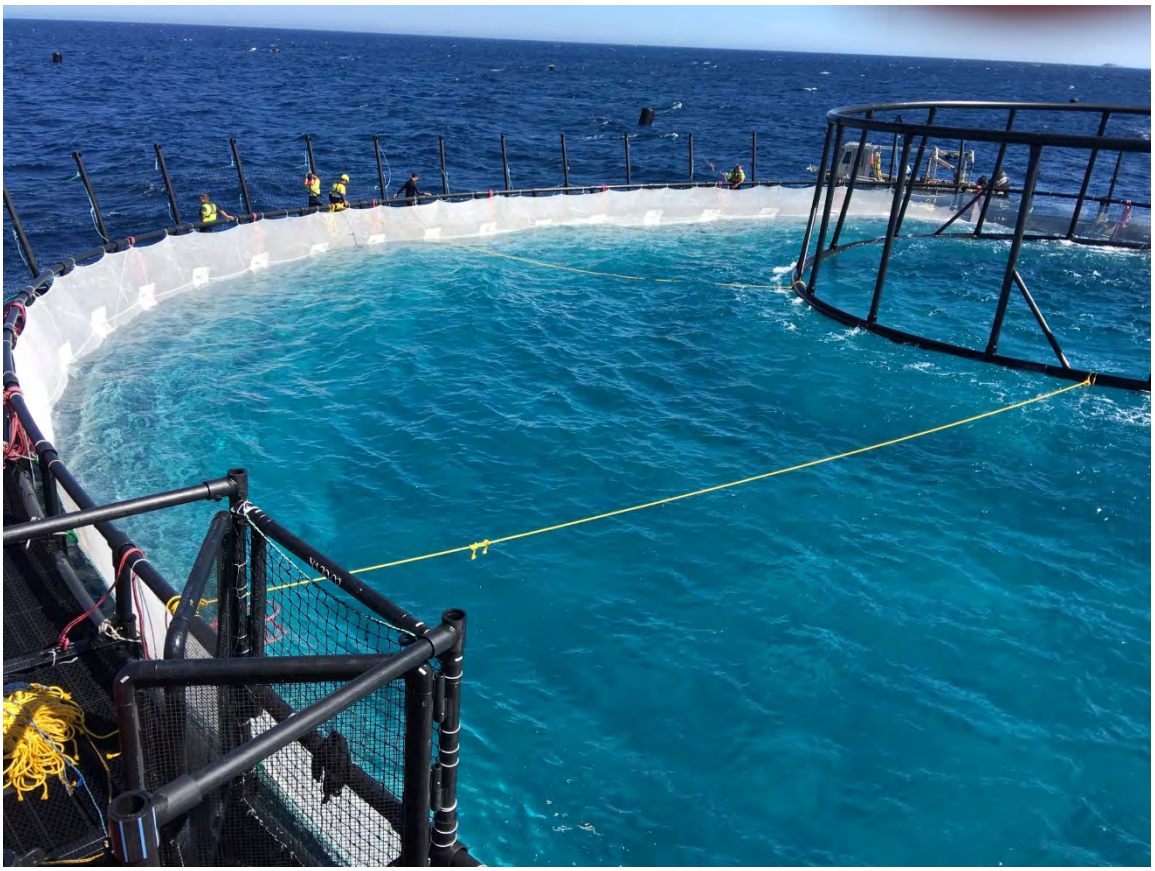
NSW GOVERNMENT Department of Primary Industries

HUON AQUACULTURE

Marine Aquaculture Research Lease

Annual Environmental Management Report

October 2017



Published by the NSW Department of Primary Industries

Marine Aquaculture Research Lease – Annual Environmental Management Report

First published November 2017

ISBN **978-1-76058-172-5**

More information

NSW Department of Primary Industries

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Cover image: Huon, 2017

[OUT17/38738]

Executive Summary

This report details the performance of the NSW Marine Aquaculture Research Lease during the first year of a NSW DPI/Huon Aquaculture Group Limited aquaculture research trial. The report complies with State Significant Infrastructure Approval SS1 – 5118 MOD1 that an Annual Environmental Management Report be submitted to the NSW Department of Planning and Environment, the NSW Office of Environment and Heritage and the Commonwealth Department of Environment and Energy.

The report covers a range of activities including: construction and deployment; operation and maintenance; environmental monitoring and biosecurity; research; transport of fingerlings; marine fauna interactions; navigational interactions; compliance with standards and performance measures and community engagement.

The report highlights compliance with all consent conditions and provides examples of where and when standards were exceeded. No non-compliance issues were identified during this review period.

The independent environmental sampling undertaken in the first year of operation has found no significant impact on benthic invertebrate ecology or water column chemistry. Samples were taken from under sea pens and within the research lease, at compliance sites on the edge of the research lease and at the three control sites located at a distance from the research lease in Providence Bay. The monitoring will continue throughout the life of the Marine Aquaculture Research Lease project to measure potential impacts on the environment as production biomass of Yellowtail Kingfish increases over time.

During the first year of operation there was:

- successful deployment of five sea pens on the Marine Aquaculture Research Lease;
- rapid transfer of more than 61,000 Yellowtail Kingfish fingerlings to the lease by boat and helicopter. Yellowtail Kingfish are the only species currently being cultured on the Marine Aquaculture Research Lease;
- no significant unexplained mortality or illness of fish;
- no new introduced pest/species identified on the lease;
- shark monitoring, which indicated sharks have not been attracted to the lease area;
- no aquatic fauna entanglement incidents;
- 166 whales and 382 dolphins recorded within and around the lease;
- 155 whales and 1195 dolphins recorded while travelling to and from the lease; and
- an increase in number of wild caught broodstock Yellowtail Kingfish held at the Port Stephens Fisheries Institute.

During the first year of operation there has been;

- regular attendance of NSW DPI and Huon Aquaculture staff at community information forums;
- ten stakeholder updates released;
- updates placed on the NSW DPI and Huon Aquaculture's websites;
- numerous research trials undertaken (e.g. genetics, hatchery, broodstock and nutrition);
- three water quality, benthic and video monitoring studies conducted with an independent contractor and the University of Newcastle;

- results of two environmental monitoring events (pre and post fish stocking) and video footage of these events placed on the web;
- additional environmental monitoring to identify seasonal variations within Providence Bay;
- work experience placements made available to students of University of Newcastle;
- operational training of staff including accredited marine fauna disentanglement training;
- upgrading of corner boundary navigational markers;
- approval, and six monthly review, of nine management plans; and
- employment of ten full time staff at NSW DPI and eight full-time and two part-time staff by Huon Aquaculture.

This report also outlines some minor incidents related to operational matters that occurred on the Marine Aquaculture Research Lease during the reporting period including:

- four infrastructure malfunctions;
- two minor fish escapements;
- one health management issue that required the use of hydrogen peroxide to treat gill and skin flukes;
- marine fauna monitoring with four reported interactions within the lease area (two whales, one seal and one bird incident);
- nine complaints registered and addressed; and
- one navigational incident.

Five sea pens are now deployed on the Marine Aquaculture Research Lease and three are stocked with Yellowtail Kingfish provided from the hatchery at NSW DPI's Port Stephens Fisheries Institute. Fish have grown quickly since stocking and have been showcased at the *Love Seafood Love Port Stephens* event, the international *Seafood Directions Conference* and Port Stephens *Go Fish* event.

The Marine Aquaculture Research Lease is providing a sound platform to investigate the viability and sustainability of sea pen aquaculture in NSW waters.

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List of Abbreviations

AMD	Aquaculture, Management and Development Pty Ltd
ANZECC	Australian and New Zealand Environment Conservation Council
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
DO	Dissolved Oxygen
DRF	Dissolved Reactive Phosphorus
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW)*
FM Act	*Fisheries Management Act 1994 (NSW)*
IALA	International Association of Lighthouse Authorities
MARL	Marine Aquaculture Research Lease
MSDS	Material Safety Data Sheets
NPWS	National Parks and Wildlife Service
NSW DPE	New South Wales Department of Planning and Environment
NSW DPI	New South Wales Department of Primary Industries
NSW OEH	New South Wales Office of Environment and Heritage
NSW RMS	New South Wales Roads and Maritime Services
PSFI	Port Stephens Fisheries Institute
ROV	Remotely Operated Vehicle
YTK	Yellowtail Kingfish

1. Introduction

NSW Department of Primary Industries (NSW DPI) and Huon Aquaculture Group Limited (Huon Aquaculture) are undertaking a five year offshore sea cage trial to: validate the commercial potential of Yellowtail Kingfish aquaculture; trial the latest sea cage technologies; and undertake environmental monitoring in the coastal waters of NSW.

The Marine Aquaculture Research Lease (MARL) is enabling NSW DPI to extend the successful Yellowtail Kingfish hatchery research at Port Stephens Fisheries Institute (PSFI) to an offshore sea cage trial. The principal objective of the MARL is to contribute to the development of sustainable marine aquaculture in NSW.

Two leases are approved for sea cage finfish aquaculture in Providence Bay, Port Stephens. A Modification Application was approved by NSW Department of Planning and Environment (NSW DPE) on 4th August 2016 to relocate the MARL and the Huon Aquaculture lease (former Pisces lease) further offshore into deeper water and adopt the latest aquaculture technologies.

In compliance with consent condition E7 of the MARL State Significant Infrastructure Approval SS1-5118, the Annual Environmental Management Report details the following:

(a) identifies the standards and performance measures that apply to the development;

(b) describes the operations that have been carried out during the reporting period;

(c) describes the research that has been carried out in the last 12 months;

(d) includes a summary of the complaints received during the reporting period

(e) includes records of maintenance activities;

(f) provides details of monitoring results with commentary on any effects of the farm compared to relevant guidelines, pre-lease sampling or control sites and an analysis of any trends or key findings, including:

  (i) incidents involving threatened species and/or marine mammals;

  (ii) impacts on marine habitats - water quality, nutrient concentrations and sediments;

  (iii) impacts on behavioural changes and predatory interactions;

  (iv) marine fauna entanglement; and

  (v) benthic fauna assemblages.

(g) identifies any non-compliance including where the environmental performance goals for the development have not been achieved during the previous reporting period, indicating the reason for failure and the action taken to rectify and prevent any reoccurrence;

(h) includes details of any navigational incident related to the operation of the development;

(i) includes details on chemical use, disease and/or introduced pests;

(j) describes what actions were, or are being, taken to ensure compliance; and

(k) environmental management targets and strategies for the following reporting period taking into account identified trends in monitoring results.

2. Construction and Deployment Activities

2.1 Construction

Prior to construction, a specialist Tri-axys wave/current measuring buoy was used to collect real-time data of wave height and direction and current speed and direction (at 1 metre intervals) through the water column. This data in concert with meteorological wind records enabled a long term (50 year) hindcast of wave heights and direction to be developed and utilised in the design specifications for the mooring system and pen infrastructure that will operate on the lease site. This work was carried out by Aquastructures A/S of Trondheim, Norway, which are recognised and acknowledged as an innovative and leading engineering house, finding viable and sustainable technical solutions for structural engineering problems in aquaculture, deep water technology, offshore, towing and marine operations. Aquastructures are certified to NS 9415 and NYTEK standards.

Construction activities for the MARL commenced in Newcastle during September 2016, including the fabrication of stingray anchors, two sea pens of 38 m diameter in Newcastle Harbour and mooring lines in the Kooragang Industrial Precinct (Figure 1).

Figure 1: The sea pens in Newcastle Harbour next to the Kooragang Industrial Precinct (Source: NSW DPI, 2016).

2.2 Deployment

The installation of the lease infrastructure commenced in late September 2016 with the deployment of the lease cardinal marks. The works comprised:

- Installation of the anchors for the navigation buoys and six pen mooring grid system (Figure 2);
- Fitting of the mooring grid system and navigation buoys to the anchors;
- Fitting of five sea pen floating collars to the mooring grid system; and
- Fitting of the containment and predator exclusion nets to the sea pens.

A NSW Office of Environment and Heritage (NSW OEH) approved observer monitored the installation activities, including the towing of the sea cages from Newcastle Harbour to the MARL (Figure 3), and recorded marine fauna interactions and sightings during deployment.

Figure 2: The deployment of anchors, anchor deployment lines and mooring lines on the MARL (Source: Huon, 2016).

Cardinal markers were installed on the corners of the lease on 25th September 2016 and were fitted with auto-notification technology to advise NSW DPI/Huon Research Team staff and NSW RMS if any markers move off the lease site.

Prior to the installation of the sea pens on the MARL, Huon Aquaculture transferred the two pens to just inside Port Stephens off the Boulders (Yacaaba Headland) on 12th October 2016. In consultation with NSW Roads and Maritime Services (NSW RMS) and Marine Parks, a temporary mooring was placed on sandy seabed in around 7 m of water for this purpose. The mooring consisted of two flat-bottomed cylindrical concrete blocks approximately 40 m apart which were subsequently removed.

Figure 3: The sea pens being towed to the MARL (Source: Huon, 2016).

No fish were stocked at Boulders and while a net was installed on one pen at the location it was not dropped to full depth until after the pen had been towed out and moored on the MARL on 15th October 2016 (Figure 4). A Notice to Mariners was circulated which was accompanied by a 'Securite' to advise water users of this temporary arrangement.

The installation of the mooring system and deployment of the first two sea pens works was completed on 16th October 2016.

Bird exclusion netting was installed on pens immediately after transfer of fingerlings from PSFI. One pen only has a floating ring structure within it to support the bird netting.

Three additional sea pens were installed on the MARL on 20th September 2017 (Figure 5).

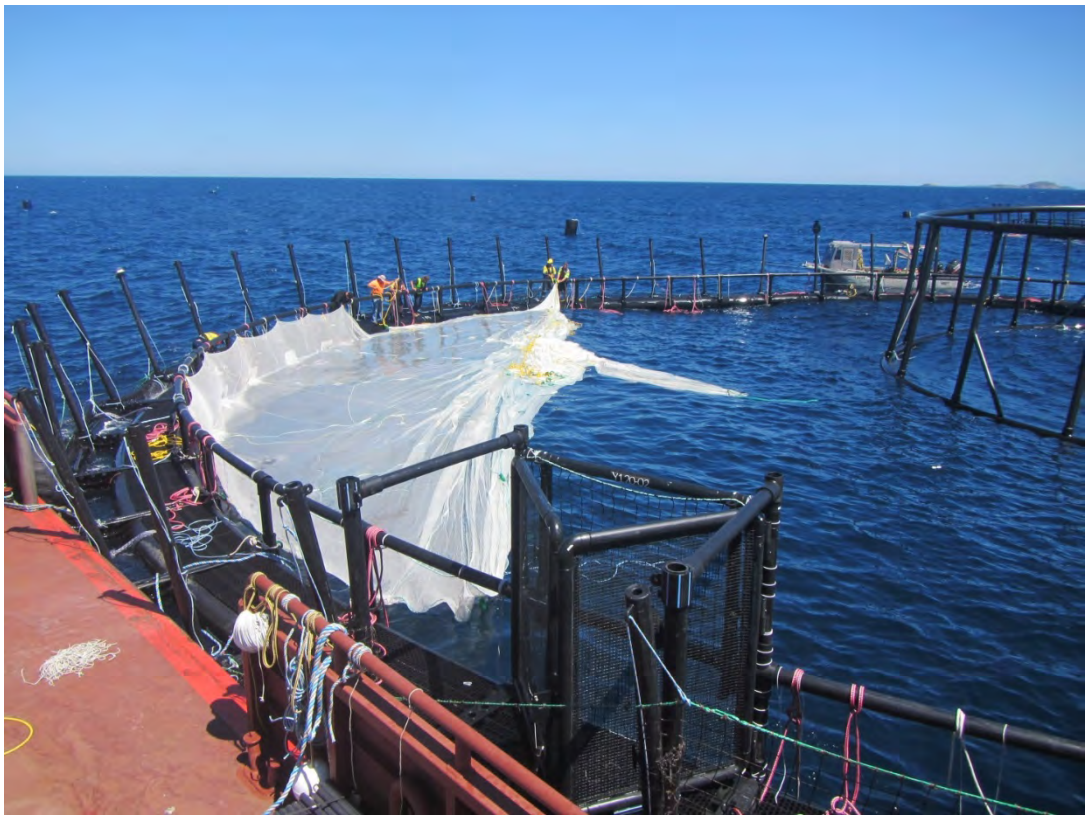

Figure 4: The culture net being fitted to the sea pen on the MARL (Source: Huon, 2016).

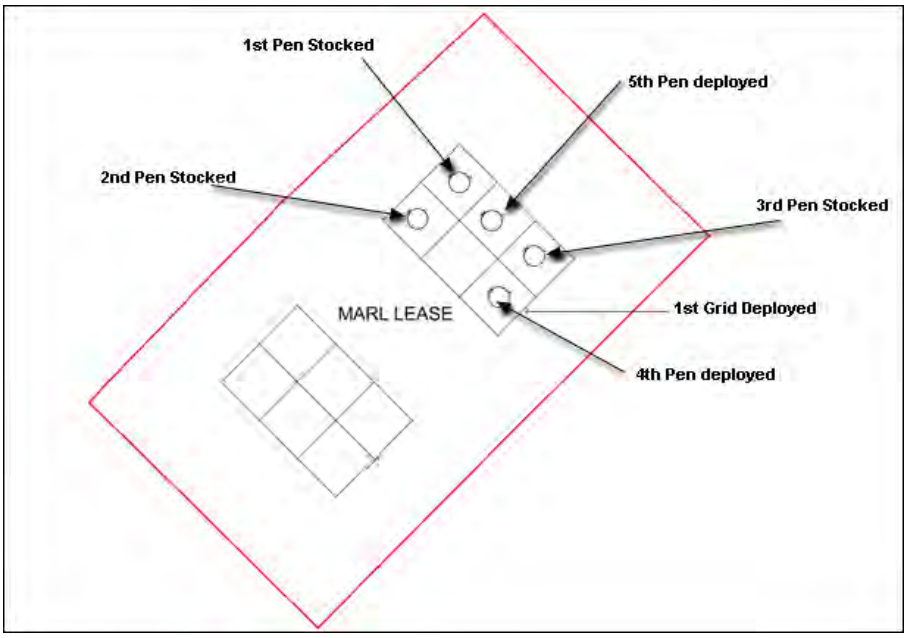

Figure 5: Three additional sea pen floating collars were fitted to the mooring grid system in September 2017 (Source: NSW DPI, 2017).

3 Operations and Maintenance

3.1 Stock Management

A health certification for the Yellowtail Kingfish fingerlings from PSFI was issued by veterinary staff at the NSW DPI Elizabeth Macarthur Agriculture Institute for all stock prior to stocking the sea pens. In the first year of operation only Yellowtail Kingfish were stocked into the sea pens on the MARL.

First Stocking

Approximately 25,000 Yellowtail Kingfish fingerlings (30g weight and 110 mm length) were stocked into the first sea pen via tanker and barge on 17th October (Figure 6) and also by helicopter bucket lift on 18th October 2016.

Figure 6: Yellowtail Kingfish fingerlings were stocked into the first sea pen via truck and vessel on 17th October 2016 (Source: NSW DPI, 2016).

Second Stocking

The second sea pen on the MARL was stocked with approximately 25,000 20g Yellowtail Kingfish fingerlings on 17th December 2016. The fingerlings were air lifted by helicopter to the sea pen from PSFI (Figure 7).

Third Stocking

The third sea pen on the MARL was stocked with approximately 11,000 120g Yellowtail Kingfish fingerlings on 29th – 30th September 2017. The fingerlings were air lifted by helicopter in new purpose built lift buckets from PSFI.

The health status and growth rates of the stock have been routinely monitored. This data is being used to compile data to validate growth models. Overall, the first and second batches of Yellowtail Kingfish stocked in October and December 2016 have displayed signs of excellent health, survival and growth rates during the MARL's first year of operation. See Section 3.2 for details on feed management, Section 3.4 for escapement records, Section 4.2.1 for the occurrence and treatment of parasites, Section 4.2.2 for stock mortality, injury and sickness records, Section 4.2.4 for the transfer of fingerlings and Section 4.2.5 for broodstock.

Figure 7: Yellowtail Kingfish fingerlings being picked up from PSFI by helicopter bucket lift and then deposited into sea pen on 18th October 2016 (Source: NSW DPI, 2016).

3.2 Feed Management

The feeding of stock commenced on 17th October 2016 when the first batch of fingerlings were transferred to the MARL. Fingerlings were initially fed daily by hand (Figure 8). Hand feeding was replaced by the use of a mechanical device in December 2016. A Feed Register has been maintained for the MARL which has recorded feed input details e.g. feed type, size and quantity.

Only pellet feed is used on the MARL that has been produced under a quality control program. This prevents the introduction of a potential disease, parasite or pest.

Feeding regimes have aimed to feed fish to an observed level of satiation without any feed waste. Appropriate feeding ensures all fish within populations have access to adequate nutrition while also minimising competition and social hierarchies within populations. Avoiding feed wastage also minimises the impact of feeding and stock on water quality and the benthic environment.

The main method of assessing satiation (fullness) in the fish has been by surface observation during feeding events. The behaviour of the fish (aggressive and high in the water column) has minimised the risks of feed waste. The planned deployment of centrally mounted feed hoppers will utilise underwater video streams and pellet detection algorithms to further improve feed access for the fish, especially in rough weather.

Effective feed inventory management and storage has been critical in ensuring that the freshness of feed has been maintained. Aquaculture feeds are stored in the Huon Aquaculture's land based facility at Shearwater Estate, Taylors Beach.

To assist in the prevention and preparation of a potential feed spill event at land based sites the following monthly routine maintenance scheduled actions have been undertaken:

- Inspection of feed storage areas to ensure they are clean and tidy;
- Ensuring storage containers are not damaged;
- Ensuring entry points to feed storage areas are secure;
- Ensuring all pest management facilities are in place and maintained;
- Ensuring non compatible products are not stored in feed storage areas; and
- Checking all spill response equipment (e.g. brooms and shovels) is in place.

Figure 8: The fingerlings were initially fed by hand daily and currently by a mechanical device (Source: NSW DPI, 2016).

To assist in the prevention and preparation of a potential feed spill event at sea the following monthly routine maintenance scheduled actions have been undertaken on the MARL vessels:

- Inspection of feed storage areas on-board vessels to ensure they are clean and tidy;
- Ensuring transport storage containers and feed hoppers are not damaged;
- Ensuring feed transfer equipment is in good working order;
- Ensuring all pest management facilities on vessels are in place and maintained;
- Ensuring non compatible products are not stored in feed storage areas; and
- Checking all spill response equipment is in place.

3.3 Sea Pen Infrastructure

The MARL sea pen infrastructure has been inspected regularly since its deployment in September 2016. Visual inspections have been undertaken by NSW DPI/Huon Research Team staff on arrival at the MARL each work day for any infrastructure issues that may require maintenance. Routine inspections and any required maintenance have been undertaken at least every three months and have covered all components of the infrastructure including nets, buoys, anchors, floating collars, ropes, chains, and connectors, as well as the cardinal markers. Subsurface components have been inspected *in situ* by divers and Remote Operated Vehicles (ROV). Inspections have also been conducted after net cleaning and severe weather to ensure that structural integrity has not been compromised.

An inspection checklist has been developed which includes a list of components that must be inspected, issues detected and any actions undertaken to rectify the structural integrity issues identified. Table 1 provides a summary of the inspection and maintenance activities for the sea pen infrastructure during the first year of operation. Table 2 provides an overview of issues identified during the inspection and maintenance activities and the actions undertaken to rectify the issue.

The sea pen infrastructure has also been regularly cleaned of biofouling to ensure all components remain structurally sound and stable (see Section 3.5 – Biofouling Removal). The use of a submersible net cleaning robot to remove biofouling commenced in November 2016.

The monitoring of the structural integrity and stability is assisting with the evaluation of the effectiveness and suitability of the sea pen design, including its ability to withstand the high energy environment of Providence Bay, how frequently repairs are required, whether line tautness is being maintained, the effectiveness of the predator and bird exclusion nets and whether escapements are being prevented (Table 2).

The first net change occurred on 24th February 2017 from the 12 mm mesh to the 35 mm mesh size for the pen with the October 2016 stocked fish. This provides the growing fish with better water flow across the sea pen.

Table 1: Inspection checklist for the structural integrity and stability of the sea pen infrastructure.

Component	Inspection	Date	Issue	Action
Mooring grid components	Sub surface	Monthly by ROV	Wear and condition	Report and replace as required
Mooring grid components	Surface	By farm staff when present	Condition and alignment	Report
Pen integrity	Sub surface	Twice weeky by diver	Net integrity, inner and predator nets	Report and repair
Pen integrity	Surface	By farm staff when present	Pen structure, components, nets	Report and repair

Table 2: Issues encountered - structural integrity and stability of the sea pen infrastructure.

Component	Inspection	Date	Issue	Action
Mooring grid components	Monthly by ROV	16th March 2017	Loss of buoyancy on grid	Upgrade and replace grid cans (completed August 2017)
Mooring grid components	Monthly by ROV	28th June 2017	Wear on transverse ropes on inshore end	Replace (completed August 2017)
Handrail YT120-01	Daily by farm staff	22nd August 2017	Broken locking pins on four uprights	Replace broken pins

During the MARL's first year of the operation, there have been four structural malfunctions with the sea pen infrastructure associated with severe weather conditions.

Malfunction One

Severe sea conditions in November 2016 resulted in the bird netting support structure rope chafing a hole in the culture net close to water line (Figure 9), which was identified during routine maintenance inspections. This resulted in 50 fish escaping which were recaptured.

The corrective action undertaken to manage this future risk was to amend the tie off point and provide chafe protection to grow net. In-pen bird netting support structures are unlikely to be used again in 120 m diameter sea pens.

Figure 9: Damage caused by bird netting support structure rope chaffing a hole in the culture net and the modification undertaken to mitigate the issue. (Source: Huon, 2016 & 2017).

Malfunction Two

One grid buoy became loose due to a shackle malfunction in March 2017 after a number of low pressure systems impacted Providence Bay (i.e. seas up to 5 m and winds up to 45 knots). The buoy was located east of the Port Stephens heads and promptly recovered. During which, it was noted that a rope and marker from a commercial trap that washed into the lease area was tangled on the buoy.

NSW Roads and Maritime Services (NSW RMS) were promptly notified of this incident.

The corrective actions being investigated to manage this future risk include:

- The ability to fit grid buoys with GPS transponders;
- Reduce hardware components associated with current mooring arrangement were possible to prevent re-occurrence; and
- Next mooring installation will have a further reduction of hardware components.

Malfunction Three

Another grid buoy became loose on 25th April 2017 when an 8.5 tonne shackle malfunctioned (Figure 10). Farm personnel where onsite when it broke free and were able to retrieve it within the boundaries of the MARL.

The corrective actions being investigated to manage this future risk include:

- Investigate the malfunction with the product manufacturer;
- The ability to fit grid buoys with GPS transponders;
- Reduce hardware components associated with current mooring arrangement were possible to prevent re-occurrence; and
- Next mooring installation will have a further reduction of hardware components.

Figure 10: Malfunctioning 8.5 tonne shackles from grid buoys (Source: Huon, 2017).

Malfunction Four

Extreme weather conditions in August 2017 resulted in the shearing of pins holding four stanchions in place on a sea pen. This caused the hand rail to drop slightly which resulted in the culture net dropping slightly (Figure 11) and permitted approximately 500 fish to escape. The size of the fish resulted in the majority of the 500 fish being contained between the culture and predator nets enabling 16 of them to be recaptured. Attempts to recapture the fish between the culture and predator nets will continue.

The damage to the sea pen infrastructure has been rectified.

The corrective action undertaken to manage this future risk is to investigate the structural soundness of the malfunctioning component, adjusting the height of the culture net and modifying future pens.

Figure 11: Picture showing dropped rail holding culture net which resulted from malfunctioned stanchion pins (Source: Huon, 2017).

3.3.1 Navigation Markers

The original spar cardinal marker buoys were replaced with Sealite Poseidon buoys on 5th October 2017. Poseidon buoys are larger in size and have enhanced visibility compared with the spar buoys. They maintain their vertical profile above sea level in large waves and strong currents. They do tend to exhibit more lateral movement around their installed position but the improved visibility is more desirable from the feedback from the community and RMS.

3.4 Escapements

Stock numbers have been regularly checked including weekly routine checks, after severe weather conditions, net changes and bathing treatments. If any significant predatory interactions (none occurred during the first year of operation) had occurred stock would have also been checked. Stock numbers have been regularly reviewed. This ensures prompt recapture attempts if an escapement occurs.

During the first year of operation of the MARL, the following escapement events occurred:

Escapement One

Date: November 2016

Numbers escaped: 50

Classification: Minor (< 5%)

Numbers recaptured: 50

Details of recapture method: Berleying using pellets to attract fish which were then dip netted from the surface.

Reason for escapement: Severe sea conditions resulted in the bird netting support structure rope chafing a hole in the growing net close to the water line.

Management actions: Amended tie off point and provided chafe protection to growing net.

Incident reporting: No – due to small numbers.

Comments: Fish congregated around the pens, specifically between the predator net and the culture net.

Escapement Two

Date: August 2017

Numbers escaped: 500

Classification: Minor (<5%)

Numbers recaptured: 16 to date

Details of recapture method: Berleying using pellets to attract fish which were then dip netted from the surface. Permission has also been granted from NSW DPI to construct and deploy a trap between the predator net and the growing net for recapture.

Reason for escapement: Extreme weather conditions - several pins holding a number of stanchions in place on the sea pen were sheared causing the hand rail to drop slightly. This had a flow on effect to drop the fish holding net slightly.

Management actions: Damage to sea pen rectified. Investigations will be conducted into structural soundness of the component and modifications on future pens will be made accordingly.

Incident reporting: Yes – DPE notified.

Comments: Fish aggregating around the pens particularly between the two nets (predator and culture nets).

Review of Escapee Recapture Protocol:

The Escapee Recapture Protocol outlines procedures to follow to attempt the recapture of stock in the event that significant numbers escape into the wild. A significant escapement is defined as any loss of the cultured species to the marine environment in excess of 5% of individuals at any one time.

The Escapee Recapture Protocol has proved effective in relation to the above issues. The Escapee Recapture Protocol will be reviewed again by the NSW DPI/Huon Research Team as part of the ongoing review process for the OEMP.

3.5 Biofouling Removal

The sea pen infrastructure and nets are naturally colonised by a range of marine biofouling organisms, including algae, ascidians, molluscs and barnacles. The removal of this biofouling is important to reduce resistance to currents and wave action which may jeopardise the integrity of the infrastructure e.g. stress moorings and deform nets (Braithwaite *et al*., 2007).

The culture nets have been regularly cleaned *in situ* using submersible net cleaning robots. Table 3 provides a summary of the biofouling removal activities undertaken during the MARL's first year of operation. The pen walkways have also been cleaned twice with the high pressure gun to remove algae and biofouling.

Table 3: Biofouling removal records (October 2016-September 2017).

Date	Method	Comments
November 2016	Submersible net cleaning Terminator	2 Clean, Fortnightly interval
December 2016	Submersible net cleaning Terminator	2 Clean, Fortnightly interval
January 2017	Submersible net cleaning Terminator	2 Clean, Fortnightly interval
Febuary 2017	Submersible net cleaning Terminator	2 Clean, Fortnightly interval
24th February 2017	Net change	Upsized 1601 – 12mm to 35mm Inner net
March 2017	Submersible net cleaning Terminator	2 Clean, Fortnightly interval
April 2017	Submersible net cleaning Terminator	2 Clean, Fortnightly interval
May 2017	Submersible net cleaning Terminator	1 Clean, 3 week cycle
5th May 2017	Netchange	Upsized 1602 – 12mm to 25mm Inner Net
June 2017	Submersible net cleaning Terminator	1 Clean, 3 week cycle
July 2017	Submersible net cleaning Terminator	1 Clean, 3 week cycle
August 2017	Submersible net cleaning Terminator	1 Clean, 3 week cycle
September 2017	Submersible net cleaning Terminator	1 Clean, 3 week cycle

3.6 Waste Management

The quantity and types of wastes generated by the MARL operations during the first year of operation have been summarised in Table 4. All waste storage containers have been inspected weekly to ensure that they are maintained in a condition appropriate for their use and containment of the specific waste.

Skips and bins have been monitored regularly to ensure that cross contamination doesn't occur. All waste removed from the site including products for reuse, have also been monitored to ensure there is no cross contamination. The NSW DPI/Huon Research Team will continue to review the type of surplus materials produced and where possible change the site design and operation to minimise products that go to landfill. Recycling or reuse of waste is a priority.

No bloodwater was released into the environment during the trial harvest of Yellowtail Kingfish.

The 1.3 tonnes of dead fish removed from the lease represent 1637 fish from approximately 3.5% of the stocked number. This is within the normal range for aquaculture operations. Table 5 provides the monthly totals of fish removed and the putative cause of mortality.

Table 4: Summary of waste generated by the MARL operations – September 2016 to September 2017.

Waste Type	Quantity	Date	Method/Place of Disposal
Feed Bags	Total to end of August 2017 = 6,050 bags	Every feeding day	Landfill
Pallet Packaging	152 pallets	As feed is consumed	Pallets returned to Chep
Cardboard	40kg (estimate)	As per deliveries	Landfill
Fish Mortality	1.3 tonnes	17/10/16 to 31/08/17	Landfill
Old Rope	4 tonnes	17/10/16 to 31/08/17	Retained for recycling
Black Water	1000 litres (estimate)	17/10/16 to 31/08/17	Marina Black Water facilities Nelson Bay
Old Engine Oil			Recycled at Waste Transfer Station

3.7 Land Based Operations

The hatchery/nursery and experimental feed trial are carried out in the existing footprint of PSFI at Taylors Beach. Additional construction work commenced at PSFI to develop a 12 tank nursery facility for the Yellowtail Kingfish fingerlings in January 2017 and was completed in April 2017. The fitout of this building is expected to be completed by early 2018.

Huon Aquaculture initially used a small facility in the Shearwater Industrial Estate at Taylors Beach before moving to an expanded facility in the same estate in May 2017. This provides offices and storage space for lease infrastructure components, gear and feed (Figure 12).

Figure 12: Huon Aquaculture's new facility for gear / feed storage at Shearwater Estate (Source: NSW DPI, 2017).

4 Chemical Use, Disease and Introduced Pests

Disease and pest control in intensive aquaculture production requires a holistic approach. Good site management, animal husbandry and rigorous biosecurity measures are central to reducing the risk of disease outbreaks and controlling the spread of infectious diseases and pests.

4.1 Port Stephens Fisheries Institute

Chemical use at PSFI associated with the MARL has been minimal during the first year of operation.

All Yellowtail Kingfish (YTK) eggs were initially treated with ozone for disinfection (1.5 ppm for 30 seconds). No other chemicals have been subsequently used directly on the fingerlings.

The new broodstock brought into the hatchery were treated with hydrogen peroxide (a 75 ppm bath, three days in a row).

The only other chemicals used are general cleaning chemicals on the tanks, associated infrastructure and inlet water. Ozone is used to disinfect the incoming seawater in the hatchery and tanks are cleaned with liquid chlorine and a cleaning agent (pyroneg). Personnel entering any of the PSFI production facilities are required to use alcohol and povidone iodine hand sprays and sodium hydroxide (caustic soda) footbaths to prevent the spread of pathogens.

4.2 Marine Aquaculture Research Lease

The sea pen infrastructure and the stock cultured within the sea pens can potentially be exposed to a range of endemic diseases, parasites and pests. The risk of endemic diseases and parasites from wild populations of fish surrounding the sea pens is identified as the greatest risk to the cultured stock. A number of preventative measures have been employed to mitigate the potential impact of endemic diseases, parasites and pests on cultured stock including the following:

- Stocking only certified disease free fish ;
- Maintaining the sea pen infrastructure including predator nets;
- Water quality monitoring;
- Biofouling management;
- Maintaining appropriate stocking densities;
- Inspecting fish health and behaviour;
- Treatment procedures;
- Collecting samples for laboratory examination; and
- Maintenance of personnel and farm equipment hygiene.

Inspections of stock and infrastructure for disease, parasites and pests has provided the NSW DPI/Huon Research Team with an opportunity to compile a list of pathogens which are a potential threat to cultured fish in NSW waters, as well as contribute to the database on native pathogens of wild fish populations.

Daily and weekly inspections have been undertaken to assess the health of stock and quantify mortalities.

4.2.1 Disease and Parasites

The health status of the stock has been regularly inspected, including the potential occurrence of disease and parasites. The incidences of disease and parasites on the MARL during the first year of operation is listed in Appendix 1 and summarised below:

- *March, April, May, July and August (2017)*
    - External skin and gill flukes were detected on stock.
    - Treatment: hydrogen peroxide (see Section 4.2.3).

The prevalence of skin and gill flukes on the fish was expected given the similar experience with the previous Snapper farm in Providence Bay and other YTK farms in Australia. The flukes are commonly found on local wild stocks of YTK and other fish species.

Section 4.2.3 provides details about the treatment process and its effectiveness, including what chemicals were used (if any).

4.2.2 Stock – Mortality, Injury and Sickness

Daily or whenever practicable (and subject to weather conditions), sea pens have been inspected to remove dead stock. Seriously injured and/or moribund stock has also been removed wherever practicable. Records have been kept on the probable causes of death, sickness or injury, and the number of dead and moribund fish (see Table 5).

Staff are aware that if a significant unexplained mortality or health issue arises that samples of affected fish need to be sent to an approved veterinary laboratory for diagnosis. No significant unexplained mortalities or health issues occurred during the MARL's first year of operation. Skin and gill flukes were the only health issues recorded during the first year of operation. Veterinary investigations are also being undertaken into the cause of the minor numbers of moribund fish.

All mortalities and/or euthanised fish have been disposed of in accordance with the Waste Management Plan for the MARL. Staff involved in the removal of mortalities and/or euthanised fish followed strict hygiene procedures for personnel, their clothes and operational equipment utilised in the removal operations. Some individual fish were humanely killed by a sharp blow to the head. However, humane destruction was routinely undertaken with an overdose of anaesthetic. No fish have been left to asphyxiate in the air.

Table 5: Occurrences of stock mortalities, injuries and sickness during the MARL's first year of operation.

Year	Month	Bent	Deformed	Eye Damage	Floater	Good	Handling	Moribund	Old	Other	Runt	Sample	Total Mortality
2016	Oct	0	0	0	0	32	250	0	15	0	3	0	300
	Nov	0	0	0	0	15	0	0	23	0	0	0	38
	Dec	35	0	1	0	18	0	0	4	0	210	0	268
2017	Jan	1	0	0	0	15	1	0	27	0	4	22	70
	Feb	0	0	0	0	4	0	1	12	0	66	0	83
	Mar	0	0	0	0	4	0	0	22	1	3	16	46
	Apr	0	4	0	0	26	26	6	41	33	6	0	142
	May	0	0	0	0	32	0	0	48	0	1	32	113
	Jun	0	0	0	18	25	0	0	54	9	4	9	119
	Jul	0	0	0	45	93	0	0	65	0	5	0	208
	Aug	0	0	0	49	68	0	0	87	0	1	45	250
	Sep	0	0	0	0	0	0	0	0	0	0	0	0
Total		**36**	**4**	**1**	**112**	**332**	**277**	**7**	**398**	**43**	**303**	**124**	**1637**

4.2.3 Chemical Use

The types of chemicals available for use and the associated treatment protocols are tightly regulated. Chemical use associated with the operation of the MARL has been in accordance with the Australian Pesticides and Veterinary Medicines Authority (APVMA). The chemicals used on the MARL during the first year of operation consist of the following:

Hydrogen peroxide

Date used:

- 27th / 28th March 2017;
- 24th / 25th April 2017;
- 17th / 18th / 29th / 30th May 2017;
- 7th / 10th July 2017; and
- 14th August 2017.

Quantity and concentration:

Concentrations vary from treatment to treatment due to linear volume, biomass of cage and water temperature. To date concentrations have ranged from 180-260 ppm. Full details of the quantity used with each treatment are provided in Appendix 1.

Approval:

The APVMA has issued a minor use permit (PER83276) for hydrogen peroxide (see Appendix 2). The permit authorises its use in the treatment of metazoan and protozoan ecto-parasitic infestations and the control of fungal infections, in freshwater and saltwater finfish, and finfish eggs under the supervision of a registered veterinary surgeon. The administration and dosage used was carried out under veterinary direction.

Properties: Breaks down quickly into water and oxygen in the presence of light leaving no residual.

Purpose: Treat skin and gill flukes.

Effectiveness: Flukes were killed within 20-30 minutes.

Method: The fish were routinely monitored for health and when the number of flukes reached a level of concern, the fish were treated. The inner net was lifted to reduce the total volume of water the fish were retained in. A specially shaped tarpaulin was placed around the inner net to form a fully enclosed 'bag'. A low concentration solution of hydrogen peroxide pre-mixed in seawater was added to the 'bag'. The tarpaulin 'bag' was removed once the flukes were killed.

4.2.4 Transfer of Fingerlings

A health check was undertaken on each batch of fingerlings prior to being transferred to the grow-out site by veterinary staff of the NSW DPI Elizabeth Macarthur Agriculture Institute.

As newly transferred juvenile fish are potentially exposed to a range of new pathogens and stressors, every attempt was made to minimise unnecessary handling, physical damage and exposure to other stressors during transfer procedures.

To assist in reducing the potential of pathogens being transferred to fingerlings the following procedures were undertaken:

- Disinfection of transport containers before and after they were used;
- Disinfection of transport water used to transfer fingerlings;
- Monitoring of water quality (particularly dissolved oxygen) during transfer;
- Rapid transfer of fingerlings from PSFI to the MARL (15 minutes air time)
- Ensuring that pen integrity (culture and predator nets especially) was maintained so that physical damage to transferred fingerlings was minimised;
- Minimise the number of fish movements and handling events;
- Ensuring that all fish have ready access to feed and feeding opportunity; and
- Monitoring fish health closely such that early mitigation could be implemented if necessary.

4.2.5 Broodstock

To ensure genetic diversity is maintained and to increase the number of YTK broodstock held at PSFI, an additional 19 wild, semi-mature fish have been captured from local waters by NSW DPI. YTK were captured from Fingal Island and Broughton Island in April 2017. Producing fingerlings from broodstock sourced from the same genetic population mitigates the risk of introducing non-endemic diseases, parasites and pests into the current population of broodstock at PSFI and or transferring them to the grow-out sites.

The new broodstock were transferred to quarantine tanks in PSFI before introduction to the broodstock program. Their health status was assessed and inspections were conducted to identify any potential disease risks that may require treatment during quarantine. During the quarantine period broodstock were inspected daily for any signs of disease and were examined for causative agents. All 19 new broodstock have settled in to the systems at the PSFI.

4.2.6 Introduced Pests

Marine pests can potentially be spread by ballast water and vessel hull biofouling (Commonwealth of Australia, 2009).

Service vessels and infrastructure for the MARL sourced from outside NSW could represent a marine pest risk for the region, so movement of service vessels and infrastructure has complied with the *National Biofouling Management Guidelines for Commercial Fishing Vessels* (Commonwealth of Australia, 2009). If the origin port of the vessel is known to have significant marine pest issues, a risk assessment is required and mitigation measures must be undertaken to prevent translocation of pests. Huon Aquaculture utilised its established “Positive Release” protocols to ensure that this risk was managed.

During the MARL’s first year of operation, four vessels were brought from Tasmania including:

- *Huon Envy* - a specially built, fast-crew-transfer and technical projects vessel.
    - *Specifications*: 11.9 m, aluminium planning hull.
    - *Preparation:* No inspection/preparation – new vessel.
    - Transfer: Delivered by road direct from the shipyard.
- *Huon Pride* – a small landing craft type vessel.
    - *Specifications:* 11.9 m, steel displacement hull.
    - *Preparation:* Subjected to manual hull cleaning, replacement of ropes, drying of bilges and sprayed with Virkon solution.
    - *Transfer:* Deck loaded onto landing craft vessel, *Wandi II*.
- *Wandi II* - large landing craft vessel.
    - *Preparation*: Vessel was slipped, hull was cleaned, ropes were replaced and sprayed with Virkon solution.
    - *Transfer*: Temporarily deployed to NSW from Tasmania in September and October 2016.
- *Delilah* – a large landing craft vessel.
    - *Preparation:* Vessel was slipped, hull was cleaned, ropes were replaced and sprayed with Virkon solution.
    - *Transfer:* Temporarily deployed to NSW from Tasmania in August and September 2017.

Positive release forms were completed for all of these transfers (except *Huon Envy* as the vessel was new) (see Appendix 3).

A further vessel, the *Omaha,* was leased by Huon to undertake works on the MARL but after trials was deemed unsuitable.

The sea pen infrastructure has been colonised naturally by a range of marine biofouling organisms, including algae, ascidians, molluscs and barnacles. Inspections of the MARL infrastructure and biofouling organisms have been regularly undertaken to ensure early detection of potential pest species.

The presence of a colonising barnacle was noted on the wave/current measuring buoy in early 2016 and subsequently on the original Spar Buoy cardinal markers and sea pen infrastructure. This barnacle was identified as *Megabalanus coccopoma,* an introduced barnacle species. Investigations revealed records of this species existing on the foreshore in Newcastle Harbour since 2009.

Filming of the seabed using Remote Observation Vehicle (ROV) under the sea pens in April 2017 has also revealed the presence of the barnacle. It was present as dislodged (possibly through wave action on the pens or by *in-situ* cleaning of the nets) clumps of the organism underneath pens. The presence of this species was also detected in the benthic sediment samples (See Appendix 5).

The species was assessed as an introduced species that was present within the region prior to the MARL's operation and as such no further action is required. The presence and abundance of this species within the MARL will continue to be monitored in the ROV and benthic sampling surveys.

4.2.7 Training

The ability of NSW DPI/Huon Research Team staff to recognise pests and abnormal or unusual signs and behaviour in fish is fundamental to early detection of fish health and pest issues. To assist in the rapid response to these issues staff have been trained and/or have expertise in the identification of potential diseases and pests that may occur in the Providence Bay region. Ongoing regular training in fish health and biosecurity will continue through in-house and external training.

During the first year of operation of the MARL, the following disease, pest and biosecurity training was undertaken by staff:

- Attendance at presentations, seminars, workshops, conferences to stay informed about the latest industry research, practices and technologies relating to fish health or aquatic pests; and
- Regular and ongoing on the job training, as well as specific training was undertaken to promote the objectives and aspirations of the Health Management Plan, including:
    - Fish welfare training;
    - Chemical handler training;
    - Training against all standard operating procedures;
    - Disinfection training;
    - Use and handling of veterinary chemicals;
    - Presentations on key fish health and welfare topics; and
    - Information sheets on key disease and fish health topics.

5 Research

The research objectives for the MARL include but are not limited to the following:

- Evaluating and adapting husbandry practices for sustainable sea pen aquaculture;
- Evaluating the use of different protein and energy (fish food) sources (Section 5.4);
- Evaluating and developing dietary research to a commercial level including testing feeding efficiency and growth performance (Section 5);
- Determining the water temperature growth models for species to determine if there are any impacts on growth related to seasonal water changes (Section 5.4);
- Investigating the potential environmental impacts of a marine aquaculture farm (see Section 6);
- Evaluating a range of mitigation measures such as anti-predator netting, controlled feeding strategies and entanglement avoidance strategies (see Section 6.2);
- Investigating the structural integrity and stability of the proposed sea pen infrastructure (inherent in the farming procedure) (see Section 3.3); and
- Economic viability, including cost of fingerlings, feed, equipment, services and sale of product (will be completed next reporting period).

This chapter details the genetic, hatchery and nutritional research that has occurred during the first year of operation of the MARL.

5.1 Yellowtail Kingfish Genetics

To ensure sustainability and to assess the possibility for a future breeding program for YTK in NSW, several genetic studies have been conducted on wild and captive animals.

To investigate genetic diversity in NSW wild YTK stocks, genetic markers called “microsatellites” have been used to construct pedigrees for over 60 wild caught fish. This work found that the wild YTK appear genetically diverse, and are unrelated to each other (no siblings were detected among the fish collected). Samples of YTK from different locations in NSW were not genetically different from each other, that is, they formed part of the one population. Further, NSW samples could not be distinguished, with respect to DNA microsatellite alleles, from South Australian samples, but the Australian samples are very different from those in the Northern Hemisphere.

The same microsatellites used for wild fish were applied to captive broodstock held at the PSFI. The genetic diversity within tanks and the genetic relationships among tanks were documented using either genetic samples of the actual broodstock or deduced from genetic samples of their offspring. This information was used as the basis for the design of a sustainable commercial breeding program and a “road map” for a 5-year breeding program was charted. This program will underpin genetic the diversity of stock being supplied to the MARL.

5.2 Hatchery Research

Tank colour

Two commercial-scale hatchery experiments were done to determine the effect of tank background (black [control] v silver) on growth and survival of YTK larvae. We know that YTK larvae require high light intensity for early stage development and that YTK larvae typically occupy the upper depths of the water column which can potentially induce higher larvae density and subsequent reduced feeding efficiency and conspecific contact and cannibalism. The aim of the experiments was to determine if coating the tank wall with a reflective, silver lining would increase light distribution through the water column and encourage homogeneous dispersal of YTK larvae through the water column.

Tank colour did not affect survival or growth of YTK larvae in both experiments, despite larvae in silver-lined tanks utilising more of the water column. Light intensity was similar through the water column in both colour treatments; however fish from the silver–lined tanks were darker than those

grown in black tanks, indicating that silver-lined tanks likely reflected more light from the tank bottom compared with black tanks.

Once the fish were removed from the treatment tanks and placed into common nursery tanks they all became the same colour. Based on these results, the standard PSFI black tank colour was deemed optimal for YTK culture and will remain as Control tanks for future experiments.

RAS & Flow-through Systems

Two experiments were completed to evaluate the suitability of recirculating aquaculture systems (RAS) and flow-through systems at PSFI for intensive culture of advanced juvenile YTK.

Experiment 1 used two 10m^3 RAS which had been constructed as demonstration facilities and had been used successfully to maintain relatively low densities of marine fish including Snapper, Mulloway and YTK. The systems had not been used to culture large biomasses of YTK. A further two, 5m^3 tanks were operated on flow-through of 10µm filtered seawater with approximately 50-70% of the tank volume exchanged each hour. Each tank was stocked with advanced YTK (15-21g) and cultured for 32 days (RAS tanks) and 24 days flow-through.

YTK grew in all tanks over the culture period. Maintenance of saturated dissolved oxygen (DO) concentration was not possible with simple air diffusion and it was necessary to infuse pure oxygen to avoid DO crashes, especially within 30-60 minutes after feeding. It was necessary to initiate 25-50% daily exchange of new disinfected seawater in RAS systems to reduce the concentration of dissolved organic material which resulted from leachate of faeces and/or the pellet diet.

Improvements needed for the RAS systems were identified and included the installation of foam fractionators to remove dissolved organics and oxygen saturating cones to optimise DO saturation. flow-through systems were relatively easy to maintain compared with RAS, however they used large volumes of new, influent seawater to maintain high water quality; 60,000-84,000 L/d/tank (12-17 times tank volume/day) compared with RAS which used 2500-5000L/d/tank. Moreover, the flow-through tanks used only filtered seawater, whereas, RAS used filtered, disinfected and temperature controlled seawater. Costs and benefits of the systems will be determined.

Experiment 2 was done in two, purpose-built 30m^3 RAS. One RAS was fitted with a standard biofilter and the other with a Biogill filter. The aim of the experiment was to compare the performance of biofilter filtration with Biogill and to determine any operational and logistical issues that could preclude the use of RAS for production of advanced YTK in land-based systems.

YTK grew well in both RAS systems with excellent food conversion ratios. The activity of the Biogill appeared to start several weeks earlier than the biofilter. Preliminary costs of operation and system efficiency were noted from these experiments and will be built upon with subsequent trials.

5.3 Hatchery Trials

Two hatchery production runs failed to produce the target of 25,000 fingerlings. Batch 3 was done in December/January 2016/17 and Batch 4 in February/March 2017 and produced 16,000 and 10,000 fish respectively. Analysis of the production data showed likely problems with larvae survival due to excessive temperature (Batch 3) and low salinity (Batch 4) at critical larvae ages. A repeat hatchery run was done in March 2017 with the aim to stabilise and optimise water temperature and salinity and resulted in normal survival and production of the target 20,000 fish. It is planned to investigate the effects of temperature and salinity variability on survival of YTK larvae in rigorous experiments.

5.4 Nutritional Research

Determine optimum feed types and feeding strategies that boost reproductive health and outputs from NSW YTK brood-stock

Based on the available results the best-practice feeding regime for YTK broodstock at PSFI remains the use of natural marine feeds such as sardine and high quality squid as opposed to commercial pellets in terms of fecundity and larval output.

Refine growth and bioenergetic models for YTK – oxygen trial

This experiment was designed to evaluate the effect of low dissolved oxygen saturation (60%) compared to normal dissolved oxygen saturation (100%) on the protein and energy utilisation of sub-adult YTK. It is the first in a series of experiments that will be conducted to improve and refine the existing growth models for YTK. Low dissolved oxygen saturation negatively affected the performance of YTK with this response tending to be more pronounced with increasing feed intake. Data generated from this study will be used to improve growth and feeding models for YTK facilitating better feed management and feed formulation.

Determine choline requirement of sub-adult YTK

Choline is an essential water soluble vitamin that has important metabolic functions and is needed for optimal growth. This study determined the choline requirement of sub-adult YTK at sub-optimal (16°C) and supra-optimal water temperature (24°C). The results demonstrated that the choline requirement of juvenile YTK does not appear to be dependent on the water temperatures investigated in this study. The minimum amount of choline needed by juvenile YTK to support rapid growth was approximately 1959-2088mg choline kg^{-1} diet. Formulating conservatively it would be prudent to ensure aquafeeds for YTK have about 2570 choline kg^{-1} diet. The current industry practice of formulating aquafeeds for YTK that contain approximately 3000mg choline kg^{-1} diet is satisfactory. Although minor reductions in the amount of dietary choline might be possible it would be advisable to continue supplementing to this level until more data on the availability of choline and potential impacts on carcass composition and health are available.

Determining the apparent digestibility of high priority feed ingredients

Information on the digestibility of raw materials is critical for formulating well utilised, sustainable aquafeeds. To that end two research trials have been conducted at PSFI with sub-adult YTK to determine the digestibility of raw materials commonly used by the Australian aquafeed industry.

Our results showed that YTK do not digest corn gluten or soy protein concentrates particularly well. The digestibility of other raw materials we investigated, including wheat, was higher, all being greater than 35%. The dry matter from rendered proteins (excluding blood meal), South American fishmeal, krill meal and lupin meals was generally greater than 50%. The protein digestibility of legumes appears to be higher than for rendered animal meals and marine protein meals. Energy digestibility of rendered meals, marine meals and legume meals bracketed values between 60% to 80%, whereas energy digestibility of wheat and soy protein concentrates was very low.

The digestibility of raw materials will be useful to producers of commercial aquafeeds and give fish producers a better understanding of the quality of raw materials being used in Australian aquafeeds for YTK. Jointly, both feed producers and farmers will benefit from more accurate formulations.

Complete experiment to optimise feeding strategies for YTK in warm water

Feeding strategies (e.g. frequency, timing, amount, type of feed and nutrient density) affect fish performance and different strategies are required to ensure feed utilisation is optimised during different parts of the grow-out cycle. Two eight week trials have been done at PSFI aimed at determining the best feeding strategies for sub-adult YTK grown at different temperatures. The first trial was done at a water temperature of 24°C and examined the performance of juvenile fish fed a single aquafeed using 4 different feeding strategies (pellet size, once daily, twice daily etc.). The second trial was similar in every way, except that it was done at a water temperature of 16°C.

Both trials have clearly demonstrated that fish in the size range we investigated (i.e. 150-500g) are comfortable consuming either 6mm or 9mm pellets and that the choice of pellet has little impact on growth rate or food conversion ratio (FCR). The studies also indicate that one carefully fed meal in the morning is probably sufficient to sustain optimum growth while at the same time subtly improving FCR.

This data will assist farm managers with on-farm feed management practices. Despite there being no statistical differences between the specific growth rate or FCR of most feed regimes, there were reasonable differences in the value of these responses. For example, feeding fish to apparent

satiation twice daily at 24°C resulted in an FCR of 1.48:1 whereas feeding once daily to apparent satiation at 24°C resulted in an FCR of 1.30:1. If realistic, this is effectively a 12% improvement in feed utilisation and could therefore represent a reasonable increase in farm gate profit. The choice between feeding for growth or feeding for better FCR can therefore be controlled by the producer if reliable information is available.

Determine conditional histidine requirements of sub-adult YTK

Histidine is one of ten essential amino acids required to ensure adequate growth and health of animals. Hitherto the histidine requirement of YTK is unknown. Dose-response studies are the usual way an animals requirements for amino acids are determined. To that end six test diets were formulated with increasing levels of histidine (0.0% to 2.0% diet). Test diets were formulated using a combination of semi-purified ingredients and other crystalline amino acids. The feeding trial was carried out at two temperatures (16°C and 24°C) and included a typical control diet to benchmark growth.

Unfortunately the experiment to determine the histidine requirement of juvenile YTK failed to provide interpretable results. Fish fed the experimental diets, whether deficient or replete in histidine, fed well (≈2% body weight per day), but they failed to gain significant weight at either 16°C or 24°C. This resulted in fairly high food conversion ratios (FCRs >4:1). Fish fed the control diet grew rapidly and fed vigorously throughout the experiment. We suspected several possible problems; 1) incorrect mixing and manufacture of the diets, 2) poor utilisation of the crystalline amino acid mix, 3) another limiting amino acid, 4) or unknown interactions between some essential or conditionally essential amino acids.

All experimental diets have been tested and they accurately reflected the histidine levels of our formulations confirming appropriate diet manufacture. However, the chemical analysis did reveal that the total tryptophan content of the diets was low and below the concentrations estimated from formulation recipes. All other essential amino acids seemed to be at adequate levels.

To test the assumption tryptophan was limiting we added another 0.5% tryptophan to each formulation and continued the trial for another 3 weeks. The amelioration of the test diets with tryptophan did not result in increases in growth rate or improvement in FCR in any group of YTK; indicating tryptophan was not limiting. Faecal material was collected from fish to determine the digestibility of protein and amino acids in these diets. This may shed some light on the ability of YTK to utilise crystalline amino acids and indicate why the trial was unsuccessful. If possible we aim to repeat this experiment (or a modified version) before the end of the project.

Determine conditional taurine / methionine requirements of sub-adult YTK

Taurine is considered a conditionally essential nutrient in some marine fish. It is added to commercial aquafeeds for YTK in Australia at a rate of about 10g kg^{-1} diet (1%). No published study exists in Australia with respect to the quantitative taurine requirements of YTK, however several studies have emerged recently that attempt to define the requirement for taurine in feeds containing high levels of soybean meal by-products. These types of feeds are generally not used in Australia.

In addition, no study has been published that defines the sparing effect or not of supplemental methionine on the taurine requirement of YTK. The requirement for these nutrients is likely to be higher in rapidly growing YTK, especially those cultured in water temperatures that regularly exceed 22°C, such as in NSW and certain parts of South Australia and Western Australia.

A six week experiment to determine the taurine requirement of juvenile YTK reared at 23°C has recently been completed. Again, a dose-response design was employed that used seven taurine levels between 0.1% and 2.0% of the diet. In addition, two methionine levels were investigated; a low level (1.1% of the diet), or a high level (2.0% of the diet). This resulted in 14 experimental feeds. The preliminary results indicate that rapidly growing juvenile YTK require approximately 0.74% dietary taurine to maximise growth rate and food conversion ratio (FCR) at 23°C when diets contain 1.1% methionine. When diets contain 2.0% methionine juvenile YTK do not exhibit a requirement for taurine, regardless of taurine inclusion level. This suggests strongly that methionine can spare taurine. This data will prove critical for aquafeed manufacturers and has

generated new hypotheses about YTKs requirement for methionine; particularly with respect to current aquafeed inclusion levels.

Refine growth and bioenergetic model for YTK (temperature)

NSW DPI is refining growth and feed models for YTK. These models will assist YTK producers predict and benchmark growth and feed intake of YTK on farms and assist aquafeed companies forecast production of feeds. Critical to the improvement of current models is understanding how temperature and oxygen effect growth rates and utilisation of protein and energy by YTK. Several trials have already been completed which have added value to existing models. These include an eight week trial to examine the effect of temperature (i.e. 15^{o}C or 25^{o}C) on the protein and energy utilisation of sub-adult YTK and an eight week trial to examine the effect of dissolved oxygen (DO) saturation (normal DO at 100% saturation and low DO at 60% saturation) on the protein and energy utilisation of sub-adult YTK.

Results from the first trial showed that water temperature had a varying effect on utilisation responses in YTK, with the magnitude of the response dependent on the nutrient examined; for example there was little influence of temperature on the utilisation response of methionine and lysine while responses for arginine and taurine utilisation were extremely diverse between temperatures. The latter study demonstrated that low DO saturation (60%) negatively affects the nutrient and energy utilisation response in YTK, with this response tending to be more pronounced with increasing nutrient and energy intake.

Data generated from these studies will be used to improve feed models for YTK facilitating better feed management and feed formulation through a better understanding of nutrient requirements and therefore dietary specifications for YTK.

Figure 13: NSW DPI staff preparing a diet to be used in the nutritional trial tanks (NSW DPI, 2017).

6. Monitoring

6.1 Water Quality and Benthic Monitoring Program

The Water Quality and Benthic Environment Monitoring Program has been implemented by NSW DPI/Huon Research Team to assess and mitigate potential impacts from the operation and is consistent with consent conditions issued under SSI-5518 MOD 1.

The Program includes monitoring of: water quality (temperature, salinity, oxygen, pH, Chlorophyl α and concentrations of nitrogen and phosphorus); biological changes (macrobenthic invertebrates, i.e. worms and crustaceans larger than 1 mm); chemical changes (the composition of elements in the seafloor); and physical changes (the particle size of sediment and video footage) (Figure 14).

Figure 14: Equipment used during the Water Quality and Benthic Environment Monitoring Program. (NSW DPI 2017)

Samples and video footage are taken from under the sea pens, on the outside edge of the MARL (compliance sites) and at three locations away from the MARL in Providence Bay (control sites).

The first or Baseline survey event for the Water Quality and Benthic Environment Monitoring Program was conducted by Aquaculture, Management and Development Pty Ltd (AMD) and the University of Newcastle between the 1st and 7th September 2016.

The Baseline survey is intended to provide pre-farming measurements of the range of variables that have been approved in order to assess the environmental performance of the fish pens. The results from future sampling events within and around the MARL will be referenced against both this baseline data and the data collected concurrently at the control sites. The data collected will be subject to seasonal differences and therefore some of the ongoing monitoring has to be planned for the same time of year.

Errors made by the private analytical laboratories chosen to carry out the nutrient analyses component rendered those results void. Therefore, a replacement set of nutrient samples was taken on 16th October 2016 (this was still prior to any fish being stocked onto the lease) and were submitted to a different laboratory for analysis.

The second sampling event (Update 1) for the Water Quality and Benthic Environment Monitoring Program was conducted by AMD and the University of Newcastle between the 17th and 20th April 2017.

The third sampling event under the program was undertaken between the 13th and 24th September 2017 and is being processed.

Additional water and benthic samples have been collected to improve baseline data as fish grow and help build a stronger picture of the effects of the operation of the MARL. The number of monitoring samples taken and analysed to date is greater than consent condition requirements.

Triplicate samples have been collected from pen sites (S3 & S4), control sites (C1 & C2), and at 35 m deep compliance sites (S1, S2, S5 & S6) at which ROV spot dives have also been undertaken (Figure 15).

NSW DPI/Huon Research Team have positioned one grid on the lease which can carry up to six sea pens. The first sampling event occurred prior to fish farming activities while the second sampling event occurred following two pens being stocked with YTK with a standing biomass of 50 tonne. In the first year of operation (September 2016 – October 2017), a total of three pens have been stocked with a standing biomass of 100 tonne of YTK. All pens have been located on the northern grid within the MARL.

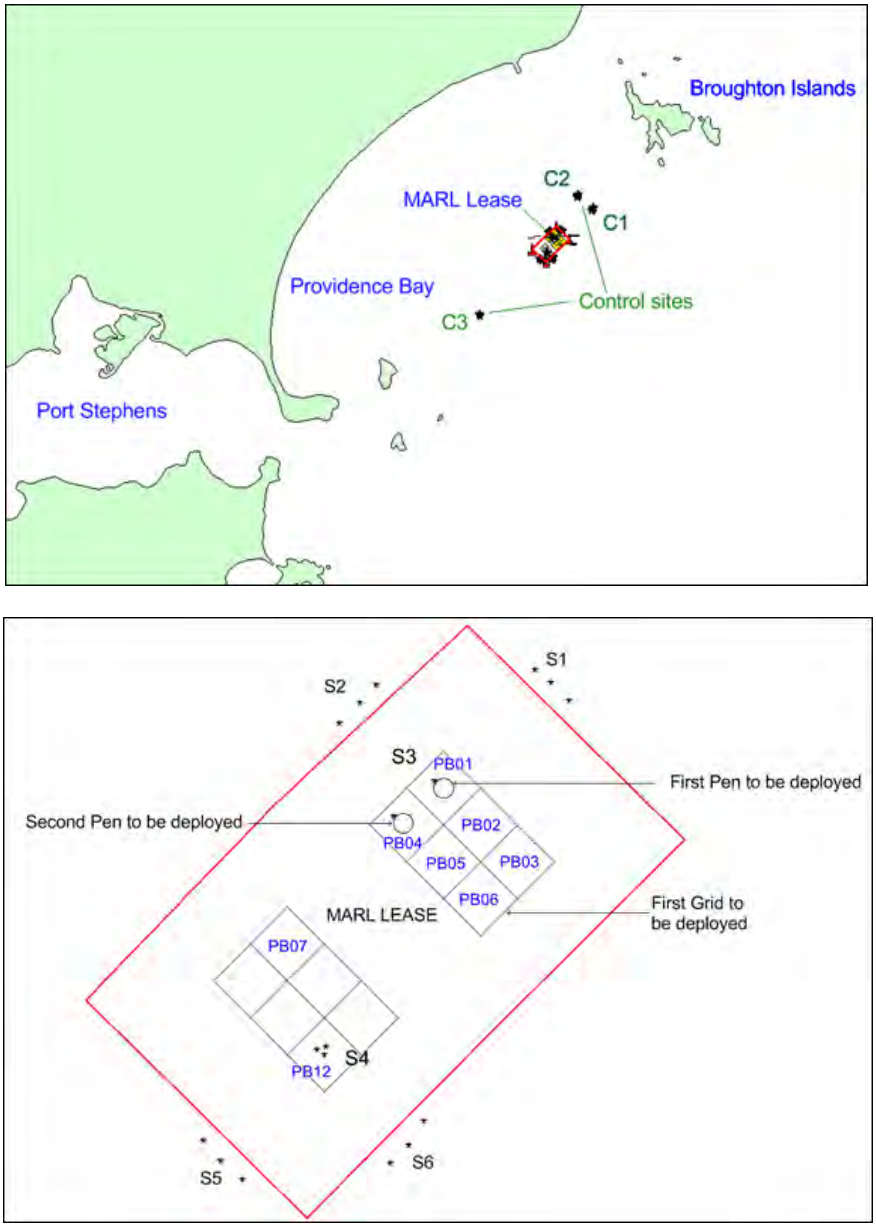

Figure 15: Location and survey sampling sites within Providence Bay and the MARL Note: Red rectangle – lease boundary (Source: AMD, 2016).

6.1.1 Water Quality Monitoring

DO, pH, salinity and temperature data in the water column were measured using a YSI 6820 model Sonde and a YSI Pro ODO Digital Optical Dissolved Oxygen Meter. The meters measured from the water's surface down to 1-2 m above the seafloor. Chlorophyll α and nutrient samples were collected by hand dipping the sample bottles into the surface water and using a Niskin bottle with graduated cord to collect samples just above the seafloor.

Baseline Survey

Results

All water quality results demonstrate that the general pattern for all water quality variables is generally very similar down through the water column. Water temperatures were highly consistent at all sites with a sea surface temperature of around 18.8°C at the surface decreasing to 18.0-18.2°C at the seafloor. DO% saturation ranged between 98-100% at the surface, decreasing down through the water column to 92-95% at the seafloor. DO concentration followed the same pattern at all sites ranging between 7.3-7.6mg/L at the surface and decreasing down to 6.9-7.3mg/L at the seafloor. Salinity was constant through the water column at 35.4-35.5 ppt indicating full strength seawater throughout, with the control sites showing a marginal decrease in salinity at the surface at approximately 35.0 ppt. pH was constant through the water column ranging between 8.16-8.19 through all depths and sites from the September sampling, while it ranged from 8.2-8.4 during the October sampling.

For the nutrients: ammonia, nitrate-nitrite and dissolved reactive phosphorus showed a slight but consistent increase close to the seafloor compared to the surface, with ammonia levels ranging from 0.011-0.019mg/L at the seafloor and 0.007-0.01 mg/L at the surface, nitrate-nitrite ranging from 0.005-0.014mg/L at the seafloor and 0.003-0.004 mg/L at the surface, and dissolved reactive phosphorus ranging from 0.006-0.008mg/L at the seafloor and 0.004-0.006 mg/L at the surface. Kjeldahl Nitrogen, Total Nitrogen and Total Phosphorus did not show any particular trends or differences between the surface and the seafloor or across sites, with KN ranging from 0.25-0.3mg/L, Total Nitrogen ranging from 0.25-0.31mg/L and Total Phosphorus ranging from 0.3-0.4mg/L.

Across all sites and surveys chlorophyll α levels ranged from 0.3-4.0µg/L. Levels at the surface increased from a mean of 0.68µg/L up to 2.26 µg/L on the seafloor in September, and for the October survey chlorophyll α levels increased from a mean of 0.68µg/L at the surface to 1.62 µg/L on the seafloor.

Interpretation

Baseline survey dataset provides evidence that there is some variability for most of these parameters between the surface and the seafloor, with DO and temperature decreasing with depth, and dissolved nutrients and chlorophyll α elevated in seafloor samples compared to surface samples.

The widespread presence of drift algae as shown in the ROV seabed surveys (see Section 6.1.2) especially in the north of Providence Bay may explain the increase in chlorophyll α levels close to the seafloor when compared to surface values. A preliminary investigation of Satellite chlorophyll α levels (AODN Data Collections, CSIRO-MODIS, 2016) for the 16th October, provided readings of 0.495µg/L(S1), 0.43 (S5), and 0.552(C1) with a mean of 0.492µg/L, which would appear to be close to the sample values (mean of 0.573 for the same sites) in the baseline dataset.

The ANZECC & ARMCANZ (2000) guidelines for coastal waters provide default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems (Table 6). A comparison of the baseline results for nutrients is provided against those triggers levels in Table 6. A number of the nutrients (particularly Total Nitrogen and Total Phosphorus) present in Providence Bay before the start of fish farming activities exceed the trigger values and therefore, there is a need to establish or develop suitable local guideline levels. It is the intention of NSW DPI/Huon Research Team to undertake monthly sampling at the control sites throughout the first 2-3 years of operation of the MARL in order to provide the basis for such guidelines. DO saturation and pH through the water column were both well within the trigger levels.

Table 6: Comparison of nutrients and chlorophyll α results with ANZECC & ARMCANZ (2000) default trigger values (Source: AMD, 2016).

Parameter	Unit	ANZECC 2000 Trigger Value	Mean Surface Baseline	Mean Seafloor Baseline
NH4-N	µg/L	15	8	13
NOx-N	µg/L	5	4	9
TN	µg/L	120	280	290
TP	µg/L	25	30	30
DRP	µg/L	10	5	7
Chl α	µg/L	1	0.676	1.621

Update Survey 1

Results

DO (% saturation) ranged between 101-102 % at the surface, decreasing down through the water column to 97-99% at 20 m depth for the control and S1-S3 sites. The % saturation levels at S4-S6 sites were slightly lower at depth (15 m and 20 m) with a minimum of 93%. Water temperatures were highly consistent at all sites and depths ranging between 21.8°C to 22.0°C.

Ammonia, nitrate-nitrite and dissolved reactive phosphorus levels were consistently higher at the seafloor compared to the surface, with ammonia levels ranging from 0.007-0.010mg/L at the seafloor and 0.005-0.06mg/L at the surface, nitrate-nitrite ranging from 0.004-0.059mg/L at the seafloor and <0.002-0.004mg/L at the surface, and dissolved reactive phosphorus ranging from 0.005-0.012mg/L at the seafloor and 0.004-0.005mg/L at the surface. These results are generally similar to the Baseline survey, with the exception of a relatively small increase in ammonia (when compared to the other sites) registered at the surface for the S3 (PB01) site.

Kjeldahl Nitrogen, Total Nitrogen and Total Phosphorus did not show any particular trends or differences between the surface and the seafloor or across sites (similar to the Baseline survey), with Kjeldahl Nitrogen ranging from 0.21-0.3mg/L, Total Nitrogen ranging from 0.21-0.34mg/L and Total Phosphorus ranging from 0.01-0.04mg/L.

Huon Aquaculture is presently also undertaking in-house monthly samples for nutrient water quality across a reduced range of sites (C1, C3, S1, S2) in order to establish or develop suitable local guideline levels. When compared to the monthly results, surface ammonia levels for S3 are also slightly elevated above the range demonstrated by those control and compliance sites. Seafloor nitrate levels in the current survey are shown to be well within the range experienced through the monthly monitoring program.

After six months of monthly surveys seafloor dissolved nutrient levels are consistently higher than at the surface across Providence Bay. Across all sites, chlorophyll α levels ranged from <0.1-1.04µg/L. Mean levels did not differ significantly between surface (0.36µg/L) and seafloor (0.38µg/L) sites.

Results for surface chlorophyll α levels taken at the monthly monitoring sites show that chlorophyll α levels throughout the survey area are generally below 2µg/L, but can on occasion become elevated across all sites (i.e. December 2016) (see Figure 16). As nutrients drive plankton productivity then it is reasonable to suppose that the high dissolved nutrient levels present in the December monthly survey may be part of the reason at least for the significant increase in chlorophyll α levels at that time. The present survey and monthly results do not suggest that there is any strong trend across the survey sites, as might be expected in such an exposed area, and the pen site (S3) did not show any sign of an increase above background levels.

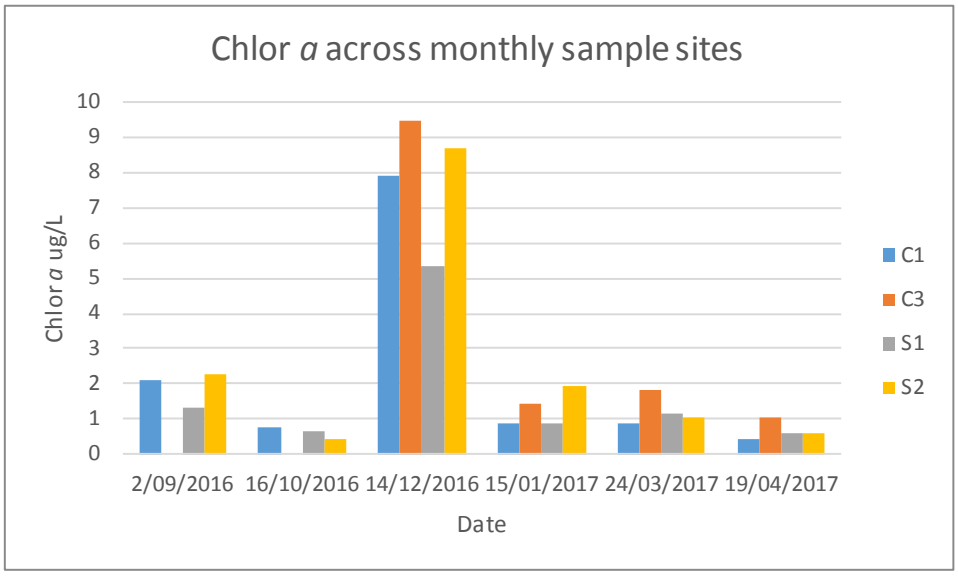

Figure 16: Monthly Chlorophyll α levels at sites C1, C3, S1 and S2 (Source: AMD, 2017).

Interpretation

Water quality monitoring is included as part of the survey program primarily in order to: define the baseline concentrations for these variables on a seasonal basis for Providence Bay; detect if there are any measurable changes in the water quality variables around the fish farm; and if so at what distances from the farm these changes might be detected.

Defining the baseline characteristics and seasonality of the water quality variables is being addressed through the monthly sampling surveys. From the present survey and the first six months of monthly data the following trends are suggested (Table 7):

- Oxygen saturation levels decreased by 5-10% in the top 20 m of the water column for all sites during the survey with sites in the southern end of the MARL lease having lower DO values at depth (for this survey 15-20 m depth). This is despite the fact that the northern control and MARL internal sites, and southern control sites were the same;
- For the Baseline survey the dissolved nutrient levels (nitrate-nitrite, dissolved reactive phosphorus) differed markedly between the seafloor and the surface samples. There were no other discernible trends for nutrients both; between sites, and, between seafloor and surface values;
- Both nitrate (seafloor) and Total Nitrogen (seafloor and surface) levels greatly exceed, and Total Phosphorus (seafloor and surface) levels slightly exceed the ANZECC & ARMCANZ (2000) default trigger values confirming a need to establish or develop suitable local guideline levels (as suggested by the Baseline survey results) for Providence Bay; and
- The monthly data suggests that there is an upwelling of nitrate rich waters into Providence Bay during the summer months.

Update 1 survey occurred when the MARL had a standing biomass of approximately 50 tonne of YTK, with the additional expectation that this would happen approximately six months after the Baseline survey, thereby also providing a seasonal (spring/autumn) comparison.

Despite some seasonal variation suggested by the monthly data, the only observed increase at the pen site is the slight increase in surface ammonia level, noting that compliance sites remained at the same levels or lower than the control sites. All other nutrient, chlorophyll α and physical/chemical water data do not yet show any upwards trend at the pen site or elsewhere around the farm.

Of interest for the future management of the farm may be the observation that oxygen saturation levels can vary in the midwater depth between the southern and northern end of the lease.

Table 7: Nutrient and chlorophyll α levels from all sites compared against ANZECC & ARMCANZ (2000) trigger values. Note: Parameters are in µg/L (Source: AMD, 2017).

		BASELINE SURVEY		UPDATE 1 SURVEY							
Parameter	ANZECC Trigger Value	Mean Surface Baseline	Mean Seafloor Baseline	Mean Surface Baseline	Mean Seafloor Baseline	Mean Surface Control sites only	Mean Seafloor Control sites only	Mean Surface Compliance sites only	Mean Seafloor Compliance sites only	Mean Surface Pen Site S3 only	Mean Seafloor Pen Site S3 only
NH4-N	15	8	13	6	9	9	9	6	10	13	8
NOx-N	5	4	9	2	27	3	38	2	14	2	4
TN	120	280	290	251	280	263	293	235	260	260	300
TP	25	30	30	21	24	27	23	15	20	20	30
DRP	10	5	7	4	8	5	9	5	6	5	5
Chl α	1	0.68	1.62	0.36	0.38	0.5	0.43	0.39	0.39	0.05	0.12

6.1.2 Seabed Remote Operating Vehicle (ROV) Surveys

Baseline Survey

Filming of the seabed was conducted with a ROV (Figure 17) at the sea pen, compliance and control sites. The seabed was generally uniform at all sites (see Figure 18).

All sites shared the common features of medium to coarse rippled sand, some shell grit and old shells, with a depauperate fauna consisting generally of what appeared to be fine burrows and at times polychaete tubes. There were occasional Pennatulaceans (Cnidaria) and juvenile Flathead at a number of sites, and the occasional brittle star (ophiuroid), small mollusc, scallop (mostly only dead shells) and amphipod (probably associated with drift algae).

Drift red algae was abundant at the control sites decreasing towards the south through the lease area and was absent from the southernmost survey sites. This together with the increase in sediment grain size from north to south may indicate a general trend across the sites. No new introduced species were identified from the survey footage.

Figure 17: Preparation of ROV on the deck of a vessel prior to deployment and ROV operator guiding the ROV to collect footage from a sampling site. (Source: NSW DPI, 2017).

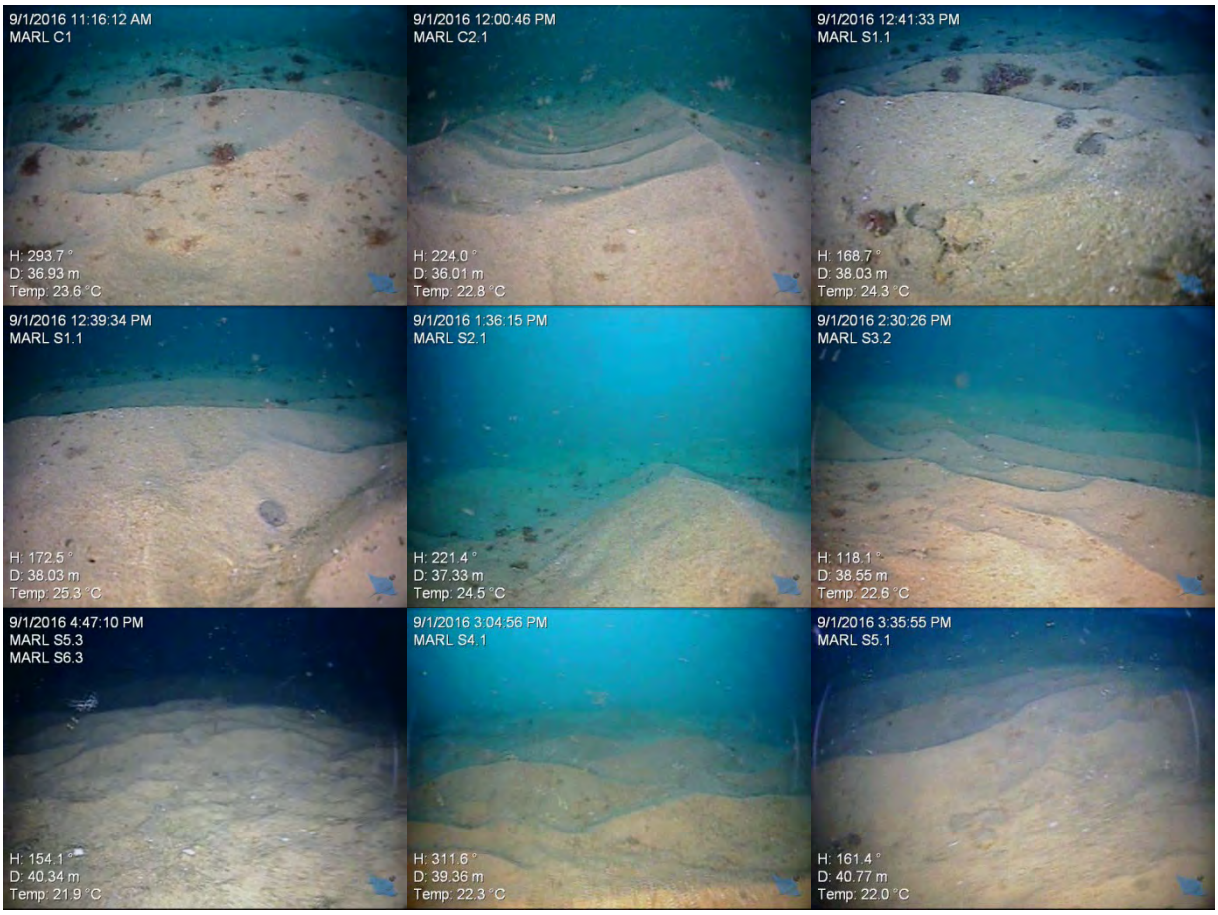

Figure 18: Screenshots of ROV footage from all sites. NB: S6 is labelled MARL S5.3/S6.3. Two shots of S1.1 show the grey/black small amorphous lumps representing the fine carbon deposits at this site. S3.2 is the seafloor prior to stocking the sea pen. (Source: AMD, 2016).

Update 1 Survey

Twenty six ROV spot dives were undertaken at the control, compliance and pen sites. All sites shared the common features of medium to coarse rippled sand (see Figure 19), some shell grit and old shells, with a depauperate fauna consisting in the main of polychaete tubes. There were occasional Pennatulaceans (Cnidaria), juvenile Flathead and Flounder, brittle stars (ophiuroid), hermit crabs and ribbon worms at several sites.

In the Baseline survey, site S1.1 showed evidence for dark grey rounded ‘globules’ suggested to be deposits of fine organic matter which was also present in grab and core samples. These ‘globules’ also appeared to significantly affect the chemical nature of the site (e.g. redox/sulphide). The present survey shows that amorphous globules although generally lighter in colour in Update 1 survey results may be more widely distributed as there was evidence for them at a number of sites (e.g. S5.1, S6.1, C3.1 screenshots in Figure 19). The under pen sites showed the presence of dislodged fouling organisms below the pens consisting of the barnacle *Megabalanus coccopoma* (see 4.2.6) and what appeared to be a small increase in general wild fish numbers. The only algae observed was small pieces of green drift algae at sites S1, S2, PB 1(S3) and C3.

Video footage of the ROV results is available on Huon Aquaculture’s website: https://www.huonaqua.com.au/about/portstephens/benthic-monitoring/

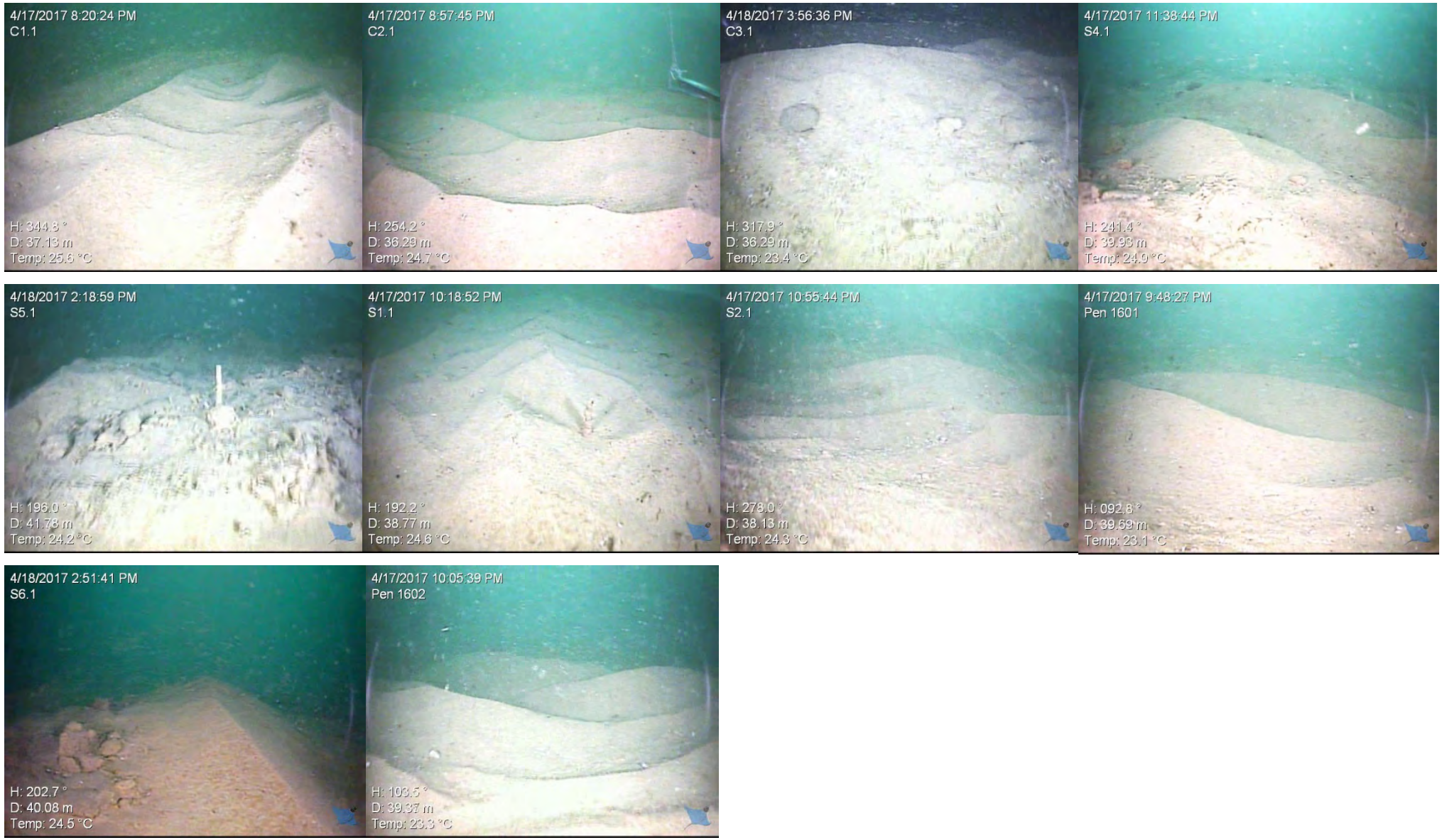

Figure 19: Screenshots of ROV footage from all sites during Update 1 Survey. NB 1601/2 are the under pen shots. (Source: AMD, 2017)

6.1.3. Macrobenthic Invertebrate Monitoring Program

Macroinvertebrates were collected at each of the eight sampling sites, using a Van Veen grab (see Figure 20) which sampled a 0.07 m^2 area of seabed. Four replicate grab samples were collected at each of the control (C1 and C2), pen (S3 and S4) and compliance (S1, S2, S5 and S6) sites, with a total of 32 grabs collected.

Based on the faunal patterns within the benthic macroinvertebrates as demonstrated in the Univariate and Multivariate analyses, any future benthic impacts should be readily observable. Reductions in faunal diversity and increases in species dominance patterns would be one of the main indicators of organic enrichment. Such a pattern would be expected to be readily discernible, given the high diversity and low-moderate dominance recorded during the Baseline survey.

Baseline Survey

A total of 2669 benthic macroinvertebrates were recorded, comprising 18 broad-scale taxa and, collectively within the polychaetes, molluscs and decapod crustaceans, nearly 60 families. In terms of abundance, the benthic fauna was dominated by crustaceans, followed by polychaetes, molluscs and echinoderms. Taxa that made essentially negligible contributions to the total abundance were anthozoans, poriferans, nemerteans and pycnogonids. It is noted that there were very few capitellid polychaetes in any of the samples.

Observed patterns show that there are relatively diverse communities and low to moderate levels of single taxon dominance (amphipods). This is consistent with that reported for a Tasmanian aquaculture site with a similar scale of exposure and sediment characteristics. It is noted that the number of taxa would be greater had the non-decapod crustaceans and ophiuroids been subjected to a more detailed examination. It is also noted that there is essentially no information on the families of these invertebrates in this study area, which limits the usefulness of such an examination. Nevertheless, the level of diversity demonstrated through this baseline survey can form the basis of an informative/discriminative monitoring program.

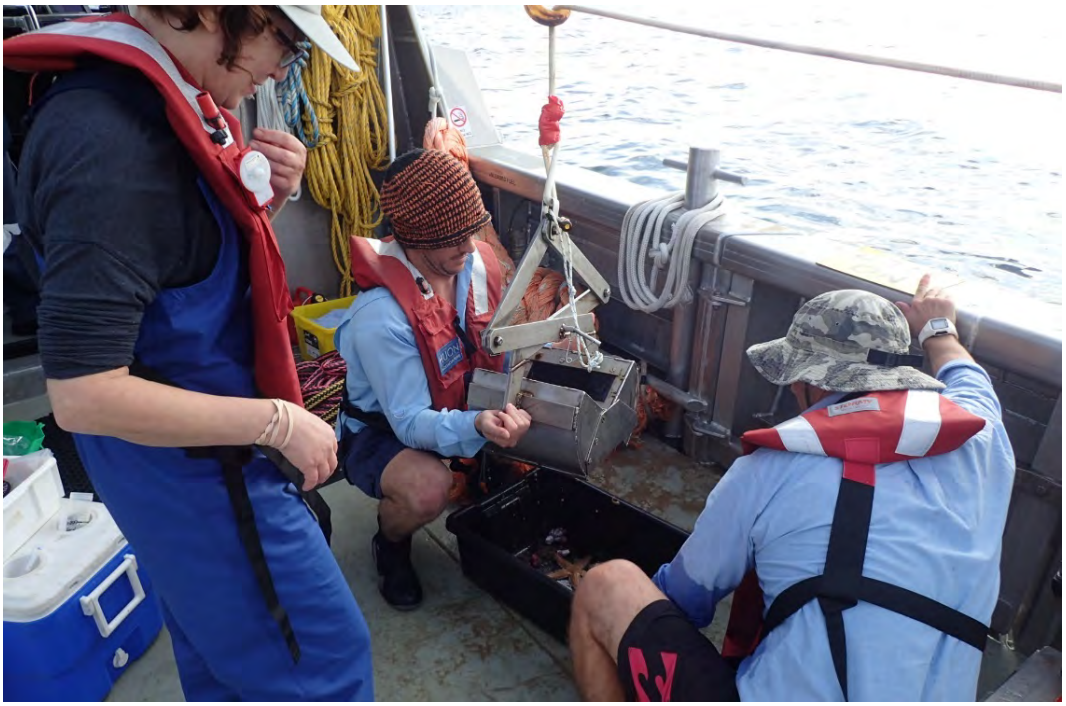

Figure 20: University of Newcastle collecting sediment samples using a Van Veen grab (Source: NSW DPI, 2016).

Update 1 Survey

A total of 7631 benthic macroinvertebrates were recorded, comprising 22 broad-scale taxa and over 65 families which were collectively within the polychaetes, molluscs and decapod crustaceans. Of the newly-sampled families, buccinid gastropods were only recorded at S3, while low numbers of dorvilleid polychaetes were found at S1, S3 and all southern sites. Although dorvilleids were not recorded in the Baseline survey, the collection of 19 very small specimens in the Update 1 survey enabled a positive identification and a re-examination of the taxonomically-similar polychaetes in the Baseline that showed that a total of three individuals were present (1 in S4 and 2 in S6). As for Baseline, there were very few capitellid polychaetes and very low numbers of caprellid amphipods were recorded.

In terms of abundance, the benthic fauna was dominated by crustaceans (80.7%, esp. tanaids and amphipods), with polychaetes (11.9%, esp. spionids) and molluscs (7.0%, esp. nuculanid and mesodesmatid bivalves, trochid gastropods and architectonid gastropods) making smaller contributions. Sixty of the 64 trochids (and of the 167 gastropods overall) were found in one replicate grab at one site (C2). Of the decapods, pasaipheids (shrimps), leucosiids (crabs) and diogenids (hermit crabs) were the most abundant. Furthermore, four small individuals of palinurids (true lobsters) and five scyllarid nisto (slipper lobsters) were present. For S3 (the current pen site), buccinid gastropods were recorded at only this site, large numbers of ostracods were recorded and ophiuroids were not present, but were present at other sites in low numbers.

Observed patterns show that there are relatively diverse communities and low to moderate levels of single taxon dominance in particularly the southern sites (tanaids: S4 and S5 (57 - 60%), C3 (50%)), with the next most abundant taxa (amphipods) contributing 20-25% to the fauna at these three sites

In the Univariate analyses for Update 1 survey, the numbers of broad-scale taxa ranged between 7 and 15 (same as for Baseline), and the number of family-level taxa of polychaetes, molluscs and decapods ranged between 6 and 24 (higher than Baseline) for each of the replicate grab samples. The number of individuals per replicate grab ranged between 24 and 705 (this upper value being far higher than the Baseline) and the overall mean (and SE) abundance was 204.5(27.8), being much greater than the 84.1 (6.8) individuals than the Baseline.

Conclusion

Based on the observed faunal patterns, and when comparing with the results from the Baseline and Update 1 survey, it is evident that S3, the pen site, is showing evidence of a difference with respect to the northern control and compliance sites. This is reflected in the increased numbers of benthic macroinvertebrates overall and of particular taxa such as ostracods and gastropods (esp. buccinids) at the pen site. This difference is expected and is likely to reflect the increased organic input (fish food and faeces) from farm operations. In this case, this is positive as it demonstrates the broad-scale analyses of the benthic macroinvertebrates were sufficient to detect such change, with these patterns being less pronounced at the family level for the polychaetes, molluscs and decapods, probably owing to the relative sparseness of the data, with zero individuals reported for many of the large number of families. This difference did not however, extend to the adjacent compliance site and was confined to the area beneath the lease.

Although the number of overall taxa were similar between the Baseline survey and Update 1 survey, the number of individuals in Update 1 survey was higher than that recorded for the Baseline. This is because of the recording of 1312 individuals from the additional control site C3 and probably also to seasonal increases in tanaids and other crustaceans, as these surveys

occurred in different seasons, i.e. Spring (September 2016) for the Baseline survey and Autumn (April 2017) for Update 1 survey.

It is recommended that family-level identification still occur in future, as the lease site is still developing and the potential appearance of new families, coupled with recording any changes in numbers of already-sampled families in the present study, provides essential insight. For example, the buccinid gastropods are known to scavenge (Aguzzi *et al*., 2012), and their appearance in the present survey is likely to be of significance. It is also important to be able to quantify any future increases in sensitive polychaete taxa, such as capitellids and dorvilleids, which were collectively represented by 30 individuals on the Update 1 survey sampling occasion at the pen sites, or any concomitant declines in bivalves or ophiuroids (Macleod & Forbes, 2004; Edgar *et al*., 2010).

The control sites have been enhanced by the addition of the third control site (C3) in the Update 1 survey, which is shown to be similar in taxonomic composition to the other southern sites, and it is recommended that sampling be continued at this site. Although C1 and C2 do not represent ideal “control” sites, owing to their initial difference from the northern compliance sites (S1 and S2) and pen site (S3) and their typically finer grain size (AMD 2016 and AMD, 2017), it is recommended that both C1 and C2 are retained in the future.

6.1.4 Substrate Monitoring Program

Sediment samples for substrate analysis were collected using a Van Veen grab.

Baseline Survey

At all sites apart from S1, sediment redox values at 30 mm sediment depth averaged 220 mV and were well above 100 mV at each site. The anoxic value for one of the triplicate samples from S1 suggests that there is a source of organic matter at this site. Sulphide concentration in sediments was below detection at all sites except for S1 at which one of the triplicate samples showed elevated (albeit still relatively low) sulphide levels. The observed redox and sulphide values were indicative of well oxygenated, unimpacted sediments.

Sediments across the area sampled were dominated by medium sand fractions with the great majority of sediments (>50% at each site) being in the 0.25 mm size class. The sediments were clean with a very low proportion of mud fractions (i.e. <0.063 mm). Patterns of particle size distribution were therefore indicative of a sedimentary environment with moderate agitation of seabed sediments and associated low abundance of fine silt and clay fractions. These patterns are considered typical of sediments in deep (i.e. >20 m) and exposed locations. The overall similarity in particle size distribution between sites implies similar depositional environments.

The organic content of the sediments was very low at all sites, as would be expected in moderately coarse, sandy sediments, ranging from only 0.02% to 0.89%, with an average of 0.09% across all sites. Again one of the triplicate samples at S1 was different (higher) than all of the other samples.

Update 1 Survey

All sites apart from S1 have mean sediment redox values above 190mV. At S1 all the triplicate samples were lower in comparison to the results from all other sites. The observed high redox values are indicative of well oxygenated, unimpacted sediments (Macleod & Forbes 2004). The more anoxic value for the samples at S1 suggests that the source of organic matter identified at this site in the Baseline survey is still present.

Sulphide concentration in sediments was below detection at all sites except for S1 & S3. Only one of the triplicate samples at S3 was above detection at 5uM, whereas all three S1 samples registered a positive value for sulphides ranging from 0.01 – 2uM. It would appear that whatever has impacted S1 (first observed during the Baseline survey) is still present at that site. The reading for S3 suggests that there may be some very slight effect now being picked up at this

pen site. These readings though are all extremely low and overall the observed sulphide concentrations therefore showed negligible significant evidence of organic enrichment (Macleod & Forbes, 2004).

Sediments across the area sampled were dominated by medium sand fractions with the great majority of sediments (>50% at each site) being in the 0.25 and 0.5mm size classes. The sediments were clean with a very low proportion of mud fractions (i.e. < 0.063mm). The mean grain size across all sites was within a narrow range with a trend of increasing mean grain size from north to south across the survey area as was also identified during Baseline survey. There were no site specific differences identified since Baseline survey.

The patterns of particle size distribution for all sites were indicative of a sedimentary environment with moderate agitation of seabed sediments and associated low abundance of fine silt and clay fractions. These patterns are considered typical of sediments in deep (i.e. >20m) and exposed locations. The overall similarity in particle size distribution between sites implies similar depositional environments.

The organic content detected during Update 1 survey was very low at all sites, ranging from <0.02% to 0.75%, with an average of 0.07% across all sites. One of the triplicate samples at C1 appeared higher than the other samples and as shown in the comparison between the two surveys (Figure 21), C1 and S1 appear to have consistently higher TOC levels, albeit that the overall levels are very small in all cases. There would appear to be no increase in TOC levels at the pen site (S3) between the two surveys.

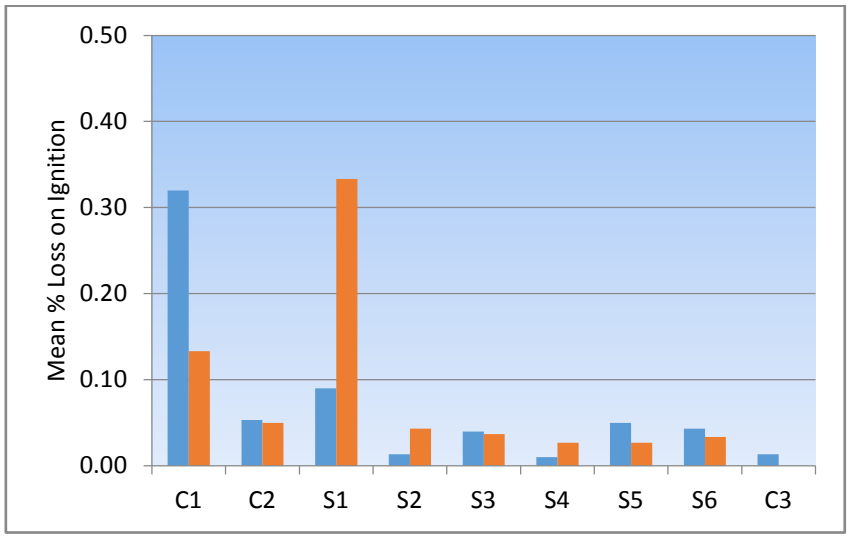

Figure 21: TOC comparison between Baseline survey (orange) and Update 1 survey (blue) (Source: AMD, 2017).

6.2 Marine Fauna Interactions

The Marine Fauna Interaction Management Plan was developed to identify and mitigate potential impacts on marine fauna associated with the MARL. The Plan includes an Interaction Protocol; Monitoring Program; Light Spill Management Plan and Observer Protocol. It was developed by the Marine Fauna Interaction Committee consisting of representatives from NSW OEH, Macquarie University, Port Stephens-Great Lakes Marine Park, Huon Aquaculture and NSW DPI. Notably, Huon Aquaculture has extensive experience in managing interactions with marine wildlife around aquaculture operations. All members of the NSW DPI/Huon Research Team have been informed about the Marine Fauna Interaction Management Plan and received appropriate training.

All marine fauna interactions with the MARL, notably threatened species, have been monitored since the sea pen infrastructure was installed in September 2016. A NSW OEH approved

observer was present during this stage of the project and during the installation of three additional pens in September 2017 to monitor any marine fauna interactions. Marine fauna monitoring has also been undertaken on all vessel trips when travelling to and from the MARL, as well as within and around the lease (see Table 8). Particular attention has been given to the movements of threatened and protected species, migratory species (e.g. Humpback whales, White Sharks, Grey Nurse Sharks, fur seals, Gould's Petrel and dolphins). Regular updates on marine fauna observations can be accessed on Huon Aquaculture's website (Web Reference 1).

The Fortress pen design has proven very effective in preventing marine fauna interactions on the MARL (Figure 22). The design prevents marine fauna from entering the pens, accessing stock and fish feed, as well as discourages marine fauna from resting on the infrastructure. The effective prevention of predatory interactions on the MARL has greatly minimised fish stress, injury and loss (Web Reference 2).

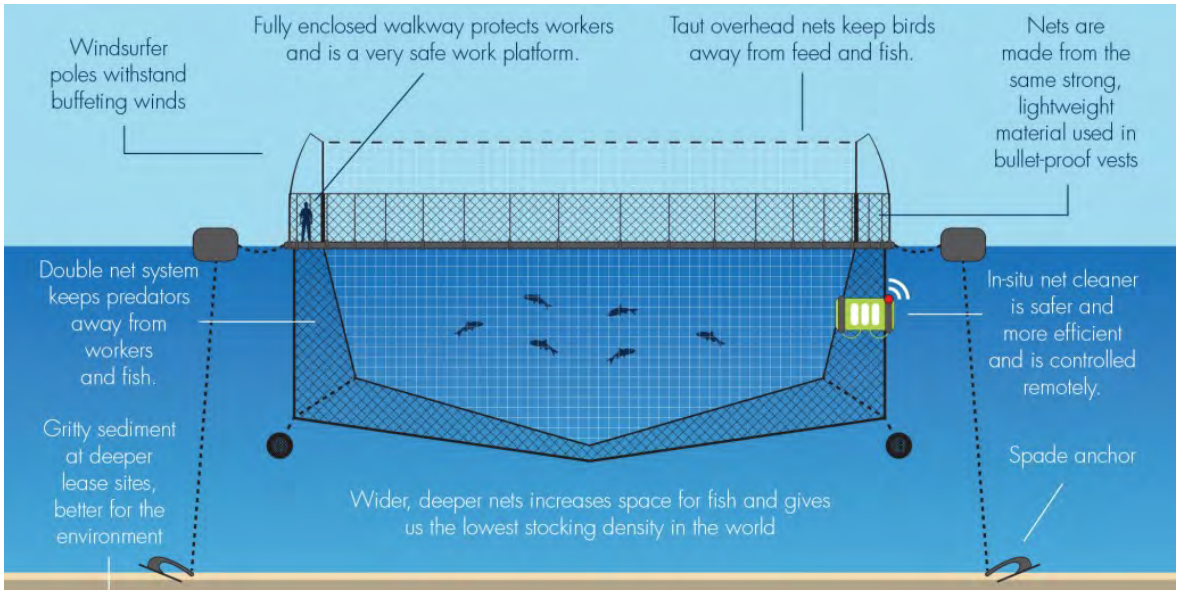

Figure 22: Revolutionary pen design – Fortress pens (Source: Huon Aquaculture, 2017).

6.2.1 Seabirds

Fish farms are seen by birds as a place to perch and a source of food – from the fish and the fish feed. Shearwaters, which may include wedge-tailed shearwaters (*Puffinus pacificus*), sooty shearwaters (*Puffinus griseus*) and short-tailed shearwaters (*Puffinus tenuirostris*), have been observed resting on the sea pen walkways. Other species that have occasionally been observed in close proximity to the sea pens include cormorants, Australasian gannets, terns, seagulls, white-bellied sea eagles, albatrosses and the little penguin (*Eudyptula minor*).

The Fortress pen design consists of an effective barrier to entry for birds and to deter birds from resting on the nets. By denying birds the opportunity to perch and access to both fish and feed, they are discouraged from viewing the pens as a place to rest and as a source of food. The design includes 60mm taut nets that are well above the water and therefore keep the birds away from the fish and the fish feed. The option of installing escape hatches to provide an exit in the event of an entry remains but has not been required due to the lack of entries.

As the principle mechanism that birds gain access to pens is through damage to bird nets resulting in tears or holes, as well as incorrectly and poorly rigged bird netting, thorough inspections of the bird exclusion nets have been part of the rigorous monthly inspection schedule, however observations are made by staff as part of their daily checks, especially after storms and rough weather. Accessing in-pen equipment e.g. feed bin or bird net support, requires the bird net to be rolled back, as well as net changing, can also provide an opportunity for birds to access the pen.

Table 8: Summary of marine fauna interactions with the MARL (Source: Huon Aquaculture, 2017).

Report Period	Observations (travelling to & from MARL)					Observations (in and around lease)							
Start - Finish	*Humpback Whale*	*Calf*	*Dolphin*	*Seal*	*Obs*	*Humpback Whale*	*Calf*	*Dolphin*	*Seal*	*Obs*	*Nature Of Interaction*	*Entangle*	*Comments & Actions*
26/09/2016 9/10/2016	13	2	53			23	3	102	3	1x Dwarf Minke	8/10/16 Report	Nil	Mooring Installation Period (Ob on board)
10/10/2016 23/10/2016	6	3	43	1		19	4	29	1			Nil	Mooring Installation Period (Ob on Board) + Fish Transported to Sea
24/10/2016 6/11/2016	5	2	34			6	1	42	1			Nil	Fish Farm Established
7/11/2016 20/11/2016	6	2	55									Nil	Feeding and Cage Maintenance
21/11/2016 4/12/2016			49					5				Nil	Feeding and Cage Maintenance
5/12/2016 18/12/2016			35					3				Nil	Second Cage
19/12/2016 1/01/2017			114									Nil	Feeding and Cage Maintenance
2/01/2017 15/01/2017			159			1	1	37				Nil	Feeding and Cage Maintenance
16/01/2017 29/01/2017			128					5				Nil	Feeding and Cage Maintenance
30/01/2017 12/02/2017	1		74		Minke swimming past lease			12				Nil	Feeding and Cage Maintenance

13/02/2017 26/02/2017			69			6		Nil	Feeding and Cage Maintenance
27/02/2017 12/03/2017			23			0		Nil	Feeding and Cage Maintenance
13/03/2017 26/03/2017			15			15		Nil	Feeding and Cage Maintenance
27/03/2017 9/04/2017			24					Nil	Feeding, Bathing and Cage Maintenance
10/04/2017 23/04/2017			8			9		Nil	Feeding and Cage Maintenance
24/04/2017 7/05/2017			17			17		Nil	Feeding, Bathing and Cage Maintenance
8/05/2017 21/05/2017			36			11		Nil	Feeding, Bathing and Cage Maintenance
22/05/2017 4/06/2017	4	1	29	5	1	6		Nil	Feeding, Bathing and Cage Maintenance
5/06/2017 18/06/2017	3	3		2				Nil	Feeding and Cage Maintenance
19/06/2017 2/07/2017		1		2		12		Nil	Feeding and Cage Maintenance
3/07/2017 16/07/2017	16	2		2		Pod		Nil	Feeding, Bathing and Cage Maintenance
17/07/2017 30/07/2017	4	1		6			1	Nil	Feeding and Cage Maintenance. Seal activity increasing –

									ensure barriers in place.
31/07/2017 13/08/2017		1					1	Nil	Feeding and Cage Maintenance
14/08/2017 27/08/2017	18		6	8		2	1	Nil	Feeding, Cage & Mooring Maintenance
28/8/2017 10/9/2017	8	2	11	14	4	5			Feeding, Cage & Mooring Maintenance
11/9/2017 24/9/2017	36	6	197	34	8	60	3		Feeding, Cage & Mooring Maintenance
25/9/2017 8/10/2017	5	4	16	17	5	4			Feeding, Cage & Mooring Maintenance

Techniques such as sounding a vessels air horn and opening the net upwind, have proven to be effective at getting birds to exit pens in these instances.

During the first year of operation, one bird entanglement incident occurred on the MARL:

Date: January/February 2017 (over a period of three weeks)

Species: Shearwaters (on their annual north migration)

Direct interactions:

- Three birds were found sitting on the walkways (released unharmed); and
- Two birds were discovered entangled in the wall of the bird net (dead).

Probable cause: Through discussion with relevant experts it was thought that the netting was visually hard to detect during low light times of the day.

Management action: Reflective streamers will be trialled during the next migration period.

Light Pollution

No night work operations have been conducted on the MARL during the first year of operation so the potential for light pollution associated with vessel lights impacting on seabirds at night is considered to be negligible. Four low intensity navigation strobe lights were attached to buoys on the corners of the MARL in accordance with NSW RMS requirements. The requirements include a range of at least four nautical miles (7.4 km) in clear conditions (transmissivity of 0.74) which are within range of Cabbage Tree Island (5.6 km from lease) and Boondelbah Island (7 km from lease).

There are no records of direct interactions between the MARL and the light sensitive species of the Gould's petrel (*Pterodroma leucoptera leucoptera*), little penguin (*Eudyptula minor*) and white-faced storm petrel (*Pelagodroma marina*). One incident occurred however, with five shearwaters during their annual north migration. Three shearwaters were found on the pen walkways which were released unharmed, while two shearwaters died due to entanglement. This incident is not considered to be related to the presence of the navigation lights on the MARL. The lack of visibility of the netting during low light periods was assessed as the likely reason for this interaction. The proposed management response is to trial reflective streamers during the next migration period.

6.2.2 Whales

During the MARL's first year of operation, 139 Humpback whales (*Megaptera novaeangliae*), 27 Humpback calves and one Minke whale (*Balaenoptera acutorostrata*) (Figure 23) have been recorded within and around the lease (see Table 8). 125 Humpback whales, 30 Humpback calves and one Minke whale were also recorded while travelling to and from the lease during the first year of operation. The following two events are the only direct interaction recorded between whales and the MARL.

Figure 23: Minke and Humpback whales within MARL (Source: Huon, 2017).

Interaction One

At 7:45am on Saturday 8th October the vessel *Wandi II* with NSW DPI/Huon Research Team staff and a NSW OEH approved marine observer approached the MARL for installation work and observed two Humpback whales within the lease area.

The whales swam through and around the lease infrastructure for approximately 40 minutes, interacting with it including tail fluke slapping, pectoral fin slapping and rubbing against the mooring lines. All interactions were documented with video and photographs. There was no sign of entanglement during this interaction. As per the Marine Fauna Interaction Management Plan, installation works were suspended for 40 minutes until the two whales left the lease area.

Infrastructure on the lease on this day consisted of 12 large black marker buoys, four Cardinal markers, anchors, chain risers; 120 mm orange mooring lines and 44 mm orange anchor installation lines (orange to provide visibility to cetaceans) topped with white foam buoys. The anchor installation lines were designed to sink following installation of the mooring grid but may be used at a later date to retrieve/reposition the anchors. The installation was completed on the 16th and 17th October 2016 in which the white buoys were removed and the lines were dropped to the seafloor.

Interaction Two

See Section 6.2.7 for details on this interaction between whales and the MARL.

6.2.3 Dolphins

The most frequently reported interaction between dolphins and fish farms is that dolphins are attracted to prey around the farm opposed to predating on fish in the sea cages (Diaz Lopez *et al.,* 2005). These were the findings for the trial operation of a Snapper farm in Providence Bay which resulted in no negative dolphin interactions with the sea pen farm over the two year statutory monitoring period (Worth & Joyce, 2001) or during the ongoing operation of the farm up until 2004 (D. Liszka 2011, *pers. comm*.). During the MARL's first year of operation, 382 dolphins were recorded within and around the lease and 1195 dolphins were recorded while travelling to and from the lease.

A nominated observer has been present during all vessel movements and MARL activities, including the deployment stage, to minimise the risk of vessel strikes, monitor marine fauna interactions and ensure that recommended distances from marine fauna are maintained by MARL service vessels when in transit.

During the environmental assessment process, it was considered unlikely that dolphins would represent a significant predatory concern to the MARL but behavioural changes associated with feeding around fish farms, notably feeding patterns and social structure, could represent a potential concern and should be closely monitored. The dolphin monitoring results for the MARL during the first year of operation are listed in Table 8.

Observations during the initial stages of the MARL indicate that dolphins displayed interest in the sea pen infrastructure as pods were aggregating in close proximity to the lease. However, this change in behaviour was only observed during the first two weeks while the sea pen infrastructure was being deployed (i.e. reporting period 26/9/16-9/10/16). Since then dolphins have not been observed aggregating in close proximity to the leases for extended periods of time.

Many dolphins have been recorded within the lease area and while travelling to and from the lease within the wider area of Providence Bay and Port Stephens but have not been observed directly interacting with the MARL infrastructure in any way or aggregating around the sea pens since early October 2016 (Table 8). Similarly, there are no records of boat strikes or entanglements.

No acoustic deterrent devices were used on the MARL.

6.2.4 Seals

The Australian fur seal (*Arctocephalus pusillus doriferus*) and the New Zealand fur seal (*Arctocephalus forsteri*) are commonly recorded in the Port Stephens region but there are also occasional sightings of leopard seals (*Hydrurga leptonyx*). Providence Bay, notably Cabbage Tree

Island located 5.6 km southwest, has become a haul-out site for an increasing number of non-breeding seals using the site annually (NPWS, 2014).

The periodic feeding of farm fish and the likely congregation of wild fish stock around the sea pens in response to these feeding events was assessed as a factor that could potentially attract seals into the vicinity of the MARL. This potential interaction could in turn modify their feeding behaviour and their interactions with humans.

Interactions between seals and finfish farms in South Australia and Tasmania for example, have included seals basking on infrastructure, entering enclosures, consuming stock, biting dead fish lying against nets and damaging nets (DAFF, 2007). However, these interactions can largely be prevented by appropriate net design, appropriate feeding regimes, constant vigilance, gear maintenance and site placement (Kemper *et al*., 2003). The Fortress pen design used on the MARL employs nets made of a Dyneema-like material (also used in bullet proof vests). The double net system keeps predators away from workers and stock and the fully enclosed walkway protects workers. The MARL is also positioned 5.6 km from the haul-out site on Cabbage Tree Island.

There have been a few sightings of fur seals within the lease area but mostly while travelling to and from the lease in close proximity to Cabbage Tree Island (Table 8; Figure 24). There are no records of fur seals attempting to prey on the stock, interacting with staff e.g. divers, entanglements or interactions with sharks during the first year of operation.

One fur seal has been recorded using the access way for one of the pens as a haul-out site during the month of August. This part of the infrastructure is the entry point outside of the sea pen – no seal has breached the enclosed walkway that surrounds each of the sea pens. This interaction will continue to be monitored over the coming months and vigilance with maintaining the structural integrity of the predator exclusion nets and walkways has been reiterated to MARL staff.

No acoustic deterrent devices were used on the MARL.

Figure 24: Fur seals hauled out on Cabbage Tree Island (Source: NSW DPI, 2017).

6.2.5 Sharks

Shark research has been undertaken by NSW DPI in collaboration with CSIRO and other researchers for a number of years. This research has included the monitoring of shark movements within NSW waters through the use of acoustic tagging and acoustic listening stations (Figure 25). Acoustic tags are deployed in fish and sharks through a range of projects lead primarily by public sector agencies and universities. The receiver is located on a buoy or attached to the seafloor, and detects transmissions from tags when a tagged animal swims within a range of 500-800 m. The

receiver logs the individual-specific tag code, the date and time, and any sensor telemetry from the tag, and allows the duration in which animals were in the vicinity to be determined.

NSW DPI deployed a Vemco VR2W acoustic listening station at a temporary mooring approximately 3 km northeast of Cabbage Tree Island (coordinates: 32°40.7570´S 152°15.5140E) on 13th November 2015 to obtain data prior to deployment of the sea pen infrastructure. It was retrieved on 13th June 2016 where 12 tagged fish were detected during that time. Eleven of which are known to be sharks (i.e. 6 Bull Sharks, 4 White Sharks and a Dusky Shark). The most common visitor was a Bull Shark that was detected on 40 separate days, while on average each shark visited the site for ~ 6 separate days.

As part of the NSW DPI Shark Management Strategy, a VR4G receiver was installed (with assistance from Huon Aquaculture) near Hawks Nest which currently provides information in real time about the presence of a tagged shark (Bull, White or Tiger) directly to Twitter and the SharkSmart App. There is also aerial surveillance of sharks at Hawks Nest with flights conducted every morning during all NSW School holidays.

Figure 25: Fitting a transmitter to a shark and a diver setting up a receiving station to monitor marine fauna movements (Source: NSW DPI, 2017).

A Vemco VR2W acoustic listening station was also deployed on the MARL in October 2016 after the first sea pen was stocked with YTK fingerlings. The receiver was in position until 10th August 2017. A total of 19 tags were recorded and included 14 White Sharks, 2 Bull Sharks and 3 Grey Nurse Sharks. The maximum time a tag was detected was 9 days, with most individuals detected on only 1 day. These patterns suggest that sharks routinely visit the MARL, and most of the detections are of transient animals undertaking broader migrations. Two Grey Nurse sharks and one unidentified shark have been sighted on the MARL in the last year.

Acoustic tag monitoring results and observations from MARL staff, including underwater inspections and the implementation of the Observer Protocol, do not indicate that the MARL has induced behavioural change or attracted increased numbers of sharks to the lease area during the first year of operation. There are no reports of entanglements, aggregation around pens, interactions with seals or evidence of attempts to prey on stock.

The Fortress pen design utilised on the MARL has proven very effective at managing interactions with sharks to date. Sharks have been denied access to stock through the pen nets, which are made of a Dyneema-like material (also used in bullet proof vests). The rigorous approach to pen cleanliness to prevent the pens becoming a source of interest is also considered to have contributed to the absence of sharks aggregating around the sea pens.

6.2.6 Marine Turtles

Marine turtle species that are likely to occur in Providence Bay include the 'vulnerable' green turtle (*Chelonia mydas*); 'endangered' leatherback turtle (*Dermochelys coriacea*) and the 'endangered' loggerhead turtle (*Caretta caretta*).

During the first year of the operation of the MARL, there were no incidents of vessel strikes or entanglements with marine turtles.

6.2.7 Marine Mammal Entanglement

There have been no reports of entanglements of marine mammals in MARL infrastructure during the first year of the operation between September 2016 and October 2017 (see Table 8). However, one incident report of an alleged entanglement incident was submitted by a marine tour operator in October 2016 immediately prior to an Incident Report in 6.2.2.

Incident Report

On Saturday 8th October 2016 at approximately 7:12 am two Humpback whales were observed within the MARL by a tour operator. On closer inspection it was observed that one whale had a rope of approximately 25 mm diameter around its back (Figure 26).

Figure 26: Photograph depicts a rope over the back of a Humpback whale (Source: Future, 2016).

NSW OEH, NSW DPE and Commonwealth Department of Environment and Energy were notified of this event. NSW OEH requested an incident report from the tour operator which was received on the 16th October 2016. The incident report outlined that as the tour operator approached the MARL, one of two Humpback whales in the lease area appeared to be entangled in at least one rope and that the whale was evidently distressed. It further outlined that as they ventured closer to assist and photograph the whale, it was observed rolling and managed to dislodge the rope. The two whales then stopped outside the lease area for 15-20 minutes circling the tour boat and then appeared to head south.

Figure 27 provides a comparison of the orange 44 mm MARL anchor deployment lines and the 24 mm rope observed during the whale interaction incident. The MARL only uses orange 44 mm anchor deployment lines and orange 120 mm mooring lines. The orange colour is believed to increase their visibility to whales.

The Marine Fauna Interaction Committee, which consists of representatives from NSW OEH, Macquarie University, Port Stephens-Great Lakes Marine Park, Huon Aquaculture and NSW DPI, reviewed the incident report and photographs provided by the tour operator. The Committee also reviewed the photographs taken by the NSW OEH approved observer and consulted a Fisheries Officer who is familiar with fishing equipment. Observations indicate the presence of two small floats in many of the photographs in addition to the white buoy attached to the anchor deployment line of the MARL (Figure 28).

The review findings concluded by the Marine Fauna Interaction Committee were that:

- The black rope seen on the whale's back was consistent with fishing trap equipment;
- The whale was not entangled in the MARL orange anchor deployment lines or mooring lines; and
- The incident was not reported through the emergency hotlines (NWS OEH or NSWDPI/Huon).

The recommendations of the Marine Fauna Interaction Committee were:

- Local tourism industry stakeholders be provided with a laminated card listing the emergency contact numbers for marine fauna interactions highlighting the need for timely

formal notification (NPWS: 0429 144 880 (131 555) and/or MARL Emergency Number: 1300 920 987);

- NSW DPI/Huon Research Team in consultation with NSW OEH, undertake marine fauna interaction response training; and
- Local ORRCA and marine tour operators to be invited to undertake marine animal interaction response training to enable them to assist/advise if an entanglement event were to occur in the future.

Figure 27: Comparison of a 24 mm rope and 44 mm anchor deployment line used on the MARL. Note: rope dimensions are measured with a load applied and these ropes are unloaded (Source: NSW DPI, 2016).

Figure 28: Larger anchor installation line white buoy and the two small floats (Source: Wiltshire, 2016).

Marine Fauna Interaction Training

Port Stephens Fisheries Institute hosted 24 personnel from Marine Parks, NPWS, NSW DPI, Huon Aquaculture and Dolphin Swim Australia for accredited wildlife interaction training provided by the Victorian Department of Environment, Land, Water and Planning in February 2017. The training was initiated under the Marine Fauna Interaction Management Plan to: develop a response plan to deal with incidents with NSW OEH and other relevant departments; and to ensure that a number of staff members receive training in wildlife rescue techniques to ensure appropriate response to potential incidents.

The accredited training program provided staff with the knowledge and practical experience necessary to respond to marine fauna entanglements. Day One of the training focussed on theory and practical issues with Day Two on the water, freeing a towed 'whale tail' entangled with ropes and buoys (Figure 29).

Figure 29: Day Two of the marine fauna interaction training – freeing a towed 'whale tail' (Source: NSW DPI, 2017).

7 Standards/Performance Measures and Environmental Targets/Strategies

In accordance with the SSI-5118 MOD 1 consent conditions the NSW DPI/Huon Research Team developed an Operational Environmental Management Plan (OEMP) which outlines the management practices and procedures to meet the standards and performance measures that apply to the MARL development. The OEMP contains a number of sub plans which provide further details on the respective standards and performance measures that apply to specific activities. Templates of seven of these redacted management plans can be viewed at http://www.dpi.nsw.gov.au/fishing/aquaculture/publications/general

The OEMP and associated sub plans were submitted and approved by NSW Department of Planning and Environment. The OEMP and associated sub plans have undergone a six monthly review to ensure that they are still relevant in meeting the conditions within the SSI-5118 consent and/or standards and conditions for operation of the MARL.

Independent environmental sampling that has been undertaken in the first year of MARL research program has found no significant impact on benthic invertebrate ecology or water column chemistry within the MARL, at the sea pen, compliance, or at the control sites. The monitoring is to continue throughout the life of the MARL project to assess any potential change as production biomass of fish increases through time. An additional control site has been added to the ongoing monitoring program to better inform the environmental monitoring.

8 Navigational Interactions

A range of mitigation measures have been implemented throughout the deployment and operation stages of the MARL to ensure navigational safety, including:

- The lease area was surveyed and delineated by four cardinal markers. The four cardinal markers were originally spar buoys and were replaced with Sealite Poseidon buoys. They exhibit more lateral movement around their installed position but the improved visibility is more desirable from the feedback from the community and regulatory authority. NSW RMS used this information to update maps and issue a 'notice to mariners' to highlight the change in navigable conditions in Providence Bay;
- The cardinal markers have been fitted with auto-notification technology to advise NSW DPI/Huon Research Team staff and NSW RMS if any markers move off the lease site;
- The sea pens are to be fitted with GPS trackers once a suitable power source can be fitted, to monitor their performance within the mooring grid;
- A 'notice to mariners' was circulated accompanied by a 'Securite' to advise water users of the installation of the temporary mooring off Boulders (Yacaaba Headland) in October 2016 to allow final configuration of the initial two pens to take place inshore. NSW RMS and Marine Parks were consulted throughout this stage of the operation;
- NSW RMS worked with Port Stephens Marine Rescue to advise mariners via 'Securite' calls of the deployment stage of the initial two pens as these were towed from Port Stephens to the MARL;
- NSW DPI placed notifications to mariners at boat ramps prior to the October long weekend as well as providing media to local papers (Port Stephens Examiner, Myall News of the Area) updating the progress of the sea pen installation and warning mariners of changed navigational conditions;
- During the pre-Christmas period advice to mariners about the changes in navigational conditions in Providence Bay was provided to: tackle shops; tourist bureaus; marinas; as well as signage placed at boat ramps;
- NSW DPI/Huon Research Team staff conducted two project update presentations for the NSW RMS Waterwayusers Group and the Port Stephens Estuary Management Committee, which consist of waterway users and tour operator members; and
- NSW DPI/Huon Research Team staff attended a Marine Rescue Port Stephens meeting to update volunteers on the project. Wave height and sea state data collected by Huon Aquaculture were provided to Marine Rescue for training purposes. Huon Aquaculture also commenced working on a project that will provide Marine Rescue with access to high speed NBN to upgrade support operations.

In the past year since the MARL infrastructure was installed, one navigational incident occurred. On 30th September 2016, a recreational boater collided with a black buoy on the lease. It was later confirmed that the lease markers were operational at the time of the incident but the recreational boater did not see them. Suggestions were made about having signs at the boat ramps. Flyers and notices about the construction of the MARL were subsequently placed at the boat ramps.

There have been four structural malfunctions with the sea pen infrastructure associated with severe weather conditions but none of the malfunctions resulted in a navigational interaction as the malfunctions were promptly rectified. See Section 3.3 for the details on the four structural malfunctions.

9 Compliance

A number of actions have been undertaken to ensure compliance with the consent conditions of the State Significant Infrastructure Approval SS1-5118 for the MARL.

9.1 Training

Personnel employed on the MARL including employees, contractors and subcontractors, have received appropriate induction training and have the required skills and qualifications to fulfil their respective roles in a competent manner. Only personnel that meet the required training and competency requirements of NSW DPI/Huon Research Team have been employed to work on the MARL.

Minimum environmental training has included:

- An induction onto the MARL and land based sites;
- A briefing on the importance of conformity with the environmental policy, procedures and requirements of the Operational Environmental Management Plan (OEMP), as well as their roles and responsibilities;
- Specialised environmental training and instruction required for undertaking allocated tasks, especially in regards to compliance with the environmental conditions of the SSI-5118 consent;
- Other specific training and instruction requirements including emergency response and operation of specific equipment; and
- Regular meetings which have included discussions on safety issues, risk assessments and controls.

9.1.1 Informing Consultants and Subcontractors

All consultants and/or subcontractors have been properly briefed and made aware of the requirements of the OEMP. The specific requirements of the OEMP have been incorporated into the induction process undertaken by all consultants and subcontractors working on site.

9.1.2 Site Meetings, Toolbox Meetings and Contractor Meetings

Any daily items or ongoing matters applicable to the environmental management of the MARL have been addressed by staff, consultants and subcontractors during site meetings, toolbox meetings and contractor meetings which have been conducted on an as needed basis. Fortnightly meetings have been held for all members of the NSW DPI/ Huon Research Team. Minutes have been kept for all meetings.

9.1.3 Marine Fauna Interaction Training

Port Stephens Fisheries Institute hosted 24 personnel from Marine Parks, NPWS, NSW DPI, Huon Aquaculture and Dolphin Swim Australia for accredited wildlife interaction training provided by the Victorian Department of Environment, Land, Water and Planning in February 2017. The training was initiated under the Marine Fauna Interaction Management Plan to: develop a response plan to deal with incidents with NSW OEH and other relevant departments; and to ensure that a number of staff members receive training in wildlife rescue techniques to ensure appropriate response to potential incidents.

The accredited training program provided staff with the knowledge and practical experience necessary to respond to marine fauna entanglements. Day One of the training focussed on theory and practical issues with Day Two on the water, freeing a towed ‘whale tail’ entangled with ropes and buoys.

9.2 Environmental Monitoring

The number of monitoring samples taken and analysed to date is greater than consent condition requirements for the MARL, where consent condition D20 indicates compulsory annual water quality and benthic sampling. Three extensive sampling events have been undertaken during the

first year of operation. Water quality, benthic fauna, sediment chemistry and particle size have been analysed which included ROV video surveys.

The first sampling event provided baseline data prior to the commencement of operation (i.e. the Baseline survey) and the second sampling event occurred six months after the sea pens were stocked with fish (i.e. Update 1 survey) and the third 12 months after deployment.

Supplementary water and benthic samples have been collected in addition to those collected during the Baseline survey and Update 1 survey. The supplementary samples aim to improve the baseline data available as fish grow which will help to build a stronger picture of the effects of the operation of the MARL. An additional control site was also added to the south of the MARL.

9.3 Review of Environmental Management Plans

A review of the Operational Environmental Management Plan (OEMP) was conducted by the NSW DPI/Huon Research Team six months after the MARL commenced operation. The OEMP was reviewed for usage, effectiveness and compliance issues. Revisions were proposed during this review, mostly to emergency contact details. The OEMP will continue to be reviewed by the NSW DPI/Huon Research Team every six months.

9.3.1 Non-Compliance

A non-compliance is defined as a non-fulfilment of a specified requirement (either legal, specified or policy) and a corrective action is defined as an action taken to eliminate the cause of a detected non-compliance and to mitigate any environmental impact.

Non-compliance items identified in the internal review process must be managed in accordance with the corrective actions stipulated within the review findings and closed out prior to the next review. Environmental incidents are to be recorded and if caused by the required procedures not being implemented or followed, a Non Compliance Report (NCR) must be prepared and issued. NCR's and corrective actions are managed by the Research Leader and the Marine Operations Manager.

NCR's have been incorporated into the review process to ensure they are considered in the continual improvement process of the OEMP.

As indicated in Section 9.3, the OEMP was reviewed for usage, effectiveness and compliance issues six months after operations commenced. No non-compliance issues were identified during this review. The OEMP will be reviewed again in November 2017 by the NSW DPI/Huon Research Team.

9.4 Navigation Safety

The original spar cardinal marker buoys were replaced with Sealite Poseidon buoys (Figure 30). Poseidon buoys are larger in size and have enhanced visibility compared with the previously installed spar buoys. They maintain their height above sea level in large waves and strong currents. They do tend to exhibit more lateral movement around their installed position but the improved visibility is more desirable from the feedback from the community and regulatory authority.

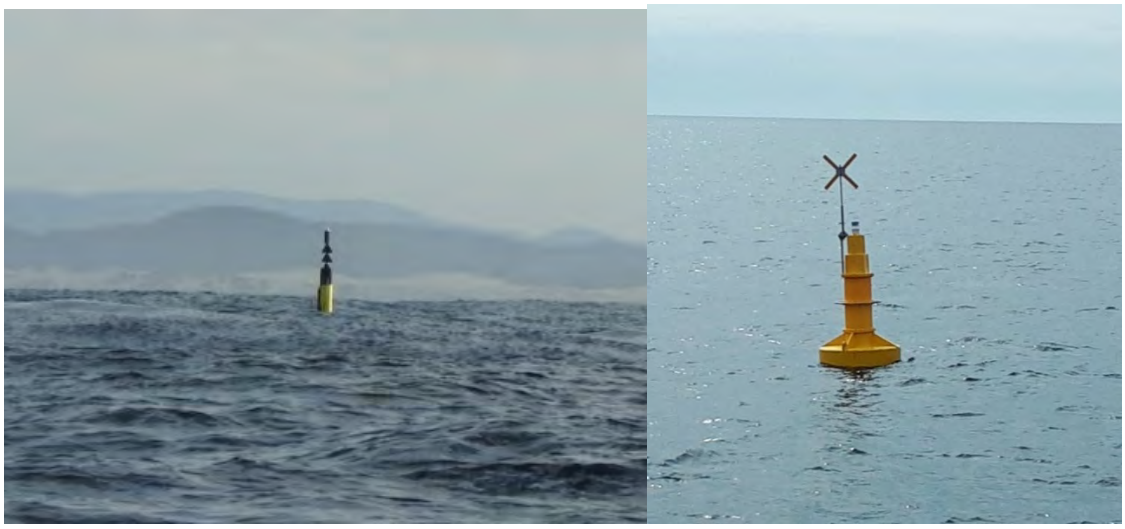

Figure 30: Original and new marker buoys (Source: NSW DPI, 2017; Huon, 2017).

9.5 Community Consultation

Community consultation during the MARL's first year of operation has consisted of the following:

- A monthly/bi-monthly stakeholder update newsletter which is available on NSW DPI's website;
- Stakeholder meetings including:
    - Huon Aquaculture Board members;
    - Port Stephens Estuary Management Committee;
    - NSW RMS Waterwayusers Group:
    - Marine Rescue Port Stephens; and
    - Hawks Nest – Tea Gardens Progress Association.
- Participation in Love Seafood Love Port Stephens promotional month of August 2016 and 2017, International Seafood Directions Conference and NSW DPI Go Fish Day ;
- 15 community/student group tours of the PSFI; and
- Signage and distribution of information sheets at boat ramps and recreational fishing outlets.

10 Feedback and Complaints

In compliance with condition E5 of the State Significant Infrastructure Approval SS1-5118, the Community Stakeholder Communication Plan for the MARL details the following:

- Processes to receive and manage feedback and complaints; and
- Phone, email and mail contact details for the development including a 24 hour contact number.

Local councils have been informed of the procedures so that on receipt of any complaints they are able to redirect issues to the appropriate regulatory departments.

The Feedback and Complaints Handling Protocols include:

- A contact number and a site contact person who manages complaints;
- A feedback and complaints register (see Section 10.1);
- Proposed mitigation measures and follow up with the complainant;
- Contingency measures when repeated complaints are received including provisions for additional monitoring and amelioration measures;
- Compliance performance agreements with residents; and

- Reporting procedures to relevant government agencies or council.

Feedback and complaints about the MARL can be registered via the following options:

- *NSW DPI*
    - Mail: Locked Bag 1, Nelson Bay 2315
    - Email: aquaculture.administration@dpi.nsw.gov.au
    - Phone: 02 49821232 Aquaculture Management
    - Emergency Hotline:- 1300 920 987
        - This contact number has been listed in local papers and on the NSW DPI website.
- *Huon Aquaculture*
    - Online: https://www.huonaqua.com.au/community/community-feedback/
    - Phone: 03 6295 8111

10.1 Feedback and Complaints Register

A feedback and complaints register has been maintained by NSW DPI/Huon Research Team staff at the Port Stephens Fisheries Institute, which has been regularly reviewed to determine the most appropriate response to feedback and complaints.

The register also records whether the complaint originated from normal operational procedures, an 'incident' or occasional procedure. For feedback or complaints associated with occasional procedures, discussions are held with complainants regarding whether it was the timing or nature of the impact and how the impacts can be better managed. In most cases it is believed that an agreement can be reached between parties regarding procedures, timetables, duration and intensity. If the feedback or complaint has resulted from normal operation procedures, these procedures are reviewed in discussion with the relevant approval authorities.

Table 9 provides a summary of the feedback and complaints register. Feedback and complaints received during the past year will be compared to those that are received in future years.

Table 9: Feedback and complaints register - September 2016 to August 2017.

No.	Date	Name	Contact details	Nature of feedback/complaint	Action taken
1	21/9/16	[redacted]	Tourist operator	SMS - Some lines in the water at the Kingfish farm in Port Stephens.	During construction of mooring grid all lines to remain taught.
2	30/9/16	[redacted]	Local boater	Call to 1800 - [redacted] collided with black buoy on lease area. Stated he did not see lit marks. He suggested that there should have been signs at boat ramps.	Discussion with boat owner and RMS. Confirmed lease markers were operational at time of incident. Flyers and notices were placed on boat ramps about the construction of the MARL.
3	8/10/16	[redacted]	Tourist operator	SMS – Report of a humpback whale with a rope on its back within the lease area. Questioned whether there was a contingency plan for entanglements?	Stakeholder advised of MARL Marine Fauna Interaction Plan. MARL Marine Fauna Interaction Committee reviewed an incident report and

				Offered assistance if this were to happen in the future.	photographs supplied by tourist operator. The Committee comprises: NSW OEH, Macquarie Uni; PSGL Marine Park; Huon and DPI. Conclusion was that the rope on the whale was not from the MARL but was consistent with fishing equipment. Review recommended local tourist operators be provided with emergency contact numbers and be involved in incident response training. DPI coordinated accredited training of 24 agency and industry personnel in January 2017.
4	2/5/17	[redacted]	Tea gardens resident	Email – Question location of Huon land base, naming the development location as Port Stephens and confirm ownership of MARL.	Email response to acknowledge and answer questions.
5	15/5/17	Rebecca Akhurst EPA	EPA Environ Line	Call to Environ Line - Concern about the use of chemicals at the MARL.	Provided detailed response to EPA including SSI consent history, APVMA approval, history of use of chemical in industry over last 25 years, Huon operational manual and description of use with veterinary supervision.
6	18/5/17	Jim Lawson RMS	RMS Nelson Bay	Call to DPI - Discussion re parking at Fishermen's' Coop and use of chemical at the MARL.	Advise that Huon has two valid parking spaces and discussed chemical usage. Details also included in stakeholder updates.
7	18/5/17	Brett Boehm	RMS Nelson Bay	Call - Discussion re parking at Fishermen's' Coop and use of chemical at the MARL.	Advise that Huon has two valid parking spaces and discussed chemical usage. Details also included in stakeholder updates
8	19/5/17	[redacted]	Local retailer	Call - Discussion re parking at Fishermen's' Coop and use of chemical at the MARL.	Advise that Huon has two valid parking spaces and discussed chemical usage. Details also included in stakeholder updates. Huon to contact [redacted]

9	25/9/17	[redacted]	Nelson Bay Resident	E-mail to Huon website regarding allegation of an altercation between resident's son and Huon team member.	Investigated by Huon Human Resources Manager with input from local witnesses – complainant was satisfied with discussions and outcome.

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12. Appendices

Appendix 1 – Parasite surveillance and treatments for the MARL

Appendix 2 - APVMA Minor Use Permit (Per83276)

Appendix 3 – Positive release forms for vessels used for the MARL

Appendix 4 – Marine Aquaculture Research Lease - Baseline Environmental Assessment

Appendix 5 – Marine Aquaculture Research Lease – Update 1 Survey Environmental Assessment

Appendix 1 – Parasite surveillance and treatments

Sea Pen 1

Date	# FISH SAMPLE	AVG GILL FLUKE			AVG SKIN FLUKE			Water Temp
		Gravid Adults	sub Adults	Juvenile	Gravid Adults	sub Adult	Juvenile	
22/12/2016	6		0	0		0	0	N/A
6/1/2017	9		0	0		1.5	2	N/A
12/1/2017	12		0	0		1.6	1.75	20
24/1/2017	10		0	0		0.5	3.4	20.6
2/2/2017	9		0.2	0		0.7	0.4	22.4
16/2/2017	6		0.16	0		2	3.8	N/A
1/3/2017	8		0.6	1.4		2.5	1	24.3
21/3/2017	8	23.62	0	65.75		3.8	5	22.9
27/3/2017	BATH 972 Litres Hydrogen Peroxide							
29/03/2017	8	0	0	0		0	0	24
6/4/2017	8	0	0.5	51	0	0	18.5	24.3
16/4/2017	8	8.13	54.63	119.88	1.3	17.5	0.25	22.5
24/4/2017	BATH 1386 Litres Hydrogen Peroxide							
25/04/2017	9	0	0	0	0	0	0	22.2
2/5/2017	8	0	0	0.75	0	0	16.75	21.9
8/5/2017	9	0	2.77	26.88	0	10.4	38.4	20.8
16/5/2017	10	0	103.4	168.5	0	54.5	4.4	21.1
17/5/2017	BATH 1900 Litres Hydrogen Peroxide							
18/5/2017	6	0	0	0	0	0.16?	0	21
22/5/2017	4	0	0	0	0	0	0	20.9
29/5/2017	BATH 2050 Litres Hydrogen Peroxide							
30/5/2017	5	0	0	0	0	0	0	20.6
6/6/2017	6	0	0	0.3	0	0	0.83	19.2

14/6/2017	5	0	1	0.4	0	0	1.6	20.7
27/6/2017	5	0	1.6	6.4	0	2.8	2.4	20.1
4/7/2017	4	-	11.2	4	-	5	4.5	19.5
10/7/2017	BATH 2150 Litres Hydrogen Peroxide							
18/7/2017	4	0	0	4.5	0	0	1	18.5
25/7/2017	4	0	8.25	0	0	0	14.25	18.9
28/7/2017	4	0	18.25	29.25	0	11.5	1.25	18.8
3/8/2017	4	3.25	33.25	10.25	-	10.5	6.5	18.6
10/8/2017	4	63.25	26	3.8	-	13.25	3.75	18.4
14/8/2017	BATH 2550 Litres Hydrogen Peroxide							
17/8/2017	4	0	0	0	0	0	0	18.4
23/8/2017	4	0	0	0	0	0	4.25	18.3
30/8/2017	5	0	0	0.2	0	0	8.8	19.1
4/9/2017	BATH 2353 Litres Hydrogen Peroxide							
11/9/2017	6	0	0	0	0	0	0	19

Sea Pen 2

Date	# FISH SAMPLE	AVG GILL FLUKE			AVG SKIN FLUKE			**Water Temp**
		Gravid Adults	Sub Adults	Juvenile	Gravid Adults	Sub Adults	Juvenile	
16/01/2017	22	0	0	0	0	0	0.045	N/A
24/01/2017	25	0	0	0	0	0	0	20.6
14/02/2017	12	0	0	0.25	0	0.25	0.25	N/A
1/03/2017	10	0	0	0	0	0.9	0.4	24.3
21/03/2017	13	16.92	0	4.69	0	1.15	1	22.9
28/3/2017	BATH 1781 Litres Hydrogen Peroxide							
29/03/2017	10	0	0	0	0	0	0	24
4/06/2017	12	0	0.42	38	0	0	1.92	24.3
16/04/2017	12	5.08	75.75	245.92	0.08	0.75	0.33	22.5
25/4/2017	BATH 1579 Litres Hydrogen Peroxide							
2/05/2017	12	0	0	0.27	0	0	2	21.9

8/05/2017	10	0	1.2	45.6	0	3.2	4.3	20.8
16/5/2017	10	0	2.5	108	0	1.3	2.3	21.1
18/5/2017	BATH 2400 Litres Hydrogen Peroxide							
22/5/2017	10	0	0	0	0	0.1?	0	20.9
30/5/2017	BATH 1900 Litres Hydrogen Peroxide							
6/06/2017	6	0	0	0	0	0	0	19.2
14/6/2017	5	0	2.8	0.8	0	0.2	2.4	20.7
27/6/2017	6	1.25	4.67	7	0	5	4.5	20.1
4/07/2017	5	-	6.2	44.2	-	8	5.6	19.5
7/07/2017	BATH 2000 Litres Hydrogen Peroxide							
18/7/2017	7	0	0	12.86	0	0	0.43	18.5
25/7/2017	5	0	1	3.4	0	0.4	16.4	18.9
28/7/2017	5	0	5.8	14.8	0	4.4	11.6	18.8
3/08/2017	5	8.4	20.6	54	-	18.4	3.6	18.6
10/08/2017	5	54.2	61.2	3.2	0	2.6	13.4	18.4
14/8/2017	BATH 2130 Litres Hydrogen Peroxide							
17/8/2017	5	0	0	0	0	0	0	18.4
23/8/2017	5	0	0	0	0	0	4.6	18.3
30/8/2017	5	0	0	0	0	0	30.2	19.1
11/09/2017	6	0	6.8	27.5	0	7.8	2.6	19

Appendix 2 – APVMA Minor Use Permit (Per83276)

Australian Government
Australian Pesticides and Veterinary Medicines Authority

PERMIT TO ALLOW SUPPLY AND MINOR USE OF UNREGISTERED VETERINARY CHEMICAL PRODUCTS

PERMIT NUMBER – PER83276

This permit is issued to the Permit Holder under Section 112 of the Agricultural and Veterinary Chemicals Code, scheduled to the Agricultural and Veterinary Chemicals Code Act 1994 (the Agvet Code) of the jurisdictions set out below. This permit allows a Supplier (as indicated) to possess the Products for the purposes of supply and to supply The Products to a person who can use The Products under permit. If this permit were not issued, supply of the Products as specified below would constitute an offence under section 78 of the Agvet Code. This permit also allows a person, as stipulated below, to use The Products in the manner specified in this permit in the designated jurisdictions. This permit also allows the Permit Holder, the Supplier (if not one and the same) and any person stipulated below to claim that The Products can be used in the manner specified in this permit.

THIS PERMIT IS IN FORCE FROM 14 NOVEMBER 2016 TO 30 NOVEMBER 2019.

Permit Holder:
Parafarm Pty Ltd (trading as Allfarm Animal Health)
No 2 Glendale Avenue
HASTINGS VIC 3915

Suppliers authorised by this permit to supply The Products and make claims:
Redox Pty Ltd
4 Holmes Rd
MINTO NSW 2566

Solvay Interox Pty Ltd
20-22 McPherson Street
BANKSMEADOW NSW 2019

Persons authorised by this permit to use The Products and make claims:
Persons having completed the Parafarm Pty Ltd (trading as Allfarm Animal Health) accreditation process and are under the direction of a veterinary surgeon registered under the law of the relevant jurisdiction.

Product to be used under permit:
HYDROGEN PEROXIDE 60%
Containing: 742 g/L HYDROGEN PEROXIDE as its only active constituent.

Directions for Use:
To be used in the treatment of metazoan and protozoan ecto-parasitic infestations and the control of fungal infections, in freshwater and saltwater finfish, and finfish eggs under the supervision of a registered veterinary surgeon. The **Attachment** to this permit provides guidance on dose rates and treatment protocols.

Withholding Periods:
Meat (fish) – Nil.
Eggs (fish) – Nil.

Jurisdiction:
ALL States.

CONDITIONS

Supply

The Suppliers authorised by this permit to supply The Products and make claims must supply The Product in a container that must:

a. be impervious to, and incapable of chemical reaction with, its contents when under conditions of temperature and pressure that are likely to be encountered in normal service; and
b. have sufficient strength and impermeability to prevent leakage of its contents during handling, transport and storage under normal handling conditions; and
c. if it is intended to be opened more than once, be able to be securely and readily closed and reclosed; and
d. have sufficient excess capacity to prevent it from breaking if its contents expand during handling, transport or storage; and
e. enable all or any part of its contents to be removed or discharged in such a way that, with the exercise of no more than reasonable care, the contents cannot:
    (i) harm any person; or
    (ii) have an unintended effect that is harmful to the environment.

The Suppliers authorised by this permit to supply The Products and make claims can only make claims for use of the Products in farmed finfish.

Use

Persons who wish to prepare for use and/or use The Products for the purposes specified in this permit must read, or have read to them, the details and conditions of this permit.

THIS PERMIT provides for the use of two unregistered products in accordance with the instructions in the **Attachment** of this permit, and The Products' Safety Data Sheet.

Any adverse event arising from the use of The Products in fish must be reported to the APVMA's Coordinator, Adverse Experience Reporting Program (phone 02 6210 4792).

The Permit Holder is to monitor the use of hydrogen peroxide in aquaculture overseas and inform the APVMA of any change in status of that use, particularly any incidents of environmental contamination. Also, the Permit Holder is to inform the APVMA of any action taken by overseas regulatory authorities in regard to the use of hydrogen peroxide in aquaculture.

Claim

A person who is authorised by this permit and makes a claim about the use of The Products, can only make a claim consistent with the Directions for Use and the instructions in the **Attachment** of this permit.

Issued by Australian Pesticides and Veterinary Medicines Authority

Attachment

POISON

KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING

HYDROGEN PEROXIDE 60%

ACTIVE CONSTITUENTS: 742*g/L* HYDROGEN PEROXIDE

Used for the treatment of metazoan and protozoan ecto-parasisitc infestations and the control of fungal infections, in farmed freshwater and saltwater finfish, and finfish eggs.

Net Contents 1200 kg

UN NUMBER 2014
PACKAGING GROUP II
HAZARD CLASS 5.1
SUBSIDIARY CLASS 8
HAZCHEM CODE 2W

DIRECTIONS FOR USE:

SALTWATER AND FRESHWATER FINFISH AND EGGS

FISH

The dosage and method of application of hydrogen peroxide necessary to control external protozoan parasites will depend on a number of factors including the species of fish. The dose and treatment regime should be advised by a veterinarian. As a guide, hydrogen peroxide can be used in the following methods:
Bath – Add 100 to 1500ppm of hydrogen peroxide to bath water depending on water temperature. Treat for up to 60 minutes. Treatment may be repeated if advised by the veterinarian. Follow the dose temperature guidelines advised by the veterinarian.
Temperature/dose ranges suggested for treatment trial with hydrogen peroxide on finfish.

Temperature (degrees C)	Dose (ppm)
<6	1500
6-10	1000-1250
10-15	600-1000
15-20	300-500
20-25	200-300
25-30	100-200
>30	<100

EGGS

As a guide, hydrogen peroxide can be used in the following methods:

1. BATH – Add 1 to 2 mL hydrogen peroxide/L (1000 to 2000 ppm) and treat eggs for up to 15 minutes. If prevailing conditions are favourable for fungal growth, repeat treatment daily or more frequently if needed. Excessive re-treatments may cause egg mortality, OR,
2. Add up to 0.25mL hydrogen peroxide/L (250ppm) and treat eggs for up to 60 minutes.

PER83276 Permit Version 1 Page 3 of 5

NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER, CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION.

WITHHOLDING PERIOD: NOT REQUIRED

PROTECTION OF WILDLIFE, FISH, CRUSTACEA AND ENVIRONMENT:

DO NOT contaminate streams, rivers, waterways or surface waters with the undiluted chemical or used container.

STORAGE: Store in the closed, original vented container in a well-ventilated area, below 30°C, away from heat and combustibles. The storage area must be an approved segregated area where spills can be contained (eg by bunding). Do not store for prolonged periods in direct sunlight. Store away from other chemicals. Do not store on wooden pallets or on a wooden floor.

DISPOSAL:

1. Treated Water Management:
    a. Freshwater: Used solutions should be held on farm and/or treated to a concentration of 0.5ppm or less before releasing to receiving waters.
    b. Marine Water: Release of treated waters should only occur under conditions likely to lead to adequate dilution/dissipation.
2. Container: Triple rinse into treatment mix. Recycle container if possible otherwise crush dispose of in accordance with site and local regulatory requirements.
3. DO NOT remove by effluent disposal truck (not adequately vented nor of compatible materials).

SAFETY DIRECTIONS:

Hydrogen peroxide's primary risk is that it is a strong oxidizer, bleaching agent and disinfectant. Its subsidiary risk is its corrosive nature. It is poisonous if swallowed. The fumes are corrosive and act as an irritant. Do not inhale vapour. Protective clothing and eyewear must be worn at all times when applying this product. When opening the container and using the product, wear impervious PVC or rubber gloves, chemically resistant goggles or eye-shield, protective suit or apron and chemically resistant boots. If the product is on skin, immediately wash area with large volume of water. Observe good hygienic practices while using. Wash personal protective equipment with large volumes of water. Store product in cool well ventilated place. DO NOT replace used product in the original container. DO NOT expose product to grease, organic chemicals (e.g. Solvents, fuels) metals or strong solutions of metal ions. Use suitable equipment for pumping and ensure equipment is adequately maintained. DO NOT store product in a circuit, between closed valves or in a container without a vent.

FIRST AID: If poisoning occurs, contact a doctor or Poisons Information Centre. Phone Australia 131126; New Zealand 0800764766.

Inhalation:
- Remove to fresh air
- If symptoms persist, call physician.

Eye contact:
- Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
- In the case of difficulty of opening the lids, administer an analgesic eye wash (oxybuprocaine).
- Consult with an ophthalmologist immediately in all cases.

Skin contact:
- Remove and wash contaminated clothing before re-use.
- Wash off with plenty of water.
- Keep warm and in a quiet place
- Consult a physician

PER83276 Permit Version 1 Page 4 of 5

Ingestion:
- The following actions are recommended:
- Call a physician immediately.
- Take victim immediately to hospital

If Victim is conscious:
- If swallowed, rinse mouth with water (only if the person is conscious)
- DO NOT induce vomiting.

If Victim is unconscious but breathing:
- Artificial respiration and/or oxygen may be necessary.

MSDS: Additional information is provided in the Material Safety Data Sheet.

Redox Pty Ltd

2 Swettenham Road,
Minto, NSW, 2566 Telephone: +61 2 9733 000

Shelf Life 12 months *(Active constituent will typically degrade less than 10g/L over 12 month period.)*
Date of Manufacture:

PER83276 Permit Version 1 Page 5 of 5

Appendix 3 – Positive Release Forms for Vessels

HUON	DOCUMENT CODE : AQF0105		
	EFFECTIVE DATE : 3 June 2015	VERSION 2	Page 1 of 1
	DOCUMENT TITLE : **Positive Release Form – Cleaning and Disinfection Protocol for Transfer of Operational Equipment Between Sites**		

NOTE: It is essential to prevent the introduction and/or spread of disease between sites. Before operations equipment (eg. boats, feed, cage, net etc.) is transferred between sites this "Positive Release" Protocol and Form must be completed. This includes all secondhand equipment plus any new equipment with potential to be contaminated (if in doubt seek approval).

For the purpose of this protocol, sites include:

- South East Region, including: APM, Port Huon, Huon River, D'Entrecasteux Channel and Storm/ Trumpeter Bay
- Macquarie Harbour
- Each Huon Hatchery Site: Lonnavale, Millybrook, Springfield, Bridport, Meadowbank, Forest Home
- Any other site operated by another aquaculture company either in Tasmania or elsewhere
- Any other site where there is the possibility of disease contamination

Description of equipment to be transferred and current/intended use: Work vessel Wandi II and work vessel Huon Pride	
Proposed transfer date: 9th September 2016	**Current location:** Port Huon, Tasmania
Proposed destination: Newcastle, NSW	
Proposed cleaning, disinfection and transfer process: 1. Clean the equipment/infrastructure thoroughly to remove all oysters, overcatch and other organic material, e.g. via manual scraping and scratching and/or high pressure cleaner. 2. Decontaminate with Virkon® (Virkon® S or Virkon® Aquatic), 1:200 spray application, allow Virkon to dry. 3. Huon Pride will then be deckloaded onto Wandii II. 4. Wandii will travel to NSW under her own power (estimated 7 day voyage) (*Detail pre-disinfection cleaning, type/concentration of disinfectant, application, contact time etc. For disinfection guidelines, refer to Section 3.5.3 of the Veterinary Health Plan)	
Any modifications required to proposed cleaning, disinfection and transfer process: None	
Notified (circle): Director of Fisheries Chief Veterinary Officer Marine Farming Branch	
Authorised by: **Signed:** (*Must be General Manager Marine Ops/Fish Health & Environment Manager/General Manager Freshwater Ops/Company Veterinarian)	
Disinfection procedure completed by:	
Cleaning and disinfection has been completed as per requirements above:	
Release approved by: **Signed:**	

HUON	DOCUMENT CODE :	AQF0105		
	EFFECTIVE DATE :	3 June 2015	VERSION 2	Page 1 of 1
	DOCUMENT TITLE :	**Positive Release Form – Cleaning and Disinfection Protocol for Transfer of Operational Equipment Between Sites**		

NOTE: It is essential to prevent the introduction and/or spread of disease between sites. Before operations equipment (eg. boats, feed, cage, net etc.) is transferred between sites this "Positive Release" Protocol and Form must be completed. This includes all secondhand equipment plus any new equipment with potential to be contaminated (if in doubt seek approval).

For the purpose of this protocol, sites include:

- South East Region, including: APM, Port Huon, Huon River, D'Entrecasteaux Channel and Storm/ Trumpeter Bay
- Macquarie Harbour
- Each Huon Hatchery Site: Lonnavale, Millybrook, Springfield, Bridport, Meadowbank, Forest Home
- Any other site operated by another aquaculture company either in Tasmania or elsewhere
- Any other site where there is the possibility of disease contamination

Description of equipment to be transferred and current/intended use:
The vessel Delilah and deck cargo including, 2 x 6 T feedbins, 12 x 10m lengths of 36mm mooring chain, 4 x 4000 litre Aqualine buoys, 4 x 6500 litre Aqualine buoys, 24 x 17T shackles, 24 x 13.5T Shackles, 3 x coils of 120mm 8 plait Mooring rope, 4 x coils of 24mm Nylon rope, 2 x Feed bin floats, 2 x feed bin halos, Accommodation container, Miscellaneous items inc tyres, snood, etc

Proposed transfer date: 3rd August 2017 (TBC) | **Current location:** Port Huon

Proposed destination: Port Stephens in NSW

Proposed cleaning, disinfection and transfer process:

All rope, chain, Aqualine buoys, mooring hardware and accommodation block have never been on an Aquaculture farm.

Feed bin equipment. (Used equipment)

- All ropes and electrical cables removed
- Scraped white tube worm from bottom of bin floats, pressure washed all surfaces (inside and out) to remove feed remnants, fouling, bird poo etc.
- Any greasy feed oils on the bin surfaces must be removed with a detergent and/or hot pressure wash
- Apply 1:200 Virkon to all surfaces (inside and out) and allow to airdry

Boat & Deck Cargo.

- Apply 1:200 Virkon to all surfaces (inside and out) and allow to airdry. (Responsible C Coulson)
- Bilges to be pumped dry and virkoned prior to departure and again on the journey to Port Stephens (Responsible C Coulson prior to departure and Seb Stockford on the journey)
- All other equipment, including the boat, to be be virkoned prior to departure and again on the journey across with 1:200 Virkon solution. (Responsible C Coulson prior to departure and Seb Stockford on the journey)
- All tie off ropes on Delilah will be replaced with new rope prior to departure

*(*Detail pre-disinfection cleaning, type/concentration of disinfectant, application, contact time etc. For disinfection guidelines, refer to Section 3.5.3 of the Veterinary Health Plan)*

Any modifications required to proposed cleaning, disinfection and transfer process:
Nil

Notified (circle): Director of Fisheries Chief Veterinary Officer Marine Farming Branch

Authorised by: **Signed:**

(*Must be General Manager Marine Ops/Fish Health & Environment Manager/General Manager Freshwater Ops/Company Veterinarian)

Disinfection procedure completed by:

Cleaning and disinfection has been completed as per requirements above: YES

Release approved by: **Signed:**

(*Must be the Operations Manager or higher management)

Appendix 4 – Marine Aquaculture Research Lease - Baseline Environmental Assessment

Please refer to the following webpage:

https://www.huonaqua.com.au/about/portstephens/environmental-monitoring/

Appendix 5 – Marine Aquaculture Research Lease – Update 1 Survey - Environmental Assessment

Please refer to the following webpage:

https://www.huonaqua.com.au/about/portstephens/environmental-monitoring/