SEPA
Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Marine Finfish Farms

Seabed environmental standards Demonstrating compliance

Guidance for operators

March 2022, Version 1

Every day SEPA works to protect and enhance Scotland's environment, helping communities and businesses thrive within the resources of our planet.

We call this **One Planet Prosperity**

1. Monitoring and demonstrating compliance

1.1 As a condition of their permits to discharge organic solids and in-feed medicine residues into coastal waters, operators of marine finfish farms must ensure that environmental standards set to protect marine life are met.

1.2 Operators must demonstrate compliance with these environmental standards by carrying out seabed monitoring and reporting the results of that monitoring. Permits for marine finfish farms include conditions setting out specific monitoring requirements and others which directly reference external documents that include technical monitoring requirements. Any external document which is directly referenced within a permit condition becomes an extension of the permit and operators must comply with the requirements of such documents.

Monitoring requirements specified in the permit include:

- when the monitoring must be carried out
- when and in which format monitoring results must be submitted to SEPA
- in some cases, where monitoring for emamectin benzoate must be undertaken

The directly referenced documents include:

- the environmental monitoring plan, which must be provided by the operator and cover where monitoring is to be undertaken (the sampling layout)
- performance standards for sample collection and sample analyses as part of the Measurement Assurance and certification Scotland scheme.

RESPONSIBILITIES	
Responsibility of operators	***What we will do***
• Understand their effects on the environment. • Comply with the environmental standards as per the farm's permit. • Provide the monitoring data necessary to demonstrate environmental standards are being met.	• Provide assurance to the public by: a) independently assessing monitoring results. b) carrying out independent environmental monitoring.

COMPLIANCE	
What is compliance?	***What will we do about non-compliance?***
• Environmental standards are met. • Monitoring data necessary to demonstrate compliance with environmental standards as per the farm's permit is provided.	• Report the site as non-compliant. • Investigate the cause of the non-compliance. • Advise operators of findings of investigation. • Take appropriate enforcement action to address the non-compliance.

1.3 Operators must submit an environmental monitoring plan to us for each of their farms setting out their planned sampling layout. We will then incorporate this environmental monitoring plan into the farm's permit to make compliance with the plan a condition of authorisation. Operators may apply for an administrative variation of their permit to incorporate an updated environmental monitoring plan at any time.

1.4 This document provides guidance to operators to assist them in preparing an environmental monitoring plan for each of their farms. It does not apply where the seabed does not allow sampling using grabs (i.e. hard substrates). For farms sited over pre-dominantly hard substrate seabed, the operators must provide suitable evidence, such as underwater imagery, to confirm seabed characteristics prevent sampling using grabs. Until an approach to hard substrate assessment is put in place, no additional monitoring is required at such sites.

2. Seabed environmental standards

2.1 The environmental standards with which operators must comply are specified in the farm's permit.

2.2 All permits will include a requirement to meet two standards for the biological condition of the seabed. One of the standards must be met at the boundary of the permitted mixing zone, the maximum area of which is specified in the permit. The other must be met within the mixing zone at the outer edges of the pens (see Figure 1).

2.3 All permits for farms discharging the in-feed, sea lice medicine, emamectin benzoate, will also include a requirement to meet a chemical environmental standard for that medicine. Farms discharging emamectin benzoate will be on one of two monitoring strategies:

- for most farms, a location for assessing compliance with an environmental standard is specified in the permit as a distance (e.g. 100 to 110 m) from the pens on a particular bearing.

- for a small subset of farms that have an authorisation issued since June 2019, monitoring is required along multiple transects to assess compliance with the allowed mixing zone area. For these farms, a transect-based sampling layout must be included in the farm's environmental monitoring plan.

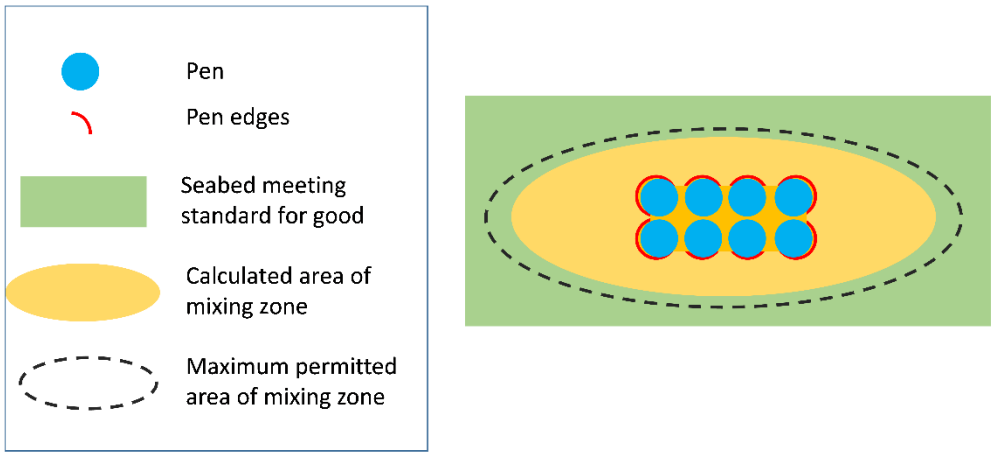


Figure 1: Where seabed environmental standards apply.

2.4 Information about the seabed environmental standards is summarised below. The shape of a mixing zone around a farm is affected by local characteristics (e.g. the strength and direction of the bed current) that determine how far deposited matter spreads across the seabed in different directions. To reflect this, a mixing zone may extend more than 100 metres in some directions provided its area does not exceed the maximum permitted area specified in the farm's permit.

Environmental standards – boundary of mixing zone
• Operation of a farm must not compromise environmental standards beyond a farm's permitted mixing zone. • The required biological standard and, if applicable, the required emamectin benzoate standard at the boundary of the mixing zone is specified in the farm's permit. • The biological standard applicable to all soft sediments is 0.64 and above as measured on the infaunal quality index (IQI) scale as set out in the 2014 Standards Directions[1]. IQI scores must be determined using the method referenced in the 2014 Standards Directions[2] or a DNA method approved by SEPA. The requirements of any approved DNA method will be published on SEPA's website. • Maximum permitted area of the mixing zone is specified in the farm's permit. It is equivalent to size of the area lying within 100 metres of pens in all directions.

Environmental standards – pen edge
• The pen edge standard is a biological standard set to maintain basic ecological functioning for assimilating farm wastes deposited within the mixing zone. • The standard is specified in the permit and must be met on the seabed adjacent to the seaward edges of the pens. • To assess compliance, seabed samples must be analysed to determine the number of species, and abundance, of the following re-worker polychaete worms[3]: a) all polychaete species listed as AMBI Group V[4] species; and b) Ophryotrocha species.

[1] https://www.gov.scot/publications/implementing-water-environment-water-services-scotland-act-2003-assessing-scotlands/

[2] SEPA will provide operators with separate guidance on calculating IQIs for assessing compliance with the mixing zone edge biological standard.

[3] Boudemos is an enrichment indicator genus that has been found at marine finfish farms in Norway and Sweden. If it appears in Scotland, it will be included in the definition of re-worker polychaete worm for the purposes of assessing compliance with the pen edge standard

[4] "AMBI Group V" species as listed in Borja, A., Franco, J., Perez, V. (2000). A Marine Biotic Index to Establish the Ecological Quality of Soft-Bottom Benthos Within European Estuarine and Coastal Environments. Marine Pollution Bulletin 40: 1100-1114

3. Guidance on environmental monitoring plans

3.1 The sampling layout must allow the area of the farm's footprint of organic matter deposition and, where relevant, emamectin benzoate deposition on the seabed to be calculated and compared with the maximum area allowed as a mixing zone by the permit.

3.2 Operators should follow the default monitoring layout described below where suitable, taking account of site characteristics. Guidance on sampling layouts where the default layout is not suitable for one for more transects is provided in paragraph 3.3 onwards.

Default monitoring layout

- Monitoring to be undertaken along 4 directions (transects) on bearings running seaward from each side of the pen group.
- The primary transect directions to be aligned with the predominant directions of the bed currents except where site conditions indicate a high likelihood that deposited matter will be spread significantly further in a different direction to the predominant bed current, in which case, refer to section 3.3.e.
- The minor transects to be oriented such as to create a broadly (i.e. within a few degrees e.g. ±10˚), orthogonal arrangement of transects.
- Transects running from a long axis of a pen group originate from any pen other than the end pens.
- Samples to be collected from 7 separate, monitoring locations (or "stations") distributed along each transect. Monitoring stations used for assessment of the area mixing zone must be at least 20 m further along the transect from the farm than the next closest monitoring station to the farm. This is to ensure that grabs are truly collecting samples from different distances from the farm and in order in terms of their true distances from the farm.
- Position fixing for each sampling station to be recorded when the grab first hits the seabed using GPS on the survey boat.
- Each transect to include 1 sampling station at the pen edge and a minimum of 2 stations beyond the impact footprint of the farm.

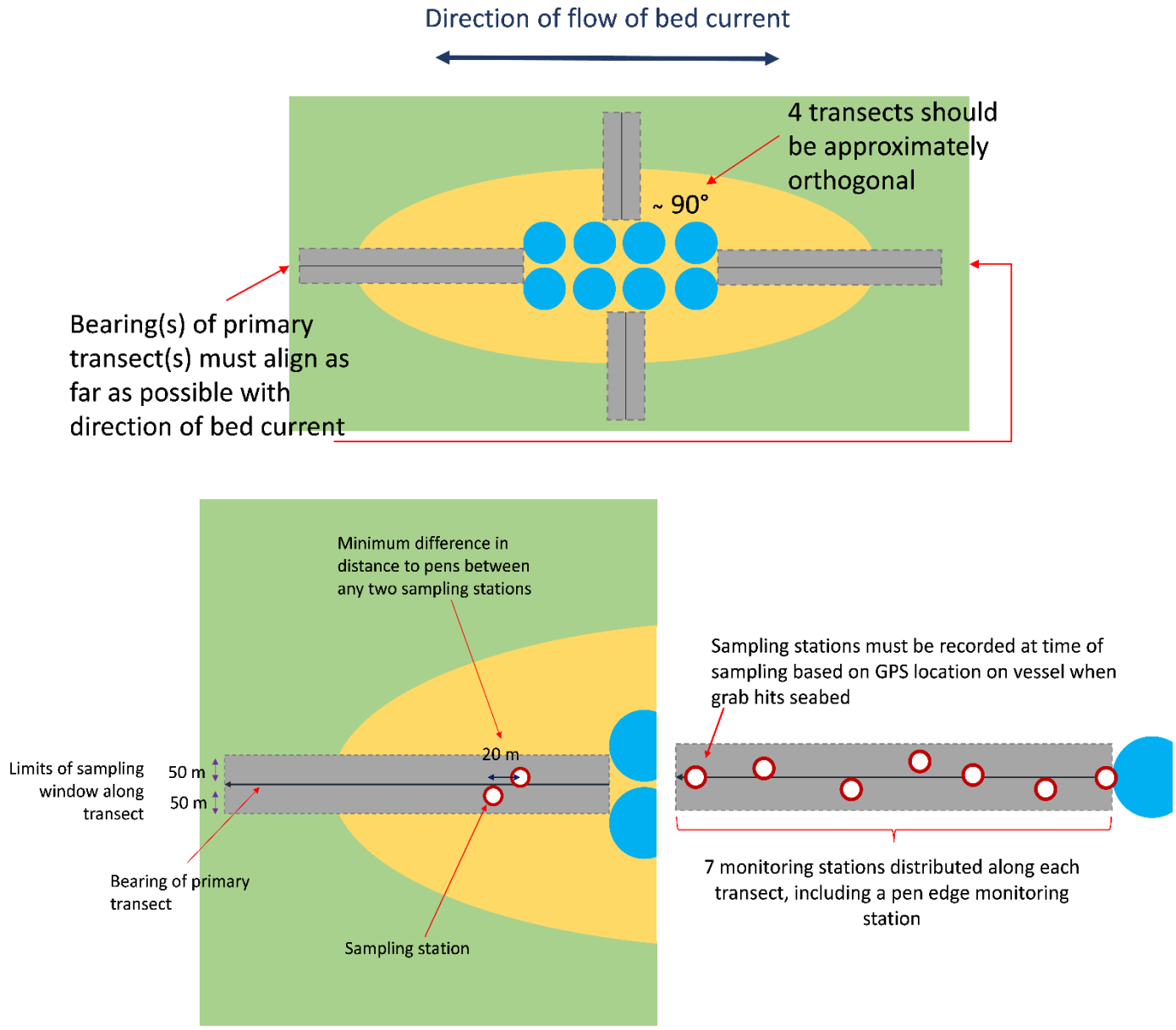


Figure 2: Schematic of default monitoring layout.

- Where a farm includes 2, separate pen groups and a transect from 1 would overlap with a transect from the other, the overlapping transects may be omitted (Figure 3). If these transects are omitted, the calculated area of the mixing zone will be based on the evidence provided[5].

[5] Where operators provide data from additional transects beyond the minimum for the default sampling layout (e.g. transects in the non-primary direction originating in the area between the pen groups), this information will be included in the calculation of the area of the farm's footprint.

- Where the distances from the centre of each pen group to the mid-point between the two groups are less than 200 m, the 4 transect default layout may be used rather than the 6 transect default layout shown in Figure 3. Six transects are required as a minimum for more widely separated (elongated) pen groups to ensure the footprint of the farm is not underestimated.

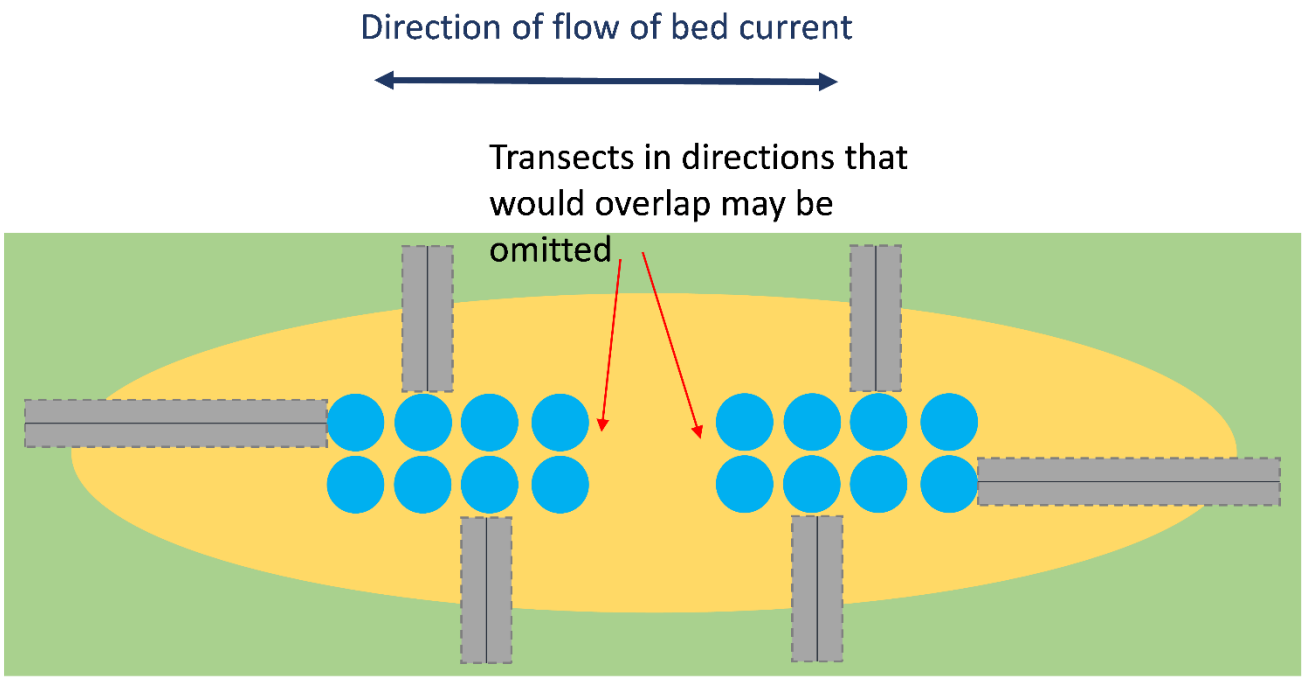


Figure 3: Default layout for a farm with 2, separate pen groups.

Farms adopting the default monitoring layout.	
What operators should do	***What we will do***
• Your environmental monitoring plan should consist of only the following information: a) Confirmation in the form of a simple statement that you will monitor as per the default monitoring layout described in this guidance; and b) the bearings of the primary transects and the sides of the pen group from which those transects will originate.	• Where we consider appropriate, check proposed directions of primary transects in the environmental monitoring plans. • Incorporate the environmental monitoring plan into the farm's permit.

Deviations from default monitoring layout

3.3 Deviations from the default monitoring layout in one or more transect directions are likely to be needed in the following circumstances:

a) Where the proximity of the farm to the shore or the characteristics of the seabed (e.g. presence of hard substrate or manufactured objects) will prevent the collection of a full set of grab samples in one or more transect directions required for the default monitoring layout[6].

b) Where an operator considers that monitoring may detect impacts on the seabed that are not the result of the operation of the farm in its current location, additional monitoring may be required to demonstrate that the impacts are not due to the operation of the farm. For example, where the location of a farm's pens has been changed, one or more of the monitoring transects may overlap with residual impacts on the seabed from the operation of the farm in its pervious location.

c) Where we have advised when permitting the discharge that additional monitoring is needed between the farm and a protected seabed habitat (e.g. a priority marine feature) to demonstrate that the operation of the farm is not endangering the protected habitat.

d) Where the default transect layout could result in sampling stations being on a protected seabed habitat, the bearing or length of that transect may need to be modified accordingly to prevent unnecessary damage to that seabed habitat.

e) Where there is a high likelihood that deposited matter will be spread significantly further in a different direction from that of the predominant bed current (e.g. because of unusually complex local bathymetry), the default orientation of the primary transects needs to be modified to reflect this. If a farm development is being proposed in an area of complex bathymetry, the operator should engage with us prior to preparing an environmental monitoring plan to discuss the potential for local influences to steer the greatest spread of deposition in a different direction to that of the predominant bed current.

[6] See section 4.12 for situations where hard substrate dominates and means grab sampling of soft sediments cannot be undertaken.

Farms needing to deviate from the default monitoring layout for one or more transects	
What should operators do	***What we will do***
• Consider how compliance with the environmental standards is assessed (see next section) and identify a monitoring layout that will provide suitable information for demonstrating compliance. • Where you are unsure, get early advice from SEPA. • For your environmental monitoring plan: a) Confirm for which transect directions the default monitoring layout will be followed. b) Where the above are primary transects, identify the bearings of those transects. c) For other transects, describe the alternative layout you are planning to use; why you need to use it; and how it will enable you to demonstrate compliance. • Include a table in the plan specifying the number of sampling stations on each transect which will be used to assess compliance with the biological standards (pen edge & mixing zone area) and, where applicable, compliance with the emamectin benzoate standard.	• Provide advice when requested. • Consider proposed deviations from the default layout and require any changes we consider necessary. • Incorporate the environmental monitoring plan into the farm's permit.

4. Demonstrating compliance

Assessment of compliance – mixing zone boundary
• Calculate distances from the pen group to the environmental standard for Good (e.g. 0.64 IQI or above and if relevant the emamectin benzoate standard) in a minimum of 4 different directions. • Fit an ellipse around calculated distances for each standard using a standardised method[7]. • Compare the area of the fitted ellipse to farm's permitted maximum mixing zone area.

ASSESSMENT OF COMPLIANCE: PEN EDGE
• Compare the pen edge results for each pen edge station with the pen edge biological environmental standard. • If results from 4 or more stations are available and only 1 does not meet the standard, assess as compliant. • If results from only 3 stations are available and all 3 meet the standard, assess as compliant. • In all other circumstances, assess as non-compliant.

4.1 To demonstrate compliance with the environmental standards that apply at the mixing zone boundary, the distance from the farm to the environmental standards for Good must be calculated along each transect direction.

4.2 Three methods can be used for calculating the distance to Good along a transect. Different methods may be used for different transects:

a) Standardised interpolation.

b) Distance to the nearest monitoring station at Good.

c) Proxy transect or proxy distance may be used where deviations from default monitoring layout are necessary (see paragraph 4.8).

What operators must do	*What we will do*
• For each transect identified in the farm's environmental monitoring plan, provide sufficient data to apply one or more of the methods for calculating the distance to the environmental standards for Good.	• Check sufficient, suitable data have been provided. • Calculate distance from pen group to Good in each transect direction. • Fit an ellipse around calculated distances. • Determine compliance by comparing area of fitted ellipse to maximum permitted mixing zone area. • Advise operators of our assessment as quickly as reasonably possible.

[7] SEPA will provide operators with guidance on the method required to interpolate the distance to Good along a transect and to calculate ellipse areas.

Interpolation method and nearest monitoring station method

4.3 The interpolation method and nearest monitoring station method have different data requirements. Operators can choose which stations' samples to analyse but must provide analysis results from sufficient of their monitoring stations to enable at least one of the methods to be applied.

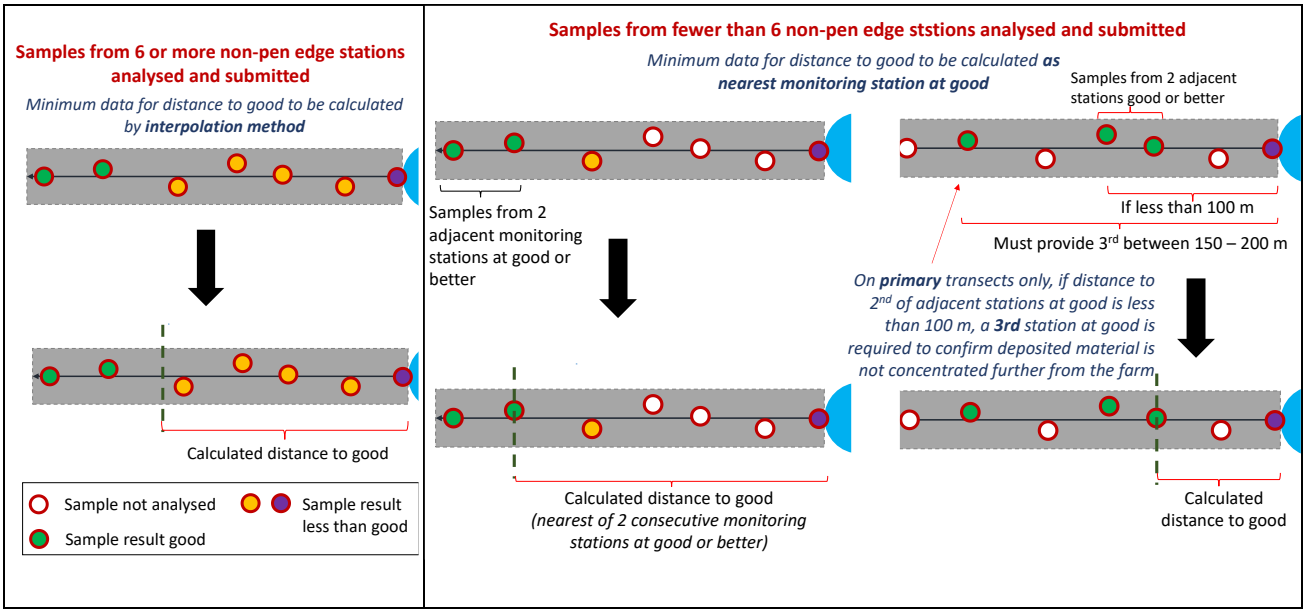
4.4 The interpolation method requires analysis results to be provided for a minimum of 6 monitoring stations plus the pen edge station along the transect. If results for sufficient monitoring stations are submitted to apply the interpolation method, the interpolation method will always be applied rather than the nearest monitoring station method.

4.5 The nearest monitoring station method will normally produce a greater distance to Good than the interpolation method.

4.6 Calibrations of NewDepomod must be based on monitoring results from all the farm's monitoring stations even if analysis of samples from a sub-set of stations and the nearest monitoring station method are used to demonstrate compliance.

Data requirements: different distance to Good methods	
Interpolation method	**Nearest monitoring station method**
Analysis results provided for a minimum of 6 monitoring stations (plus the pen edge station)[8] on the transect, including a minimum of 2 stations beyond the impact footprint of the farm.	Analysis results provided for fewer than 6 monitoring stations (excluding pen edge station) on the transect but include a minimum of 2 adjacent monitoring stations at Good. On primary transects, to confirm deposition is not accumulating further from the farm, results for a 3rd station between 150 and 200 m from the pens must be provided if the 2nd of the adjacent stations at Good is less than 100 m from the pens.

[8] 6 stations is the minimum number to provide adequate statistical confidence to apply the interpolation method (which uses non-linear regression to determine the distance to Good) given that perfectly monotonic declines in impact along a transect and perfect spacing of monitoring stations cannot be relied upon to occur in practice.



4.7 A farm will be assessed as non-compliant if samples from insufficient monitoring stations are analysed to enable the distances to Good along transects to be appropriately estimated. Where indirect methods are needed to estimate distances to Good because samples were not collected or analysed from stations at sufficient distances along the transect, operators must remedy this for the next production cycle or be assessed as not complying with their environmental monitoring plan.

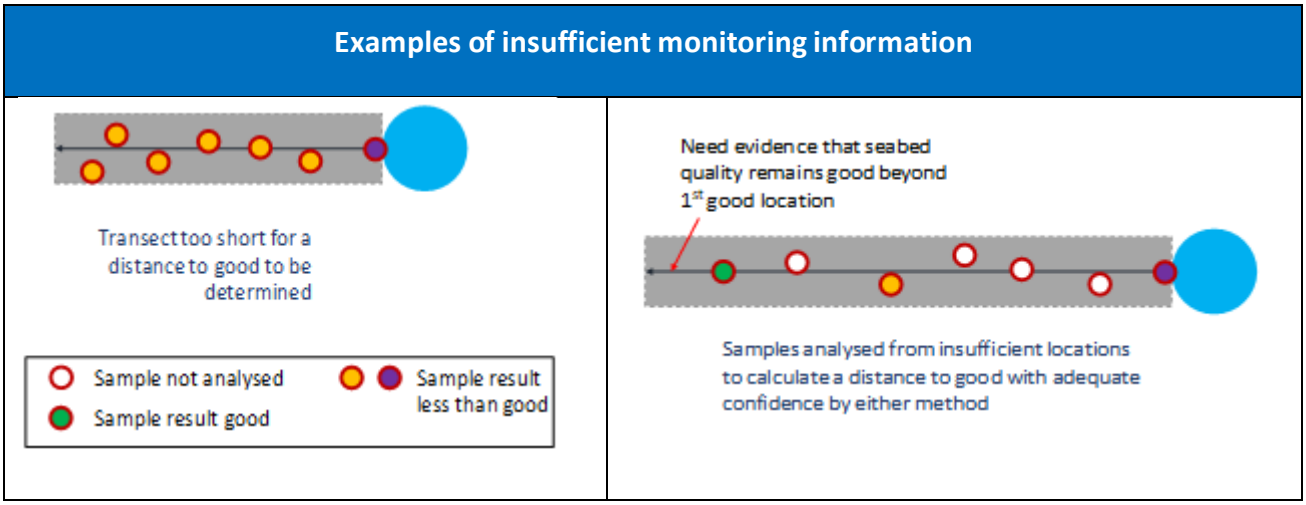
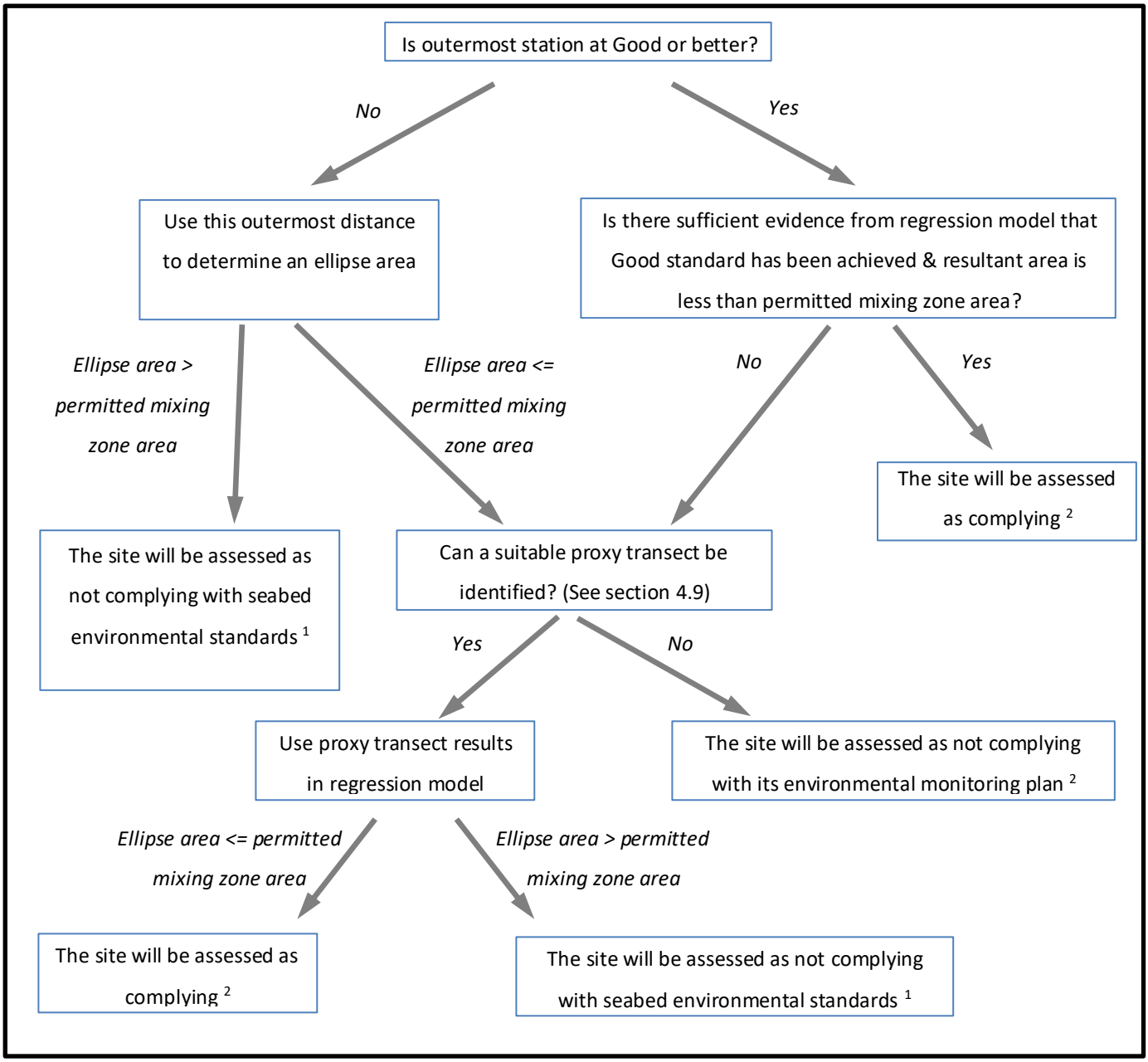


Figure 4: Flowchart of compliance assessment scenarios where insufficient monitoring results are provided to enable the distance to Good along a transect to be directly calculated



Deviation from default monitoring layout

4.8 Where sufficient grab samples along a particular transect cannot be collected due to the proximity of the farm to the shore or seabed characteristics, monitoring approaches, such as those outlined below, may be used instead.

4.9 When a survey is being undertaken for the first time or where seabed characteristics have changed since the last survey, operators may find it is not possible to collect samples in accordance with the sampling layout identified in the farm's environmental monitoring plan. Operators should make every attempt in such cases to switch to a

suitable alternative sampling layout as described in this section to enable a distance to Good to be calculated for the transect or transects concerned.

Proxy transect	Proxy distance	Minor adjustment of transect bearing
Can another transect be identified that can be used to estimate the distance to Good along the transect concerned?	Will one of the following provide a suitable estimate of the distance to Good where the proximity of the farm to the shore is preventing use of the default layout: • the distance to the shore? • the distance to the first sampling location where Good is achieved even though fewer than 7 locations can be sampled?	Would modifying the bearing of the transect enable sufficient locations to be sampled without compromising the fitting of an appropriate ellipse?

4.10 The proxy transect method uses results from one transect (the proxy transect) to infer the distance to Good along another. It can be used where the spread of deposited matter along the proxy transect is expected to be broadly comparable to the spread of matter along the transect concerned. The first step involved is deciding if the likely spread of deposition along two transects (samples from one of which cannot be obtained) is likely to be similar. This may be based on the expected similarity of the bed current speeds (taking account of tidal flow directions relative to the farm) and bathymetry. It then involves calculating the distance to Good along the transect that can be sufficiently sampled (the proxy transect). This calculated distance is then taken as the estimated distance to Good along the transect that cannot be sufficiently sampled. For farms close to shore, the distance estimate can be set to the shorter of the distance to the shore (at MLWS) and the distance to Good along the proxy transect.

4.11 Where there is a high likelihood that deposited matter will be spread significantly further in a different direction to that of the predominant bed current, the orientation of the primary transect should be modified to align with that direction rather than the direction of the predominant bed current.

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