Environmental Impact Assessment

Volume 2 - Main Report

Renewal of Marine Finfish Aquaculture Licence at Deenish Island, Co. Kerry

Licence Ref: AQ199 - Licence Site Ref: T6/202

Produced by

AQUAFACT International Services Ltd

On behalf of

MOWI Ireland

December 2020

AQUAFACT INTERNATIONAL SERVICES LTD.,
12 KILKERRIN PARK,
LIOSBAUN, TUAM RD., GALWAY.
www.aquafact.ie
info@aquafact.ie
tel +353 (0) 91 756812

Report Approval Sheet

Client	MOWI Ireland
Report Title	Environmental Impact Assessment - Volume 2 - Main Report - Renewal of Marine Finfish Aquaculture Licence at Deenish Island, Co. Kerry - Licence Ref: AQ198 - Licence Site Ref: T6/202
Job Number	JN1524
Report Status	Draft
Issue Date	14/12/2020

Rev	Status	Issue Date	Document File Name	Author (s)	Approved by:
1	Final	14/12/2020	JN1524 Deenish EIA - Volume 1 - Main Report	Louis Maloney James Forde	Mark Costelloe

AQUAFACT

Table of Contents

List of Figures

List of Tables

Appendices[1]

Appendix 1 Licence AQ199 Cover Page

Appendix 2 MOWI Standard Operating Procedures I

- Appendix 2.1 Pen Moorings and Decommissioning
- Appendix 2.2 Nets
- Appendix 2.3 Fish Movements and Husbandry
- Appendix 2.4 Waste Management and Biosecurity

Appendix 3 MOWI Standard Operating Procedures II

- Appendix 3.1 Fish Health Management
- Appendix 3.2 Material Safety Data Sheets for Positive List of Medicines
- Appendix 3.3 Sea Lice and Sea Lice Treatment
- Appendix 3.4 Predator Control
- Appendix 3.5 Environmental Management Policy

Appendix 4 MOWI Standard Operating Procedures III Emergency Plans

Appendix 5 MOWI Standard Operating Procedures IV Single Bay Management Plans

Appendix 6 Benthic Audits

Appendix 7 Aquaculture Stewardship Council Certification and Survey Report

Appendix 8 Hydrodynamic Modelling

Appendix 9 AA Conclusion Statement by Licensing Authority for Kenmare River SAC

Appendix 10 Special Areas of Conservation and Special Protection Areas

Appendix 11 Archaeological Assessment

Appendix 12 Water Quality Monitoring Data at Deenish 2010-2018

[1] Appendices included in '*Environmental Impact Assessment - Volume 3 – Appendices - Renewal of Marine Finfish Licence at Deenish Island, Co. Kerry - Licence Ref: AQ199 – Licence Site Ref: T6/202*'.

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 licence AQ199. Licence AQ199 relates to one site, namely T6/202 (the site is also referred to herein as the Deenish site). The site is located off Deenish Island, a small island situated approximately 5 km off the Co. Kerry coast between Ballinskelligs Bay and Kenmare Bay (see **Figure 1-1**).

The aquaculture licence renewal application for Licence AQ199, which is submitted under the Fisheries (Amendment) Act, 1997 and the Foreshore Act, 1933, includes a request to **1)** amend the boundaries of the licenced area and **2)** amend operating conditions attached to the licence.

1) Amendment to Site Boundaries:

The boundaries of the existing site are shown in red in **Figure 1-1**. For the aquaculture licence renewal application for Licence AQ199, the applicant requests that the boundaries of the licensed area be amended to those shown in blue in **Figure 1-1**.

2) Amendment to Licence Operating Conditions:

The existing licence has an annual harvest restriction of 500 tonnes and an allowable input of 400,000 fish. A temporary amendment to the licence was granted in 2011 under special conditions and upheld by ALAB in 2012 to change the licence specification to input 800,000 smolts every second or every other year; i.e. the equivalent number (twice) of smolts as the yearly licence, but on a biannual basis and to replace the annual harvest tonnage to a maximum standing biomass as is appropriate to the smolt input number.

For the aquaculture licence renewal application for Licence AQ199, the applicant requests that the operating conditions of the licence be amended to allow a maximum allowable biomass (MAB) of 2,200t at the site if the environmental protocols show no detriment to the environment.

1.2. Purpose of this Report

Specifically, 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).

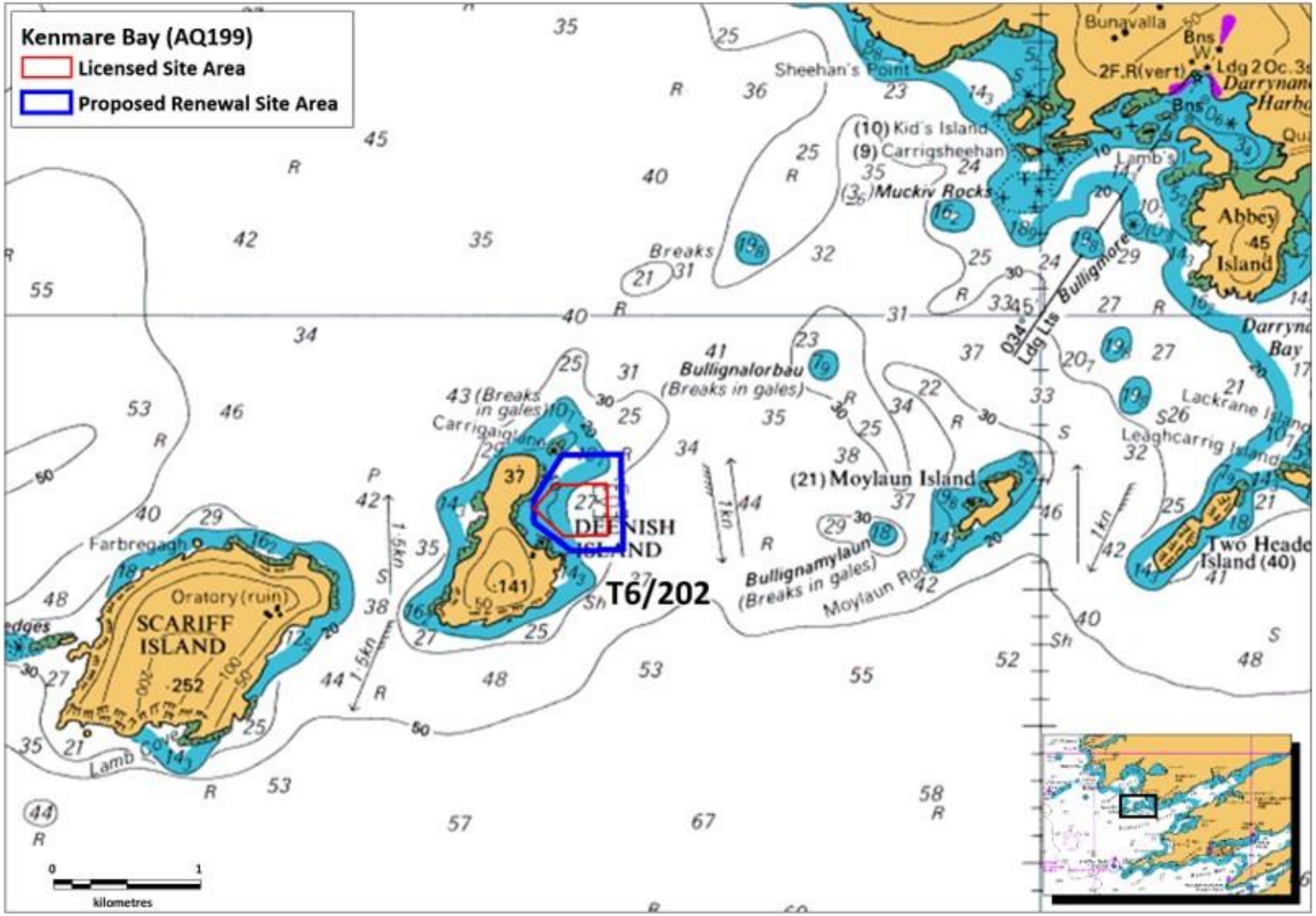


Figure 1-1: Location of the site at Deenish Island. Current site boundaries presented in red, proposed boundaries outlined in blue.

1.3. Environmental Impact Assessment

An EIA was undertaken to support an aquaculture licence renewal application by Comhlucht Iascaireachta Fanad Teoranta for licence AQ199 which is submitted under the Fisheries (Amendment) Act, 1997 and the Foreshore Act, 1933. 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)* (EU, 2017).
- *Environmental Impact Assessment of Projects. Guidance on Scoping (Directive 2011/92/EU as amended by 2014/52/EU)* (EU, 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) (EU, 2017).
- Fisheries (Amendment) Act, 1997.
- Foreshore Act, 1933.
- 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 of 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 subsequentially 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)a 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

The Fisheries (Amendment) Act, 1997 obliges any person wishing to engage in aquaculture on land or in a marine area to be licenced. The Aquaculture (Licence Application) Regulations, 1998 (S.I. No. 236 of 1998) (as amended), specifies how applications for licences should be made using the official Application Form provided, and paying the appropriate Application Fee. The official Application Form is to be used where a Foreshore Licence is also required.

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 AQ199 and the request to change the boundaries of the site and the operating conditions attached to the licence.

Aquaculture licensing arrangements in place under the Fisheries (Amendment) Act, 1997 require public advertisement of all licence applications. 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 Department of Agriculture, Food and Marine (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 11**)	AQUAFACT	AQUAFACT
Cumulative Impacts (**Section 14**)	AQUAFACT	AQUAFACT

2. Site Description/ Existing Environment

The following sections describes the operations that will be undertaken at the site should DAFM approve renewal of the licence and approve the requests to **1)** amend the boundaries of the licenced area and **2)** amend the operating conditions attached to the licence.

For the aquaculture licence renewal application for Licence AQ199, the applicant requests that the operating conditions of the licence be amended to allow a MAB of 2,200t at the site (see **Section 1.1** for details) and change the footprint of the license area from 14.5ha to 33.5ha (see **Section 2.1** for details).

The T6/202 Deenish site is located off the eastern side of the uninhabited Deenish island, which is situated off the coast of Co. Kerry between Ballinskelligs Bay and Kenmare Bay (see **Figure 2-1**). 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 MOWI.

2.1. Area and Layout of the Proposed Site

The boundaries of the existing licenced area are shown in red in **Figure 2-1** with the new proposed boundaries shown in blue. The spatial extent of the existing site is 14.5ha while the spatial extent of the new proposed site is 33.5ha. Coordinates for the corner points of the proposed site denoted in **Figure 2-1** are presented in **Table 2.1**.

Table 2.1: Coordinates and area of proposed aquaculture site.

Site Corner	WGS84		Area (Ha)
	Lat	Long	
NW	51 ° 44’ 30.814911’’	-10º 12’ 51.81302’’	33.5
NE	51 ° 44’ 31.207155’’	-10º 12’ 30.981764’’	
SE	51 ° 44’ 10.19204’’	-10º 12’ 29.957247’’	
SW	51 ° 44’ 9.848952’’	-10º 12’ 48.182258’’	
South Inshore	51 ° 44’ 16.069564’’	-10º 12’ 1.516496’’	
North Inshore	51 ° 44’ 20.919178’’	-10º 12’ 1.753844’’	
NW	51 ° 44’ 30.814911’’	-10º 12’ 51.81302’’	

2.2. Site Description

The location of the aquaculture site in the lee of Deenish Island provides shelter to the site from westerly and southerly swells (**Figure 2-1**). The seafloor underneath the northern pens is primarily flat. Sediments in this area are predominantly sands (ranging to fine and medium sand) with varying proportions of coarse shell fragments. Water depths increase toward the southern pens. The sea floor under the southern pens is uneven and comprises gravel and rocky reef.

In Kenmare Bay, to the northeast of Deenish Island bay, the spring tidal range is typically 3.5m while neap tides range from approximately 1.6m to 1.8m. The flooding tide off the headlands of Kenmare Bay runs north northwest and the ebbing tide runs south. Tidal flows in Kenmare 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. The seabed is relatively deep at the main outer channel of Kenmare Bay range from 60m to 75m while depths in the enclosed bays of Ballinskelligs are generally less than 30m. Water depth along the western boundary of the proposed licenced area closest to Deenish is Island is approximately 6m. Depths increase eastward away from the island reaching approximately 30m and 33m respectively on the northern and southern boundaries.

Neap and spring tide drogue surveys of the tidal stream flows at the Deenish site were conducted in 1997. The drogue surveys found that minimum current magnitudes at the 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.

A hydrographic study undertaken at the site in April to May 2010 showed water currents close to the seabed, at mid-water depth and at the surface were 6.3cm sec^{-1}, 7.9cm sec^{-1} and 9.2cm sec^{-1} respectively. Mean current direction was WNW close to the seabed, WNW/ NW at mid-water and NW at the surface (Watermark, 2012). The maximum tidal range was 3.41m on Spring tides. Minimum tidal range was 1.44m.

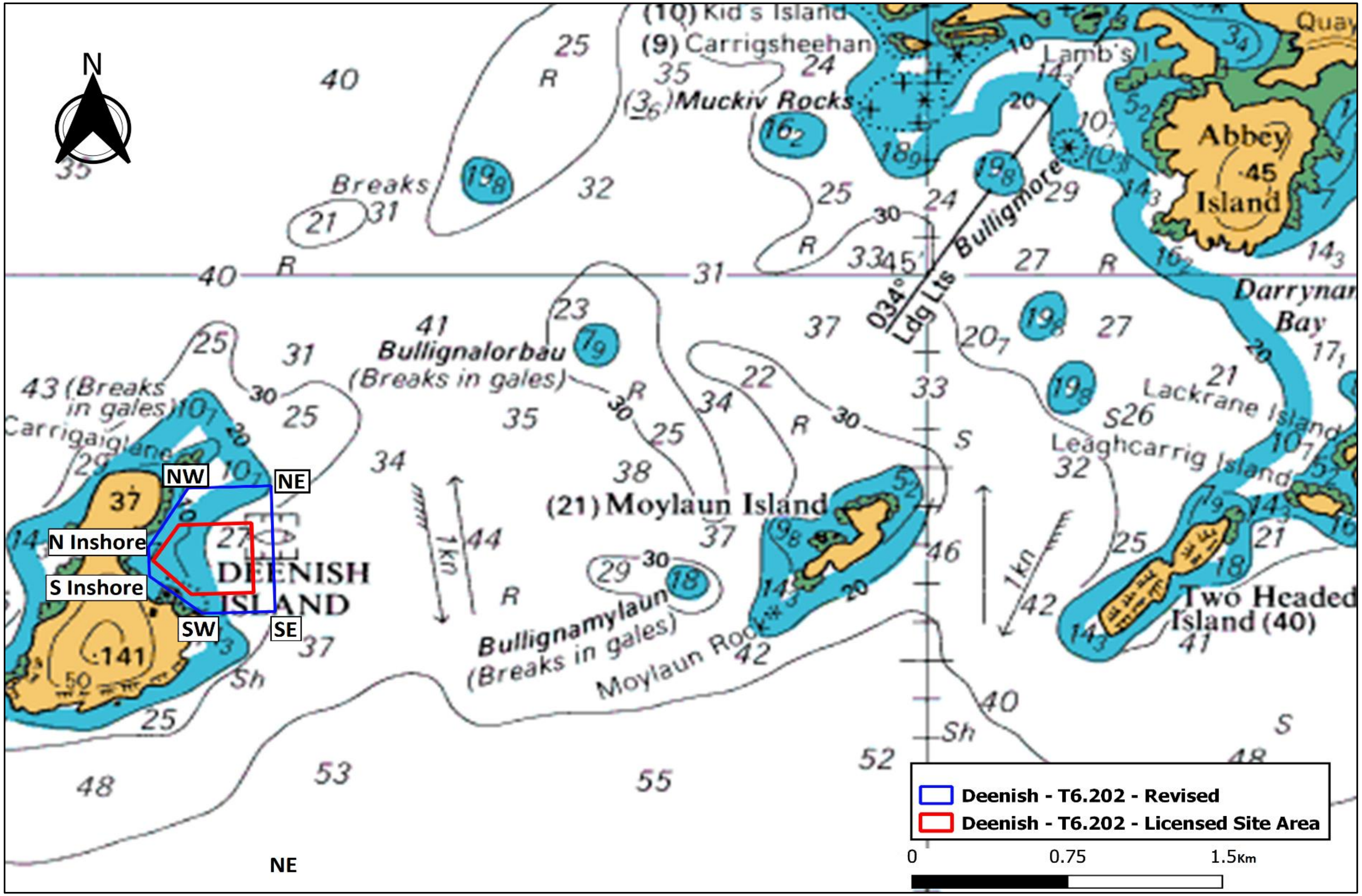


Figure 2-1: Location of the site at Deenish Island, Co. Kerry. Current site boundaries presented in red, proposed boundaries outlined in blue. Coordinates for the corner point of the proposed site are presented in Table 2.1.

2.3. Pens

A maximum of 15 Aqualine pens will be deployed at the site. The pen at the site will be set out in a 5 x 3 grid arrangement (see **Figure 2-3**). Corner site buoys with navigational lights (4 sec 2 mile) will be located at the corners of the licenced sites as illustrated in **Figure 2-3** which shows the farm layout.

The pens will have a 100m circumference, a diameter of 40m, a net wall depth of 8m and a depth to the cone of 10m. The total capacity will be 41,422 m^3 (6,904m^3 per pen). These will be supported within 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; see **Figure 2-4**.

Each pen will be held in place in a mooring square with squares secured together in a mooring grid. The side dimensions of each square will be 70m x 70m. The dimensions of the entire grid will be 350m x 210m. Aerial and cross-section views of the pens at the site are shown in **Figure 2-5** through **Figure 2-7.**

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. Sinker tubes will also be used (35kg/m). Fence nets and bird (top) nets will be supported off the handrails and stanchions. There will be radar reflectors on the pens.

2.4. Pen Moorings

The pens will be held to in the mooring grid by mooring bridles attached to the pen floatation rings. There will be four sets of 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. Single 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 site are shown in are shown in **Figure 2-8**.

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 anchors will be a combination of 1,000, 1,500kg and 2,000kg plough anchors with respective holding capacities of 20T, 30T and 40T. Axial anchors will be 1,500kg plough anchors with holding capacities of 30T. Mooring bridles will be used to connect the four corners of each grid square to at least eight points on 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. The deployment and mooring of the pens are covered by Standard Operating Procedure (SOP) *SOP25462* and *SOP26638*, see **Appendix 2.1**. 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; see *SOP28940* in **Appendix 2.1.**

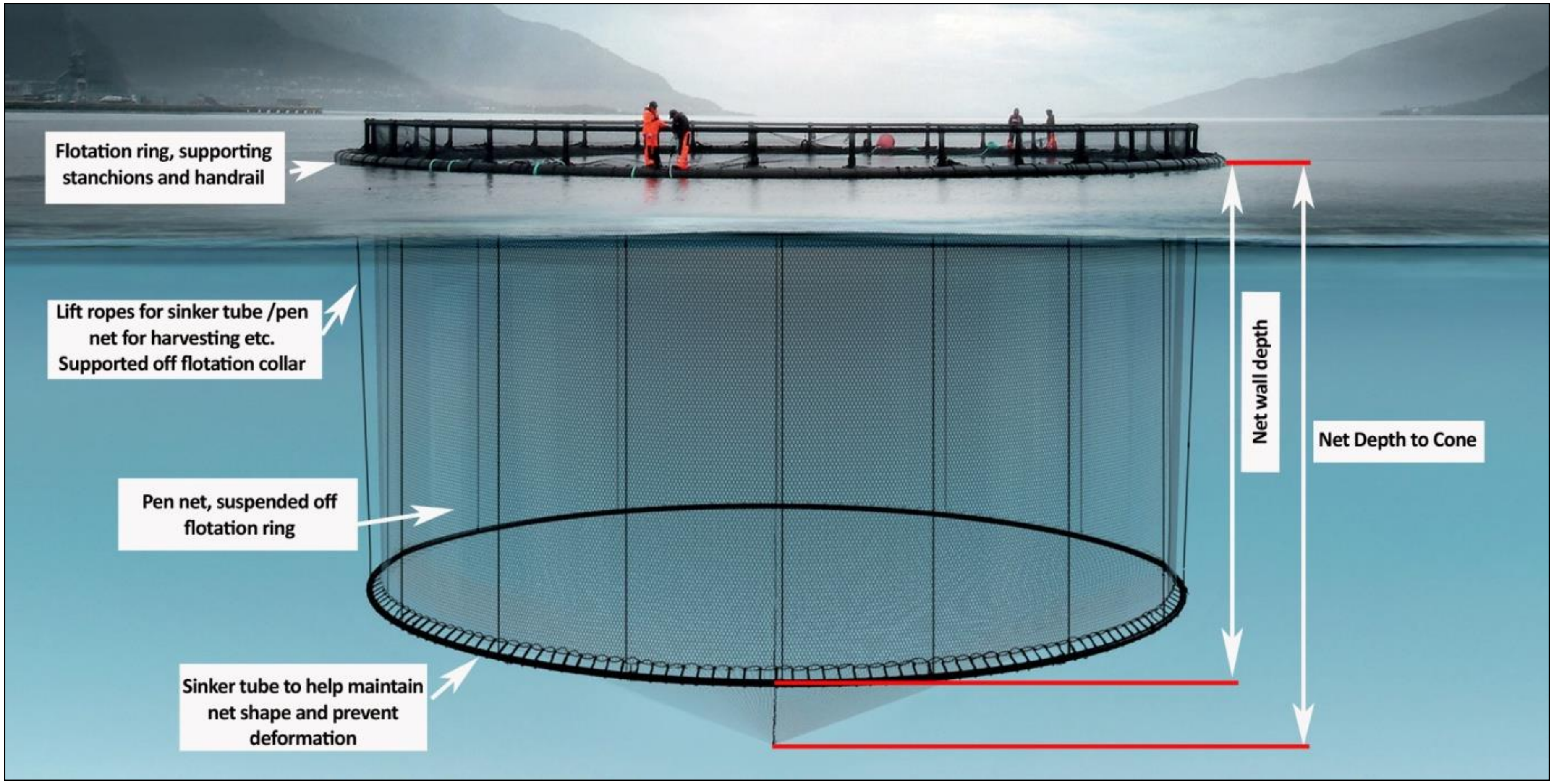


Figure 2-2: Image showing the general nature of the pen type proposed for the Deenish site (Source: Akvagroup; modified from www.akvagroup.com).

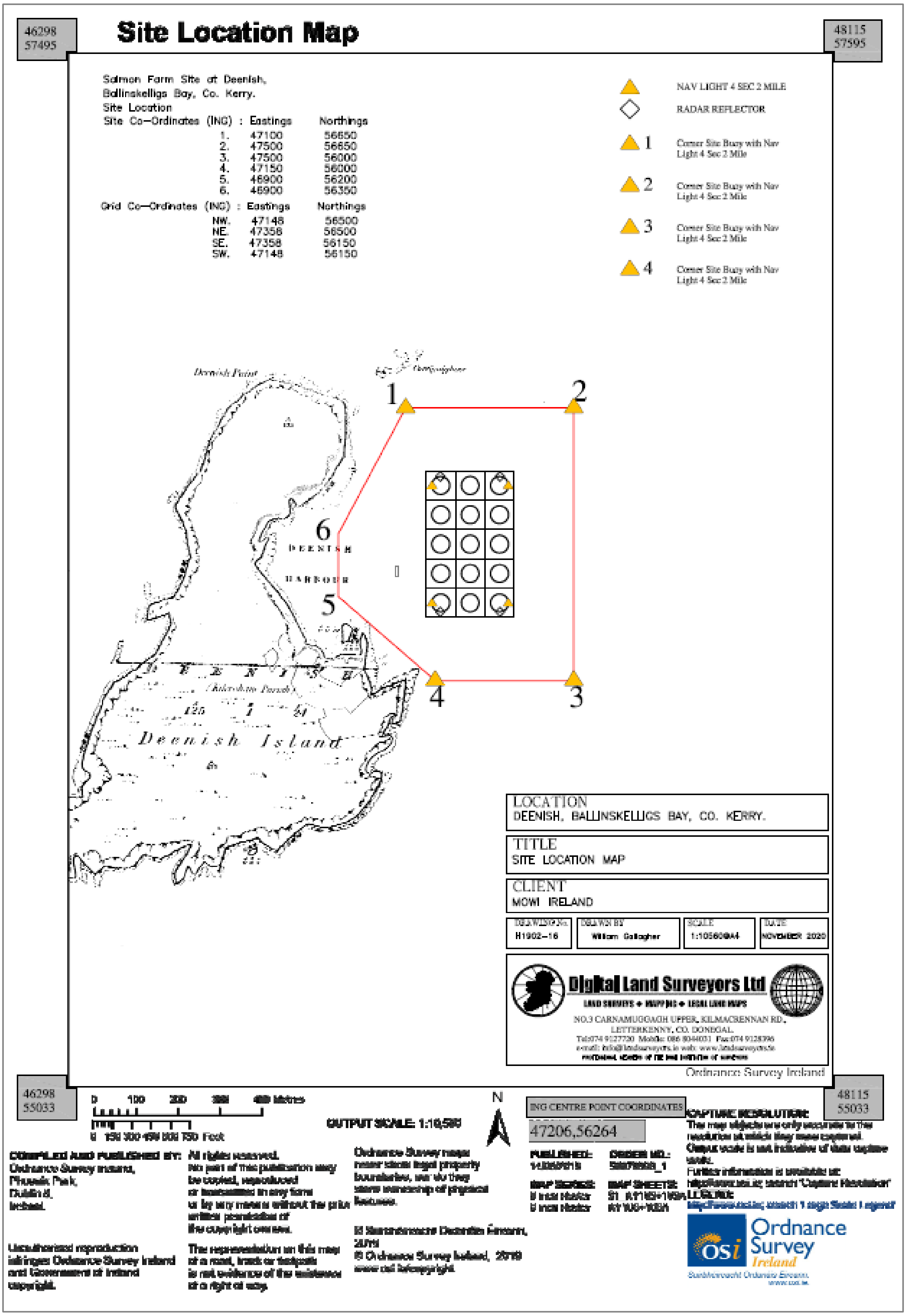


Figure 2-3: Proposed pen and farm layout at the proposed Deenish site.

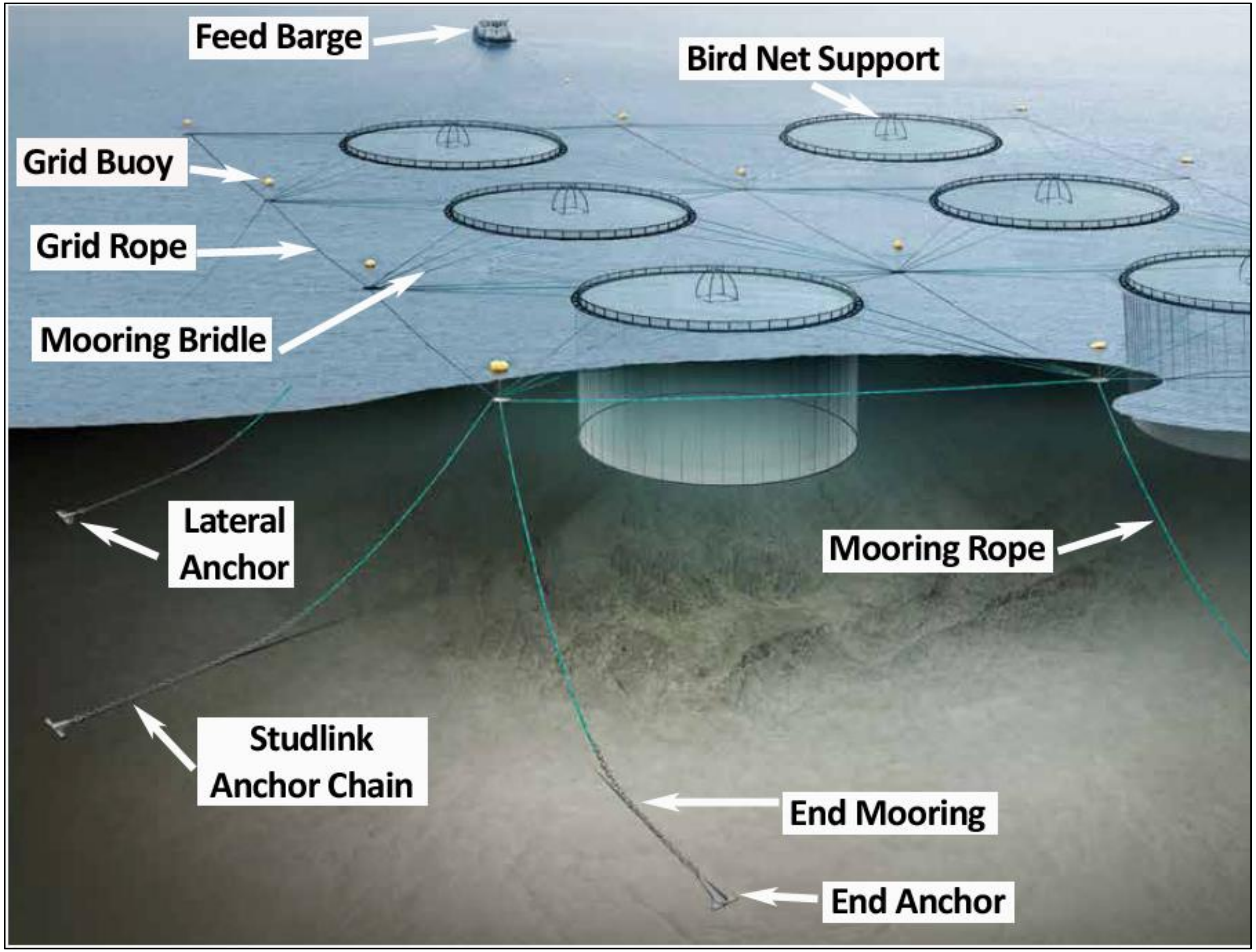


Figure 2-4: Generalised pen and farm layout with associated moorings (Source: Akvagroup; modified www.akvagroup.com).

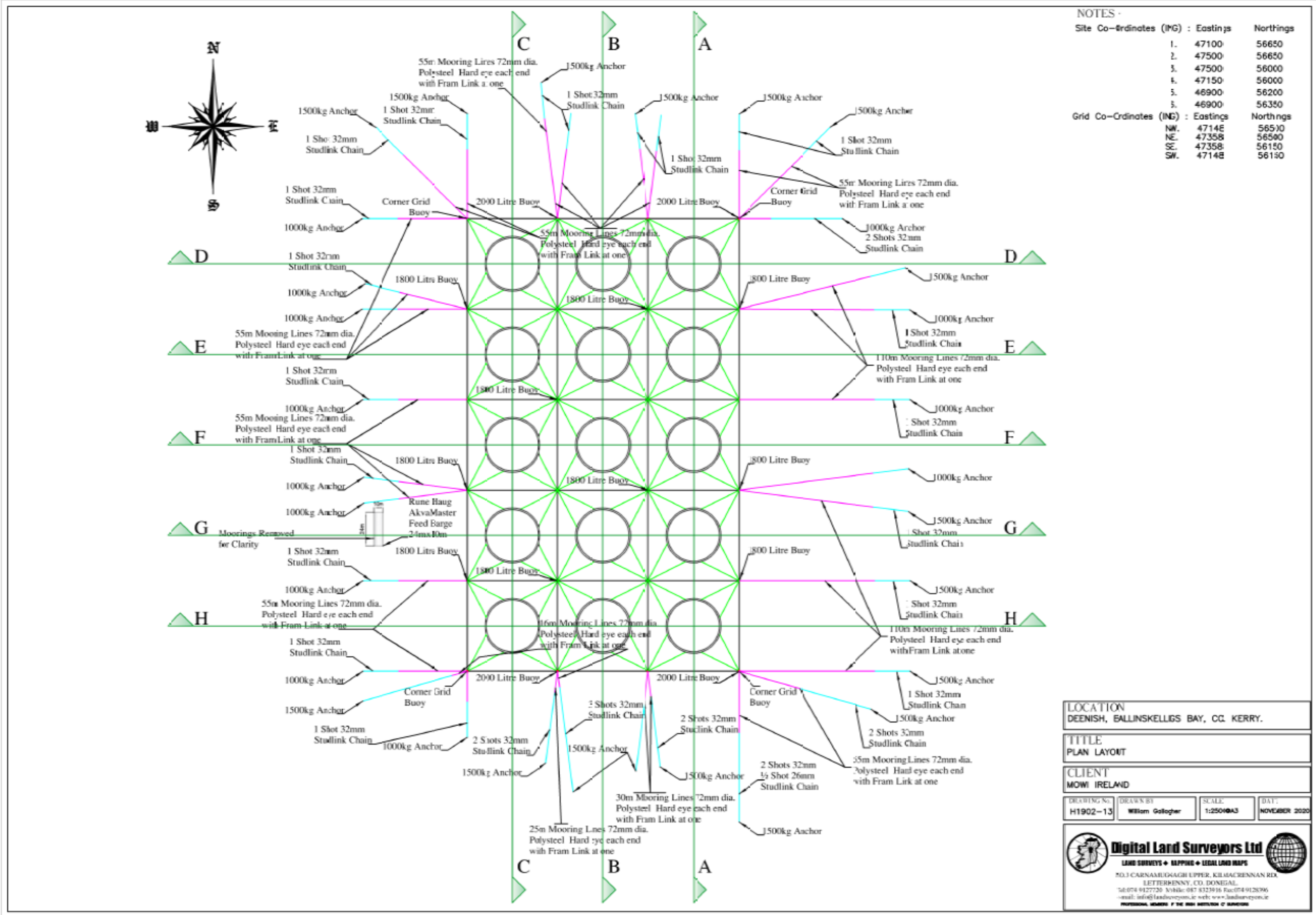


Figure 2-5 Pen layout at for the proposed Deenish site.

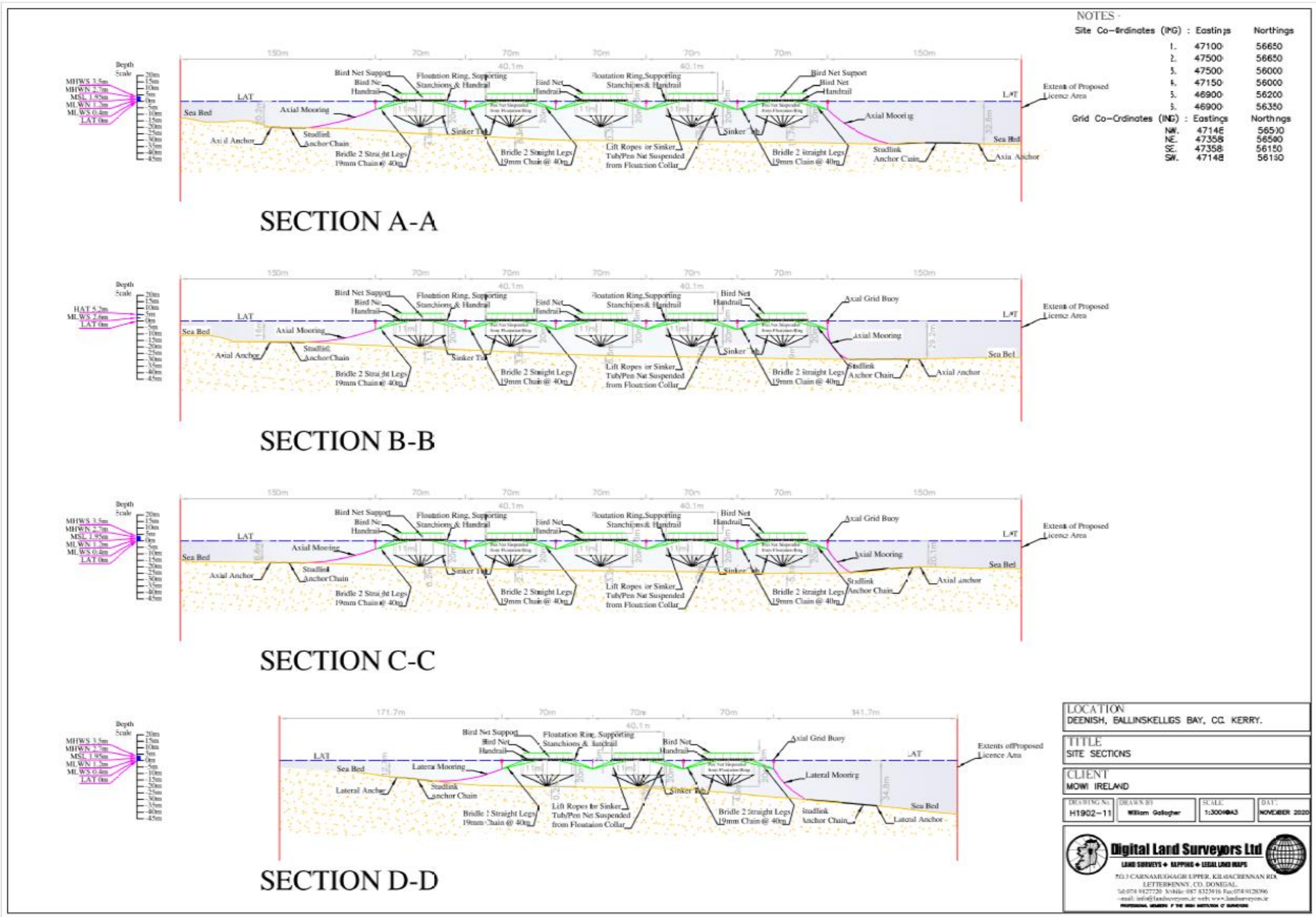


Figure 2-6: Cross-section of pen layout for the Deenish site.

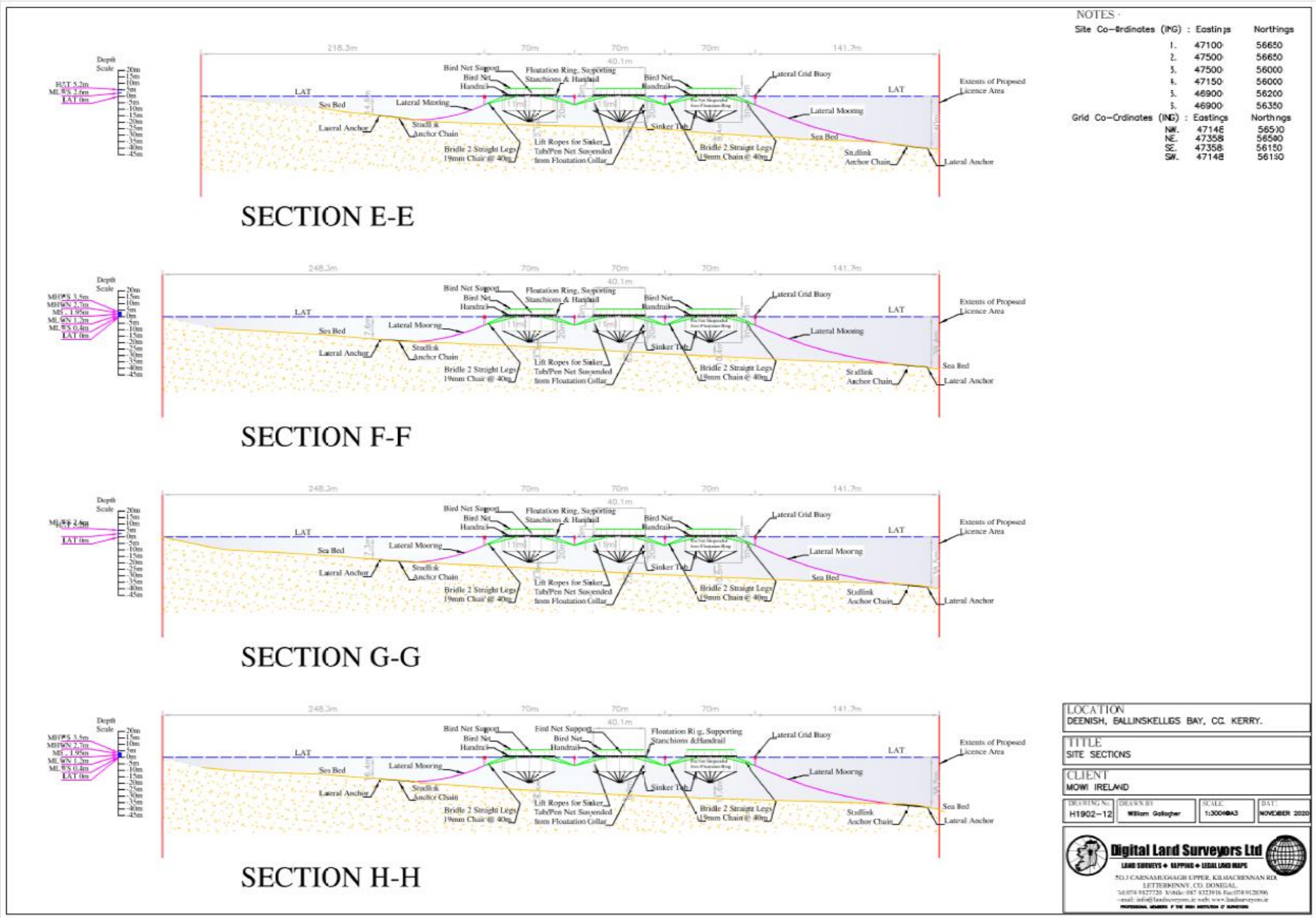


Figure 2-7: Cross-section of pen layout for the Deenish site.

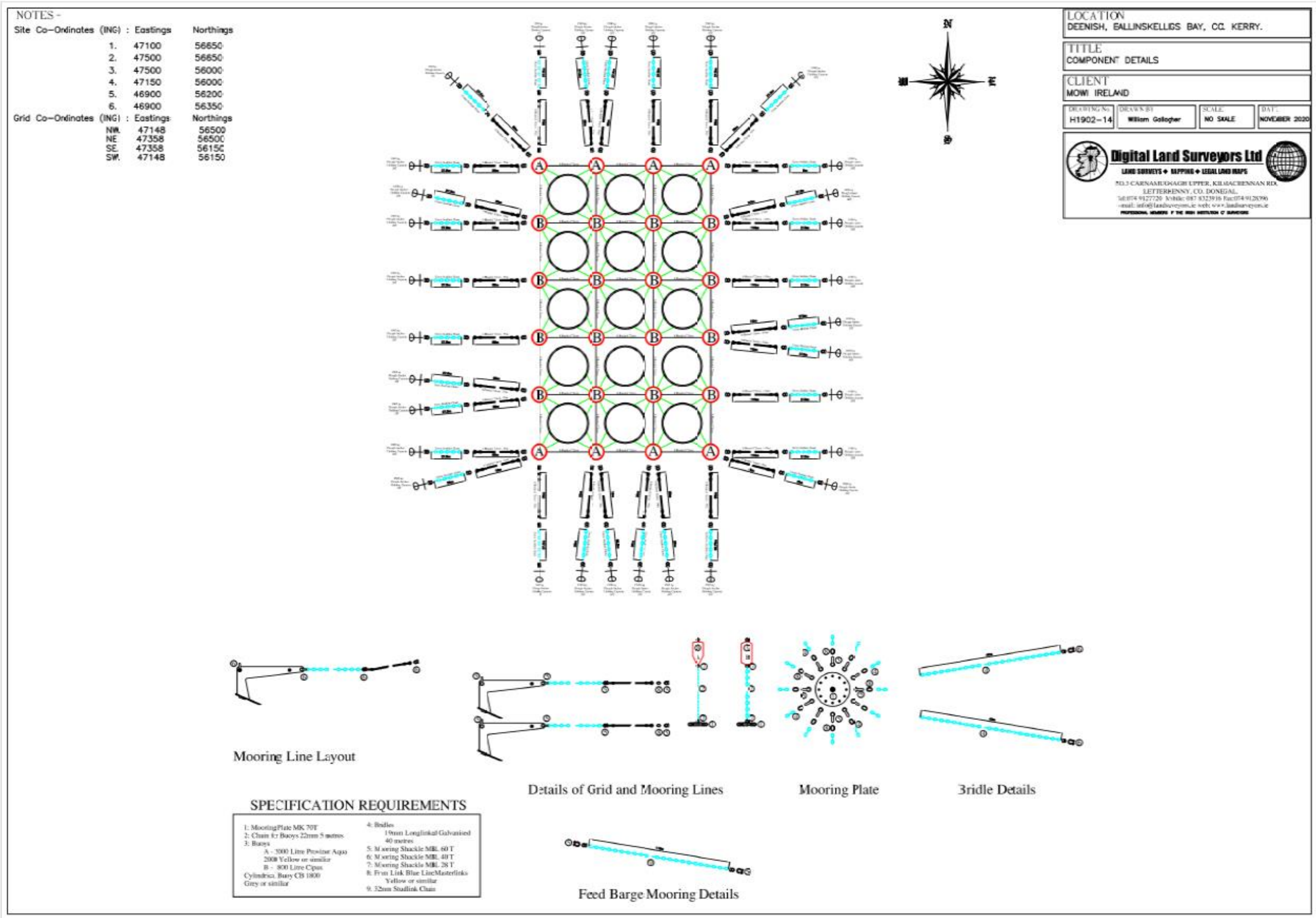


Figure 2-8: Moorings at the Deenish site.

2.5. 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 16mm (210/96 Nylon IRC 460g/m^2) braided twine, with a 15mm mesh. The smolt nets will be changed in the late spring after about six months and replaced with grower nets, made of 22mm-25mm (210/150 Nylon IRC 500g/m^2) braided twine with a mesh size of 22-25mm. Full specifications of nets and roping are provided in **Appendix 2.2**.

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 2-9**. 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. The specifications and installation of the bird netting is outlined in **Appendix 2.2**.

2.6. Shore Based Facilities

Figure 2-10 shows the access routes to and from the aquaculture site. Feed storage, diving and staff facilities will be located at the Cork County Council pier at Travara (denoted 4 on **Figure 2-10**). The pier will also be the main access point for service vessels to and from shore and will serve as the mooring point for vessels when not in use.

Figure 2-11 shows the access routes to Travara pier from the R571 and R575 regional roads which may be used by staff accessing the pier. Vessels that may be travelling between multiple locations (such as the wellboat) 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 Wellboat 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 Christina R harvest vessel.

A 22-ton articulated lorry operated by O'Callaghan transport will bring feed to the site at a minimum 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 will bring the fish to the processing factory, the regularity depending on the harvest schedule.

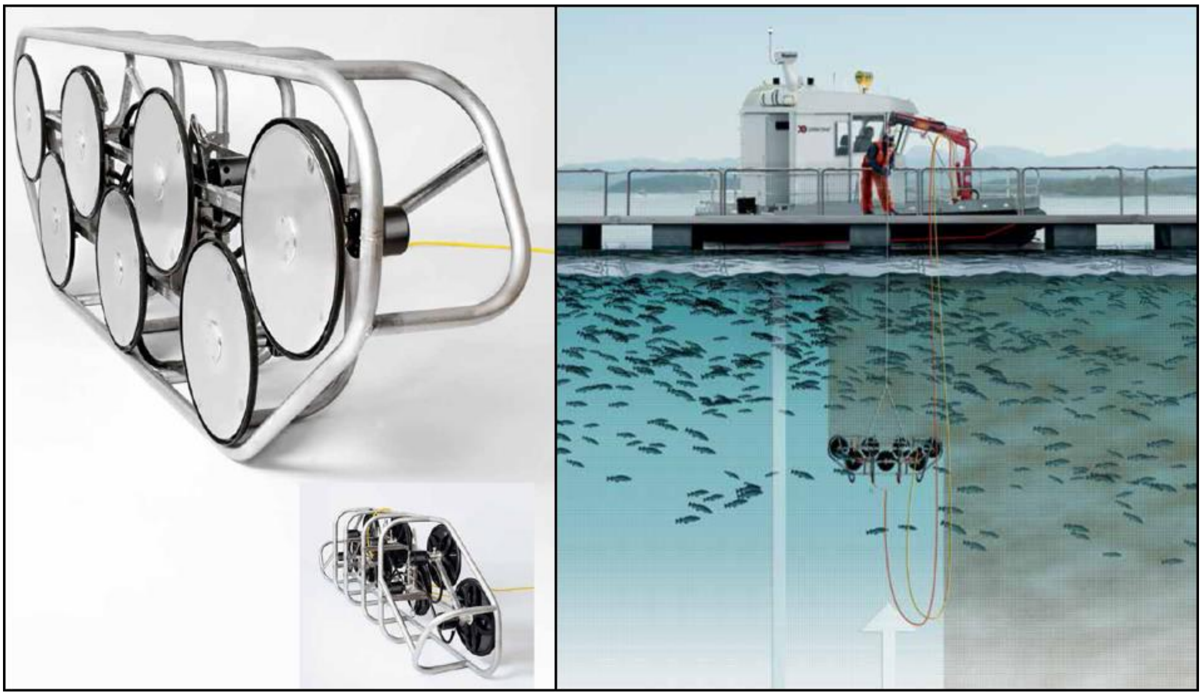


Figure 2-9: Net cleaning with the IDEMA net washer (© Akvagroup; www.akvagroup.com).

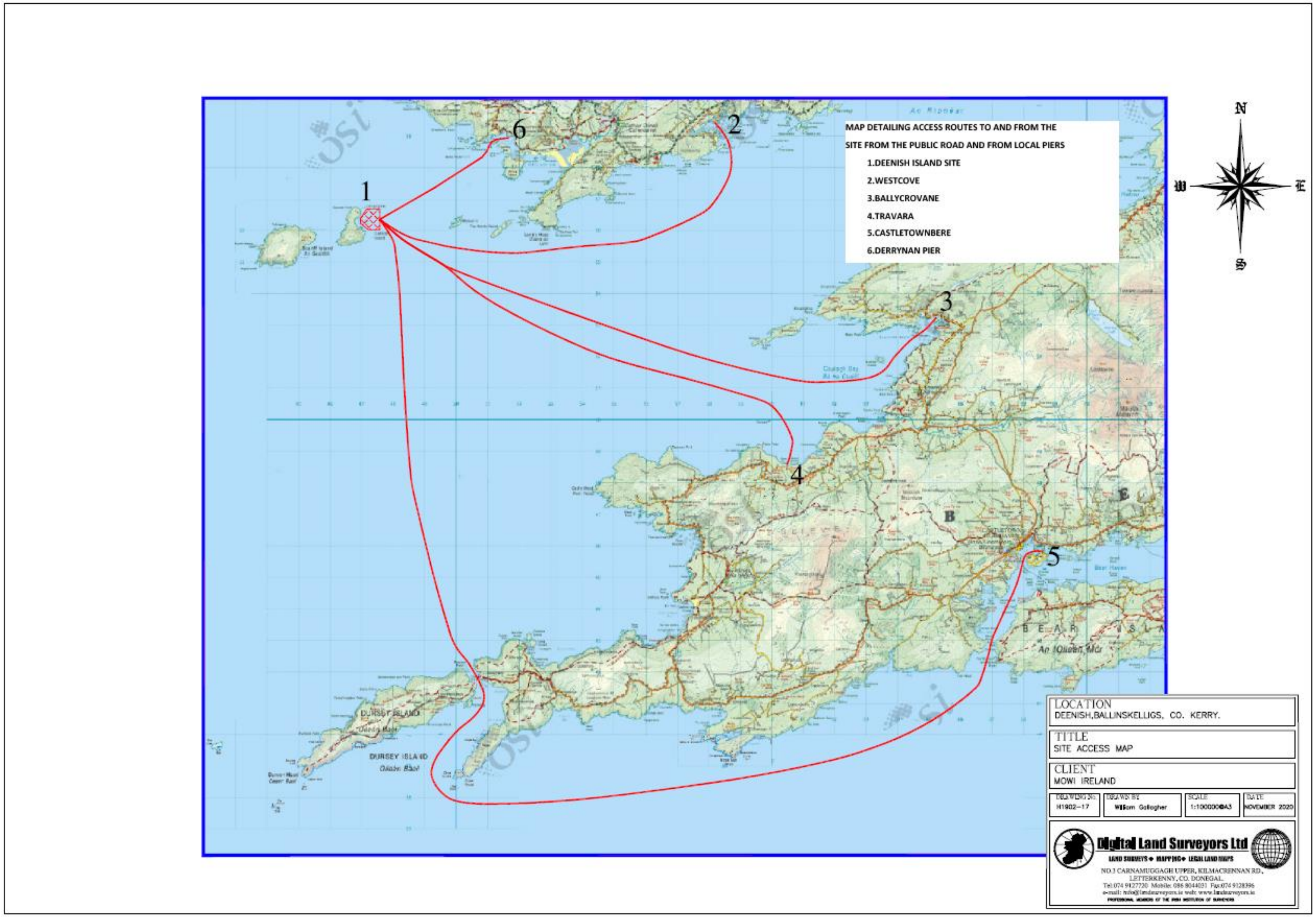


Figure 2-10: Access route to and from the site.

Figure 2-11: Access routes to and from the onshore facilities from the main R571 and R575 road.

2.7. Service vessels

The sites will be serviced by the following vessels:

- 1 x 16m twin engine workboat with 30tm crane (MV Orchid).
- 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, 50kg 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).

2.8. 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 2.2 shows the production and harvest models for the Deenish 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 (March). The smolts will be S1 (full year) 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 2.2** at peak stocking density of ≤ 10kg/m^3. Model estimate of 9.5m^3 illustrated in red text in **Table 2.2**.

Peak biomass will occur between June and July of Year 2 in each production cycle (see **Table 2.2**). 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 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 the site is projected to be 1.25:1 (see **Table 2.2**). 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 (see **Section 2.10.4**). 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 2.2 shows that the intended maximum stocking density of fish at the 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 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 2.2: Production cycle for T6/202.

Year	Month	Months growth	Fish number begin month	Fish number end month	Mortality per month %	Mortality number/ month	Mean weight gms begin month	Mean weight gms end month	Total Biomass T begin month	Total Biomass T end month	Mean SD @ pen volume 230,165	Biogain / month T	Harvest Number	Harvest MW kg	Harvest Tonnes	FCR	Feed used T / month
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	269.6	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

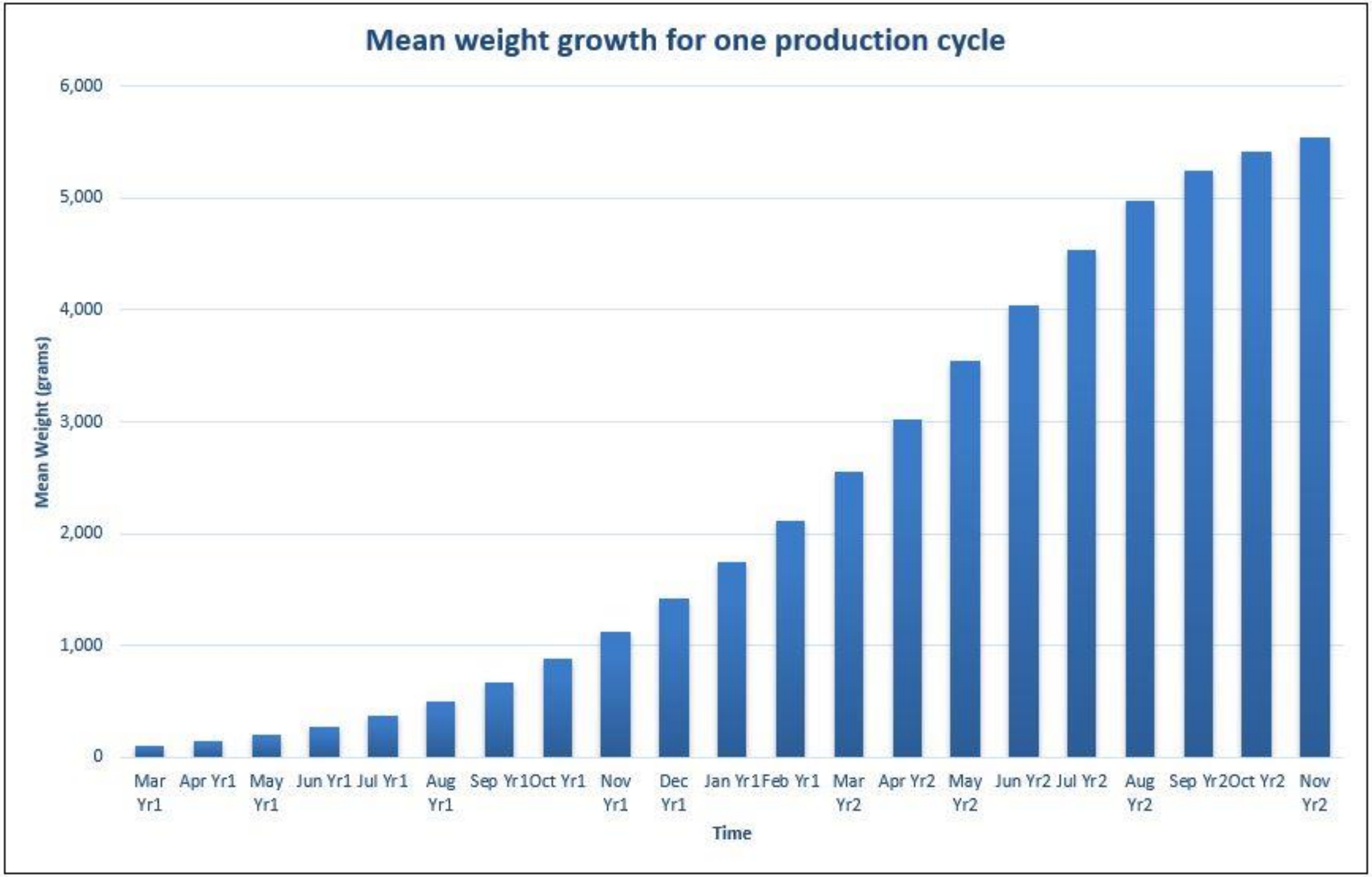


Figure 2-13: Mean weight growth for one production cycle.

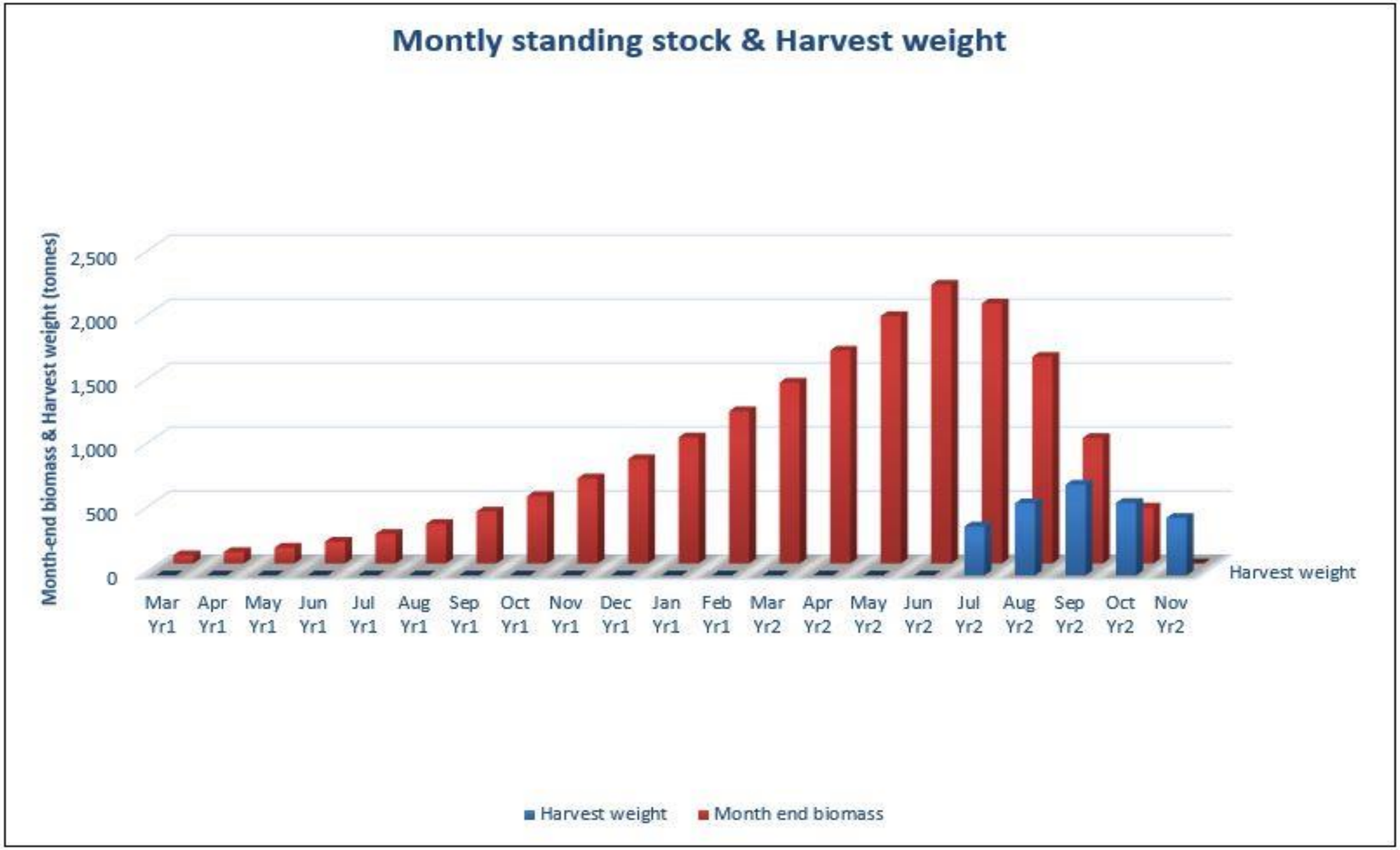


Figure 2-14: Total stock and harvest biomass for three production cycles.

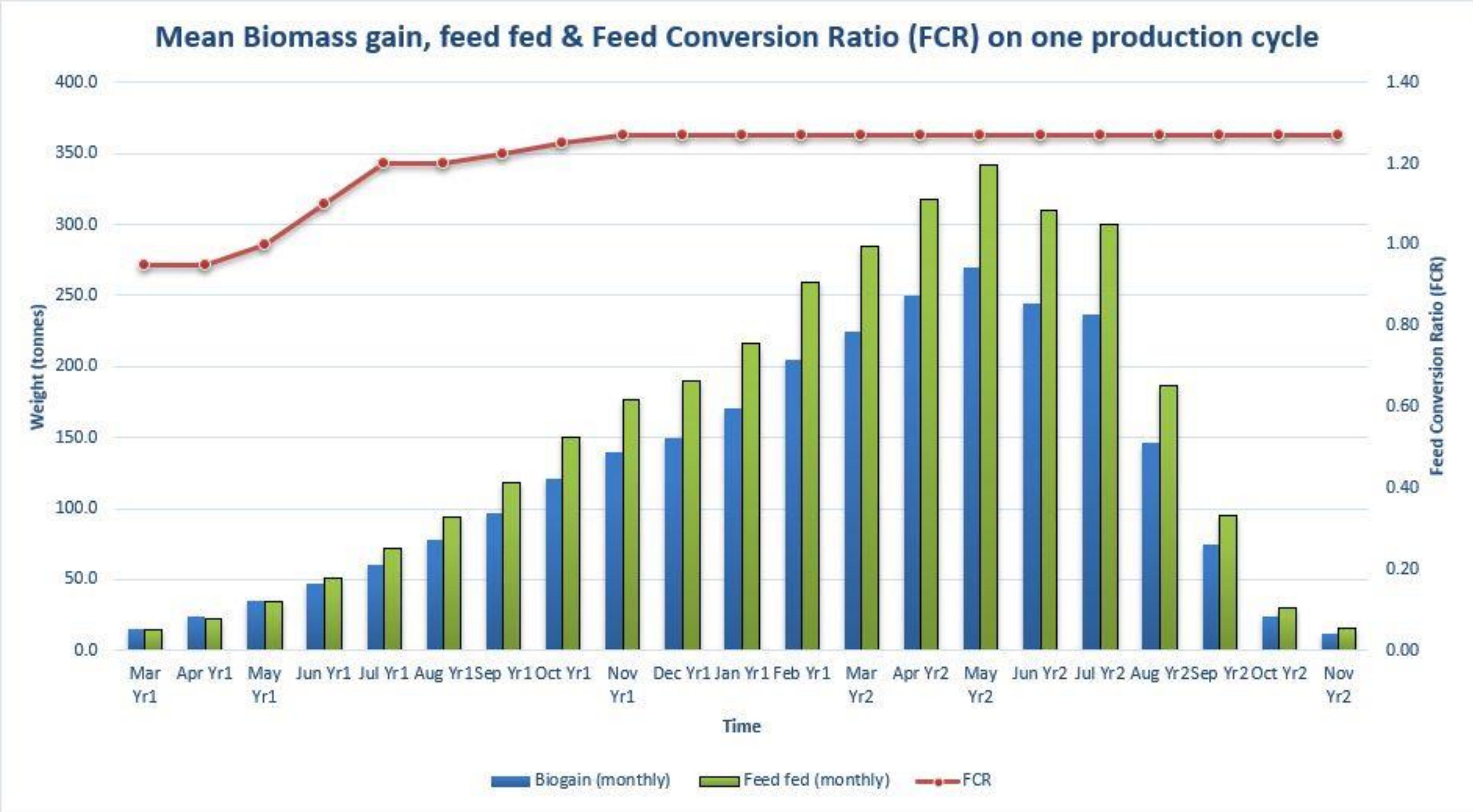


Figure 2-15: Mean Biomass gain, feed fed tonnes and Feed Conversion Ratio (FCR) for one production cycle.

		2018												2019												2020											
Site	Licence No.	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Deenish (Mowi)	AQ 199	Grow out												Grow out																							

Figure 2-16: Proposed stocking and fallowing plan of the Deenish site.

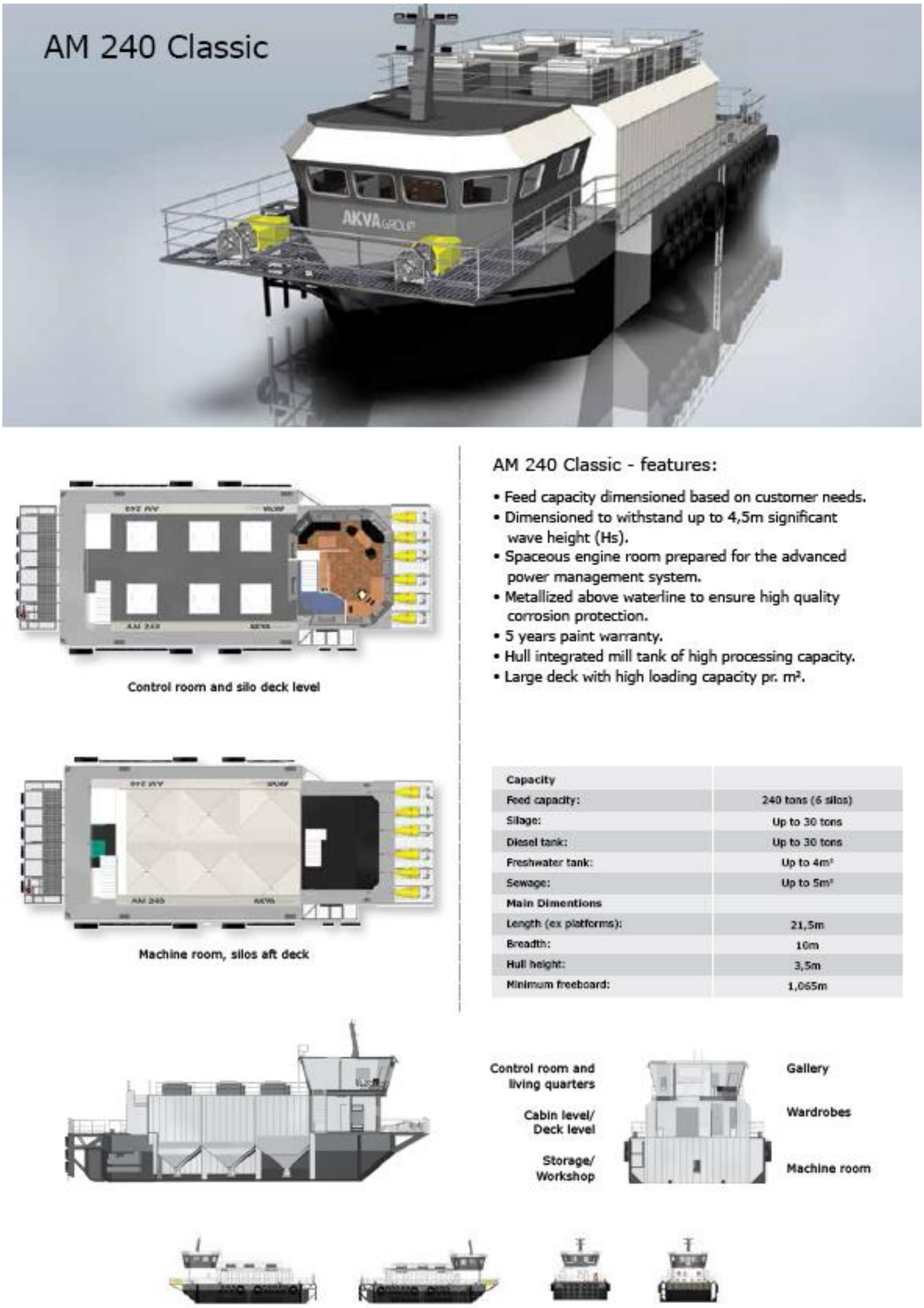
2.9. Feed and Feeding

Salmon at the site farm will be fed organic rations 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). It is the intention of MOWI to manufacture its own organic rations in the future.

The main components of the organic feed 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 and the proposed type is the Akva Master 240 Classic or similar (see **Figure 2-17**). 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 the shore 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 2-18** and **Figure 2-19**). 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*).



AM 240 Classic - features:

- Feed capacity dimensioned based on customer needs.
- Dimensioned to withstand up to 4,5m significant wave height (Hs).
- Spaceous engine room prepared for the advanced power management system.
- Metallized above waterline to ensure high quality corrosion protection.
- 5 years paint warranty.
- Hull integrated mill tank of high processing capacity.
- Large deck with high loading capacity pr. m².

Capacity	
Feed capacity:	240 tons (6 silos)
Silage:	Up to 30 tons
Diesel tank:	Up to 30 tons
Freshwater tank:	Up to 4m³
Sewage:	Up to 5m³
Main Dimentions	
Length (ex platforms):	21,5m
Breadth:	10m
Hull height:	3,5m
Minimum freeboard:	1,065m

Figure 2-17 Specification of proposed AM 240 Classic feed barge (Source: Akvagroup; www.akvagroup.com).

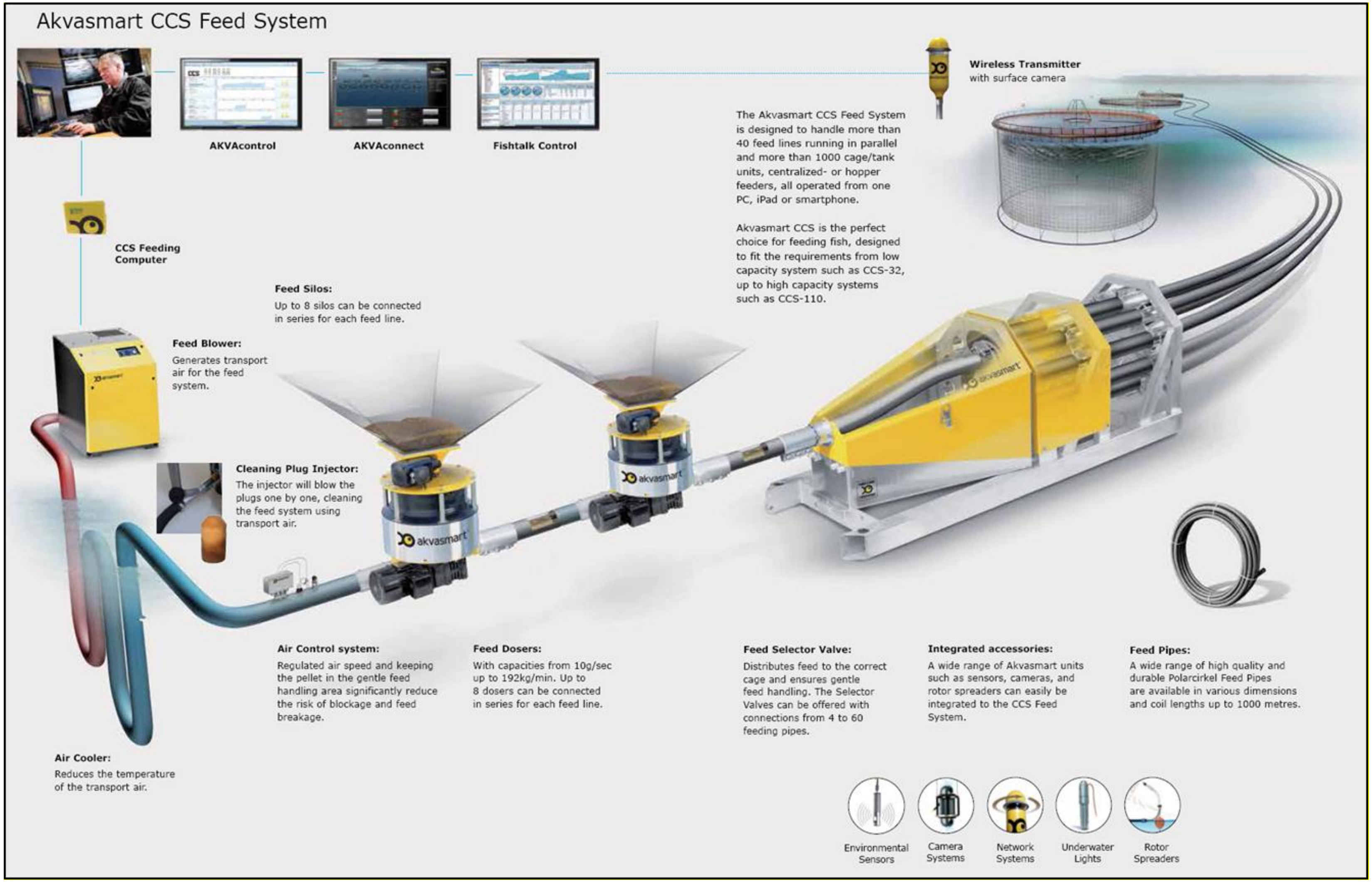


Figure 2-18: Specification of proposed Akvasmart CCS feed system (Source: Akvagroup; www.akvagroup.com).

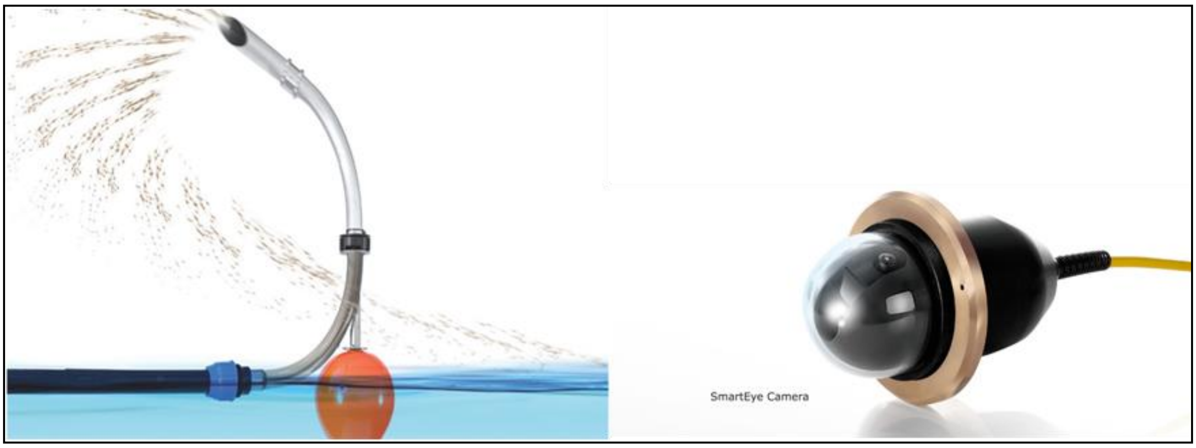


Figure 2-19: Rotor spreader and underwater camera which form part of the automatic feeder system (Source: Akvagroup; www.akvagroup.com).

2.10. Husbandry Management

2.10.1. Smolt Delivery

Smolts will be size-graded and counted at the hatchery prior to transportation to the site. Smolts will be transported by road tankers from the MOWI smolt units at Lough Altan or Pettigo. They will then be loaded onto the MV Grip Transporter well boat for delivery to the 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 2.14** (Accidents and Emergencies).

2.10.2. Grading

Stock is usually graded by either passive or wellboat 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 2-20** 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 2-20: The proposed well boat MV Grip Transporter distributing fish to two pens (© Magnar Lyngstad, MarineTraffic.com).

2.10.3. Harvesting & Processing

The harvesting period for stock at the proposed site will run between months 17 and 22 of the production cycle. Harvesting is the final process in the cycle requiring the use of a well boat. Fish already selected for harvest by passive grading will be pumped into the well boat holding tank and through a de-watering unit from where they will make their way to the percussion unit (SI-5 model; flow-through humane stunning system). The stunned fish will then be carried on to the bleeding table by means of a conveyor belt. They will then be manually cut through one gill arch only. Stunned and bled fish will then be pumped into insulated steel road containers containing a mixture of seawater and ice for transport to the MOWI Packing and Processing Station at Rinmore, County Donegal. The prevention of escapes during harvesting is dealt with in **Section 2.14** (Accidents and Emergencies).

2.10.4. Site Discharges

As detailed in **Section 2.9** (Feed and Feeding), MOWI Ireland will use organic feed at the site. **Table 2.3** and **Table 2.4** shows the proximate analysis and digestibility of this organic feed.

Table 2.5 shows the projected feed requirements for one production cycle based on growth and feed data outlined in **Table 2.2** in **Section 2.8** (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 2.3** and **Table 2.4**), a breakdown of the feed into its soluble and settleable waste components is presented in **Table 2.6**.

Projected feed requirements of one production cycle (**Table 2.5**) and the soluble and settleable waste components of feed used (**Table 2.6**) are used to calculate the following;

1) monthly total BOD of discharges (see **Figure 2-21**).
2) monthly solids (see **Figure 2-22**).
3) monthly carbon discharges (see **Figure 2-23**).
4) monthly nitrogen discharges (see **Figure 2-24**); and
5) monthly phosphorus discharges (see **Figure 2-25**)

Based on these outputs, growth and discharge parameters will increase monthly, from input until the peak site standing stock of 2,200 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 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 2.3: 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 (%)	Phos-phorus (%)	Digesti-ble protein (%)	Protein digesti-bility (%)	Potential FCR	Carbohyd rate (%)	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 2.4 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 2.5: 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 (%)	
				Type	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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	Ecolife	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 (%)	
				Type	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	Ecolife	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	Ecolife	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	**Fallow**																
Total/Av.	**2,623.15**										**3,285.1**	**1,274.5**	**203.9**	**29.9**	**1,696.5**	**83.4**	**89.3**

Table 2.6: 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	**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

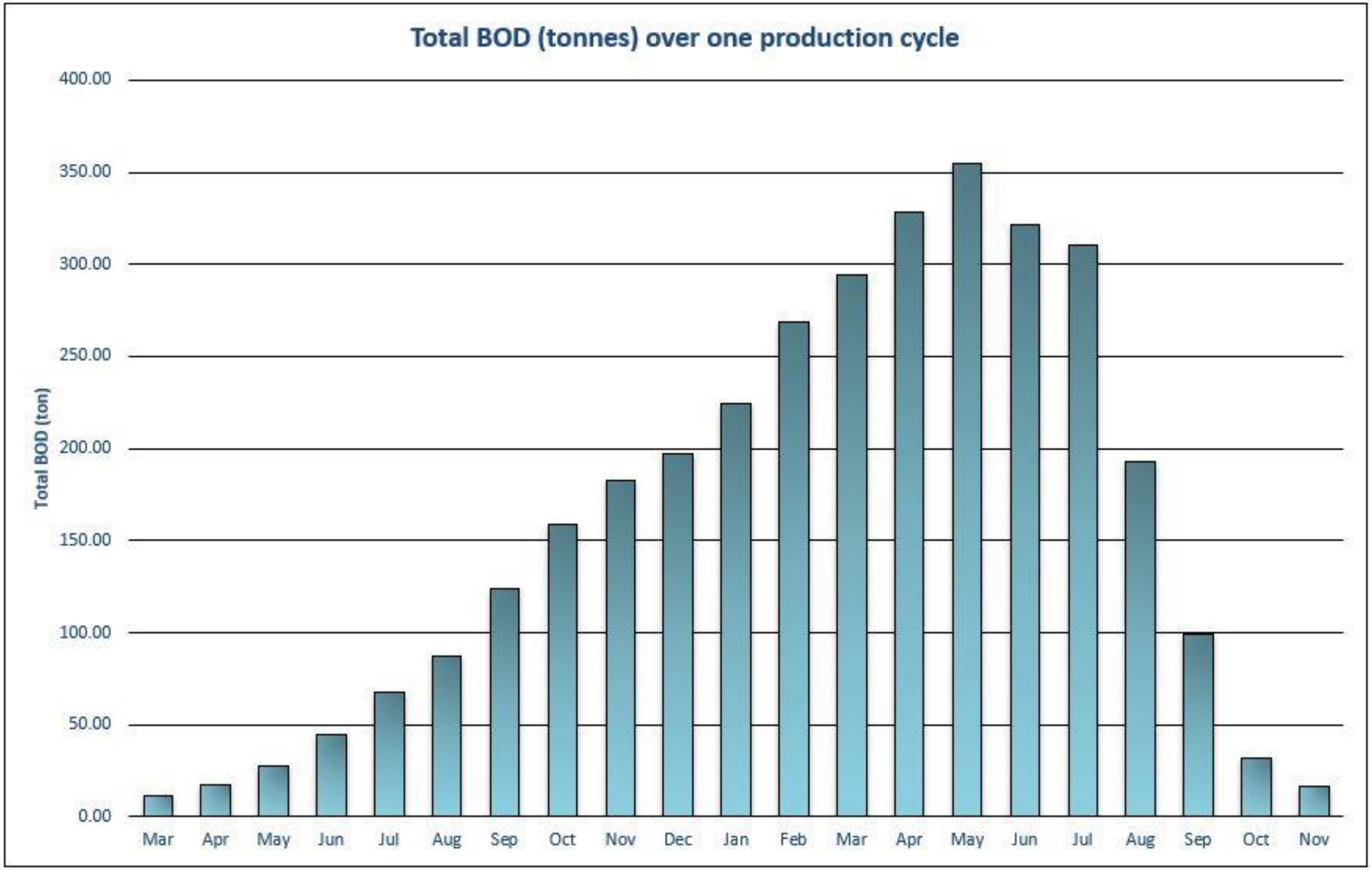


Figure 2-21 Total BOD of waste discharges (tonnes per month) for one production cycle.

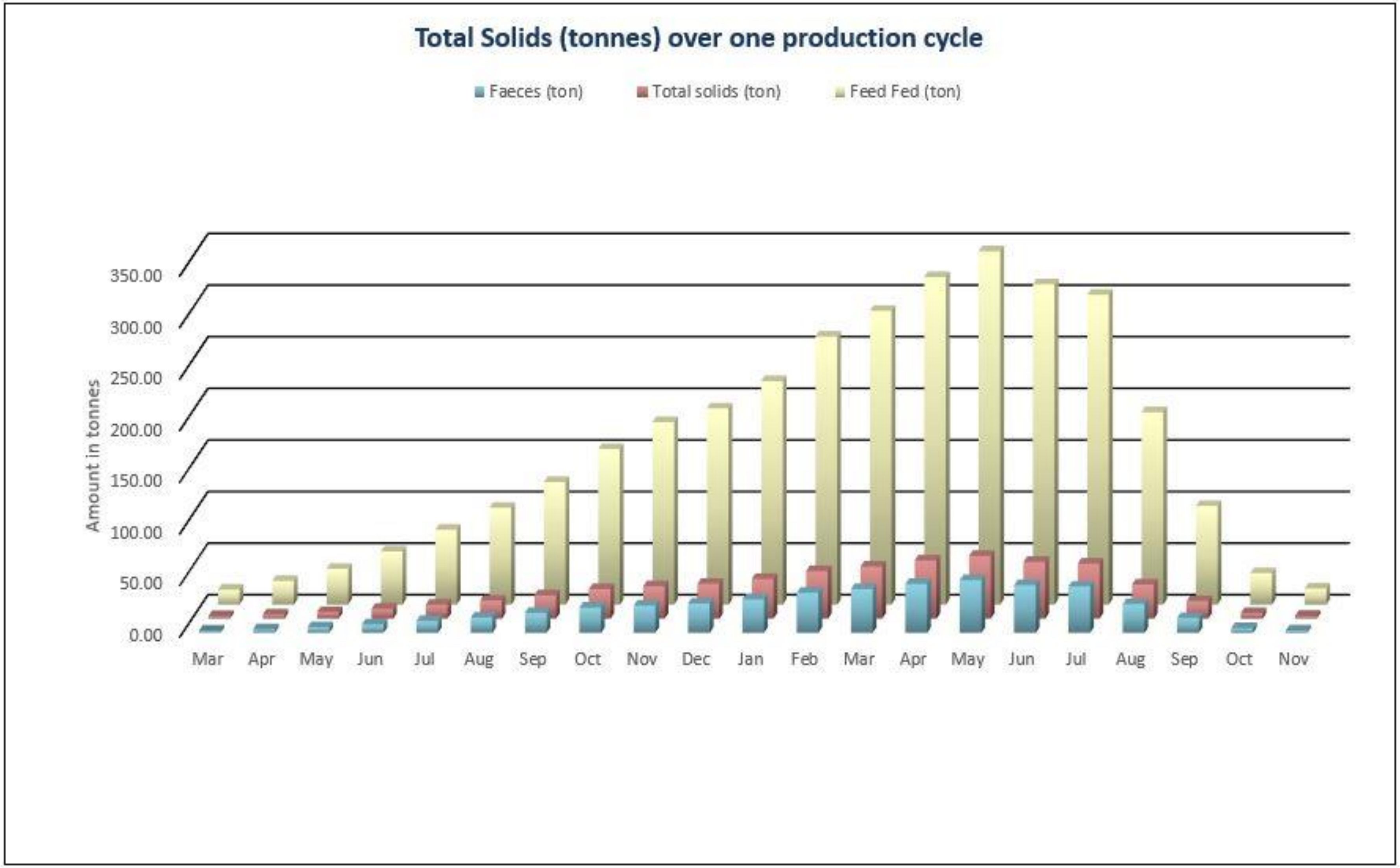


Figure 2-22 Total solids discharge (tonnes per month) for one production cycle.

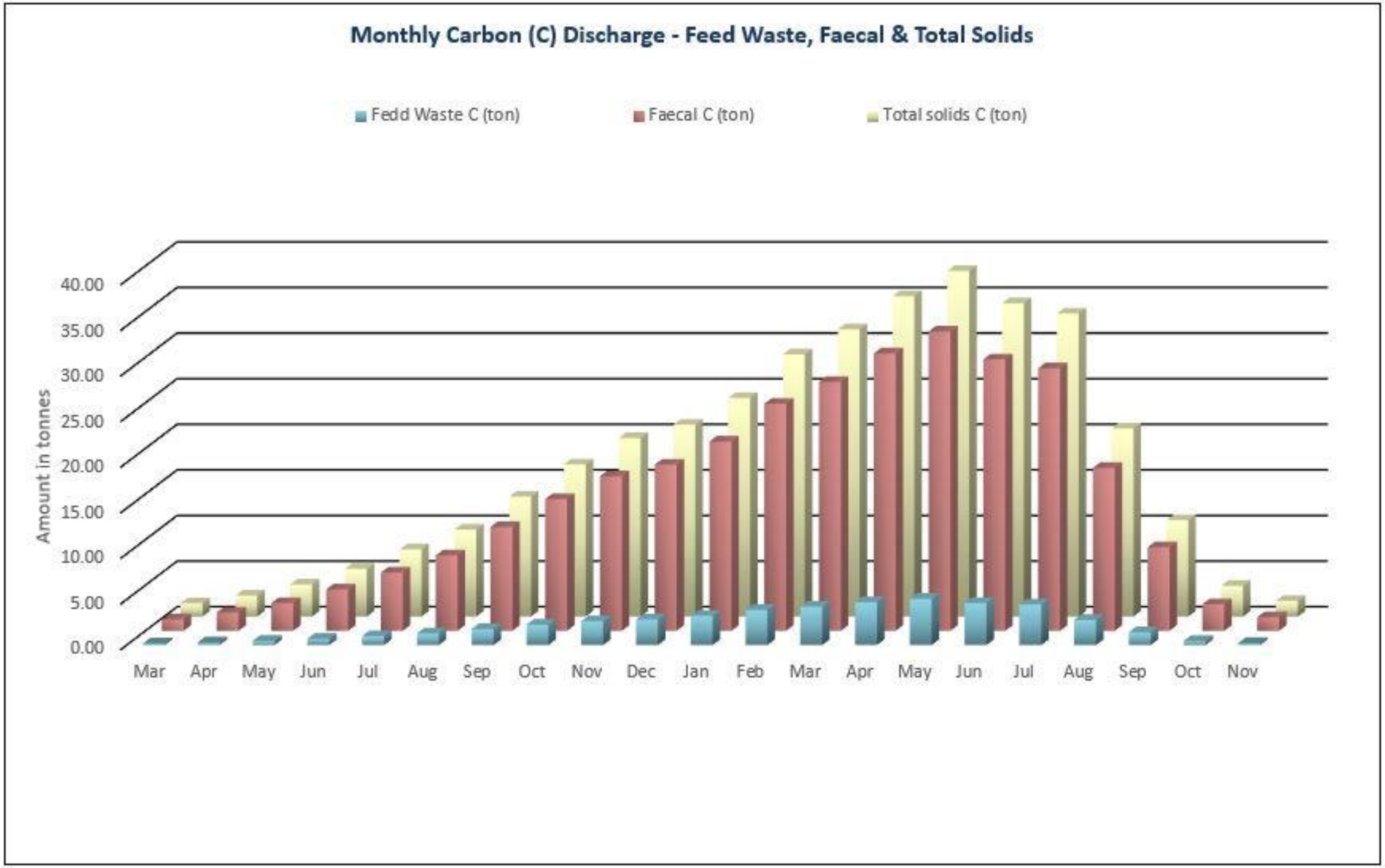


Figure 2-23 Total Carbon discharge (tonnes per month) for one production cycle.

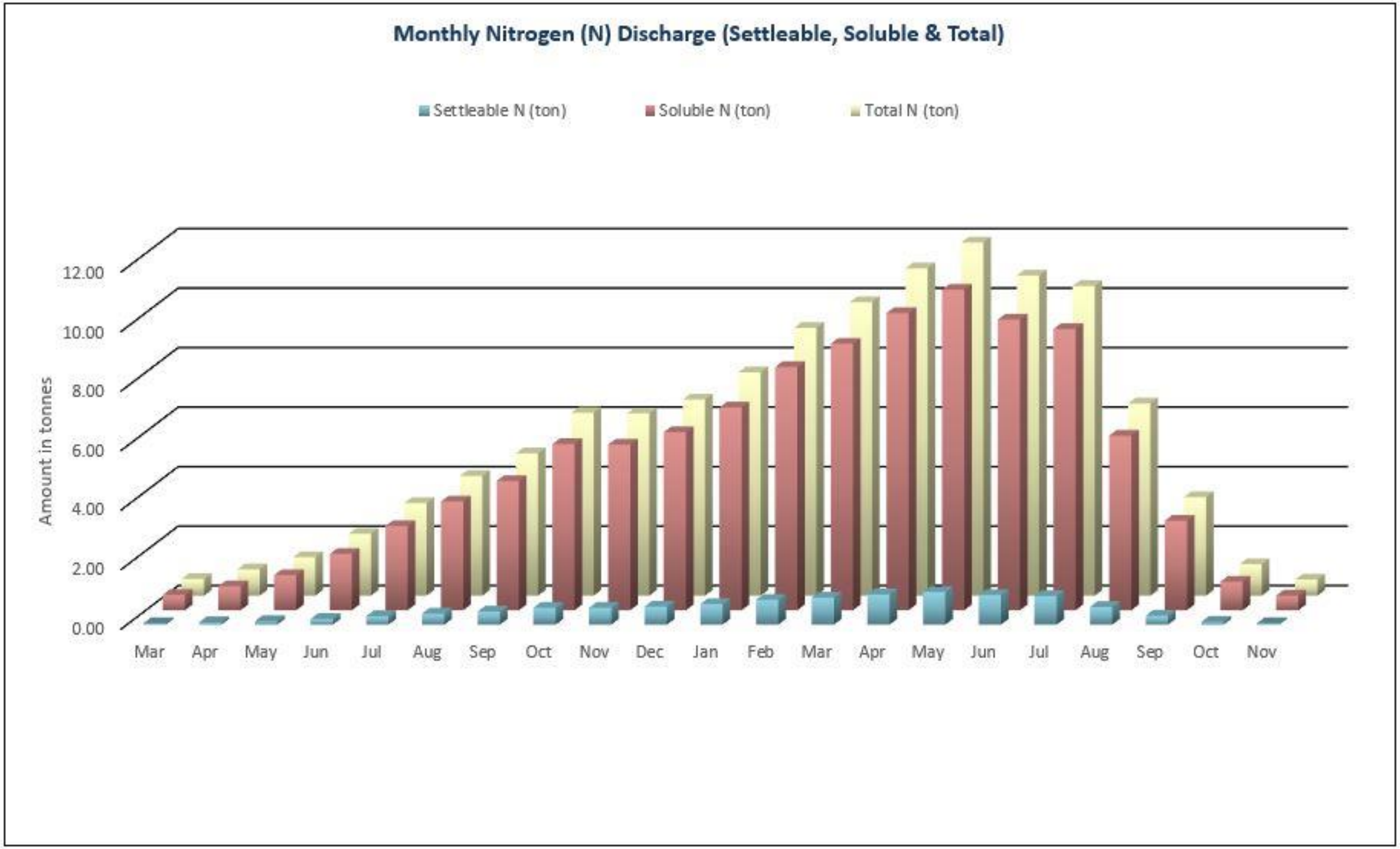


Figure 2-24 Total nitrogen discharge (tonnes per month) for one production cycle.

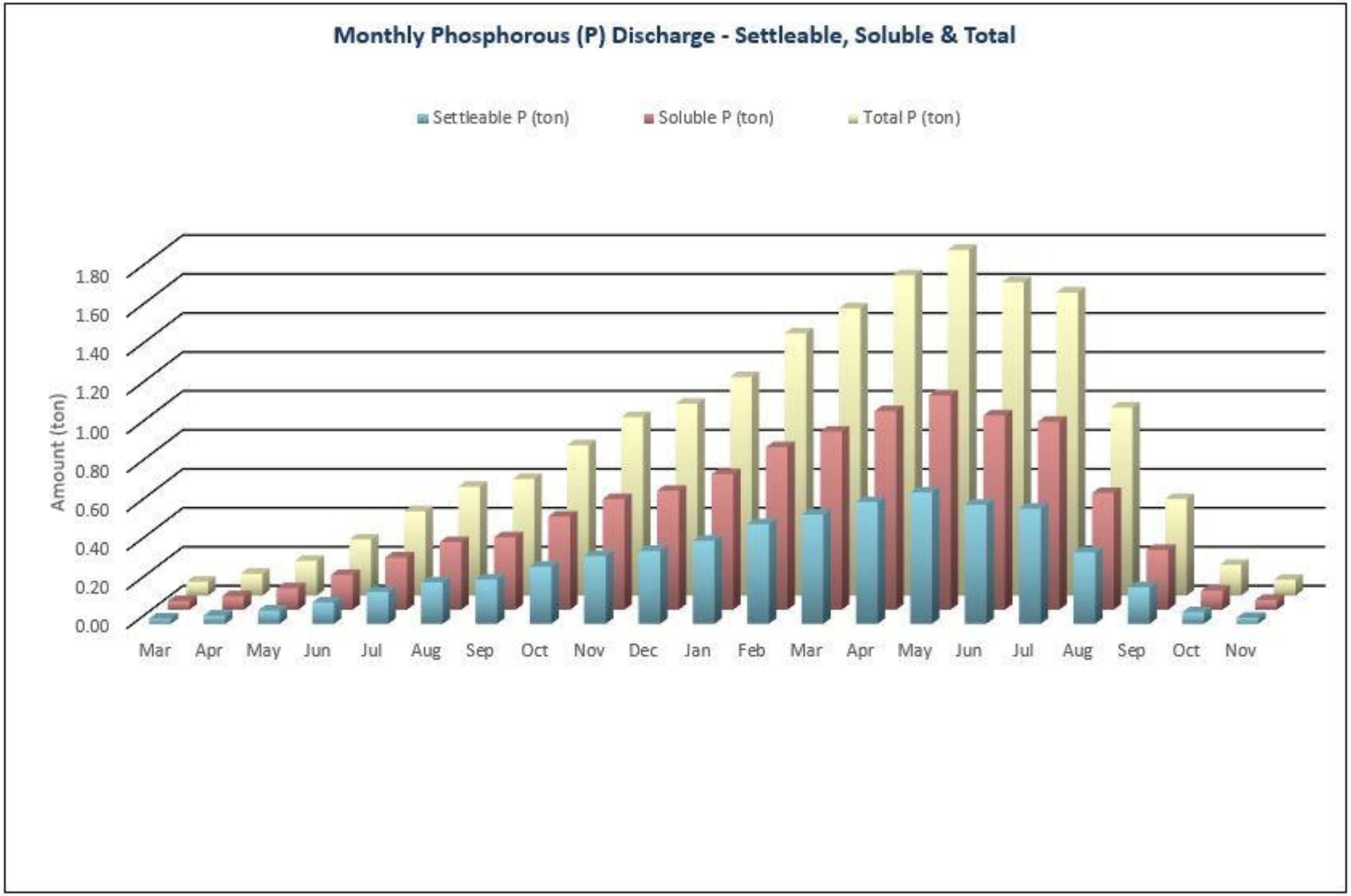


Figure 2-25 Total phosphorus discharge (tonnes per month) for one production cycle.

2.11. Waste Management

2.11.1. Harvesting Waste

After stunning and bleeding of harvested fish, the dead fish are collected in closed steel road tankers which 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. All filtered waste water is then treated by means of chemical precipitation (flocculation) followed by dissolved air flotation. All sludge collected at the effluent treatment plant will be sent to an approved rendering plant for final disposal (see **Appendix 2.4**).

All filtered waste water 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 is sent to a licensed facility for high temperature rendering.

2.11.2. Mortality Disposal

MOWI will ensure that mortalities will be disposed of in a manner limiting risk of disease to healthy stocks, contamination of water, as well as smell and introduction of pests. All animal by-product wate will be managed in accordance with the European animal by-products Regulations

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 for incineration at an approved animal by-products rendering plant, as required by DAFM guidelines.

Culled fish and mass mortalities are dealt with under a separate SOP (*SOP25560*; see **Appendix 2.4**).

2.12. 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.

2.12.1. 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 MOWI Ireland Positive Medications List describes medicines approved for use in farmed salmon in Ireland (see **Appendix 3.1**). **Appendix 3.2** contains Material Safety Data Sheets (MSDS) for the positive medications. 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, using 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) (see **Appendix 3.2** for MSDS).
- 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) (see **Appendix 3.2** for MSDS).

- 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) (see **Appendix 3.2** for MSDS);
- 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* (see **Appendix 3.2** for MSDS);
- ALPHA JECT micro 1 PD; manufactured by Pharmaq. An IP injectable fish vaccine to promote immunity against SPDV (see **Appendix 3.2** for MSDS).

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 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 2.12.2.3**. For gill parasites such as amoeba the only effective treatment currently available is a freshwater bath (*SOP36945*, **Appendix 3.1**). **Table 2.7** shows the disease medications used at the site between the year 2010 and 2017.

Table 2.7: Medications used for the treatment of diseases at T6/202 from 2010 – 2017.

		Slice®		Maracycline		Alphamax		Hydrogen Peroxide		Dates
Generation	Year	Total Quantity (Kg)	AI g	Total Quantity (Kg)	AI g	Total Quantity (ml)	AI ml	Total Quantity (L)	AI L	
10S1	2010					4750	47.5			14th Dec 2010
11S1	2011			470	470					17th – 31st Dec 2011
12S1	2012	70	140							28th Sept – 4th Oct 2012
12S1	2012							24000	8400	June – July 2012
13S1	2013			160	160					10th – 20th Oct 2013
15S1	2016	150	300							9th – 15th Jan 2016
15S1	2016					40000	400			11th – 13th Mar 2016
15S1	2016							57000	27930	19th - 22nd May 2016
17S1	2016	65	130							May 2017
AI = Active Ingredient										

2.12.2. 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.

Amoebic Gill Disease (AGD) 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. AGD monitoring carried out by MOWI is outlined in *SOP33878* in **Appendix 3.3**.

2.12.2.1. 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 several species indigenous to European waters. The Lumpsucker, *Cyclopterus lumpus,* is also used for this purpose.

MOWI intend to stock the 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. It is MOWI's objective to have 100% supply of hatchery-reared cleaner fish available to all sites by 2021. It is MOWI's objective to have 100% supply of hatchery-reared cleaner fish available to all sites by 2021.

In Deenish, 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 17S1 (October 2016) input of salmon to T6/202 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 SLICE administered in May 2017

2.12.2.2. 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. Treatment 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 (15S1/2 and Atlantic Salmon 2017) are described below and presented in **Table 2.8.** *L. salmonis* counts recorded during inspections are presented alongside treatment trigger levels in place at the time.

Marine Institute sea lice counts indicates that ovigerous female *L. salmonis* lice at the Deenish T6/202 site did not exceed the threshold levels (0.5 and 2 throughout the entire production cycle for the 2015 origin S1/2 fish. The only date where there was a spike in numbers was during week 33 and week 42 of 2016 where a maximum of 0.48 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 2.8**). A Treatment of Slice, Alphamax (Deltamethrin) and Hydrogen Peroxide were successfully administered as ovigerous sea lice counts of *L. salmonis* did not exceed the threshold level of 0.5 and 2 during the 15S1 growth cycle.

Atlantic Salmon 2017

Marine Institute sea lice counts indicates that ovigerous female lice on the Deenish T6/202 site did not exceed the threshold levels (0.5 and 2 throughout the entire production cycle for 2017 Atlantic Salmon). The only date where there was a spike in ovigerous females was during week 25 and week 30 of 2018 where a maximum of 0.21 ovigerous sea lice per fish was recorded, this being a non-significant spike that was far below 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 (see **Table 2.8**.

Table 2.8 Records of sea lice infestation at the Deenish since 2015 (O'Donoghoe 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 2015 15S1/2**									
	11	13/03/2015	0.5	0.00	0.03	0.03	0.10	0.14	0.24	0.27
	12	19/03/2015	0.5	0.00	0.04	0.04	0.07	0.17	0.24	0.28
	15	09/04/2015	0.5	0.02	0.01	0.03	0.16	0.06	0.21	0.24
	17	21/04/2015	0.5	0.00	0.04	0.04	0.14	0.19	0.33	0.37
	20	14/05/2015	0.5	0.00	0.01	0.01	0.21	0.13	0.34	0.35
	22	26/05/2015	0.5	0.00	0.03	0.03	0.38	0.28	0.66	0.69
	25	18/06/2015	2	0.00	0.15	0.15	0.08	0.14	0.22	0.37
	29	15/07/2015	2	0.00	0	0.00	0.62	0.56	1.18	1.18
	33	11/08/2015	2	0.02	0.02	0.04	1.07	1.09	2.16	2.2
	38	15/09/2015	2	0.00	0.02	0.02	0.09	0.06	0.15	0.17
	44	29/10/2015	2	0.11	0.07	0.18	0.00	0.02	0.02	0.2
	48	23/11/2015	2	0.10	0.39	0.49	0.21	0.23	0.44	0.93
2016	4	27/01/2016	2	**Missed due to weather**						
	5	03/02/2016	2	0.11	0.51	0.62	0.00	0	0.00	0.62
	11	14/03/2016	0.5	0.02	0.04	0.06	0.00	0.02	0.02	0.08
	12	23/03/2016	0.5	0.04	0.07	0.11	0.00	0.02	0.02	0.13
	15	12/04/2016	0.5	0.10	0.19	0.29	0.00	0.05	0.05	0.34

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*	
	17	25/04/2016	0.5	0.10	0.21	0.31	0.02	0	0.02	0.33
	19	11/05/2016	0.5	0.15	0.53	0.68	0.05	0.15	0.20	0.88
	21	25/05/2016	0.5	0.00	0.08	0.08	0.00	0	0.00	0.08
	23	09/06/2016	2	0.00	0.15	0.15	0.00	0	0.00	0.15
	29	21/07/2016	2	0.04	0.02	0.06	0.36	0.58	0.94	1
	33	18/08/2016	2	0.32	0.55	0.87	3.81	6.82	10.63	11.5
	38	19/09/2016	2	0.03	0.07	0.10	0.00	0.03	0.03	0.13
	42	19/10/2016	2	0.48	0.57	1.05	4.43	7	11.43	12.48
	Harvested Out									
	Atlantic Salmon 2017									
2017	18	04/05/2017	0.5	0.00	0.29	0.29	0.01	0.09	0.10	0.39
	22	30/05/2017	0.5	0.00	0.28	0.28	0.02	0	0.02	0.3
	24	13/06/2017	2	0.00	0.13	0.13	0.00	0.01	0.01	0.14
	30	26/07/2017	2	0.00	0.02	0.02	0.15	0.12	0.27	0.29
	33	15/08/2017	2	0.00	0.18	0.18	0.38	0.46	0.84	1.02
	39	25/09/2017	2	0.00	0.05	0.05	0.08	0.19	0.27	0.32
	43	27/10/2017	2	0.07	0.02	0.09	2.63	2.74	5.37	5.28
	44	02/11/2017	2	0.09	0.18	0.27	4.41	3.32	7.73	7.46
2018	5	29/01/2018	2	0.00	0.04	0.04	0.18	0.39	0.57	0.61

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*	
	7	13/02/2018	2	0.04	0.35	0.39	2.02	0.88	2.90	3.29
	10	09/03/2018	0.5	0.04	0.38	0.42	0.44	0.52	0.96	1.38
	13	26/03/2018	0.5	0.05	0.17	0.22	0.27	0.23	0.50	0.72
	14	04/04/2018	0.5	0.03	0.11	0.14	0.02	0	0.02	0.16
	17	27/04/2018	0.5	0.04	0.05	0.09	0.04	0.11	0.15	0.24
	19	09/05/2018	0.5	0.07	0.33	0.40	0.07	0.1	0.17	0.57
	21	23/05/2018	0.5	0.05	0.07	0.12	0.00	0.02	0.02	0.14
	25	21/06/2018	2	0.13	0.2	0.33	0.05	0.08	0.13	0.46
	30	25/07/2018	2	0.21	0.22	0.43	0.67	0.77	1.44	1.87

2.12.2.3. Treatments

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

1. **Slice® in-feed treatment**

   Slice® MSDS is included in **Appendix 3.2**. Slice® was developed and licenced 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 several 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.

See *SOP26077* in **Appendix 3.3** for procedural information on the application of Slice®. If required, MOWI shall apply one Slice® treatment to T6/202 stocks in the spring of the first input year. This will at the latest be applied in April. Maximum Treatable Biomass for the site will be 123 tonnes.

2. **Alphamax® bath treatment**

The Alphamax® MSDS is included in **Appendix 3.2**. 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 2.9 shows the sea lice treatment summary for T6/202 since 2010. These treatments are administered to make sure that ovigerous females sea lice numbers do not exceed the threshold levels of 0.5 (march – may) and 2 (June – February) sea lice per fish **Table 2.8.**

Table 2.9 Sea lice treatments at the site since 2010.

Crop	Product	Active Ingredient	Administration Date	Active Ingredient (quantity)
2010 input (10S1)	Alphamax	Deltamethrin	14th December 2010	47.5ml
2011 input (11S1)	Maracyline	Oxytetracycline hydrochloride	17th to 31st Dec 11	470g
2012 input (12S1)	Paramove	Hydrogen Peroxide	June – July 2012	8,400L
	Slice	Emamectin Benzoate	28th Sept-04th Oct'12	140g
2013 (13S1)	Maracyline	Oxytetracycline hydrochloride	10 - 20th Oct 13	160g
2016 input (15S1)	Slice	Emamectin Benzoate	9th -15th January 2016	300g
	Alphamax	Deltamethrin	11th – 13th March 2016	400ml
	Paramove	Hydrogen Peroxide	19th - 22nd May 2016	27,930L
2016 input (17S1)	Slice	Emamectin Benzoate	May 2018	130g

2.13. 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 site as seal predation on penned salmon has not been an issue at this licenced site. Predation control is covered by *SOP29575* (see **Appendix 3.4**).

2.14. 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 and 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 numbers 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 (see **Appendices 2.4**) 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.

2.14.1. Staff

The MOWI Occupational Health and Safety management system is certified to OHSAS 18001:2007. All staff are always instructed to wear life jackets or floatation suits 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.

2.14.2. 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 2.14.1**. Radio or telephone contact to the relevant base station must be used to raise in-house support or emergency services as required.

2.14.3. 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*).

2.14.4. 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.

2.14.5. 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 Deenish 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.

2.14.6. Fish Escapes

No farmed escapees have been reported in Deenish 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 Deenish 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 (*SOP4075*).

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.

2.15. Single Bay Management/ Coordinated Local Area Management Schemes

The site 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. 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 licenced 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 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 around the pre-winter treatment for all fish in Deenish (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 six sites licenced for the culture of Atlantic Salmon[2] (including the Deenish site) (see **Table 2.10**). The sites at Doon Point and Kilmakilloge Harbour are currently unstocked and have been so for some time while the site at Cloonee, Tuoist is land-based. MOWI are currently operating the Deenish (T06/202A) site and the Inishfarnard (T5/233) site, under the respective licenses AQ199 and AQ198. MOWI will coordinate the timing and class of treatments used at the Inishfarnard and the Deenish sites.

Table 2.10: Salmon aquaculture licences in Kenmare Bay.

Licence reference	Site Name	Distance to Deenish Site
T06/064/7	Doon Point, Kenmare River	4.1km northwest
T06/064A	Kilmakilloge Harbour	15.8km northeast
T06/064B	Kilmakilloge Harbour	16.5km northeast
T06/112	Cloonee, Tuoist.	15.8km northeast
T06/233	Inishfarnard Island	20.0km east

2.16. Decommissioning

At the end of their lifespan or during certain maintenance tasks, fish pens must 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**.

[2] Further detail on aquaculture operation in Kenmare Bay is included in **Section 11.3** below.

3. Consideration of Alternatives

The project area 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 the island.

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

- The AQ199 licence renewal application requests a change from the current licence operating conditions to a MAB 2200 tonnes.
- A change the boundaries of the site (see **Figure 2.2**). The spatial extent of the existing site is 14.5ha while the spatial extent of the new proposed site is 33.5ha.

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 AQ199 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 Network (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 5.2 through **Section 5.5** below presents further detail on these elements while **Section 5.6** 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 5.4** 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 & Socio-economics*

5.1.1. Description of the Receiving Environment

The closest Electoral Divisions to the proposed aquaculture starting from west to east are: Ballinskelligs (Baile an Sceilg), Emlaghmore (An tImleach), Lough Currane (Loch Luíoch), Ballybrack (An Baile Breac), Darrynane (Doire Fhíonáin) (Electoral Division includes Deenish Island) and Caherdaniel (Cathair Dónall) (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 6 Electoral Divisions as of 2016 was 2,147 comprising 850 households. Of the 6 Electoral Divisions Emlaghmore located on the western side of Ballinskellig Bay has the highest total population at 871, followed by Ballinskelligs (total population of 390). Both of these communities would be the furthest distance from the proposed Deenish site (26.5km via road or 10km visually from coast to the site).

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%).

Between 2011 and 2016 Lough Currane showed the greatest change with an increase in population of 15.6%. Increases were also observed in Ballinskelligs (4%) and Cathair Dónall (0.3%). Population decrease was observed in Ballybrack with a decrease of 10.8%, Emlaghmore (6%) and Darrynane (5.3%). The age structure of the population within the 6 EDs consisted of 20.03% under 18 years, 56.45% between 18 and 64 years (5.82% 18-24yr; 21.66% 25-44yr; 28.97% 45-64yr) and 23.52% older than 65 years.

The principal status of the population of the 6 Electoral Divisions consisted of 49.8% at work, 26.0% retired, 8.0% students, 6.9% looking after the home, 5.4% unemployed, 2.9% permanent sick/disability, 0.7% seeking their first job and 0.3% other. The percentage of unemployment (5.4%) was below the national average of 7.8% in 2016 (currently 5.6% as of 2019). The social classes were made up of 27.2% managerial and technical, 18.82% non-manual workers, 17.84% skilled manual, 12.67% gainfully occupied and unknown, 12.62% semi-skilled, 6.61% professional workers and 4.24% unskilled.

The workforce was employed in the following industries: 28.23% other, 21.37% professional services, 15.64% commerce and trade, 12.26% agriculture, forestry and fishing, 7.09% manufacturing industries, 6.97% building and construction, 4.39% transport and communications and 4.05% public administration.

The occupation of the workforce is broken down as follows: skilled trade occupations (28.83%), professional occupations (12.39%), elementary occupations (10.86%), associate professional and technical occupations (8.43%), managers, directors and senior officials (8.12%), caring, leisure and other service occupations (7.72%), sales and customer service occupations (6.8%), administrative and secretarial occupations (7.72%), not stated (5.08%) and process, plant and machine operatives (4.06%).

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 BIM data on employment of people in aquaculture only accounts for staff on the sea farm and does not include processing plant, admin, diving, maintenance, veterinary and other service staff directly employed by MOWI to service the Deenish site. The BIM (2017) survey. 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 was 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
Ballinskelligs	390 (375)	195 (189)	195 (186)	456 (452)
Emlaghmore	871 (926)	432 (450)	439 (476)	752 (750)
Lough Currane	311 (269)	165 (136)	146 (133)	310 (289)
Ballybrack	83 (93)	42 (45)	41 (48)	93 (99)
Darrynane	179 (189)	86 (94)	93 (95)	284 (286)
Caherdaniel	313 (312)	161 (148)	152 (148)	423 (433)
Total	**2,147 (2,164)**	**1,081 (1,078)**	**1,066 (1,086)**	**2,318 (2,309)**

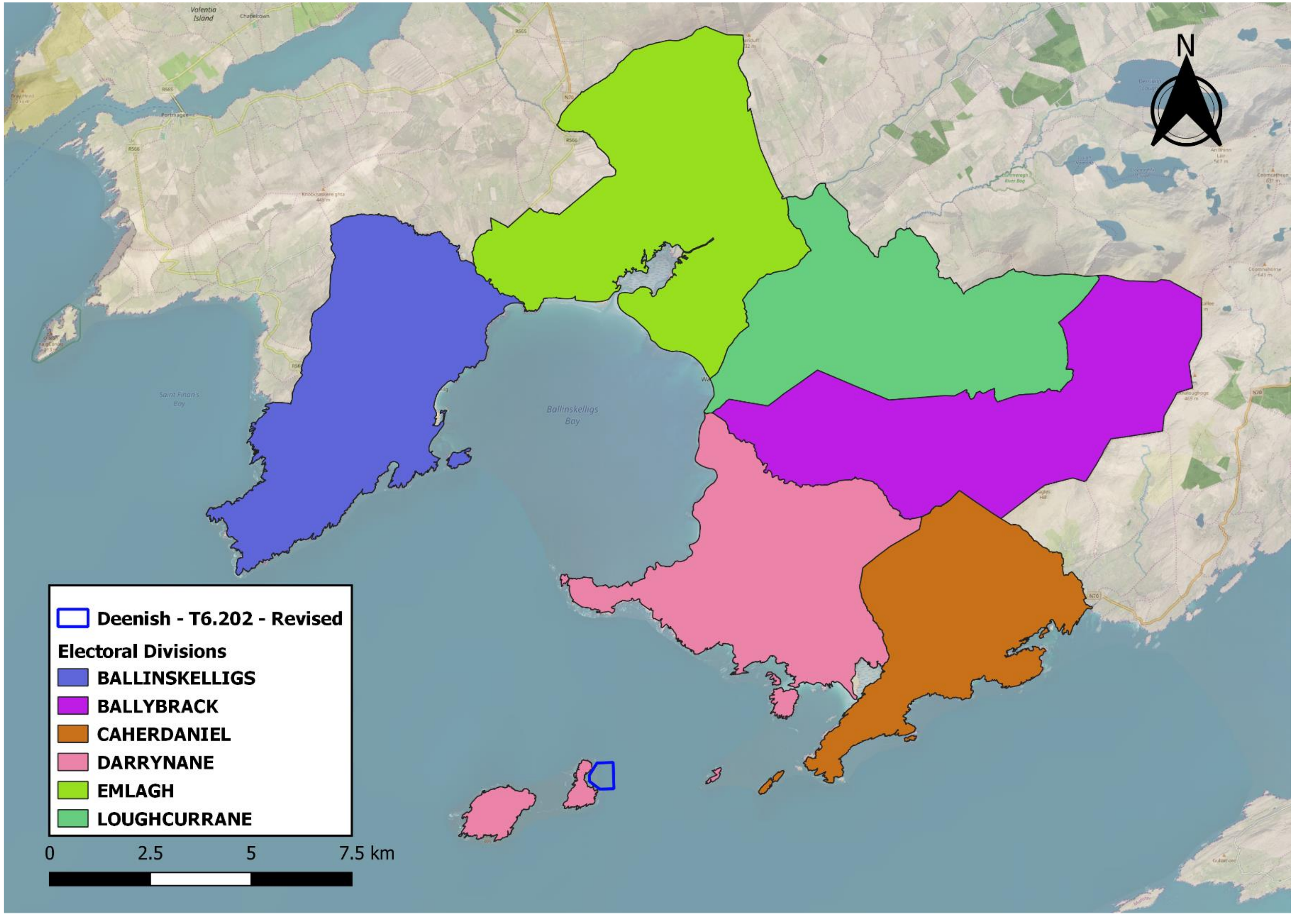


Figure 5-1: Electoral Divisions

5.1.2. Impact Assessment

The uninhabited Deenish Island is located off Iveragh Peninsula on the Co. Kerry coast. The presence of coastal communities within this region and aquaculture employment in the area illustrate the importance of the maritime industry in the region. 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 must 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 at Deenish Island 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 are also hired consisting 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. Staff will increase by a further 6 people during harvesting (3 full time crew assisted by 3 harvest crew).

5.1.3. Conclusion

The existing licence and farm has 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, socio-economics and tourism (including recreation) and wate management as relevant to human health. The receiving environment for these factors are outlined in Land and Soils (see **Section 6.6**), 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*' report (Screening for AA 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 Natura 2000 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 into the current report.

[3] Document File Name: *'JN1524 Screening for Appropriate Assessment and Natura Impact Statement - Volume 1 Main Report, Volume 2 Appendices - Licence Renewal of Marine Finfish Licence at Deenish Island, Co. Kerry - Licence Ref: AQ199 – Licence Site Ref: T6/202'*

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) *Lutra lutra* (*Otter*)	**Section 6.2.7**
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**

Table 6.2 Qualifying Features of 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 6.6**

6.2. Benthic Ecology

6.2.1. Potential Impacts

The potential source of impact to benthic habitats from operations at the site is predominately organic enrichment due to settleable solids discharged from the fish site 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

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

The Deenish site is located within the Kenmare River SAC. **Section 6.2.5.5** considers the potential impact of operations at the proposed site on the Conservation Objectives of Qualifying Feature Habitats of Kenmare River SAC for which potential impacts could not be discounted at the Screening for AA stage. The assessment of likely impact to Qualifying Feature Habitats follows NPWS guidance on interpretation of the Conservation Objectives of the SAC.

6.2.3. Description of Receiving Environment

As outlined above, the site is located on the eastern flanks of Deenish Island and is sheltered from westerly and southerly swells (**Figure 1-1** and **Figure 2-1**). The seabed under the pens located to the north of the site is primarily flat and is characterised by predominantly sands sediments (ranging to fine and medium sand) with varying proportions of coarse shell fragments. Water depths increase toward the southern pens. The sea floor under the southern pens is uneven and comprises gravel and rocky reef.

The site is located with the Kenmare River SAC (Site code: 002158). 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 support a wide variety of habitats and communities. The site contains three Annex I marine habitats namely reefs (1170), large shallow inlets and bays (1160) and submerged or partially submerged cave (8330). The site overlaps several community types identified in Annex I benthic habitats 1170 and 1160 namely; Coarse sediment dominated by polychaetes community complex; Intertidal reef community complex;

Laminaria-dominated community complex; Subtidal reef with echinoderms and faunal turf community complex.

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.

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 a 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 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

6.2.4.2. Annual Audits Results and Assessment

Annual monitoring survey have been carried out in recent years with the most recent audits carried out in May 2018[4] and September 2019[5]. **Appendix 6** contains the 2018 and 2019 audit reports.

In May 2018 at the time of the audit, 1,532.7 tonnes of fish were stocked on site with 44.6 tonnes having been input to the site in March 2017 following a 10 week week fallow period. This gave an onsite biomass production of approximately 1,488 tonnes prior to the survey. This level of biomass production was significantly higher than the biomass production occurring at the site prior to the September 2019 audit. The stock biomass on-site in September 2019 survey was approximately 387.2 tonnes with 42.4 tonnes put to sea in February 2019 following an eight week fallow period, giving a production biomass at the site prior to survey of 344.8 tonnes.

The benthic audits undertaken in May 2018 and September 2019 (AQUAFACT 2018, 2019) identified no major signs of impact detected beyond the edge 10m stations (i.e. TI 10m and T2 10m stations). There were no observations of outgassing or bacterial mats in the area.

2018 Audit

In 2018 all the stations surveyed along Transect 2 (i.e. T2 under to T2 100m) were characterised as fine to medium grained sand (see **Figure 6-1**).

Stations located along Transect 1 under the fish pens and up to 20 m from the pens (i.e. T1 Under to T1 20) comprised fine to medium sand (see **Figure 6-2**) (and were similar to those identified at Transect 2). Sediments at the Transect 1 stations located underneath the pens and at the edge of the

[4] AQUAFACT 2018. Environmental Survey Beneath Finfish pens at Deenish aquaculture site (T6/202), Kenmare Bay, Co. Kerry. October 2018. Produced by AQUAFACT International Services Ltd.

[5] AQUAFACT 2019b. Environmental Survey Beneath Finfish pens at Deenish aquaculture site (T6/202), Kenmare Bay, Co. Kerry. May 2018. Produced by AQUAFACT International Services Ltd.

pens (i.e. T1 Under, T1 Edge) were formed into small hills and depressions by the bioturbating activity of opportunistic polychaeta including Capitella sp. complex and Malacoceros. *Arenicola marina* casts and uneaten feed pellets were also visible at the sites. Images of the seabed under the fish pens (i.e. T1 Under) and at the edge of the pens (i.e. T1 Edge) are shown in **Figure 6-3**.

Transect 1 stations located 50m and 100m from the pens (i.e. T1 50 and T1 100) were characterised as coarse sands with relatively high proportions of shell gravel material (see **Figure 6-2**). At these sites drift algae and phyodetrital material were present along with burrowing anemone *Cerianthus lloydi Asterias rubens* (see **Figure 6-4**).

2019 Audit

Surveys undertaken along Transect 1 and Transect 2 in September 2019 showed that the condition of the seafloor habitats did not change significantly since May 2018. Fine to medium grained sediments were observed at all Transect 2 stations (i.e. T2 Under to T2 50) (see **Figure 6-5**) and at the T1 Under and T1 10 (see **Figure 6-6**). These sites showed evidence of bioturbation activity of *Capitella* sp. complex and *Malacoceros* sp. *Arenicola marina* casts and uneaten feed pellets were also visible at the sites. Relatively more coarse stations were identified further from the pens. Fauna at these sites included the anemone *Cerianthus lloydi*, brittlestar, and the starfish *Asterias rubens.*

Impact Assessment

Capitella and *Malacoceros* sp. 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.

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 at the sites will in time revert to a pre-disturbed state. 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.

6.2.4.3. Conclusions

The audits undertaken in 2018 and 2019 show that the benthic community in the vicinity of the site can tolerate the tonnages produced in those years.

It can be **concluded that the operations at the proposed site, together with the mitigation measures proposed (i.e. implementation of a fallow period), will not significantly affect benthic ecology**. Any disturbance experienced will be temporary with the species characterising the community types recovering to pre-disturbed state following cessation of activity.

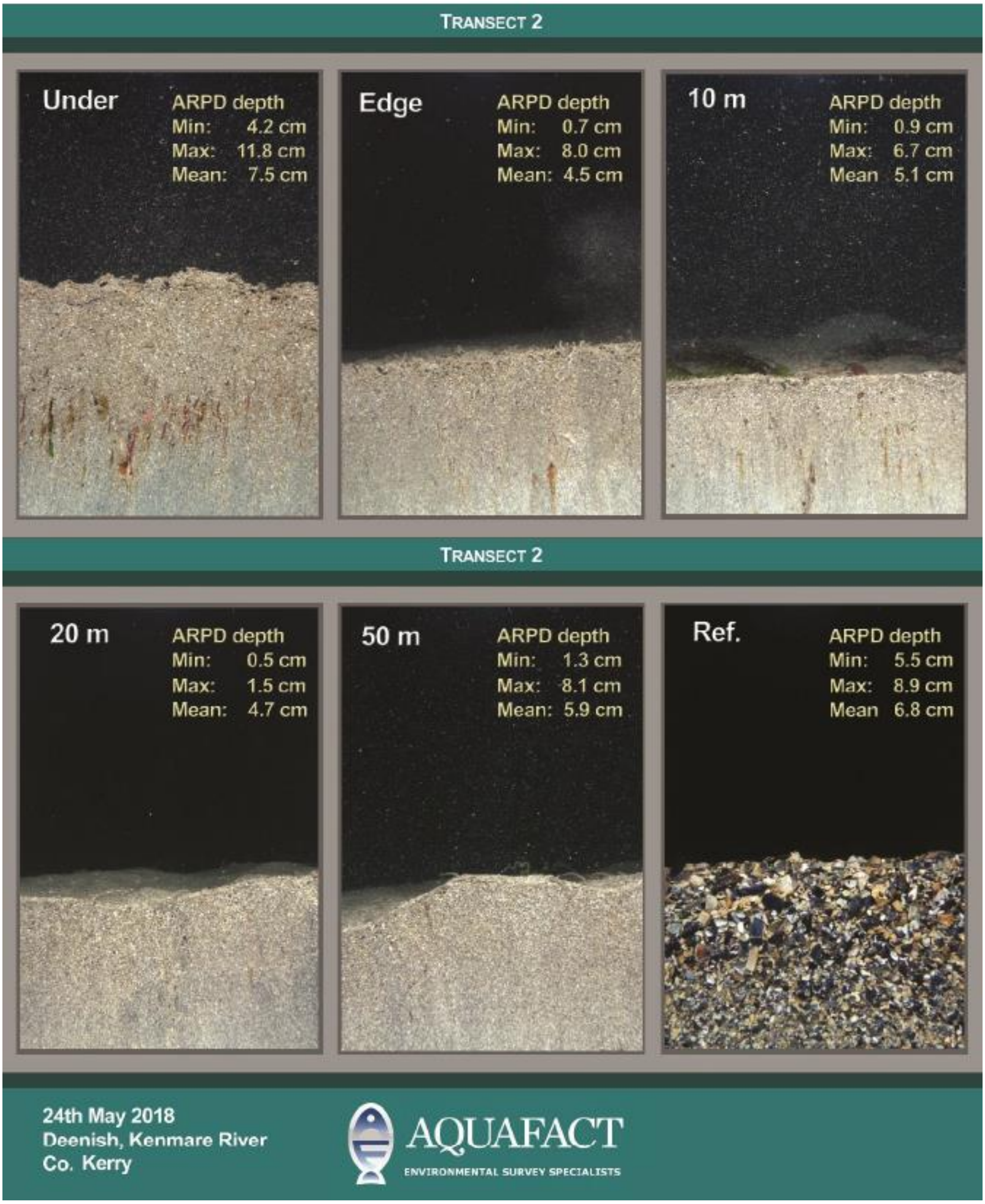


Figure 6-1: 2018 Audit: Representative photographs of the seafloor taken along Transect 2 by Sediment Profile Imagery (SPI) (May 2018)

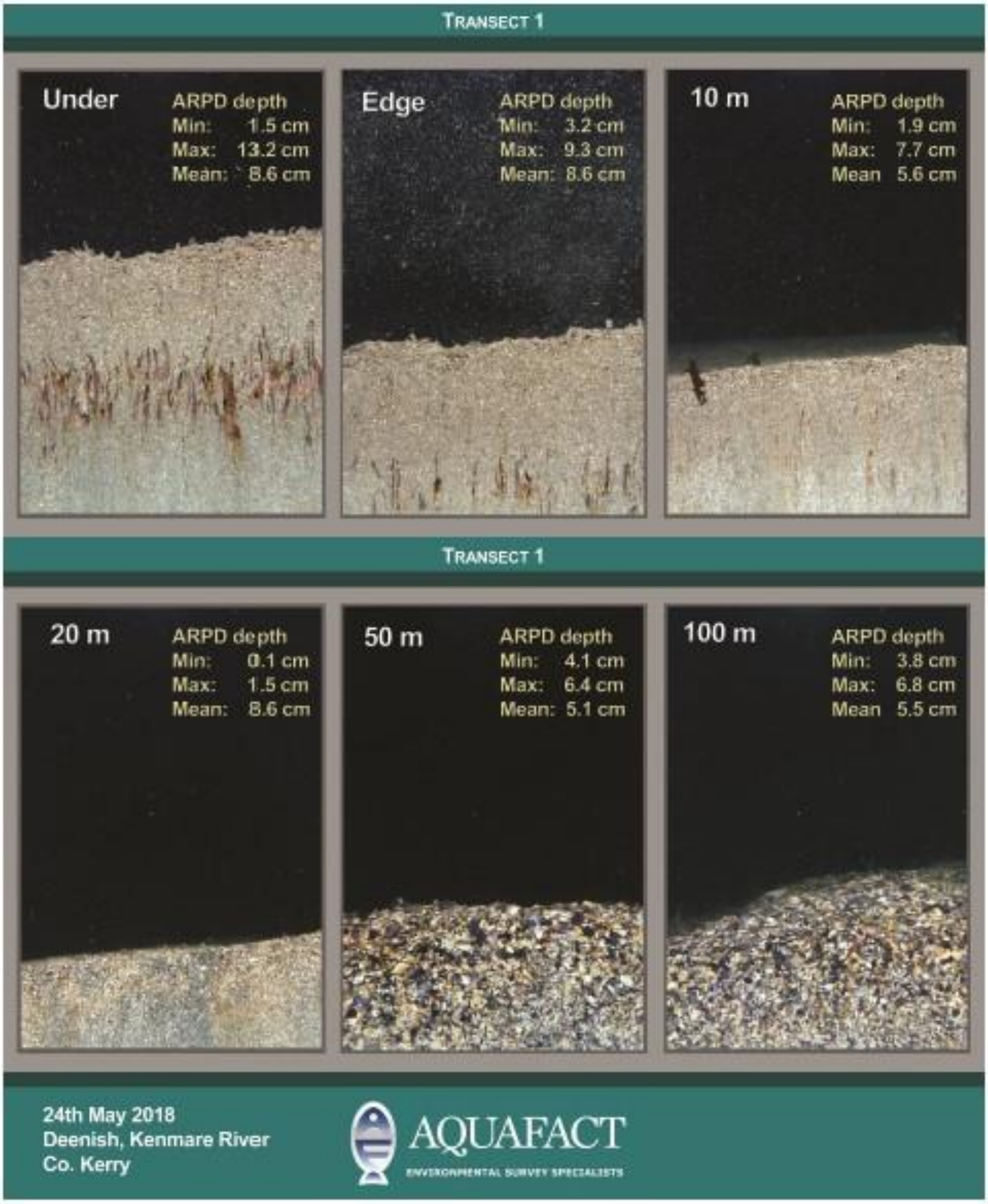


Figure 6-2: 2018 Audit: Representative photographs of the seafloor taken along Transect 1 by Sediment Profile Imagery (SPI) (May 2018)

Figure 6-3: 2018 Audit: Representative photographs of the seafloor taken along Transect 1 (May 2018)

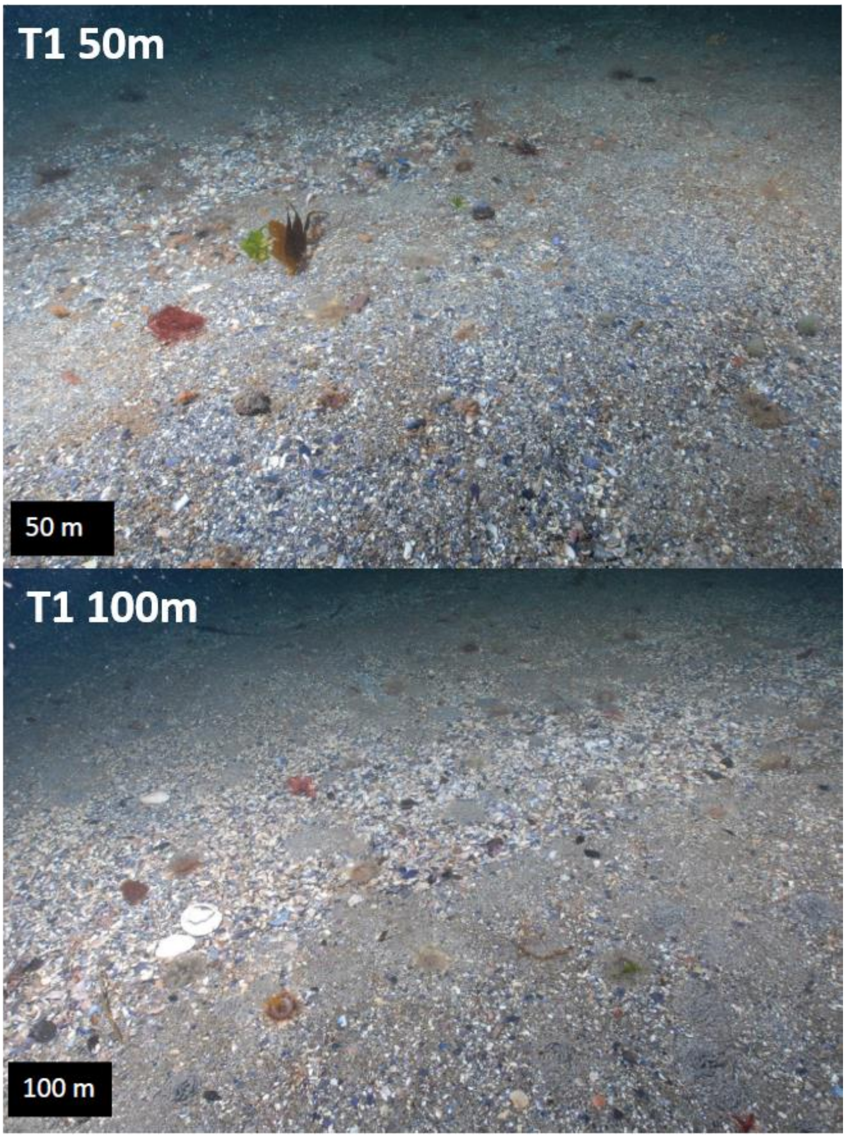


Figure 6-4: 2018 Audit: Representative photographs of the seafloor taken along Transect 1 (May 2018)

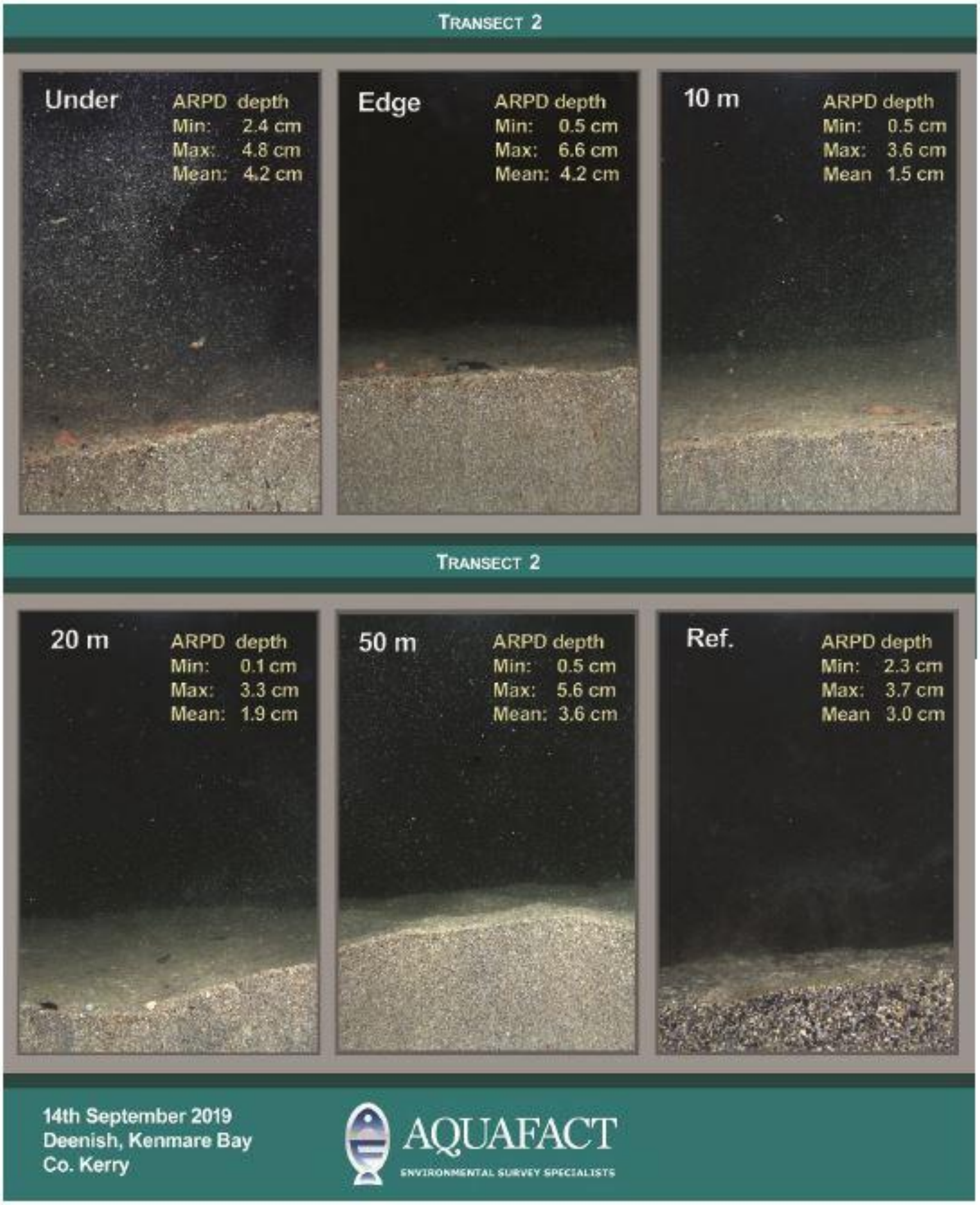


Figure 6-5 2019 Audit: Representative photographs of the seafloor taken along Transect 2 by Sediment Profile Imagery (SPI) (September 2019)

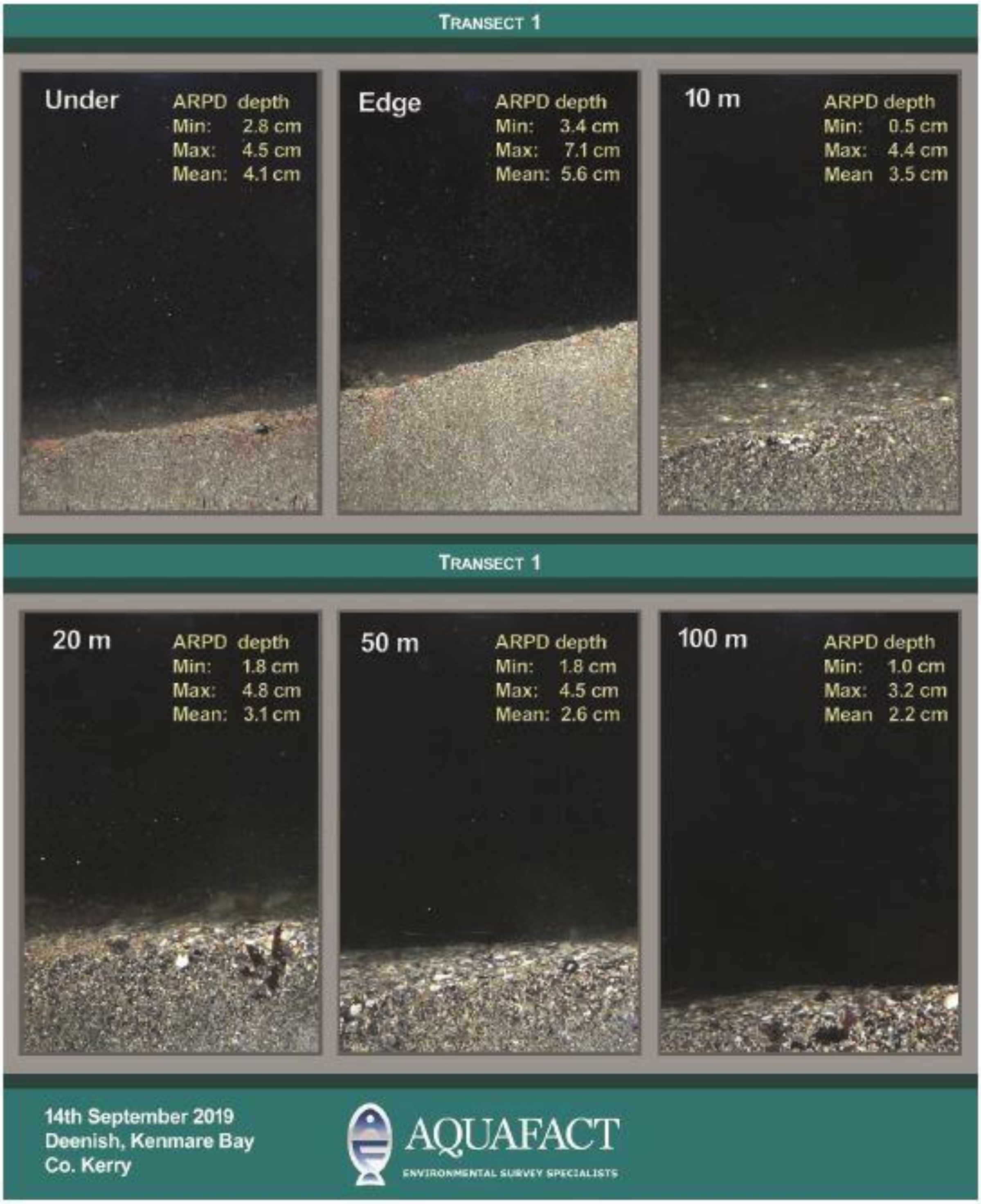


Figure 6-6: 2019 Audit: Representative photographs of the seafloor taken along Transect 1 by Sediment Profile Imagery (SPI) (September 2019)

6.2.5. Aquaculture Stewardship Council Accreditation

6.2.5.1. Background

Aquaculture Stewardship Council (ASC) Accreditation[6] 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 the Allowable Zone of Effect (AZE) which is the area of sea-bed or volume of the receiving water body in the immediate vicinity of the farm within 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 Deenish based on the site configuration and local hydrodynamic characteristics, which resulted in a 30m equivalent ellipse axis of approximately 64m from the edge of the surveyed pen along the long axis and 10m outside the edge on the narrow axis.

6.2.5.3. Assessment Methodology

Impacts are assessed using the AZTI marine Benthic Index (AMBI). 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 **Table 6.4**. It should be noted that AMBI was originally developed for European coastal waters. The tool can be used as a guideline for establishing the ecological quality in Irish waters.

[6] Aquaculture Stewardship Council Certificate and 2018 Survey report included in **Appendix 7**

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 7 monitoring stations (including 1 reference station) were sampled at the site in 2018. The reference stations at Deenish was located outside the AZE and as such can be used to determine natural baseline organic enrichment level at the site.

6.2.5.5. AMBI Results and Assessment

AMBI scores were calculated for the monitoring stations at Deenish in 2018 (see **Table 6.5)**. The majority of sites were classified as 'Moderately Disturbed' (4 of 7). Of the 7 monitoring stations sampled 1 was classified as 'Slightly Disturbed' and 1 was classified as 'Undisturbed'. The reference station was classified as 'Stations classified as 'Slightly Disturbed'.

'Slightly Disturbed' were characterised by high abundances of Nematoda. Stations classified as 'Moderately Disturbed' were characterised by Group V species which are pollution tolerant including *Capitella* sp. complex, *Malacoceros vulgaris* and *Tubificoides benedii*.

The AMBI scores at stations at the Deenish site indicate aquaculture activity can lead to local increased organic enrichment, with scores of 'Moderately disturbed' driven by the high relative abundance of *Capitella* sp. and *Malacoceros vulgaris*.

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 Deenish site, Kenmare Bay in 2018.

Station	AMBI Score	AMBI Classification
9	1.311	Slightly disturbed

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

Station	AMBI Score	AMBI Classification
1	3.999	Moderately disturbed
2	3.380	Moderately disturbed
3	3.487	Moderately disturbed
4	4.344	Moderately disturbed
5	3.138	Slightly disturbed
6	1.135	Undisturbed

6.2.5.6. Conclusions

It can be **concluded that the operations at the proposed site, together with the mitigation measures proposed (i.e. implementation of a fallow period), will not significantly affect the benthic ecology**. Any disturbance experienced will be temporary with the species characterising the community types recovering to pre-disturbed state following cessation of activity.

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 Stage 1 Screening for AA stage[7]:

- 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[8]. For Large shallow inlets and bays [1160] and Reefs [1170] the Conservation Objectives are to maintain the favourable conservation condition of the

[7] For summary see Section 2.4 of *JN1524 Deenish NIS - Volume 1 - Main Report*

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

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
✓	✓	Laminaria-dominated community complex
✓	✓	Subtidal reef with echinoderms and faunal turf community complex

The 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[9]). 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.

[9] 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

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.
(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.

Qualifying Interest (Community Type)	Attribute (measure)	Target
(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 Deenish 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 cages 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 6-7**. The predicted maximum deposition rate at the farm is 1.4mm per month of which 1.68kg per m^2 of organic material per month (or 54g per m^2 per day). While slight migration of settleable solids outside of the licenced production area to the north and south is predicted the predicted maximum deposition rate in these areas is low at less than 0.2mm per month.

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 characterising 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 characterising species may recover to pre-disturbed state or may persist and accumulate over time.

The spatial over lap 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 6-8**.

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 areal extent (ha) and as percentages of the total community type area.

6.2.6.2. Assessment

Of the 11 constituent community types identified in the Qualifying Feature Large shallow inlets and bays the proposed licenced area and sedimentation footprint overlapped respectively 4 community types.

In the case the Qualifying Feature Reef the proposed licenced area and sedimentation footprint overlapped to varying extents each of the 3 community types.

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

6.2.6.3. Conclusions

It can be concluded that in light the Conservation Objectives defined for the Kenmare River SAC the **operations at the Deenish Island site will not significantly affect Annex I benthic habitats** for which the SAC is designated.

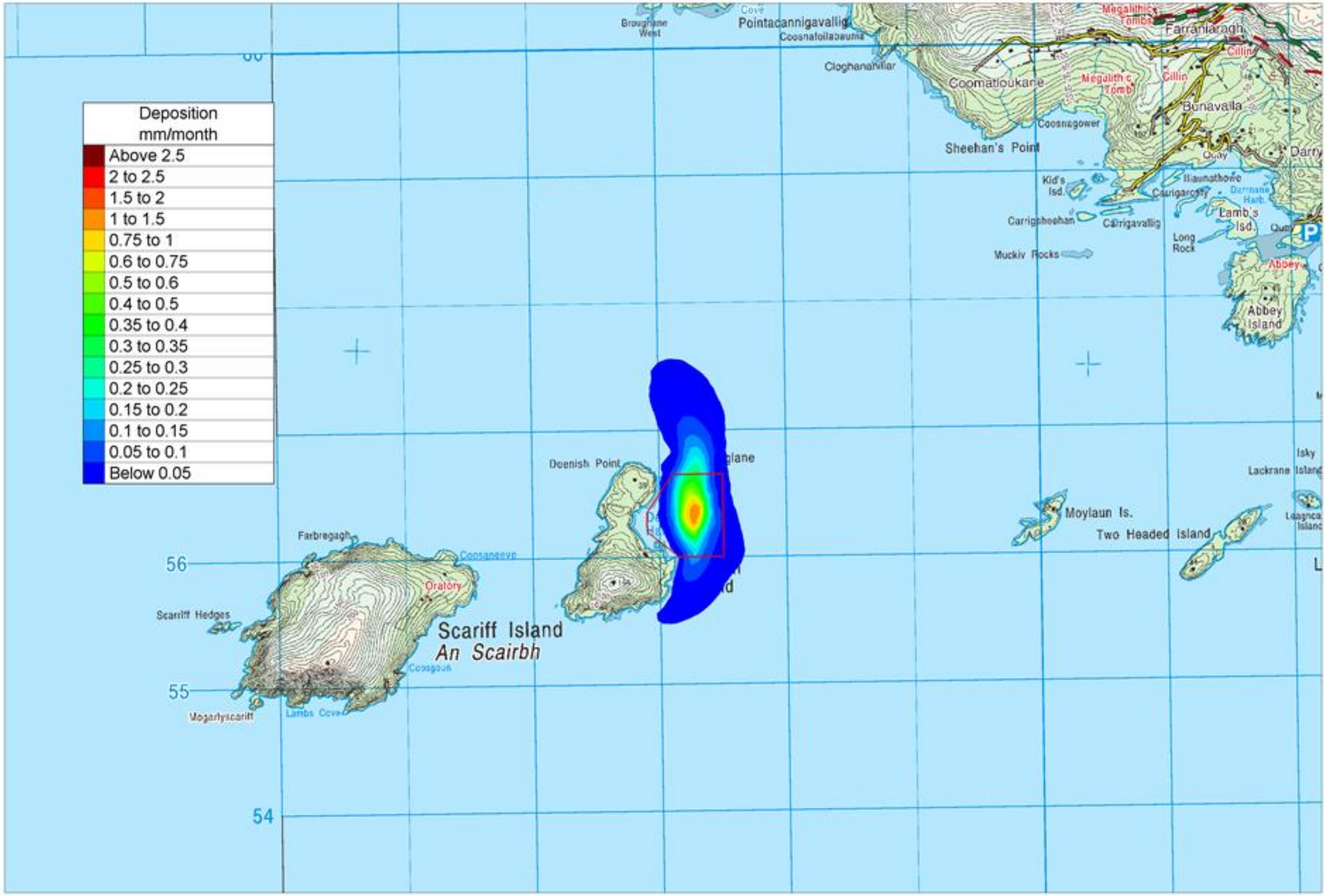


Figure 6-7: Predicted maximum monthly settleable solids sedimentation rates at Deenish Farm Production Site.

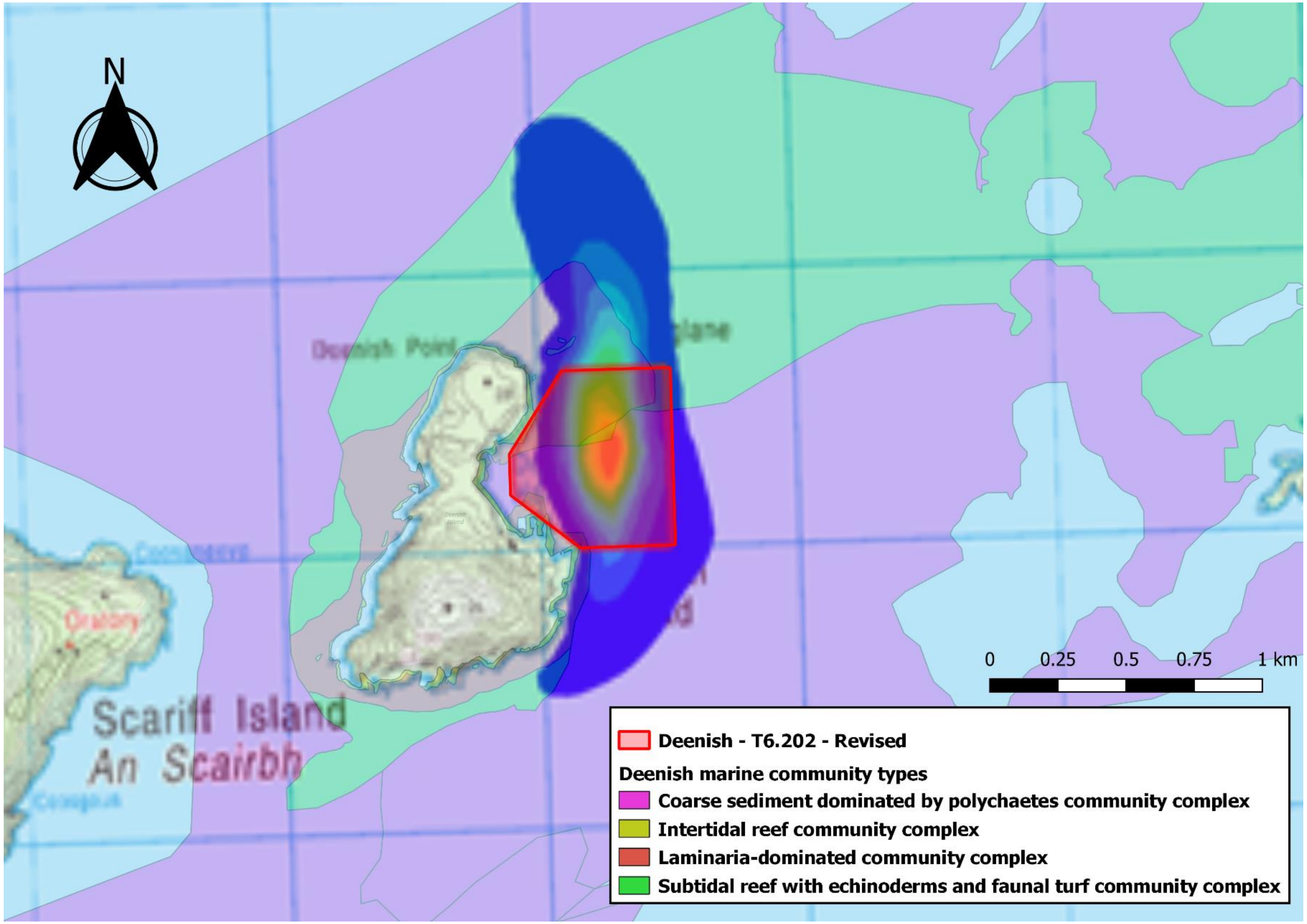


Figure 6-8: Predicted maximum monthly settleable solids sedimentation rates

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 %age of community type	Overlap (ha)	Overlap %age 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)	-	-	-	-
	Coarse sediment dominated by polychaetes community complex (8,314ha)	21.43ha	0.26%	42.29	0.51%
	Shingle (1ha)	-	-	-	-
	Intertidal reef community complex (526ha)	0.06ha	<0.01%	0.26	0.05%
	Laminaria-dominated community complex (3,359ha)	9.40ha	<0.01%	21.137	0.63%
	Subtidal reef with echinoderms and faunal turf community complex (4,808ha)	0.47ha	<0.01%	35.37	0.73%

Qualifying Interest	Community Type (extent ha)	Proposed Site Footprint		Sedimentation Footprint	
		Overlap (ha)	Overlap %age of community type	Overlap (ha)	Overlap %age of community type
Reefs (1170)	Intertidal reef community complex (681ha)	-	-	-	-
	Laminaria-dominated community complex (3,678ha)	9.40ha	<0.01%	21.137ha	0.57%
	Subtidal reef with echinoderms and faunal turf community complex (4,383ha)	0.47ha	<0.01%	35.37ha	0.73%

6.2.7. Mitigation Measures

Organic enrichment due to settleable solids discharged from the fish site is the main source of potential impact to marine benthic habitats. Potential effects of settleable solids will be mitigated through the implementation of fallow periods between production cycles at the site. Following each production cycle, the proposed Deenish site will lie fallow for a minimum of one month. This fallow period allows will occur over the winter months when the site is at its most hydro-active thereby allowing dispersal of solids that may have accumulated under the pens during the production cycle. The fallow period also allows sufficient time for the seabed sediments and associated faunal community to recover to pre-production (pre-disturbed) state. Detail of the recovery of sediment and faunal communities following cessation of activities is documented in **Section 6.2.4** and **Section 6.2.5** above.

6.2.8. Overall Conclusion

Operations at the proposed site, together with the mitigation measures proposed, will **not significantly affect** benthic ecology or Annex I benthic habitats of the Kenmare SAC in light the Conservation Objectives

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 17 seal, whale and dolphin species have been recorded in the waters coastal waters of Ballinskelligs Bay, Deenish Island and Kenmare Bay[10] (see **Table 6.10**).

Table 6.10: Marine mammals recorded in Bantry 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*)

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

Bottle-nosed Dolphin (*Tursiops truncatus*)*
Common Dolphin (*Delphinus delphis*)
Common Porpoise (*Phocoena phocoena*)*
Cuvier's Beaked Whale (*Ziphius cavirostris*)
Killer Whale (*Orcinus orca*)
Long-finned Pilot Whale (*Globicephala melas*)
Pygmy Sperm Whale (*Kogia breviceps*)
Risso's Dolphin (*Grampus griseus*)
Striped Dolphin (*Stenella coeruleoalba*)
True's Beaked Whale (*Mesoplodon mirus*)
White-beaked Dolphin (*Lagenorhynchus albirostris*)
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.

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., 2016). 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:

- Kenmare River SAC (002158) (project within SAC)
- Glengarriff Harbour and Woodland SAC (000090) (66.9km from project)
- Kilkieran Bay and Islands SAC (002111) (184.1km from project)
- Galway Bay Complex SAC (000268) (204.0km from project)

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 sites 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 south east. 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, 2013). 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)
- Roaringwater Bay and Island SAC (000101)
- Slyne Head Islands SAC (000328)
- Inishbofin and Inishshark SAC (000278)
- Duvillaun Islands SAC (000495)
- Inishkea Islands SAC (000507)
- Slieve Tooey/Tormore Island/Loughros Beg Bay SAC (000190)
- Horn Head and Rinclevan SAC (000147)
- Saltee Island SAC (000707)

- Lambay Island SAC (000204)

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 ten's 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 standing event was reported on the south shore of Kenmare Bay at Ballydonegan on the Beara Peninsula in 1989. Standings were also recorded at Allihies Bay on the Beara Peninsula in 1989, 1995 and 1997. Standings of individuals were recorded at Waterville, Ballinskellig Bay in 1986 and 1990.

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) and West Connacht Coast SAC (002998). 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 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 were sighted in the outer bay north of Dursey Island in 2010, 2013 and 2014. A total of 4 standing 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 Ballinskelligs Bay and Kenmare Bay. The NBC database includes over 40 records of the species in the greater area. Typically, the species is recorded in small groups ranging from 2 to 10 individuals. Three SACs in Irish waters have been designated for the species; namely Blasket Islands SAC (002172) (NPWS, 2013b), 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 nosed Dolphin 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 standing event was reported on the south shore of Kenmare Bay at Ballydonegan on the Beara Peninsula in 2005.

Killer Whale (*Orcinus orca*)

The killer whale is the largest dolphin species, reaching up to 9.5 m in length, also being the most widespread cetacean on earth, occurring in areas from the polar ice pack, to the warm waters of the tropics. Within the UK and Ireland, they are most commonly sighted off northern and western Scotland, also occurring west and south of Ireland. Data correlated for presentation in the Atlas indicate sighting predominantly in inshore waters of the northeast, north, west and south coasts. Smaller numbers of sightings have occurred in offshore waters over the Irish Shelf. Two killer whales were recorded in 2012 off Puffin Island to the north west of Ballinskelligs Bay.

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. Strandings of the species were recorded in Ballinskelligs Bay in 1983, 2007 and 2015 while five strandings have been recorded in Kenmare Bay area and south east of Deenish Island.

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 repot in 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 record of the species in 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. The species was also recorded stranded at Allihies Bay Beara Peninsula, Co. Cork. In Ballinskelligs Bay strandings have been recorded in 1986, 2005, 2009, 2013 and 2014.

True's Beaked Whale (*Mesoplodon mirus*)

Little is known of the True's beaked whale global distribution; they occur in the warm temperate Atlantic waters, with Ireland marking their most northerly limit. One stranding is recorded in 1972 in Ballinskelligs Bay.

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 shelf's 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 are strandings records of the species at Derrynane Bay in 1914 and in outer Kenmare Bay 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 west of Deenish Island in 2010.

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). In Ballinskelligs Bay and Kenmare Bay minke whales have been commonly recorded. Numerous sighting of individuals have been reported off Deenish Island.

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 site is located approximately 13km to the north east at Cove Harbour on the northern coastline of Kenmare Bay. Given this distance, operations at the site will not result in disturbance effects at seal haul-out sites and the likelihood of an impact occurring is remote; it is concluded that there will **no significant effects**.

As there is potential that harbour seals and grey seal may 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, the 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 **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 licenced 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 **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, however, 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 **no significant effects**.

6.3.3. Impacts on Cetacean Species

While 15 species of odontocetes (toothed whales and dolphins), including the Habitats Directive Annex II Species Bottle-nosed Dolphin (*Tursiops truncatus*) and Common Porpoise (*Phocoena phocoena*), and 3 species of mysticetes (baleen whales) have been recorded in Kenmare Bay, 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 **no significant effects** to pinniped or cetacean species.

6.4. Otter

6.4.1. Description of the Receiving Environment

The site is present within the Kenmare River SAC which is designated for otter. 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. Conservation Objectives for Otter in the Kenmare River SAC are included in **Appendix 10**.

6.4.2. Impacts on Otter

Otters 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 most dives being <3m

(Kruuk *et al.,* 1985) 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 of Deenish Island where otters can forage, is too significant for them to be found at the 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

Section 6.5 considers potential effects on commercial fisheries and aquaculture. Specifically, this section focuses on spawning and nursery areas.

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, horse mackerel, white belly angler monk and whiting (**Figure 6-13** to **Figure 6-20**). All nursery grounds, with the exception of herring, 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

The Dunmanus-Bantry-Kenmare catchment area includes all river waterbodies that flow into the following bays: Ballinskelligs, Kenmare, Bantry and Dunmanus.

Flowing into the Ballinskelligs bay and into the north-western section of Kenmare bay (up until the Sneem river) there is a total of 13 river waterbodies: Alachaí Beag Theas, Ardsheelhane, Coomnahorna, Cummeragh, Coom, Derreendrislagh, Emlaghmore, Finglas, Inny, Isknagahiny, Liss, Owreagh and Sneem. Out of these 13 rivers there are two well-known salmonids rivers, these being, the Finglass and Inny rivers.

The River Inny which discharges into Ballinskelligs bay is approximately 11.63km from the Deenish site by sea and the River Finglass discharges in to Ballinskelligs bay and is approximately 8.36km by sea from the Deenish site.

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 Deenish site that is designated for salmon is 4.9km across sea and land, this being the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC (000365). 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 licenced since 2014. The Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC is spans from the southwestern point of the Iveragh peninsula towards Killarney town, Co. Kerry and then across to Millstreet town, Co. Cork.

The main river the southwestern section of the entering the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC is the river Finglass which links to lough Currane and then to the river Cummeragh which connects to the highland lakes: Derriana, Namona, Cloonaghlin, Iskanamacteery and Coomeathain. These rivers and lakes fall under the Waterville rivers and lakes system which is managed by the South West Regional Fisheries Board. This system is utilised for salmon fishing each year with its open season being from 17th January to 30th. Trout fishing also takes place from 7th January to 12th October. Sea trout fishing between the 1st – 12th October is fly only. All Sea trout fishing is currently operating on a catch and release basis for the 2019 season (https://fishinginireland.info/salmon/southwest/waterville/). It was reported that 297 salmon where caught using rod and line during the 2018 season, 179 of these salmon were harvested and 118 were released (IFI, 2018)

The River Inny which flows into Ballinskelligs bay to the NNE of the Deenish 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).

6.5.2. Impact to Fisheries

Given the nature of salmon farming there is potential that operations may directly impact wild salmonid populations:

- increasing lice infection rate in wild salmon;
- disease spread;
- the introduction of therapeutants; and
- genetic interaction between farmed and wild Atlantic salmon.

6.5.3. Sea Lice

6.5.3.1. Background

Sea lice are natural parasites of both wild and farmed fish. There two main species found in Ireland; *Lepeophtheirus salmonis* which infests only salmonids and while *Caligus elongatus* which is known to parasitise over 80 different species of marine fish (O'Donohoe *et al.,* 2017). *Lepeophtheirus 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).

Lepeophtheirus 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 6-9**. 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 are met by a critical mass of waiting copepodids, such that a successful infestation ensues.

Lepeophtheirus evolved this strategy of infesting salmonid smolt during their migration, countless millennia ago, long before the advent of salmon farming. In fact, *Lepeophtheirus* 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, dependant 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 if 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, downstream of it.

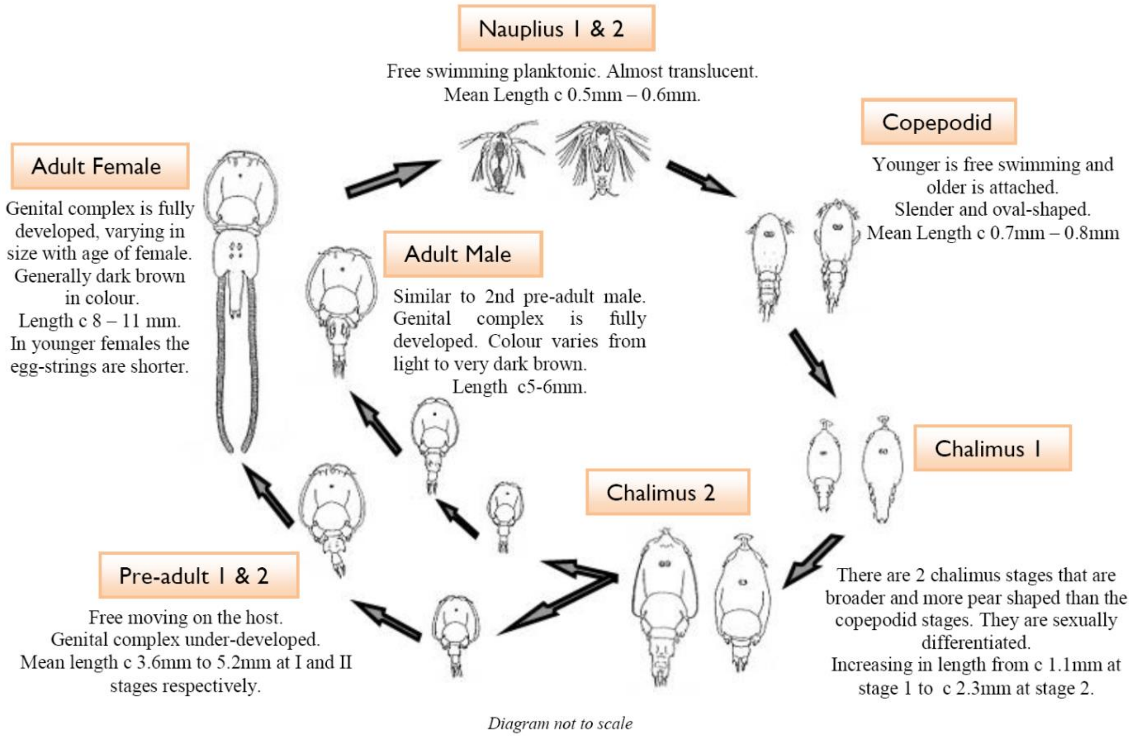


Figure 6-9 Life cycle of *Lepeophtheirus salmonis* (O'Donohoe et al., 2017 after Schram, 1993 & Hamre, 2013).

6.5.3.2. Modelling Potential Impact

For the proposed salmon production operations at the Deenish site, three-dimensional hydrodynamic simulation modelling was undertaken to determine the transport and dispersion of sea lice (*Lepeophtheirus salmonis*) larvae from the farm. 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 & Altibright's (1991) laboratory research into survival rates for temperatures of 12^{o}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 lice 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 Deenish 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 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 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 6-10** and **Figure 6-11** 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 and 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 6-12**); plume median, average, 95-percentile, 99-percentile and maximum concentrations at these stations are presented in **Table 6.11**.

6.5.3.3. 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 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 is 5.3 No./m^3.

Infestation routes and treatment strategies for *Lepeophtheirus* are illustrated by the empirical data given in **Section 2.12**. This indicates that ovigerous female lice on the MOWI Ireland Deenish 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."

6.5.3.4. 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 licenced sites within the bay through the Single Bay Management Plan (see **Section 2.15** for further details) will minimise any potential risk on wild salmonids; consequently it can be concluded that the proposed operations at the Deenish site **will not result in significant effects to salmonids**.

Table 6.11: Modelled Larvae concentrations at reference stations

Reference Sites	Modelled No./m^3				
	Average	Median	95-percentile	99-percentile	Maximum
1	1.458	1.112	3.771	5.001	6.175
2	0.228	0.105	0.793	1.452	1.94
3	0.095	0.041	0.384	0.601	0.8
4	0.208	0.084	0.749	1.14	1.547
5	0.086	0.03	0.371	0.604	1.032
6	0.067	0.041	0.226	0.319	0.443
7	0.009	0.003	0.045	0.097	0.121
8	0.014	0.007	0.048	0.071	0.092
9	0.019	0.017	0.043	0.065	0.099
10	0.025	0.017	0.069	0.095	0.114

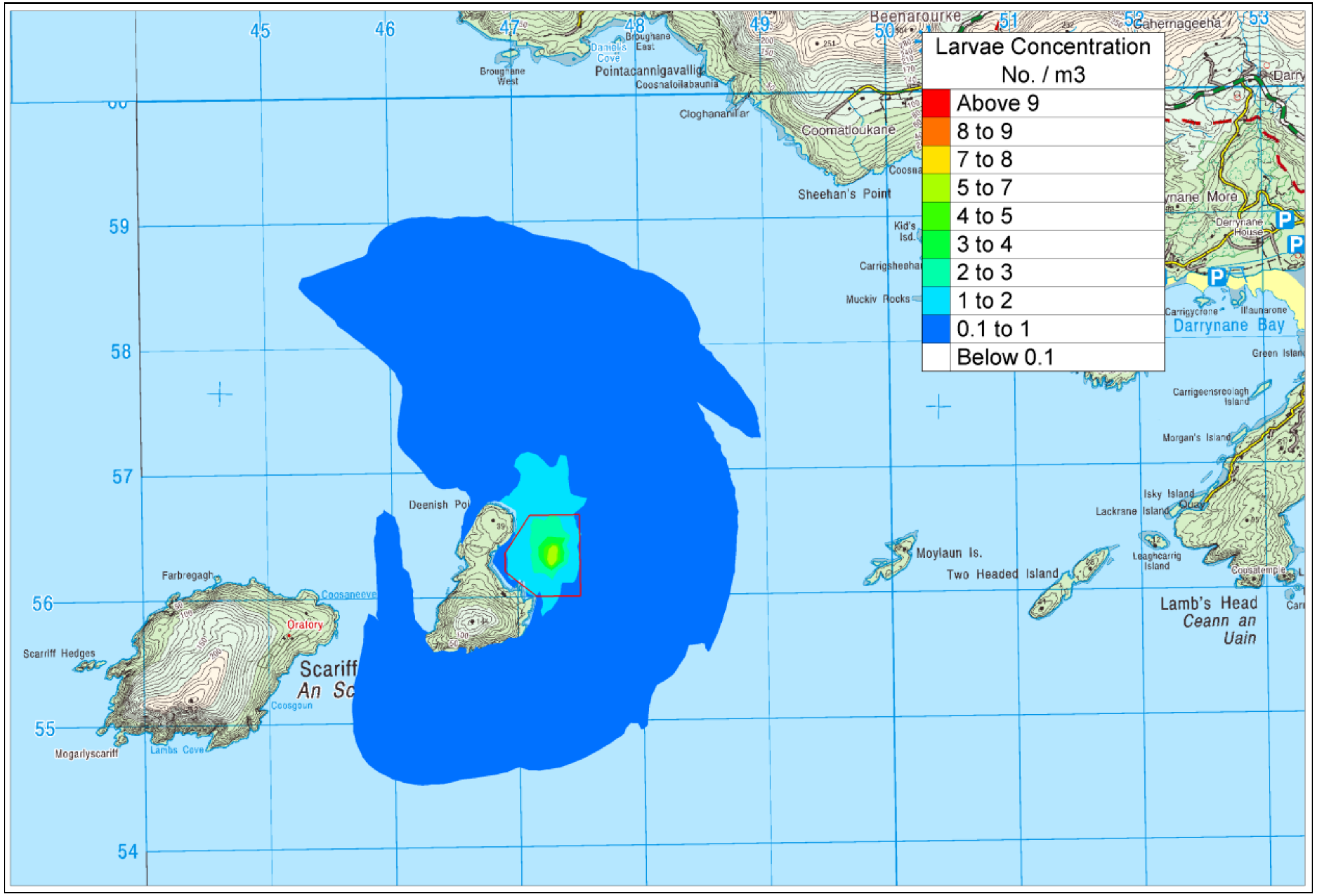


Figure 6-10: Predicted tidal maximum nauplius I larvae numbers (No./m^3) from operations proposed at the Deenish site.

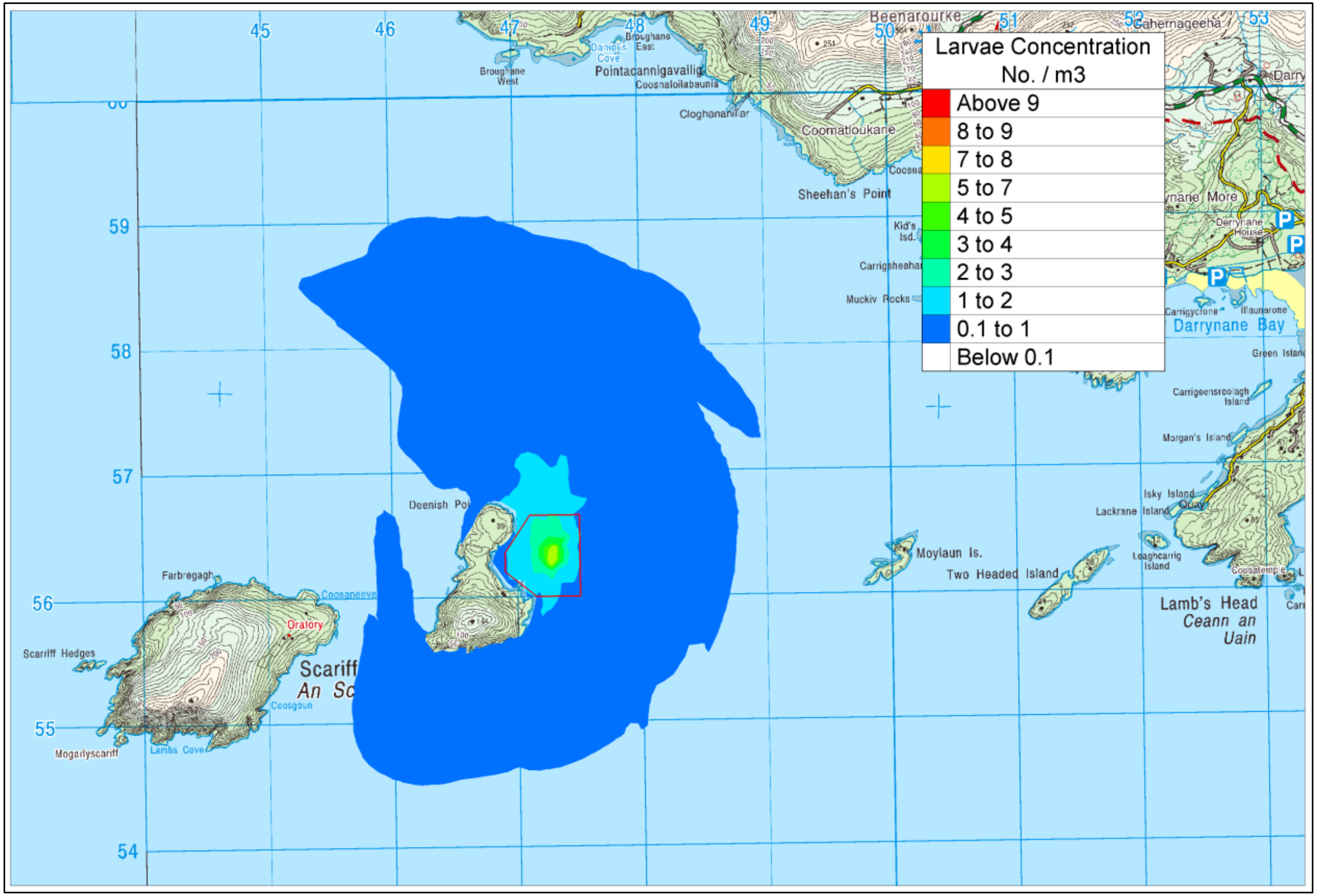


Figure 6-11: Predicted tidal mean Nauplius I larvae numbers (No./m3) from the Deenish site.

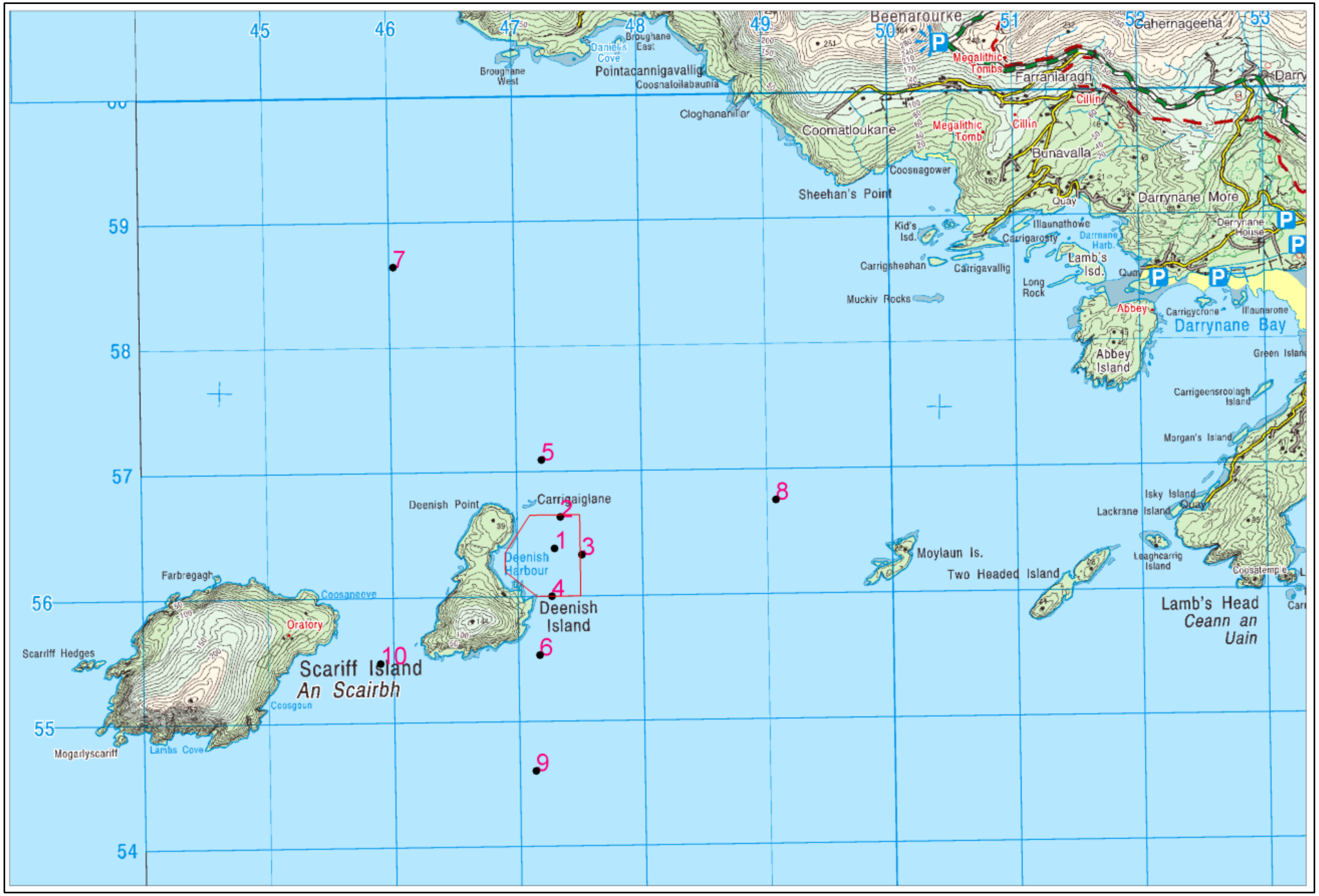


Figure 6-12: References station at Predicted tidal mean Nauplius I larvae numbers (No./m3) from the Deenish site.

6.5.4. Disease spread

6.5.4.1. Background

Disease occurrence in organic farming in covered in **Section 2.12**. 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.

6.5.4.2. 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 (see **Section 2.12** for details), it is highly unlikely that the farm act as a significant source of disease; **consequently, there will no significant effects to salmonids**.

6.5.5. Therapeutants

6.5.5.1. 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.

6.5.5.2. Assessment and Conclusions

Modern treatments, in particular those for lice, break down and disperse rapidly post-treatment, with no prospect of deleterious impact on wild salmonid stocks. For example, Slice® a licenced 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 its can be concluded that **there will no significant effects to salmonids**.

6.5.6. Escapees

6.5.6.1. Background

Glover *et al.* (2017) reviewed the current status of knowledge on half a century of genetic interaction between famed 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 Medium 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.

6.5.6.2. 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, there will no significant effects to salmonids**.

6.5.7. Mitigation Measures

There is potential the wild salmonids maybe affected by the proposed farm through lice infestation, disease spread and the introduction of therapeutants. Details of the farm management schemes (i.e. Single Bay Management, CLAMS) designed to co-ordinate husbandry practices are detailed in **Section 2.15**. These schemes ensure the breaking of disease and parasite life cycles with the effect of enhancing the efficacy of lice control and reducing the overall incidence of disease in the stocks and the use of therapeutants, thereby reducing risks to wild population of salmon. Wilds populations of salmon are also at risk from genetic interaction with escapees from fish farms. **Section 2.14.6** details measures in place to reduce the risk of escapees occurring.

6.5.8. Overall Conclusions

Given the control of diseases on the farm (see **Section 2.12** for details), it is highly unlikely that the farm act as a significant source of disease; **consequently, there will no significant effects to salmonids**.

The continuous weekly monitoring as well as coordinated treatment of all licenced sites within the bay through the Single Bay Management Plan (see **Section 2.15** for further details) will minimise any potential risk on wild salmonids; consequently it can be concluded that the proposed operations at the Deenish site **will not result in significant effects to salmonids**.

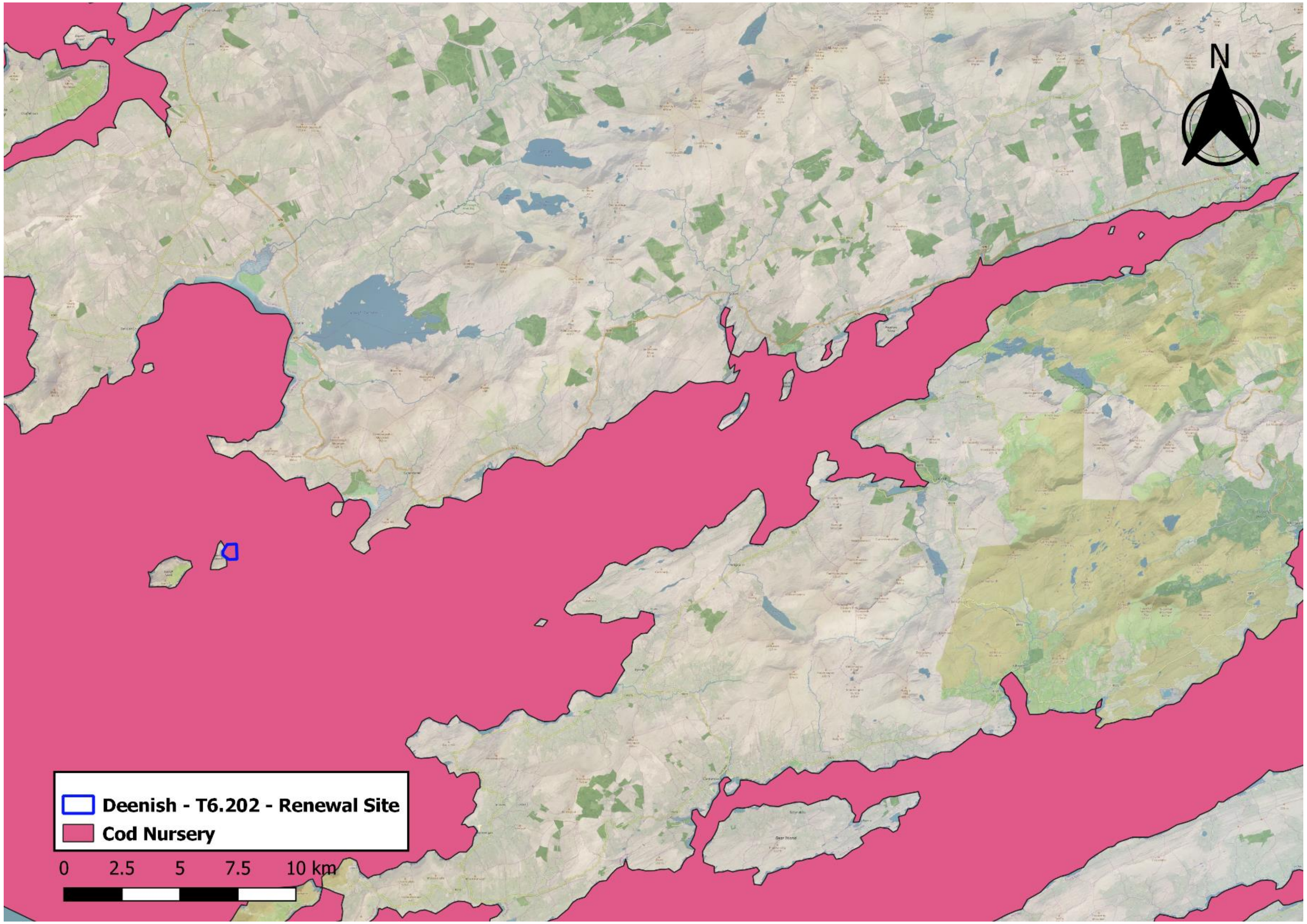


Figure 6-13: Cod nursery ground (Source: Lordan & Gerritsen, 2009).

Figure 6-14: Herring nursery ground (Source: Lordan & Gerritsen, 2009).

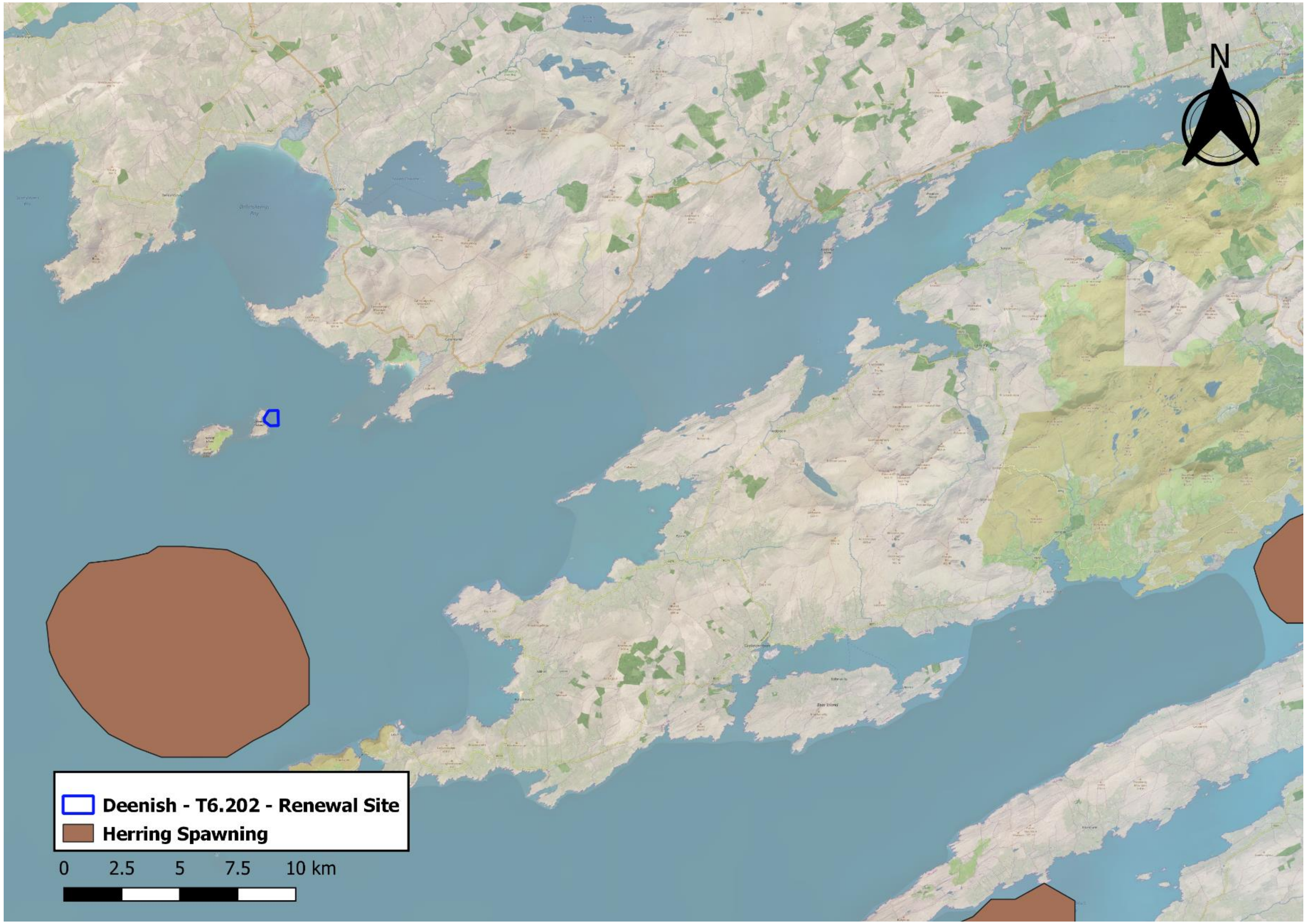


Figure 6-15: Herring spawning ground (Source: Lordan & Gerritsen, 2009).

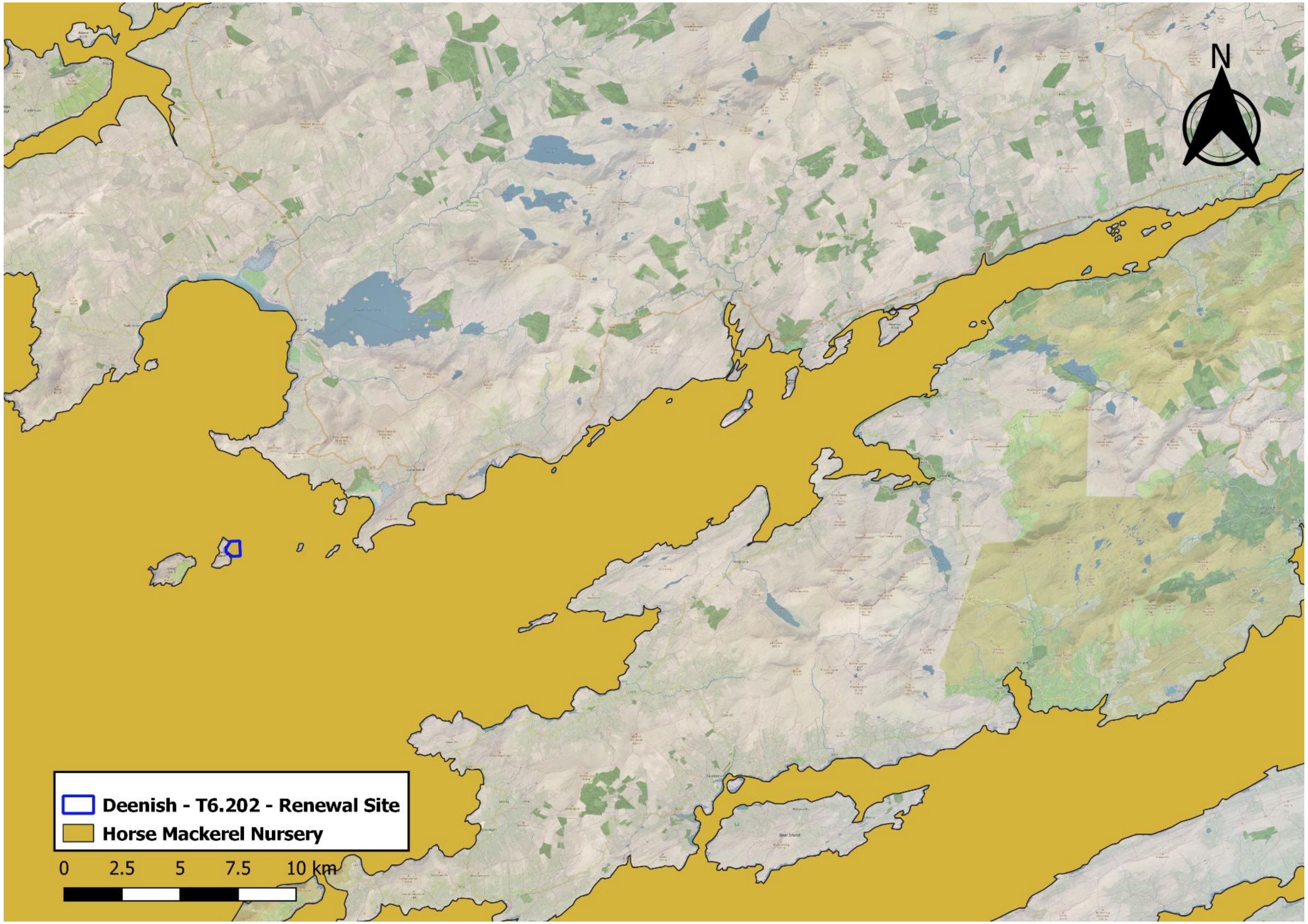


Figure 6-16: Horse mackerel nursery ground (Source: Lordan & Gerritsen, 2009).

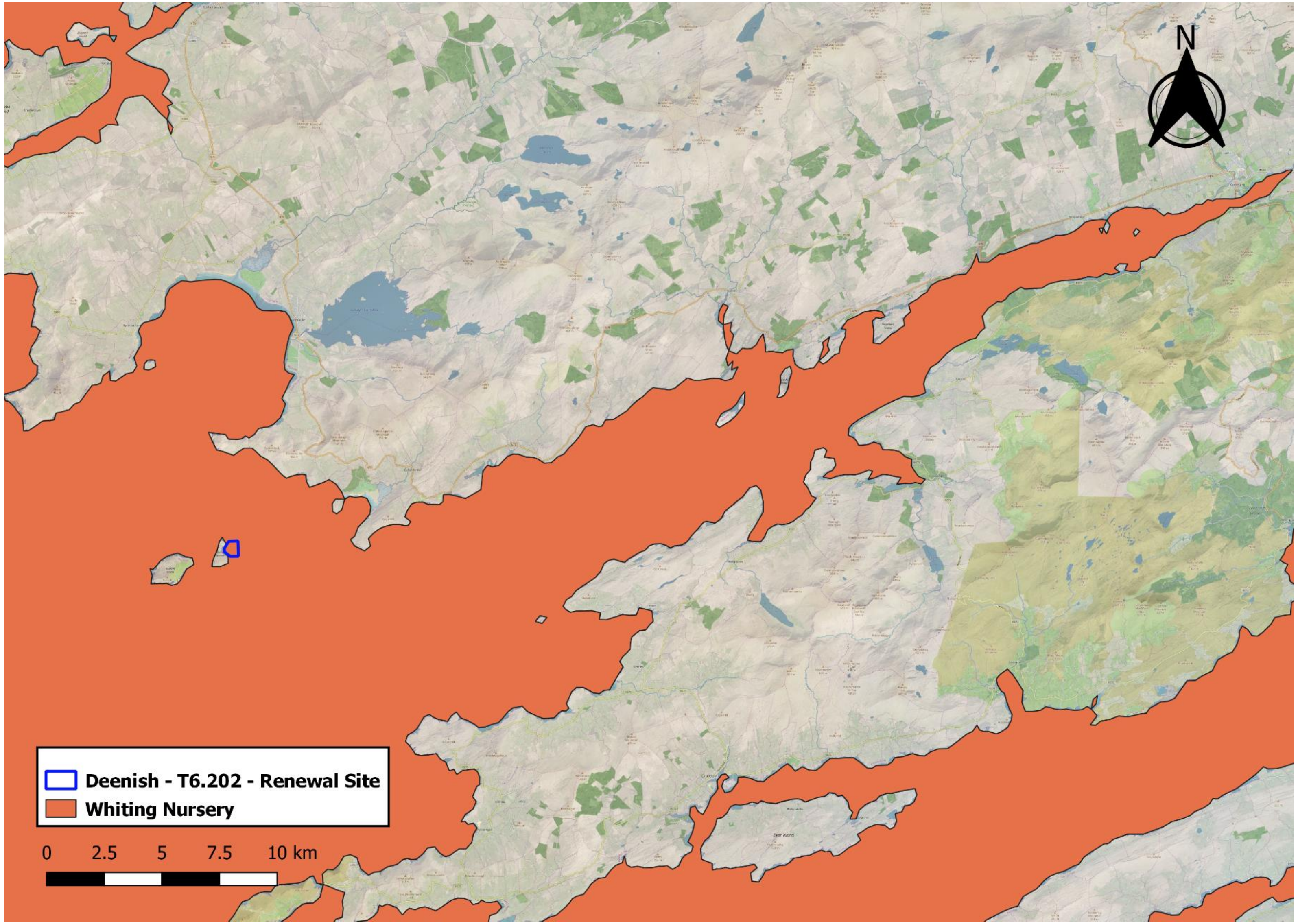


Figure 6-17: Whiting nursery ground **(Source: Lordan & Gerritsen, 2009).**

Figure 6-18: Whiting spawning ground **(Source: Lordan & Gerritsen, 2009).**

Figure 6-19: White bellied angler/ monkfish nursery ground spawning ground (Source: Lordan & Gerritsen, 2009).

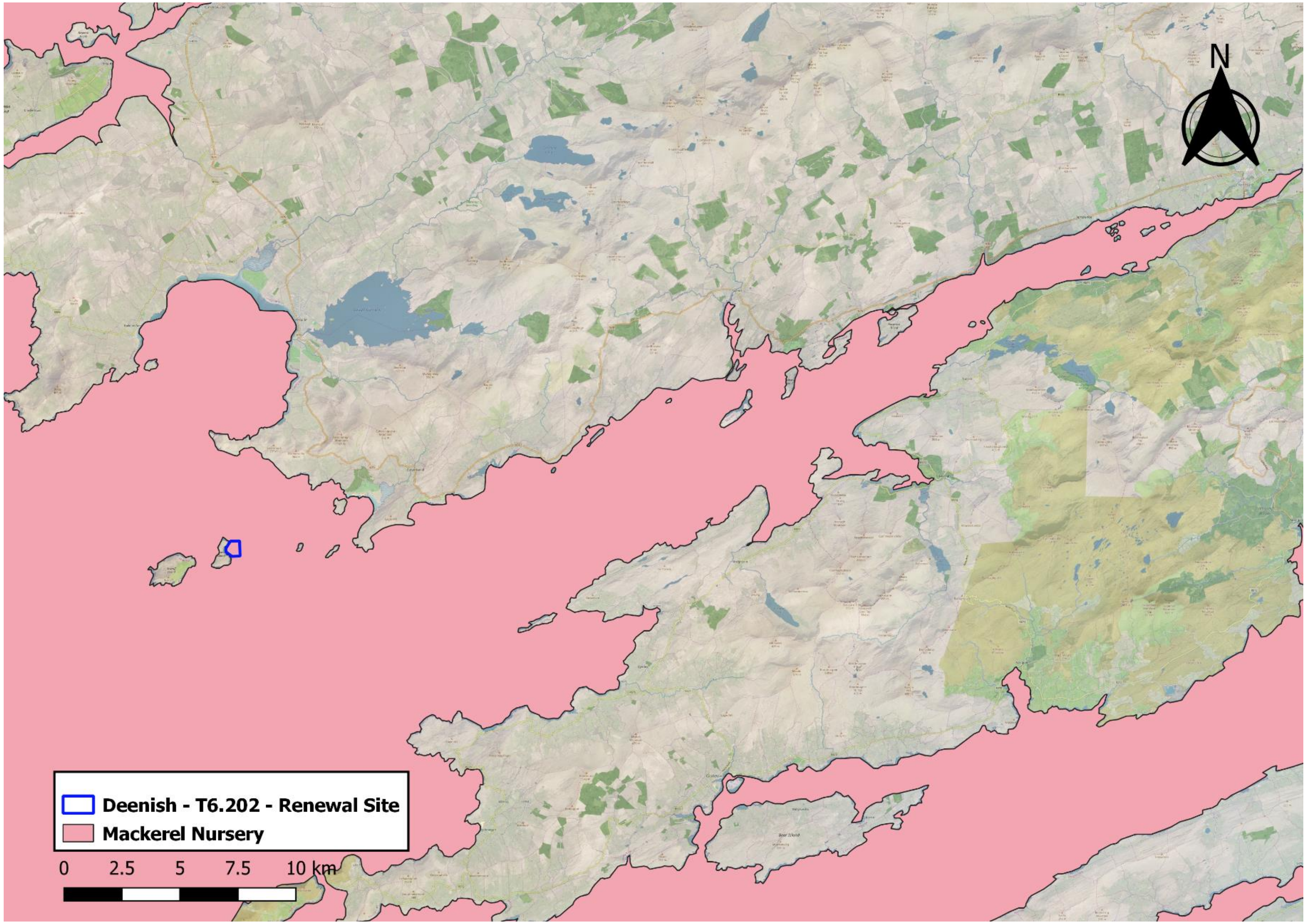


Figure 6-20: Mackerel nursery ground (Source: Lordan & Gerritsen, 2009).

6.6. Birds

The assessment of potential effects to birds focused on 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.

6.6.1. Description of the Receiving Environment

The Deenish site is in the Deenish island and Scariff Island SPA (Site code: 004175). Other SPAs located close to the proposed site include the Beara Peninsula SPA (Site code: 004155), The Bull and the Cow Rocks SPA (Site code: 004066), Iveragh Peninsula (Site code: 004154), The Skelligs (Site code: 004007) and Puffin Island SPA (Site code: 004003).

Due to the mobile nature of birds, Qualifying Features and notable species of SPA sites within the foraging range of the Deenish 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 Stage 1 Screening for AA[11] stage for the Qualifying Features of SPAs listed in **Table 6.12**.

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** (0km - project within site)
Common Tern (*Sterna hirundo*) (30 km)	**Amber**	**Castlemaine Harbour SPA (004029)** (34.7km)

[11] For summary see Section 2.4 of *JN1524 Deenish NIS - Volume 1 - Main Report*

[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)
Fulmar (*Fulmarus glacialis*) (580km)	**Green**	**Beara Peninsula SPA (004155)** (10.6km)
		Blasket Islands SPA (004008) (41.3km)
		Clare Island SPA (004136) (227.7km)
		Cliffs of Moher SPA (004005) (141.4km)
		Deenish Island and Scariff Island SPA (004175) (0km -project within site)
		Dingle Peninsula SPA (004153) (40.7km)
		Duvillaun Islands SPA (004111) (258.8km)
		High Island, Inishshark and Davillaun SPA (004144) (200.0km)
		Horn Head to Fanad Head SPA (004194) (424.5km)
		Iveragh Peninsula SPA (004154) (3.3km)
		Kerry Head SPA (004189) (75.5km)
		Lambay Island SPA (004069) (343.0km)
		Puffin Island SPA (004003) (16.1km)
		Saltee Islands SPA (004002) (249.9km)
		Skelligs SPA (004007) (20.0km)
		Tory Island SPA (004073) (412.6km)
		West Donegal Coast SPA (004150) (336.2km)
Gannet (*Morus bassanus*) (709km)	**Amber**	**Saltee Islands SPA (004002)** (249.9km)
		Skelligs SPA (004007) (20.0km)
		The Bull and the Cow Rocks SPA (004066) (16.4km)
Guillemot (*Uria aalge*) (340km)	**Amber**	**Clare Island SPA (004136)** (227.7km)
		Cliffs of Moher SPA (004005) (141.4km)
		Horn Head to Fanad Head SPA (004194) (424.5km)
		Inishmore SPA (004152) (154.1km)
		Ireland's Eye SPA (004117) (335.9km)
		Iveragh Peninsula SPA (004154) (3.3kmkm)
		Lambay Island SPA (004069) (343.0km)
		Loop Head SPA (004119) (92.1km)
		Mid-Waterford Coast SPA (004193) (191.1km)
		Old Head of Kinsale (004021) (115.5km)
		Saltee Islands SPA (004002) (249.9km)

Qualifying Feature (Species Foraging Distance km)	**BoCCI[13]**	**SPA** (Shortest linear distance[6] from project km)
		Skelligs SPA (004007) (20.0km)
Herring Gull (*Larus argentatus*) (92km)	**Red**	**Blasket Islands SPA (004008)** (41.3km)
Kittiwake (*Rissa tridactyla*) (300km)	**Amber**	**Aughris Head SPA** (297.8km)
		Blasket Islands SPA (004008) (41.3km)
		Clare Island SPA ((004136) (227.7km)
		Cliffs of Moher SPA (004005) (141.4km)
		Helvick Head to Ballyquin SPA (004192) (175.4km)
		Inishmore SPA (004152) (154.1km)
		Loop Head SPA (004119) (92.1km)
		Old Head of Kinsale (004021) (115.5km)
		Puffin Island SPA (004003) (16.1km)
		Saltee Islands SPA (004002) (249.9km)
		Skelligs SPA (004007) (20.0km)
		Wicklow Head SPA (004127) (316.5km)
Lesser Black-backed Gull (*Larus fuscus*) (181km)	**Amber**	**Ballycotton Bay SPA (004022)** (150.5km)
		Ballymacoda (004023) (1158.0km)
		Blasket Islands SPA (004008) (43.3km)
		Cork Harbour SPA (004030) (123.2km)
		Deenish Island and Scariff Island SPA (004175) (0km -project within site)
		Puffin Island SPA (004003) (16.1km)
Manx Shearwater (*Puffinus puffinus*) (330km)	**Amber**	**Blasket Islands SPA (004008)** (41.3km)
		Cruagh Island SPA (004170) (197.5km)
		Deenish Island and Scariff Island SPA (004175) (0km -project within site)
		Puffin Island SPA (004003) (16.1km)
		Skelligs SPA (004007) (20.0km)
Puffin (*Fratercula arctica*) (200km)	**Amber**	**Blasket Islands SPA (004008)** (41.3km)
		Cliffs of Moher SPA (004005) (141.4km)
		Puffin Island SPA (004003) (16.1km)
		Skelligs SPA (004007) (20.0km)
		The Bull and the Cow Rocks SPA (004066) (16.4km)
Razorbill (*Alca torda*) (340km)	**Amber**	**Blasket Islands SPA (004008)** (41.3km)
		Clare Island SPA (004136) (227.7km)

Qualifying Feature (Species Foraging Distance km)	**BoCCI**[13]	**SPA** (Shortest linear distance[6] from project km)
		Cliffs of Moher SPA (004005) (141.4km)
		Ireland's Eye SPA (004117) (335.9km)
		Puffin Island SPA (004003) (16.1km)
		Saltee Islands SPA (004002) (249.9km)
Storm Petrel (*Hydrobates pelagicus*) (65km)	**Amber**	**Blasket Islands SPA (004008)** (41.3km)
		Deenish Island and Scariff Island SPA (004175) (0km -project within site)
		Magharee Islands SPA (004125) (64.2km)
		Puffin Island SPA (004003) (16.1km)
		Skelligs SPA (004007) (20.0km)
		The Bull and the Cow Rocks SPA (004066) (16.4km)

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 2015). 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. 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). 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). 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). 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 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). 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). 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 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). 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 2014). 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. 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 2011). 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). 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). 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). 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). 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). Notatble 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). 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 survey 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). The site includes the sea cliffs and the land adjacent to the cliff edgeSea 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 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). 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). 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 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). 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 is 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). 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). 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 site is 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. 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). The cliffs at the sites rise to about 60 m and it is here that most of the seabirds 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.

6.6.2. Potential Impacts

6.6.2.1. 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 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.

6.6.2.2. Entanglement/ Mortality Risk

There is potential that bird species may predate of 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. 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.

6.6.2.3. Impacts on Foraging and Licenced Area Habitat Suitability

If the licenced area coincides with foraging areas suitable 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.

6.6.3. Impact Assessment Methodology

6.6.3.1. 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**);
- licenced area habitat suitability (**Table 6.15**); and
- species habitat flexibility (**Table 6.16**).

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

6.6.3.2. 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

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

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
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

6.6.3.3. Species Population Sensitivity

The determination of the sensitivity of species population considers 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 receptors 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
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.

6.6.3.4. Licenced 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
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

6.6.3.5. 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

6.6.4. Assessment of Impact Significance

The level of impact is determined by combining assessments of 1) Disturbance, 2) Population Sensitivity, 3) Licenced Area Habitat Suitability and 4) Habitat Flexibility Scores. The level of impact are 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

Level of Impact	Impact Significance	Definition
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.

6.6.5. 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]	Licenced 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 SIGNIICANT)
Arctic tern (*Sterna paradisaea*)	2	High – BoCCI Amber List	2	3	Negligible	Potential Imperceptible Impact (NOT SIGNIICANT)
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 SIGNIICANT)
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 SIGNIICANT)
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 SIGNIICANT)

[15] BoCCI - Birds of Conservation Concern in Ireland

Qualifying Feature	Disturbance	Population Sensitivity BoCCI[15]	Licenced Area Habitat Suitability	Habitat Flexibility Scores	Overall Level of Impact	Impact Significance
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 SIGNIICANT)
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 SIGNIICANT

7. Land and Soils

7.1. Description of the Receiving Environment

7.1.1. Seabed Substrata

The seabed in outer Kenmare Bay to the east and northeast of the site predominately comprise patches of gravel, gravelly mud mixed sediment, boulder and cobble fields and coarse sediment, and coarse sand while to the north of the site the seabed comprises areas of coarse sand and coarse sediment (Emodnet 2019) (**Figure 7-1**).

Annual Benthic Audit survey undertaken in 2019[16] at the site focused on two transects (**Figure 7-1**) (AQUAFACT, 201) (see **Appendix 6**). Survey findings confirm that the sediments at the site consist of a variety of fine to medium grained sand with shell fragments (**Table 7.1**).

7.1.2. Redox

The 2019 Benthic Audit survey showed that apparent redox potential discontinuity (aRPD) at the site ranged from maximum of 4.2cm (directly underneath the pens and at the edge of the pens) to a minimum of 1.5cm (10m 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 pens was selected as a good representation of ambient conditions in proximity to the aquaculture site: aRPD at the reference point was 3.0cm.

7.1.3. Organic Carbon

Organic matter (as measured using LOI method) values recorded in 2019 at the site ranged from 1.79% to 3.56% (see **Table 7.1**) (AQUAFACT, 2019). In general, LOI values recorded at the 2 transects decreased with increasing distance from the pens with levels were highest directly below or at the edge of the cage due to discharges from the site.

[16] AQUAFACT 2019b. Environmental Survey Beneath Finfish pens at Deenish aquaculture site (T6/202), Kenmare Bay, Co. Kerry. May 2018. Produced by AQUAFACT International Services Ltd.

Table 7.1 Aquafact Benthic Audit Results – Sample Station, mean aRDP, Substrate Type, Outgassing (AQUAFACT 2019b).

Sample Station	Mean aRDP (cm)	Substrate	Outgassing	LOI%
T1 Under	4.1	Fine grained sand	No	3.16
T1 Edge	5.6	Fine grained sand	No	3.00
T1 10m	3.5	Coarse sand	No	2.52
T1 20m	3.1	Coarse sand/ gravel sediment	No	2.61
T1 50m	2.6	Coarse sand/ gravel sediment	No	2.87
T1 100m	2.2	Coarse sand (high proportion of shell material)	No	2.31
T2 Under	4.2	Fine grained sand	No	-
T2 Edge	4.2	Medium/ fine grained sand (shell material throughout)	No	3.41
T2 10m	1.5	Fine grained sand	No	3.56
T2 20m	1.9	Fine grained sand	No	1.79
T2 50m	3.6	Fine grained sand	No	2.06
Reference Point	3.0	Coarse sand/ gravel sediment (high proportion of shell material)	No	2.69

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 2,200 tonnes) at the proposed renewal site (33.5ha) indicates that the predicted maximum monthly sedimentation rate at the pens is 1.4mm per month of which 1.68kg per m^2 of organic material per month (or 54g per m^2 per day). The organic material deposited on the seabed under the pens will consist of food waste and faeces. This waste will be largely confined to an area of fine and medium sand within the footprint of the pens with very slight migration of settleable solids outside of the licenced production area to the south and east of the pens (see **Section 6.2.6**). The volume of organic material deposited on the seabed monthly will feed the natural cycle of community succession (detailed in **Section 6.2.4.2**). The likelihood of the renewal of the licence resulting in increased organic matter loading is Highly Likely. As a consequence, the benthic community typical of undisturbed non-production sites will be gradually depleted over time by the increased organic loading and replaced by opportunistic polychaete species that 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 on species diversity. However, the fallow period at the end of the 2 year production cycle occurs in the winter months, which is the most active hydrodynamically, resulting in the redistribution and dispersal of organic matter beneath the pens prior to the introduction of excess organic matter to the seabed during a new production cycle.

As the disturbance is temporary, very localised and confined to the AZE (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 AZE is likely to occur.

7.3. Mitigation Measures

The fallow period between growth cycles at the 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 Deenish 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 and 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**.

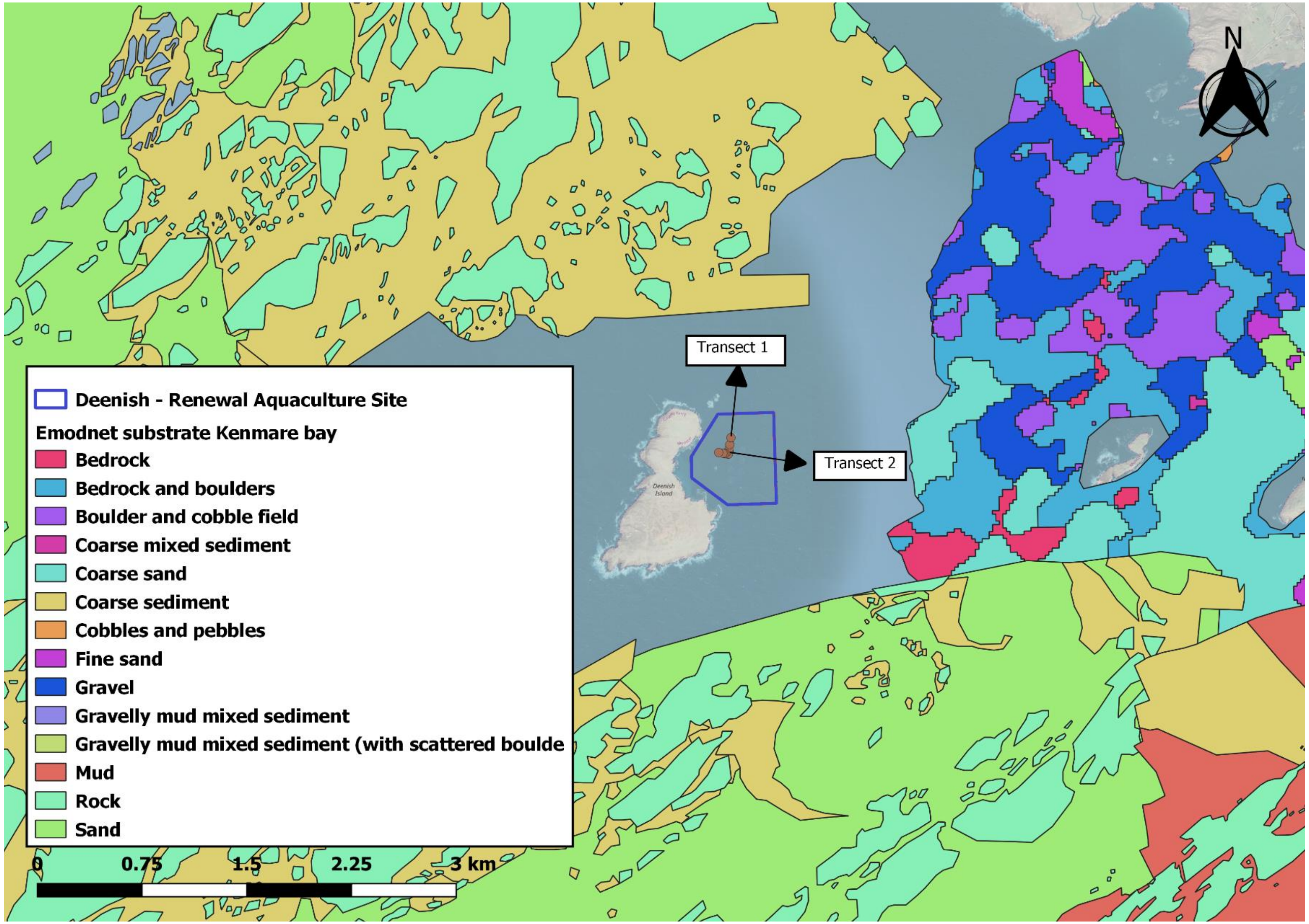


Figure 7-1: Sediment type in Kenmare Bay (AQUAFACT 2018; INFOMAR 2013) and sampling transects

8. Water

8.1. Description of the Receiving Environment

8.1.1. Water Depth

Depths increase eastward away from the island reaching approximately 30m and 33m respectively on the northern and southern boundaries. A bathymetric survey was carried out off the eastern flank of Deenish Island as part an archaeological assessment undertaken in the area (see **Appendix 11**). **Figure 8-1** and **Figure 8-2** respectively present a digitised bathymetric map and a 3D terrain model of the area survey; water depths in the survey area range from 2m on the northwest margins of the survey site to depths of up to 50m to the east of the site. The Deenish site is located within the bathymetric survey area shown in **Figure 8-1** and **Figure 8-2**; water depths at the site range from 15m – 50m. Further detail of bathymetry at the site is presented in **Section 2.2** above.

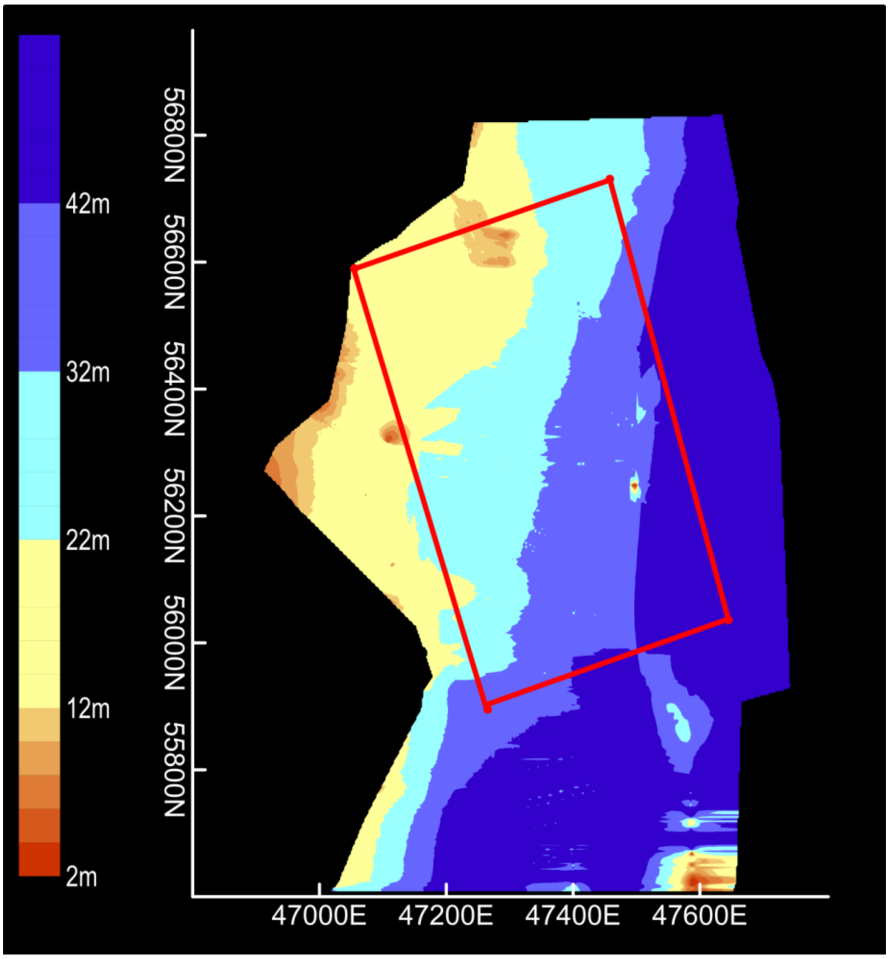


Figure 8-1: 2D Bathymetric contours off the eastern flanks of Deenish Island (Source: Boland, 2015).

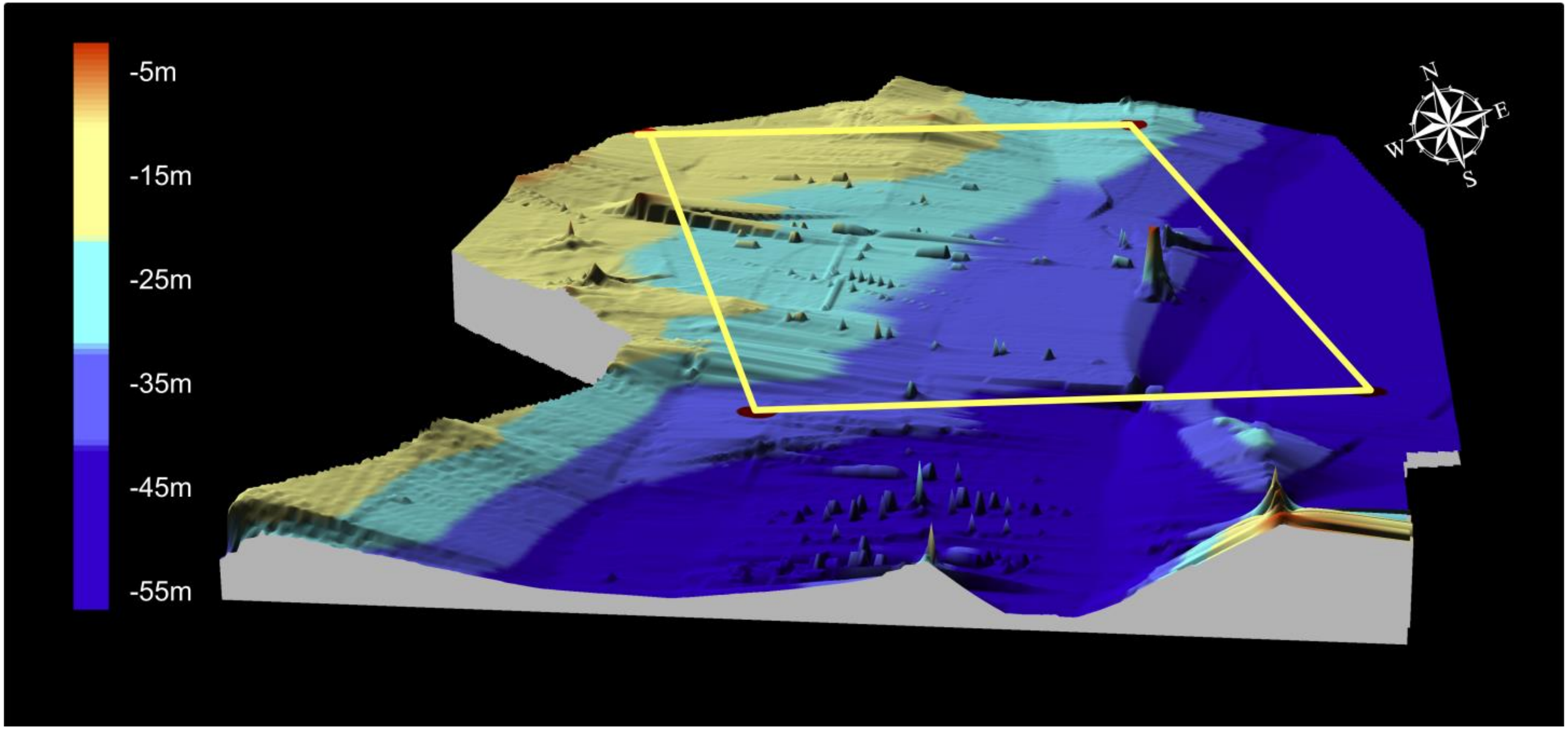


Figure 8-2: **3D digital terrain model developed from bathymetric data acquired off the eastern flanks of Deenish Island (Source: Boland,**

8.1.2. Tidal Velocities and Circulation

A hydrographic study undertaken at the site in April to May 2010 showed water currents close to the seabed, at mid-water depth and at the surface were 6.3cm sec^{-1}, 7.9cm sec^{-1} and 9.2cm sec^{-1} respectively. Mean current direction was WNW close to the seabed, WNW/ NW at mid-water and NW at the surface (Watermark, 2012). The maximum tidal range was 3.41m on Spring tides. Minimum tidal range was 1.44m.

A hydrographic survey of the tidal currents in outer Kenmare Bay carried out by Irish Hydrodata (August 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. It was found that the tidal flow direction was almost equally distributed around the compass.

Neap and spring tide drogue surveys of the tidal stream flows at the Deenish Island site were conducted in 1997. The drogue releases were strongly influenced by strong wind conditions that prevailed during the surveys. The drogues on both neap and spring tides had a tendency of sticking at the site in the shallows. The current direction was found to be generally northwards and averaging over 0.1m/s in all cases.

Overall, survey results for Deenish Island indicate that currents run north on the ebb tide, turning through east at low water, to south to south east on the flood tide. Flood currents are stronger than ebb currents. Current speed increases slightly with depth. The results suggest dominant currents to the north and south-east in the site area, in particular in spring tides. Longer duration of northern flow, to ebb mid-tide during neaps, results in a net northerly flow. Mean ebb and flood currents of 0.1m/sec, whilst periods of peak currents of 0.25 – 0.35m/sec during the tidal cycle on both Springs and Neaps indicates potential for rapid dispersal and dilution away from the site, even during still weather conditions.

The computed hydrodynamics from the Telemac model (**Figure 8-3** to **Figure 8-6**) agree reasonably well with the findings from the surveys**.** At the proposed aquaculture licensed site at Deenish, the tidal stream flows increase eastward away from the Island. The strongest tidal streams occur further east and northeast and southeast of the site with neap tide maximum velocities of 0.1 to 0.15m/s and spring tide maximum velocities of 0.25 to 0.35m/s. Under certain conditions a local anticlockwise gyre occurs in the vicinity of the farm site influenced by the stronger flows in the narrows between the islands and by the shape of the eastern shoreline of Deenish Island.

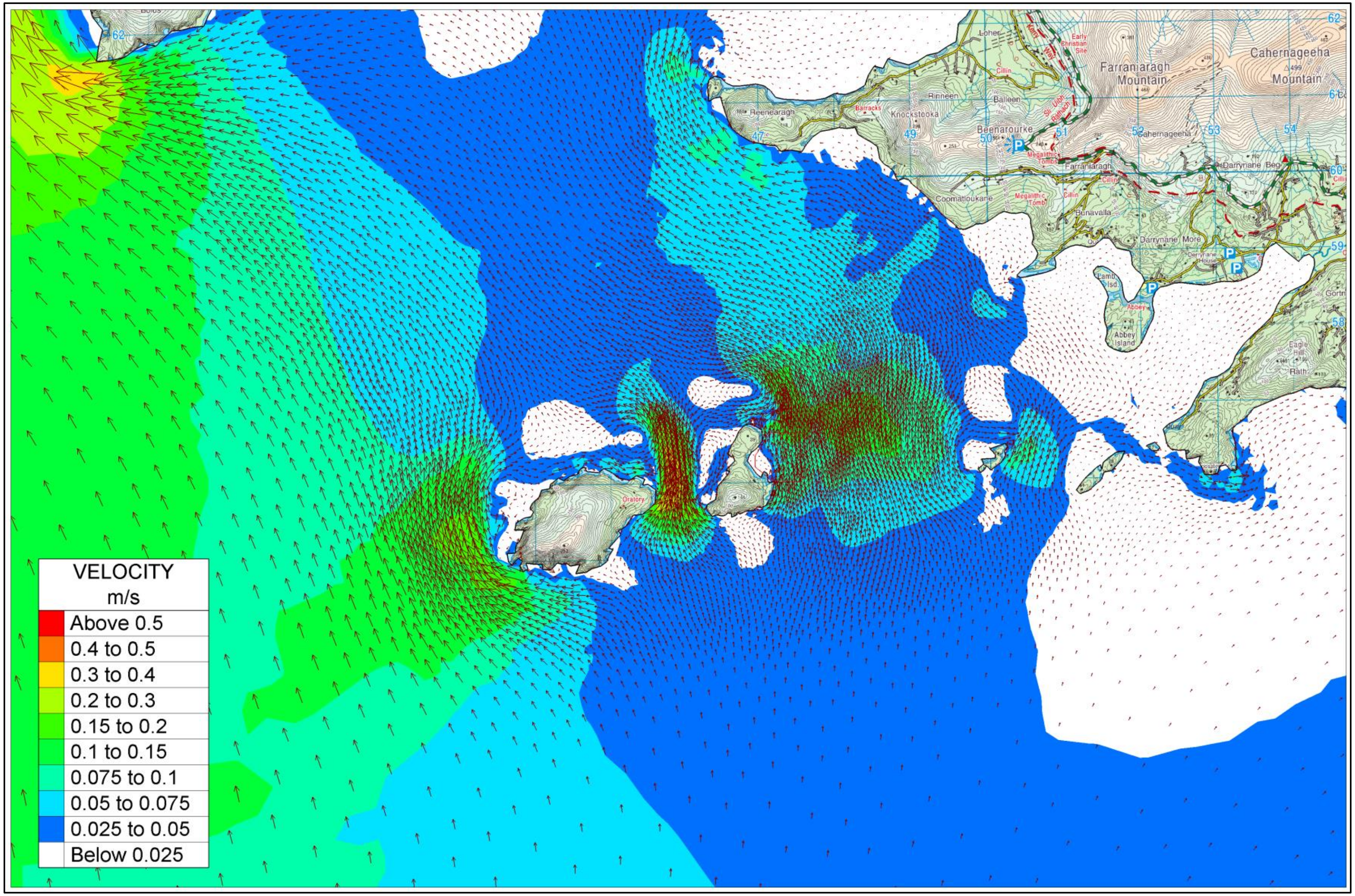


Figure 8-3 Computed mid-depth tidal velocities in the vicinity of Deenish and Scarriff Islands on flooding neap tide.

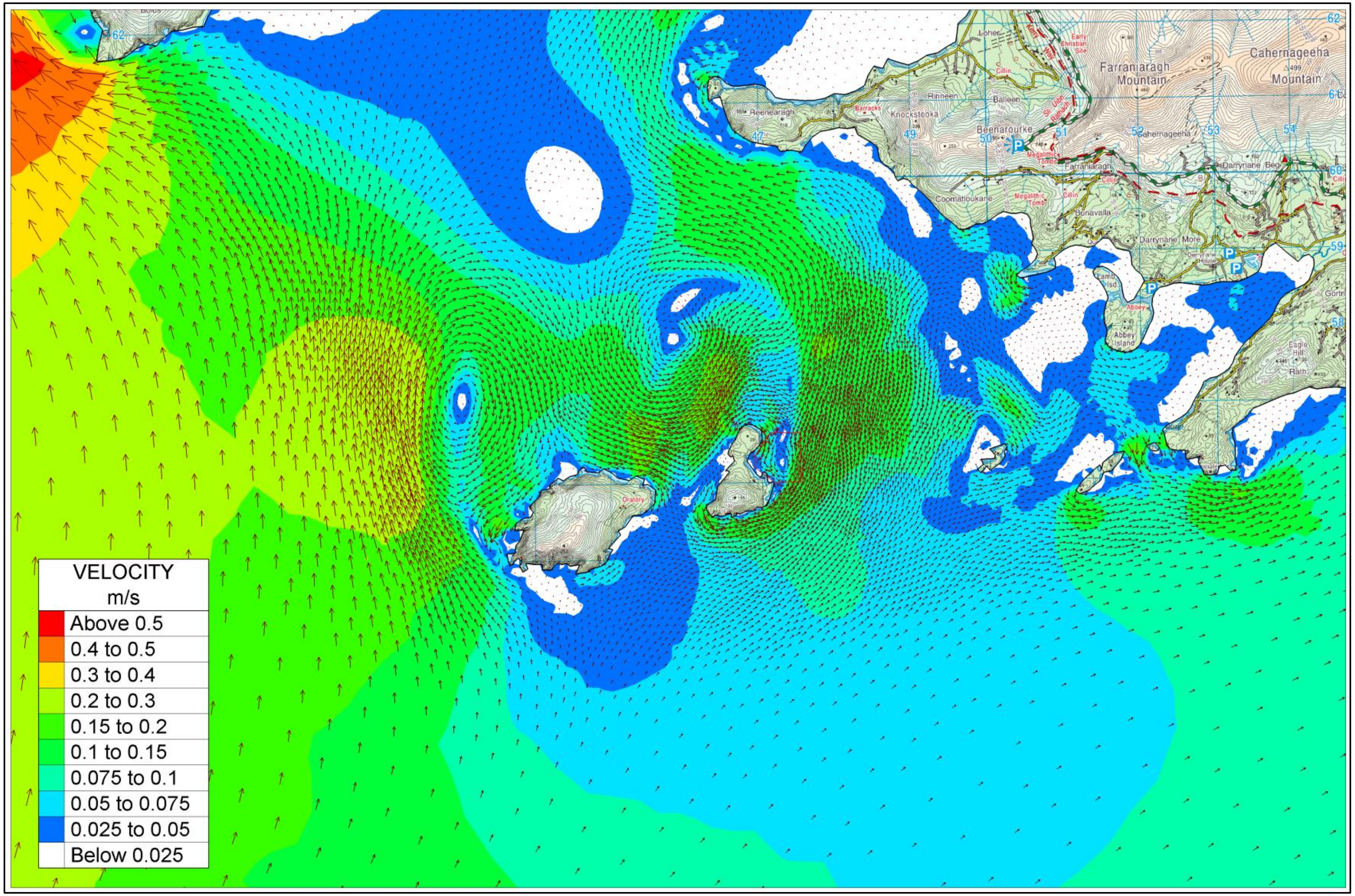


Figure 8-4: Computed mid-depth tidal velocities in the vicinity of Deenish and Scarriff Islands on flooding spring tide

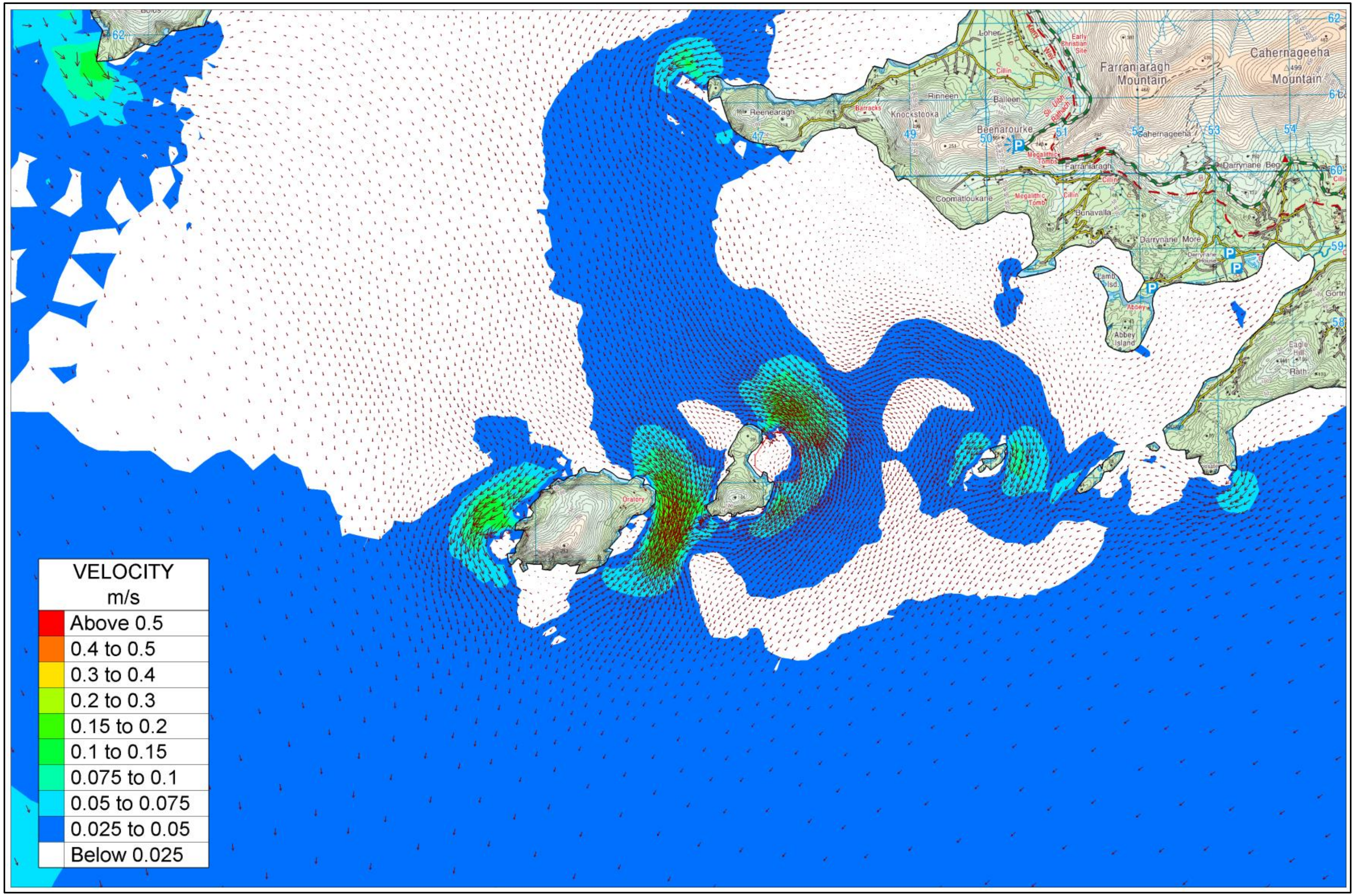


Figure 8-5: Computed mid-depth tidal velocities in the vicinity of Deenish and Scarriff Islands on ebbing neap tide

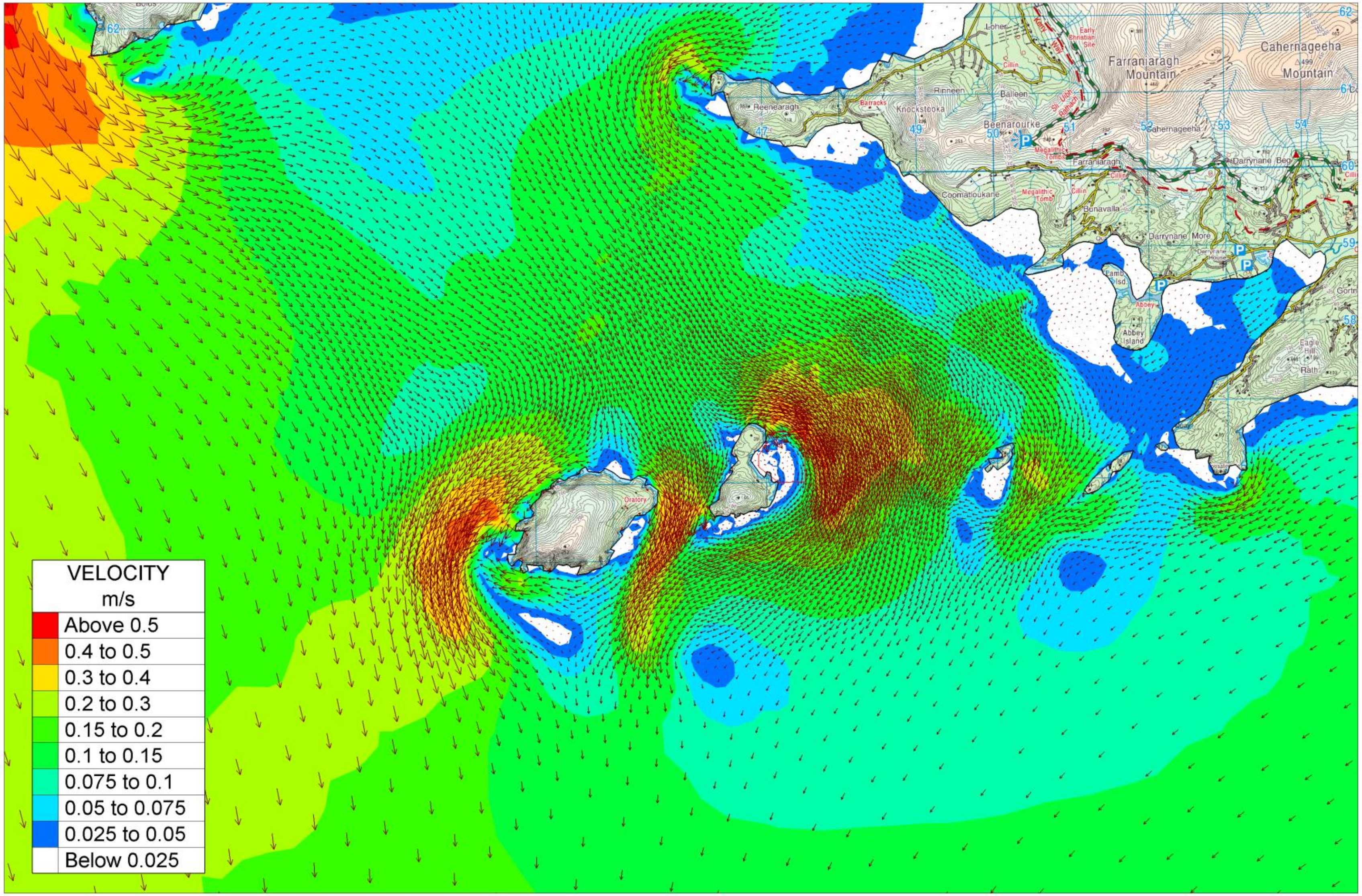


Figure 8-6: Computed mid-depth tidal velocities in the vicinity of Deenish and Scarriff Islands on ebbing spring tide

8.1.3. Wave Climate

A hydrodynamic wave climate modelling study (see **Appendix 8**) was carried out in 2019 to inform the assessment of potential impact of activities at the Deenish site. The following wave climate simulations were performed to determine the most adverse wave climate likely to occur at the Deenish 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 8-7** through **Figure 8-12** while summary wave characteristics for each simulation are presented below in **Table 8.1.**

The Deenish Island site is shown to be a very exposed site, due to the deep waters on approaches and relatively deep waters at the site itself. Large Atlantic swell waves of long period can significantly impact the licenced site from the south to the west sectors producing 100 year storm waves of 6 to 8m. The most critical direction producing the largest wave heights is the Southwest, followed closely by the westerly storm waves. Shelter from Deenish Island is provided close in towards the shoreline at the proposed licensed site. The local-wind wave simulation produces maximum significant wave heights of 1.0 to1.5m and for south, 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 5.1 to 8.7 seconds. Deenish Island provides some degree of protection against wind waves which are less capable of diffracting and refracting around the island than the longer period Atlantic swell waves.

8.1.4. Freshwater Input

The contributing catchment area, the Dunmanus-Bantry-Kenmare Catchment, drains a total area of 1,898 km^2 (EPA Catchments). This catchment includes a total of 31 subcatchments, 93 river bodies, 39 lakes, 13 transitional and 6 coastal water bodies and 3 groundwater bodies constitute this catchment area. The main rivers and subcatchments which drain into Kenmare and Ballinskelligs bay can be seen in **Figure 8-13**.

Table 8.1: Summary of Computed Design Wave Conditions at the centre point of the Deenish Site (51.7098° -10.0098°)

Simulations 1 to 3 Extreme 100year Atlantic storm Swell			
Site	Significant Wave Height HMO* (m)	Mean Wave Period TMOY** (sec)	Wave direction (degrees)
South	6.080	11.97	346.5
Southwest	7.923	12.34	352.0
West	7.032	13.87	357.8
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	0.953	5.094	357.0
Southwest	1.305	6.904	5.756
West	1.472	8.685	111.1

*	**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.

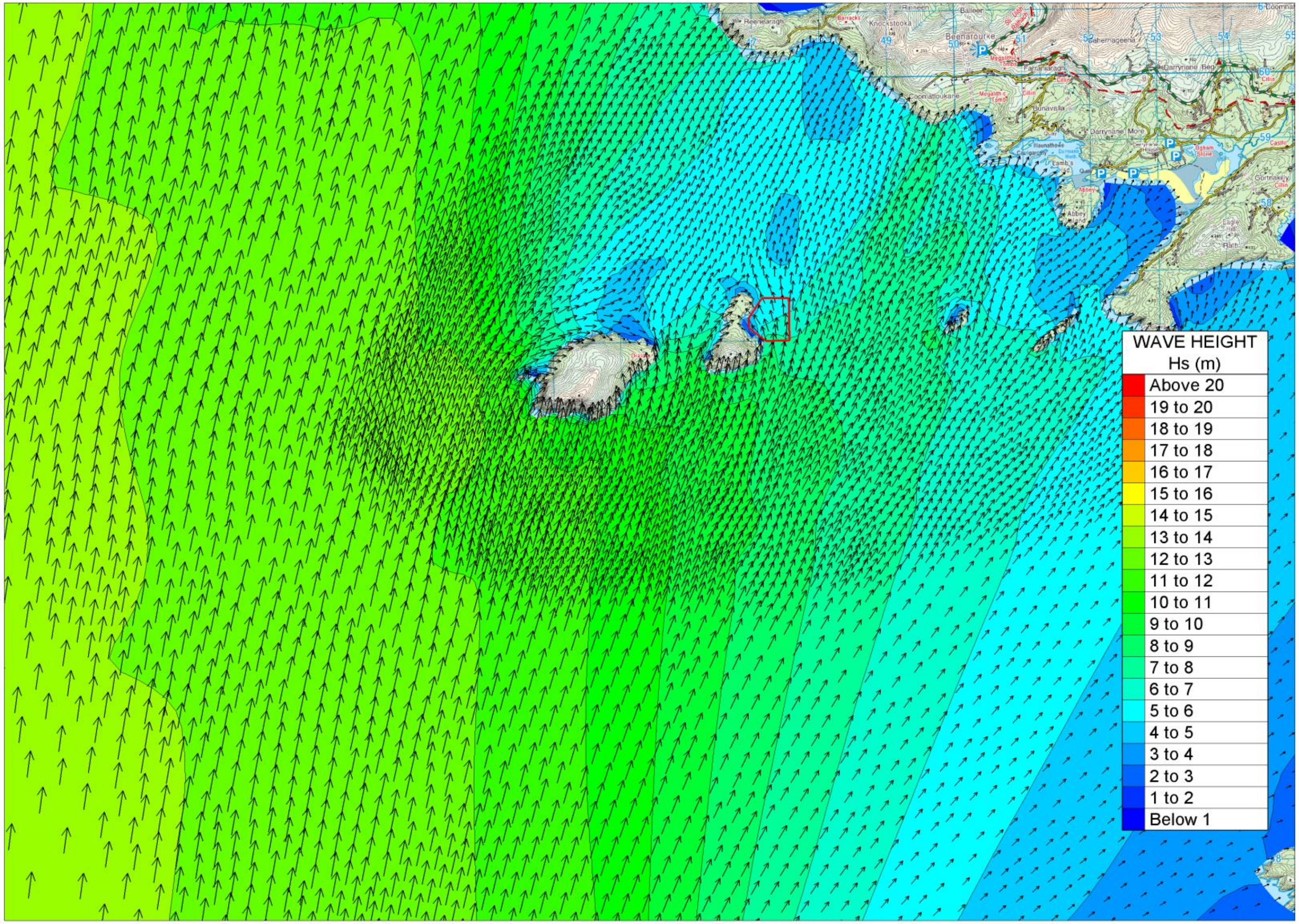


Figure 8-7: Extreme Atlantic swell event – southerly

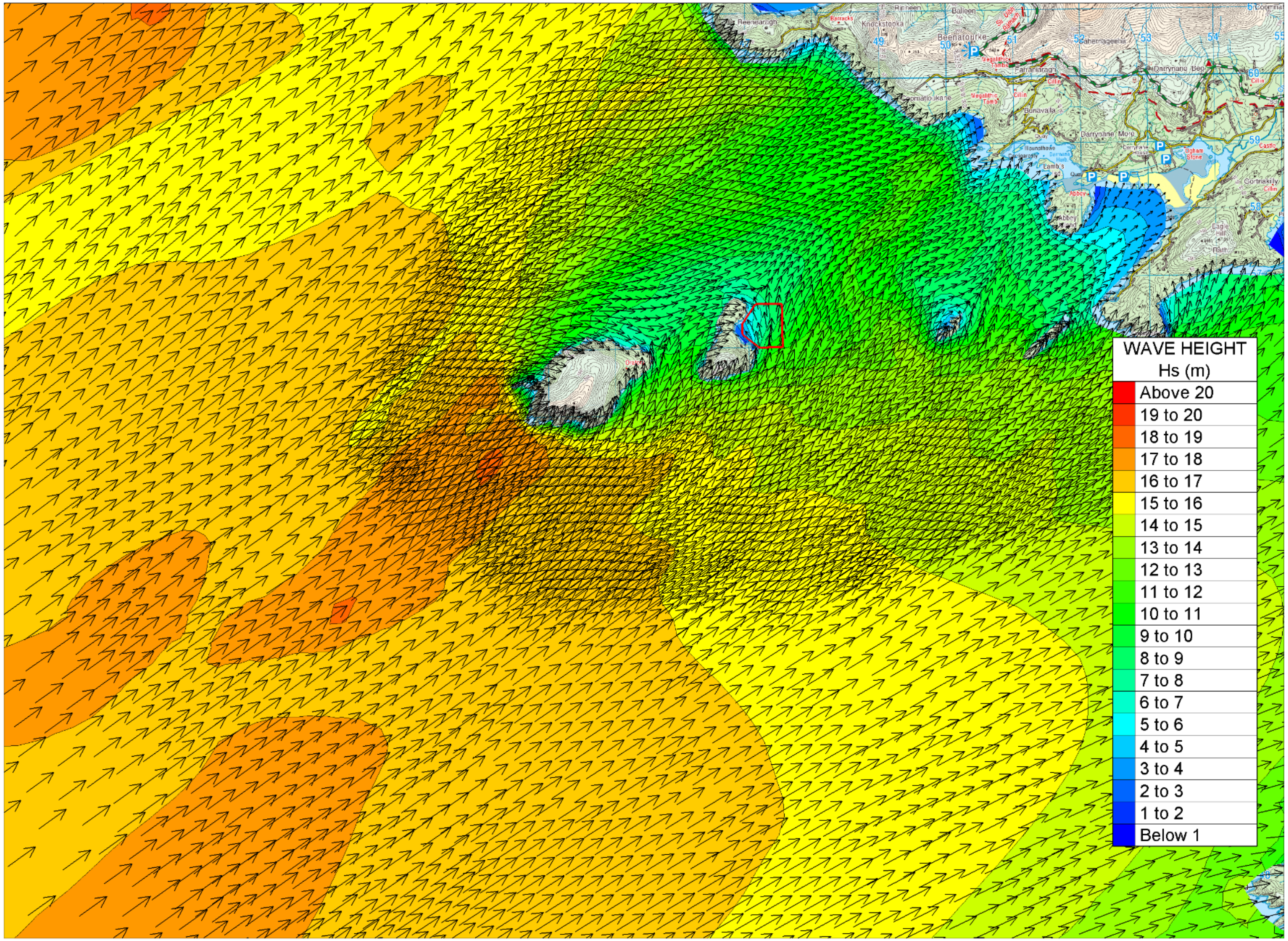


Figure 8-8: Extreme Atlantic swell event – south-westerly

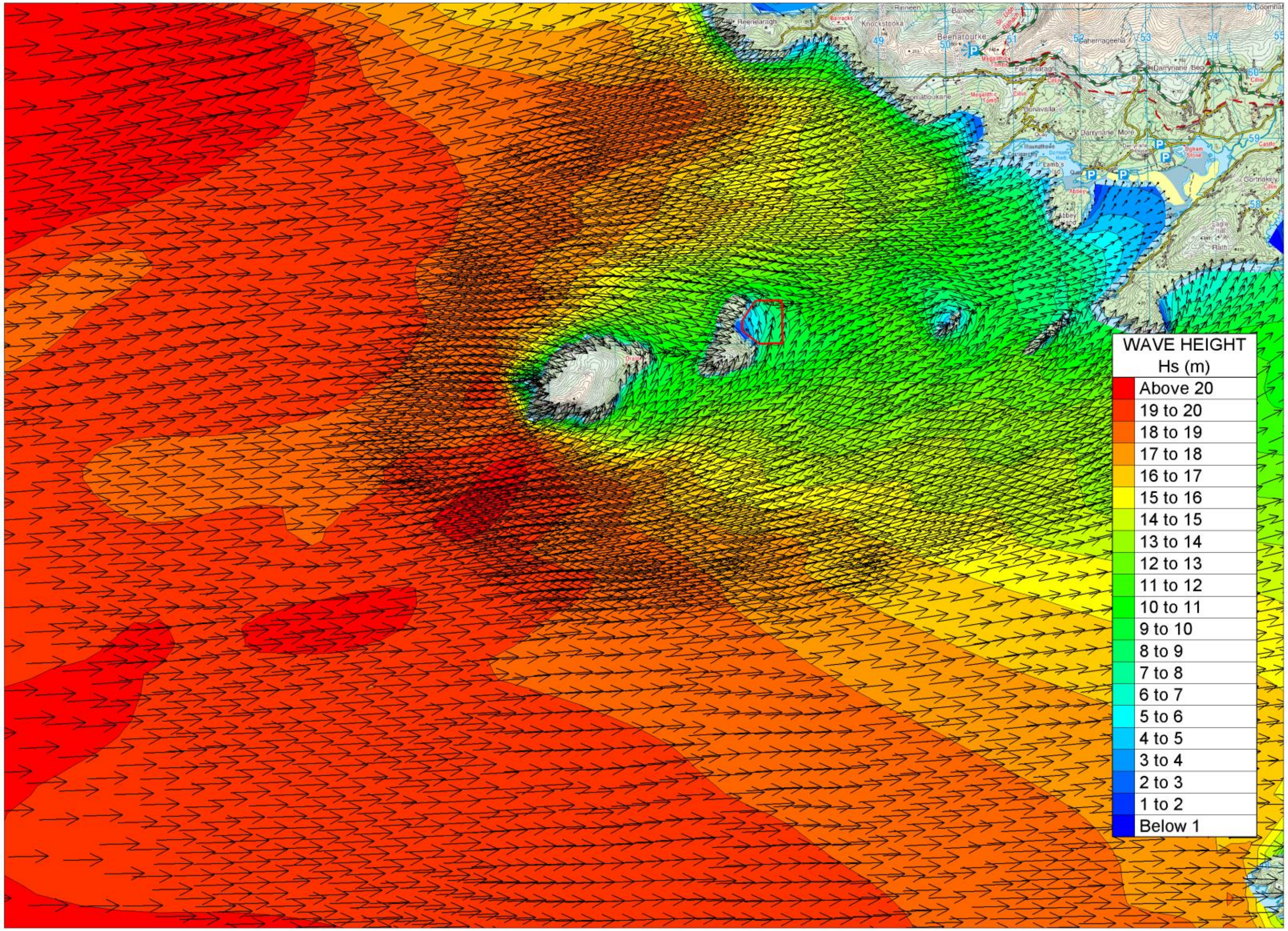


Figure 8-9: Extreme Atlantic swell event – westerly

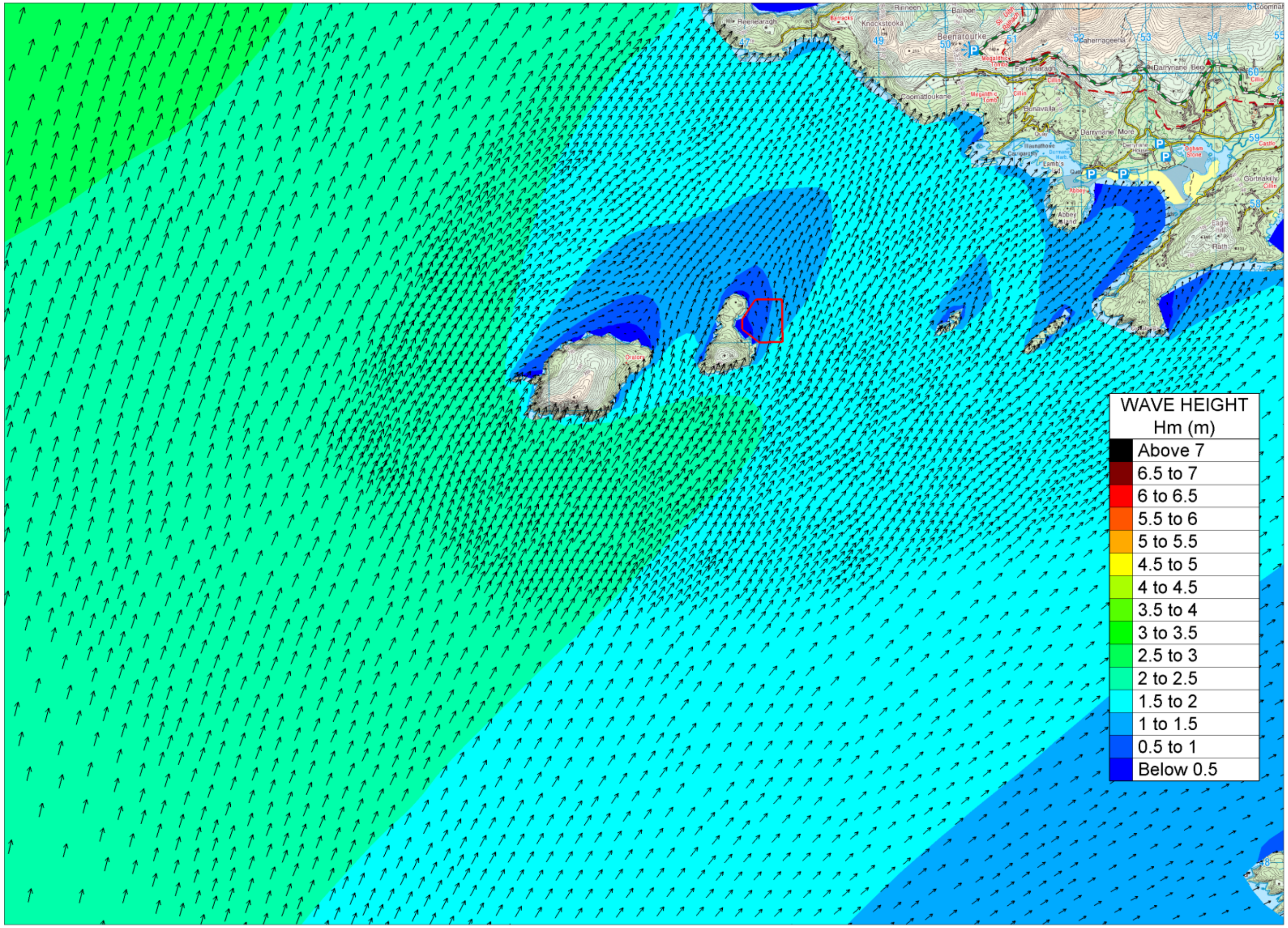


Figure 8-10: Local fetch 100 year southerly wind-waves

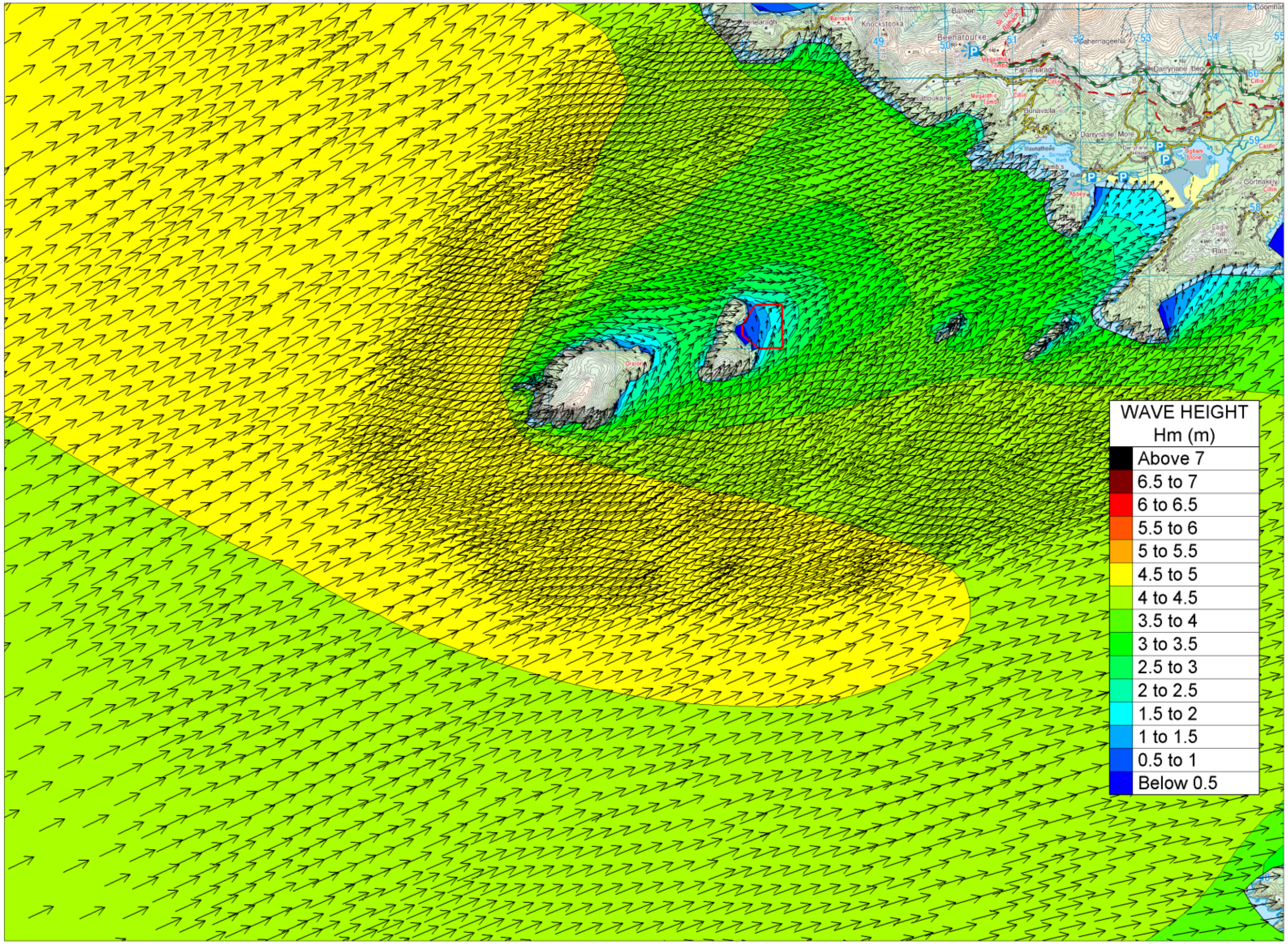


Figure 8-11: Local fetch 100 year south-westerly wind-waves

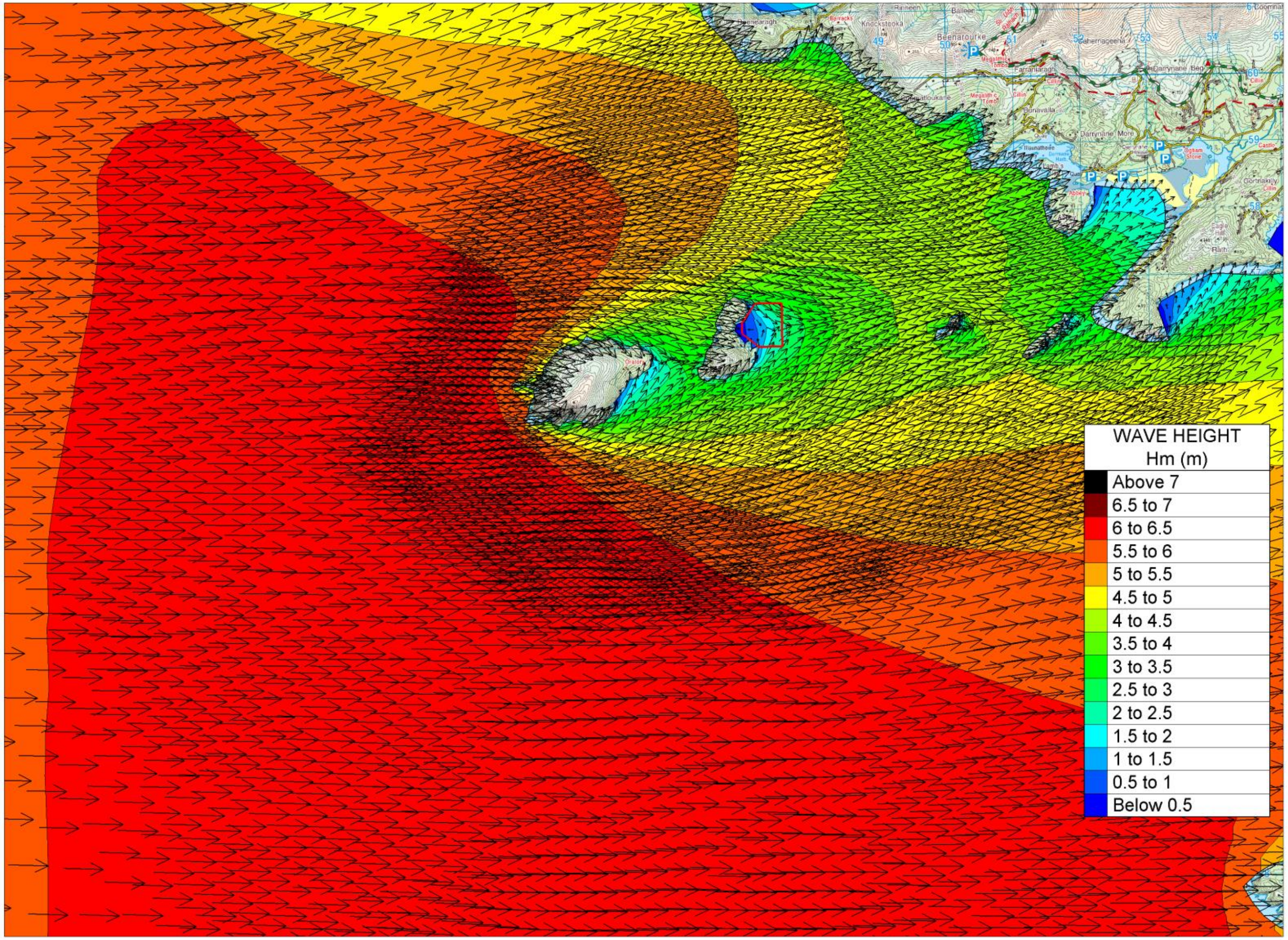


Figure 8-12: Local fetch 100year westerly wind-waves

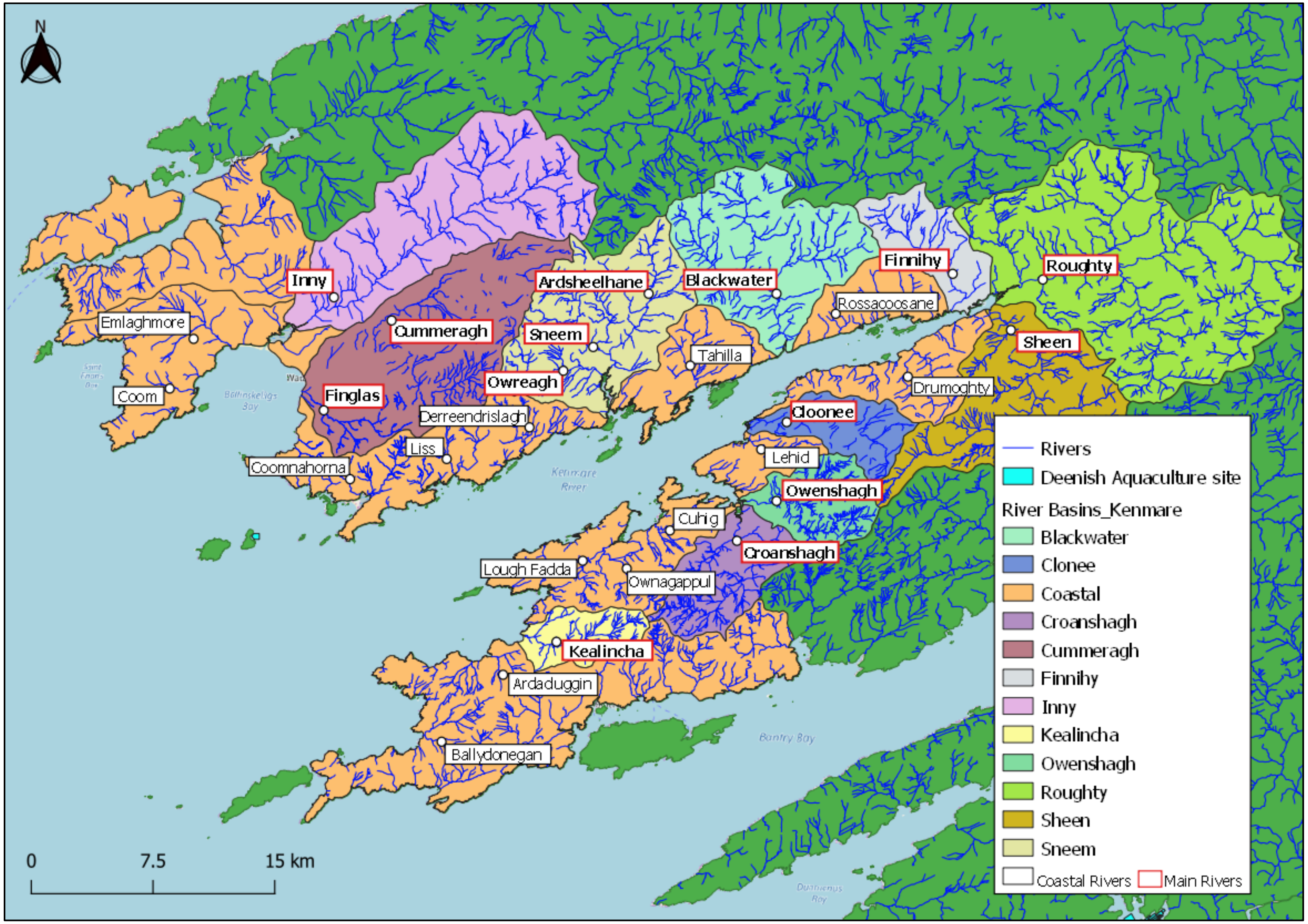


Figure 8-13: Main rivers and river basins within Kenmare and Ballinskelligs Bay.

8.1.5. Temperature and Salinity

The two closest sites to the Deenish site monitored under the Shellfish Waters Directive (SWD) are located in Kenmare Bay (see **Figure 8-14**); the sites named, KG010 and M56 are respectively located approximately 28km and 23km from the Deenish 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 24km east of the Deenish site (see **Figure 9.16**).

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 were 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 monitoring.

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 monitoring.

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

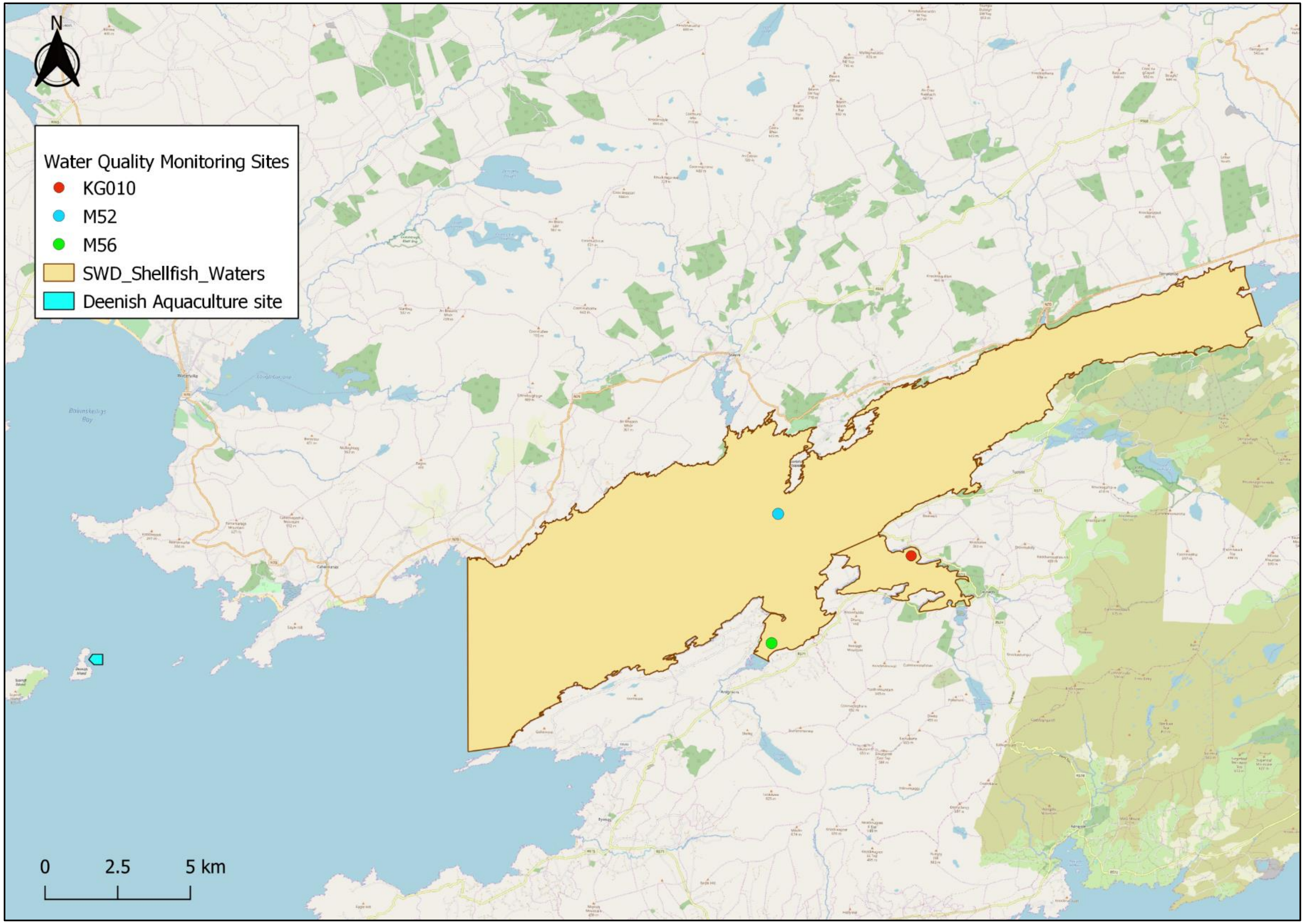


Figure 8-14: SWD and WFD Monitoring sites in Kenmare Bay.

8.1.6. Water Quality

8.1.6.1. Monitoring at the Deenish Site

Nutrient monitoring surveys are carried out by MOWI at the Deenish sites monthly during the December to March period following Monitoring Protocol No. 2 (DMNR, 2000c). Sampling is carried out during the December to March 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). The following sections summarise the findings of monitoring of water quality parameters undertaken for in 2017 to 2018 while the monitoring results are presented in full in **Table 8.5**[17]**.**

Figure 8-15 shows the location of the nutrient monitoring site at the Deenish 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)
- Dissolved Inorganic Nitrogen (DIN)
- Phosphorus
- Chlorophyll

Nitrite (NO_2)

In December 2017 nitrite levels recorded at 1m water depth (1.66µg/L) and 1 m (1.66µg/L) from the seabed exceeded the level recorded at the reference site (1.38µg/L). For this sampling event, the level of nitrite recorded at mid water depth was the same at the reference level. For the other four sampling events, the level of nitrite recorded at water sample depths was below the level recorded at the reference site for the sampling events. These results indicate the farm is not significantly affecting nitrite levels in the area.

[17] Monitoring results for 2010-2018 are included in **Appendix 12**.

Nitrate (NO_3)

Nitrate levels in the majority (10 of 12) of samples recovered at the monitoring station were below the nitrate level recorded at the reference site, indicating the farm is not significantly affecting nitrate levels in the area.

Ammonium (NH_4)

Ammonium levels recorded at the monitoring site in December 2017 and January 2018 were below the levels recorded at the reference site. While the ammonium levels recorded at the monitoring site in February 2018 (8.64µg/L) and March 2018 (11.84µg/L) exceeded levels recorded at the reference site for those months (6.69µg/L and 11.48µg/L respectively), the exceedances were relatively small and are considered to be within the levels of natural variation. Consequently, it is concluded that the farm is not significantly affecting ammonium levels in the area.

Phosphorus

Average phosphorus levels of samples recovered in December 2017 (25.73µg/L) and February 2018 (28.83µg/L) exceeded levels recorded at the reference site during these month (23.20µg/L and 28.83µg/L respectively); the exceedances observed were relatively small and ranged between 11.0% and 4.0% of reference levels. Average phosphorus levels recorded in January 2018 and March 2018 were respectively 17.8% and 7.6% below reference levels recorded. Based on these results it is concluded that the farm is not significantly affecting phosphorus levels in the area.

Dissolved Inorganic Nitrogen (DIN)

In December 2017 average DIN levels at the monitoring site (78.91µg/L) were below the level recorded at the reference station (113.83µg/L). Average DIN levels at the monitoring site increased significantly in January 2018 (128.00µg/L) and exceeded reference levels (60.65µg/L). However, average levels fell significantly in both February 2018 (52.11µg/L) and March 2018 (73.91µg/L) and were below level recorded at the reference sit in both months. The results indicate that the farm is not having a long-term effect on DIN levels in the area.

Chlorophyll

In general, chlorophyll levels at the monitoring site and reference site ranged without trend from 0 to a maximum of 0.94µg/L.

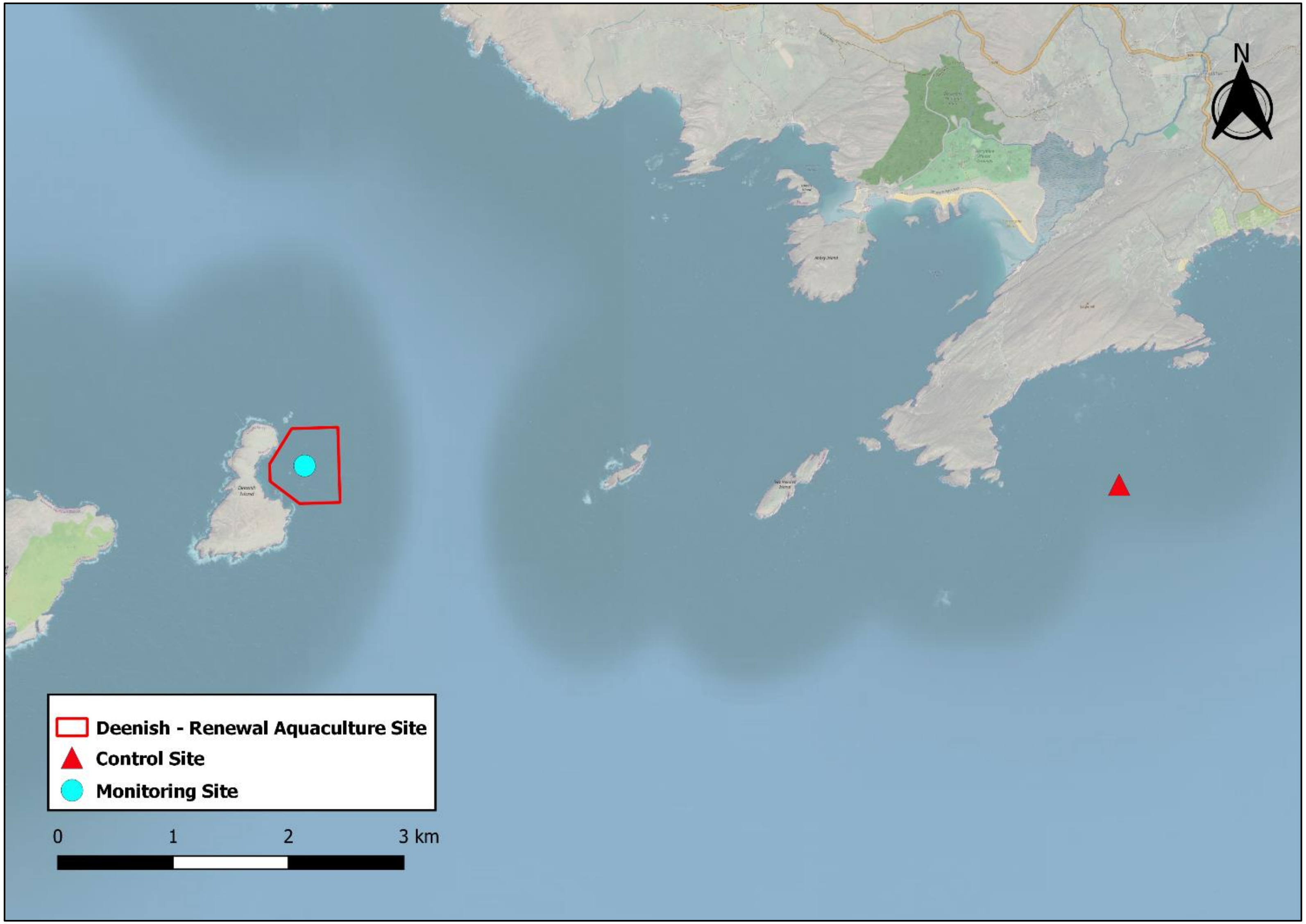


Figure 8-15: Location of water quality monitoring site at the Deenish site relative to the control monitoring site.

Table 8.5: Water Quality Monitoring for T6/202

Date	Depth	NO_2 µg/l	NO_3 µg/l	NH_4 µg/L	DIN mg/l	Phosphorus µg/L	Chlorophyll µg/L
	1m	3.4	79.78	8.2		43.11	0.72
	Mid	2.53	26.33	7.06		22.45	1.73
28/01/2010	Bottom -1	3.69	88	7.06		33.72	2.14
	1m	2.7	24.4	6.27		51.93	0.5
	Mid	3.26	61.2	4.97		59.69	0.27
26/02/2010	Bottom -1	2.7	63.29	7.56		94.61	0.2
	1m	2.98	79.1	8.85		36.41	0.05
	Mid	2.14	48.79	3.68		24.77	0.96
24/03/2010	Bottom -1	2.98	96.73	4.97		53.87	1.03
	1m	4.16	119.46	28.33		28.74	0.2
	Mid	2.25	114.81	33.21		6.32	0
18/12/2010	Bottom -1	1.98	106.85	22.47		33.91	0
	1m	6.89	122.15	16.6		18.39	0.44
	Mid	3.89	112.67	13.67		66.67	0.14
17/01/2011	Bottom -1	1.98	110.96	15.63		37.36	0
	1m	2.25	50.79	23.44		64.94	0.68
	Mid	1.98	59.86	20.51		21.84	0.79
07/02/2011	Bottom -1	2.52	52.88	34.19		25.29	0.59
	1m	2.8	25.61	9.77		20.11	0.1
	Mid	4.71	30.25	4.88		4.6	0.05
21/03/2011	Bottom -1	1.7	20.18	16.6		0	0.08
	1m	3.73	39.45	16.44		19.05	0
	Mid	4.85	36.93	13.33		33.38	0
17/12/2011	Bottom -1	6.52	55.87	11.25		26.21	0
21/01/2012	1m	2.89	88.66	14.37		26.21	0

	Mid	4.57	65.8	14.37		26.21	0
	Bottom -1	4.01	86.13	14.37		31.59	0
	1m	3.73	87.13	5.03		24.42	0
	Mid	2.89	57.12	2.95		22.63	0
24/02/2012	Bottom -1	3.73	87.13	3.99		28.01	0
	1m	3.73	38.72	6.06		35.17	0.29
	Mid	4.29	30.12	8.14		26.21	0.02
28/03/2012	Bottom -1	4.57	26.92	11.25		26.21	0
	1m	4.08	86.31	23.03		23.7	0.4
	Mid	3.79	82.46	16.47		20.01	0.67
18/12/2012	Bottom -1	4.36	109.4	14.59		29.23	0.07
	1m	3.36	58.18	8.99		31.34	0.19
	Mid	4.21	79.16	6.95		31.34	0.02
25/01/2013	Bottom -1	4.21	94.25	7.97		22.11	
	1m	2.03	235.72	21.89		41.26	0
	Mid	1.32	125.79	25.98		25.17	0
15/02/2013	Bottom -1	0.97	77.3	23.26		21.6	0.06
	1m	3.79	82.46	16.47		20.01	0.67
	Mid	4.11	12.47	18.11		18.67	0.06
14/03/2013	Bottom -1	5.61	22.68	12.79		24.66	0.13
	1m	0.89	66.51	0.45		24.62	0
	Mid	1.74	73.03	0		24.62	0
17/12/2013	Bottom -1	1.45	66.38	0.45		29.95	0
	1m	1.17	85.52	3.58		18.33	0
	Mid	1.17	62.91	2.58		12.66	0
	Bottom -1	0.91	67.45	1.59		14.55	0
10/01/2014	Control	2.52	95.33	12.53		18.33	0
	1m	0.98	28.63	17.22		20.35	0
17/02/2014	Mid	1.27	34.63	5.71		20.35	0

	Bottom -1	0.98	35.47	8.84		18.18	0
	Control	1.06	74.64	5.82		12.42	0
	1m	1.56	19.53	5.71		20.35	0.17
	Mid	1.86	55.73	6.75		29.03	0
	Bottom -1	1.86	63.14	9.89		39.88	0
06/03/2014	Control	0.5	29.45	3.56		16.45	0
	1m	2	44.44	2.07		8.62	
	Mid	3.11	45.3	0.13		12.23	
	Bottom -1	2.55	54.48	9.78		5.01	
05/12/2014	Control	3.01	38.66	4.7		11.59	0
	1m	5.02	47.3	2.63		18.52	
	Mid	4.35	41.24	10.81		23.35	
16/01/2015	Bottom -1	3.68	34.76	6.26		21.74	
	1m	3.01	37.97	8.85		11.59	0
	Mid	3.01	37.97	3.31		11.59	0.22
	Bottom -1	3.29	40.46	3.31		9.68	0
25/02/2015	Control	3.01	38.66	4.7		11.59	0
	1m	2.2	21.5	7.47		0.13	0
	Mid	2.47	26.82	13		9.68	0
	Bottom -1	3.56	35.4	7.47		19.23	0
13/03/2015	Control	4.1	29.39	11.62		11.59	0.15
	1m	2.1	147.73	13.8		64.83	0
	Mid	0.98	87.09	7.08		29.57	0
	Bottom -1	2.1	154.43	33.95		22.52	0
22/12/2015	Control	0.98	80.38	7.08		62.48	0
	1m	1.98	72.9	5.91		43.38	0
	Mid	2.53	81.59	7.9		56.54	0
	Bottom -1	1.7	78.7	5.91		54.5	0
11/01/2016	Control	1.7	80.54	3.92		70.82	0

	1m	2.1	154.43	33.95		22.52	0
	Mid	1.07	6.78	0.72		17.45	0
	Bottom -1	2.49	5.84	0.72		17.45	0.22
29/02/2016	Control	2.77	22.98	3.88		21.4	0.08
	1m	0.98	80.38	7.08		62.48	0
	Mid	7.03	83.84	17.47		34.1	0
	Bottom -1	8.16	98.59	17.47		76.56	0.11
24/03/2016	Control	7.59	87.7	11.54		55.33	0
	1m	2.08	31.52	7.05		33.19	0.85
	Mid	2.92	43.71	9.17		47.15	0.77
09/12/2016	Bottom -1	3.19	48.52	13.41		39.17	0.34
	1m	2.18	131.16	19.38		1.31	3.41
	Mid	1.62	161.38	11.83		2.97	1.02
	Bottom -1	1.05	149.69	6.79		2.35	3.2
06/01/2017	Control	3.58	119.35	7.63		3.79	0.71
	1m	2.44	53.93	14.88		29.33	0
	Mid	2.71	65.1	7.08		27.34	0.18
	Bottom -1	2.44	73.27	7.08		35.3	0.13
17/02/2017	Control	2.29	29.5	18.6		19.69	0.41
	1m	2.02	28.82	5.32		19.69	0.72
	Mid	2.02	31.94	5.32		12.96	0
31/03/2017	Bottom -1	3.11	36.22	81.44		15.2	0.41
	1m	1.66	61.84	1.34	64.84	27	0.66
	Mid	1.38	76.47	1.34	79.19	23.2	0.28
	Bottom -1	1.66	88.64	2.39	92.69	27	0.19
15/12/2017	Control	1.38	109.02	3.43	113.83	23.2	0.58
	1m	2.26	124.37	5.53	132.16	31.51	1.11
	Mid	1.98	116.25	5.53	123.76	29.61	0.59
30/01/2018	Bottom -1	2.26	122.51	3.21	127.98	23.92	0.94

	Control	2.84	42.24	15.57	60.65	30.13	0
	1m	2.57	37.45	7.91	47.93	30.13	0
	Mid	2.29	42.04	9	53.33	28.18	0
	Bottom -1	2.29	43.77	9	55.06	28.18	0
28/02/2018	Control	3.08	132.89	6.69	142.66	27.72	1.14
	1m	2.07	58.69	12.54	73.3	17.66	0.11
	Mid	2.07	58.69	9.38	70.14	19.74	0
	Bottom -1	2.07	62.63	13.59	78.29	17.66	0
31/03/2018	Control	2.36	80.71	11.48	94.55	25.99	0
	1m	3.17	141.06	5.96	150.19	31	
	Mid	3.17	138.49	9.01	150.67	31	
	Bottom -1	3.17	141.06	4.95	149.18	33.07	
12/12/2018	Control	4.33	136.53	4.95	145.81	31	

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 Deenish site while the relative location of the waterbodies and Deenish site is shown in **Figure 8-16**.

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

Waterbody (EU code)	Waterbody WFD - Status
South Western Atlantic Seaboard coastal waterbody (IE_SW_150_0000)	Good
Ballinskelligs Bay coastal waterbody (IE_SW_200_0000)	Unassigned
Outer Kenmare River coastal waterbody (IE_SW_190_0000)	Good
Ardgroom Transitional waterbody (IE_SW_190_0100)	Unassigned
Kilmakilloge Harbour Transitional waterbody (IE_SW_190_0200)	Good
Sneem Harbour Transitional waterbody (IE_SW_190_0600)	Unassigned
Drongawn Lough, Sneem Transitional waterbody (IE_SW_190_0500)	Good
Blackwater K Estuary Transitional waterbody (IE_SW_190_0400)	Unassigned
Inner Kenmare River Transitional waterbody (IE_SW_190_0300)	Good

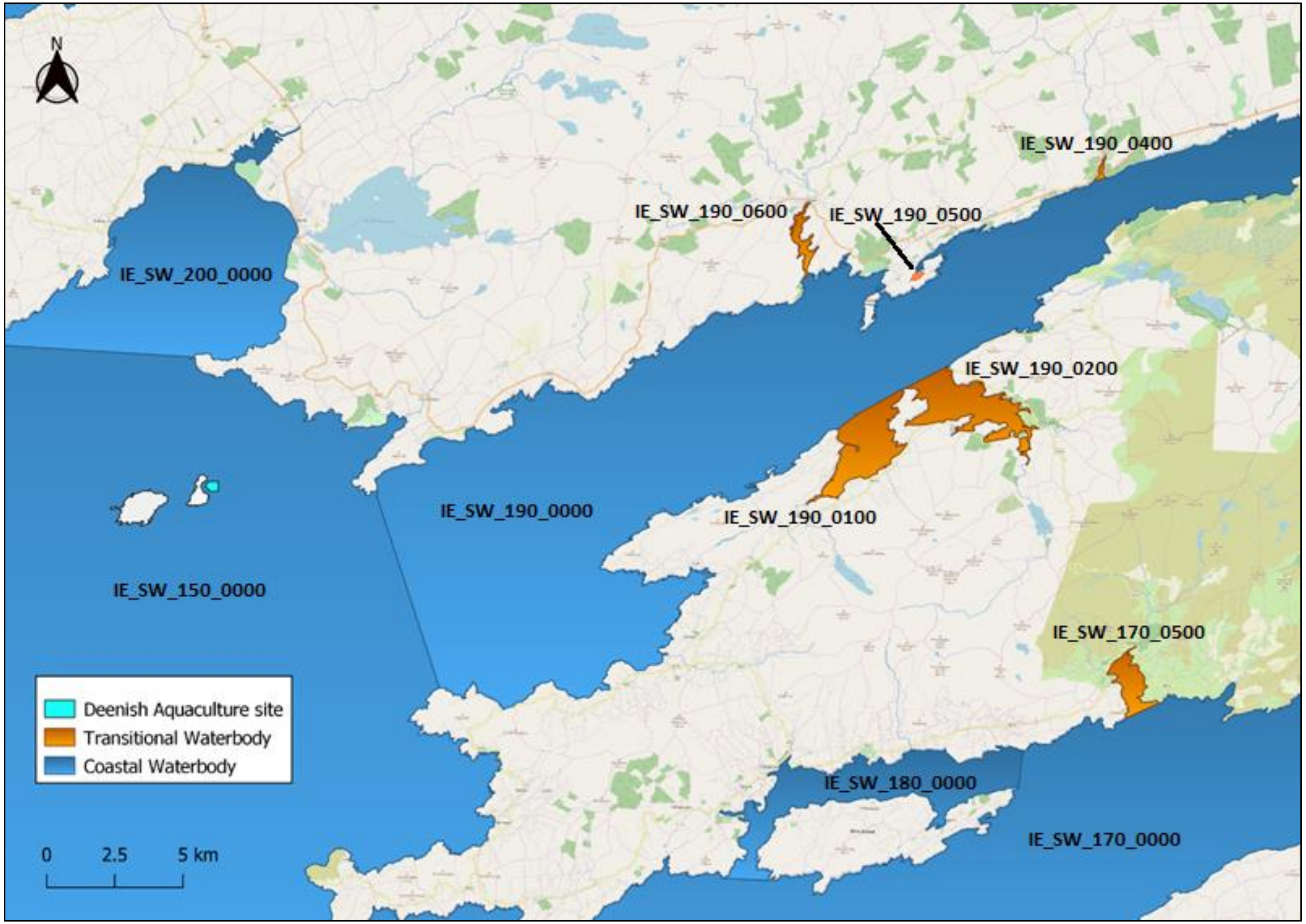


Figure 8-16: WFD waterbodies in the vicinity of the Deenish site. Waterbody code displayed.

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, organohalogens, metals (dissolved), faecal coliforms, phytoplankton and substances affecting the taste of shellfish. A Pollution Reduction Programme (PRP) has been established for Kenmare River (encompassing Sneed 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 Deenish site monitored under the SWD are located in Kenmare Bay (see **Figure 8-14**). **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 Taisce, 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 Blue Flag beaches at Derrynane More and Ballinskelligs; respectively the beaches are located approximately 3.2km northwest and 2.9km north of the Deenish site (EPA Maps[18]).

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

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

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. **Section 2.12** details the treatments used by MOWI at the site.

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 impacts on water quality. The following sections consider potential impacts 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. 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 Deenish 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[19]. 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

[19] 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° 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 8-17** and **Figure 8-18**. The median, average, and maximum nitrogen concentrations for 10 reference sites located in the vicinity of the site (see **Figure 8-19**) 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 Deenish site (reference site 1: maximum concentration 0.535mg/l N; median concentration is 0.082 mg/l N) (**Table 8.10)**. The predicted median concentration level (for which the water quality objectives standard applies) at the pens meets (is lower than) the EQS DIN limit of 0.17mg/l N. The instantaneous maximum of 0.535mg/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 being generally below 0.02mg/L N at the site boundary and within a relatively short distance beyond this is <0.005mg/L.

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**.

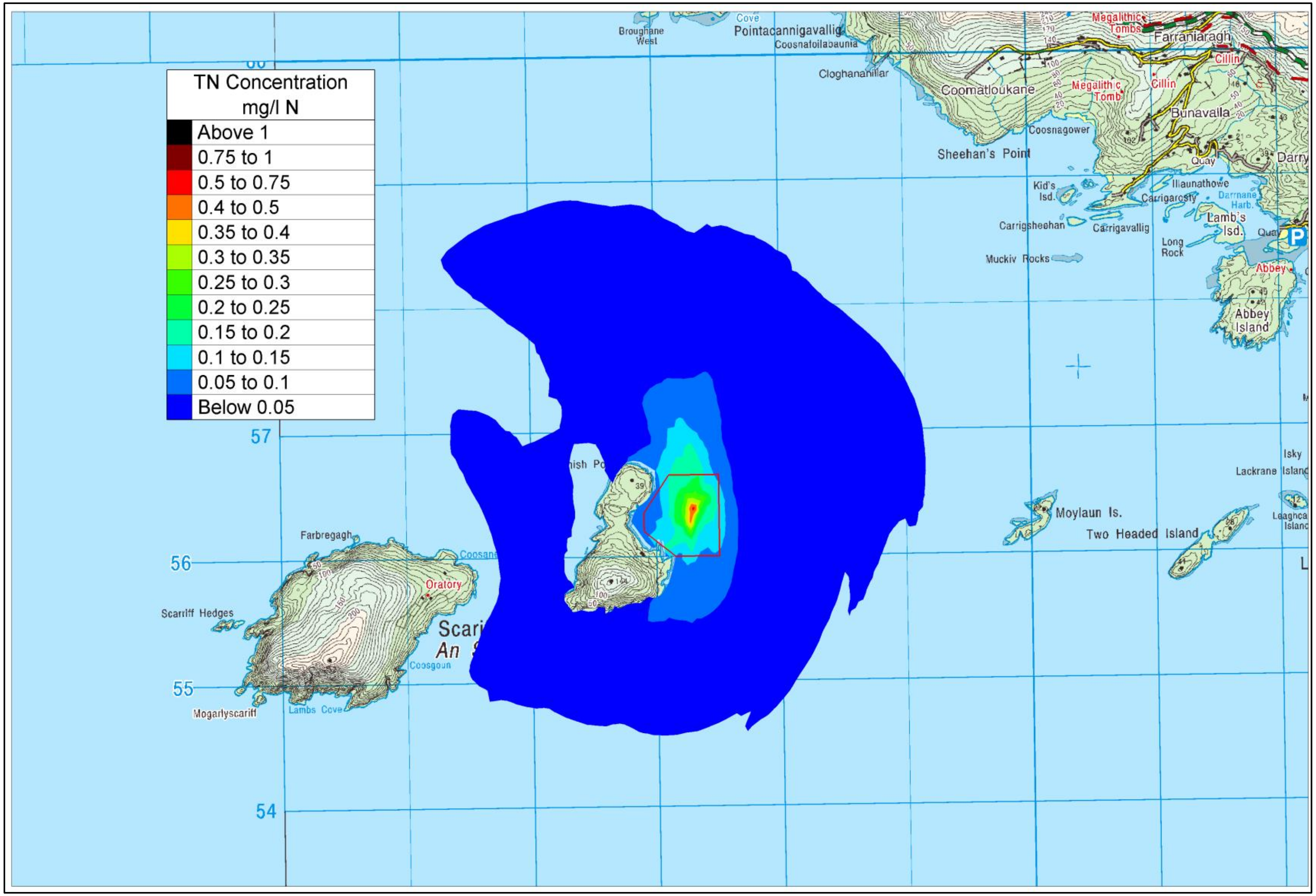


Figure 8-17: Predicted maximum total nitrogen concentration envelope (mg/l N) for the Deenish site

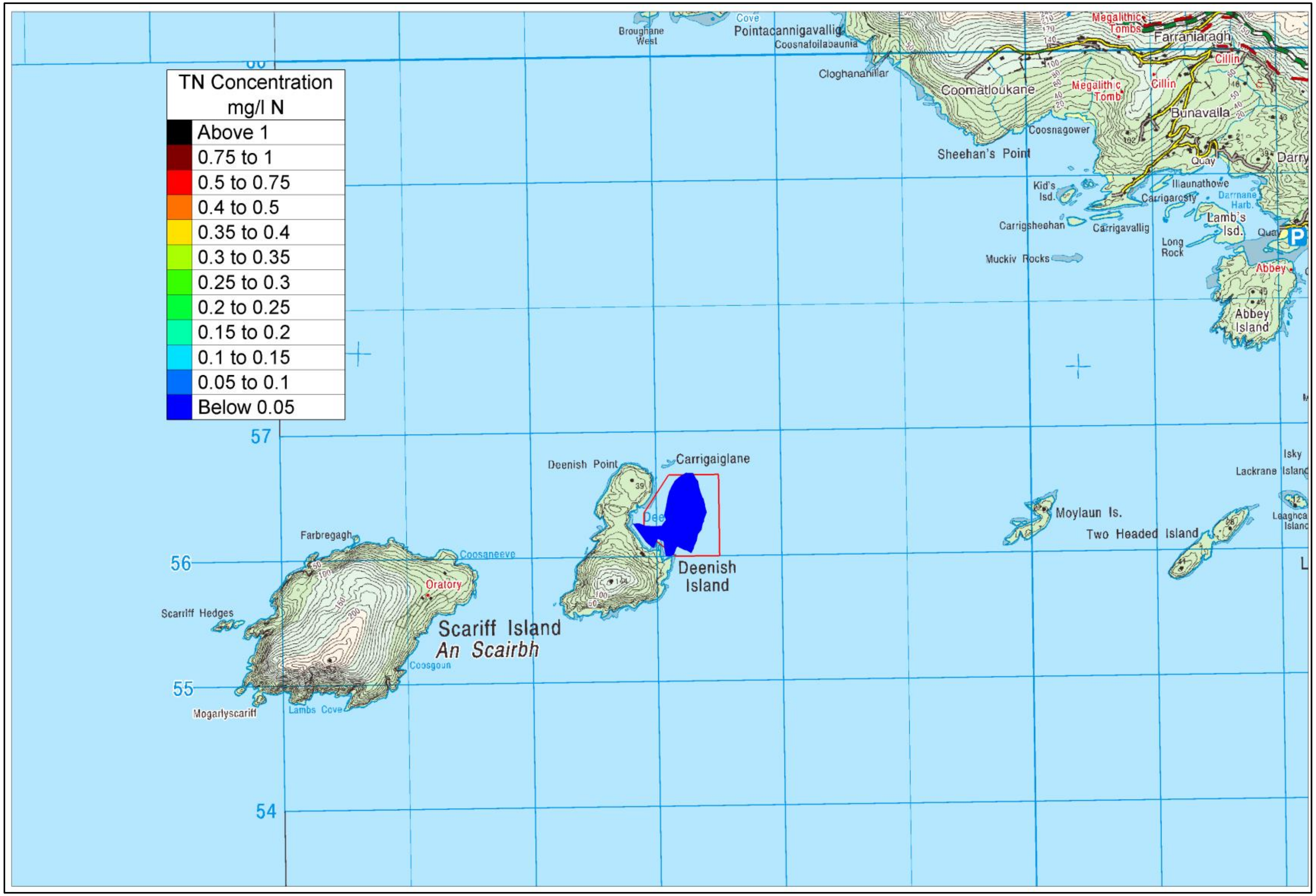


Figure 8-18: Predicted tidal mean total nitrogen concentration envelope (mg/l N) for Deenish Site.

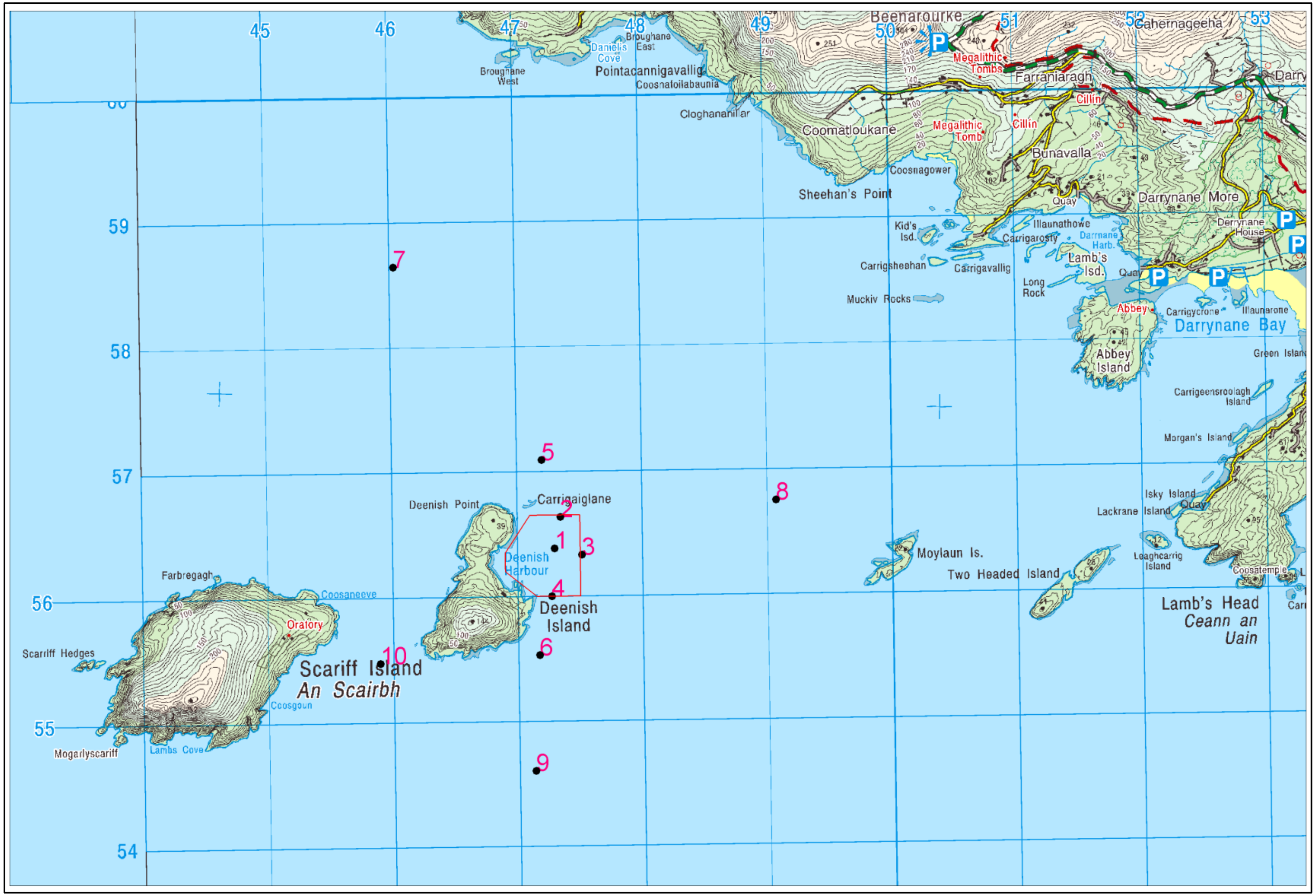


Figure 8-19: Reference sites for water quality model

Table 8.10: Predicted Total Nitrogen Concentration statistics (mg/l) at Reference Sites for Maximum Production at the Deenish site

Reference Sites	Solute Concentrations		
	Average	Median	Maximum
1	0.111	0.082	0.535
2	0.022	0.011	0.199
3	0.008	0.005	0.126
4	0.020	0.010	0.141
5	0.010	0.005	0.107
6	0.008	0.006	0.052
7	0.002	0.001	0.012
8	0.002	0.001	0.011
9	0.003	0.003	0.011
10	0.004	0.003	0.017

8.2.2.3. Phosphorus

Dispersal plumes of phosphorus levels are presented **Figure 8-20** and **Figure 8-21**. Phosphorous concentrations at the ten selected reference sites (see **Figure 8-19**) 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 0.0123mg/l at the cages (i.e. reference site 1) (and lower elsewhere) and 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**.

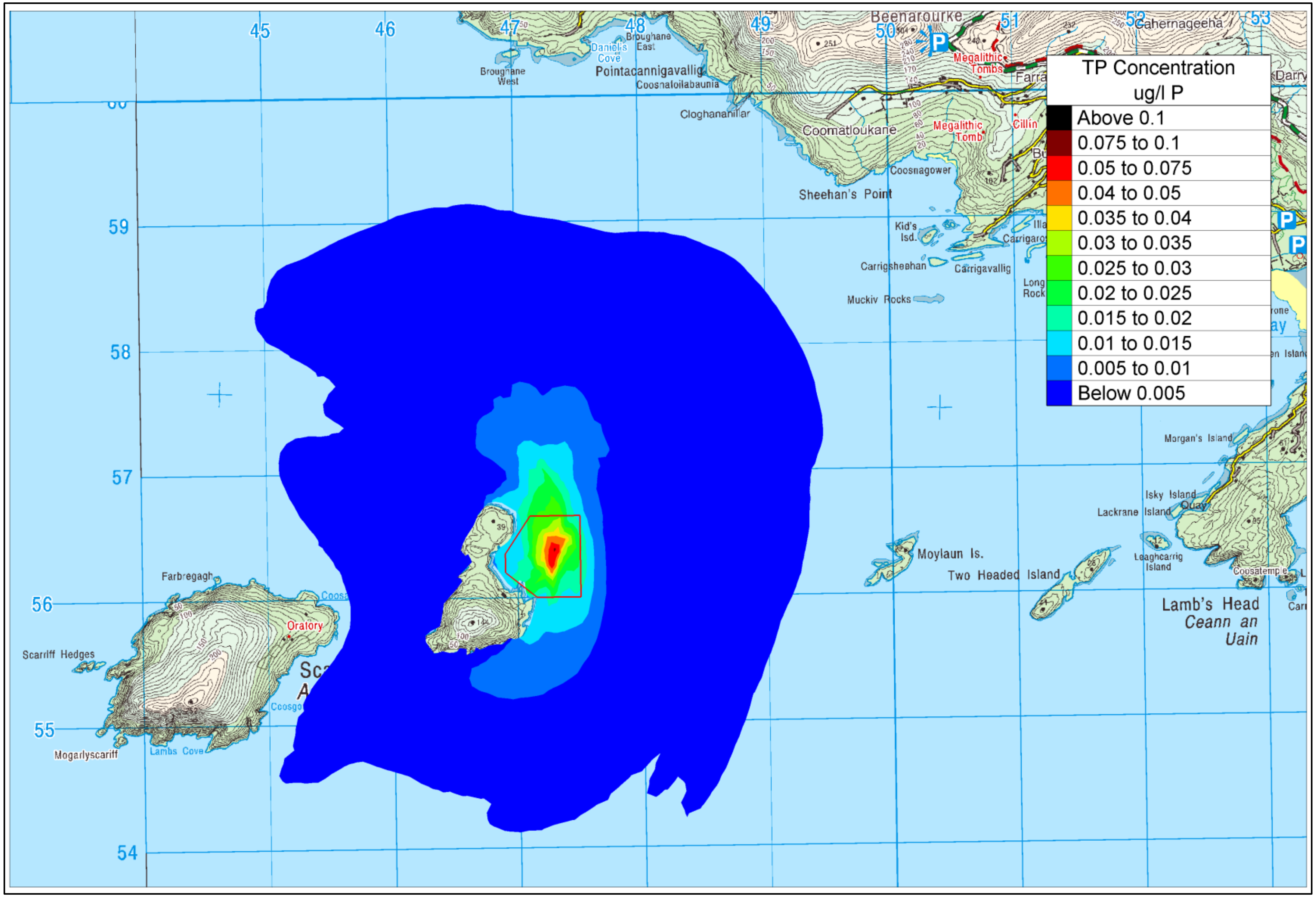


Figure 8-20: Predicted Maximum Total Phosphorous Concentration Envelope (mg/l P) for the Deenish site.

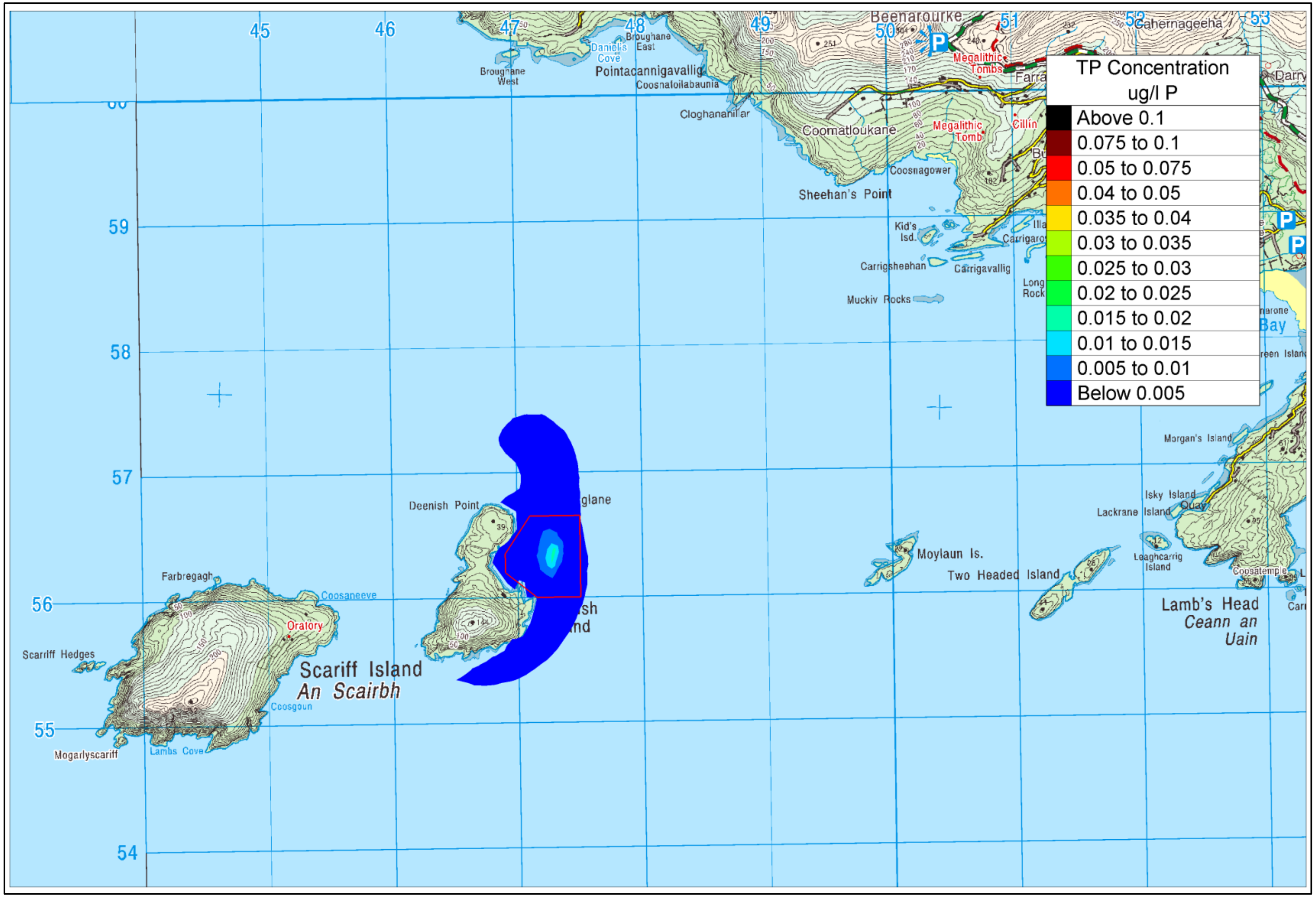


Figure 8-21:Predicted lunar mean Total Phosphorous Concentration Envelope (mg/l P) for the Deenish site.

Table 8.11: Predicted Total Phosphorous Concentration statistics (mg/l) at Reference Sites for Maximum Production at Deenish site.

Reference Sites	Solute Concentrations		
	Average	Median	Maximum
1	0.0165	0.0123	0.0797
2	0.0033	0.0016	0.0297
3	0.0013	0.0007	0.0187
4	0.0029	0.0015	0.0210
5	0.0014	0.0007	0.0159
6	0.0012	0.0009	0.0078
7	0.0002	0.0002	0.0018
8	0.0003	0.0002	0.0016
9	0.0004	0.0004	0.0017
10	0.0006	0.0004	0.0026

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 Deenish site 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-cage 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 was 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 35 day 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 8-22** and **Figure 8-23**. The median, average, and maximum nitrogen concentrations for 10 reference sites located in the vicinity of the site (see **Figure 8-19**) 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 site 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 cages is 15.963mg/l O_2 which exceeds the EQS limits of 4mg/l O_2. The tidal average concentration at the farm site cages is 3.313mg/l O_2, while the tidal average concentration at the reference sites immediately outside the boundary to the north (reference site 2) and south (reference site 4) is 0.671mg/l O_2 and 0.584mg/l O_2 exceeding the EQS limit of 4mg/l O_2. At reference site 3 and 5 through 10, the predicted tidal average BOD concentrations vary between 0.286 to 0.049 mg/l O_2. The adjacent coastal waters surrounding the Deenish site have predicted tidal average concentrations of 0.05 to 0.1mg/l and maximum concentrations of 0.3 to 0.5mg/l O_2.

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**.

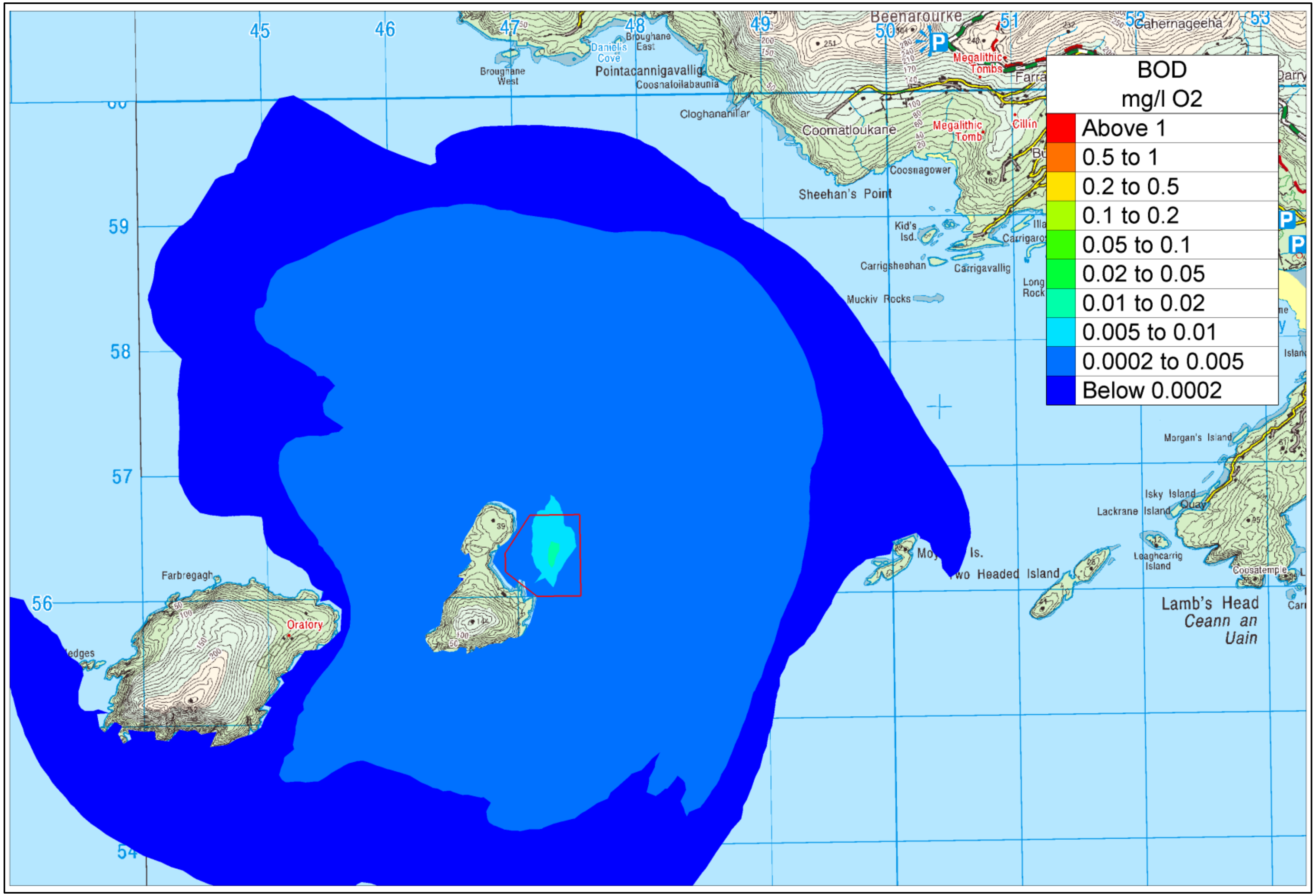


Figure 8-22: **Predicted Maximum BOD Concentration Envelope (x1000 mg/l O_2) for the Deenish site.**

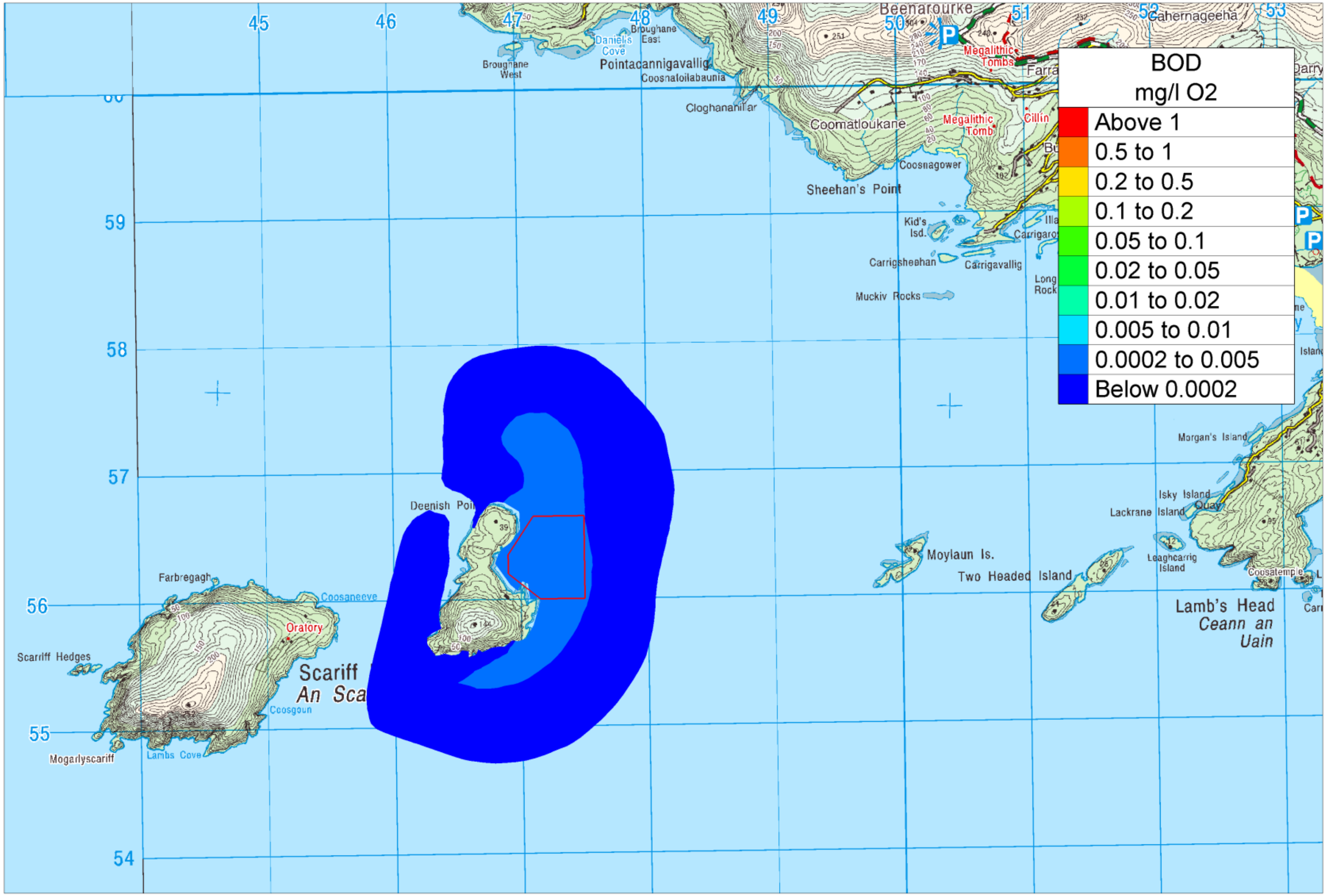


Figure 8-23: Predicted lunar mean BOD Concentration Envelope (x 1000 mg/l O_2) for the Deenish site.

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

Reference Sites	Solute Concentrations		
	Average	Median	Maximum
1	3.313	2.458	15.963
2	0.671	0.320	5.953
3	0.252	0.140	3.752
4	0.584	0.309	4.197
5	0.286	0.135	3.193
6	0.233	0.176	1.552
7	0.049	0.036	0.357
8	0.057	0.039	0.320
9	0.086	0.080	0.336
10	0.111	0.082	0.517

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 licenced 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 licenced, 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.

The renewal application and requests change to the boundaries of the existing site and to the operating conditions attached to the licence. As shown above, discharges predicted from the proposed operations will not give rise to negative effects on water; 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. There are 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[20].

Table 9.1 details the levels of pollutants in 'Rural West' AQIH.

It should be noted that the closest facility to the Deenish 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, pharmaceuticals) are located too great a distance for the site to result in an impact air pollution near the Deenish 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/m³)	Nitrogen dioxide (1 hr mean, µg/m³)	Sulphur dioxide (1 hr mean, µg/m³)	$PM_{2.5}$ particles (Running 24 hr mean, µg/m³)	PM_{10} particles (Running 24 hr mean, µg/m³)
Good	3	67-100	135-200	60-89	24-35	34-50

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

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.

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 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 current 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 Deenish site. The renewed licenced and changes to the operating conditions will have **no significant effects** 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 licenced 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.

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 licenced 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: Ballinskelligs (154), Emlaghmore (333), Lough Currane (122), Ballybrack (33), Darrynane (167) (Electoral Division includes Deenish Island) and Caherdaniel (134). In total, 77% of the population (≥ 5 years) that travel for work, school or college of the 6 EDs surrounding the Ballinskelligs Bay use the road network for commuting (by car, van, bus, motorbike etc). This represents 92% of the total population ≥5 years.

Figure 11-1 shows the proposed road network that will be used to access Travara pier as part of the planned aquaculture operations primarily for fish, mortality and feed transportation as well hosting staff shore-based facilities. **Table 11.1** shows the Annual Average Daily Traffic (AADT) levels at traffic counters located approximately 4km north of Kenmare town.

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	2018	2019	2020
TMU N71 110.0 W	AADT	1,168	1,179	584
	% HGV	1.1%	1.1%	1.3%

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. amendments to the site boundaries and operating conditions) will not lead to significant changes in traffic volumes: the renewed licenced will have **no significant effect on traffic**.

Figure 11-1: Road network used by aquaculture traffic to Travara Pier.

11.2. Shipping/Navigation

11.2.1. Description of the Receiving Environment

The closest port to the Deenish site is Castletownbere harbour, which is second busiest port in Ireland, and one of the largest natural harbours in the world, is located 24km south of the Deenish fish farm (96km from Caherdaniel via road). Castletownbere is also Irelands largest whitefish port[21]. In 2016, Castletownbere had 14,008 tonnes of Irish fish landings[22].

Castletownbere Harbour's most frequent vessels in 2017 were cargo, fishing and service vessels (Emodnet, 2019). In terms of the 21 Irish ports, Castletownbere was ranked 2nd largest in terms of its landings by weight in 2017, with a total tonnage of 9011T. This overall tonnage accounts for 3.67% of Ireland's landings for 2017[23]. By tonnage, the three main species of fish landed at Castletownbere Harbour in 2017 were hake, monkfish and megrim.

The main approach to the harbour is by Ardnakinna point to the west, there is also the eastern approach between Roancarrigmore and Carrigavaddra Beacon.

11.2.2. Impact Assessment

As this is a licence renewal application, all aquaculture associated ship traffic makes up part of the existing shipping levels in the area. Shipping traffic associated with the Deenish site will not significantly change due to the renewal license and changing the site boundaries or operating conditions attached to the licence.

11.2.3. Conclusion

Shipping traffic associated with 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 shipping traffic associated with the Deenish site. If approved, the renewed licenced will have **no significant effects** on shipping traffic.

---

[21] Fishery Harbours: https://www.agriculture.gov.ie/seafood/fisheryharbours/castletownberefisheryharbourcentre/

[22] Census Statistics of Fish Landings: https://www.cso.ie/en/statistics/environmentstatistics/fishlandings/

[23] CSO Statistics of Port Traffic: https://www.cso.ie/en/releasesandpublications/er/spt/statisticsofporttraffic2017/

11.3. Commercial Fisheries and Aquaculture

11.3.1. Description of the Receiving Environment

The following sections briefly describe the fishing and aquaculture activity occurring in the occurring in the Ballinskelligs Bay to Kenmare Bay region.

11.3.1.1. Pot Fisheries

The categories of pot fishing occurring in the region are Brown Crab, Lobster and Crab and Shrimp (**Figure 11-2**). The Deenish site coincides with the Brown Crab fishing area (see **Figure 11-2**). 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 existing licence overlaps 14.5ha of ground identified lobster and crab pot fishery. If approved the proposed renewal site will overlap 33.5ha of the lobster and crab pot fishery.

11.3.1.2. Trawl Fisheries

Little trawling activity takes place in the vicinity of the Deenish site. Bottom trawling for Nephrops takes place further south near Castletownbere in Bantry Bay where vessels under 15m in length are used. The intensity of bottom trawl fishing has decreased yearly from 2006 (92,000hours) to 2012 (97,000 hours) with fishing for demersal fish using bottom trawls restricted by EC 227/2013. 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 takes place in both Kenmare and Bantry Bay occurring primarily in winter and spring (Marine Institute, 2015).

Trawl fisheries does not overlap with the proposed Deenish T6/202 site (see **Figure 11-3**).

11.3.1.3. Line Fishery

Line fishing occurs along the entirety of the southwest coast from Shannon Estuary to Bantry Bay. This usually takes place during the summer months further west off the Kerry/Cork coast for mackerel and pollack using troll lines.

There is no overlap between the occurrence of line fishing and the Deenish T6/202 site (see **Figure 11-4**).

11.3.1.4. Net Fishery

Net fishing (tangle net) takes place along the southwest coast from Cahersiveen to Lamb's head near Deenish Island (Marine Institute, 2015). 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).

There is no overlap between the net fishing and the T6/202 Deenish site (**Figure 11-5**).

11.3.1.5. Fish Landings

Castletownbere is the nearest fishery harbour to the site. **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 the dominate species 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
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

11.3.1.6. Aquaculture

Existing aquaculture in the Kenmare Bay area is shown in **Figure 11-6**. The Aquaculture Licence GIS Database[24] indicates that aquaculture in the SAC largely focuses on shellfish species and finfish (Salmon). The main cultured shellfish species is mussels with smaller quantities of oysters. Sites are also licenced for scallops and clams, but the species are not currently produced in the area.

There are also six locations dedicated to the culture of Atlantic Salmon (including the Deenish site) (see **Table 11.4**). MOWI are currently operating the Deenish (T06/202A) and Inishfarnard (T5/233) aquaculture sites, under the respective licenses AQ199 and AQ198. The Inishfarnard site is located approximately 20km away from the Deenish site. The salmon farms at Doon Point and Kilmakilloge Harbour are unstocked and have been so for some time, and currently do not pose an impact to the environment. There is a total of 54 other aquaculture sites further in inner Kenmare Bay and river. These sites include 35 mussel farms, 10 scallop farms and 5 oyster farms.

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

The total value of aquaculture in Co. Kerry in 2016 was €21.9. Of this €14.3m was attributed to salmon culture (2,494 tonnes), €4.7m to Gigas oyster culture (830 tonnes), €1.2m to seabed mussel culture (1,728 tonnes) and €1.0m to native oyster culture (175 tonnes)[25]. In addition, 1,048 tonnes of rope mussel worth approximately €663,270 and 3 tonnes of scallops worth €12,000 were also cultured.

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 at Deenish and stock only with S1 fish. In addition, MOWI will focus its lice treatment regime around the pre-winter treatment for all fish in the wider region (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, 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 all sites are fallow for 4 to 6 weeks every production cycle.

Table 11.4: Salmon aquaculture licences in Kenmare River SAC

Licence reference	Site Name	Distance to Inishfarnard Site
T6/064/7	Doon Point, Kenmare River	4.1km northwest
T6/064A	Kilmakilloge Harbour	15.8km northeast
T6/064B	Kilmakilloge Harbour	16.5km northeast
T6/112	Cloonee,Tuoist.	15.8km northeast
T5/233	Inishfarnard, Island	20.0km southwest

11.3.2. Impact Assessment

A range of fishing activity occurs within the in the occurring in the Ballinskelligs Bay to Kenmare Bay region as described above. The existing licence does not significantly affect fisheries in the bay. The existing licence 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 from

[25] BIM Annual Aquaculture Survey 2017 http://www.bim.ie/media/bim/content/publications/aquaculture/BIM-Annual-Aquaculture-Survey-2017.pdf

14.5ha to 33.5ha. This increase in spatial overlap is insignificant relative to the lobster and crab fishing area identified in the vicinity of the site.

11.3.3. Conclusion

The renewal of the licence and change to operating conditions of the licence will not significantly affect fishing.

The renewal of the existing licence will see production at the site increase from 500 tonnes (annually) to 2,672 tonnes[26] of harvestable weight over a 2-year period (an approximate annual increase of 836 tonnes). Based on BIM 2016 annual survey aquaculture figures, this would increase aquaculture production in Co. Kerry from 6,313 tonnes to 7,149 tonnes, with salmon production increasing from 2,494 tonnes to 3,330 tonnes. This increase in salmon production would equate to an increase to the economy from aquaculture production of €4.78m (based on 2016 figures). This is a **positive effect** of the renewal of the licence and change to operating conditions of the licence.

[26] Harvested yield form **Table 2.2 Section 2.8**

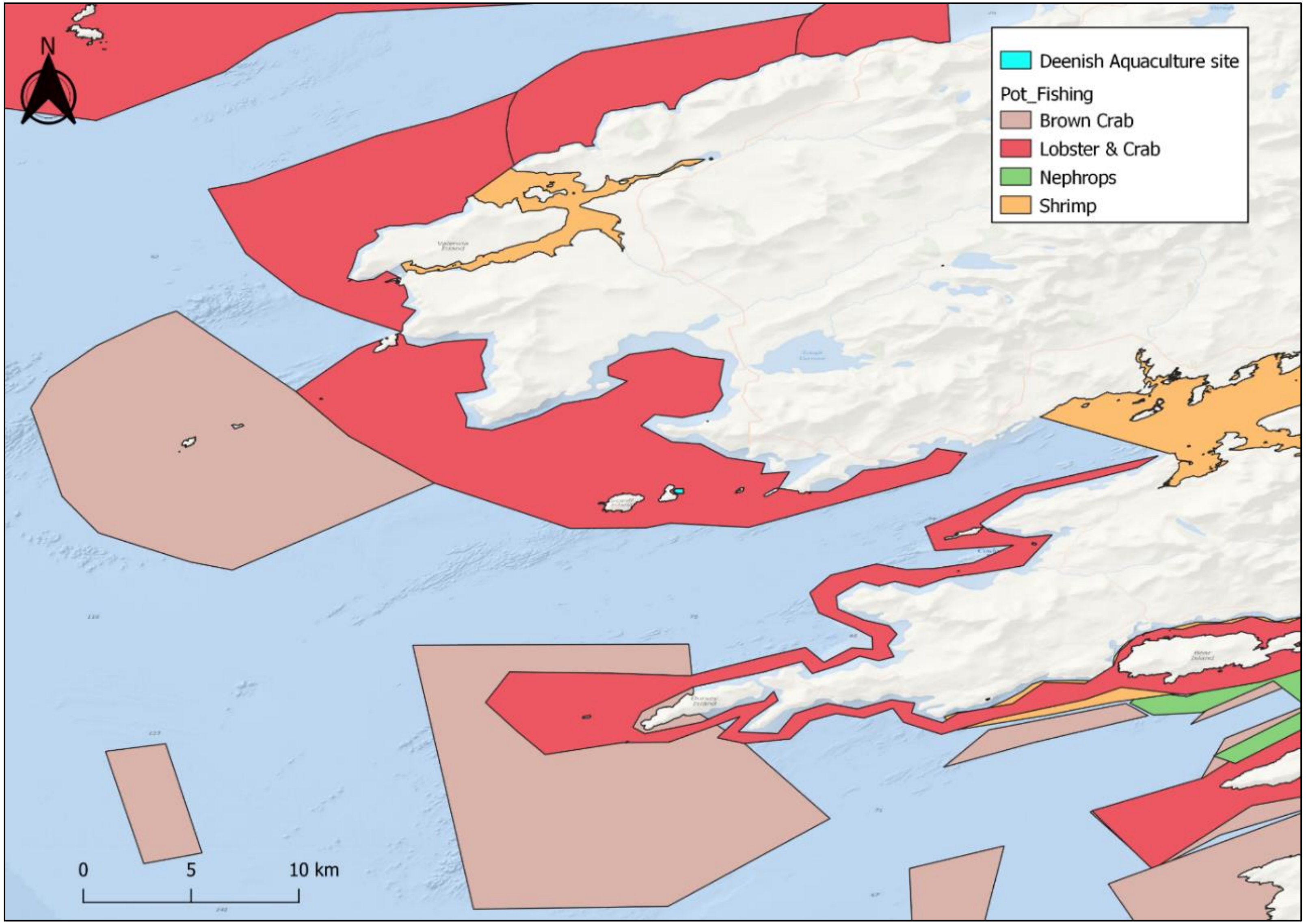


Figure 11-2: Pot fisheries (Source: http://atlas.marine.ie/; 27/05/2019).

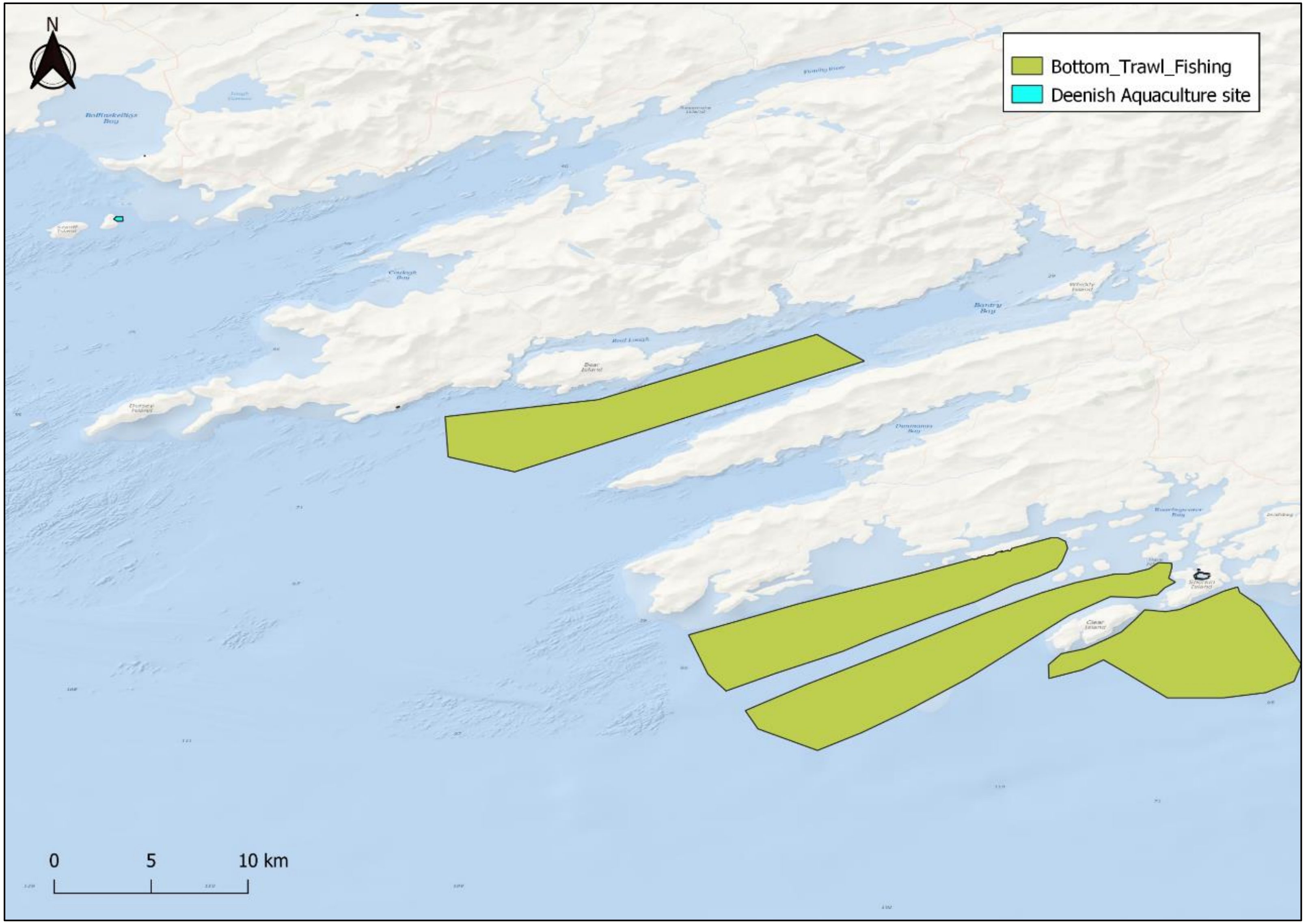


Figure 11-3: Trawl fisheries (Source: http://atlas.marine.ie/; 27/05/2019).

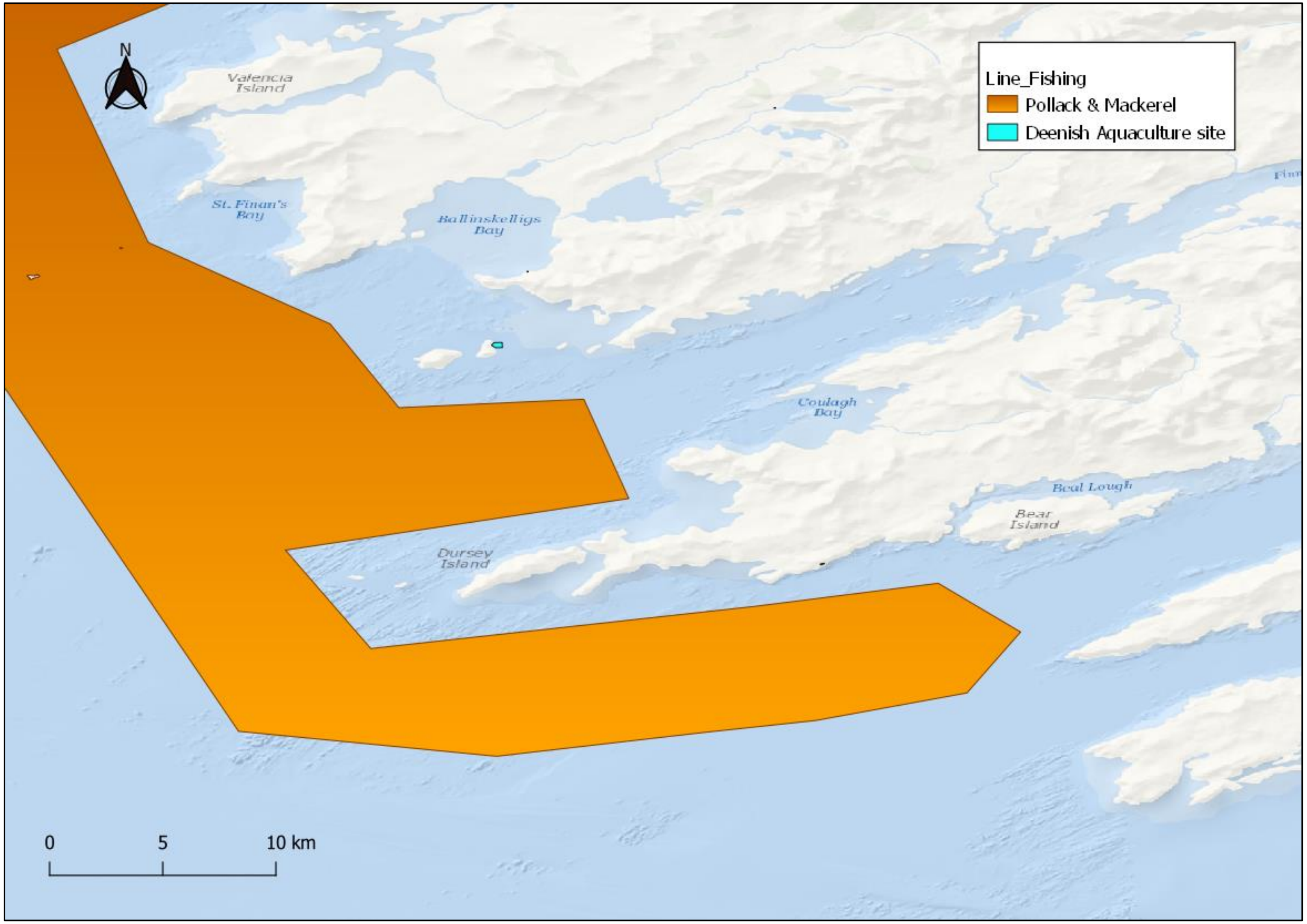


Figure 11-4: Line fisheries in the vicinity of Kenmare Bay (Source: http://atlas.marine.ie/; 27/05/2019).

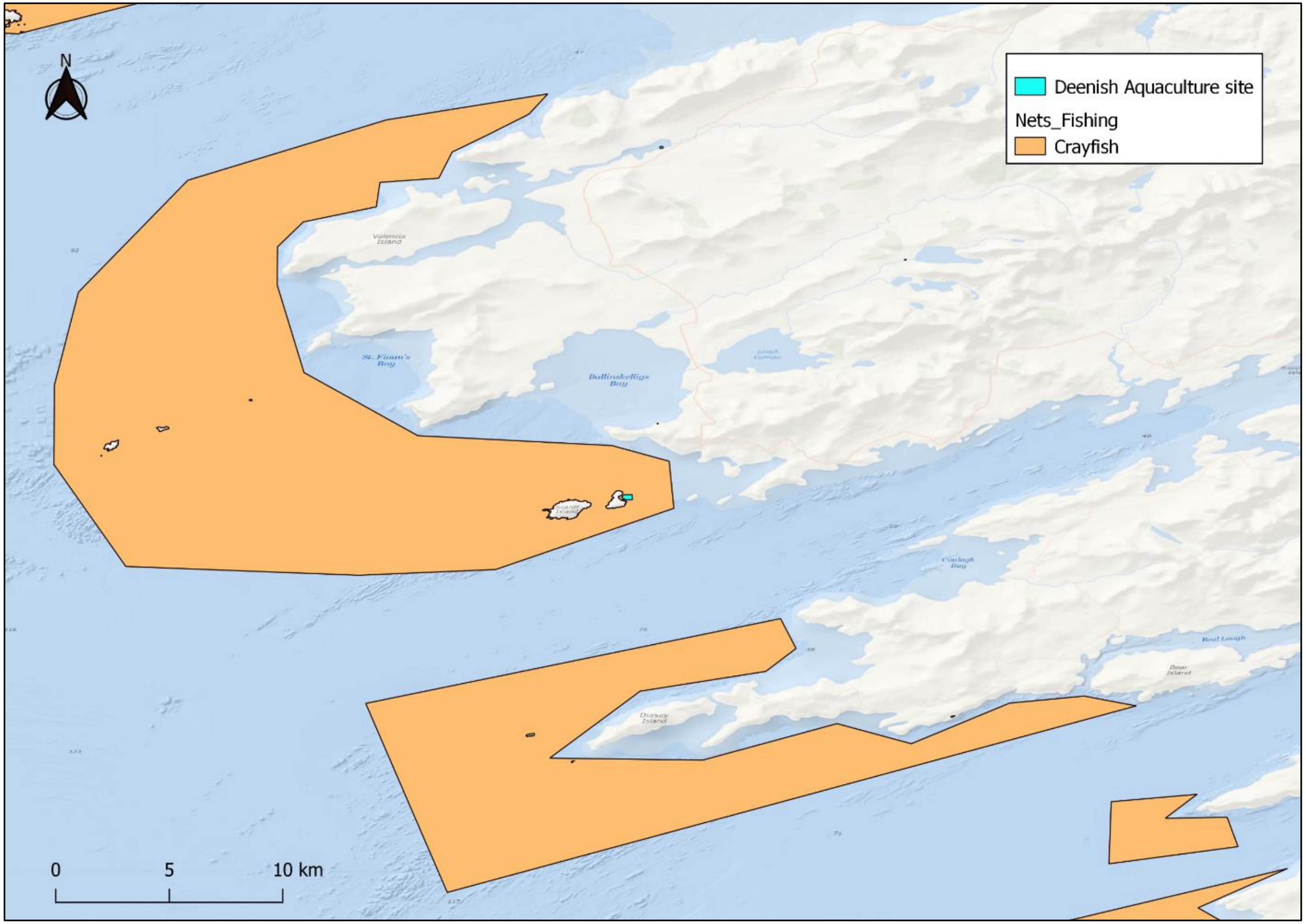


Figure 11-5: Net fisheries (Source: http://atlas.marine.ie/; 27/05/2019).

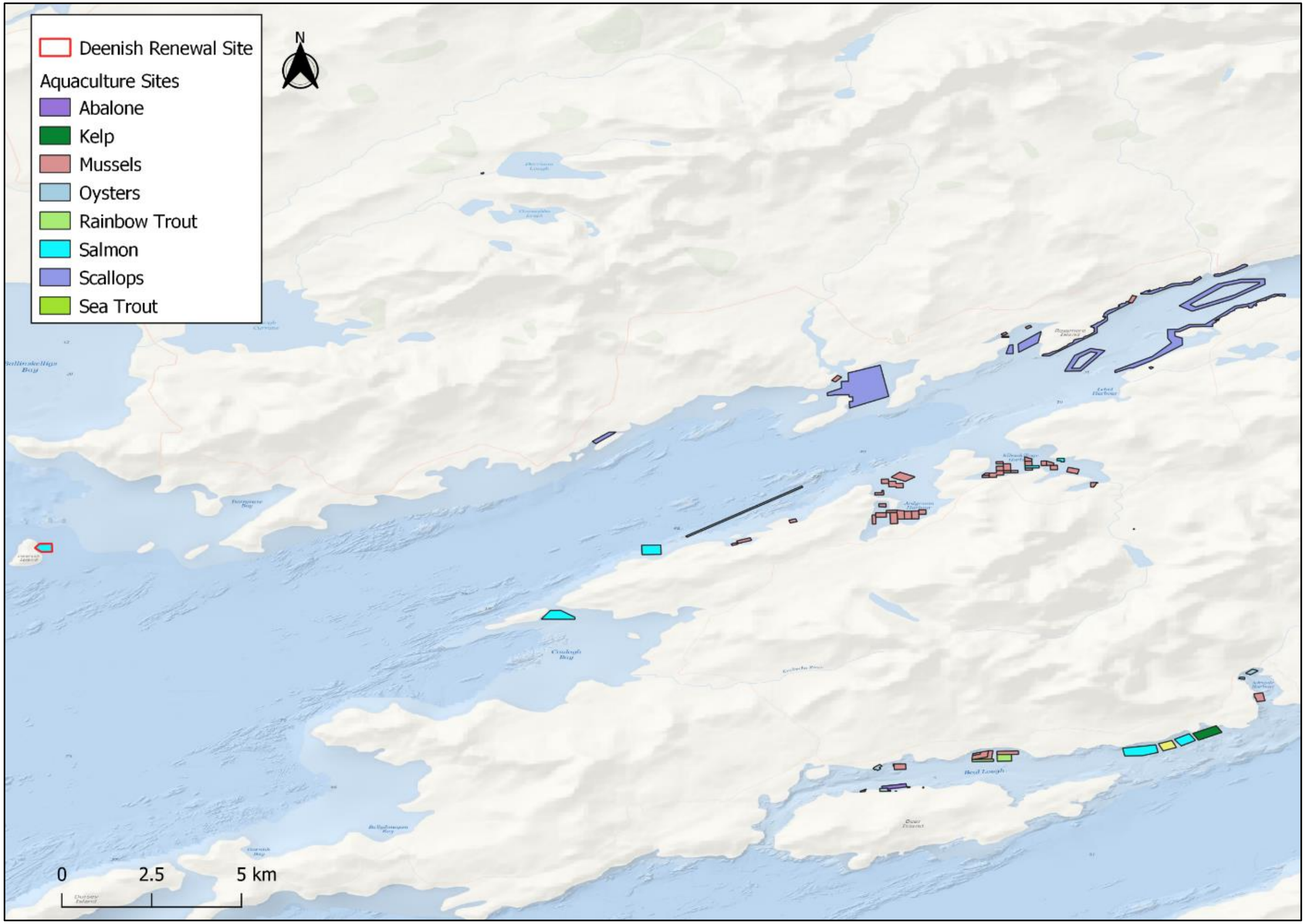


Figure 11-6: Aquaculture (Source: http://atlas.marine.ie/; 29/05/2019).

11.4. Tourism and Recreation

11.4.1. Description of the Receiving Environment

The location of key tourism and recreational sites in the region are shown in **Figure 11-7**. While there are no figures available to accurately estimate the number of tourists that visit the Ballinskelligs Bay area specifically, the Fáilte Ireland statistics show that the south west region received a total of 2.4 million overseas visitors in 2017 spending €968m and 2.1 million Irish resident trips to the south west region generating €419m (Fáilte Ireland 2017 performance south west region).

Tourism focuses on the landscape, seascape, history and cultural qualities in the area including the 'Wild Atlantic Way' which runs along the entirety of the west coast of Kerry. There are two discovery points located close to Deenish Island, including Dursey Island (17 km south) and Skellig Michael (23 km west). Boats to Skellig Michael depart from Portmagee (25 km northwest). There is also an access point for departure to Skellig Michael at Bunavalla pier located near Derrynane Harbour (5 km east). 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 south west coast (Fáilte Ireland 2017 performance south west region).There are also Blue Flag bathing beaches at Derrynane More and Ballinskelligs located approximately 3.2km north and 2.9km northwest the Deenish site (EPA Maps[27]).

Due to the absence of marinas within the vicinity of Deenish 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 Deenish Island 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[28]).

The closest shipwreck to Deenish is located approximately 12 km west (Lat: 51.73, Lon: -10.39) of T6/202 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). There are 3 further shipwrecks located closer to Derrynane beach, a U-Boat 'Ethel B. Jacobs' lost in 1899 located approximately 5 km east (Lat: 51.7559, Lon: -10.1372), U-Boat ' Thomas Rua O'Suillabhan' located approximately 5 km east (Lat: 51.7559, Lon:

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

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

-10.1382) and an additional unknown wreck at Lat: 51.7559 and Lon: -10.1362 (Irish Wrecks[29]). Further detail of wreck located near the site is presented in **Section 12**.

There are several shore angling sites surrounding Deenish Island and Ballinskelligs Bay (Fishing Ireland[30]). The closest includes Lambs Head (5 km east) where fishing for conger, dogfish, bullhuss, pollock and ballan wrasse occur. In Derrynane (6 km east) fishing for bass, coalfish, cod, flounder, mullet, sea trout, golden grey mullet and turbot occurs. Further NE into Ballinskelligs Bay there are 3 additional shore angling sites (Hog's Head, Waterville beach and Inny Strand) where fishing for bass, coalfish, cod, dab, dogfish, flounder, mullet, pollock, ballan wrasse, plaice and golden grey mullet occurs (Fishing Ireland).

Salmon fishing in Ballinskelligs Bay takes place in the River Inny (13 km NE) and Lough Currane (spate river system situated 10 km from T6/202) within the Waterville lakes and river system. The season runs from 17th January to 30th September of each year, with sea trout fishing open from 17th January to 12th October and fly fishing open only from 1st to 12th October. In 2015, a total of 15.5% of nationally caught sea trout were caught on the Waterville/Currane system equating to 206 fish over 40cm (IFI Wild Salmon and Sea Trout Statistic Report 2016). In 2017, the Currane system was part of the top four sea trout producing water systems in Ireland (IFI Wild Salmon and Sea Trout Statistic Report 2017b). In 2017, 135 salmon were caught on a catch and release basis (60% increase from 2015) by rod/line and 191 fish harvested (36% decrease from 2015) in the Waterville/Currane system. 91 sea trout were caught on a catch and release basis (65% decrease from 2015) with 18 harvested (88% decrease from 2015) (IFI Wild Salmon and Sea Trout Statistic Report 2017b).

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).

11.4.2. 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 14.5Ha to 33.5Ha. The relative change in site area is not significant and will not prohibit or impact upon any existing recreational activity in the bay.

---

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

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

Section 14 (Landscape and Visual Resources) indicates that the fish farm infrastructure proposed for the renewed licence can only be seen for a very small section of the N70 Wild Atlantic Way Scenic Route. If the licence is application is approved, the visual amenity would not be significantly impacted and the likelihood of current tourism remaining the same is Highly Likely.

11.4.3. Conclusion

The application includes a request to change the boundary of the site from 14.48Ha to 33.48Ha and operations form 10 pens to 15 pens. The increase in area covered by the pens will increase by 19Ha. If approved, the renewed licenced will have **no significant effects** on tourism and recreational activities.

11.5. Waste Management

After stunning and bleeding of harvested fish, the dead fish are collected in closed steel road tankers which 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^{TM} 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 (see **Appendix 2.4** for *SOP25564* on Waste Monitoring and Management). All filtered waste water 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 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 (*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 for incineration at College Proteins of Nobber, County Meath, an approved animal by-product 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**.)

11.5.1. 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.

11.5.2. Conclusion

MOWI currently have facilities and requirements in place for waste management; as a result, the renewal license will have **no significant effects** on the waste management process and therefore no significant effect on the local environment of the site.

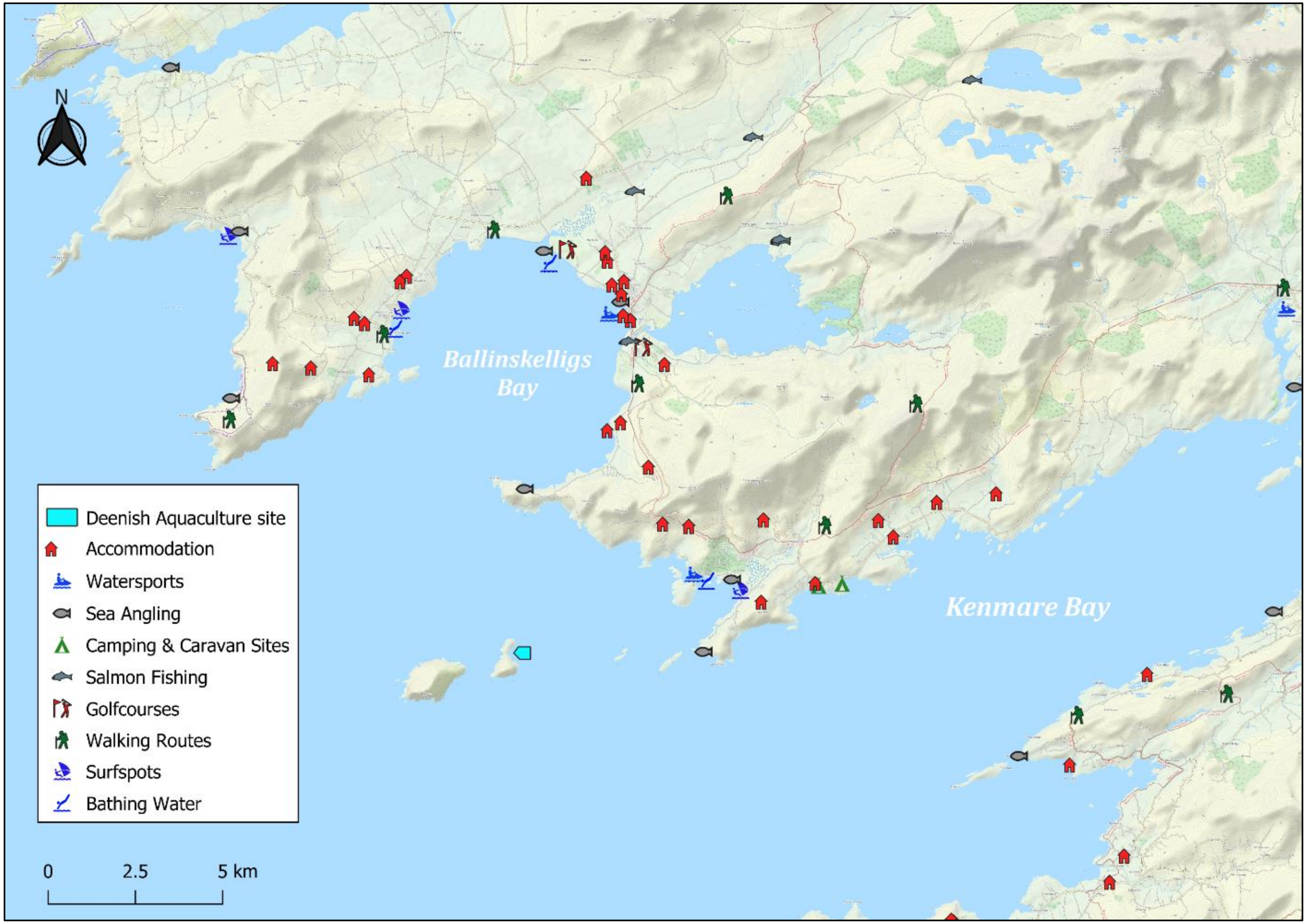


Figure 11-7: Location of tourism and recreational sites in the vicinity of the proposed renewal site.

12. Cultural Heritage and Archaeology

12.1. Description of the Receiving Environment

A detailed archaeological assessment of the seabed surrounding the 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 38 sites listed in the Sites and Monuments Records for the townlands within 5km of the Deenish site (see **Figure 13.1**); including a megalithic structure and ecclesiastical sites (hermitage, souterrain, church and enclosure) on Scariff Island to the south west, as well as ringforts, huts and megalithic tombs present on the Kerry mainland.

The archaeological assessment also considered shipwrecks within Ireland's waters using 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 7 vessels which were lost within or around the area of Deenish Island with a further 26 vessels recorded as having been lost in the greater Kenmare Bay area.

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 and impact on any of the sites located in the adjacent townlands, including Scariff Island, that are recorded in the Sites and Monuments Record.

The seabed at the location of the proposed site will be impacted by the laying and bedding of substantial anchors. The nearest shoreline to the east of the sites will not be impacted by the proposed development.

The rock substrate was interpreted as having a low potential for the retention of archaeological material. The coarse substrate was interpreted as having a low to medium potential for the retention of archaeological material. The finer substrate, which comprises a smaller area of the site, was interpreted as having a high potential for the retention of archaeological material

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 should be diver truthed prior to the deployment of the anchoring system and a further side-scan survey should be conducted over the Deenish 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 accommodate carefully 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

The coastline surrounding Deenish Island runs from the Bolus Head and Ballinskelligs Bay, Co. Kerry (*c*.10km northwest) to Lambs Head and Dursey Island, Co. Cork (*c*.17km south).

Seascapes are an important attribute to the Kerry coastline with rugged peninsulas and drowned valleys. A seascape is described as a discreet area containing a seaward component, a coastline component and a landward component (AECOM 2010). The physical characteristics of the Kerry coastline adjacent to Deenish Island includes steep exposed wild coastline with long peninsulas, sounds and islands providing a range of dramatic sea views, outer bays consist of exposed rocky headlands and islands with rugged hills or mountainous regions separated by large drowned valleys (AECOM 2010).

Kerry is known nationally for its scenic landscape including seascapes and rocky peninsulas. There are 46 Landscape Character Areas (LCA) (Kerry County Council 2012) which are defined by the Heritage Council as unique, geographically specific areas of a particular landscape type with individual character and identity (Kerry County Council 2015). The closest LCAs to Deenish Island includes St. Finans Bay and Valentia Island (no. 44), Inny Valley (no. 18) and Cahernageeha and Derrynane Bay (no. 45) (see **Figure 13-1**).

The following landscape descriptions are extracted from Kerry County Council Landscape Character Assessment report 2012. Each of the LCAs described below are important for scenery, nationally important landscapes (with the exception of Inny Valley) and are all designated as Prime and Secondary Special Amenity zones (relating to their sensitivity to development).

St. Finans Bay and Valentia Island LCA (no. 44) is situated northwest of Deenish Island *c*. 9km and comprises of Valentia Island to Bolus Head. The landscape consists of Transitional Marginal Land, Flat Peatland, Coast and Mountain Moorland with dominant features including mountains and seascapes. Valentia Island to the north entails a ridge of hills, sloping down to the sea on the southern side, with cliffs on the northern side. The summits and slopes of the high topography comprise of open moorland and the occurrence of bare rock being quite rare. Rock outcrops occur adjacent to the coastline, but the land is enclosed and grazed. There are peat bogs on the lowlands along with forestry plantations with some pasture also present. This LCA is a very open and scenic landscape with tourists visiting Valentia Island as well as Portmagee for passenger boats to Skellig Michael, a UNESCO World Heritage Site. Overall this LCA is a high-quality landscape.

Inny Valley LCA (no. 18) is located *c*. 10km north of Deenish Island and stretches from Waterville on its western side to Ballaghisheen to the northeast. The landscape here consists of Transitional Marginal Land and Mountain Moorland. A ring of mountains and high topography bound this area on three sides with the western boundary formed mainly by the N70 and coastline. The rocky summits of the mountains, which form the eastern boundary, are sparsely vegetated with moorland which continues down to the lower slopes in some areas, often being replaced by extensive areas of coniferous plantation, which is especially notable at the eastern end of the River Inny Valley. A prominent feature of this LCA is the valley being surrounded by a ring of mountains with oak woodland and peatbog also present.

Cahernageeha and Derrynane Bay LCA (no. 45) is located *c.* 4.5km east from Deenish Island and constitutes south of Waterville and Lough Curran to Cahernageeha (499m) mountain which separates this area from the adjoining LCA to the northwest. The landscape type consists of Mountain Moorland, Transitional Marginal Land and Coast. A ridgeline encircles the valley to the north of Caherdaniel and Castlecove before descending to the sea near Bunnow Harbour. The contorted coastline provides a series of rocky bays and inlets with numerous islands extending out to sea with Scariff and Deenish Islands clearly visible from the coastline. Steep cliffs characterise the western side of the coastline and a sand bar extends across Derrynane Bay. Rock outcrops remain a predominant feature of the landscape, especially near the coast. Other areas of interest within this LCA include the Architectural Conservation Area of Caherdaniel where numerous archaeological monuments can be found. There are also Blue Flag beaches located at Derrynane, the Kerry Way walking route as well as the Ring of Kerry tourist route. Overall, this area is of high quality landscape.

There are 6 rural settlements surrounding Ballinskelligs Bay, from west to east they include Ballinskelligs, Emlaghmore, Lough Currane, An Ballybrack, Derrynane and Caherdaniel. Ballinskelligs Bay is a Gaeltacht region, with its origins traced back to monks in the 5th or 6th century. To the south west of the village is Bolus Head, which overlooks St. Finan's Bay and the Skellig Rocks. This area has an abundance of pre-historic and early Christian ruins including Cill Rialiag, an early Christian monastic settlement, located on the road to Bolus Head. Other areas of interest include McCarthy Mór Tower, also known as the Ballinskelligs castle, which dates back to the 16th century as well as the 12th century Ballinskelligs Augustinian Priory, also known as the Abbey, located on the R566 Skellig Ring road. Ballinskelligs also contains a Blue Flag beach located at the western edge of the bay and within the Kerry Dark-Sky Reserve. Ballinskelligs is also part of Wild Atlantic Way.

In the rural area of Lough Currane, Waterville village, which was developed in the 19th century, sits at the coastal edge of this ED forming part of the Ring of Kerry and Wild Atlantic Way. Archaeological sites of interest include Church Island which sits on Lough Currane and was introduced to Ireland in the 12th century. The Lough Currane lake system is one of the largest and best known for sea trout fishing and also salmon fishing.

The rural settlement of Derrynane sits just off the main N70 route. The area is known for its National Historic Park with the plantations and garden laid out in the 18th and 19th century. Derrynane house which sits within the national park was built in the 1650s and was the home of Daniel O'Connell. Sites of archaeological interest within this ED includes Loher Stone Fort, a defended farmstead, which dates back to the 9th century, located *c.* 4km from the main Derrynane village and Derrynane Abbey built in the 6th century, which is located on Abbey Island. Deenish and Scarriff Island are also part of the Derrynane electoral division both representing seascapes of high landscape value. Monuments of interest present here include a megalithic structure, ecclesiastical enclosure and church (National Monuments Service). Closer to the coastline within the 5kkm zone structures such as ringforts, hut sites, megalithic tomb and church. Derrynane also forms part of the Ring of Kerry and Wild Atlantic Way, with Derrynane beach issued as a Blue Flag beach.

Caherdaniel, the closest rural area to Deenish Island (*c.*5km east), sits on the N70 forming part of the Ring of Kerry and Wild Atlantic Way. Sites of archaeological importance within Caherdaniel includes the stone fort of Caherconnell dating back to 600 B.C. and Staigue Fort which dates back to the Bronze Age, which is an almost circular fort 27.4m in diameter (https://voicesfromthedawn.com/staigue-fort/).

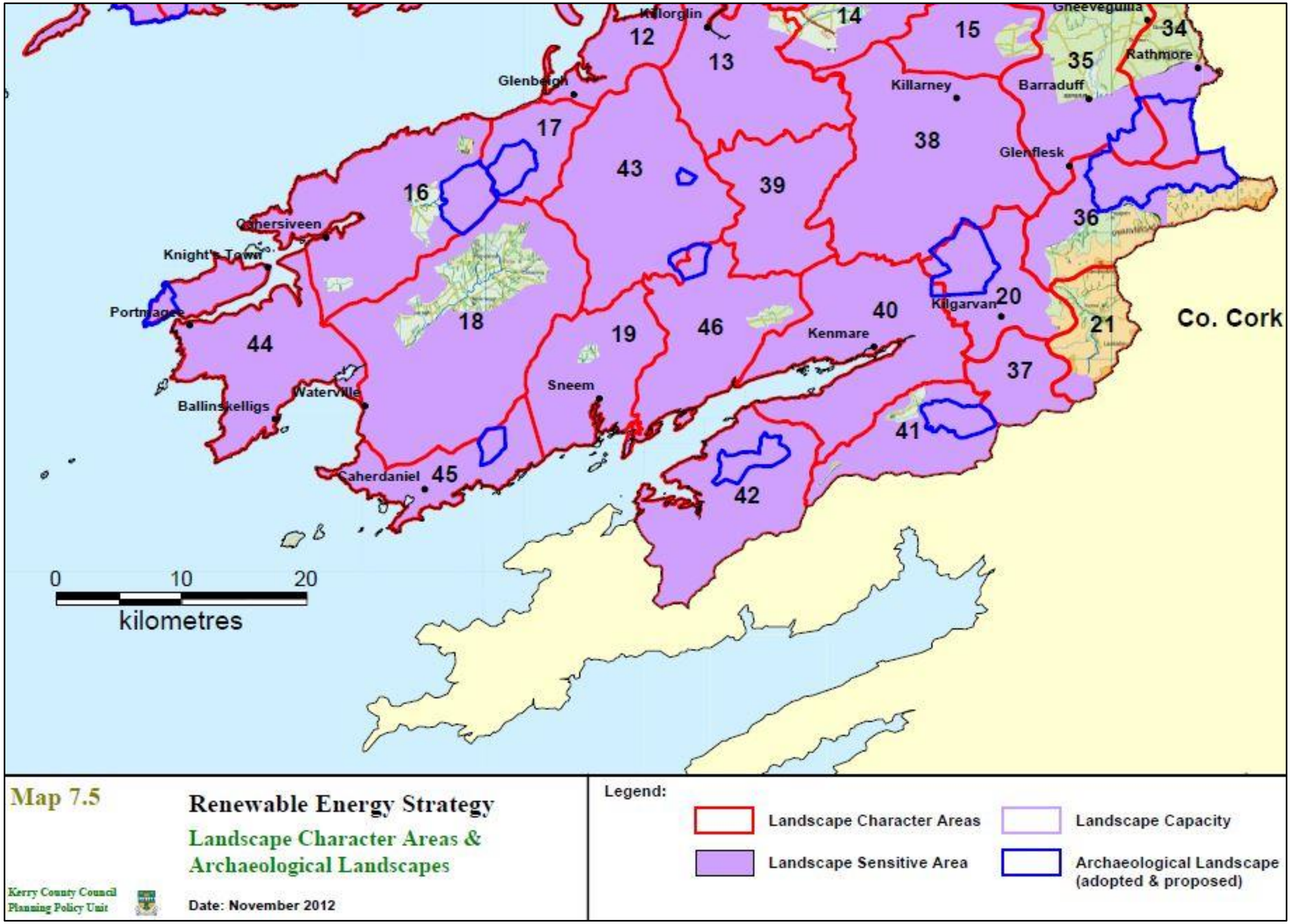


Figure 13-1: Landscape Character Areas and Scenic Routes. Data adapted from Kerry County Council Development Plan.

13.2. Landscape & Visual Impact Assessment

Within the Kenmare Bay area Kerry County Development Plan 2015 – 2021 (Kerry County Council, 2015) identified various views and prospects as well as amenity/zoning areas surrounding Ballinskelligs Bay and Deenish Island (see **Figure 13-2**). Prime and Secondary Special Amenity zones have been designated to the Kerry area with Prime Amenity Zones constituting landscapes which are very sensitive and have little or no capacity to accommodate development with any development which is considered, having to demonstrate satisfactory integration into the landscape and compliance with proper planning and sustainable development in the area (Kerry County Council 2015). Secondary Special Amenity zones are sensitive to development and therefore require proposed developments to take into account topography, vegetation, existing boundaries and features of the area in order to minimise the effect on the landscape (Kerry County Council 2015). Of these, Secondary Special Amenity zones make up the majority of the landscape areas surrounding Kenmare Bay including Deenish Island, however areas including Derrynane bay and islands off Lambs Head are designated Prime Amenity Zones (**Figure 13-2**).

Figure 13-2 illustrates the above zoning with views and prospects which can be used for scenic purposes, however little is described in terms of areas of high scenic amenity within the region. Having said that, Kerry is known for its outstanding natural beauty which is recognised internationally with south and west Kerry considered among the most scenic landscapes in the Country from a tourist perspective (Kerry County Council 2009), it is therefore imperative to preserve and protect these views and prospects from any development which may hinder them.

Finfish culture has been ongoing in Kenmare Bay since 1990's, the current proposal will increase the licenced area from 10 pens to 15 pens. The increase in pen numbers will therefore create a greater area for which the pens will be visible from the shore, however it 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 Deenish Island at Travara 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 around 4km. However, Deenish Island is visible from a section of the N70 from an elevated view and, although greater than 7km from the site in places, this boundary was used as the outer boundary to determine the zone of potential impact around the proposed aquaculture site that is located in the Ballinskelligs Bay area.

There are restricted views of the bay from the 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 location where the site could be viewed individually or in combination from the surrounding area (**Figure 13-3**). The lens used on the camera was a standard 50mm 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. **Table 13.4** presents the locations and coordinates of the recorded vantage points along with the site of observation. Pens were located at the production site T6/202 to accurately represent the view from each vantage point. Views from the vantage points with pens overlain are presented in **Figure 13-4** to **Figure 13-16**.

Table 13.4: Prominent vantage points

Vantage Point	Location	Coordinates		Distance from Site (km)
		Latitude	Longitude	
1	Elevated minor road	51.77896	-10.2032	4.6
2	Beenarorke viewing spot with parking. Overlooks Kenmare Bay.	51.77619	-10.1672	5.3
3	Elevated road view	51.77483	-10.1618	5.5
4	Elevated road view	51.7757	-10.152	5.9
5	Last view of site on elevated road	51.77268	-10.1771	4.5
6	Minor road	51.77332	-10.1674	5.3
7	Minor road	51.7724	-10.1606	4.8
8	Cul-de-sac	51.76407	-10.1598	5.2
9	Minor road	51.76565	-10.1537	6.1
10	On minor road, last view of site	51.77331	-10.1448	5.5
11	Pier	51.76053	-10.1425	6.8
12	First spot that site can be seen along Lambs Head road.	51.75635	-10.1193	6.9
13	Along shore road, slightly elevated.	51.75234	-10.1247	6.4

Figure 13-2: Amenity Zoning areas, Views and Prospects and National Monument sites (adapted from Kerry County Council Development Plan.

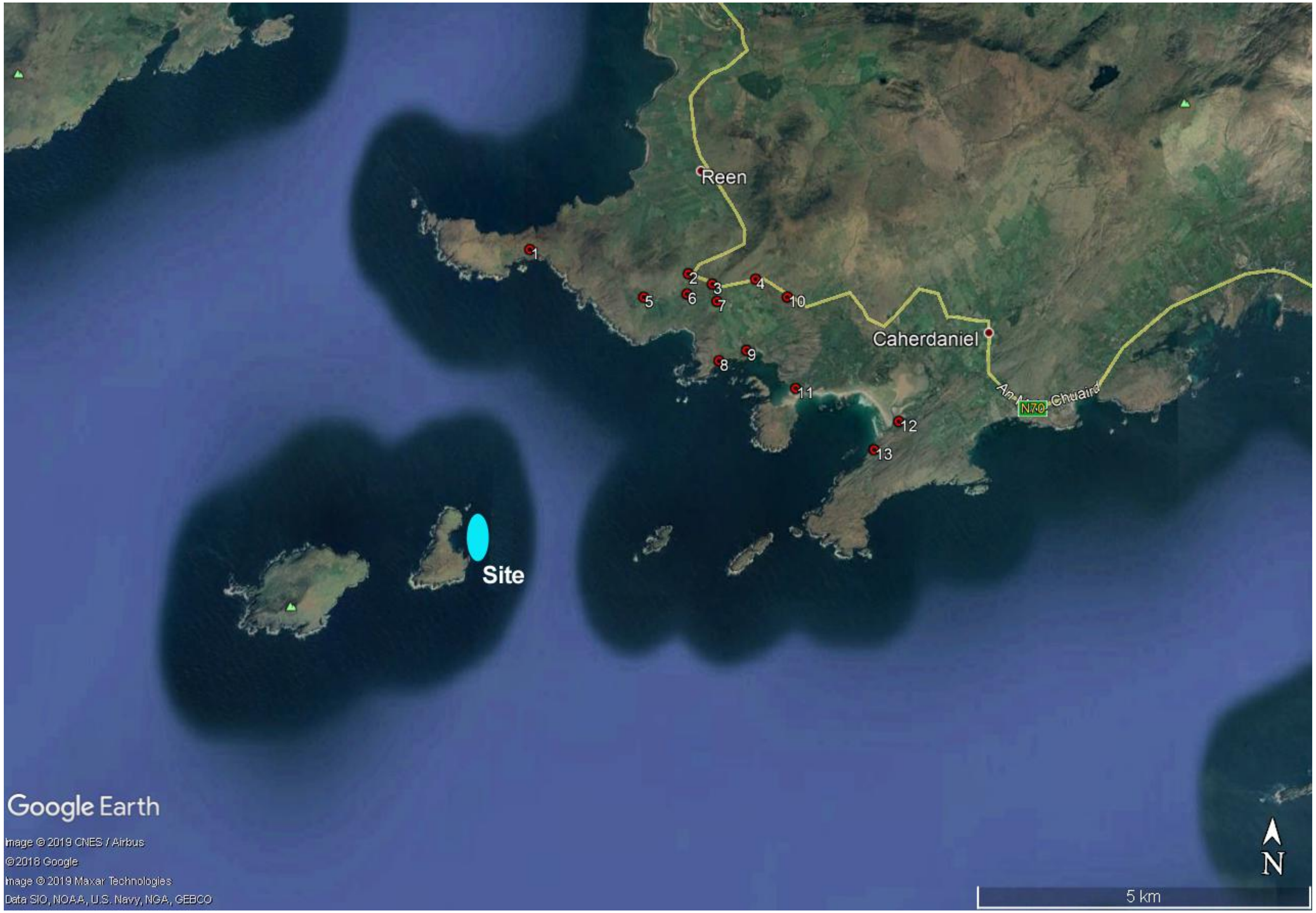


Figure 13-3: Visual vantage points

Vantage Point 1

Figure 13-4: View of site from vantage point 1

Comment: Elevated view from a minor road that ends in a dead end. A number of single dwellings along the road. Pens visible under the island.

Vantage Point 2

Figure 13-5: View of site from vantage point 2

Comment: Wild Atlantic Way viewing spot with parking for cars and buses. Overlooks Kenmare Bay with view of Deenish Island and pens. Due to the topography of the landscape, this is the first location that the pens are visible along the N70 coming from Reem. There are no dwellings close to here.

Vantage Point 3

Figure 13-6: View of Site T6/202 from Vantage Point 3.

View from the N70. Pens visible on the sheltered side of Deenish Island

Vantage Point 4

Figure 13-7: View of Site T6/202 from Vantage Point 4.

Comment: Elevated view from pub/restaurant located at junction of minor road with N70. Number of individual dwellings also located here.

Vantage Point 5

Figure 13-8: View of Site T6/202 from Vantage Point 5.

Comment: Last view of the pens along minor road that ends in cul-de-sac.

Vantage Point 6

Figure 13-9: View of Site T6/202 from Vantage Point 6.

Comment: View from minor road running off to a farmyard.

Vantage Point 7

Figure 13-10: View of Site T6/202 from Vantage Point 7.

Comment: Elevated view at junction of minor roads. Last view of the pens on moving down the road to shore.

Vantage Point 8

Figure 13-11: View of Site T6/202 from Vantage Point 8.

Comment: End of minor road overlooking lobster holding ponds and sheds.

Vantage Point 9

Figure 13-12: View of Site T6/202 from Vantage Point 9.

Comment: View of Deenish Island on minor road that ends at pier. Pens difficult to distinguish.

Vantage Point 10

Figure 13-13: View of Site T6/202 from Vantage Point 10.

Comment: Last view of the site from N70

Vantage Point 11

Figure 13-14: View of Site T6/202 from Vantage Point 11.

Comment: View from end of road at a pier and carpark with a single dwelling. Site partially visible

Vantage Point 12

Figure 13-15: View of Site T6/202 from Vantage Point 12.

Comment: First viewpoint that the site is visible from the Lambs head road. Pens not distinguishable

Vantage Point 13

Figure 13-16: View of Site T6/202 from Vantage Point 13.

Comment: Elevated road along Lambs head with a number of individual houses. Pens not clearly distinguishable from background.

In terms of cumulative visual impact for Ballinskelligs Bay as a whole, the proposed Deenish site will not have a significant effect as the current site is visually limited to vantage points along the tip of Lambs head and even so the site is only fully distinguishable on a very clear day.

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 the 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 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 for a short distance along the N70 and minor roads that access dwellings and piers at the shoreline. Based on the definition of sensitivity and magnitude as given in **Table 13.1** and **Table 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 licenced block 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 requests to change the boundaries of the site from 14.5ha to 33.5ha and operations from 10 pens to 15 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 licence T6/202 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 11.3.1.6** for further details). The sites considered in the assessment of potential cumulative effect include salmon farms at Doon Point, Kilmakilloge Harbour, and at Inishfarnard Island. The sites at Doon Point and Kilmakilloge Harbour are currently unstocked and have been so for some time; consequently, cumulative effects from these sites are excluded. In contrast, there is potential that operations at the Inishfarnard site could act in combination with Deenish site operations to result in cumulative impacts.

The Inishfarnard island site is currently operated by MOWI. As part of a licence renewal application for the Inishfarnard site an '*Appropriate Assessment Screening and Natura Impact Statement*' report[31] (AA Screening and NIS) has been prepared to address Article 6(3) obligations under EC Directive 92/43/EEC and an EIA[32] undertaken to address the Directive 2011/92/EU as amended by Directive 2014/52/EU. The AA Screening and NIS, and the EIA concluded that operations at the Inishfarnard site will not result in significant environmental effects on the site or the wider surrounding environment

For the current study, the assessment of potential cumulative impacts identified that the only aspects of the Deenish and Inishfarnard projects that could potentially give rise to cumulative impacts are discharges from the farms. For the Deenish[33] and Inishfarnard[34] sites three-dimensional hydrodynamic simulation modelling exercises were undertaken to determine fate of discharges from the sites. The discharges considered in the modelling exercises included sea lice larvae, and discharges that have the potential to impact on water quality (i.e. settleable solids, nutrient levels, oxygen demand and dangerous substances). The modelling exercises indicated that as plumes of discharges from the respective sites 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), cumulative impacts

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

[32] Document File Name: *JN1524 Inishfarnard EIA - Volume 1 – Non-technical Summary, JN1524 Inishfarnard EIA - Volume 2 - Main Report,* : *JN1524 Inishfarnard EIA - Volume 3 - Appendices*

[33] Deenish modelling exercise presented in Appendix 8 of *JN1524 Deenish NIS - Volume 2 - Appendices*

[34] Inishfarnard modelling exercise presented in Appendix 8 *JN1524 Inishfarnard NIS - Volume 2 - Appendices*

are unlikely to occur. In conclusion, given that the spatial footprint of discharges from the farms do not overlap it is concluded that **cumulative impacts can be excluded**.

In addition, as outlined in the AA of aquaculture activity in Kenmare River SAC (see **Appendix 9**) undertaken by the Marine Institute the level of aquaculture activity (both existing and proposed) at the time of the assessment (which included those licences listed above) are consistent with the Conservation Objectives for the Annex I Habitats and Annex II Species; consequently in-combination effects with other aquaculture activities in the area were excluded.

15. Difficulties Encountered

No difficulties were encountered during the production of this report.

16. Conclusions

This EIA has been undertaken to ensure the competent authority is enabled to make an informed decision on the proposed aquaculture project at Deenish Island 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 Deenish 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 together with the mitigation measures proposed, will not significantly affect the environment.

17.References

Aller, R.C. (1982). The effects of macrobenthos on chemical properties of marine sediment and overlying water. In: McCall, P. L. and M. J. S. Tevesz (eds.). Animal-Sediment Relations. New York. Plenum Press. pp.53-102.

Amundrud, T.L. & Murray, A.G. (2009). Modelling sea lice dispersion under varying environmental forcing in a Scottish sea loch. J. Fish Dis. 32 (1): 27-44.

AQUAFACT. (2014a). Environmental Surveys Beneath Finfish pens at Deenish, Kenmare Bay. August 2014. Produced on behalf of Marine Harvest Ireland.

AQUAFACT. (2014b). Environmental Survey following Aquaculture Stewardship Council (ASC) Standard for Benthic Monitoring at Deenish, Kenmare Bay, Co. Kerry. Report prepared on behalf of Marine Harvest.

AQUAFACT. (2015a). Environmental Survey beneath Finfish pens at Aquaculture Site (T5/233), Kenmare Bay, Co. Cork. Report prepared on behalf of Marine Harvest

AQUAFACT. (2015b). Environmental Survey following the Aquaculture Stewardship Council (ASC) Standard for Benthic Monitoring at Inishfarnard, Kenmare Bay, Co. Cork. Report prepared on behalf of Marine Harvest

AQUAFACT. (2017). Environmental Survey beneath Finfish pens at Deenish Aquaculture Site (T5/233), Kenmare Bay, Co. Cork. Prepared on behalf of Marine Harvest

AQUAFACT. (2018a). Environmental Survey beneath Finfish pens at Deenish Aquaculture Site (T5/233), Kenmare Bay, Co. Cork. Report prepared on behalf of Marine Harvest

AQUAFACT. (2018a). Environmental Survey following the Aquaculture Stewardship Council (ASC) Standard for Benthic Monitoring at Deenish, Kenmare Bay, Co. Cork. Report prepared on behalf of Marine Harvest

AQUAFACT (2019a). Dispersion modelling of salmon farm site at Deenish Island, Kenmare Bay. Report prepared on behalf of Marine Harvest. August 2019.

AQUAFACT. (2019b). Environmental Survey beneath Finfish pens at Deenish Aquaculture Site (T5/233), Kenmare Bay, Co. Cork. Report prepared on behalf of Marine Harvest

ATKINS. (2012). Galway Bay Salmon Farm. Bird Screening Report – risk assessment of potential for impacts on important bird populations. Report prepared for the Marine Institute/BIM. 30th March 2012.

Bagge, P. (1969). The succession of the bottom communities in polluted estuarine habitats. Limnologica 7 (1): 87-94.

Berrow, S.D., Whooley, P., O'Connell, M., Wall, D., (2010). Irish Cetacean Review 2000-2009.

Beveridge, M.C.M. (1996). Cage aquaculture (2nd Edition). Fishing News Books, Oxford.

BIM. (2012). Environmental Impact Statement (EIS) for deep sea fish farm development in Galway Bay, Co. Galway, Ireland. Report prepared by BIM.

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

BIM. (2017). BIM Annual Aquaculture Survey 2016.

Bolam, S.G. & Fernandes, T.F. (2002). Dense aggregations of tube-building polychaetes: response to small-scale disturbances. Journal of Experimental Marine Biology and Ecology, 269: 197-222.

Boland, D. (2015). Marine geo-archaeological assessment, proposed fish-farm site, Inishfarnard, Kenmare River, Co. Kerry. Report prepared for Marine Harvest Ireland. October 2015.

Cawley, A.M. (1998). Simulating the Spread and fate of sea lice larvae from an infested Atlantic salmon farm on the west coast of Ireland. In: Computational Methods in Water Resources XII Vol 2, Computational Mechanics Publications, Southampton, p225-232. ISBN 1 85312 653 5.

Chanin P. (2003a). Ecology of the European Otter. Conserving Natura 2000 Rivers Ecology Series No. 10. English Nature, Peterborough.

Chanin, P. (2003b). Monitoring the Otter Lutra. Conserving Natura 2000 Rivers Monitoring Series No. 10, English Nature, Peterborough.

Ciardi na Mara Teo. (1994). A study of the socio-economic impact of aquaculture in Ceanter na nOilean.

CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.

Clifford, S. L., McGinnity, P., & Ferguson, A. (1998). Genetic changes in an Atlantic salmon population resulting from escaped juvenile farm salmon. Journal of Fish Biology, 52, 118–127.

Colhoun, K. & Cummins, S. (2013). Birds of Conservation Concern in Ireland 2014–2019. Irish Birds, 9: 523-544.

Connors, B. M., Braun, D. C., Peterman, R. M., Cooper, A. B., Reynolds, J. D., Dill, L. M., Ruggerone, G. T. & Krkošek, M. (2012). Migration links ocean-scale competition and local ocean conditions with exposure to farmed salmon to shape wild salmon dynamics. Conservation Letters, 5: 304–312.

Cork County Council Maps. http://corkcoco.maps.arcgis.com/apps/Viewer/index.html?appid=da57dce5b97747e6bc962902248836fb Accessed on 30th April 2019.

Cork County Council. (2007). Cork County Draft Landscape Strategy. Cork County Council Planning Policy Unit. November 2007.

Cork County Council. (2013). Draft Cork County Development Plan 2013. Volume One: Main Policy Material. Planning Policy Unit, Cork County Council. 9th December 2013.

Cork County Council. (2014). Cork County Development Plan 2014. Volume Two: Heritage and Amenity.

Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O' Keeffe, C. (2004). Harbour seal population assessment in the Republic of Ireland: August 2003. Irish Wildlife Manuals, No. 11. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

DAFF. (2008). Monitoring Protocol No. 1 for Offshore Finfish Farms; Benthic Monitoring, DAFF, December 2008.3

DAFM. (2014). Guidance Notes for applicants for an Aquaculture Licence and Foreshore Licence for a single specific site.

De Jongh, A. & L. O'Neill. (2010.) Otter tracking study of Roaringwater Bay. Unpublished draft report to NPWS.

De Laune, R. D., Reddy C. N. and W. H. Patrick (1981). Effect of pH and redox potential on concentration of dissolved nutrients in an estuarine sediment. Jounal of Environmental Quality 10 (3): 276-79.

Directive (2014). Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance

DMNR (2000d). Protocol for Fallowing at Offshore Fin fish Farms. DMNR 11TH May 2000.

DMNR. (2000a). Monitoring Protocol No. 3 for Offshore Finfish Farms; Sea Lice Monitoring and Control, DMNR / DAFF, 11th May 2000.

DMNR. (2000b). Monitoring Protocol No. 5; Protocol for Fallowing at Offshore Finfish Farms; DMNR / DAFF, 11th May 2000.

DMNR. (2000c). Monitoring Protocol No. 2 for Offshore Finfish Farms; Water Column Monitoring, DMNR / DAFF, 11th May 2000.

DMNR. (2001). Guidelines for the Assessment of the Landscape and Visual Impacts of Marine Aquaculture Operations. 2001.

Duck, C. & Morris, C. (2013). An aerial survey of harbour seals in Ireland: Part 1: Lough Foyle to Galway Bay. August 2011. Unpublished report to the National Parks & Wildlife Service, Department of Arts, Heritage & the Gaeltacht, Dublin.

Emodnet (2019) - https://www.emodnet-humanactivities.eu/view-data.php - accessed on 22/11/19.

Emodnet Substrate Type (Emodnet 2019). Https://www.atlas.marine.ie - Accessed on 20/11/2019.

EPA (2017). Guidelines on the information to be contained in Environmental Impact Assessment Reports. EPA August 2017.

EPA (2019). Ireland's Provisional Greenhouse Gas Emissions. 1990 – 2018.

EPA Air Quality Index for Health. (2019). http://www.epa.ie/air/quality/ Accessed on 16th April 2019.

EPA Catchments. (2019). https://www.catchments.ie/data/#/catchment/21?_k=e5szou Accessed April 2019.

EPA Maps. (2019). https://gis.epa.ie/EPAMaps/ Accessed March 2019.

EPA. (2014a). Coastal Water Quality 2010-2012. http://gis.epa.ie/GetData/Download. Accessed 16/4/2018.

EPA. (2014b). Transitional Water Quality 2010-2012. http://gis.epa.ie/GetData/Download. Accessed 16/4/2018.

EPA. (2015). Advice notes for preparing Environmental Impact Statements. Draft. September 2015.

EPA. (2017). Guidelines on the information to be contained in Environmental Impact Assessment Reports. Draft. August 2017.

E-PRTR. (2019). European Pollutant Release and Transfer Register. https://prtr.eea.europa.eu/#/pollutantreleases Accessed on 17th April 2019.

EU (2017). Environmental Impact Assessment of Projects. Guidance on screening. Directive 2011/92/EU as amended by 2014/52/EU.

EU (2017). Environmental Impact Assessment of Projects. Guidance on scoping. Directive 2011/92/EU as amended by 2014/52/EU.

EU (2017). Environmental Impact Assessment of Projects. Guidance on the preparation of Environmental Impact Assessment Report. Directive 2011/92/EU as amended by 2014/52/EU.

European commission (2001). Guidance on the preparation of the environmental impact assessment report (Directive 2011/92/EU as amended by 2014/52/EU). Environmental impact assessment of projects. Eu publications.

Fenchel, T. M. & R. J. Reidl. (1970). The sulphide system: a new biotic community underneath the oxidised layer of marine sand bottoms. Marine Biology 7: 255-68.

Finstad, B., and Bjørn, P. A. (2011). Present status and implications of sea lice on wild salmonids in Norwegian coastal zones. In: Sea lice: An Integrated Approach to Understanding Parasite Abundance and Distribution. S. Jones and R. Beamish (Eds.). Wiley-Blackwell, Oxford, UK, 281–305.

Finstad, B., Kroglund, F., Strand, R., Stefansson, S. O., Bjørn, P. A., Rosseland, B. O., Nilsen, T. O., and Salbu, B. (2007). Sea lice or suboptimal water quality – reasons for reduced postsmolt survival? Aquaculture, 273: 374–383.

Fisher, J. B. (1982). Effects of macrobenthos on freshwater sediment diagenesis. In: McCall, P. L. and M. J. S. Tevesz (eds.). Animal-sediment relations - the biogenic alteration of sediments. Topics in Geobiology Vol.2. New York. Plenum Press.

Fishing Ireland. (2019) http://www.fishinginireland.info/sea/southwest/kerry.htm and http://www.fishinginireland.info/salmon/index.htm Accessed March 2019.

Fiske, P., Lund, R. A., & Hansen, L. P. (2006). Relationships between the frequency of farmed Atlantic salmon, Salmo salar L., in wild salmon populations and fish farming activity in Norway, 1989-2004. ICES Journal of Marine Science, 63, 1182–1189.

Forbes, T. L., Forbes V. E. and M. H. Depledge (1994). Individual physiological responses to environmental hypoxia and organic enrichment - Implications for early soft bottom community succession. Journal of Marine Research 52 (6): 1081-100.

Furness, R.W., Wade, H.M. & Masden, E.A. (2013) Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management. 119: 56-66.

Furness, R.W., Wade, H.M., Robbins, A.M.C, & Masden, E.A. (2012). Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. ICES Journal of Marine Science. 69(8): 1466-1479.

Gargan, P. G., Forde, G., Hazon, N., Russell, D. J. F., and Todd, C. D. (2012). Evidence for sea lice-induced marine mortality of Atlantic salmon (Salmo salar) in western Ireland from experimental releases of ranched smolts treated with emamectin benzoate. Canadian Journal of Fisheries and Aquatic Sciences, 69: 343–353.

Garthe, S. & O. Hüppop. (2004). Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology, 41, pp. 724-734.

Garvey, S. & J. Bennett. (1991). Aquaculture and rural development in the west of Ireland. Presented at the European Aquaculture Conference, Dublin, Ireland, June 10-14. 1991.

Glover, K. A., Pertoldi, C., Besnier, F., Wennevik, V., Kent, M., & Skaala, Ø. (2013). Atlantic salmon populations invaded by farmed escapees: Quantifying genetic introgression with a Bayesian approach and SNPs. Bmc Genetics, 14, 4.

Glover, K. A., Quintela, M., Wennevik, V., Besnier, F., Sørvik, A. G. E., & Skaala, O. (2012). Three decades of farmed escapees in the wild: A spatio-temporal analysis of population genetic structure throughout Norway. PLoS One, 7(8), e43129.

Glover, K.A., Solberg, M.F., McGinnity, P., Hindar, K., Verspoor, E., Coulson, M.W., Hansen, M.M., Araki, H., Skaala, Ø. and Svåsand, T., (2017). Half a century of genetic interaction between farmed and wild Atlantic salmon: Status of knowledge and unanswered questions. Fish and Fisheries, 18(5), pp.890-927.

Godwin, S. C., Dill, L. M., Reynolds, J. D., and Krkošek, M. (2015). Sea lice, sockeye salmon, and foraging competition: lousy fish are lousy competitors. Canadian Journal of Fisheries and Aquatic Sciences, 72: 8.

Gray, J. S., Clarke, K. R., Warwick R. M. & G. Hobbs. (1990). Detection of initial effects of pollution on marine benthos: an example from the Ekofish and Eldfisk oilfields, North Sea. Marine Ecology Progress Series 66: 285-99.

Green, D. M., Penman, D. J., Migaud, H., Bron, J. E., Taggart, J. B., & McAndrew, B. J. (2012). The impact of escaped farmed Atlantic salmon (Salmo salar L.) on catch statistics in Scotland. PLoS One, 7(9), e43560.

Hamre, L.A., Eichner, C., Caipang, C.M.A., Dalvin, S.T., Bron, J.E., Nilsen, F., Boxshall, G. & Skern-Mauritzen, R. (2013). The Salmon Louse Lepeophtheirus salmonis (Copepoda: Caligidae) Life Cycle Has Only Two Chalimus Stages. PLoS ONE 8(9): e73539. doi:10.1371/journal.pone.0073539

Hansen, L.P. (2006). Migration and survival of farmed Atlantic salmon (Salmo salar L.) released from two Norwegian fish farms. ICES Journal of Marine Science, 63, 1211-1217.

Harvey, M., Gauthier D. and Munro, J. (1998). Temporal changes in the composition and abundance of the macro-benthic invertebrate communities at dredged material disposal sites in the Anse à Beaufils, Baie des Chaleurs, eastern Canada. Marine Pollution Bulletin 36 (1): 41-55.

ICES. (2016). Report of the Workshop to address the NASCO request for advice on possible effects of salmonid aquaculture on wild Atlantic salmon populations in the North Atlantic (WKCULEF), 1–3 March 2016, Charlottenlund, Denmark. ICES CM 2016/ACOM:42, 44 pp

IFA. (2015). Aquaculture Research A National Study. May 2015.

IFI. (2013). Wild salmon and sea trout statistics report 2012. IFI/2012/1-4151.

IFI. (2014). Wild salmon and sea trout statistics report 2013. IFI/2013/1-4219.

IFI. (2015). Wild salmon and sea trout statistics report 2014. IFI/2014/1-4219.

IFI. (2016). Wild salmon and sea trout statistics report 2015. IFI/2015/1-4254.

IFI. (2017a). Consolidated fish counter summary report 2016. IFI/2017/1-4376.

IFI. (2017b). Wild salmon and sea trout statistics report 2016. IFI/2015/1-4374.

IFI. (2018). Consolidated fish counter summary report 2017. IFI/2018/1-4403.

IFI. (2019). Report of the Technical Expert Group on Salmon (TEGOS) – to Inland Fisheries Ireland (IFI). The Status of Irish Salmon Stocks in 2018 with Catch Advice for 2019. January 2019.

INFOMAR. (2019). https://www.infomar.ie/ Accessed for shipwreck data April 2019.

Irelands Marine Atlas. (2019). https://atlas.marine.ie/#?c=51.7719:-10.0051:11 Accessed March, April 2019.

Irish Underwater Council. (2019). Dive Sites of Ireland. http://diving.ie/dive-sites-2/ Accessed April 2019.

Irish Wrecks. (2019). http://irishwrecks.com/ Accessed March 2019.

Jackson, D. & Minchin, D. (1992). Aspects of the reproductive output of two caligid copepod species on cultivated salmon. Invertebrate Reproductive Development, 22: 87-90.

Jackson, D., Copley, L., Kane, F., Naughton, O., Kennedy, S. & O'Donohoe, P. (2005). Thirteen years of monitoring sea lice in farmed salmonids. In 'Long-term monitoring; Why, What, Where, When & How?' Edited by John Solbé, Proceedings of 'The importance of long-term monitoring of the environment' conference. Sherkin Island Marine Station, Ireland. pp 92-105.

Jackson, D., Cotter, D., Newell, J., O'Donohoe, P., Kane, F., McDermott, T., Kelly, S. & Drumm, A. (2014). Response to M Krkošek, C W Revie, B Finstad and C D Todd's comment on Jackson et al. 'Impact of Lepeophtheirus salmonis infestations on migrating Atlantic salmon, Salmo salar L., smolts at eight locations in Ireland with an analysis of lice-induced marine mortality'. Journal of Fish Diseases 37, 419-421.

Jackson, D., Cotter, D., Ó'Maoilédigh, N., O'Donohoe, P., White, J., Kane, F., Kelly, S., McDermott, T., McEvoy, S., Drumm, A., Cullen, A. & Rogan, G. (2011a). An evaluation of the impact of early infestation with the salmon louse Lepeophtheirus salmonis on the subsequent survival of outward migration Atlantic salmon Salmo salar L., smolts. Aquaculture 320, 159-163.

Jackson, D., Cotter, D., Ó'Maoilédigh, N., O'Donohoe, P., White, J., Kane, F., Kelly, S., McDermott, T., McEvoy, S., Drumm, A. & Cullen, A. (2011b). Impact of early infestation with the salmon louse Lepeophtheirus salmonis on the subsequent survival of outwardly migrating Atlantic salmon smolts from a number of rivers on Ireland's south and west coasts. Aquaculture 319, 37-40.

Jackson, D., Kane, F., O'Donohoe, P., Mc Dermott, T., Kelly, S., Drumm, A. & Newell, J. (2013). Sea lice levels on wild Atlantic salmon, Salmo salar L., returning to the coast of Ireland. Journal of Fish Diseases, 36: 293–298. doi: 10.1111/jfd.12059.

Johnson, S. C. and Albright, L. J. (1991). Development, growth, and survival of Lepeophtheirus salmonis (Copepoda: Caligidae) under laboratory conditions. Canadian Journal of Zoology, 69(4), 929–950.

Jovani, R., Lascelles, B.,Garamszegi, L.Z., Mavor, R., Thaxter, C.B. & D. Oro. (2016). Colony size and foraging range in seabirds. Oikos 125(7): 968-974.

Kabata, Z. (1979). Parasitic Copepoda of British Fishes. The Ray Society, London.

Karlsson, S., Diserud, O. H., Fiske, P., & Hindar, K. (2016). Widespread genetic introgression of escaped farmed Atlantic salmon in wild salmon populations. ICES Journal of Marine Science, 73, 2488–2498.

Krkošek, M., Revie, C., Gargan, P., Skilbrei, O.T., Finstad, B. & Todd, C.D. (2013). Impact of parasites on salmon recruitment in the Northeast Atlantic Ocean. Proceedings of the Royal Society B 280, 20122359.

Krkošek, M., Revie, C.W., Finstad, B. & Todd, C.D. (2014). Comment on Jackson et al. 'Impact of Lepeophtheirus salmonis infestations on migrating Atlantic salmon, Salmo salar L., smolts at eight locations in Ireland with an analysis of lice-induced marine mortality'. Journal of Fish Diseases 37, 415-417.

Kruuk, H. & Moorhouse, A. (1991). The spatial organization of otters (Lutra lutra) in Shetland. Journal of the Zoological Society of London, 224:41-57.

Kruuk, H. (1995). Wild otters predation and populations. Oxford University Press, Oxford.

Kruuk, H., Glimmerveen, U. & Ouwerkerk, E. J. (1985). The effects of depth on otter foraging in the sea. Annual Report institute of Terrestrial Ecology, Cambridge, 1984.

Lenders, H. J. R., Chamuleau, T. P. M., Hendriks, A. J., Lauwerier, R., Leuven, R., & Verberk, W. (2016). Historical rise of waterpower initiated the collapse of salmon stocks. Scientific Reports, 6, 29269.

Lordan, C. & Gerritsen H. (2009). Marine Institute. Working Document on the Assessment of the "Irish Box" in the context of the Western Waters Regime. Working paper prepared for ICES Advisory Committee.

Marine Institute (2019). Report supporting Appropriate Assessment of Aquaculture and Fisheries Risk Assessment in Kenmare River SAC (Site Code: 02158) Marine Institute, Rinville, Oranmore, Co. Galway. March 2019.

Marine Institute. (2013). Marine Mammals and Megafauna in Irish Waters - Behaviour, Distribution and Habitat Use. Biotelemetry of Marine Megafauna in Irish Waters. Marine Research Sub-Programme (NDP 2007-113) Series.

Marine Institute. (2015). Article 6.2 (Habitats Directive) Risk Assessment. The effects of fisheries on Qualifying Interests in Special Areas of Conservation in Irish coastal waters. Version 2. July 2015.

Marine Institute. (2017a). Monitoring trace metals and organohalogens in shellfish (2014) and physiochemical parameters and trace metals in seawater (2015) under the Shellfish Waters Directive. CHEMREP 2017-002. April 2017.

Marine Institute. (2017b). Report supporting Appropriate Assessment of Aquaculture and Fisheries Risk Assessment in Kenmare River SAC (Site Code: 2158)

McCafferty, D.J. (2005). Ecology and conservation of otters (Lutra lutra) in Loch Lomond and The Trossachs National Park. Glasgow Naturalist, 24: 29-35.

McGinnity P., Prodöhl, P.A., Ferguson, A. & T. Cross. 2003. Fitness reduction and potential extinction of wild populations of Atlantic salmon, Salmo salar, as a result of interactions with escaped farm salmon. Proceedings: Biological Sciences 270: 2443–2450.

Met Éireann. (2019). https://www.met.ie/climate/available-data/monthly-data https://www.met.ie/climate/what-we-measure/wind and https://www.met.ie/climate-ireland/1981-2010/valentia.html Accessed on 17th April 2019.

NASCO – North Atlantic Salmon Conservation Organisation. (2010). Guidance on Best Management Practice to address impacts of sea lice and escaped farmed salmon on wild salmon stocks. SLG(09)5.

National Monuments Service. (2019) http://webgis.archaeology.ie/historicenvironment/ Department of Artsm Heritage, Regional, Rural and Gaeltacht Affairs. Accessed on 30th April 2019.

Nilsson, H. C. & R. Rosenberg. (1997). Benthic habitat quality assessment of an oxygen stressed fjord by surface and sediment profile images. Journal of Marine Systems 11 (3-4): 249-64.

Nilsson, H. C. (1998). Marine benthic macrofaunal response to oxygen deficiency. Ph.D. Thesis. Dept. of Marine Ecology. Göteborg University, Sweden.

NPWS. (2012). Harbour Seal Pilot Monitoring Project January 2012. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. Unpublished Report.

NPWS. (2013a). National Otter Survey of Ireland 2010/12. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS. (2019). Conservation Objectives Series. Blackwater River (Kerry) SAC Site Code: 002173

NPWS. (2014). Site Synopsis. Blackwater River (Kerry) SAC Site Code: 002173

NPWS. (2014). Conservation Objectives Series. Blasket Islands SAC Site code: 002172.

NPWS. (2013). Site Synopsis. Blasket Islands SAC Site code: 002172.

NPWS. (2013). Conservation Objectives Series. Duvillaun Islands SAC Site Code: 000495

NPWS. (2014). Site Synopsis. Duvillaun Islands SAC Site Code: 000495

NPWS. (2015). Conservation Objectives Series. Glengarriff Harbour and Woodland SAC Site Code: 000090.

NPWS. (2013). Site Synopsis. Glengarriff Harbour and Woodland SAC Site Code: 000090.

NPWS. (2014). Conservation Objectives Series. Horn Head and Rinclevan SAC Site Code: 000147

NPWS. (2018). Site Synopsis. Horn Head and Rinclevan SAC Site Code: 000147

NPWS. (2015). Conservation Objectives Series. Inishbofin and Inishshark SAC Site Code: 000278

NPWS. (2013). Site Synopsis. Inishbofin and Inishshark SAC Site Code: 000278

NPWS. (2015). Conservation Objectives Series. Inishkea Islands SAC Site Code: 000507

NPWS. (2013). Site Synopsis. Inishkea Islands SAC Site Code: 000507

NPWS. (2013). Conservation Objectives Series. Site Name: Kenmare River SAC. Site Code: 002158

NPWS. (2016). Site Synopsis. Kenmare River SAC. Site Code: 002158

NPWS. (2017). Conservation Objectives Series. Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC Site Code: 000365

NPWS. (2013). Site Synopsis. Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment SAC Site Code: 000365

NPWS. (2014). Conservation Objectives Series. Kilkieran Bay and Islands SAC Site code: 002111

NPWS. (2015). Site Synopsis. Kilkieran Bay and Islands SAC Site code: 002111

NPWS. (2013). Conservation Objectives Series. Lambay Island SAC Site Code: 000204

NPWS. (2014). Site Synopsis. Lambay Island SAC Site Code: 000204

NPWS. (2012). Conservation Objectives Series. Lower Shannon Estuary SAC Site code: 002165.

NPWS. (2013). Site Synopsis. Lower Shannon Estuary SAC Site code: 002165.

NPWS. (2011). Conservation Objectives Series. Roaring water Bay and Islands SAC Site code: 00101.

NPWS. (2014). Site Synopsis. Roaring water Bay and Islands SAC Site code: 00101.

NPWS. (2013). Conservation Objectives Series. Rockabill to Dalkey Island SAC Site code: 003000.

NPWS. (2014). Site Synopsis. Rockabill to Dalkey Island SAC Site code: 003000.

NPWS. (2011). Conservation Objectives Series. Saltee Island SAC Site Code: 000707

NPWS. (2013). Site Synopsis. Saltee Island SAC Site Code: 000707

NPWS. (2015). Conservation Objectives Series. Slieve Tooey/Tormore Island/Loughros Beg Bay SAC Site Code: 000190

NPWS. (2018). Site Synopsis. Slieve Tooey/Tormore Island/Loughros Beg Bay SAC Site Code: 000190

NPWS. (2012). Conservation Objectives Series. Slyne Head Islands SAC Site Code: 000328

NPWS. (2014). Site Synopsis. Slyne Head Islands SAC Site Code: 000328

NPWS. (2015). Conservation Objectives Series. West Connacht SAC Site code: 002998

NPWS. (2014). Site Synopsis. West Connacht SAC Site code: 002998.

NPWS. (2018). Conservation Objectives Series. Aughris Head SPA Site Code: 004133

NPWS. (2012). Site Synopsis. Aughris Head SPA Site Code: 004133

NPWS. (2014). Conservation Objectives Series. Ballycotton Bay SPA Site code: 004022

NPWS. (2015). Site Synopsis. Ballycotton Bay SPA Site code: 004022

NPWS. (2015). Conservation Objectives Series. Ballymacoda Bay SPA Site code: 004023

NPWS. (2014). Site Synopsis. Ballymacoda Bay SPA Site code: 004023

NPWS. (2018). Conservation Objectives Series. Beara Peninsula SPA Site code: 004155

NPWS. (2015). Site Synopsis. Beara Peninsula SPA Site code: 004155

NPWS. (2018). Conservation Objectives Series. Blasket Islands SPA Site code: 004008

NPWS. (2015). Site Synopsis. Blasket Islands SPA Site code: 004008

NPWS. (2011). Conservation Objectives Series. Castlemaine Harbour SPA Site Code: 004029

NPWS. (2014). Site Synopsis. Castlemaine Harbour SPA Site Code: 004029

NPWS. (2018). Conservation Objectives Series. Clare Island SPA Site code: 004136

NPWS. (2014). Site Synopsis. Clare Island SPA Site code: 004136

NPWS. (2018). Conservation Objectives Series. Cliffs of Moher SPA Site code: 004005

NPWS. (2015). Site Synopsis. Cliffs of Moher SPA Site code: 004005

NPWS. (2014). Conservation Objectives Series. Cork Harbour SPA Site code: 004030

NPWS. (2015). Site Synopsis. Cork Harbour SPA Site code: 004030

NPWS. (2018). Conservation Objectives Series. Cruagh Island SPA Site code: 004170

NPWS. (2010). Site Synopsis. Cruagh Island SPA Site code: 004170

NPWS. (2018). Conservation Objectives Series. Deenish Island and Scariff Island SPA Site Code: 004175

NPWS. (2015). Site Synopsis. Deenish Island and Scariff Island SPA Site Code: 004175

NPWS. (2018). Conservation Objectives Series. Dingle Peninsula SPA Site code: 004153

NPWS. (2014). Site Synopsis. Dingle Peninsula SPA Site code: 004153

NPWS. (2018). Conservation Objectives Series. Duvillaun Islands SPA Site code: 004111

NPWS. (2014). Site Synopsis. Duvillaun Islands SPA Site code: 004111

NPWS. (2018). Conservation Objectives Series. Helvick Head to Ballyquin SPA Site code: 004192

NPWS. (2015). Site Synopsis. Helvick Head to Ballyquin SPA Site code: 004192

NPWS. (2018). Conservation Objectives Series. High Island, Inishshark and Davillaun SPA Site code: 004144

NPWS. (2010). Site Synopsis. High Island, Inishshark and Davillaun SPA Site code: 004144

NPWS. (2018). Conservation Objectives Series. Horn Head to Fanad Head SPA Site code: 004194

NPWS. (2014). Site Synopsis. Horn Head to Fanad Head SPA Site code: 004194

NPWS. (2018). Conservation Objectives Series. Inishmore SPA Site code: 004152

NPWS. (2014). Site Synopsis. Inishmore SPA Site code: 004152

NPWS. (2018). Conservation Objectives Series. Ireland’s Eye SPA Site code: 004117

NPWS. (2010). Site Synopsis. Ireland’s Eye SPA Site code: 004117

NPWS. (2018). Conservation Objectives Series. Iveragh Peninsula SPA Site code: 004154

NPWS. (2015). Site Synopsis. Iveragh Peninsula SPA Site code: 004154

NPWS. (2018). Conservation Objectives Series. Kerry Head SPA Site code: 004189

NPWS. (2015). Site Synopsis. Kerry Head SPA Site code: 004189

NPWS. (2018). Conservation Objectives Series. Lambay Island SPA Site code: 004069

NPWS. (2011). Site Synopsis. Lambay Island SPA Site code: 004069

NPWS. (2018). Conservation Objectives Series. Loop Head SPA Site code: 004119

NPWS. (2009). Site Synopsis. Loop Head SPA Site code: 004119

NPWS. (2018). Conservation Objectives Series. Magharee Islands SPA Site code: 004125

NPWS. (2014). Site Synopsis. Magharee Islands SPA Site code: 004125

NPWS. (2018). Conservation Objectives Series. Mid-Waterford Coast SPA Site code: 004193

NPWS. (2015). Site Synopsis. Mid-Waterford Coast SPA Site code: 004193

NPWS. (2018). Conservation Objectives Series. Old Head of Kinsale Site code: 004021

NPWS. (2014). Site Synopsis. Old Head of Kinsale Site code: 004021

NPWS. (2018). Conservation Objectives Series. Puffin Island SPA Site code: 004003

NPWS. (2015). Site Synopsis. Puffin Island SPA Site code: 004003

NPWS. (2011). Conservation Objectives Series. Saltee Islands SPA Site code: 004002

NPWS. (2012). Site Synopsis. Saltee Islands SPA Site code: 004002

NPWS. (2018). Conservation Objectives Series. Skelligs SPA Site code: 004007

NPWS. (2015). Site Synopsis. Skelligs SPA Site code: 004007

NPWS. (2018). Conservation Objectives Series. The Bull and the Cow Rocks SPA Site code: 004066

NPWS. (2014). Site Synopsis. The Bull and the Cow Rocks SPA Site code: 004066

NPWS. (2018). Conservation Objectives Series. Tory Island SPA Site code: 004073

NPWS. (2015). Site Synopsis. Tory Island SPA Site code: 004073

NPWS. (2018). Conservation Objectives Series. West Donegal Coast SPA Site code: 004150

NPWS. (2015). Site Synopsis. West Donegal Coast SPA Site code: 004150

NPWS. (2018). Conservation Objectives Series. Wicklow Head SPA Site code: 004127

NPWS. (2012). Site Synopsis. Wicklow Head SPA Site code: 004127

Marine Institute, 2017. Report supporting Appropriate Assessment of Aquaculture and Fisheries Risk Assessment in Kenmare River SAC (Site Code: 2158). https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/aquaculturelicensing/appropriateassessments/KenmareAAandRAReport171017.pdf

Marine Institute, 2019. Appropriate Assessment Conclusion Statement by Licensing Authority for aquaculture activities in Kenmare River SAC. https://www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/aquaculturelicensing/appropriateassessmentconclusionstatement/2019new/AppAssessmentConStatement%20AquacultureActivitiesKenmareRiverSAC090919.pdf

Ó Cadhla, O., Keena, T., Strong, D., Duck, C. & L. Hiby. (2013) Monitoring of the breeding population of grey seals in Ireland, 2009 - 2012. Irish Wildlife Manuals, No. 74. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Dublin, Ireland.

O'Connor, R., Whelan, B., Crutchfield, J. & A. O'Sullivan. (1992). Review of the Irish Aquaculture Sector and recommendations for development.

O'Donohoe, P., Kane, F., Kelly, S., McDermott, T., D'Arcy, J., Casserly, J., Nixon, P. & D. Jackson. (2017). National survey of sea lice (Lepeophtheirus salmonis Kroyer and Caligus elongatus Nordmann) on fish farms in Ireland – 2016. Irish Fisheries Bulletin No. 47 April 2017.

O'Donohoe, P., Kane, F., Kelly, S., McDermott, T., D'Arcy, J., Casserly, J., Downes, J. & D. Jackson. (2018). National survey of sea lice (Lepeophtheirus salmonis Kroyer and Caligus elongatus Nordmann) on fish farms in Ireland – 2017. Irish Fisheries Bulletin No. 48 April 2018.

O'Donohoe, P., Kane, F., Kelly, S., McDermott, T., Drumm, A. & D. Jackson. (2015). National survey of sea lice (Lepeophtheirus salmonis Kroyer and Caligus elongatus Nordmann) on fish farms in Ireland – 2014. Irish Fisheries Bulletin No. 45 March 2015.

O'Donohoe, P., Kane, F., Kelly, S., McDermott, T., Drumm, A., Nixon, P. & D. Jackson. (2016). National survey of sea lice (Lepeophtheirus salmonis Kroyer and Caligus elongatus Nordmann) on fish farms in Ireland – 2015. Irish Fisheries Bulletin No. 46 March 2016.

Omori, R. L., Hirano T. and H. Takeoka (1994). The limitations to organic loading on a bottom of a coastal ecosystem. Marine Pollution Bulletin 28 (2): 73-80.

Parrish, D. L., Behnke, R. J., Gephard, S. R., McCormick, S. D., & Reeves, G. H. (1998). Why aren't there more Atlantic salmon (Salmo salar)? Canadian Journal of Fisheries and Aquatic Sciences, 55, 281–287.

Pearson, T. Rosenberg, R. (1978.) Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. Oceanography and Marine Biology - an Annual Review 16: 229–311.

Potter EC.E., Russell I.C. (1994). Comparison of the distribution and homing of hatchery-reared and wild Atlantic salmon, Salmo salar L., from north-east England. Aquaculture Research / Volume 25, Issue S2.

Reid, N., Hayden, B., Lundy, M.G., Pietravalle, S., McDonald, R.A. & W.I. Montgomery. (2013). National Otter Survey of Ireland 2010/12. Irish Wildlife Manuals No. 76. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Rosenberg, R., Hellman, B. and B. Johansson (1991). Hypoxic tolerance of marine benthic fauna. Marine Ecology Progress Series 79: 127-31.

Saunders. G. (2017). Aquaculture Licences Appeals Board Appeal Ref No. AP2/2015 Technical Advisor's Report: Supplementary Briefing Note Otter (Lutra lutra) impact assessment. 24th November 2017. Report prepared by Graham Saunders Marine Ecology.

Schram, T.A. (1993). Supplementary descriptions of the developmental stages of Lepeophtheirus salmonis (Krøyer, 1837) (Copepoda: Caligidae). In: Pathogens of wild and farmed fish Ed; GA Boxshall & D Defaye, Ellis Horwood Ltd, London, UK. pp. 30-47.

SEPA. (2005). Regulation and Monitoring of Marine Cage Fish Farming in Scotland. Annex H. Methods for Modelling In-feed Anti-parasitics and Benthic effects. https://www.sepa.org.uk/media/114787/ffm_anx_h.pdf

SFPA. (2019). Sea-Fisheries Protection Authority. Fish landing data https://www.sfpa.ie/Data-Statistics/Reports/Annual-Statistics Accessed 27/05/2019.

Sharples, R.J., Moss, S.E., Patterson, T.A., Hammond, P.S. 2012. Spatial Variation in Foraging Behaviour of a Marine Top Predator (Phoca Vitulina) Determined by a Large-Scale Satellite Tagging Program. PlosOne; 7(5): e37216.

Cronin, M.A., Jessopp, M.J., Del Villar, D. 2011. Tracking grey seals on Irelands' continental shelf Report to National Parks & Wildlife Service, Department of Arts, Heritage and Gaeltacht November 2011 Coastal & Marine Research Centre University College Cork Ireland

Shepherd, P.C.F., Evans Ogden, L.J. & Lank, D.B. (2003). Integrating marine and terrestrial habitats in shorebirdconservation planning. Wader Study Group Bull. 100: 40–42.

Skilbrei, O. T. (2010). Adult recaptures of farmed Atlantic salmon postsmolts allowed to escape during summer. Aquaculture Environment Interactions, 1, 147–153.

Skilbrei, O. T., Finstad, B., Urdal, K., Bakke, G., Kroglund, F., and Strand, R. (2013). Impact of early salmon louse, Lepeophtheirus salmonis, infestation and differences in survival and marine growth of sea-ranched Atlantic salmon, Salmo salar L., smolts 1997–2009. Journal of Fish Diseases, 36: 249–260. doi:10.1111/jfd.12052.

Skilbrei, O. T., Heino, M., & Svåsand, T. (2015). Using simulated escape events to assess the annual numbers and destinies of escaped farmed Atlantic salmon of different life stages, from farms sites in Norway. ICES Journal of Marine Science, 72, 670–685.

Smith, P., G. Edwards, B. O'Connor, M. Costelloe and J. Costelloe. (1997). Photographic Evidence of the importance of Macrofauna in the Removal of Feed Pellets from the Sediment under Marine Salmon Farms. Bull. Eur. Ass. Fish Pathol. Vol. 17, Issue 1, pages 23-26.

SNH (2018) Environmental Impact Assessment Handbook. Guidance for competent authorities, consultation bodies, and others involved in the Environmental Impact Assessment process in Scotland. April 2018.

Stabell, O. B. (1984). Homing and Olfaction in salmonids: A critical review with special reference to Atlantic salmon. August 1984.

Thaxter. (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation 156: 53-61.

The Standing Scientific Committee on Salmon. (2017). The Status of Irish Salmon Stocks in 2016 with Precautionary Catch Advice for 2017. Independent Scientific Report to Inland Fisheries Ireland. April 2017.

Theede, H., Ponat, A., Hiroki, K. & Schlieper, C. (1969). Studies on the resistence of marine bottom invertebrates to oxygen-deficiency and hydrogen sulphide. Marine Biology 2: 325-37.

Thorstad, E. B., Todd, C. D., Uglem, I., Bjørn, P. A., Gargan, P. G., Vollset, K. W., Halttunen, E., et al. (2015). Effects of sea lice Lepeophtheirus salmonis on wild sea trout Salmo trutta—a literature review. Aquaculture Environmental Interactions, 7: 91–117.

Treasurer, J. W., Wadsworth, S. & Grant, A. (2000). Resistance of sea lice, Lepeophtheirus salmonis (Krøyer), to hydrogen peroxide on farmed Atlantic salmon, Salmo salar L. Aquaculture Research 31(11): 855-860.

Tyler-Walters, H., Tillin, H.M., d'Avack, E.A.S., Perry, F., Stamp, T., (2018). Marine Evidence-based Sensitivity Assessment (MarESA) – A Guide. Marine Life Information Network (MarLIN). Marine Biological Association of the UK, Plymouth, pp. 91. Available from https://www.marlin.ac.uk/publications.

Vollset, K. W., Barlaup, B. T., Skoglund, H., Normann, E. S., and Skilbrei, O. T. (2014). Sea lice increase the age of returning Atlantic salmon. Biological Letters, 10: 20130896. http://dx.doi.org/10.1098/rsbl.2013.0896.

Vollset, K. W., Barlaup, B. T., Skoglund, H., Normann, E. S., and Skilbrei, O. T. (2014). Sea lice increase the age of

Vollset, K. W., Krontveit, R. I., Jansen, P., Finstad, B., Barlaup, B. T., Skilbrei, O. T., Krkošek, M., et al. (2016). Impacts of parasites on marine survival of Atlantic salmon: a meta-analysis. Fish and Fisheries, 7: 91–113; doi:10.1111/faf.12141.

Wall, D., Murray, C., Brien, J.O., Kavanagh, L., Ryan, C., Glanville, B., Williams, D., Enlander, I., Connor, O., Mcgrath, D., Whooley, P., Berrow, S.D., Wilson, C. (2013). Atlas of the Distribution and Relative Abundance of Marine Mammals in Irish Offshore Waters : 2005 – 2011, The Irish Whale and Dolphin Group.

Watermark aqua-environmental, (2012). Natura Impact Statement for a salmon farm installation At Deenish Island, Kenmare Bay, Co. Kerry. Prepared on behalf of Marine harvest island.

Weston, D. P. (1990). Quantitative examination of macrobenthic community changes along an organic enrichment gradient. Marine Ecology Progress Series 61: 233-44.

Whoriskey, F. G., Brooking, P., Doucette, G., Tinker, S., & Carr, J. W. (2006). Movements and survival of sonically tagged farmed Atlantic salmon released in Cobscook Bay, Maine, USA. ICES Journal of Marine Science, 63, 1218–1223.

Yamamoto, N. & Lopez, G. (1985). Bacterial abundance in relation to surface area and organic content of marine sediments. Journal of Experimental Marine Biology and Ecology 90: 209-20.

Youngson, A. F., Webb, J. H., MacLean, J. C., & Whyte, B. M. (1997). Frequency of occurrence of reared Atlantic salmon in Scottish salmon fisheries. ICES Journal of Marine Science, 54, 1216–1220.