MITCHELL DAYSH

WESTERN FIRTH MARINE FARMING CONSORTIUM

PROPOSED MARINE FARM

Resource Consent Application and Assessment of Environmental Effects

January 2017

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A

PART A

Resource Consent Application

FORM 9

APPLICATION FOR RESOURCE CONSENT

Sections 88 and 145, Resource Management Act 1991

To **Auckland Council**
Private Bag 92300
Auckland 1142

1. **The Western Firth Marine Farming Consortium apply for the following resource consents:**

All necessary resource consents to authorise the establishment, operation, and maintenance of a marine farm, including, but not limited to:

- A coastal permit for a **discretionary activity** for the following activities:
  - Occupation of the Coastal Marine Area;
  - Erect, use and maintain structures that are fixed on the seabed;
  - Disturb the seabed;
  - Deposit material on the seabed; and
  - Undertaking all ancillary activities.
- A discharge permit for a **discretionary activity** for the discharge of contaminants associated with the establishment, operation and maintenance of a marine farm.

2. **The activity to which the application relates (the proposed activity) is as follows:**

Aquaculture activities involving the establishment, operation and maintenance of a 470 ha marine farm within a total area of 664 ha in the western Firth of Thames. There will be a total of 35 blocks within the marine farm, with 956 lines over 470 ha of farmed area.

The proposed marine farm would be utilised to grow and harvest Greenshell™ Mussels (*perna canaliculus*).

3. **The site at which the proposed activity is to occur is as follows:**

The proposed marine farm is located within the jurisdiction of Auckland Council in the western Firth of Thames, between 5 and 8 km south-east of Waimangō Point. The total extent of the marine farm is 664 ha and is bound by the following map references:

- 1808996.94E 5900020.76N
- 1808692.52E 5903056.72N
- 1809044.17E 5903057.72N
- 1812437.09E 5900542.10N
- 1812488.38E 5900030.69N

Water depths through the site range from 13 – 21 metres.

4. **The full name and address of each owner or occupier (other than the applicant) of the site to which the application relates are as follows:**

Her Majesty the Crown.

5. **There are no other activities that are part of the proposal to which this application relates.**

6. **No additional resource consents are needed for the proposal to which this application relates.**

7. **I attach an assessment of the proposed activity's effect on the environment that—**

(a) Includes the information required by Clause 6 of Schedule 4 of the Resource Management Act 1991; and

(b) Addresses the matters specified in Clause 7 of Schedule 4 of the Resource Management Act 1991; and

(c) Includes such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.

8. **I attach an assessment of the proposed activity against the matters set out in Part 2 of the Resource Management Act 1991.**

9. **I attach an assessment of the proposed activity against any relevant provisions of a document referred to in section 104(1)(b) of the Resource Management Act 1991, including the information required by clause 2(2) of Schedule 4 of that Act.**

10. **I attach all information required to be included in this application by the Auckland Unitary Plan, the Resource Management Act 1991, or any regulations made under that Act:**

Signature: P.P

(Richard Turner, Mitchell Daysh Limited, on behalf of the Western Firth Marine Farming Consortium)

Date: 20 January 2017

Address for Service: Western Firth Marine Farming Consortium
Mitchell Daysh Limited
PO Box 4653
Mount Maunganui

Telephone: 07 577 1261

Cellphone: 021 332 235
Email: richard.turner@mitchelldaysh.co.nz

Contact person: Richard Turner

Note to applicant

You must include all information required by this form. The information must be specified in sufficient detail to satisfy the purpose for which it is required.

You may apply for 2 or more resource consents that are needed for the same activity on the same form. If you lodge the application with the Environmental Protection Authority, you must also lodge a notice in form 16A at the same time.

You must pay the charge payable to the consent authority for the resource consent application under the Resource Management Act 1991 (if any).

If your application is to the Environmental Protection Agency, you may be required to pay actual and reasonable costs incurred in dealing with this matter (see section 149ZD of the Resource Management Act 1991).

PART B

Assessment of Environmental Effects

1. INTRODUCTION

1.1 BACKGROUND

This Assessment of Environmental Effects ("**AEE**") has been prepared in support of resource consent applications under the Resource Management Act 1991 ("**RMA**") by members of the Western Firth Marine Farming Consortium ("**Consortium**") to enable the construction, operation and maintenance of a 470 ha marine farm (within a total area of 664 ha) in the western Firth of Thames, Auckland. The proposed marine farm would be utilised to grow and harvest Greenshell™ Mussels (*perna canaliculus*).

The site of the proposed marine farm is between 5 and 8 km south-east of Waimangō Point, as shown in Figure 1 below. It aligns with the area identified for marine farming in the western Firth of Thames in the Hauraki Gulf Marine Spatial Plan 2016.

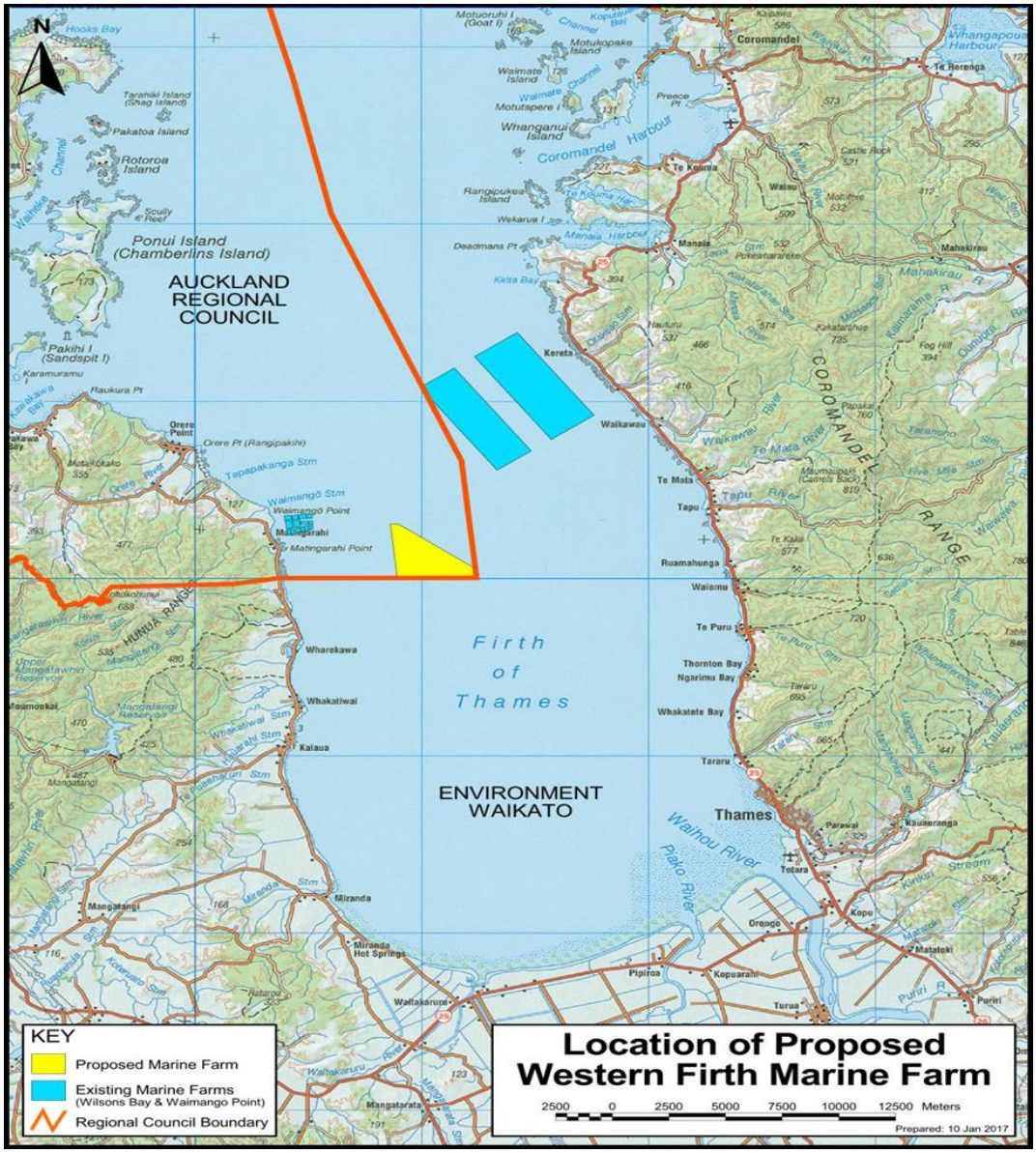

Figure 1: The Western Firth of Thames proposed marine farm location.

1.2 THE APPLICANT – WESTERN FIRTH MARINE FARMING CONSORTIUM

The Consortium is an unincorporated joint venture of parties representing applicants that made resource consent applications to the former Auckland Regional Council for aquaculture (spat catching) in the western Firth of Thames between 2000 and 2001 (and which are still on hold). The Consortium was formed in 2002 in the interests of creating an integrated and coordinated approach to the development of aquaculture in the western Firth of Thames.

The resource consent applications for spat catching by the members of the Consortium were placed on hold by Government as part of the enactment of the Resource Management (Aquaculture Moratorium) Amendment Act 2002.

The membership of the Consortium currently comprises:

- Thames Mussels Limited, including:
  - The Hauraki Maori Trust Board;
  - Sealord; and
  - Sea Investments Limited.
- Sanford Limited;
- Coromandel Marine Farmers Limited:
  - Consisting of 24 marine farmer shareholders.
- A & J Bartrom:
  - Including for Gulf Mussels Limited.
- Kuku Moana Limited:
  - Including Glenfield Accounting Services Limited.
- Simunovich Fisheries Limited.

The Consortium includes significant representation from Hauraki Iwi, who regard aquaculture development as a modern extension of traditional kaimoana activities.

The proposed marine farm is principally located over parts of the Coastal Marine Area ("**CMA**") currently subject to the resource consent applications for spat catching by the individual members of the Consortium. That is, there is very little change to the extent of space sought for the proposed marine farm relative to the existing spat catching applications by the Consortium (which are considered to retain priority over more recent applications in the Firth of Thames).

It is currently the intention of the individual members of the Consortium to withdraw their resource applications for spat catching within the Auckland Region once the resource consent applications for the proposed marine farm have been granted by Auckland Council.

1.3 REPORT STRUCTURE

This AEE is set out in 12 sections as follows:

Section 1 Is this introduction.

Section 2 Provides a description of the proposed marine farm.

Section 3 Describes the zoning attributed to the site of the proposed marine farm by the Auckland Unitary Plan, and the proposed activities requiring resource consent from Auckland Council.

Section 4 Describes the environmental setting of the proposed marine farm.

Section 5 Identifies the positive effects associated with the development of the proposed marine farm.

Section 6 Is an assessment of the potential effects of the proposed marine farm on coastal processes and ecology in the Firth of Thames.

Section 7 Is an assessment of the navigational and recreational effects of the proposed marine farm.

Section 8 Is an assessment of the landscape, natural character and visual amenity effects of the proposed marine farm.

Section 9 Addresses cultural matters.

Section 10 Describes the proposed staging and monitoring programme for the proposed marine farm.

Section 11 Sets out the RMA framework within which these applications are to be assessed. It includes an analysis of section 104 requirements, including the provisions of the relevant planning documents, as well as sections 105 and 107.

Section 12 Is the concluding statement.

2. DESCRIPTION OF THE PROPOSAL

2.1 INTRODUCTION

This section of the AEE contains a description of the activities associated with the construction, operation and maintenance of the proposed marine farm. It is set out in the following sections:

Section 2.2 Describes the location of the proposed marine farm.

Section 2.3 Describes the site selection process for the proposed marine farm.

Section 2.4 Describes the design of the proposed marine farm.

Section 2.5 Describes the activities to be undertaken at the proposed marine farm.

2.2 LOCATION OF THE PROPOSED MARINE FARM

As noted in section 1 and Figure 1 of this AEE, the site of the proposed marine farm is located between 5 and 8 km off the western coastline of the Firth of Thames, near Waimangō Point. The site is also approximately 10 km north-east of Kaiaua.

The total extent of the marine farm is 664 ha and is bound by the following map references:

- 1808996.94E 5900020.76N
- 1808692.52E 5903056.72N
- 1809044.17E 5903057.72N
- 1812437.09E 5900542.10N
- 1812488.38E 5900030.69N

The farmed area will comprise 470 ha. The configuration of the proposed marine farm is discussed further in section 2.4 of this AEE.

Water depths across the site range from 13 to 21 metres.

The total extent of the proposed marine farm is mostly encapsulated in the area already subject to resource consent applications for spat catching by the Consortium.

2.3 SITE SELECTION

2.3.1 Firth of Thames

The Consortium considers that the western Firth of Thames is one of the best locations in New Zealand for the expansion of marine farming. In this regard, it is considered that the western Firth of Thames provides good water quality, suitable water depths, sheltered waters, and adequate currents and nutrient supply.

The western Firth of Thames is also accessible to the necessary shore-based facilities required to support the growing and harvesting of mussels.

The suitability of the western Firth of Thames for marine farming is also evidenced by:

- The considerable amount of research by various agencies into the suitability of the area for marine farming;[1]
- The limited amount of potential conflict between the proposed marine farm and other users of the area, as exemplified by constraints mapping undertaken by the previous Auckland Regional Council and for the Hauraki Gulf Marine Spatial Plan 2016;
- The fact that the site is not subject to any environmental or cultural overlays as defined in the Auckland Unitary Plan.

These points have been reinforced through the specific ecological, landscape, natural character and visual amenity, and navigation / recreation assessments commissioned by the Consortium as part of preparing its resource consent application for the proposed marine farm.

2.3.2 Selection of the Site

The total extent and shape of the site of the proposed marine farm in the western Firth of Thames (as shown in Figure 1 of this AEE) has been determined by the Consortium based on a number of factors. These factors include, amongst other things, the proposed marine farm being located:

- In an area of the Firth of Thames that has sufficient water depth, water quality and flow that will enable the successful growing and harvesting of mussels. In particular, it is noted that mussel is an indigenous species and was abundant in the Firth of Thames until the 1960's;
- Within that part of the western Firth of Thames within the jurisdiction of Auckland Council (given that marine farming is a prohibited activity outside of specifically zoned areas under the Waikato Regional Coastal Plan);
- A sufficient distance off the coast such that it will not cause inappropriate visual or natural character effects from the coastline;
- In an area that does not impede reasonable navigation of the Firth of Thames by commercial and recreational vessels; and
- A sufficient distance from the coast that it does not represent an impediment to the use of boat ramps and launching facilities along the western coastline of the Firth of Thames.

It is also noted that a site away from the coast will mean that the proposed marine farm is less susceptible to any potential sanitation constraints caused by contaminants in runoff from the adjacent land – which can, on occasion, affect near-shore marine farms.

2.4 PROPOSED MARINE FARM DESIGN DETAILS

2.4.1 Introduction

The following sections outline the layout and design of the proposed marine farm. While the scale and density of the proposed marine farm will remain within the envelope described

[1] Western Firth Marine Farming Consortium (2011). *"Aquaculture Legislation Amendment Bill No. 3 2010 – Submission by the Western Firth Marine Farm Consortium – To the Primary Production Select Committee.*

in this section of the AEE, it is anticipated that matters of design detail relating to the floatation systems, anchoring, buoyage and lighting may be further refined and change over time.

2.4.2 Scale and Farm Layout

The proposed marine farm will comprise a total of 35 blocks with 956 conventional mussel longlines over the total area of 664 ha (that is, the 35 blocks collectively comprise the 470 ha of farmed area). The 35 blocks will range in size from approximately 6.75 ha to 17.85 ha around the outer blocks, with the inner blocks approximately 13.77 ha.

The spacing between each of the blocks will range between 50 and 75 metres.

A layout plan of the proposed marine farm, identifying the location and size of each block, is attached as **Appendix A** to this AEE.

The lines in each block will be spaced approximately 20 metres apart, which is equivalent to 1.44 lines / ha of the total area, or 2.03 lines / ha of the farmed area.

At the ends of each line there will be a screw or block anchor securing the line to the seabed. Each line will start with approximately 10 seeding floats, with additional floats added up to 35 – 40 floats per line at the time of harvest.

The backbone lines of the proposed marine farm will be located either at the surface, or if sea conditions require, up to 5 metres below the surface. The backbone lines are discussed further in section 2.4.4 of this AEE.

2.4.3 Staging

The Consortium are proposing that the marine farm be developed in the following stages:

- Stage 1 – 75% of lines installed (i.e. 720 lines); and
- Stage 2 – full development (i.e. 956 lines).

Monitoring of the effects of Stage 1 may commence once 70% of the lines are installed (i.e. 670 lines), although development in any block will not be able to proceed to Stage 2 (i.e. more than 75% of lines) until the necessary monitoring is completed and it is demonstrated that the relevant environmental triggers have not been breached; and

2.4.4 Floatation System

The site of the proposed marine farm site is relatively sheltered in comparison to offshore marine farms. As such, the backbones may be located on the surface of the water or require submerging up to 5 metres below the surface.

Single or double backbone longlines may be used at the proposed marine farm. However, future technology and development of other farming systems may prove other methods to be a viable alternative.

The backbones will be attached to floats and anchored to the seafloor by screw or concrete block anchors. The mussels will be grown on dropper ropes suspended from the

backbones. The dropper ropes will occupy approximately 10 metres of depth and will be spaced approximately 0.8 metres apart along the backbone.

Indicative line designs are shown in Figures 2 and 3 below. Figure 2 shows a surface backbone line, while Figure 3 shows a subsurface or submerged backbone line.

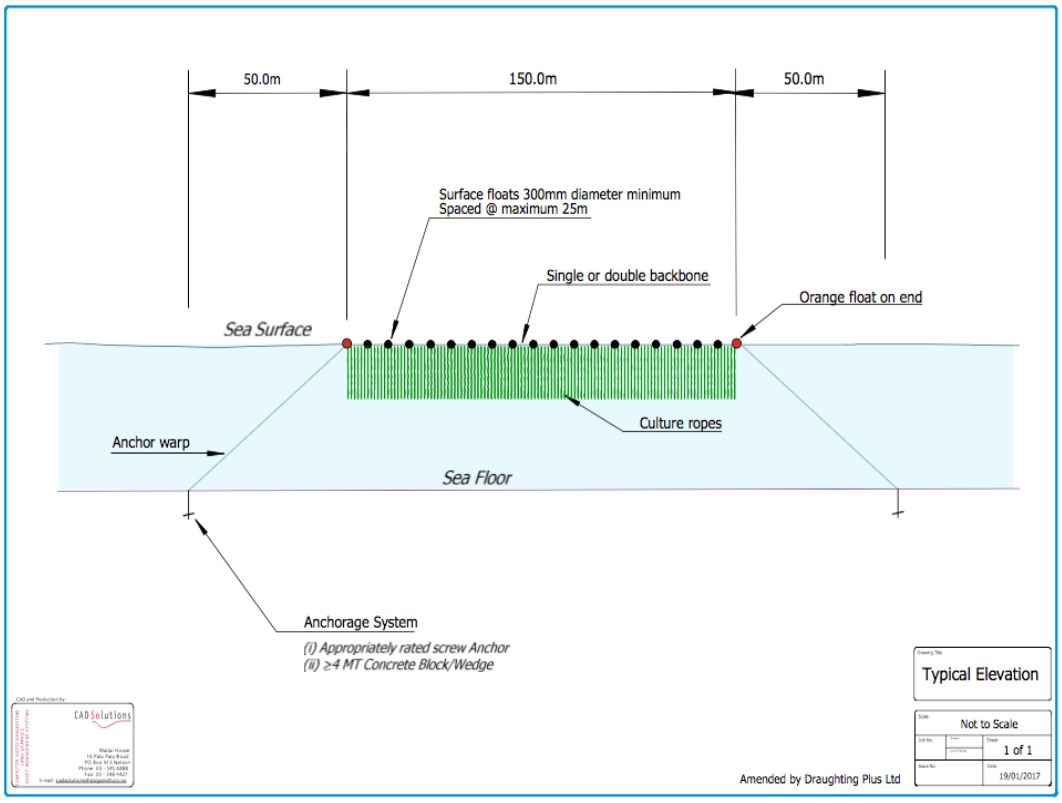

Figure 2: Elevation view of a longline with a surface backbone.

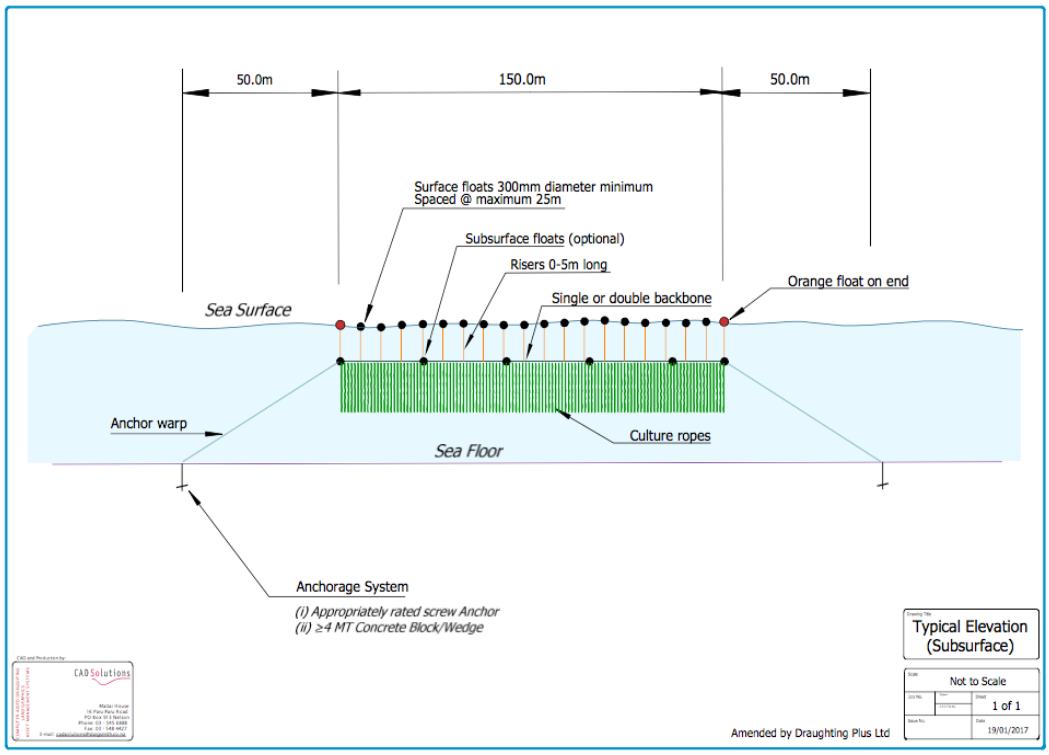

Figure 3: Elevation view of longline installation with a subsurface backbone.

2.4.5 Anchoring

Screw anchors are likely to be suitable for use in the seabed below the site. These anchors are particularly suitable to marine farming as they resist vertical pull out loads and have been adopted in marine farms in the Marlborough Sounds.

Screw anchors are lightweight with high holding power. The anchors typically consist of a 6 metre long shaft welded to a circular steel auger plate at the bottom. The shaft is either a 50 mm solid bar or a 76 mm diameter tube. The anchor is screwed into the seafloor by a hydraulically powered motor. The installation procedure is fast, requires only a light handling weight crane, and can be installed without the use of divers.

Appropriately sized and designed concrete anchors are also suitable and may be used on the proposed marine farm.

Any equipment failures at the proposed marine farm will be evident from the sea surface. These can be easily monitored and identified by the relative position of the surface floats, which will provide an early indication of any potential problems.

2.4.6 Buoyage and Lighting

The proposed marine farm will at all times comply with the lighting and marking requirements of Maritime New Zealand's "*Guidelines for Aquaculture Management Areas and Marine Farms*".[2]

The buoyage and lighting configuration proposed for the proposed marine farm is shown in Figure 4. The buoyage and lighting configuration of the proposed marine farm is discussed further in section 7 of this AEE.

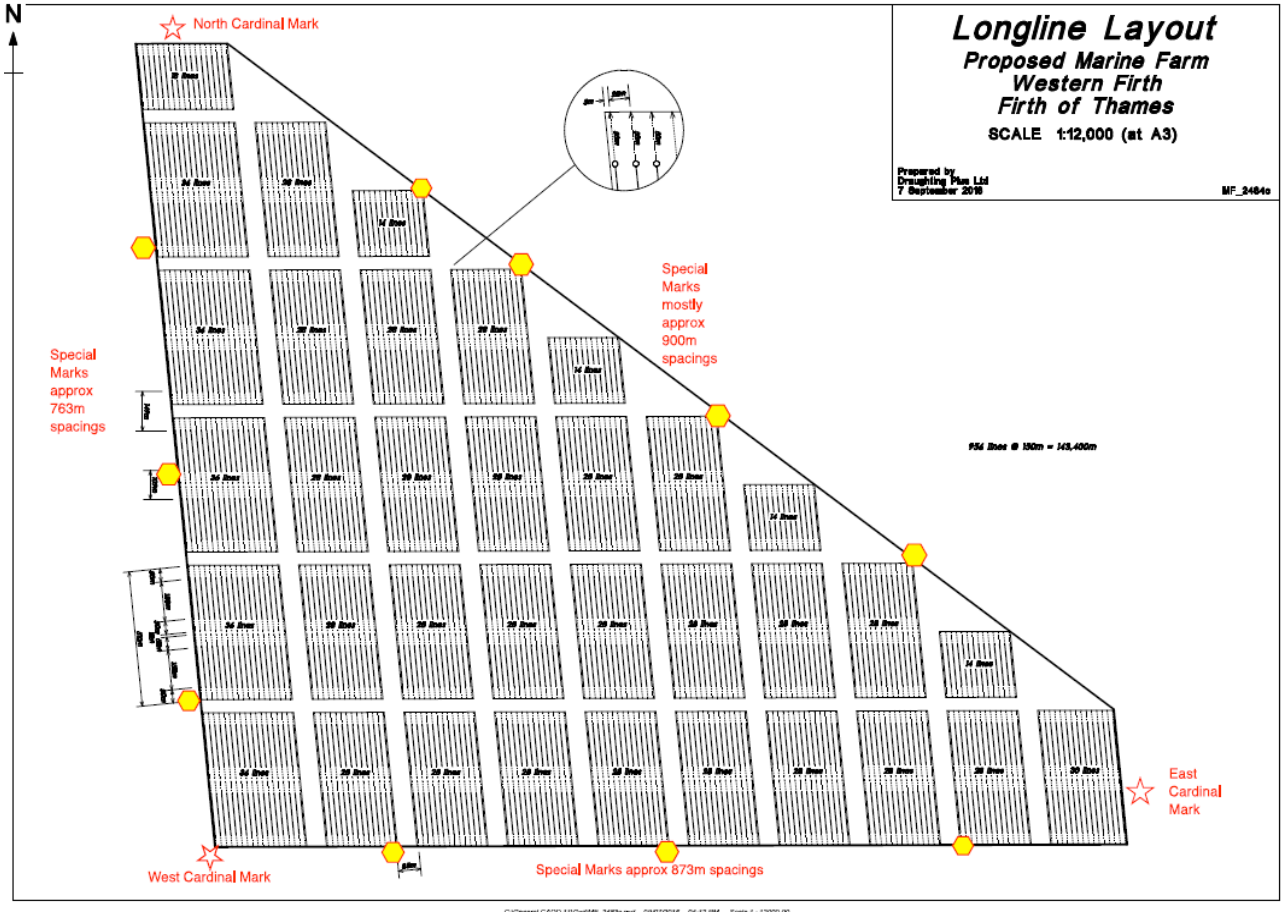

Figure 4: Proposed buoyage and lighting configuration.

2.5 PROPOSED MARINE FARM OPERATIONS

The key activities undertaken at the proposed marine farm will include:

- **Attachment of spat:**
  - a) spat will be seeded onto ropes at the marine farm. A cotton sleeve is used to attach spat to the ropes. This biodegrades once the organisms have attached themselves to the lines; or

[2] Maritime New Zealand (2004). *Guidelines for Providing Aids to Navigation in New Zealand.* https://www.maritimenz.govt.nz/commercial/ports-and-harbours/documents/Aids-to-navigation-guidelines.pdf

- b) spat catching rope will be hung out on the lines to catch naturally occurring spat

- **Spat growth to seed mussel stage** – it will take between six to 12 months for spat to grow to the seed mussel stage;
- **Attachment of seed mussels to growing rope** – the seed mussels are attached to a growing rope with a cotton biodegradable sleeve;
- **Growth phase** – the mussels are left to grow for a 12 to 18 month period in order to reach a harvestable size of typically 90 mm - 120 mm. Mussel growth depends on the availability of an adequate supply of phytoplankton, (a short-lived plant at the bottom of the food chain). Common farming practices produce a totally organic product in the form of live mussels; and
- **Harvesting** - harvesting is carried out using specialised machinery which lifts the longline and strips the mussels, cleans them and places them into storage sacks or vessels ready for processing.

The site may also be used for intermediate seed holding. This would be seeded onto the ropes at 20-30 mm and on grown to 40-50 mm. The size of the freshly seeded rope at the intermediate seed holding stage would be approximately 40 mm (16 mm diameter rope, with seed and stocking attached).

Apart from the operations involved in constructing the proposed marine farm, the attachment of the spat, removal and re-attachment of the larger seed mussels, and harvesting are the major activities to be carried out at the farm. The farming operations are generally sporadic, although there could be up to six vessels working at the farm at key periods (i.e. harvesting). The vessels that will service the marine farm will be standard mussels harvesting vessels, which will range in size from 20 to 40 metres.

The proposed marine farm will be serviced by existing facilities in the Firth of Thames, and possibly at the Port of Auckland. In time the proposed marine farm may also make use of the expansion of Sugarloaf Wharf in Coromandel Harbour.

An Environmental Code of Practice has been developed by the New Zealand Mussel Industry Council in consultation with regulatory authorities and scientists.[3] It addresses all activities associated with the mussel industry, from the collection of spat, to the harvesting of mussels and the disposal of waste material. The Consortium proposes to undertake its marine farming activities in accordance with the Code of Practice in order to minimise any environmental effects of its operations at the proposed marine farm.

[3] Aquaculture New Zealand Greenshell™ Mussel Industry Environmental Code of Practice New Zealand Mussel Industry Council Limited, 1999 (Revised, June 2007 by Aquaculture New Zealand).

3. RELEVANT ZONING AND RESOURCE CONSENTS REQUIRED

3.1 INTRODUCTION

The relevant statutory planning document for the assessment of the resource consents required for the proposed marine farm is the Auckland Unitary Plan, and more specifically the Regional Coastal Plan, which is included as Chapter F. This chapter contains a description of the zoning attributed to the proposed marine farm site and the resource consent requirements for the associated activities.

The Consortium was advised by Auckland Council in late December 2016 that the aquaculture provisions in the Regional Coastal Plan are now considered operative in accordance with section 86F of the RMA (and notwithstanding that there are appeals to the High Court on aspects of the Regional Coastal Plan).[4]

Furthermore, the transitional rule (established by way of a gazette notice) prohibiting new marine farming activities in the Hauraki Gulf in accordance with section 4 of the Marine Farming Act 1971 is also considered to be inoperative in accordance with section 86F of the Act.

In light of the above, resource consent application for marine farming activities (including mussel farming) can now be made for sites within the coastal environment of the Auckland Region – subject to the rules established by the Auckland Unitary Plan.

3.2 ZONING AND OVERLAYS

The proposed marine farm would be located in the Coastal – General Coastal Marine Zone under the Auckland Unitary Plan, in the south-east corner of the coastal environment administered by Auckland Council.

The site of the proposed marine farm is not subject to any environmental or cultural overlays under the Auckland Unitary Plan (e.g. sites of significant ecological value, areas of outstanding natural character, sites and places of significance to Mana Whenua). The closest overlays to the site of the proposed marine farm in the Auckland Unitary Plan are as follows:

- Significant Ecological Area – Marine 2 Overlay (SEA-M2-40a) – which is located approximately 5 km to the west of the site along the coastline between Orere Point in the north and Waimangō Point in the south;
- Outstanding Natural Landscape Overlay (Area 62 – Hunua Ranges) – which extends up to 750 m offshore and from Matingarahi in the north to the Auckland Council boundary in the south and is located approximately 4.25 km to the west of the site; and
- High Natural Character Overlay (Area 163 – Matingarahi Point) – which has the same offshore boundary as the Outstanding Natural Landscape Overlay referenced above.

[4] Email from Alan Moore to J Wilson, 20 December 2016.

3.3 ACTIVITY STATUS

The proposed marine farm will involve the following activities under section 12 of the RMA:

- Occupation of the CMA;
- The erection of structures that are fixed to the seabed;
- Disturbance of the seabed;
- Deposition of material on the seabed; and
- All ancillary activities.

In addition, the proposed marine farm will involve the discharge of contaminants associated with the establishment, operation and maintenance activities (i.e. biodegradable and organic matter).

Rule A115 and Table F2.19.9 provide for aquaculture activities pursuant to sections 12(1), 12(2), and 12(3) of the RMA, including any associated discharge of contaminants and water into water pursuant to section 15 of the RMA.

Rule A115 classifies the proposed marine farm as a **discretionary activity**.

3.4 CONSENT LAPSE AND DURATION

The Consortium seeks a consent lapsing date of 5 years from the grant of resource consent, and a term of 35 years for the resource consents required for the proposed marine farm (in accordance with section 123A of the RMA).

A 5 year lapse period is sought by the Consortium in order to provide sufficient flexibility to time the construction and commissioning of the proposed marine farm with a range of variable conditions (e.g. spat supply and the timing of the construction of other projects).

A consent term of 35 years is considered appropriate given that the Consortium is proposing to stage development of the proposed marine farm and undertake robust monitoring to ensure that the actual effects on the coastal environment align with those predicted in this AEE. A longer consent term will also provide the Consortium with investment certainty such that it can confidently commit to the capital expenditure associated with the development of the proposed marine farm.

4. ENVIRONMENTAL SETTING

4.1 OVERVIEW

The Consortium commissioned three technical assessments to support this AEE and the assessment of the actual and potential effects of the proposed marine farm on the environment. Each of these assessments included an assessment of the existing environmental setting, which are considered in the following subsections as follows:

Section 4.2 Provides an overview of the ecological environment of the site and Firth of Thames, including hydrodynamics, currents, water quality and plankton, the benthic environment, fisheries, marine mammals, and birds.

Section 4.3 Provides an overview of the landscape, natural character and visual amenity of the site of the proposed marine farm and the nearby coastline.

Section 4.4 Provides an overview of the existing navigation and recreational activities occurring in the Firth of Thames.

4.2 ECOLOGICAL ENVIRONMENT AND COASTAL PROCESSES

4.2.1 Overview

The Consortium commissioned Aquatic Environmental Sciences ("**AES**") to complete an assessment of the actual and potential effects of the proposed marine farm on ecology and coastal processes. This assessment also contains a description of the existing environment and values, which is summarised in the subsections below as follows:

Section 4.2.2 Provides an overview of the wider Firth of Thames environment.

Section 4.2.3 Describes the hydrodynamics of the Firth of Thames.

Section 4.2.4 Outlines the water quality and plankton in the Firth of Thames.

Section 4.2.5 Describes the benthic environment of the Firth of Thames.

Section 4.2.6 Outlines the Firth of Thames fishery from recreational and commercial perspectives.

Section 4.2.7 Outlines the marine mammals present in the Firth of Thames.

Section 4.2.8 Outlines the bird species present in the Firth of Thames and at a nearby RAMSAR site.

4.2.2 The Firth of Thames

The Firth of Thames is a 1,100 km^2 tidal estuarine embayment that links with the Hauraki Gulf on its seaward side.[5] It lies in the northern part of the Hauraki Rift and is bounded by fault lines along the Hunua and Coromandel Ranges.

[5] Zeldis, J. (2006). Water, salt and nutrient budgets for Hauraki Gulf and adjacent Firth of Thames, New Zealand. LOICZ – Biogeochemical Modelling Node report.

The northern boundary of the Firth of Thames, an arbitrary boundary where it merges into the Hauraki Gulf, is located due east of Auckland and runs from Thumb Point (north-east of Waiheke Island) to Coromandel Harbour. The Firth of Thames is between 20 – 26 km wide, has a maximum depth of 35 metres near the northern boundary and shoals towards extensive intertidal mudflats of the inner Firth of Thames.

The southern part of the Firth of Thames is very shallow, with a maximum depth of 5 metres at mean low water spring tides.[6] The southern part of the Firth of Thames is also characterised by extensive intertidal mudflats that form one of the most comprehensive shorebird habitats in New Zealand. The land surrounding the southern part of the Firth of Thames is notable for the extent of modification that has occurred. In this regard, 90,000 acres of Piako swamp has been converted to agricultural pasture following the passing of the Hauraki Plains Act in 1908 - which has resulted in the Hauraki Plains becoming one of the most productive and extensive dairy farming regions in New Zealand.[7]

The Firth of Thames is also the receiving environment for the 3,600 km^2 Hauraki Plains catchment, and is subject to extensive inputs of sediment from the Piako and Wahou Rivers.[8] The catchment consists of a range of land uses - including agriculture, residential, industrial, mining, production forestry and conservation estate. 43% of the land area in the catchment is classified as being prone to severe erosion. Sedimentation and nutrient loading have altered the ecology of the Firth of Thames, with mangrove coverage increasing from 50 ha in 1963 to over 1,200 ha by the end of 2004.[9]

From the 1920s to 1960s a commercial mussel dredge fishery operated in the Firth of Thames. The fishery ultimately became uneconomic due to the resulting low population densities, from which the fishery did not recover. This is believed to be because of fine sediments that provide little surface structure for spat settlement and the ongoing resuspension of silt from storms, which prevent larval settlement and growth.[10]

There is over 2,000 ha of existing or approved marine farms and related zones in the Firth of Thames - producing around 30,000 tonnes per year. The major development to date has been in Wilson Bay on the eastern side of the Firth of Thames. In addition, there are existing mussel farms off Waimangō Point on the western side of the Firth of Thames.

4.2.3 Hydrodynamics

Water circulation and movement (hydrodynamics) are important to marine farming as they determine the distribution of plankton groups, flushing rates, and, therefore, the

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6 Battley, P.F.; Brownell, B. (Eds.) (2008). Population biology and foraging ecology of waders in the Firth of Thames: update 2007. Seabird Coast report.

7 Gibbs, M. (2005). Application of a Bayesian network model and a complex systems model to investigate risks of a proposed aquaculture development on the carrying capacity of shorebirds at the Miranda Ramsar wetland. Cawthron Report No. 1055.

8 Battley, P.F.; Brownell, B. (Eds.) (2008). Population biology and foraging ecology of waders in the Firth of Thames: update 2007. Seabird Coast report.
Zeldis, J. (2006). Water, salt and nutrient budgets for Hauraki Gulf and adjacent Firth of Thames, New Zealand. LOICZ – Biogeochemical Modelling Node report.

9 Brownell, B.; Boyer, J.K.; Walsh, J.L. (2008). Chapter III. Benthic production, environmental constraints and wader foraging in the Firth of Thames Ramsar site. In Population biology and foraging ecology of waders in the Firth of Thames: update 2007 (Battley & Brownell eds). Seabird Coast report.

10 Morrison, M.A.; Lowe, M.L.; Parsons, D.M.; Usmar, N.R.; McLeod,I.M. (2009). A review of land-based effects on coastal fisheries and supporting biodiversity in New Zealand. New Zealand Aquatic Environment and Biodiversity Report No. 37.

replenishment of new water into harbours and bays. This can have a major influence on farmed and naturally occurring shellfish, as well as other biota.[11]

Circulation and movement is primarily driven by tides, winds and river flows. Additional structure is added to the water column by stratification, which is driven by solar and freshwater inputs.[12] Each of these is addressed below.

4.2.3.1 Tides

Tides in the Firth of Thames are semi-diurnal with a height of 2.9 metres and 2.2 metres for the average springs and neap tides respectively. The Earth's rotation deflects currents to the west, causing flood tides to be stronger on the eastern side (near Wilson Bay) and ebb tides to be stronger on the western side. Tidal currents in the southern waters of the Firth of Thames are weak (in the order of < 0.05 m/s^{-1}).[12]

Tidal currents generally flow south into the Firth of Thames below depths of 10 metres, and flow north out of the Firth of Thames at the surface. In the vicinity of Wilson Bay, time-averaged results based on tide and temperature data, show the upwelling and surface currents flow offshore in a westerly direction.

Wind stress modifies tidal flows, and while currents are generally dominated by tides in the Firth of Thames, the cumulative effects of the wind can be seen when flows are time-averaged.[12]

4.2.3.2 Wind Generated Currents

In the Hauraki Gulf a strong link between hydrodynamics (particularly upwelling and down-welling) and regional winds is evident, with strong north-west winds causing upwelling and south-east winds causing down-welling. Upwelled water is colder and richer in nitrogen and other nutrients, whereas down-welling conditions remove nutrient-rich water away from the coast.

The status of the El Nino – Southern Oscillation ("**ENSO**") index has an impact on winds around the Hauraki Gulf. During El Nino, winds are predominantly from the south-west, especially in winter and spring, resulting in upwelling, with a change to down-welling summer when nutrient poor, warm surface waters are brought close to the coast. While during La Nina periods, winds are more likely to be easterly.

In the Firth of Thames, wind is of secondary importance to the tidal currents, but it has a dominant influence on time-averaged currents. Persistent winds can set up circulation patterns with north to east-north-east winds resulting in a clockwise residual circulation in the lower Firth of Thames and winds from the east – south-west resulting in an anti-clockwise circulation pattern. Long-term trends tend to show currents flowing southwards towards the lower Firth of Thames along the seabed.[12]

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[11] James, M. (2010). Proposed spat catching farms in the Western Firth of Thames – ecological considerations in response to S92 requests. AES Client Report.

[12] Stephens, S. (2003). Ecological sustainability assessment for Firth of Thames shellfish aquaculture: Task 1 – hydrodynamic modelling. NIWA Client Report HAM2003-113. Environment Waikato Technical Report number 05/05; Auckland Regional Council Technical Publication number TP 252.

4.2.3.3 Stratification

Stratification occurs when light, buoyant water overlies heavy, dense water and is caused either by temperature differences (warm water is lighter than cold water), or by differences in salinity (freshwater is lighter than seawater).

In winter, the Firth of Thames becomes stratified due to the freshwater runoff from the Firth of Thames catchment, while in summer variations in temperature due to solar radiation and heat exchange cause stratification.[12] During stratification the thermocline, is generally 5 metre deep close to shore, and 10 – 12 metres deep throughout the more open waters of the Firth of Thames.[11]

Data from moorings in the western Firth of Thames showed that in late spring / summer, the water column is weakly stratified, with a vertical gradient of approximately 0.5 practical salinity unit ("**psu**"), and could alternate between stratified and mixed conditions.[5] During this period, surface currents are relatively uniform spatially, and flow north at approximately 0.2 m/s^{-1} near the coast, with a slow south return flow down the centre of the Firth of Thames.

In unstratified winter conditions, numerical modelling found an anticlockwise eddy was generated, which extended from the surface to the seabed.[12] However, other studies have found that in winter and early spring that stratification was more prevalent and stronger. Temperature and salinity data from the current meter transects off Waimangō Point in April 2001 showed the west end (closest to shore) had a stratified water column, but in contrast, the water column in the east of the Firth of Thames was mixed, suggesting that salinity was the major driver of stratification in the Firth of Thames at this time of year.

Stratification of the water column can have a strong influence on the distribution and productivity of plankton by restricting organisms to the upper layers, transporting them by wind driven flows and isolating them from nutrient rich bottom waters. Vertical mixing tends to be strongest in winter breaking up the stratification and although nutrients then become more available, plankton are mixed below the well-lit surface waters and as a result, they can experience periods of light limitation.[11]

4.2.4 Water Quality and Plankton

Large scale processes originating offshore and driven by the ENSO cycle result in the physical conditions, nutrient supply, and productivity of the Firth of Thames and Hauraki Gulf varying from year to year.

During large-scale rain events large volumes of freshwater enter the Firth of Thames from the Piako and Waihou Rivers. However, the range of salinity is not great at approximately 2 psu. This indicates that oceanic processes drive salinity in the Firth of Thames, rather than river inputs.[5]

4.2.4.1 Nutrient Status

The Firth of Thames is a productive region supporting a range of commercial and recreational fisheries (dominated by flatfish, rig and snapper), and extensive mangrove, saltmarsh, seagrass and intertidal flats that provide high quality habitat for invertebrates, fish and birds (particularly in the southern areas of the Firth). The supply of nutrients that drives

this productivity comes predominantly from the large river inflows, which have a combined average of 160 m^3/s^{-1}, and the upwelling of deeper nutrient rich water from offshore.[5]

Productivity in the Firth of Thames and Hauraki Gulf not only varies from year to year, due to the ENSO cycle, but also seasonally due to the balance between light and nutrients limiting phytoplankton growth changes during the year. In addition, weather-driven events affect upwelling, nutrient supply and stratification, which impacts productivity on the scale of days and weeks.

Near seabed concentrations of nitrate have been surveyed as being low. However, over a period of nearly seven years there were several occurrences of markedly higher or lower nitrate concentrations.[5] Phases of higher or lower concentrations appear to be driven by low-frequency variation in periods of upwelling or down-welling favourable wind, and cross-shelf advection of resulting high- and low-nutrient waters into the Hauraki Gulf. These changes can cause near-bed nitrate to vary two-three fold.

During upwelling phases, the ocean contributes the majority of the dissolved inorganic nitrogen ("**DIN**") to the Firth of Thames, while during oligotrophic periods, river inputs supply most of the DIN to the Firth of Thames. However, river flood events only last a few day and annually-averaged river flows and associated nutrient concentrations vary relatively little compared to the changes in nutrient loading associated with upwelling changes. This indicates that upwelling dynamics are the most likely to cause long-term variation DIN loading in the Firth of Thames.[5]

The Firth of Thames and Hauraki Gulf have been surveyed to be a net exporter of dissolved inorganic phosphorus ("**DIP**"). This indicates that these are net heterotrophic[13] and denitrifying[14] systems. The surveys also found that the mineralisation and denitrification fluxes were larger than the sums of riverine and oceanic mixing fluxes of dissolved inorganic and organic nutrients, meaning that the oxidation and denitrification occurring in the system must be fuelled by imported particulate organic matter ("**POM**"). Further, preliminary calculations suggested that the tidal mixing rates of particulate organic carbon ("**POC**") and particulate organic nitrogen ("**PON**") across the boundary of the wider Hauraki Gulf-Firth of Thames system are sufficient to meet the demand for POM.[5]

4.2.4.2 Water Clarity and Total Suspended Solids

The availability of light is determined by water clarity, which is controlled by turbidity and suspended sediments. Flood flows from rivers into the inner reach of the Firth of Thames provide a significant volume of sediment, with resuspension from wind generated waves also important in the shallow tidal flats. Wind and tidal currents cause a net retention of sediment brought into the southern part of the Firth of Thames.

Light attenuation has been reported as being 0.8 m^{-1} in the inner Firth of Thames and 0.2 m^{-1} in the extended Firth of Thames.[15] Monitoring for February 2014 – Jan 2016 in Wilson Bay

[13] An organism that cannot manufacture its own food and instead obtains its food and energy by taking in organic substances

[14] A microbially facilitated process of nitrate reduction (performed by a large group of heterotrophic facultative anaerobic bacteria) that may ultimately produce molecular nitrogen (N_2) through a series of intermediate gaseous nitrogen oxide products

[15] Green, M.; Zeldis, J. (2015). Firth of Thames water quality and ecosystem health. Report prepared by NIWZ for the Waikato Regional Council.

shows that transparency was consistently reduced at the site to the south of the farm due to the influence of riverine inputs, which introduce large amounts of sediment to the Firth of Thames.[16]

4.2.4.3 Plankton

Phytoplankton (planktonic algae) and zooplankton (animals) inhabit the water column. Phytoplankton, which are the major source of food for filter-feeding bivalves and zooplankton, occur as single planktonic cells, colonies or chains in the water column. When phytoplankton die they sink to the seafloor, thereby contributing to the sedimentation of organic matter, which in turn provides a food source for deposit feeding animals living on or in the sediments. Plankton communities are highly variable and dynamic in space and time, undergoing relatively predictable seasonal cycles. Phytoplankton form the base of the marine food web and as such, farmed mussels must compete for this resource with other secondary producers living in the surrounding environment.[11]

Surveys across the Firth of Thames and Hauraki Gulf observed concentrations ranging from 0 – 21 mg/m^{-3}.[17] Measurements taken in 2001 ranged from 3 – 4 mg m^{-3} in spring, and 1 – 2 mg m^{-3} in summer. These concentrations give a reasonable indication of chlorophyll-a levels likely to be observed across the proposed marine farm site. However, depending on the state of the ENSO and the degree of influence of offshore upwelling, year-to-year variations could be significant. Based on criteria developed for mussel growing conditions in the Marlborough Sounds, the levels of chlorophyll-a measured suggests that growing conditions will be good for the proposed marine farm.[18]

Zooplankton consist of a range of taxa which include protozoa, crustacean copepods and larval forms of various shellfish, crustacea, and fish. Research on zooplankton populations in the region of the proposed marine farm has observed that zooplankton (>100 µm) markedly increases in biomass from November to January, as animals feed on the increased biomass of phytoplankton observed in spring and summer. However, considerable inter-annual variability occurs due to the larger-scale El Nino and La Nina patterns. Maps of zooplankton distribution show that the outer Firth of Thames frequently supports the highest biomass of zooplankton in the Hauraki Gulf and Firth of Thames.[11]

A number of surveys have been carried out on the distribution of fish eggs and larvae. These studies demonstrate the importance of the Hauraki Gulf and Firth of Thames for recruitment of a range of fish species, including snapper and flatfish. Results show that spawning occurs in coastal areas of the Hauraki Gulf, largely within the 30 metre depth contour, and seasonal and inter-annual variability are similar to zooplankton in general. The outer Firth of Thames

16 Stenton-Dozey, J.; Zeldis, J. (2016). Wilson Bay Marine Farming Zone Area B water quality monitoring: Biennial report for February 2014 to January 2016. NIWA Client Report: CHC2016-060. Report prepared for Wilson Bay Area B Compliance (ABC Ltd).

17 Zeldis, J.; Sharples, J.; Uddstrom, M.; Pickmere, S. (1998). Fertilising the continental shelf: Biological oceanographic studies on the northeastern New Zealand continental margin. Water and Atmosphere 6 (1).

18 Inglis, G.J.; Hayen, B.J.; Ross, A.H. (2000). An overview of factors affecting the carrying capacity of coastal embayments for mussel culture. NIWA report to MFE, Report No CHC00/69.
Zeldis, J.; Hayden, B.; Image, K.; Ren, J.; Hatton, S.; Gall, M. (2001). Assessment of sustainable production issues for a marine farm proposal in Firth of Thames (Waimango Point) by Thames Mussels Ltd. NIWA Client Report CHC01/44.

appears to be the most important site for snapper spawning and larval survival across the Hauraki Gulf and Firth of Thames.[11]

4.2.5 Benthic Environment

The seabed in the western Firth of Thames is generally dominated by fine material, mostly muds, with a zone of shell-gravel close to shore. Extensive inter-tidal mudflats are found in the inner Firth of Thames and these provide essential habitat for birdlife and other marine fauna. The seabed is gently sloping to depths of between 13 and 21 metres in the vicinity of the proposed marine farm.[11]

The following sub-sections discuss the properties of the benthic environment in the vicinity of the proposed marine farm.

4.2.5.1 Sediment Physico-Chemical Properties

Surveys within the vicinity of the proposed marine farm by Cawthron[9] found that in the shallower, western and south-east locations, the seabed was composed of sandy mud, whole dead mussel shell and 'shell gravel'. Sediments progressively changed to soft sandy mud, with less shell fragment with increasing water depth.

The findings from Cawthron are supported by the results of a side-scan sonar survey of locations in the western Firth of Thames, which concluded that sediments appeared to be a mixture of mud and shell in all sub-regions surveyed. There was no evidence of rocky reef substrate, but extensive shell beds were observed in some transects. Grab sample analysis also supports these conclusions.[19, 20] Grab samples taken in conjunction with the side-scan sonar survey provided more detailed results, indicating that grain-size distribution was dominated by small (<0.063 mm) 'mud' particles (>80% of the total) in the northern and south-western sub-regions. However, in the south-eastern sub-region 'mud' only accounted for 30% of total grain size distribution, where sediments were dominated by shell fragments of varying sizes. POC and PON both tended to be lower in the south-east sub-region, where shell fragments dominated the sediments.[19]

Organic matter concentrations of the sediment in the Firth of Thames were found to be relatively low, with a range of approximately 4 – 9% at the shallowest stations and those located on the south-west of the Firth of Thames.[20] This is similar to previous findings where values were primarily between 7 and 8% with a maximum of 11% total organic matter. During this same study, redox values were relatively high in most areas sampled, with the exception of the inner Firth of Thames stations, and there was no evidence of sulphide 'outgassing' or mats of sulphide-metabolising bacteria on the sediment surface.

Concentrations of copper and zinc in the sediment were low throughout the south-western Firth of Thames.[21] However, some evidence of anthropogenic inputs of copper and zinc into the Firth of Thames sediment have been found.[20] Levels found were well below the levels identified in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality

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19 Broekhuizen, N.; Chiaroni, L.; Cairney, D.; Budd, R.; Cartner, K. (2010). A benthic habitat description for sub-sections of the seabed in the north-western Firth of Thames. NIWA Client Report: HAM2010-103.

20 Morrisey, D.; Keeley, N.; Elvines, D.; Taylor, D. (2016). Firth of Thames and Hauraki Gulf enrichment stage mapping. Cawthron Report No. 2824.

21 Morrisey, D.; Keeley, N.; Elvines, D.; Taylor, D. (2016). Firth of Thames and Hauraki Gulf enrichment stage mapping. Cawthron Report No. 2824.

("**ANZECC guidelines**"), maximum values for benthic metals and metalloids found in the southern and eastern parts of the Firth of Thames were similar to urbanised estuaries in the upper Waitemata Harbour and Tamaki River.

4.2.5.2 Faunal Communities

Previous surveys have recorded the bivalve *Theora lubrica*, cockles (*Austrovenus stutchburyi*) and pipi (*Paphies australis*) as forming extensive beds on the western shores of the Firth of Thames. In the late 1960s, extensive mussel (*Perna canaliculus*) beds were reported in the Hauraki Gulf and Firth of Thames, and dense beds once existed, at least in parts of the site of the proposed marine farm. By the early 1970s, the mussel beds had been heavily depleted by fishing, and recent surveys indicate that there are only remnant beds present.[11, 22]

Dredge and grab sample surveys within the vicinity of the proposed marine farm were undertaken in 2000 and 2001. The biota sampled at these sites was considered to be reflective of the sediment characteristics, with deposit feeders dominating the epifauna, as is expected in a soft mud community. The most common species were deposit-feeding heart urchins (*Echninocardium cordatum*), brittle stars (*Amphiura rosea*), the tusk shell (*Cadulus teliger*), and the nut shell *Nucula nitidula* as well as suspension-feeding bivalves *Dosinia lambata*, *Neilo austalis*, and *Arthritica bifurca*. Polychaete worms from the *Onuphidea* and *Lumbrineridae* families were also present. It was concluded that the level of infauna species diversity and abundance found was indicative of a healthy benthic community.[23]

A NIWA grab-sample survey in 2010, found that while benthic communities in the vicinity of the site of the proposed marine farm varied somewhat spatially, they were considered typical of communities found in muddy bottom environments, with no species considered 'rare' found. The communities were dominated by bivalves, polychaetes and amphipods, but the dominance moved from bivalves (*Theora lubrica* and *Nucula nitidula*) at the northern sites to polychaetes (*Heteromastus filiformis* and *Minuspio* sp.) at sites in the south-east where species diversity and abundances were higher.

The Asian date mussel (*Musculista senhousia*) was by far the most abundant species in the south-western sub-area surveyed, with 100% coverage in some locations. The presence of this invasive pest species has resulted in a considerable modification of the community in this area, resulting in low species diversity.[24]

Grab samples collected in 2015 from a large number of sites across the Firth of Thames found that the most abundant infaunal taxa were the capitellid polychaete (*Heteromastus filiformis*) phoxocephalid amphipods, the opheliid polychaete *Armandia maculate*, the introduced bivalve *Theora lubrica*, an unidentified polychaete (*Prionospio sp*.), polychaetes

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22 Morrison, M.A.; Lowe, M.L.; Parsons, D.M.; Usmar, N.R.; McLeod,I.M. (2009). A review of land-based effects on coastal fisheries and supporting biodiversity in New Zealand. New Zealand Aquatic Environment and Biodiversity Report No. 37.

23 Brown, S.; Asher, R. (2000a). Benthic survey and assessment of effects for a proposed mussel spat catching site: Waimangu Point, Firth of Thames. Cawthron Report No. 596.
Brown, S.; Asher, R. (2000b). Benthic survey and assessment of effects for an expansion to a proposed mussel spat catching site: Waimangu Point, Firth of Thames. Cawthron Report No. 613.

24 Broekhuizen, N.; Chiaroni, L.; Cairney, D.; Budd, R.; Cartner, K. (2010). A benthic habitat description for sub-sections of the seabed in the north-western Firth of Thames. NIWA Client Report: HAM2010-103

Prionospio multicristata and *Cossura consimilis*, tanaid crustaceans and paranoid polychaetes. Comparatively high numbers of individuals and taxa were found at the sites closest to the western Firth of Thames, with lowest abundances found to the north of the Wilson Bay Marine Farming Zone and closest to the southern shores of the Firth of Thames.[20]

The conclusion of this survey was that the wider Firth of Thames is indicative of an unstable or slightly stressed environment, relatively low in taxa abundance and diversity however, the western Firth of Thames is less impacted than the eastern Firth of Thames. This was considered to be because of the large sedimentation pulses that occur in the Firth of Thames following significant rain event that tend to move up the eastern side of the Firth of Thames, and / or the disturbance and resuspension of sediments during storm events due to the comparatively shallow nature of the Firth of Thames.

4.2.6 Fish Populations

Parts of the Firth of Thames are considered to be a popular fishing area, particularly for recreational fishermen with 'medium' to 'high' numbers of recreational vessels found per square kilometre.[25] In contrast, on a national basis, with all commercial fishing methods accounted for, the Firth of Thames is considered to have a low catch per square kilometre.[26]

The main species caught include snapper, kahawai, kingfish, trevally, john dory and gurnard. The Hauraki Gulf and Firth of Thames are also important areas for snapper spawning and provide a sheltered environment for juvenile finfish, including snapper, john dory, rig, school shark and barracoota.[27, 28]

4.2.7 Marine Mammals

Marine mammals are regularly encountered in the waters of the wider Hauraki Gulf and the Firth of Thames, and the Hauraki Gulf in particular is considered to contain a high diversity of marine mammals.

The marine mammal species most likely to be encountered in the wider Firth of Thames are short-beaked common dolphins (*Delphinus delphis*), bottlenose dolphins (*Tursiops truncates*), killer whales / orca (*Orcinus orca*), Bryde's whales (*Balaenoptera edeni/brydei*) and various species of beaked whales.[29] A brief description of each species is provided below:

- **Short-beaked common dolphins** - are not considered globally threatened, and although some regional populations are in decline, this is not the case in New Zealand. They are the most abundant cetacean species in the Hauraki Gulf, are found year round, and there is a high rate of re-sighting amongst the approximately 500 resident individuals. They inhabit coastal water and have been encountered in water as shallow

[25] Lloyd, B. (2003). Potential effects of mussel farming on New Zealand's marine mammals and seabirds. Discussion Paper produced by Department of ConservationMinistry for Primary Industries (MPI) (2015a). New Zealand Amateur Fishing: amateur and charter fishing vessels map.

[26] Ministry for Primary Industries (MPI) (2015b). New Zealand Commercial Fishing: all fishing methods map.

[27] Ministry of Fisheries (MFish) (2009). Wilson Bay interim Aquaculture Management Areas (AMAs) final evaluation report.

[28] Ministry for Primary Industries (MPI) (2014). Fisheries Assessment Plenary, May 2014: stock assessments and stock status. Compiled by the Fisheries Science Group, Ministry for Primary Industries.

[29] Du Fresne, S. (2008). Evaluation of the impacts of finfish farming on marine mammals in the Firth of Thames. Du Fresne Ecology Ltd Client Report.

as 7 metres. The feed on a variety of fish species including arrow squid, false trevally and pilchards;

- **Bottlenose dolphins** - There are three discontinuous groupings of bottlenose dolphins in New Zealand (eastern North Island, northern South Island and Fiordland). The eastern North Island population is considered to be a wide-ranging population covering the Bay of Islands and the Hauraki Gulf. Calving every 3 – 6 years and thought to live to 45 (males) – 50 (females), average pod sizes range from 2 – 20 individuals, with an average size of 14 in the Hauraki Gulf. Bottlenose dolphins feed primarily on fish and, to a lesser extent, cephalopods, however prey preferences appear to differ between groups;
- **Killer whale** - are 'nationally critical' in New Zealand, with a population of approximately 200 individuals. There are three sub-group of killer whale in New Zealand, one in the North Island, one in the South Island, and one that moves between the two islands. The calving interval for killer whale is around five years, and females live to a maximum of 80 – 90 years, whereas males are thought to live to a maximum of 50 – 60 years. Killer whales forage on rays, sharks, finfish and other cetaceans;
- **Bryde's whale** - are 'nationally critical' in New Zealand. There are two species present in New Zealand waters, the pygmy form (*B. edeni*), which is usually less than 11.5 metres in length, and the 'ordinary' form (*B. brydei*) which reaches a maximum length of between 14.6 and 15.6 metres. Genetic analysis has found that the 'ordinary' form are the most likely Bryde's whale species to be found in the Hauraki Gulf, which is where most Bryde's whales in New Zealand are found. They have been recorded along the entire north-east coast of the North Island, from the Hauraki Gulf to North Cape, as well as in the Bay of Plenty. Sightings of these creatures in the Hauraki Gulf seems to be higher during spring and summer, and they are regularly seen in the Firth of Thames. Calving occurs in late winter and early spring, and the average reproductive cycle is about two years. Bryde's whales feed primarily on small fish, but are also thought to eat crustaceans; and
- **Beaked whales** - are listed as 'data deficient' globally and nationally. Distribution data is sparse, with few 'at-sea' sightings. However, New Zealand was recently identified as having the highest diversity for beaked whales and in particular is known to have high numbers of Gray's beaked whale (*Mesoplodon grayi*). Recorded maximum ages of beaked whales are 84 years for males and 54 years for females. No information is provided on calving frequency. Many species of beaked whales are found in groups ranging from one to 20 individuals, although groups of up to 100 individuals have been recorded for members of the Beradius species, such as Arnoux's beaked whale (*B. arnuxii*). Beaked whales are thought to be long and deep divers, spending much of their time underwater, and cephalopods and other deep water species (greater than 200 m) are preferred prey items.

4.2.8 Birds

A total of 132 bird species have been recorded in the Firth of Thames, predominantly around Kaiaua and Miranda (at the north-west end of the RAMSAR site). Of these, approximately 60 species are considered abundant or common, with the remainder being occasional or

rare visitors. It is estimated approximately 35,000 wading birds visit the Firth of Thames each year, of which approximately 11,000 are from Siberia and Alaska.[30]

According to the RAMSAR information sheet,[31] the most noteworthy trans-equatorial migrants found in the Firth of Thames along with their International Union for Conservation of Nature Red List of Threatened Species[32] status are:

- Eastern bar-tailed godwit;
- Lesser knot;
- Pacific golden plover;
- Turnstone;
- Curlew sandpiper;
- Sharp-tailed sandpiper; and
- Eastern curlew.

In addition, a number of domestic/internal migrant birds that are also known to over-winter in the Firth of Thames (DoC 2016, RAMSAR, 2004), as follows:

- South Island pied oyster catcher;
- Pied stilt; and
- Wrybill.

The New Zealand dotterel and black stilt, which are classified as 'nationally vulnerable' and 'nationally critical' respectively, also regularly visit the area in small numbers and the dotterel is known to nest at Miranda.

In addition to the migrant species, the resident breeding species in the western Firth of Thames include:

- Variable oystercatcher;
- Northern New Zealand dotterel;
- Black-billed gull; and
- Banded rail.

4.2.8.1 RAMSAR Site

Due to the importance of the area to over-wintering and migrating water birds, the intertidal area of the southern and western shores of the Firth of Thames between Kaiaua and the west bank of the Waihou River were designated as an international RAMSAR wetland in January 1990. The margins of the RAMSAR site are defined by the extremes of mean low water spring tides and mean high water spring tides, covering 8,500 – 9,000 ha.

30 Battley, P.F.; Brownell, B. (Eds.) (2008). Population biology and foraging ecology of waders in the Firth of Thames: update 2007. Seabird Coast report.
31 Ramsar (2004). Information sheet on Ramsar wetlands (RIS): Firth of Thames.
32 The IUCN Red List of Threatened Species (IUCN). Version 2016-2 (2016). http://www.iucnredlist.org.

This area is one of the three most important coastal stretches for seabirds in New Zealand, and supports particularly dense populations of shorebirds for the amount of intertidal habitat available. Most of the bird species found on the intertidal mud and sand flats, and adjacent shallow waters are migratory, with a large proportion arriving from the Northern Hemisphere to over-winter.[33] The average number of waders present in the area over the year is 25,000 individuals, while the total number present may be up to 40,000 migratory birds during the summer months.[34]

In addition to providing habitat for waders, the RAMSAR site also has an array of wetland and estuarine habitats that are attractive to many other coastal birds, such as the white-faced heron, banded rail, shags and fernbirds. The shell banks of the area are vital roosting sites for larger numbers of shorebirds, and important breeding sites for up to 1,000 pairs of white-fronted terns at Taramaire, black-billed gulls at Miranda, three species of shags in the fringing mangroves and a few pairs of the nationally vulnerable northern New Zealand dotterel.[35]

4.3 VISUAL, NATURAL CHARACTER AND LANDSCAPE AMENITY

4.3.1 The Firth of Thames Context

The visual, landscape and natural character assessment undertaken by Isthmus notes that the Firth of Thames is a large scale coastal inlet, opening to the Hauraki Gulf to the north. The firth is enclosed by the Hunua Ranges to the west, the Coromandel Ranges to the east and the low lying coastal flood plains of the Waitakaruru, Piako and Waihou Rivers to the south. The north-west opening of the firth is also enclosed by Ponui and Waiheke Islands.

The Hunua and Coromandel Ranges both rise to considerable height, with a dominant cover of largely indigenous vegetation on either side of the Firth of Thames. These large-scale landforms provide the physical landscape context for the Firth of Thames, which is the 'floor' between the uplifted ranges on either side.

The flood plains to the south are much less visibly connected to the Firth of Thames, with the entire south coastal edge, from Miranda to Thames, over 20km in length, generally edged with a wide band of mangroves, which limits views between the firth and the flood plains (and vice versa).

Settlements along the eastern, southern and western edges of the Firth of Thames, including Te Mata, Ruamahanga, Te Puru, Tararu, Thames, Waitakaruru, Miranda, Kaiaua and Orere Point are all on the lower land on the coastal edge. A limited number of roads cross the Coromandel and Hunua Ranges, providing some elevated views of the Firth of Thames. However, settlements are located on, and strongly connected to, the coast of the Firth of Thames.

33 Department of Conservation. (2016). Firth of Thames: Waikato Wetlands.
34 Ramsar (2004). Information sheet on Ramsar wetlands (RIS): Firth of Thames.
35 Battley, P.F.; Brownell, B. (Eds.) (2008). Population biology and foraging ecology of waders in the Firth of Thames: update 2007. Seabird Coast report.

4.3.2 The Western Firth of Thames

The western Firth of Thames is located on the eastern edge of the Hunua Ranges.

There is an existing marine farm located east of Matingarahi Point, which is clearly visible from the East Coast Road and from the shoreline.

There is very little to visually discern one part of the western Firth of Thames from any other, apart from the relationship with the land on the edge of the inlet. The waters at the south end of the western Firth of Thames tend to be discoloured with sediment from the Waihou, Piakou and Waitakaruru Rivers. In conjunction with the very shallow waters in the inlet, some 5 to 15 metres deep for the most part, the sedimentation gives the waters a murky appearance.

There are two regional parks on the edge of the western Firth of Thames, being the Tapapakanga and Waharau Regional Parks.

The site of the proposed marine farm itself is a triangular expanse of water and sea floor. The shallow waters within the proposed marine farm site range from approximately 13 to 21 metres deep. At this depth, the water is closer to the open ocean 'blue', than the discoloured southern half of the Firth of Thames.

As noted in section 3.2 above, the closest overlays to the site of the proposed marine farm in the Auckland Unitary Plan are as follows:

- Significant Ecological Area – Marine 2 Overlay (SEA-M2-40a) – which is located approximately 5 km to the west of the site along the coastline between Orere Point in the north and Waimangō Point in the south;
- Outstanding Natural Landscape Overlay (Area 62 – Hunua Ranges) – which extends up to 750 m offshore and from Matingarahi in the north to the Auckland Council boundary in the south and is located approximately 4.25 km to the west of the site; and
- High Natural Character Overlay (Area 163 – Matingarahi Point) – which has the same offshore boundary as the Outstanding Natural Landscape Overlay referenced above.

4.4 COMMERCIAL AND RECREATIONAL ACTIVITIES

4.4.1 Commercial Fishing

The proposed marine farm is located in the Fisheries Statistical Area 007 ("**SA007**"), which is closed to trawling and Danish seining, resulting in long lining and set netting being the main commercial fishing methods.

Targeted fisheries for flatfish and rig are considered to be of particular importance within SA007. From 1995 to 2008, 69% of the total flatfish and 48% of rig caught in Fisheries Management Area 1 ("**FMA1**") was sourced from SA007. During this same period, SA007 accounted for 17% of grey mullet, 9% of snapper, 8% of kahawai, 6% of school shark, 2% of both red gurnard and john dory, and 1% of trevally caught in the entire area of FMA1. When considering all inshore finfish species in the Quota Management System (excluding Tuna),

SA007 accounted for 4% of the total estimated catch weight in FMA1 between October 1995 and May 2009.

Latitude and longitude data provided to the Ministry of Fisheries ("**MFish**") by commercial fishers show that fishing events are widely dispersed across SA007, although the area in the vicinity of the proposed marine farm site does appear to be less heavily fished than areas further south and east. The available date is for approximately 20% of all commercial fishing trips that occurred between October 2007 and May 2009. Utilising the same data set, MFish found that 92% of the vessels were targeting snapper by line and around 6% of the vessels were targeting rig by set net.

4.4.2 Recreational and Customary Fishing

The Firth of Thames provides an important recreational fishery, with flounder and snapper the main species caught. Other species targeted by recreational fishers in the Firth of Thames include kahawai, gurnard, tarakihi, bluenose, kingfish, rig, john dory, groper, trevally and grey mullet.

The main methods utilised are rod and line fishing, and set netting, with shellfish harvesting also occurring along the shoreline. Set net fishers are focused in the mid-Hauraki Gulf and Firth of Thames, primarily targeting flatfish (yellow-belly flounder), grey mullet, kahawai and rig.

It is understood that the wider Firth of Thames is important to Hauraki Iwi, for kutāi (mussels), tuangi (cockles), snapper and patiki (flatfish). The most popular catch methods are likely to be the same as those employed by recreational fishers.

4.4.3 Vessel Traffic

There appears to be little available quantitative data about existing vessel traffic in the Firth of Thames. However, the information in the following sub-sections has been obtained by Mr Larry Robbins (OBE FNI) on behalf of the Consortium as part of the navigation assessment.

4.4.3.1 Ferry Traffic

A regular ferry service exists between Auckland and Coromandel. However, the route of the ferry tracks well north of the site of the proposed marine farm.

4.4.3.2 Large Commercial Traffic

Routes used by large commercial vessels lie well to the north of the proposed marine farm, running generally from the entrance to Waitemata Harbour north-eastwards to the Colville Channel and northwards towards North Cape.

The Duty Officer in the Auckland Harbour Control Office also indicated that they knew of no instance where a large commercial vessel had ventured, or needed to proceed, towards the site of the proposed marine farm - either on passage or to anchor.

4.4.3.3 Other Commercial Traffic

McCallum Bros Limited operate a variety of small commercial vessels, principally tug and barge traffic. They advise that at least one trip per week (increasing to 2 or 3 per week in summer months) is made to a landing in the Waihou River carrying sand from Pakiri Beach in a self-propelled barge. Cargoes of machinery, trucks and grey metal may also be carried to the landing from Auckland.

The McCallum Bros Limited vessels will also make transit from Kopu Landing to Great Barrier Island.

The McCallum Bros Limited vessels generally transit 'more or less' up the middle of the Firth of Thames and if on passage to, or from, Auckland will use the southerly (Sandspit) passage into the Waiheke Channel or pass to the north of Waiheke. They consider the existing marine farms to be *"well charted and buoyed"* and that they *"do not present a major navigational difficulty."*

4.4.3.4 Commercial Fishing Traffic

Commercial fishing in the Firth of Thames is mainly carried out from small fishing dorys ranging from 5 to 7 metres in length. All of these fishing dorys are trailer boats which launch from local boat ramps along the Thames Coast, occasionally launching from the Kaiaua side of the Firth of Thames when there is a strong westerly wind.

Some fishing dorys launch out of the Kopu and Piako Rivers, but they tend to remain in the southern part of the Firth of the Thames - away from the site of the proposed marine farm.

4.4.3.5 Naval Vessels

While naval vessels may conceivably venture into the area around the site of the proposed marine farm on training exercises, it is understood that the Royal New Zealand Navy focusses its training in the Hauraki Gulf itself. In this regard, Navy vessels will normally stay north of the line between Ruthe Passage and Te Kouma Harbour when undertaking exercises.

4.4.3.6 Recreational Traffic

There are a number of boat ramps giving access into the Firth of Thames as shown in Figure 5 below. These ramps are well-used by trailer boats, generally for those going fishing.

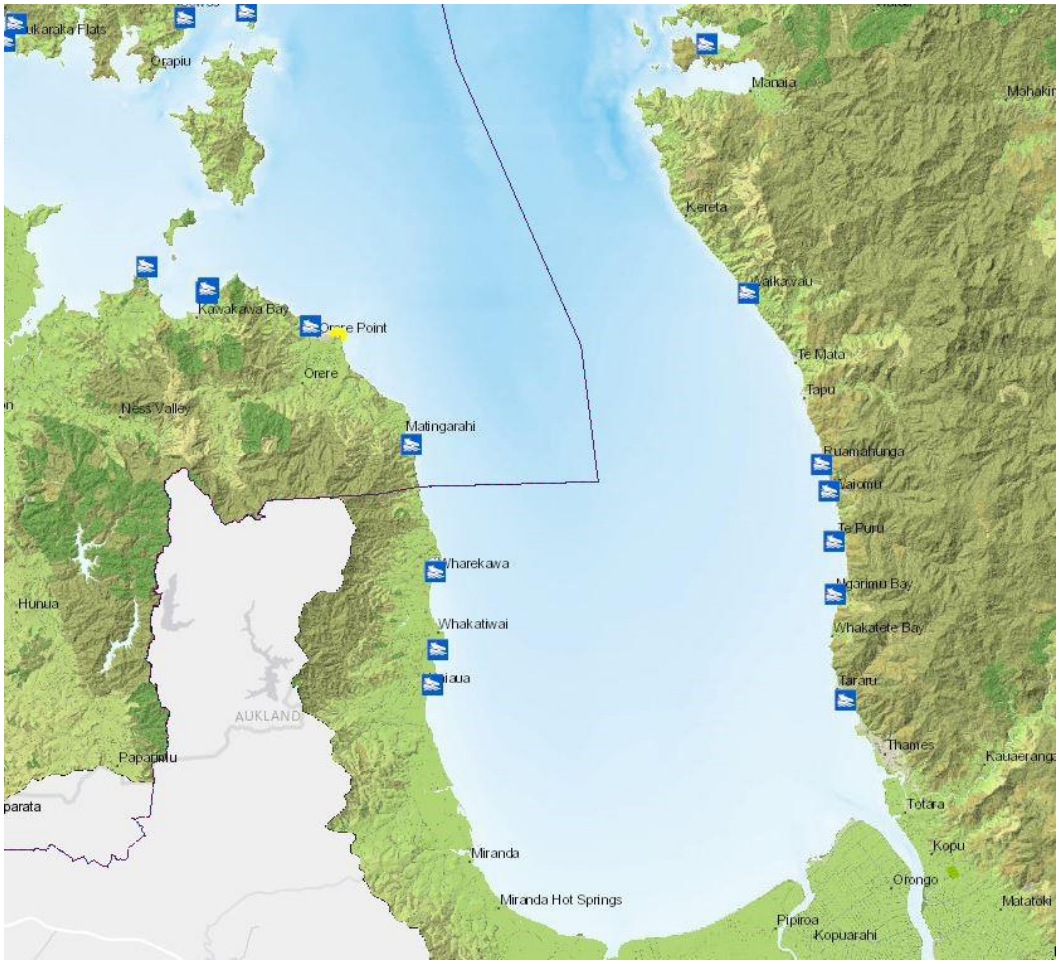

Figure 5: Boat Ramps in the Firth of Thames.

The Waikato Regional Council Harbourmaster advised that *"around 200-300"* vessel movements were typically undertaken by recreational fishing vessels from boat ramps in the Firth of Thames area over a weekend. This number was also provided independently by other sources.

Based on site investigations, the most popular boat ramp is at Waikawau. On weekend visits to the Firth of Thames around a dozen trailers were parked at the ramp and boats were observed coming and going. On a subsequent visit around two dozen trailers were in the car park.

The Ramp Warden at Waikawau advised that at least 100 vessels had launched at the ramp over Labour Weekend in 2016. The website of the Waikawau Boat Ramp Society also advises that "the ramp is used by up to 400 boats a day over the summer holidays …"[36]

Mr Bruce Hartill, Fisheries Scientist NIWA, provided some tabulated data from a survey undertaken on behalf of the Ministry of Primary Industries in 2011/2012. This is essentially a snapshot of activity around noon on the survey days. All those consulted in the survey on

[36] http://www.waikawauboatramp.co.nz/

indicated that almost all of the recreational fishers actually fished within, and around, the marine farms off Wilson Bay.

5. POSITIVE EFFECTS

The establishment and operation of the proposed marine farm in the western Firth of Thames will generate a number of positive social, cultural and economic effects.

The Hauraki Gulf Marine Spatial Plan 2016 notes that the contribution of aquaculture to Gross Domestic Product in the Auckland Region in 2008 was $28.2 million. Further, it identifies that aquaculture supports 507 full time equivalents (**"FTEs"**) associated with direct farming, processing, and those employed in supporting services and industries. The impact of aquaculture on employment, both directly and indirectly, in the Waikato Region was estimated to be 423 FTEs in 2011.[37]

The proposed marine farm will provide further social and economic benefits through the provision of additional domestic and export revenue, and will assist in growing the economic value of the aquaculture industry. In addition, the proposed marine farm will provide direct and indirect job opportunities in the Auckland and Waikato Regions. These jobs will be associated with farming and processing activities, and the employment of people in supporting services (e.g. transport and logistics).

Furthermore, the proposed marine farm will generate the following positive ecological effects on the coastal environment:

- The attraction of fish with associated recreational opportunities;
- The attraction of pelagic species and the associated increased biodiversity;
- The removal of nutrients from the overly enriched Firth of Thames;
- The creation of additional marine habitat;
- The potential for mussel beds to naturally re-establish underneath the proposed marine farm; and
- The removal of suspended sediment from the water column.

[37] Sapere, 2011.

6. ECOLOGICAL AND COASTAL PROCESS EFFECTS

As outlined in section 4.2 of this AEE, the Consortium commissioned AES to complete an assessment of the potential effects of the proposed marine farm on the ecology and coastal processes of the Firth of Thames. The following contains a summary of that assessment.

6.1 OVERVIEW

The potential effects of marine farming and vary considerably depending on the environment (i.e. estuaries, bays or open coast), site variability, farm size, hydrodynamics and the nature of the seabed.

The potential ecological effects of marine farming broadly fall into three categories:

- Effects on the water column;
- Effects on the benthic habitat and communities; and
- Effects on the wider marine environment - including fish, birds and mammals.

Mussel farming is a relatively non-intensive form of aquaculture that relies upon the natural environment for the provision of food and seed stock. Mussels feed on phytoplankton, detritus and other organic particles that they filter from the water column. Only a small proportion of the filtered material is ingested, the rest is expelled as mucous bound deposits of organic and inorganic material that settle, along with faecal material, on the seafloor below the farms, or is swept away by currents. Feeding and metabolic processes result in the release of regenerated nutrients through excretion which are then available as a nutrient source for primary production.

Assessing the potential effects of marine farms requires an understanding of the linkages between trophic levels and sources (as outlined in section 4.2 of this AEE), but the most important are likely to be the removal and recycling of nutrients, the removal of plankton from the water column (depletion), and the subsequent deposition of organic and inorganic material. These are discussed in more detail below.

6.2 POTENTIAL EFFECTS ON WATER CURRENTS AND CIRCULATION

6.2.1 Introduction

Marine farms have the potential to alter current direction and speed, with the magnitude dependent on the structure, layout and size of the farm and current velocity. Most mussel lines are orientated parallel to the flow to reduce drag, but there can still be effects on the currents - particularly around larger farms.

6.2.2 Potential Effects

Measurements taken around 3 ha and 80 ha marine farms in Golden Bay,[38] and a 412 ha marine farm in the Firth of Thames,[39] have found that current speeds are lower inside marine farm boundaries, with higher speeds below the farms. This indicates that marine farms may act as barriers to water flow. Complex current changes have been observed under rafts and around long-lines, but the degree of change will depend on orientation of farm structures and most of the earlier issues were with densely packed rafts and lines.

Generally, the effects of marine farms on hydrodynamics have been found to be localised and are unlikely to extend more than a few hundred metres beyond the marine farm. Unpublished modelling carried out by NIWA showed that the direct effects of a farm on flow are likely to be only significant in the zone that is about half-the-farm upstream to one-farm length downstream of the mean flow.

Measurements around the Wilson Bay Area A development after Stage 1 (over 426 ha) found tidal currents at the farm site were reduced by approximately 1.2 cm/s near the surface and 1.8 cm/s near the seabed. These reductions represent less than a 10% reduction, which is not considered significant.[39] Further, a report prepared for the Ministry of Fisheries concluded that there is no evidence of effects at the bay scale from marine farming developments in New Zealand, including those in the Firth of Thames.

6.2.3 Mitigation

The spacing between lines on large farms in the Firth of Thames, Tasman Bay and Golden Bay varies between 25 – 50 metres, while the proposed marine farm that is part of this resource consent application is proposing a space of 20 metres between lines.

Long-lines will be orientated parallel to the current to minimise any effects on currents, and these are unlikely to affect movement of sediment or shoreline processes given that the proposed marine farm is approximately 5 km offshore and the current flow is predominantly parallel to shore.

While the buffer between the adjacent blocks is slightly less for the proposed marine farm than at Wilson Bay Area A, it is expected to have a similar impact on currents and only a short distance downstream.

6.3 POTENTIAL EFFECTS ON THE PELAGIC ENVIRONMENT

6.3.1 Introduction

The most import effects on the water column include the removal and recycling of nutrients, the removal of plankton from the water column (depletion), and the subsequent deposition, and the cumulative effects of depletion on carrying capacity of the system. Each of these effects is discussed in the sections below.

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38 Ogilvie, S.C.; Ross, A.H.; Schiel, D.R. (2000). Phytoplankton biomass associated with mussel farms in Beatrix Bay, New Zealand. Aquaculture 181: 71-80.
Plew, D.R.; Stevens, C.L.; Spigel, R.H.; Hartstein, N.D. (2005). Hydrodynamic Implications of Large Offshore Mussel Farms. Journal of Oceanic Engineering 30: 95-108.

39 Stenton-Dozey, J.; Zeldis, J.; Vopel, K. (2005). Mussel farming in Wilson Bay, Firth of Thames – a public document 2005. NIWA Client Report: CHC2005-036.

6.3.2 Nutrient Cycling

The release of inorganic nutrients, such as ammonia-N, can increase nutrient supply for phytoplankton and alter chemical processes and availability. Mussel farming generally results in a nutrient sink, but can also enhance primary production through excretion of nutrients and its remineralisation in sediments.

Mussels excrete large amounts of nitrogen, primarily as ammonia-nitrogen, but can also excrete significant amounts of dissolved organic nitrogen and reactive phosphorus. When measuring nitrogen levels inside and outside small marine farms in the Marlborough Sounds, mixed results were found - including a possible increased growth of phytoplankton within farms as a result of regenerated nitrogen during summer, when phytoplankton were nitrogen limited.

When the proposed marine farm is fully developed there could be elevated levels of recycled nutrients (particularly ammonia-nitrogen) for a small distance downstream before mixing with other waters or uptake by phytoplankton. Modelling of DIN under different farm and wind scenarios for large areas of marine farm development in the Firth of Thames predicted that the enhanced concentrations would be expected to be very localised around a farm area and under most wind conditions would extend no more than a few kilometres downstream.[40] Predictions were that full development of the Firth of Thames proposed aquaculture management areas (i.e. 2,000 ha on the eastern side and 6,000 ha on the western side) would have comparatively little influence on the relative abundance of DIN during spring (when natural concentrations are relatively high), but during summer (relatively low ambient DIN), modelling showed that farms could raise the ambient DIN concentrations two to four fold. It should be noted that this finding is based on mussel excretion rates measured in chamber experiments, rather than natural conditions. However, modelling results are also consistent with field observations that the Hauraki Gulf is strongly nitrogen limited during summer, but much less so during spring. The carrying capacity of the Firth of Thames is further considered in section 6.3.4 of this AEE.

It also needs to be remembered that this is regenerated nitrogen, not new nitrogen to the system. Because regenerated ammonia-N is readily taken up by phytoplankton the downstream level of dissolved nutrients need to be considered. However, the effect of the proposed marine farm on nutrient cycling in the Firth of Thames should not be more than minor.

The removal of nutrients can have positive effects on water quality through reduced nutrients and eutrophication.[41] Overseas, in some cases mussel farming is seen as a management tool and the removal of nutrients by mussels, mussel harvesting, and use of raw material for feed and fertiliser are used to offset nutrient discharges in nutrient trading schemes.

[40] Broekhuizen, N.; Ren, J.; Zeldis, J.; Stevens, S. (2003). Ecological sustainability assessment for Firth of Thames shellfish aquaculture: Tasks 2-4 – Biological Modelling. NIWA Client Report: HAM2003-120.

[41] Lindahl, O.; Kollberg, S. (2008). How mussels can improve coastal water quality. Bioscience-explained, Vol 5 (1), 1-14.

6.3.3 Depletion

Mussels are very efficient at filtering organic and inorganic particles in the size range of 5 – 100 µm. Smaller zooplankton (e.g. ciliated protozoa) can be easily ingested, and potentially larger macrozooplankton 200 – 500 µm (e.g. copepods) and even mesozooplankton >500 µm (e.g. fish eggs and invertebrate larvae) may be removed. However, the larger zooplankton will mostly be able to avoid capture. Experiments simulating conditions to be found in mussel farms have found little selectivity at the phytoplankton group level. However larger taxa such as dinoflagellates, appear to be selectively grazed by mussels greater than 60 mm shell length and smaller phytoplankton (<2 µm) may not be effectively removed.[42]

The effects of marine farms on food resources in the water column are generally highest locally (i.e. within, or close to, the farm boundaries) but can also be experienced further afield. Far-field effects are those that could also potentially impact the soft muddy inter-tidal areas in the southern Firth of Thames, inshore regions and other parts of the subtidal area in the central and western Firth of Thames. In the inshore and intertidal areas, detritus from terrestrial sources and benthic production is often the most important source of carbon for deposit feeders and grazers, with detritus and phytoplankton production important for suspension feeders. Thus, it is the open water ecosystem and food web that would potentially be the most impacted by depletion of water going through a farming area.

As efficient filterers, mussels can remove substantial amounts of particulate material from the water column as water passes through a marine farm. Clearance rates of up to 8.6 litres/hour/mussel have been recorded for larger mussels.[42]

Studies of smaller marine farms in the Marlborough Sounds[38] have not detected any statistically significant depletion of phytoplankton at distances greater than 80 metres beyond farm boundaries. Localised depletion was found within an 80 ha block in Golden Bay, and in one of the surveys patches of lower chlorophyll *a* (indicator of phytoplankton biomass) levels were detected beyond the farm boundary. Reduced chlorophyll *a* was detected outside the farm boundaries on the other two surveys, but this may not be related solely to mussel filtering activity because of freshwater inputs with low phytoplankton levels at the time. Where there was strong evidence in the Golden Bay study of mussels causing a measurable reduction of phytoplankton within the marine farm, concentrations recovered to within the ambient concentrations (outside and upstream of the farm) within 200 –500 metres of the farm boundary. This recovery was likely to be due mostly to mixing with water that had not been filtered by the mussels.

Of 36 chlorophyll *a* surveys collated in the study completed for the Ministry of Fisheries, 21 had concentrations that were 1 – 15% lower within the farmed area than outside and the remaining no or little difference. It was concluded that typically small farms have little effect on phytoplankton concentrations outside the farm.

The predictions of relatively low levels of depletion around larger farms is consistent with monitoring around the marine farms at Wilson Bay Area A, which, at least up until 2004,[39]

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[42] James, M.R.; Weatherhead, M.A.; Ross, A.H. (2001). Size-specific clearance, excretion and respiration rates and phytoplankton selectivity for Perna Canaliculus at low levels of natural food. New Zealand Journal of Marine and Freshwater Research 35: 73-86.

had found no evidence of systematic depletion of chlorophyll *a* as a result of 75% development of Stage 1 (approximately 350 lines). The measurements suggested depletion at the farm scale averaged 9.4% and over the entire survey area (92 km^2) were between 5-10%, noting that chlorophyll *a* was highly variable. This is consistent with simple estimates using mussel biomass and flushing rates where it was calculated that depletion could average 8.4% noting that these estimates take no account of mixing or phytoplankton growth. Based on this data there is no evidence at this stage of systematic depletion of chlorophyll *a* or that the 25% trigger had been reached as a result of the Area A farms after Stage 1 was completed. The measurements suggested depletion at the farm scale averaged 9.4% and over the entire survey area (92 km^2) depletion was between 5 - 10%, noting that chlorophyll *a* was highly variable. This is consistent with simple estimates using mussel biomass and flushing rates, where it was calculated that depletion could average 8.4% (noting that these estimates take no account of mixing or phytoplankton growth).

Monitoring during Stage 2 of Wilson Bay Area A (at present 816 of 1026 lines installed) has found up to 19.5% depletion compared with controls. Based on this data there is no evidence at this stage of systematic depletion of chlorophyll *a* or that the 25% trigger had been reached as a result of the Area A marine farms after Stage 1 and most of Stage 2.

For Wilson Bay Area B, 50% of a 26 ha block is now fully developed and depletion was estimated at 5.7% - well below the 25% trigger.

With respect to the proposed marine farm, changes in direction of tidally induced currents can move water backwards and forwards through a farm so flushing rate is not simply a function of mean current speed and direction. The net cumulative flushing rate through the proposed marine farm site takes into account these changes and was used here in addition to average instantaneous speed to estimate the time it would take to flush the site. Flushing rate was estimated by Zeldis et al. (2001) for a similar sized marine farm immediately to the west and one to the south of the proposed marine farm, with an average of approximately 12.5 hours based on daily estimates and 20-58 hrs over the 15 day deployment of current meters for cumulative estimates.

The filtration rate for the mussels was estimated by assuming that the full farm area would be stocked evenly across the mussel sizes 35-60 mm, 60-85 mm and 85-100 mm for mussel growing lines and on average 20 mm for spat lines. Clearance rates for the three sizes of mussels were estimated using published allometric power curves for clearance rate versus shell length (Hatton 1999). The farm stocking rates were provided by Consortium and assume 130 mussels/m of crop rope, 1000 spat/m for spat rope, 35% of lines would be for spat holding and 65% crop, and a depth of droppers of 10 metres.

Depletion was then estimated by dividing the volume of the proposed marine farm site by the time it would take for the same volume of water to pass through the site. This is illustrated in Table 1 below.

Table 1: Depletion percentage estimates for various flushing estimates.

Development	**12.5 hrs (mean)**	**20 hrs (cumulative for north site)**	**58 hrs (cumulative for south site)**

50%	6.7%	10.6%	30.8%
75%	-0.0%	16.0%	46.3%
100%	13.3%	21.3%	61.7%

The depletion estimates at full development range from 13 – 62% depending on the flushing rate. Estimates for cumulative rates are considered to be conservative, as the estimates do not take into account refiltering water. This is supported by measurements of depletion around existing marine farms, which are less than 10% of the farm boundary length away from the farm boundaries. A more realistic depletion is likely to be in the order of 21%, which will be confirmed through the monitoring programme in accordance with the staged development (see section 10.3 of this AEE).

By running the lines parallel to the shoreline and main currents, depletion will be less than if the lines were run perpendicular. The Firth of Thames is also naturally productive with chlorophyll *a* levels typically in the range of:

- 1.5 – 2.5 µg/L in the western Firth of Thames;
- 0.7 – 10 µg/L around Waimangō Point; and
- 1 – 4 µg/L at the Thames Mussel site.

These levels suggest good growing conditions for mussels as was experienced in the past with extensive natural mussel beds across the Firth of Thames.

In summary, the depletion estimates and measurements around existing large marine farms indicate effects for the proposed marine farm would not be more than minor beyond a short distance downstream.

6.3.4 Carrying Capacity

Preliminary modelling of the Firth of Thames predicted moderate depletion around larger farms in the Wilson Bay Marine Farm Zone, but that these effects were unlikely to extend far beyond the farm (generally downstream effects would be about the size of the farm itself).

Substantial modelling work has been carried out on the potential for depletion from large scale marine farms in both the eastern and western Firth of Thames.[40, 39, 43] The estimate of depletion around the Wilson Bay Area A was that fully developed it would deplete phytoplankton by no more than 10% across an area equivalent to 2.7% of the Firth of Thames. This is well below limits of acceptable change developed by Environment Waikato (being 20% over 10% of the Firth of Thames).[44]

[43] Broekhuizen, N.; Oldman, J.; Image, K.; Gall, M.; Zeldis, J. (2005). Verification of plankton depletion models against the Wilson Bay synoptic survey data. NIWA Client Report: HAM2005-002.

[44] NIWA (2003a). Wilson Bay Marine Farming Zone – outcomes from the workshop on trigger points (or performance criteria). NIWA project EVW03249, Hamilton, Feb 2003.
NIWA (2003b). Wilson Bay Marine Farming Zone – outcomes from the workshop on trigger points (or performance criteria). NIWA project EVW03249, Hamilton, May 2003.

To assess carrying capacity and cumulative effects of marine farming in the Firth of Thames as whole, logistical and biophysical models were developed and run under a range of hydrological conditions.[40] The farm scenarios were:

- No farms;
- Existing farms (less than 2,000 farmed ha); and
- Full development of 2,000 ha in the eastern Firth of Thames and 6,000 ha (total farmed area) in the western Firth of Thames.

The model assumed gaps of 25 metres between lines and a mixture of spat and crop farms.

Conclusions from this modelling exercise for fully developed blocks in the eastern and western Firth of Thames were:

- With the logistical model:
  - Fast growing phytoplankton (e.g. flagellates) and protozoa would be depleted by less than 10% within the marine farms and the effect would not extend outside the farm areas; and
  - Slower growing phytoplankton (e.g. diatoms) and protozoa would be depleted by over 20% within marine farms and there could be a halo of depleted water extending several kilometres downstream of the farmed area.
- With the biophysical model:
  - There would be up to 30% depletion in the farms when fully developed and a depleted zone could extend several kilometres or at least the size of the development, downstream. Consistent with other studies, the model results suggested that there could actually be enhancement in summer (up to 20%) within the farms because of the generation or recycling of nutrients;
  - Existing farms could reduce larger zooplankton and potentially fish eggs and smaller larvae by 2 - 6 % and when the farms are fully developed could be 2.5-15%. Depletion is predicted to be localised and even under maximum predicted depletion would not be sufficient to reduce zooplankton populations below their natural minimum. The highest depletions also assume that eggs and larvae are as vulnerable as phytoplankton and thus would not be realistic;
  - There could be changes to phytoplankton species with a shift to more flagellates which could benefit zooplankton at the expense of benthic fauna;
  - It is unlikely that changes in phytoplankton abundance would produce anything other than subtle changes in production or standing stock of zooplankton; and
  - The extent of the depleted plume from either the eastern or western Firth of Thames would be unlikely to extend into the inter-tidal area of the inner Firth of Thames.

Based on the above information and data, and full development of earlier proposed marine farms in the eastern and western Firth of Thames, depletion of plankton could be up to 30% within the farm footprints and there could be a plume of depleted water, with the amount of depletion reducing over several kilometres downstream of the proposed marine farm.

The area of the Firth of Thames is approximately 1,100 km^2. Thus, to exceed the limits of acceptable change developed by Environment Waikato the depleted zone would have to average out at over 20% for an area of 110 km^2. The potential area occupied affected if 8,000 ha was fully developed in the Firth of Thames is approximately 80 km^2 which suggests with full development of the eastern and western Firth of Thames the entire development would still be under the performance indicators and trigger levels developed by Environment Waikato.

Although the models make a number of assumptions they are valuable for looking at different scenarios and cumulative effects in the Firth of Thames, and are the best way to look at cumulative effects. The proposed marine farm is only 664 ha in total (470 ha actually farmed area). Therefore, when combined with the present developments in the eastern Firth of Thames there will be less than 3,300 ha compared with the up to 8,000 ha in the model. It can be concluded with a high degree of confidence that the proposed marine farm would result in effects that were well within the performance indicators and trigger levels developed by Environment Waikato and cumulative effects would be considerably smaller than those predicted if the potential aquaculture management area was fully developed.

The similarity between predictions, estimates and measured survey data to date for the Wilson Bay Area A development gives confidence that large scale farms, if managed properly (including via line management and stocking rates) are sustainable at the farm and embayment level.

6.4 POTENTIAL EFFECTS ON THE BENTHIC ENVIRONMENT

Potential effects on the benthic environment are generally localised, and primarily arise from:

- The sedimentation of organic-rich faecal and pseudofaecal (undigested food) material released from the mussels; and
- The deposition and accumulation of live mussels, mussel shell litter and organic material under the farms.

Enhanced sedimentation rates beneath marine farms can result in the benthic habitat becoming organically enriched relative to adjacent, unfarmed areas. Sedimentation consists of silt, mud and clay sized particles, live organisms, and shells and shell fragments.

There can be some increase in the organic content of the sediment beneath mussel farms, but it has never been found to be severe enough to completely deplete oxygen in the sediments or destroy benthic communities. Studies of the effects of long-line mussel farming on the benthos vary considerably in severity with some finding significant deposition, changes to sediment texture and diversity of benthic fauna, and organic content. De Jong (1994) found no measureable impact on sensitive benthic species beneath small mussel farms. Wong (2009) found that the Waiheke Island mussel farm (Man of War Bay) resulted in changes in benthic species and abundances and concluded that measures of species richness and abundance (including very rare and uncommon taxa) were all increased by the presence of the mussel farm. Wong (2009) also found that the benthic footprint of this marine farm did not appear to extend greater than 20 metres outside one assessed boundary. Directly beneath some marine farms, benthic species may be displaced

with species such as brittle stars and heart urchins typically being reduced in numbers. However, an increase in biodiversity is often found (Morrisey et al. 2016) facilitated by reintroduction of shell material to the seabed.

There have been no recorded cases of significant organic enrichment in sediments, or changes in communities more than 10 to 40 metres from farm boundaries for small farms (3 – 20 ha) or 200 metres from the edge of larger developments (400 ha), and this is considered to be the likely extent of effects of the proposed marine farm.

6.4.1 Sedimentation, Organic Enrichment and Benthic Community

The proposed marine farm can be likened to a filter, which concentrates planktonic particles from a wide area of the water column and deposits them in a localised area of seabed in the form of faeces and pseudo-faeces. Rates of particle sedimentation will vary seasonally with phytoplankton abundance and quality, and characteristics of the hydrodynamic environment.

Surveys in the Wilson Bay Area A have found high natural variability in the benthic habitat with significant inputs, sedimentation of clay and increased organic material from other sources. Effects on the benthic community which have been detected and can be attributed to marine farms, have been restricted to close to the farms and are not found beyond a few hundred metres of farm boundaries. These effects appear small relative to spatial and temporal variability due to other causes, and even then, may not be directly related to marine farming.[45] The only effects that are likely to be attributed to the marine farms are those seen immediately beneath the farms themselves. These observations are supported by the recent enrichment stage mapping by Cawthron in the Firth of Thames.[46] Organic carbon enrichment was still well within the range found in unenriched coastal sediments.

Monitoring results have shown variability in the fraction of fine sand 100 metres to the north of the existing marine farms in the Wilson Bay Marine Farm Zone between 2001 and 2005 with a linear increase evident, however 2007 was similar to 2002.[47] Similarly, organic content of the sediments has not changed appreciably under the marine farms over the monitoring period, and has shown no consistent trends away from the marine farm boundary. In some cases finer sediments accumulating to the south of the marine farms clearly came from natural river inputs. Under the marine farms and at the edges there is some evidence of finer material accumulating and some changes in community composition with increasing numbers of mobile animals and burrows.[45]

Changes in sediment characteristics and benthic communities as a result of biodeposition and remineralisation have been observed under the mussel farms at Waimangō Point. The substrate under the existing farm and at the edge is mostly silt / clay with higher levels of shell material, elevated organic content, nitrate and chlorophyll levels compared with reference sites. Sedimentation rates were found to be significantly lower at the edge of the farm (44 g m^{-2} d^{-1}, of which 2.8 g m^{-2} d^{-1} was faecal material) than under the farm (106 g m^{-2} d^{-}

[45] Stenton-Dozey, J.; Zeldis, J.; Vopel, K. (2005). Mussel farming in Wilson Bay, Firth of Thames – a public document 2005. NIWA Client Report: CHC2005-036.

[46] Morrisey, D.; Keeley, N.; Elvines, D.; Taylor, D. (2016). Firth of Thames and Hauraki Gulf enrichment stage mapping. Cawthron Report No. 2824.

[47] Vopel, K.; Giles, H.; Budd, R.; Hart, C. (2007). Wilsons Bay sediment profile imaging: 2. Pilot Study. NIWA Client report EVW07213.

[1] and 15.2 g m^{-2} d^{-1} respectively). In a recent survey carried out around and under the farm, evidence of minor enrichment and higher diversity directly under the farm was found, but this was not present 150 metres away. There were no apparent effects of the marine farm on sediment composition due to the relatively high currents.

Effects of the marine farm at Waimangō Point, in particular accumulation of faecal material, was restricted to the farm footprint and extended a maximum distance of approximately 300 metres beyond the farm, but it was noted that subsequent re-suspension could increase this distance albeit at a lower intensity. As was observed at Wilson Bay Area A and off Waimangō Point, some sediment characteristics cannot necessarily be attributed to marine farm operation as opposed to natural events and processes.

With respect to the proposed marine farm site, the benthic environment is composed of fine material with predominantly muddy habitat and with larger particles typically being shell fragments. Under the proposed marine farm, and for a short distance downstream (up to several hundred metres), low level organic enrichment is expected to be seen along with increases in infauna, particularly deposit feeding (polychaetes), scavenging taxa (crabs, amphipods, starfish) and possibly a reduced abundance of suspension feeders (bivalves). Impacts are more likely to be focused within the boundaries of the proposed marine farm and buffer zones between blocks where there could be a build-up of deposited material. Strong currents in the area may disperse the material further than would be expected in sheltered places such as the Marlborough Sounds.

However, potential effects from the proposed marine farm would be expected to be similar to those observed for Wilson Bay Area A (i.e. relatively minor within the farm boundaries and decreasing to undetectable levels within a few hundred metres of the farm boundaries).

6.4.2 Deposition of Mussels

The deposition and accumulation of live mussels (blue and green) and shell material on the seabed is one of the most visually conspicuous impacts of marine farms. Such communities can be viewed as having a positive effect by providing more reef-like habitat for mobile species, including fish, and increasing local biodiversity. Diver observations below marine farms have shown a variable response in the development of reef-like communities.

The clumps of mussels and shell fragments can alter the seafloor and often change it from a relatively featureless and depauperate mud habitat, to a mud habitat interspersed with hard material, thereby increasing its complexity. Clumps of material attract a variety of species, including crabs, sponges, anemones and starfish, which are not normally found in abundance on soft mud. Biological diversity therefore may be increased beneath the proposed marine farm, but these effects are localised and occur within close proximity. The extent of the impacts from the 'footprint' is directly related to the size and orientation of farms and the direction and velocity of currents that transport material away from the long-lines.

Although the sediments are highly variable spatially and temporally, under the marine farms in Wilson Bay Area A and at their edges, there was some evidence of finer material accumulating and changes in the mobile animals at the end of Stage 1 development. However, as predicted, it was concluded that, effects have not extended beyond farm

boundaries. The accumulation of mussels under farms appears to have facilitated increased habitat complexity as noted in surveys of enrichment scale in the Firth of Thames. This has led to a more diverse and productive fauna with more enrichment tolerant species in the farmed areas, which is generally seen as a positive effect of marine farms. This would occur around the proposed marine farm.

6.4.3 Enhancement of Benthic Predator and Pest Populations

The accumulation of shell-drop beneath the proposed marine farm will, in time, attract a range of bivalve predators, including starfish, octopus and fish. These species feed on bivalves and other benthic fauna beneath farms, but their distribution is likely to correspond with the distribution of mussel clumps and should be restricted to within a few hundred metres of the farm boundaries.

Potential adverse effects associated with the introduction of pest species can be substantially mitigated by adhering to best management practices. However, a number of pest species are already present in the Firth of Thames area. Although it was postulated that the introduced seaweed Undaria was unlikely to grow in the Firth of Thames because of the relatively high temperatures, Undaria has been present since 2002 in the Wilson Bay Marine Farming Zone, especially over winter (Tom Hollings, pers. comm.). The invasive tunicate Styela clava has been recorded on occasions on marine farms in the Firth of Thames, but can be episodic.

Structures associated with the proposed marine farm (buoys, droppers and anchors) will provide new hard substrate habitat for the likes of suspension-feeding ascidians, barnacles, hydroids and other mussel species, as well as larvae of some species that will subsequently drop off and establish below the proposed marine farm.

The introduced Asian date mussel started spreading in places forming a very dense carpet over the muddy bottoms of the Firth of Thames and the Hauraki Gulf in the late 1980s. Other taxa, such as blister worms (*Polydora haswelli*) and parchment worms (*Chaetopterus variopedatus*), have become a serious problem in the Firth of Thames in recent years, although the latter appears less abundant now. Beds of Asian date mussels have also been observed below the existing farm at Waimangō Point, but their presence is not just related to farms. It should be noted that the bivalve Theora lubrica, which has been found as a dominant species at sites to the north of the proposed marine farm, is also an invasive species that was introduced to New Zealand in the 1970s. Along with the Asian date mussel these two species are of concern throughout New Zealand as they out-compete native species.

Sheltered harbours and estuaries are at the greatest threat from the Asian date mussel and it has spread rapidly since the 1970s. It can be found on soft bottoms, as well as hard substrates, where they form extensive mats effectively smothering other species. Effects can be short-lived as the beds often only live for a couple of years before dying out. However, effects on other fauna and the habitat can be long-lasting. While the proposed marine farm will provide hard substrate habitat for invasive species there are clearly already extensive areas in the western Firth of Thames already occupied by such invasive species. Any effects of the proposed marine farm are likely to be minor, as they will be confined to the footprint or a short distance away and the wider environment is already occupied by a

number of invasive species. Best practice however, will be used to minimise the risk of further invasions.

6.4.4 Enrichment Stage

Cawthron Institute have developed an Enrichment Stage ("**ES**") as an integrated approach to classifying the state of the seabed in relation to seabed (organic matter, metals, redox potential, free sulphides) and faunal (diversity and biotic indices) characteristics. Originally the ES was developed for fin-fish farming, but more recently has been applied to mussel farming and general descriptions of benthic habitats, including a survey of the Firth of Thames. Although some areas of the Firth of Thames scored low based on high organic matter and sediment chemistry, this was offset by relatively high scores for macrofauna diversity. Consequently, the overall ES scores were similar across much of the eastern and southern areas of the Firth of Thames, including aquaculture areas. Relatively low ES scores (i.e. more natural) occurred in the western Firth of Thames.

A gradient of moderate enrichment along the eastern side of the Firth of Thames was identified however, it should be noted that levels of organic carbon in the Wilson Bay Marine Farming Zone were well within the typical range for unenriched coastal sediments and did not indicate unusually high levels of deposition of organic matter. Sedimentation from land has had a significant impact on the Firth of Thames and faunal components of the ES were lower (more diverse) within the Wilson Bay Marin Farming Zone, possibly as a result of the presence of marine farms than areas outside farms where diversity was generally low.

The survey of the Firth of Thames did not extend to the proposed marine farm, but one site is close to the outer corner and one is a few kilometres to the south-east. These two sites had a shelly-mud substrate with an overall ES of 2.03 and 2.53, which is well below the recommended trigger of 4.0 for ES scores. These sites will provide a good baseline along with new sites around the proposed marine farm for monitoring changes as a result of the proposed marine farm.

Also relevant to the proposed marine farm is that under the existing Wilson Bay Area A, which has been well monitored, the ES is compliant with the recommended trigger for overall ES scores (ES < 4.0). The survey results show that at this level of development observed changes in the benthic environment as a result of mussel farming are relatively minor and within the range for the wider area. If the line spacing and level of development is similar for the proposed marine farm (proposed 2.03 lines /farmed ha) as the Wilson Bay Area A marine farms (2.18 lines/farmed ha), then the level of effects of the proposed farm should be no more than minor (noting that the lines for the proposed marine farm are 150 m in length compared with 140 m for Wilson Bay Area A).

6.5 POTENTIAL EFFECTS ON OTHER SPECIES AND HABITATS

A number of other species and habitats have the potential to be affected by the proposed marine farm. These include:

- Natural mussel beds;
- Inshore habitats;

- Genetic change in mussels;
- Shading caused by the proposed marine farm;
- Rock lobster;
- Finfish;
- Birds; and
- Mammals.

6.5.1 Natural Mussel Beds

Mussels are capable of living naturally in high current soft sediment benthic environments such as those found in the western Firth of Thames. As already noted, a commercial dredge fishery for mussels once operated in the Firth of Thames indicating that subtidal populations of mussels in the harbour must once have been common and covered much of the area.

Loss of mussels from the proposed marine farm may, therefore, mimic natural habitats that may have once been present historically in the Firth of Thames ecosystem and provide greater habitat heterogeneity and faunal diversity. Clearly, the area can support large populations of mussels and attempts are being made to reinstate mussel beds. It is considered that the proposed farm will have less than minor impact on natural mussel beds and may encourage their re-establishment.

6.5.2 Inshore Habitats

The inshore habitat near the proposed marine farm includes kelp beds, reef habitats, and associated biota, which could potentially be affected by depleted phytoplankton plumes or the dispersal of biodeposits. However, simulations have shown that strong north-east winds are required to move water towards the shore.[48] That said, winds from the north-east are typically short and intermittent compared with the prevailing south-west winds. In the case of biodeposits, most of this material would settle out close to the farm.

Intertidal macrofauna also often rely on benthic production, rather than planktonic production. The area around the western Firth of Thames is mostly characterised by gravel and boulder beaches, and shell banks, rather than reefs. Keeley (in Brownell 2004) described the foreshore as typically featureless and as the proposed marine farm will be at least 5 km offshore it is likely that it will have a less than minor impact on nearshore habitats.

6.5.3 Genetic Change in Mussels

The majority of farmed mussels in the Hauraki Gulf are grown from spat sourced from 90 Mile Beach (Kaitaia spat). This practice has been occurring since the 1970s so if there was any influence on the genetics of local mussels this will have already occurred.

Kaitaia spat will be the predominant source of spat for the proposed marine farm. It is, therefore, considered that the proposed marine farm will have less than a minor impact on

[48] Broekhuizen, N.; Zeldis, J.; Stevens, S.; Oldman, J.W.; Ross, A.H.; Ren, J.; James, M.R. (2002). Factors related to the sustainability of shellfish aquaculture operations in the Firth of Thames: a preliminary analysis. NIWA Client Report: EVW02243.

nearshore habitats, the genetic diversity, the productivity or resilience of natural occurring mussel stock in the area.

6.5.4 Shading

The proposed marine farm has the potential to shade the seabed, which in turn can affect the availability of light reaching the seabed for macrophytobenthos ("**MPB**"). However, there is no evidence of significant MPB beds in the western Firth of Thames and most of the productivity that drives the benthic community comes from the settlement of phytoplankton and other organic material from terrigenous origins.

MPB have the ability to adapt to low light levels through photoadaptation, are naturally subject to high variability in light availability and do not utilise all the light reaching the seabed. Therefore, if there were any shading effects it would be negligible and would not adversely affect the productivity or abundance of invertebrate or fisheries resources.

6.5.5 Rock Lobster

Marine farming has the potential to affect rock lobster abundance by providing an additional food resource and substrates for pueruli (pre-juvenile stage of the rock lobster lifecycle) settlement.[27] However, pueruli have rarely been found in collectors placed in the western Firth of Thames and it is expected that only a small number pass through the area of the proposed marine farm.

The mussel reefs that may form under the proposed marine farm and the farm lines themselves may provide substrate for pueruli that otherwise may not have survived, therefore providing a positive effect. Overall, it is considered that effects on the productivity and abundance of rock lobster would be less than minor.

6.5.6 Finfish

Effects on finfish can be both adverse (through potential reductions in plankton, alteration of benthic and water column food resources and spawning habitat) and positive (through providing refuge, food resources and aggregation sites).

The reduction in plankton has been discussed already in this AEE, and although there may be a depletion within and immediately downstream of the proposed marine farm, there will not be a significant effect on the wider environment that would impact on food resources for fish.

The proposed marine farm could have a positive effect by increasing abundance, productivity and diversity of benthic fauna, which in turn will have benefits for benthic resources for high trophic levels as significant degradation of the seabed is not predicted.

The Hauraki Gulf supports a major snapper fishery. The most important areas for snapper recruitment are the outer Firth of Thames and inner parts of the Hauraki Gulf. The area of the proposed marine farm had moderate levels of snapper eggs and larvae. Recruitment is highly variable between years with the most significant factor for recruitment believed to be sea surface temperatures while eggs and larvae are developing (Boyd 2002, Appendix 1). The area of the proposed marine farm had moderate levels of eggs and larvae.

Mussel farming can potentially impact on recruitment to fisheries by filtering out eggs and larvae. However, there is no evidence that the level of farming intensity in New Zealand is having a significant impact on snapper populations and estimates of removal of eggs and larvae are likely to be overestimated because re-filtration through a farm is not taken into account. It should also be noted that eggs of snapper, an important recreational and commercial species, are 0.8-2 mm which is above the preferred size range for mussels.

Results from the modelling carried out by Broekhuizen et al (2002) predicted that with full development of 2,000 ha of aquaculture in the eastern Firth of Thames and up to 6,000 ha in the western Firth of Thames the daily per-capita mortality rate could rise by approximately 2%. By way of comparison, the natural mortality rate for snapper eggs and larvae is believed to be approximately 99.9% per day. With only 10% (660 ha) of the modelled western Firth of Thames to be developed, then the additional mortality would be negligible and would not affect recruitment to the fishery.

Overall, the effects of the proposed marine farm can be considered minor for removal of eggs and larvae with some positive effects also occurring including increased biodiversity and food resources and recreational and charter boat fishing opportunities.

6.5.7 Seabirds

Marine farming has the potential to cause positive and adverse effects on seabirds. Positive effects may occur through the provision of a valuable food resource, with shags, terns and gulls having been observed foraging around farms. Adverse effects may occur through changes in food resources, general disturbance, entanglements, and downstream effects on shorebird habitat and feeding.

It should be noted that there is no evidence of entanglement of seabirds in marine farms in New Zealand and the risk is considered low with the current method of cultivation for mussel farms. There is an Environmental Code of Practice to avoid entanglement away from the farms through lost lines and other debris which minimises this potential risk.

Concerns have been raised about the potential impact of marine farms in the western Firth of Thames on the internationally important birdlife and RAMSAR site, which is 15 – 20 km from the proposed marine farm. The concern is that the marine farms have the potential to deplete water in the inner Firth of Thames and at the RAMSAR site. Based on average current speeds, tidal movement and residual currents it would take approximately 10 days for water at the proposed marine farm to reach the RAMSAR site. During this period there would be extensive mixing with water that has not been depleted by the marine farm and the growth of phytoplankton (doubling rates of around 50% per day) downstream of the proposed marine farm. Based on these estimates and the predicted depletion rates of the western Firth of Thames farms (20 – 30% at the farms and decreasing away from the farms), then impacts would be undetectable in the inner Firth of Thames.

A staged approach (discussed in section 10.2 below) to the commissioning of the proposed marine farm, and appropriate monitoring between the western Firth of Thames farm site and inner Firth of Thames will allow unexpected effects, if they were to occur, to be assessed and if necessary mitigated.

6.5.8 Marine Mammals

There is no overlap of the proposed marine farm and areas of special significance identified by the Department of Conservation for marine mammals as whale migration routes and main occurrence of Hectors dolphins, fur seals and New Zealand sea lion are outside the Firth of Thames and the Hauraki Gulf.

Short-beaked common dolphin, bottle-nose dolphins, killer whales, Bryde's whales and various other beaked whales may be encountered in the Firth of Thames. While Bryde's whale, killer whales, bottle-nose and common dolphin occur throughout the year and feed in the area, others such as humpback whale and occasional southern right whale may be found only during their annual migrations.

There have been few studies of the effects of marine farms on mammals, but concerns have been raised around the changes in habitat and the exclusion from some areas. Reported adverse effects have been the exclusion of dusky dolphins from some mussel farm areas and the reported entanglement and deaths of two Bryde's whales in mussel spat catching lines. There are no reported entanglements of dolphins in mussel lines.

Effects on dolphins are equivocal as some are often observed foraging around mussel lines, although there is some evidence that some species may not use areas of mussels farms as much as other areas, presumably because the solid structure act as barriers for their sonar. However, it is unlikely that they will be excluded from an area purely because of the proposed marine farm.

The effect of noise from activities at the proposed marine farm has also been raised, but in general most marine mammal species demonstrate few avoidance behaviours, are tolerant of most underwater noise from farms, and inquisitive enough to approach vessels.

Overall, habitat exclusion, underwater noise and entanglement appear to be minor for marine farms. The Firth of Thames is approximately 1,110 km^2, thus, even when considering Area A and B of the Wilson Bay Marine Farm Zone and the proposed marine farm, as a worst case would only exclude marine mammals from less than 1% of the Firth of Thames.

6.6 ECOLOGICAL EFFECTS SUMMARY

The proposed marine farm is in an area of relatively high currents with a muddy-shell substrate and relatively diverse and abundant fauna.

The main effects that have been considered are reduced currents, depletion of plankton and degradation of the benthic habitat through increased finer material and organic content, changes to the infauna and epifauna community, flow on effects to fish resources, marine mammals and birds, and more direct impacts on mammals and birds from spatial exclusion and risk of entanglement.

Results from numerous studies around small farms and recent work around large farms in the Firth of Thames and Tasman / Golden Bay have found no adverse effects on benthic habitat beyond 100 – 200 metres from farm boundaries and within 500 metres for water column components.

Based on the results of surveys around similar size marine farms and environments to the proposed marine farm, as well as surveys and modelling for the proposed marine farm, the effects would be expected to be the same with no more than minor effects observed more than 500 metres from the farm boundary (200 metres for benthic effects) and not at levels that would affect the wider environment of the western and greater Firth of Thames.

The proposed marine farm would meet the limits of acceptable change criteria developed for the Firth of Thames and would not have more than minor effects on the wider environment or coastal systems.

Positive effects of the farm include potential reduction in eutrophication, increased benthic biodiversity, refuge for and attraction of some fish species and increased recreational fishing opportunities.

7. EFFECTS ON NAVIGATION AND RECREATION

7.1 OVERVIEW

The Consortium engaged Larry Robbins OBE FNI to complete an assessment of the potential effects of the proposed marine farm on navigation by commercial and recreational vessels in the Firth of Thames.

7.2 EFFECTS ON COMMERCIAL AND RECREATIONAL VESSEL MOVEMENTS

As discussed in section 4 of this AEE, the site of the proposed marine farm is not located in an area that experiences a lot of movements by commercial and recreational vessels. In this regard:

- Maritime Rule 90[49] defines the Auckland pilotage area. The eastern most limit lies within the Hauraki Gulf itself, and the area for the proposed marine farm does not fall within any defined pilotage area;
- Routes used by large commercial vessels lie well to the north of the proposed marine farm, running generally from the entrance to Waitemata Harbour north-eastwards to the Colville Channel and northwards towards North Cape;
- The route of the ferry between Auckland and Coromandel tracks well north of the site of the proposed marine farm;
- McCallum Bro Ltd operate a variety of small commercial vessels, principally tug and barge traffic in the Firth of Thames and tend to travel through the middle of the Firth when landing at the Waihou River; and
- The Firth of Thames is not recommended in publications[50] as being attractive for small-craft cruising and there is scarce mention of it in various recreational yachtsmen and boating publications. Those recreational fishing vessels that do launch from the boat ramps around the Firth of Thames are understood to congregate in, and around, existing mussel farms off Wilson Bay.

The general location of marine traffic in the Hauraki Gulf and the Firth of Thames is provided in Figure 6 below (information sourced from Seasketch).

[49] Maritime New Zealand (2016). *Maritime Rules – Part 90: Pilotage*. http://www.maritimenz.govt.nz/rules/part-90/Part90-maritime-rule.pdf

[50] For example, Coastal Cruising Handbook – Millennium Edition.

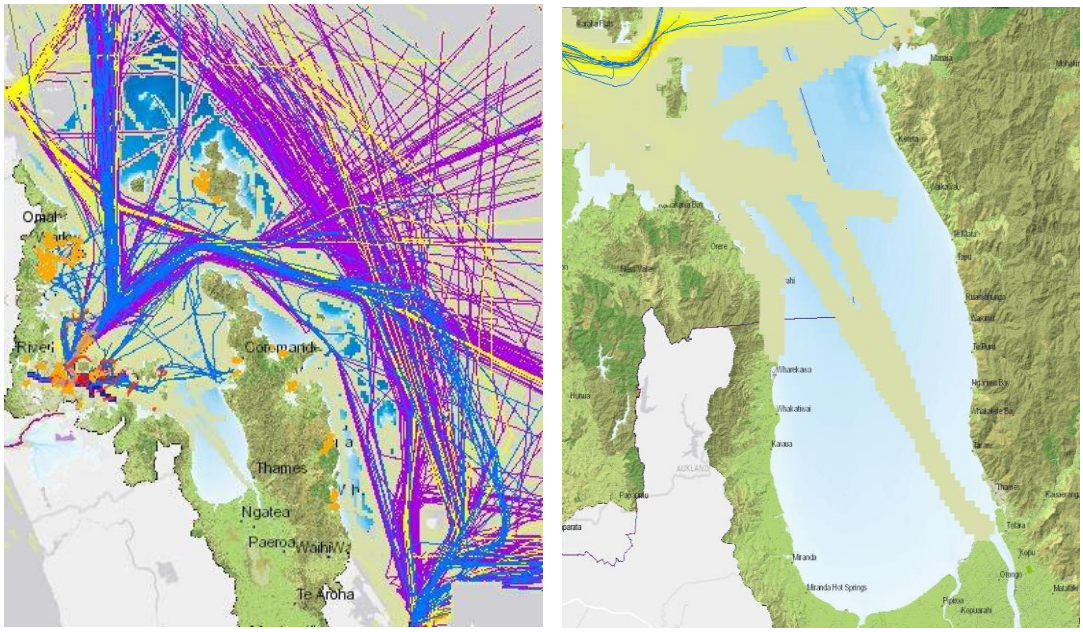


Figure 6: Marine traffic in the Firth of Thames (left: wider area, right: Firth of Thames).

Overall, it is considered extremely unlikely that the proposed marine farm will prove to be a hazard to merchant vessels since large commercial vessels do not come into the vicinity of the proposed marine farm. Likewise, the proposed marine farm is very unlikely to prove hazardous to Navy vessels.

Small commercial vessels transiting to the Waihou River should not be unduly impacted by the proposed marine farm as the navigational tracks they are likely to employ will generally lead between the existing marine farms and the proposed marine farm.

The area of the proposed marine farm is not generally frequented by sailing vessels or launches, although the occasional yacht ventures to Thames. Recreational fishing vessels congregate in and around existing mussel farms off Wilson Bay, and the same would likely occur at the proposed marine farm, which would therefore not be an obstacle to these vessels.

Any potential effects will also be mitigated by the navigational lighting that is proposed (discussed in section 7.5 below).

7.3 EFFECTS ON EXISTING NAVIGATIONAL HAZARDS AND ROUTES

The relevant navigation chart for the site of the proposed marine farm is NZ533 “Firth of Thames”. The current edition was published in 1999 by Land Information New Zealand.

The proposed marine farm site was last surveyed in 1978, since then a number of small corrections have been made to the navigational chart. These include notices adding the limits of the marine farms off Wilson Bay and associated buoyage, none of which affect the proposed marine farm.

The navigation chart does not show any navigation routes, prohibited anchorages, fish farms, outfalls or cable in the area of the proposed marine farm.

The nearest navigational dangers in the vicinity of the proposed marine farm are the buoys marking the south-west corner of an existing marine farm approximately 4.8 km from the nearest point of the proposed marine farm, and a small marine farm off Waimango Point, which is approximately 3.7 km west from the north-west point of the proposed marine farm.

The Guideline for Aquaculture Management Areas and Marine Farms indicates that offshore marine farms should not be located within 1000 m of any recognised navigational routes. Discussions with the Coromandel Harbourmaster and Auckland Deputy Harbourmaster indicated that there are no recognised or designated navigational tracks or routes in the Firth of Thames.

Fishing vessels and small commercial vessels, such as those operated by McCallum Bro Limited would not be unduly affected by the proposed marine farm. Additional distances to avoid the proposed marine farm would be minimal. At its narrowest point there would be a channel over 2.6 nautical miles wide, and courses past the farm would be more or less in line with the currents, although across the prevailing wind direction.

A mooring zone for recreational and small commercial vessels is located at Windy Point in Coromandel Harbour. The most likely route between Windy Point and Sandspit or Ruthe Passages would generally lead well to the north of the proposed marine farm.

7.4 EFFECTS ON RECREATIONAL FISHING

As noted above, it is understood that most of the recreational fishing effort in the Firth of Thames is undertaken in, and around, the marine farms in Wilson Bay (with some minor fishing effort also occurring around the marine farms at Waimangō Point). This is illustrated in Figure 7 below.

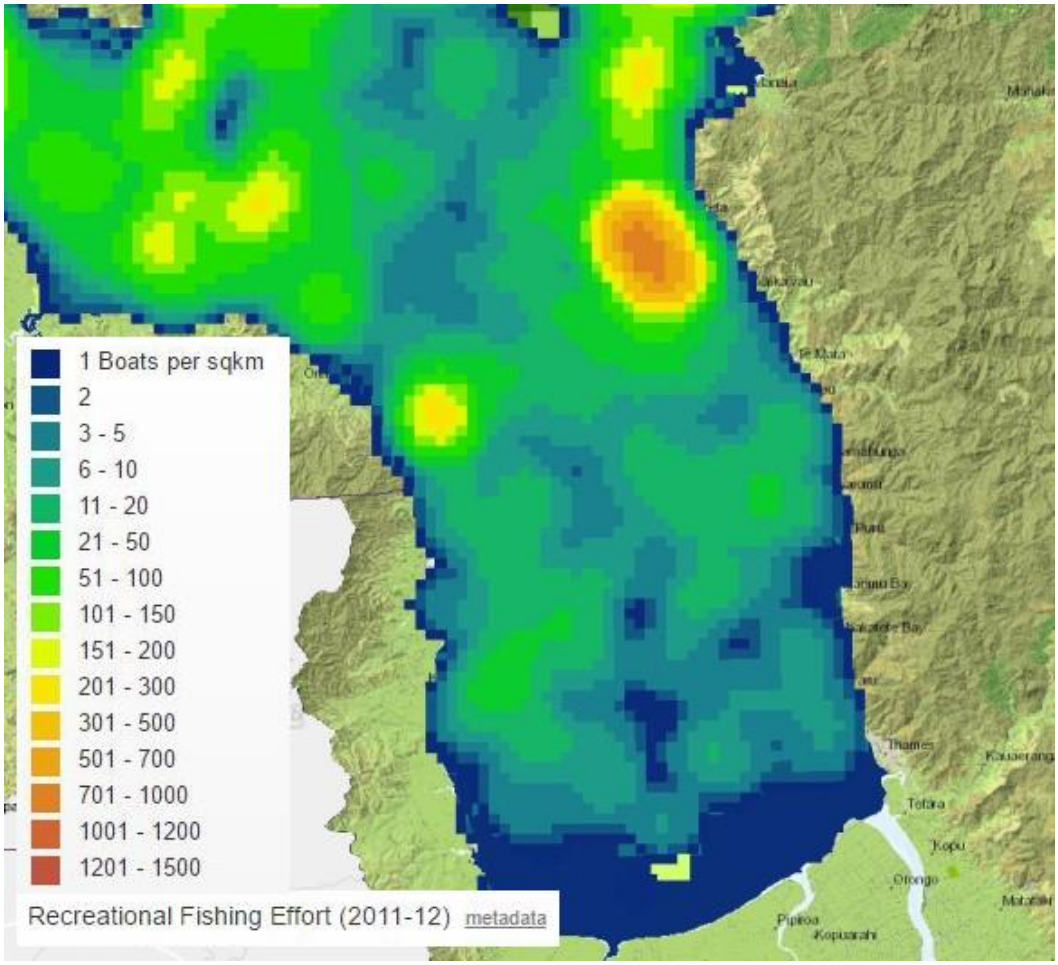


Figure 7: Firth of Thames Recreational Fishing Effort 2011 / 2012 (Seasketch).

The potential effects on the proposed marine farm on fish populations that are targeted by recreational fishers are discussed in section 6.5.6 of this AEE.

Given that the potential effects on the mortality of fish populations and the removal of eggs and larvae will be minimal, and that the proposed marine farm will increase biodiversity and food resources, it is considered that the net effect on recreational fishing in the Firth of Thames will be positive.

7.5 NAVIGATIONAL MARKS

Guidance on the marking of a marine farm is provided in the booklet "*Guidelines for Aquaculture Management Areas and Marine Farms"* published by Maritime New Zealand. Marking and lighting of the proposed marine farm will be in compliance with these guidelines.

In general, the decisions to be made in relation to beaconage and buoyage relate to:

- Visibility of navigation marks;
- Simplicity of marks, which should enable an instinctive decision to be made regarding which side to pass on;

- Identification – marks should be instinctively identifiable; and
- Maintenance cost – increased complexity and number of marks implies increased maintenance cost.

The lighting and marking scheme will be approved by both the Harbour Master and Maritime New Zealand in accordance with the guidelines referenced above.

As the farms in the Wilson Bay area are a reasonable distance apart, it is suggested that the farms can be marked independently of each other, and new marks are unlikely to be confused with the existing ones. The proposed layout of navigation marks is provided in Figure 4 above.

7.6 CONSTRUCTION OF THE PROPOSED MARINE FARM

The nature of the seabed indicates that there should be few problems in mooring or anchoring the barge(s) required during the construction of the proposed marine farm. The greatest risk would occur if refuelling operations were conducted with the barge(s) at sea. The Harbourmaster's standing instructions relating to refuelling must be complied with.

During construction the barge(s) and associated vessels will restrict navigation in a small area. Potential effects can be mitigated by issuing navigation warnings and undertaking sensible precautions on board. The following could be undertaken:

- The Harbourmaster promote an exclusion area around the barge(s) and construction area;
- Marking of the construction area with buoys;
- The issue of a Temporary Notice to Mariners warning of the construction of the proposed marine farm, and exclusions area by Land Information New Zealand;
- Appropriate warning signals, in accordance with the International Regulations for Preventing Collisions at Sea, supplemented by flag signals in accordance with the International Code of Signals, to be exhibited by the barge(s) and associated vessels;
- A lookout a listening watch on VHF Channel 16 to be maintained on the barge or a designated attendant vessel when on station to warn off any vessels approaching the area; and
- The barge(s) should be lit during the hours of darkness.

8. EFFECTS ON LANDSCAPE, VISUAL AMENITY AND NATURAL CHARACTER

8.1 INTRODUCTION

As outlined in section 4 of this AEE, the Consortium commissioned Isthmus to undertake an assessment of the potential landscape, visual amenity and natural character effects of the proposed marine farm on the environment and to inform this AEE.

8.2 LANDSCAPE AND VISUAL AMENITY EFFECTS

When considering the landscape effects of the proposed marine farm, the key consideration is the visual component of any potential effects on the landscape as there will be no direct terrestrial impacts.

The main visible elements of a marine farm proposal are typically the buoys, lights at night, and vessels visiting the farm for maintenance and harvesting. There are many variables that can influence the visibility and potential visual effects of a marine farm. The key variables are:

- The size, density and buoyancy of surface buoys - the density of the buoys will influence the appearance of the farm, particularly when seen from distant viewpoints. When buoys visually overlap they are likely to be more visible than as discrete buoys, separated by water. When the buoys are supporting a heavy crop they can be predominantly submerged, reducing their visibility;
- The colour of the buoys - dark buoys will generally be less prominent against a grey sea than orange buoys;
- Weather and sea conditions - farms are generally more visible in calm, smooth conditions and in clear light, reflections on smooth water can appear to increase the size of the buoys. In contrast, buoys can be temporarily lost from view in swell or choppy conditions;
- The angle of view and elevation of viewpoint - visibility of the farms generally increases with elevation and is lowest when viewed from sea level;
- Backdrop - viewing marine farm structures against a land backdrop can reduce their level of visibility rather than viewing them silhouetted against the open sea; and
- Distance of viewer from the visible structures of the marine farm.

Due to the curvature of the earth and the surface of the sea, the surface of the water is visible for approximately 5 km when viewed from the same level as the sea. From elevated locations, more of the surface of the water is visible. However, over increasing distance, less of the sea and detail of what is on the surface can be seen due to increasing atmospheric haze.

The main land based locations where the surface of the Firth of Thames and the location of the proposed marine farm would be visible, would include the roads, which are generally at or are close to sea level, and which navigate the edges of the firth. A small number of local roads climb onto higher land into the Hunua Ranges to the west and the Coromandel

Ranges to the east. There are no land based locations to the south, on the flood plains, where the site or the proposed marine farm would be visible.

Despite it's very large scale, the proposed marine farm will generally not be visible from land based locations and land-based viewing opportunities are very limited.

With respect to views from sea, in calm, clear viewing conditions buoys can be visible up to distances of approximately 2.5 km - though their clarity and discernibility noticeably decreases at distances of approximately 1 km - 1.5 km.

8.3 NATURAL CHARACTER EFFECTS

While natural character is not defined in the RMA, a recognised working definition of natural character is that the degree or level of natural character within the coastal environment depends on:

- The extent to which natural elements, patterns and processes occur; and
- The nature and extent of modifications to the ecosystems and landscape/seascape.

The highest degree of natural character (greatest naturalness) occurs where there is the least modification.

Policy 13 of the New Zealand Coastal Policy Statement ("**NZCPS**") determines that natural character includes the following matters:

a. *natural elements, processes and patterns;*

b. *biophysical, ecological, geological and geomorphological aspects;*

c. *natural landforms such as headlands, peninsulas, cliffs, dunes, wetlands, reefs, freshwater springs and surf breaks;*

d. *the natural movement of water and sediment;*

e. *the natural darkness of the night sky;*

f. *places or areas that are wild or scenic;*

g. *a range of natural character from pristine to modified; and*

h. *experiential attributes, including the sounds and smell of the sea; and their context or setting.*

The Firth of Thames includes a wide range of activities that can have a bearing on the level of natural character. These include farming, forestry, recreation, residential settlement, tourism and aquaculture. In particular, the landscape of the western Firth of Thames reflects some of these uses and the ensuing modifications, particularly the farmland and hilled backdrop which dominates the edge of the firth.

It is also noted that the site of the proposed marine farm is not identified as having outstanding or high natural character values in the Auckland Unitary Plan. The closest area of high natural character is located approximately 4.2 km to the west of the site of the proposed marine farm.

Placing buoys and longlines across the surface of the sea and longlines will inevitably induce some change to the natural character of the coastal environment. However, the assessment of potential effects in this AEE notes that any impacts on currents will not affect the functioning of the Firth of Thames and not be significant.

With respect to the ecological values of the Firth of Thames, it is noted that the effects would be expected to be the same as other marine farms of a similar scale - with no more than minor effects observed more than 500 metres from the farm boundary (200 metres for benthic effects) and not at levels that would affect the wider environment of the western and greater Firth of Thames. The proposed marine farm would also meet the limits of acceptable change criteria developed for the Firth of Thames and would not have more than minor effects on the wider environment or coastal systems.

With respect to the overall naturalness of the Firth of Thames, it is noted that proposed marine farm will generally not be visible from land based locations and land-based viewing opportunities will be very limited. The site of a marine farm will not be unusual to those on vessels in the area – as there are already marine farms of various sizes located in the western and eastern Firth of Thames.

Overall, while the marine farm will represent a modified element in the coastal environment, the immediate area is not considered to have outstanding or high natural character. In particular, the proposed marine farm will not generate adverse effects on natural character that are inappropriate or significantly adverse.

9. CULTURAL MATTERS

9.1 INTRODUCTION

The Hauraki Gulf Marine Spatial Plan 2016 notes that as well as being important aquaculture industry players as a result of commercial involvements and Treaty settlements, Māori hold mana moana with associated inherited kaitiaki responsibilities. As such, Māori have dual roles in relation to aquaculture which require careful negotiation.

As kaitiaki, local hapū and iwi have noted the potential negative effects associated with aquaculture. In this regard, marine farms can compete for traditional coastal marine space and occupy areas in which mana whenua have traditional interests. Physical structures can also present potential impediments to iwi use of significant resources, such as kaimoana grounds, and can create barriers to culturally important practices such as traditional waka routes and modern waka ama.

Another particular concern noted by iwi for the Hauraki Gulf Marine Spatial Plan 2016 are the visual effects of marine farms on the experience and enjoyment of whānau that still reside on ancestral coastal lands, and for those reconnecting with lands returned via Treaty settlements.

Further, the Hauraki Gulf Marine Spatial Plan 2016 notes that in the absence of iwi involvement over recent decades, marine farms in the Hauraki Gulf have been located inappropriately close to coastal wāhi tapu (sacred sites). Marine farms are also a potential barrier to mana whenua environmental and kaimoana restoration goals, and bring a risk of entanglement and loss of territory for marine mammals. Coastal hapū are regular witnesses to paru, rubbish resulting from farms, including lost floats and lines. But they are also concerned with pollution that is unseen, the accumulation of detritus and waste on the seabed.

9.2 CONSIDERATION OF THE POTENTIAL EFFECTS OF THE PROPOSED MARINE FARM

While the Consortium intend to further engage with iwi of the Hauraki Gulf in order to gain a better understanding of the potential effects of the proposed marine farm on their cultural associations with the Firth of Thames, it is noted that the Consortium includes significant representation from Hauraki Iwi - who regard aquaculture development as a modern extension of traditional kaimoana activities. As such, it is viewed that the development of aquaculture in the western Firth of Thames can be undertaken in a manner that aligns with mana whenua objectives for the area and also provide for cultural well-being.

It is also noted that the Hauraki Gulf Marine Spatial Plan 2016 recognises the western Firth of Thames (and the site of the proposed marine farm specifically) as being a location where the development of aquaculture is appropriate in the Hauraki Gulf. This is considered important in the consideration of the potential cultural effects of the proposed marine farm given that Sea Change Tai Timu Tai Pari was led by a governance group representing a partnership between mana whenua and local and central government agencies.

It is also noted that the proposed marine farm is not located near any sites or places of significance to mana whenua identified in the Auckland Unitary Plan.

With respect to some of the general concerns of mana whenua with aquaculture development noted in section 9.1 above, the following comments are relevant with respect to the development of the proposed marine farm and its location in the western Firth of Thames:

- The proposed marine farm is located in an area identified for aquaculture development in the Hauraki Gulf Marine Spatial Plan 2016, so it should not compete for traditional coastal marine space and occupy areas in which mana whenua have traditional interests;
- The fact that the proposed marine farm is located approximately 5 km offshore means that it should not represent a barrier to navigation by iwi around inshore areas of the western Firth of Thames. Further, access will be available between the 35 individual blocks that comprise the marine farm;
- The proposed marine farm will be located a sufficient distance from the coast that it will not cause adverse visual or natural character effects from the coastline;
- The ecological assessment has confirmed that the proposed marine farm is not likely to cause a risk of entanglement to marine mammals, and that the cumulative loss of available habitat for marine mammals in the Firth of Thames will be less than 4%; and
- Consent conditions can be imposed to ensure that the mooring lines are maintained in a structural sound condition and that the Consortium takes responsibility for the removal of any debris from the proposed marine farm that washes ashore.

The Consortium intend to undertake further engagement with the relevant iwi of the Hauraki Gulf on the proposed marine farm so as to ensure that it does adversely affect iwi's inherited kaitiaki responsibilities, while also ensuring that it provides for the social, economic and cultural wellbeing of those iwi that form part of the Consortium.

10. STAGING OF THE PROPOSED MARINE FARM

10.1 INTRODUCTION

As outlined in section 4 of this AEE, the Consortium is proposing to stage the development of the proposed marine farm in order to ensure that the development has minimal effect on food webs in the wider context and to confirm that effects are as predicted.

A staged development approach was adopted in Wilson Bay Area A – which involved a two stage development approach. Stage 1 was regularly monitored and when 75% of the lines had been developed additional monitoring and a review of previous monitoring was undertaken to confirm the effects of development. Following the completion of this monitoring (and its confirmation of the effects of the development), approval was granted by the Waikato Regional Council to develop Stage 2 of the marine farms.

10.2 STAGING

While results from previous monitoring programmes have found no consistent adverse effects outside the farm boundaries for staged development of other large farms, it is proposed that the proposed marine farm be developed in the following stages:

- Stage 1 – 75% of lines installed (i.e. 720 lines); and
- Stage 2 – full development (i.e. 956 lines).

Development in any block would not proceed from Stage 1 to Stage 2 until:

- At least 70% of the total consented lines are developed;
- Satisfactory monitoring results are obtained; and
- Agreement is given by the Auckland Council.

Monitoring of basic water column parameters would be undertaken and a small number of sites for benthic monitoring would be required when 50% of the lines are developed (478 lines). Full development of Stage 1 would only halt if the relevant triggers were breached.

Full monitoring surveys would be carried at the end of Stage 1 and 2. This would include currents, water column and benthic surveys.

10.3 MONITORING

The following monitoring is proposed to confirm that actual effects are in line with predicted effects in this AEE. A detailed monitoring programme will be developed before the proposed marine farm is established.

10.3.1 Water Column Monitoring

The main objective of the water column monitoring will be to provide spatial and temporal data that will allow an assessment of whether effects are significantly adverse or no more than minor as predicted, and to minimise any such effects through adaptive management. The focus of the monitoring will be on local-scale effects within the immediate vicinity of the proposed marine farm.

The following monitoring is proposed:

- Salinity, temperature, water clarity, chlorophyll *a*:
- Nutrients, including total nitrogen, DIN, total and dissolved reactive phosphorus; and
- Dissolved oxygen.

The parameters under the first bullet point are the most critical and are proposed to be monitored within the proposed marine farm at least monthly over a 12-month period, first as a baseline, then following the installation of 50% of lines, and then upon completion of Stages 1 and 2. Sampling may be an integrated surface sample (tube sample down to 10 metres). However, consideration will also be given to the installation of a buoy mounted fluorimeter which will enable a much greater intensity of sampling. Within farm results will be compared with non-impacted reference sites.

Spatial surveys of current speed and direction, and spatial surveys of chlorophyll *a* measured as fluorescence will be conducted at the end of Stages 1 and 2 to demonstrate that the effects outside the proposed marine farm are no more than minor. These measurements would only be required if measured depletion within the proposed marine farm was higher than predicted (or exceeded the limits of acceptable change).

10.3.2 Benthic Habitat Monitoring

The benthic habitat will be monitored in accordance with the following:

- Benthic samples be taken within the site of the proposed marine farm (under and between lines) and at reference sites;
- Sampling will use the most appropriate technology at representative sites and to include grabs for sediment characteristics and infauna, and photoquadrats and / or video imagery if conditions are suitable. Grab sampling should include triplicate samples for the baseline and at the end of Stage 1 and 2;
- Analyses to include sediment physico-chemical characteristics (sediment size, redox, organic content, total free sulphides, total nitrogen and phosphorus) and cores for infauna species and abundance;
- Epifauna communities based on photograph quadrats and to include identification of bacteria mats and burrows / holes. Video footage or quadrat photographs be taken for general features along at least three transects within the farm area and at least two at reference sites;
- Monitoring will be carried out prior to any development commencing to provide a robust baseline, and then after Stage 1 and Stage 2 are developed; and
- A limited programme (with a reduced number of site and replicates) is proposed when 50% of lines have been installed.

10.4 STANDARDS AND LIMITS

Trigger levels will be used to ensure that the proposed marine farm does not have cumulative effects on the Firth of Thames as a whole.

At present, the standards or limits for water column for the Wilson Bay Marine Farming Zone are that the reduction in chlorophyll *a* within a farm be less than 25% compared with a control. The cumulative effects for all farms are based on the limits of acceptable change approach, with no more than a 20% reduction over 10% of the Firth of Thames.

Environmental quality standards are considered important for the benthic environment as part of any monitoring plan to ensure that there are no significant adverse effects and that any effects found approximate those predicted. Considerable work has gone into developing guidelines and standards for marine farming in recent years including shellfish farming in the Firth of Thames. The environmental quality standards included in Keeley et al. (2015) for the Firth of Thames is that:

- Within the zone of maximum effect:
  - Mean overall ES score should be less than 4 or no more than 2 higher than the mean of control sites;
- At the outer limit of effects:
  - Mean overall ES should be less than 3 or no more than 2 higher than the mean of control sites;

It is proposed that these limits be adopted for the proposed marine farm.

The zone of maximum effect will need to be determined, but is likely to be within approximately 50 metres of the boundary along the line of the prevailing current, and the outer limits of effects will be approximately 500 metres downstream.

11. STATUTORY CONSIDERATIONS

11.1 REQUIREMENTS OF A CONSENT APPLCATION

Section 88 of the RMA requires that an application for a resource consent be made in the prescribed form and manner, and include, in accordance with Schedule 4, the information relating to the activity, including an assessment of the effects of the activity on the environment.

The resource consent applications for the proposed marine farm accompanying this AEE are in the prescribed form, as set out in Form 9 of the Resource Management (Forms, Fees, and Procedure) Regulations 2003.

An assessment of the contents of this AEE against Schedule 4 is provided in **Appendix B** of this AEE. By way of summary, the AEE meets the requirements of the Fourth Schedule, and the requirements of section 88.

11.2 SECTION 104 ASSESSMENT

11.2.1 Introduction

Section 104(1) of the RMA lists the matters that the consent authority must have regard to when considering an application for resource consent. Section 104(1) states:

> ***104 Consideration of applications***
> *(1) When considering an application for a resource consent and any submissions received, the consent authority must, subject to Part 2, have regard to–*
> *(a) any actual and potential effects on the environment of allowing the activity; and*
> *(b) any relevant provisions of*
> *(i) a national environmental standard:*
> *(ii) other regulations:*
> *(iii) a national policy statement:*
> *(iv) a New Zealand coastal policy statement:*
> *(v) a regional policy statement or proposed regional policy statement:*
> *(vi) a plan or proposed plan; and*
> *(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.*

Section 104(1) does not give any of the matters to which a consent authority is required to have regard primacy over any other matter. All of the matters are to be given such weight as the consent authority sees fit in the circumstances, and all provisions are subject to Part 2 of the RMA.

Set out below is an assessment of all matters relevant to these consent applications under section 104(1) of the RMA.

11.2.2 Actual and Potential Effects

The actual and potential effects of the proposed marine farm on the environment are set out in detail in sections 5 to 9 of this AEE. Overall, it is concluded that the proposed marine farm will not have any significant adverse effects and that a range of measures are available to

avoid, remedy or mitigate the actual and potential effects of the farm. In particular, a staged development approach and monitoring programme will ensure that the actual effects of the proposed marine farm are no greater than anticipated and provide the option for operational changes to be made in the event of unforeseen adverse effects occurring.

11.2.3 New Zealand Coastal Policy Statement 2010

11.2.3.1 Overview

The NZCPS sets out a number of objectives and policies for achieving the purpose of the RMA in relation to the coastal environment. It contains provisions which address the following matters of relevance to the proposed marine farm:

- Aquaculture and the provision for social and economic wellbeing;
- The precautionary approach;
- Indigenous biodiversity;
- Natural character and landscape values; and
- Amenity and access.

The NZCPS provisions relating to each matter are addressed below.

11.2.3.2 Provision for Aquaculture and Social and Economic Wellbeing

Objective 6 and Policies 6 and 8 of the NZCPS seek to, amongst other things, enable people and communities to provide for their social and economic wellbeing through the use and development of natural and physical resources in the coastal environment.

The relevant aspects of Objective 6 and Policies 6 and 8 to the proposed marine farm are set out below:

> ***Objective 6***
> *To enable people and communities to provide for their social, economic, and cultural wellbeing and their health and safety, through subdivision, use, and development, recognising that:*
> - *the protection of the values of the coastal environment does not preclude use and development in appropriate places and forms, and within appropriate limits;*
> - *some uses and developments which depend upon the use of natural and physical resources in the coastal environment are important to the social, economic and cultural wellbeing of people and communities;*
> - *functionally some uses and developments can only be located on the coast or in the coastal marine area;*
> - *...*
> - *the protection of habitats of living marine resources contributes to the social, economic and cultural wellbeing of people and communities;*
> - *...*
> - *the proportion of the coastal marine area under any formal protection is small and therefore management under the Act is an important means by which the natural resources of the coastal marine area can be protected; and*
> - *....*

Policy 6 Activities in the coastal environment

(1) In relation to the coastal environment:

...

(j) where appropriate, buffer areas and sites of significant indigenous biological diversity, or historic heritage value.

(2) Additionally, in relation to the coastal marine area:

(a) recognise potential contributions to the social, economic and cultural wellbeing of people and communities from use and development of the coastal marine area, ...:

(b) recognise the need to maintain and enhance the public open space and recreation qualities and values of the coastal marine area;

(c) recognise that there are activities that have a functional need to be located in the coastal marine area, and provide for those activities in appropriate places;

(d) ...

(e) promote the efficient use of occupied space, including by:

(i) requiring that structures be made available for public or multiple use wherever reasonable and practicable;

(ii) requiring the removal of any abandoned or redundant structure that has no heritage, amenity or reuse value; and

(iii) considering whether consent conditions should be applied to ensure that space occupied for an activity is used for that purpose effectively and without unreasonable delay.

Policy 8 Aquaculture

Recognise the significant existing and potential contribution of aquaculture to the social, economic and cultural well-being of people and communities by:

(a) including in regional policy statements and regional coastal plans provision for aquaculture activities in appropriate places in the coastal environment, recognising that relevant considerations may include:

(i) the need for high water quality for aquaculture activities; and

(ii) the need for land-based facilities associated with marine farming;

(b) taking account of the social and economic benefits of aquaculture, including any available assessments of national and regional economic benefits; and

(c) ensuring that development in the coastal environment does not make water quality unfit for aquaculture activities in areas approved for that purpose.

Key directives of these provisions when considering these applications for the proposed marine farm include:

- The social and economic benefits of the proposed marine farm are to be recognised[51] and taken into account;[52]
- The functional need of the proposed marine farm to locate in the coastal environment is to be recognised; and[53]
- The protection of the values of the coastal environment does not preclude use and development where it is located in an appropriate place and form, and within appropriate limits.[54]

51 Policy 6(2)(a).
52 Policy 8(b).
53 Policy 6(c).
54 Objective 6.

Aquaculture generates around $500 million in revenue to New Zealand.[55]

As already stated in section 5 of this AEE, the Hauraki Gulf Marine Spatial Plan 2016 also notes that the contribution of aquaculture to Gross Domestic Product in the Auckland Region in 2008 was $28.2 million. Further, the Spatial Plan identifies that aquaculture supports 507 FTEs associated with direct farming, processing, and those employed in supporting services and industries. The impact of aquaculture on employment, both directly and indirectly, in the Waikato Region was estimated to be 423 FTEs in 2011.[56]

The proposed marine farm will provide further social and economic benefits through the provision of additional domestic and export revenue, and will assist in the objective of growing the economic value of the aquaculture industry. In addition, the proposed marine farm will provide direct and indirect job opportunities in the Auckland and Waikato Regions. These jobs will be associated with farming and processing activities, and the employment of people in supporting services (e.g. transport and logistics).

It is also considered that the proposed marine farm aligns with the direction provided in the NZCPS with respect to recognising that there are activities that have a functional need to be located in the CMA, and to provide for those activities in appropriate places. As already noted in section 2 of this AEE, the western Firth of Thames is considered to an appropriate location for a marine farm because of its good water quality, water depth and the relative shelter it provides. In addition, the site of the proposed marine farm is not located within, or immediately adjacent to, any sites of environmental or cultural value identified in the Auckland Unitary Plan.

In light of the above, it is considered that the site of the proposed marine farm is an appropriate location and that the marine farm itself will assist in enabling people and communities to provide for their social and economic wellbeing through the use and development of natural and physical resources in the coastal environment.

11.2.3.3 Precautionary Approach

Policy 3 of the NZCPS addresses the precautionary approach. It states:

> ***Policy 3 Precautionary approach***
>
> *(1) Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse.*
>
> *(2) In particular, adopt a precautionary approach to use and management of coastal resources potentially vulnerable to effects from climate change, so that:*
>
> *(a) avoidable social and economic loss and harm to communities does not occur;*
>
> *(b) natural adjustments for coastal processes, natural defences, ecosystems, habitat and species are allowed to occur; and*
>
> *(c) the natural character, public access, amenity and other values of the coastal environment meet the needs of future generations.*

Clause (1) of Policy 3 is considered most relevant to the proposed marine farm in that it directs decision-makers to adopt a precautionary approach towards proposed activities

55 Aquaculture New Zealand.
56 Sapere, 2011.

whose effects on the coastal environment are *"uncertain, unknown, or little understood, but potentially significantly adverse."*

While the technical assessments undertaken to support the resource consent applications conclude that there will not be any significant adverse effects generated by the proposed marine farm, it is recognised that there can potentially be unexpected effects when undertaking an activity in the coastal environment. For this reason, the development of a number of marine farms around New Zealand has involved a staged development and a concurrent monitoring programme in order to ensure a precautionary approach is followed.

As noted in section 10 of this AEE, the Consortium is proposing the staged development of the proposed marine farm in order to ensure that any environmental effects are no greater than anticipated in the technical assessments (particularly the ecological assessment by AES). Full development of the proposed marine farm will not occur until it can be demonstrated that the defined environmental triggers for the marine farm will not be exceeded.

This approach also allows for modifications to be made to the development of the proposed marine farm so as to avoid or mitigate any unforeseen environmental effects. This could include changes to the operational management of the marine farm (e.g. stocking density or the removal of lines), should this be deemed necessary following the review of monitoring data.

11.2.3.4 Indigenous Biodiversity

Objective 1 and Policy 11 of the NZCPS are its key provisions in respect of the management of indigenous biodiversity in the coastal environment. They state:

> ***Objective 1***
> *To safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land, by:*
> - *maintaining or enhancing natural biological and physical processes in the coastal environment and recognising their dynamic, complex and interdependent nature;*
> - *protecting representative or significant natural ecosystems and sites of biological importance and maintaining the diversity of New Zealand's indigenous coastal flora and fauna; and*
> - *maintaining coastal water quality, and enhancing it where it has deteriorated from what would otherwise be its natural condition, with significant adverse effects on ecology and habitat, because of discharges associated with human activity.*
>
> ***Policy 11 Indigenous biological diversity (biodiversity)***
>
> *To protect indigenous biological diversity in the coastal environment:*
> *(a) avoid adverse effects of activities on:*
> *(i) indigenous taxa[4] that are listed as threatened[5] or at risk in the New Zealand Threat Classification System lists;*
> *(ii) taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened;*
> *(iii) indigenous ecosystems and vegetation types that are threatened in the*

coastal environment, or are naturally rare;

(iv) habitats of indigenous species where the species are at the limit of their natural range, or are naturally rare;

(v) areas containing nationally significant examples of indigenous community types; and

(vi) areas set aside for full or partial protection of indigenous biological diversity under other legislation; and

(b) avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on:

(i) areas of predominantly indigenous vegetation in the coastal environment;

(ii) habitats in the coastal environment that are important during the vulnerable life stages of indigenous species;

(iii) indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass and saltmarsh;

(iv) habitats of indigenous species in the coastal environment that are important for recreational, commercial, traditional or cultural purposes;

(v) habitats, including areas and routes, important to migratory species; and

(vi) ecological corridors, and areas important for linking or maintaining biological values identified under this policy.

In summary, Objective 1 and Policy 11 of the NZCPS seek to avoid the adverse effects of activities on significant or important indigenous biodiversity values in the coastal environment, and avoid the significant adverse effects of activities on other indigenous biodiversity values in the coastal environment.

While the benthic environment within the vicinity of the proposed marine farm is considered typical of communities found in muddy bottom environments and does not contain any species that are considered rare, the Hauraki Gulf and the Firth of Thames does support marine mammals that are listed as threatened or at risk in the New Zealand Threat Classification System – including killer whale and Bryde's whale. Further, the intertidal area of the southern and western shores of the Firth of Thames is designated as a RAMSAR wetland and includes bird species that qualify as significant or important under Clause (1) of Policy 11 of the NZCPS.

As outlined in section 6 of this AEE, the ecological assessment by AES concludes that there is no overlap between the proposed marine farm and areas of special significance for marine mammals identified by the Department of Conservation, as whale migration routes and the main occurrence of Hectors dolphin, fur seals and the New Zealand sea lion are outside the Firth of Thames and the Hauraki Gulf.

AES also notes that Keeley et al. (2009) concluded that to date habitat exclusion, underwater noise and potential entanglement appear to be minor issues for mussel farming. Given that the Firth of Thames is approximately 1,100 km^2, full development of the proposed marine farm along with Areas A and B of the Wilson Bay Marine Farming Zone would only exclude marine mammals from less than 4% of the total area of the Firth of Thames.

With respect to potential effects on birds, section 6 of this AEE notes that the proposed marine farm will be at least 15 km from the RAMSAR site and that the most important feeding areas for wading birds are the intertidal areas in the southern Firth of Thames. It is also

noted that Keeley et al. (2009) concluded that mussel farms provide a valuable food resource for birds with shags, terns and gulls observed foraging around farms. Keeley et al. (2009) also found no evidence of entanglement of seabirds in marine farm structures in New Zealand, and with the current method of cultivation for mussel farms the risk of this occurring is considered low. The New Zealand Greenshell™ Mussel Environmental Code of Practice includes measures to prevent entanglement in lines and other farming equipment and debris that are no longer attached to farms (usually due to storm damage).

Overall, it is not considered that the proposed marine farm will adversely affect the life-cycle of the species and taxa identified in Clause (1) of Policy 11 of the NZCPS, and AES also conclude that the proposed marine farm will not generate significant adverse effects on habitats and areas of the coastal environment in accordance with Clause (2) of the NZCPS.

11.2.3.5 Natural Character and Landscape Values

Objective 2 of the NZCPS addresses natural character and landscape values. It states:

> ***Objective 2***
> *To preserve the natural character of the coastal environment and protect natural features and landscape values through:*
> - *recognising the characteristics and qualities that contribute to natural character, natural features and landscape values and their location and distribution;*
> - *identifying those areas where various forms of subdivision, use, and development would be inappropriate and protecting them from such activities; and*
> - *encouraging restoration of the coastal environment.*

Policy 13 provides direction on how natural character is to be preserved. It states:

> ***Policy 13 Preservation of natural character***
> *(1) To preserve the natural character of the coastal environment and to protect it from inappropriate subdivision, use, and development:*
> *(a) avoid adverse effects of activities on natural character in areas of the coastal environment with outstanding natural character; and*
> *(b) avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on natural character in all other areas of the coastal environment; including by:*
> *(c) assessing the natural character of the coastal environment of the region or district, by mapping or otherwise identifying at least areas of high natural character; and*
> *(d) ensuring that regional policy statements, and plans, identify areas where preserving natural character requires objectives, policies and rules, and include those provisions.*
> *(2) Recognise that natural character is not the same as natural features and landscapes or amenity values and may include matters such as:*
> *(a) natural elements, processes and patterns;*
> *(b) biophysical, ecological, geological and geomorphological aspects;*
> *(c) natural landforms such as headlands, peninsulas, cliffs, dunes, wetlands, reefs, freshwater springs and surf breaks;*
> *(d) the natural movement of water and sediment;*
> *(e) the natural darkness of the night sky;*
> *(f) places or areas that are wild or scenic;*
> *(g) a range of natural character from pristine to modified; and*
> *(h) experiential attributes, including the sounds and smell of the sea; and their*

context or setting.

Policy 15 contains direction on how natural features and landscapes in the coastal environment are to be protected. It states:

> ***Policy 15 Natural features and natural landscapes***
> *To protect the natural features and natural landscapes (including seascapes) of the coastal environment from inappropriate subdivision, use, and development:*
> *(a) avoid adverse effects of activities on outstanding natural features and outstanding natural landscapes in the coastal environment; and*
> *(b) avoid significant adverse effects and avoid, remedy, or mitigate other adverse effects of activities on other natural features and natural landscapes in the coastal environment; including by:*
> *(c) identifying and assessing the natural features and natural landscapes of the coastal environment of the region or district, at minimum by land typing, soil characterisation and landscape characterisation and having regard to:*
> *(i) natural science factors, including geological, topographical, ecological and dynamic components;*
> *(ii) the presence of water including in seas, lakes, rivers and streams;*
> *(iii) legibility or expressiveness—how obviously the feature or landscape demonstrates its formative processes;*
> *(iv) aesthetic values including memorability and naturalness; (v) vegetation (native and exotic);*
> *(vi) transient values, including presence of wildlife or other values at certain times of the day or year;*
> *(vii) whether the values are shared and recognised;*
> *(viii) cultural and spiritual values for tangata whenua, identified by working, as far as practicable, in accordance with tikanga Māori; including their expression as cultural landscapes and features;*
> *(ix) historical and heritage associations; and*
> *(x) wild or scenic values;*
> *(d) ensuring that regional policy statements, and plans, map or otherwise identify areas where the protection of natural features and natural landscapes requires objectives, policies and rules; and*
> *(e) including the objectives, policies and rules required by (d) in plan*

The proposed marine farm is not located near any identified areas of outstanding natural character or outstanding natural features / landscapes identified in the Auckland Unitary Plan (the closest areas identified as having high natural character and outstanding natural landscape values are located approximately 4.2 km to the west of the proposed marine farm). As such, it is not considered that the proposed marine farm will adversely affect any areas of outstanding natural character or outstanding natural features / landscapes in accordance with Clause (1)(a) of Policy 13 and Clause (a) of Policy 15 of the NZCPS.

With respect to avoiding significant adverse effects and avoiding, remedying or mitigating other adverse effects of activities on natural character and other natural features / landscapes in all other areas of the coastal environment, section 8 of this AEE concludes that the proposed marine farm will not generate significant adverse effects on other natural character or landscape values. Further, a number of measures have been proposed by the Consortium to avoid, remedy or mitigate the potential effects of the proposed marine farm on natural character and landscape values - including locating the marine farm at least 5km offshore and limiting the intensity of development.

In light of the above, it is considered that the proposed marine farm can be established in accordance with the management expectations set out in Clause (1)(b) of Policy 13 and Clause (b) of Policy 15 of the NZCPS.

11.2.3.6 Amenity and Access

Objective 4 of the NZCPS addresses the public open space and recreation values attributed to the coastal environment. It states:

> ***Objective 4***
> *To maintain and enhance the public open space qualities and recreation opportunities of the coastal environment by:*
> - *recognising that the coastal marine area is an extensive area of public space for the public to use and enjoy;*
> - *maintaining and enhancing public walking access to and along the coastal marine area without charge, and where there are exceptional reasons that mean this is not practicable providing alternative linking access close to the coastal marine area; and*
> - *recognising the potential for coastal processes, including those likely to be affected by climate change, to restrict access to the coastal environment and the need to ensure that public access is maintained even when the coastal marine area advances inland.*

The NZCPS contains no clear policy direction as to how activities such as the proposed marine farm should be managed to achieve Objective 4. However, Policy 6 does contain the following relevant matters which should be had regard when considering the development:

> ***Policy 6 Activities in the coastal environment***
> *...*
> *(2) Additionally, in relation to the coastal marine area:*
> *...*
> *(b) recognise the need to maintain and enhance the public open space and recreation qualities and values of the coastal marine area;*
> *...*
> *(e) promote the efficient use of occupied space, including by:*
> *(i) requiring that structures be made available for public or multiple use wherever reasonable and practicable;*
> *(ii) requiring the removal of any abandoned or redundant structure that has no heritage, amenity or reuse value; and*
> *(iii) considering whether consent conditions should be applied to ensure that space occupied for an activity is used for that purpose effectively and without unreasonable delay.*

Section 7 of this AEE discuss the potential effects of the proposed marine farm on navigation and recreation in the Firth of Thames. In particular, this section notes that navigation and recreation within the vicinity of the site of the proposed marine farm is reasonably low and that it will not represent a hindrance to commercial vessels in the Western Firth of Thames (as commercial vessels do not generally use the area). In addition, the proposed marine farm will be lit with navigational lighting in accordance with the requirements of Maritime New Zealand.

Public access will be available between the marine farm lines and the 35 blocks comprising the proposed marine farm. In this regard, the gaps between each of the blocks will range between 50 and 72 metres at the sea floor - with considerably greater distance at the surface. Based on experience at other marine farms, including those at Wilson Bay, the provision of access through the proposed marine farm will provide increased recreational fishing opportunities.

Given the above, it is considered that any potential adverse effects on navigation and public access will be minimal and that the proposed marine farm will align with the management expectations of Policy 6(2)(b) of the NZCPS.

With respect to Policy 6(2)(e) of the NZCPS, section 2 of this AEE outlines the rationale for the location of the proposed marine farm and the extent of that CMA that it will occupy.

11.2.4 Regional Policy Statement

The Auckland Regional Policy Statement (**"Auckland RPS"**) was incorporated into the Auckland Unitary Plan process on 30 September 2013, and is contained in Chapter B of the Auckland Unitary Plan. The Auckland RPS contains 11 chapters, Chapter B8 addresses the coastal environment, and contains the following sections relevant to the proposed marine farm:

- B8.2 – Natural Character;
- B8.3 – Subdivision, use and development;
- B8.4 – Public access and open space.
- B8.5 – Managing the Hauraki Gulf/Te Moana Nui o Toi/Tīkapa Moana

11.2.4.1 Natural Character

B8.2.1. Objectives

(1) Areas of the coastal environment with outstanding and high natural character are preserved and protected from inappropriate subdivision, use and development.

(2) Subdivision, use and development in the coastal environment are designed, located and managed to preserve the characteristics and qualities that contribute to the natural character of the coastal environment.

...

B8.2.2. Policies

...

(3) Preserve and protect areas of outstanding natural character and high natural character from inappropriate subdivision, use and development by:

(a) avoiding adverse effects of activities on natural character in areas of the coastal environment scheduled as outstanding natural character; and

(b) avoiding significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on natural character in all other areas of the coastal environment.

(4) Avoid significant adverse effects and avoid, remedy or mitigate other adverse effects on natural character of the coastal environment not identified as outstanding natural character and high natural character from inappropriate subdivision, use and development.

...

As noted above regarding the discussion on the NZCPS, the proposed marine farm is not located near any areas of the coastal environment with outstanding natural character (as identified in the Auckland Unitary Plan). Likewise, the nearest area identified as having high natural character is approximately 4.2 km to the west of the site of the proposed marine farm. As such, it is not considered that the proposed marine farm will adversely affect any areas of outstanding or high natural character.

With respect to avoiding significant adverse effects and avoiding, remedying or mitigating other adverse effects of activities on natural character, section 8 of this AEE concludes that the proposed marine farm will not generate significant adverse effects on other natural character or landscape values. Further, a number of measures have been proposed by the Consortium to avoid, remedy or mitigate the potential effects of the proposed marine farm on natural character and landscape values - including locating the marine farm at least 5km offshore and limiting the intensity of development.

In light of the above, it is considered that the proposed marine farm can be established in accordance with the management expectations set out in the Auckland RPS with respect to natural character.

11.2.4.2 Subdivision, Use and Development

B8.3.1. Objectives

(1) Subdivision, use and development in the coastal environment are located in appropriate places and are of an appropriate form and within appropriate limits, taking into account the range of uses and values of the coastal environment.

(2) The adverse effects of subdivision, use and development on the values of the coastal environment are avoided, remedied or mitigated.

(3) The natural and physical resources of the coastal environment are used efficiently and activities that depend on the use of the natural and physical resources of the coastal environment are provided for in appropriate locations.

(4) Rights to occupy parts of the coastal marine area are generally limited to activities that have a functional need to locate in the coastal marine area, or an operational need making the occupation of the coastal marine area more appropriate than land outside of the coastal marine area.

...

(6) Conflicts between activities including reverse sensitivity effects are avoided, remedied or mitigated.

...

B8.3.2. Policies

<u>Use and development</u>

(1) Recognise the contribution that use and development of the coastal environment make to the social, economic and cultural well-being of people and communities.

(2) ...

(3) Provide for use and development in the coastal marine area that:

(a) have a functional need which requires the use of the natural and physical resources of the coastal marine area;

...

(c) have an operational need making a location in the coastal marine area appropriate and that cannot practicably be located outside the coastal

marine area; or

(d) enable the use of the coastal marine area by Mana Whenua for Māori cultural activities and customary uses.

(4) Require subdivision, use and development in the coastal environment to avoid, remedy or mitigate the adverse effects of activities above and below the mean high water springs, including the effects on existing uses and on the coastal receiving environment.

(5) Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown or little understood, but could be significantly adverse.

...

Aquaculture

(10) Provide for aquaculture activities in appropriate places and forms and within appropriate limits in the coastal environment, taking into account all of the following:

(a) the quality of water required for the aquaculture activity;

(b) land-based facilities and infrastructure required to support the operation of aquaculture activities; and

(c) the potential social, economic and cultural benefits associated with the operation and development of aquaculture activities.

...

The assessment provided in section 11.2.3 of this AEE with respect to the NZCPS is also considered applicable to the objectives and policies relating to use and development in the coastal environment under the Auckland RPS. In this regard, the proposed marine farm will provide further social and economic benefits through the provision of additional domestic and export revenue, and will assist in the objective of growing the economic value of the aquaculture industry.

It is also considered that the proposed marine farm has a functional need to be located in the CMA. As already noted in section 2 of this AEE, the western Firth of Thames is considered to an appropriate location for a marine farm because of its good water quality, water depth and the relative shelter it provides. In addition, the site of the proposed marine farm is not located within, or immediately adjacent to, any sites of environmental or cultural value identified in the Auckland Unitary Plan.

In light of the above, it is considered that the site of the proposed marine farm is an appropriate location and that the marine farm itself will assist in enabling people and communities to provide for their social and economic wellbeing through the use and development of natural and physical resources in the coastal environment.

The measures proposed to avoid, remedy and mitigate the potential adverse effects of the proposed marine farm on the coastal receiving environment are detailed in sections 6 to 9 of this AEE. Likewise, the Consortium's proposed approach of staging development and undertaking a concurrent monitoring programme is discussed in section 10 of this AEE – which highlights this proposals consistency with the policy direction towards adopting a precautionary approach towards activities whose effects on the coastal environment are uncertain.

11.2.4.3 Public Access and Open Space

B8.4.1. Objectives

(1) Public access to and along the coastal marine area is maintained and enhanced, except where it is appropriate to restrict that access, in a manner that is sensitive to the use and values of an area.

(2) Public access is restricted only where necessary to ensure health or safety, for security reasons, for the efficient and safe operation of activities, or to protect the value of areas that are sensitive to disturbance.

(3) The open space, recreation and amenity values of the coastal environment are maintained or enhanced, including through the provision of public facilities in appropriate locations.

B8.4.2. Policies

(1) Subdivision, use and development in the coastal environment must, where practicable, do all of the following:

(a) maintain and where possible enhance public access to and along the coastal marine area, including through the provision of esplanade reserves and strips;

(b) be designed and located to minimise impacts on public use of and access to and along the coastal marine area;

...

(d) take into account the likely impact of coastal processes and climate change, and be set back sufficiently to not compromise the ability of future generations to have access to and along the coast.

(2) Provide for a range of open space and recreational use of the coastal environment by doing all of the following:

(a) identifying areas for recreational use, including land-based facilities for those uses, where this ensures the efficient use of the coastal environment;

(b) enabling the provision of facilities in appropriate locations that enhance public access and amenity values;

(c) enabling Māori cultural activities and customary use; and

(d) managing uses to avoid conflicts and mitigate risks.

(3) Restrict public access to and along the coastal marine area, particularly walking access, only where it is necessary to do any of the following:

(a) protect public health and safety;

...

(f) have a level of security necessary to carry out an activity or function that has been established or provided for;

(g) provide for exclusive use of an area to carry out an activity granted an occupation consent under section12 of the Resource Management Act 1991;

...

As already discussed in relation to the NZCPS, section 7 of this AEE discuss the potential effects of the proposed marine farm on navigation and recreation in the Firth of Thames. In particular, this section notes that navigation and recreation within the vicinity of the site of the proposed marine farm is reasonably low and that it will not represent a hindrance to commercial vessels in the Western Firth of Thames (as commercial vessels do not generally use the area). Public access will also be provided between the 35 blocks comprising the proposed marine farm.

Given the above, it is considered that any potential adverse effects on navigation and public access will be minimal and that the proposed marine farm will align with the management expectations of the Auckland RPS.

11.2.4.4 Managing the Hauraki Gulf / Te Moana Nui o Toi / Tīkapa Moana

B8.5.1. Objectives

...

(3) *Economic well-being is enabled from the use of the Hauraki Gulf's natural and physical resources without resulting in further degradation of environmental quality or adversely affecting the life-supporting capacity of marine ecosystems.*

B8.5.2. Policies

Integrated management

...

(2) *Require the integrated management of use and development in the catchments, islands, and waters of the Hauraki Gulf to ensure that the ecological values and life-supporting capacity of the Hauraki Gulf are protected, and where appropriate enhanced.*

(3) *Require applications for use and development to be assessed in terms of the cumulative effect on the ecological and amenity values of the Hauraki Gulf, rather than on an area-specific or case-by-case basis.*

...

(5) *Avoid use and development that will compromise the natural character, landscape, conservation and biodiversity values of the islands, particularly in areas with natural and physical resources that have been scheduled in the Unitary Plan in relation to natural heritage, Mana Whenua, natural resources, coastal, historic heritage and special character.*

...

(10) *Work with agencies and stakeholders to establish an ecological bottom line, or agreed target, for managing the Hauraki Gulf's natural and physical resources which will do all of the following:*

- *(a) provide greater certainty in sustaining the Hauraki Gulf's ongoing life supporting capacity and ecosystem services;*
- *(b) assist in avoiding incremental and ongoing degradation;*
- *(c) co-ordinate cross-jurisdictional integrated management and effort to achieve agreed outcomes;*
- *(d) better measure the success of protection and enhancement initiatives;*
- *(e) assist in establishing a baseline for monitoring changes;*
- *(f) enable better evaluation of the social and economic cost-benefits of management; and*

...

Maintaining and enhancing social, cultural and recreation values

(15) *Identify, maintain, and where appropriate enhance, areas of high recreational use within the Hauraki Gulf by managing water quality, development and potentially conflicting uses so as not to compromise the particular values or qualities of these areas that add to their recreational value.*

...

Providing for the use of natural and physical resources, and for economic activities

(17) *Provide for commercial activities in the Hauraki Gulf and its catchments while ensuring that the impacts of use, and any future expansion of use and development, do not result in further degradation or net loss of sensitive*

marine ecosystems.

...

As already discussed in this AEE, the proposed marine farm will enable economic well-being by increasing production from aquaculture in the Auckland Region and contribute jobs to the economy. This benefits will, however, be achieved in a manner that does not cause further degradation to the overall quality of the Hauraki Gulf. In particular, a key component of the ecological assessment undertaken by AES has been on ensure the carrying capacity of the Firth of Thames is maintained and development is undertaken within defined limits of acceptable change.

For the reasons outlined in sections 6 and 8 of this AEE, it is also considered that the proposed marine farm will not compromise the natural character, landscape and biodiversity values of areas that have been scheduled as significant in the Auckland Unitary Plan. Further, public access to the coastal marine area will be maintained by virtue of the location of the proposed marine farm away from the coast and the proposed spacing / layout of the blocks.

11.2.5 Auckland Unitary Plan

The Regional Coastal Plan is contained in Chapter F of the Auckland Unitary Plan, and it contains nine chapters, seven of which address the seven coastal zones, one containing the introduction, and one addressing vehicles on beaches. As outlined in section 3 of this AEE, the proposed marine farm will be located in the Coastal – General Coastal Marine Zone, which is addressed in Chapter F2.

The sections of the Regional Coastal Plan most relevant to the proposed marine farm include:

- Chapter F2.14 – Use, development and occupation in the coastal marine area; and
- Chapter F2.15 – Aquaculture.

11.2.5.1 Chapter F2.14 – Use, Development and Occupation in the Coastal Marine Area

F2.14.2. Objectives [rcp]

(1) The high public value of the coast and coastal marine area as open space area with free public access is maintained.

(2) Occupation rights are provided for in appropriate locations, and in appropriate circumstances for use and development that has a functional need to be located in the common marine and coastal area, and for infrastructure that has an operation need to be located below mean high water springs and cannot be practicably located on land.

(3) Limit exclusive occupation to where it can be demonstrated it is necessary for the efficient functioning of the use and development or is needed for public safety, and any loss of public access and use as a result is minimised and mitigation is provided where practicable.

(4) Efficient use is made of coastal marine area by consolidating use and development within appropriate areas, where practicable.

(5) Activities that do not have a functional or operational need to be undertaken in the common marine and coastal area are provided for within zones or precincts only where they can demonstrate:

(a) the need for a common marine and coastal area location;

(b) *they cannot practicably be located on land outside of the coastal marine area; and*

(c) *they are consistent with the use and value of the area, including the adjacent land area, and do not compromise natural character, ecological, public access, Mana Whenua, historic heritage, or amenity values.*

(6) *Activities that do not have a functional or operational need to be undertaken in the coastal marine area do not unduly limit the use of areas for marine and port activities or result in adverse cumulative effects.*

(7) *Use and development in the coastal marine area is supported by all necessary land-based access and infrastructure.*

(8) *...*

F2.14.3. Policies [rcp]

(1) *Enable use and occupation of the common marine and coastal area to provide for use and development that:*

(a) *has a functional or operational need to be below mean high water springs and may require public access to be restricted; or*

(b) *is necessary to provide for the use of the coastal marine area by Mana Whenua for Māori cultural activities and customary uses; and*

(c) *will not compromise or limit the operation of existing activities that have occupation rights within the common marine and coastal area.*

(2) *Provide for exclusive occupation rights in the common marine and coastal area only where it can be demonstrated this is necessary for the efficient functioning of the use and development or is needed for public safety, and will enable the most efficient use of space by activities in the common marine and coastal area and require that the loss of public access and recreational use is mitigated.*

(3) *Avoid use and occupation of the common marine and coastal area by activities that do not have a functional need to be undertaken below mean high water springs, unless the proposed use:*

(a) *can demonstrated it needs to be located in the common marine and coastal area and cannot practicably be located on land outside of the common marine and coastal area;*

(b) *is consistent with the objectives and policies for the relevant zone or precinct;*

(c) *will enhance amenity values and not conflict with marine activities; or*

(d) *any necessary land-based infrastructure can be provided.*

(4) *Avoid granting rights of exclusive occupation in areas with high public use and where it will have a significant adverse effect on public access and recreational use of the common marine and coastal area.*

(5) *Provide for use and occupation of the common marine and coastal area by infrastructure, where it does not have a functional need to locate in the common marine and coastal area but has an operational need, and only where it cannot be practicably located on land and avoids, remedies, or mitigates other adverse effects on:*

(a) *the existing use, character and value of the area;*

(b) *public access, recreational use and amenity values;*

(c) *natural character and scenic values, from both land and sea;*

(d) *water quality and ecological values;*

(e) *coastal processes including erosion;*

(f) *other lawfully established use and development in the coastal marine area or on adjoining land;*

(g) *the anticipated future use of the area for marine activities; and*

(h) *Mana Whenua or historic heritage values.*

(6) *Provide for the use and occupation of the common marine and coastal area*

associated with the effective operation, maintenance, upgrading and development of the components of the electricity transmission network that have an functional or operational need to locate in the coastal marine area in appropriate areas.

(7) ...

(10) Require any proposed use and development for activities in the common marine and coastal area to demonstrate that any necessary land-based access and infrastructure can be appropriately provided for.

(11) Determine the appropriate duration for granting rights of occupation having regard to the:

(a) extent of public use and access of the area and the impact of restrictions on the loss of public use and access;

(b) level of investment in the development and need for security of tenure to ensure its financial and economic viability and/or long term public benefit;

(c) land use and coastal development changes proposed in the vicinity through any statutory management strategies or plans that anticipate a change in public use and access in the area; and

(d) term of other consents in the vicinity, and the strategic benefit of all consents in an area expiring simultaneously.

(12) ...

Chapter F2.14.2 of the Regional Coastal Plan repeats similar themes from the NZCPS and RPS with respect to maintaining public access, ensuring that the resources in the CMA are used efficiently, and that the CMA is principally used for activities that have a functional or operational need to need to be there. Given this, it is considered that the analysis provided above with respect to the NZCPS and the RPS also applies with respect to the consideration of the proposed marine farm against Chapter F2.14.2 of the Regional Coastal Plan.

11.2.5.2 Chapter F2.15 – Aquaculture

F2.15.2. Objectives [rcp]

(1) The cultural, social and economic benefits of aquaculture are recognised.

(2) New aquaculture or the expansion or realignment of established aquaculture activities, occurs in appropriate locations and at appropriate scales that avoid, or where appropriate minimise, conflicts with ecological, social and cultural values and other uses.

(3) Established aquaculture activities are provided for and are not compromised by other uses or by activities that degrade water quality.

(4) Aquaculture activities are managed to minimise the risk of introducing or spreading harmful aquatic organisms.

F2.15.3. Policies [rcp]

(1) Require new aquaculture activities to be located and designed to avoid adverse effects on those characteristics and qualities that contribute to the identified values of:

(a) D9 Significant Ecological Areas Overlay – Marine 1 and 2;

(b) D17 Historic Heritage Overlay;

(c) D21 Sites and Places of Significance to Mana Whenua Overlay;

(d) D11 Outstanding Natural Character and High Natural Character overlays; and

(e) D10 Outstanding Natural Features Overlay; and Outstanding Natural Landscapes Overlay.

(2) Require, in addition to Policy F2.15.3(1), that new aquaculture activities be

designed and located to avoid significant adverse effects, and avoid, remedy or mitigate other adverse effects on the characteristics and qualities that contribute to the values of:

(a) Coastal – Mooring Zone;

(b) popular and safe navigation routes and anchorages, for example by complying with the current Maritime NZ guidelines for aquaculture;

(c) areas with high recreational use or amenity value; and

(d) public access, particularly to highly used areas.

(3) ...

(4) ...

(5) Require that structures used for aquaculture, or the introduction or relocation of equipment or stock, are managed to avoid, as far as practicable, the release or spread of harmful aquatic organisms.

(6) ...

(7) Apply a precautionary approach, such as adaptive management, when assessing applications for aquaculture activities that propose using species, techniques or locations not previously used for aquaculture and where the adverse effects are uncertain, unknown or little understood but are potentially significant.

(8) ...

(9) Where facilities and infrastructure associated with new aquaculture activities are necessary, require them to be provided for in an integrated manner where practicable including via the consolidation of the location of facilities or the sharing of wharf structures.

(10) Manage the allocation of space in areas where there is high and competing demand for space, or where there may be the opportunity for allocation of authorisations or consents within future aquaculture zones, through mechanisms described in Part 7A of the Resource Management Act, or by weighted attributes tendering that takes into account:

(a) economic, social, cultural and environmental sustainability;

(b) the local employment opportunity and profit retention in the Auckland region or other social good; and

(c) the opportunity for Mana Whenua to benefit by the location of the activity within their rohe moana.

(11) Consider aquaculture to be generally more appropriate when located in areas where it consolidates existing aquaculture activities provided that potential opportunities to maintain biosecurity are not compromised.

(12) ...

It is considered that aquaculture provisions in Chapter F2.15 effectively provide a comprehensive checklist of the matters to be considered when decision-makers consider resource consent applications for different types of aquaculture activities in the Auckland Region – based on the direction provided by the NZCPS and the RPS. Given this, the following provides a summary of how the proposed marine farm aligns with the matters set out in the objectives and policies in Chapter F2.15 of the Auckland Unitary Plan:

- The social and economic benefits of the proposed marine farm are discussed in section 5 of this AEE, and in section 11.2.3.2 in relation to the relevant provisions of the NZCPS;
- The location of the proposed marine farm means that adverse effects on overlay areas in the Auckland Unitary Plan relating to significant ecological values, historic heritage values, sites and places of significance to Mana Whenua, outstanding and high natural

character value, and outstanding natural features / landscapes will be avoided. No design measures are considered necessary to avoid adverse effects in this instance;

- The assessment of effects in section 7 of this AEE details the potential effects of the proposed marine farm on navigation and recreation in the Firth of Thames. In particular, it is noted that the proposed marine farm is not located near a Coastal – Mooring Zone in the Auckland Unitary Plan and will not adversely affect the usability of any popular or safe navigation routes in the Firth of Thames. The layout and design of the proposed marine farm is also such that recreational vessels (e.g. small boats) will be able to navigate their way through the farm blocks;
- In order to avoid the spread of unwanted pests and diseases, the proposed marine farm will be operated in accordance with the New Zealand Mussel Industry Seed Code of Practice;
- The application of the precautionary approach (and adaptive management) is discussed in section 11.2.3.3 of this AEE as it relates to the consistency of the proposed marine farm with Policy 3 of the NZCPS;
- With respect to associated facilities and infrastructure, no new infrastructure is proposed by the Consortium as part of the development of the proposed marine farm at this stage (including due to the staged development of the marine farm). In this regard, the support vessels will utilise the existing boat ramp / wharf facilities around the Firth of Thames – while the harvesting of mussels will be managed from the existing facilities located along the coastline of the Firth of Thames. As such, an integrated and efficient approach to the use of shore-based facilities will be adopted; and
- The site of the proposed marine farm in the Firth of Thames is considered appropriate given that it will consolidate existing aquaculture activities in the area – those being at Wilson Bay and Waimangō Point – and will not compromise biosecurity in the area.

Overall, it is considered that the location and design of the proposed marine farm will ensure that it is consistent with the outcomes sought by the Regional Coastal Plan with respect to aquaculture in the Auckland Region.

11.2.6 Other Matters

11.2.6.1 Hauraki Gulf Marine Park Act 2000

The Hauraki Gulf Marine Park Act 2000 ("**HGMPA**") came into force on 27 February 2000. The purpose of the Act is set out in section 3 as follows:

> ***3 Purpose***
> *The purpose of this Act is to—*
> *(a) integrate the management of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments:*
> *(b) establish the Hauraki Gulf Marine Park:*
> *(c) establish objectives for the management of the Hauraki Gulf, its islands, and catchments:*
> *(d) recognise the historic, traditional, cultural, and spiritual relationship of the tangata whenua with the Hauraki Gulf and its islands:*
> *(e) establish the Hauraki Gulf Forum.*

Section 13 of the HGMPA sets out that particular regard of sections 7 and 8 of the HGMPA must be had, section 7 sets out to recognise the national significance of the Hauraki Gulf and section 8 sets out the management of the Hauraki Gulf.

> ***7 Recognition of national significance of Hauraki Gulf***
>
> *(1) The interrelationship between the Hauraki Gulf, its islands, and catchments and the ability of that interrelationship to sustain the life-supporting capacity of the environment of the Hauraki Gulf and its islands are matters of national significance.*
>
> *(2) The life-supporting capacity of the environment of the Gulf and its islands includes the capacity—*
>
> *(a) to provide for—*
>
> *(i) the historic, traditional, cultural, and spiritual relationship of the tangata whenua of the Gulf with the Gulf and its islands; and*
>
> *(ii) the social, economic, recreational, and cultural well-being of people and communities:*
>
> *(b) to use the resources of the Gulf by the people and communities of the Gulf and New Zealand for economic activities and recreation:*
>
> *(c) to maintain the soil, air, water, and ecosystems of the Gulf.*
>
> ***8 Management of Hauraki Gulf***
>
> *To recognise the national significance of the Hauraki Gulf, its islands, and catchments, the objectives of the management of the Hauraki Gulf, its islands, and catchments are—*
>
> *(a) the protection and, where appropriate, the enhancement of the life-supporting capacity of the environment of the Hauraki Gulf, its islands, and catchments:*
>
> *(b) the protection and, where appropriate, the enhancement of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments:*
>
> *(c) the protection and, where appropriate, the enhancement of those natural, historic, and physical resources (including kaimoana) of the Hauraki Gulf, its islands, and catchments with which tangata whenua have an historic, traditional, cultural, and spiritual relationship:*
>
> *(d) the protection of the cultural and historic associations of people and communities in and around the Hauraki Gulf with its natural, historic, and physical resources:*
>
> *(e) the maintenance and, where appropriate, the enhancement of the contribution of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments to the social and economic well-being of the people and communities of the Hauraki Gulf and New Zealand:*
>
> *(f) the maintenance and, where appropriate, the enhancement of the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments, which contribute to the recreation and enjoyment of the Hauraki Gulf for the people and communities of the Hauraki Gulf and New Zealand.*

Based on the ecological assessment, and its focus on the potential cumulative effects of the proposed marine farm with other activities in the Firth of Thames, it is not considered that the farm will impact on the protection of the life-supporting capacity of the environment of the Hauraki Gulf.

Further, and based on the fact that the site of the proposed marine farm is located in an area identified for marine farming in the Hauraki Gulf Marine Spatial Plan 2016 it is considered

that it can be development in a manner that also protects the cultural associations of Mana Whenua with the Firth of Thames.

11.2.6.2 Auckland Council Navigation Safety Bylaw 2014

The Auckland Council Navigation Safety Bylaw 2014 ("**the Bylaw**") came into force on 25 October, applies to Auckland's navigable waters, and is pursuant to the Maritime Transport Act 1994, the Local Government Act 2002 and the Local Government (Auckland Council) Act 2009. Section 4 of the Bylaw sets out its purpose, which is to:

(a) regulate and control the use or management of vessels;
(b) regulate the placing and maintenance of moorings and maritime facilities;
(c) prevent nuisances arising from the use of vessels;
(d) prevent nuisances arising from the actions of persons and things on or in the water;
(e) reserve the use of any waters for specified persons or vessels;
(f) in relation to any sporting event, training activity, ceremonial or other authorised customary event,—
(i) prohibit or regulate the use of vessels;
(ii) regulate, or authorise the organisers of an event to regulate, the admission of persons to specified areas:
(g) regulate and control the use of anchorages;
(h) prescribe vessel traffic separation and management schemes;
(i) specify requirements for the carriage and use of personal flotation devices and buoyancy aids on recreational vessels;
(j) require the marking and identification of personal water craft.

Under the Bylaw, marine farm, such as that proposed by the Consortium, are considered structures. Those rules in the Bylaw that apply to structures and are relevant to the proposed marine farm include:

14 Speed of vessels
(1) A person in charge of a vessel must not operate a vessel at a proper speed exceeding 5 knots within:
...
(d) 200 metres of any structure;
17 Notification of collisions or accidents
(1) The owner and/or person in charge of a vessel that has been involved in a collision or accident must report the details of such, where:
(a) the collision or accident has caused damage to another vessel, or a navigation aid or any structure;
...
(3) A report must include:
...
(b) a full description of any damage to vessels or structures; and
...
21 Wake of recreational vessels
(1) A person in charge of a recreational vessel must ensure that the vessel's wake or the wake from any person or object being towed:
...
(b) does not cause danger or risk of damage to other vessels, structures, or navigation aids; and
...
78 Intervention by the Harbourmaster

(1) In any case where the Harbourmaster is not satisfied adequate precautions have been taken to ensure the health or safety of any person or the public or to avoid damage to any vessel, structure, wharf or the environment, the Harbourmaster may prohibit or restrict the activity until it is satisfied adequate precautions have been taken.

The proposed marine farm will be operated in a manner that complies with the Bylaw. In addition, and based on the assessment of potential navigation effects in section 7 of this AEE, it is not considered that the proposed marine farm will represent a hazard to commercial and recreational vessels operating in the Firth of Thames. Any potential effects will also be avoided or mitigated by the installation of navigational lighting around the perimeter of the marine farm.

11.2.6.3 Hauraki Iwi Environmental Plan

The Hauraki Iwi Environmental Plan ("**HIEP**") became operative in March 2004, and it provides a strategy for collective action by Hauraki Whānui to sustain the mauri if the natural environment and cultural heritage of the Hauraki rohe over the next 50 years. The Hauraki rohe extends from Matakana Island (north of Tauranga), to Matakana Estuary (north of Warkworth). The parts of the vision for the HEIP relevant to the proposed marine farm are that *"the land and sea have once again become abundant food baskets"* and that *"all waahi tapu and cultural heritage sites and landscapes in Hauraki are being protected, managed and rehabilitated by kaitiaki at all levels of the tribal spectrum"*.

Part 3 of the HIEP identifies key resource and geographical based issues of concern to Hauraki Whānui and develops corresponding objective and outcomes for them. The HEIP does this by dividing Part 3 into subsections, by environment, relevant to the proposed marine farm is *"Tangaroa Rerenga Wai Tai"*, the sea. Objectives and outcomes sought are as follows:

Objectives

a) Protect and restore coast, beach and estuarine habitats and ecosystems in the Hauraki tribal region.

...

e) To agree on siting and production levels for marine farming in Tikapa Moana.

f) To establish a fully developed habitat, resource and productivity based strategy and monitoring programme for Hauraki's coastal seas.

...

Outcomes

a) Restoration of the mauri of local ecosystems and fisheries

b) Improved water and seabed quality

c) Increased fisheries production from Tikapa Moana

d) Fisheries and marine farming at sustainable levels in Tikapa Moana

...

Part 5 provides a framework for action by Hauraki Whānui to progress towards the objective and outcomes of Part 3. Regarding Tangaroa Rerenga Wai Tai these actions focus on Hauraki Whānui developing and adopting regional strategies, plans and programmes, methods, protocols, and working with potential external partners such as the Ministry of Fisheries, Regional Council, Department of Conservation, and NIWA.

11.2.6.4 Hauraki Gulf Marine Spatial Plan 2016

The Hauraki Gulf Marine Spatial Plan 2016 is a non-statutory plan developed by Sea Change – Tai Timu Tai Pari ("**Sea Change**"). Drafting of the plan began in late 2013 and was completed in late 2016. The Hauraki Gulf Marine Spatial Plan 2016 and Sea Change are driven by a Project Steering Group with 16 members from mana whenua, the Hauraki Gulf Forum, Auckland Council, Waikato Regional Council, Territorial Authorities, the Ministry for Primary Industries and Department of Conservation, and a Project Board of five six members, one from each of the above groups.

As already noted in this AEE, the proposed marine farm is located in an area identified in the Hauraki Gulf Marine Spatial Plan 2016 as being appropriate for aquaculture development in the Hauraki Gulf.

11.2.7 Part 2 Matters

11.2.7.1 Section 5 of the RMA

The provisions of section 104 of the RMA are all *"subject to Part 2"*. The purpose of the RMA (section 5) is to promote the sustainable management of natural and physical resources. The Act defines *"sustainable management"* as:

> *(2) ...managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while—*
>
> *(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
>
> *(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
>
> *(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

Applying section 5 of the RMA, and the other relevant matters under Part 2 of the Act, can involve the assessment of conflicting considerations - including the positive and adverse effects associated with the use, development and protection of resources. In addition, the consideration of the matters in sections 5(2)(a) – (c) is often informed by the direction provided in the objectives and policies in the relevant statutory planning documents, which have been considered in detail in section 5.2 of this AEE.

With respect to the requirement that any adverse effects of activities be avoided, remedied or mitigated, case law has established that it is not required that all effects be avoided, or that there is no net effect on the environment. Rather, section 5(2)(c) of the RMA is concerned about doing what is reasonably necessary, given the circumstances of the particular case, to lessen the severity of the effects of an activity. The approach to managing effects at the proposed marine farm, including its location and design, and its monitoring and adaptive management regime is consistent with this requirement.

11.2.7.2 Section 6 – Matters of National Importance

Section 6 of the RMA identifies matters deemed to be of national importance. In exercising their functions and powers under the RMA, consent authorities must recognise and provide for the relevant matters. With respect to the proposed marine farm, the matters of relevance are:

> *(a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins and the protection of them from inappropriate subdivision, use and development:*
> *(b) The protection of outstanding natural features and landscapes from inappropriate subdivision, use and development:.*
> *(c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:*
> *(d) The maintenance and enhancement of public access to and along the coastal marine area, lakes and rivers:*
> *(e) The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, wahi tapu, and other taonga:*
> *(f) The protection of historic heritage from inappropriate subdivision, use, and development:*

Section 6(g) of the RMA is not considered relevant to this assessment as there are no recognised customary activities identified in the area around the proposed marine farm.

Section 6(a)

The preservation of the natural character of the coastal environment in the vicinity of the proposed marine farm and its protection from inappropriate use and development is a matter of national importance in accordance with section 6(a) of the RMA. Of particular note when considering the proposed marine farm in this context:

- The definition of what constitutes natural character has evolved over the period since the enactment of the RMA. It has become generally accepted that natural character derives from the presence of natural elements, biophysical features and perceptual aspects;
- Protection in a section 6(a) context means keeping safe from injury or harm, rather than absolute protection, prevention or prohibition; and
- An assessment of 'appropriateness' in a section 6(a) context must be made on a case by case basis in terms of the values that contribute to the natural character of a site.

The relative significance of the various values that comprise the natural character of the western Firth of Thames, and the anticipated effects of the proposed marine farm on those values, are outlined in sections 4 and 8 of this AEE respectively. In particular, it is noted that the proposed marine farm is not located in an area of high or outstanding natural character (with the closest area of high natural character being approximately 4.2 km to the west of the site) and is a considerably distance from shore – meaning its impact on the aesthetic values of the Firth of Thames will be minimised.

Effects on the various coastal processes evident in the Firth of Thames are also expected to minimal. In this regard, as the longlines will be orientated parallel to the current at the proposed marine farm, any effects on the currents will be minimised and would be unlikely

to affect movement of sediment or shoreline processes - as the proposed marine farm site is at least 5 km offshore and the current flow is predominantly parallel to the shore.

Overall, it is considered that the proposed marine farm does not constitute inappropriate development and will not impact on the protection of natural character in accordance with section 6(a) of the RMA.

Section 6(b)

Section 6(b) seeks to protect outstanding natural features and landscapes from inappropriate use and development. As already noted in this AEE, the nearest outstanding landscape to the proposed marine farm is located approximately 4.2 km to the west. Given this, it is not considered that the proposed marine farm will affect the protection of any outstanding natural landscape and does not constitute an inappropriate development.

Section 6(c)

Section 6(c) of the RMA seeks to protect areas of significant indigenous vegetation and significant habitats of indigenous fauna.

As noted in section 3 of this AEE, the proposed marine farm is not located in an area identified in the Auckland Unitary Plan as being a significant ecological area. That said, it is acknowledged that the Hauraki Gulf and the Firth of Thames provide habitat for marine mammals that are listed as threatened or at risk. Further, the intertidal area of the southern and western shores of the Firth of Thames is designated as a RAMSAR wetland.

Based on the effects assessment in section 6 of this AEE, it is not considered that the proposed marine farm will affect the protection of areas that are significant habitats of indigenous fauna. Habitat exclusion, underwater noise and potential entanglement appear to be minor issues for mussel farming. In addition, given that the Firth of Thames is approximately 1,100 km^2, full development of the proposed marine farm along with Areas A and B of the Wilson Bay Marine Farming Zone would only exclude marine mammals from less than 4% of the total area of the Firth of Thames.

With respect to potential effects on birds, section 6 of this AEE notes that the proposed marine farm will be at least 15 km from the RAMSAR site and that the most important feeding areas for wading birds are the intertidal areas in the southern Firth of Thames. There is also no evidence of entanglement of seabirds in marine farm structures in New Zealand, and with the current method of cultivation for mussel farms the risk of this occurring is considered low.

Section 6(d)

Section 6(d) relates to the maintenance and enhancement of public access to, and along, the CMA.

Section 7 of this AEE discuss the potential effects of the proposed marine farm on navigation and recreation in the Firth of Thames. In particular, navigation and recreation within the vicinity of the site of the proposed marine farm is reasonably low and that it will not represent

a hindrance to commercial vessels in the Western Firth of Thames (as commercial vessels do not generally use the area).

Public access would be provided between the 35 blocks comprising the proposed marine farm. In this regard, the gaps between each of the blocks will range between 50 and 72 metres. Based on experience at other marine farms, including those at Wilson Bay, the provision of access through the proposed marine farm will provide increase recreational fishing opportunities.

Given the above, it is considered that any potential adverse effects on navigation and public access will be minimal and that the proposed marine farm will generally enable the maintenance of public access to, and along, the CMA.

Section 6(e)

Section 6(e) of the RMA refers to the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, wahi tapu and other taonga.

As noted in section 8 of this AEE, the Consortium intend to further engage with iwi of the Hauraki Gulf in order to gain a better understanding of the potential effects of the proposed marine farm on their cultural associations with the Firth of Thames. That said, it is noted that the Consortium includes significant representation from Hauraki Iwi - who regard aquaculture development as a modern extension of traditional kaimoana activities. As such, it is viewed that the development of aquaculture in the western Firth of Thames can be undertaken in a manner that aligns with section 6(e) of the RMA.

It is also noted that the proposed marine farm is not located near any sites or places of significance to mana whenua identified in the Auckland Unitary Plan.

11.2.7.3 Section 7 – Other Matters

Section 7 of the RMA identifies additional matters that consent authorities shall have particular regard to when exercising their functions and powers under the Act. With respect to the proposed marine farm, the following matters in section 7 of the RMA are considered to be relevant:

(a) Kaitiakitanga:
(aa) The ethic of stewardship:
(b) The efficient use and development of natural and physical resources:
(ba) ...
(c) The maintenance and enhancement of amenity values:
(d) Intrinsic values of ecosystems:
(e) [Repealed]
(f) Maintenance and enhancement of the quality of the environment;
(g) Any finite characteristics of natural and physical resources:
...

Sections 7(a) and (aa)

Sections 7(a) and (aa) of the RMA require particular regard to given to kaitiakitanga and the ethic of stewardship.

As with the discussion on section 6(e) of the RMA, it is considered that the proposed marine farm can be developed in a manner that gives particular regard to the kaitiakitanga responsibilities of the iwi of the Hauraki Gulf. This will be considered further in discussions with relevant iwi.

Section 7(b)

Section 7(b) of the RMA is concerned with the efficient use and development of natural and physical resources.

The proposed marine farm is considered to be an efficient use of natural and physical resources as it will enable the utilisation of a coastal location that is suitable for the growing of mussels (due to its water depth, water quality and sheltered located). The operation of the proposed marine farm will also rely on the utilisation of existing shore-based facilities around the Firth of Thames – limiting the need to develop further infrastructure in the short term.

Section 7(c)

With respect to section 7(c) of the RMA, the potential effects of the proposed marine farm on amenity values will be primarily limited to the amenity values of those persons traversing the CMA in a vessel in the vicinity of the proposed marine farm.

Based on the navigation assessment in section 7 of this AEE, the number of experience traversing past the site in vessels are likely to be reasonably limited due to the reasonably low usage of the Firth of Thames by commercial and recreational vessels. Any potential amenity effects will be minimised by the low profile of the proposed marine farm in the water, the proximity of the vessel to the marine farm, and changing weather and sea conditions (i.e. the visibility of the proposed marine farm – excluding the navigation lighting - will generally be reduced in swell conditions).

The proposed marine farm will not generally be visible or obvious in the seascape to people living and travelling around the shoreline of the western Firth of Thames (except potentially from elevated locations). As with the above, potential effects on amenity will be reduced by the low profile of the proposed marine farm

Aspects of recreational amenity may also be enhanced by virtue of people utilising the marine farm as a location to fish – as has been experienced at Wilson Bay in the Coromandel.

Section 7(i) Sections 7(d), (f) and (g)

Sections 7(d), (f) and (g) of the RMA relate to the intrinsic values of ecosystems, the quality of the environment, and the finite characteristics of natural and physical resources. Based on the conclusions outlined in sections 6 of this AEE, it is considered that particular regard has been given to the intrinsic values of ecosystems and to the maintenance of the quality of the environment in the location and design of the proposed marine farm and its monitoring and adaptive management regime.

11.2.7.4 Section 8 – Treaty of Waitangi

Section 8 sets out that all persons exercising functions and power under the RMA, in relation to managing the use, development and protection of natural and physical resources, shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

The Consortium is not a *"person exercising functions and powers under the RMA"* for the purpose of the resource consent applications to establish the proposed marine farm. In this regard, Auckland Council have the *"functions and powers under the RMA"* with respect to the resource consent applications being sought by the Consortium.

That said, it is considered that the development of the proposed marine farm will assist in providing for the rights of iwi with respect to aquaculture development in the Firth of Thames.

11.2.7.5 Overall Conclusion Regarding Part 2

There are two general elements of sustainable management in the context of section 5 of the RMA that must be considered when assessing a resource consent application. They are whether a proposal will enable people and communities to provide for their social, economic and cultural wellbeing, and (at the same time) whether the environment will be safeguarded through the avoidance, remediation or mitigation of adverse effects.

The development of the proposed marine farm will have significant and demonstrable positive effects in terms of sustaining the social and economic wellbeing of the local and regional community.

In addition, extensive consideration has been to the natural and physical resource values of the project site in developing and designing the proposed marine farm. As such, a number of potential environmental effects have been able to be avoided through site selection and design. Whilst the proposed marine farm will have some effects on the environment, these effects will be avoided, remedied or mitigated as far as practicable through the imposition of the robust resource consent conditions including the robust monitoring and adaptive management regime. It is, therefore, considered that the project will safeguard the life-supporting capacity of air, water, soil and ecosystems.

Overall, it is considered that the project site is an appropriate location for a proposed marine farm of the nature proposed and that the construction, operation and maintenance of the proposed marine farm will promote the sustainable management of natural and physical resources in accordance with Part 2 of the RMA.

11.3 SECTION 105 – MATTERS RELEVANT TO DISCHARGE APPLICATIONS

In addition to the matters which a consent authority must have regard to under section 104 of the RMA, section 105 of the Act sets out additional matters which must be considered when considering applications for discharge or coastal permits. In particular, section 105 of the RMA states:

> *(1) If an application is for a discharge permit or coastal permit to do something that would contravene section 15 or section 15B, the consent authority must, in addition to the matters in section 104(1), have regard to—*

(a) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and
(b) the applicant's reasons for the proposed choice; and
(c) any possible alternative methods of discharge, including discharge into any other receiving environment.

The discharges from the proposed marine farm are limited to biodegradable and organic matter from the mussel lines. The sensitivity of the coastal receiving environment is addressed in section 4 of this AEE, while the effects of the biodegradable and organic matter on the environment and water quality are addressed in section 6.

Various design elements (including stocking density) contribute to the discharge of biodegradable and organic matter from the mussel lines. In this case the configuration of the proposed marine farm has been designed to not exceed the carrying capacity of the receiving environment and to avoid, remedy or mitigate any potential adverse effects of the discharge.

Monitoring and the use of environmental trigger levels will also be utilised to manage the potential effects of the discharge of biodegradable and organic matter from the mussel lines matter to the coastal environment.

11.4 SECTION 107 – RESTRICTION TO GRANT DISCHARGE PERMITS

Section 107 describes certain circumstances in which a consent authority shall not grant a discharge or coastal permit. In particular, a consent authority cannot grant a permit seeking to discharge a contaminant or water into water if, after reasonable mixing, the contaminant or water discharged is likely to give rise to all, or any, of the following effects in the receiving waters:

(c) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
(d) Any conspicuous change in colour or visual clarity;
(e) Any emission of objectionable odour;
(f) The rendering of fresh water unsuitable for consumption by farm animals;
(g) Any significant adverse effects on aquatic life.

Based on the assessment in section 6 of this AEE, and the conclusions regarding the water quality and ecological effects of the proposed marine farm, it is not considered that the granting of the resource consents sought by the Consortium will give rise to any of the effects listed above after reasonable mixing.

12. CONCLUDING STATEMENT

The proposed marine farm will have significant and demonstrable positive effects in terms of sustaining the social and economic wellbeing of the local and regional community.

The addition of mussel farming to the Firth of Thames will also assist in mitigating the decline of the health of the Firth. This decline is due to man-made land based activities. Mussel farming will, by returning a once abundant native species to the environment, will assist in reversing the decline by increasing habitat biodiversity, reducing nutrient loading and filtering the waters of the Hauraki Gulf.

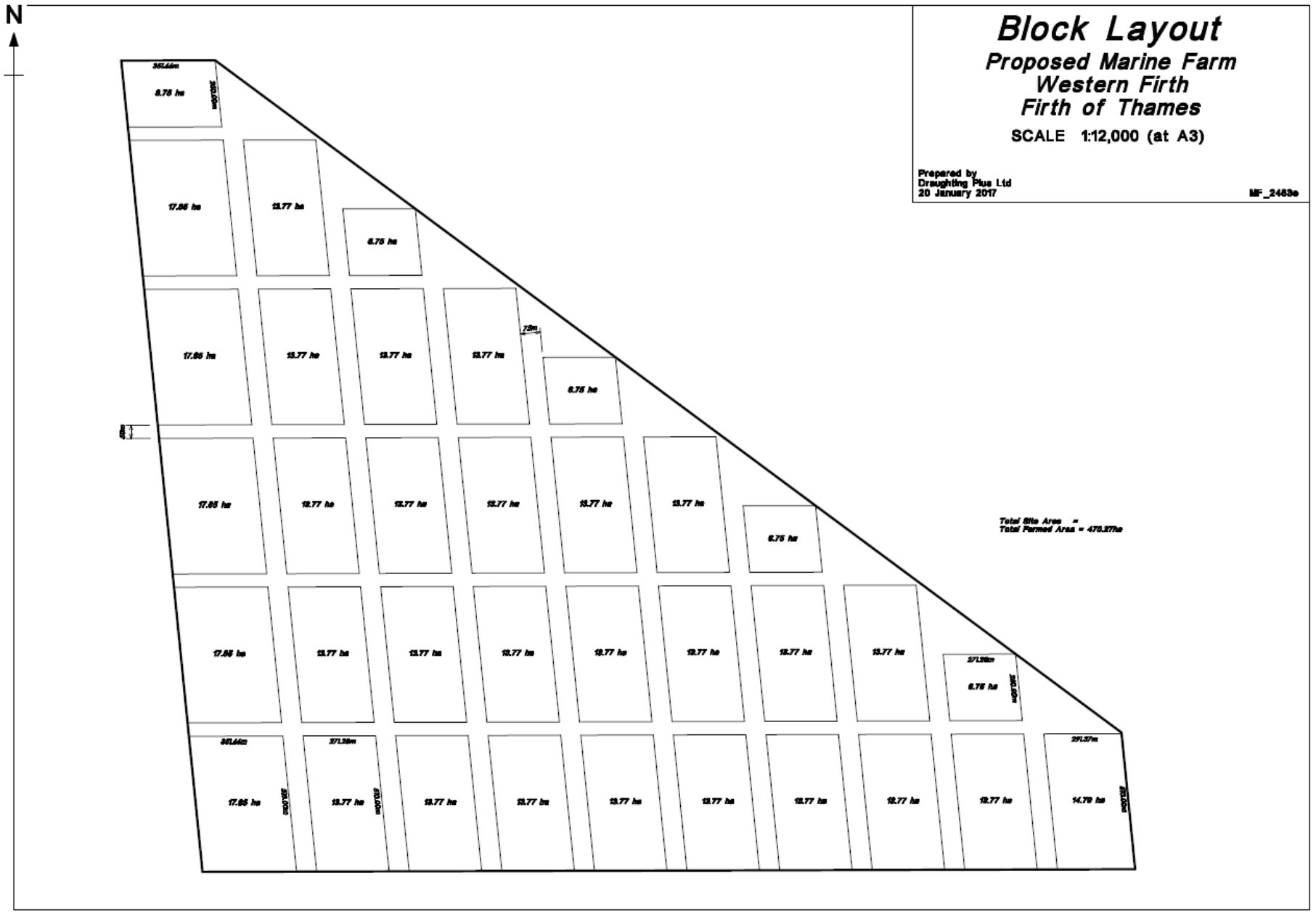
Extensive consideration has been given to the natural and physical resource values in the Firth of Thames in developing and designing the proposed marine farm. As such, a number of potential environmental effects have been able to be avoided through site selection and design.

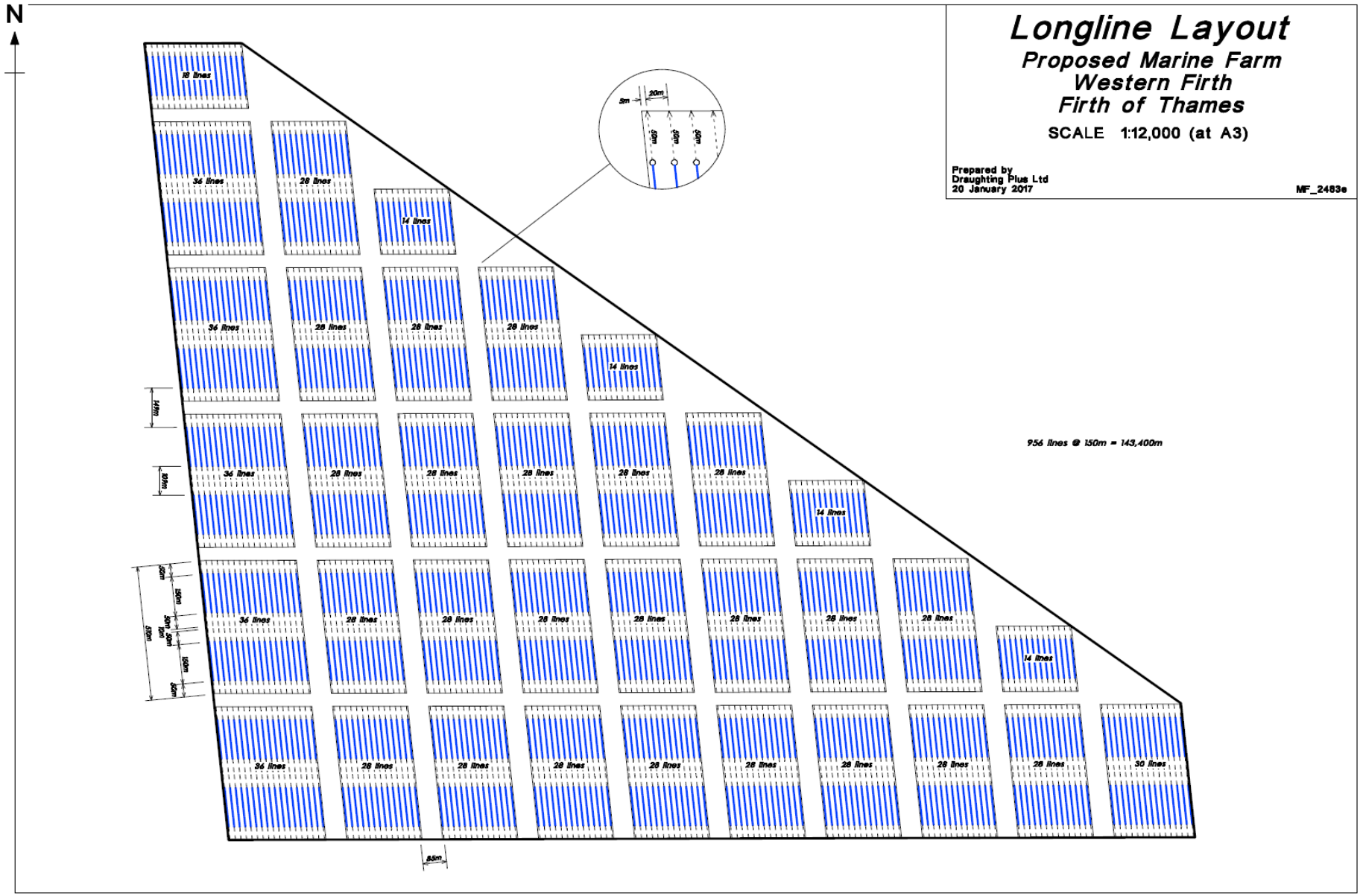
Whilst the proposed marine farm will have some effects on the environment, these effects will be avoided, remedied or mitigated as far as practicable through the imposition of robust resource consent conditions - including the robust monitoring and staged development regime. It is, therefore, considered that the project will safeguard the life supporting capacity of air, water, soil and ecosystems.

Overall, it is considered that the project site is an appropriate location for a marine farm of the nature proposed by the Consortium and that the construction, operation and maintenance of the proposed marine farm can promote the sustainable management of natural and physical resources in accordance with Part 2 of the RMA. Having considered the relevant statutory tests that apply to it, there is no reason it should not be granted.

APPENDIX A

Proposed Marine Farm Block and Longline Layout


N
Block Layout
Proposed Marine Farm
Western Firth
Firth of Thames
SCALE 1:12,000 (at A3)
Prepared by
Draughting Plus Ltd
20 January 2017
MF_2483e
361.44m
6.75 ha
360.00m
17.86 ha
13.77 ha
6.75 ha
72m
8.75 ha
Total Site Area =
Total Farmed Area = 470.37ha
371.28m
361.37m
14.79 ha



Longline Layout

Proposed Marine Farm
Western Firth
Firth of Thames

SCALE 1:12,000 (at A3)

Prepared by
Draughting Plus Ltd
20 January 2017

MF_2483e

B

APPENDIX B

Schedule 4 Assessment

Clauses 2, 3, 6 and 7 of the Schedule 4 of the RMA specify information requirements that are relevant to these applications and this AEE. The tables below outline where that information is provided in this AEE.

In accordance with Clause 1 of Schedule 4, in each case the information required by its other sections, and which is included in this AEE, is specified in sufficient detail to satisfy the purpose for which it is required.

Schedule 4: Clause 2 – Information required in all applications.

(1)	**An application for a resource consent for an activity (the activity) must include the following:**	**Location Addressed in AEE**
	(a) a description of the activity:	See section 2.
	(b) a description of the site at which the activity is to occur:	See section 4.
	(c) the full name and address of each owner or occupier of the site:	Her Majesty the Crown.
	(d) a description of any other activities that are part of the proposal to which the application relates:	Not applicable.
	(e) a description of any other resource consents required for the proposal to which the application relates:	See section 3.
	(f) an assessment of the activity against the matters set out in Part 2:	See section 11.
	(g) an assessment of the activity against any relevant provisions of a document referred to in section 104(1)(b).	See section 11.
(2)	The assessment under subclause (1)(g) must include an assessment of the activity against—	
	(a) any relevant objectives, policies, or rules in a document; and	See section 11.
	(b) any relevant requirements, conditions, or permissions in any rules in a document; and	See section 11.

	(c) any other relevant requirements in a document (for example, in a national environmental standard or other regulations).	See section 11.
(3)	An application must also include an assessment of the activity's effects on the environment that	
	(a) includes the information required by clause 6; and	Outlined below.
	(b) addresses the matters specified in clause 7; and	Outlined below.
	(c) includes such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.	This assessment of environmental effects is considered to have drawn from technical assessments

Schedule 4: Clause 3 – Additional information required in some applications.

Information Requirement	Location Addressed in AEE
An application must also include any of the following that apply:	
(a) if any permitted activity is part of the proposal to which the application relates, a description of the permitted activity that demonstrates that it complies with the requirements, conditions, and permissions for the permitted activity (so that a resource consent is not required for that activity under section 87A(1)):	No permitted activities are relied upon.
(b) if the application is affected by section 124 or 165ZH(1)(c) (which relate to existing resource consents), an assessment of the value of the investment of the existing consent holder (for the purposes of section 104(2A)):	Not applicable.

(c)	if the activity is to occur in an area within the scope of a planning document prepared by a customary marine title group under section 85 of the Marine and Coastal Area (Takutai Moana) Act 2011, an assessment of the activity against any resource management matters set out in that planning document (for the purposes of section 104(2B)).	Not applicable

Schedule 4: Clause 6 – Information required in assessment of environmental effects.

Information Requirement			Location Addressed in AEE
(1)	An assessment of the activity's effects on the environment must include the following information:		
	(a)	if it is likely that the activity will result in any significant adverse effect on the environment, a description of any possible alternative locations or methods for undertaking the activity:	As outlined in sections 6 – 9 the activity will not have any significant adverse effects on the environment
	(b)	an assessment of the actual or potential effect on the environment of the activity:	See sections 5 – 9.
	(c)	if the activity includes the use of hazardous substances and installations, an assessment of any risks to the environment that are likely to arise from such use:	Not applicable.
	(d)	if the activity includes the discharge of any contaminant, a description of	See section 4.
		(i) the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and	
		(ii) any possible alternative methods of discharge, including discharge into any other receiving environment	

	(e) a description of the mitigation measures (including safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effect	
	(f) identification of the persons affected by the activity, any consultation undertaken, and any response to the views of any person consulted:	
	(g) if the scale and significance of the activity's effects are such that monitoring is required, a description of how and by whom the effects will be monitored if the activity is approved:	
	(h) if the activity will, or is likely to, have adverse effects that are more than minor on the exercise of a protected customary right, a description of possible alternative locations or methods for the exercise of the activity (unless written approval for the activity is given by the protected customary rights group).	
(2)	A requirement to include information in the assessment of environmental effects is subject to the provisions of any policy statement or plan.	See section 11.
(3)	To avoid doubt, subclause (1)(f) obliges an applicant to report as to the persons identified as being affected by the proposal, but does not—	No specific consultation has been undertaken in preparing this application.
	(a) oblige the applicant to consult any person; or	
	(b) create any ground for expecting that the applicant will consult any person.	

Schedule 4: Clause 7 – Matters that must be addressed by assessment of environmental effects.

Information Requirement			Location Addressed in AEE
(1)	An assessment of the activity's effects on the environment must address the following matters:		
	(a)	any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects:	See sections 5 - 9.
	(b)	any physical effect on the locality, including any landscape and visual effects	See sections 6 and 8.
	(c)	any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity	See section 6.
	(d)	any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural value, or other special value, for present or future generations	See sections 6 – 19
	(e)	any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants	See section 6.
	(f)	any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations.	Not applicable.
(2)	The requirement to address a matter in the assessment of environmental effects is subject to the provisions of any policy statement or plan		See section 11.