelling for Tabhaigh East.

Pen	Easting	Northing	Net Depth (m)
1	142496	923243	20
2	142460	923150	15
3	142403	923280	20
4	142366	923187	15
5	142310	923316	20
6	142273	923223	15
7	142217	923353	20
8	142180	923259	15

2. MODEL DETAILS

Simulations were performed utilising the NewDepomod model which focussed on localised deposition of waste solids from the proposed pen locations. The model was configured with the standard default parameter values specified by SEPA and using measured flow data to force the model.

Table 3. Summary of the near-bed hydrographic data at Tabhaigh East.

Hydrographic Summary	ID420	ID436
Deployment Date	Jun – Oct 2023	Feb – May 2024
Easting	142334	142285
Northing	923275	923535
Mean Speed (m/s)	0.0407	0.0506
Residual Speed (m/s)	0.002	0.009
Residual Direction (°G)	239	290
Tidal Amplitude Parallel (m/s)	0.067	0.076
Tidal Amplitude Normal (m/s)	0.034	0.049
Major Axis (°G)	285	285

2.1 Local Deposition: NewDepomod

NewDepomod is a bespoke modelling software designed to simulate the dispersion of particulate wastes from salmon farms. The model (SAMS, 2021) has been developed by the Scottish Association for Marine Science (SAMS) and is supplied under licence. The version used for the modelling described here was version 1.5.1.

A regular model grid was prepared. The grid for simulating solids deposition covered a 2 km x 2 km area, with a 25 m grid spacing in both directions. The grid size was 80 x 80 cells. A flat bathymetry was used, with a water depth of 63.7 m, this was the recorded depth from ID436 which made up the majority of the data used. The flowmetry file combined the data from ID420 and ID436; after merging the length of the combined record was truncated to exactly 90 days in total. The site has a wave exposure index of 3.4 which allows for 120% of the mixing zone to be utilised (SEPA 2023). This area constraint was applied in the waste solids modelling.

2.1.1 Local Waste Feed and Faeces

The model was configured exactly as specified by SEPA in the modelling guidance published in April 2023 (SEPA, 2023). The site was modelled for a maximum biomass of 2,075 tonnes with a feed load of 7 kg tonne^{-1} day^{-1}. This configuration of the model produces a conservative estimate of the benthic footprint, with a deposition rate of 250 g m^{-2} equating approximately to an Infaunal Quality Index (IQI) of 0.64 (the boundary between moderate and good status). Work by SEPA has shown that footprints predicted by this "standard default" configuration broadly match the footprint area derived from seabed samples, although there is a great deal of variability from site to site.

Following the standard default approach, NewDepomod was used to simulate one year of deposition at the maximum farm biomass. Results were analysed over the final 90 days of the simulation, with the mean deposition rate across the model domain being calculated and the footprint area being delimited by the 250 g m^{-2} contour (SEPA, 2023). The results are presented in §3.1.

3. RESULTS

3.1 Waste Solids Deposition

The modelled footprint for the proposed Tabhaigh East farm using the SEPA standard default method is shown in Figure 2. The area of the modelled footprint, defined as the area where the deposition rate exceeds 250 g m^{-2} was 0.21 km^2 was within the allowable mixing zone (120% of the 100 m mixing zone). The maximum 90-day-mean deposition was 2,316.1 g m^{-2}, while the mean intensity of deposition within the footprint was 557.8 g m^{-2}, well below the critical value of 4,000 g m^{-2} for this highly exposed site (wave exposure index of 3.4, §1.1).

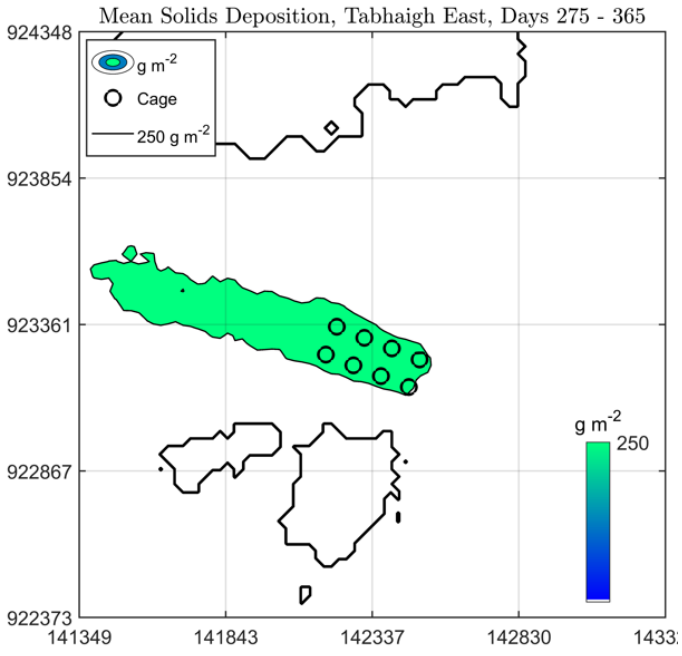

Figure 2. The modelled footprint for Tabhaigh East using the SEPA standard default method for the proposed biomass of 2,075 tonnes with 8 x 160 m pens (○).

4. SUMMARY AND CONCLUSIONS

The proposed biomass of 2,075 tonnes in 8 x 160 m pens requested for consent at Tabhaigh East, and the associated feed loading (Table 4), has been shown to meet pertinent Environmental Quality Standards. The SEPA standard default method, which is designed to provide a conservative prediction of particulate deposition, predicted that deposition would meet both mixing zone area and deposition intensity criteria.

Table 4. Summary of Results

Site Details	
Site Name:	Tabhaigh East
Site Location:	Loch Erisort
Peak Biomass (T):	2,075
Feed Load (T/year):	5,302
Pen Details	
Number of Pens:	8
Pen Dimensions:	160 m Circumference
Working Depth (m):	15 & 20
Configuration:	2x4, 100 m matrix
NewDepomod Results	
Allowable Mixing Zone (m^2):	177,358
Maximum Deposition (g m^{-2}):	2,316.1
Modelled Footprint Area (m^2):	210,000
Mean Footprint Deposition (g m^{-2}):	557.8

5. REFERENCES

Scottish Association of Marine Science (SAMS), 2021, NewDepomod https://www.sams.ac.uk/science/projects/depomod/

SEPA, 2019. Aquaculture Modelling. Regulatory modelling guidance for the aquaculture sector. Scottish Environment Protection Agency, Air & Marine Modelling Unit, July 2019, 68pp.

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SEPA, 2024b. Aquaculture modelling screening & risk identification report: Tabhaigh East (TABE1). Scottish Environment Protection Agency, Air & Marine Modelling Unit, November 2024.