Environmental Impact Assessment

Volume 2 - Main Report

Renewal of Marine Finfish Aquaculture Licence in Kenmare Bay, Co. Cork

Licence Site Ref: T5/233

Produced by

AQUAFACT International Services Ltd

On behalf of

MOWI Ireland

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AQUAFACT

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[1] Appendices included in '*Environmental Impact Assessment Report - Volume 3 – Appendices - Renewal of Marine Finfish Aquaculture Licence in Kenmare Bay, Co. Cork - Licence Site Ref: T5/233.*

1. Introduction

1.1. Background

This report accompanies an aquaculture licence renewal application by Comhlucht Iascaireachta Fanad Teoranta (trading as MOWI Ireland) to the Department of Agriculture, Food and the Marine (DAFM) for site T5/233 which is located off Inishfarnard Island within Coulagh Bay at the mouth of Kenmare Bay (the site is also referred to herein as the Inishfarnard site) (**Figure 1-1**).

The aquaculture licence renewal application for the site includes a request to **1)** amend the boundaries of the licensed area and **2)** amend Conditions 2 (d) and 2 (e) of the licence.

1) Amendment to Site Boundaries:

The boundaries of the existing are shown in red in **Figure 1-2**. For the aquaculture licence renewal application, the applicant requests that the boundaries of the licensed area be amended to those shown in blue in **Figure 1-2**. The area of the existing licensed area is 25.94ha while the proposed area measures 52.73 ha.

2) Amendment to Licence Conditions 2 (d) and 2 (e)

Conditions 2 (d) and 2 (e) of the licence (dated: 30/01/1995) are as follows:

> Condition 2 (d) - the stock of fish in the pens shall not exceed such quantity as may be specified by the Minister from time to time, the number of smolts to be stocked at the site should not in any event exceed 400,000. Licensed stocking densities are not to be exceeded and will be subject to inspection at any time by the Department of the Marine
>
> Condition 2 (e) - the Licensee shall not harvest more than 500 tonnes (dead weight) of fish in any one calendar year.

On 8 January 2018 the conditions of the licence were amended by deleting Conditions 2 (d) and 2 (e) of the licence; and including the following Condition: -

‘The pens or pens shall be subject to a Maximum Allowable Biomass of 2,177 tonnes, being the Maximum Standing Stock permitted at the licensed area. The stocking of the licensed area shall be subject to inspection at any time by the Department of Agriculture, Food, and the Marine’.

For the aquaculture licence renewal application, the applicant requests that licence amendments made on 8 January 2018 be applied to the licence.

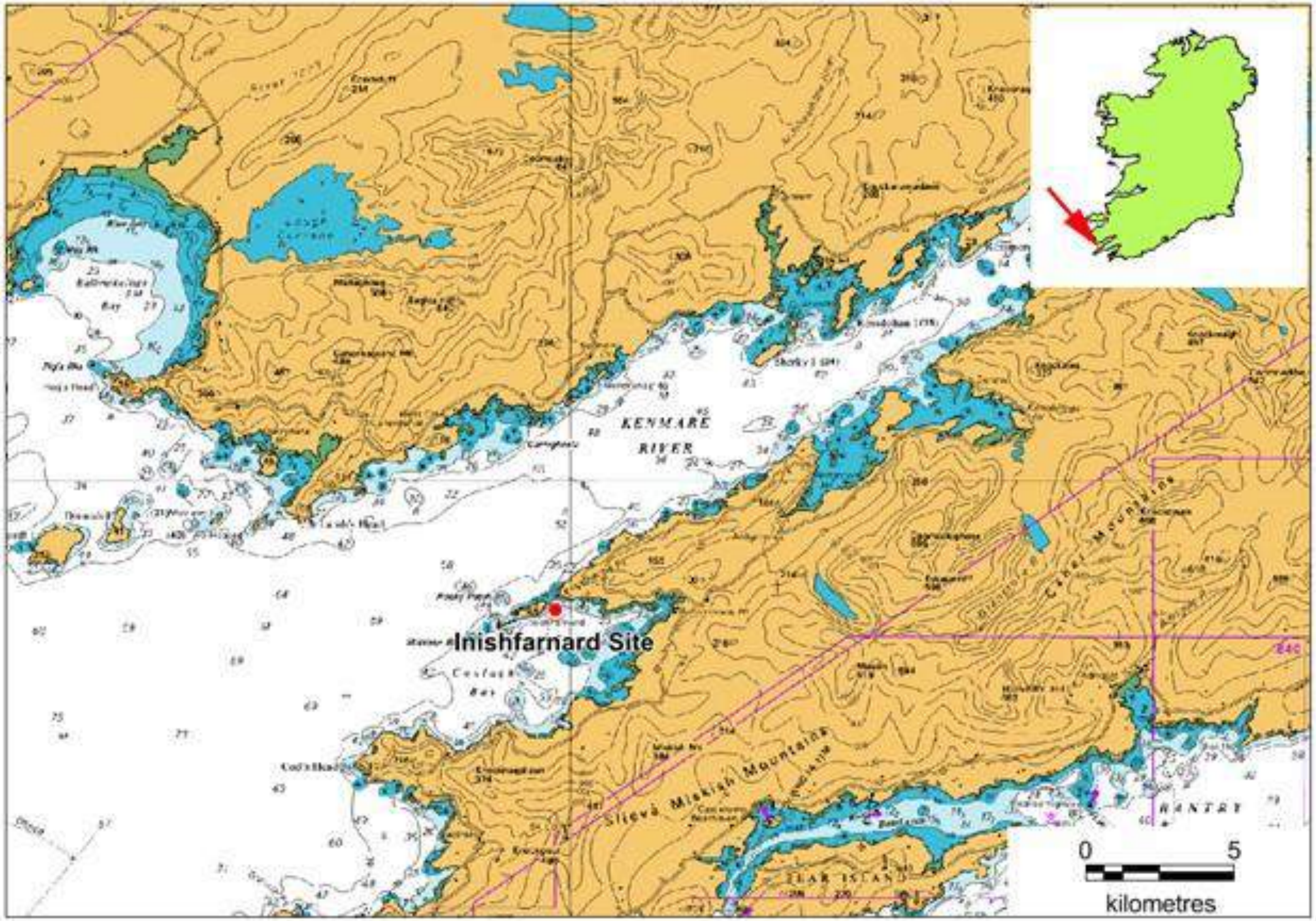

Figure 1-1 Location of the Inishfarnard site.

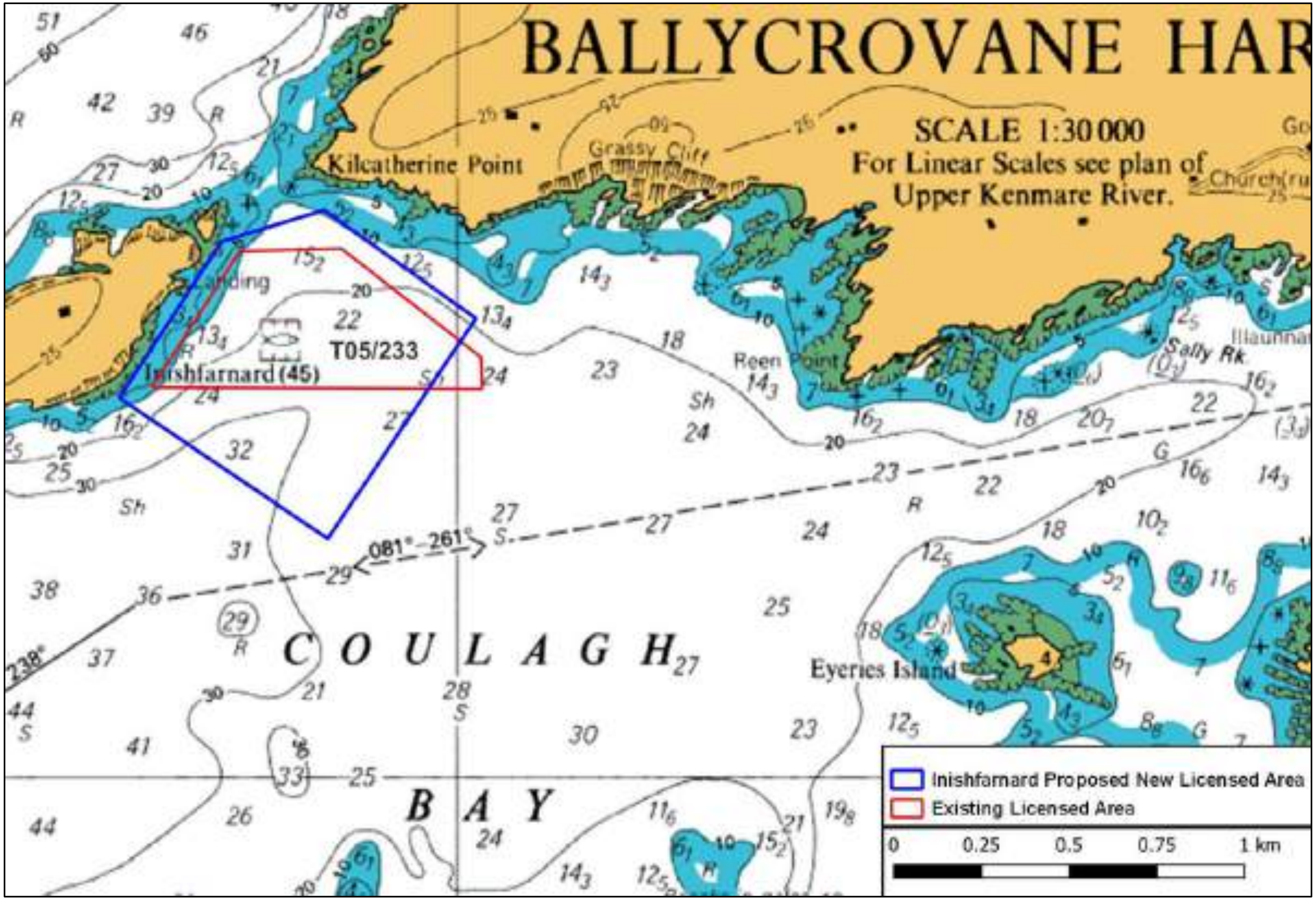

Figure 1-2: Location of the Inishfarnard site. Current site boundaries presented in red, proposed boundaries outlined in blue.

1.2. Purpose of this Report

This report has been prepared to address Environmental Impact Assessment (EIA) reporting obligations under the Directive 2011/92/EU of 13th December 2011 (herein referred to as the 2011 Directive) as amended by Directive 2014/52/EU (herein referred to as the 2014 Directive).

1.3. Environmental Impact Assessment

An EIA was undertaken to support an aquaculture licence renewal application by Comhlucht Iascaireachta Fanad Teoranta to the DAFM for the site at Inishfarnard Island in Coulagh Bay at the mouth of Kenmare Bay. The aquaculture licence renewal application includes a request to change the boundaries of the site and the operating conditions attached to the licence (see **Section 1.1** for detail).

The EIA has been undertaken with regard to the following legislation and guidance:

- European Council Environmental Impact Assessment (EIA) Directive 2011/92/EU of 13th December 2011 on the assessment of the effects of certain public and private projects on the environment and as amended by Directive 2014/52/EU of 16 April 2014.
- *Environmental Impact Assessment - Guidance on EIA Screening* (Directive 2011/92/EU) (European Commission, 2001).
- *Environmental Impact Assessment - Guidance on EIA Scoping* (Directive 2011/92/EU) (European Commission, 2001).
- *Environmental Impact Assessment of Projects. Guidance on Screening (Directive 2011/92/EU as amended by 2014/52/EU)* (European Union, 2017).
- *Environmental Impact Assessment of Projects. Guidance on Scoping (Directive 2011/92/EU as amended by 2014/52/EU)* (European Union, 2017).
- *Environmental Impact Assessment of Projects. Guidance on the preparation of the Environmental Impact Assessment Report* (Directive 2011/92/EU as amended by 2014/52/EU) (European Union, 2017).
- Aquaculture (Licence Application) (Amendment) Regulations 2010 (SI 280 of 2010).
- *Advice Notes for Preparing Environmental Impact Statements Draft September 2015* (EPA, 2015).
- *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports Draft August 2017* (EPA, 2017).
- *Guidance Notes for applicants for an Aquaculture Licence and Foreshore Licence for a single specific site* (DAFM, 2014); and

- *Environmental Impact Assessment – Workshop Guidance Document on the Renewal/ Review of Marine Finfish Aquaculture Licences* (BIM, 2016).

1.4. Environmental Impact Assessment Process

Implementation of EIA as an instrument to protect the environment was initially brought into force through the European Council (EC) Directive 85/337/EEC which was amended by EC Directives 97/11/EC, 2003/35/EC, and 2009/31/EC all of which are codified within Directive 2011/92/EU of 13th December 2011 (herein referred to as the 2011 Directive). The 2011 Directive was subsequently amended by Directive 2014/52/EU (herein referred to as the 2014 Directive). Specifically, EIA requires that any project, which is likely to have significant impact (positive or negative) on the environment by virtue, inter alia, of its size, nature or location is subject to a full assessment of effects upon the natural and human environment.

Under Article 3 the 2011 Directive the EIA process must identify, describe, and assess likely effects (positive and negative) of a proposed development on the following factors:

- **a.** human beings, fauna, and flora.
- **b.** soil, water, air, climate, and the landscape.
- **c.** material assets and the cultural heritage.
- **d.** the interaction between the factors referred to in points **a**, **b,** and **c**.

Under the 2011 Directive the findings of the EIA are presented in an Environmental Impact Statement (EIS) that summarises the full EIA process including descriptions of baseline conditions, project activities and alternatives, assessed project impacts, mitigation measures, and residual risks.

Under Article 5(3) of the 2011 Directive, an EIS must include the following:

- **a.** a description of the project comprising information on the site, design, and size of the project.
- **b.** a description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects.
- **c.** the data required to identify and assess the main effects which the project is likely to have on the environment.
- **d.** an outline of the main alternatives studied by the developer and an indication of the main reasons for his choice, taking into account the environmental effects.
- **e.** a non-technical summary of the information referred to in points **a** to **d**.

The 2014 Directive, which came into effect on 16th May 2017 and was subsequently adopted and transposed into Irish Law on 1st September 2018, sets out a variety of changes to the 2011 Directive.

The 2014 Directive uses the term 'Environmental Impact Assessment Report' (EIAR) for what was formerly referred under the 2011 Directive as an EIS. To strengthen the EIA procedure the 2014 Directive redefined subject matters to be used in the assessment of the potential effects of proposed projects on environment factors. The subject matters in the 2014 Directive fully address subject matters defined in the 2011 Directive. Specifically, the subject matters defined in the 2014 Directive, are:

- **a.** population and human health.
- **b.** biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC.
- **c.** land, soil, water, air, and climate.
- **d.** material assets, cultural heritage, and the landscape; and
- **e.** the interaction between the factors referred to in points **a** to **d**.

The 2014 Directive also outlines that an EIAR should contain.

- **a.** description of the project.
- **b.** description of the likely significant effects of the project on the environment. Effect to be described include direct, indirect, secondary, cumulative, short, medium, and long-term, permanent, and temporary, positive, and negative.
- **c.** description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment; and
- **d.** description of the reasonable alternatives studied by the developer.

The EIA of the current aquaculture licence renewal has taken into account the 2011 Directive and the 2014 Directive. This report, which summarises the full EIA undertaken, has been presented according to the requirement defined for an EIAR in 2014 Directive.

The obligation to conduct EIA under Irish law arises under Section 172(1) of the Planning and Development Act 2000 (as amended). The European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018) transpose the requirements of EIA 2004 Directive, amending previous 2011 Directive, into planning law. The current proposal is a project as understood by Article 1(2) of the 2011 Directive and the 2014 Directive as it involves the execution of installations, and it is an Annex II project type (Project 1(f) *Intensive fish farming*).

Part II of Schedule 5 of the Planning and Development Regulations, 2001 (as amended sets out the thresholds for the requirement for EIA for Annex II project types in Ireland. The thresholds are set at levels that distinguish between those projects which, by virtue of their nature, size, or location, would be likely to have significant effects on the environment and those which would not. The current project exceeds the threshold set for *Seawater fish breeding installations with an output which would exceed 100 tonnes per annum.*

Regulation 5 of the Aquaculture (Licence Application) Regulations 1998 (as amended) requires that an application under Section 10 of the Fisheries (Amendment) Act, 1997 for an aquaculture licence in respect of seawater salmonid breeding installations shall be accompanied by an EIS. Aquaculture licensing is administered through the Aquaculture and Foreshore Management Division (AFMD) of the DAFM. DAFM have clarified that this applies to applications for renewal/ review of existing licences (BIM, 2016).

1.5. Aquaculture Licence Application Process

This report which summarises the EIA process undertaken for the current application has been prepared to assist the AFMD of the DAFM in carrying out its EIA and reaching a decision with respect to the renewal of finfish aquaculture licence for the Inishfarnard sites and the request to change the boundaries of the site and the operating conditions attached to the licence.

Once an application goes to Public Notice the relevant documentation will be available on the DAFM website and interested parties and the public will have the opportunity to comment on applications and these comments will be duly considered before a licensing decision is made.

1.6. Environmental Impact Assessment Consultation

A consultation procedure is adhered to as required for an EIAR; this consists of submitting an EIAR to the DAFM. The DAFM will then send the report to relevant statutory consultees e.g., Marine Institute, Inland Fisheries Ireland, National Parks, and Wildlife Services.

Once the DAFM and relevant statutory consultees approve that all sections of the report have been successfully covered the EIAR will be made available for public consultation in accordance with advice issued by DAFM and a notice is published in the local papers to alert the public.

1.7. Environmental Impact Assessment Team

The EIA has been reported here by AQUAFACT International Services Ltd. Members of the Project EIA and Design Team and their responsibilities can be seen in **Table 1.1**.

Table 1.1: EIAR Team

Environmental Subject Matter/ Topic	Compilation of EIAR Chapter	Consultant
Population and Human Health (see **Section 5**)	AQUAFACT	AQUAFACT
Biodiversity (**Section 6**)	AQUAFACT	AQUAFACT
Land and Soils (**Section 7**)	AQUAFACT	AQUAFACT
Water (**Section 8**)	AQUAFACT	Hydro Environmental Ltd.
Air and Climate (**Section 9**)	AQUAFACT	AQUAFACT
Noise (**Section 10**)	AQUAFACT	AQUAFACT
Material Assets (**Section 11**)	AQUAFACT	AQUAFACT
Cultural Heritage and Archaeology (**Section 12**)	AQUAFACT	David Boland
Landscape and Visual Resources (**Section 13**)	AQUAFACT	AQUAFACT
Cumulative Impacts (**Section 14**)	AQUAFACT	AQUAFACT

2. Site Description/ Existing Environment

The Inishfarnard site is located off the uninhabited Inishfarnard Island in Coulagh Bay on the southern shoreline of outer Kenmare Bay (**Figure 1-1**). Salmon production has been operating at the site since 1995. Between 1995 and 2004 the operations at the site were undertaken by three operators namely, Silver King Seafoods Ltd., Murpet Fish Ltd. and Gaelic Seafoods (Ireland) Ltd. Since 2008 the site has been operated by Comhlucht Iascaireachta Fanad Teoranta.

The following sections describe the operations that will be undertaken at the site should DAFM approve renewal of the licence, approve the change the site boundary and permit a production level MAB of 2,177 tonnes at the site. Subject to approval of the licence renewal application the Inishfarnard site will be used as a smolt grower and harvest site with no transfer of fish until harvest unless there are stock health complications.

2.1. General Location

The site is located on the eastern side off Inishfarnard Island less than 1km from the Cork coastline at Kilcatherine Point. The location of the aquaculture site in the lee of Inishfarnard Island (see **Figure 2-1**) provides shelter to the site from westerly and southerly swells. The seabed under the site is primarily flat and predominantly consists of sand (ranging to fine and medium sand) with some coarse shelly and gravel material.

The spring tidal range in the bay is typically 3.5m while neap tides range from approximately 1.6m to 1.8m. The flooding tide off the Kenmare Bay headland runs north northwest and the ebbing tide runs south. Tidal flows in Kenmare Bay and the adjoining Coulagh Bay are slack particularly on neap tides due to the orientation of the bay and the relatively deep waters in the area particularly at the mouth to Kenmare Bay. Water depths in the Coulagh Bay are variable and generally less than 30m. Water depths in the main outer channel range from approximately 60m to 75m near the mouth of the bay. Water depths in the west of the site towards Inishfarnard Island and northwards towards the Cork shoreline vary from 15m to 30m. Water depths increase southward away from Inishfarnard island and towards the mouth of Coulagh Bay. Average water depths over the proposed licensed site area are 25.3m below mean sea level. Water depth at the midpoint of the site is approximately 28m. Neap and spring tide drogue surveys of the tidal stream flows at the Inishfarnard site were conducted in 1997. The drogue surveys found that minimum current magnitudes at the Inishfarnard site occurred around the turn of the tide and ranged from 0.02m/s to 0.07m/s with a maximum current speed mid-flood period ranging between 0.05m/s and 0.26m/s.

2.2. Pen Layout at the Proposed Site

A maximum of 16 pens will be deployed at the site. The layout of the proposed pens at the site is shown in **Figure 2-1** alongside coordinates for the corner points of the proposed site. The pens will have a 126 m circumference, a 40.1 m diameter. Aerial and cross-sectional drawings of the pens are shown in **Figure 2-2** through **Figure 2-5**. Due to water depth, both pens in Section A-A and two pens in Section B-B display a net wall depth of 8 m and a depth to cone of 17 m. The remaining pens have a net wall depth of 11 m and a depth to cone of 20 m. The pens will be supported with heavy-duty polyethylene or steel base frames set at regular intervals around the floatation ring, upon which stanchions will be mounted to support the heavy-duty handrail that runs around the pen (**Figure 2-6**). Pen nets, mooring bridles, and sinker ropes (if required) and seal nets (if required) will be supported off the base frames of the floatation ring. Fence nets and bird (top) nets will be supported off the handrails and stanchions.

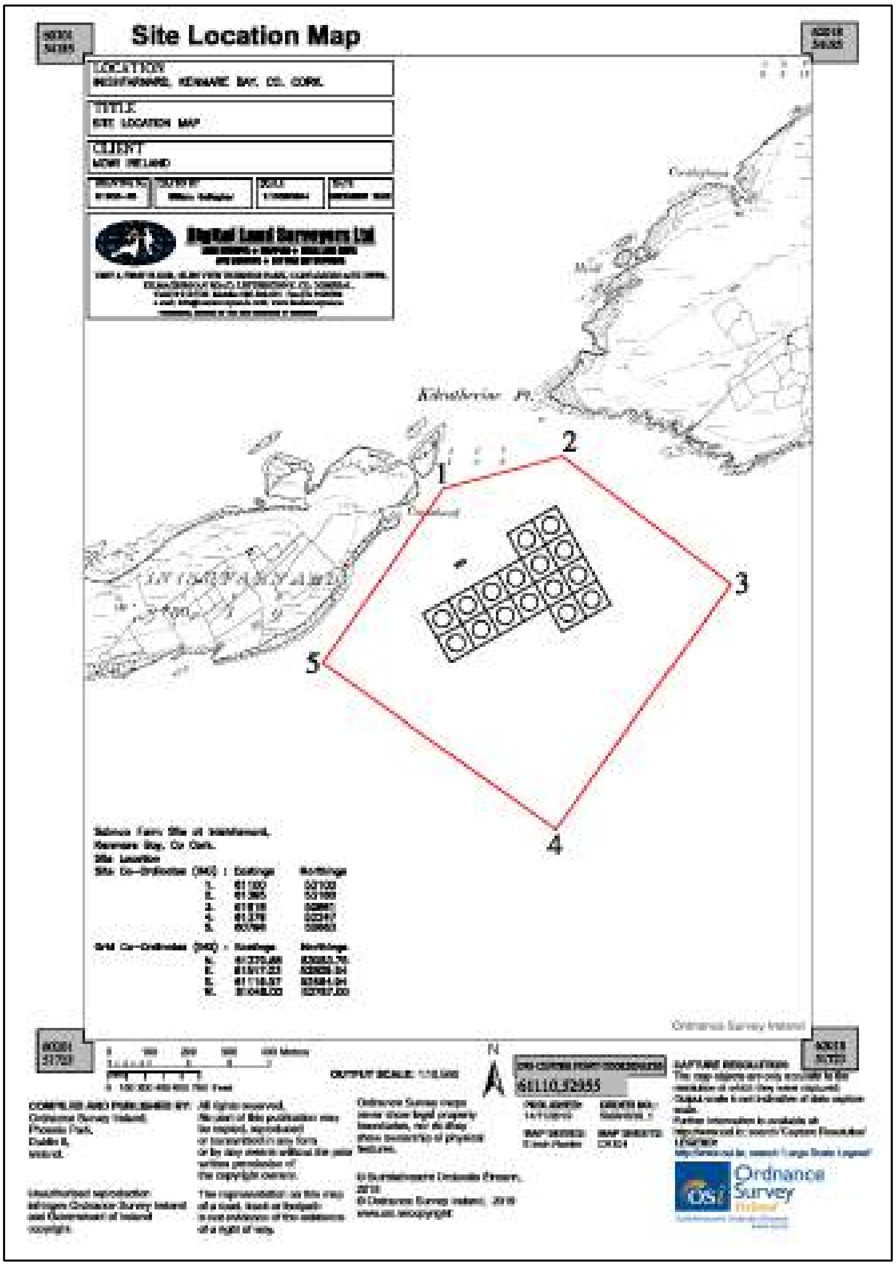

Figure 2-1: Proposed pen and farm layout at the renewed Inishfarnard site.

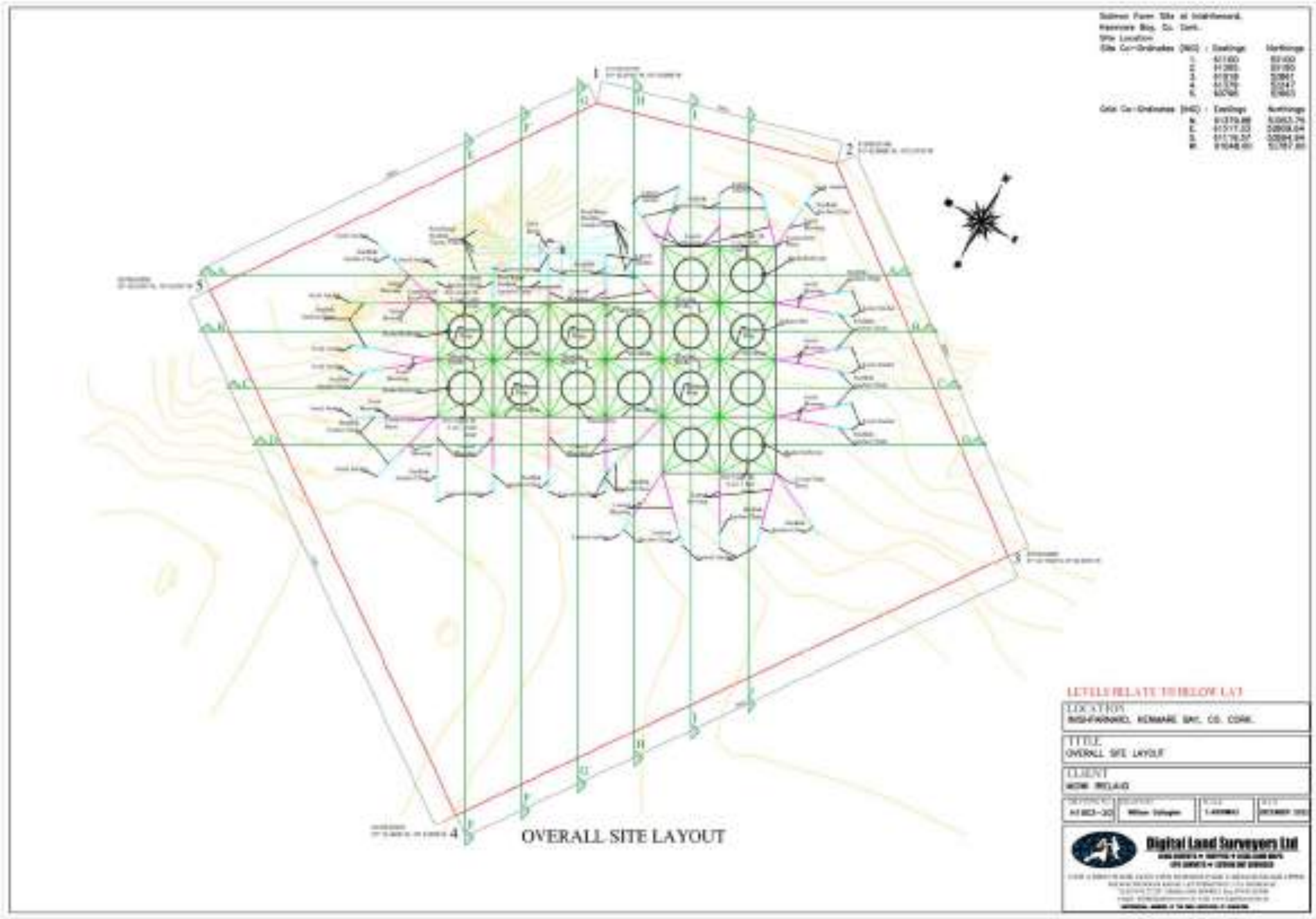

Figure 2-2: Aerial view of pen layout

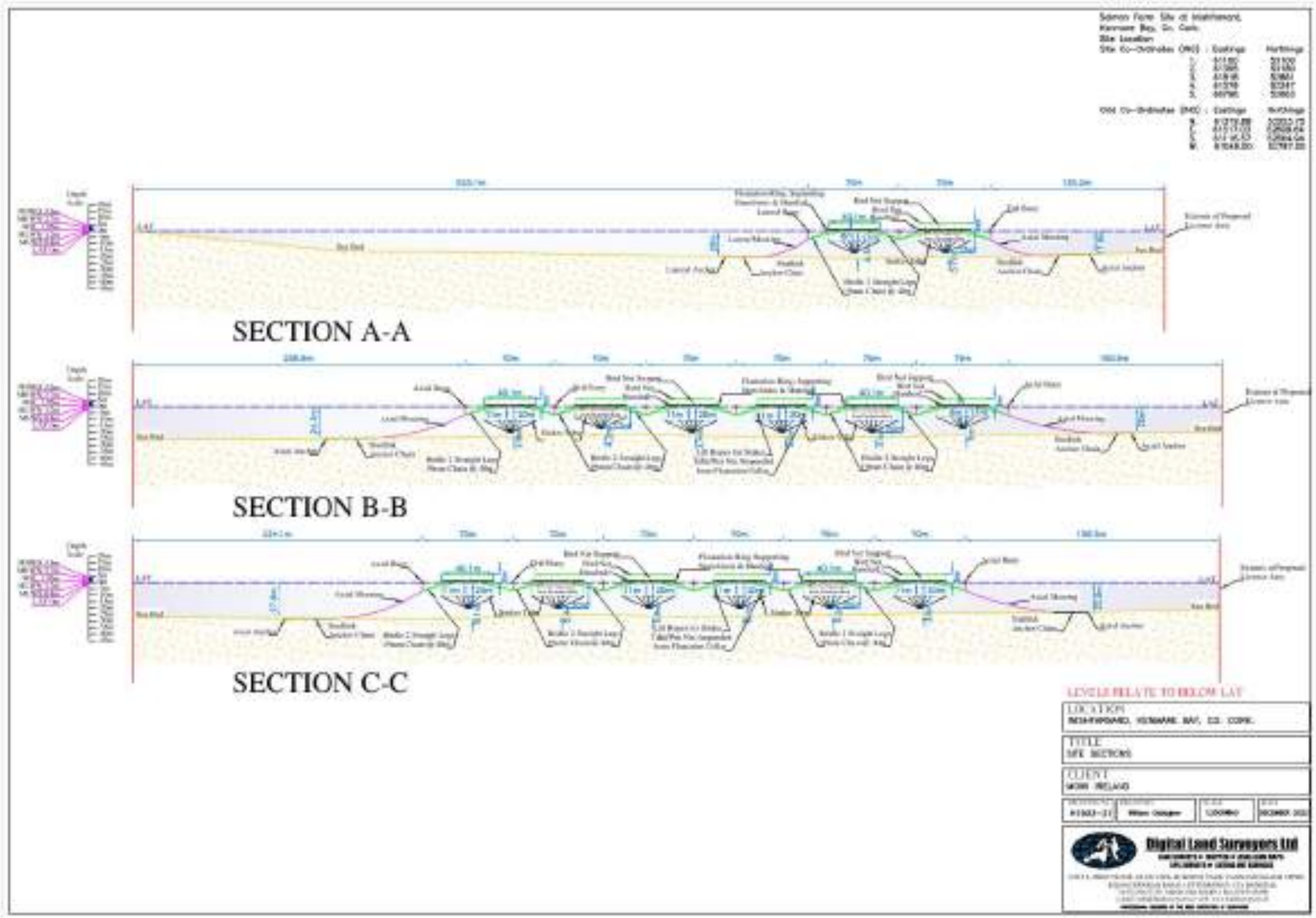

Figure 2-3: Cross-section of pen layout.

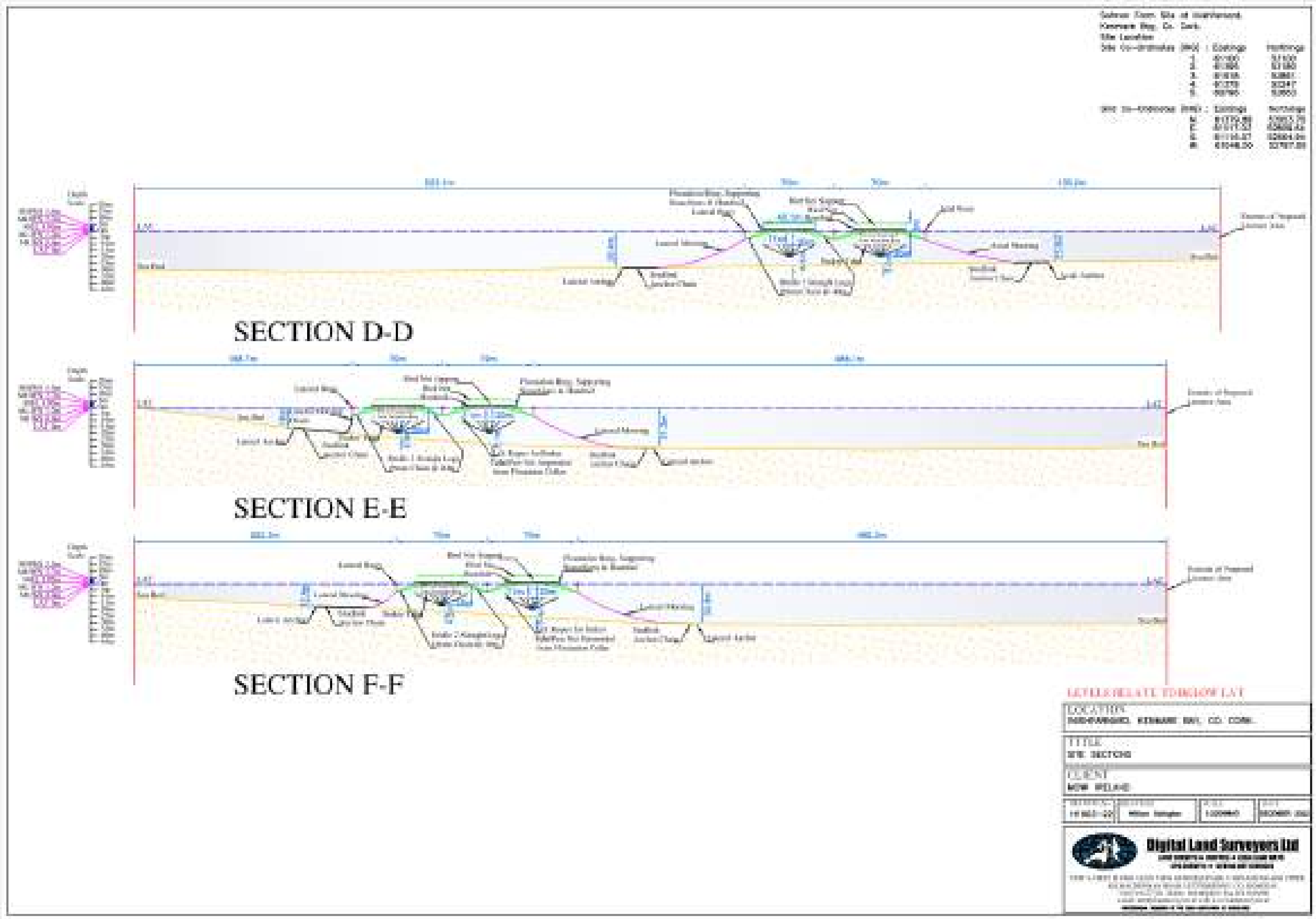

Figure 2-4: Cross-section of pen layout.

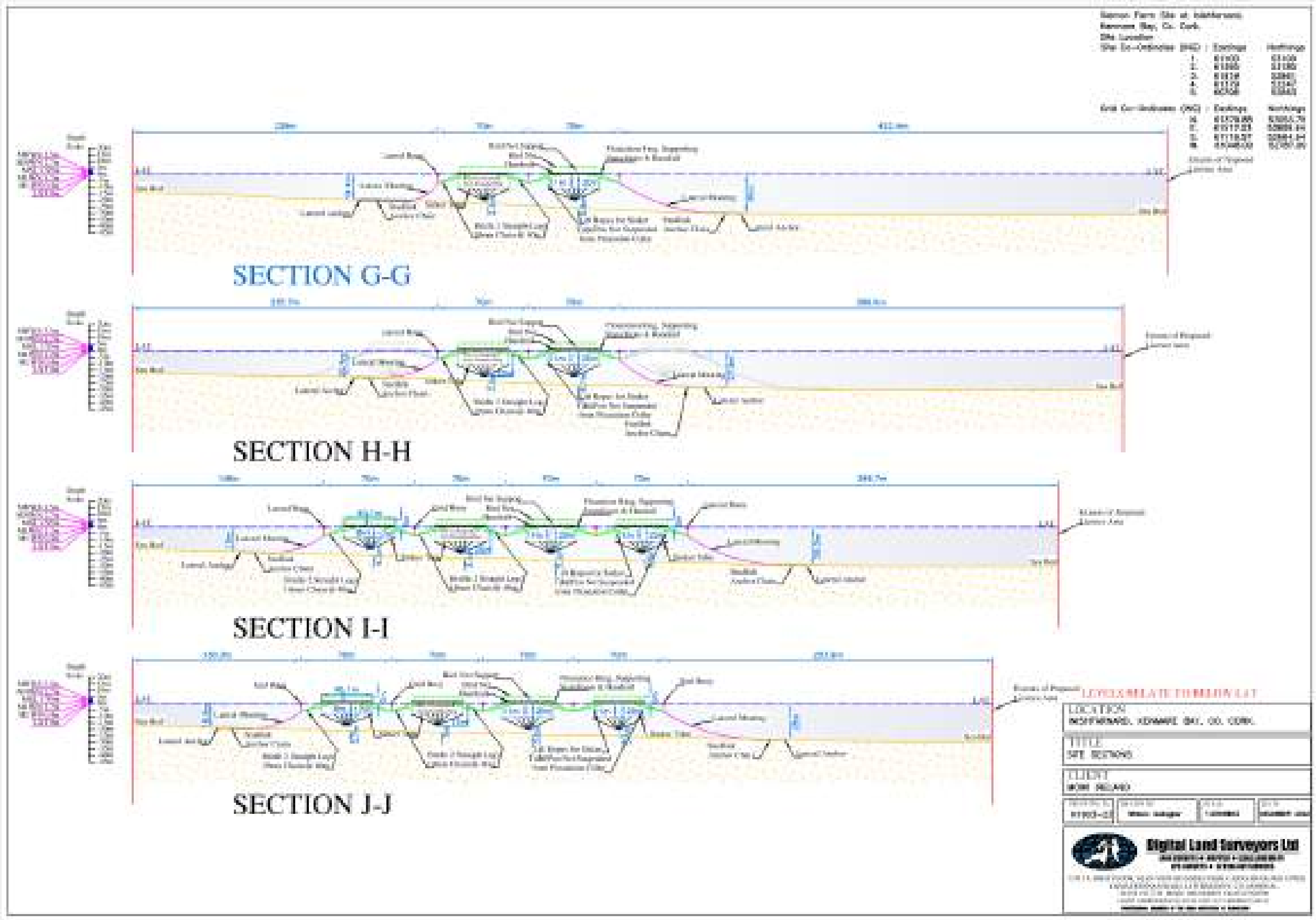

Figure 2-5: Cross-section of pen layout.

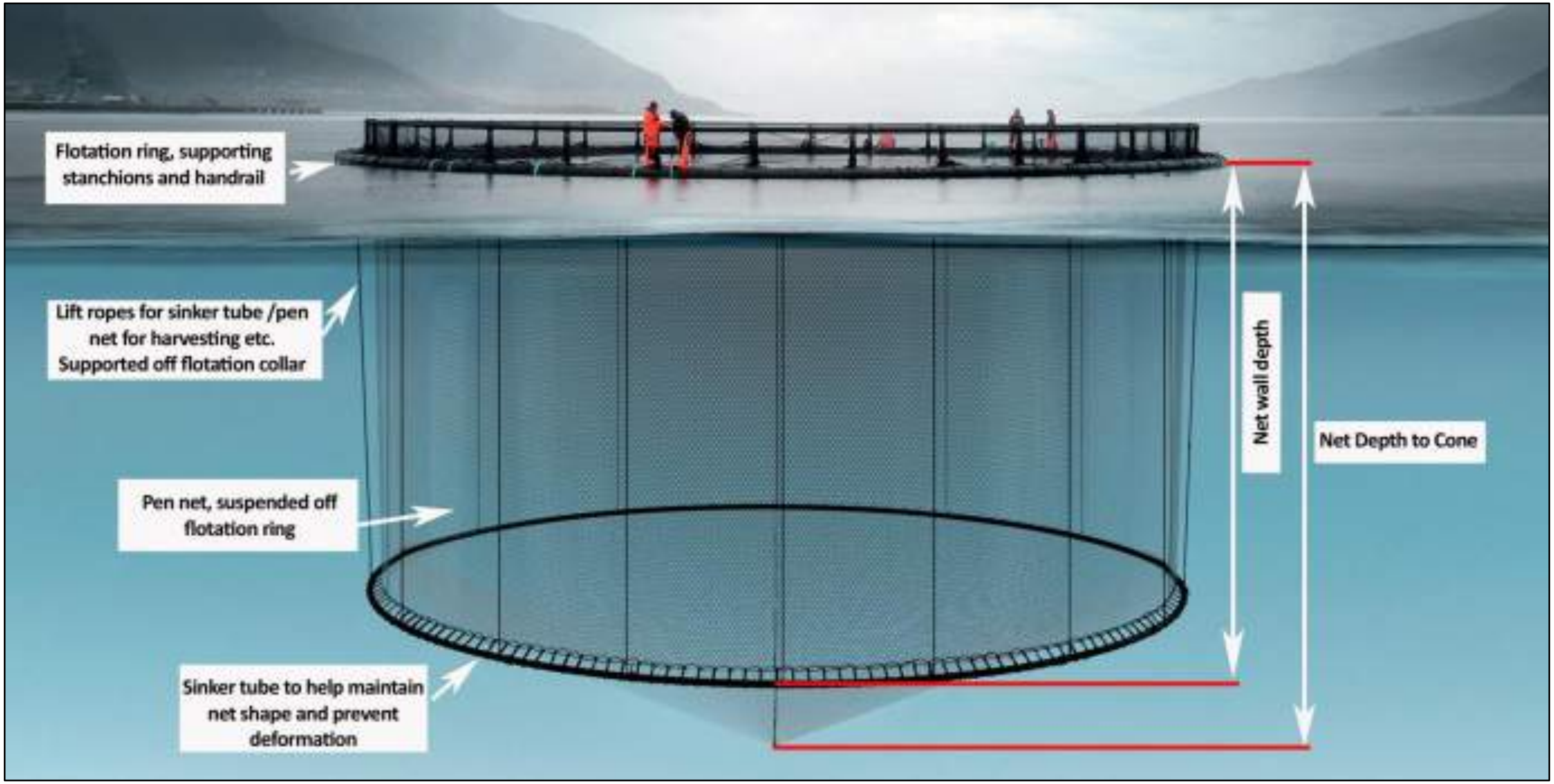

Figure 2-6: Image showing the general nature of the pen type proposed for the Inishfarnard site (Source: Akvagroup; modified from www.akvagroup.com).

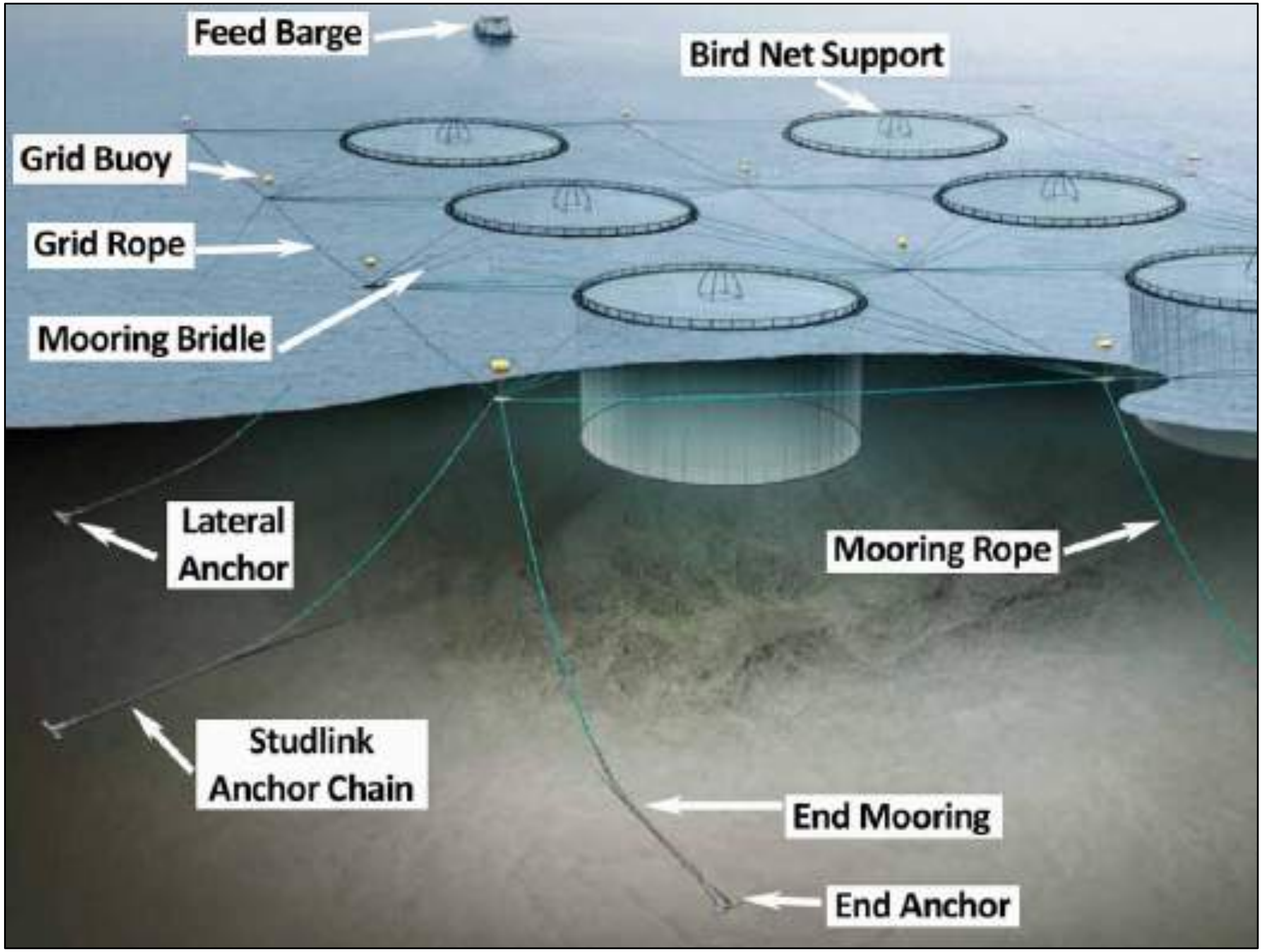

Figure 2-7: Generalised pen and farm layout with associated moorings (Source: Akvagroup; modified www.akvagroup.com).

2.3. Pen Moorings

Each pen will be attached to a pen floatation ring and held in place in a mooring square with squares secured together in a mooring grid. There will be four sets of mooring bridles on each pen ring. The mooring grid is a heavy-duty rope-work structure comprising a series of squares, each of which supports a pen. In this case, the mooring grid will be submerged so that farm work vessels can pass freely across it. At every grid square corner, there will be a grid buoy supporting the grid. These are also the points at which the mooring bridles, which support the pen floatation rings within the grid squares, join the grid. The grid is then held in shape, submerged and in tension by moorings which, in turn, are anchored to the seabed. Lateral moorings join the grid at every square corner down each side of the grid, while end (axial) moorings join the grid on every square corner at the ends of the grid. The moorings for the sites are shown in **Figure 2-8** and **Figure 2-9**.

The shape of the grid will be maintained by the tension provided through the grid moorings. Each mooring assembly will comprise a heavyweight braided nylon rope running from each grid corner, which will be attached to a length of heavy-duty stud link anchor chain of specified weight, which will join in turn to an anchor of specified design and weight. The purpose of the stud link chain is to maintain the tension on the grid with changing tidal water depths. Lateral and axial anchors will be a combination of 1,000 and 1,500 kg plough anchors. Mooring bridles will be used to connect the four corners of each grid square to the pen floatation ring. This will maintain the position and shape of the pen floatation ring within the grid square with minimal deformation, even in adverse sea conditions.

Radar reflectors and navigational lights (4 sec 2 mile) will be positioned on the four corners of the grid block. Corner site buoys with navigational lights (4 sec 2 mile) will be located at the corners of the licensed site. Grid moored systems require the application of more or less even tension on all moorings to keep the grid taught. Tension is maintained by the use of adequate moorings, anchor chains and anchors to suit seabed and hydrographic conditions and the dimensions of the system. Grid frame integrity is checked biennially by divers.

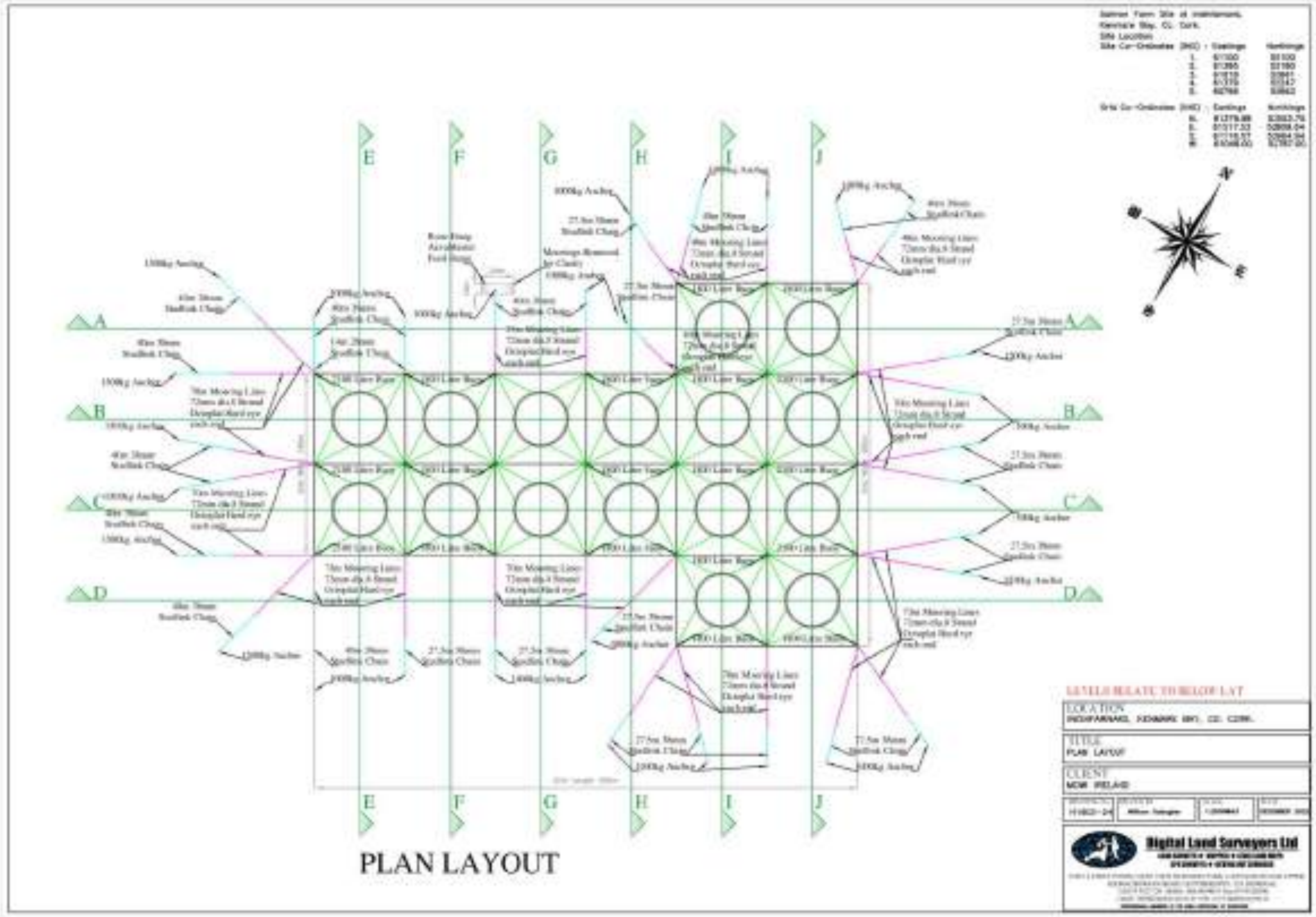

Figure 2-8: Moorings at the Inishfarnard site.

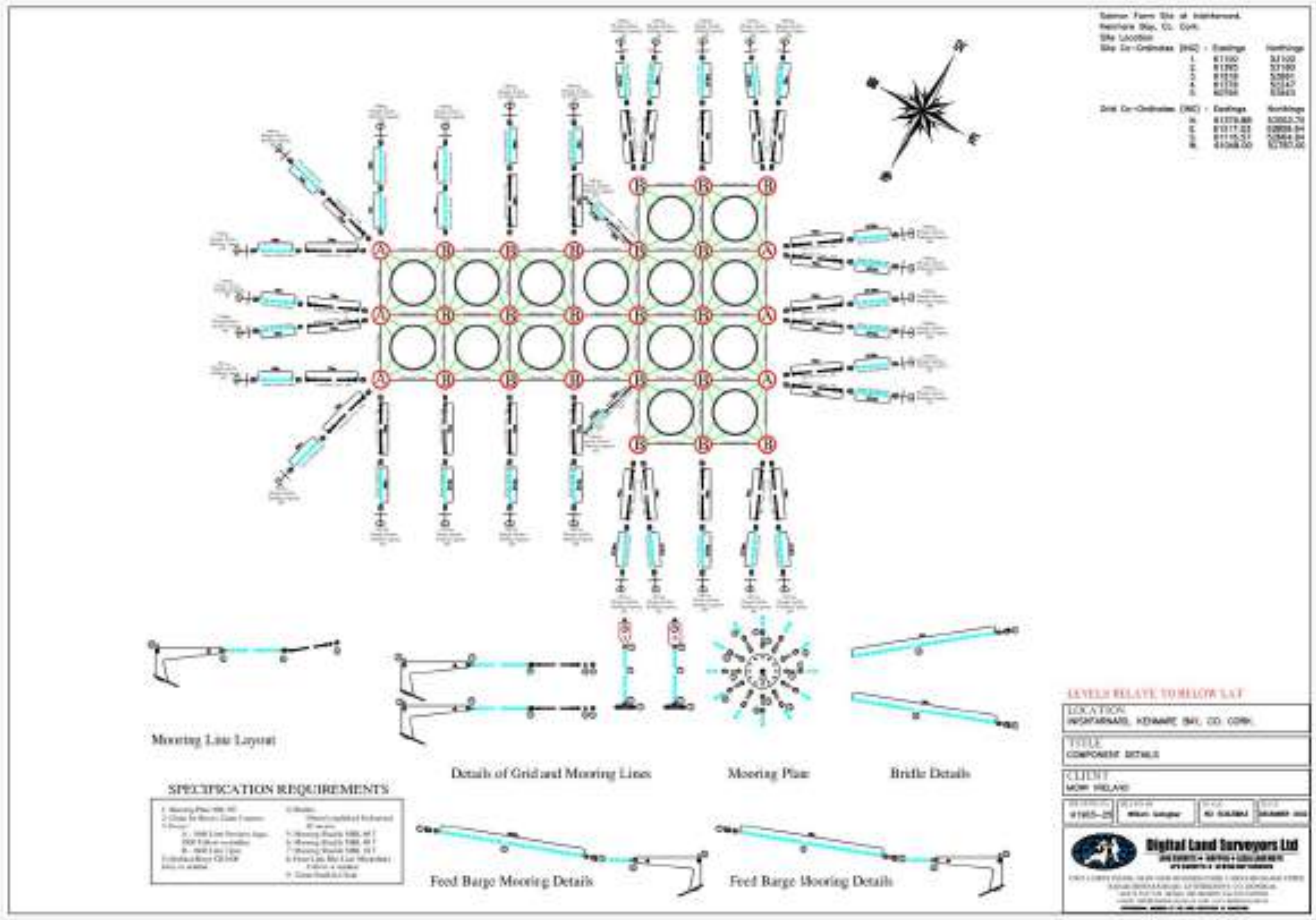

Figure 2-9: **Moorings at the Inishfarnard site**

2.4. Nets

Nets will be made of knotless nylon sheeting. In compliance with organic standards, no net antifouling treatment will be used. Smolt nets, with a smaller mesh size than grower nets, will be installed at the beginning of the cycle. These will be made of 210/96 Nylon IRC 460g/m^2 braided twine, with a 16 mm mesh. The smolt nets will be changed in the late spring after about six months and replaced with grower nets, made of 210/150 Nylon IRC 500g/m^2 braided twine with a mesh size of 22mm-25mm. Nets will be cleaned *in-situ* on a regular basis throughout the growth cycle using a 7-head K-188-30 Idema net cleaner, linked to an Idema K-188-399-SD-JD-150, 150hp diesel-powered pressure washer. The cleaning head is raised and lowered up and down the sidewalls of the pen using a jib and capstan, also mounted on the vessel. The net washing system and mode of operation can be seen in **Figure 2-10**.

Net cleaning and Idema washer maintenance are carried out as per *SOP25468* which is included in **Appendix 2.2**. Nets will only be changed when the need arises. Regular diver inspections will check for net damage. Minor repairs are generally made by divers *in situ* whilst washing, disinfection and larger repairs are carried out either in the company's shore-based facility at Ballycrovane Pier or at Dinish Island, Castletownbere. Net checking, changing, and mending will be carried out as per *SOP28941*, *SOP26166* and *SOP28646* (see **Appendix 2.2**).

At the end of each cycle, the fish pens are recovered to shore for maintenance.

Dark-coloured bird (top) nets will be used to protect the stock against bird predation throughout the life cycle.

2.5. Shore Based Facilities

Figure 2-11 shows the access routes to and from the site from local roads and piers. Feed storage, diving and staff facilities will be located at the Cork County Council pier at Ballycrovane. The pier will be the access point for service vessels to and from shore and will serve as the mooring point for vessels when not in use.

Vessels that may be travelling between multiple locations (such as the well boat) have the potential to transfer Invasive Alien Species (IAS), such as *Didemnum*, *Styela*, *Undaria etc*., from one location to a new location. The MV Grip Transporter Well boat is chartered for MOWI use only. It is registered on the Aquaculture Animal Transport Register as a 'Specialist Transporter' in compliance with SI No. 261 of 2008 regarding the Health of Aquaculture Animals and products (https://www.fishhealth.ie/fhu/moving-fish-shellfish/transporting-aquaculture-animals). As a specialist transporter, the well boat is obliged to comply with water exchange rules and biosecurity management and cleaning protocols which includes the external surfaces of the vessel.

The size and nature of traffic to and from the site will consist of 7-10 MOWI employees (7 full time on site with remaining fish health, operations/maintenance and admin staff split between 4 other sites) and approximately 11 contracting staff. During harvesting this will increase by a further 6 due to the presence of MOWI harvest crew on the MH Christina R harvest vessel.

A 22-ton articulated lorry operated by O'Callaghan transport will bring feed to the site at a minimum of once per week (maximum of four times per week). An approved ABP transporter will collect mortalities a minimum of once per week, the interval depending on the rate of mortality at the sites. Additional traffic will occur during harvesting when an articulated lorry brings the fish to the processing factory, the regularity depending on the harvest schedule.

Figure 2-10: Net cleaning with the IDEMA net washer (© Akvagroup; www.akvagroup.com).

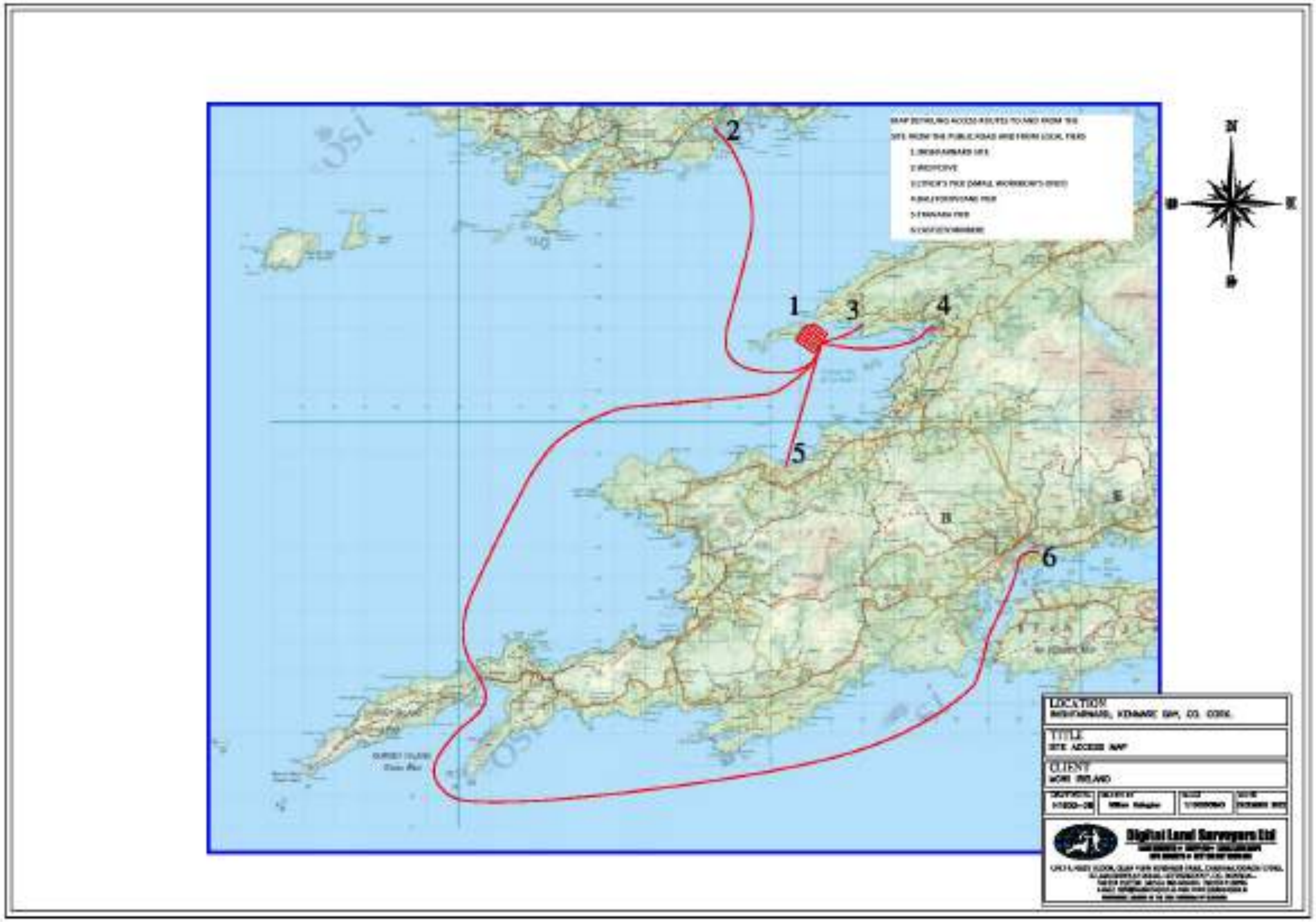

Figure 2-11: Access routes.

2.6. Service vessels

The sites will be serviced by the following vessels:

- 1 x 17m twin engine workboat with 50tm crane.
- 1 x 7m small tender work boat; and
- 1 x 5m PolarCirkel HDPE boat.

These vessels will be used to transfer feed, equipment and crew and will have the capacity to carry out a wide range of day-to-day farm tasks including towing, anchor handling and net changing.

The well boat, MV Grip Transporter is under long-term lease to MOWI and is used for smolt transfer, counting, grading, bath treatment and harvesting (see **Figure 2-12**). The MV Grip Transporter was Norwegian built in 1993 and is 60.4 m in length, with a beam of 11m and a draught of 4.45 m. A reduced 969KW Caterpillar main engine powers the vessel, with a 93 KW Caterpillar auxiliary engine. The vessel has a total well tank capacity of 1,250 m^3 for fish containment. It has six circulation pumps, considerable water chilling capacity and a 4-channel, 50 kg per hour oxygen/ozone generation system. For fish moving, counting, and grading, the vessel is equipped with two 5,000 litre vacuum pumps, two fish counters with a 200 to 300 tonnes per hour capacity and a 100-300,000 smolt per hour counter plus a ten track, three-way grader with separate counters, capable of grading and counting up to 60 tonnes of fish per hour. It is also fitted with six deck cranes of up to 24 tonne-metre lift. This vessel will be moored at Killybegs, Co. Donegal.

Figure 2-12: The proposed well boat MV Grip Transporter (© Magnar Lyngstad, MarineTraffic.com).

2.7. Production Model

The production cycle at the site will be 24 months long that includes fallowing and will operate under a policy of strict separation of generations, with an 'all in all out' model with no movement during the grow-out phase.

Table 2.1 shows the production and harvest models for the Inishfarnard site. Approximately 650,000 smolts with an average weight of 75g will be added to the pens at the beginning of each 24-month cycle. The smolts will be S1 stock of Fanad/ MOWI strain from the Altan and/ or Pettigo smolt units in Donegal. Smolts will be transferred in accordance with *SOP25478* with stock development monitored in accordance with *SOP25451* (**Appendix 2.3**). Following transfer, the smolts will grow out to an approximate mean weight of 2.5 kg in approximately 13-14 months post transfer. After this time, they will be counted, graded, and redistributed in preparation for harvest (fish may not always be counted at grading, particularly if passive grading is employed (*SOP30997*)). The proposed site is projected to hold a maximum total biomass onsite of approximately 2,200 tonnes (model estimate 2,177 tonnes highlighted in yellow in **Table 2.1** at peak stocking density of ≤ 10kg/m^3). Model estimate of 9.5kg/m^3 illustrated in red text in **Table 2.1**.

Peak biomass will occur between June and July of Year 2 in each production cycle (see **Table 2.1**). Mean harvest weight is expected to range between 4.5kg and 5.6kg. Projected harvest mean fish weight (based on MOWI standard growth data) can be seen in **Figure 2-13** while mean weight growth for one production cycle is shown in **Figure 2-14.** Mortality levels throughout the production cycle are estimated at 19.2%. Harvesting will begin in July of year 2, approximately 17 months after the smolts were transferred to the site.

Harvesting will take place on board a harvest vessel at sea (dead haul) and will then be transferred to the processing factory in Rinmore, Co. Donegal via articulated lorry in insulated 30m^3 Food Grade Tankers. The total harvest weight of 2,672 tonnes (model est. 2,671.9 tonnes) of salmon will be completed by the end of December (month 22), some 6 months later.

The mean cycle Feed Conversion Rate (FCR) for the stock held at T5/233 is projected to be 1.25:1 (see **Table 2.1**). Essentially, 1.25 kg of dry, proprietary salmon feed will be required to achieve each 1 kg growth of salmon (as wet weight). This FCR is readily achieved using modern salmon feeds and feed application technology. FCR is the most influential parameter in the growth of stock and in the discharge of organic wastes from salmon farm sites. At a mean FCR of 1.25:1, 3,285.1 tonnes of organic salmon feed will be fed to the stock in each production cycle. This is based on the assumptions that 650,000 smolts weighing 48.8 tonnes are inputted to the system each cycle and that the final harvest weight is 2,671.9 tonnes. This means that the weight of the fish produced (or total fish growth) on the site in each cycle will be 2,623.3 tonnes (2,671.9 – 48.8 tonnes). The weight of fish produced (2,623.3 tonnes) multiplied by the FCR of 1.25 results in the requirement for 3,285.1 tonnes of feed. **Figure 2-15** shows the mean biomass gain, feed fed tonnes and FCR for one production cycle.

Table 2.1 shows that the intended maximum stocking density of fish at the Inishfarnard site is 9.5 kg/m^3. This is low by international standards and 1/5 of the peak stocking levels used for salmon in the past. This is in line with animal welfare principles and organic salmon farming standards to which MOWI operate their organic units. The advantage of low stocking densities includes benefits to fish health, survival, scale and fin integrity, growth rate and the evenness of fish weight mean distribution in the pen population. In addition, there will be benefits in more diffuse deposition of settleable solids beneath pens as a result of the lower stock biomass standing over each square meter of seabed.

The site T5/233 will be fallow for 3 months at the end of the harvest period from December of year 2 prior to the input of the next generation of smolts in the following new cycle in March.

Table 2.1: Production cycle for T5/233.

Year	Month	Months growth	Fish number		Mortality		Mean weight gms		Total Biomass T		Mean SD @ per volume 230,165	Biogain / month T	Harvest			FCR	Feed used T / month
			begin month	end month	per month %	number/ month	begin month	end month	begin month	end month			Number	MW kg	Tonnes		
1	Mar	1	650,000	633,750	2.50	16,250	75	101	48.8	64.0	0.3	15.3	0	0	0	0.95	14.5
1	Apr	2	633,750	624,244	1.50	9,506	101	141	64.0	88.0	0.4	24.0	0	0	0	0.95	22.8
1	May	3	624,244	619,250	0.80	4,994	141	198	88.0	122.6	0.5	34.6	0	0	0	1.00	34.6
1	Jun	4	619,250	616,154	0.50	3,096	198	275	122.6	169.4	0.7	46.8	0	0	0	1.10	51.5
1	Jul	5	616,154	613,073	0.50	3,081	275	375	169.4	229.9	1.0	60.5	0	0	0	1.20	72.6
1	Aug	6	613,073	610,007	0.50	3065	375	505	229.9	308.1	1.3	78.2	0	0	0	1.20	93.8
1	Sep	7	610,007	604,517	0.90	5490	505	670	308.1	405.0	1.8	97.0	0	0	0	1.23	118.8
1	Oct	8	604,517	597,263	1.20	7,254	670	880	405.0	525.6	2.3	120.6	0	0	0	1.25	150.7
1	Nov	9	597,263	588,304	1.50	8,959	880	1,130	525.6	664.8	2.9	139.2	0	0	0	1.27	176.8
1	Dec	10	588,304	574,773	2.30	13,531	1,130	1,417	664.8	814.5	3.5	149.7	0	0	0	1.27	190.1
1	Jan	11	574,773	564,427	1.80	10,346	1,417	1,745	814.5	984.9	4.3	170.5	0	0	0	1.27	216.5
1	Feb	12	564,427	561,041	0.60	3,387	1,745	2,120	984.9	1,189.4	5.2	204.5	0	0	0	1.27	259.7
2	Mar	13	561,041	554,308	1.20	6,732	2,120	2,550	1,189.4	1,413.5	6.1	224.1	0	0	0	1.27	284.6
2	Apr	14	554,308	549,874	0.80	4,434	2,550	3,025	1,413.5	1,663.4	7.2	249.9	0	0	0	1.27	317.4
2	May	15	549,874	546,025	0.70	3,849	3,025	3,540	1,663.4	1,932.9	8.4	269.5	0	0	0	1.27	342.3
2	Jun	16	546,025	539,472	1.20	6,552	3,540	4,036	1,932.9	2,177	9.5	244.4	0	0	0	1.27	310.4
2	Jul	17	539,472	447,999	1.20	6,474	4,036	4,534	2,177	2,031.2	8.8	236.4	85,000	4.500	382.50	1.27	300.2
2	Aug	18	447,999	324,415	0.80	3,584	4,534	4,975	2,031.2	1,614.0	7.0	146.7	120,000	4.700	564.00	1.27	186.4
2	Sep	19	324,415	186,819	0.80	2,595	4,975	5,248	1,614.0	980.4	4.3	75.2	135,000	5.250	708.75	1.27	95.5
2	Oct	20	186,819	80,698	0.60	1,121	5,248	5,420	980.4	437.4	1.9	24.0	105,000	5.400	567.00	1.27	30.4
2	Nov	21	80,698	0	0.50	403	5,420	5,544	437.4	0.0	0.0	12.3	80,295	5.600	449.65	1.27	15.6
2	Dec	22	FALLOW														
2	Jan	23															
2	Feb	24															
Totals						124,705						2,623.2	525,295	5.09	2,671.90		3,285.1

Fish numbers / percent summary		
Fish transferred to grower site Nov	650,000	%
Grower site mortality allowance / %	124,705	19.2
Total fish number harvested	525,295	

Harvest / biogain summary tonnes	
Total weight harvested	2,671.9
Transfer weight in, Nov	48.8
Total biogain	2,623.2

Feeding and feed conversion rate summary	
Growout cycle feed	3,285.1
Biogain	2,623.2
Thus overall feed conversion rate	1.25

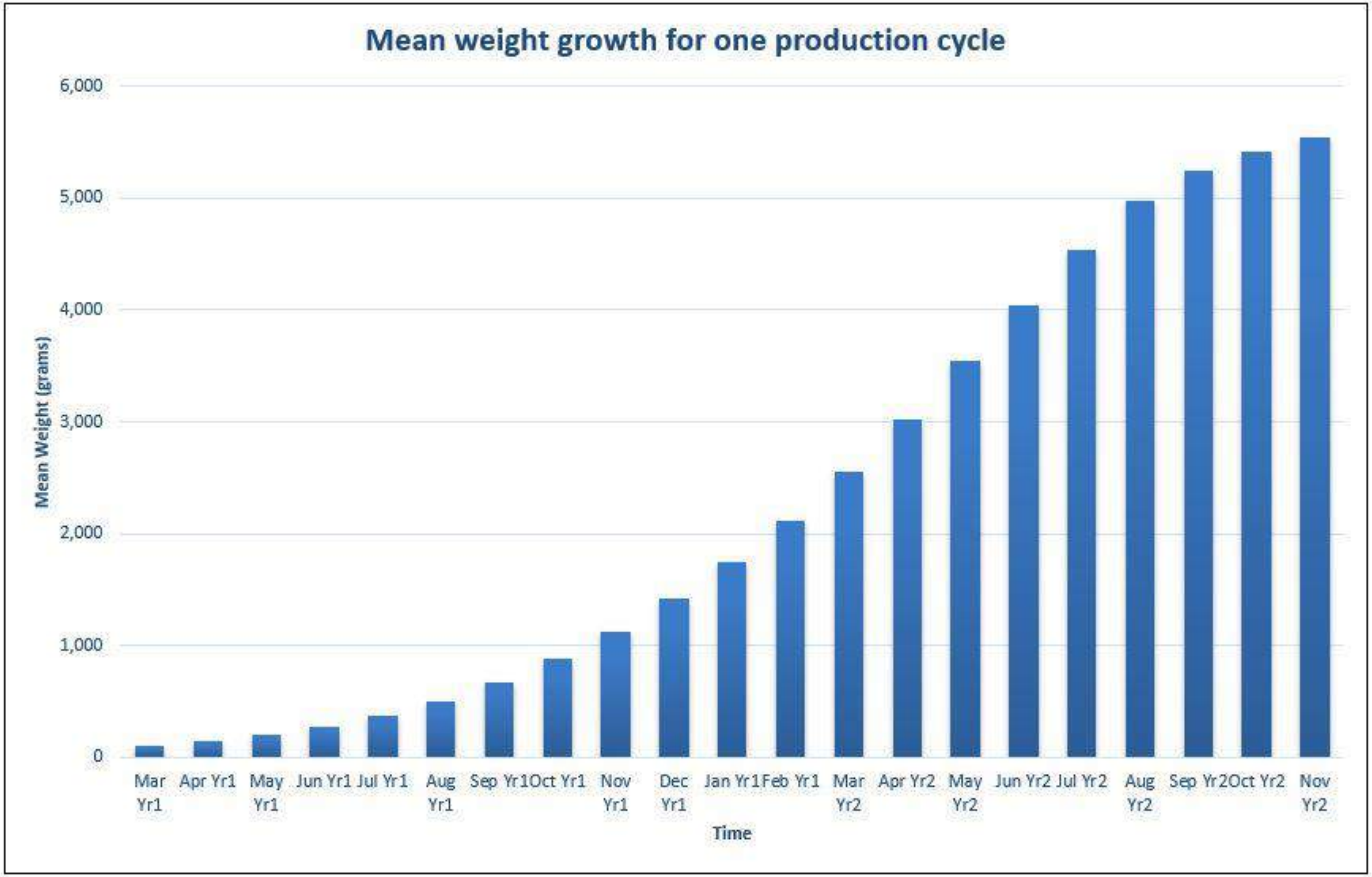

Figure 2-13: Mean weight growth for one production cycle.

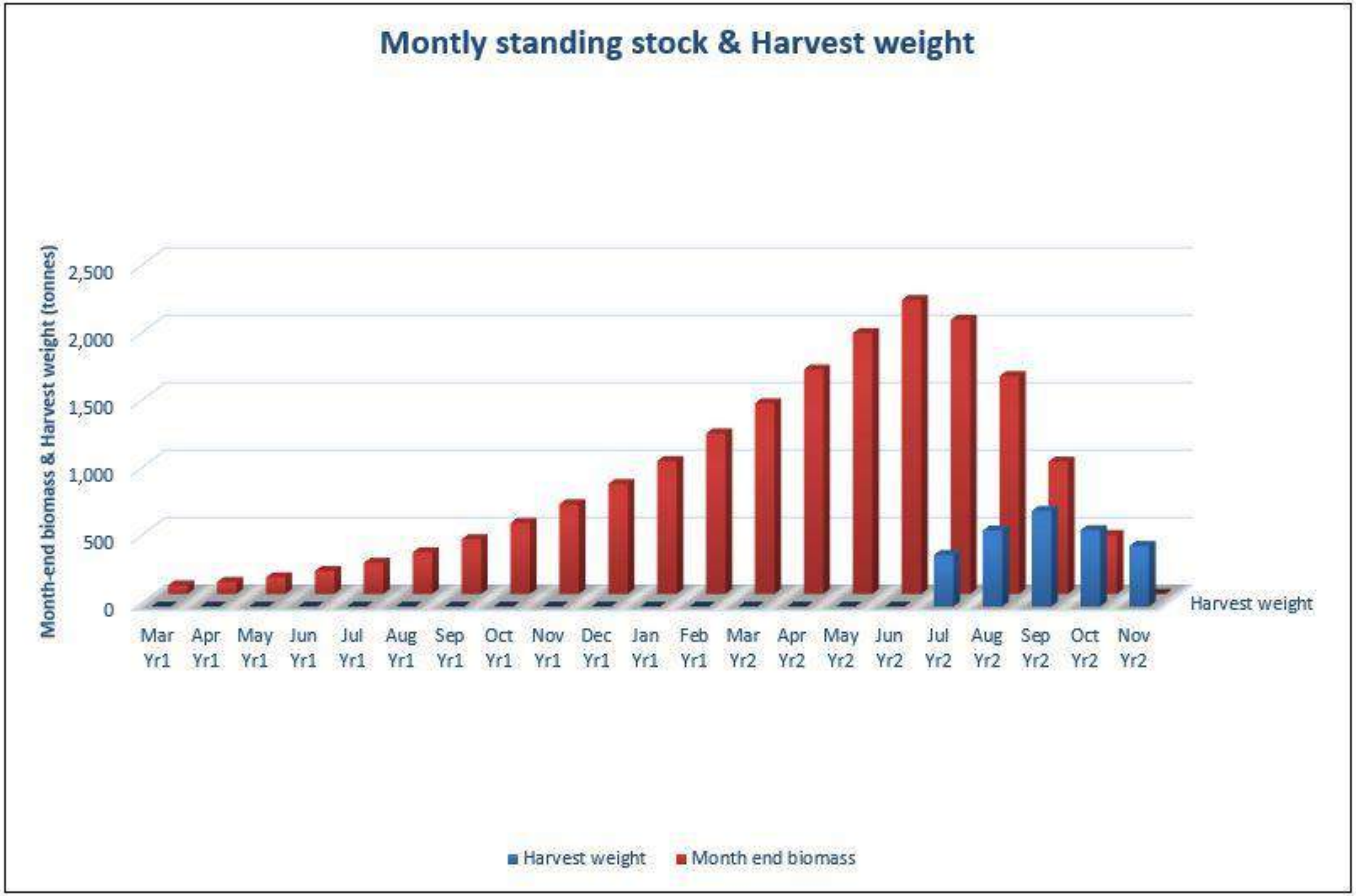

Figure 2-14: Total stock and harvest biomass for one production cycle.

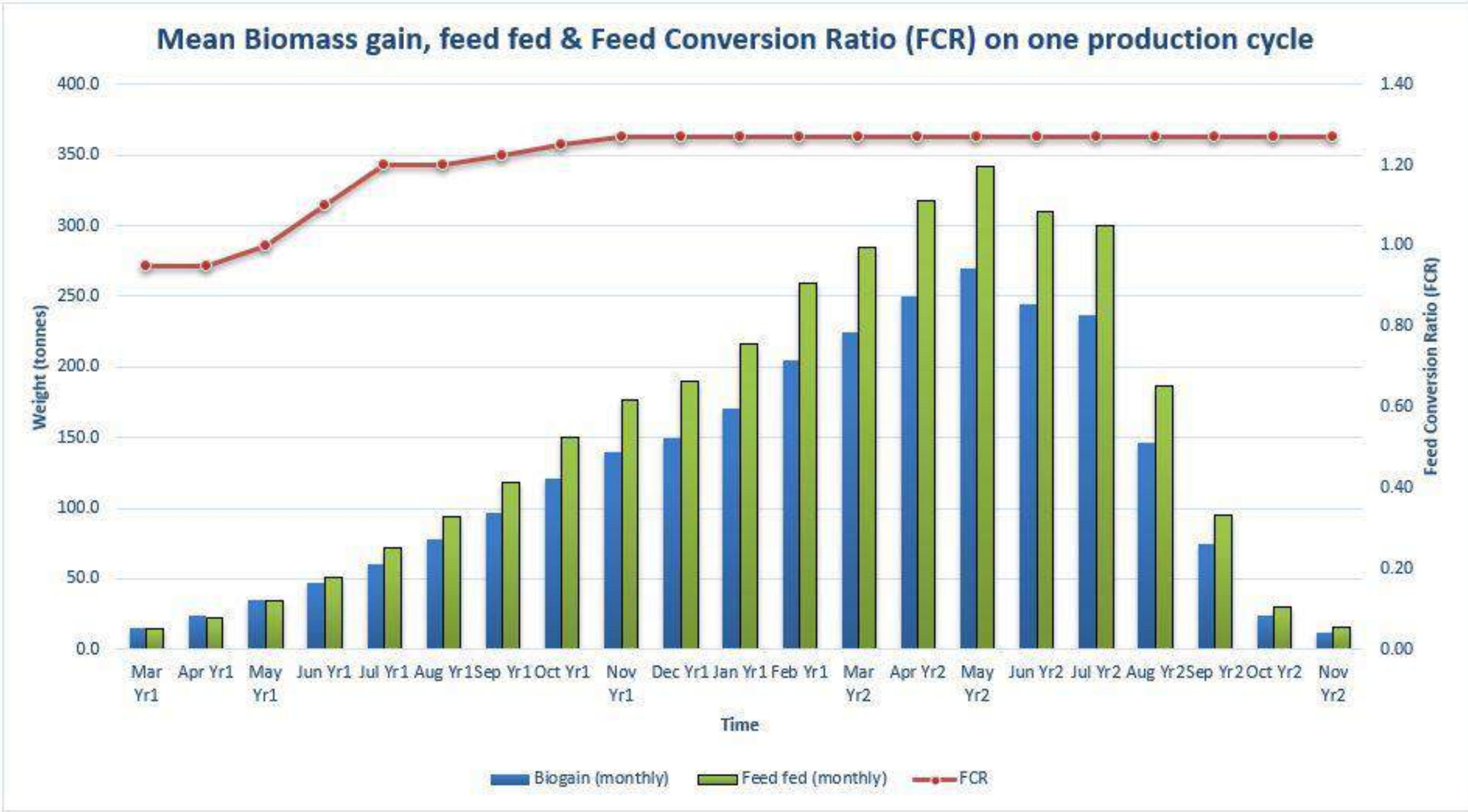

Figure 2-15: Mean Biomass gain, feed fed tonnes and Feed Conversion Ratio (FCR) for one production cycle.

2.8. Feed and Feeding

Salmon at the Inishfarnard farm will be fed commercially available organic salmon diet that comply with EU Directives 834/2007/EC and 889/2008/EC as amended by 710/2009/EC and are certified to the organic standards set by a number of international organic certifiers e.g., Organic Food Federation (UK), Naturland (Germany) and Agriculture Biologique (France).

The main components of the organic diet that will be used are protein 38-46%, lipid/oil 22-32.5%, nitrogen 12-14% and phosphorous 0.9-1%. The constituents of food have changed radically in the last number of years with a higher oil content and lower carbohydrate content which results in a higher digestibility factor and, hence, less waste. In order to meet the requirements of the organic standards, Pearl is produced using a limited selection of raw materials, trimmings derived fish meals and oils, organic plant raw materials, natural pigments, natural antioxidants, and only organic approved vitamins and minerals. In addition, raw materials are specifically sourced in order to meet the full nutritional requirements of the organic fish, without compromising organic approval.

A feed barge/office will be required at the site. The proposed type of feed barge/office is the Akva Master 240 Classic or similar (see **Figure 2-16**). The purpose of the feed barge is to feed the stock automatically throughout the day thereby minimising waste and optimising the Feed Conversion Rate (FCR). The feeding barge will be deployed on the shoreward, most sheltered side of the site and will have a length of 24m and a beam of 10m. The total feed storage capacity of the barge will be just over 400m^3, held in 2 x 63m^3, 2 x 65m^3 and 4 x 37m^3 silos, each with its own feed delivery system. Feed will be delivered by road to Ballycrovane pier and from there to the barge.

It is proposed to use automatic Akva feeders to transfer the feed from the barge to the pens. The system proposed is the Akvasmart CCS feed system or similar with rotor spreaders and underwater cameras (see **Figure 2-17** and **Figure 2-18**). This feed system will feed the correct amount of feed, at the optimal rate, on time and it is fully integrated with camera control, pellet, and environmental sensors and fishtalk production control software. The system is designed to handle more than 40 feed lines running in parallel or a combination of feed lines and regular electric feed hoppers. An SOP for feeding can be found in **Appendix 2.3** (*SOP25453*).

Figure 2-16: Office/feed barge

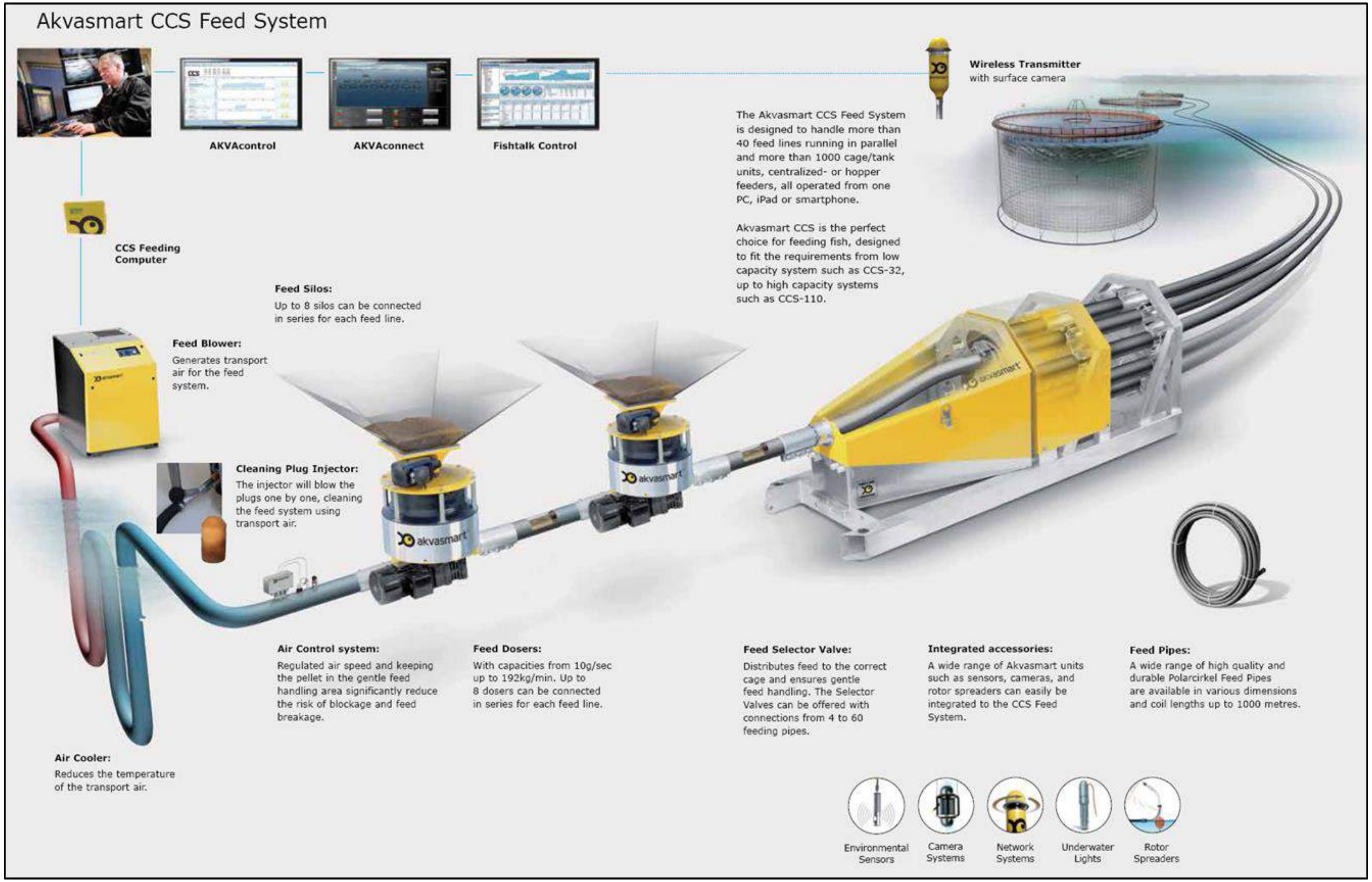

Figure 2-17: Specification of proposed Akvasmart CCS feed system (Source: Akvagroup; www.akvagroup.com).

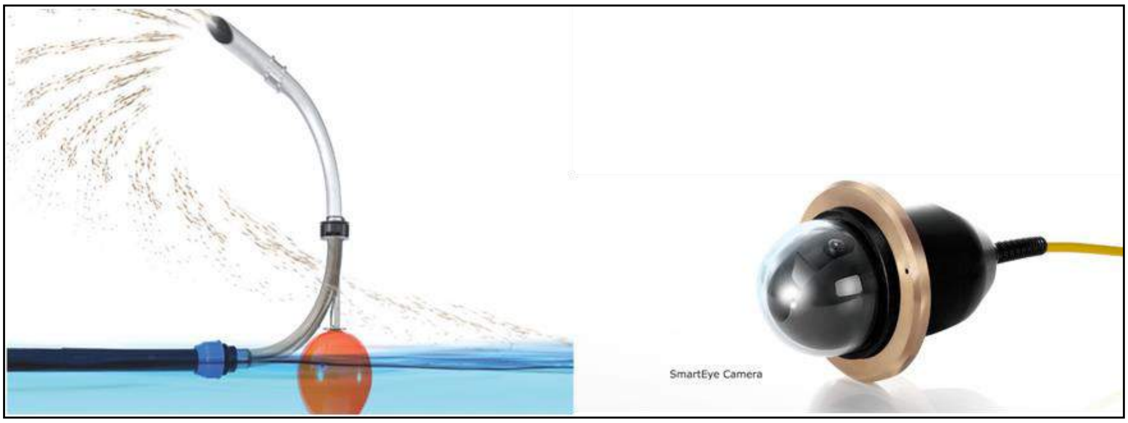

Figure 2-18: Rotor spreader and underwater camera which form part of the automatic feeder system (Source: Akvagroup; www.akvagroup.com).

2.9. Husbandry Management

2.9.1. Smolt Delivery

Smolts will be size-graded and counted at the hatchery prior to transportation to the Inishfarnard site. Smolts will be transported by road tankers from the MOWI smolt units at Lough Altan or Pettigo to Ballycrovane pier. They will then be loaded onto the MV Grip Transporter well boat for delivery to the Inishfarnard site. Smolt delivery is covered by *SOP25478*; see **Appendix 2.3**. In general, smolts are check-counted as they are released into each pen from the well boat. The prevention of escapes during smolt transfer is dealt with in **Section 2.13** (Accidents and Emergencies).

2.9.2. Grading

Stock is usually graded by either passive or well boat methods, at a mean weight of about 2.5kg, which is reached in the winter of the second year, roughly 12 months after transfer. The pens and nets will be lifted to concentrate the fish which will then be pumped into the grader on the deck of the MV Grip Transporter well boat. The fish will be graded by girth (which has a fish mean weight equivalent) and then counted prior to distribution to destination pens. **Figure 2-19** shows fish coming through the grader and being distributed to two pens. The grader is in the foreground and two distribution pipes, supported by cranes, are channelling fish of separate mean weight ranges into two destination pens. If necessary, individual grades can be held in well boat tanks to await the emptying of source pens prior to redistribution. Grading helps with the accounting of fish stocks, interrupts the development of peer groups within the pen, reduces aggression, improves feeding, promotes more even growth, and improves the evenness of fish weight at harvest. The SOP for fish grading (*SOP23009*) is given in **Appendix 2.3**.

Another grading procedure, passive grading will be used in preparation for harvest. This will employ a passive grading panel with specifically sized "slots" to retain the selected size of fish required. This is stitched into a seine net or similar. The slots in the panel are generally made of flexible pieces of plastic piping which are woven into a mesh to prevent damage to the fish as they are retained or pass through the panel. The passive grader will be introduced into a pen where a good proportion of the fish are close to or have reached the appropriate harvest mean weight. The fish will be left behind the grading panel usually overnight. The smaller fish will swim through the passive grader, leaving pre-harvest-sized fish ready for removal from the pen. The SOP for passive grading (*SOP30997*) is given in **Appendix 2.3**. Fish for harvest are then removed by well boat to an additional pen where they will remain on a ration diet until harvest weight is reached.

Figure 2-19: The proposed well boat MV Grip Transporter distributing fish to two pens (© Magnar Lyngstad, MarineTraffic.com).

2.9.3. Harvesting & Processing

The harvesting period for stock at the proposed Inishfarnard site will run between months 17 and 22 of the production cycle. Harvesting is the final process in the cycle. Fish already selected for harvest are pumped from a pen directly into the stun and bleed harvest system on the deck of the harvest vessel. Only after stun and bleed are the fish fed to the vessel hold for transport back to Ballycrovane pier and uploading into the road tankers for transport to the MOWI Packing and Processing Station at Rinmore, County Donegal. The prevention of escapes during harvesting is dealt with in **Section 2.13** (Accidents and Emergencies).

2.9.4. Site Discharges

Table 2.2 and **Table 2.3** shows the proximate analysis and digestibility of this organic feed.

Table 2.4 shows the projected feed requirements for one production cycle based on growth and feed data outlined in **Table 2.1** in **Section 2.7** (Production Model).

Based on proximate analysis (i.e. determination of the values of the macronutrients in the rations) and digestibility of the feed (see **Table 2.2** and **Table 2.3**), a breakdown of the feed into its soluble and settleable waste components is presented in **Table 2.5**.

Projected feed requirements of one production cycle (**Table 2.4**) and the soluble and settleable waste components of feed used (**Table 2.5**) are used to calculate the following;

1) monthly total BOD of discharges (see **Figure 2-20**).
2) monthly solids (see **Figure 2-21**).
3) monthly carbon discharges (see **Figure 2-22**).
4) monthly nitrogen discharges (see **Figure 2-23**); and
5) monthly phosphorus discharges (see **Figure 2-24**)

Based on these outputs, growth and discharge parameters will increase monthly, from input until the peak site standing stock of 2,177 tonnes is reached, at which point harvesting will commence in June/July of the second year.

The growth of the fish remaining in the pens will continue for some months until the peak harvest mean weight of 5,600g is reached and the balance of the fish will then be harvested from the system.

All discharge parameters will decrease steadily once harvest has commenced, as the total number of fish and standing stock will decrease, to reach zero, at the end of the harvesting period. The next cycle will commence, after the fallowing period, when the pens are empty. There will be no discharges from the site during the fallowing period.

Following each production cycle, the Inishfarnard site will lie fallow for a minimum of one month following the completion of harvest. It is critical that the fallowing period occurs over the winter months as this is when the site is at its most hydro-active, leading to relatively rapid dispersal of any solids that may have accumulated under the pens during the production cycle, allowing the entire site sufficient time to rejuvenate before the commencement of next cycle.

Table 2.2: Proximate analysis, digestibility, and feed carbon content of organic ration.

Ration size (mm)	Mean fish weight range (g)	Gross energy (MJ/kg)	Digestible energy (MJ/kg)	Feed digesti-bility (%)	Oil (%)	Protein (%)	Phosphorus (%)	Digestible protein (%)	Protein digesti-bility (%)	Potential FCR	Carbohydrate (%)	NFE (%)	Ash (%)	Moisture (%)
2.0	15-50	22.2	18.5	83.33	22	46.0	1.0	40.4	87.83	0.70	14.00	12.00	11.00	5.00
3.0	50-150	22.2	18.5	83.33	22	46.0	1.0	40.4	87.83	0.70	14.00	12.00	11.00	5.00
4.5	150-500	22.7	18.8	82.82	24	44.0	1.0	38.2	86.82	0.78	14.00	12.00	10.00	5.00
6.5	500-1000	23.3	19.2	82.40	26	42.0	0.9	36.1	85.95	0.80	16.00	14.00	9.00	5.00
9.0	1000-2000	24.1	20.2	83.82	32.5	37.9	0.9	34.4	90.77	0.98	17.00	14.00	8.50	5.00
12.0	2000+	24.1	20.2	83.82	32.5	37.9	0.9	34.4	90.77	1.05	17.00	14.00	8.50	5.00

Table 2.3 Feed carbon content of organic ration.

Protein C (%)	Fat C (%)	CHO C (%)	Total C (%)
25.30	16.50	5.60	47.40
25.30	16.50	5.60	47.40
24.20	18.00	5.60	47.80
23.10	19.50	6.40	49.00
20.85	24.38	6.80	52.02
20.85	24.38	6.80	52.02

Table 2.4: Projected feed requirements and specifications for one production cycle.

Month ending	Bio gain Tonnes	FCR	Average weight month end (g)	Feed specification						Feed and nutrient content tonnes / month					Digestibility (%)	
				Size (mm)	Protein (%)	Oil (%)	Phos. (%)	CHO (%)	Total C (%)	Feed fed	Feed protein	Total N	Total P	Total C	Total feed	Protein
Mar	15.3	0.95	101	3	46	22	1	14	47.4	14.5	6.7	1.1	0.1	6.9	83.3	87.8
Apr	24.0	0.95	141	3	46	22	1	14	47.4	22.8	10.5	1.7	0.2	10.8	83.3	87.8
May	34.6	1	198	4.5	44	24	1	14	47.8	34.6	15.2	2.4	0.3	16.5	82.8	86.8
June	46.8	1.1	275	4.5	44	24	1	14	47.8	51.5	22.7	3.6	0.5	24.6	82.8	86.8
July	60.5	1.2	375	4.5	44	24	1	14	47.8	72.6	31.9	5.1	0.7	34.7	82.8	86.8
Aug	78.2	1.2	505	4.5	44	24	1	14	47.8	93.8	41.3	6.6	0.9	44.8	82.8	86.8
Sept	97.0	1.225	670	6.5	42	26	0.9	16	52.02	118.8	49.9	8.0	1.1	61.8	82.4	86.0
Oct	120.6	1.25	880	6.5	42	26	0.9	16	52.02	150.7	63.3	10.1	1.4	78.4	82.4	86.0
Nov	139.2	1.27	1130	9	37.9	32.5	0.9	17	52.02	176.8	67.0	10.7	1.6	92.0	83.8	90.8
Dec	149.7	1.27	1417	9	37.9	32.5	0.9	17	52.02	190.1	72.0	11.5	1.7	98.9	83.8	90.8
Jan	170.5	1.27	1745	9	37.9	32.5	0.9	17	52.02	216.5	82.1	13.1	1.9	112.6	83.8	90.8
Feb	204.5	1.27	2120	12	37.9	32.5	0.9	17	52.02	259.7	98.4	15.7	2.3	135.1	83.8	90.8
Mar	224.1	1.27	2550	12	37.9	32.5	0.9	17	52.02	284.6	107.9	17.3	2.6	148.0	83.8	90.8
Apr	249.9	1.27	3025	12	37.9	32.5	0.9	17	52.02	317.4	120.3	19.2	2.9	165.1	83.8	90.8
May	269.6	1.27	3540	12	37.9	32.5	0.9	17	52.02	342.3	129.7	20.8	3.1	178.1	83.8	90.8
June	244.4	1.27	4036	12	37.9	32.5	0.9	17	52.02	310.4	117.6	18.8	2.8	161.5	83.8	90.8
July	236.4	1.27	4534	12	37.9	32.5	0.9	17	52.02	300.2	113.8	18.2	2.7	156.2	83.8	90.8
Aug	146.7	1.27	4975	12	37.9	32.5	0.9	17	52.02	186.4	70.6	11.3	1.7	96.9	83.8	90.8
Sept	75.2	1.27	5248	12	37.9	32.5	0.9	17	52.02	95.5	36.2	5.8	0.9	49.7	83.8	90.8

Month ending	Bio gain Tonnes	FCR	Average weight month end (g)	Feed specification						Feed and nutrient content tonnes / month					Digestibility (%)	
				Size (mm)	Protein (%)	Oil (%)	Phos. (%)	CHO (%)	Total C (%)	Feed fed	Feed protein	Total N	Total P	Total C	Total feed	Protein
Oct	24.0	1.27	5420	12	37.9	32.5	0.9	17	52.02	30.4	11.5	1.8	0.3	15.8	83.8	90.8
Nov	12.3	1.27	5544	12	37.9	32.5	0.9	17	52.02	15.6	5.9	0.9	0.1	8.1	83.8	90.8
Dec - Feb	**Fallow**															
Total/Av.	**2,623.15**									**3,285.1**	**1,274.5**	**203.9**	**29.9**	**1,696.5**	**83.4**	**89.3**

Table 2.5: Projected soluble and settleable waste discharge budget including BOD discharges.

Month ending	Feed Values		Settable Solids (tonne)			Settleable solids carbon			Nitrogen discharge			Phosphorus discharge			Total BOD discharge			Total solids BOD (ton)
	BOD5 (ton)	S Solids (ton)	Feed waste (ton)	Faeces (ton)	Total solids (ton)	Feed waste C (ton)	Faecal C (ton)	Total solids C (ton)	Settleable N (ton)	Soluble N (ton)	Total N (ton)	Settle-able P (ton)	Soluble P (ton)	Total (ton)	N BOD (ton)	C BOD (ton)	Total BOD (ton)	
Mar	2.88	0.62	0.41	2.23	2.64	0.20	1.27	1.46	0.05	0.51	0.56	0.03	0.04	0.07	2.58	8.43	11.00	4.14
Apr	4.53	0.97	0.65	3.50	4.15	0.31	1.99	2.30	0.08	0.81	0.89	0.04	0.07	0.11	4.05	13.26	17.31	6.52
May	7.09	1.59	0.99	5.48	6.46	0.47	3.05	3.52	0.12	1.17	1.29	0.07	0.11	0.18	5.92	21.66	27.57	9.94
Jun	11.47	2.96	1.47	8.16	9.62	0.70	4.54	5.24	0.19	1.89	2.08	0.11	0.18	0.29	9.52	35.30	44.81	14.87
Jul	17.68	5.31	2.07	11.49	13.55	0.99	6.39	7.38	0.29	2.83	3.11	0.16	0.27	0.43	14.23	53.29	67.52	21.02
Aug	22.86	6.86	2.67	14.85	17.52	1.28	8.26	9.54	0.37	3.65	4.02	0.21	0.35	0.56	18.39	68.88	87.27	27.17
Sep	29.60	9.22	3.39	19.26	22.65	1.76	11.39	13.15	0.44	4.34	4.78	0.23	0.37	0.60	21.87	101.95	123.81	37.13
Oct	38.38	12.39	4.30	24.44	28.73	2.23	14.45	16.68	0.57	5.58	6.15	0.29	0.48	0.77	28.11	130.94	159.05	47.14
Nov	45.80	15.21	5.04	26.36	31.40	2.62	16.95	19.57	0.57	5.56	6.13	0.35	0.57	0.92	28.01	155.03	183.04	54.83
Dec	49.24	16.35	5.42	28.35	33.76	2.82	18.22	21.04	0.61	5.98	6.59	0.37	0.61	0.98	30.12	166.70	196.82	58.96
Jan	56.09	18.62	6.17	32.28	38.46	3.21	20.76	23.97	0.69	6.81	7.51	0.43	0.70	1.12	34.30	189.87	224.18	67.16
Feb	67.28	22.34	7.40	38.73	46.13	3.85	24.90	28.75	0.83	8.17	9.00	0.51	0.83	1.35	41.15	227.75	268.90	80.55
Mar	73.73	24.48	8.11	42.44	50.55	4.22	27.28	31.50	0.91	8.96	9.87	0.56	0.91	1.47	45.09	249.58	294.67	88.27
Apr	82.22	27.30	9.04	47.32	56.37	4.70	30.43	35.13	1.02	9.99	11.00	0.62	1.02	1.64	50.28	278.32	328.60	98.44
May	88.69	29.45	9.76	51.05	60.81	5.08	32.82	37.90	1.10	10.77	11.87	0.67	1.10	1.77	54.24	300.24	354.48	106.19
Jun	80.41	26.70	8.85	46.28	55.13	4.60	29.76	34.36	0.99	9.77	10.76	0.61	1.00	1.61	49.18	272.19	321.37	96.27
Jul	77.79	25.83	8.56	44.77	53.33	4.45	28.79	33.24	0.96	9.45	10.41	0.59	0.96	1.56	47.57	263.32	310.89	93.13
Aug	48.28	16.03	5.31	27.79	33.10	2.76	17.87	20.63	0.60	5.86	6.46	0.37	0.60	0.97	29.53	163.44	192.96	57.81
Sep	24.75	8.22	2.72	14.24	16.97	1.42	9.16	10.57	0.31	3.01	3.31	0.19	0.31	0.49	15.14	83.77	98.91	29.63
Oct	7.88	2.62	0.87	4.54	5.40	0.45	2.92	3.37	0.10	0.96	1.05	0.06	0.10	0.16	4.82	26.68	31.50	9.44

Month ending	Feed Values		Settable Solids (tonne)			Settleable solids carbon			Nitrogen discharge			Phosphorus discharge			Total BOD discharge			Total solids BOD (ton)
	BOD5 (ton)	S Solids (ton)	Feed waste (ton)	Faeces (ton)	Total solids (ton)	Feed waste C (ton)	Faecal C (ton)	Total solids C (ton)	Settleable N (ton)	Soluble N (ton)	Total N (ton)	Settle-able P (ton)	Soluble P (ton)	Total (ton)	N BOD (ton)	C BOD (ton)	Total BOD (ton)	
Nov	4.04	1.34	0.44	2.32	2.77	0.23	1.49	1.72	0.05	0.49	0.54	0.03	0.05	0.08	2.47	13.66	16.13	4.83
Dec - Feb	**Fallow**																	
Total	840.66	274.37	93.62	495.88	589.50	48.35	312.67	361.02	10.84	106.57	117.41	6.51	10.62	17.13	536.56	2,824.25	3,360.82	1,013.4

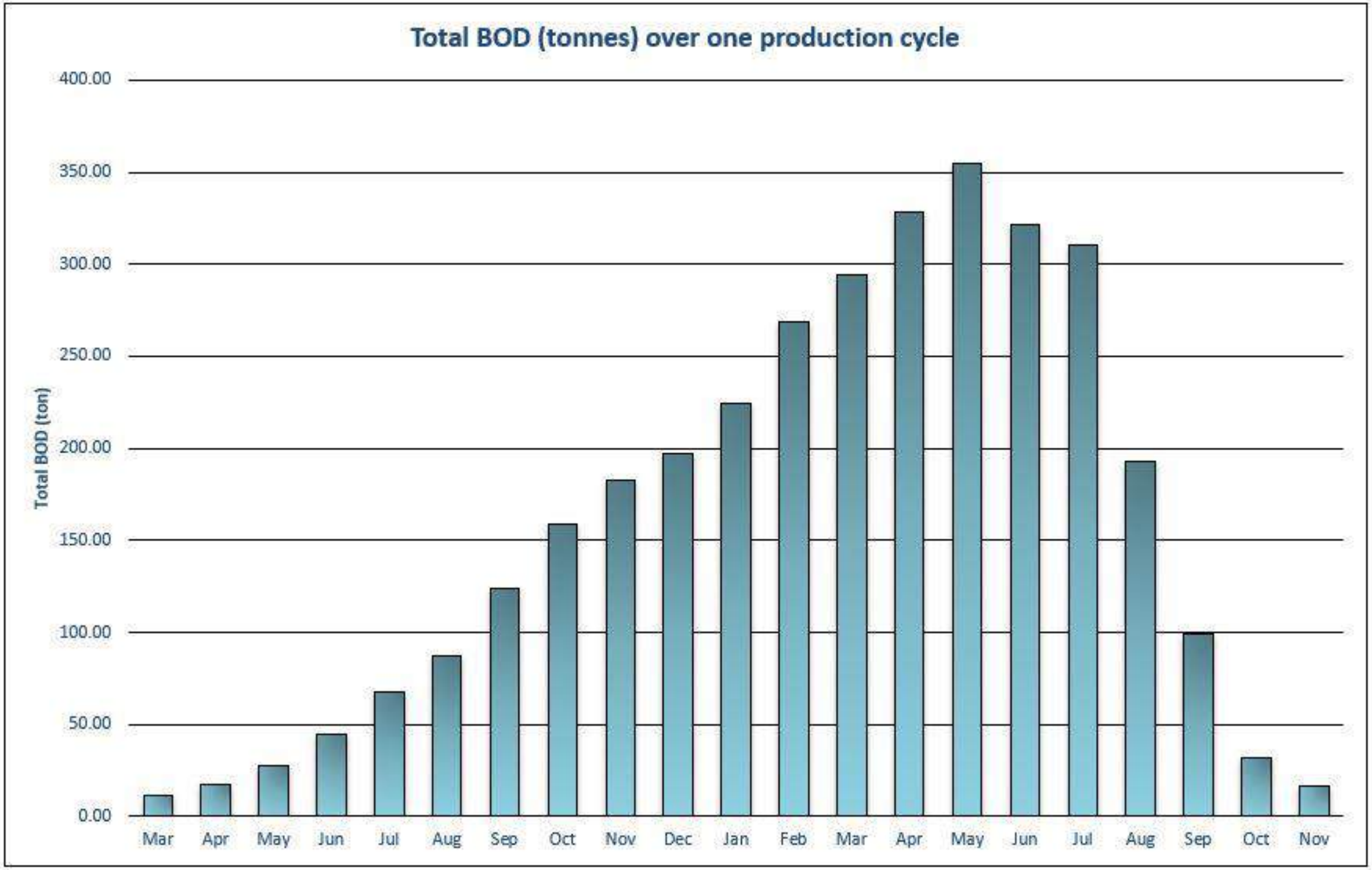

Figure 2-20 Total BOD of waste discharges (tonnes per month) for one production cycle.

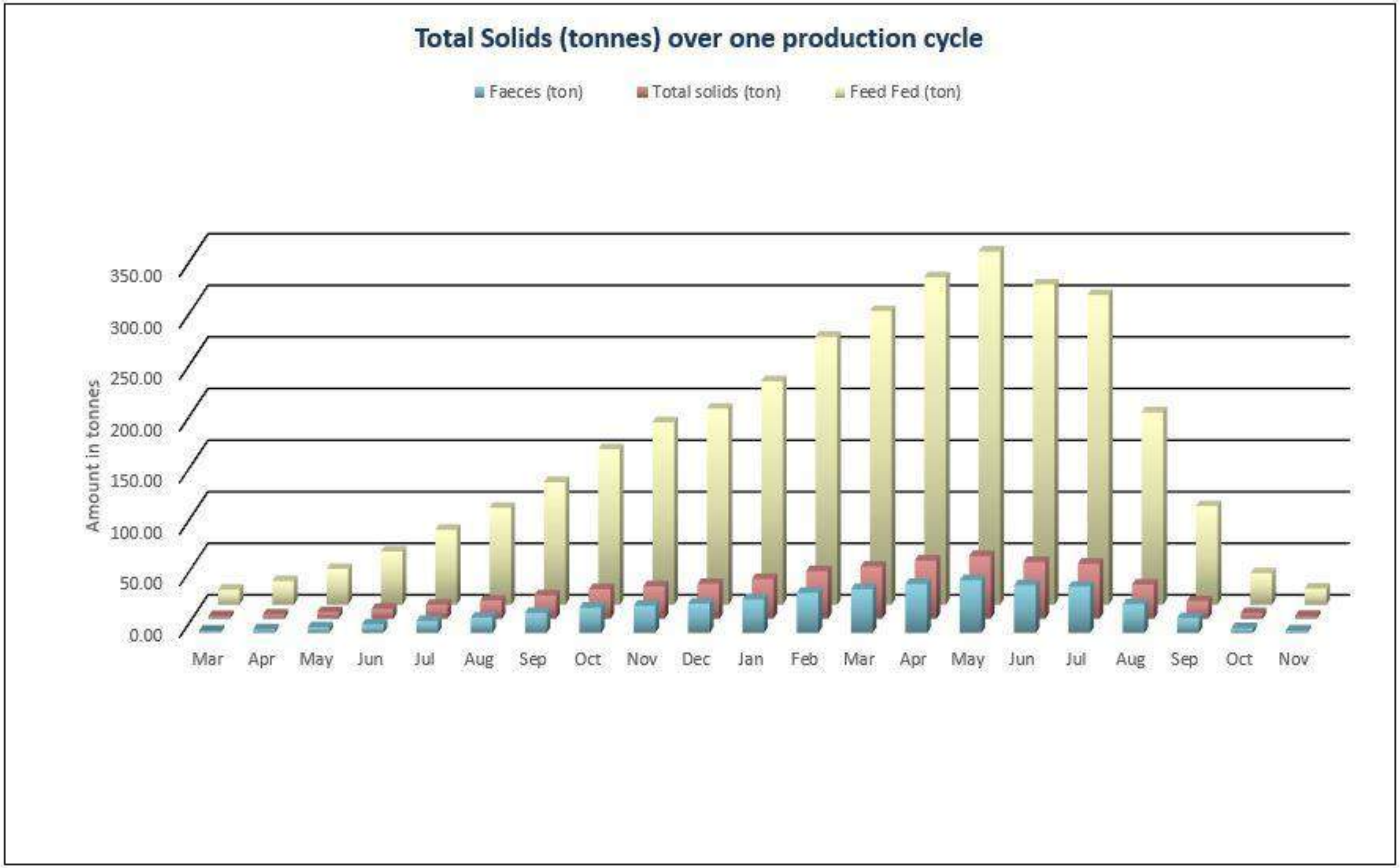

Figure 2-21 Total solids discharge (tonnes per month) for one production cycle.

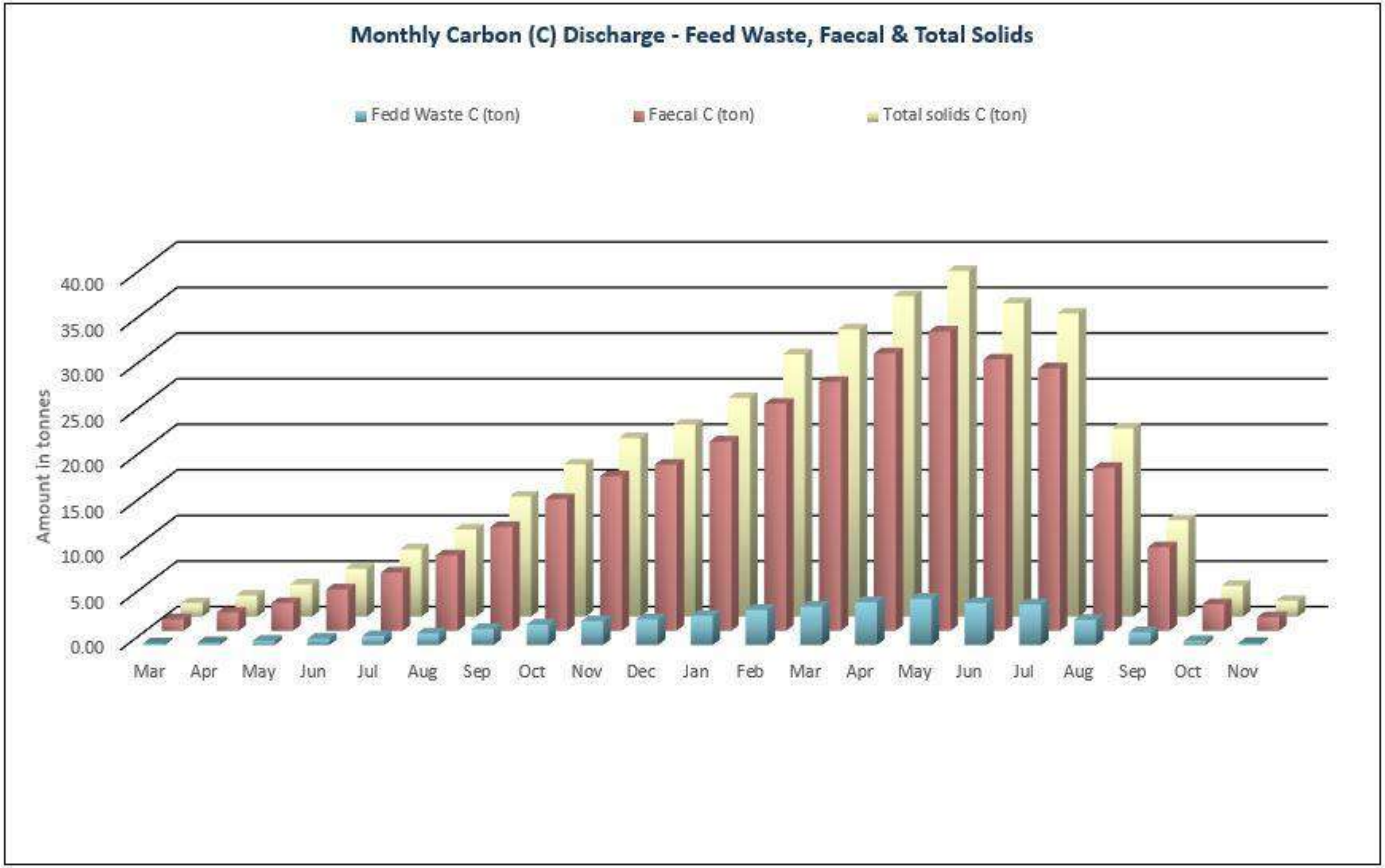

Figure 2-22 Total Carbon discharge (tonnes per month) for one production cycle.

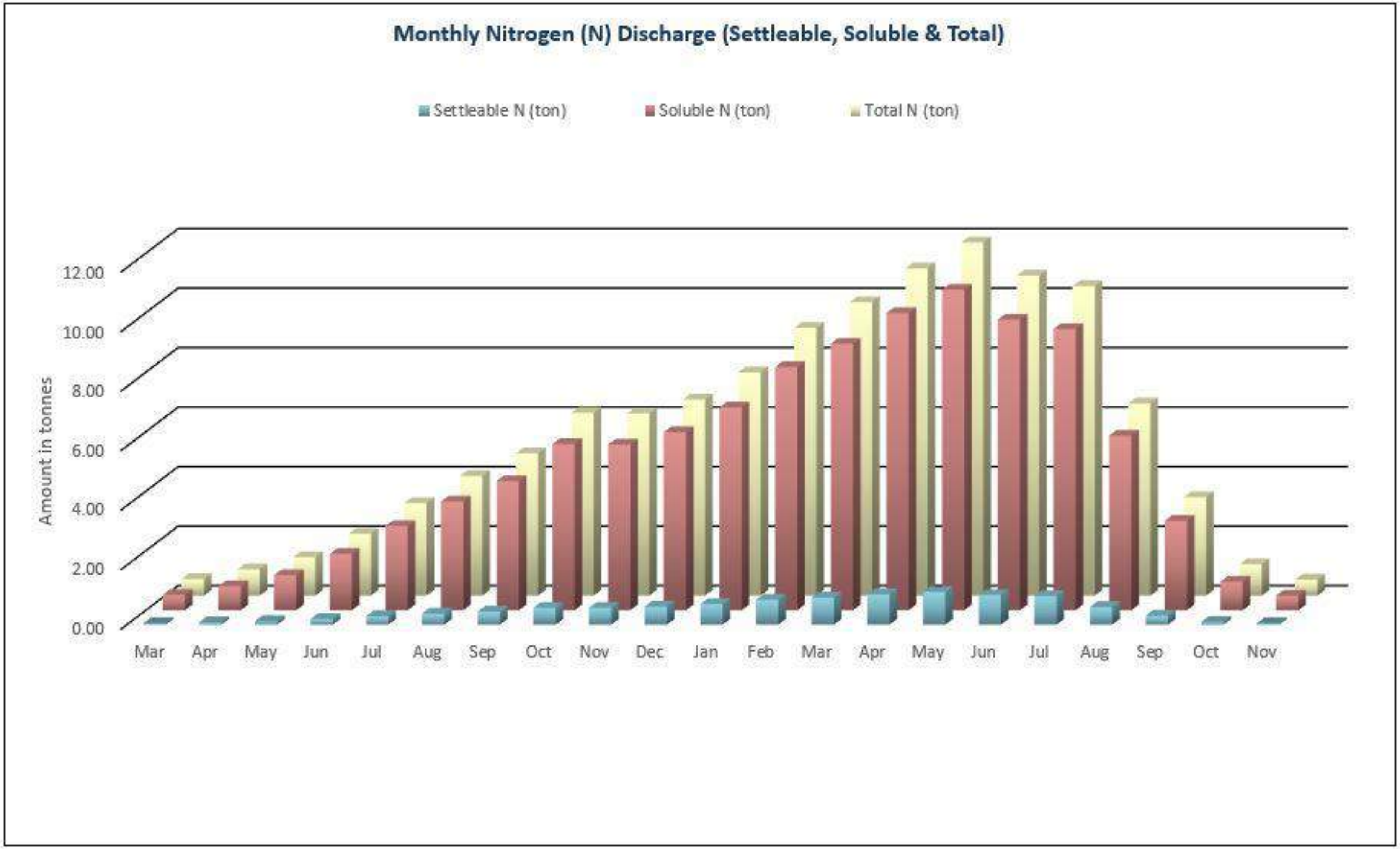

Figure 2-23 Total nitrogen discharge (tonnes per month) for one production cycle.

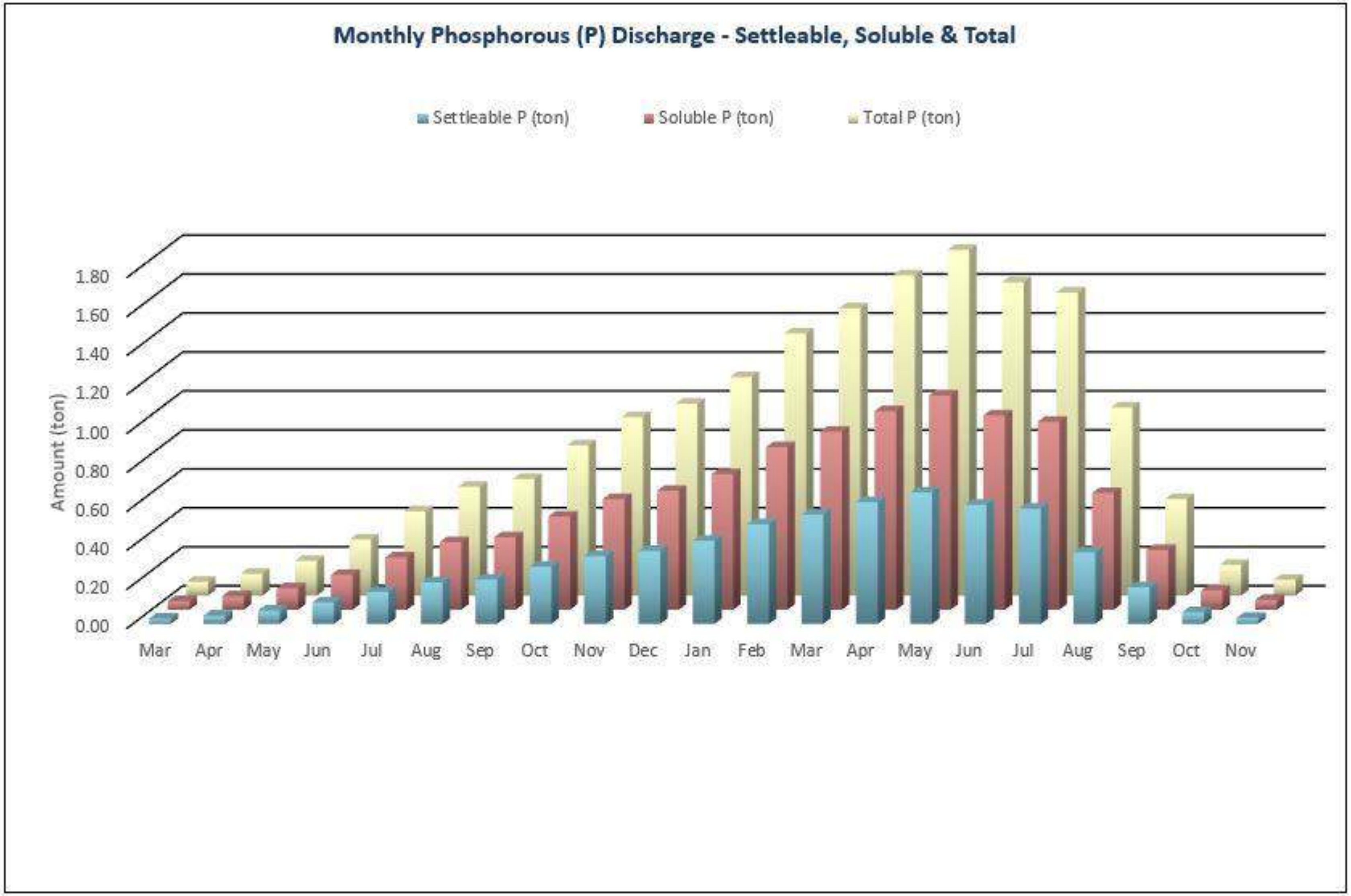

Figure 2-24 Total phosphorus discharge (tonnes per month) for one production cycle.

2.10. Waste Management

2.10.1. Harvesting Waste

After stunning and bleeding of harvested fish, the dead fish are collected in closed steel road tankers at Ballycrovane Pier. The closed steel road tankers will contain an ice/seawater slurry. In both cases, the blood water is collected with the fish and the fish will continue to bleed out into the sealed collection tanks. The tanks are then transported by road to Rinmore Processing plant in Fanad, Co. Donegal for processing.

All harvest effluent (*i.e.*, blood water, wash water, melted ice *etc*.) is collected outside of and within the processing plant by means of underground drains and sumps. This liquid effluent is pumped through fine mesh Salsnes™ filters in order to remove suspended solids and organic debris prior to collection in a large balancing tank for pre-treatment balancing. The filtrate from these filters is added to the daily organic solid waste loads. All sludge collected at the effluent treatment plant will be sent to an approved rendering plant for final disposal.

All filtered wastewater is then treated by means of chemical precipitation (flocculation) followed by dissolved air flotation. Offal and trimming waste arising from the processing facility is collected continuously from the process. Daily accumulations of waste from stocks that do not have listed diseases are managed in the following ways:

- Offal is pumped into an ensiling chamber and mixed with formic acid to produce silage with pH<4. This silage is sold as Rest-Raw-Material to third parties for oil and protein extraction.
- Offal and trimmings which is not ensiled is transported to approved ABP processing plants for rendering.

If a listed disease is identified in any batches of slaughtered fish, then all solid waste arising from processing will be handled by an approved ABP facility.

2.10.2. Mortality Disposal

Routine mortalities will be disposed of under the Standard Operating Procedure for Waste and Waste Management (*SOP25564*; see **Appendix 2.4**), which covers the matter of the management and disposal of all routine wastes from MOWI installations. Mortalities will be removed from pens by divers at least once a week, or more frequently subject to observed mortality trends. Collected mortalities will be taken to an approved animal by-products rendering plant, as required by DAFM guidelines.

2.11. Health Management

Heath management on all MOWI sites is conducted according to MOWI's '*Fish Health Management Plan*'. The plan underpins the company's obligations under EU and national legislation, namely:

- European Communities (Health of Aquaculture Animals and Products) regulations 2008 (S.I. No 261 of 2008), as amended by the European Communities (Health and Aquaculture Animals and Products) (Amendment) Regulations 2010 (S.I. No 398 of 2010), 2011 (S.I. No 430 of 2011) and 2015 (S.I. No 23 of 2015).
- EC Council Directive 2001/82/EC and SI 144 of 2007 (Animal Remedies Regulations).
- Commission Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation).
- Commission Regulation (EU) No 142/2011 of 25 February 2011 implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council

The main goals of the *Fish Health Management Plan* for MOWI Ireland are as follows:

- To prevent and control fish diseases and ensure the maintenance of a high level of fish health and welfare.
- To minimise environmental impact; and
- To rear salmon in accordance with industry guidelines and the current best practices of the industry.

The primary actions of the health plan are:

- Vigilance and regularity in stock monitoring against key performance indicators.
- Disciplined and detailed record keeping.
- Official notification in the event of disease outbreaks; and
- Application of therapy under veterinary supervision / prescription, in strict adherence to the organic standards that will apply at the site.

The health plan lays down that observation of the stock, from which all remedial actions will stem, will comprise:

- Daily (surface) observations of fish behaviour by site managers and feeding operatives, as well as during routine operations such as feeding and net changing.

- Professional diver observation of behaviour and general fish health at least weekly or more frequently, subject to mortality trends, with recording of all mortalities by number and likely cause of death.
- A minimum of bimonthly clinical examination of all stocks by the MOWI veterinarian; and
- The stock performance (e.g., feeding rate, mortality rates) will be assessed at least once a week by the Production Manager for any indications of disease or abnormalities in the stock.

2.11.1. Treatment of Disease

The Production Manager shall notify the Fish Health Unit of the Marine Institute within 48 hours of the suspected appearance of any abnormal losses or mortalities and shall carry out instructions issued by the Fish Health Unit Manager as a result of notification including instructions relating to the treatment, disposal and destruction of diseased stocks. In addition, the AFMD section of the DAFM will also be notified of any abnormal losses or mortalities.

The medication of fish for the treatment of disease is covered by *SOP24337*; see **Appendix 3.1**. The MOWI Ireland Positive Medications List included in **Appendix 3.1** describes medicines approved for use in farmed salmon in Ireland while Material Safety Data Sheets (MSDS) for the positive medications are included in **Appendix 3.2**.

The majority of the medicines permitted are supplied on the advice of the company's veterinary surgeons on prescription. MOWI takes a preventative approach to the susceptibility of stock to exposure to the most common infectious diseases by the use of vaccines prior to transfer to seawater. Vaccine selection is based on a destination site risk assessment. Vaccines are selected from the following permitted list.

- Alphaject 2-2; manufactured by Pharmaq Ltd. A bivalent IP injectable fish vaccine, protecting against the commonest, endemic bacterial diseases, Furunculosis (causative agent *Aeromonas salmonicida*) and IPNV (Infectious pancreatic necrosis).
- Norvax Compact PD (pancreatic disease) manufactured by MSD Animal Health. An IP injectable fish vaccine, containing inactivated PD virus, to promote immunity against PD virus (causative agent Salmonid alphavirus (SAV) subtypes 1 and 3)
- ALPHA JECT micro® 6; manufactured by Pharmaq. An IP injectable fish vaccine to promote immunity against Furunculosis, Vibriosis, Coldwater Vibriosis, Winter sore and infectious pancreatic necrosis (IPN).
- Aquavac PD3 manufactured by MSD Animal Health. IP injection for active immunisation of Atlantic salmon to reduce clinical signs (heart lesions and pancreas lesions), viremia, viral

shedding, and mortality from infection with salmon pancreas disease virus (SPDV) and to reduce mortality from infections with infectious pancreatic necrosis (IPNV) and *Aeromonas salmonicida subsp. salmonicida* (Furunculosis).

- Aquavac PD7 manufactured by MSD Animal Health. An IP injectable fish vaccine to promote immunity against SPDV strain F93-125, IPNV serotype SP, *Aeromonas salmonicida* subsp. *salmonicida*, *Vibrio salmonicida, Vibrio anguillarum* serotype O1 and O2a and *Moritella viscosa*.
- ALPHA JECT micro 1 PD; manufactured by Pharmaq. An IP injectable fish vaccine to promote immunity against SPDV.

As a generalisation, farmed fish are affected by a small range of "domestic" diseases, much as other domesticated stock. Some are indigenous to local wild fish species. Fish are vaccinated for the most common bacterial and viral diseases. If required, clinical outbreaks are treated with medicines approved for salmon aquaculture, under the relevant SOPs (e.g., *SOP24337*, see **Appendix 3.1**).

Although new or unrecognised diseases do occur, their antecedents can, more often than not, be found in other salmon farming areas such as Norway or Scotland. However, such occurrences are unusual, and, in consequence, occurrences are treated with the utmost urgency by both the company and its veterinary consultants. Industry experience, over many years, is that disease is frequently preceded by stock stress, caused, for example, by overcrowding, high temperature / low oxygen, poor nutrition, or stock predation. Farming to organic standards reduces or eliminates many of these stressors which has led to a radical reduction in disease outbreaks and in the frequency of treatment.

In the event of an outbreak of bacterial disease, which is normally indicated by fish behaviour, or other symptoms, such as appearance of indicative lesions, moribund fish or mortality, the standard operating procedure entails isolation of the pathogen from a standard range of tissues and testing against a range of antibiotics to establish a sensitivity pattern so that the best treatment can be selected. Frequently however, treatment must start on the best available information before completion of sensitivity testing in order to limit losses. Treatments for fish disease take one of two forms. They can be applied in medicated feed, in which case the prescription medicine, supplied as a powder, is surface dressed onto a standard feed ration. These are generally mixed to veterinary prescription by feed manufacturers. Alternatively, soluble treatments can be applied to the fish in a medicated bath. In the past such treatments have been carried out in shallowed, skirted pens. However, in MOWI's case, bath treatments are generally applied using well boat tanks or completely enclosed treatment tarpaulins. This reduces the quantity and cost of medication required and also greatly reduces the release of spent medication into the wider environment on completion of the treatment. Whilst antibiotics are generally applied in medicated feeds, for sea lice parasites both in-feed and bath type lice treatments are available; see **Section 2.11.2.3**. For gill parasites such as amoeba, the only effective treatment currently available is a freshwater bath (*SOP36945*, **Appendix 3.1**).

Table 2.6 shows the disease medications used at Inishfarnard between the year 2008 and 2017.

Table 2.6: Medications used for the treatment of diseases at Inishfarnard (T5/233) from 2008 – 2017.

		Slice®		Alphamax		Hydrogen Peroxide		
Generation	Year	Total Quantity (Kg)	AI g	Total Quantity (ml)	AI ml	Total Quantity (L)	AI L	Dates
08S1	2008	400	800					10th-16th Dec '08
10S1	2010			5000	50			11th-12th Dec'10
10S1	2011	150	300					20th-26th Jan'11
11S1	2012			4500	45			28th Mar'12
10S1	2012					34000	11900	26th Mar'12
11S1	2012					16000	5600	15th-17th May'12
12S1	2013					60000	2100	12th-15th Mar'13
14S1	2015	210	420					27th Dec'14 - 04th Jan'15
14S1	2015					9000	3150	11th - 16th Feb 2015
14S1	2015					46000	16100	16th - 21st Nov'15
14S1	2015			65375	653.75			07th - 14th May'15
14S1	2016					24000	11760	14th - 15th Jan'16
16S1	2017			60000	600			May-17
AI = Active Ingredient								

2.11.2. Parasite Control

Sea lice are natural parasites of both wild and farmed fish. Two sea lice species are major parasites of European salmonids. The marine louse, *Caligus elongatus* parasitises many marine fish species including salmon. The salmon louse, *Lepeophtheirus salmonis* is more euryhaline in habit and is a parasite specific to salmonids in brackish to fully marine conditions (25 to 35‰). *L. salmonis* is the more problematic of the two species for both wild and farmed salmonids. The Marine Institute has established levels for ovigerous female *L. salmonis* per fish above which treatment is required; further details on treatment trigger levels are provided in **Section 2.11.2.2** below.

Amoebic Gill Disease is caused by a microscopic protozoan parasite (amoeba) *Neoparamoeba perurans.* The parasite colonises the gills causing severe gill pathology which appears as pale grey/ white swellings and patches which can develop and spread over the gill surface. Amoebic Gill Disease monitoring carried out by MOWI is outlined in *SOP33878* in **Appendix 3.3**.

2.11.2.1. Cleaner Fish

In recent years, MOWI has developed a new non-medicinal strategy to control sea lice using cleaner fish. Cleaner fish are species which display a natural behaviour of removing parasites and dead skin from other fish species in the wild. The main interest is in wrasse of the genus *Labroides*, of which there are a number of species indigenous to European waters. The Lumpsucker, *Cyclopterus lumpus*, is also used for this purpose.

MOWI intend to stock the Inishfarnard site with cleaner fish. This will involve the stocking of hatchery-reared wrasse and lumpsucker at a rate of 6% of the salmon pen population. Cleaner fish are already deployed in MOWI farms in Ireland with good success. MOWI use a combination of wrasse (summer months only) and lumpsuckers (winter months). The wrasse are caught locally in Kenmare Bay. The lumpfish are hatchery reared – at present the supply is from Weymouth. Results to date illustrate that cleaner fish will maintain ovigerous lice levels on salmon in pens at or below 0.1 lice per fish. It also has the beneficial effect of radically reducing the use of chemical treatments and, therefore, treatment dispersal.

In Inishfarnard, cleaner fish will be deployed from the first June post transfer at a ratio of 7 cleaner fish per 100 salmon. These will be supplemented with locally caught wrasse during summer months. Cleaner fish can be re-captured using baited lobster pots or creels. As a precaution, cleaner fish are removed from the pens before size-grading of salmon, bath treatments and when fasting salmon prior to harvest. Guidelines for the culture, capture and subsequent maintenance of cleaner fish for use in salmon culture are included in *SOP39773* (See **Appendix 3.3**). The current 16S1 (October 2017) input of salmon to T5/233 site were stocked with hatchery reared lumpsuckers at time of salmon input. To date, this salmon stock input has only had one treatment for sea lice in the form of Alphamax administered in May 2018.

2.11.2.2. Monitoring

Regular sea lice monitoring is carried out in Kenmare Bay for the current operations and will continue under any new licence granted. Statutory monitoring is carried out by the Marine Institute and follows the mandatory lice monitoring and control protocols described in Department of the Marine and Natural Resources (DMNR) guidance (DMNR, 2000a; b). This comprises the inspection and sampling of fish on every salmonid farm site in each Single Bay Management Area a minimum of fourteen times per annum. Inspections are carried out monthly, with the following exceptions:

- During the “susceptible Spring period” for migrating wild salmonid smolt especially sea trout smolt, during March to May, when there are two inspections per month and treatment trigger levels are set at an average of 0.5 ovigerous female *L. salmonis* lice per fish.
- Over the two-month period of December to January lice growth is slow and therefore only one inspection is required. Trigger levels are set at an average of 2 ovigerous female *L. salmonis* per fish.

On each inspection, two samples of 30 fish are taken, under standard conditions. The first sample is taken from a standard pen, sampled on every inspection, whilst the second is taken from another pen, selected at random. Further details on sea lice monitoring can be found in **Appendix 3.3** (*SOP25450*).

In addition to the statutory monitoring of sea lice, MOWI Ireland will examine at least 10 fish from each salmon pen, every week. During the susceptible spring period, if levels of ovigerous female *L. salmonis* numbers reach an average of 0.5 per fish then a treatment is mandatory. At all other times of the year the treatment trigger level is 2.0 ovigerous lice per fish.

Marine Institute National Sea lice counts of three growth cycles (14S1, 16S1 and 18S1) are described below and presented in **Table 2.7**. *L. salmonis* counts recorded during inspections are presented alongside treatment trigger levels in place at the time.

S1 2014

MI sea lice counts indicates that ovigerous female *L. salmonis* lice on the Inishfarnard T5/233 site did not exceed the threshold levels (0.5 and 2 per fish throughout the entire production cycle for 2014 origin S1 fish). The only date where there was a spike in numbers was during week 17 where 0.39 ovigerous sea lice per fish was recorded this being just under the threshold level of 0.5. Coinciding with this spike in ovigerous female lice was an increase in ‘juvenile and mobile sea lice’. It is assumed that these spikes can only have arisen from a flush of wild origin copepodids in the bay that settled on farmed stock, which then required treatment (see **Table 2.7**). Treatments of Slice® (Emamectin Benzoate), Hydrogen Peroxide and Alphamax (Deltamethrin) were successfully administered as ovigerous sea lice counts of *L. salmonis* did not exceed the threshold level of 0.5 and 2 during the 14S1 growth cycle.

S1 2016

Marine Institute sea lice counts indicates that ovigerous female *L. salmonis* on the Inishfarnard T5/233 site did not exceed the threshold levels (0.5 and 2 per fish) throughout the entire production cycle for 2016 origin S1 fish. The only date where there was a spike in ovigerous females was during week 24 of 2017 where 0.52 ovigerous sea lice per fish was recorded, this being under the threshold level of 2. Coinciding with this spike in ovigerous female lice was an increase in juvenile and mobile sea lice. It is assumed that these spikes can only have arisen from a flush of wild origin copepodids in the bay which settled on farmed stock, which then required treatment (see **Table 2.7**). A treatment of Hydrogen Peroxide and Alphamax (Deltamethrin) were successfully administered as ovigerous sea lice counts of *L. salmonis* did not exceed the threshold level of 0.5 and 2 during the 16S1 growth cycle.

S1 2018

MI sea lice counts indicates that there were no ovigerous female *L. salmonis* recorded in 2018 S1 salmon on the Inishfarnard - T5/233 site in 2018. There were no major spikes in juvenile and mobile sea lice as 0.04 lice per fish was the highest recording.

Table 2.7 Records of sea lice infestation at the Inishfarnard since MOWI's use of the site. Counts exceeding the treatment trigger levels are highlighted (O'Donohoe et al. 2015 – 2018).

Year	Week Number	Date	*Lepeophtheirus salmonis*				*Caligus elongatus*			Total Lice
			Treatment Trigger Level	Ovigerous Female Lice	Juvenile & Mobile Lice	Total *Lepeophtheirus salmonis*	Ovigerous Female Lice	Juvenile & Mobile Lice	Total *Caligus elongatus*	
2015	Atlantic Salmon 2014 14S1									
	4	19/01/2015	2	0.02	0.24	**0.26**	0.09	0.09	**0.18**	**0.44**
	6	05/02/2015	2	0.03	0.42	**0.45**	0.07	0.13	**0.20**	**0.65**
	11	13/03/2015	0.5	0.02	0.11	**0.13**	0.00	0.04	**0.04**	**0.17**
	12	18/03/2015	0.5	0.19	0.59	**0.78**	0.02	0.07	**0.09**	**0.86**
	15	09/04/2015	0.5	0.04	1.66	**1.70**	0.00	0.04	**0.04**	**1.74**
	17	21/04/2015	0.5	0.39	1.82	**2.21**	0.00	0.00	**0.00**	**2.21**
	20	15/05/2015	0.5	0.03	0.00	**0.03**	0.00	0.00	**0.00**	**0.03**
	22	26/05/2015	0.5	0.00	0.00	**0.00**	0.00	0.02	**0.02**	**0.02**
	25	17/06/2015	2	0.00	0.04	**0.04**	0.00	0.07	**0.07**	**0.11**
	29	14/07/2015	2	0.00	0.00	**0.00**	0.33	0.34	**0.67**	**0.67**
	33	12/08/2015	2	0.18	0.17	**0.35**	0.20	0.28	**0.48**	**0.83**
	38	16/09/2015	2	0.00	0.09	**0.09**	0.04	0.00	**0.04**	**0.13**
	44	29/10/2015	2	0.08	0.26	**0.34**	0.02	0.08	**0.10**	**0.44**
	48	23/11/2015	2	0.07	0.17	**0.24**	0.04	0.00	**0.04**	**0.28**
2016		Harvested Out week 7 – 15/02/2016								
		Fallow for 4 weeks								
		Atlantic 2016 – 16S1 - input on week 13 – 28/03/2016								
	19	10/05/2016	0.5	0.00	0.01	**0.01**	0.10	0.17	**0.27**	**0.28**

Year	Week Number	Date	*Lepeophtheirus salmonis*				*Caligus elongatus*			Total Lice
			Treatment Trigger Level	Ovigerous Female Lice	Juvenile & Mobile Lice	Total *Lepeophtheirus salmonis*	Ovigerous Female Lice	Juvenile & Mobile Lice	Total *Caligus elongatus*	
	21	25/05/2016	0.5	0.00	0.05	**0.05**	0.10	0.42	**0.52**	**0.57**
	23	08/06/2016	2	0.00	0.04	**0.04**	0.04	0.01	**0.05**	**0.09**
	29	22/07/2016	2	0.00	0.00	**0.00**	0.00	0.47	**0.47**	**0.47**
	33	17/08/2016	2	0.00	0.00	**0.00**	0.05	0.10	**0.15**	**0.15**
	38	19/09/2016	2	0.03	0.05	**0.08**	2.01	2.28	**4.29**	**4.38**
	41	10/10/2016	2	0.00	0.12	**0.12**	0.87	0.78	**1.65**	**1.77**
	44	03/11/2016	2	0.00	0.00	**0.00**	0.02	0.00	**0.02**	**0.02**
2017	3	17/01/2017	0.5	0.00	0.09	**0.09**	0.72	0.38	**1.10**	**0.19**
	7	16/02/2017	0.5	0.03	0.14	**0.17**	0.03	0.00	**0.03**	**0.20**
	10	09/03/2017	0.5	0.07	0.23	**0.30**	0.12	0.25	**0.37**	**0.67**
	13	29/03/2017	0.5	0.18	0.43	**0.61**	0.58	0.42	**1.00**	**1.61**
	15	11/04/2017	2	0.19	1.04	**1.23**	0.10	0.15	**0.25**	**1.48**
	16	18/04/2017	2	0.27	1.76	**2.03**	0.16	0.18	**0.34**	**2.37**
	18	04/05/2017	2	0.28	7.34	**7.62**	0.40	0.42	**0.82**	**8.44**
	22	30/05/2017	2	0.11	0.50	**0.61**	0.00	0.00	**0.00**	**0.61**
	24	13/06/2017	2	0.52	11.02	**11.54**	0.07	0.20	**0.27**	**11.81**
	30	25/07/2017	2	0.07	0.29	**0.36**	0.00	0.04	**0.04**	**0.40**
	Harvested Out week 39 - 25/09/17									
	Fallow 4.25 months									
	Atlantic Salmon 2018 – 18S1 - input									

Year	Week Number	Date	*Lepeophtheirus salmonis*				*Caligus elongatus*			Total Lice
			Treatment Trigger Level	Ovigerous Female Lice	Juvenile & Mobile Lice	Total *Lepeophtheirus salmonis*	Ovigerous Female Lice	Juvenile & Mobile Lice	Total *Caligus elongatus*	
	26/02/18									
2018	13	26/03/2018	0.5	0.00	0.00	**0.00**	0.01	0.13	**0.14**	**0.14**
	14	04/04/2018	0.5	0.00	0.00	**0.00**	0.03	0.33	**0.36**	**0.36**
	17	26/04/2018	0.5	0.00	0.04	**0.04**	0.12	0.07	**0.19**	**0.23**
	19	09/05/2018	0.5	0.00	0.04	**0.04**	0.06	0.16	**0.20**	**0.24**
	21	23/05/2018	0.5	0.00	0.03	**0.03**	0.23	0.61	**0.84**	**0.87**
	25	21/06/2018	2	0.00	0.05	**0.05**	0.58	0.08	**0.66**	**0.71**
	30	25/07/2018	2	0.00	0.03	**0.03**	0.00	0.03	**0.03**	**0.06**
	34	21/08/2018	2	0.00	0.02	**0.02**	0.03	0.05	**0.08**	**0.10**
	36	07/09/2018	2	0.00	0.00	**0.00**	0.10	0.27	**0.37**	**0.37**
	40	05/10/2018	2	0.00	0.02	**0.02**	1.74	1.95	**3.69**	**3.71**
	45	06/11/2018	2	0.00	0.04	**0.04**	2.34	1.65	**3.99**	**4.03**

2.11.2.3. Treatments

The treatments that will be employed by MOWI at the proposed Inishfarnard site are as follows:

1. **Slice® in-feed treatment**

   Slice® was developed and licensed specifically as an oral treatment against salmonid lice infestation. It has superseded a range of earlier oral and bath treatments because of its ease of use, effectiveness against all lice parasitic stages, and environmental acceptability, resulting from its rapid degradation post-treatment and required short pre-sale withdrawal time.

   Slice® is a proprietary pre-mix containing 0.2% Emamectin Benzoate (EmBZ), for surface coating onto salmon feed, at a rate of 5kg Slice® / tonne of feed. Slice® is supplied in 2.5kg sachets of pre-mix, containing 5g of EmBZ in an inert matrix. Thus, one sachet of pre-mix is sufficient for wet-coating or dry-coating onto feed pellets, to produce 500kg of medicated feed. The recommended rate is 50μg EmBZ per kg fish biomass per day for seven consecutive days. Thus, each tonne of biomass requires 5kg of medicated feed per day (that is at a feed rate of 0.5% body weight per day) for the seven-day treatment period. Feed medicated with Slice® is generally supplied via the feed manufacturer, using the appropriate quantity of Slice® pre-mix, supplied to them under veterinary prescription.

   Slice® acts on the lice by binding to specific high affinity binding sites, resulting in increased membrane permeability to chloride ions and disruption of a number of physiological processes, most notably neurotransmission. Slice® protects fish against lice for ten or more weeks, subject to temperature. It has been determined that 10% of the EmBZ dose is excreted during the treatment period. Of the remaining 90% of the chemical, approximately 99% is excreted over the subsequent 216 days. This excretion has an exponential decay profile such that 50% of the chemical remaining in the fish is released, on average, over each ensuing 36-to-37-day period, that is, approximately 2.5 Spring / Neap tidal cycles, although this varies with water temperature. It has been determined that EmBZ breaks down into “non-toxic” subcompounds with a half-life period of 250 days.

   Schering-Plough, the manufacturers of Slice®, state that no withdrawal period is necessary post-treatment, prior to human consumption, on the condition that salmon are not treated more than once in the 60-day period prior to the fish being harvested.

   Despite this recommendation, the Norwegian Government recommends that a minimum withdrawal period of 175-degree days be used from treatment to first harvest for human consumption. This is approximately two weeks at 12°C to 14°C. This withdrawal period will be applied at the Kenmare Bay site.

2. **Alphamax® bath treatment**

Alphamax® is manufactured by Pharmaq Limited. Its active ingredient is the synthetic pyrethroid Deltamethrin. Pyrethroids are a group of natural and synthetic chemicals which act on insects and related organisms (such as sea lice) by blocking neural transmission pathways. Deltamethrin does not bioaccumulate in fish and, if released into the environment (for example if in-pen treatment is employed), less than 10% persists and is widely dispersed after 10 days, whilst its half-life in sediments under treated pens has been found to be 140 days, with 90% biodegraded by 12 months. However, these are not issues for MOWI who will use enclosed well boat tanks for bath treatments. Treatment dosage and time is 0.2ml Alpha Max® (=2µg Deltamethrin) per m^3 seawater in the well tank for 40-45 minutes.

See *SOP29142* in **Appendix 3.3** for procedural information of the application of Alphamax. The well boat MV Grip Transporter, which will be used for Alphamax® treatments, has two 600m^3 tanks. These require a total dose of 120ml of Alphamax®, containing 1.2mg of Deltamethrin, per tank, per treatment. The well tanks have the combined capacity to treat 100 tonnes of fish per treatment. Alpha Max® treatment by well boat is conducted on a 24-hour-day basis, with each treatment period lasting a maximum of four hours, from the crowding and pumping of the fish from the fish pens into the well tanks, to their release, post treatment, back to the pens. Thus, in the worst-case scenario, to treat the total T5/233 of 2,177 tonnes, a total of 22 four-hourly treatment periods would be required, lasting a total of 88 hours (3.7 days).

MOWI will also implement a treatment efficacy monitoring procedure to determine the efficacy of treatments and identify if a treatment was optimal or sub-optimal. If a treatment is considered sub-optimal (<80% effective in 1 or more pens), the potential factors that may have led to the treatment being sub-optimal will be analysed with the goal of devising follow-up plans to ensure that such factors are avoided or minimised in the future. The details of sub-optimal lice treatment can be found in *SOP26074* in **Appendix 3.3**.

Table 2.8 shows the sea lice treatment summary for the Inishfarnard site since 2008. These treatments are timed with the spikes in ovigerous females shown in **Table 2.7.**

Table 2.8 Sea lice treatments at Inishfarnard site since 2008.

Crop	Product	Active Ingredient	Administration Date	Active Ingredient (quantity)
2008 Input 08S1	Slice®	Emamectin benzoate	10th-16th Dec '08	800 g
2010 Input 10S1	Alphamax	Deltamethrin	11th-12th Dec'10	50ml
2011 Input 10S1	Slice®	Emamectin benzoate	20th-26th Jan'11	300 g
2012 Input 11S1	Alphamax	Deltamethrin	28th Mar'12	45ml
2012 Input 10S1	Hydrogen peroxide	Hydrogen peroxide	26th Mar'12	11,900 l
2012 Input 11S1	Hydrogen peroxide	Hydrogen peroxide	15th-17th May'12	5,600 l
2013 Input 12S1	Hydrogen peroxide	Hydrogen peroxide	12th-15th Mar'13	21,000 l
2015 Input 14S1	Slice®	Emamectin benzoate	27th Dec'14 - 04th Jan'15	420 g
	Hydrogen peroxide	Hydrogen peroxide	11th - 16th Feb 2015	3,150 l
	Hydrogen peroxide	Hydrogen peroxide	16th - 21st Nov'15	16,100 l
	Alphamax	Deltamethrin	07th - 14th May'15	653.75ml
2016 Input 16S1	Hydrogen peroxide	Hydrogen peroxide	14th - 15th Jan'16	11,760 l
2017 Input 16S1	Alphamax	Deltamethrin	May-17	600ml
2019 Input 18S1	Alphamax	Deltamethrin	Aug-19	37.5ml

2.12. Predator Control

Predator control includes bird netting to prevent bird predation on salmon. Pen netting is weighted to prevent seal predation. No acoustic deterrents will be used at the Inishfarnard site as seal predation on penned salmon has not been an issue at this licensed site. Predation control is covered by *SOP29575* (see **Appendix 3.4**).

2.13. *Accidents and Emergencies*

Emergency plans apply to eventualities, which, as a result of circumstance or unforeseen occurrence, may fall temporarily out of the control of the operator. It must be emphasised at the outset that such eventualities are extremely rare; none of those listed has occurred on MOWI sites to date and are not known to have occurred on any other local aquaculture installation in the last six years. That said, such hazards exist cannot be ignored. In many cases it is their infrequency and lack of familiarity, which are the primary causes of loss of control. Consequently, adequate emergency plans must be in place to deal with such eventualities. Insofar as is possible, the risk of hazard or consequential event is mitigated or reduced by:

- Site selection.
- Use of adequately specified equipment and structures.
- Installation of appropriate management systems.
- Standard registration of all farm operational data.
- Employment of staff suitably qualified for job specified.
- Diver qualification to a minimum of HSE Part 4 diver's certificate; all divers to be accompanied underwater.
- Regular equipment inspection.
- Regular servicing of vessels, vehicles, and other moving plant.
- Regular inspection of safety aids (life rafts, fire extinguishers, life jackets, navigation lights, winkies).
- Regular inspection and testing of diving equipment.
- Provision of guards over moving plant.
- Marine safety and rescue training.
- Wearing of lifejackets for all staff at sea.
- First aid training and availability of first aid kits.
- Availability of emergency flare kits.
- Fitting of life rafts to all main vessels.
- Disciplinary procedures.
- Ready availability of radios, telephones, and emergency number lists.
- Protective clothing where necessary.
- Prohibition of unaccompanied access to company equipment and vessels by contractors, representatives, public servants, and private individuals, who must be also provided with waterproofs and safety equipment as necessary when on company property.

Much of this information is enshrined, as required, in the Company's SOPs relating to health and safety which set out the lines of responsibility for overseeing all operational health and safety systems and procedures.

In salmonid farming, the list of potential hazards, or circumstances which may lead to consequential hazardous events or loss can be summarised as follows:

- **Staff:** Injury, man overboard, illness at work, poisoning, fire.
- **Vehicles:** Breakdown, collision, fire.
- **Vessels:** Loss of power, capsize, collision, grounding, fouling, loss of radio contact, fire.
- **Fish farm installations**:
    - Fish mass mortality: May result from asphyxiation, disease, predator attack, poisonous blooms, oil leakage or other contamination.
    - Mass fish escape: May result from loss of net integrity (predator attach), wear and tear, storm damage or collision.
    - Normal weather eventualities: Collision with vessel, loss of net integrity, fish escape, net fouling, poisonous blooms, predator attack, contamination, or oil leakage.
    - Storm weather eventualities: Structural or net damage, loss of moorings, fish escape, pen adrift.

MOWI’s Environmental Management Policy is included in **Appendix 3.5**.

2.13.1. Staff

The MOWI Occupational Health and Safety management system is certified to ISO 45001:2018. All staff are instructed to wear life jackets or floatation suits at all times when at sea. All vessels will carry first aid kits, radios or mobile telephones and flare kits. Staff will undergo routine training in first aid and rescue, including BIM courses in marine safety, first aid and radio use. In the event of an emergency, the attending personnel must contact the relevant base station, stating the nature of the event, position, and other relevant details. The base station will then contact any required emergency service. In the case of staff at sea, nearby vessels must also be contacted, as required. In the event of accident at work, a report must be submitted to the local Health and Safety Authority Office.

2.13.2. Vehicles

Any event involving vehicles, which is hazardous or may lead to a hazard, is dealt with following a similar procedure as to what is stated in **Section 2.13.1**. Radio or telephone contact to the relevant base station must be used to raise in-house support or emergency services as required.

2.13.3. Vessels

Vessels carry first aid kits, radios or mobile telephones and flare kits. Larger inboard vessels must carry radios, fire extinguishers, asbestos blankets, and life rafts/ lifebelts. Any injury arising must be dealt with using standard first aid procedures, involving contact to shore base, and onward to emergency service as required. In the event of vessel damage, capsize or loss of power, contact is made to the base station with position and nature of event, with a request for assistance. Further actions are taken as necessary to ensure staff and public safety and minimise the risk of loss of vessel or consequential loss. In the case of events involving vessels, depending on the seriousness of the incident, a report must also be submitted to the Department of Transport, Marine Safety Directorate, Marine Survey Office. A fire emergency evacuation procedure *SOP28074* in **Appendix 4**). Fuel oils are the principal hazardous chemicals associated with an aquaculture site. **Appendix 4** contains MOWI Ireland's emergency plan for chemical spills (*SOP26162*).

2.13.4. Fish Farm Installations

Barring serious human accidents on or around farm installations, the main, albeit rare, hazards associated with salmon farm units are:

- Mass fish mortality may occur as a result of collision / net collapse, disease, asphyxiation, storm damage, poisonous phytoplankton, jellyfish caused mortality, predator attack, oil leakage and other contamination.
- Mass fish escape, which may follow as a loss of net integrity in storm or even normal weather conditions or follow other structural damage to the pen structures (for example by collision).

These are considered the main hazards because they carry the greatest risk of widespread consequences. Other possible hazards are those involving collision between moving vessels and pen structures, loss of moorings and drifting of pens. These eventualities are dealt with separately below.

2.13.5. Mass Fish Mortality

Mass mortality events have greatly reduced in number with the maturation and increased experience base of the industry. The most predictable causes of mass mortality are associated with disease and asphyxiation. Mass mortality can often be brought on by stress, associated with high stocking density, fouled nets and warm weather, also the primary cause of asphyxiation. In the case of the Inishfarnard site, the most potent strategies for the avoidance of a mass mortality are low stocking densities required for organic farming, the experience of the staff and the full adoption of single bay management.

Appropriate site selection, regular net inspection, anti-fouling and cleaning will also all assist in avoiding these problems. Vaccination, regular veterinary inspection, and appropriate action on the first signs of stock distress can greatly reduce the risks of disease outbreak. Whatever the cause, the primary risks in a fish mortality event are disease transmission to other pens (in a disease-based event) and pollution. Once the mortality has been registered, the company plan comprises the use of all hands, divers and boat-mounted, crane-operated brailers and fish pumps to remove the mortalities, with counting, into harvest bins as quickly as possible. Standing arrangements exist with renderers for the disposal of mass mortalities in such an emergency. Following mortality removal, diver must check the fish remaining in the pen on ensuing days to remove any additional mortalities. Once the event has passed, the fish remaining in the pen must be moved and counted into new accommodation, in order to determine the total number of fish in the pen and to confirm the level of the mortality. The quicker the mortalities and moribund fish are removed, the lower the chance of consequential pollution or disease hazard. *SOP25560* (**Appendix 4**) outlines the procedures to be followed during a mass mortality.

2.13.6. Fish Escapes

No farmed escapees have been reported in Inishfarnard since MOWI began operating T5/233. MOWI have in place a fish escape prevention policy (see *SOP36708* **Appendix 4**) which is implemented at all its sites. The stock in the farm pens is the stock in trade of the company. As well as being fully aware of the potential impact risks of escapees on local wild fisheries (subject to species in question and season), it is essential to the company's commercial viability to contain its fish for harvest. Thus, the guidelines set out below to avoid fish escapes are adhered to as a matter of commercial necessity as well as in the interests of the environment. In respect of fish farm escapes, MOWI will follow the guidelines on containment of farmed salmonids, drawn up between the North Atlantic Salmon Organisation (NASCO) and the International Salmon Farmers Association (ISFA) (NASCO, 2010).

These guidelines first set out preventative measures, which are observed by the company, in respect of:

- Site selection.
- Equipment and structural specification.
- Preventative strategies, inspection, and maintenance.
- Staff training.

Under these guidelines, the selection of the Inishfarnard site has considered fish escape risk, which increases, for example, in areas exposed to excessively heavy seas or heavy boat traffic. All floating pen equipment, nets and associated structures will be specified to withstand local current and wave climate conditions (see **Section 8**). Mooring systems will be designed to withstand predicted 50-year local wave climate conditions and thus to protect the integrity of the pens. Preventative strategies include guidelines for the use of vessels around pens and the provision of adequate navigational lighting and radar reflectors to prevent damage arising due to navigational errors by non-company vessels.

Net Inspection (by diver and on net-changing; see **Appendix 2.2**; *SOP28941* and *SOP26166*) as well as maintenance of nets and other pen and grid components (see **Appendix 2.2** *SOP28646* and **Appendix 2.1** *SOP28940*) are carried out on a routine basis. All nets are number-coded, the net stock is rotated, and usage recorded.

Nets are cleaned and dried prior to storage and are stored off the ground in vermin-free conditions. Nets are inspected before use and regularly renewed. Spare nets are always available. Members of staff are trained in preventative net inspection and maintenance. All farm activities which may increase the risk of fish escape are carried out by staff aware of the risks and trained for the task in hand. The majority are also covered by SOPs, these include:

- Fish sampling.
- Fish movements for smolt transfer, grading, relocation and harvesting.
- Net changing; and
- Use of vessels in the vicinity of pens.

The practice of moving fish by pen towing is not now used under current best practice, the preference being to use well boats, in the interests of both fish health and safety. In readiness for any escape event, the company has a contingency plan and a registration and verification procedure. Any indication of escape, such as loss of net integrity, will be immediately followed up by repair or net change, as required, subject to weather conditions. Once an escape has been confirmed, the event must be reported to the AFMD in Clonakilty and to Inland Fisheries Ireland (IFI) and the Marine Institute. The fish remaining in the pen must be transferred and counted into a new enclosure and the extent of the escape verified. The event is then fully reported, stating species, strain, hatchery of origin, age, mean weight and length of stock, escape number and likely level of maturation in the year of escape. This information must be provided to the AFMD, IFI and DAFM within 24 hours of the incident. The company will co-operate with any program attempting to recapture the stock, which may be mounted or ordered by the relevant authorities. *SOP25561* (**Appendix 4**) outlines the procedures to be followed for fish escapes. **Appendix 4** also contains a fish escape action flow chart (*SOP40755*).

A similar verification and reporting procedure must be also undertaken in the event of unexplainable reductions in stock numbers discovered, for example, during normal transfer, grading or harvesting procedures. Under these circumstances, the pen structures occupied by the stock in question must be fully inspected following discovery of the shortfall.

2.14. *Single Bay Management/ Coordinated Local Area Management Schemes*

The Inishfarnard T5/233 site in Kenmare Bay is part of the Single Bay Management/ CLAMS (Coordinated Local Area Management Schemes).

Single Bay Management arrangements for fin-fish farms are designed to co-ordinate husbandry practices in such a way that best practice is followed and that stocking, fallowing and treatment regimens on individual farms are appropriately coordinated with the neighbouring farms. The goal is to ensure that practices on individual farms act synergistically to enhance the beneficial effects to the bay as a whole. An important component in this process is establishing effective lines of communication between the operators. The non-confrontational environment of Single Bay Management meetings between licensed operators has proved a valuable forum in the process of conflict resolution and avoidance both within the industry and between the industry and its neighbours. The Single Bay Management process has proved very effective in enhancing the efficacy of lice control and in reducing the overall incidence of disease in the stocks. Single Bay Management plans are subject to revision for each production cycle. This arises out of changes in production plans related to:

- New Licence applications.
- In response to changing markets.
- New husbandry requirements; and
- Both internal company restructuring and inter-company agreement.

Crucial elements in the success of this plan are identified as:

- separation of generations.
- annual fallowing of sites.
- strategic application of chemotherapeutants.
- good fish health management; and
- close co-operation between farms.

Appendix 5 contains the Inishfarnard Integrated Pest Management / Single Bay Management Plan. The synchronised production and fallowing in single bay areas is essential to ensure the breaking of disease and parasite life cycles. This requires the use of single year classes in each bay area. MOWI Ireland use single generation site occupancy in Kenmare Bay and stock only with S1 fish.

MOWI will focus its lice treatment regime on the pre-winter treatment for all fish in Inishfarnard (under the CLAMS/ Single Bay Management group) which will be over-wintered. During the months of January to May, numbers of ovigerous female and total *L. salmonis* will be maintained as close to zero as possible using cleaner fish and appropriate treatments where necessary. Where two sites are stocked in the Bay, treatments will be carried out on both during the same time period and with the same chemical class and in consultation with other fin fish farmers in the Bay.

In Kenmare Bay there are five sites licensed for the culture of Atlantic Salmon[2] (including the Inishfarnard site) (**Table 2.9**). A site at Cloonee, Tuoist which was previously licensed for salmon culture is now closed and the licence has been revoked. MOWI are currently operating the Inishfarnard site and the Deenish site. MOWI and other operators within the bay will coordinate the timing and class of treatments.

Table 2.9: Salmon aquaculture licences in Kenmare Bay.

Licence reference	Site Name	Distance to Inishfarnard Site
T06/064/7	Doon Point, Kenmare River	*ca*. 31 km northeast
T06/064A	Kilmakilloge Harbour	*ca.* 16 km northeast
T06/064B	Kilmakilloge Harbour	*ca.* 16 km northeast
T06/112	Cloonee, Tuoist.	site closed; licence revoked
T06/202A	Deenish, Island	*ca*. 14 km west

2.15. Decommissioning

At the end of their lifespan or during certain maintenance tasks, fish pens have to be dismantled. This task is only carried out after the fish pen has been taken ashore. The pen must be beached on a hard surface out of water and away from rising/falling tide. When a decision is taken to decommission a floating farm site and all related equipment, a precise method of steps must be followed. These include removal of netting, ropes, chain mooring bridles; transport of the pens ashore; dismantling and recycling of pens; removal of moorings and buoys and the removal of anchors. The methodology of decommissioning floating farm installations is described in *SOP36887* in **Appendix 2.1**. Any decommissioning activities are likely to be undertaken at the shore at Ballycrovane Pier.

[2] Further detail on aquaculture operations in Kenmare Bay is included in **Section 11.2 Commercial Fisheries and Aquaculture** below.

3. Consideration of Alternatives

Kenmare Bay was identified as a suitable location for the proposed salmon farming for the following reasons:

- It is an existing site where salmon production has been carried out successfully for over 20 years with negligible impact on the environment; and
- There is a relatively low level of tourist activity in the vicinity of Inishfarnard Island.

The renewal application varies from the original licence in the following ways:

- The licence renewal application requests a change from the current licence operating conditions to a maximum allowable biomass (MAB) of 2,177 tonnes.
- A change the boundaries of the site (see **Figure 1-2**). The spatial extent of the existing site is 25.94 ha while the extent of the proposed site is 52.73 ha.

4. Impact Assessment Methodology

4.1. Overview of Approach for Environmental Impact Assessment - Assessing Impact Significance

As described in **Section 1.4** the EIA process under the 2011 Directive and 2014 Directive are largely similar with the exception being the scope of the subject matters used in the assessment of the potential effects of proposed projects on environment factors. Specifically, the subject matters in the 2014 Directive, which fully address those defined in the 2011 Directive, have been redefined to broaden the scope of the subject matters and so strengthen the overall EIA procedure.

Under the 2011 Directive and the 2014 Directive the EIA assessment process are summarised in EIS and EIAR respectively; while both provide descriptions of baseline conditions, project activities and alternatives, the EIA process under the 2014 Directive and associated EIAR provide a more comprehensive assessment of project impacts, mitigation measures, and residual risks to the environment. Consequently, the EIA for the current project used the subject matter defined in the 2014 Directive with the findings presented using the criteria defined in EPA (2017) guidance.

Table 4.1 outlines the subject matters considered in the assessment of the potential environmental effects of the renewal of finfish aquaculture licence and the change the boundaries of the site and the operating conditions attached to the licence. **Table 4.1** also indicates where the subject matters are assessed in this report.

Table 4.1: EIAR Subject Matter.

Subject Matter	Assessed in:
Population and Human Health	**Section 5**
Biodiversity	**Section 6**
Land and Soils	**Section 7**
Water	**Section 8**
Air and Climate	**Section 9**
Noise	**Section 10**
Material Assets	**Section 11**
Cultural Heritage and Archaeology	**Section 12**
Landscape and Visual Resources	**Section 13**
Cumulative Impacts	**Section 14**

The method used here to assess the significance of impacts to environment factors have been developed with reference to the following sources:

- *Guidelines on the information to be contained in environmental impact assessment reports. Draft, August* 2017 (EPA, 2017).
- *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, and Coastal, 2nd edition* (CIEEM, 2016).
- *Marine Evidence-based Sensitivity Assessment (MarESA) – A guide. Marine Life Information Netowrk (MarLIN). Marine Biological Association of the UK* (Tyler-Walters *et al.,* 2018).
- *Environmental Impact Assessment Handbook. Guidance for competent authorities, consultation bodies, and others involved in the Environmental Impact Assessment process in Scotland* (SNH, 2018).

In summary, for each subject matter and pressure (or impact mechanism), the assessment of impact identifies receptors sensitive to that pressure and implements a systematic approach to understand the level and significance of impact based on the following elements:

- Sensitivity of a receptor to the pressure.
- Magnitude of impact to the receptor.
- Likelihood of occurrence of impact; and
- Level of impact

Section 4.2 through **Section 4.5** below presents further detail on these elements while **Section 4.6** describes the determination of the significance of impacts.

4.2. Sensitivity/ Value

The sensitivity of a receptor to a pressure is a function of its capacity to accommodate change induced by the pressure and its ability to recover if it is affected, and is defined by the following factors:

- **Tolerance to change:** the ability of the receptor to accommodate temporary and permanent change.
- **Recoverability:** the temporal scale taken for the receptor to return to its natural state following cessation of an effect.
- **Adaptability:** the ability of a receptor to avoid or adapt to an effect; and
- **Value:** a measure of the receptor’s importance, rarity and worth.

Where required specific magnitude criteria relevant to the different impact assessment topics covered in this EIAR are presented in each of the impact assessment sections of the EIAR. Sensitivity categories used are Very High, High, Medium, Low and Negligible.

4.3. Magnitude of Effects

Effects (or impacts) are considered with reference to the following:

- **Magnitude:** relates to the quantum of impact (e.g., the number of individuals affected).
- **Extent:** predicted in a quantified manner and relates to the area over which an impact occurs.
- **Duration:** refers to the time during which the impact is predicted to continue until recovery.
- **Reversibility:** addressed by identifying whether an impact is ecologically reversible wither spontaneously or through specific action.
- **Timing and Frequency:** impacts in relation to important seasonal and/or life-cycle constraints should be evaluated (salmon run). Similarly, the frequency with which activities (and associated impacts) take place can be an important determinant of the impact.

Where required specific magnitude criteria relevant to the impact assessment for different subject matters are presented in relevant assessment sections below. Magnitude of effects are Severe, Major, Moderate, Minor, Negligible and can be Negative, Neutral or Positive.

4.4. Likelihood of Occurrence

The likelihood (or probability) of an impact occurring assigned to assessment of impacts to capture the probability that the impact will occur and considers the probability that the receptor will be present. This element of the assessment is generally based on experienced professional judgement knowledge of the receptor.

For each impact assessment a narrative is provided describing the consideration of likelihood of effect. The narrative provides context to the specific impact being considered. Likelihood of impact is described as highly likely, probable, possible, unlikely, or remote as detailed in **Table 4.2** below.

Table 4.2: Impact Classification Table - Likelihood

Category	Description
Remote	<1% likelihood of impact occurring
Unlikely	1-20% likelihood of impact occurring
Possible	20-50% likelihood of impact occurring
Probable	50-95% likelihood of impact occurring
Highly Likely	>95% likelihood of impact occurring

4.5. Level of Impact

The level of impact (negative or positive), is determined by combining categories identified for sensitivity/ value of receptors (see **Section 4.2**) and the magnitude of effect (see **Section 4.3**) as outlined in **Table 4.3**.

Table 4.3: Level of Impact.

Magnitude of Effect	Sensitivity/Value				
	Very High	High	Medium	Low	Negligible
Severe	Severe	Severe	Major	Moderate	Minor
Major	Severe	Major	Major	Moderate	Minor
Moderate	Major	Major	Moderate	Minor	Negligible
Minor	Moderate	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

4.6. Assessment of significance

The level of impact calculated, based on the sensitivity/ value of the receptor (see **Section 4.2**), the magnitude of effects (see **Section 4.3**) and the likelihood of occurrence (see **Section 4.4**), determines the significance of the impact. If the level of impact is determined to be moderate, major, or severe then the impact is significant as detailed in **Table 4.4** below.

Table 4.4: Criteria for assessing impact significance (based on EPA, 2017).

Level of Impact	Impact Significance	Definition
Negligible	No change (**NOT SIGNIFICANT**)	No discernible change in the ecology of the affected feature
Negligible	Imperceptible Impact (**NOT SIGNIFICANT**)	An impact capable of measurement but without noticeable consequences
Minor	Slight Impact (**NOT SIGNIFICANT**)	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate	Moderate Impact (**SIGNIFICANT**)	An impact that alters the character of the environment that is consistent with existing and emerging trends
Major	Significant Impact (**SIGNIFICANT**)	An impact which, by its character, magnitude, duration, or intensity alters a sensitive aspect of the environment
Severe	Profound Impact (**SIGNIFICANT**)	An impact which obliterates sensitive characters.

5. Population and Human Health

5.1. *Population & Socioeconomics*

5.1.1. Description of the Receiving Environment

The closest Electoral Divisions to the proposed aquaculture starting from west to east are: Cathair Dónall (Caherdaniel)and Castlecove located in Co. Kerry and Kilcatherine and Coulagh located in Co. Cork (see **Figure 5-1**). **Table 5.1** shows the population in each Electoral Divisions according to the 2016 and 2011 Census along with number of permanent dwellings (http://census.cso.ie/sapmap/).

The total population of the 4 Electoral Divisions as of 2016 was 1,962 which constituted of 1,776 households. Of the 4 Electoral Divisions Kilcatherine has the highest total population at 804, followed by Coulagh (total population of 536), Castlecove (309) and lastly Cathair Dónall (313). In general, there was little change in population level in the Electoral Divisions between 2011 and 2016. Population levels in Castlecove decreased (3.1%) and increased in Cathair Dónall (0.3%) and Coulagh (2.1%). No change in population was observed at Kilcatherine.

The age structure of the population within the 4 Electoral Divisions consisted of 21.3% under 18 years, 56.5% between 18 and 64 years (5.1% 18-24yr; 19.3% 25-44yr; 32.2% 45-65yr) and 22.2% older than 65 years.

The principal status of the population of the 4 Electoral Divisions consisted of 50.7% at work, 25.2% retired, 8.9% student, 6.8% looking after the home, 4.7% unemployed, 3.1% permanent sick/disability, 0.5% other and 0.2% seeking their first job. The percentage of unemployment was 4.7% which was below the national average of 7.8% in 2016. National unemployment in 2019 is 5.6%. The social classes were made up of 28.5% managerial and technical, 17.5% non-manual, 15.9% skilled manual, 15.7% gainfully occupied and unknown, 14.0% semi-skilled, 5.0% professional workers and 3.7% unskilled.

The workforce is employed in the following industries: 21.5% professional services, 18.7% agriculture, forestry, and fishing, 14.9% commerce and trade, 8.7% manufacturing industries, 5.9% building and construction, 4.0% public administration, 3.5% transport and communications, and 22.8% defined as other.

The occupation of the workforce is broken down as follows: skilled trade occupations (30.9%), professional occupations (10.8%), elementary occupations (8.9%), caring, leisure and other services (8.7%), associate professional and technical occupations (8.2%), administrative and secretarial (7.3%), managers, directors, and senior officials (7.2%), process, plant, and machine operatives (7.1%), not stated (6.5%) and sales and customer service occupations (4.4%).

Due to the proximity of the Inishfarnard site to Co. Kerry and to Co. Cork aquaculture employment figures in 2016 in both counties are presented below.

In 2016, 253 people were employed in the aquaculture industry in Co. Cork (BIM, 2017) of which 19 people were employed in salmon aquaculture and 3 people employed in smolt/ parr/ ova production.

It is important to note that the BIM data on employment of people in aquaculture does not include processing plant, administration, diving, maintenance, veterinary and other service staff directly employed. The total value of aquaculture in Co. Cork in 2016 was €33.2m, of which €14.7m is attributed to salmon production and €1.5m from smolt production. The aquaculture production levels in Co. Cork in 2016 were 11,655 tonnes of which 4,267 tonnes was the yield produced from salmon aquaculture and 441 tonnes attributable to smolt production (total tonnage of smolts produced in 2016).

In 2016, 390 people were employed in the aquaculture industry in Co. Kerry (BIM, 2017) of which 7 people were employed in salmon aquaculture. The total value of aquaculture in Co. Kerry was €22m, of which €14.3m is attributed to salmon production. The aquaculture production levels in Co. Kerry in 2016 were 6,313 tonnes of which 2,494 tonnes were associated to salmon production.

Table 5.1: 2016 population of EDs in the vicinity of the proposed aquaculture sites (Source: http://census.cso.ie/sapmap/). 2011 figures are shown in brackets.

Electoral Division	Total	Males	Females	No. Permanent Dwellings
Cathair Dónall	313 (312)	161 (164)	152 (148)	423 (433)
Castlecove	309 (319)	165 (171)	144 (148)	311 (323)
Kilcatherine	804 (804)	401 (424)	400 (380)	580 (566)
Coulagh	536 (525)	258 (283)	251 (242)	433 (424)
Total	1,962 (1,960)	985 (1,042)	947 (918)	1,747 (1,746)

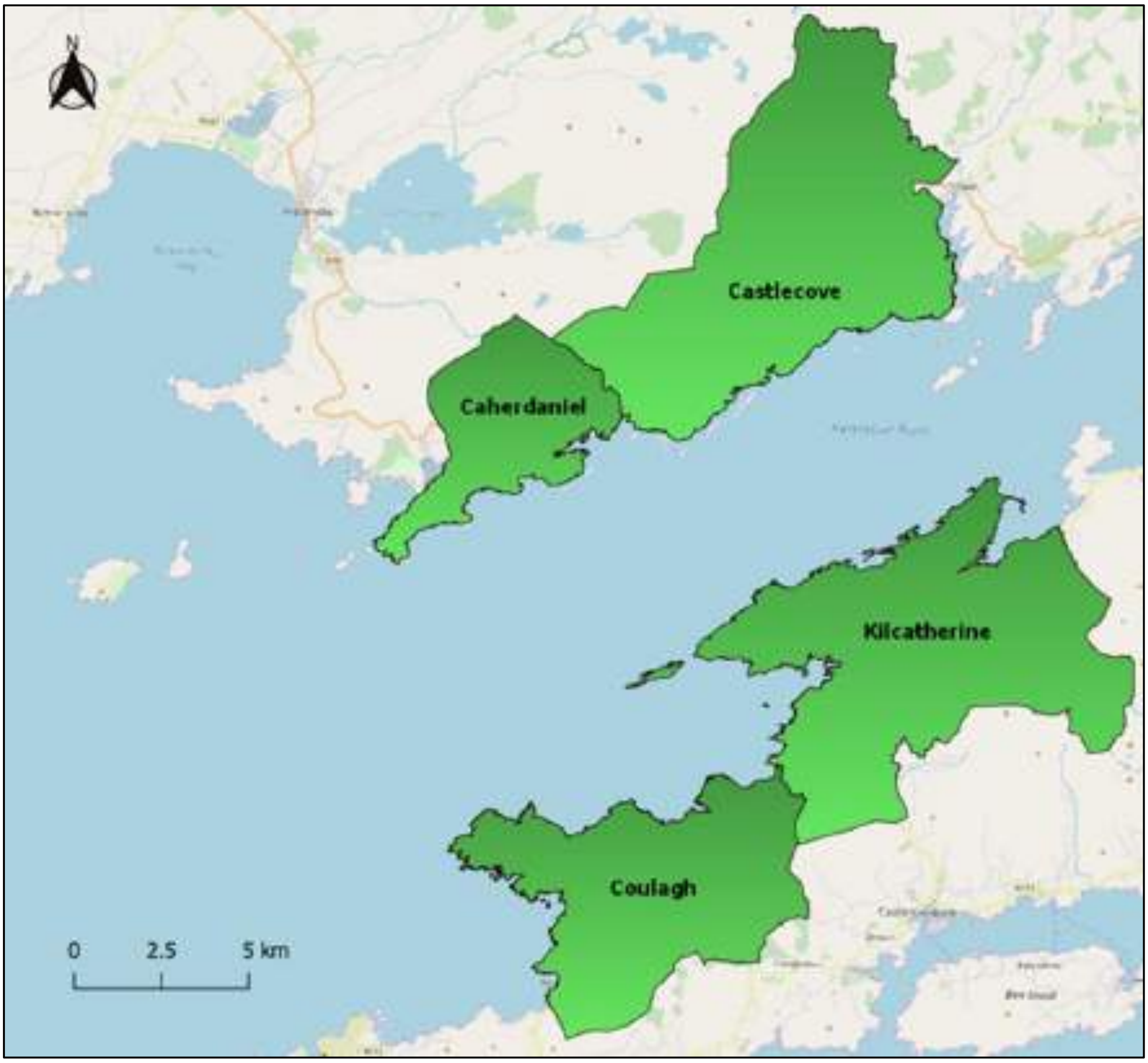

Figure 5-1: Electoral Divisions

5.1.2. Impact Assessment

The uninhabited Inishfarnard Island is located off Kilcatherine point on the Beara Peninsula on the west coast of Co. Cork. The area forms part of the Wild Atlantic Way due to the presence of this scenic route in the Kilcatherine area. The presence of coastal communities within this region and aquaculture employment in the area illustrate the importance of the maritime industry in this coastal region. In addition, Kilcatherine area is located approximately 16km from Castletownbere, the second busiest fishing port in Ireland in terms of its landings, with 14,008 tonnes of Irish fish landings in 2016 attributed to the Cork port (CSO Fish Landings data 2007-2016). Fish farming offers a means of maintaining a similar type of lifestyle as traditional fishing. Salmon farming has brought much needed income to many parts of rural Ireland. As with any new development, however, it has been greeted with a degree of suspicion and criticism. Dealing with this has been helped by involvement of the local community and establishment of dialogue channels. Communication is seen as the way forward for the successful integration of fish farming with rural Ireland and traditional fishing.

To fully describe the impacts on human beings in the existing environment, an in-depth socio-economic study would need to be carried out in the area to get a broad representation of the people's views. This would be a major project in itself and is beyond the scope of this EIA. Therefore, to deal with the issue this EIA has drawn on similar studies and opinion polls carried out in areas of Ireland where aquaculture occurs. It is believed that while these studies may not necessarily reflect the views held by local communities in the Kenmare Bay region, it is thought the general feeling of the communities to aquaculture would be similar and studies have been used to inform this EIA.

As with any development or expansion scheme, consideration has to be given to the feelings and views of the local community. Although the expansion of farms has the potential to increase local employment and income there is also the potential to disrupt and disadvantage locals not involved in the development. For this reason, it is essential that communication channels are established at the outset and locals are made aware of the proposals. It is essential that any possible areas of contention are dealt with in the appropriate manner. This involves adopting effective mitigation measures if they are deemed necessary and regular consultations with the local community. It is hoped that this attitude will facilitate open negotiations between stakeholders. To this end, local stakeholders, associations, and any individuals who may have an interest in the current development proposals by MOWI Ireland will have an opportunity to express their opinions during the public consultation process prior to the development proceeding. All valid opinions will be taken seriously, and every effort will be taken to alleviate any concerns and incorporate mitigation measures into the proposal where appropriate.

It is important that mutual respect exists between the farm and all members of the community. In identifying the key reasons for changing attitudes, O'Connor *et al*. (1992) suggest that many of the problems encountered have their origins in:

- the nature of the relatively remote coastal areas which have provided the best sites for aquaculture operations.
- the history of marginalisation of the communities living in these areas, with a population structure damaged by heavy emigration, leaving a sense of powerlessness towards outside agencies.
- the strategy of locating technically advanced and highly capitalised enterprises in communities with no skills for dealing with the potentials, limitations, or challenges of this type of economic development; and

- no local public participation in the initial strategy for aquaculture development, and therefore no mutually agreed goals for social development.

To overcome these perceptions and to achieve sustained prosperity from the development of a natural resource of the type used by aquaculture O'Connor *et al*. (1992) suggest that there must be:

- successful integration of economic goals with social and environmental priorities at all levels.
- these goals to be agreed by consensus at local and national levels; and
- an explicit policy favouring the development of a type of aquaculture and a structure for the industry which merges with and supports the patterns of land use, lifestyles, and occupations of local communities.

It is generally agreed that dialogue is the only way forward and all parties with vested interests in the water must be consulted to have their opinions voiced. Cairde na Mara (1994) carried out a questionnaire in Ceantar an nOilean and discovered the majority of people (85%) favoured the presence of fish farms. The main areas where respondents thought fish farming has had a good influence were in employment creation (cited by 83%), keeping people at home (74%) and improving the standard of living (74%). However, 50% of those questioned felt there was insufficient information available on the activities of fish farms.

An opinion poll on aquaculture, commissioned by the Irish farmers Association (IFA), was carried out in May and June 2015 with the objective of gathering topical data on the priorities, concerns, perceptions, and information sources of the Irish public on the aquaculture industry and to assess changing perceptions since an opinion poll carried out in 2008 (IFA, 2015).

Some of the main findings of the research are:

- An increase in local residents “happy to see a fish farm in their area” from 27% (2008) to 49% (2015).
- A decrease between 2008 and 2015 in local residents opposed to a fish farm in their area from 7% to 5%.
- Support for aquaculture development among local residents without an existing fish farm nearby: 25% (2008) - 27% (2015).
- Overall support for new farms among residents in areas without an existing fish or shellfish farm – those who would not object (79% 2008 and 2015).
- Overall attitudes for 2008 and 2015 for the possible installation of a fish farm locally are generally not strongly negative.

- Main reasons for opposition to a fish farm in the locality (unprompted): don’t understand it 31%, water pollution concerns 24%, conditions fish are kept in 19%, quality of the fish 18%, “nothing in it for me” 17%.
- Main reasons for support of a fish farm in the locality (unprompted): employment 59%; ensures fish stocks 27%; a healthy food to eat 22%; wealth creation/helps support local communities 18%; ensures fish do not become scarce 19%; cheaper fish 14%.

Irish salmon farming on a national level is significant and while the majority of people appreciate and acknowledge the tremendous boost it has given to rural Ireland, environmental concerns remain and are the basis for much of the opposition to the industry.

Salmon farming has brought significant employment to remote parts of Ireland. Coastal areas which in the past have been characterised by a substantial emigration of young people can now provide a certain amount of suitable employment which avails of the boating and fishing skills endemic to the area. Fish farming can also be looked upon as a means of exploiting an abundant and ostensibly renewable natural resource at a time when stocks of wild fish are diminishing.

It is probable that the response from the local community to the fish farm development in Kenmare Bay, would be similar to that of the local communities in the studies mentioned above. Garvey & Bennet (1991) suggest that results from surveys such as these can be used to consider the social (employment and housing), cultural (maintenance of indigenous culture), political (empower local initiatives), economic (wealth distribution and job creation) and physical (conservation of natural resources) dimensions of developments. In any community there will be mixed feelings to the development, some will welcome the additional employment it will bring, while others will question its commitment to environmental issues and its effect upon the environment. MOWI Ireland have made their plans known locally in an effort to include the community in the development. It is the first step in establishing communication channels to try and bridge the gap that exists.

The existing aquaculture operations in Coulagh Bay employs, from the local population, 7 full-time employees, with 4 cleaner fish/fish health coordinators, 6 operations staff, 2 mechanical staff and 2 admin staff all shared between four different sites, equating to 10.5 full time employees onsite. Contracting staff also hired consist of 4 part time staff from Beara Iron, 1 part time electrician, 4 divers working 3 days per week and 1 driver for transportation purposes from O’Callaghan transport.

5.1.3. Conclusion

The existing licence and farm have a **positive** effect on local employment. The renewal application varies from the existing licence in that it requests change to the boundaries of the existing site and to the operating conditions attached to the licence. If approved, the requested changes will not lead to a significant increase in the number of staff employed but will ensure that the **positive effect** of the farm on local employment is **maintained**. If the licence is not renewed, there will be a negative effect on local employment with the loss of 10.5 onsite full-time employees and 7-11 part-time jobs from the local community.

5.2. Human Health

5.2.1. Description of the Receiving Environment

The receiving environment for human health in the context of the proposed development is considered with respect to those effects to human population described above and those potential effects to the following factors: water quality, air quality, noise, traffic, socioeconomics, and tourism (including recreation) and water management as relevant to human health. The receiving environment for these factors are outlined in Land and Soils (see **Section 7**), Water (see **Section 8**), Air and Climate (see **Section 9**), Noise (**Section 10**) and Material Assets (see **Section 11**).

In terms of Health and Safety, MOWI operate to an Occupational Health and Safety management system (18001:2007 HSAS certified) as detailed in the Company's SOPs relating to health and safety (see **Appendix 4**). These SOP's set out the lines of responsibility for overseeing all operational health and safety systems and emergency procedures. In addition, MOWI have an Environmental Management Policy (see **Appendix 3.5**) which enables the company to contribute to sustainable aquaculture, protect the environment, meet regulatory and corporate compliance obligations, while ensuring safe control MOWI products are delivered, distributed, and manufactured.

5.2.2. Conclusion

Considering the above, the renewal application including the requested change to the boundaries of the existing site and the operating conditions attached to the licence will not give rise to negative effects on human health; it is concluded that there will be **no significant effects**.

6. Biodiversity

6.1. Conservation Sites – Habitats and Species

The assessment of potential impact to conservation sites considers sites that form part of the Natura 2000 network. These sites include Special Areas of Conservation (SACs) designated under the Habitats Directive (92/43/EEC) due to their significant ecological importance for species and habitats protected under Annexes I and II respectively of the Habitats Directive, and Special Protection Areas (SPAs), designated for the protection of populations and habitats of bird species protected under the EU Birds Directive (Council Directive 2009/409/EEC). Features for which SACs and SPAs are designated are called Special Conservation Interests or Qualifying Interests (collectively referred to herein as Qualifying Features).

For the current application an '*Appropriate Assessment Screening and Natura Impact Statement*' (*AA Screening and NIS*)[3] has been prepared to address Article 6(3) obligations under the European Community (EC) Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (commonly known the Habitats Directive), which is transposed into Irish legislation under the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended). The Screening for AA and NIS report determined that it can be excluded on the basis of objective scientific information that the project, individually or in-combination with other plans or projects, will have a significant effect on a European site.

The Screening for AA and NIS report considers potential connectivity between Qualifying Feature species and habitats of SACs and SPAs and aspects of the aquaculture operations at the proposed site. Where potential connectivity between a Qualifying Feature and aspect of the proposed project was shown to exist, an assessment was undertaken to determine the significance of the interactions identified.

Respectively **Table 6.1** and **Table 6.2** list Qualifying Features of SACs and SPAs for which potential interactions were identified and indicates where these assessment have been incorporated in the current report.

[3] Document File Name: *JN1524 Inishfarnard NIS - Volume 1 - Main Report, JN1524 Inishfarnard NIS - Volume 2 - Appendices*

Table 6.1 Qualifying Features of SACs

Annex I Habitats	Assessed in:
Large shallow inlets and bays Reefs	**Section 6.2**
Annex II Marine Mammal Species	**Assessed in:**
Phocoena phocoena (Harbour porpoise) *Halichoerus grypus* (Grey seal) *Phoca vitulina* (Harbour seal) *Tursiops truncatus* (Common Bottlenose Dolphin)	**Section 6.3**
Annex II Aquatic Mammal Species	**Assessed in:**
Lutra lutra (Otter)	**Section 6.4**
Annex II Migratory Fish Species	**Assessed in:**
Salmo salar (Atlantic salmon)	**Section 6.5**
Annex II Aquatic Mollusc Species:	**Assessed in:**
Margaritifera margaritifera (Freshwater Pearl Mussel)	**Section 6.6**

Table 6.2 Qualifying Features of SACs and SPAs

Bird Species		Assessed in:
Arctic tern (*Sterna paradisaea*) Black Guillemot (*Cepphus grylle*) Chough (*Pyrrhocorax pyrrhocorax*) Common Tern (*Sterna hirundo*) Fulmar (*Fulmarus glacialis*) Gannet (*Morus bassanus*) Great Black-backed Gull (*Larus marinus*) Guillemot (*Uria aalge*) Herring Gull (*Larus argentatus*)	Kittiwake (*Rissa tridactyla*) Lesser Black-backed Gull (*Larus fuscus*) Manx Shearwater (*Puffinus puffinus*) Peregrine (*Falco peregrinus*) Puffin (*Fratercula arctica*) Razorbill (*Alca torda*) Shag (*Phalacrocorax aristotelis*) Storm Petrel (*Hydrobates pelagicus*)	**Section 6.7**

6.2. Benthic Ecology

6.2.1. Potential Impacts

The potential source of impact to benthic habitats from operations at the Inishfarnard site is predominantly organic enrichment due to settleable solids discharged from the fish sites which comprised fish faeces and feed waste. Solid wastes arising from the culture of fish can impact the seabed and associated benthic communities.

6.2.2. Assessment Methodology

Specifically, **Section 6.2.4** describes the findings of **Annual Benthic Audits** undertaken at the site from 2017 to 2019 as part of ongoing monitoring while **Section 6.2.5** describes monitoring and assessment undertaken in 2016 and 2018 to meet **Aquaculture Stewardship Council Accreditation**.

Section 6.2.6 considers the potential impact of operations at the proposed site on the Conservation Objectives of Kenmare River SAC for which potential impacts could not be discounted at the Screening stage. The assessment of likely impact follows NPWS guidance on interpretation of the Conservation Objectives of the SAC.

6.2.3. Description of Receiving Environment

As outlined above, the project is located in Kenmare River SAC. The bay is a long, narrow, south-west facing glacial valley which is exposed to winds and swells from the south-west at the mouth that diminish towards the head of the bay (NPWS, 2016). Numerous islands and inlets along the length of the bay provide areas of additional shelter. The exposed coast to ultra-sheltered areas supports a wide variety of habitats and communities. The site contains three Annex I marine habitats namely reefs, large shallow bay and marine caves. There is also a very high number of rare and notable marine species present and some uncommon benthic communities.

In relatively exposed areas the sublittoral sediment is composed mainly of coarse shelly sand and gravel which support sparse bivalves, including *Lutraria* sp, while soft mud sand habitats in sheltered area are dominated by borrowing megafauna, including Norwegian Prawn (*Nephrops norvegicus*) and the burrowing sea cucumber *Neopentadactlya mixta* and macrofaunal polychaetes, crustaceans and brittlestar echinoderms. The SAC also supports the rare burrowing anemone P*achycerianthus multiplicatus* and communities characterised by burrowing brittlestars including the uncommon *Ophiopsila annulosa*. The living red carcareous algae 'maerl' is reported in a number of the sheltered bays. Notable faunal groups associated with maerl included crustaceans while associated flora included red and brown algae. Infralittoral and circalittoral rocky reef areas occur at the head of the bay. Assemblages associated with the hard substrates can be divided into two broad categories based on depth.

Coarse and mobile sand beaches in outer parts bay support typically intertidal sand faunal communities dominated by sand hoppers in the high shore and polychaete worms in the low shore.

The SAC also supports sea caves that back into cliff faces. The communities characterising the caves include encrusting sponges, ascidians, and bryozoans.

Good examples of perennial vegetation of stony banks occur at two locations within Kenmare River SAC - Pallas Harbour and Rossdohan Island. Characteristic species recorded here include thrift, common scurvygrass, rock samphire and sea campion.

6.2.4. Annual Benthic Audits

6.2.4.1. Audit Design

Following Benthic Monitoring Guidelines laid down by the DAFM (December, 2008) annual benthic audits are undertaken at the Inishfarnard site to monitor the benthic environment. The annual audits involve direct observation, sampling, and recording (photographic and written) of benthic conditions at sites along transects:

Transect 1 (T1) aligned with the prevalent water current

- directly under the pen (T1 Under)
- under the edge of the pen (T1 Edge)
- 10m from the edge of the pen (T1 10m)
- 20m from the edge of the pen (T1 20m)
- 50m from the edge of the pen (T1 50m)
- 100m from the edge of the pen (T1 100m)

Transect 2 (T2) aligned perpendicular to the prevalent water current

- directly under the pen (T2 Under)
- under the edge of the pen (T2 Edge)
- 10m from the edge of the pen (T2 10m)
- 20m from the edge of the pen (T2 20m)
- 50m from the edge of the pen (T2 50m)

Control/ reference station

In addition to direct observations at each of the stations, a sediment profile camera system was used to acquired sediment profile images (SPI).

6.2.4.2. 2019 Benthic Audit Results

Annual monitoring survey have been carried out for production cycles in recent years (AQUAFACT, 2017, 2018a and 2019a) with the most recent audit carried out in November 2019, covering the most recent production cycle (AQUAFACT, 2019a). The audit reports from 2017, 2018 and 2019 are included in **Appendix 6**.

The benthic audits in April 2017 and July 2018 (AQUAFACT, 2017, 2018a) identified no major signs of impact detected beyond the edge 10m stations (i.e., TI 10m and T2 10m stations). At the time of the April 2017 survey the seabed at the stations located under the fish pens (i.e., T1 Under and T2 Under) were characterised as muddy sand which was formed into small hills and depressions by the bioturbating activity of a dense population of opportunistic polychaeta including *Capitella* sp. complex and *Malacoceros* (see **Figure 6-1**). A patchy distribution of *Beggiatoa* sp. bacterial mats was present at the stations due to the presence of excess feed and faecal material increasing the organic carbon levels at the station leading to localised enrichment. At the stations located at the edge of the pens and 10m from the edge of the pens there was evidence dark sediment near the seabed surface and scattered patches of *Beggiatoa* sp. There were no major signs of impact detected beyond the edge 20m stations, edge 50m stations and edge 100m stations (see **Figure 6-2**).

In 2018 the seafloor at the sites under the pens was characterised by medium sand with aggregations of the mussel *Mytilus edulis* and the plumose anemone *Metridium dianthus.* It was noted that while uneaten feed was present no bacterial mats were observed in the area. The sediments and seafloor at the stations located at 10m and 20m from the edge of the pens were largely similar to those under the pens. At 50m and 100m from the edge of the pens the seafloor was characterised a medium sand with high percentage of shell material. The SPI images indicate that the sediment in these areas were well oxygenated (see **Figure 6-2**)

The audits carried out in 2017 identified faunal species at the stations under the fish pens that act to assimilate excess organic material and increase the oxygen content of the sediment, namely the polychaetes *Capitella* sp. complex and *Malacoceros vulgaris* (see **Figure 6-1**). *Capitella* and *Malacoceros* are first order deposit feeding opportunists that proliferate in reduced sediments to such a degree that there is a pronounced unbalance in the faunal assemblages. Once populations of these deposit-feeding species are established they play a major role in assimilating excess organic material at the bottom. These can also increase the apparent redox potential discontinuity (aRPD) depth through bioturbation of benthic sediments. This in turn increases oxygen levels and depths mitigating anoxia in surface sediments. This is evidenced by the SPI images of well oxygenated sediments at the site in 2018 where the bioturbation activity of the opportunistic polychaete community acted to remove excess organic material and reduce impacts (see **Figure 6-1**).

At the time of the May 2019 audit, the seabed at stations located directly underneath the fish pens were characterised by fine to medium sand that was formed into small hills and depressions by the bioturbation activity of a populations of *Malacocerus vulgaris* and *Capitella* sp. complex (see **Figure 6-1**). There were no observations of outgassing or bacterial mats in the area. Over time the assimilation of organic material by the opportunistic polychaete assemblage and the bioturbation of sediment will act to reduce impacts at the site and increase the depth of oxygen penetration into the sediments. The sediments under the sites in 2019 will in time revert to a state similar to that observed under the pens in 2018 (see **Figure 6-1**). In general, the seabed at the stations located at the edge of the pens and beyond appear to be in good condition and showed no signs of impact from the adjacent finfish activities (see **Figure 6-2**).

6.2.4.3. Conclusions

The audits undertaken in 2017 through 2019 show that the benthic community in the vicinity of the Inishfarnard site can tolerate the tonnages produced in those years.

It should be noted that on 8 January 2018 the conditions of Licence AQ484 were amended to allow a Maximum Allowable Biomass (MAB) of 2,177 tonnes. Since the amendment were made in early 2018 the licensee has increased tonnage at the site with view of producing a MAB of 2,177 tonnes.

It can be **concluded that the operations will not significantly affect benthic habitats at the site** and any disturbance experienced will be temporary with the species characterising the community types recovering to pre-disturbed state following cessation of activity.

Figure 6-1: Sediment profile imagery at stations located under the pens at the Inishfarnard site in 2017, 2018 and 2019.

Figure 6-2: Sediment profile imagery at stations located 100m from the edge of pens at the Inishfarnard site in 2017, 2018 and 2019.

6.2.5. Aquaculture Stewardship Council Accreditation

6.2.5.1. Background

Aquaculture Stewardship Council (ASC) Accreditation is a certification and labelling scheme that guarantees consumers that the seafood they are purchasing is sustainable for the environment. To attain accreditation the producer must demonstrate that the production of seafood in question does result in unsustainable impacts to the environment.

6.2.5.2. Allowable Zone of Effect

For aquaculture developments impacts should be confined to the Allowable Zone of Effect (AZE), which is the area of seabed or volume of the receiving water body in the immediate vicinity of the farm in which some deviation from national and international environmental quality standards is expected but is not beyond a point (threshold) where critical goods and services provided by the marine ecosystem are irreversibly compromised. Typically, the AZE is defined as a 30m buffer area around the edge of the pens. However, a site specific AZE (SSAZE) was determined for Inishfarnard based on the site configuration and local hydrodynamic characteristics, which resulted in a 30m equivalent ellipse axis of approximately 50m from the edge of the pens along the long axis and 20m outside the edge on the narrow axis.

6.2.5.3. Assessment Methodology

Impacts are assessed using the AZTI-Tecnalia marine benthic Index (AMBI[4]); AZTI is a scientific and technological centre working with the United Nations. AMBI is a tool for measuring organic enrichment disturbance based on the proportions of sensitive and stress tolerant benthic invertebrate species present. Specifically, species are allocated to one of five ecological sensitivity groups depending on their sensitivity to an increasing stress gradient (i.e., organic matter enrichment). The ecological sensitivity groups are described in **Table 6.3**.

Based on the weighted average of the sensitivity scores of individuals across the five ecological sensitivity groups AMBI scores (or biotic index) are calculated. The scores range from 0 to 7. The AMBI score scale is sub-divided into five pollution disturbance classes by assigning a numerical value to each of the class boundaries. There are five disturbance classes and corresponding AMBI score range are shown in (see **Table 6.4**). It should be noted that AMBI was originally developed for European coastal waters. The tool be used as a guideline for establishing the ecological quality of Irish waters.

[4] https://ambi.azti.es/

Table 6.3 AMBI Groups

Group	Description
Group I	Species very sensitive to organic enrichment (present under unpolluted conditions);
Group II	Species indifferent to enrichment (always present in low densities);
Group III	Species tolerant to excess organic matter enrichment (indicative of slight unbalance situations);
Group IV	Second-order opportunistic species (indicative slight to pronounced unbalanced situations)
Group V	First-order opportunistic species (indicative pronounced unbalanced situations

Table 6.4 AMBI score range and disturbance classes

Pollution disturbance class	Biotic Index Range	Dominating ecological sensitivity group
Unpolluted	0 – 1	I
Slightly Polluted	2 – 3	II – III
Moderately Polluted	3 – 5	IV – V
Heavily Polluted	5 – 6	V
Extremely polluted	6 - 7	Azoic

6.2.5.4. Survey Design

A total of 9 monitoring stations (including 1 reference monitoring station) were sampled at the site in both 2018 and 2019 (AQUAFACT, 2018b, 2019b). In both years the reference stations at Inishfarnard were located outside the AZE of 30m and as such can be used to determine natural baseline organic enrichment level at the site. Aquaculture Stewardship Council Certificate included in **Appendix 7.**

6.2.5.5. 2018 and 2019 AMBI Results

AMBI scores were calculated for the reference and the monitoring stations surveyed at Inishfarnard in 2018 and 2019. The reference station, outside the influence of the farm was classified as 'Slightly Disturbed' in 2018 and 2019. It should be noted that this classification is largely due to the naturally low species count in this type of habitat.

Of the 8 stations surveyed in 2018, 7 were classified as 'Slightly Disturbed' or 'Moderately Disturbed' while 1 site was classified as 'Undisturbed' (see **Table 6.5**). Stations classified as 'Slightly Disturbed' and 'Moderately Disturbed' were characterised by Group V species which are pollution tolerant including *Capitella* sp. complex, *Malacoceros vulgaris* and *Tubificoides benedii.* The station classified as 'undisturbed' was characterised by relatively greater abundance of Group I and Group II Non-Pollution Indicator species including *Pholoe baltica* and *Photis longicaudata*.

In 2019 AMBI scores showed that 2 (of 8) stations were classified as 'Heavily Disturbed' while 6 (of 8) stations were classified as 'Slightly Disturbed' or 'Moderately Disturbed' indicating that aquaculture activity can lead to local impacts on benthic infaunal communities. The stations were dominated to varying extents by pollution tolerant species including *Capitella* sp. complex, *Malacoceros vulgaris* and *Tubificoides benedii.*

As shown in **Section 6.2.4**, pioneering deposit-feeding polychaetes *Capitella* sp. complex and *Malacoceros vulgaris* will act to assimilate excess organic material, increase sediment oxygen levels through bioturbation action thereby mitigating anoxia in sediments and allowing the sediments to recover to an unimpacted state.

Table 6.5 AMBI Score, and equivalent disturbance classification obtained from reference stations sampled in the vicinity of the Inishfarnard site, Kenmare Bay, 2018 and 2019.

	2018		2019	
Station	AMBI Score	AMBI Classification	AMBI Score	AMBI Classification
9	1.131	Slightly disturbed	1.950	Slightly disturbed

Table 6.6 AMBI Scores and equivalent disturbance classification obtained from eight stations sampled in the vicinity of the Inishfarnard site, Kenmare Bay, 2018 and 2019.

	2018		2019	
Station	AMBI Score	AMBI Classification	AMBI Score	AMBI Classification
1	2.705	Slightly disturbed	4.805	Moderately disturbed
2	1.794	Slightly disturbed	2.947	Slightly disturbed
3	1.077	Undisturbed	1.854	Slightly disturbed
4	3.913	Moderately disturbed	5.205	Heavily disturbed
5	2.524	Slightly disturbed	3.382	Moderately disturbed
6	1.748	Slightly disturbed	2.130	Slightly disturbed
7	4.449	Moderately disturbed	3.893	Moderately disturbed
8	4.762	Moderately disturbed	5.596	Heavily disturbed

6.2.5.6. Conclusions

It can be **concluded that the operations will not result in significantly long-term effects on benthic habitats in the vicinity of the site** and any disturbance experienced will be temporary. The species characterising the community types at presents will drive the recovery of the sediments to pre-disturbed state.

6.2.6. Annex I Benthic Habitats

Potential likely significant effects of the proposed project to the following marine Annex I benthic habitats of Kenmare River SAC could not be screened out at the screening stage (see Section 2.4 of *AA Screening and NIS*[5] for summary):

- Large shallow inlets and bays [1160]
- Reef [1170]

The Conservation Objectives, which are, in effect, management targets for habitats and species in the Kenmare River SAC were identified in NPWS, 2013[6]. For Large shallow inlets and bays [1160] and Reefs [1170] the Conservation Objectives are to maintain the favourable conservation condition of the features. Specifically, the natural condition of the designated features should be preserved with respect to their area, distribution, extent, and community distribution. Constituent community types (i.e., communities and community complexes) recorded within the above Qualifying Interest habitats are outlined in **Table 6.7** (NPWS, 2013).

Table 6.7: Community types within Qualifying Interest 1160 and 1170 at Kenmare River SAC

Qualifying Feature		Community Type
Large shallow inlets and bays 1160	Reefs 1170	
✓		Zostera-dominated community
✓		Maërl-dominated community
✓		*Pachycerianthus multiplicatus* community
✓		Intertidal mobile sand community complex
✓		Muddy fine sands dominated by polychaetes and *Amphiura filiformis* community complex
✓		Fine to medium sand with crustaceans and polychaetes community complex
✓		Coarse sediment dominated by polychaetes community complex
✓		Shingle
✓	✓	Intertidal reef community complex

[5] Document File Name: *JN1524 Inishfarnard NIS - Volume 1 - Main Report, JN1524 Inishfarnard NIS - Volume 2 - Appendices*

[6] NPWS, 2013. Conservation Objective Series Kenmare River SAC (site code: 2158) https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002158.pdf

Qualifying Feature		Community Type
Large shallow inlets and bays 1160	**Reefs 1170**	
✓	✓	Laminaria-dominated community complex
✓	✓	Subtidal reef with echinoderms and faunal turf community complex

The features, attributes and targets of the Qualifying Interests Large shallow inlets and bays and Reefs and their constituent community types are outlined in **Table 6.8** below (NPWS, 2013[7]). Targets are identified that focus on a wide range of attributes with the ultimate goal of maintaining function and diversity of favourable species and managing levels of negative species.

Table 6.8: Attributes and Targets for Qualifying Interest 1160 and 1170 in Kenmare River SAC

Qualifying Interest (Community Type)	Attribute (measure)	Target
Large shallow inlets and bays 1160	**Habitat area (ha)**	**The permanent habitat area is stable or increasing, subject to natural processes; 39,322ha.**
(Zostera-dominated community)	Community extent (ha)	Maintain the extent of community subject to natural processes; 20ha.
(Maërl-dominated community)	Community extent (ha)	Maintain the extent of community subject to natural processes; 47ha.
(*Pachycerianthus multiplicatus* community)	Community extent (ha)	Maintain the extent of community subject to natural processes; 6ha.
(Intertidal mobile sand community complex)	Community distribution (ha)	Conserve the community in a natural condition: 63ha.
(Muddy fine sands dominated by polychaetes and *Amphiura filiformis* community complex)	Community distribution (ha)	Conserve the community in a natural condition: 20,150ha.
(Fine to medium sand with crustaceans and polychaetes community complex)	Community distribution (ha)	Conserve the community in a natural condition: 1,989ha.

[7] NPWS, 2013. Kenmare River SAC (site code: 2158) Conservation objectives supporting document - Marine habitats and species Version 1 March 2013

https://www.npws.ie/sites/default/files/publications/pdf/002158_Kenmare%20River%20SAC%20Marine%20Supporting%20Doc_V1.pdf

Qualifying Interest (Community Type)	Attribute (measure)	Target
(Coarse sediment dominated by polychaetes community complex)	Community distribution (ha)	Conserve the community in a natural condition: 8,314ha.
(Shingle)	Community distribution (ha)	Conserve the community in a natural condition: 1ha.
(Intertidal reef community complex)	Community distribution (ha)	Conserve the community in a natural condition: 526ha.
(Laminaria-dominated community complex)	Community distribution (ha)	Conserve the community in a natural condition: 3,359ha.
(Subtidal reef with echinoderms and faunal turf community complex)	Community distribution (ha)	Conserve the community in a natural condition: 4,808ha.
Reefs (1170)	**Distribution (occurrence)**	**The distribution of reefs remains stable, subject to natural processes**
	Habitat Area (ha)	**The permanent habitat area is stable or increasing, subject to natural processes**
(Intertidal reef community complex)	Community structure (Biological composition)	Conserve in a natural condition; 681ha.
(Laminaria-dominated community complex)	Community structure (Biological composition)	Conserve in a natural condition; 3,678ha.
(Subtidal reef with echinoderms and faunal turf community complex)	Community structure (Biological composition)	Conserve in a natural condition; 4,838ha.

6.2.6.1. Modelling Potential Impact

For the proposed salmon production operations at the Inishfarnard site, three-dimensional hydrodynamic simulation modelling was undertaken to determine the transport and dispersion of settleable solids surrounding the site. Details of the model are presented in full in **Appendix 8**. In summary, solid discharges from the farm were calculated based on production and feeding levels proposed at the site (see **Section 2** above). The fate, dispersion and transport of these solids were modelled following discharge into the water column at mid-water depth at the fish pens (i.e., approximately 4m below surface). The settleable solids discharged from the fish sites comprised two sources of organic particulate matter: fish faeces and feed waste. Of the feed supplied to a fish farm an estimated 97% is consumed by the fish stock while the remaining 3% is uneaten and settles to the bottom. The simulations show localised deposition immediately beneath the farm pens and within the proposed licensed site area. The modelled footprint of maximum monthly settleable solids sedimentation rates at the farm and surrounds is shown in **Figure 6-3**. The predicted maximum deposition rate at the farm is 2.13mm per month of which 2.56kg per m^2 of organic material per month (or 82.5g per m^2 per day). Very slight migration of settleable solids outside of the licensed production area to the south and east is predicted. Outside of the proposed licensed site area the predicted deposition rate is low at less than 0.05mm per month (<2g per m2 per day)**.**

The Conservation objectives supporting document for the Kenmare River SAC (2013) provides guidance on interpretation of the Conservation Objectives of the SAC. This guidance is scaled relative to the anticipated sensitivity of habitats and species to disturbance by the proposed activities.

For the practical purpose of management of habitats, a 15% threshold of overlap between a disturbing activity and a habitat is given in the NPWS guidance. Below this threshold, which was used by Marine Institute in the AA of aquaculture activity in Kenmare River SAC (Marine Institute, 2017, 2019) (see **Appendix 9**), disturbance is deemed to be non-significant. Disturbance is defined as that which leads to a change in the characterizing species of the habitat (which may also indicate change in structure and function). Such disturbance may be temporary or persistent in the sense that change in characterizing species may recover to pre-disturbed state or may persist and accumulate over time.

The spatial overlap of the proposed site and the modelled sedimentation footprint with community types identified in Qualifying Feature Large shallow inlets and bays and Reefs are shown in **Figure 6-4**. **Table 6.9** highlights the specific community types that the proposed site and the sediment footprint overlap. For community types that coincide with the proposed site and the sedimentation footprint, overlaps are expressed as a real extent (ha) and as percentages of the total community type area in **Table 6.9**.

6.2.6.2. Assessment

Of the 11-constituent community identified in the Qualifying Feature Large shallow inlets and bays the proposed licensed area and associated sedimentation footprint overlapped respectively 3 and 4 community types (see **Table 6.9**).

In the case the Qualifying Feature Reef the proposed licensed area overlapped to varying extents each of the 3 community types identified while the sedimentation footprint overlapped 2 of the 3 community types (see **Table 6.9**).

In all cases the percentage of the community overlapped by the proposed licensed area and/ or the sedimentation footprint was below the 15% threshold for a disturbing activity identified in NPWS guidance (NPWS, 2013) (see **Table 6.9**).

6.2.6.3. Conclusions

It can be **concluded that the proposed site and operations will not significantly affect the Conservation Objectives of the SAC** and any disturbance experienced will be temporary with the species characterising the community types recovering to pre-disturbed state following cessation of activity.

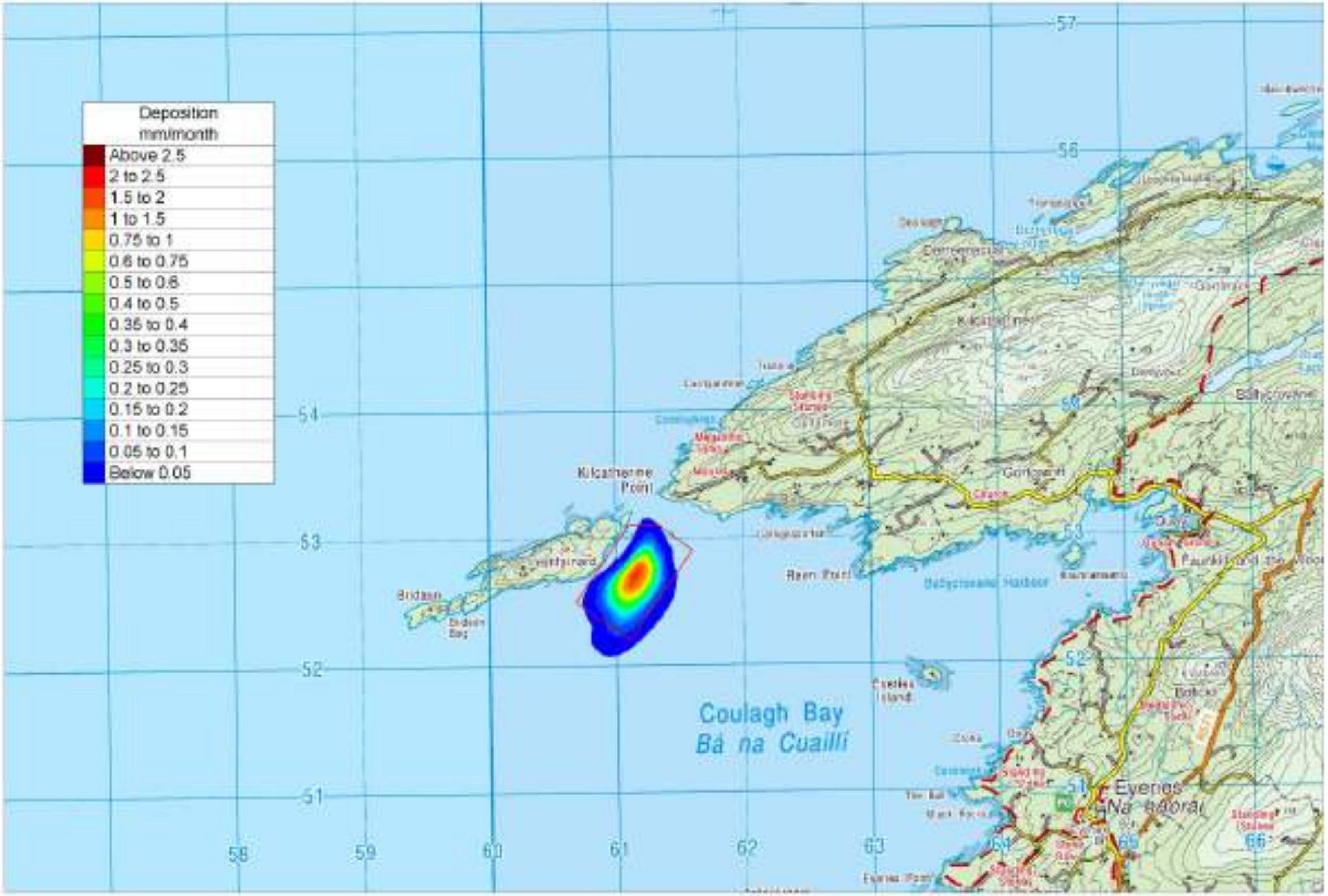

Figure 6-3: Predicted maximum monthly settleable solids sedimentation rates at Inishfarnard Farm Production Site.

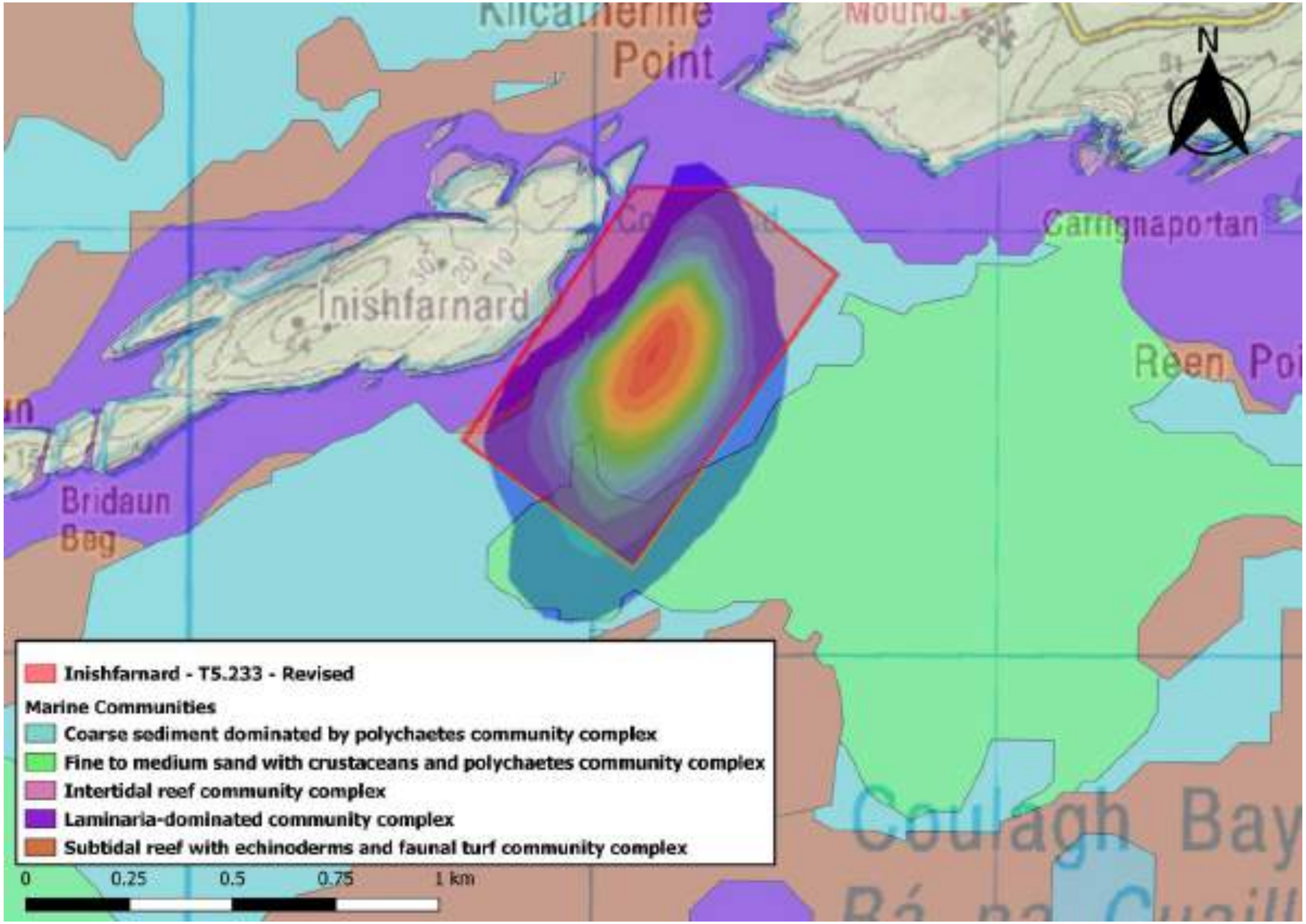

Figure 6-4: Predicted maximum monthly settleable solids sedimentation rates at Inishfarnard Farm Production Site.

Table 6.9: Overlap of proposed site and sedimentation footprint with community types

Qualifying Interest	Community Type (extent ha)	Proposed Site Footprint		Sedimentation Footprint	
		Overlap (ha)	Overlap % Of community type	Overlap (ha)	Overlap % Of community type
Large shallow inlets and bays 1160	Zostera-dominated community (20ha)	-	-	-	-
	Maërl-dominated community (47ha)	-	-	-	-
	Pachycerianthus multiplicatus community (6ha)	-	-	-	-
	Intertidal mobile sand community complex (63ha)	-	-	-	-
	Muddy fine sands dominated by polychaetes and *Amphiura filiformis* community complex (20,150ha)	-	-	-	-
	Fine to medium sand with crustaceans and polychaetes community complex (1,989ha)	3.98ha	0.20%	13.18ha	0.66%
	Coarse sediment dominated by polychaetes community complex (8,314ha)	31.72ha	0.38%	30.61ha	0.37%
	Shingle (1ha)	-	-	-	-
	Intertidal reef community complex (526ha)	0.04ha	<0.01%	-	-
	Laminaria-dominated community complex (3,359ha)	-	-	3.90ha	0.08%
	Subtidal reef with echinoderms and faunal turf community complex (4,808ha)	-	-	0.34ha	<0.01%

Qualifying Interest	Community Type (extent ha)	Proposed Site Footprint		Sedimentation Footprint	
		Overlap (ha)	Overlap % Of community type	Overlap (ha)	Overlap % Of community type
Reefs (1170)	Intertidal reef community complex (681ha)	0.04ha	<0.01%	-	-
	Laminaria-dominated community complex (3,678ha)	7.51ha	0.20%	3.90ha	0.11%
	Subtidal reef with echinoderms and faunal turf community complex (4,383ha)	0.51ha	0.01%	0.34ha	<0.01%

6.3. Marine Mammals

6.3.1. Description of the Receiving Environment

The National Biodiversity Centre (NBC) online database records sightings and strandings of marine mammal species around the Irish coast. A total of 14 seal, whale and dolphin species have been recorded in Kenmare Bay and surrounds[8] (see **Table 6.10**)

Table 6.10: Marine mammals recorded in Kenmare Bay (source Biodiversity Ireland[3])

Pinnipeds
Common Seal (*Phoca vitulina*) *
Grey Seal (*Halichoerus grypus*) *
Odontocetes (toothed whales and dolphins)
Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)
Bottle-nosed Dolphin (*Tursiops truncatus*) *
Common Dolphin (*Delphinus delphis*)
Common Porpoise (*Phocoena phocoena*) *
Cuvier's Beaked Whale (*Ziphius cavirostris*)
Long-finned Pilot Whale (*Globicephala melas*)
Pygmy Sperm Whale (*Kogia breviceps*)
Risso's Dolphin (*Grampus griseus*)
Striped Dolphin (*Stenella coeruleoalba*)
Mysticetes (baleen whales)
Fin Whale (*Balaenoptera physalus*)
Humpback Whale (*Megaptera novaeangliae*)
Minke Whale (*Balaenoptera acutorostrata*)

6.3.1.1. Pinniped Species

Common seals and grey seals are resident species commonly found throughout Irish waters. Common seals and grey seals have terrestrial colonies (haul-out sites) along all coastlines of Ireland. The species use haul-out sites to rest, rear young, engage in social activity, etc. The species leave the haul-out sites to forage and move between sites.

[8] Biodiversity Ireland - https://maps.biodiversityireland.ie/Map (accessed 14/11/2019)

Common seal (or harbour seal) (*Phoca vitulina*):

Kenmare Bay is of regional and national importance in terms of its harbour seal population (NPWS, 2012a). Surveys undertaken at a total of 26 sites in Kenmare Bay in August 2003 recorded a total 391 individuals (Cronin *et al*., 2004). Surveys were undertaken at the Kenmare River and at Illaunsillagh (outer Kenmare River) in 2009, 2010 and 2011. Counts recorded at Illaunsillagh sites in the years 2009, 2010 and 2011 were 21, 32 and 37 in 2009, 2010 and 2011. The river and bay forms part of the Kenmare River SAC (Site code: 002158) which is designated for harbour seal. Kenmare River SAC holds an important population of Common Seal (maximum count of 391 in the all-Ireland survey of 2003) (NPWS, 2016).

A study undertaken on common seal foraging behaviour indicated that while common seal were site-faithful individuals may travel considerable distances (Sharples *et al*., 2012). In summary, the study assessed movement in seals at seven locations around the coast of Britain: namely the Moray Firth, St Andrews Bay, the Orkney Islands, the Shetland Islands, the western Outer Hebrides, The Wash, and the Thames estuary. The study reported a large degree of variation in seal movements. On average, seals in the Moray Firth made the longest foraging trips (100.6 km). Some seals from The Wash were reported to make repeated foraging trips of more than 200km while an individual from the Orkney site, moved repeatedly between Orkney and Shetland, a distance of more than 220km each way. Given the wide-ranging behaviour in the species, there is potential that individuals from SACs within 220km of the project may occur in the project area; the SACs in question are:

- Glengarriff Harbour and Woodland SAC (000090) (NPWS, 2013, 2015)
- Blasket Islands SAC (002172) (NPWS, 2011, 2014)
- Roaringwater Bay and Island SAC (000101) (NPWS, 2011, 2014)

Conservation Objectives for Common seal in the above SACs are included in **Appendix 10**.

Grey seal (*Halichoerus grypus*):

Grey seals are a widespread species around the Irish coast, with greatest concentrations on the south-west, west and north-west coasts. The two closest SAC designated for the species to the project are Blasket Islands SAC (Site code: 002172) to the north and Roaringwater Bay and Island SAC (Site code: 000101) to the southeast. The Blasket Islands SAC has a large grey seal population (648-833 breeding in 2005: one-off moult count of 989 seals in 2007) (NPWS, 2014). A grey seal minimum population was estimated in the Roaringwater Bay and Islands SAC in 2005 at 116-149 (NPWS, 2014).

Cronin *et al*. (2011) investigated grey seal movement on Irelands’ continental shelf. Of the total of 529 foraging trips recorded, the furthest foraging trip was 511km. Given this wide-ranging behaviour, there is potential that individuals from any Irish SACs designated for the species may occur in the project area. The SACs are:

- Blasket Islands SAC (002172) (NPWS, 2011, 2014)
- Roaringwater Bay and Island SAC (000101) (NPWS, 2011, 2014)
- Slyne Head Islands SAC (000328) (NPWS, 2014, 2015)
- Inishbofin and Inishshark SAC (000278) (NPWS, 2013, 2014)
- Duvillaun Islands SAC (000495) (NPWS, 2013, 2014)
- Inishkea Islands SAC (000507) (NPWS, 2013, 2015)
- Slieve Tooey/Tormore Island/Loughros Beg Bay SAC (000190) (NPWS, 2015, 2018)
- Horn Head and Rinclevan SAC (000147) (NPWS, 2014, 2018)
- Saltee Island SAC (000707) (NPWS, 2011, 2013)
- Lambay Island SAC (000204) (NPWS, 2013, 2014)

Conservation Objectives for Grey seal in the above SACs are included in **Appendix 10**.

6.3.1.2. Cetacean Species

Odontocetes (toothed whales and dolphins)

Atlantic White-sided Dolphin (*Lagenorhynchus acutus*):

This dolphin often occurs in groups from tens to hundreds, and can occur in groups of up to 1,000, most often offshore. Their distribution in northwest Europe is predominantly clustered in an area from west of Ireland, to the north and north-west of Britain. Smaller numbers occur around the west of Ireland. It is possible that they follow mackerel as they spawn off the south-west of Ireland's coast in February/ March. Four stranding events are reported in the NBC database. One stranding event was reported on the south shore of Kenmare Bay at Ballydonegan on the Beara Peninsula in 1989. Strandings were also recorded at Allihies Bay on the Beara Peninsula in 1989, 1995 and 1997.

Bottle-nosed Dolphin (*Tursiops truncatus*):

Bottle-nosed dolphins are found off all Irish coasts with inshore animals moving around the entire Irish coastline and between the UK and Ireland (Wall *et al*., 2013). There are 5 records of the species in Kenmare Bay reported in the NBC database: 1 sighting of a pod of 8 individuals in the inner bay in 2013, 3 sightings of small pods of 2 to 5 individual in 2012 and a single sighting of a pod of 3 individuals in 2013. In Ireland two SACs have been designated for the species: namely Lower River Shannon SAC (002165) (NPWS, 2013) and West Connacht Coast SAC (002998) (NPWS, 2014). Given the wide-ranging behaviour of the species, there is potential that individuals from the SACs may occur in the project area. Conservation Objectives for Bottle-nosed Dolphin in the Lower River Shannon SAC and West Connacht Coast SAC SACs are included in **Appendix 10**.

Common dolphin (*Delphinus delphis*):

Common dolphin is the most widespread and abundant dolphin species in Ireland, occurring throughout all Irish waters to varying densities with the bulk of the records from offshore waters on the Irish Shelf off the south and southwest coasts (Wall *et al*., 2013). Recorded all year round, the highest densities were recorded off the south and south-west coasts in the summer and autumn. Extremely large pods (100 - 1000's) can occur in the southern approaches of the Irish sea in spring and summer. The NBC database includes a total of 6 stranding event in the inner bay and along the north and south shore of the middle bay. Groups of 20 and 100 individuals were sighted in the outer bay north of Dursey Island in 2010, 2013 and 2014. A total of 4 stranding events are recorded at Ballydonegan and Allihies Bay on the Beara Peninsula

Common (or Harbour) Porpoise (*Phocoena phocoena*):

The harbour or common porpoise is the smallest (average body length of <1.5 m) and most abundant cetacean in north-western coastal shelf waters. It is a common inshore species found across the entire Irish coast. In offshore areas, the harbour porpoise occurs in its greatest density outside of the survey area within the Irish Sea and its northern and southern channels. Porpoises are common off the south coast of Ireland throughout the year. Their relative abundance within the Irish Sea shows little seasonal variation. Monitoring has indicated an offshore movement in early summer, most likely linked to calving. Harbour porpoises have been frequently recorded throughout Kenmare Bay. The NBC database includes over 40 records of the species in the greater bay area. Typically, the species is recorded in small groups ranging from 2 to 10 individuals. Three SACs have been designated for the species: namely Blasket Islands SAC (002172) (NPWS, 2013), Roaringwater Bay and Islands SAC (000101) (NPWS, 2014) and Rockabill to Dalkey Island SAC (003000) (NPWS, 2014). Given the wide-ranging behaviour of the species, there is potential that individuals from the SAC may occur in the project area. Conservation Objectives for Harbour porpoise in the Blasket Islands SAC, Roaringwater Bay and Islands SAC and the Rockabill to Dalkey Island SAC are included in **Appendix 10**.

Cuvier's Beaked Whale (*Ziphius cavirostris*):

Little data exists for the distribution of Cuvier's Beaked Whale. The majority of beaked whale sightings in Irish waters are in slope and canyon habitats of the Rockall Trough, but also in the deeper waters of the central Rockall Trough. Beaked whales are thought to migrate to southern temperate waters in summer and early winter, then returning to colder northern waters in early spring. One stranding event was reported on the south shore of Kenmare Bay at Ballydonegan on the Beara Peninsula in 2005.

Long-finned Pilot Whale (*Globicephala melas*):

The long-finned pilot whale is one of the largest dolphins, with lengths averaging 6.7m for males and 5.7m for females, they have a square bulbous head with a lightly protruding beak. The body is dark grey to black with a grey-white anchor shaped patch on the chin. The species is typically found in water depth of 200 - 3,000 m beyond the Irish shelf edge where bottom relief is greatest but can also swim into coastal bays and fjords. They are often seen with other cetaceans, notably bottlenose dolphins. Most often, pilot whales occur in large pods (approximately 20 individuals), and large numbers of up to 1,000 have been observed off the British Isles during April, coinciding with the start of peak conception. Five strandings have been recorded in the greater Kenmare Bay area Bay in the NBC database; 1998 (2 events), 1990, 1993 and 2009 (3 events).

Pygmy Sperm Whale (*Kogia breviceps*):

This rare species has been reported throughout the tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans. The species is rarely reported sighted at sea with the vast majority of records based on strandings. The NBC includes a total of 10 strandings of the species recorded, one of which was reported from Kenmare Bay in 2009.

Risso's Dolphin (*Grampus griseus*):

This large robust dolphin, typically around 3.5 m, is to be found in small to medium sized groups (5-20 individuals, but often considerably higher). They are a comparatively uncommon species. Risso's dolphins have been recorded on a regular but infrequent basis around the entire Irish coast. While they are most often sighted at depths of greater than 200m in areas over continental shelf slopes or the slopes of oceanic islands elsewhere in the world, the dolphin seems to display a preference for inshore shelf waters in Ireland. Relative abundances off the north and northwest coasts are low. They have been recorded in Irish waters from April to November, peaking in the summer months and largely absent from Irish waters from December to March. In the NBC database one stranding event of the species was reported in 2011 at Eyeries on the south Kenmare shore. Single individuals were reported in 2011 and 2013 in the outer bay while a small group of 8 was recorded in 2013.

Striped Dolphin (*Stenella coeruleoalba*):

These dolphins are sleek in appearance, with a body coloration consisting of dark grey cape extending from the beak to the dorsal fin, lighter grey flanks, leading to a pink-white underside. Sightings of striped dolphin in Ireland are very rare. By-catch data indicate their presence in the deep waters to the southwest of the Irish Shelf. This data is insufficient to infer seasonal or temporal trends. The NBC database includes 3 recorded strandings from Kenmare Bay, 1 along the north shore in 1998, 1 on the south in 2008 and 1 on the north shore in the outer bay in 2013.

Mysticetes (baleen whales)

Fin Whale (*Balaenoptera physalus*):

The second largest of the baleen whales, the fin whale is Ireland's most common large baleen whale, reaching a length of between 17.5 and 20.5 m. They are classed as being an endangered species. Most often they occur alone or in pairs, but also form larger pods of 3-20. They prefer deep waters, 400 - 2,000 m beyond continental shelves and high areas with variations in bathymetry. They are primarily distributed along or beyond the 500 m depth contour, in areas like Rockall Trough and Porcupine Bight. They are commonly sighted off the Irish coast, with the highest relative abundance being off the south coast, inshore to the deeper waters of Labadie Bank in the south and Celtic Deep in the east. In the NBC database there is 1 strandings of the species recorded in outer Kenmare Bay in the vicinity of Inishfarnard island in 1984.

Humpback Whale (*Megaptera novaeangliae*)

Present in Irish waters from June to February, with little sightings from March to May when they are assumed to have migrated to tropical breeding grounds. Foraging animals were most frequent off the south coast from late July to February. These whales show a high-level of site fidelity off the south coast. They also peak in abundance in the western Irish Sea in early spring and summer. A single sighting of the species in outer Kenmare Bay in 2010 is recorded in the NBC database.

Minke Whale (*Balaenoptera acutorostrata*):

The minke whale is the most likely whale species to be seen in inshore Irish waters (Berrow *et al*., 2010). The highest relative abundances of minke whale have been recorded off the south and southwest coasts of Ireland in the autumn and in the western Irish Sea in spring (Wall *et al*., 2013). A single sighting is recorded in outer Kenmare Bay in 2010. In Kenmare Bay minke whales have been commonly recorded. Numerous sightings of small group of the species have been reported in the middle and outer bay.

6.3.2. Impacts on Pinniped Species

The potential impacts seal species are:

- Disturbance
- Entanglement

Disturbance

Seal responses to disturbance can vary widely depending on the location and nature of the disturbance from increased alertness to movement towards the water and entering the water (Marine Institute, 2019). Disturbance by small boats and people have been reported to result in flushing responses in seals at distances of between 80m and 1km. The closest seal haul-out site to the Inishfarnard site is located approximately 2.2km to the east of the site off Eyeries Island. Given this distance, it is unlikely that operations at the site will result in disturbance effects at seal haul-out sites and the likelihood of an impact occurring is remote; it is concluded that there will be **no significant effects**.

As there is potential that harbour seals and grey seals may forage in the vicinity of the site in Kenmare Bay, effects from underwater noise and vibrations generated by the service vessels, well boat and feed barges must be considered. As is standard practice in marine vessel construction the engines will be on flexible sound dampening mounts. This effectively reduces the vibrations and the transfer of noise into the aquatic environment. Farmed salmon stock generally show no negative response or stress to the low-level noise generated during normal farm activities (BIM, 2012). It should be noted that the underwater noise generated by the farm vessels will not be any more significant than normal fishing / recreational activities. Small fish are known to shoal around the pens of salmon farms as structures themselves can act as artificial reefs, an act that is unlikely to occur if there were any serious noise issues associated with the farm. Consequently, it is unlikely that operations at the site will result in disturbance effects and the likelihood of an impact occurring is remote; it is concluded that there will be **no significant effects**.

As both greys and harbour seals have the potential to occur in the vicinity of the site, it may be necessary to use anti-predator nets and/ or Acoustic Deterrent Devices (ADDs) to protect the stock from seal depredation. As ADDs have never been required at the licensed site, it is extremely unlikely that they will be required if the licence is renewed. Therefore, there will be no impacts due to these devices; it is concluded that there will be **no significant effects**.

Entanglement

The fish pens and associated infrastructure (nets, ropes, anchor lines etc.) pose an entanglement risk to pinniped species foraging in the site area. However, in contrast to fishing gear, there are far fewer documented entanglement cases in salmon aquaculture gear. Although entanglement incident would most likely result in the fatality of the individual marine mammal, it is unlikely to be more than an isolated incident and the impact on the population would be similar in magnitude to natural variation. Consequently, it is concluded that there will be **no significant effects**.

6.3.3. Impacts on Cetacean Species

Given that the Bottle-nosed dolphin and Harbour porpoise have been reported in Kenmare Bay there is potential that the species may occur near Inishfarnard site. However, cetaceans rarely interact with marine farm sites and so disturbance and entanglement impact can be discounted. In addition, for the reasons outlined above for pinnipeds, the impact of noise and vibrations on cetaceans will be insignificant. As a result, no impact on cetacean species is expected.

6.3.4. Conclusions

The likelihood of impacts occurring is remote; it is concluded that there will be **no significant effects** to cetacean species.

6.4. Otter

6.4.1. Description of the Receiving Environment

The Inishfarnard site is present within the Kenmare River SAC which is designated for otter (NPWS, 2013). The inner bay is well used by otters, with vegetation providing lying up spots and holts. The Conservation Objective for the species is to restore the favourable conservation condition.

6.4.2. Impacts on Otter

Otter's forage and feed within 80m to 100m of the coastline (Kruuk & Moorhouse, 1991; De Jongh & O'Neill, 2010) and can travel distances up to 500m across estuaries or between islands (De Jongh & O'Neill, 2010). The diving depth of otters typically ranges from 10-12m with the majority of dives being <3m (Kruuk *et al.,* 1986) and lasting <20 seconds. Kruuk & Moorhouse (1991) reported that small benthic fish, eels, and crustaceans are common prey items for otters, and they appear to have a strong preference for hunting in areas with dense seaweed cover in shallow, rocky environments. Although the proposed aquaculture renewal site is located within the Kenmare River SAC, the distance from the coastline where otters are usually present, is too significant for them to be found at the Inishfarnard site. Furthermore, the water depths at the farm sites are in excess of the diving range of otters and the habitat type at the farm sites is not conducive to foraging and therefore it is extremely unlikely that otters will come into contact with the aquaculture pens or be impacted by the aquaculture activity.

6.4.3. Conclusions

The likelihood of an impact occurring on otters is remote, the consequence of an impact if realised is negligible; it is concluded that there will be **no significant effects** to otter.

6.5. Fisheries

6.5.1. Description of the Receiving Environment

6.5.1.1. Commercial species

Six species use the Kenmare Bay region as a nursery area, these include cod, herring, mackerel, white belly angler monk and whiting (**Figure 6-5** to **Figure 6-9**). All nursery grounds, with the exception of herring and white belly angler monk, overlap with the proposed aquaculture renewal site. Kenmare Bay also have the presence of adult herring, mackerel, megrim, hake, whiting, haddock, monkfish, Atlantic cod, blue whiting, horse mackerel and Atlantic salmon (Ireland's Marine Atlas).

6.5.1.2. Salmonids

Within 25km of Inishfarnard Island, a total of 24 rivers drain into Kenmare Bay: Blackwater (Kerry), Tahilla, Drimna More, Ardsheelhane, Sneem, Oweragh, Derreendrislagh, Liss, Coomnahorna, Finglas (Waterville), Feorus east, Cloonee (Kerry), Lehid, Owenshagh, Croanshagh, Cashelkeelty, Cuhig, Ownagappul, Lough Fadda stream, Tranacapoul, Ballycrovane, Kealincha, Ardacluggin and Ballydonegan with the River Inny, Emlaghmore, and Coom River draining into Ballinskelligs bay (see **Figure 6-10**). In the innermost section of Kenmare Bay, the River Roughty, Finnihy, Rossacoosane, Sheen and Drumoghty can be found. All the above rivers fall into the Dunmanus-Bantry-Kenmare catchment area (EPA Catchments). Four rivers within the Dunmanus-Bantry-Kenmare catchment used for salmonid fishing include the Blackwater (Kerry), River Inny, River Sheen, and River Roughty all of which are found in the inner Kenmare Bay.

The River Inny which discharges into Ballinskelligs bay is approximately 20km from the Inishfarnard site while the Blackwater River (Kerry) discharges into the northern side of Kenmare Bay is approximately 24km from the Inishfarnard site, the River Sheen is approximately 35km from Inishfarnard and the River Roughty which enters at the innermost section of Kenmare Bay is 37km from Inishfarnard.

Atlantic salmon (*Salmo salar*) is a protected species (in freshwater) under Annex II of the Habitats Directive (92/43/EEC). The closest SAC to the Inishfarnard site designated for the species is the Blackwater River (Kerry) SAC (002173). Salmon are also protected under the E.U. Freshwater Fish Directive (78/659/EEC), transposed into Irish law in 1988 through the European Communities Regulation on Quality of Salmonid Waters (S.I. No. 293/1988). This requires that salmonid waters must sustain their natural populations of Atlantic salmon, sea trout / brown trout (*Salmo trutta*), char (*Salvelinus*) and whitefish (*Coregonus*). Drift net fishing for salmon was banned at the end of the 2006 season. Draft net fishing has not been licensed since 2014.

The Blackwater River (Kerry) SAC (NPWS, 2014) with a catchment area of 88km^2, is located on the southern side of the Iveragh peninsula and is approximately 38.43km in total flowing north to south traversing through Killarney National Park, MacGillycuddy's Reeks and Caragh River Catchment SAC (NPWS, 2013) before entering the Kenmare River estuary. The Blackwater (Kerry) is designated as Salmonid status under the E.U. Directive 78/659/EEC and is also a designated SAC with salmon (*Salmo salar)* species of conservation importance (IFI, 2014a).

The main tributaries entering the Blackwater include the Kealduff and Derreendarragh, both being important regions for salmonid production, and consisting of 3 lakes set over the 5 ha of catchment area encompassing Lough Brin, Fadda and Beg (IFI, 2014a).

The river is used for salmon fishing each year from 15th March to 30th September with approximately 1,500 salmon and grilse entering the river annually. Trout fishing also takes place from 15th March to 12th October. The river is currently operating on a catch and release basis for the 2019 season (http://www.fishinginireland.info/salmon/southwest/blackwater.htm).

Salmonid catch depletion and electrofishing surveys were conducted on the Blackwater (Kerry) by IFI in 2014. Catch depletion surveys reported 0+ and 1+ salmon had an overall mean abundance of 0.416 fish per m^2 and 0.208 fish per m^2 respectively (IFI, 2014a). Catchment wide electro-fishing reported a mean catch of 17.82 salmon fry/5min electrofishing, while the cumulative average of 4 surveys conducted between 2008 and 2014 reported a value of 19.31 salmon fry/5min electrofishing (IFI, 2014a). These average salmon fry abundance values are above the threshold of 17 set by the Standing Scientific Committee on Salmon (SSCS) and can be considered to be indicative of good spawning grounds.

2017 records from a fish counter located 100m upstream of the Blackwater River estuary detected 95 spring salmon, 377 grilse, 39 late summer salmon and 69 sea trout (IFI, 2017a) while in 2018, 76 spring salmon, 285 grilse, 39 late summer salmon and 71 sea trout (IFI, 2018).

The River Inny which flows into Ballinskelligs bay to the north of Inishfarnard site has an approximate catchment size of 122km^2 and is a characterised spate river. The river is primarily a grilse fishery with approximately 250 fish produced annually with the majority of salmon present from mid-June (http://www.fishinginireland.info/salmon/southwest/waterville.htm). Angling points include Foildrenagh Bridge and Ballynakilly Bridge. Surveys undertaken in 2018 reported an average of 20.7 salmon fry per 5mins electro-fishing (IFI 2019).

The River Roughty has a catchment size of 202km^2 and is approximately 32km in length which runs into Kenmare Bay at the mouth of the estuary with tributaries including Cleady, Ownbeg and Slaheny. Fishing for salmon begins from the 15th of March to 30th September each year. Angling point include the Roughty Bridge, Artully Bridge, Coolyard Bridge, Slahney Bridge, Cahergal Bridge, Morleys Bridge, and Inchee Bridge (http://www.fishinginireland.info/salmon/southwest/roughty.htm).

The River Sheen is a classified spate river system with a catchment size of 100km^2. A reasonable run of spring salmon occurs from March with grilse occurring in mid-June to late July (http://www.fishinginireland.info/salmon/southwest/sheen.htm). Access points for salmon fishing include the Sheen bridge, Dromanassig bridge and Dromagorteen bridge.

In 2017 the River Roughty was above the conservation limit[9] with both the River Blackwater and Inny below the conservation limit and therefore advised to operate on a catch and release basis for 2018 (The Standing Scientific Committee on Salmon, 2017).

[9] The Conservation Limit (CL) is the minimum number of fish required to conserve the naturally sustainable stock present in a water body. Fishing is only allowed where a surplus exists over and above the conservation limit.

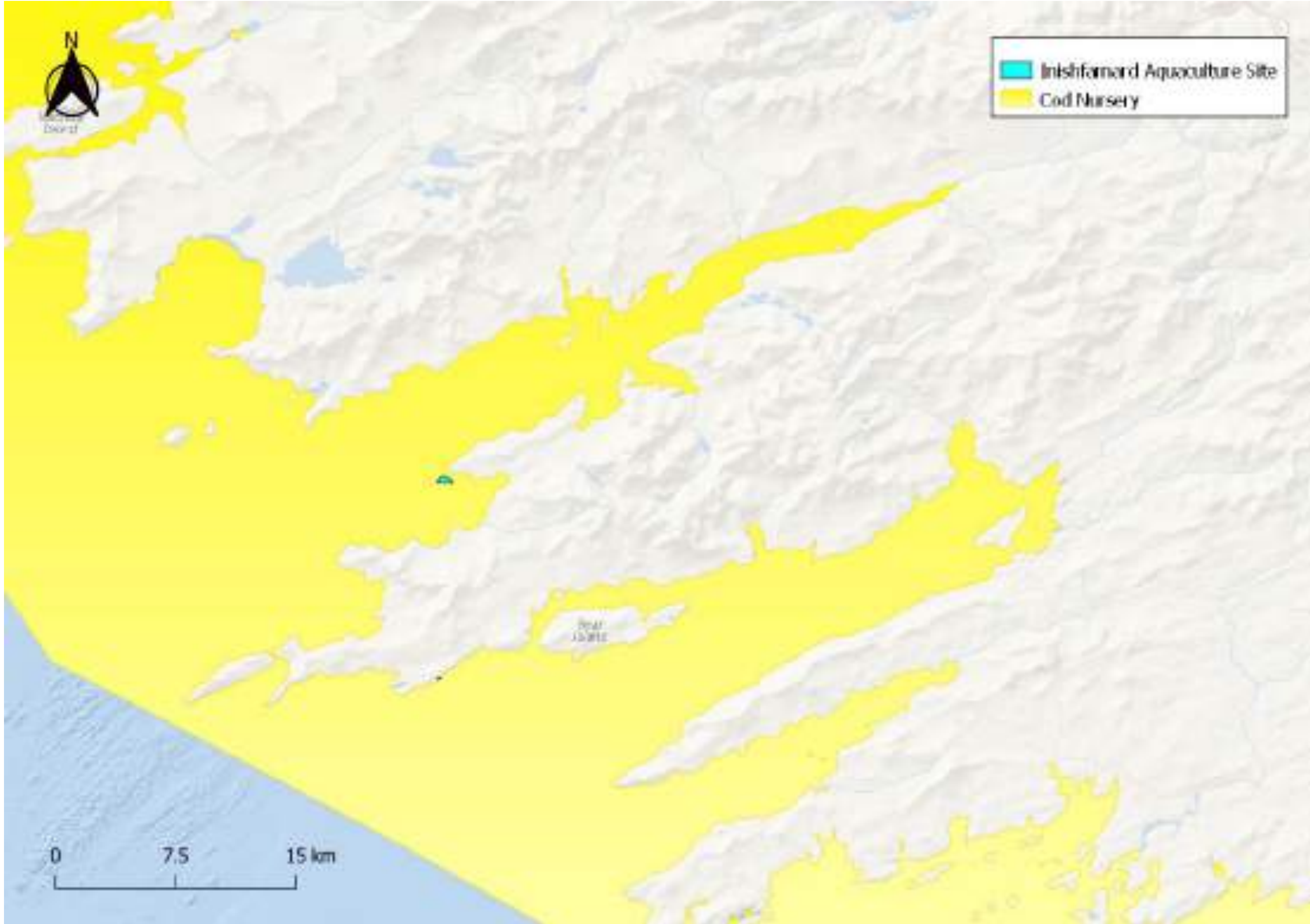

Figure 6-5: Cod nursery ground (Source: Lordan & Gerritsen, 2009).

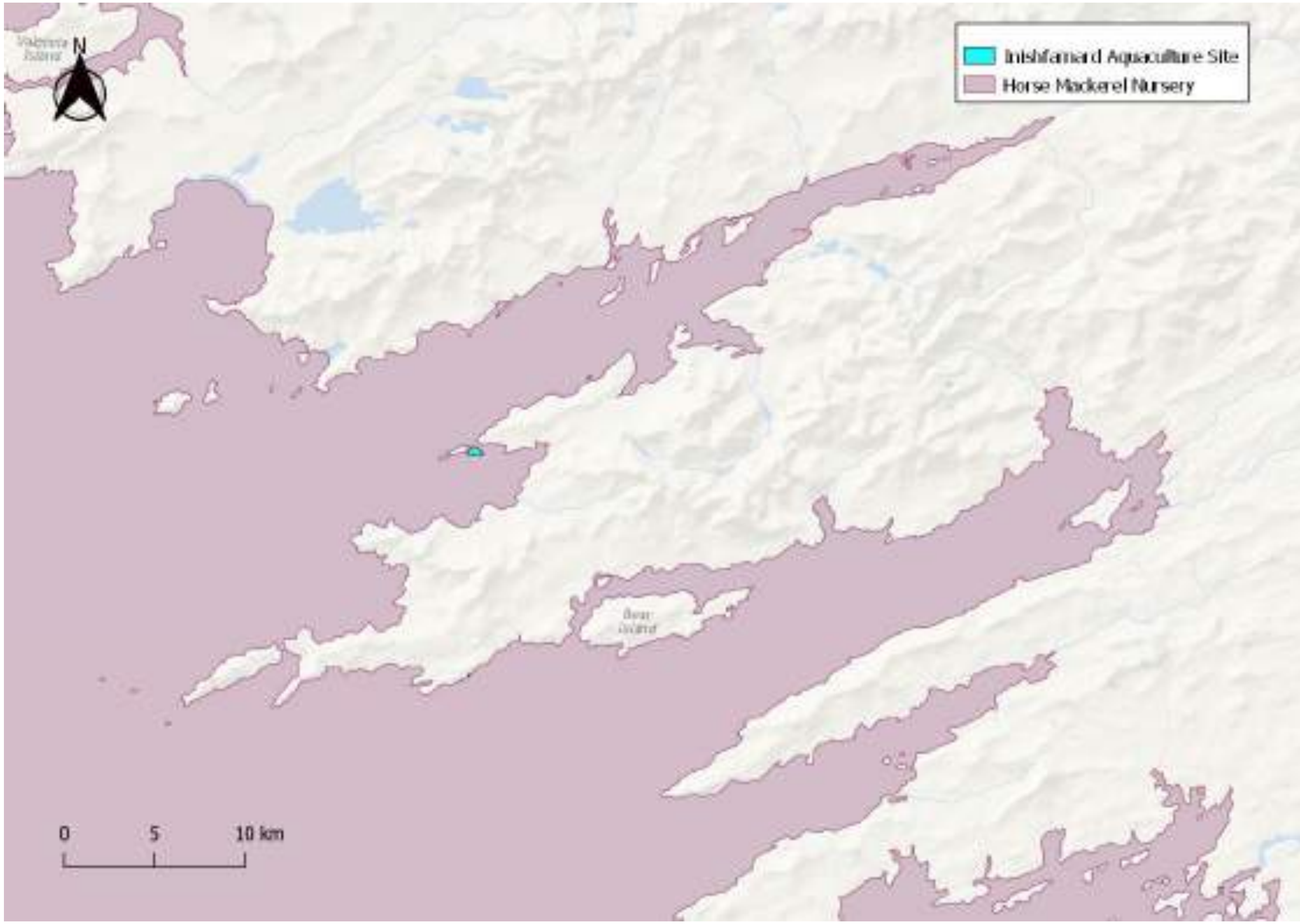

Figure 6-6: Horse mackerel spawning ground (Source: Lordan & Gerritsen, 2009).

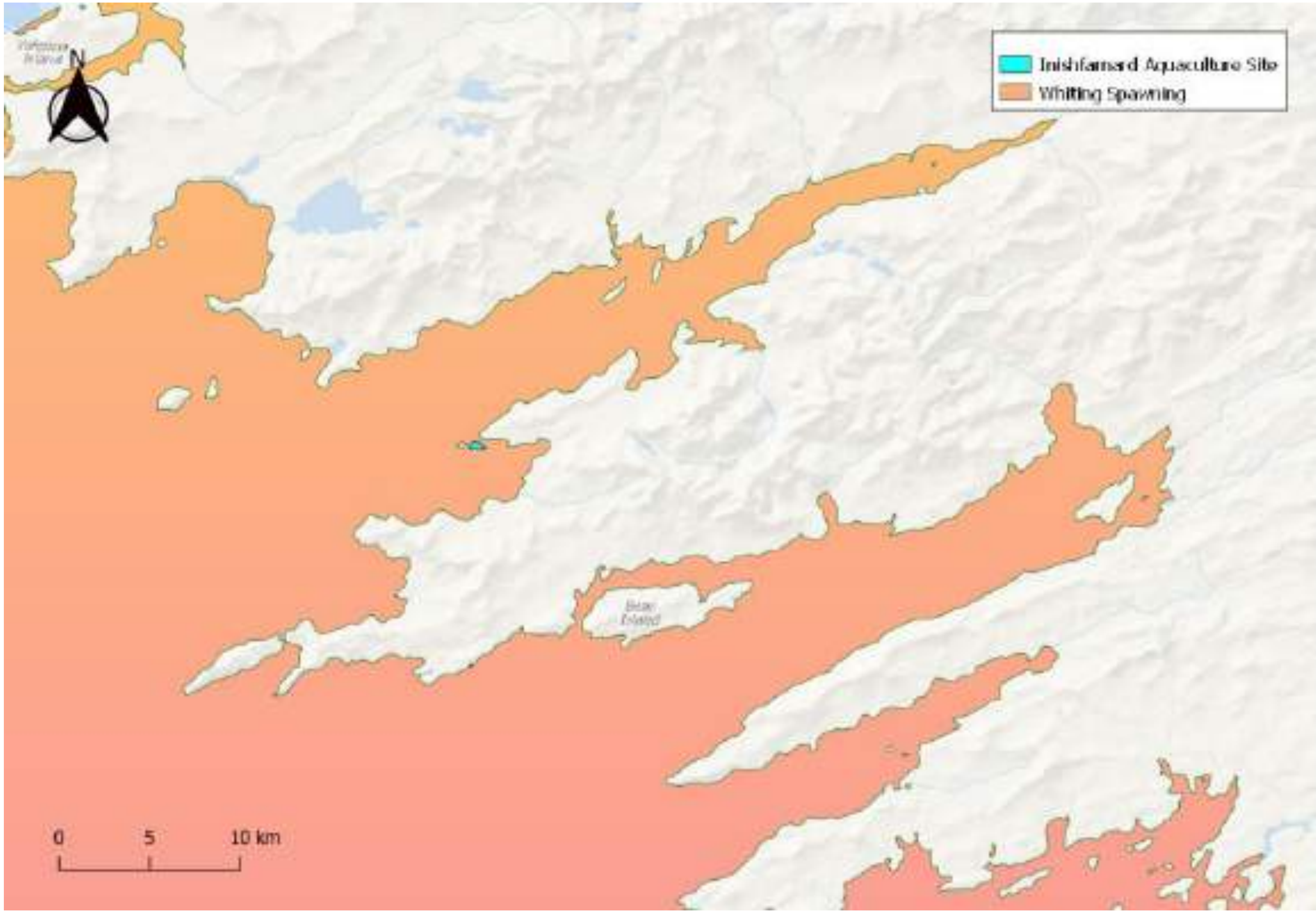

Figure 6-7: Whiting spawning ground (Source: Lordan & Gerritsen, 2009).

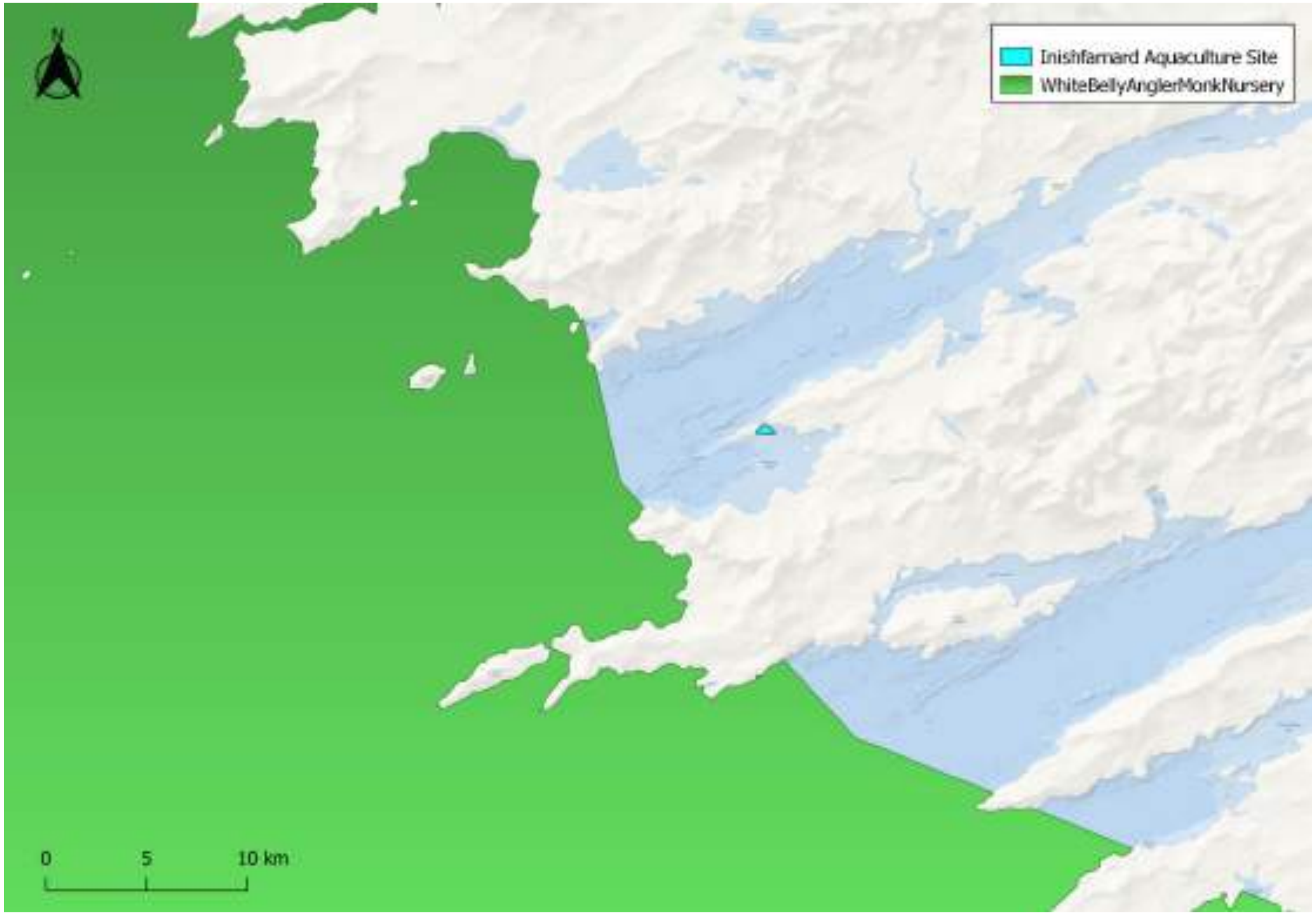

Figure 6-8: White bellied angler/ monkfish nursery ground spawning ground (Source: Lordan & Gerritsen, 2009).

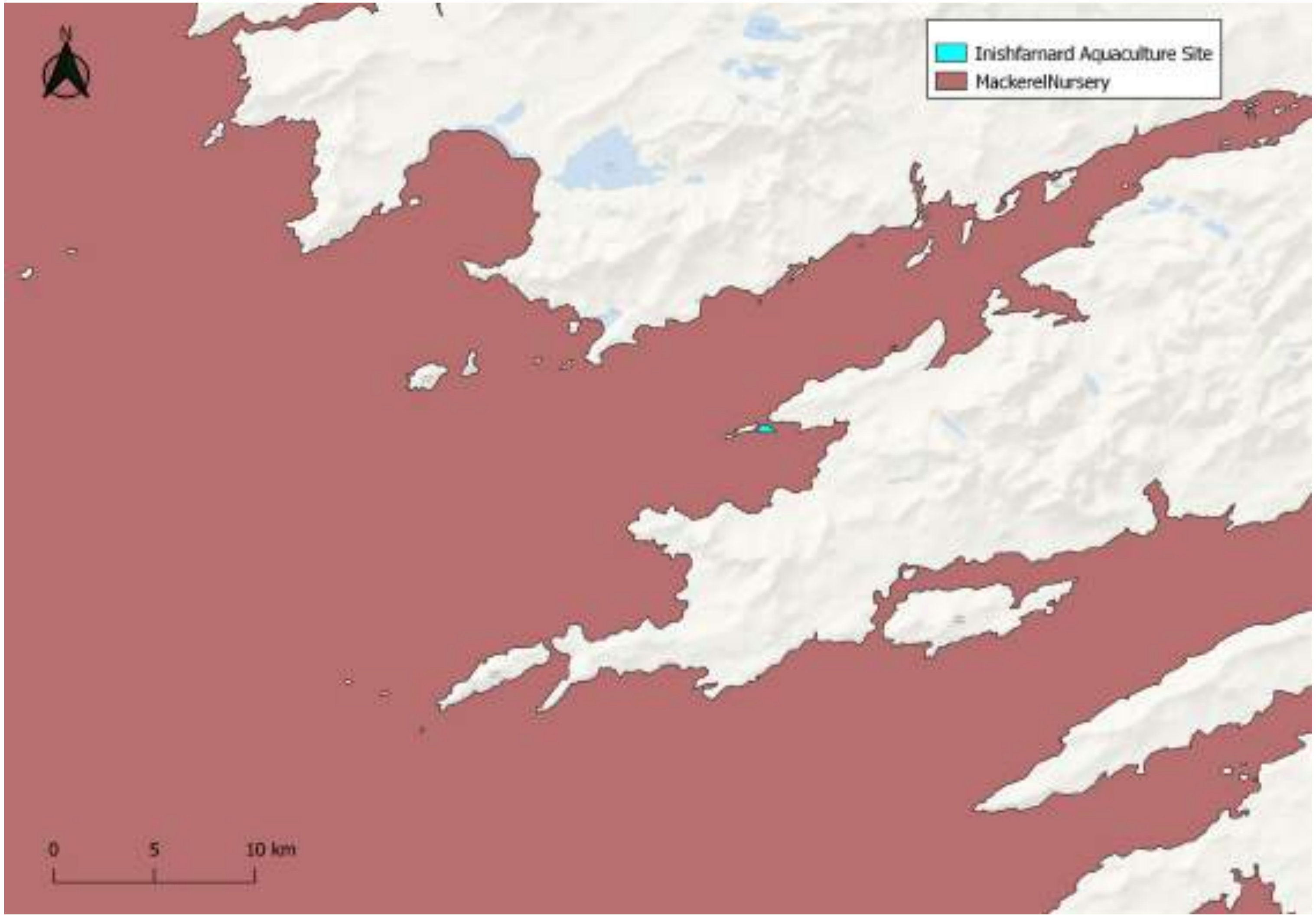

Figure 6-9: Mackerel nursery ground (Source: Lordan & Gerritsen, 2009).

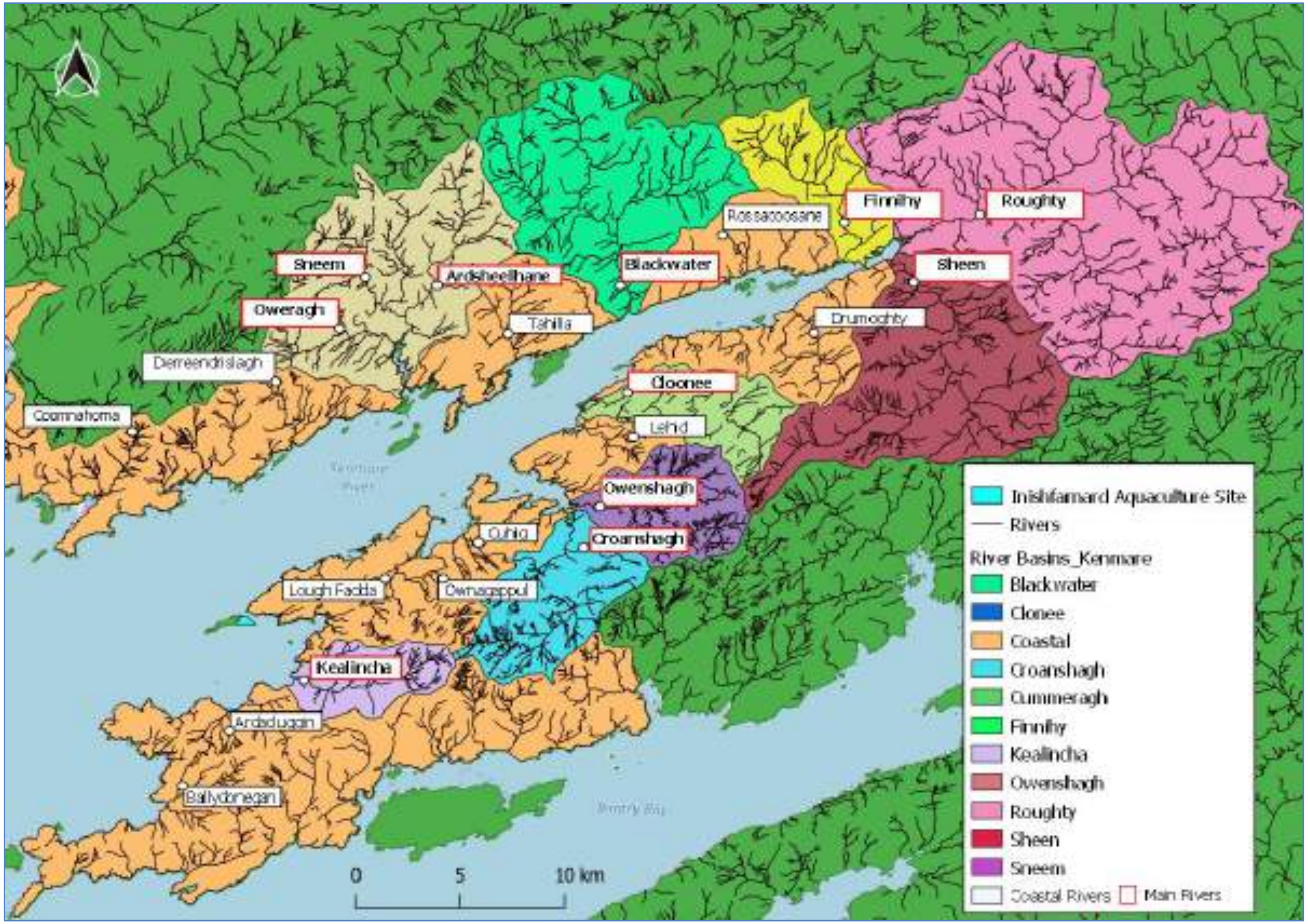

Figure 6-10: Main rivers and river basins within Kenmare Bay.

6.5.2. Impacts on Fisheries

6.5.2.1. Sea Lice

6.5.2.1.1. Background

Sea lice are natural parasites of both wild and farmed fish. There are two main species found in Ireland; *L. salmonis* which infests only salmonids and *C. elongatus,* which is known to parasitise over 80 different species of marine fish (O'Donohoe *et al.,* 2017). *L. salmonis* is the larger of the two species and is regarded as the more damaging parasite. It is endemic at a high prevalence (>90%) within wild populations (Jackson *et al.,* 2013), and occurring frequently on farmed salmonids (Jackson & Minchin, 1992; Jackson *et al.,* 2005).

L. salmonis is an obligate parasite with a direct lifecycle with 8 stages (comprising of nauplius 1, nauplius 2, copepodid, chalimus 1, chalimus 2, pre-adult 1, pre-adult 2 and the adult stages (O'Donohoe *et al.,* 2017). The life cycle is shown in **Figure 6-11**. The nauplius 1 stage hatches from paired egg-strings and is dispersed in the plankton. It moults to nauplius 2, also planktonic, which is followed by a copepodid, the infective stage where attachment to the host takes place. The copepodid then moults through the attached chalimus stages before becoming a mobile pre-adult. There are two pre-adult stages before maturing to the adult phase. The adult female can produce a number of batches of paired egg-strings, which in turn hatch into the water column to give rise to the next generation (Hamre, 2013; Kabata, 1979; Schram, 1993). Hatch rate is variable according to season, host, and other factors but peaks at about 400 Nauplii per clutch. The copepodid attaches to its target host through the development of a frontal filament.

Copepodids have limited strategies to assist in seeking out hosts. They can dart by up to 10cm on sensing a passing host fish. They may also be able to adjust their position in the water column, sinking towards the seabed in response to the ebbing tide (geotaxis), to assist in maintaining their position and population density, close to estuaries and inshore margins, through which their target hosts migrate. Once attached, to the host, the louse feeds on blood and tissue. It develops through four chalimus larval stages and two pre-adult stages before maturing. The time taken between metamorphoses for this cycle to complete, and the next generation of eggs to be produced, is temperature-dependant.

Lice fecundity peaks in spring, when infective copepodid stages appear to congregate near the river mouths, from which smolts emerge. The precise mechanism behind this phenomenon is not clear but it is likely that ovigerous female lice are carried into the inshore margins near estuaries on wild adult salmon, returning to their native rivers to spawn. By this means, a critical mass of descending smolts is met by a critical mass of waiting copepodids, such that a successful infestation ensues.

L. salmonis evolved this strategy of infesting salmonid smolt during their migration, countless millennia ago, long before the advent of salmon farming. In fact, *L. salmonis* must be very successful at host targeting because the clutch size of lice juveniles is quite small for a parasite that releases its young into open waters to complete its life cycle rather than directly onto a host species.

Copepodids cannot feed and only survive as long as their internal yolk supplies last. Any that fail to find wild hosts drift seawards and die within ten days or so, depending on temperature, as their yolk supplies run out. Inadvertently, salmon farms offer a new, alternative host source since they are situated at fixed locations downstream of river mouths and their relatively high stocking density mirrors the natural shoaling of their wild cousins, prior to their migration dispersal.

However, whilst wild fish disperse seawards from their native estuaries, effectively ending their exposure to the parasite, farmed salmon remain at high densities, within the confines of their pens. This makes it easy for chance encounters with small numbers of drifting wild copepodids to result in widespread infestation of farm stocks within one or two lice generations if the infestation is not treated. This is the primary means of lice infestation of well-managed salmon farms, their secondary route being infestation by copepodid drift from one farm site to others.

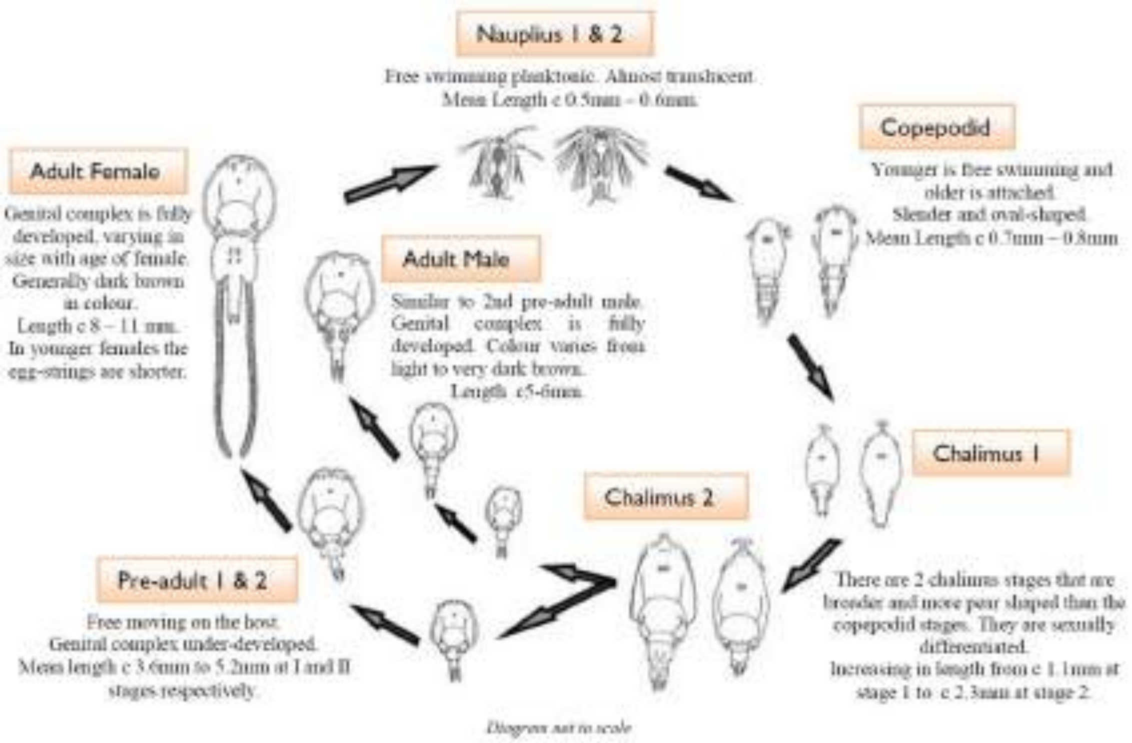

Figure 6-11 Life cycle of *Lepeophtheirus salmonis* (O'Donohoe *et al*., 2017 after Schram, 1993 & Hamre, 2013).

6.5.2.1.2. *Modelling Potential Impact*

For the proposed salmon production operations at the Inishfarnard site, three-dimensional hydrodynamic simulation modelling was undertaken to determine the transport and dispersion of sea lice (*L. salmonis*) larvae from the farm (**Appendix 8**). For the purposes of modelling larval lice dispersal from the salmon farm sites it was assumed that the average number of adult female Lice per fish is 1 and that each adult female louse releases on average 250 viable nauplius I larvae into the water column per hatch. The nauplius I will metamorphose into nauplius II larvae which then metamorphose into the infective copepodid larvae stage. These three larval stages are free living in the water column and can be treated as passive particles being advected and dispersed by the ambient currents. The infective copepodid larvae stage occurs within approximately 4 days post hatch and generally has a maximum longevity of approximately 10 days at typical springtime temperatures. Water temperature affects the die-off rates of the copepodid larvae. The ability of the copepodids to latch onto a host is thought to diminish with age. An exponential decay is used to model the longevity of the larvae with a decay coefficient of 0.241 day-1 (Amundrud and Murray 2009). Other sea lice larvae dispersion modelling studies (Cawley, 1998) used a higher decay rate of 0.364 day-1 based on Johnson & Albright's (1991) laboratory research into survival rates for temperatures of 12°C degrees and salinity of 30 to 35 psu.

DAFM set trigger level for lice treatment during the susceptible spring period (when wild salmon migrate) is 0.5 ovigerous female lice per fish (at bi-weekly monitoring). Therefore, the assumption of 1 ovigerous female louse per fish for baseline simulations of the dispersal of larvae from the salmon farm within Kenmare Bay and the potential to infect wild salmon is considered to be reasonably conservative.

March Year 2 production and harvesting fish numbers were used as the maximum total of adult fish numbers at the Inishfarnard site (561,041). The modelling used 1 louse per adult fish producing 250 eggs per louse gives the following average input rate of 52.4 larvae released per second.

The sea lice larvae simulations were performed over a 35-day period which included a 6-day warm period followed by a 29-day lunar cycle period using a time step of 15 seconds and outputting predicted plume results at 15-minute interval over that period. The hydrodynamics simulated were representative of a complete spring-neap-spring lunar cycle.

The simulation output is presented both as the predicted tidal maximum and tidal average (mean) Nauplius I larvae plume concentration envelope (see **Figure 6-12** and **Figure 6-13,** respectively). The maximum plume concentration envelope plot represents the instantaneous maximum concentration both in the water column and over time with the maximum concentration outputted spatially over the model domain. It should be noted that such maximum concentrations spatially do not occur simultaneously in time and that the frequency and duration of occurrence is relatively low.

The average larvae plume concentration (nauplius and copepodid stages) envelope represents the average concentration plume in the water column over time and is reasonably similar in magnitude (generally higher) to the statistical median (50-percentile) concentration, particularly over a 29-day simulation period. A total of 10 reference sites were selected in the vicinity of the site (see **Figure 6-14**). Plume median, average, 95-percentile, 99-percentile, and maximum concentrations at these stations are presented in **Table 6.11**.

6.5.2.1.3. Assessment

Modelling shows that lice larval numbers reduce dramatically in concentration with increasing distance from the site with tidal average concentrations less than 0.1 larvae per m^3 and generally not discernible from background concentrations remote from the licensed farm sites. The instantaneous maximum concentrations just outside of the licensed farm site is typically at 0.9 to 1.9 No /m^3 and rapidly reduces to trace numbers. The predicted maximum larvae concentrations at the production site are 5.3 No./m^3.

Infestation routes and treatment strategies for *L. salmonis* are illustrated by the empirical data given in **Section 2.11**. This indicates that ovigerous female lice on the MOWI Ireland Inishfarnard site did not breach trigger levels throughout the entire production cycle for 2014, 2016 and 2018.

Several laboratory studies have investigated the effect of lice on the physiology of Atlantic salmon, sea trout, and Arctic charr smolts (reviewed in Finstad & Bjørn, 2011; Thorstad *et al*., 2015). Major primary (nervous, hormonal), secondary (blood parameters), and tertiary (whole body response) physiological effects (e.g., high levels of plasma cortisol and glucose, reduced osmoregulatory ability, and reduced non-specific immunity) occur when the lice develop from the sessile chalimus second stage to the mobile first pre-adult stage. Reduced growth, reproduction, swimming performance, and impaired immune defence have also been reported (Finstad & Bjørn, 2011). The susceptibility and response to louse infection varies among individuals, populations, and species of salmonid. Laboratory studies show that 0.04–0.15 lice per gram fish weight can increase stress levels and that infections of 0.75 lice per gram fish weight can kill hatchery-reared smolts if all the lice develop into pre-adult and adult stages. This is the equivalent of 11 lice per smolt. This is also supported by field studies (ICES, 2016).

Evidence suggests that sea lice induced mortality has an impact on Atlantic salmon returns, which may impact the achievement of conservation limits in salmon rivers. This research in recent years has tended to be based on a variety of statistical analyses of large quantities of data gathered from releases of tagged salmon smolts, a proportion of which have been treated with Slice®, to protect from lice infestation, and recaptures of the resultant returning salmon (Jackson *et al.,* 2011a, b; Gargan *et al.,* 2012; Jackson *et al.,* 2013; Krkošek *et al.,* 2013; Skilbrei *et al.,* 2013; Jackson *et al.,* 2014; Krkošek *et al.,* 2014; Vollset *et al.,* 2014; Vollset *et al.,* 2016). These studies assumed that the louse treatments were efficacious and that released smolts were exposed to lice during the period of the outmigration in which the treatment was effective.

Furthermore, the studies were not designed to discriminate between lice from farm and non-farm sources. In addition, the baseline marine survival from untreated groups, which is used as a comparator for treated groups, is itself likely to be affected by louse abundance, introducing an element of circularity that leaves the interactive effects between lice and other factors on salmon survival poorly characterized (ICES, 2016).

ICES (2016) advice on the impacts of salmon aquaculture and sea lice on wild salmon outlines the differing perspectives on the mortality attributable to lice (Jackson *et al.,* 2013; Krkošek *et al.,* 2013) as follows:

> "*In one view (Jackson et al., 2013), the emphasis is placed on the absolute difference in marine mortality between fish treated with parasiticides and those that are not. In this instance, viewed against marine mortality rates at or above 95% for fish in the wild, the mortality attributable to lice has been estimated at around 1% (i.e., mortality in treated groups is 95% compared to 96% in untreated groups). This "additional" mortality between groups is interpreted as a small number compared to the 95% mortality from the treatment groups.*
>
> *The other perspective of this same example is in terms of the percent loss of recruitment, or abundance of returning adult salmon, due to exposure to sea lice. In this perspective, the same example corresponds to a 20% loss in adult salmon abundance due to sea lice; for every five fish that return as adults in the treated groups (95% mortality), four fish return as adults in the untreated group (96% mortality). In other words, one in five fish is lost to sea lice effects. These perspectives are solely differences in interpretation of the same data. Where impacts of lice have been estimated as losses of returns to rivers, these indicate marked variability, ranging from 0.6% to 39% (Gargan et al., 2012; Krkošek et al., 2013; Skilbrei et al., 2013). These results suggest that a small incremental increase in marine mortality due to lice (or any other factor) can result in losses of Atlantic salmon that are relevant for fisheries and conservation management, and which may influence the achievement of conservation requirements for affected stocks (Gargan et al*., *2012). Vollset et al. (2016)* (sic) *concluded that much of the heterogeneity among trials could be explained by the release location, time period, and baseline (i.e., marine) survival. Total marine survival was reported to be the most important predictor variable. When marine survival was low (few recaptures from the control group), the effect of treatment was relatively high (odds ratio of 1.7:1).*

However, when marine survival was high, the effect of treatment was undetectable (odds ratio of ~1:1). One explanation for this finding is that the detrimental effect of lice is exacerbated when the fish are subject to other stressors, and the findings of other studies support this hypothesis (Finstad et al., 2007; Connors et al., 2012; Jackson et al., 2013; Godwin et al., 2015). Potential interactive effects of multiple factors are likely to be important for explaining the result from meta-analysis where the effect of sea lice on salmon survival depends on the baseline survival of untreated fish (Vollset et al., 2016 (sic)).

In conclusion the authors cautioned that though their study supported the hypothesis that lice contribute to the mortality of salmon, the effect was not consistently present and strongly modulated by other risk factors, suggesting that population-level effects of lice on wild salmon stocks cannot be estimated independently of the other factors that affect marine survival."

6.5.2.1.4. Conclusions

The control and reduction of sea lice within farmed salmon pens in Kenmare Bay is important to the welfare of wild salmon as well as to the farmed salmon. Additionally, as sea trout tend to remain in coastal areas for longer than salmon, they may be exposed to lice for longer than migrating salmon post-smolts. The continuous weekly monitoring as well as coordinated treatment of all licensed sites with the bay through the Single Bay Management (see **Section 2.14** for further details) plan once trigger levels have been breached is imperative to minimise any potential risk on wild salmonids. Consequently, it can be concluded that the proposed operations at the Inishfarnard site are unlikely to result in significant impact in sea lice infestations in wild salmon populations.

Table 6.11: Modelled Larvae concentrations at reference stations

Reference Sites	Modelled No./m^3				
	Average	Median	95-percentile	99-percentile	Maximum
1	2.050	1.856	3.610	4.408	5.296
2	0.198	0.107	0.614	0.763	0.895
3	0.068	0.054	0.146	0.168	0.193
4	0.313	0.300	0.517	0.652	0.822
5	0.656	0.588	1.403	1.558	1.858
6	0.121	0.114	0.209	0.235	0.248
7	0.004	0.004	0.011	0.013	0.014
8	0.007	0.005	0.023	0.030	0.033
9	0.010	0.008	0.022	0.028	0.031
10	0.018	0.017	0.031	0.035	0.039

Figure 6-12: Predicted tidal maximum nauplius I larvae numbers (No./m3) from operations proposed at the Inishfarnard site.

Figure 6-13: Predicted tidal mean Nauplius I larvae numbers (No./m3) from the Inishfarnard Farm Production Site.

Figure 6-14: References station at Predicted tidal mean Nauplius I larvae numbers (No./m3) from the Inishfarnard Farm Production Site.

6.5.2.2. Escapees

6.5.2.2.1. Background

Glover *et al.* (2017) reviewed the current status of knowledge on half a century of genetic interaction between farmed and wild Atlantic salmon. Impact risk depends on the maturity of the escapees and farmed fish are harvested before they fully mature. By and large, escapees are more likely to die or be preyed upon at sea than to enter a river system, in particular if they are immature, which is the most likely prospect (Hansen, 2006; Skilbrei, 2010; Whoriskey *et al.*, 2006). Fish will only enter a river system if they escape close to maturation and survive to mature. Further, overrunning of redds or interbreeding with wild fish also only becomes a risk if escapees are mature. Overrunning and displacement of wild salmon eggs is an impact risk because farmed fish tend to mature later than wild stock. However, later maturation would limit interbreeding risks. While the evidence indicates that survival to sexual maturity of escapees is very low, and only a small proportion manages to survive and enter rivers, the number is often numerically high due simply to the high numbers involved in escape events (Glover *et al.*, 2017). The actual numbers, however, can be expected to be dependent on both the stage of the life cycle and the time of the year at which they escape (Skilbrei *et al.*, 2015).

Fears of interactions between farmed and wild salmon stocks were expressed by McGinnity *et al.* (2003). However, the scenario that the authors depict could only result from significant, persistent, or annual escapes surviving to enter single rivers. Nevertheless, farmed escapees have been documented in rivers in most regions where there is commercial aquaculture. In addition, escapees have been reported in oceanic feeding areas as well as in rivers far away from major farming regions (Glover *et. al.*, 2017). While escapees display considerable potential for long-distance dispersal/migration the incidence of farmed escaped salmon in rivers is correlated with the volume of farming within that region (Fiske *et al.,* 2006; Green *et al.,* 2012; Youngson *et al.,* 1997; Clifford *et al.,* 1998).

Experiments have shown that adult escapees have reduced spawning success compared to wild salmon that depends on the life stage at which they escape into the wild, mature and attempt to spawn with wild fish, and the level of competition with wild fish in the spawning grounds. Farmed females display a greater relative spawning success than farmed males which will increase the relative frequency of hybrid as opposed to pure farmed offspring. Wild populations that are already experiencing natural declines in adult abundance will be more vulnerable to introgression of farmed salmon due to the reduced level of competition faced by escapees once on the spawning grounds. The offspring of farmed and hybrid salmon will also compete with wild salmon for both territory and resources. (Glover *et al.,* 2017). There is unequivocal evidence of the introgression of farmed salmon into ca. 150 native Norwegian populations (ranging from 0% to 47%) (Glover *et al.,* 2013; Karlsson *et al.,* 2016). Reduced genetic variability will affect a species' ability to cope with a changing environment. One-way gene flow, as occurs through successful spawning of farmed escapees, potentially represents a powerful evolutionary force. It erodes genetic variation among wild populations (Glover *et al.*, 2012). Many wild salmon populations are already under evolutionary strain from a wide variety of anthropogenic challenges (Lenders *et al.,* 2016; Parrish *et al.,* 1998) and such populations are more likely to be vulnerable to the potential negative effects of introgression. The long-term consequences of introgression on native populations can be expected to lead to changes in life-history traits, reduced population productivity and decreased resilience to future impacts such as climate change. Only a substantial or complete reduction in the number or escapees in rivers, and/or creating a reproductive barrier through sterilization of farmed salmon can eliminate these impacts (Glover *et al.* 2017).

Preventing the escape of fish is a priority for MOWI Ireland. MOWI has an improved standardised pen, net and mooring design adopted on all farms. They have classified their sites in Kenmare Bay as having a High Risk for susceptibility to storm damaged based on the wave climate and hydrographic regime in the locality. Pen, mooring and anchor design within Kenmare Bay reflects this and strongly mitigates against storm damage thus reducing the risk of an escape event.

6.5.2.2.2. Assessment and Conclusions

In the event of an escape incident occurring the magnitude of impact depends on the number of escapees, their level of maturity and the time of year of the event. Large escapes (tens of thousands of individuals) of mature fish in the spawning season have a greater potential for impact significance than small escapes of smolts. Large escape events have the potential to have a significant effect on wild salmon populations in the area especially considering the low returns within many salmon rivers. However, the likelihood of an escape event occurring is remote and MOWI have adopted a range of measures to prevent such an occurrence; **consequently, significant direct effects to the Qualifying Feature salmon can be excluded**.

6.5.2.3. Disease spread

6.5.2.3.1. Background

Disease occurrence in organic farming in covered in **Section 2.11**. Diseases contracted by farmed salmon mainly arise in the first instance from local wild stocks. Regulation of farmed stock movements is such that the introduction of diseased farmed fish from other regions is unlikely.

6.5.2.3.2. Assessment and Conclusions

The use of vaccines and effective veterinary supervision have brought the eradication and control of diseases on salmon farms to a level that surpasses accepted levels for other livestock. In MOWI's view any lower level of vigilance defeats the objectives of their business model. Given the control of diseases on the farm, it is highly unlikely that the farm act as a significant source of disease; **consequently, significant direct effects to the Qualifying Feature salmon can be excluded**.

6.5.2.4. Therapeutants

6.5.2.4.1. Background

The use of chemicals, including antibiotics, has been reduced with the introduction of vaccines and the application of organic standards. In-feed antibiotic treatments are never used prophylactically for farmed salmon.

6.5.2.4.2. Assessment and Conclusions

Modern treatments, in particular for lice, break down and disperse rapidly post-treatment, with no prospect of deleterious impact on wild salmonid stocks. For example, Slice® a licensed in–feed treatment for sea lice which, where hydrographic conditions suit its application, is commonly chosen in preference to bath treatments as it is considered more effective, in that it kills all lice stages and is more environmentally benign. Slice® is a proprietary pre-mix containing 0.2% Emamectin Benzoate (EmBZ), for surface coating onto salmon feed, at a rate of 5kg Slice® / tonne of feed (that is 10g EmBZ / tonne of feed). It is manufactured by Merck Animal Health Inc. The treatment is applied, on veterinary prescription, as a surface dressing to salmon feed, prior to use. The course of treatment lasts 7 days. SEPA (2015) has determined that 10% of the EmBZ dose ingested is excreted during this treatment period. Of the remaining 90% of the chemical, approximately 99% is excreted over the subsequent 216 days. This excretion has an exponential decay profile such that 50% of the chemical remaining in the fish is released, on average, over each ensuing 36 – 37-day period. It has also been determined that EmBZ breaks down into "non-toxic" sub-compounds with a half-life period of 250 days. Given the limited potential for the introduction and persistence of therapeutants in the environment it can be concluded that **significant direct effects to the Qualifying Feature salmon can be excluded**.

6.5.3. Mitigation Measures

Single Bay Management arrangements for fin-fish farms are designed to co-ordinate husbandry practices in such a way that best practice is followed and that stocking, fallowing and treatment regimens on individual farms are compatible with the arrangements on neighbouring farms. The Single Bay Management process has proved very effective in enhancing the efficacy of lice control and in reducing the overall incidence of disease in the stocks. Single Bay Management plans are subject to revision for each production cycle. This arises out of changes in production plans related to:

- New Licence applications.

- In response to changing markets.
- New husbandry requirements.
- Both internal company restructuring and inter-company agreement.

Crucial elements in the success of this plan are identified as.

- separation of generations.
- annual fallowing of sites.
- strategic application of chemotherapeutants.
- good fish health management.
- close co-operation between farms

MOWI shall focus its lice treatment regime on the pre-winter treatment for all fish in Kenmare Bay (under the CLAMS/ Single Bay management group) which will be over-wintered. During the months of January to May, numbers of ovigerous female and total *L. salmonis* will be maintained as close to zero as possible using cleaner fish and appropriate treatments where necessary. Where sites are stocked in the Bay, treatments will be carried out on the sites during the same time period and with the same chemical class and in consultation with other fin fish farmers in the Bay (see Single Bay Management Plan in **Appendix 5**).

In the event that a salmon escape may occur, MOWI has a Standard Operating Procedure, to mitigate its effects as far as possible; see **Appendix 4**. In readiness for any escape event, the company has a contingency plan and a registration and verification procedure. Any indication of escape, such as loss of net integrity, will be immediately followed up by repair or net change, as required, subject to weather conditions. Once an escape has been confirmed, the event must be reported to the Aquaculture and Foreshore Management Division (AFMD) of the DAFM, the Marine Institute and reported online to Inland Fisheries Ireland (IFI). The fish remaining in the pen must be transferred and counted into a new enclosure and the extent of the escape verified. The event is then fully reported, stating species, strain, hatchery of origin, age, mean weight and length of stock, escape number and likely percentage of maturation in the year of escape. This information must be despatched as soon as possible and preferably within 24 hours to the AFMD, IFI and Marine Institute. The company will co-operate with any program attempting to recapture the stock, which may be mounted or ordered by the relevant authorities. However, on the basis that prevention is the best route in this case, specifications of pens, nets, moorings, and maintenance and working practices are all carefully considered to avoid or prevent escapes. In addition, annual staff training on escape prevention will be conducted.

6.6. Freshwater Pearl Mussel

6.6.1. Description of the Receiving Environment

6.6.2. Salmon and Pearl Mussel

A comparison of trout versus salmon dominated rivers of Ireland shows that all identified pearl mussel rivers are associated with salmon and sea trout. Salmon and freshwater pearl mussel have been cited as symbiotic in their relationship, with both species providing a beneficial role for the other (Ziuganov & Nezlin 1988, Ziuganov *et al*., 1994) with salmon gills hosting mussels during their glochidial stage and pearl mussels preventing early senility in salmon (Ziuganov, 2005).

Potential loss of host fish has been cited as a potential reason for pearl mussel decline (Araujo & Ramos 2001, Anon 2005, Geist et al. 2005).

6.6.2.1. Assessment and Conclusions

As outlined in Section 3.5 of the *AA Screening and NIS*[10] prepared for the current licence renewal, significant effects of the project on wild salmon, an obligate host for pearl mussel larvae, could result in knock-on (indirect) impact on the Conservation Objectives established for freshwater pearl mussel.

As demonstrated in **Section 6.5.2** above and in Section 3.5.2 *AA Screening and NIS* the operations at the proposed site will not result in significant direct effects to the Qualifying Feature salmon can be excluded, consequently indirect effect to freshwater pearl mussel can be excluded.

6.7. Birds

The assessment of potential effects to bird species focused bird species protected under the EU Birds Directive (Council Directive 2009/409/EEC) for which Special Protection Areas (SPAs) are designated. The species for which SPAs are designated are called Special Conservation Interests (SCIs) (and referred to herein as Qualifying Features). The assessment also considers notable species identified in SPAs.

[10] Document File Name: *JN1524 Inishfarnard NIS - Volume 1 - Main Report, JN1524 Inishfarnard NIS - Volume 2 - Appendices*

6.7.1. Description of the Receiving Environment

There is no overlap between the Inishfarnard renewal site and SPAs in the area, however, due to the mobile nature of birds, Qualifying Features, and notable species of SPA sites within within the foraging ranges of the Inishfarnard site are considered.

Based on the species-specific foraging ranges, potential likely significant effects of the proposed project could not be screened out at the screening stage for the Qualifying Features of SPAs listed in **Table 6.12** (see Section 2.4 of *AA Screening and NIS*[11] for summary). **Table 6.12** also presents the conservation status of species following is determined with reference to Colhoun and Cummins (2013[12]). Short description of the SPAs listed in **Table 6.12** are presented below while Conservation Objectives for the relevant Qualifying Features of the above SPAs are included in **Appendix 10**.

Table 6.12: Qualifying Features of SPAs with foraging ranges overlapping the project area. Maximum foraging ranges used.

Qualifying Feature (Species Foraging Distance km)	**BoCCI**[13]	**SPA** (Shortest linear distance[6] from project km)
Arctic tern (*Sterna paradisaea*) (30km)	**Amber**	**Deenish Island and Scariff Island SPA (NPWS, 2015, 2018)** (13.5km)
Common Tern (*Sterna hirundo*) (30 km)	**Amber**	**Castlemaine Harbour SPA (004029) (NPWS, 2011, 2014)** (36km)
Fulmar (*Fulmarus glacialis*) (580km)	**Green**	**Beara Peninsula SPA (004155) (NPWS, 2015, 2018)** (5.6km)
		Blasket Islands SPA (004008) (NPWS, 2011, 2015) (53.3km)
		Clare Island SPA (004136) (NPWS, 2014, 2018) (230.6km)
		Cliffs of Moher SPA (004005) (NPWS, 2015, 2018) (140.0km)
		Deenish Island and Scariff Island SPA (004175) (NPWS, 2015, 2018) (13.5km)
		Dingle Peninsula SPA (NPWS, 2014, 2018) (004153) (45.2km)
		Duvillaun Islands SPA (NPWS, 2014, 2018) (004111) (26.2km)

[11] Document File Name: *JN1524 Inishfarnard NIS - Volume 1 - Main Report, JN1524 Inishfarnard NIS - Volume 2 - Appendices*

[12] Colhoun K. and Cummins, S. 2013 Birds of Conservation Concern in Ireland 2014-19. Irish Birds 9:523-544 d

[13] BoCCI - Birds of Conservation Concern in Ireland

Qualifying Feature (Species Foraging Distance km)	**BoCCI**[13]	**SPA** (Shortest linear distance[6] from project km)
		High Island, Inishshark and Davillaun SPA (004144) (NPWS, 2010, 2018) (203.8km)
		Horn Head to Fanad Head SPA (004194) (NPWS, 2010, 2018) (406.1km)
		Iveragh Peninsula SPA (004154) (NPWS, 2015, 2018) (7.3km)
		Kerry Head SPA (004189) (NPWS, 2015, 2018) (76.0km)
		Lambay Island SPA (004069) (NPWS, 2011, 2018) (333.6km)
		Puffin Island SPA (004003) (NPWS, 2015, 2018) (29.6km)
		Saltee Islands SPA (004002) (NPWS, 2011, 2012) (236.2km)
		Skelligs SPA (004007) (NPWS, 2015, 2018) (34.3km)
		Tory Island SPA (004073) (NPWS, 2015, 2018) (411.5km)
		West Donegal Coast SPA (004150) (NPWS, 2015, 2018) (289.5km)
Gannet (*Morus bassanus*) (709km)	**Amber**	**Saltee Islands SPA (004002) (NPWS, 2011, 2012)** (236.2km)
		Skelligs SPA (004007) (NPWS, 2015, 2018) (34.3km)
		The Bull and the Cow Rocks SPA (004066) (NPWS, 2014, 2018) (21.6km)
Guillemot (*Uria aalge*) (340km)	**Amber**	**Clare Island SPA (004136) (NPWS, 2014, 2018)** (230.6km)
		Cliffs of Moher SPA (004005) (NPWS, 2015, 2018) (140.0km)
		Horn Head to Fanad Head SPA (004194) (NPWS, 2014, 2018) (406.1km)
		Inishmore SPA (004152) (NPWS, 2014, 2018) (154.4km)
		Ireland's Eye SPA (004117) (NPWS, 2010, 2018) (326.4km)
		Iveragh Peninsula SPA (004154) (NPWS, 2015, 2018) (7.3km)
		Lambay Island SPA (004069) (NPWS, 2011, 2018) (333.6km)
		Loop Head SPA (004119) (NPWS, 2019, 2018) (93.4km)

Qualifying Feature (Species Foraging Distance km)	**BoCCI**[13]	**SPA** (Shortest linear distance[6] from project km)
		Mid-Waterford Coast SPA (004193) (NPWS, 2015, 2018) (177.2km)
		Old Head of Kinsale (004021) (NPWS, 2014, 2018) (101.1km)
		Saltee Islands SPA (004002) (NPWS, 2011, 2012) (236.1km)
		Skelligs SPA (004007) (NPWS, 2015, 2018) (34.3km)
Herring Gull (*Larus argentatus*) (92km)	**Red**	**Blasket Islands SPA (004008) (NPWS, 2011, 2015)** (53.3km)
Kittiwake (*Rissa tridactyla*) (300km)	**Amber**	**Aughris Head SPA (NPWS, 2012, 2018)** (296.8km)
		Blasket Islands SPA (004008) (NPWS, 2011, 2015) (53.3km)
		Clare Island SPA (004136) (NPWS, 2014, 2018) (230.6km)
		Cliffs of Moher SPA (004005) (NPWS, 2015, 2018) (140.0km)
		Helvick Head to Ballyquin SPA (004192) (NPWS, 2015, 2018) (162.0km)
		Inishmore SPA (004152) (NPWS, 2014, 2018) (154.4km)
		Loop Head SPA (004119) (NPWS, 2019, 2018) (93.4km)
		Old Head of Kinsale (004021) (NPWS, 2014, 2018) (101.1km)
		Puffin Island SPA (004003) (NPWS, 2015, 2018) (29.6km)
		Saltee Islands SPA (004002) (NPWS, 2011, 2012) (236.2km)
		Skelligs SPA (004007) (NPWS, 2015, 2018) (34.3km)
		Wicklow Head SPA (004127) (NPWS, 2012, 2018) (305.5km)
Lesser Black-backed Gull (*Larus fuscus*) (181km)	**Amber**	**Ballycotton Bay SPA (004022) (NPWS, 2014, 2015)** (136.6km)
		Ballymacoda Bay SPA (NPWS, 2014, 2018) (004023) (144.5km)
		Blasket Islands SPA (004008) (NPWS, 2011, 2015) (53.3km)
		Cork Harbour SPA (004030) (NPWS, 2014, 2015) (109.7km)

Qualifying Feature (Species Foraging Distance km)	**BoCCI**[13]	**SPA** (Shortest linear distance[6] from project km)
		Deenish Island and Scariff Island SPA (004175) (NPWS, 2015, 2018) (13.5km)
		Puffin Island SPA (004003) (NPWS, 2015, 2018) (29.6km)
Manx Shearwater (*Puffinus puffinus*) (330km)	**Amber**	**Blasket Islands SPA (004008) (NPWS, 2011, 2015)** (53.3km)
		Cruagh Island SPA (NPWS, 2010, 2018) (004170) (201.1km)
		Deenish Island and Scariff Island SPA (004175) (NPWS, 2015, 2018) (13.5km)
		Puffin Island SPA (004003) (NPWS, 2015, 2018) (29.6km)
		Skelligs SPA (004007) (NPWS, 2015, 2018) (34.3km)
Puffin (*Fratercula arctica*) (200km)	**Amber**	**Blasket Islands SPA (004008) (NPWS, 2011, 2015)** (53.3km)
		Cliffs of Moher SPA (004005) (NPWS, 2015, 2018) (140.0km)
		Puffin Island SPA (004003) (NPWS, 2015, 2018) (29.6km)
		Skelligs SPA (004007) (NPWS, 2015, 2018) (34.3km)
		The Bull and the Cow Rocks SPA (004066) (NPWS, 2014, 2018) (21.6km)
Razorbill (*Alca torda*) (340km)	**Amber**	**Blasket Islands SPA (004008) (NPWS, 2011, 2015)** (53.3km)
		Clare Island SPA (004136) (NPWS, 2014, 2018) (230.6km)
		Cliffs of Moher SPA (004005) (NPWS, 2015, 2018) (140.0km)
		Ireland's Eye SPA (004117) (NPWS, 2010, 2018) (326.4km)
		Puffin Island SPA (004003) (NPWS, 2015, 2018) (29.6km)
		Saltee Islands SPA (004002) (NPWS, 2011, 2012) (236.2km)
Storm Petrel (*Hydrobates pelagicus*) (65km)	**Amber**	**Blasket Islands SPA (004008) (NPWS, 2011, 2015)** (53.3km)
		Deenish Island and Scariff Island SPA (004175) (NPWS, 2015, 2018) (13.5km)
		Magharee Islands SPA (004125) (NPWS, 2014, 2018) (26.4km)

Qualifying Feature (Species Foraging Distance km)	**BoCCI**[13]	**SPA** (Shortest linear distance[6] from project km)
		Puffin Island SPA (004003) (NPWS, 2015, 2018) (29.6km)
		Skelligs SPA (004007) (NPWS, 2015, 2018) (34.3km)
		The Bull and the Cow Rocks SPA (004066) (NPWS, 2014, 2018) (21.6km)

Aughris Head SPA

Aughris Head is a rocky headland on the north-facing Co. Sligo coastline, located some 20 km west of Sligo Town (NPWS, 2012, 2018). Its near-vertical cliffs reach a maximum height of 30 m above sea level (NPWS, 2012). The marine area to a distance of 500 m from the base of the cliffs is included in the site. The site was designated for Kittiwake (742 breeding pairs). Other breeding seabirds including Guillemot (811 pairs), Razorbill (58 pairs) and Fulmar (94 pairs).

Ballycotton Bay SPA (004022)

Situated on the south coast of Co. Cork, Ballycotton Bay is an east-facing coastal complex, which stretches northwards from Ballycotton to Ballynamona, a distance of c. 2 km (NPWS, 2014, 2015). The site comprises two sheltered inlets which receive the flows of several small rivers. The site is designated for important populations of waterbirds including Teal (903), Ringed Plover (167), Golden Plover (2,383), Grey Plover (124), Lapwing (2,782), Black-tailed Godwit (136), Bar-tailed Godwit (175), Curlew (853), Turnstone (179), Common Gull (584) and Lesser Black-backed Gull (1,293) - all figures are five year mean peaks for the period 1995/96 to 1999/2000. Other notable species at the site include Shelduck (99), Wigeon (522), Mallard (232), Oystercatcher (255), Dunlin (575), Sanderling (56), Redshank (117), Greenshank (12) and Great Black-backed Gull (324). The site is also designated for Wetland & Waterbirds.

Ballymacoda Bay SPA (004023)

This coastal site stretches north-east from Ballymacoda to within several kilometres of Youghal, Co. Cork (NPWS, 2014, 2018). It comprises the estuary of the Womanagh River, a substantial river which drains a large agricultural catchment. Part of the tidal section of the river is included in the site and on the seaward side the boundary extends to, and includes Bog Rock, Barrel Rocks, and Black Rock. The inner part of the estuary is well sheltered by the Ring peninsula, a stabilised sand spit with sand dunes at its northern end and salt marshes on the landward side. Ballymacoda Bay is of high ornithological importance and is designated for Wigeon (907), Teal (887), Ringed Plover (153), Grey

Plover (535), Lapwing (4,063), Sanderling (98), Dunlin (3,192), Bar-tailed Godwit (581), Curlew (1,145), Redshank (357) and Turnstone (137), Black-headed Gull (1,560), Common Gull (1,120) and Lesser Black-backed Gull (5,051).

Beara Peninsula SPA (004155)

Beara Peninsula SPA (004155) consists of high coast and sea cliff sections which supports heath and coastal grassland, as well as sites further inland (NPWS, 2015, 2018). The SPA is of importance due to the presence of nationally important Fulmar and Chough. The Chough species are primarily found along the coast from Bear Island to Reenmore Point, including Dursey Island with the characterised marginal agricultural land with semi-natural vegetation in proximity to the cliffs making this a favourable location for the species. Other species within the SPA include Shag (*Phalacrocorax aristotelis*), Herring Gull (*Larus argentatus*), Lesser Black-backed Gull (*Larus fuscus),* Razorbill (*Alca torda*) and Black Guillemot (*Cepphus grylle*) as well as Peregrine (*Falco peregrinus*).

Blasket Islands SPA (004008)

The Blasket Islands are situated at the end of the Dingle peninsula in Co. Kerry (NPWS, 2015, 2018). The site comprises all of the main islands in the group, as well as the various islets and rocks, and also the seas which surround the islands to a distance of 500 m. There are six main islands, plus some smaller islands, islets, and sea stacks. The largest island, Great Blasket, is separated from the mainland by the Blasket Sound, a distance of some 2 km. The smallest island, Beginish, lies close to Great Blasket, while the other islands (Inishtooskert, Inishnabro, Inishvickillane, Tearaght Island) are between about 7 km and 12 km from the mainland. The Blasket Islands SPA is one of the most important seabird colonies and is designated for breeding population of Storm Petrel and Manx Shearwater (c. 52,141 and 19,534 pairs respectively: 2000/2001 survey). The site is also designated for nationally important populations: Fulmar (2,179 pairs), Lesser Black-backed Gull (at least 333 pairs), Herring Gull (131 pairs), Kittiwake (773 pairs) and Puffin (4,924 pairs) (1988 survey). An incomplete survey in 1999/2000 recorded a nationally important population of Shag (60 pairs). The site is also designated for Arctic Tern (at least 200 pairs in 1988 and 102 pairs in 2001). Other notable species include Guillemot, Oystercatcher, Peregrine, Raven, Rock Dove, Twite, and Wheatear.

Castlemaine Harbour SPA (004029)

Castlemaine Harbour SPA is a large coastal site occupying the innermost part of Dingle Bay. It extends from the lower tidal reaches of the River Maine and River Laune to west of the Inch and Rosbehy peninsulas (c. 16 km from east to west) (NPWS, 2011, 2014). The average width of the estuary is 4-5 km though it is c. 11 km wide at the outer limit. The site comprises the estuaries of the River Maine and the River Laune, both substantial rivers, and has extensive areas of intertidal sand and mud flats.

The site is designated for important populations of waterbirds including Red-throated Diver (56), Cormorant (136), Wigeon (6,819), Mallard (487), Pintail (145), Scaup (74), Common Scoter (3,637), Oystercatcher (1,035), Ringed Plover (206), Sanderling (335), Bar-tailed Godwit (397), Redshank (341), Greenshank (46) and Turnstone (144). The site support nationally important numbers of Chough and is designated for the species. The site is also designated for Wetland & Waterbirds.

Clare Island SPA (004136)

Clare Island lies at the entrance to Clew Bay, in Co. Mayo, and some 5 km from the mainland (NPWS, 2014, 2018). The site comprises all of the cliffs on the island, a length of approximately 10 km, as well as the land adjacent to the cliff edge (inland for 300 m) and the adjacent marine waters (to distances of 200 m or 500 m, depending on auk distribution).The site is designated for important populations of waterbirds including the largest population in the country of Fulmar (4,029 pairs), and nationally important populations of Shag (89 pairs), Common Gull (39 pairs), Kittiwake (1,785 pairs), Guillemot (1,528 pairs), Razorbill (354 pairs) and Black Guillemot (62 individuals). The site is also designated for Chough (16 pairs) Other notable species at the site include Cormorant, Gannet, Great Black-backed Gull, Herring Gull, Lesser Black-backed Gull, Peregrine, and Puffin.

Cliffs of Moher SPA (004005)

This site extends a distance of some 9.5 km along the north Clare coast from Faunmore in the north to just south of Cancregga Point in the south (NPWS, 2015, 2018). The cliffs, which rise to 203 m in height. The site includes the cliffs, the land adjacent to the cliff edge (inland for 300 m) as well as the adjacent sea area to a distance of up to 500 m from the cliff base. The site is designated for important populations of including Chough (12 pairs 2002/ 2003), Fulmar (3,566 pairs), Kittiwake (7,698 pairs), Guillemot (13,375 pairs) and Puffin (1,365 pairs) and Razorbill (Alca torda) (5,159) (1998/1999 survey). Other notable species at the site include Black Guillemot, Great Black-backed Gull, Herring Gull, and Shag.

Cork Harbour SPA (004030)

Cork Harbour is a large, sheltered bay system, with several river estuaries - principally those of the Rivers Lee, Douglas, Owenboy and Owennacurra (NPWS, 2004, 2015). The SPA site comprises most of the main intertidal areas of Cork Harbour, including all of the North Channel, the Douglas River Estuary, inner Lough Mahon, Monkstown Creek, Lough Beg, the Owenboy River Estuary, Whitegate Bay, Ringabella Creek and the Rostellan and Poulnabibe inlets. The site is designated for important populations of waterbirds including Black-tailed Godwit (1,896) and Redshank (2,149) (all figures given are five year mean peaks for the period 1995/96 to 1999/2000) and nationally important populations of the following 19 species occur: Little Grebe (57), Great Crested Grebe (253), Cormorant (521), Grey

Heron (80), Shelduck (2,009), Wigeon (1,791), Teal (1,065), Mallard (513), Pintail (57), Shoveler (103), Red-breasted Merganser (121), Oystercatcher (1,809), Golden Plover (3,342), Grey Plover (95), Lapwing (7,569), Dunlin (9,621), Bartailed Godwit (233), Curlew (2,237) and Greenshank (46). Other species for whcioh the site is designated include Mute Swan (38), Whooper Swan (5), Pochard (72), Gadwall (6), Tufted Duck (64), Goldeneye (21), Coot (53), Ringed Plover (73), Knot (26) and Turnstone (113), Black-headed Gull (3,640), Common Gull (1,562) and Lesser Black-backed Gull (783). Notable species at the site include Little Egret and Mediterranean Gull, two species which have recently colonised Ireland. Other notable species at the site include Coot, Gadwall, Goldeneye, Greenshank, Knot, Mallard, Mute Swan, Pochard, Ringed Plover, Tufted Duck, Turnstone and Whooper Swan. The site is also designated for Wetland & Waterbirds.

Cruagh Island SPA (004170)

Cruagh Island is located approximately 2 km west of Omey Island, off the Connemara coast in Co. Galway (NPWS, 2010, 2018). It is a small- to medium sized, low-lying island (maximum height 62 m) and is uninhabited. The island is dominated by a maritime grassy sward with some exposed rock. The sea area to a distance of 500 m is included in the site to accommodate 'rafting' shearwaters. The site is designated for important populations of Manx Shearwater (3,286 pairs), Great Black-backed Gull (30 pairs) and Barnacle Goose. The site is regular feeding site for Barnacle Goose during the winter.

Deenish Island and Scariff Island SPA (004175)

Deenish Island and Scariff Island are small- to medium-sized islands situated between 5 and 7 km west of Lamb's Head off the Co. Kerry coast; they are thus very exposed to the force of the Atlantic Ocean. Scariff is the larger of the two (NPWS, 2015, 2018). It is steep-sided all the way around and rises to a peak of 252 m. The highest cliffs are on the south side. The island vegetation is a mix of maritime grassland, areas dominated by Bracken (*Pteridium aquilinum*) and heathy areas with Ling Heather (*Calluna vulgaris*). The site is designated for important populations of waterbirds including Arctic Tern (54 pairs in 1995) Fulmar (385 pairs in 2000), Lesser Black-backed Gull (97 pairs in 2000), Manx Shearwater (2,311 pairs) and Storm Petrel (estimated 6,200 pairs). Other notable species at the site include Black Guillemot, Great Black-backed Gull, Herring Gull, and Shag.

Inishmore SPA (004152)

Situated approximately 8 km off the south coast of County Galway, Inishmore (Árainn) is the largest of the three Aran Islands (NPWS, 2014, 2018). The site comprises all of the cliffs and rocky shore along the entire southern side of the island, part of the low cliffs/rocky shore at the west end, and the low cliffs/rocky shore at the east end - a distance of over 17 km of coastline. Also included are the two islands west of Inishmore (Brannock Island and Rock Island), Straw Island at the east end of Inishmore, the dune system at Barr na Coise, and the adjacent seas out to 500 m from the shoreline. The cliffs vary in height, being often less than 20 m but rising to over 80 m near Dún Aonghasa where they are notably sheer. The site is designated for important populations of birds including Arctic Tern (338 in 1995), Guillemot (2,312 pairs in 1999), Kittiwake (587 pairs in 1999), Little Tern (3 pairs in 1995, 13 pairs in 1999). Other notable species at the site include Black Guillemot, Chough, Fulmar, Great Black-backed Gull, Herring Gull, Peregrine, Razorbill and Shag.

Ireland's Eye SPA (004117)

Ireland's Eye is an uninhabited island located about 1.5 km north of Howth in Co. Dublin (NPWS, 2010, 2018). The site encompasses Ireland's Eye, Rowan Rocks, Thulla, Thulla Rocks, Carrageen Bay and a seaward extension of 200m in the west and 500m to the north and east. The island has an area of c. 24 ha above the high tide mark. The site is designated for important populations of waterbirds including Cormorant (306 pairs in 1999), Guillemot (1,468 pairs in 1999), Herring Gull (246 pairs in 1999), Kittiwake (941 pairs in 1999), Razorbill (460 pairs in 1999). Other notable species at the site include Fulmar, Gannet, Great black-backed Gull, Greylag Goose, Lesser Black-backed Gull, Light-bellied Brent Goose, Oystercatcher, Peregrine, Puffin, Ringed Plover, Shag and Shelduck.

Iveragh Peninsula SPA (004154)

The Iveragh Peninsula SPA is a large site situated on the west coast of Co. Kerry (NPWS, 2015, 2018). The site encompasses the high coast and sea cliff sections of the peninsula from just west of Rossbehy in the north, around to the end of the peninsula at Valencia Island and Bolus Head, and as far east as Lamb's Head in the south. The site includes the sea cliffs, the land adjacent to the cliff edge and also areas of sand dunes at Derrynane and Beginish. The site is designated for an important breeding population of Chough (106 breeding pairs in 1992, 88 in 2002/2003). The site is also designated for Fulmar (766 pairs in 1999-2000), Guillemot (2,860 pairs in 1999-2000), Kittiwake (1,150 pairs in 2000), Peregrine (5 pairs in 1999-2002).

Kerry Head SPA (004189)

Kerry Head SPA is situated on the south side of the mouth of the River Shannon in north Co. Kerry (NPWS, 2015, 2018). It encompasses the sea cliffs from just west of Ballyheigue, around the end of Kerry Head to the west and north-eastwards as far as Kilmore. The site includes the sea cliffs and land adjacent to the cliff edge. The site is designated for an internationally important population of breeding Chough (32 breeding pairs in the 1992, 30 in the 2002/03 survey). The site is also designated for a nationally important population of Fulmar (421 pairs). Other notable species include Shag (8 pairs in 2000) and Peregrine (2 pairs in 2002).

Lambay Island SPA (004069)

Lambay Island lies approximately 4 km off the north Co. Dublin coastline and is separated from it by a channel of 10-13 m in depth (NPWS, 2011, 2018). East of Lambay Island the water deepens rapidly into the Irish Sea basin. The island, which rises to 127 m, has an area of 250 ha above high tide mark. The site is designated for important breeding populations of Fulmar (585 pairs in 1999), Lesser Black-backed Gull (309 pairs in 1999), Kittiwake (4,091 pairs in 1999), Herring Gull (1,806 pairs in 1999), Puffin (265 pairs in 1999) and Razorbill (2,906 pairs in 1999). The site is also designated for internationally important populations of Cormorant (675 pairs), Shag (1,122 pairs) and Guillemot (40,705 pairs). Other designated species include Barnacle Goose, Black Guillemot, Common Gull, Curlew, Gannet, Great Black-backed Gull. Notable species at the site include Light-bellied Brent Goose, Manx Shearwater, Oystercatcher, Purple Sandpiper and Turnstone.

Loop Head SPA (004119)

Loop Head is situated at the most westerly point in Co. Clare, approximately 20 km south-west of Kilkee (NPWS, 2009, 2018). The site includes the cliffs, shoreline, and the adjacent marine area to a distance of 500 m from the shore. The vertical cliffs are impressive, rising to 60 m and extending for 5 km along the coast. The site is designated for breeding important populations Guillemot (2,687 pairs in 1987) and Kittiwake (690 pairs in 1987). Notable species at the site include Chough, Fulmar, Peregrine, and Razorbill.

Magharee Islands SPA (004125)

The Magharee Islands lie about 2 km north of the Magharees Peninsula on the north side of the Dingle Peninsula, Co. Kerry (NPWS, 2014, 2018). The site includes the main Magharee Islands (“Seven Hogs”), the islands of Mucklaghmore and Illaunnabarnagh to the east, Illaunnanoon and Doonagaun Island to the south and several smaller rocky islets. Illaunimmill and Illauntannig are the largest of the islands included in the site. The site is designated for Barnacle Goose which frequent the site in winter months (85 – four surveys mean between 1993 and 2003. Other species for which the site is designated include breeding tern species including Arctic Tern (232 pairs in 1995), Common Tern (58 pairs in 1995) and Little Tern (36 pairs in 1995). The site is also designated for nationally important populations of Shag (61 pairs in 2001), Storm Petrel (1272 in 2007), Common Gull (43 pairs in 2001). Other notable species at the site include Chough, Cormorant, Fulmar, Great Black-backed Gull, Herring Gull, Lesser Black-backed Gull, and Roseate Tern.

Mid-Waterford Coast SPA (004193)

The Mid-Waterford Coast SPA encompasses the areas of high coast and sea cliffs in Co. Waterford between Newtown Cove to the east and Ballyvoyle to the west (NPWS, 2015, 2018). The site includes the sea cliffs and the land adjacent to the cliff edge Sea cliffs are the predominant habitat of the site; these occur along its length and are generally well-vegetated by a suite of typical sea cliff species. Above the cliff's areas of heath, improved grassland, unimproved wet and dry grassland, and woodland occur. The site is designated for an internationally important population of breeding Chough (24 breeding pairs in the 1992, 20 pairs in the 2002/03). The site is also designated for a nationally important population of Peregrine (10 pairs in 2002), Cormorant (79 pairs in 1999-2000) and Herring Gull (147 pairs in 1999-2000). Other notable species at the site include Black Guillemot, Fulmar, Razorbill and Shag.

Old Head of Kinsale (004021)

The Old Head lies approximately 10 km south of the town of Kinsale in Co. Cork and is a 5 km long headland formed of steeply inclined beds of rock (NPWS, 2014, 2018). The site comprises a section of the cliffs on the western side of the narrow isthmus leading to the Head and a 500 m seaward extension. These are vertical rock cliffs providing optimum habitat for ledge nesting seabirds. The site is designated for important populations of Guillemot (2,303 pairs in 2000) and Kittiwake (951 pairs in 2001). Other notable species at the site include Chough, Fulmar, Herring Gull, Peregrine, Razorbill and Shag.

Puffin Island SPA (004003)

Puffin Island lies approximately 0.5 km off the northern side of St Finan's bay in south-west Co. Kerry (NPWS, 2015, 2018). It is a long, narrow island of Old Red Sandstone. The island is almost divided into two halves – the southern half is a long narrow, rocky ridge, rising to 130 m, while the northern half broadens into a grassy plateau though has a high point of 159 m. The island is surrounded by mostly steep cliffs and slopes. It is designated for internationally important populations of Storm Petrel (5,177 pairs in 2000) and Manx Shearwater (6,329 pairs in 2000) and nationally important populations of breeding Puffin (5,125 pairs in 2000), Fulmar (447 pairs in 2000), Razorbill (402 pairs in 1985 - incomplete survey in 2000) and Lesser Black-backed Gull (139 pairs in 2000) and Kittiwake (25 pairs in 2000). Other notable species at the site include Great Black-backed Gull, Guillemot and Shag.

Saltee Islands SPA (004002)

The Saltee Islands SPA is situated some 4-5 km off the coast of south Co. Wexford and comprises the two islands, Great Saltee and Little Saltee, and the surrounding seas both between them and to a distance of 500 m from them (NPWS, 2011, 2012). The bedrock of the islands is of Precambrian gneiss and granite. Both islands have exposed rocky cliffs on their south and east – those on Great Saltee being mostly c. 30 m high, those on Little Saltee about half this height. The northern and western sides of both islands are fringed with shingle and boulder shores, backed by boulder clay cliffs, as well as small areas of intertidal sandflats. Sea caves occur at the base of the cliffs on Great Saltee. The Saltee Islands sites is designated for nationally important Gannet colony (2,446 pairs in 2004), Fulmar (520 pairs in 1998-2000), Cormorant (273 pairs in 1998-2000), Shag (268 pairs in 1998-2000), Lesser Black-backed Gull (164 pairs) in 1998-2000, Herring Gull (73 pairs in 1998-2000), Kittiwake (2,125 pairs in 1998-2000), Guillemot (14,362 pairs in 1998-2000), Razorbill (2,505 pairs in 1998-2000) and Puffin (1,822 pairs in 1998-2000). Other notable species recorded at the site include Chough, Hen Harrier, and Peregrine.

Skelligs SPA (004007)

The site comprises Great Skellig and Little Skellig islands (NPWS, 2015, 2018). These highly exposed and isolated islands, which are separated by a distance of 3 km, are located in the Atlantic some 14 km and 11 km (respectively) off the County Kerry mainland. Both islands are precipitous rocky sea stacks, Great Skellig rising to 218 m and Little Skellig to 134 m. The Skelligs comprise one of the most important seabird colonies in the country for populations and species diversity. The sites are designated for Fulmar (830 pairs in 2002), Gannet (29,683 pairs in 2004), Guillemot (1,652 pairs in 2002), Kittiwake (1,035 in 2002), Puffin (6,000 pairs estimated in 2002), Storm Petrel (9,994 pairs in 2002). Other notable species at the site include Razorbill and Chough

The Bull and the Cow Rocks SPA (004066)

This site consists of two very small rock islands, the Cow, and the Bull. The site is designated for Storm Petrel, Gannet and Puffin (NPWS, 2014, 2018). The site hosts one of the most important Storm Petrel colonies in Ireland (3,500 pairs in 2000), as well as the nationally important gannet species possessing its second largest colony in Ireland on Bull Island (3,694 in 2004). Additional bird species include Great Black-backed Gull, Cormorant, Kittiwake, Guillemot, Fulmar, Herring Gull, and Razorbill.

Tory Island SPA (004073)

Tory Island is a remote, rocky island lying some 11 km to the north of Bloody Foreland in County Donegal (NPWS, 2015, 2018). The island is around 4 km long by 1 km wide. The eastern section comprises high (up to 83 m), dramatic coastal cliffs which continue along much of the north coastline. The southern shoreline is low-lying, consisting of bedrock shore and boulder beach. A marine area, extending 500 m from the base of the cliffs along the eastern and north-east side of the island, is included within the site. The sites are designated for: Fulmar, Corncrake, Razorbill and Puffin. Tory Island SPA supports a breeding population of Corncrake (25 pairs - five year mean between 2003 and 2007, based on records of calling males). Tory Island SPA also supports nationally important breeding populations of Fulmar (641 pairs), Razorbill (671 pairs) and Puffin (1,402 pairs) - all figures from 1999. Other species that occur include Black Guillemot, Black-headed Gull, Chough, Great Black-backed Gull, Guillemot, Herring Gull, Kittiwake, Lapwing, Oystercatcher, Peregrine, Redshank, Ringed Plover, Shag, Snipe, Tree Sparrow, Little Tern, and Storm Petrel.

West Donegal Coast SPA (004150)

The West Donegal Coast SPA comprises separate sections of the Co. Donegal coastline and extends from Muckros Head in the south, northwards to Slieve League, Malin Beg, Rocky Point, Glen Head, Slieve Tooey, Maghera, Loughros Point, Dunmore Head, Aran Island, Magheradrumman, Carrickfin, Carnboy, Bunbeg, Magheragallan, Lunniagh, as far as Carrick, to the south of Bloody Foreland (NPWS, 2015, 2018). The site includes the high coast areas and sea cliffs of the mainland and Aran Island, the land adjacent to the cliff, areas of sand dunes/machair at Maghera, Mullaghderg, Braade/Carrickfin/Carnboy, Magheragallan and Lunniagh/Carrick, and also several areas further inland of the coast at Croaghmuckros and Slieve League, north of Glencolumbkille and south of Dunmore Head. A low-lying area of land on the coast at Bunbeg used by roosting Chough is also included. The site is designated for Chough, Peregrine, Fulmar, Cormorant, Shag, Herring Gull, Kittiwake and Razorbill. Other species noted at the sites include Barnacle Goose, Black Guillemot, Great Black-backed Gull, Lesser Black-backed Gull, Ring Ouzel, Twite, and Puffin.

Wicklow Head SPA (004127)

Wicklow Head is a rocky headland site situated approximately 3 kilometres south of Wicklow town (NPWS, 2012, 2018). The cliffs at the sites rise to about 60 m and it is here that most of the seabird's breed. The site comprises the cliffs and cliff-top vegetation, as well as some heath vegetation. The marine area to a distance of 500 m from the base of the cliffs is included in the site. The site was designated for a nationally important population of Kittiwake (956 pairs in 2002). Oher notable species at the site includes Fulmar, Shag, Herring Gull, Guillemot and Razorbill, Black Guillemot, Peregrine, Ravens, Stonechat, Whitethroat and Linnet.

6.7.2. Potential Impacts

6.7.2.1. Disturbance Risk

Potential disturbance effect to bird species could arise in two ways:

i. from avoidance of the farm structures; and
ii. from avoidance of activity associated with the salmon farm.

In general, birds seem to use artificial structures as roosting sites when they prove suitable. Birds will avoid artificial structures when they interfere with specific habitat requirements such as flight paths or maintaining open views to detect predators. Considering the scale of the pens in the proposed renewal sites, this is unlikely to be an issue.

There will be daily human activity at the licence renewal site while the site is stocked with fish. This activity will include work boat transport to and from the site as well as daily activity relating to feeding, health and quality checks, sampling, and removal of mortalities. These activities would be low level with a limited number of people on site. Larger scale activities will include net pen maintenance, including in situ net cleaning, stock grading, stock treatment and harvesting. These activities will require a larger human presence and the use of more equipment on site including a well boat. Following the harvest period potentially large maintenance activities will also take place.

6.7.2.2. Entanglement/ Mortality Risk

There is potential that bird species may predate on farmed fish and thereby become entangle in farm pens and nets. However, if reasonable mitigation measures are taken against predation, such as the correct installation and fixing of bird nets, most species will do nothing more than perch until disturbed. The measures that will be employed include correct installation and fixing of bird nets with 80 mm mesh size.

Entanglement of birds in nets is also less likely when nets are correctly installed and kept taut. Gulls are also habitual followers of fish farm vessels as they are with fishery vessels. Cormorants are the most persistent avian predators of farmed fish. They are capable of breaching the pen nets underwater and on occasions can also breach bird nets, to predate on the salmon stock. However, mitigating measures can deter such activities. Experience at MOWI suggests that cormorants should not prove problematic at this site as long as the stock is adequately protected. No direct predator control will be employed at the licence renewal site.

6.7.2.3. Impacts on Foraging and Licensed Area Habitat Suitability

If the licensed area coincides with suitable foraging areas, the farming operation may directly and indirectly effect bird foraging success. For instance, the farm structures may act as a fish aggregation device or artificial reef thereby increasing bird prey availability. Bird foraging success may also be positively affected through the provision of resting/ roosting locations and/ or the creation of sheltered waters in the lee of structures.

As shown in **Section 6.2** the proposed development effects the benthic habitats and communities in the vicinity of the farm through organic enrichment. There is potential that organic enrichment may indirectly affect the foraging behaviour of bird species by effecting benthic and demersal prey.

There is also potential that bird species may supplement natural foraging and diet by directly predating on farmed salmon.

6.7.3. Impact Assessment Methodology

6.7.3.1. Criteria Overview

A risk assessment[14] to examine the potential impacts on birds listed in **Table 6.12** has been carried using criteria for the following:

- species risk of disturbance (as detailed in **Table 6.13**).
- species population sensitivity (**Table 6.14**).
- licensed area habitat suitability (**Table 6.15**); and
- species habitat flexibility (**Table 6.16**).

The significance of risk is presented in **Table 6.18**.

6.7.3.2. Disturbance Risk

The greatest potential impact from human activity will be associated with boat movements around the site. The sensitivity of various high conservation value species to such impacts will vary. Species that regularly follow fishing trawlers and larger boats (*i.e.,* the gulls and Fulmars) are unlikely to be significantly displaced by boat movements. A disturbance scale developed by Garthe & Hüppop (2004), and Furness *et al.* (2012, 2013) rated the potential vulnerability of seabirds to disturbance on a scale of 1–5, with 1 representing hardly any escape/avoidance behaviour and/or non/very low fleeing distance and 5 representing strong escape/ avoidance behaviour and/or large fleeing distance. Using the disturbance scale, relevant Qualifying Features (presented in **Table 6.12**) are assigned to disturbance categories in **Table 6.13**.

Table 6.13: Disturbance risk categories of Qualifying Features of SPAs.

Qualifying Feature	Disturbance Category
Fulmar (*Fulmarus glacialis*)	1
Manx Shearwater (*Puffinus puffinus*) *	1
Storm Petrel (*Hydrobates pelagicus*) *	1
Arctic tern (*Sterna paradisaea*)	2

[14] The methods of impact assessment have been adapted from Atkins (2012)

Qualifying Feature	Disturbance Category
Common Tern (*Sterna hirundo*)	2
Gannet (*Morus bassanus*)	2
Herring Gull (*Larus argentatus*)	2
Kittiwake (*Rissa tridactyla*)	2
Lesser Black-backed Gull (*Larus fuscus*)	2
Puffin (*Fratercula arctica*)	2
Guillemot (*Uria aalge*)	3
Razorbill (*Alca torda*)	3

6.7.3.3. Species Population Sensitivity

The determination of the sensitivity of species population takes into account the following

- Tolerance to change: the species' ability to accommodate temporary and permanent change
- Recoverability: the ability of the receptor to return to its natural state following cessation of an effect.
- Adaptability: the ability of a receptor to avoid or adapt to an effect
- Value: a measure of the receptor's importance, rarity and worth.

In general, populations with very poor conservation status including species on the BoCCI red list have little capacity to tolerate change and recover following an impact. In contrast, populations that are not of conservation concern typically exhibit capacity to absorb impacts.

Table 6.14: Sensitivity criteria

Sensitivity	Definition
Very High	Receptor population has no tolerance of effect. e.g., no capacity to absorb change, a population level effect very likely to occur Likely to be limited to populations with very poor conservation status - BoCCI Red List
High	Receptor population has a very limited tolerance of effect. e.g., likely to have no capacity to absorb change, so a population level effect likely. Likely to be limited to populations with poor existing conservation status - BoCCI Amber List
Medium	Receptor population has limited tolerance of effect. e.g., very minor capacity to absorb change, so a population effect possible. Likely to include but not be limited to populations with poor existing conservation status - BoCCI Green List

Sensitivity	Definition
Low	Receptor population has some tolerance of effect. e.g., likely to have minor capacity to absorb additional mortality or reduction in productivity or habitat loss, so a population level effect unlikely.
Negligible	Receptor population generally tolerant of effect. e.g., likely to have moderate capacity to absorb additional mortality or reduction in productivity or habitat loss, so a population effect very unlikely.

6.7.3.4. Licensed Area Habitat Suitability

The habitat suitability of the licence renewal site is coded as follows:

1. habitat conditions include specific features (substrate type, upwellings, etc.) identified as being important for the species.
2. habitat conditions generally suitable (e.g., within depth range) but lack specific features identified as being important for the species.
3. habitat conditions include some features identified as unsuitable in some studies.
4. habitat conditions generally unsuitable.

Habitat preference follows that identified for the species in Furness *et al.* (2012, 2013).

Table 6.15: Habitat Suitability

Qualifying Feature	Species Habitat Preference	Suitability Score
Arctic tern (*Sterna paradisaea*)	Coastal marine	2
Common Tern (*Sterna hirundo*)	Estuaries, sea lochs sheltered coast, few inland on river and lochs	2
Herring Gull (*Larus argentatus*)	Forages around ship in inshore areas, on shoaling fish, in the intertidal, in agricultural areas, on refuse and in streets.	2
Kittiwake (*Rissa tridactyla*)	Birds forage over continental shelf with the 200m contour.	2
Lesser Black-backed Gull (*Larus fuscus*)	Feed in a range of habitats in coastal areas, and in agricultural areas, and extensive use is made of refuse tips and other sources of human waste.	2
Razorbill (*Alca torda*)	Found in a range of marine habitats but generally in shallow sea	2
Guillemot (*Uria aalge*)	Typically feeds offshore with inshore and pelagic feeding less common.	3

Qualifying Feature	Species Habitat Preference	Suitability Score
Fulmar (*Fulmarus glacialis*)	Oceanic and shelf break although large number can occur near trawler on continental shelf	4
Gannet (*Morus bassanus*)	Oceanic, pelagic but mainly offshore over continental shelf	4
Manx Shearwater (*Puffinus puffinus*)	Pelagic although mainly over continental shelf	4
Puffin (*Fratercula arctica*)	Feed far from the coast and is pelagic in winter.	4
Storm Petrel (*Hydrobates pelagicus*)	Pelagic, generally found over continental shelf.	4

6.7.3.5. Species Habitat Flexibility

The habitat use flexibility scores are based on Garthe & Hüppop (2004) and Furness *et al.* (2012, 2013). The score value ranges from 1 to 5 with 1 indicating species is very flexible in habitat use and to 5 indicating the species is reliant on specific habitat characteristics. Species that are coded low occupy large sea areas with no specific habitat preferences while species that are coded high rely on specific habitat features.

Table 6.16: Habitat Flexibility Scores.

Qualifying Feature	Flexibility Scores
Fulmar (*Fulmarus glacialis*)	1
Herring Gull (*Larus argentatus*)	1
Manx Shearwater (*Puffinus puffinus*)	1
Storm Petrel (*Hydrobates pelagicus*)	1
Common Tern (*Sterna hirundo*)	2
Gannet (*Morus bassanus*)	2
Kittiwake (*Rissa tridactyla*)	2
Lesser Black-backed Gull (*Larus fuscus*)	2
Arctic tern (*Sterna paradisaea*)	3
Guillemot (*Uria aalge*)	3
Puffin (*Fratercula arctica*)	3
Razorbill (*Alca torda*)	3

6.7.4. Assessment of Impact Significance

The level of impact is determined by combining assessments of 1) Disturbance, 2) Population Sensitivity, 3) Licensed Area Habitat Suitability and 4) Habitat Flexibility Scores. The level of impact is described in **Table 6.17**, based on the sensitivity/value of the receptor, the magnitude of effects and the likelihood of occurrence, determines the significance of the impact.

The level of potential impact and significance to species are detailed in **Table 6.18**

Table 6.17: Level of Impact

Level of Impact	Impact Significance	Definition
Negligible	No change (**NOT SIGNIFICANT**)	No discernible change in the ecology of the affected feature
Negligible	Imperceptible Impact (**NOT SIGNIFICANT**)	An impact capable of measurement but without noticeable consequences
Minor	Slight Impact (**NOT SIGNIFICANT**)	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate	Moderate Impact (**SIGNIFICANT**)	An impact that alters the character of the environment that is consistent with existing and emerging trends
Major	Significant Impact (**SIGNIFICANT**)	An impact which, by its character, magnitude, duration, or intensity alters a sensitive aspect of the environment
Severe	Profound Impact (**SIGNIFICANT**)	An impact which obliterates sensitive characters.

6.7.5. Conclusions

The likelihood of impacts occurring is remote; it is concluded that there will **no significant effects**.

Table 6.18: Potential impacts on bird populations.

Qualifying Feature	Disturbance	Population Sensitivity BoCCI[15]	Licensed Area Habitat Suitability	Habitat Flexibility Scores	Overall Level of Impact	Impact Significance
Herring Gull (*Larus argentatus*)	2	Very High BoCCI Red List	2	1	Minor	Potential Slight Impact (NOT SIGNIFICANT)
Arctic tern (*Sterna paradisaea*)	2	High – BoCCI Amber List	2	3	Negligible	Potential Imperceptible Impact (NOT SIGNIFICANT)
Common Tern (*Sterna hirundo*)	2	High – BoCCI Amber List	2	2	Negligible	Potential Imperceptible Impact
Gannet (*Morus bassanus*)	2	High – BoCCI Amber List	4	2	Negligible	(NOT SIGNIFICANT)
Guillemot (*Uria aalge*)	3	High – BoCCI Amber List	3	3	Negligible	Potential Imperceptible Impact
Kittiwake (*Rissa tridactyla*)	2	High – BoCCI Amber List	2	2	Negligible	(NOT SIGNIFICANT)
Lesser Black-backed Gull (*Larus fuscus*)	2	High – BoCCI Amber List	2	2	Negligible	Potential Imperceptible Impact
Manx Shearwater (*Puffinus puffinus*)	1	High – BoCCI Amber List	4	1	Negligible	(NOT SIGNIFICANT)
Puffin (*Fratercula arctica*)	2	High – BoCCI Amber List	4	3	Negligible	Potential Imperceptible Impact
Razorbill (*Alca torda*)	3	High – BoCCI Amber List	2	3	Negligible	(NOT SIGNIFICANT)

[15] BoCCI - Birds of Conservation Concern in Ireland

Qualifying Feature	Disturbance	Population Sensitivity BoCCI[15]	Licensed Area Habitat Suitability	Habitat Flexibility Scores	Overall Level of Impact	Impact Significance
Storm Petrel (*Hydrobates pelagicus*)	1	High – BoCCI Amber List	4	1	Negligible	Potential Imperceptible Impact
Fulmar (*Fulmarus glacialis*)	1	Medium - BoCCI Green List	4	1	Negligible	No change NOT SIGNIFICANT

7. Land and Soils

7.1. Description of the Receiving Environment

7.1.1. Seabed Substrata

The seabed in Kenmare Bay comprises coarse sediment, sand sediments and reefs (Emodnet, 2019). Benthic Audit survey undertaken in 2018 at the site focused on two transects (**Figure 7-1**) (AQUAFACT, 2018a) (see **Appendix 6**). Survey findings confirm that the sediments at the site consist of a variety of fine to medium grained sand with high to medium percentages of shell and course sediment (**Table 7.1**).

7.1.2. Redox

The 2018 Benthic Audit survey showed that apparent redox potential discontinuity (aRPD) at the site ranged from maximum of 10.6 cm (directly underneath the pens) to a minimum of 2cm (50m from the pen) with no outgassing present at any of the sampling stations (see **Table 7.1**) (AQUAFACT, 2018a). A reference point 150m from the directly underneath the station was selected as good representation of ambient conditions in proximity to the aquaculture site: aRPD at the reference point was 5.6cm.

7.1.3. Organic Carbon

Organic matter (as measured using LOI method) values recorded in 2018 at the Inishfarnard site ranged from 4.37% to 11.4% (see **Table 7.1**) (AQUAFACT, 2018a). In general, LOI values recorded at the 2 transects decreased with increasing distance from the pens.

Table 7.1 Aquafact Benthic Audit Results – Sample Station, aRDP, Substrate Type, Outgassing (AQUAFACT, 2018a).

Sample Station	Orientation	aRDP (cm)	Substrate	Outgassing	LOI%
T1 Under	N/A	10.6	Medium Sand with Shell Gravel, Faecal Matter and Food Debris	No	11.4
T1 Edge	NE - SW	7.1	Medium Grained Sand with Shell	No	6.9
T1 10m	NE - SW	7.4	Fine/Medium Grained Sand with Shell	No	4.44
T1 20m	NE - SW	6.7	Medium Grained Sand with Shell	No	4.37
T1 50m	NE - SW	2.4	Medium Grained Sand with High % of Shell Fragment	No	5.93

Sample Station	Orientation	aRDP (cm)	Substrate	Outgassing	LOI%
T1 100m	NE - SW	7	Course Sediment with High % of Shell Fragment	No	4.18
T2 Under	N/A	9	Medium Sand with Shell Gravel, Faecal Matter and Food Debris	No	-
T2 Edge	NW - SE	5.2	Medium Sand with Shell Gravel, Faecal Matter and Food Debris	No	6.68
T2 10m	NW - SE	5.9	Medium Grained Sand with Shell	No	8.82
T2 20m	NW - SE	7.2	Coarse Grained Sediment with M. Edulis Shell	No	5.52
T2 50m	NW - SE	8.6	Course Sediment with Cobbles and M. Edulis Shell	No	5.61
Reference Point	N/A	7.5	Course Sediment with Cobbles and M. Edulis Shell	No	5.05

7.2. Impacts on Land & Soils

As discussed above in **Section 6.2** (Impacts on Benthic Ecology), modelling of proposed production (i.e., maximum allowable biomass of 2,177 tonnes) at proposed renewal site (52.73 ha) indicates that the predicted maximum monthly sedimentation rate at the pens is 2.13mm per month. The organic material deposited on the seabed under the pens will consist of food waste and faeces. This waste will be confined to an area of fine and medium sand within the footprint of the pens.

The volume of organic material deposited on the seabed monthly will feed the natural cycle of biological succession (detailed in **Section .2.4.2**). The likelihood of the renewal of the licence resulting in increased organic matter loading is Highly Likely. As a consequence, the *in-situ* population will be gradually depleted over time by the increased organic loading and replaced by species which thrive in areas of excess organic input. There will be a change in the characterising species and the structure and function of the faunal community. This is a temporary negative impact as the species diversity will be reduced. However, the three-month fallow period at the end of the 2-year production cycle occurs in the winter months, which is the most active hydrodynamically. This results in the redistribution and dispersal of organic matter beneath the pens to allow sufficient recovery enabling the environment to return to its original state prior to the introduction of excess organic matter to the seabed.

As the disturbance is temporary, very localised and confined to the area directly under and in the immediate vicinity of the pens (see **Section 6.2.5** for details) and the fact that recovery will occur during the fallow period, the magnitude of effect is considered to be Moderate resulting in a **Minor** level of impact that is **Not Significant**. This impact is Highly Likely to occur. No impact on the seafloor beyond the immediate vicinity of the pens is likely to occur, which has shown to be the case as recorded in the annual benthic audits at the current level of production (see Section 6.2.4.2).

7.3. Mitigation Measures

The three-month fallow period between growth cycles at the T5/233 site will allow full recovery and ensure that the disturbance is not cumulative. The Protocol for Fallowing of Offshore Fin Fish Farms as released by DAFM in 2000 state that sites are fallowed annually for a minimum of 30 days to allow sufficient recovery (DMNR, 2000d). Therefore, the fallowing period at the Inishfarnard site of 3 months exceeds this obligation and will therefore allow full recovery for the benthic system and environment.

Increases in tonnages should only be allowed following satisfactory findings from the previous audit that show that the benthic community can comfortably tolerate the existing tonnages as required in the Benthic Monitoring Protocol No. 1 (DAFF, 2008).

A change to the existing benthic communities is unlikely as increases in tonnages beyond what is currently carried out will only be allowed following satisfactory benthic audits indicating that there is sufficient assimilative capacity to absorb the increases.

7.4. Conclusion

The renewal application requests change to the boundaries of the existing site and to the operating conditions attached to the licence. As shown above, the proposed operations will not give rise to long term negative effects on local sediment; it is concluded that there will **no significant effects**.

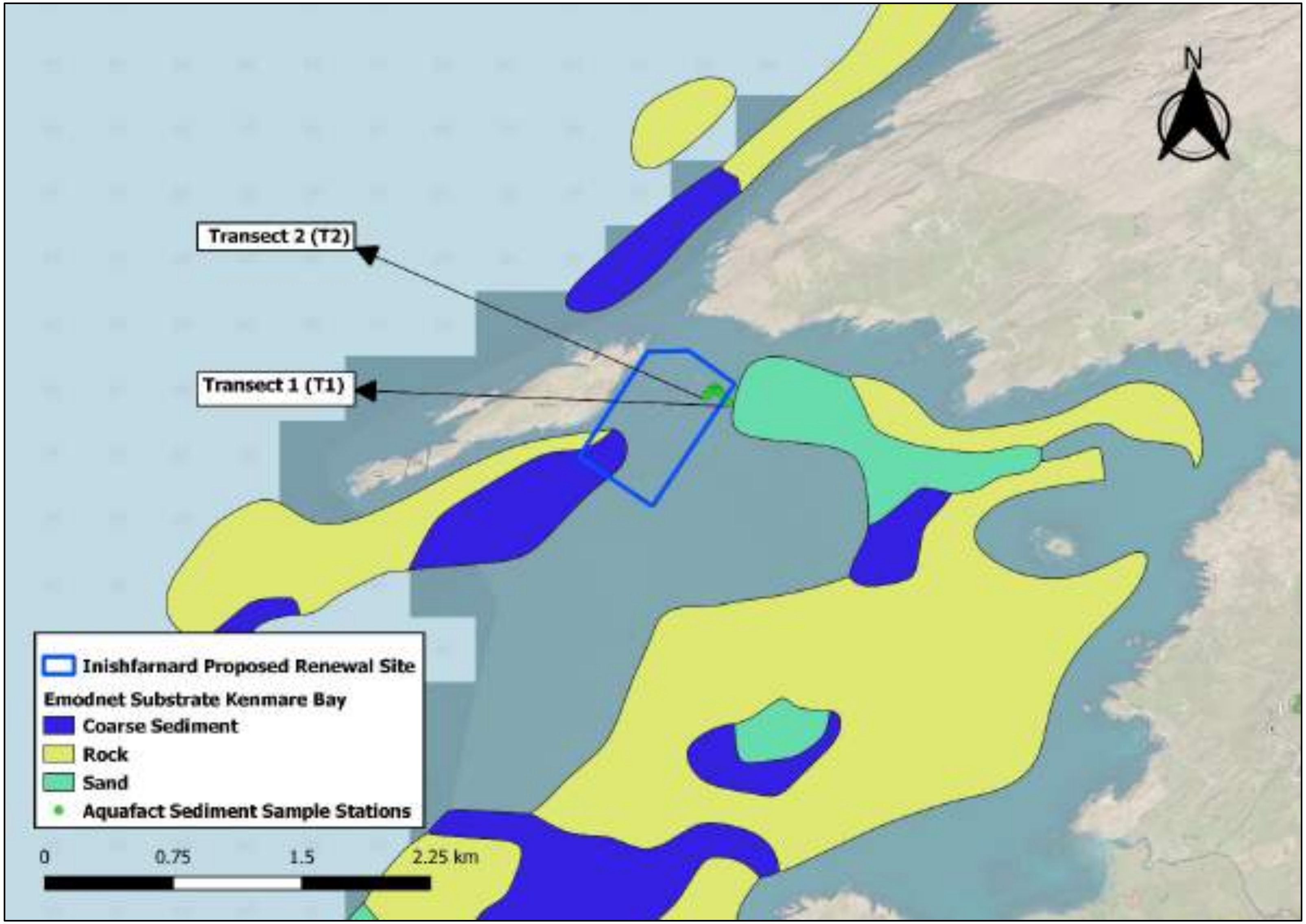

Figure 7-1: Sediment type in Kenmare Bay (AQUAFACT, 2018a; INFOMAR, 2013) and sampling transects

8. Water

8.1. Description of the Receiving Environment

8.1.1. Water Depth

A bathymetric survey at the Inishfarnard site was carried out in 2015 as part an archaeological assessment in the area (see **Appendix 11**). **Figure 8-1** present a digitised bathymetric map and a three-dimensional terrain model of the area relative to the site boundary of the existing licensed area (outlined in yellow). Water depth within the existing licensed area ranges from 11m to 19m in the north of the site to between 23m to 31m in the south. The depth range within the proposed renewal licensed area extends from 11m to a depth of 35m.

8.1.2. Tidal Velocities and Circulation

The seabed at Kenmare Bay is quite deep in the main outer channel at 60 to 75m towards the mouth. The enclosed bays of Ballinskelligs and Coulagh are variable with depths generally less than 30m. The bathymetry at the Inishfarnard Island farm site deepen southward away from the island and towards the mouth of Coulagh Bay.

The average water depths over the proposed licensed site area is 25.3m below mean sea level and depths vary from 15 to 30m with the site slightly shallower westward towards Inishfarnard Island and northwards towards the Cork Shoreline. Water depth at the midpoint of the licensed site is approximately 28m.

The spring tidal range is typically 3.5m and the neap is approximately 50% of this at 1.6 to 1.8m. The flooding tide off the Kenmare Bay Headland runs north northwest and the ebbing tide runs south. Tidal flows in Kenmare Bay and the adjoining Coulagh Bay and Ballinskelligs Bays are slack particularly on neap tides influenced by the bay's orientation and relatively deep waters particularly at the mouth to Kenmare Bay.

The outer Kenmare Bay area is exposed to Atlantic swells from the southwest and west sectors. The Inishfarnard site is afforded some shelter from headlands surrounding Coulagh Bay to the south and east and the Inishfarnard Island to the north but is found to be exposed to westerly waves. Further offshore of Inishfarnard Island outside Coulagh Bay, the Atlantic swell waves diffract around to approach the bay and site from a south-westerly and westerly direction.

A hydrographic survey of the tidal currents in outer Kenmare Bay carried out by Irish Hydrodata (Aug 1990) indicated weak tidal stream velocities throughout the outer bay area with still weather astronomical currents of 0.06 to 0.10m/s in the main channel. Slacker tidal currents were recorded in Coulagh Bay area of the order of 0.02 to 0.04m/s. It was found that the tidal flow direction was almost equally distributed around the compass, indicative of slack flow conditions.

Neap and spring tide drogue surveys were conducted at the Inishfarnard site area in 1997. The surveys found that minimum current magnitudes occurred around the turn of the tide (0.02m/s to 0.07m/s) while maximum current speed was found around the mid-flood period (0.05 to 0.26m/s). The drogues followed a circulatory, anti-clockwise path from release at the farm site.

Under the slack tidal streams that characterise the outer Kenmare Bay area the dominant influence on hydrodynamics will be meteorological conditions in respect to variable wind conditions. The mean wind condition is 5.5m/s wind speed from the southwest.

Hydrodynamics of the area was modelled by Telemac in 2019. There was reasonable agreement between modelling results (see **Figure 8-2** to **Figure 8-7**) and the finding of Irish Hydrodata survey and the drogue survey undertaken in 1990 and 1997 respectively.

At the Inishfarnard site tidal stream flows increase northwards towards the sound between Inishfarnard and Kilcatherine Point and southwards towards the mouth to Coulagh Bay. Very slack flows (<0.04m/s) are predicted to occur during neap tides (throughout the tidal cycle) at the farm site and within Coulagh Bay. The strongest velocities are located within the sound between the island and the headland to the north of the site, with 0.075m/s predicted on ebbing tide and 0.125m/s on the flooding tides. On spring tides, the velocities increase by approximately 50% but still remain relatively slack at generally less than 0.08m/s within the farm site and in the inner Coulagh Bay area.

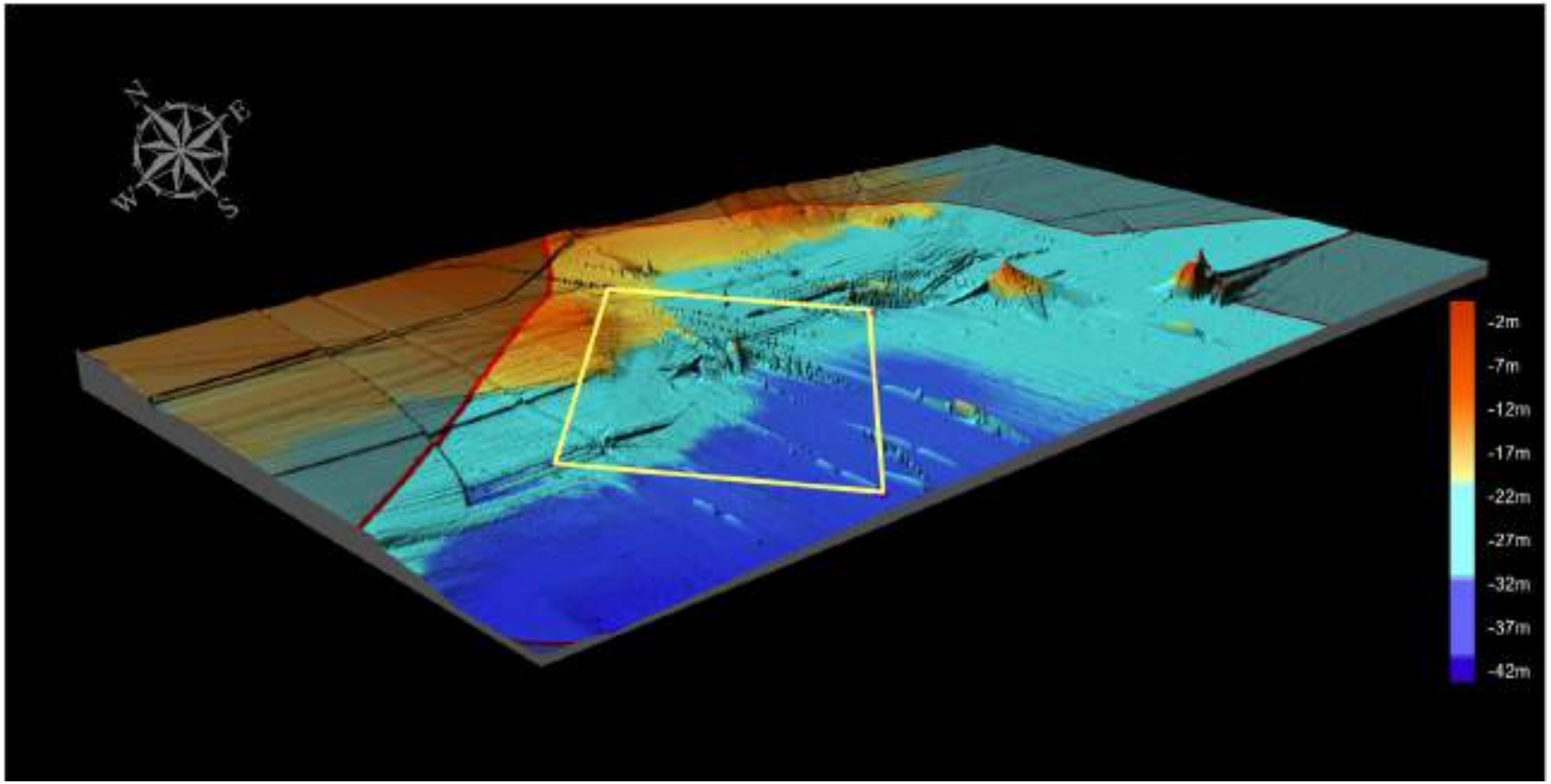

Figure 8-1: Digital terrain model developed from bathymetric data acquired near Inishfarnard site (Source: Boland, 2015).

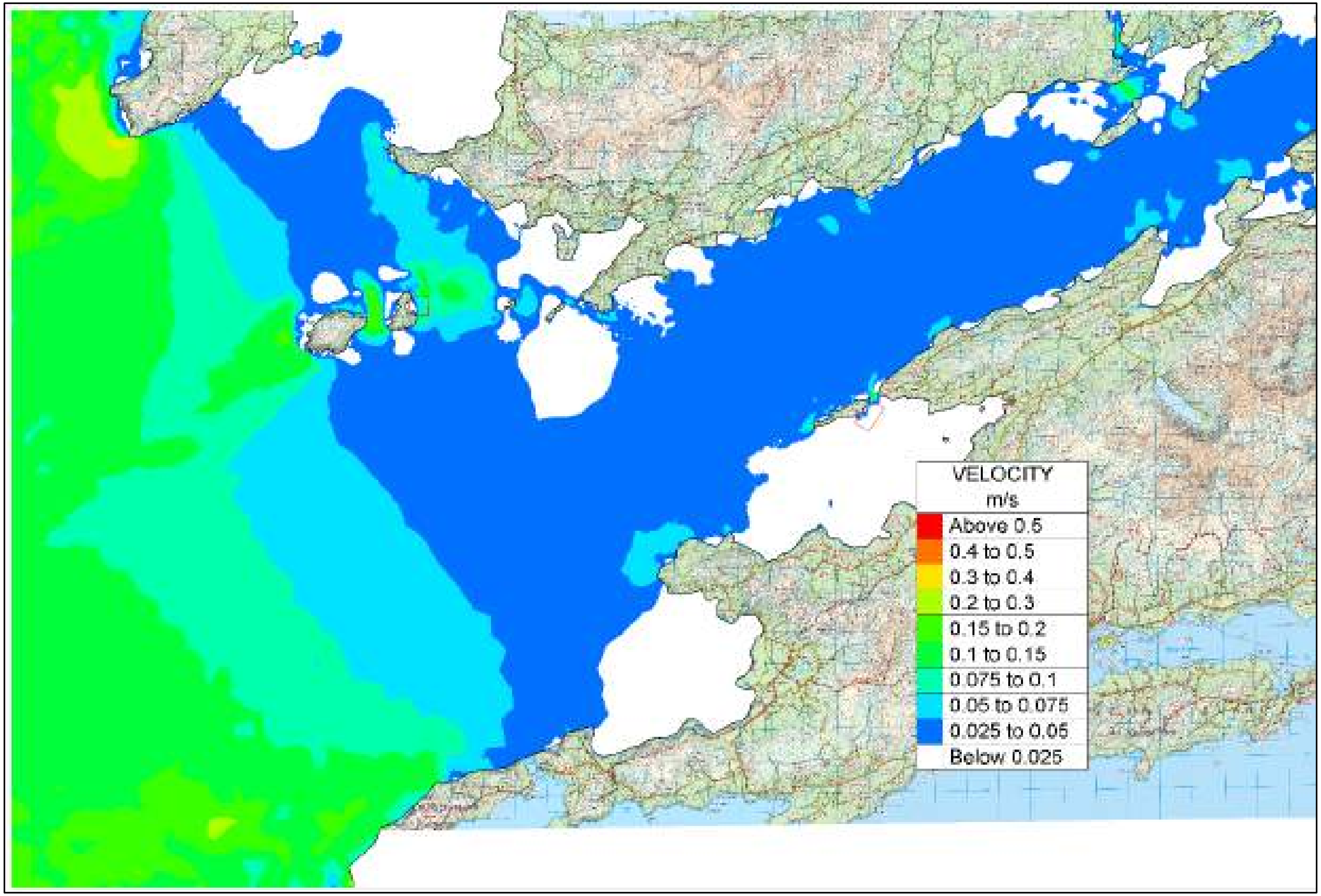

Figure 8-2: Computed mid-depth tidal velocity magnitudes for flooding neap tide

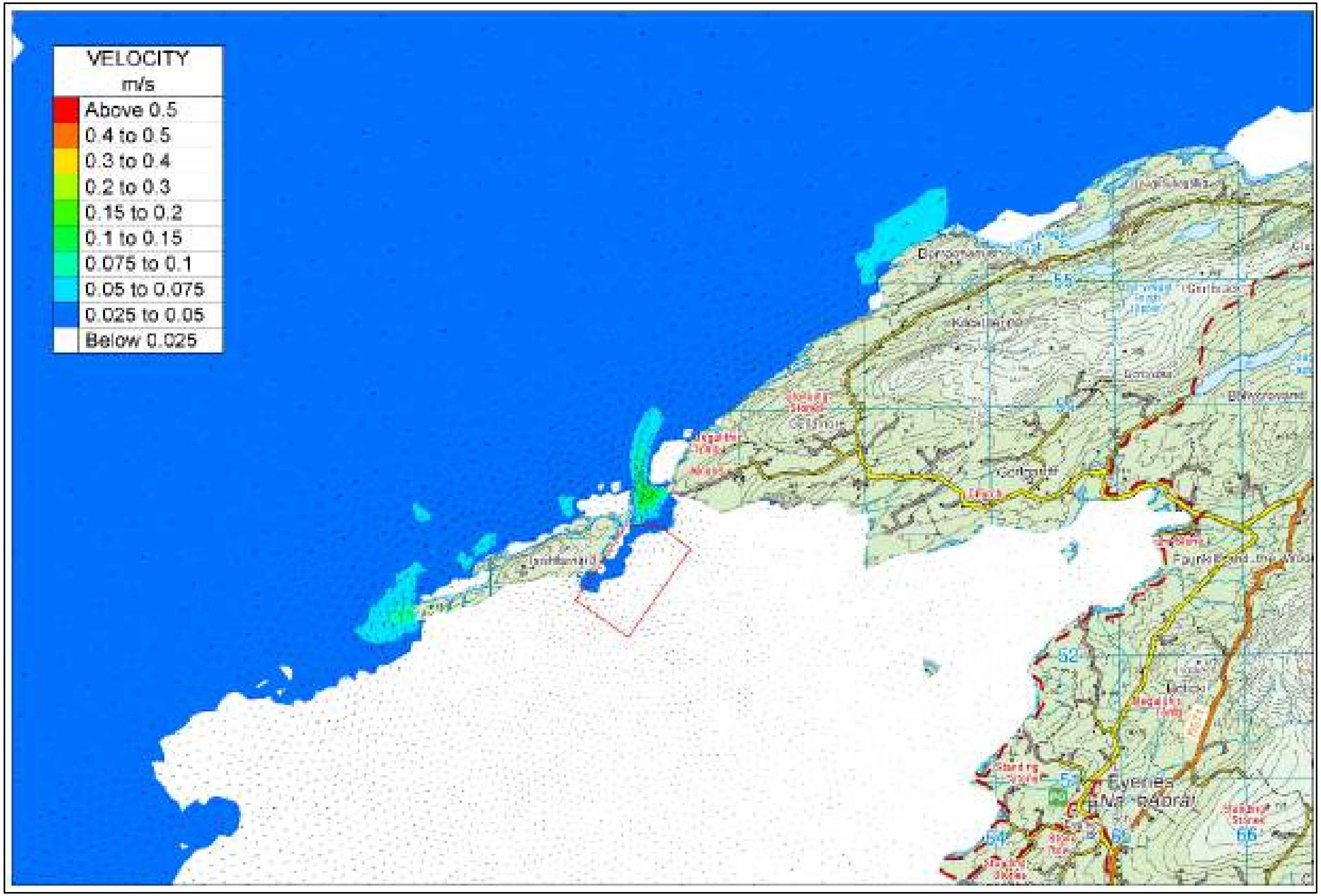

Figure 8-3: Computed mid-depth tidal velocities for flooding neap tide

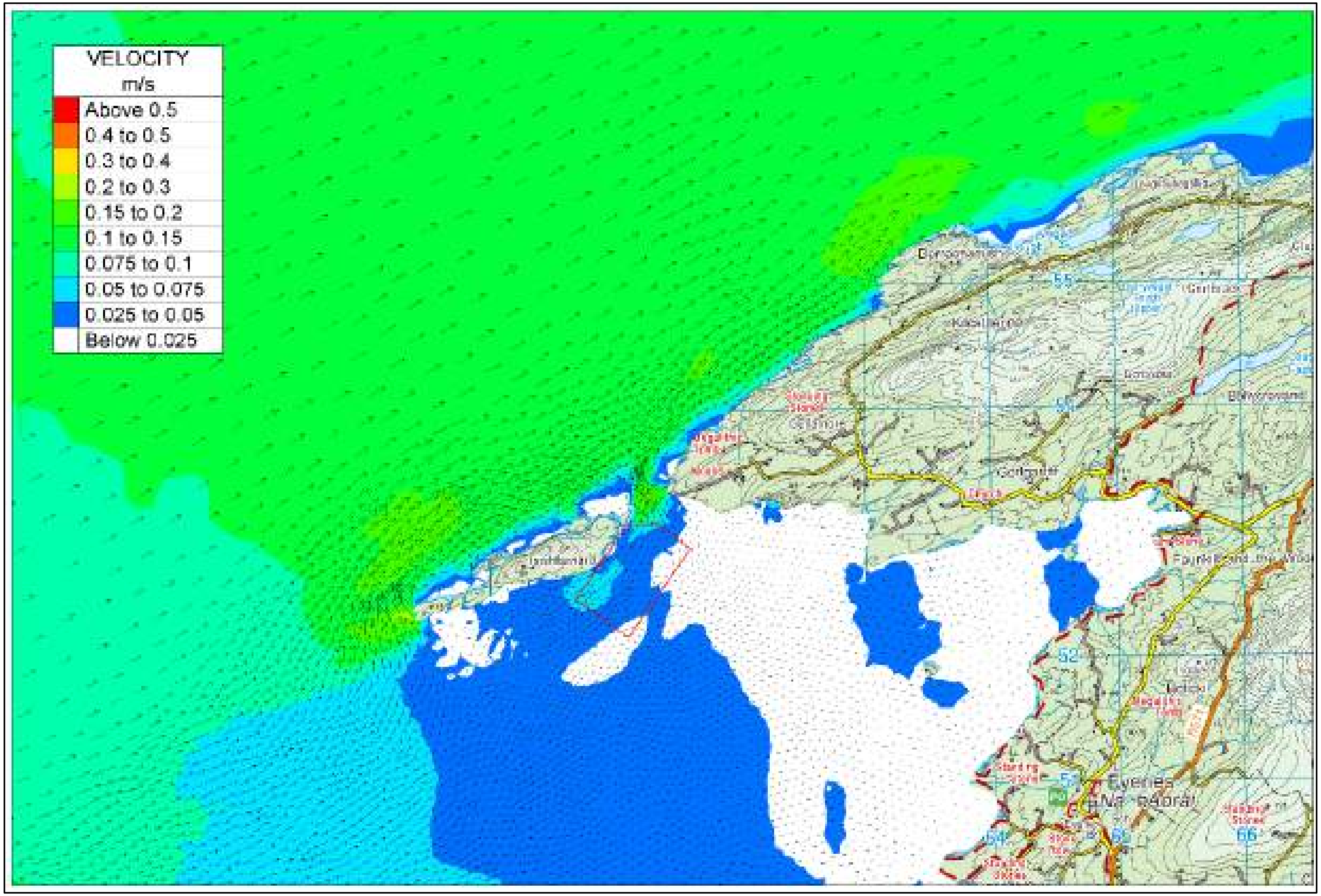

Figure 8-4: Computed mid-depth tidal velocities for flooding spring tide

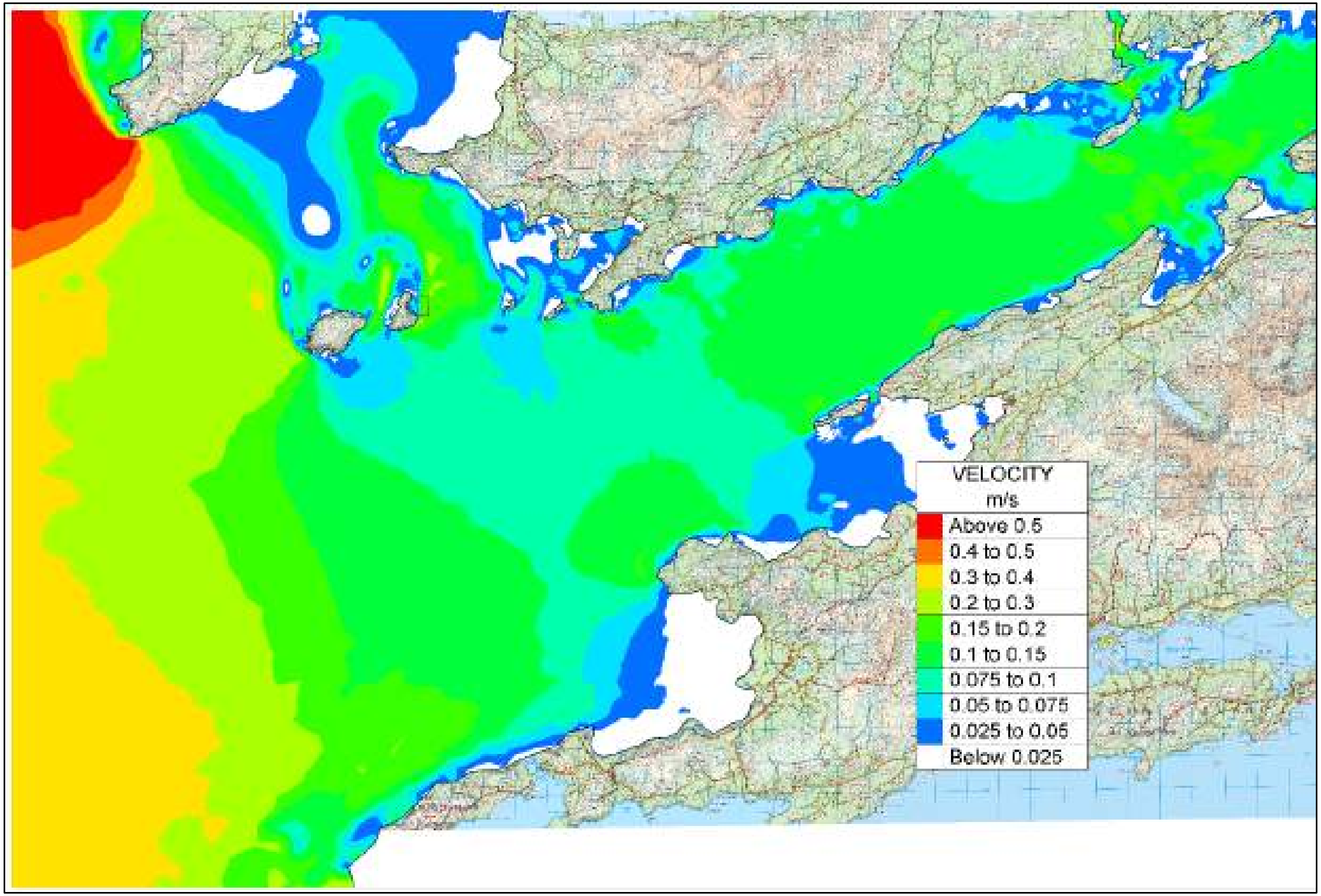

Figure 8-5: Computed mid-depth tidal velocity magnitudes for ebbing neap tide

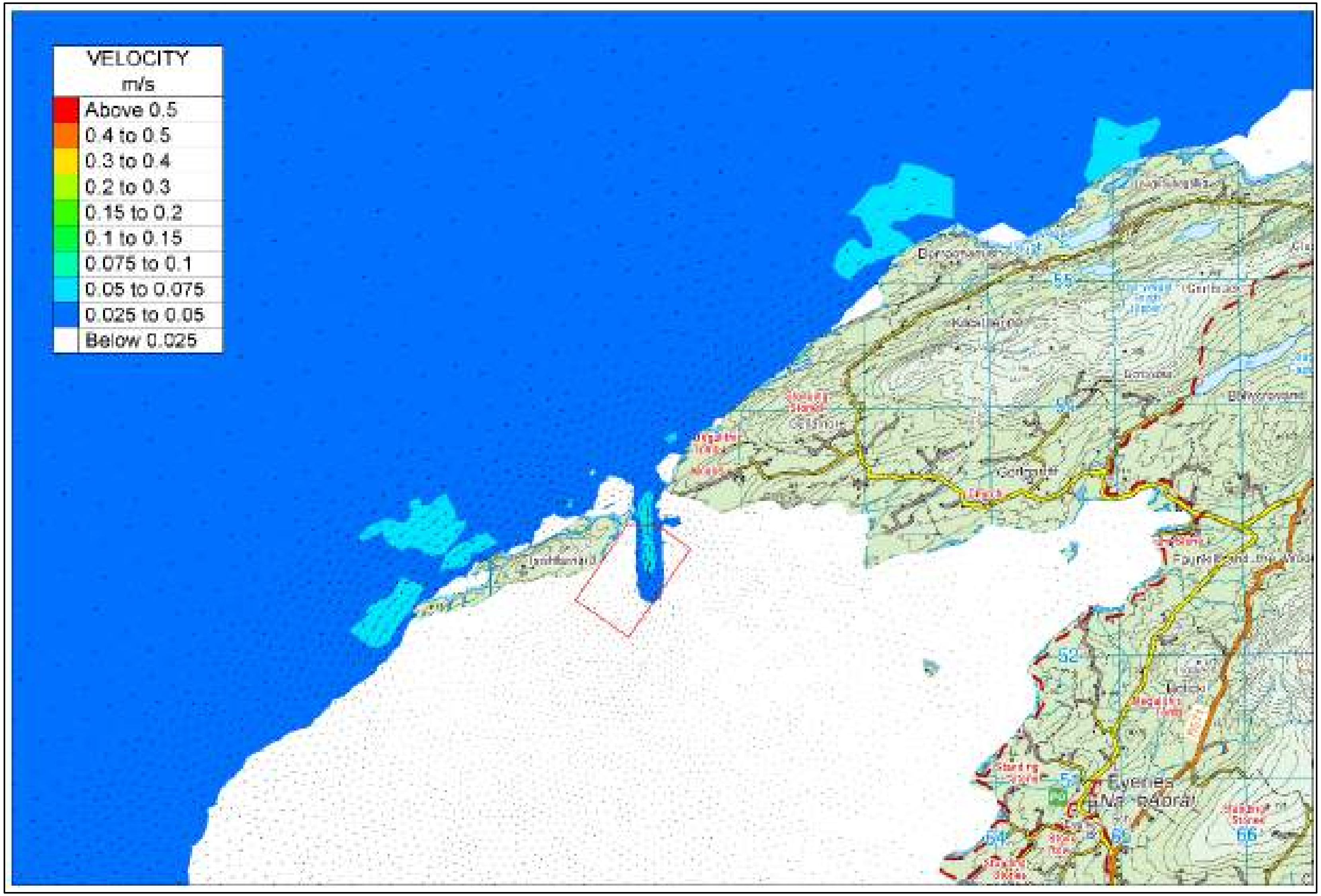

Figure 8-6: Computed mid-depth tidal velocities for ebbing neap tide

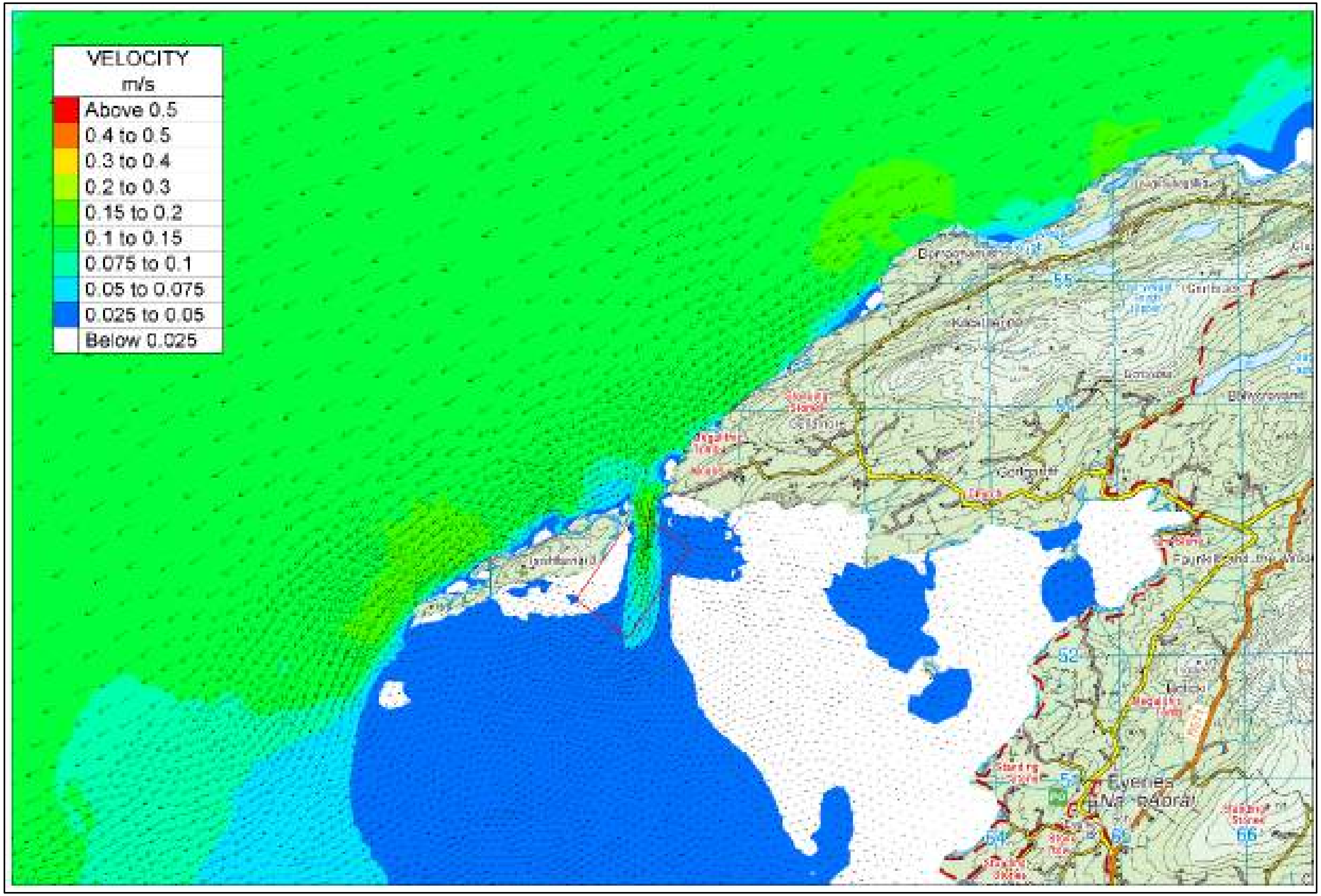

Figure 8-7: Computed mid-depth tidal velocities for an ebbing spring tide

8.1.3. Wave Climate

A hydrodynamic wave climate modelling study for Kenmare Bay (see **Appendix 8**) was carried out in 2019 to inform the potential impact assessment of activities at the Inishfarnard aquaculture site. The following wave climate simulations were performed to determine the most adverse wave climate likely to occur at the Inishfarnard Site:

1. Extreme Atlantic storm swell event from the south sector of 12.5m significant wave height and 13.5sec period.
2. Extreme Atlantic storm swell event from the southwest sector of 13.5m significant wave height and 15.0sec period.
3. Extreme Atlantic storm swell event from the west sector of 18.0m significant wave height and 17.0sec period.
4. Local wind-waves produced by a 100year return period (24.5m/s) southerly wind.
5. Local wind-waves produced by a 100year return period (25.4m/s) south-westerly wind.
6. Local wind-waves produced by a 100year return period (28.6m/s) westerly wind.

The computed significant wave height colour contour plots for the above six simulations are presented in **Figure 8-8** through **Figure 8-13** while summary wave characteristics for each simulation are presented below in **Table 8.1.**

The Inisfarnard site is a moderately exposed site. The site is exposed to south-westerly and westerly storms and reasonably sheltered from southerly storms and completely sheltered to northerly and easterly storms. Large Atlantic swell waves of long period can significantly impact the licensed site from the southwest and west sectors producing worse case storm waves of 4.6m to 5.2m. The most critical direction producing the largest wave heights is the westerly. The local-wind wave simulation produces maximum significant wave heights of 1.8m to 2.3m for southwest and westerly storm winds. As is the case with local wind waves the wave period is shorter than the Atlantic swell conditions computed at 6.9 to 7.7 seconds.

8.1.4. Freshwater Input

The contributing catchment area of Kenmare Bay consists of the Dunmanus-Bantry-Kenmare Catchment which drains a total area of 1,898 km^2 (EPA Catchments). A total of 20 sub catchments, 91 river bodies, 29 lakes, 20 transitional and coastal water bodies and 3 groundwater bodies constitute this catchment area. The main rivers and sub catchments which drain into Kenmare Bay can be seen in **Figure 8-14**.

Table 8.1: Summary of Computed Design Wave Conditions at the centre point of the Inishfarnard licensed Site (51.7098º -10.0098º)

Simulations 1 to 3 Extreme 100year Atlantic storm Swell			
Site	**Significant Wave Height HMO* (m)**	**Mean Wave Period TMOY** (sec)**	**Wave direction (degrees)**
South	0.971	10.69	54.1
Southwest	4.637	13.32	50.8
West	5.234	13.45	51.0
Simulations 4 to 6 Local generated Wind Waves within model domain			
Site	**Significant Wave Height HMO* (m)**	**Mean Wave Period TMOY** (sec)**	**Wave direction (degrees)**
South	0.747	4.48	61.9
Southwest	1.810	6.93	60.0
West	2.319	7.71	58.5

*	**HMO =** average height of the third-highest waves in a record within a particular time period or the standard deviation of the surface elevation times four.
**	**TMOY =** is the average measure of time it takes for the wave cycle to complete.

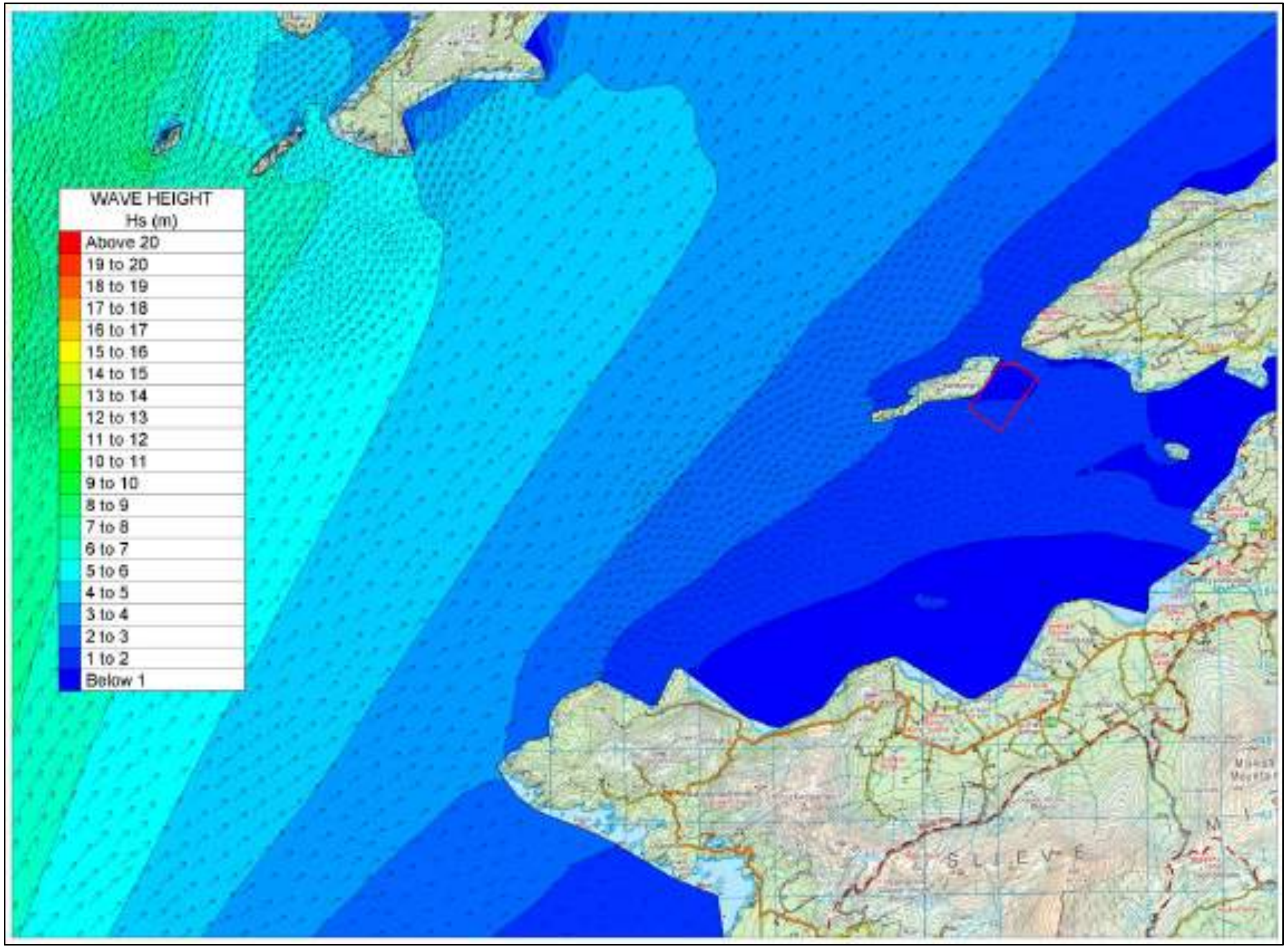

Figure 8-8: Extreme Atlantic swell event – southerly

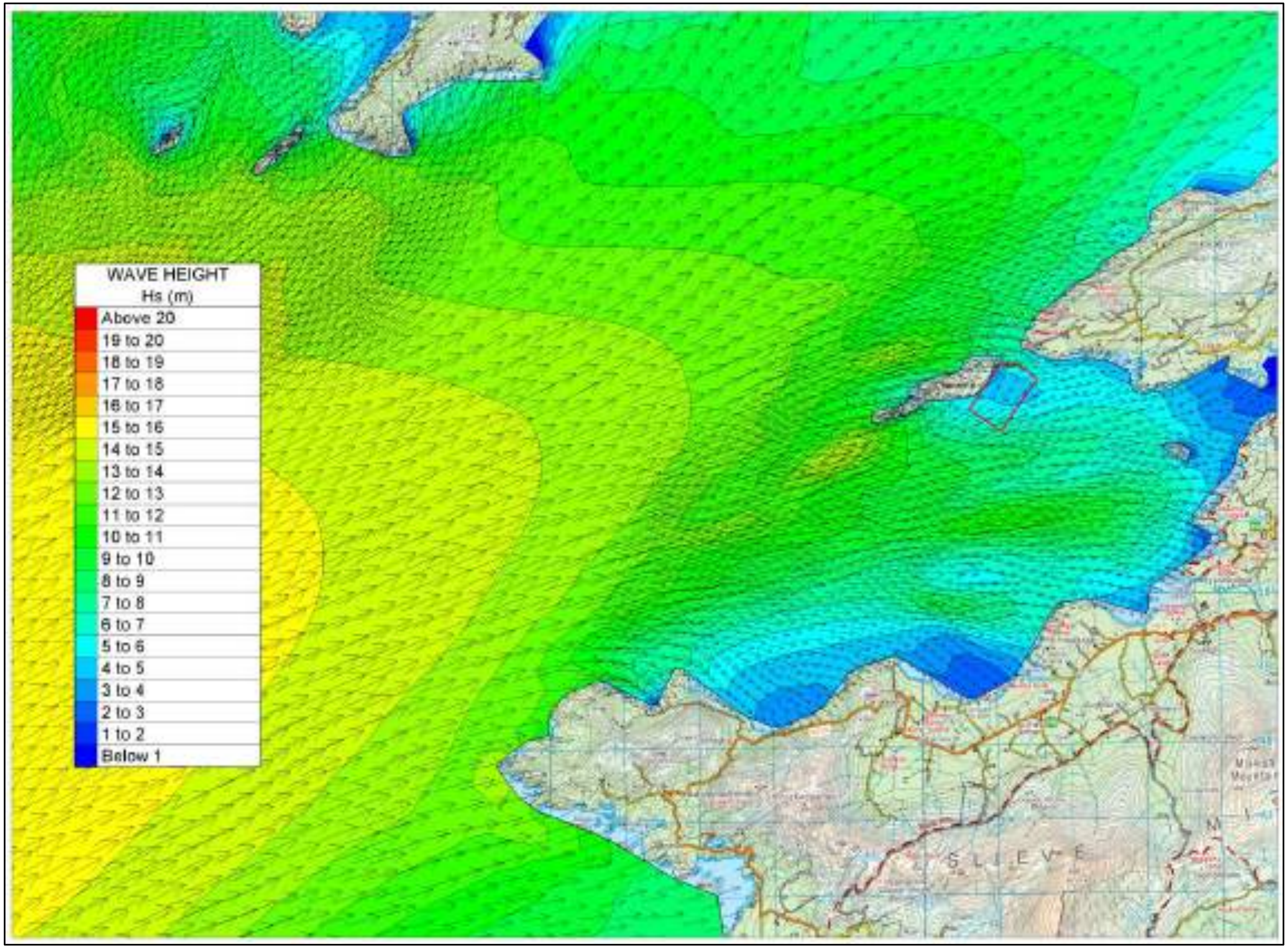

Figure 8-9: Extreme Atlantic swell event – south-westerly

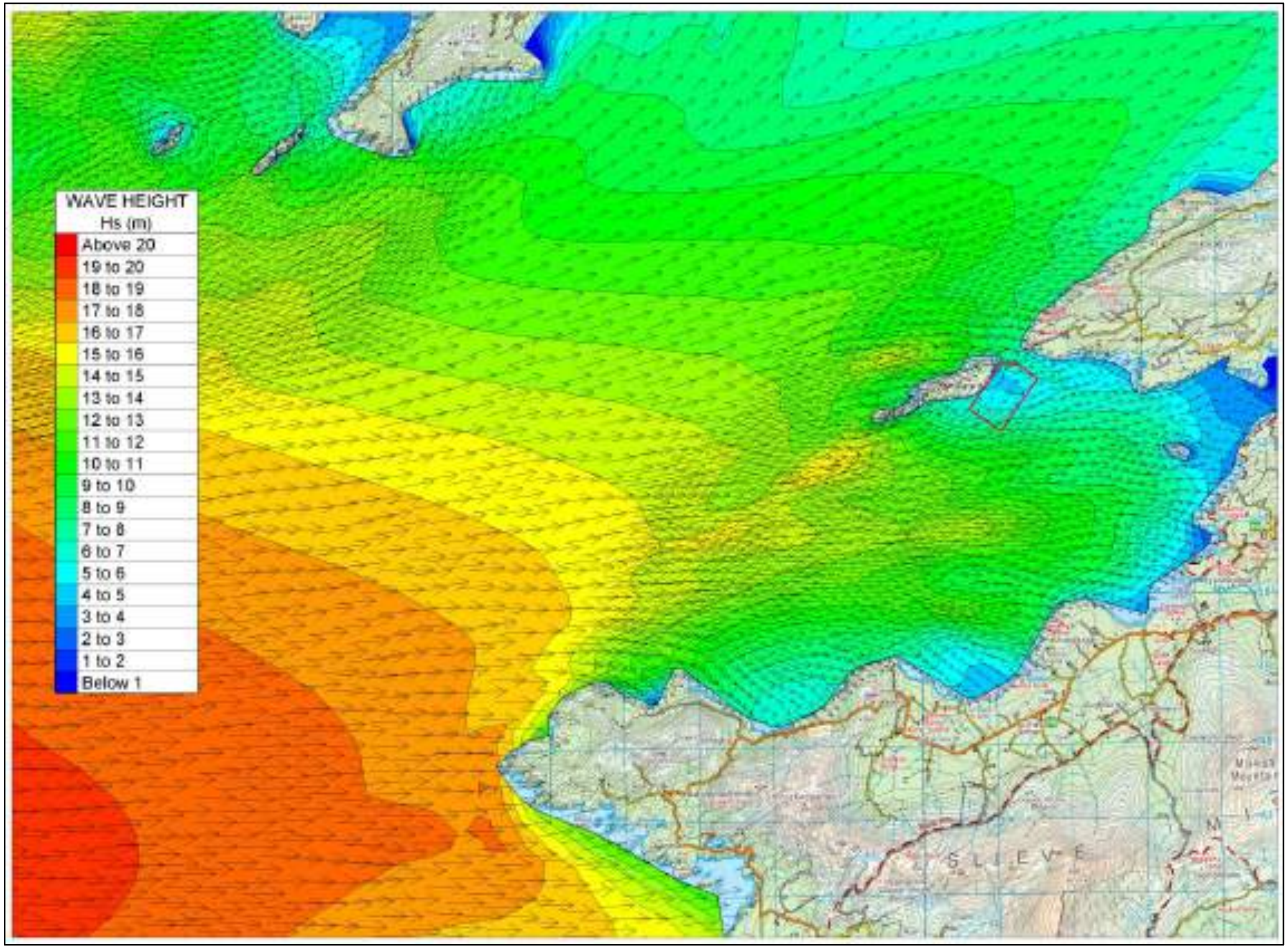

Figure 8-10: Extreme Atlantic swell event – westerly

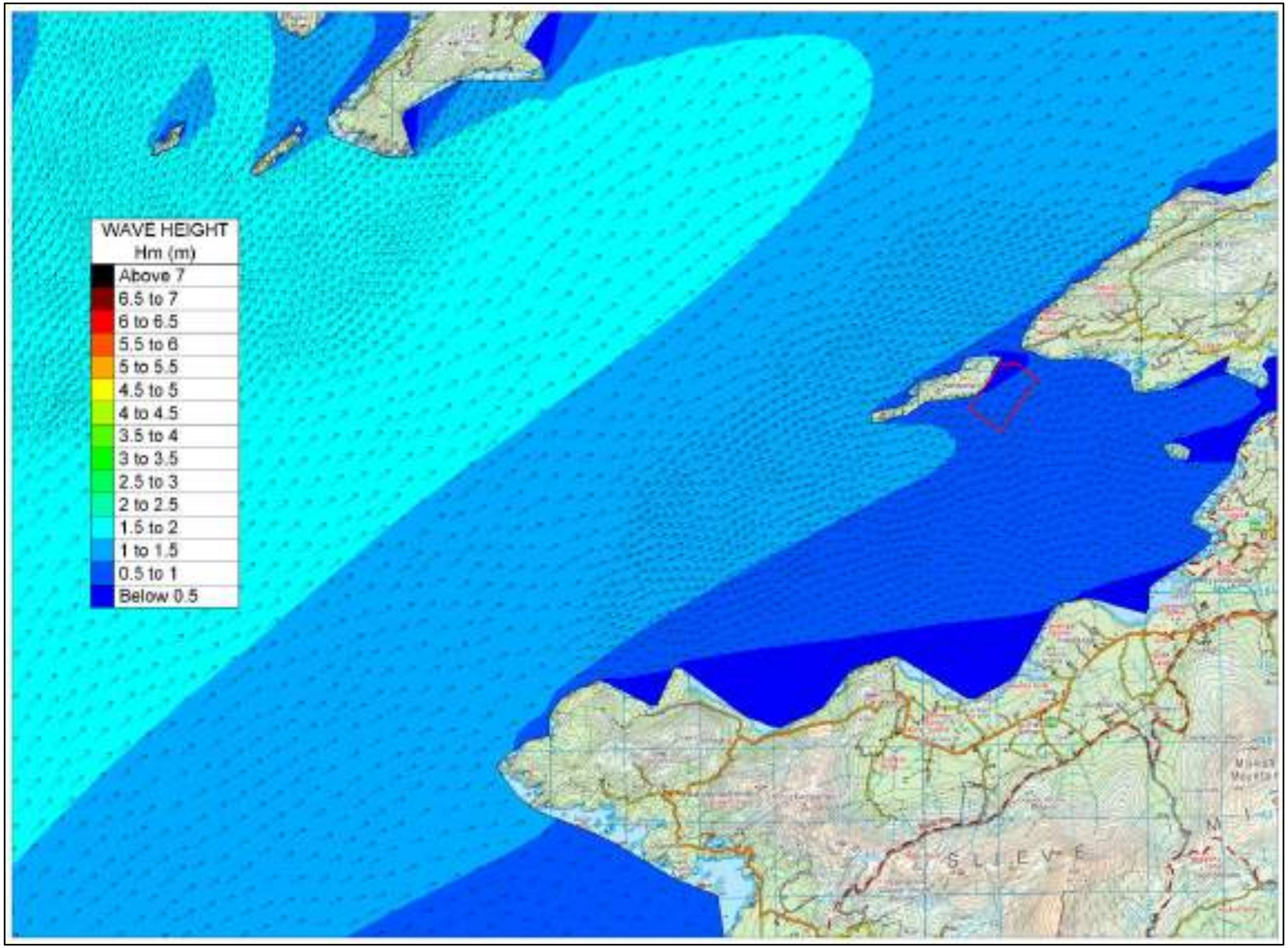

Figure 8-11: Local fetch 100-year southerly wind-waves

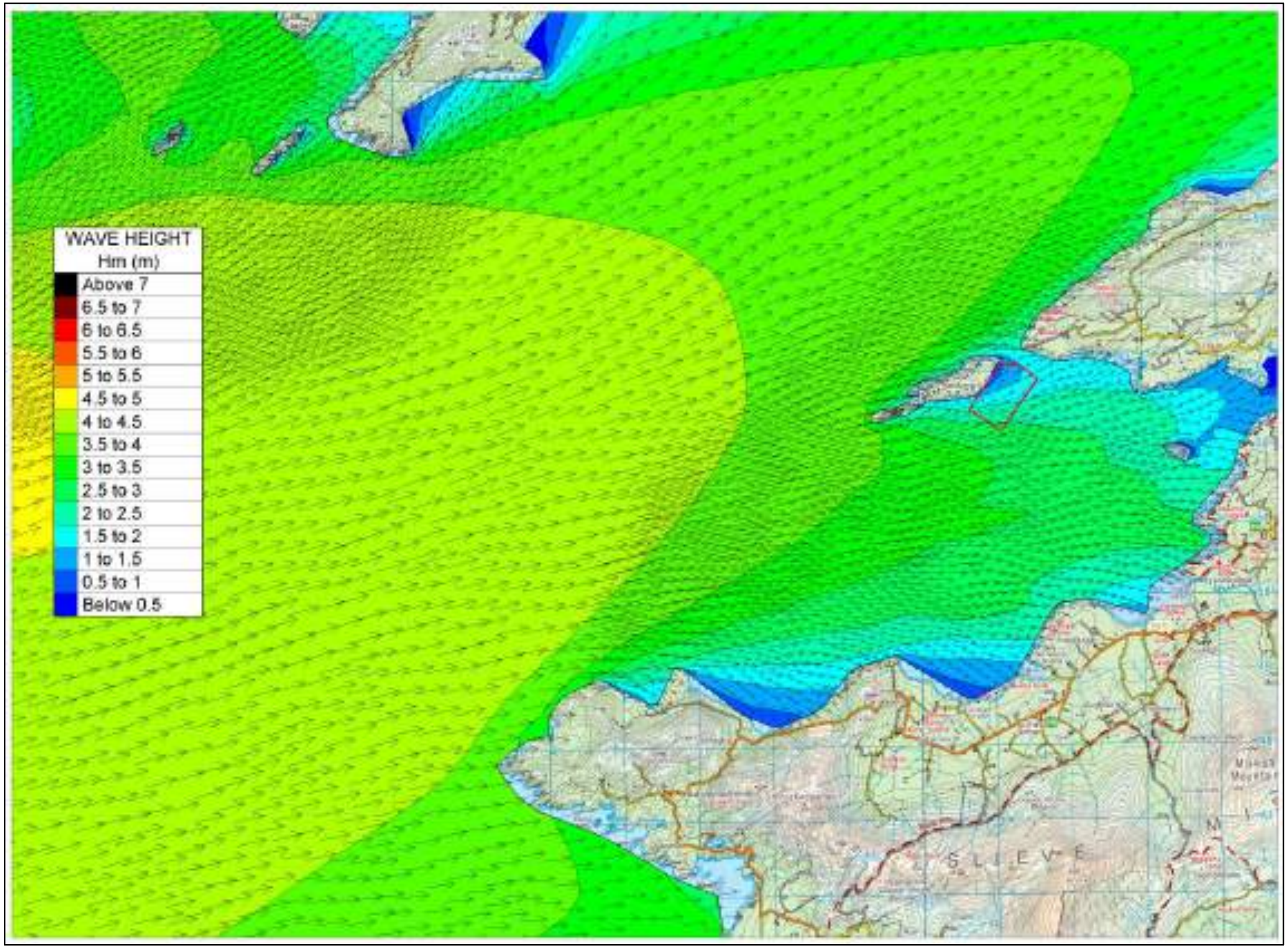

Figure 8-12: Local fetch 100 year south-westerly wind-waves

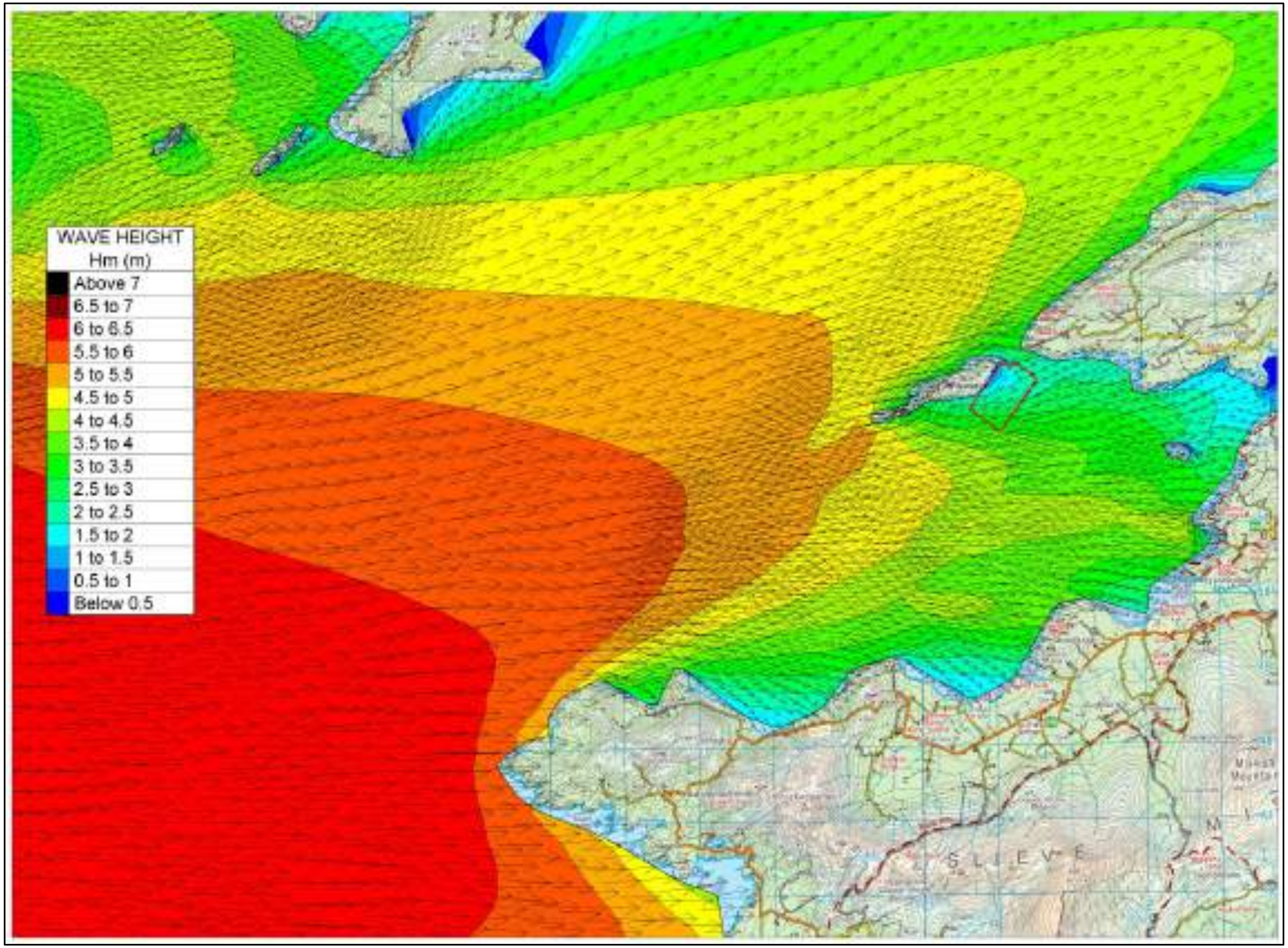

Figure 8-13: Local fetch 100year westerly wind-waves

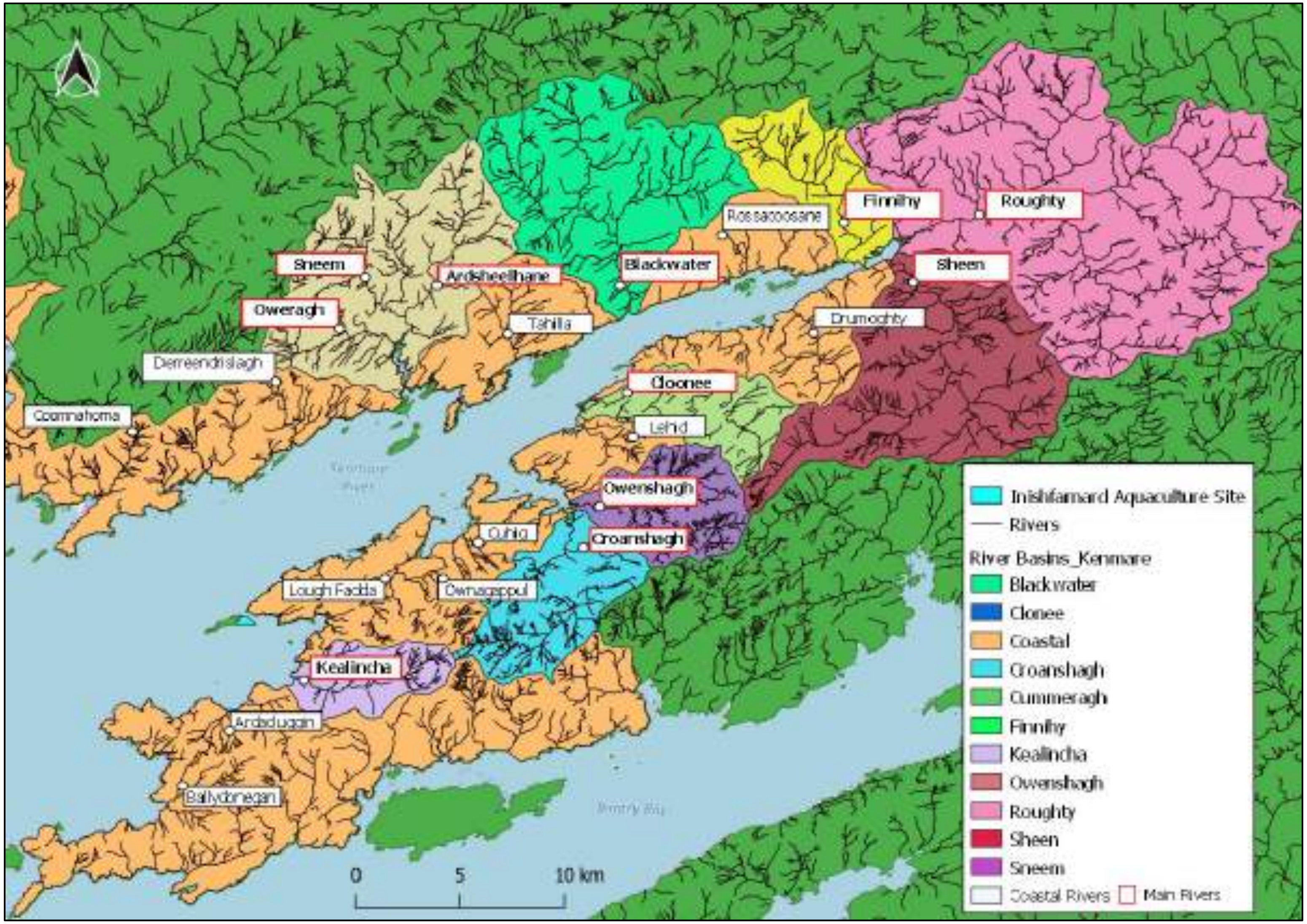

Figure 8-14: Main rivers and river basins within Kenmare Bay.

8.1.5. Temperature and Salinity

The two closest sites to the Inishfarnard site monitored under the Shellfish Waters Directive (SWD) are located in Kenmare Bay (see **Figure 8-15**); the sites named, KG010 and M56 are respectively located approximately 15km east and 10km east of the Inishfarnard site. Site KG010 is monitored by the EPA while M56 is monitored by the Marine Institute. One site within Kenmare Bay is also monitored by the Marine Institute under the WFD; the site, named M52, is located approximately 12km northeast of the Inishfarnard site (see **Figure 8.16**).

The SWD sites are sampled four times per year and the WFD site is sampled monthly for physicochemical parameters using a probe which takes measurements throughout the water column from the surface to the seabed. **Table 8.2** through **Table 8.4** shows water temperature and salinity at the monitoring sites.

In general, monitoring at KG010, M56 and M52 shows that water temperature was lowest in the Winter months (December, January, February) and Spring months (March, April, May) increased to maximum levels in the months of Summer (June, July, and August) and Autumn (September, October, November) before decreasing to winter minima.

Surface salinity values at the KG010 varied widely over time without trend, ranging from a minimum value of 17.69psu to a maximum of 34.78psu. In contrast, bottom salinity at the site was more constant and ranged from a minimum of 32.77psu to a maximum of 34.78psu.

At M56 surface salinity values varied from a minimum value of 16.16psu to a maximum value of 33.75psu.

At M52 monthly salinity values were in general lowest in the early months of the year (January through May; range 14.16psu to 31.06psu) and higher in later months (June through December; range 32.30psu to 34.78psu).

Table 8.2: Temperature and salinity values at KG010 monitored in 2017 as part of SWD.

Site	Month	Temperature (°C)		Salinity (psu)	
		Surface	Bottom	Surface	Bottom
KG010	March	9.14	9.08	17.69	32.77
	June	15.44	14.49	20.21	32.61
	July	16.59	13.81	33.64	34.78
	August	16.59	15.75	24.06	33.52

Table 8.3: Temperature and salinity data at M56 monitored in 2018 as part of SWD.

Site	Month	Temperature (°C)	Salinity (psu)
		Surface (0.5m)	
M56	April	9.41	16.16
	June	16.51	33.75
	August	16.64	32.72
	December	10.81	32.71

Table 8.4: Temperature and salinity values at site M52 monitored in 2018 as part of WFD monitoring

Site	Month	Temperature (°C)	Salinity (psu)
		Surface (0.5m)	
M52	January	8.37	25.06
	February	7.09	29.87
	March	8.67	24.16
	April	9.05	31.06
	May	11.1	26.74
	June	15.9	32.97
	July	19.32	34.62
	August	16.60	32.42
	September	13.59	34.78
	October	13.62	33.83
	December	10.83	32.30

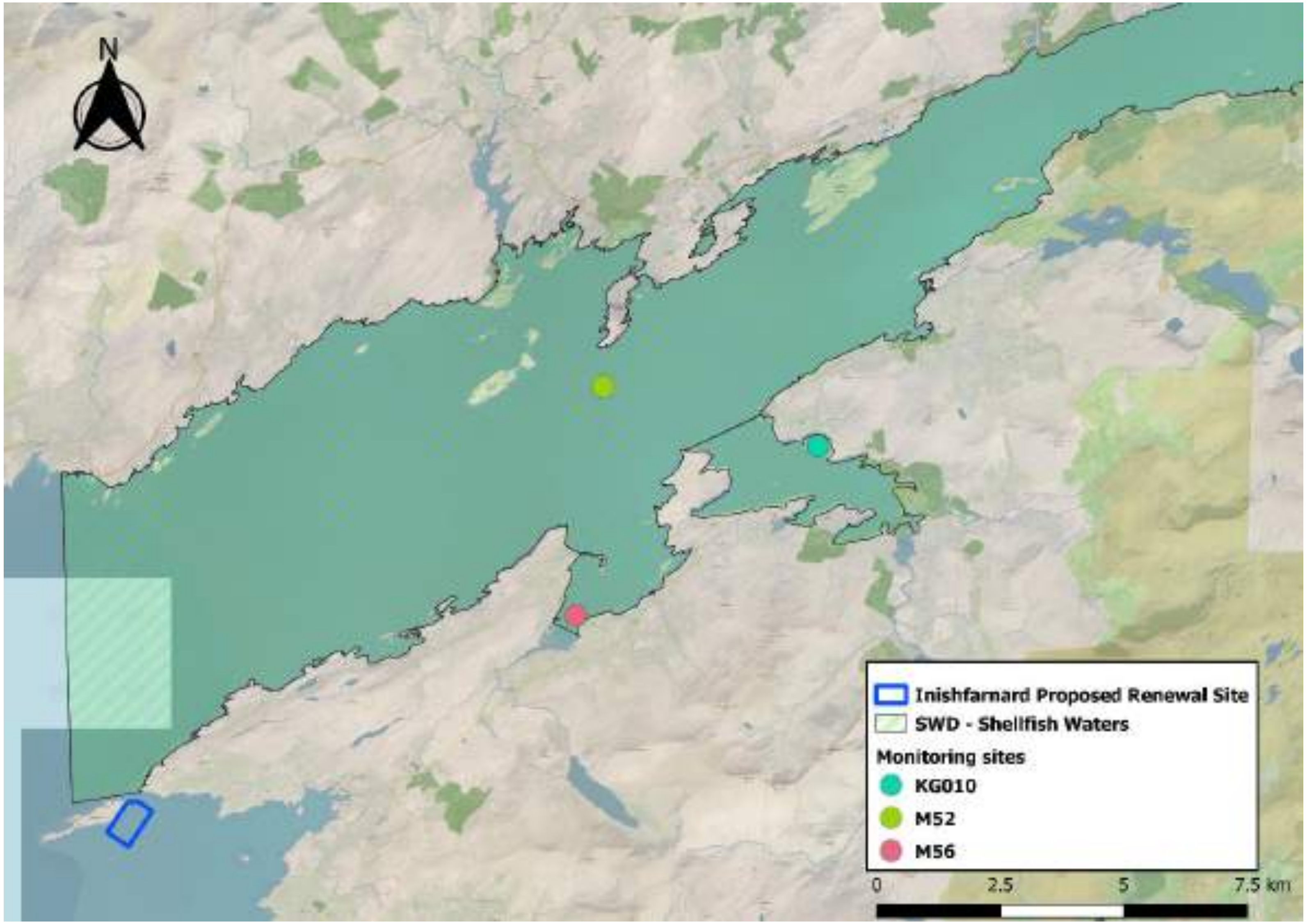

Figure 8-15: Kenmare Bay designated Shellfish Waters; monitoring sites relative to the Inishfarnard proposed renewal site.

8.1.6. Water Quality

8.1.6.1. Monitoring at the Inishfarnard Site

Nutrient monitoring is carried out by MOWI at the Inishfarnard sites monthly during the December to March period following Monitoring Protocol No. 2 (DMNR, 2000c). Sampling is carried out during this period as it is a period when nutrient levels are highest due to low levels of phytoplankton in the water (as evidenced by low chlorophyll levels recorded during the surveys). **Figure 8-16** shows the location of the nutrient monitoring site at the Inishfarnard site and the reference (or control) site in outer Kenmare Bay. The reference is used as general representative of the waterbody outside the influence of the fish farm. At the nutrient monitoring site, samples are retrieved at 3 water sample depths (i.e., 1m depth, mid water depth and 1m from seabed) while at the reference station a single sample is recovered. The samples are analysed for the following parameters:

- Nitrite (NO_2)
- Nitrate (NO_3)
- Ammonium (NH_4)
- Phosphorus
- Chlorophyll

The following sections summarise the findings of monitoring of water quality parameters undertaken in December 2018, January 2019, February 2019, and March 2019; the monitoring results are summarised in **Table 8.5** and presented in full in **Appendix 12**.

Nitrite (NO_2)

For three (of four) sampling events in **Table 8.5**, the level of nitrite recorded at water sample depths was the same as the level recorded at the control site or below the level recorded at the control site for the sampling event. In the case of February 2019, mid water nitrite (4.14µg/L) was slightly above the nitrite level of 3.82µg/L recorded at the control. However, nitrite levels at 1m water depth and 1m above the seabed were the same as the control site at 3.82µg/L. These results indicate the site did not significantly influence nitrite levels in the area.

Nitrate (NO_3)

Nitrate level at the monitoring station for the sampling events were generally not significantly different to the levels recorded at the control site, indicating the site did not significantly affect nitrate levels in the area. In February 2019 and March 2019 nitrate levels recorded at all water sample depths were below the level recorded at the control site for the sampling event. In December 2018 and January

2019, nitrate levels at 1m from the seabed slightly exceed the control site, while level at 1m water depth and mid water depth were below levels recorded at the controls.

Ammonium (NH_4)

Ammonium level at the monitoring site in December 2018 ranged from 12.02µg/L to 13.07µg/L and were above the level recorded at the control site (4.95µg/L). However, for January 2019, February 2019, and March 2019 the level of ammonium recorded at all water sample depths were the same as the level recorded at the control site or below the level recorded at the control site; indicating that the fish farm does not have significant long-lasting effect on ammonium levels.

Phosphorus

Phosphorus levels at the monitoring site and control site varied without trend over the four sampling events. In December 2018 and February 2019 levels at the monitoring station slightly exceeded that recorded at the control site while in March 2019 and January 2019 levels at the site were below the level recorded at the control site, indicating that the fish farm does not have significant long-lasting effect on phosphorus levels.

Chlorophyll

In general, chlorophyll levels recorded at the monitoring site for each of the four sampling events were similar to levels recorded at the control site.

Figure 8-16: Location of water quality monitoring site at the Inishfarnard site relative to the control monitoring site.

Table 8.5: Water Quality Monitoring for T5/233

Date	Depth	NO_2 µg/l	NO_3 µg/l	NH_4 µg/L	Phosphorus µg/L	Chlorophyll µg/L
12/12/2018	1m	3.17	114.53	12.05	37.22	129.75
	Mid depth	3.46	115.11	12.05	31.00	130.62
	1m from seabed	3.46	145.06	13.07	31.00	161.59
	Control	4.33	136.53	4.95	31.00	145.81
21/01/2019	1m	2.33	88.28	2.65	26.87	93.26
	Mid depth	2.33	97.32	2.65	28.92	102.30
	1m from seabed	2.33	103.89	3.73	33.03	109.95
	Control	2.33	102.25	4.82	28.92	109.40
26/02/2019	1m	3.82	80.71	2.67	27.24	87.20
	Mid depth	3.82	79.85	3.75	23.14	87.42
	1m from seabed	4.14	83.88	5.9	21.1	93.92
	Control	3.82	86.78	4.82	23.14	95.42
20/03/2019	1m	2.26	26.07	4.87	20.56	33.20
	Mid depth	2.57	24.92	4.87	24.51	32.36
	1m from seabed	2.26	26.93	7.01	20.56	36.20
	Control	2.57	28.35	7.01	26.49	37.93

8.1.6.2. Water Framework Directive

The EU Water Framework Directive (2000/60/EC) requires all Member States to protect and improve water quality in all waters so that a 'Good' ecological status is achieved by 2015, or at the latest 2027. The core objectives of the Directive are to prevent deterioration, restore good ecological status, reduce chemical pollution, and achieve objectives of protected areas.

In assessing the surface water status of individual water bodies (the basic management unit under the WFD), the Directive requires Member States to assess both the chemical and ecological status.

Chemical status is assessed by compliance with environmental standards for chemicals that are listed in the WFD and the Environmental Quality Standards (EQS) Directive (2008/105/EC). These priority substances include metals, pesticides, and various industrial chemicals. The ecological status of surface waters is based on the assessment of specified biological quality elements, such as phytoplankton, benthic invertebrates, macroalgae, angiosperms (seagrass and saltmarsh), and fish (in transitional waters only) as well as supporting hydromorphological, chemical (specific pollutants), and physico-chemical elements such as dissolved oxygen, inorganic nitrogen, and phosphorus.

Ecological status is classified into five categories based on the degree of deviation away from the reference condition for each of these individual elements. The five categories are high, good, moderate, poor, and bad.

The WFD has been transposed into Irish law by means of the following main Regulations. These Regulations cover governance, the shape of the WFD characterisation, monitoring and status assessment programmes in terms of assigning responsibilities for the monitoring of different water categories, determining the quality elements and undertaking the characterisation and classification assessments.

- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003)
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations, 2010 (S.I. No. 610 of 2010)
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011)
- European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014)

Of particular relevance to this project are the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).

Table 8.6 lists WFD waterbodies near the Inishfarnard site alongside their WFD status. Ardgroom, Blackwater K Estuary, Sneem Harbour and Ballinskelligs Bay, are not monitored by the WFD and have been given the status of 'unassigned'. All coastal and transitional waterbodies were classified as unpolluted for the reporting period 2010-2012 (EPA, 2014a, b). Locations of the waterbodies in relation to the Inishfarnard site are presented in **Figure 8-17**.

Table 8.6: Waterbodies in proximity to the Inishfarnard Site and their Water Framework Directive status.

Waterbody (EU code)	Distance from Inishfarnard Site (km)	Waterbody WFD - Status
Outer Kenmare River coastal waterbody (IE_SW_190_0000)	0	Good
Southwestern Atlantic Seaboard coastal waterbody (IE_SW_150_0000)	6	Good
Ardgroom Transitional waterbody (IE_SW_190_0100)	10.9	Unassigned
Kilmakilloge Harbour Transitional waterbody (IE_SW_190_0200)	13.53	Good
Sneem Harbour Transitional waterbody (IE_SW_190_0600)	13.8	Unassigned
Ballinskelligs Bay coastal waterbody (IE_SW_200_0000)	17.3	Unassigned
Drongawn Lough, Sneem Transitional waterbody (IE_SW_190_0500)	19.56	Good
Blackwater K Estuary Transitional waterbody (IE_SW_190_0400)	23.98	Unassigned
Inner Kenmare River Transitional waterbody (IE_SW_190_0300)	31.7	Good

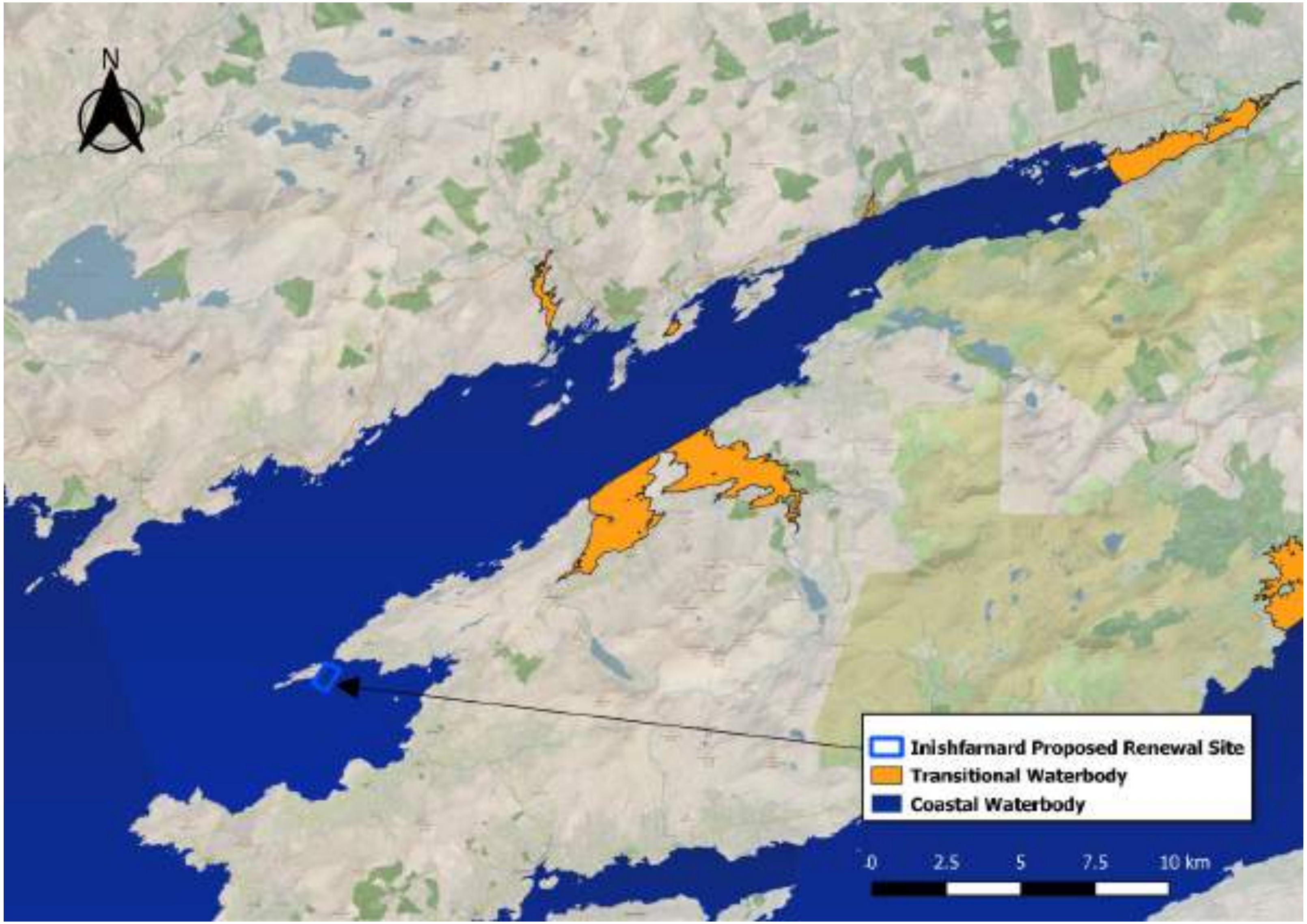

Figure 8-17: WFD waterbodies in the vicinity of the proposed Kenmare Bay aquaculture site.

8.1.6.3. Shellfish Water Directive

The SWD is implemented in Ireland by the European Communities (Quality of Shellfish Waters) Regulations 2006 (SI No. 268 of 2006) (as amended). The Directive concerns the quality of shellfish waters and applies to those coastal and brackish waters designated by member States as needing protection or improvement in order to support shellfish life and growth and thus to contribute to the high quality of shellfish products directly edible by man. Since 2013, the SWD has been subsumed into the WFD.

Shellfish refers to bivalve and gastropod molluscs including mussels, oysters, cockles, scallops, clams, periwinkles etc. The Directive sets physical, chemical, and microbiological requirements that the designated shellfish water must either comply with or endeavour to improve. Monitoring within Kenmare Bay includes the following quality parameters: pH, dissolved oxygen, temperature, salinity, colouration (after filtration), suspended solids, petroleum hydrocarbons, organ halogens, metals (dissolved), faecal coliforms, phytoplankton and substances affecting the taste of shellfish. A Pollution Reduction Programme (PRP) has been established for Kenmare River (encompassing Sneem and Ardgroom) and Kilmakilloge Harbour to ensure compliance with the standards and objectives for these waters established by the Shellfish Waters Directive.

An extensive monitoring programme for chemical and microbiological parameters is in place to ensure the quality of designated shellfish waters around the coast. As outlined in **Section 8.1.5** the two closest sites (KG010 and M56) to the Inishfarnard site monitored under the SWD are located in Kenmare Bay (see **Figure 8-15**). **Table 8.7** and **Table 8.8** below provides dissolved oxygen and chlorophyll level recorded at the sites (salinity and temperature level at the sites are included in **Section 8.1.5**).

Table 8.7: Dissolved oxygen and chlorophyll levels at KG010 monitored in 2017 as part of SWD.

Site	Month	Dissolved Oxygen (%)		Chlorophyll (µg/l)	
		Surface	Bottom	Surface	Bottom
KG010	March	98.30	93.80	0.50	0.50
	June	100.50	82.45	1.05	1.85
	July	100.8	102.5	0.80	5.95
	August	105.8	98.55	0.85	1.45

Table 8.8: Dissolved oxygen and chlorophyll levels at M56 monitored in 2018 as part of SWD.

Site	Month	Dissolved Oxygen (%)	Chlorophyll (µg/l)
		Surface (0.5m)	
M56	April	106.70	3.60
	June	110.70	0.03
	August	99.60	1.78
	December	96.90	0.73

8.1.6.4. Bathing Waters Directive

The Bathing Waters Directive of 2006 is implemented in Ireland under Bathing Water Quality Regulations SI No. 79 of 2008 and SI No. 351 of 2011. Local authorities are responsible for bathing water quality in their area in addition to monitoring and public information. Assessments are carried out on potential sources of pollution that might affect bathing waters and impair bathers' health including presence of tarry residues, glass, plastics, rubber and other waste, intestinal enterococci and *E. coli*, proliferation of cyanobacteria and proliferation of macroalgae or phytoplankton. Bathing waters will fall into one of four classifications based on this monitoring: Excellent, Good, Sufficient and Poor. The Blue Flag Scheme is administered in Ireland by An Twice, the National Trust for Ireland. The quality criteria for Blue Flag status must comply with the guideline standards laid down by the EU Bathing Waters Directive as well as additional criteria in relation to general management and facilities available.

There are two Blue Flag beaches within the Kenmare Bay area. One located at Derrynane More, approximately 9.7km NW from the renewal site T5/233 and the other situated 22km NW in Baile an Sceilg (EPA Maps).

8.1.6.5. Dangerous Substances

The Dangerous Substances Directive (2006/11/EC) (76/464/EEC Repealed) stipulates the rules for protection against, and prevention of, pollution resulting from the discharge of certain substances into the aquatic environment. Two lists of dangerous substances have been compiled. Discharge of substances from List I must be eliminated, while discharge of substances from List II must be reduced.

List I contains certain substances selected mainly on the basis of their toxicity, persistence and bioaccumulation (with the exception of those which are biologically harmless or which are rapidly converted into substances which are biologically harmless) and includes organohalogens and their compounds, organophosphorus compounds, organotin compounds, carcinogenic substances, mercury and its compounds, cadmium and its compounds, persistent mineral oils and hydrocarbons of petroleum origin and persistent synthetic substances. This list may be amended as new evidence of the toxicity of substances is established.

List II contains certain substances which can have a deleterious effect on the aquatic environment, but which can be confined to a given area and which depends on the characteristics and location of the water into which they are discharged. They include metalloids and their compounds, biocides and their derivative not appearing on List I, cyanides, fluorides, inorganic compounds of phosphorus and elemental phosphorus, non-persistent mineral oils and hydrocarbons of petroleum origin, toxic or persistent organic compounds of silicon, substances which have an adverse effect on the oxygen balance (particularly ammonia and nitrites) and substances which have a deleterious effect on the taste and/or smell of products for human consumption.

The European Communities (Control of Dangerous Substances in Aquaculture) Regulations 2008 (SI 466 of 2008) was introduced for the purpose of giving effect to the Dangerous Substances Directive, Habitats Directive and WFD on pollution caused by certain dangerous substances into the aquatic environment so far as these Directives relate to the protection of waters in the marine environment from aquaculture activities. The Regulations require that the level of discharge of a substance set by a licensing authority must be based on the relevant environmental quality standards (EQS), or objectives set in accordance with the WFD. **Table 8.9** present the EQS for substances used in the treatment of marine finfish in aquaculture. MOWI use Slice®, Alphamax and Paramove for parasite control at the Inishfarnard site. **Table 2.8** in **Section 2.11** shows the treatments used by MOWI in Kenmare Bay since 2008.

Table 8.9: EQS for substances used in the treatment of marine finfish

The following standards shall apply 24 hours post treatment at 100m from site	
Cypermethrin (Excis)	0.5 ng/l
Teflubenzuron	30 ng/l
Emamectin benzoate (Slice®)	0.22 ng/l
Alphamax (Deltamethrin)	2 ng/l
Azamethiphos	150 ng/l

8.2. Impacts on Water Quality

Discharges from the fish farm have the potential to impact on water quality. The following sections consider potential impacts on water quality with respect to nutrient levels, oxygen demand and dangerous substances.

8.2.1. Nutrient and BOD Modelling

Three-dimensional hydrodynamic simulation modelling was undertaken to determine the transport and dispersion of total nitrogen and phosphorus (nutrients) loadings from the proposed operations and the likely biological oxygen demand (BOD) of waters surrounding the site. Details of the model are presented in full in **Appendix 8**. In summary, nitrogen, and phosphorus solute loadings of solid discharges from the farm were calculated based on production and feeding levels proposed at the site (see in **Section 2.9.4** above). The fate, dispersion and transport of these solutes were modelled following discharge into the water column at mid-water depth at the fish pens (i.e., approximately 4m below surface).

The models indicated that peak solute load output occurs in May of Year 2 of the production cycle with solids discharges estimated at 60.81 tons. The total nitrogen and total phosphorus loadings of the solids in May Year 2 are 11.87 tons and 1.77 tons respectively. The nitrogen and phosphorous dispersal were modelled as a constant daily discharge of 383kg and 57.1g per day respectively. These figures included both fish feed wastage and fish faeces. A constant daily solid discharge of 354.48 tons with a daily BOD of 11,434.8kg were modelled.

Simulations were run to determine nitrogen and phosphorus plumes extending from the site and the BOD of water surrounding the site. The simulation outputs are presented below both as 'the maximum plume concentration envelope' and 'the average plume concentration envelope'. In this instance, the maximum plume concentration envelope is an output from a model that displays the highest possible concentrations of a particulate matter (phosphorus, nitrogen etc.) that is produced from the Inishfarnard site when stocking levels are at maximum capacity.

The maximum plume concentration envelope plot represents the instantaneous maximum concentration both in the water column and over time with the maximum concentration outputted spatially over the model area[16]. The average plume concentration envelope represents the average concentration plume in the water column and over time. It should be noted that the model assumed

[16] It should be noted that such maximum concentrations spatially do not occur simultaneously in time and that the frequency and duration of occurrence is relatively low

no decay of nitrogen and phosphorus over time or space; this considered to represent the worst-case approach as in reality soluble nitrogen and phosphorous is taken-up and assimilated through natural primary production by plants and organisms present in the water column. A BOD decay rate of 0.02mg/L/day^{-1} (typical decay rate at 10^{o} C in a temperate climate) was input to allow for a limited assimilation of BOD in the water column.

The findings of the modelling simulations of nitrogen, phosphorus and BOD plumes are described in **Section 8.2.2.1**, **Section 8.2.2.3**and **Section 8.2.3,** respectively .

8.2.2. Nutrients

8.2.2.1. Nitrogen

Dispersal plumes of nitrogen loadings at the site are presented in **Figure 8-18** and **Figure 8-19**. The median, average, and maximum nitrogen concentrations for 10 reference sites located in the vicinity of the site (see **Figure 8-20**) are presented in **Table 8.10**.

The water quality objectives are based on the Surface Water Regulations 1989. These water quality objectives require a winter median limit of total oxidised Nitrogen/ Dissolved Inorganic Nitrogen (DIN) (at Salinity > 34.5 psu) of 0.17mg/l for that waterbody to obtain high status for coastal waters and 0.25mg/l for good status coastal waters. For transitional waters (salinity 0 – 35 psu) the recommended winter median limit varies from 2.6mg/l to 0.25mg/l (for salinities varying from 0 to 35psu).

The maximum predicted concentration occurs adjacent to the fish pens at Inishfarnard site (maximum concentration 0.700mg/l N; median concentration is 0.16 mg/l N) (Table 8.10). The predicted median concentration level at the pens, for which the water quality objectives standard applies, is lower than the EQS DIN limit of 0.17mg/l N. The instantaneous maximum of 0.7mg/l N occurs only for a short period and only at a specific location within the water column (4m below the water surface). Outside the proposed licensed area, the median concentration meets the EQS DIN standard of 0.17mg/l N. At the site boundary the level is 0.065 mg/l N and reduces to <0.05mg/l within a relatively short distance from the boundary.

8.2.2.2. Conclusions

If approved, the requested changes to the existing licence (i.e., change to the boundaries and operating conditions) will not significantly affect water quality. Consequently, it can be concluded that the area will continue to comply with the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009). Any impacts on water quality, if realised, will be **negligible and not significant**.

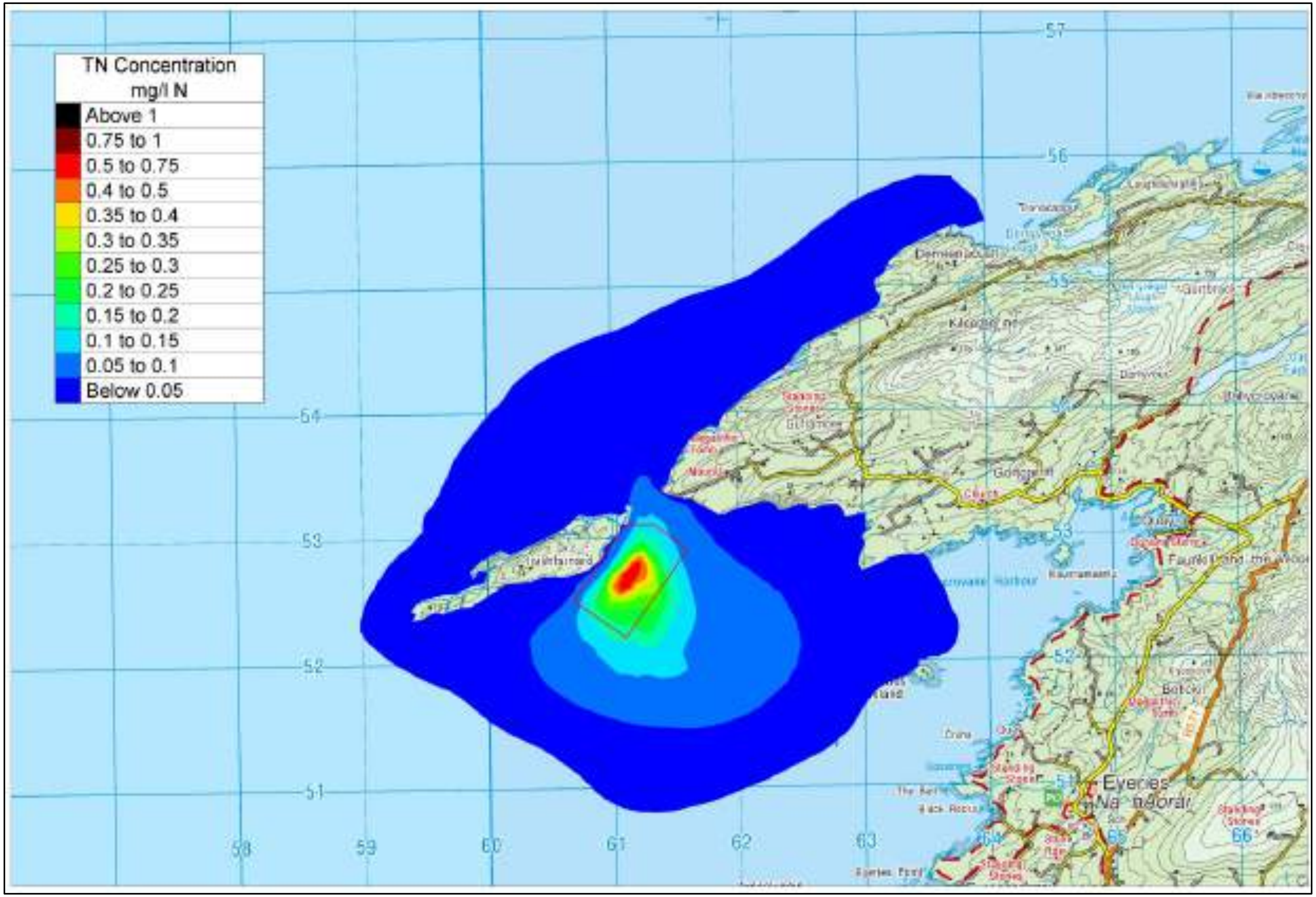

Figure 8-18: Predicted maximum total nitrogen concentration envelope (mg/l N) for Inishfarnard Site.

Figure 8-19: Predicted tidal mean total nitrogen concentration envelope (mg/l N) for Inishfarnard Site.

Figure 8-20: Reference sites for water quality model

Table 8.10: Predicted Total Nitrogen Concentration statistics (mg/l) at Reference Sites for Maximum Production at Inishfarnard Site

Reference Sites	Solute Concentrations		
	Average	Median	Maximum
1	0.190	0.160	0.700
2	0.040	0.030	0.110
3	0.020	0.020	0.040
4	0.060	0.050	0.170
5	0.070	0.060	0.280
6	0.031	0.033	0.052
7	0.004	0.005	0.011
8	0.003	0.003	0.013
9	0.007	0.006	0.015
10	0.005	0.005	0.012

8.2.2.3. Phosphorus

Dispersal plumes of phosphorus levels are presented **Figure 8-21** and **Figure 8-22**. Phosphorous concentrations at the ten selected reference sites (see **Figure 8-20**) are presented in **Table 8.11**.

In terms of transitional waterbodies, the water quality objectives set out in the Surface Water Regulations 1989 for Molybdate Reactive Phosphorous (MRP) are: winter median limit of 0.06mg P/l for transitional waters with salinity of 0 to 17psu and a winter median limit of 0.04mg P/l for salinity of 35psu. The transitional waters are well inland at the head of the estuary and not impacted by the proposed fish farm discharge plume.

Results show that the predicted phosphorous concentrations are relatively low at a median value of 0.024mg/l at the pens (and lower elsewhere) which falls well within the EQS median allowable limit of 0.04mg P/l set for transitional waters (**Table 8.11**). In reality the fish farm site is located in coastal waters at the mouth to the bay which do not have any EQS limit for phosphorous. Within a reasonable short distance of the licensed area the median concentrations fall below 0.005mg/l P.

8.2.2.4. Conclusions

If approved, the requested changes to the existing licence (i.e., change to the boundaries and operating conditions) will not significantly affect water quality. Consequently, it can be concluded that the area will continue to comply with the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009). Any impacts on water quality, if realised, will be **negligible and not significant**.

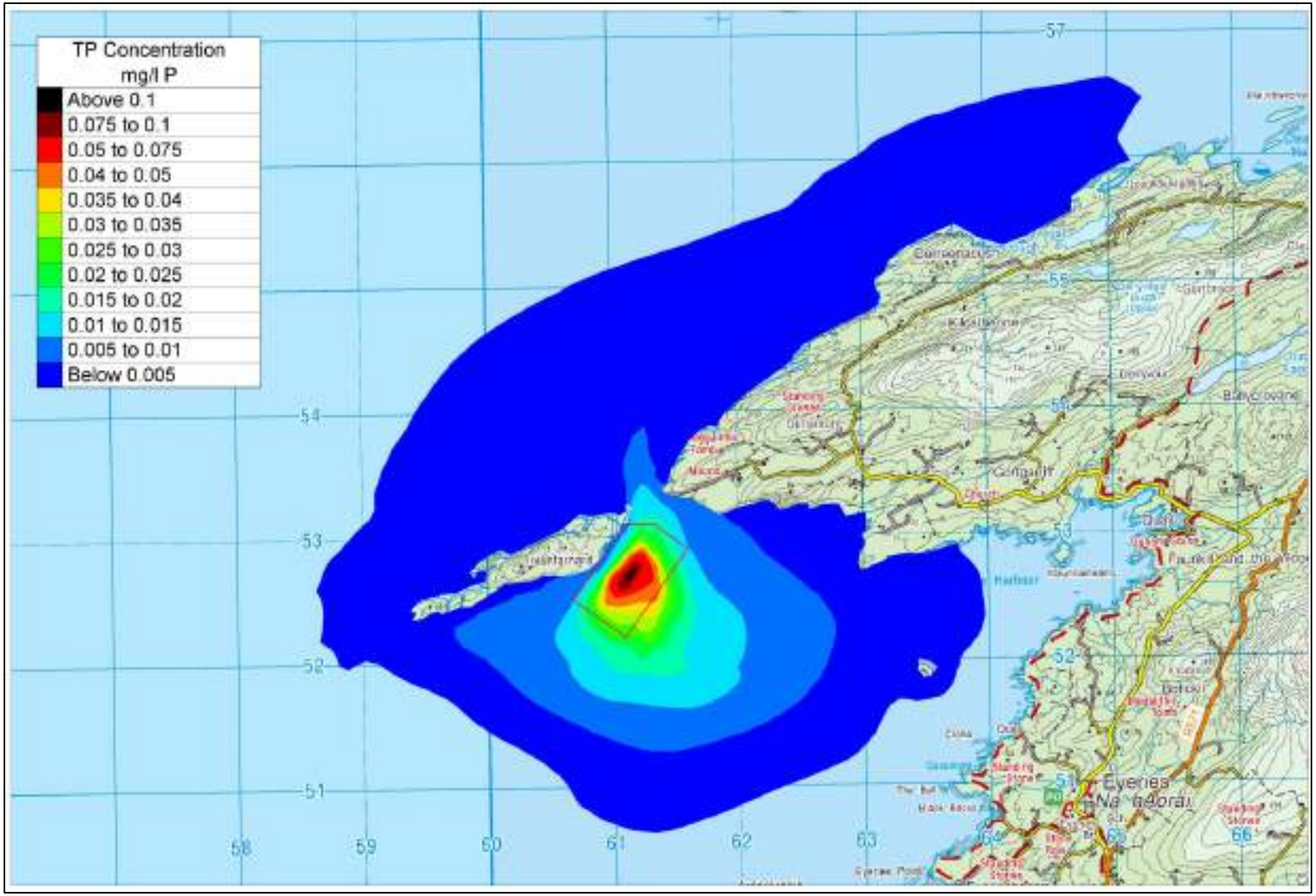

Figure 8-21: Predicted Maximum Total Phosphorous Concentration Envelope (mg/l P) for Inishfarnard Farm Production Site.

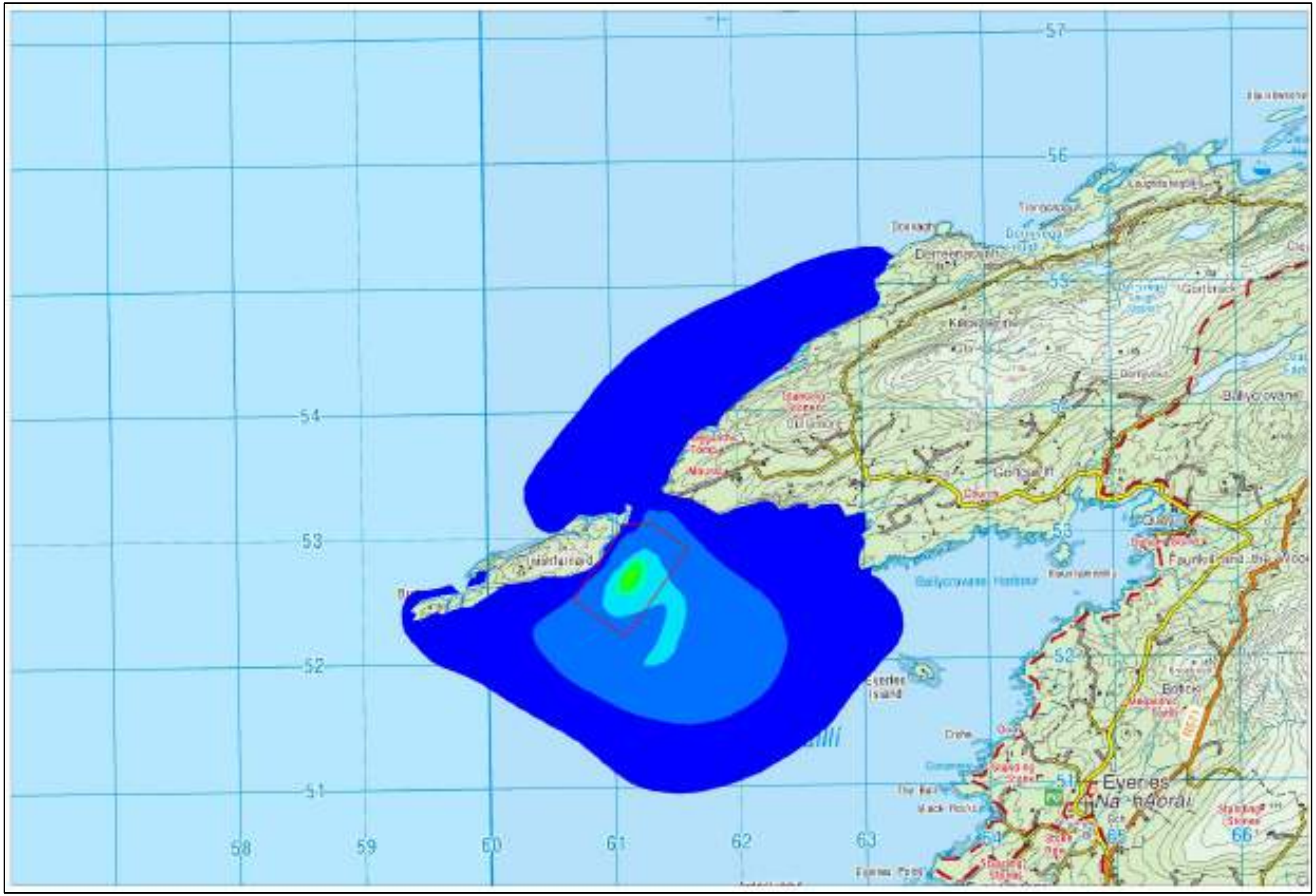

Figure 8-22:Predicted lunar mean Total Phosphorous Concentration Envelope (mg/l P) for Inishfarnard Farm Production Site.

Table 8.11: Predicted Total Phosphorous Concentration statistics (mg/l) at Reference Sites for Maximum Production at Inishfarnard Site

Reference Sites	Solute Concentrations		
	Average	Median	Maximum
1	0.028	0.024	0.104
2	0.006	0.005	0.016
3	0.003	0.003	0.006
4	0.009	0.008	0.025
5	0.011	0.01	0.041
6	0.005	0.005	0.0078
7	0.001	0.0007	0.0017
8	0.0005	0.0004	0.0019
9	0.001	0.001	0.0022
10	0.001	0.001	0.0017

8.2.3. Oxygen Demand

Three-dimensional hydrodynamic simulations of the transport and dispersion of total BOD load from the proposed salmon farm production at the Inishfanard Site in Kenmare Bay was performed using a seven vertical layer model, in sigma coordinates and a variable horizontal mesh as described earlier. The solute loading was released as a continuous discharge into the water column at mid-pen depth and its subsequent advection and dispersion modelled both horizontally and vertically.

The production and feeding model of the proposed fish farm operations provides monthly biomass and feeding figures at the production site. This production and feeding model were interrogated and found that the peak output load occurs in the month of May Year 2 of the production cycle having a solids discharge of 60.81 tons with a total BOD load of 354.48 tons over the month which was modelled as a constant discharge of (11,434.8kg per day).

BOD simulations were performed over a full 35day lunar period using a time step of 15 seconds and outputting predicted plume results at 15-minute interval over that period. The hydrodynamics simulated were representative of a complete astronomical spring-neap-spring lunar cycle.

A BOD decay rate of 0.02 day-1 (typical decay rate at 10^{o}C in a temperate climate) was input to allow for a limited assimilation of BOD in the water column.

BOD plumes in the vicinity of the site are presented in **Figure 8-23** and **Figure 8-24**. The median, average, and maximum BOD concentrations for 10 reference sites located in the vicinity of the site (see **Figure 8-20**) are presented in **Table 8.12**.

The water quality objectives (WQO's) based on the Surface Water Regulations 1989 for Biochemical Oxygen Demand (BOD) for Freshwater are maximum value of < 5mg/l and a recommended trigger action value (TAV) for an annual median < 2mg/l. There are no coastal standards for BOD set out but for transitional waters a 95-percentile concentration of < 4mg/l and a 98-percentile of less than 5mg/l.

The fish farm is located in coastal waters at the mouth of the bay and the transitional / estuarine zone is confined to the inner head of the bay which is not affected by the fish farm discharge.

Results show that the instantaneous maximum BOD concentration at the farm site pens (reference site 1) is 20.82mg/l O_2 which exceeds the EQS limits of 4mg/l O_2. The tidal average concentration at the farm site pens is 5.64mg/l O_2. Immediately outside of the licensed area the predicted tidal average BOD concentrations vary between 1.2 to 2.1mg/l O_2 and the maximum BOD concentrations between 3.0 and 8.2mg/l O_2. The adjacent coastal waters surrounding the Inishfarnard site area in Coulagh Bay have predicted tidal average concentrations of 0.5 to 1.0 mg/l and maximum concentrations of 1.0 to 3.0mg/l O_2.

The predicted BOD 95-percentile concentration at the boundary of the proposed licensed site varies from 2.5mg/l to 4.3mg/l, which for a short distance to the southeast of the site slightly exceeds the 4 mg/l limit set for transitional waters. It should be noted that the site and surrounding waters in Coulagh Bay are coastal waters for which no BOD standards have been set by the Surface Water Regulations.

8.2.3.1. Conclusions

If approved, the requested changes to the existing licence (i.e., change to the boundaries and operating conditions) will not significantly affect water quality. Consequently, it can be concluded that the area will continue to comply with the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009). Any impacts on water quality, if realised, will be **negligible and not significant**.

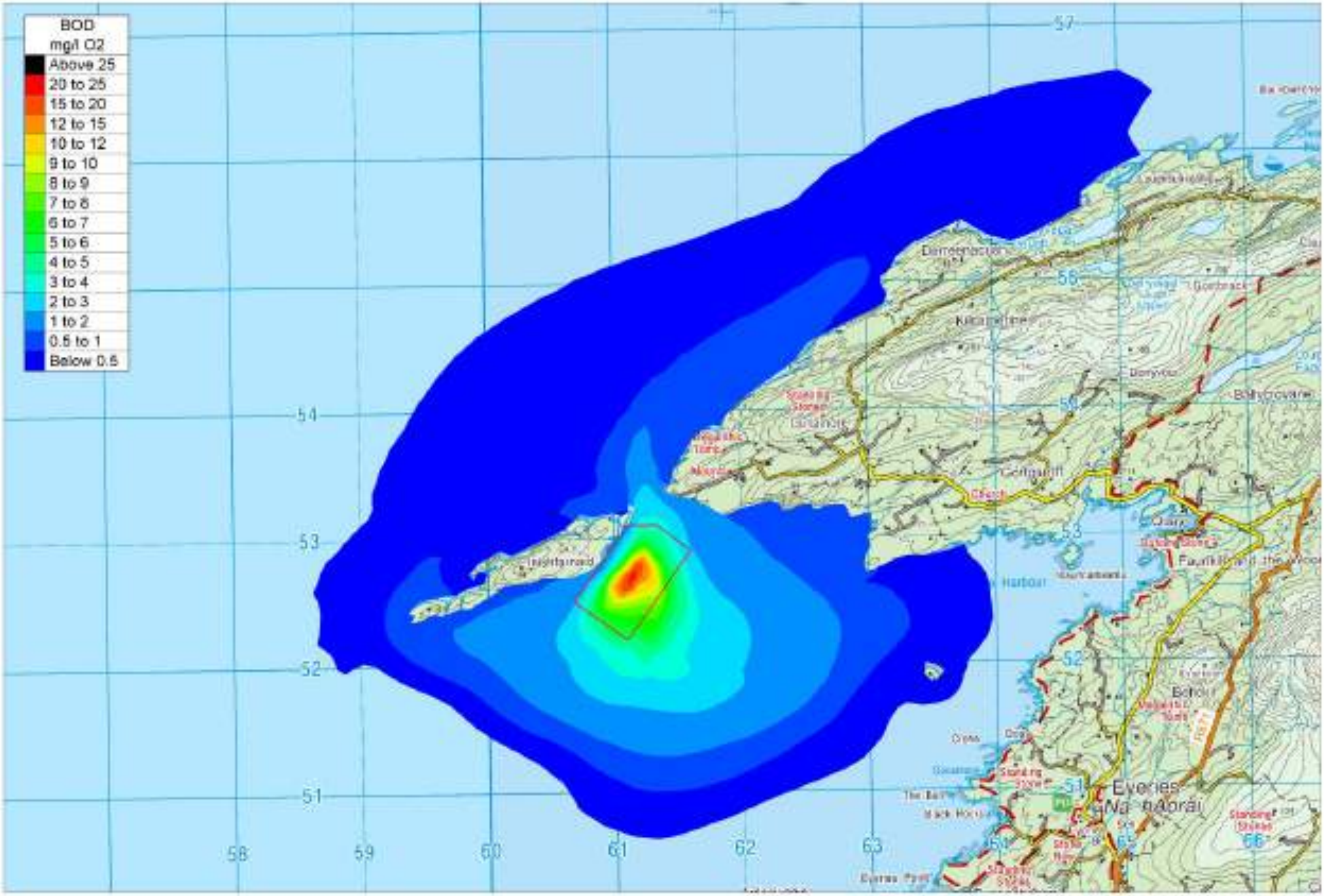

Figure 8-23: Predicted Maximum BOD Concentration Envelope (x1000 mg/l O_2) for Inishfarnard Farm Production Site.

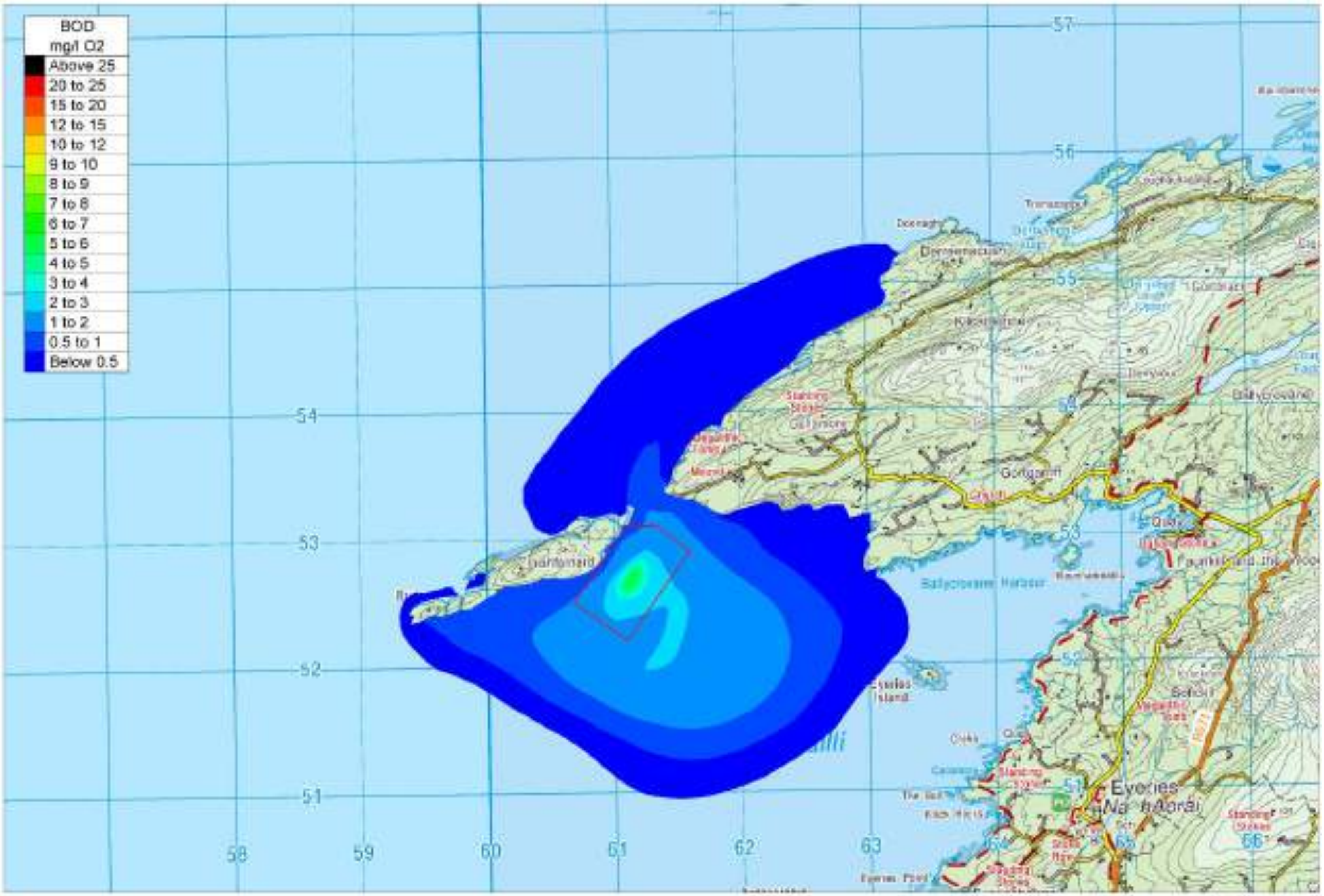

Figure 8-24: Predicted lunar mean BOD Concentration Envelope (x 1000 mg/l O_2) for Inishfarnard Farm Production Site.

Table 8.12: Predicted BOD Concentration statistics (mg/l O_2) at Reference Sites for Maximum Production at Inishfarnard Site

Reference Sites	Solute Concentrations		
	Average	Median	Maximum
1	5.64	4.81	20.82
2	1.16	1.00	3.40
3	0.61	0.52	1.20
4	1.75	1.61	4.94
5	2.13	1.91	8.20
6	0.93	0.99	1.56
7	0.13	0.15	0.34
8	0.10	0.08	0.38
9	0.20	0.19	0.45
10	0.15	0.15	0.35

8.2.4. Dangerous Substances

As Slice® is administered in feed, any uneaten feed will settle to the seabed beneath the pens and will be confined to this area.

Slice® is a licensed in–feed treatment for sea lice which, where hydrographic conditions suit its application, is commonly chosen in preference to bath treatments as it is considered more effective, in that it kills all lice stages and is more environmentally benign. Slice® is a proprietary pre-mix containing 0.2% Emamectin Benzoate (EmBZ), for surface coating onto salmon feed, at a rate of 5kg Slice®/ tonne of feed (that is 10g EmBZ / tonne of feed). It is manufactured by Merck Animal Health Inc. The treatment is applied, on veterinary prescription, as a surface dressing to salmon feed, prior to use. The course of treatment lasts 7 days. SEPA (2005) has determined that 10% of the EmBZ dose ingested is excreted during this treatment period. Of the remaining 90% of the chemical, approximately 99% is excreted over the subsequent 216 days. This excretion has an exponential decay profile such that 50% of the chemical remaining in the fish is released, on average, over each ensuing 36 – 37-day period. It has also been determined that EmBZ breaks down into "non-toxic" sub-compounds with a half-life period of 250 days.

MOWI have pioneered the use of well boats for lice bath treatments in Ireland, as a means of improving treatment efficacy whilst reducing medication use and the dispersal of used medication into inshore waters. MOWI use enclosed well boat tanks for bath treatments of Alphamax.

If the renewal site is licensed, the area will continue to comply with the European Communities (Control of Dangerous Substances in Aquaculture) Regulations 2008 (SI 466 of 2008).

8.2.5. The Environmental Liability Directive

The EU Directive 2004/35/CE on Environmental Liability with regard to the prevention and remedying of environmental damage was transposed into Irish law under European Communities (Environmental Liability) Regulations 2008 (S.I. No. 547 of 2008). These Regulations establish a framework of liability based on the 'polluter-pays' principle in order to prevent and remedy environmental damage. MOWI consider the aquatic environment to be their most important primary resource which is governed by the principles of sustainable and long-term care for the natural environment. MOWI have an Environmental Management Policy (see **Appendix 3.5**) which is based on a systematic approach to environmental management which enables the company to create options for contributing to sustainable aquaculture by:

- protecting the environment by preventing or mitigating adverse environmental impacts.

- mitigating the potential adverse effect of environmental conditions on MOWI farms and operations.
- assisting MOWI in the fulfilment of regulatory and corporate compliance obligations.
- enhancing environmental performance.
- controlling or influencing the way MOWI's products and services are produced and delivered, manufactured, distributed, consumed, and disposed by using a life cycle perspective that can prevent environmental impacts from being unintentionally shifted elsewhere within the life cycle.
- achieving financial and operational benefits that can result from implementing environmentally sound alternatives that strengthen MOWI's market position; and
- communicating environmental information to relevant stakeholders.

8.3. Conclusion

Discharges from the farm in its current form do not have a significant effect (positive or negative) on water quality.

Discharges predicted from the proposed operations if granted the requested changes to the boundaries of the existing site and to the operating conditions attached to the licence as detailed above, will not give rise to negative effects on water quality; it is concluded that there will **no significant effects**.

9. Air and Climate

This section assesses the potential air quality and climatic impacts that the proposed development may have on the receiving environment during the operations. The assessment includes a description of the existing air quality at the site and considers the emissions which may be released from site operations that may impact existing air quality, and the mitigation measures (as detailed in operation SOPs) that will be implemented to control and where possible, minimise the impact that the development may have on local ambient air quality and climate. The ambient air quality data collected and reviewed for the purpose of this study focused on the principal substances considered by the EPA in deriving Air Quality Index for Health (AQIH). The description of the local environment also considers ammonia (NH_3) and methane levels (CH_4).

9.1. Description of the Receiving Environment

Air quality standards and guidelines referenced in this report include those from Ireland and the European Union. To reduce the risk to health from poor air quality, National and European statutory bodies have set limit values in ambient air for a range of air pollutants.

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the National Air Quality Standards Regulations 2011 (S.I No. 180 of 2011), which incorporate European Commission Directive 2008/50/EC which has set limit values for the pollutants SO_2, NO_2, PM_{10}, benzene and CO Council Directive 2008/50/EC combines the previous Air Quality Framework Directive (96/62/EC) and its subsequent daughter directives (including 1999/30/EC and 2000/69/EC). The European 2008/50/EC Clean Air for Europe (CAFÉ) Directive is the current air quality directive for Europe which supersedes the European Directives 1999/30/EC and 2000/69/EC. EU legislation on air quality requires that Member States divide their territory into zones for the assessment and management of air quality. The air quality in each zone is assessed and classified with respect to upper and lower assessment thresholds based on measurements over the previous five years. Upper and lower assessment thresholds are prescribed in the legislation for each pollutant.

The zones in place in Ireland in 2017 are as follows:

- **Zone A** - the Dublin conurbation,
- **Zone B** - the Cork conurbation
- **Zone C** - comprising 23 large towns in Ireland with a population >15,000.

- **Zone D** - the remaining area of Ireland.

To support the assessment of air quality the EPA have devised an Air Quality Index for Health (AQIH). The AQIH is based on a scale of 1 to 10 with higher values indicating lower air quality. The six AQIH regions are:

1. Dublin City
2. Large Towns
3. Rural West
4. Cork City
5. Small Towns
6. Rural East

The Kenmare Bay area within which the site is located is in the 'Rural West' region. The air quality in the 'Rural West' is assigned an index of 3 and categorised as Good[17]. **Table 9.1** details the levels of pollutants in 'Rural West' AQIH.

It should be noted that the closest facility to the Inishfarnard site that could result in air contamination due to emissions of NH_3 and CH_4 is the Roughty Valley Co-op Society Limited, a pig production company located 45km east at Kilgarvan, Co. Kerry. In 2016 the total NH_3 emitted from the Roughty Valley Co-op equated to 19t and the CH_4 equalled 107t (European Pollutant Release and Transfer Register - E-PRTR). All other facilities (i.e., landfill, animal processing and pharmaceuticals) are located too great a distance from the site to result in an impact on air pollution near the Inishfarnard site.

Table 9.1: Air pollutant levels in 'Rural West' AQIH Level 3 - Good (Source: EPA)

Air Quality	Index	Ozone (Running 8 hr mean, µg/m^3)	Nitrogen dioxide (1 hr mean, µg/m^3)	Sulphur dioxide (1 hr mean, µg/m^3)	$PM_{2.5}$ particles (Running 24 hr mean, µg/m^3)	PM_{10} particles (Running 24 hr mean, µg/m^3)
Good	3	67-100	135-200	60-89	24-35	34-50

9.2. Impact Assessment

The main source of atmospheric emissions from the proposed operations will result from engine exhaust gases from engines and diesel generators associated with the service vessels and vehicle. The principal atmospheric emissions associated with fuel combustion are carbon dioxide (CO_2), nitrous oxide (NO_2), CH_4, SO_2, carbon monoxide (CO) and volatile organic carbons (VOCs). Of these emissions CO_2, CH_4 and NO_2 are three principal greenhouse gasses.

[17] AIQH: www.airquality.epa.ie

Greenhouse gases differ in their ability to trap heat in the atmosphere. Carbon dioxide has the lowest ability to trap heat, whilst of the emissions discussed here, NO_2 has the greatest ability although it is emitted in smaller amounts. Global warming potentials (GWPs) are a measure of the relative radiative effect of a given substance compared to CO_2, integrated over a chosen time horizon. The GWP value depends on how the gas concentration decays over time in the atmosphere (IPCC, 1995). Carbon dioxide is given a reference GWP of 1 to which other greenhouse gases are compared; respectively NO_2 and CO_2 have GWP values of 310 and 21.

Based on information from the EPA, the total greenhouse gas emissions (CO_2 equivalent) for Ireland in 2018 was 60.51 million tonnes (EPA, 2019). It should be noted that predicted emissions from the proposed operation are insignificant when considered on the scale of national emissions; consequently, the proposed project is not considered a major source of greenhouse gases.

Other sources of emissions to air from the aquaculture activities will be from:

- aerosols generated from sea lice treatments; and
- dust generated from feed.

Standard operating procedures are in place to ensure all equipment is operating efficiently and all vessels will comply with Irish and EU standards for emissions. Lice treatments will be kept to a minimum (see **Appendix 3.3**). All feed will be covered in a dark heavy tarpaulin when loaded on boats/barges.

9.3. Conclusion

Emissions from the current situation at the farm do not have a significantly effect (positive or negative) on air quality and climate.

If approved, the requested changes to the existing licence (i.e., change to the boundaries and operating conditions) will not lead to significant changes in emissions associated with the Inishfarnard site. The renewed licensed and changes to the operating conditions will have **no significant effect** on air and climate.

10. Noise

10.1. Description of the Receiving Environment

Small numbers of personnel and vessels move around the site on a daily basis throughout the production cycle. At certain times, heavy equipment, such as service vessels with cranes or well boats with deck-mounted cranes, fish pumps and grading equipment moor at the site, especially during harvest.

Noise on the site emanates from fixed equipment, in particular the generator on the feed barge. This is housed in a heavily insulated container below deck, which greatly limits noise transfer into the environment. Other sources of noise include fixed equipment such as feed dosers, feed distribution pipes, which lie on the water surface, and the feed spreader plates, fixed to the ends of the pipes, which distribute the food to the fish within the pens.

Other source of noise included outboard and inboard engines of moving equipment such as service vessels and the well boat.

Whilst noise can travel some distance over the sea surface in calm weather conditions, the noise profile of net pen farm operations is regular, low in register and is rapidly attenuated, thereby creating little disturbance. Thus, noise is not considered a significant feature of such an operation, or a likely or significant environmental impact mechanism.

10.2. Impact Assessment

The “acceptable” level of noise arising from industrial activity in Ireland is determined by the Environmental Protection Agency (Environmental Protection Agency Act, 1992 and the Environmental Protection Agency Act (Noise) Regulations 1994 (SI No 179 of 1994). The EPA licences a diverse range of activities from waste management facilities to power plants. EPA guidance for licensed activities is based on World Health Organisation standards and best international practice. The levels adopted by the EPA have been used by the Department of Environment, Heritage, and Local Government to set levels for all significant developments in Ireland. In summary, the EPA noise limits for industrial activity are as follows:

- Daytime - 55 dBA re 20 μPa.
- Night-time - 45 dBA re 20 μPa.

These levels are recognised as striking a reasonable balance between competing land uses such as industrial activity and residential amenity.

At the site noise generation is kept to a minimum as excessive noise can stress salmon which can negatively impact on their growth and wellbeing. The main source of noise from the aquaculture activities will be from:

- Diesel generators and blowers on the feed barge.
- Service vessel engines.
- Compressor for fish vacuum pumps.
- Stun bleed system; and

These noises tend to be consistent, of middle register and quite low in decibel terms. The noise levels currently generated at the aquaculture site will be maintained if the licence is renewed.

10.3. Conclusion

There is no evidence that these noise levels from the current farm are having any impact on the local communities.

If approved, the requested changes to the existing licence (i.e., change to the boundaries and operating conditions) will not lead to significant changes in the nature and level of operations with respect to noise emissions; any impacts, if realised, will be **Negligible**. The renewed licensed and changes to the operating conditions will have **no significant effect** on the ambient noise climate.

11. Material Assets

11.1. Traffic

11.1.1. Description of the Receiving Environment

The 2016 census recorded the following number of cars per Electoral Divisions: Cathair Dónall (130), Castlecove (125), Kilcatherine (308) and Coulagh (228). In total, 80% of the population of the four Electoral Divisions over the age of 5 that travel by van, bus, motorbike etc for work, school or college use the local road network for commuting. This represents 50% of the total population (≥5 years).

Figure 2-11 shows the access routes to and from the site from local roads that will be used to access Ballycrovane pier as part of the planned aquaculture operations primarily for fish, mortality, and feed transportation as well as hosting staff shore-based facilities. **Table 11.1** shows the Annual Average Daily Traffic (AADT) levels at a traffic counter located closest to the Inishfarnard site outside of Kenmare town.

11.1.2. Impact Assessment

The traffic associated with the existing aquaculture operations in Coulagh Bay consists of 7 full-time employees on a daily basis increasing from approximately 7-11 employee cars on a weekly basis and during the harvesting period. A 22 ton 16.4m long articulated lorry brings feed to the site at a minimum of once per week (maximum 4 times per week) and a waste disposal lorry, which collects mortalities, a minimum of once per week, the interval depending on the rate of mortality at the site. Additional traffic occurs during harvesting when an articulated lorry brings the fish to the processing factory, the regularity depending on the harvest schedule.

11.1.3. Conclusion

The existing licence does not have a significantly effect (positive or negative) on traffic. If approved, the requested changes to the existing licence (i.e., change to the boundaries and operating conditions) will not lead to significant changes in traffic volumes associated with the Inishfarnard site. If approved, the renewed licensed will have **no significant effect** on traffic.

Table 11.1 Annual average daily traffic data from 2 sites passed in the vicinity of the proposed aquaculture sites in Kerry/Cork (Source: www.nratrafficdata.ie).

Traffic Counter Site	Traffic Count	2019*	2018	2017	2016	2015
TMU N70 010.0 E	AADT	1,732	2,284	2,237	2,203	2,090
	% HGV	1.9%	1.9%	2%	2.1%	1.9%
TMU N71 110.0 W	AADT	978	1,177	1,316	1,243	1,204
	% HGV	1%	1.1%	1.2%	1.1%	1.1%

11.2. Commercial Fisheries and Aquaculture

11.2.1. Description of the Receiving Environment

The following sections briefly describe the fishing and aquaculture activity occurring in the region.

11.2.1.1. Pot Fisheries

In general, the level of potting in the bay is low and primarily occurs outside the renewal site. The categories of pot fishing in Kenmare Bay are Brown Crab, Lobster & crab, and Shrimp (**Figure 11-1**). There are up to 6 vessels <8m in length which fish from Ballinskelligs and Kenmare Bay using 1,500 pots and a further 8 vessels <10m length which fish 2,500 pots in inner Kenmare Bay (Marine Institute, 2015). Larger scale shrimp fisheries occur in the inner Kenmare River with 19 vessels and 9,500 pots. The lobster and crab pot fishery covers approximately 13,445ha. The existing site overlaps 21.49 ha of lobster and crab pot fishery ground. If approved, the requested changes to the site boundaries will increase the spatial overlap with the lobster and crab fishery. The increase in spatial overlap is insignificant relative to the lobster and crab fishing area.

11.2.1.2. Trawl Fisheries

Trawl fisheries does not overlap with the proposed Inishfarnard T5/233 site. The closest bottom trawling area relative to the Inishfarnard site is located in Bantry Bay (see **Figure 11-2**). In this area vessels under 15m in length are used. The intensity of bottom trawl fishing in the area has decreased yearly from 2006 (92,000hours) to 2012 (67,000 hours) with fishing for demersal fish using bottom trawls restricted by EC 227/2013 to herring only. No targeted fishing for cod, haddock or whiting is allowed (Marine Institute, 2015).

Beam trawling gear activity decreased from 2007 (2,203 hours) to 2012 (209 hours) (Marine Institute, 2015). Pelagic trawling and seining for sprat take place in both Kenmare and Bantry Bay occurring primarily in winter and spring (Marine Institute, 2015).

11.2.1.3. Line Fishery

There is no overlap between line fishing activity and the Inishfarnard T5/233 site. Line fishing occurs along the entirety of the southwest coast from Shannon Estuary to Bantry Bay. Line fishing for mackerel and pollack using troll lines usually takes place during the summer months further west off the Kerry/Cork coast for mackerel and pollack using troll lines (see **Figure 11-3**).

11.2.1.4. Net Fishery

There is no overlap between net fishing and the T5/233 Inishfarnard site. Net fishing takes place surrounding the western point of the Beara Peninsula using tangle nets for crayfish and further north surrounding Ballinskelligs Bay (**Figure 11-4**). Fishing for crayfish usually occurs from May to October. Data from 2007 shows 18 vessels fished using 110mn miles of tangle nets off the Kerry coast, with a further 23 vessels off the Cork coast using 84nm of net (Marine Institute, 2015).

Trammel and gill netting occur further west off the Kerry coast in late spring and summer. Seine netting for sprat take place in Kenmare and Bantry and for herring in Tralee and Dingle Bays (Marine Institute, 2015).

11.2.1.5. Fish Landings

Castletownbere is the nearest fishery harbour to Kenmare Bay. **Table 11.2** shows the landing data in Castletownbere from 2010 to 2017 (SFPA). Castletownbere was the top Irish port by landed value from 2015 to 2017, it was also ranked 2nd highest in terms of landed weight from 2010 to 2017.

Landings from Irish vessels exclusively into Castletownbere in 2017 amounted to 9,011 tonnes equating to a value of €31,044,760. Castletownbere was ranked second out of the 20 Irish ports in 2017 for both value and weight of landings from Irish vessels.

Table 11.3 shows the species landed into Castletownbere from 2012 to 2016. Landings in recent years were dominated by hake and monkfish angler nei.

Table 11.2: Total fish landings data for Castletownbere from 2010 - 2016 (Source: SFPA)

Year	Weight (Tonnes)	Value (€)
2017	36,446	112,297,775
2016	39,563	110,816,026
2015	45,763	112,665,079
2014	35,004	82,103,000
2013	32,105	57,674,000
2012	32,382	55,614,000
2011	25,427	45,123,000
2010	19,030	29,883,000

Table 11.3 Landings by species (tonnes) into Castletownbere from 2012 - 2016 (Source: CSO)

Species	2012	2013	2014	2015	2016
Atlantic Herring	1,568	1,779	2,220	1,901	1,875
Atlantic Mackerel	1,040	1,187	1,139	1,757	513
Boarfish	6,937	5,528	700	131	381
Haddock	813	617	655	900	975

Species	2012	2013	2014	2015	2016
Hake European	5,662	6,527	10,823	19,354	14,566
Horse Mackerel	813	263	472	284	424
Lobster Norway	722	672	748	1,031	1,371
Megrim nei	2,773	3,328	3,630	3,818	3,978
Monkfish Angler nei	3,896	4,710	6,287	5,718	7,464
Sprat European	1,269	562	1,147	2,174	1,861
Tuna Albacore	3,106	1,809	2,053	2,089	1,479
Whiting	1,401	1,662	1,406	1,247	1,308
Other Species	2,567	3,460	3,725	5,361	3,367

11.2.1.6. Aquaculture

Existing aquaculture in the Kenmare Bay area is shown in **Figure 11-5**. The Aquaculture Licence GIS Database[18] indicates that aquaculture in the Kenmare River SAC largely focuses on shellfish species and finfish (Salmon). The main cultured shellfish species is mussels with smaller quantities of oysters. Sites are also licensed for scallops and clams, but the species are not currently produced in the area.

In Kenmare Bay there are five sites licensed for the culture of Atlantic Salmon[19] (including the Inishfarnard site) (see **Table 11.4**). A site at Cloonee, Tuoist which was previously licensed for salmon culture is now closed and the licence has been revoked.

The three closest shellfish aquaculture sites to the Inishfarnard site include one oyster farm and two mussel farms. The oyster farm is located approximately 5km to the northeast of the Inishfarnard site in Kenmare Bay, while the mussel farms are located approximately 6km east and 7km east in Cleanderry harbour and Gouleenacoush harbour, respectively. There is a total of 54 other aquaculture sites further in inner Kenmare Bay and river. These sites include 35 mussel farms, 10 scallop and 5 oyster.

The total value of aquaculture in Co. Cork (2016) was €33.2m (11,655 tonnes) and in Co. Kerry €21.89m (6313 tonnes). Of this, €25.2m was attributed to salmon (4,269 tonnes) for Co. Cork and €14.3m (2376 tonnes) for Co. Kerry, €4.1m to rope mussel (6,434 tonnes) for Co. Cork and €663,270 (568 tonnes) for

[18] Aquaculture Licence GIS Data 23-12-2019
https://www.agriculture.gov.ie/seafood/engineering/publications/gisdata/

[19] Further detail on aquaculture operations in Kenmare Bay is included in **Section 11.2 Commercial Fisheries and Aquaculture** below.

Co. Kerry, €3.3m to oyster (840 tonnes) for Co. Cork and €4.6m (2376 tonnes) for Co. Kerry, €300,000 from freshwater trout (90 tonnes) for Co. Cork, €264,000 to smolt (18 tonnes) for Co. Cork, €60,000 abalone (2 tonnes) and €22,500 (2 tonnes) from urchin for Co. Cork, , €35,000 to seaweed (35 tonnes) and €12,000 to scallop (3 tonnes) farming for Co. Kerry .

MOWI's operations are guided by the Kenmare Bay Integrated Pest Management / Single Bay Management Plan. The synchronised production and fallowing in single bay areas is essential to ensure the breaking of disease and parasite life cycles. This requires the use of single year classes in each bay area. MOWI uses single generation site occupancy in Kenmare Bay and stock only with S1 fish. In addition, MOWI will focus its lice treatment regime on the pre-winter treatment for all fish in Kenmare Bay (Kenmare Bay CLAMS/Single Bay Management group) which will be over-wintered. During the months of January to May, numbers of ovigerous female and total *L. salmonis* will be maintained as close to zero as possible using cleaner fish and appropriate treatments where necessary. Where two sites are stocked in the Bay, treatments will be carried out on both during the same time period and with the same chemical class and in consultation with other fin fish farmers in the Bay. MOWI will aim to ensure that the entire Kenmare Bay is fallow for 4 to 6 weeks every production cycle.

Table 11.4: Salmon aquaculture licences in Kenmare Bay

Licence reference	Site Name	Distance to Inishfarnard Site
T06/064/7	Doon Point, Kenmare River	*ca*. 31 km northeast
T06/064A	Kilmakilloge Harbour	*ca*. 16 km northeast
T06/064B	Kilmakilloge Harbour	*ca.* 16 km northeast
T06/112	Cloonee, Tuoist.	site closed; licence revoked
T06/202A	Deenish, Island	*ca*. 14 km west

11.2.2. Impact Assessment

A range of fishing activity occurs within the Coulagh, and Kenmare Bay area as described above. The existing site does not significantly affect fisheries in the bay. The existing site overlaps one fishery; namely the lobster and crab fishery. If approved, the requested changes to the site boundaries will increase the spatial overlap with the lobster and crab fishery. The increase in spatial overlap is insignificant relative to the lobster and crab fishing area.

11.2.3. Conclusion

The renewal of the licence and change to operating conditions of the licence will not have a significant effect on fishing.

The renewal of the existing licence will see a change from an increase from 500 tonnes (annually) to 2,672 tonnes[20] of harvestable weight over a 2-year period. On an annual basis, this would increase aquaculture production in Co. Cork from 11655 tonnes to 12991 tonnes, with salmon production increasing from 4269 tonnes to 5,605 tonnes. This increase in salmon production would equate to an increase to the economy from aquaculture production in Co. Cork of €7.87m (based on 2016 figures). This is a **positive effect** of the renewal of the licence and change to operating conditions of the licence.

[20] Harvested yield form **Table 2.1 Section 2.7**

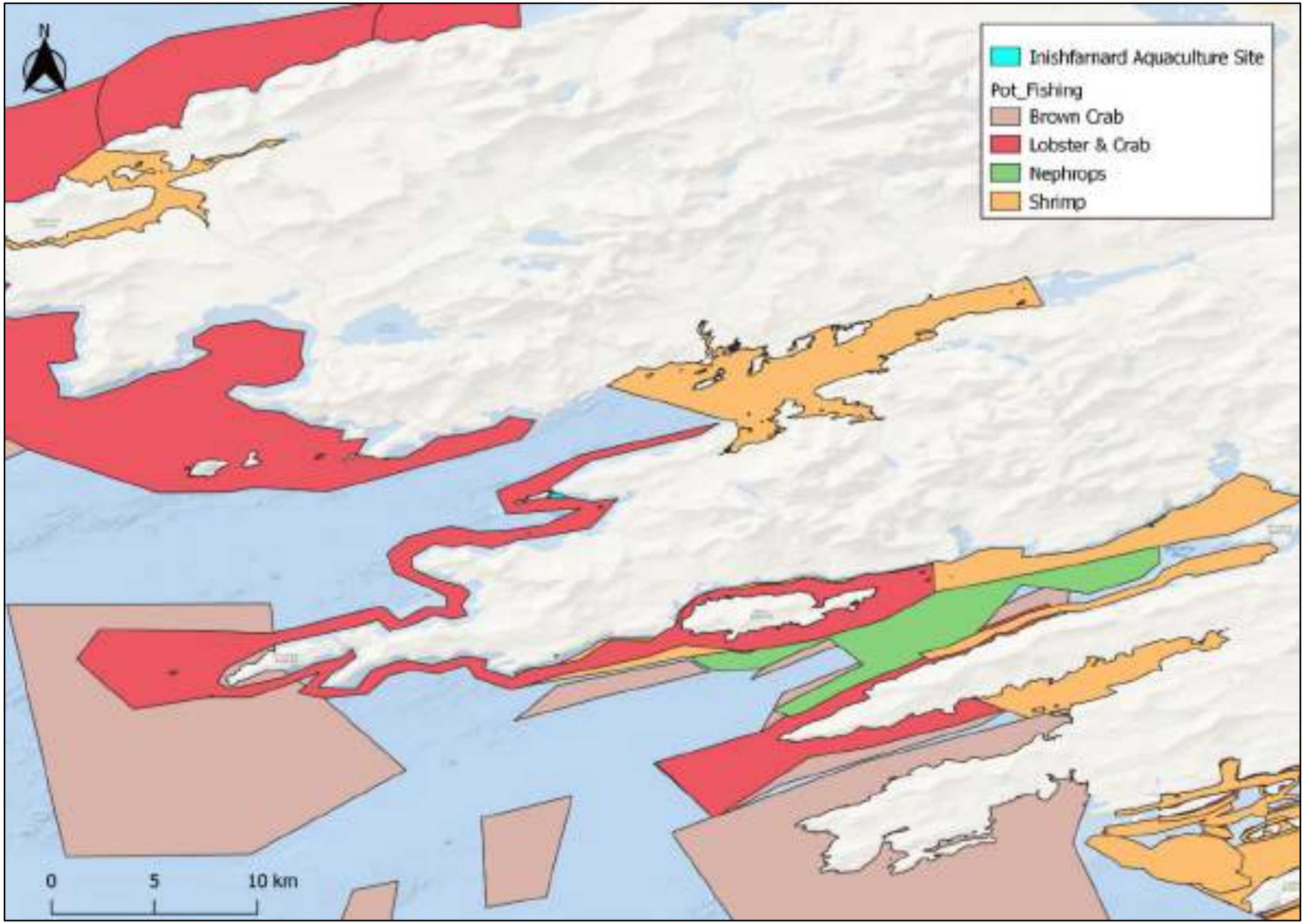

Figure 11-1: Pot fisheries in the vicinity of Kenmare Bay (Source: http://atlas.marine.ie/; 27/05/2019).

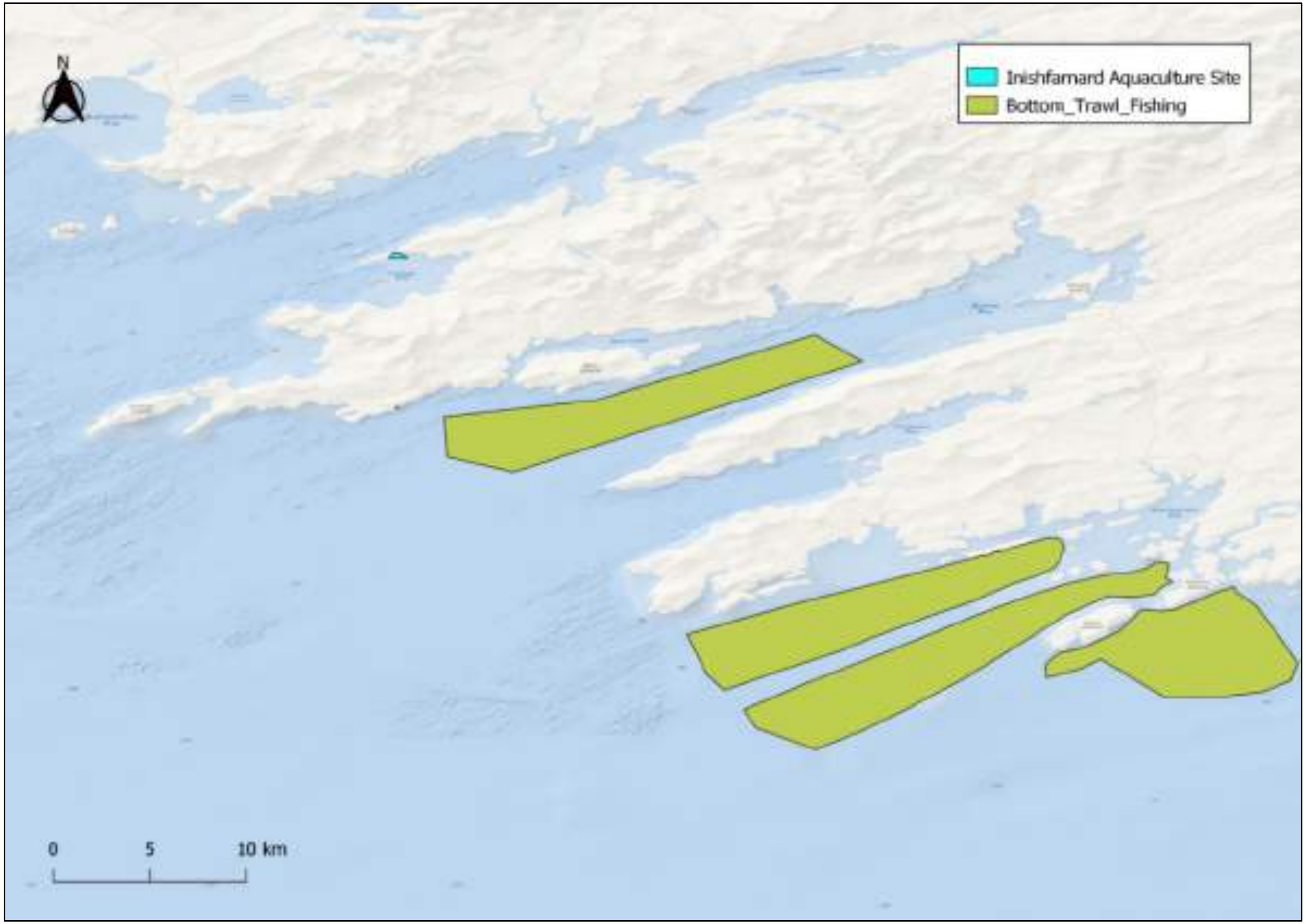

Figure 11-2: Trawl fisheries in the vicinity of Kenmare Bay (Source: http://atlas.marine.ie/; 27/05/2019).

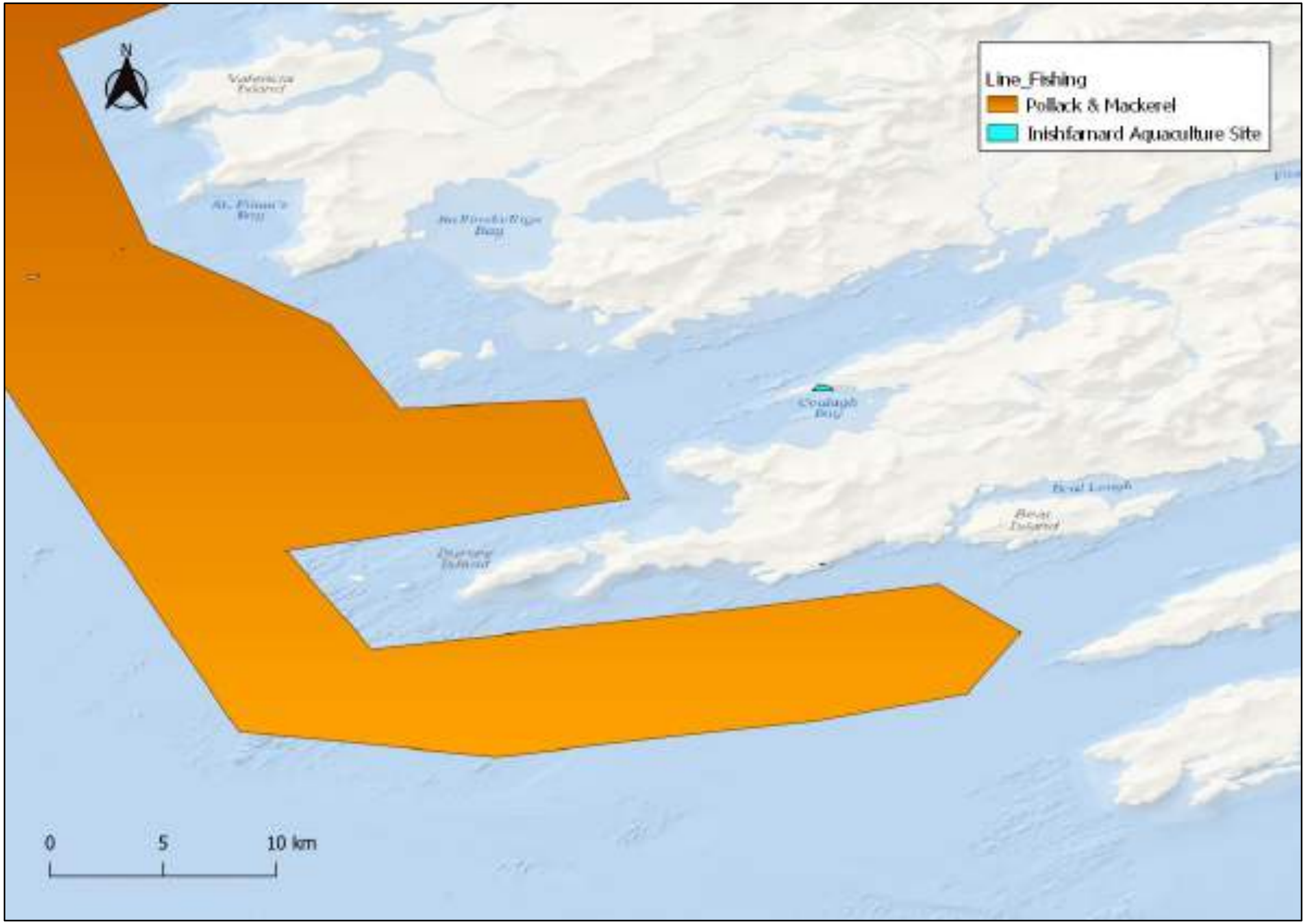

Figure 11-3: Line fisheries in the vicinity of Kenmare Bay (Source: http://atlas.marine.ie/; 27/05/2019).

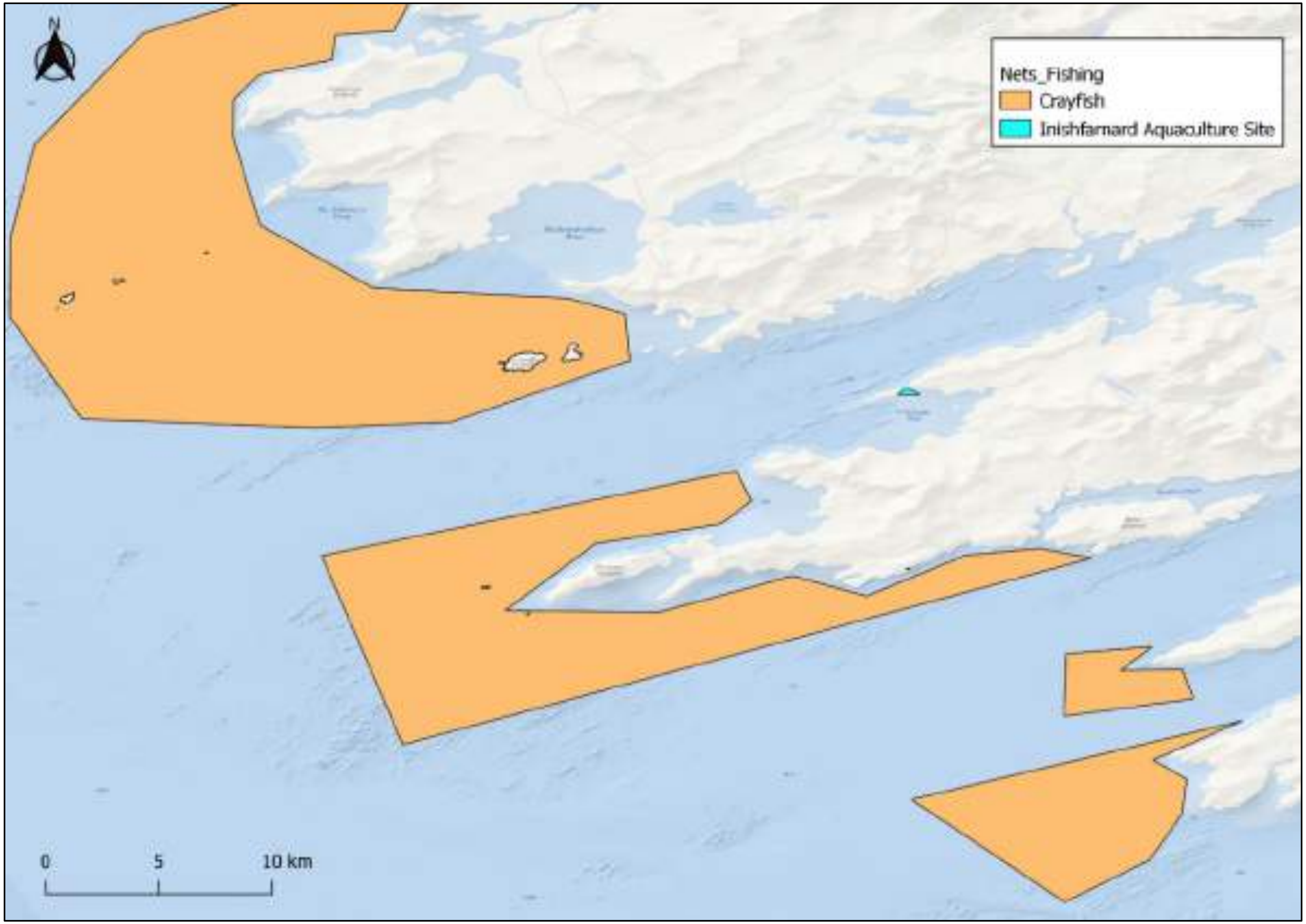

Figure 11-4: Net fisheries in the vicinity of Kenmare Bay (Source: http://atlas.marine.ie/; 27/05/2019).

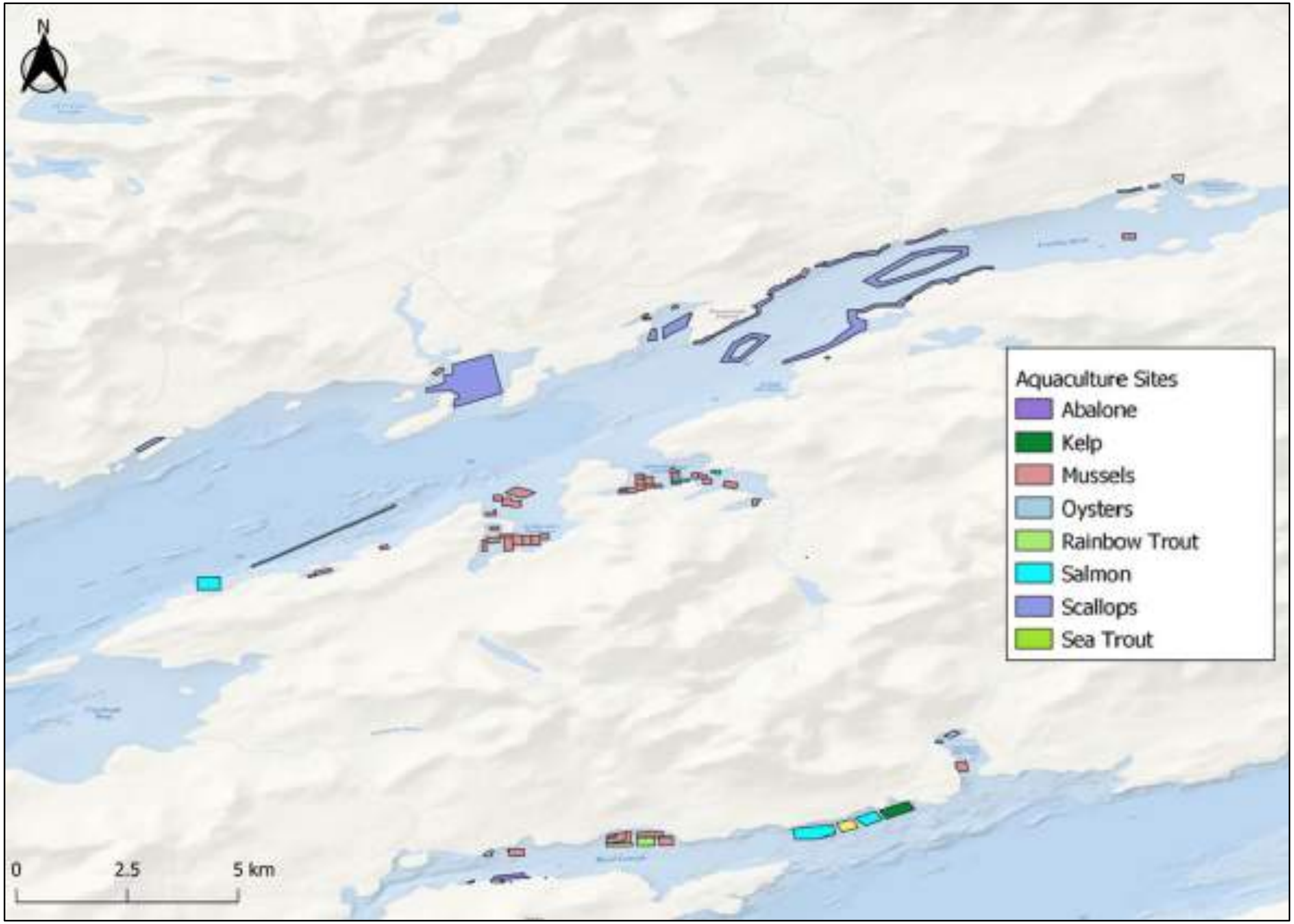

Figure 11-5: Aquaculture in Kenmare Bay (Source: http://atlas.marine.ie/; 29/05/2019).

11.3. Tourism and Recreation

11.3.1. Description of the Receiving Environment

The tourism product is based on the landscape, seascape, history, and cultural qualities of the area. The location of key tourism and recreational sites in the vicinity of the Inishfarnard site are shown in **Figure 11-6**. Tourism is focused round the coast including the 'Wild Atlantic Way' which follows the route along the Beara Peninsula. There is one discovery point located along Beara Peninsula close to the Inishfarnard site which is Dursey Island (15 km SW). Tourism figures from the Central Statistics Office show that in 2017 Ireland had 10.6 million visitors of non-Irish residents of which 2.4 million visited the southwest coast (Fáilte Ireland 2017 performance southwest region).

While there are no figures available to accurately estimate the number of tourists that visit the Kenmare Bay area specifically, the Fáilte Ireland statistics show that the southwest region received a total of 2.4 million overseas visitors in 2017 spending €968m and 2.1 million Irish resident trips to the southwest region generating €419m (Fáilte Ireland 2017 performance southwest region).

There are no designated bathing waters/beaches in close proximity to the Inishfarnard site. The closest is located at Derrynane beach approximately 9.7km northwest from the site and another in Baile an Sceilg located approximately 22km northwest, both of which are Blue Flag beaches (EPA Maps[21]).

Due to the absence of marinas within the vicinity of Inishfarnard Island, the closest being Cahersiveen marina (30km North), yachting is not a significant past time in the area. Little SCUBA diving takes place around in the surrounding waters of Inishfarnard with the closest sites located around Caherdaniel (9.6km north) in Derrynane harbour, Abbey Island (10km northwest), Lambs Head 8km northwest), Two Headed Island (10km west), Moylaun Island (11km west), Deenish Island (14km west) and Scarriff Island (16km west) (Irish Underwater Council[22]).

There are several shipwrecks close to Inishfarnard, one of which is located approximately 25km west (Lat: 51.73, Lon: -10.39) of Inishfarnard (T5/233) site which is a trawler shipwreck of vessel Braesomar. This shipwreck is located at a depth of 79.08m, length 40m and width 8.5m (INFOMAR[23]). There is an additional wreck located 12km east (Lat: 51.76967, Long: -9.873667) in Kenmare Bay, which is identified as a U-Boat 'Sea Flower' lost in 1968. An additional unknown wreck located 7.7km west (Lat:

[21] EPA Maps: https://gis.epa.ie/EPAMaps/

[22] Irish Underwater Council: http://diving.ie/

[23] INFOMAR Wreck: https://www.infomar.ie/maps/downloadable-maps/shipwrecks

51.7011, Lon: -10.1164) and another which is identified as a U-Boat 'Diamantes' lost in 1939 located approximately 10.8km west (Lat: 51.66678, Lon: -10.1931) (Irish Wrecks[24]). Further detail of wreck located near the site is presented in **Section 12**.

There are several shore angling sites surrounding the site (Fishing Ireland[25]), the closest being Kilcatherine Point, which is adjacent to Inishfarnard Island, Doon Point (4.5km east), Oileainin (4.5km southwest), Cumar Dron Leac (5.6km southwest), Cuasa Teorann (5.6km southwest) and Carrig Fhada (6km southwest). At each of these locations an array of species can be caught including mackerel, pollock, ballan wrasse, trigger fish, coalfish, conger, and dogfish.

Salmon fishing in the Kenmare Bay region takes place in two locations close to Inishfarnard Island, River Sheen (spate river) and River Roughty both located approximately 36km east into Kenmare Bay. The salmon season runs from 15th March to 30th September each year with seatrout from 15th March to 12th October (River Roughty only). The River Roughty is a large river approximately 32km long with a catchment of 202km^2. In 2017, 35 salmon were caught in the River Sheen on a catch and release basis (18% decrease from 2015) and 73 salmon were harvested (11% decrease from 2015). In the same year, 172 salmon were caught on the river Roughty on a catch and release basis (59% increase from 2015) and 69 salmon were harvested (33% decrease from 2015) and 2 sea trout were caught on a catch and release basis (33% decrease from 2015) with no sea trout harvested (IFI Wild Salmon and Sea Trout Statistic Report 2016 & 2017).

In addition to the above, Castletownbere Harbour is a cruise ship destination, although numbers are quite low in comparison to other ports around the country, with 1 visit in 2016 totalling 135 passengers (Census Statistics of Port Traffic 2016).

11.3.2. Impact Assessment

Recreational and tourism activities in the area currently take place in harmony with the existing aquaculture operation. The renewal application varies from the existing licence in that it requests change to the boundaries of the existing site and to the operating conditions attached to the licence. If approved, the site boundaries will increase from 25.94ha to 52.73ha. The relative change in site area is not significant and will not prohibit or impact upon any existing recreational activity in the bay.

Section 13 (Landscape and Visual Resources) indicates that the fish farm infrastructure proposed for the renewed licence can only be seen from vantage points towards the tip of Kilcatherine Point. If the

[24] Irish Wrecks: http://irishwrecks.ie/

[25] Fishing Ireland: https://fishinginireland.info/

licence application is approved, the visual amenity would not be significantly impacted and the likelihood of current tourism remaining the same is Highly Likely.

11.3.3. Conclusion

The application includes a request to change the boundary of the site from 25.94ha to 52.73ha and operations from 12 pens to 16 pens. If approved, the renewed licensed will have **no significant effect** on tourism and recreational activities.

11.4. Waste Management

After stunning and bleeding of harvested fish, the dead fish are collected in closed steel road tankers at Ballcrovane Pier. The closed steel road tankers will contain an ice/seawater slurry. In both cases, the blood water is collected with the fish and the fish will continue to bleed out into the sealed collection tanks. The tanks are then transported by road to Rinmore Processing plant in Fanad, Co. Donegal for processing.

All harvest effluent (*i.e.,* blood water, wash water, melted ice etc.) is collected outside of and within the processing plant by means of underground drains and sumps. This liquid effluent is pumped through fine mesh Salsnes™ filters in order to remove suspended solids and organic debris prior to collection in a large balancing tank for pre-treatment balancing. The filtrate from these filters is added to the daily organic solid waste loads. All sludge collected at the effluent treatment plant will be sent to an approved rendering plant for final disposal.

All filtered wastewater is then treated by means of electro-flocculation followed by ozonation, prior to disposal at sea using an ecoFloc FTS-160 treatment system.

Offal and trimming waste arising from the processing facility is collected continuously from the process. Daily accumulations of waste from stocks that do not have listed diseases are managed in the following ways:

- Offal is pumped into an ensiling chamber and mixed with formic acid to produce silage with pH<4. This silage is sold as Rest-Raw-Material to third parties for oil and protein extraction.
- Offal and trimmings which is not ensiled is transported to approved ABP processing plants for rendering.

If a listed disease is identified in any batches of slaughtered fish, then all solid waste arising from processing is sent to College Proteins in Nobber, Co. Meath for high temperature rendering.

Routine mortalities will be disposed of under the Standard Operating Procedure for Waste and Waste Management which cover the matter of the management and disposal of all routine wastes from MOWI installations. Mortalities will be removed from pens by divers at least once a week, or more frequently subject to observed mortality trends. Collected mortalities will be taken for incineration at an approved animal by-products rendering plant, as required by Department of Agriculture, Marine and Food guidelines.

Culled fish and mass mortalities are dealt with under a separate SOP (*SOP 25560*; see **Appendix 4**.)

11.4.1. Impact Assessment

Waste management operations are already in place for the current site so that waste products from the current aquaculture license do not have a significant effect on the surrounding farm's environment. The renewal license will involve an increase in production levels, however there will be no significant change in any of the waste management operations and therefore there will be no impacts on waste management operations.

11.4.2. Conclusion

MOWI currently have facilities and requirements in place for waste management; as a result, the renewal license will not have a significant effect on the waste management process and therefore no significant effect on the local environment of Inishfarnard site.

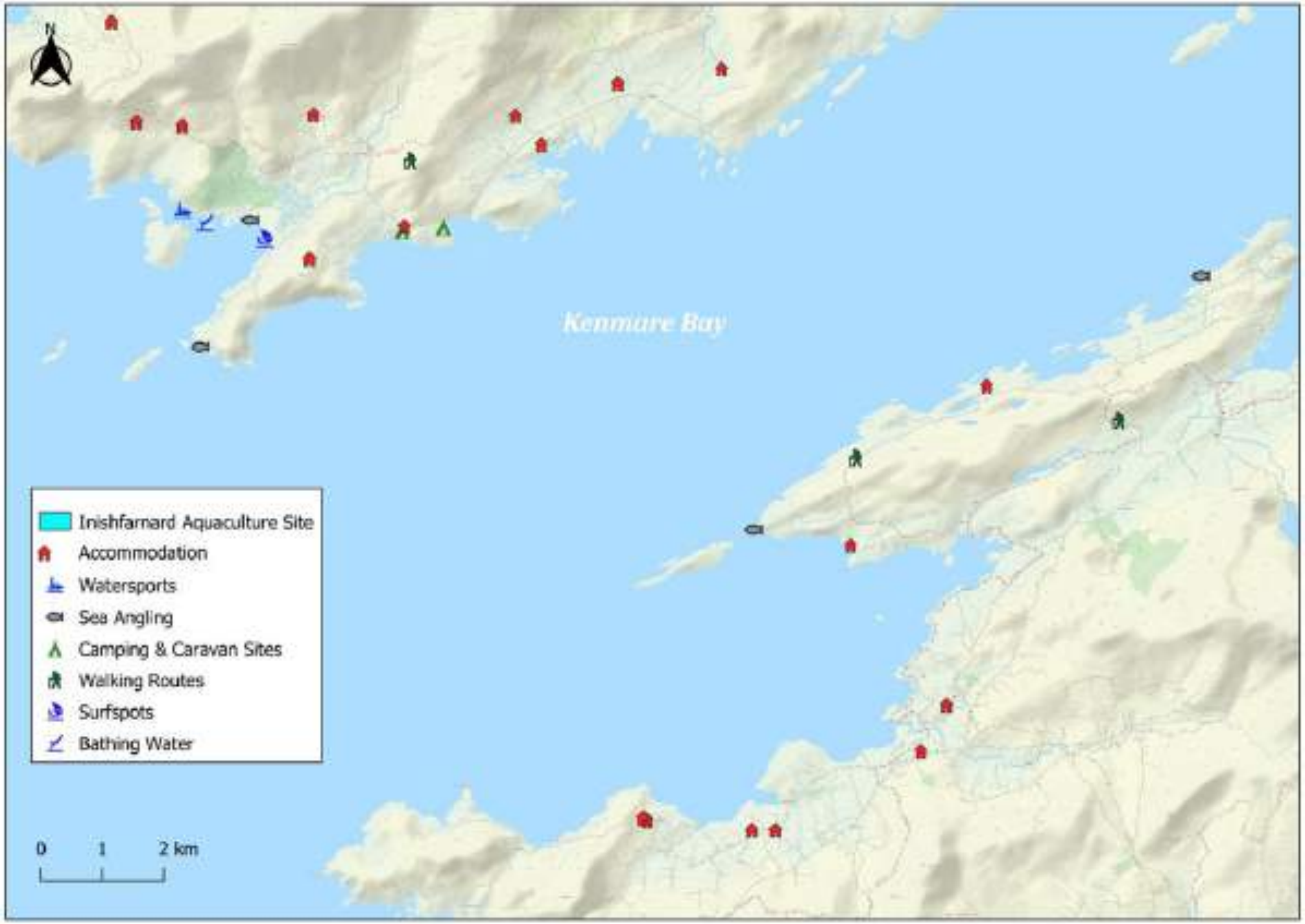

Figure 11-6: Location of tourism and recreational sites in the vicinity of the proposed renewal site.

12. Cultural Heritage and Archaeology

12.1. Description of the Receiving Environment

A detailed archaeological assessment of the seabed surrounding the Inishfarnard site, and the nearby coastal area was carried out in 2016. The assessment is presented in full in **Appendix 11**. In summary, the assessment identified 62 sites listed in the Sites and Monuments Records for the townlands within 5km of the Inishfarnard aquaculture site area (see **Figure 13.1**); including a megalithic tomb, standing stones, souterrain, stone sculptures, cairns, and ringforts.

The archaeological assessment also considered shipwrecks within Ireland’s waters through the use of INSS/INFOMAR’s shipwreck database. The Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) programme is a joint endeavour shared between the Marine Institute (MI) and the Geological Survey of Ireland (GSI). This venture is the predecessor to the Irish National Seabed Survey (INSS) and is focussed around creating integrated mapping products related to the seabed. INSS/ INFOMAR survey the seafloor using side scan sonar and multibeam echosounders and often survey shipwrecks. The shipwreck inventory records all known wrecks for the years up to and including 1945 and to date approximately 12,000 records have been compiled and integrated into the database.

Inspection of the inventory of wrecks revealed a listing of 5 vessels which were lost within or around the area of Inishfarnard (Braesomar – 25km WNW of Inishfarnard site, Kerry Head – 23km SSW of Inishfarnard site, Tarquah – 33.3km SW of Inishfarnard Site, Exodus – 34.75km SW of Inishfarnard Site, Ixkote – 46km SW of Inishfarnard site and the Asuncion Rivero - 58.6km WSW of inishfarnard site. A further 26 vessels recorded as having been lost in the greater Kenmare Bay area. The archaeological assessment also considered shipwrecks within Ireland’s waters through the use of INSS/INFOMAR’s shipwreck database.

The archaeological assessment identified the rock substrate within and adjacent to the site as having a low potential for the retention of archaeological material, while coarse and finer substrate, which is the predominate seabed type at the site was interpreted as having a medium to high potential for the retention of archaeological material. Side-scan sonar survey, however, conducted at the site revealed no features of interest which may have indicated the presence of upstanding or submerged archaeological remains.

12.2. Impact Assessment

The proposed licence renewal will have no direct interaction with surrounding shipwrecks and impact on any of the sites located in the adjacent townlands that are recorded in the Sites and Monuments Record. The assessment has been based on a 5km radius drawn from the current Inishfarnard aquaculture site boundary and includes the boundary of the proposed site. As no archaeological features or indications of archaeological materials were identified from the side-scan sonar survey conducted over the proposed aquaculture site, the proposed licence renewal will have no impact on archaeology.

12.3. Conclusion

If approved the renewed licence will have **no significant effects** on cultural heritage including archaeology.

12.4. Ongoing Monitoring

It is proposed that the bedding path and location of the proposed anchoring system will be inspected by divers prior to the deployment of the anchoring system to ensure that archaeological material, not previously identified, are not impacted. It is further proposed that a side-scan survey will be conducted over the Inishfarnard site following the installation of the anchors to determine if their installation has revealed the existence of submerged archaeological material.

13. Landscape and Visual Resources

The Irish coastline is an important resource for many activities and its landscapes and seascapes are recognised as part of the natural heritage (DMNR, 2001). In particular, coastal landscapes and seascapes are a vital resource for activities such as leisure and tourism, wild fisheries and nature conservation interests. Existing pressures on landscape are related to impacts on the natural, built, and cultural environment including impacts on the aesthetic landscape and sensitive views, resulting from the cumulative impacts arising from inappropriate typology, use, siting, and design of developments. Consequently, it is crucial that the aquaculture industry should develop in harmony with the landscape and other users of the coastal resource.

The following section assesses the impact of the aquaculture site on the visual landscape following the guidelines as detailed in '*Guidelines for the Assessment of the Landscape and Visual Impacts of Marine Aquaculture Operations*' (DMNR 2001). As outlined in these guidelines, landscape sensitivity should be assessed as high, medium, or low with a broad outline of these definitions shown in **Table 13.1**.

Table 13.1: Landscape and Visual Sensitivity Levels

Sensitivity	Category	Definition
Low	**Landscape**	Landscape that can accommodate aquaculture developments without detriment to its character or features. No special landscape qualities or values apply
	Visual	Viewers have limited viewing opportunities and/or low amenity expectations, such as farmers, fishermen, aquaculture, or other workers.
Medium	**Landscape**	Landscape that can carefully accommodate sites, small scale aquaculture development that respects existing landscape character and features. May have some special qualities or values at a local level
	Visual	Viewers have moderate amenity expectations and/or short or intermittent viewing opportunities, such as passing motorists, ferry users and temporary residents
High	**Landscape**	Landscape that is vulnerable to change as a result of aquaculture development. Change may damage landscape feature(s) that are important or distinctive in a regional or national context. Special qualities or values at a regional or national scale apply.
	Visual	Viewers have high amenity expectations and/or prolonged viewing opportunities, such as tourists, people involved in recreational pursuits such as walking or sailing and local communities.

The magnitude of change to both landscape and visual receptors should be assessed in a standardised way. Magnitude of change is a function of the nature, size and extent of the changes brought about by the development and the definitions for different levels of impact magnitude are presented in **Table 13.2**.

Table 13.2: Impact Magnitude Levels

Magnitude category	Receptor	Definition/Description
Low	**Landscape**	Limited or virtually imperceptible change in landscape elements and features, giving rise to negligible change in landscape character and qualities.
	Visual	Narrow visual envelope and/or few viewers affected. Generally long-distance views and/or limited changes in view.
Medium	**Landscape**	Moderate change in landscape elements and features, giving rise to a noticeable change in landscape character and qualities.
	Visual	Visual envelope of moderate size and/or moderate number of viewers affected. Some short or middle distance and/or moderate changes in view.
High	**Landscape**	Extensive change in landscape elements and features, giving rise to a marked change in landscape character and qualities.
	Visual	Extensive visual envelope and/or high number of viewers affected. Short distance views and/or major changes in view.

To assess the overall significance of the impacts that are predicted to occur, the site-specific sensitivity of the receptor and magnitude of effect are combined as outlined in **Table 13.3**.

Table 13.3: Significance Levels Matrix

Sensitivity of Landscape or Visual Receptor	Magnitude of change		
	High	Medium	Low
High	Very Substantial	Substantial	Moderate
Medium	Substantial	Moderate	Slight
Low	Moderate	Slight	Negligible

13.1. Receiving Environment - General Landscape

Inishfarnard Island is located in Coulagh Bay on the southeast coast of the mouth of outer Kenmare Bay. The coastline of Coulagh Bay extends for from Kilcatherine Point (less than 1km northeast of the site) to townland of Eskinanane (approximately 5.6km southwest of the site).

This western region of Cork is known nationally for its scenic landscape including seascapes and rocky peninsulas. There are 76 Landscape Character Areas (LCA) identified by Cork County Council which were assessed by their natural, scenic, and cultural values (Cork County Council, 2007). The area surrounding Inishfarnard Island falls into the category and region of Rugged Ridge Peninsulas whose landscape value (environmental or cultural benefits) and sensitivity (ability to accommodate change or intervention without suffering unacceptable effects to its character and values) is characterised as very high, as well as the landscape being nationally important and of high ecological value (see **Figure 13-1**).

The main landscape of the region predominantly consists of rocky peninsulas separated by drowned valleys and relatively low-lying bays with the sheltered areas of the bay comprising flatter terrain extending inland and rising to low ridges and hills (Cork County Council, 2007). The rocky peninsulas consist of a thin blanket of peat comprising of a mix of moorland with fertile areas of farmland and woodland including some smaller regions of coniferous plantations on higher ground (Cork County Council, 2007). Within this Rugged Ridge Peninsula landscape type 12 LCA exist, with those closest to Inishfarnard including Ballycrovane Harbour comprising of low rocky coastal ridges and Ardgroom consisting of a rugged ridge, rocky marsh, and hump-back coastal fringes (Cork County Council, 2007).

Two scenic routes are present along the coastline adjacent to Inishfarnard Island. The local road between Eyeries, Kilcatherine and Ardgroom (S116) provides views of Coulagh Bay, Cleanderry Wood SAC and Kenmare River SAC. The second route (S117) comprises the R575 between Bealbarnish Gap, Allihies and Eyeries and provides views of Coulagh Bay, the Atlantic Ocean, Slieve Miskish and Knocknagallaun mountains. The routes are described as having prevalent rural character and of very high landscape value (Cork County Council, 2014; Cork County Council Maps). The regions high scenic amenities, extensive coastline and marine leisure, tourism is an important industry and highly valued.

Rural communities within close proximity to the Inishfarnard area include the electoral divisions of Kilcatherine (population of 804 in 2016) and Coulagh (population of 536 in 2016). Both of the scenic routes described above pass through these communities and form part of the Wild Atlantic Way route. There are also several historic sights of interest within these regions including a megalithic tomb and church in Kilcatherine, standing stones and sculpture in Eyeries and Coulagh and hut sites in Reentrusk (National Monuments Service).

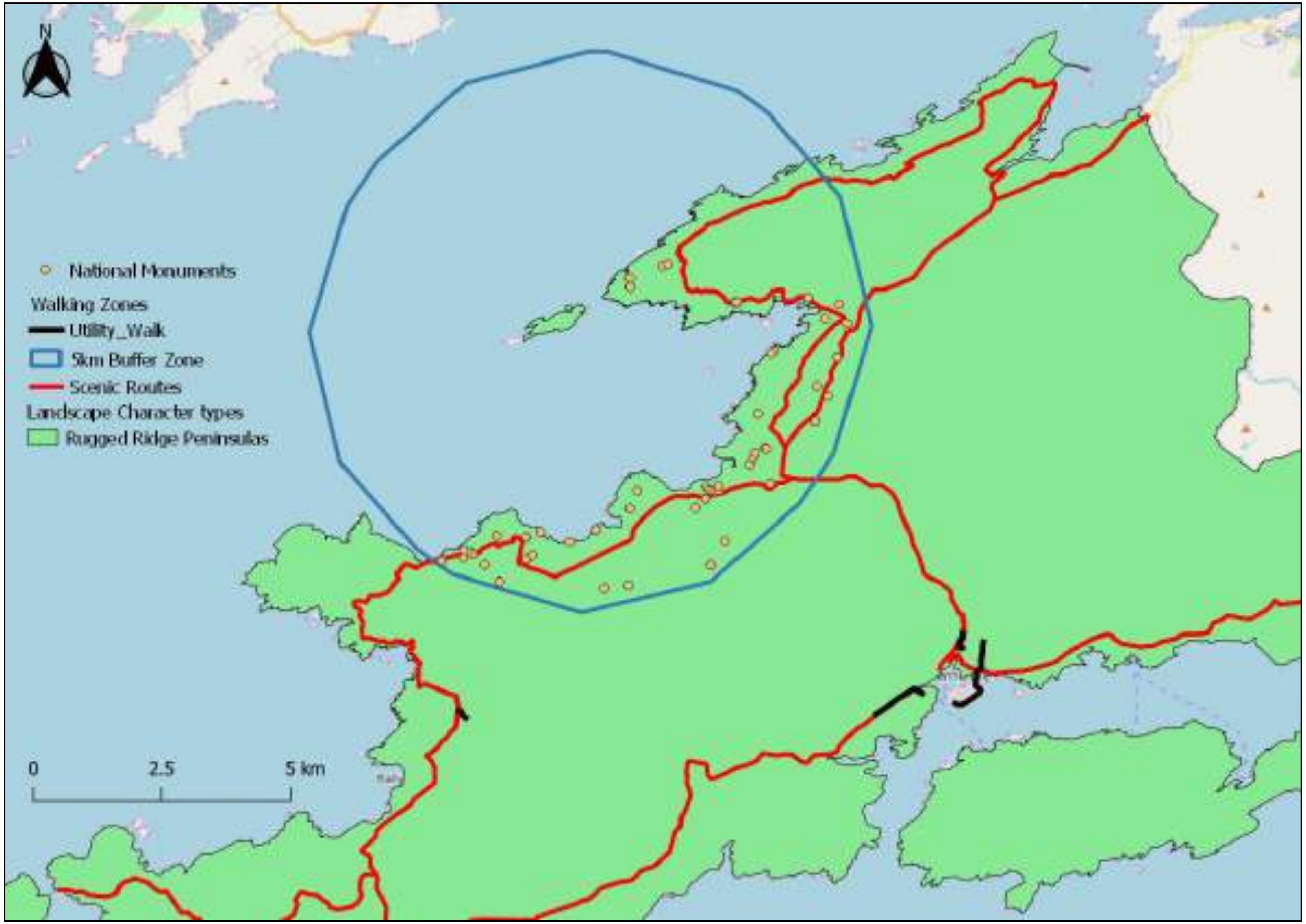

Figure 13-1: Landscape Character Types and Scenic Routes surrounding Inishfarnard site. Data adapted from Cork County Council Development Plan.

13.2. Landscape & Visual Impact Assessment

Within the Coulagh Bay region the Cork County Council Development Plan 2014 identified various regions which were scenically important, primarily associated within the Wild Atlantic Way route. As a landscape which is nationally important and classified as having very high value, it is therefore sensitive to future development and change and imperative to preserve and protect the views and prospects.

Finfish culture has been ongoing in Kenmare Bay since 1990's, the current proposal will change the boundaries of the existing license area from 25.94ha to 52.73ha and an increase from 12 pens to 16 pens. The increase in pen numbers will therefore create a greater area for which the pens will be visible from the shore. However, this increase is not significant enough to pose an impact on the landscape or visual amenity to what is already currently present with the existing site. A small rural road leads to the shore-based facilities and access to Inishfarnard Island at Ballycrovane Pier which has been in place since the fish culture began in the bay and will therefore not pose an impact on the landscape.

The *Guidelines for Landscape and Visual Impact Assessment of Marine Aquaculture* (DMNR, 2001) contend that in practice, even the largest pen installation will be barely visible, even in the best weather conditions, at distances greater than approximately 4km. Consequently, a distance of 5km was used to determine the zone of potential visual impact around the proposed aquaculture site that is located in the Coulagh Bay area.

In general, there is limited access to the shore on the mainland within the 5km zone and, given the topography of the surrounding countryside, there is restricted views of the bay from the villages, individual dwellings and minor roads that service the area. In order to determine the potential visual impact that the pen arrangements would have on the visual environment, digital photographs were taken from vantage points looking towards the proposed site location. **Table 13.4** presents the locations and coordinates of the recorded vantage points, which are shown in **Figure 13-2**. The lens used on the camera was a standard 50 mm lens as required by the DMNR Guidelines (DMNR, 2001). At each of the vantage points, a photograph was taken in the direction of the site and the coordinates and angle noted. Pens were located on the site in order to accurately determine the location of the proposed site. Views from the vantage points with pens overlain are presented in **Figure 13-3** to **Figure 13-17**.

Figure 13-2: Visual vantage points, Coulagh Bay

Table 13.4: Prominent vantage points around Coulagh Bay

Vantage Point	Location	Coordinates		Distance from Site (km)
		Latitude	Longitude	
1	Kilcatherine Point	51.71596	-10.0054	0.6
2	Minor Road	51.71745	-9.99825	0.9
3	House drive	51.71533	-9.97369	2.4
4	Elevated road	51.71599	-9.96334	3.0
5	Elevated road	51.70609	-9.9496	4.1
6	Elevated road	51.70138	-9.95232	4.0
7	Eries Village	51.69612	-9.95597	3.9
8	Cul-de-sac to shore	51.69394	-9.96745	3.5
9	Wild Atlantic Way meets Eries Road	51.69005	-9.95416	4.4
10	Road to Allihies	51.68253	-9.96957	4.2
11	Cul-De-Sac to stony beach	51.6849	-9.97251	3.9
12	Minor Road	51.68146	-9.98199	3.8
13	Pier on circular road off the Wild Atlantic Way	51.67318	-10.0169	4.3
14	up steep road	51.67301	-10.0296	4.5
15	Minor Road	51.66486	-10.0624	6.4

Vantage Point 1

Figure 13-3: View of site from vantage point 1

Comment: Viewpoint from end of lane at Kilcatherine Point. Shorefishing location. No dwelling.

Vantage Point 2

Figure 13-4: View of site from vantage point 2

Comment: View from end of a minor road cul-de-sac with single dwelling. Due to local topography, the site is not visible along this road until this point reached.

Vantage Point 3

Figure 13-5: View of site from vantage point 3

Comment: In driveway of house. Site not visible along minor road up to this point.

Vantage Point 4

Figure 13-6: View of site from vantage point 4

Comment: Elevated minor road, site partially visible.

Vantage Point 5

Figure 13-7: View of site from vantage point 5

Comment: Elevated minor road at single dwelling.

Vantage Point 6

Figure 13-8: View of site from vantage point 6

Comment: Elevated minor road with detached houses along its path.

Vantage Point 7

Figure 13-9: View of site from vantage point 7

Comment: View from the outskirt of Eyeries village. There is no view of the site once entering the village although may be view from the rear of the houses on the seaward side.

Vantage Point 8

Figure 13-10: View of site from vantage point 8

Comment: End of a cul-de-sac where there are two houses and mobile home.

Vantage Point 9

Figure 13-11: View of site from vantage point 9

Comment: View from a bed & breakfast where the Eyeries road meets the Wild Atlantic Way route

Vantage Point 10

Figure 13-12: View of site from vantage point 10

Comment: View from road to Allihies

Vantage Point 11

Figure 13-13: View of site from vantage point 11

Comment: Cul-de-sac to stony beach

Vantage Point 12

Figure 13-14: View of site from vantage point 12

Comment: View from the R575.

Vantage Point 13

Figure 13-15: View of site from vantage point 13

Comment: View from pier on circular minor road off the R575

Vantage Point 14

Figure 13-16: View of site from vantage point 14

Comment: View from R575 as it climbs up the mountain.

Vantage Point 15

Figure 13-17: View of site from vantage point 15

Comment: Final view of the site on R575

In terms of cumulative visual impact for Coulagh Bay as a whole, the proposed Inishfarnard site will not have a significant effect as the current site is visually limited to vantage points towards the tip of Kilcatherine point (see **Figure 13.5** and **Figure 13-6**).

Consequently, the cumulative visual impact of the development with other existing developments will be negligible.

13.3. Conclusions

Visual impacts on observers relate to changes in available views of the landscape, and the effect of these changes on people. The visual impact of a proposed development has to consider the sensitivity of an observer, or observer group, and the scale of the visual impact. There is also a philosophical aspect to an observer's sensitivity to landscape changes, notably whether or not the observer supports aquaculture usages in the region. Unlike the siting of a new farm, fish rearing pens including those at Inishfarnard have been a normal part of the landscape in Kenmare Bay and the shore base a permanent and normal part of the shoreline during this period.

Since first introduced into the bay, pen design and mooring arrangements have changed over the years and pens, top nets and ancillary equipment are now designed to have as minimal visual impact on the environment as possible. Although the present proposal will see an increase in the areas in the bay where pens are moored compared to previous arrangements, the pens are only visible from the vantage points as outlined above. However, given the topography of the coastline, the potential visible impact is limited for passing traffic as the aquaculture site is only fully visible from **vantage point 1**, **vantage point 2** and **vantage point 3** (see **Figure 13-3**, **Figure 13-4** and **Figure 13-5** respectively). Based on the definition of sensitivity and magnitude as given in **Figure 13-1** and **Figure 13-2** above, the significance of the visual impact from all vantage points would be classified as moderate for new installations. However, compared to the present situation with an existing shore base and four licensed blocks in the bay, the significance of the visual impact from all vantage points would be classified as slight or **negligible**. If approved the renewed licence will have **no significant effects** on landscape and visual resources.

13.4. Mitigation Measures

The application includes a request to change the boundaries of the site from 25.94ha to 52.73ha and operations from 12 pens to 16 pens. MOWI Ireland undertake to make every effort to maintain the site in good order utilising pens and associated moorings, buoys, top nets etc. in a way to have minimal impact as possible on the environment.

14. Cumulative Impact Assessment

The cumulative impact of the renewal of the licence for the Inishfarnard site and any other projects in the vicinity (existing or permitted) was examined during the EIA procedure.

The only projects that could have the potential to give rise to cumulative impacts are salmon farms within Kenmare Bay (see **Table 11.4 Section 11.2.1.6** for further details). The sites considered in the assessment of potential cumulative effect include salmon farms at Deenish Island, Doon Point, and Killmackillogue Harbour.

The site at Deenish island is currently operated by MOWI. As part of a licence renewal application for the Deenish site, an AA Screening and NIS[26] has been prepared to address Article 6(3) obligations under EC Directive 92/43/EEC and an EIA[27] undertaken to address the Directive 2011/92/EU as amended by Directive 2014/52/EU. The AA Screening and NIS, and EIA concluded that the proposed operations at the Deenish site will not result in significant environmental effects on the site or the wider surrounding environment.

For the current study, the assessment of cumulative impacts identified that the only aspects of the Deenish and Inishfarnard projects that could give rise to potential cumulative impacts are discharges from the farms; the potential discharges identified include nutrient, biological oxygen demand (BOD), and lice larvae. The modelling exercises undertaken for the Inishfarnard site (presented in **Appendix 8**) and the Deenish site showed no potential combined effect on nutrient, BOD, and sea lice larvae discharges from the sites as the respective plumes do not combine being separated by the deep Kenmare Bay channel with limited northerly or southerly flows (i.e., limited hydraulic connection between the sites).

While the farms at Doon Point and Kilmakilloge Harbour are currently unstocked, and have been so for some time, licence renewal applications for the sites have been submitted to the DAFM. If the licence applications are approved, there is potential that the sites could be stocked in the future and at the same time as other sites in the bay, and the potential for cumulative impact must be considered. As is the case for the Deenish, the aspects of the Doon Point and Kilmakilloge Harbour farms that could give

[26] Document File Name: *JN1524 Deenish NIS - Volume 1 - Main Report, JN1524 Deenish NIS - Volume 2 - Appendices*

[27] Document File Name: *JN1524 Deenish EIA - Volume 1 – Non-technical Summary, JN1524 Deenish EIA - Volume 2 - Main Report, JN1524 Deenish EIA - Volume 3 - Appendices*

rise to cumulative impacts with the Inishfarnard farm are discharges from the farms (*i.e*., nutrients, BOD, and sea lice larvae). The modelling exercise undertaken for the Inishfarnard farm (presented in **Appendix 8**) shows that the nutrient, BOD, and sea lice larvae discharge plumes from the farm are largely localised to the site, and that discharge levels are generally not discernible from background concentrations within relatively short distances from the sites. The small spatial footprint and the low concentrations of the discharges, coupled with the fact that the Inishfarnard site is located 4 km from the nearest aquaculture site at Doon Point, it can be concluded that there will be no cumulative impacts on nutrient, BOD, and sea lice larvae level.

In conclusion, discharges from the farms within the Bay will not interact and result in cumulative impacts. It is concluded that **cumulative impacts can be excluded**.

15. Difficulties Encountered

No difficulties were encountered during the production of this report.

16. Conclusions

This EIA has been undertaken so as to ensure the competent authority is enabled to make an informed decision in accordance with the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU. The decision to be made for an EIA is whether the proposed aquaculture operations at the Inishfarnard site is or is not likely to have significant effects on the environment.

Based on the nature of the proposed site operations, this EIA appraisal has concluded that the proposed operations are not likely to have a significant effect on the environment.

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