

Environmental Monitoring Plan (EMP) – Benthic
Number CAR/L/1003062



Chalmers Hope,
Scapa Flow, Orkney.

ENVIRONMENTAL
MONITORING PLAN
(EMP) – BENTHIC
LICENSE NUMBER
CAR/L/1003062

Environmental Monitoring Plan, BENTHIC – SITE SPECIFIC

EMP/CAR/L/1003062

FOR

LICENCE REFERENCE NUMBER: CAR/L/1003062

ADDRESS OF PREMISES: Chalmers Hope, Scapa Flow, Orkney.

The responsible person (Cooke Aquaculture Scotland Limited), as named in the licence, will carry out monitoring at the premises as specified in the protocol below.

The benthic Environmental Monitoring Plan (EMP) will be modified, in agreement with SEPA should it be deemed necessary. The modified EMP will be dated and shall clearly state that it replaces and supersedes the previous version.

Version: 1

Dated: 12th January 2022.

Benthic Monitoring Plan Objective

The EMP has been developed to provide sufficient information to calculate a 100m mixing zone ellipse for the site, based upon the NewDepomod modelling footprint at an IQI value of 0.64. Compliance will be determined if the sampled 0.64 IQI ellipse area is equal or less than the 100m mixing zone.

Monitoring Plan

The existing site consists of 120m circumference pens, in 1 group of 2 x 6 arrangement with a 70m separation. Pen centre locations are provided in table 1. The pen groups are aligned on a NW axis. All pens at the site have a net depth of 12m.

Table 1. Pen centre locations.

Pen No.	Easting	Northing	Latitude	Longitude
1	328834	1001162	58°53.512'N	3°14.195'W
2	328784	1001212	58°53.538'N	3°14.247'W
3	328735	1001261	58°53.564'N	3°14.299'W
4	328686	1001311	58°53.591'N	3°14.352'W
5	328636	1001361	58°53.617'N	3°14.404'W
6	328587	1001410	58°53.643'N	3°14.456'W
7	328883	1001211	58°53.539'N	3°14.144'W
8	328834	1001261	58°53.565'N	3°14.196'W
9	328785	1001311	58°53.591'N	3°14.248'W
10	328735	1001360	58°53.618'N	3°14.301'W
11	328686	1001410	58°53.644'N	3°14.353'W
12	328637	1001460	58°53.670'N	3°14.405'W

The species to be farmed onsite is the Atlantic Salmon (*Salmo salar*) at a Maximum Standing Biomass of 2500T. The permitted medicines on site are;

- Slice (Emamectin Benzoate)
- Salmosan or Salmosan Vet (Azamethiphos)
- Excis (Cypermethrin)
- ALPHAMAX™ (Deltamethrin)

The allowable 100m mixing zone area for the site has been calculated as 167,628 m². The predicted impact area is 10,625 m², this is equivalent to 6.34% of the 100m mixing area. A predicted mean deposition beneath the cages of 262.1 g m⁻² occurs. This is below the threshold EQS parameters of 2,000 g.m⁻² for sites with wave exposure below 2.8.

This has been based upon the SEPA Finfish Aquaculture Sector Plan; Annex 1 (published November 2018) proposed mixing zone. This is documented in the Regulatory Modelling Guidance for the Aquaculture Sector (published July 2019)

Locations of the proposed monitoring transects have been superimposed on the modelled output for benthic solids, using the 250gm⁻² contour, that corresponds to an equivalent 0.64 IQI. These are shown in

Figure 1 below. Based on this model, the farm has an impacted area of 10,625 m². This occupies 6.34% of the allowable 100m mixing zone. The mean deposited mass is 262.1 g.m⁻², as the sites wave exposure index is calculated as 2.77, the EQS standard is set at 2,000 g.m⁻².

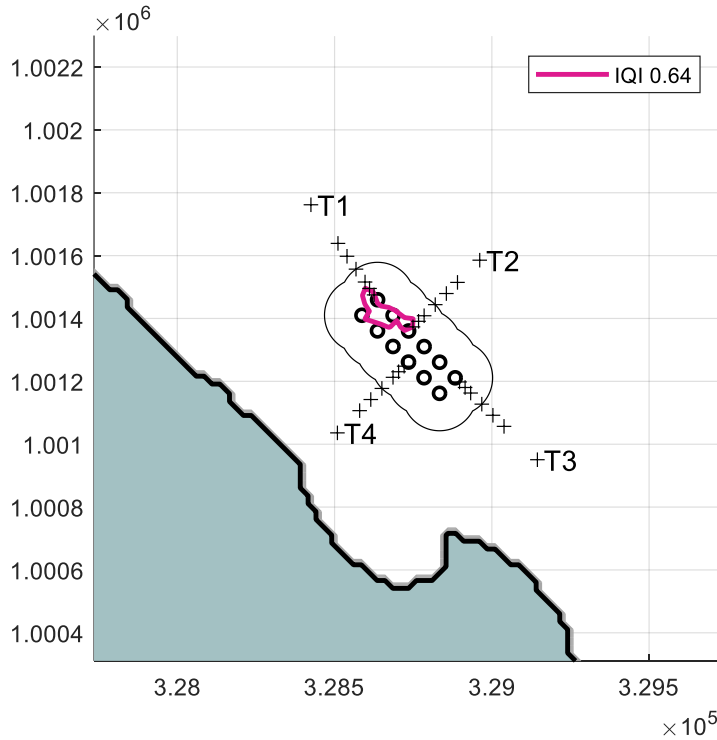


Figure 1. Modelled benthic impact, pen layout, 100m mixing zone, and proposed sample stations.

Table 2: Locations of the proposed benthic monitoring stations

Station Name	Easting (m)	Northing (m)	Latitude	Longitude	Distance from cage edge (m)	Bearing (degrees)
NW000	328626	1001475	58°53.678'N	3°14.417'W	0	325
NW025	328611	1001496	58°53.689'N	3°14.433'W	25	325
NW050	328597	1001516	58°53.700'N	3°14.448'W	50	325
NW100	328568	1001557	58°53.722'N	3°14.479'W	100	325
NW150	328540	1001598	58°53.744'N	3°14.509'W	150	325
NW200	328511	1001639	58°53.766'N	3°14.540'W	200	325
NW350	328425	1001762	58°53.831'N	3°14.632'W	350	325
NE000	328749	1001373	58°53.625'N	3°14.287'W	0	45
NE025	328767	1001391	58°53.635'N	3°14.268'W	25	45
NE050	328785	1001409	58°53.644'N	3°14.250'W	50	45
NE100	328820	1001444	58°53.664'N	3°14.214'W	100	45
NE150	328855	1001479	58°53.683'N	3°14.178'W	150	45
NE200	328891	1001515	58°53.702'N	3°14.142'W	200	45
NE300	328961	1001585	58°53.741'N	3°14.070'W	300	45
SE000	328897	1001198	58°53.532'N	3°14.129'W	0	135

SE025	328915	1001180	58°53.523'N	3°14.110'W	25	135
SE050	328933	1001163	58°53.513'N	3°14.092'W	50	135
SE100	328968	1001127	58°53.495'N	3°14.054'W	100	135
SE150	329003	1001092	58°53.476'N	3°14.017'W	150	135
SE200	329039	1001057	58°53.457'N	3°13.979'W	200	135
SE350	329145	1000951	58°53.401'N	3°13.867'W	350	135
SW000	328721	1001248	58°53.557'N	3°14.313'W	0	225
SW025	328703	1001230	58°53.547'N	3°14.332'W	25	225
SW050	328686	1001213	58°53.538'N	3°14.350'W	50	225
SW100	328650	1001177	58°53.518'N	3°14.386'W	100	225
SW150	328615	1001142	58°53.499'N	3°14.422'W	150	225
SW200	328580	1001107	58°53.480'N	3°14.458'W	200	225
SW300	328509	1001036	58°53.441'N	3°14.530'W	300	225

The in-feed chemical treatment of Emamectin Benzoate is simulated using the new framework to determine benthic impact. This uses the 100m mixing zone principal and is documented in the Regulatory Modelling Guidance for the Aquaculture Sector (published July 2019). As the has existing chemical license the is permitted to use a chemical quantity of 250g. This has a predicted impact area of 1,021,651m², where the relocation of the sites results in less than 15% of new area impact. Transect monitoring stations are shown in Figure 2.

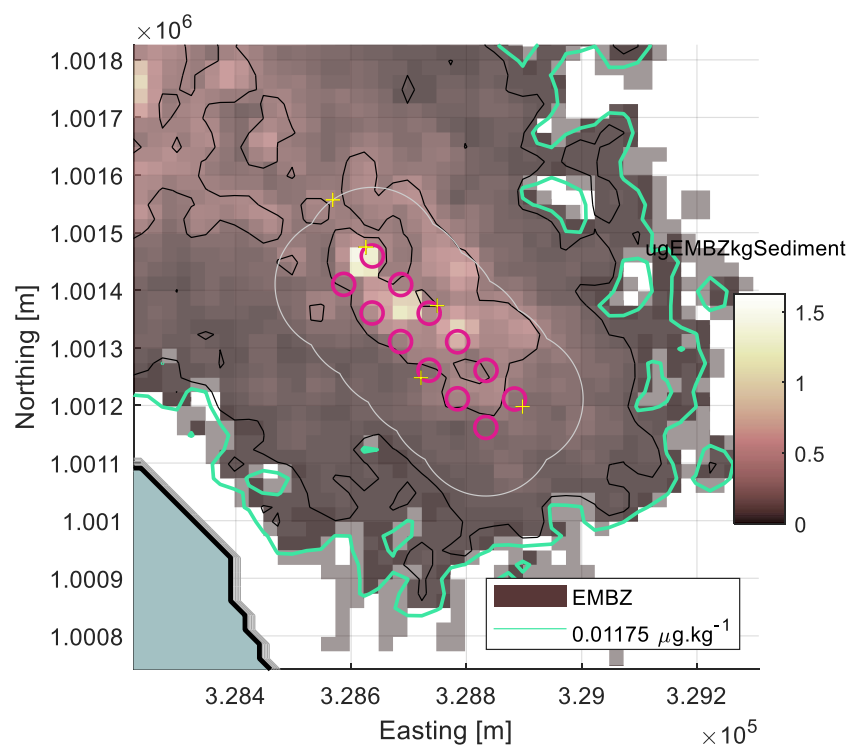


Figure 2. Modelled EMBZ impact, pen layout, 100m mixing zone, and proposed sample stations.

Table 3: Locations of the proposed EMBZ monitoring stations.

Station Name	Easting (m)	Northing (m)	Latitude	Longitude	Distance from cage edge (m)	Bearing (degrees)
NW000	328626	1001475	58°53.678'N	3°14.417'W	0	325
NW100	328568	1001557	58°53.722'N	3°14.479'W	100	325
NE000	328749	1001373	58°53.625'N	3°14.287'W	0	45
SE000	328897	1001198	58°53.532'N	3°14.129'W	0	135
SW000	328721	1001248	58°53.557'N	3°14.313'W	0	225

Sampling Plans and Protocol

Two sampling plans are proposed

A, Benthic Survey - IQI and residue multiple transect 100m mixing zone

B. Emamectin Benzoate, in-feed residues sampling plan.

Any changes to this proposed sampling programme will be agreed with SEPA prior to fieldwork commencing if deemed appropriate.

A. Benthic Survey Plan

The responsible person will carry out the described monitoring strategy during the period as defined in the Finfish Aquaculture Sector Baseline survey & seabed and water quality monitoring plan; Interim performance standard MACS-FFA-01. Version 0.1 June 2019.

Samples will be obtained along multiple transects. These transects will provide even coverage around the site. Transects shall be arranged orthogonally, however site-specific variations may apply. A minimum of four transects originating at the pen edges are proposed, with two oriented along the major axis of the allowable mixing zone and two along the minor axis.

Modified transect arrangements may be required in certain circumstances (e.g. due to areas of hard substrate), in these cases adjustments to the transect bearing of plus or minus 15 degrees will attempt to offer an alternative sample location. Additional transects may be required where the allowable mixing zone is not generally ellipsoidal in shape. Such arrangements will be agreed in consultation with SEPA.

In any given direction, the minimum transect length will equal the greater value of either:

- The extent of the allowable mixing zone plus 50 metres;

or

- 150 metres from the pen edge.

A minimum of seven sampling stations are located along each transect. Of these:

- One sampling station is located at the pen edge;
- One is located at the edge of the allowable mixing zone;
- At least two are located beyond the edge of the allowable mixing zone.

Sampling stations are sufficiently spaced to allow a gradient or trend of impact to be determined along a transect.

Potential suitable stations are provided within **Table 2: Locations of the proposed benthic monitoring stations**.

These stations provide a basis to begin survey work, however total scope of work will maintain flexibility to ensure adequate proportionate coverage is achieved. Variation to the outlined stations during field work could be caused by several variables including but not limited to, hard substrates, obstacles, and changes in the levels of visible enrichment. Given the extent of the transects reference stations are not required.

Samples will be collected and analysed for benthic infauna and chemical residues and the following physico – chemical parameters;

- Total Organic Carbon (TOC) – A minimum of one sub sample with an approximate volume of 50ml shall be taken from the surface 0-2cm at each sample station. This will be stored in an airtight container in a cool box or refrigerator until frozen for later analysis. The TOC will then be calculated using either the loss of ignition or by combustion.
- Particle Size Analysis (PSA) - A minimum of one sub sample with a volume of more than 100ml at each sample station shall be collected. The sample will be taken using a core from the full depth of the grab sample. If a 0.045m² grab is used, the replicate samples for fauna may be combined. This will be stored in an airtight container in a cool box or refrigerator until frozen for later analysis. Analysis of PSA will be conducted using either dry sieving or laser granulometry.
- Residual Survey - Core depth for physico-chem analysis shall be taken from 0-5cm, as per the residue samples. As the benthic ecology sampling and analysis is not a mandatory component of the residues survey, they will remain optional.

Field notes will accompany all sampling and shall include observations on weather conditions, position fixing problems, a visual description of the sediments including the presence of waste feed, faeces, fungus etc

Benthic Protocols.

All sample locations will have positions recorded, using a suitable position fixing method such as DGPS

Timing.

Samples will be collected within one month of the site reaching 75% of the maximum biomass on the downward slope.

Sample Collection

For benthic invertebrate analysis 2 grabs will be collected if using a 0.045m² grab or a single grab if using a 0.1m² grab at each sampling location specified in table 2. Samples will be taken using a Van Veen grab or similar. The following information shall be obtained and recorded during the collection process of each grab sample. Any grab that is notably smaller in size will be rejected.

- Depth of station sampled
- Percentage of grab filled
- Bite depth

- Time of collection
- Purpose of grab
- Position (Lat/Long)
- Consistency
- Organic matter present
- Colour
- Smell
- Presence of Beggiatoa
- Presence of Faeces
- Presence of waste feed pellets

Sample Labelling

Suitably sized and clean sample pots will be used. Each sample pot will be clearly labelled to allow it to be uniquely identified with the following information.

- Survey name
- Sample site
- Sample station code
- Replicate number
- Sample type
- Sampling date
- Samplers initials

Benthic Biology: Sample preparation.

Each replicate will be processed separately, the grab, sieve and any container used will be rinsed and cleaned between each sample collected.

Samples will be washed and sieved onsite using a 1mm stainless steel sieve, all materials retained on the sieve shall be transferred to a clean, airtight container. Samples will be preserved using buffered formal Saline using (50g Sodium tetraborate into 2.5litres of 40% Formaldehyde solution) diluted down to a 4% solution with seawater.

Sample Analysis

Samples shall be analysed by a suitably qualified benthic taxonomist and approved laboratory. These laboratories are listed in Appendix, Used Laboratories, Benthic Taxonomy. These laboratories are participants of the National Marine Biological Analytical Quality Control scheme (NMBAQC).

B. In-Feed Residues Protocol

All sample stations as stated in table 3 will be sampled with their positions recorded using a suitable position fixing method, such as DGPS.

Sample Collection

Samples will be collected between 80-169 days after the cessation of the last treatment in the current growing cycle. If no treatment is administered this survey is not required.

At each sampling location specified, samples will be collected and analysed as per benthic protocol. In addition to this, 3 sediment cores will be taken at each location to a depth of 5cm and kept as individual replicates using a rinsed metal corer and stored in glass containers with aluminium lids

Samples will be kept cool and frozen as soon as possible (within no more than 5 days) after collection.

Sample Labelling

Samples will be labelled as per benthic protocol sample labelling.

Sample Analysis

Samples will be submitted to a reputable laboratory for further analysis with appropriate evidence of analytical ability and approved by SEPA. These laboratories are listed in Appendix, Used Laboratories, Physico-chemical.

Benthic biology

At least one sample will be analysed for benthic biology if the timings do not coincide with the benthic survey as outlined above in A. Benthic Survey Plan

GENERAL REPORTING.

The report shall be submitted to SEPA on the standard reporting template and IQI workbook within 16 weeks. If this is not possible then contact should be made with SEPA.

Appendix

Used Laboratories

Benthic Taxonomy

- Biotikos (Inga Williamson)
- Fish Vet Group (Kate Mc Ewen)
- Benthic Solutions (Hung Liu)
- Myriad Taxonomy (Jocelyn Richards)

Physico-chemical

- PSA - Peatfield Scientific Ltd (www.peatfieldscientificltd.co.uk) NMBAQC Lab Number PSA_2622
- LOI - Peatfield Scientific Ltd (www.peatfieldscientificltd.co.uk)
- TOC - James Hutton Ltd (www.huttonltd.com) Suitability of TOC analysis method confirmed with SEPA (Jennifer Best) January 2020.
- Residues - Peatfield Scientific Ltd (www.peatfieldscientificltd.co.uk) used for analysis of samples with a required LOD of 0.1µg/kg wet weight.