

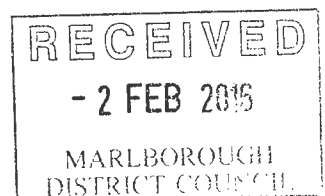
*Davidson Environmental Limited*

Biological report in relation  
to a new marine farm  
application located in  
Kaikoura Bay, Port  
Underwood

Research, survey and monitoring report number 830

*A report prepared for:  
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January 2016



Bibliographic reference:

Davidson, R.J. 2016. Biological report in relation to a new marine farm application located in Kaikoura Bay, Port Underwood. Prepared by Davidson Environmental Ltd. for Scott Madsen Family Trust. Survey and monitoring report no. 830.

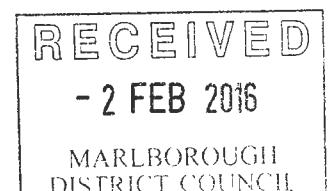
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January 2016



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## 1.0 Introduction

The aim of the present study was to provide biological information for a new 1.9 ha marine farm application located along the eastern shoreline of Port Underwood in Kaikoura Bay (Figure 1, Plates 1 and 2). Specifically, this study provides biological information relating to the benthos, habitats and ecological attributes of the marine farm.

Information on the benthos from adjacent areas including representative samples from (a) under an existing mussel farm located south-east of the application, and (b) from a known significant site located near the application were also collected.



**Figure 1. Location of the application site (red circle) located in Port Underwood.**



*Plate 1. Oblique Google Earth aerial showing the location of application (grey) in Kaikoura Bay, Port Underwood.*

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*Plate 2. Looking southward from a position north of the application looking towards the head of Kaikoura Bay.*

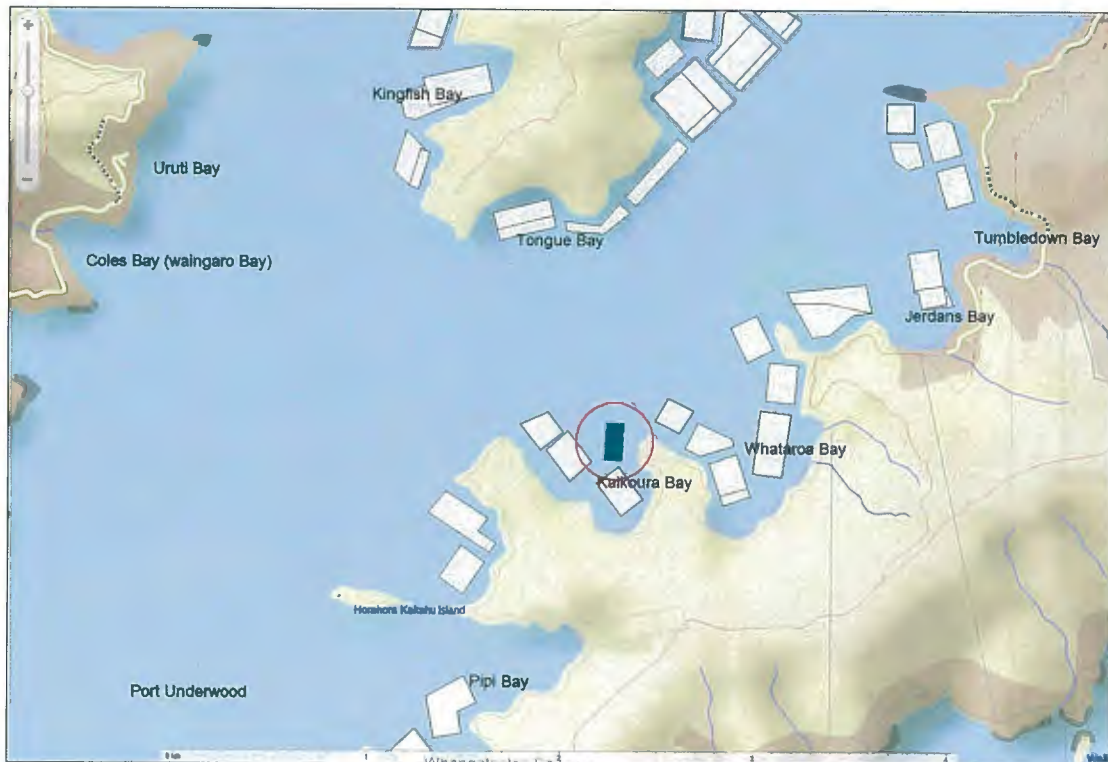
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## 2.0 Background information

### 2.1 Study area

Kaikoura Bay is a small bay located along the eastern shoreline of Port Underwood. Kaikoura Bay has a coastline length of approximately 1600 m and covers a sea area of approximately 25.9 ha. The Bay is approximately 745 m wide across the mouth and is approximately 5.2 km from Ngakuta Bay, at the head of the eastern arm of Port Underwood.

A number of existing marine farm consents are located around the present application (Figure 2).



**Figure 2. Location of the application area (red circle) and other consented marine farms in the vicinity (grey).**

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## 2.2 Historical reports

One biological report was found in relation to an earlier marine farm application at the present site (Brosnan 1999). The author stated:

“This report presents a biological description of benthic habitats and associated conspicuous macrobenthic communities from an area [2.9 ha] proposed as a marine farm located along Kaikoura Point, Port Underwood. The sea floor extends from the shore as large boulders, interspersed with broken shell and fine silt to a depth of around 10 m and to a distance of 70 m from shore. From 70 m, the sea floor is mainly composed of fine silt and clays. The topography of the sea floor is rather constant at a distance of 100 m from the shore, averaging a depth of 15 m.

A total of 26 species was recorded, covering a wide range of animal and plant groups. The most widespread organism along the transects was a polychaete tubeworm that exists in the fine sediments of the sea floor. The density of these tubeworms are reasonably high and are common throughout the fine sediments of Port Underwood. These tubeworms were observed only on fine silt substrates.

The habitat that supported the greatest number of species was the stone and cobble substrates which extended to a depth of around 10 m, with 24 species. The habitat that supported the least number of species was the silt/clay habitats which dominated the majority of the transects. Live horse mussels were observed however the density of the horse mussel was below the trigger levels (DoC, 1995). No lampshells (Brachiopoda) were observed on any of the transects. No large hydroid species were observed. One species of bryozoan was identified as *Caberea solida*. Only one tuft of the bryozoan was observed and was no bigger than 5 cm tall.

Dead tubeworm mounds were observed at a depth of 5 m and a distance of 50 m from shore. These mounds now have a thick covering of coralline paint (Lithothamnion). A transverse dive along the site revealed that all the *Galeolaria hystrix* mounds observed were in fact dead. The only living specimens of *Galeolaria hystrix* were seen growing individually on large boulders or rock.”

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Brosnan (1999) concluded:

“The present study identified that the most diverse benthic community exists between 0 and 10 m depth which is inshore of the proposed farm boundary. Horse mussels were detected in low densities, below the trigger levels set by the Department of Conservation (DoC, 1995). The bottom type was dominated by fine silt and clays and only the first 10 m of water appeared to contain rock and cobble as the main substrate type. The topography is reasonably consistent beneath the proposed marine farm and a constant depth (14-15 m).

The study site is located well within Port Underwood and experiences low tidal currents and little wave action. An area north of the proposed farm has been identified as containing tubeworm mounds. The transects undertaken in the present study also noted the presence of tubeworm mounds at a depth of around 5 m and located a distance of 50 m from the shore. However, all the tube worm mounds observed in this study were dead and broken.”

### 3.0 Methods

A new biological survey for the present application was conducted on 16th December 2015. Prior to fieldwork, the proposed marine farm application corners were plotted onto mapping software (TUMONZ). The laptop running the mapping software was linked to a portable USB GPS receiver allowing real-time plotting of the corners of marine farm surface structures and to pinpoint drop camera stations in the field. This GPS system has a maximum error of +/- 5 m. The depth at each corner of the proposed marine farm was surveyed using the real-time GPS.

#### 3.1 Sonar

Sonar investigations were conducted using a Furuno colour sounder. This unit provides standard sonar imaging. Prior to the collection of drop camera photographs, the boundaries of the application were investigated using the sonar devise. Any bottom abnormalities such as reefs, hard substrata or abrupt changes in depth were noted for latter inspection using the drop camera (see section 3.2).

### **3.2 Drop camera stations, site depths and diver inspection**

A total of 36 drop camera photographs were collected from the survey area. Most photographs were collected from within the proposed marine farm area, however, photographs were also collected from areas inshore and alongshore of the application. A number of photographs were also collected from under backbones on an adjacent existing mussel farm.

At each site, a Sea Viewer underwater splash camera fixed to an aluminium frame was lowered to the benthos and an oblique still photograph was collected where the frame landed. At most photo-point stations the camera was allowed to drift allowing viewing of a wider area around the photo-point station.

The location of photograph stations was selected in an effort to obtain good coverage of the proposed application area. Additional photographs were taken when any features of particular interest (e.g. shell debris, reef structures, cobbles) were observed on the remote monitor on-board the survey vessel. All photographs collected during the survey have been included in Appendix 1.

Two GPS positions were collected from the low tide mark inshore of the application. This was done by positioning the survey vessel and GPS receiver over the low tide mark. The position of the low tide mark was determined using the transition zone between intertidal and subtidal biological communities.

### **3.3 Surface photographs**

A surface photograph was collected looking towards the proposed marine farm area from an area north of the application. This was collected using the iPhone4s panoramic function to minimize any distortion usually associated with "stitching" separate photos together.



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## 4.0 Results

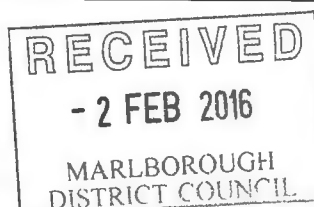
### 4.1 Application corner depths

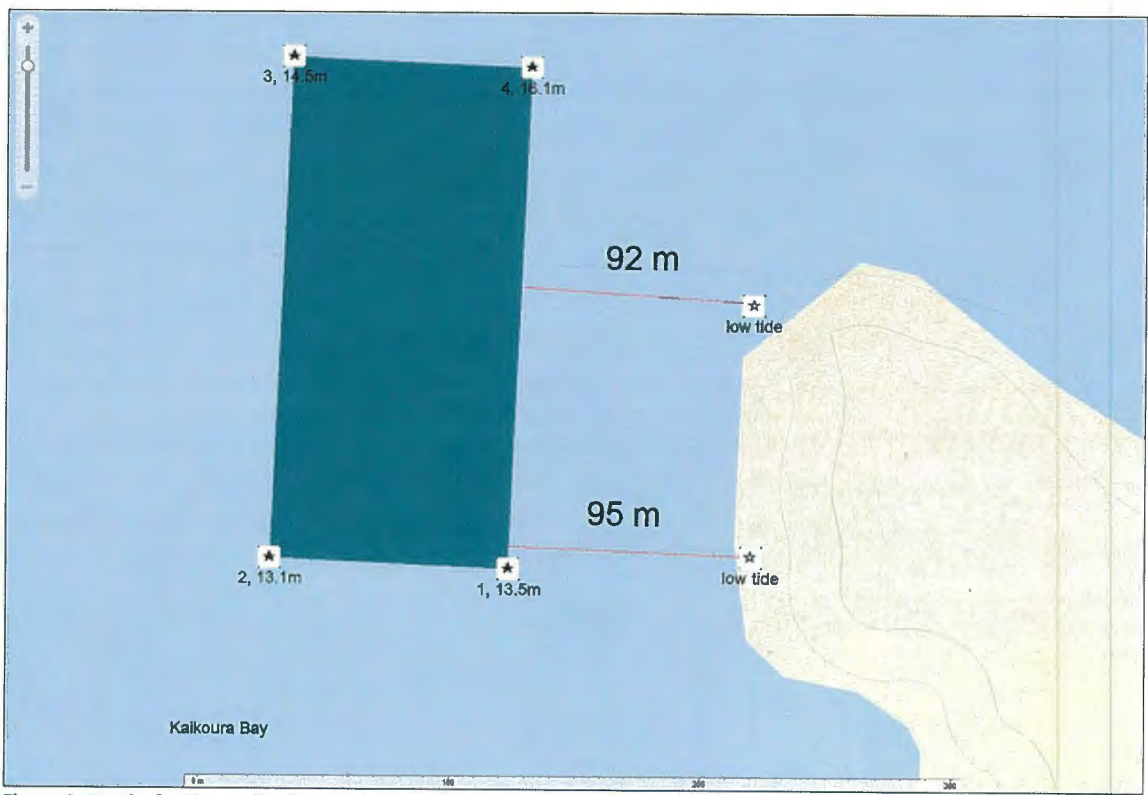
Inshore corner depths of the application ranged from 13.5m to 16.1m, while the offshore corner depths ranged from 13.1 m to 14.5m (Table 1, Figure 3).

The distance between low water and the inshore boundary of the application was 92m (north) and 95m (south) (Figure 3).

*Table 1. Depths recorded from the corners of proposed consent corners. Depths adjusted to datum. Coordinates = NZTM (Northing/Easting). Low tide coordinates and the distance to the initially proposed marine farm are listed.*

Type	No. & Depth (m)	Coordinates
Application corner	1, 13.5m	1696176.9,5424532.4
Application corner	2, 13.1m	1696081.8,5424536.4
Application corner	3, 14.5m	1696090.5,5424736.2
Application corner	4, 16.1m	1696185.4,5424732.1
Low tide (south)		1696273.4,5424537.1
Low tide (north)		1696274.4,5424638.0





**Figure 3. Depths for the application (teal rectangle). The position of low tide and the distance to the application is indicated.**

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## 4.2 Substratum and habitats

Substratum and habitat distribution relative to the proposed marine farm application were based on 36 drop camera images combined with sonar depth soundings conducted throughout the application. Topographical and biological features inside the application were compared to adjacent areas and areas under the adjacent mussel farm (Figures 4a, 4b, Table 2, Appendix 1).

Habitats and substratum recorded from the application were characterised by silt and clay substratum (Table 2). This mud substratum supported an abundant population of Maldanid tubeworms (Plate 4). Branching algae were observed amongst and growing over and amongst tubeworms. Soft tubeworms and branching algae were observed from: (a) all photos taken in the application area (e.g. Plate 5); (b) inshore of the application; and (c) under the adjacent mussel farm (e.g. Plate 6). Within increasing distance into Kaikoura Bay including areas inshore of the adjacent farm, the cover of algae and tubeworms appeared to decline (Plate 7, Photos 15-22 In: Appendix 1).

The area north and east of the application and offshore of the promontory is known to support an area of calcareous tubeworms (*Galeolaria hystrix*) (Plate 9) (Davidson *et al.* 1995, Davidson *et al.* 2011, Davidson and Richards 2011, Page *et al.* 2011). Based on the present drop camera images and side-scan sonar collected by Page *et al.* (2011), these tubeworm mounds are located directly offshore of the promontory tip and approximately 50 m from the application boundary.

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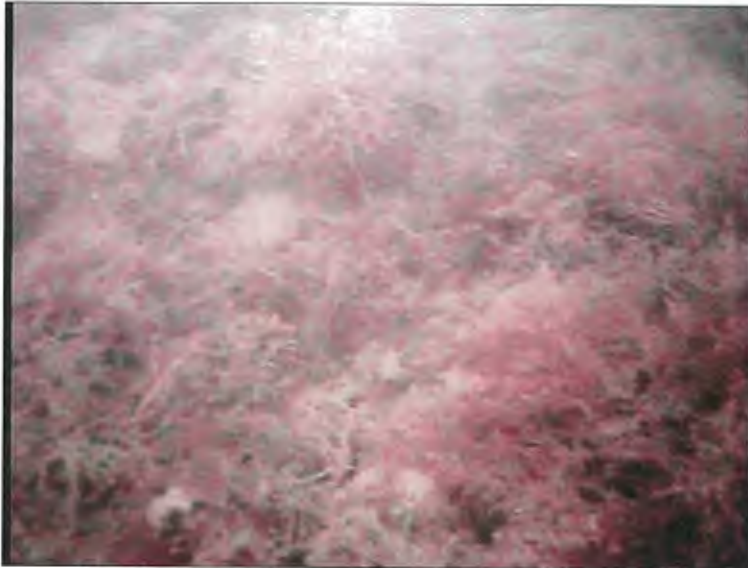


**Plate 4. Silt and clay substratum within the proposed application (photo 1, 15.6m depth).  
Note: Maldanid tubeworms and branching algae.**



**Plate 5. Branching algae growing on the substratum and over tubeworms (photo 14, 13.4m depth).**

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**Plate 6.** Branching algae growing over and amongst tubeworms located under the adjacent mussel farm (photo 20, 13.3 m).



**Plate 7.** Maldanid tubeworms located inshore of adjacent mussel farm (photo 18, 13.6 m).

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**Plate 8. Boulder, bedrock and cobble substratum inshore of the application (photo 27, 4.2m).**



**Plate 9. *Galeolaria hystrix* tubeworm mounds growing on bedrock offshore of the adjacent promontory (photo 33, 7m).**

**Table 2. Coordinates of drop camera stations showing location relative to the marine farm application (NZTM). Colours are: red = under backbones in adjacent farm, teal = application, grey = adjacent farm, blue = no farm. Depth, substratum & biological data are also listed.**

No. & Depth (m)	Coordinates	Location	Position	Substratum and biota	Shell debris
1. 15.6m	1696173.1,5424712.9	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
2. 14.7m	1696137.0,5424711.6	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
3. 14.7m	1696101.2,5424710.4	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
4. 14.4m	1696195.4,5424699.0	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
5. 14.4m	1696139.3,5424695.7	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
6. 13.8m	1696103.6,5424670.0	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
7. 13.7m	1696087.5,5424625.5	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
8. 13.6m	1696131.2,5424625.9	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
9. 14.0m	1696149.0,5424626.4	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
10. 13.6m	1696205.8,5424574.4	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
11. 13.6m	1696130.0,5424577.4	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
12. 13.6m	1696182.6,5424586.2	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
13. 13.6m	1696122.4,5424545.7	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
14. 13.4m	1696108.9,5424529.9	In application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
15. 13.4m	1696167.7,5424470.3	In adjacent farm	Under backbones	Silt and clay, Maldenid tubeworms & branching algae	Moderate
16. 13.5m	1696202.1,5424427.1	In adjacent farm	Under backbones	Silt and clay, Maldenid tubeworms & branching algae	Low
17. 13.8m	1696248.0,5424371.6	In adjacent farm	Under backbones	Silt and clay, branching algae	None
18. 13.6m	1696270.9,5424391.5	Inshore of adjacent farm	No farm structures	Silt and clay, Maldenid tubeworms	None
19. 13.2m	1696222.7,5424497.3	Inshore of adjacent farm	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
20. 13.3m	1696173.7,5424481.2	In adjacent farm	Under backbones	Silt and clay, Maldenid tubeworms & branching algae	None
21. 14.2m	1696138.3,5424447.4	In adjacent farm	Under backbones	Silt and clay, branching algae	None
22. 13.1m	1696156.5,5424422.3	In adjacent farm	Under backbones	Silt and clay, Maldenid tubeworms & branching algae	None
23. 14.5m	1696195.3,5424595.3	Inshore of application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
24. 11.8m	1696224.2,5424600.7	Inshore of application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
25. 8.3m	1696244.0,5424608.1	Inshore of application	No farm structures	Cobbles, pebbles, shell and silt, branching algae	None
26. 4.0m	1696258.3,5424609.0	Inshore of application	No farm structures	Cobbles, pebbles, shell and silt	None
27. 4.2m	1696259.8,5424647.8	Inshore of application	No farm structures	Boulders, bedrock, cobbles, pebbles, shell and silt	None
28. 5.5m	1696260.2,5424674.1	Inshore of application	No farm structures	Cobbles, pebbles, shell and silt	None
29. 7m	1696263.6,5424696.1	Inshore of application	No farm structures	Bedrock, tubeworm mounds, filamentous algae	None
30. 8.9m	1696249.3,5424685.7	Inshore of application	No farm structures	Natural shell, silt	None
31. 13.6m	1696218.9,5424690.8	Inshore of application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
32. 5.9m	1696258.4,5424718.4	Inshore of application	No farm structures	Bedrock	None
33. 7m	1696251.5,5424720.7	Inshore of application	No farm structures	Bedrock, tubeworm mounds, filamentous algae	None
34. 11m	1696244.1,5424747.9	Inshore of application	No farm structures	Bedrock, tubeworm mounds	None
35. 15.2m	1696214.1,5424747.1	Inshore of application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None
36. 14.9m	1696215.1,5424718.1	Inshore of application	No farm structures	Silt and clay, Maldenid tubeworms & branching algae	None

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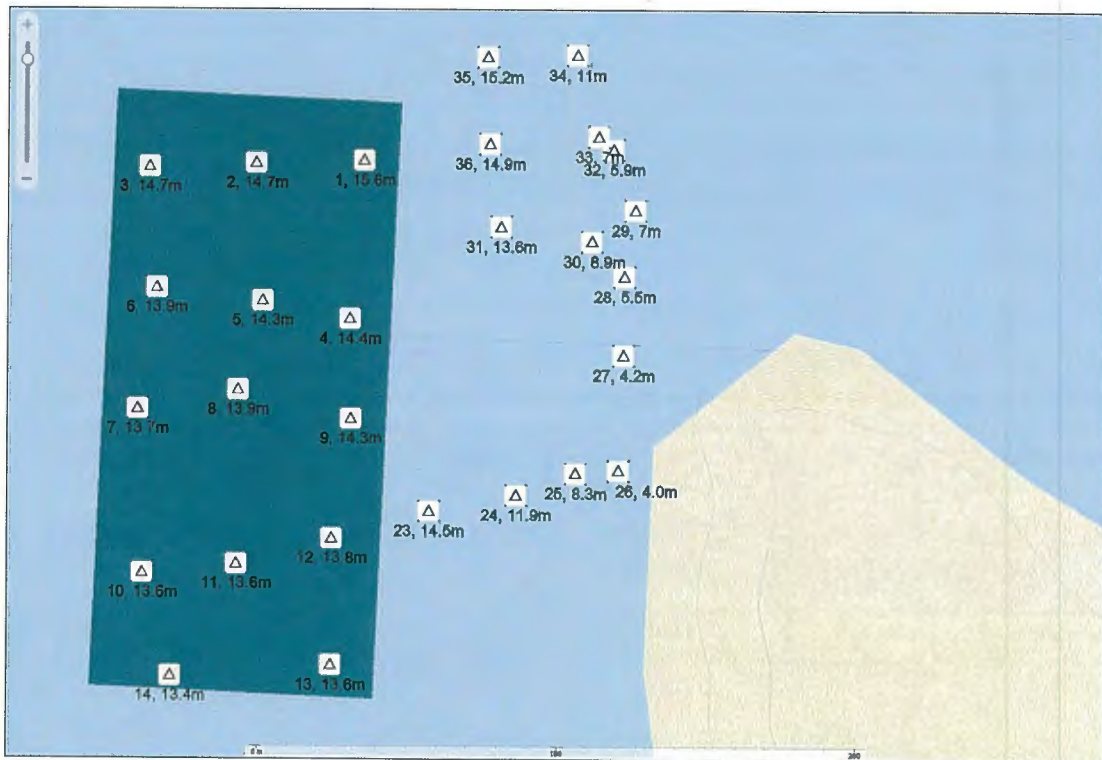


Figure 4a. Drop camera stations (triangles) with photograph number and water depth (m).

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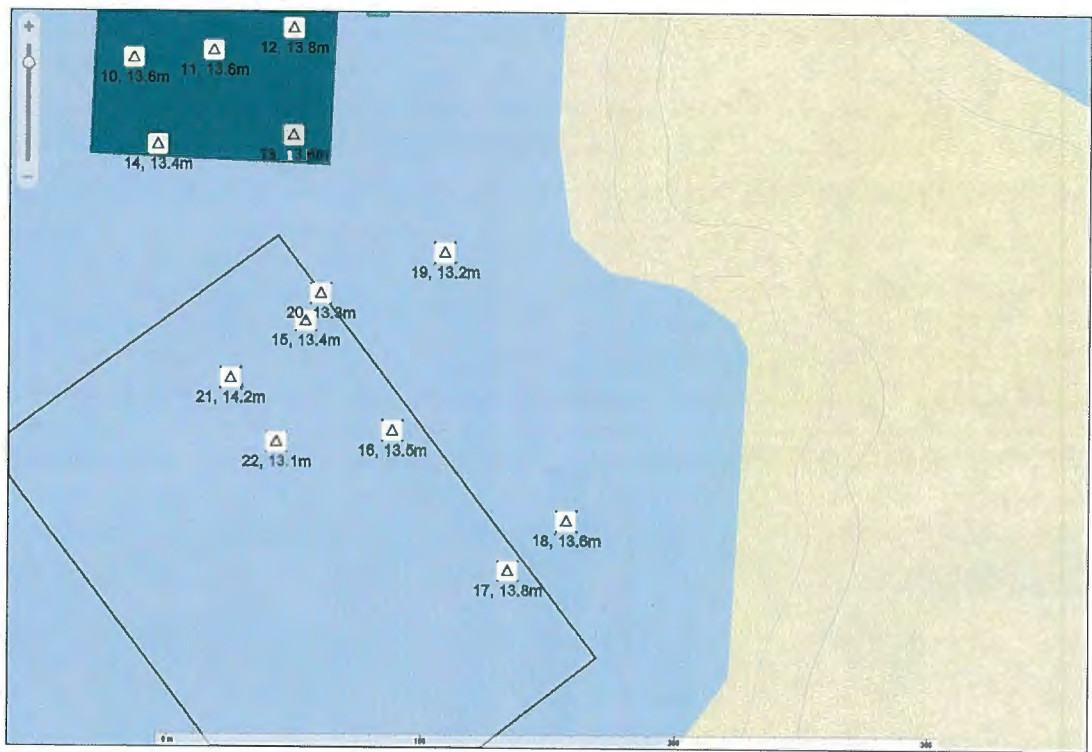


Figure 4b. Drop camera stations (triangles) with photograph number and water depth (m) from a mussel farm south of the application.

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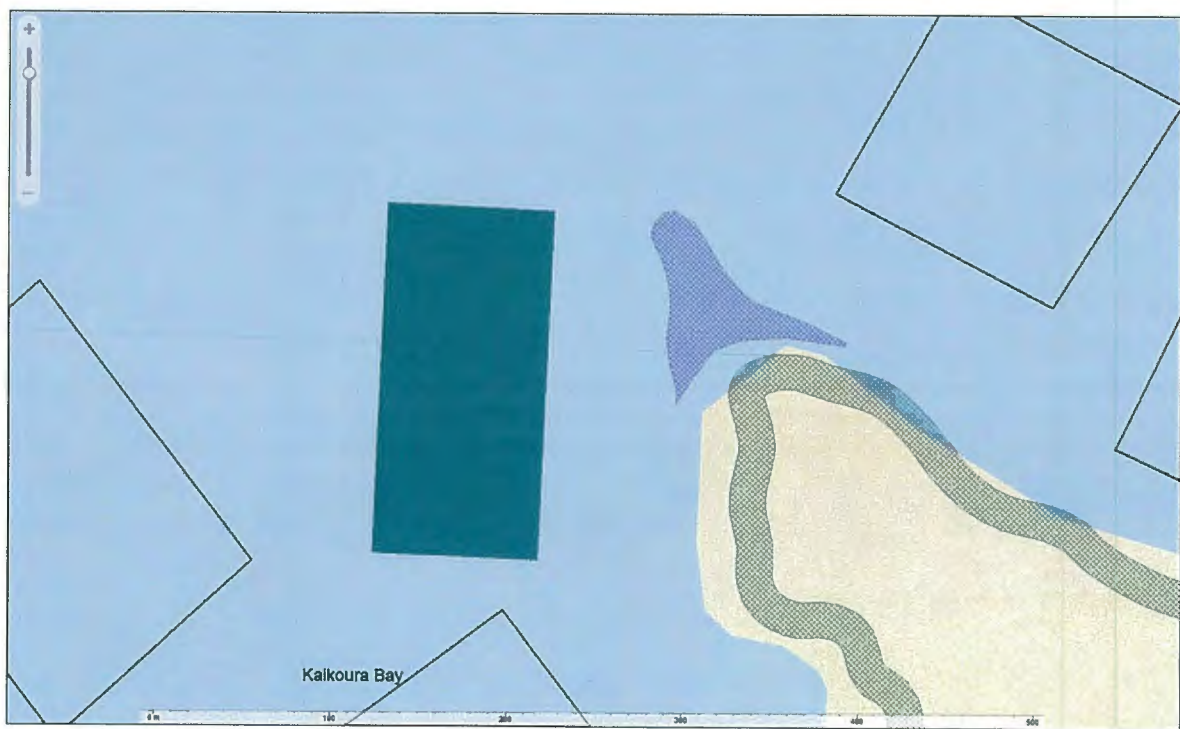


Figure 5. Approximate location of tubeworm mounds (*G. hystrix*) in relation to the application (teal) and other mussel farms (black lines).

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## 5.0 Conclusions

### 5.1 Benthos

The benthos under the application was dominated by silt and clay. The benthos immediately inshore and alongshore of the application were comparable.

Silt and clay is the dominant substratum in Port Underwood. The Port is notoriously muddy and this is likely due to sediment arriving from river discharges from the Wairau and Awatere Rivers during flood events. This fine sediment is carried northwards by tidal currents where it settles onto the benthos in the calmer waters of the Port. Mud substratum in the Port is very soft and easily disturbed.

Combinations of bedrock, boulders, cobbles, shell and silt were observed as a relatively narrow strip close to shore and at a reef extending from the promontory located north-east of the application. No hard substrata were recorded in or close to the application area.

### 5.2 Species and communities

Relatively few invertebrate species were observed under the consent. Species present were characteristic of silt dominated shores in sheltered locations in the Sounds (McKnight and Grange 1991).

Of note were low-lying species of algae consistently recorded on the benthos in the application, areas inshore and alongshore of the application and under the adjacent mussel farm. Branching, filamentous and foliose alga is notoriously seasonal and appear little influenced by the presence of mussel farms in Port Underwood. No material samples were collected, but three species were visible on photographs. One species is the adventive alga *Chnoospora minima* that was first recorded from the Marlborough Sounds from the eastern side of Port Underwood (Nelson and Duffy 1991). Maldanid soft tubeworms were also regularly observed in high abundance under and near the application. In the Marlborough Sounds, Maldanid tubeworms are usually recorded in high turbidity areas and are often observed adjacent and under mussel farms in Port Underwood. Both algae and Maldanids were observed under the adjacent mussel farm in the present study.

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No scallops or horse mussels were seen in the present study. It is unlikely scallops are present as they are rare in the Port, however, horse mussels are likely to be present, but their absence from photographs suggest they are not common.

Calcareous tubeworm mounds located offshore of the adjacent promontory have been recorded and recognised as being of biological value (Davidson *et al.* 1995, 2011, Davidson and Richards 2011). The tubeworm mounds have been the subject of a survey to assess their distribution and health as part of the marine farm monitoring programme associated with mussel farm 8444 located on the northern side of the promontory (Page *et al.* 2011). The authors reported that tubeworms were in good health and abundant offshore of the promontory.

### **5.3 Mussel farming impacts**

#### **5.3.1 Benthic impacts**

This site has previously been consented for mussel farming, however, no mussel shell was observed within the application suggesting that the site has never been farmed or at least not farmed in recent years.

If approved for a new mussel farm, it is probable that the impact of shellfish farming at this site will result in the deposition of mussel shell material. Mussels also act to concentrate sediment from the water column to the benthos under and in close proximity to droppers. Based on the literature and assuming the level of farming activity would be consistent with other farms in the Port, it is very unlikely that the surface sediments would become anoxic, especially as the site is shallow (<16 m depth) (Hartstein and Rowden 2004, Keeley *et al.* 2009, Davidson and Richards 2014). Tidal flows are expected to be relatively low but higher than within the adjacent Kaikoura and Whataroa Bays. Winds are also likely to be an important driver of water movement in this area.

#### **5.3.2 Productivity**

Mussel farms can influence adjacent farms by slowing water flow to other farms located in downstream positions. This is particularly pronounced in quiescent areas of the Sounds.

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However, published work by Zeldis *et al.* (2008, 2013) suggests that the major factors influencing productivity in the Marlborough Sounds relate to cyclical weather patterns in the summer (El Nino and La Nina) and river derived nutrient inputs in winter. Slow crop cycles in some years are therefore a reflection of a particular weather cycle and much less about the number of farms. Little work on productivity drivers has, however, been conducted in the Port Underwood area. It is likely that productivity is strongly influenced by the proximity of Cook Strait waters and the riverine inputs from the Wairau and Awatere Rivers.

There has been no data presented to show that the ecological carrying capacity of the Marlborough Sounds including Port Underwood has been reached. There is considerable evidence that shows the major drivers of the Pelorus system for example, naturally lead to large within and between year variability. Relative to this, the impact of mussel farms appears to be “material” but relatively small compared to major environmental drivers.

A number of other mussel farm exist in close proximity to the present application area, however, the proximity to the main Reach of Port Underwood is likely to reduce water residence times.

### 5.3.3 11 arm seastars

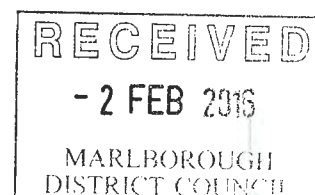
Inglis and Gust (2013) raised a concern that because 11 arm sea stars can reach densities 39 times those outside farms, this elevated population could lead to recruitment of these predators into the wider population. In a long term investigation of the recovery of a mussel farm, Davidson and Richards (2014) sampled sites under retired backbones, retired warps and four control sites located away from mussel farms. The 11 arm sea star population was indeed elevated under the retired backbones, but their numbers quickly declined to background levels and remained low and stable throughout the remainder of the study after the farm was removed. Data from this long term study suggests that 11 arm seastar numbers increase under farms (most likely in response to food availability), however, their densities at control sites and under retired warps remained at low levels throughout the study despite concerns that seastars recruit into adjacent areas by either migration or juvenile settlement.

#### **5.4 Boundary adjustments, recommendations and monitoring**

The application is located over a substratum considered suitable for shellfish farming.

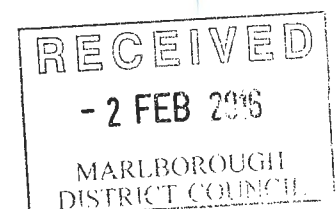
An area located to the north and east of the application is known to support a significant marine site (Davidson *et al.* 2011). The calcareous tubeworm beds have been investigated as part of a mussel farm monitoring study (Page *et al.* 2011). The authors stated “*tubeworm mounds surveyed were healthy showing no signs of death, damage or necrosis*”. Further authors stated “*habitats at each of these sites show no indication of impact from the farm with high percent live tubeworms occurring and a dominance of flora and fauna common in unimpacted open coast environments*”.

Based on the proximity of the *Galeolaria hystrix* tubeworms and their recognised biological importance, it is recommended that the extent and health of mounds be monitored once every two years for three occasions. After the third sample it is recommended that the results be reviewed and the need for continued monitoring be assessed.



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## Appendix 1. Drop camera photographs

Photo site 1



Photo 2



Photo site 3



Photo site 4



Photo 5



Photo site 6



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Photo site 7



Photo site 8



Photo 9



Photo 10



Photo 11



Photo 12



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Photo 13



Photo 14



Photo 15



Photo 16



Photo 17



Photo 18



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Photo 19



Photo 20

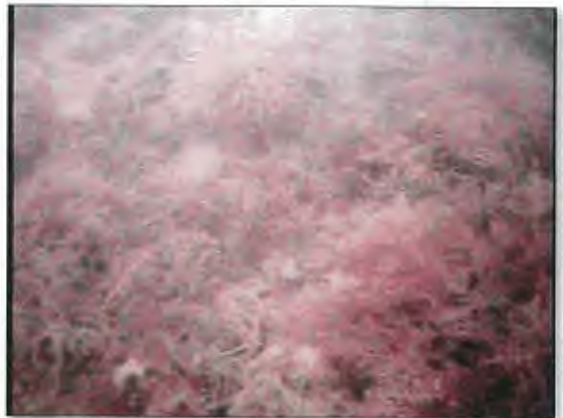


Photo 21



Photo 22



Photo 23



Photo 24



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Photo 25



Photo 26



Photo 27



Photo 28



Photo 29



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Photo 31



Photo 32



Photo 33



Photo 34



Photo 35



Photo 36



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