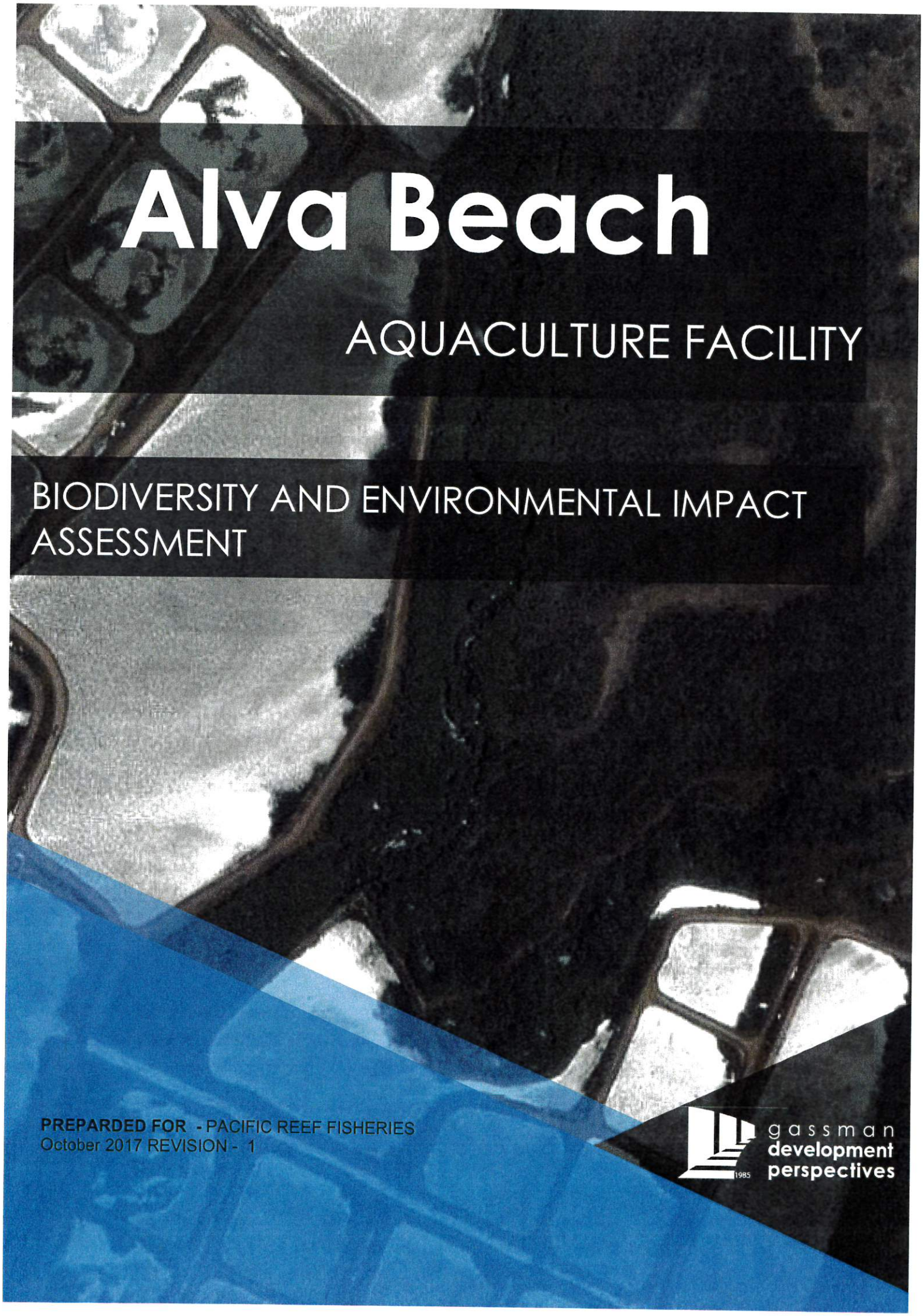

Alva Beach

AQUACULTURE FACILITY

BIODIVERSITY AND ENVIRONMENTAL IMPACT ASSESSMENT

PREPARDED FOR - PACIFIC REEF FISHERIES
October 2017 REVISION - 1

gassman development perspectives
1985

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Approval for Issue

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V1.0	Brian Gassman	Director		17.08.2017

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1 Introduction

Pacific Reef Fisheries Pty Ltd (PRF) is seeking certification for its Ayr Farm operations under the Aquaculture Stewardship Council (ASC) Shrimp (2014) and Cobia (2016) Standards. The ASC is a global organisation working internationally to promote the best environmental and social choice practices in aquaculture. One of the requirements to gain certification is to undertake a Biodiversity and Environmental Impact Assessment (B-EIA). This document aims to meet this requirement.

Key steps in this process were:

- Undertake a document review and gap analysis;
- Describe the farm and its effects;
- Analysis of environmental impacts (including their likelihood and severity) and measures to address such impacts in accordance with the standard's methodology.

This document forms part of a package of information tools and documents aimed at demonstrating PRF's compliance with the ASC, including a detailed Social Impact Assessment. The accompanying Social Impact Assessment also describes some of the issues covered within the B-EIA, particularly with reference to perceived social impacts and amelioration methods relating to environmentally-relevant activities.

2 Aims

2.1 Key Aims

One of the requirements to gain certification is to undertake a Biodiversity and Environmental Impact Assessment (B-EIA). The context of the B-EIA within the Standard is set out in Table 1.

Table 1. Requirements for B-EIA

PRINCIPLE 2. SITE FARMS IN ENVIRONMENTALLY SUITABLE LOCATIONS WHILE CONSERVING BIODIVERSITY AND IMPORTANT NATURAL ECOSYSTEMS		
Criterion 2.1: Biodiversity Environmental Impact Assessment (B-EIA)		
		Auditor Evaluation (Required Actions):
2.1.1	Indicator: Farm owners shall commission a participatory B-EIA and disseminate results and outcomes openly in locally appropriate language. The B-EIA process and document must follow the outline in Appendix I. Requirement: Report available and complies to B-EIA Appendix I process Applicability: All	A. Verify farm has a B-EIA report and that the methodology adopted complied with Appendix I. Go through Appendix I checklist point by point. Ensure farm is following B-EIA recommendations and monitoring protocol. Verify the farm is familiar with Appendix I, the B-EIA and that they have been implementing the findings. Verify that workers are aware of the B-EIA content and the measures needed to palliate/compensate the operation effects on the environment.

This report therefore aims to meet requirements noted within the standards for delivery of the B-EIA.
Other requirements delivered within this report relating to the Shrimp Standard are:

- A risk assessment of environmentally relevant activities relating to the site;
- Allowance for and maintenance of farms sitting in Protected Areas (requirement 2.2.1);
- Allowance for and maintenance of farms sitting in mangrove ecosystems and other natural wetlands (requirement 2.2.2);
- Allowance for and maintenance of farms sitting in critical habitats of endangered species (requirement 2.3.1);

- Procedures in place to avoid negative impacts on endangered species (requirement 2.3.2);
- Coastal barriers between the farm and the marine environment (requirement 2.4.1);
- Riparian buffer zones (requirement 2.4.2);
- Corridors for wildlife movement (requirement 2.4.3);
- Conductance or chloride concentration in freshwater wells (requirement 2.5.3);
- Soil specific conductance or chloride concentration (requirement 2.5.4); and
- Prevention measures for escapes (requirement 6.1.2).

Other requirements delivered within this report relating to the Cobia Standard are:

- Evidence of an assessment of the farm's potential impacts on biodiversity and nearby ecosystems that contains at a minimum (requirement 2.3.1):
    a) identification of proximity to critical, sensitive or protected habitats and species,
    b) description of the potential impacts the farm might have on biodiversity, with a focus on affected habitats or species,
    c) a description of strategies and current and future programs underway to eliminate or minimize any identified impacts the farm might have,
- Allowance for the farm to be sited in a legally designated protected area (requirement 2.3.2)

2.2 Assessment Type

Page 119 of the standard notes a requirement for large-scale farms to utilize qualified staff for drafting of the B-EIA. The following section notes the qualifications and experience of staff utilized for this report.

2.2.1 Relevant Staff

Mark Spears is a qualified ecologist and senior environmental scientist with over ten years of experience undertaking ecological and environmental assessments for infrastructure and development projects. Mark is author of past monitoring reporting for PRF and has authored several secondary reports relevant to the -EIA under this Standard. He is also a member of EIANZ, and subscribes to the ethics associated with his membership.

Doug Mohr is a qualified ecologist and senior environmental scientist with over 15 years of experience undertaking ecological and environmental assessments for infrastructure and development projects. Doug is currently a PhD candidate focusing on terrestrial ecology. Doug is a key author of the B-EIA undertaken for PRF under this Standard.

Kathryn Tibbles is a qualified environmental scientist with over 5 years of experience undertaking ecological and environmental assessments for infrastructure and development projects. Kathryn holds a Bachelor of Environmental Management majoring in Natural Systems and Wildlife from the University of Queensland.

John Moloney is General Manager of Pacific Reef Fisheries. John has been involved in the prawn farming industry for the last 24 years in various senior management roles, and is the current vice president of the Australian Prawn Farmers Association. John holds a Bachelor of Marine Science Degree from the University of Sydney and has completed his Masters Degree in Aquaculture at the University of Tasmania.

Wayne Di Bartolo is the Environmental Officer of Pacific Reef Fisheries. Wayne has been involved in the prawn farming industry for the last 15 years. Wayne holds a Bachelor of Applied Science in Aquaculture from James Cook University.

Kristian Mulholland is the Assistant Environmental Officer of Pacific Reef Fisheries. Kristian has been involved the prawn farming industry for the last 4 years. Kristian holds a Bachelor of Science Majoring in Aquaculture and Marine Biology from James Cook University.

3 Screening

The Standard notes that a required section of a B-EIA is a "screening section", which is used to determine whether a proposal (site) should be subject to B-EIA and, if so, at what level of detail.

Due to the scale and location of the site, a B-EIA is determined as being required and detailed information relating to the following potential/actual impacts is detailed in this report and relevant Appendices:

- protected areas and areas supporting protected species;
- other areas that are not protected but are important for biodiversity and biodiversity services, including extractive reserves, indigenous people's territories, wetlands, fish breeding grounds, soils prone to erosion, relatively undisturbed or characteristic habitat, flood storage areas, groundwater recharge areas;
- water quality values.

4 Scoping

4.1 Introduction

The main purpose of this section is to identify relevant issues and impacts and to establish terms of reference for the B-EIA. The scoping section has been developed in accordance with the B-EIA methodology, with recognition that the site is in operation.

4.2 Site History

The site is located approximately 14km ENE of the Township of Ayr, QLD (see Figure 1 below).

Figure 1. Site Location

The farm was originally approved by Burdekin Shire Council in 1998, Town Plan zoning "Special Purpose Agriculture – Aquaculture". Approval was granted for the former Lot 8 on RP735795 which after amalgamation with a land portion to the west in the early 1990's became Lot 1 on RP804106. Figure 2 below shows a simplified timeline relating to farm construction. More detailed information relating to this aspect is provided within the accompanying P-SIA.

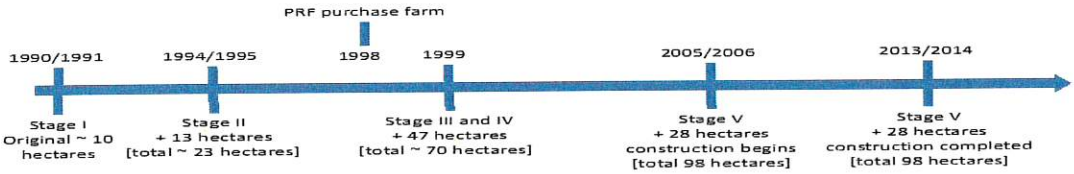


Figure 2. Farm Construction Timeline

4.3 Site Description

PRF owns and operates an aquaculture facility to the east of Ayr in the North Burdekin valley, Queensland. The facility is located close to the coast between Kalamia Creek and Little Alva Creek, and lies south of the small township of Alva Beach. PRF have operated the farm since 1998. The farm operations consist of 98 hectares of grow-out ponds to produce marine prawns (*Penaeus monodon*) and Cobia (*Rachycentron canadum*). Intake water for PRF is sourced from Kalamia Creek and treated tailwater is discharged into Little Alva Creek.

Figure 3 shows site location and infrastructure.

4.4 Site Operation

Currently, the farm operates with 98 hectares of growout ponds (see Figure 3 below). These are stocked with Prawns and Cobia for 12 months of the year. Ponds are approximately 1 hectare in surface area and have a depth of approximately 1.5 meters, thus holding approximately 15 ML of water each. The ponds are supplied by pumping from Kalamia Creek. A balancing storage exists on the property to improve seawater supply reliability to the growout ponds. Pacific Reef Fisheries have moved away from traditional water management systems and have now adopted a low water exchange/biofloc system whereby water usage is substantially reduced for prawn culture

Using traditional methods prawn farms can expect to use up to 15% of the pond volume per day, however by moving towards low water exchange/ biofloc systems water usage is reduced to 1-2% of the pond volume per day. This management system promotes heterotrophic bacterial growth, which provides a more stable environment for prawn culture.

Methods to culture Cobia in earthen ponds is relatively new to the Australian aquaculture industry. Pacific Reef Fisheries currently adopts a high water exchange system, however techniques are being developed to help become more sustainable.

Figure 3. Site Infrastructure

Pond tail-waters are collected via a drain system and processed through a 3 stage water treatment system before it is released in to the Little Alva System. This system incorporates a sedimentation area, sand filtration, and polishing areas.

The primary sedimentation area, constitutes approximately 10% of the grow-out pond area. This stage allows for the settling of solids and some nutrient uptake from filter feeding organisms.

The secondary treatment area includes a 0.6ha sand filter. This filter is capable of treating up to 11ML of discharge waters per day. Data collected from the filter, shows that we can achieve a 70% reduction in total suspended solids (TSS) and a 30% reduction in total nitrogen (TN).

The water finally passes through a polishing system comprising High Rate Algal Ponds (HRAP) and constructed mangrove wetland. The HRAP technology has been developed in conjunction with MBD Energy, and is world first cutting edge technology for aquaculture. Essentially high value seaweed products are grown using the tail-waters, resulting in both cleaner discharge water and an additional commercial product for sale. Data to date shows that the HRAP technology is capable of further reducing TN and TP loads on the environment by 40% and 20% respectively.

The water also passes through 24ha of mangrove wetland that has been constructed by Pacific Reef as part of the existing farm water management system. This wetland is now well established with large numbers of trees greater than 5m tall throughout the system. Ponds are stocked with prawn post-larvae beginning in about June/July each year up to Christmas with harvesting occurring from December through to June the following year. Cobia are produced all year round with fingerlings reaching market size within (~4kg) 18 months. Farm production of Prawns and Cobia is >1000T and 100T respectively annually.

PRF is a large employer in the Burdekin with up to 70 people employed in Full and Part-Time positions.

4.5 Terms of Reference

The Standard notes that the scope developed shall address a range of issues based on existing information and any preliminary surveys or discussions. Table 2 notes these issues and attached reporting within this document where such information may be sourced.

Table 2. Requirements for Scoping and Relevant Documents

Standard Scoping Requirement	Summary	Relevant Documents
The type of farming used, possible alternative methods and a summary of activities likely to affect biodiversity.	The farm's current method is utilization of terrestrial ponds to provide habitat for two marine species. The key impact to biodiversity is the construction of the ponds themselves, which has been already undertaken in accordance with a range of environmental approvals. Current potential impacts are outlined in the Risk assessment (Appendix B).	Risk assessment (Appendix B) + "Stage 5 Initial Advice Statement" (SKM, 2000).
An analysis of opportunities and constraints for biodiversity, including "no net biodiversity loss" or "biodiversity restoration" alternatives.	The key impact to biodiversity is the construction of the ponds themselves, which has been already undertaken in accordance with a range of environmental approvals. Given the sites previous management (cattle farming over cleared / weed infested land) and current management as undertaken in accordance with site risk assessments and approval conditions, ongoing management is predicted to have a minimal impact on biodiversity values.	Risk assessment (Appendix B) + "Stage 5 Initial Advice Statement" (SKM, 2000).
Expected or already experienced biophysical changes (in soil, water, air, flora, fauna) resulting from activities or proposed activities or induced by any socioeconomic changes.	Given the sites previous management (cattle farming) and current management as undertaken in accordance with site risk assessments and approval conditions, ongoing management is predicted to have a minimal impact on environmental values.	Risk assessment (Appendix B) + "Stage 5 Initial Advice Statement" (SKM, 2000).
Spatial and temporal scale of influence, identifying effects on connectivity between ecosystems and potential cumulative effects.	Effects on ecosystem connectivity are considered to be minimal given the site's location (edge of an intensive sugar cane growing area) and the presence of a 1km+ wide retained coastal vegetation corridor to the east	B-EIA (see further sections)

Standard Scoping Requirement	Summary	Relevant Documents
	of the site. Potential cumulative effects are considered to be minimal given the scale of intensive sugar cane farming in the region.	
Available information on baseline conditions prior to an existing farm and any baseline conditions for proposed farms along anticipated trends in biodiversity in the absence of the farm.	Biodiversity trends would have been synonymous with typical coastal cattle grazing in the region (decreasing water quality, sporadic vegetation clearing / decreasing biodiversity. If the prawn farm was not put in place there is a strong argument that sugar cane growing could have also occurred in the area. Sugar cane growing is generally associated with high discharge or nutrients and pesticides which can affect a range of environmental values.	"Stage 5 Initial Advice Statement" (SKM, 2000).
Likely biodiversity impacts associated with the farm operation in terms of composition, structure and function.	As indicated in the risk assessment, if operational restrictions and guidelines are maintained current farm operation should have minimal impact on these values and any changes to coastal vegetation values should be detected during regular monitoring.	Risk assessment (Appendix B) + "Stage 5 Initial Advice Statement" (SKM, 2000).
Biodiversity services and values identified in consultation with stakeholders and anticipated changes in these, highlighting any irreversible impacts.	Irreversible impacts are limited to vegetation clearing resulting from infrastructure installation, although it can be argued that such clearing may have occurred because of other land uses in the area without the operations construction. Values impacted post-construction are minimal due to regulatory requirements and monitoring.	B-EIA and Participatory Social Impact Assessment (p-SIA)+ Risk assessment (Appendix B) + Approvals / License Conditions
Biodiversity services and values identified in consultation with local experts (without a vested interest in the area in question) and anticipated changes in these, highlighting any irreversible impacts.	As above, see attached reporting.	
Possible measures to avoid, minimize or compensate for significant biodiversity damage or loss, making reference to any legal requirements.	As indicated in the risk assessment, if operational restrictions and guidelines are maintained current farm operation should have minimal impact on these values and any changes to coastal vegetation values should be detected during regular monitoring.	Risk assessment (Appendix B) + "Stage 5 Initial Advice Statement" (SKM, 2000).

Standard Scoping Requirement	Summary	Relevant Documents
Information required to support decision making and a summary of important gaps. Proposed IA methodology and timescale.	Not applicable. The site is currently operational.	NA

4.6 Impact Study

One of the most up-to-date documents relating to the most recent (and largest) expansion of the operation is SKM's "Stage 5 Initial Advice Statement" (2000). The report summarises the project, site and impact as follows:

- The majority of the additional 30 hectares of growout ponds will be sited over lands that have pasturage value and until recently dominated by weeds.
- The existing condition of the environment is that soils are free from soil contamination, suitable for engineering purposes (pond constructability and maintenance), and free from acid sulphate content.
- Most 'desirable' native vegetation is outside the footprint of the proposed ponds, so will be largely undisturbed and maintained.
- Where there will be (limited) interference to marine plants on the freehold property, separate approval under *Fisheries Act* will be sought.
- Where freshwater ponds will be lost these will be in highly ephemeral, weed-fringed depressions with little habitat value.
- The drainage pattern across the proposed Stage V development will ensure transfer of saline pond tail waters into a large central canal that already has saline characteristics. This avoids mixing salty waters into currently existing freshwater environments. Drainage from upstream in the catchment will be preserved by linking a low depression into the Stage V pond drainage system.
- Once approved, Stage V development will be consistent with the current operating principles of the farm. Water cycle management will include: tailwater treatment via settlement ponds to remove suspended solids, followed by extended travel time through canals, and, passage through a constructed mangrove wetland for nutrient removal (all on the freehold property).

4.7 Summary of Existing Operation's Approvals

Key licensing and permit conditions for the PRF farm operation include:

- Approval Decision 2001/402 under the Environmental Protection and Biodiversity Conservation Act (EPBC): approval from the Commonwealth Government for expansion of the farm to 98 hectares and discharge of aquaculture waste to Alva Creek
- Environment Authority EPPR00864913: this is approval by DEHP for cultivating or holding crustaceans and other organisms in enclosures, dredging and processing of seafood product
- DEEDI Permit 2005BC0307: this approval is for authorisation to conduct aquaculture on and harvest approved list of species
- Burdekin Shire Council Decision Notice CONS13-0015 for a material change of use (expansion) of the existing aquaculture facility Stage V.

A key document utilized for water and mangrove monitoring is the Environmental Impact Monitoring Program, 2013 (contained for reference in Appendix B).

4.8 Summary of Stakeholder Concerns – P-SIA

A Participatory Social Impact Assessment (P-SIA) was completed by 'Just Add Lime' in associated with Acacia Associates and Gassman Development Perspectives to support the B-EIA.

The P-SIA is a stand alone report which includes a comprehensive stakeholder analysis, a listing of social impacts (including likelihood and severity), and measures to address these social impacts. The P-SIA is intended to be read in conjunction with this B-EIA to provide a holistic view of related environmental impacts and management plans.

A summary of the P-SIA is provided below in the following sections.

4.8.1 P-SIA Methodology

The basic methodology of the P-SIA is detailed below.

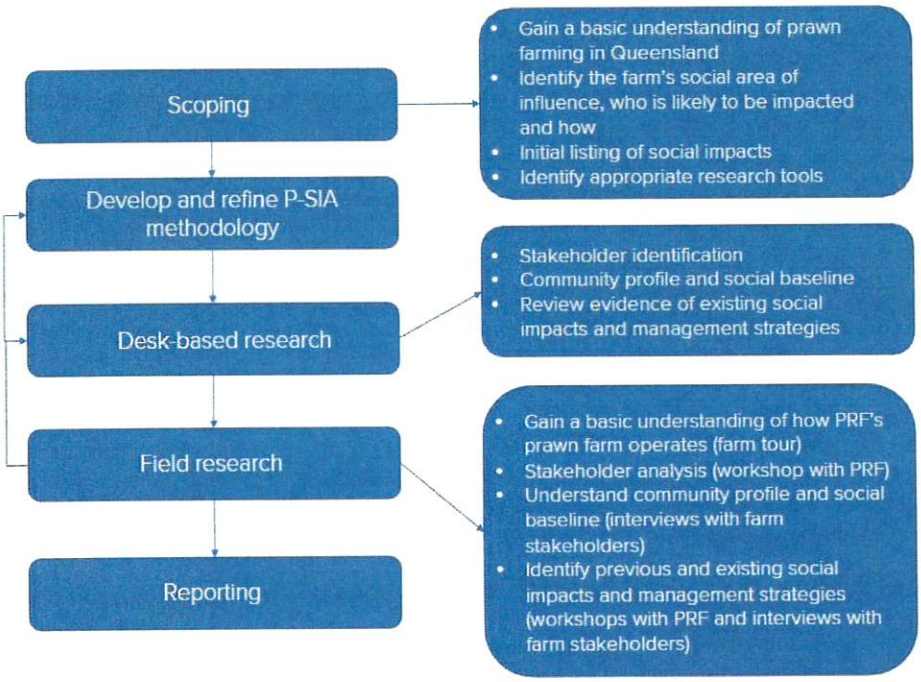


Figure 4 – Methodology for P-SIA

4.8.2 Stakeholder Analysis

Initial stakeholder analysis was conducted during the scoping phase, and as part of the desktop based research phase. Following this, the stakeholder analysis was further refined through workshops with Pacific Reef Fisheries staff.

The following Table summarises how stakeholders use the local area and gives a picture of the social context of the Alva Beach aquaculture facility.

Table 3 – How people use the p-SIA study area

Use	Description
Economic	Major employers in the area include Burdekin Shire Council, agriculture (including sugar cane farms and mills, cattle and horticulture), aquaculture (prawn farm) and industries supporting agriculture and aquaculture (e.g. retail, manufacturing and engineering).
Natural Resource	Coastal areas are used all year round for recreational purposes such as swimming, kite surfing, fishing and crabbing by local people and tourists (backpackers and grey nomads). Groundwater and stream water are used for irrigation.
Human Assets	There are numerous state and private primary and high schools in Ayr and Home Hill. Emergency services including hospitals are located in Ayr and Home Hill.
Physical Indfrastructure	Trent Road, Beach Road are the two main access roads from Ayr to the farm. Electricity and potable water are also provided. Key residential areas are Ayr, Home Hill and Alva Beach. People also live on sugar cane and cattle farms in the area.
Social and Cultural Aspects	Use of the coastal areas includes swimming, fishing (including crabbing) from land and boats and kite surfing.

Note: The table above is an extract from the stand alone P-SIA document completed by 'Just Add Lime' and for complete context should be read in its entirety from that document.

4.8.3 Stakeholder Consultation

The table below summaries the timeline of the stakeholder consultation that was undertaken in order to prepare the P-SIA.

Table 4 – Extracted from P-SIA prepared by 'Just Add Lime'

Timeframe	Task
w/b 8 May 2017	PRF contacted potential stakeholders to ask if they would like to be involved and provide background information (see Attachment 4 for briefing note)
w/b 8 May – w/b 29 May 2017	Rachel Maas contacted those stakeholders who agreed to participate in the p-SIA and organised a time and place to meet.
w/b 21 May 2017 - w/b 29 May 2017	Rachel Mass provided copy of information and consent form template (see Attachment 5) and research questions (see Attachment 6) to stakeholders participating in the p-SIA.
w/b 29 May 2017	Consultations with stakeholders were undertaken in the week beginning 29 May 2017 and were held at a time and location that suited the stakeholder/s. A schedule of the stakeholder consultations is provided in Table 4.
w/b 29 May 2017 – w/b 14 June 2017	Draft meeting notes were provided to participating stakeholders and they were requested to review and update or delete/add any more comments. Final meeting notes are provided in Attachment 7.

The full list of stakeholders identified can be found with the P-SIA document.

Stakeholder consultation discussions were kept informal so that open questions could be asked. Consequently, the findings were a true reflection of stakeholders views, and not a review of a list of pre determined social impacts.

4.8.4 Natural resource impacts identified

This section details the natural resource impacts identified as areas of concern by stakeholders as part of the P-SIA undertaken in 2017. For the full range of social impacts and concerns identified as part of the participatory process, the P-SIA should be read in its entirety.

The primary natural resource concern identified by some stakeholders was regarding the potential for increasing the salinity of groundwater in the area, particularly as a result of sea water leeching through the farm ponds into the surrounding soil and groundwater. This concern was at its peak during the Material Change of Use (MCU) process for the Stage V expansion in 2005. Since then the level of concern has decreased over time.

As part of the development approval conditions for the Stage V MCU, research on potential ground water impacts was undertaken and it was recognized that salinity issues can occur as a result of natural process and human activities, and could not (and still can not) be attributed to one particular cause or industry. Consequently, conditions were added to the development approval granted by Burdekin Shire to specifically address concerns about ground water impacts, including supervision of pond construction, limits placed on salinity indicators and monitoring of groundwater bores on and off the farms.

Since the MCU for Stage V was approved and enacted, there have been no complaints or concerns raised with Pacific Reef Fisheries or Burdekin Shire Council in relation to these matters.

Measures implemented by Pacific Reef Fisheries to mitigate the potential for salinisation of groundwater and address the concerns of stakeholders are detailed in Section 5.7 of this report.

In the assessment of the MCU for the Stage V pond expansion, completed in 2005, public submissions identified other concerns regarding storm water, site drainage and effluent disposal. As a result, conditions were added to the development approval granted by Burdekin Shire Council to specifically address these concerns through monitoring programs. Throughout the stakeholder consultation undertaken as part of the P-SIA in 2017, these concerns were not raised by any stakeholders. Therefore it is considered, that at this point in time, salinisation of ground water remains the primary concern of some stakeholders.

4.9 Risk Assessment

Given the scale of the operation a raft of risks and risk management processes exist to assist in managing commercial risks and complying with regulatory requirements. A thorough risk assessment of environmental and sustainability issues relating to the current operation is provided in Appendix B.
Aspects with a risk score of High or Extreme and their associated actions are provided in Table 5.

Table 5 High / Extreme Aspects and Actions

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Staff Environmental Awareness								
Are staff inducted and given sufficient training?	Yes	Yes	C	4	H-	Staff inducted and trained Training matrix completed and updated regularly	All Management	
Extreme Weather Events								
Do Cyclones occur?	Yes	Yes	C	4	H-	Follow PRF Serve Weather Plan Increase correspondents with government agencies	All Management	
Can extreme weather cause Damage to infrastructure?	Yes	Yes	C	5	H+	Follow PRF Serve Weather Plan	All Management	
Power								
Can loss of stock occur due to power failure?	Yes	Yes	D	5	H-	Follow Power Failure Contingency Plan Regular HV power line inspections by electrical companies/contractors	All Management and Staff	
Pump/Aerator								
Can loss of Stock occur due to Pump/Aerator failure?	Yes	Yes	D	5	H-	Follow Pump Failure Contingency plan Regular aerator maintenance Back-up pumps/aerators on site to replace faulty units	All Management and Staff	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Disease								
Can loss of Stock occur due to disease Outbreak?	Yes	Yes	C	5	H+	Ensure to follow Disease Management Plan and corresponding work instructions	John, Wayne, Brad, Matt, Bastien	
Is there Potential to transfer Disease to external environment?	Yes	Yes	C	5	H+	Ensure to follow Disease Management Plan and corresponding work instructions Deter predators from ponds using methods described in the predator management plan	John, Wayne, Brad, Matt, Bastien	
Is there potential for Disease transfer within farm?	Yes	Yes	C	5	H+	Ensure to follow Disease Management Plan and corresponding work instructions	John, Wayne, Brad, Matt, Bastien	
Is there potential for Disease transfer between farms?	Yes	Yes	C	5	H+	Ensure to follow Disease Management Plan and corresponding work instructions	John, Wayne, Brad, Matt, Bastien	
Genetic Pollution								
Can stock escape into the external environment?	Yes	Yes	C	4	H-	Screens in ponds and settlement pond inspected weekly Survivals and feed consumption monitored closely Traps in place to monitor escapees	All Management and Staff	
Local Conservation Issues								
Does degradation of Receiving environment occur?	No	No	D	2	L-	PRF employ Gassman Development Perspectives to undertake Environmental Impact Monitoring according to the EIMP. Water quality monitoring of receiving environment. Water quality to comply with DEHP and DOE license agreements Water Quality Buoy deployed at mixing zone monthly.	Wayne/John	
Wildlife interactions								
Does Predation on stock occur?	Yes	Yes	B	5	E	PRF follow predator management plan Daily observations of bird sightings recorded	All Staff	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
						and reported to QPWS		
Does Disease transfer occur?	Yes	Yes	B	5	E	Routine health monitoring of cultured stock Report any behavioral or unusual activities in culture stock Deter predators from ponds using methods described in the predator management plan Disposal area is located away from production areas	All Staff	
Is the surrounding ecology of Flora and Fauna affected by operations?	Yes	Yes	C	4	H-	PRF employ Gassman Development Perspectives to undertake Environmental Impact Monitoring according to the EIMP	Wayne	
Chemical Storage and Handling								
Is the Hazardous Substances Register Up-To-Date and accessible?	Yes	Yes	C	5	H+	Hazardous Substances Register updated annually and located on company server and administration	Wayne/Brad	
Are SDS's Up-To-Date and accessible?	Yes	Yes	C	5	H+	SDS's updated annually and are located with hazardous substances and on the company server	Wayne/Brad	
Are chemicals stored correctly to avoid spills and leaks?	Yes	Yes	C	5	H+	Chemicals stored in designated areas Chemicals stored on bunded pallets	Wayne/Brad	
Is there a potential for misuse for explosions of chemicals?	Yes	Yes	C	5	H+	SDS's updated annually and are located with hazardous substances and on the company server Staff training and awareness	Wayne/Brad	
Are gas cylinders secured?	No	Yes	D	5	H-	Gas bottles need to be chained and secured inside workshop (September 2016)	Trevor	
Feed								
Is feed sourced sustainable?	Yes	Yes	D	5	H-	Ridley no-catch diet used Commercial trails of Novacq to commence this season (2016)	Brad/John	
Are FCR values optimised?	Yes	Yes	A	3	H+	Feed consumptions managed throughout the entire crop using feed trays FCR's monitored weekly High spec feed used	Brad/John and all Managers	
Storage and Handling of Fuels and Oils								

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Is there potential for Leaks and Spills?	Yes	Yes	C	3	M	SDS's available Fuel stored in bunded areas with sumps (see photo) to contain leaks and spills Bunded pallets for oil drums Spills kits available Training of staff	Trevor	
Is there potential for Fire and Explosion?	Yes	Yes	C	5	H+	Emergency evacuation plans in place Fire Extinguishers available and staff are trained in their correct use	Kylie	
Staff Facilities								
Is there potential for smoking to cause fire?	Yes	Yes	C	4	H-	Staff aware of designated areas Litter bins provided for butts	Brad/Wayne	
Wild-Caught Broodstock								
Does taking wild stocks to use for commercial breeding affect wild populations?	Yes	Yes	D	5	H-	Translocation permits in place Domestication programme in place to reduce pressure on wild stocks	Bastein	

5 Mitigation

5.1 Introduction

As part of Standard requirements, the B-EIA must define appropriate mitigation and offsetting requirements related to previous and continuing impacts. This has been reinforced by Shrimp Standard representatives as particularly relating to the following requirements:

Shrimp Standard:
- 2.1.1
- 2.2.2
- 2.3.1 - 2.3.2
- 2.4.1 - 2.4.3
- 2.5.3 – 2.5.4
- 6.1.2

Cobia Standard:
- 2.3.1 - 2.3.2

5.2 Allowance for and maintenance of farms sitting in Protected Areas

This section relates to requirement Shrimp - 2.2.1 & Cobia 2.3.2.

The Shrimp Standard, using a reference from N.Dudley defines a protected area as:
"A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values".

No area of the lots utilized for the operation are sited within such a protected area, legislated (e.g. RAMSAR wetland / GBR area) or voluntary (e.g. Land for Wildlife property etc). The site infrastructure was cross checked with Protectedplanet.net and the Alva Beach Site does not lie within other protected areas.

5.3 Allowance for and maintenance of farms sitting in mangrove ecosystems and other natural wetlands

This section relates to requirement Shrimp 2.2.2.

A stand-alone Mangrove Offsets Review is included in Appendix B. This review included an investigation into the pre-development and current ecological conditions of the subject site.

The site was found to have facilitated over 20ha of regenerated mangroves, in contrast with the estimated 150 individual mangrove stems removed as part of the development. This was a result of the selected site being heavily modified prior to being acquired by Pacific Reef Fisheries. A monitoring program exists for adjacent mangrove areas (Environmental Impact Monitoring Program, 2013 – contained for reference in Appendix B) and a Mangrove Studies Report (2014-2017) has been undertaken outlining the benefits of internal rehabilitation.

Consequently, it is considered that the natural regeneration of mangrove areas significantly outweighs the relatively small number of mangroves originally removed.

5.4 Allowance for and maintenance of farms sitting in critical habitats of endangered species

This section relates to requirement Shrimp 2.3.1 and Cobia 2.3.1.

Not applicable. Within previous reporting the auditor has noted:

"The farm is not located in an area considered a critical habitat for endangered species. The closest AZE site is the Bowling Green Bay National Park which is home to the McDonalds Frog. The southern border of the National Park is located approximately 5 km north of the farm site."

It should be noted that no habitat for this species exists on-site so it has not been covered in the accompanying endangered species management plan.

5.5 Procedures in place to avoid negative impacts on endangered species

This section relates to requirement Shrimp 2.3.2 and Cobia 2.3.1.

A stand alone Endangered Species Management Plan is included in Appendix B.

A number of IUCN listed Endangered and Critically Endangered species were considered as possible occurrences within a vicinity of the Pacific Reef Fisheries site. The attached report has outlined management measures to ensure that risks of death or injury to listed IUCN endangered species is minimised or eliminated. This report should be referred to as a management plan and provided to commencing staff who will be operating equipment, vehicles or working in areas which are considered to possibly contain endangered species.

5.6 Coastal barriers between the farm and the marine environment / Riparian buffer zones

This section relates to requirements Shrimp 2.4.1, 2.4.2 and 2.4.3.

5.6.1 ASC Shrimp Standard Requirements

Item 2.4.1 of the ASC Shrimp Standard (Coastal barriers) notes a requirement for a *"minimum permanent barrier (or natural) between farm and marine environments" with values set at 100m to 2km dependant on the coastal environment and the effects of storm surges etc*

Item 2.4.2. (Riparian buffers): *"a minimum width of permanent native and natural vegetation between farms and natural aquatic/brackish environments is required . . . as defined in national legislation at the time of construction, or as determined is necessary by the B-EIA, or following the indications given in the Guidance below, whichever is greater."*

Item 2.4.3 (Corridors) notes a "minimum width of permanent native and natural vegetation through farms to provide human or native wildlife movement across agricultural landscapes".

5.6.2 Legislative Requirements

At the time that Pacific Reef Fisheries acquired the property in 1998, there were no pieces of legislation which required buffers to waterways, coastal barriers or corridors. Prior to this time, a total of 24ha of ponds had been constructed. The planning scheme which was relevant at the time of both acquisition and construction was the 1977 Town Planning Scheme for the Shire of Ayr. No reference to these requirements was found in a review of this planning scheme.

Additionally, the first state legislation which required or related to buffers was the Vegetation Management Act 1999, which commenced the year after Pacific Reef Fisheries acquired the property. Consequently, it has been assessed that no formal legislative requirements were in place at the time the farm was acquired by Pacific Reef Fisheries, or constructed prior to this time.

5.6.3 Previous Site Condition

Prior to its conversion into a prawn farm, the property was described in the original Environmental Impact Statement as a degraded cattle grazing land, with grazing widespread across the property which was largely cleared with invasive woody weeds over much of the area (SKM, 2000). Consequently, the existing vegetated buffers to waterways were minimal in the first instance, with grazing possible as far as the cattle could walk. A comparison of aerial imagery from 1993 to 2017 indicates that native vegetation buffers to waterways generally have been maintained in the same width and condition as those prior to purchase.

1993 (prior to purchase – stage 1 in place, note cleared paddocks and woody weeds versus native vegetation)

1999 (following purchase, pre-stages 3 and 4, note cleared paddocks and cleared woody weeds)

2004 (pre-stage 5, stages 3 and 4 in place)

2016 – Present (all current stages in place)

5.6.4 ASC Shrimp Standard Compliance

5.6.4.1 Requirement 2.4.3 (Corridors)

A coastal corridor ranging from 1.2 -1.5km has been maintained to the east of the site. This corridor is primarily native coastal vegetation and minor / major watercourses. Due to the size and quality of this vegetation the site is compliant with this criterion.

5.6.4.2 Requirement 2.4.1 (Coastal Buffers)

The standard notes a 100m-2km buffer from coastline. As the site's operational boundary is located over 1.2-1.5km from such features compliance has been achieved relating to this aspect as no adverse effects such as flooding or significant erosion into adjacent areas has been observed during storms / cyclonic activity since Pacific Reef's expansions (100 Year ARI Flood Assessment Comments, SKM, 2000).

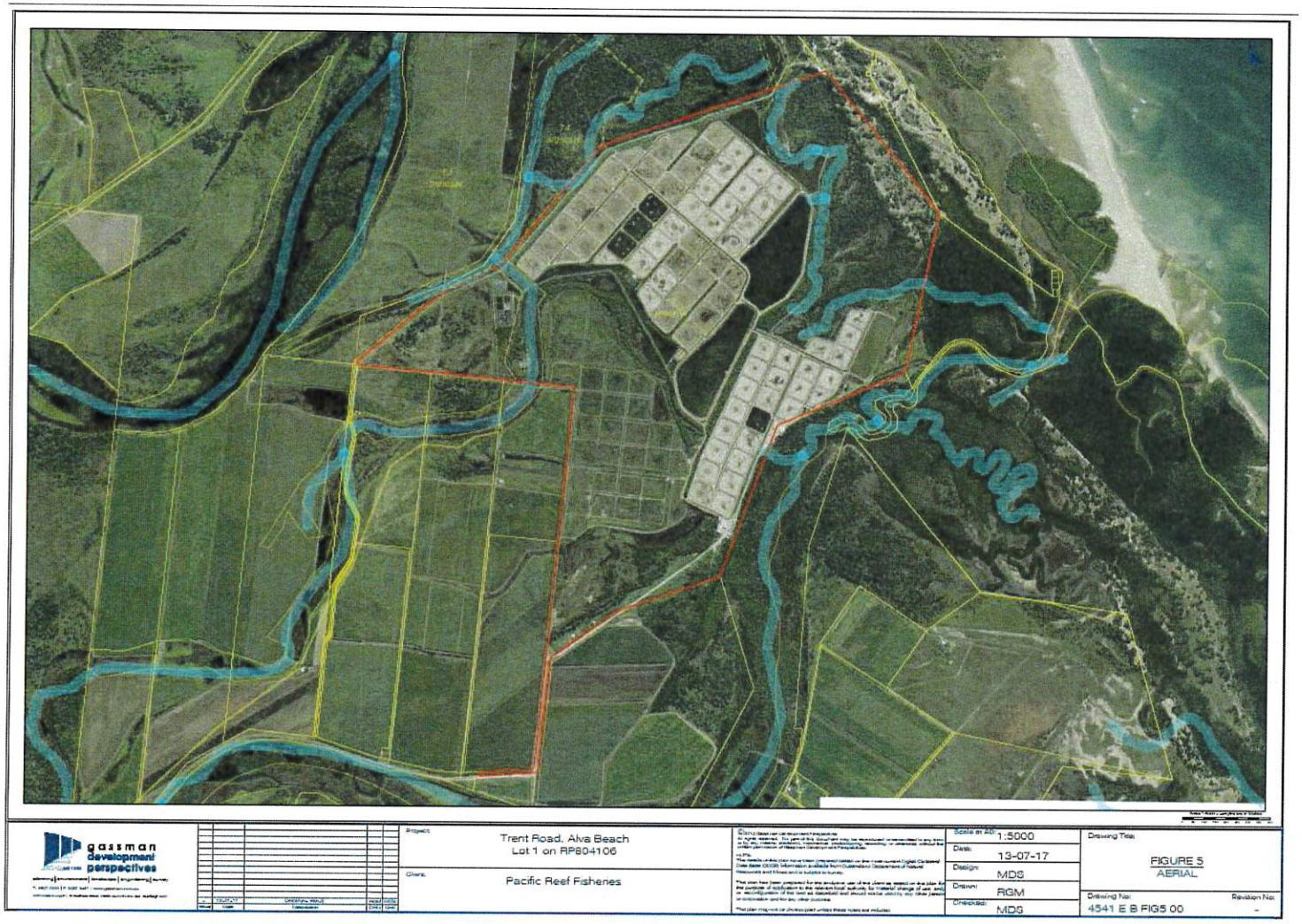
5.6.4.3 Requirement 2.4.2 (Riparian Buffers)

For confined natural watercourses such as rivers and streams, to comply with the ASC standard the zone of natural or restored vegetation should be >25metres wide on both sides of a watercourse.

Due to the complexity of waterways around the site and their mobile nature, the following process was followed to determine waterway buffer compliance:

- Regulated waterways linked to QLD's Vegetation Management Act Framework were utilized to determine waterway location.
- Waterways underneath operational areas (i.e. previously removed under approval) were removed.
- VMA waterways were then buffered by 25m and overlayed on aerial photography to determine which waterways occurred within 25m of operational areas, including perimeter tracks.
- Figure 4 shows these waterways and their 25m buffer areas.

0.33km of such waterways were found to be within 25m of operational areas, 0.3% of the total waterways (37km) found within a 3km radius of the western area of the operation.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Project:
Trent Road, Alva Beach
Lot 1 on RP804106
Client:
Pacific Reef Fisheries
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Date: 13-07-17
Design: MDS
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FIGURE 5
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Drawing No: 4541 E B FIG5 00
Revision No: -

The images below are indicative of the areas where riparian buffers were <25m. These areas are non-erosive (stable) and largely vegetated. Speed of vehicles within these areas is limited to 40km/hr and fauna are avoided when seen

Indicative images highlighting stable buffer intersect areas, typically vegetated with native coastal vegetation.

While it is unclear what the objective of buffer requirements is in the ASC Shrimp Standard, common objectives of riparian buffers include fauna movement / protection and water quality. Riparian function within these buffer-intersect areas is stable and similar in terms of hydrological / nutrient outputs as demonstrated in detailed water quality / vegetation monitoring undertaken on both the site and an adjacent, comparative reference site not influenced by the farm (Environmental Impact Monitoring Program, 2005 – contained for reference in Appendix B).

All major stages of the prawn farm have been installed and became operational prior to application for certification under the standard, making design with consideration of riparian buffers impossible. As the areas that do not meet the buffer requirement are minimal, legislative requirements regarding such buffers have been met and as core buffer values (water quality / protection of fauna) are maintained across the site, it is believed that requirement 2.4.2 of the ASC Shrimp Standard has been met.

5.7 Conductance or Chloride Concentration in Freshwater Wells / Soil

This section relates to requirement Shrimp 2.5.3 / 2.5.4 / 2.5.5

- 2.5.3 For all freshwater wells (identified prior to full assessment), specific conductance may not exceed 1,500 mhos per centimeter and/or chloride concentration may not exceed 300 milligrams per liter.46
- 2.5.4. No increase in soil-specific conductance or chloride concentration in adjacent land ecosystems and agricultural fields when compared to first year of monitoring.
- Requirement 2.5.5 relates to spoil being transferred offsite. As spoil management and placement occurs on-site this requirement is met by default without further reporting requirements.

Freshwater contamination has in the past been a key cause of concern from adjacent stakeholders. The accompanying P-SIA provides a detailed history of these issues together with the mitigation measures / ground-truthing undertaken by PRF.

The development approval granted by Burdekin Shire Council for the facilities' Stage V pond expansion condition that a Groundwater Monitoring and Management Plan be developed and implemented. A copy of the Groundwater Monitoring and Management Plan is attached within Appendix B.

Burdekin Shire Council also undertakes groundwater monitoring in parallel with the monitoring undertaken by Pacific Reef Fisheries. Feedback from Burdekin Shire Councils monitoring program and the farms own monitoring, both indicate consistent results with no complaints lodged about potential increases in salinity since the facilities' expanded Stage V ponds began operating.

A Surface Soil Monitoring program has been included in Section 5.7.2.1. This monitoring program specifies a monitoring protocol (the location of sampling stations and the frequency of monitoring) for measuring the specific conductance of soil in adjacent land ecosystems and agricultural fields.

The results from Pacific Reef Fisheries ground water and surface soil monitoring programs are made publicly available on request. The parallel monitoring done by Burdekin Shire Council is also available on request; however no requests to view this data have been made as yet. The consistent results from Pacific Reef Fisheries and the Burdekin Shire Council's monitoring programs provide sufficient evidence to eleviate stakeholder concerns regarding the potential for salinisation of groundwater as a result of the facilities operations.

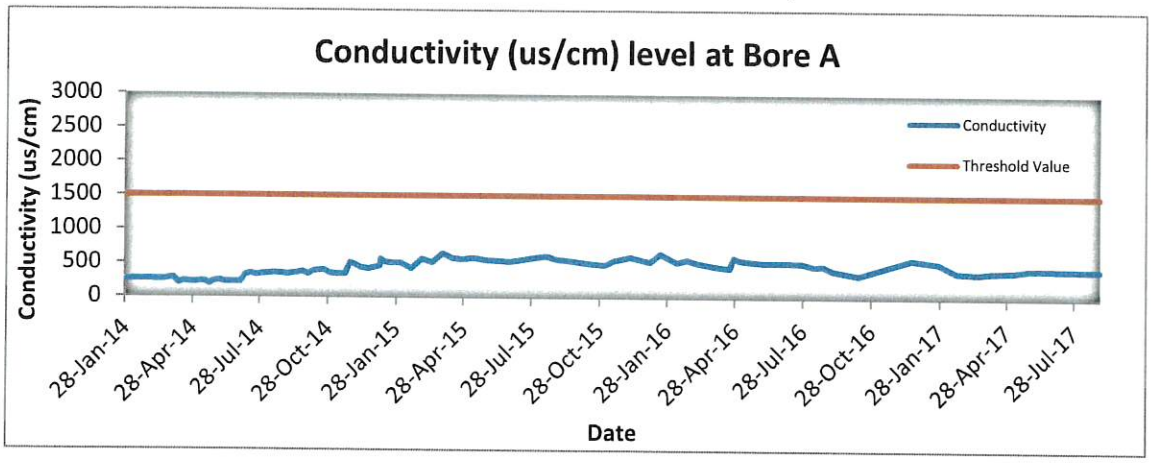
The following sections identify the freshwater well and surface soil monitoring locations, and provide a summary of the conductivity data results obtained from the respective monitoring efforts.

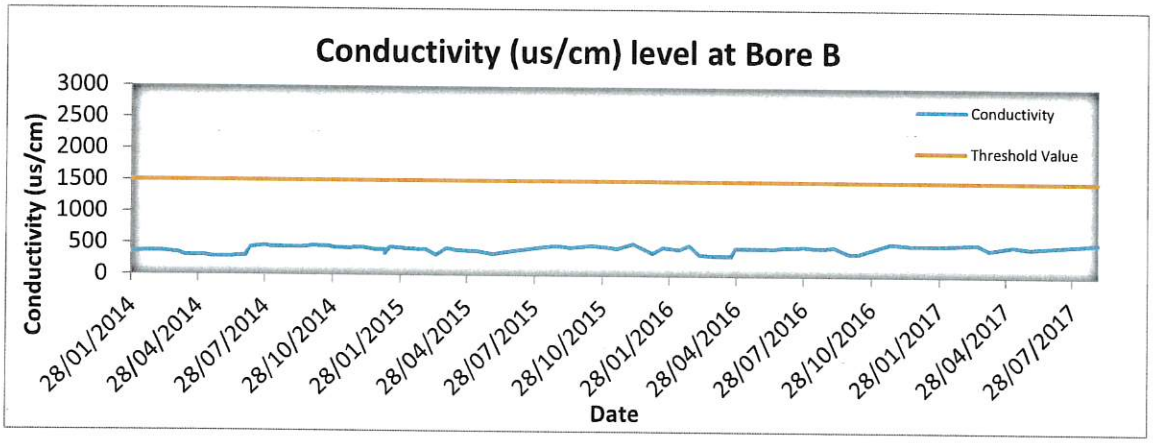
5.7.1 Requirement 2.5.3: Freshwater Wells

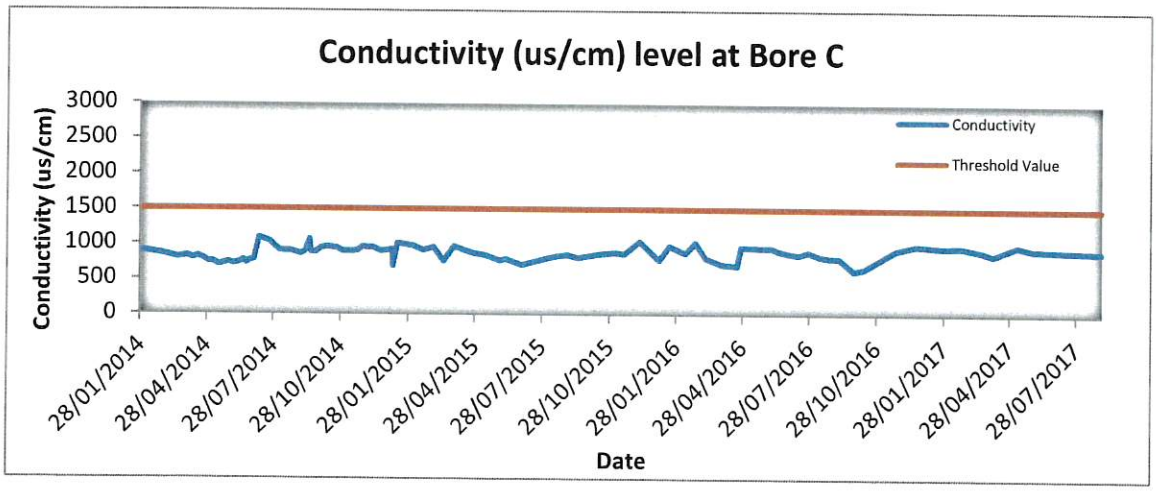
Freshwater Well locations within the facility are shown in the figure below (As per the Groundwater Monitoring and Management Plan approved by the Burdekin Shire Council), with relevant conductance measurements for the last year shown in the following graphs. No values observed in these wells exceeded the maximum permissible level.

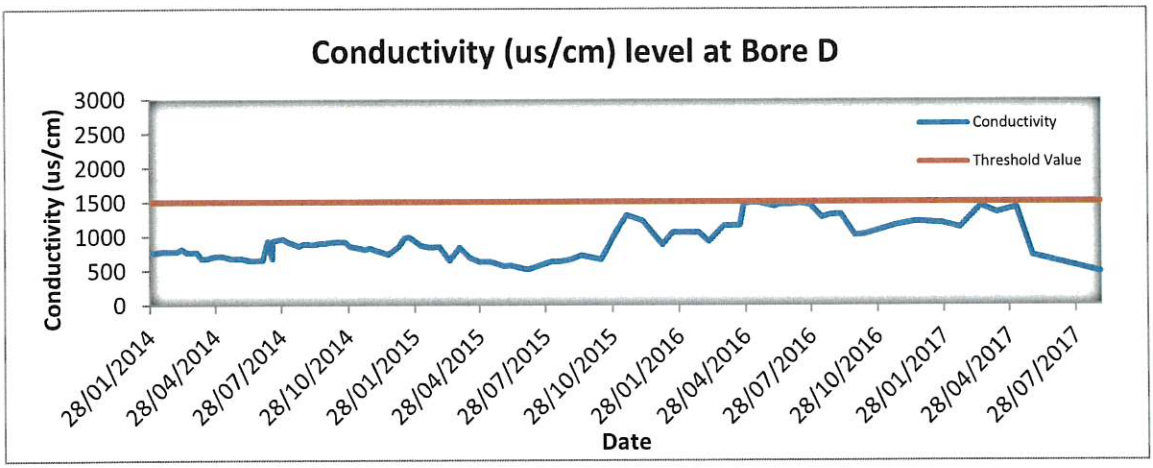
Figure 6. Freshwater Well Locations

Figure 7. Specific Conductance Values in Freshwater Wells, 2015-2017.





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Conductivity (us/cm)
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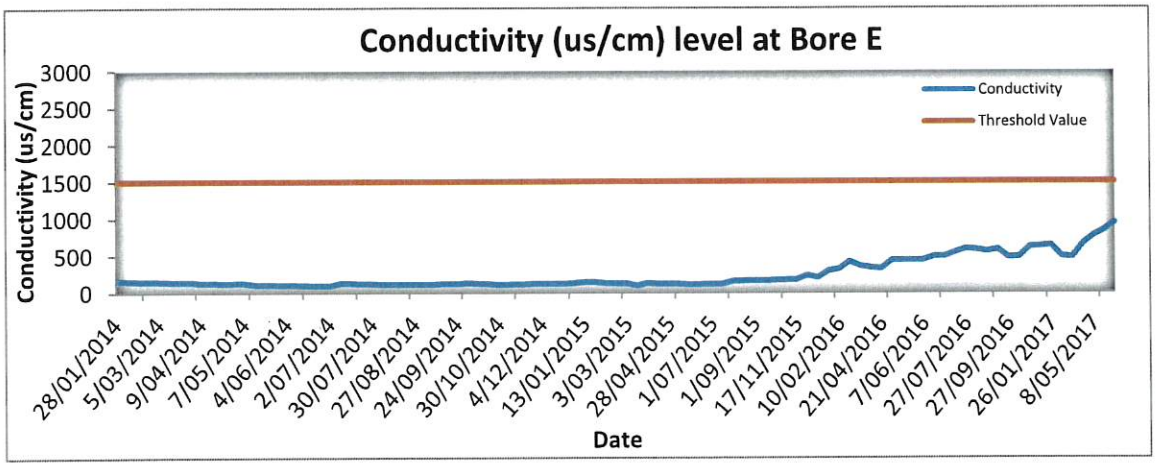
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17/11/2015
10/02/2016
21/04/2016
7/06/2016
27/07/2016
27/09/2016
26/01/2017
8/05/2017
Date

5.7.2 Requirement 2.5.4: Surface Soil

A monitoring plan is included in the following section, with the first six-month period's data included in table below.

Table 6. Surface Soil Measurement, first period

Monitoring Location (refer to map below)	First Monitoring Date	First Value Obtained (us/cm)	Permissible Net Increase (25% of first monitoring values)	Maximum Permissible Level
A	25/07/2017	1040	260	1300
B	25/07/2017	392	98	490
C	25/07/2017	150	37.5	187.5
D	25/07/2017	451	112.75	563.75

5.7.2.1 Surface Soil Monitoring Program

A Surface Soil Monitoring Plan is included in this section.

The Plans objectives include:

- Where a significant risk exists, identify a monitoring protocol (the location of sampling stations and the frequency of monitoring) for measuring the specific conductance of soil in adjacent land ecosystems and agricultural fields;
- Soil salinity must be measured 25m within adjacent land ecosystems and agricultural fields every 6 months.

Monitoring Point Locations

- Monitoring locations occur on adjacent properties generally absent from regular salt-water influence.
- All monitoring points are located >25m from the operational boundary.
- Natural systems to the east have been excluded from monitoring as they are intertidal areas already heavily saline.

Figure 8. Soil monitoring locations

Procedure

The procedure for measuring chloride or specific conductance in soils is derived from the method used by Boyd et al. (2006) for aquaculture pond soil:

1. Soil samples must be taken by forcing a core sampler (a 1-inch PVC tube would suffice but a professional soil sampler can also be used) into the ground with a hammer to a depth of 20cm.
2. Samples must be dried (either by placing them in thin layers on plastic sheets and exposing them to the air in a warm, well-ventilated place, or in an oven at 60°C) and then pulverized and mixed (using a mortar or a mechanical soil crusher).
3. Then the measurement involves taking a 20g sample of dry soil and placing it in a glass container, adding 40 mL of distilled water and shaking the mixture by hand for five minutes. The specific conductance can be measured directly in the solution or the solution can be filtered and the chloride concentration measured.
4. Multiply measurement-specific conductance values by two to adjust for the dilution (40 mL of water for 20g of soil).
5. Specific conductance values over 1,500 µS/cm or chloride concentrations above 300 mg/L indicate that the soil is saline.
6. This test will be performed approximately every 6 months.

Net increase is defined as an increase of 25% or more from initial values submitted during the initial certification audit.

5.8 Prevention Measures for Escapees

This section relates to requirement Shrimp 6.1.2.

This criterion has been previously assessed by ASC Shrimp Standard Auditors.

Several key documents form the basis of escape control:

- Pond Preparation Section of the Operations Manual;
- Work Instruction: Outlet Preparation;
- Work Instruction: Escapee Recovery of Cultured Prawns;
- Cobia Cage Plan Checklist.

To summarise these documents:

- Outlets are engineered to prevent the smallest life-form of prawn introduced into ponds from passing through;
- A recovery plan for escapees is in place, which focuses on a monitoring-based system. If farmed prawns are detected in the natural environment via daily monitoring of traps in the PRF Mangrove Wetland, processes are put in place to restrict further discharge until the breach can be identified;
- Regular data capture against these operations documents is undertaken and recorded.

Table 7 summarises requirements. Escapee management plans, operational checklist templates and maps are located within Appendix B. Cobia (*Rachycentron canadum*) production also occurs on-site and while not the subject of this B-EIA, its control measures are included in the Appendix B and for completeness.

Table 7 Escapee prevention management requirements

Broad Requirement	Detailed Requirement	Method in Which Operation Meets Requirement
A. Effective screens or barriers of appropriate mesh size for the smallest animals present; double screened when non-indigenous species. **Requirement:** Yes **Applicability:** All	A. Review records for shrimp size in different holding units.	Auditor to undertake.
	B. Review records for mesh or grill size. Confirm that the mesh /grill size that was selected was appropriate for the smallest animals present at the time used.	A combination of oyster mesh and fly screen are utilised on outlets which are small enough to restrict access of smallest lifeform of tiger prawns.
	C. During the on-site visit, inspect the size of net mesh or grills to confirm compliance. Where non-indigenous species are in culture, confirm that the farm has used double screens.	Auditor to undertake.
B. Perimeter pond banks or dykes are of adequate height and construction to prevent breaching in exceptional flood events [108]. **Requirement:** Yes **Applicability:** All	A. Review records covering ≥ 25 years or statement from government agencies to establish the maximum height of high water when flooding occurs.	Flood modelling indicates pond upper banks are above a Q100 event.
	B. Review statement and map. During the on-site visit. Review evidence and verify that the lowest bund height is sufficient to cope with 25 years height.	Auditor to undertake.
C. Regular, timely inspections are performed and recorded in a permanent	A. Review records to verify inspections are regular and timely.	Records to be provided on request.

Broad Requirement	Detailed Requirement	Method in Which Operation Meets Requirement
register. **Requirement:** Yes **Applicability:** All	B. Witness the farm performing an inspection of meshes and grills to confirm that the program is effective.	Auditor to undertake.
D. Timely repairs to the system are recorded. **Requirement:** Yes **Applicability:** All	A. Review the register to verify repairs are performed and recorded.	An attached Waternote with checklist is provided in Appendices. The traps are regularly checked and maintained.
E. Installation and management of trapping devices to sample for the existence of escapes; data is recorded. **Requirement:** Yes **Applicability:** All	A. Review how the farm uses trapping devices to monitor escapees.	Trapping device design and monitoring requirements are provided in the Pond Preparation Section of the Operations Manual and Work Instruction: Outlet Preparation.
	B. Review records of inspection and observed escapees.	Auditor to undertake.
	C. During the on-site visit, inspect to verify that traps are configured properly and located suitably to ensure effective farm-wide monitoring of escapees.	Auditor to undertake.
F. Escape recovery protocols in place. **Requirement:** Yes **Applicability:** All	A. Review escape recovery protocols and assess that protocols are implemented, there are records of escapes, records of actions taken and records of procedural modifications to prevent reoccurrence.	An escape protocol is in place (refer to the *Work Instruction: Escapee Recovery of Cultured Prawns*). The instruction is operational. Discharge Reports are available in the audit pack. No escapes have been detected.

6 Future Activities

6.1 Overview

The ASC Shrimp Standard list several requirements regarding B-EIA distribution, monitoring and updating. As these are future activities a summary of proposed processes is provided in subsequent sections.

6.2 Distribution to Other Parties / Review and Decision-Making

The B-EIA and P-SIA reports have been sent to the key relevant stakeholders for review and comment. As yet, no comments or feedback has been received. If feedback is provided, these comments will be assessed together with auditor comments / requirements, and where required the B-EIA will be updated to ensure it complies with ASC Standard requirements.

Monitoring results will be provided to the public through appropriate communication channels to ensure that monitoring is easily accessible and to help alleviate stakeholder concerns regarding lack of information on potential groundwater salinisation.

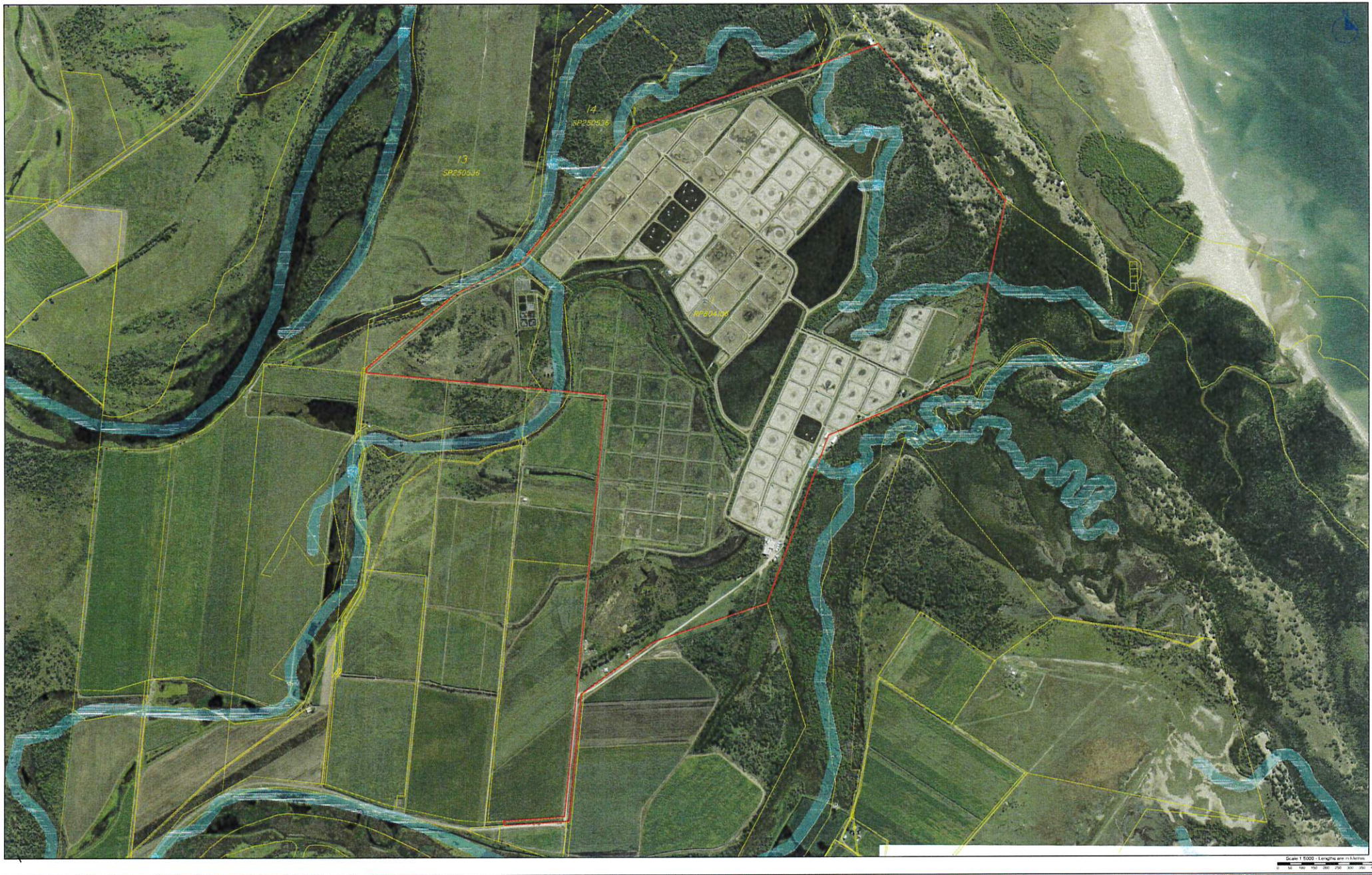
6.3 Management, Monitoring, Evaluation and Auditing

Approvals-based and internal monitoring / actions will continue to be undertaken at their required frequencies. The B-EIA will be reviewed / assessed annually to ensure compliance with the method is maintained. Audits will be undertaken at a frequency prescribed by the ASC Shrimp and Cobia Standards

Outcomes of internal review and audits will be incorporated into B-EIA updates where required to comply with the ASC Shrimp and Cobia Standards.

A single digital folder containing all relevant B-EIA documents will be created within PRF's data management system. These documents will be backed up either on an alternative server or a cloud-based system annually at a minimum.

Appendix A: Site Mapping



gassman development perspectives
planning | environment | landscape | engineering | survey

Issue	Date	Description	RGM	VRB
	25-05-17	ORIGINAL ISSUE	DRN	CHK

Project: Trent Road, Alva Beach
Lot 1 on RP804106

Client: Pacific Reef Fisheries

NOTE:
The details of this plan have been prepared based on the most current Digital Cadastral Data Base (DCDB) information available from Queensland Department of Natural Resources and Mines and is subject to survey.

This plan has been prepared for the exclusive use of the client as stated on this plan for the purpose of application to the relevant local authority for material change of use and or reconfiguration of the land as described and should not be used by any other person or corporation and for any other purpose.

This plan may not be photocopied unless these notes are included.

Scale at A0	1:5000
Date	13-07-17
Design	MDS
Drawn	RGM
Checked	MDS

Drawing Title: FIGURE 4 AERIAL

Drawing No: 4541 E B FIG2 00

Revision No: -

Appendix B: Supporting Documentation

Site Address: Alva Beach, QLD, 4807

Completed by: Wayne and Kristian

Date Completed: 24th August 2017

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
1. Staff Environmental Awareness								
Are staff aware of Environmental and Sustainability policies and procedures?	Yes	Yes	D	3	L+	Presented in induction and signed off in Training Matrix	Wayne/Brad	
Is there sufficient supervision and number of staff at the farm?	Yes	No				Staff Management Structure in place	John	
Do staff understand company Policies and government regulations and licences	Yes	Yes	D	3	L+	Staff inducted and trained Training matrix completed and updated regularly	Wayne/Brad	
Is there turnover of staff, especially itinerant staff at the farm?	Yes	No				Experienced seasonal workers return at the start of each season	Wayne/Brad	
Is there experienced/educated staff at the farm?	Yes	No				Staff with tertiary degrees combined with industry experience	Wayne/Brad	
Are staff inducted and given sufficient training?	Yes	Yes	C	4	H-	Staff inducted and trained Training matrix completed and updated regularly	All Management	
2. Extreme Weather Events								
Does Major Flooding occur?	Yes	Yes	D	3	L+	Pond levels have been constructed to 1:100 year flood level	Wayne, John, Brad	
Can extreme weather events affect Groundwater Levels?	Yes	Yes	D	2	L-	Groundwater monitored	Wayne	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Does extreme weather impact Water Quality?	Yes	Yes	B	2	M+	Manage stormwater flows through Rubicon Tidal Gate. Increased Water Quality Monitoring Increase correspondents with government agencies	Wayne/Kristian	
Do Cyclones occur?	Yes	Yes	C	4	H-	Follow PRF Serve Weather Plan Increase correspondents with government agencies	All Management	
Do king tides affect this site?	No	No					Wayne	
Can extreme weather cause Damage to infrastructure?	Yes	Yes	C	5	H+	Follow PRF Serve Weather Plan	All Management	
Does Drought affect the site?	Yes	Yes	D	3	L+	Monitor Groundwater	Wayne/Kristian	
Does Pollution from stormwater occur? (oil, Grease, litter and sediments)	Yes	Yes	C	3	M	Oil contained in IBC's and Drums and stored undercover Litter stored in industrial bins provided and secured during serve weather Water Quality monitored for Total suspended solids and turbidity Regular inspections at W1 to ensure no slicks or other visible floating oil, grease, scum or litter is leaving the farm	Wayne, John, Brad	
3. Power								
Can loss of stock occur due to power failure?	Yes	Yes	C	5	H+	Follow Power Failure Contingency Plan Regular HV power line inspections by electrical companies/contractors	All Management and Staff	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
4. Energy								
Is power consumption managed to reduce cost and the company's environmental footprint?	Yes	Yes	B	2	M+	Lower power use by managing aerator use i.e. turn off units during the day Monitor usage (KW/hour) daily/weekly/monthly Use more energy efficient aerators Install VSD's across all pumps and freezers Ensure freezer seals are in good condition Ensure freezer compressors are not leaking gas Training and awareness in energy consumption Eco-efficiency Energy Consumption Surveys. Yearly reports to achieve lower energy demands each season.	All Management and Staff	
Is fuel consumption managed to reduce cost and the company's environmental footprint?	Yes	Yes	C	2	L+	Lower fuel consumption by reducing unnecessary usage Introduce more fuel efficient vehicles Training and awareness in energy consumption	All Management and Staff	
5. Pump/Aerator								
Can loss of Stock occur due to Pump/Aerator failure?	Yes	Yes	C	5	H+	Follow Pump Failure Contingency plan Regular aerator maintenance Back-up pumps/aerators on site to replace faulty units Use of Sodium Percarbonate to increase oxygen.	All Management and Staff	
Can vacuum pumps potentially contaminate water and soil?	No	No				All water-lubricated vacuum pumps used.	All Management and Staff	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
6. Disease								
Can loss of Stock occur due to disease Outbreak?	Yes	Yes	C	5	H+	Ensure to follow Disease Management Plan and corresponding work instructions	John, Wayne, Brad, Matt, Bastien, Kristian	
Is there Potential to transfer Disease to external environment?	Yes	Yes	C	5	H+	Ensure to follow Disease Management Plan and corresponding work instructions Deter predators from ponds using methods described in the predator management plan	John, Wayne, Brad, Matt, Bastien, Kristian	
Is there potential for Disease transfer within farm?	Yes	Yes	C	5	H+	Ensure to follow Disease Management Plan and corresponding work instructions	John, Wayne, Brad, Matt, Bastien, Kristian	
Is there potential for Disease transfer between farms?	Yes	Yes	C	5	H+	Ensure to follow Disease Management Plan and corresponding work instructions	John, Wayne, Brad, Matt, Bastien, Kristian	
Is Destruction and Disposal of Dead Stock managed?	Yes	No				Ensure to follow Disease Management Plan	All Management and Staff	
Do Escapees occur at the Hatchery site?	Yes	Yes	D	2	L-	Escapees from hatchery end up in evaporation pond	Hatchery Staff	
7. Genetic Pollution								
Can stock escape into the external environment?	Yes	Yes	C	4	H-	Screens in ponds and settlement pond inspected weekly Survivals and feed consumption monitored closely Traps in place to monitor escapees Tidal Gate operational if escapees are detected. Escapee Protocol In place	All Management and Staff	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Can escapees from Hatchery cause genetic pollution?	Yes	Yes	D	2	L-	Escapees from hatchery end up in evaporation pond	Hatchery Staff	
8. Harmful Algal Blooms								
Does discharge of Harmful Algal Species occur?	Yes	Yes	C	2	L+	Pond water algae identification done daily Harmful species treated on site Discharge water filtered through sand filter to remove algae cells	Wayne	
9. Groundwater Resources								
Is Groundwater used?	Yes	No					Wayne	Freshwater Only for amenities
Is there potential for contamination of groundwater?	Yes	Yes	D	4	M-	Follow Groundwater management Plan	John/Wayne/ Kristian	
Does the use of bore water affect Groundwater levels?	No	No					Wayne	Freshwater Only for amenities
10. Erosion and Sediment Control								
Do Earthworks occur? (Repairs to batters on ponds, channels, drains and reservoirs)	Yes	Yes	C	3	M	Minimise Earth works during the wet season. Minimise the removal of vegetation Revegetate areas after repairs were erosion has occurred Correct material used. (eg. River rock, bentonite) and correct earthmoving practises used	John, Brad	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
11. Local Conservation Issues								
Does degradation of Receiving environment occur?	No	No	D	2	L-	PRF employ Gassman Development Perspectives to undertake Environmental Impact Monitoring according to the EIMP Water quality monitoring of receiving environment. Water quality to comply with DEHP and DOE license agreements Water Quality Buoy deployed at mixing zone monthly.	Wayne/John	
12. Wildlife interactions								
Does Predation on stock occur?	Yes	Yes	B	5	E	PRF follow predator management plan Daily observations of bird sightings recorded and reported to QPWS	All Staff	
Does Damage Mitigation on wildlife occur?	Yes	Yes	D	4	M-	PRF follow predator management plan Only licensed and authorised staff permitted to cull Annual return submitted to DEHP	Brad/Wayne and licensed staff	
Does Disease transfer occur?	Yes	Yes	B	5	E	Routine health monitoring of cultured stock Report any behavioural or unusual activities in culture stock Deter predators from ponds using methods described in the predator management plan Disposal area is located away from production areas Disease Management Plan in place	All Staff	
Is there potential for Loss of wildlife on power lines?	Yes	Yes	C	2	L+	Install power line bird deterrents to increase visibility	Brad &Wayne	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Does disturbance of native plants occur? (eg. Mangroves)	Yes	Yes	D	2	L-	Mangrove disturbance minimised. DAFF Self-Assessable forms completed and approved before any disturbances occur.	Wayne	
Do pest weed species occur at the site?	Yes	Yes	D	2	N	PRF follow Burdekin Shire Council weed management plan	Wayne	
13. Odour								
Do odours from dead stock occur?	Yes	Yes	C	2	L+	Disposal area is located away from production areas	Brad	
Do odours from wet pond sludge occur?	Yes	Yes	B	1	L+	No sensitive areas in close proximity Sludge allow to oxidise before removal	Brad	
Do odours from processing waste occur?	Yes	Yes	B	1	L+	Wet waste frozen until pick-up Bins provided for all other waste	Andrew	
14. Noise								
Does noise impact wildlife?	Yes	Yes	E	2	N	Regular maintenance on vehicles and plant	Trevor	
Does noise impact surrounding neighbours?	Yes	Yes	D	2	L-	PRF work with complainants to resolve issues	John/ Wayne	
Does the operation of vacuum pumps at pumping site affect recreational fishermen and tourists?	Yes	Yes	D	1	N	Water-lubricated vacuum pumps produce minimal noise	Trevor	
Do feeding operations affect staff and neighbours?	Yes	Yes	D	1	N	Feeding operations between 6am – 12am	Brad	
Do back-up generators affect neighbours?	Yes	Yes	E	1	N	Regular maintenance on generators No neighbours in the vicinity of operations	Trevor	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Does the operation of aeration affect neighbours?	No	No				Regular maintenance No neighbours in the vicinity of operations	Wayne	
Does the blower system at the Hatchery affect neighbours?	No	No				Regular maintenance on blower system No neighbours in the vicinity of operations	Bastein	
15. Dust								
Does dust from feeding operations affect neighbours?	Yes	Yes	C	1	L-	Ensure quality of feed is optimal and excessive fines/dust is reported	Brad	
Does dust from loading Agriculture Lime into Lime Spreader affect the surrounding environment?	Yes	Yes	D	1	N		Wayne/Brad	
Does dust from loading Hydrate Lime into Lime Spreader affect the surrounding environment?	Yes	Yes	D	1	N		Wayne/Brad	
16. Wastewater								
Is there a potential for excessive Volumes to be released?	Yes	Yes	D	3	L+	Low water exchange system adopted in ponds Volumes are managed through the Rubicon Tidal Gate located at W1	Pond Managers and Wayne	
Is there a potential for Water Quality to be affected?	Yes	Yes	B	3	M+	R&D currently underway to reduce the use of nitrogen based fertilisers Low water exchange system adopted in ponds to reduce nutrient and solid loads Water Quality monitored according Discharge Management Plan and EIMP Repair/Replace/Install Baffles in all settlement ponds (Need to research safer procedures for instalments and maintenance)	John, Brad, Matt, Pond Managers Wayne, Kristian	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
						Continue the use of sand filtration and Macro Algae production through MBD/JCU R&D		
Is the surrounding ecology of Flora and Fauna affected by operations?	**Yes**	**Yes**	**C**	**4**	**H-**	**PRF employ Gassman Development Perspectives to undertake Environmental Impact Monitoring according to the EIMP**	**Wayne/Kristian**	
Does Water pollution occur from Processing?	**Yes**	**Yes**	**C**	**2**	**L+**	**Strainers used in drains to catch solids** **Registered biodegradable chemicals used for cleaning and sanitation** **Rotating drum filter in treatment system** **All water bioremediated by settlement pond** **Water Quality monitored according Discharge Management Plan and EIMP**	**Andrew/Wayne**	
Does Wastewater from hatchery affect the surrounding environment?	**No**	**No**				**Evaporation pond used. No discharge**	**Bastein**	
17. Waste								
Is waste from feed bags controlled?	**Yes**	**Yes**	**B**	**3**	**M+**	**Bins emptied regularly** **PRF minimise feed bag rubbish by using bulk (1T) feed bags supplied by Ridley** **All feed bags are recycled**	**Wayne/Brad**	
Does Recycling Occur?	**Yes**	**No**				**Recycling Bins provided for paper/cardboard and metal** **All feed bags are recycled** **Increase number of recycling bins (2016)**	**Wayne**	
Is Waste Oil disposed of correctly	**Yes**	**Yes**	**C**	**3**	**M**	**Waste oil removed off-site by NQ resource recovery. Receipts of disposal kept**	**Wayne/Trevor**	
Are Batteries disposed of	**Yes**	**Yes**	**D**	**2**	**L-**	**Batteries removed off-site by NQ resource recovery or metal resource company.**	**Wayne/Trevor**	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
correctly?						Receipts of disposal kept		
Are Chemical Drums disposed of correctly?	Yes	Yes	C	3	M	Drum muster approved chemical drums sent to Burdekin shire council	Wayne/Trevor	
Is Contaminated Soil disposed according to the SDS?	Yes	Yes	D	2	L-	Contaminated soil contained and disposed of by NQ resource recovery SDS kept on company server and administration Receipts of disposal kept	Wayne/Trevor	
Are Oily Rags/Oil filters disposed of correctly?	Yes	Yes	D	2	L-	Contaminated oily rags and filters contained and disposed of by NQ resource recovery Receipts of disposal kept	Wayne/Trevor	
Is there an aim to Reduce Pond Sludge?	Yes	Yes	C	2	L+	R&D to trial Pro-biotics to help reduce pond sludge	John/Brad	
Is Pond Sludge disposed of/stored correctly?	Yes	Yes	C	2	L+	Pond Sludge is stored in DEHP approved areas on site Can be used as fill for erosion repair on site.	John/Brad	
18. Chemical Storage and Handling								
Is the Hazardous Substances Register Up-To-Date and accessible?	Yes	Yes	C	5	H+	Hazardous Substances Register updated annually and located on company server and administration	Wayne/Brad	
Are SDS's Up-To-Date and accessible?	Yes	Yes	C	5	H+	SDS's updated annually and are located with hazardous substances and on the company server	Wayne/Brad	
Are chemicals stored correctly to avoid spills and leaks?	Yes	Yes	C	5	H+	Chemicals stored in designated areas Chemicals stored on bunded pallets	Wayne/Brad	
Is there a potential for misuse for explosions of chemicals?	Yes	Yes	C	5	H+	SDS's updated annually and are located with hazardous substances and on the company server	Wayne/Brad	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
						Staff training and awareness		
Is chemical usage recorded?	**Yes**	**Yes**	**E**	**4**	**M-**	**Recorded on WQ pivot table**	**Wayne/Brad**	
Are gas cylinders secured?	**Yes**	**Yes**	**D**	**5**	**H-**	**Gas bottles chained up at workshop.**	**Trevor**	
19. Site								
Is the site appropriate for an aquaculture facility?	**Yes**	**Yes**	**D**	**3**	**L+**	**Site approved by government for aquaculture operations**	**John**	
Are pumping sites affecting Recreational Fishermen and Tourists? (Visually)	**Yes**	**Yes**	**E**	**1**	**N**		**John**	
20. Feed								
Is aquaculture feed stored to minimise pest infestations?	**Yes**	**Yes**	**B**	**1**	**L-**	**Ensure up to date and approved pest control is used to limit infestation of pests** **Do routine monthly inspections of bait stations (see log) and visual inspections for infestations** **Keep shed clean and tidy and free from other equipment and materials** **Clean up feed spills**	**Trevor, Brad, Wayne**	
Is there Potential water pollution from feeding operations?	**Yes**	**Yes**	**B**	**3**	**M+**	**Minimise feed wastage and Optimise FCR by correct feeding operations and management.** **Correct training and record in training matrix** **Use more efficient feeds to improve FCR's** **Ensure bioremediation techniques are optimised to comply with government regulations** **Monitor water quality according to**	**Brad/Wayne**	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
						Discharge Management Plan		
Is feed sourced sustainable?	**Yes**	**Yes**	**D**	**5**	**H-**	**Ridley no-catch diet used**	**Brad/John**	
Are FCR values optimised?	**Yes**	**Yes**	**A**	**3**	**H+**	**Feed consumptions managed throughout the entire crop using feed trays** **FCR's monitored weekly** **High spec feed used**	**Brad/John and all Managers**	
21. Aeration								
Is there a potential for aeration to have Oil spills and leaks?	**Yes**	**Yes**	**C**	**2**	**L+**	**Vacuum pump used to remove oil helps reduce oil spills. Waste oil transported in sealed oil drums and transferred into IBC** **Spill kits made available** **Training of all employees. Training recorded on training matrix** **Maintenance performed on concrete floor in aeration shed**	**Wayne**	
Is there correct Disposal of Decommissioned Units?	**Yes**	**Yes**	**B**	**1**	**L+**	**Designated storage area at aeration shed** **Aeration stripped for working parts and stored in aeration shed** **Broken and faulty parts are:** **Plastics – Identify recycling options** **Steel – sent to local metal waste recycler** **Used/old Oil – taken off site by NQ Resource Recovery (receipts kept on file)**	**Wayne**	
22. Transport								
Can a Failure occur when tying down loads which may cause danger to other road users?	**Yes**	**Yes**	**D**	**3**	**L+**	**Training and reporting of incidents** **Use approved tie down devices**	**Brad/Matt**	

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Do Contractors cause Fumes, Chemical Spills, Noise, Dust, Accidents and Translocation of Pest Species when visiting the site?	Yes	Yes	E	3	L-	Ensure contractor agreements are in place Ensure Visitor and Contractors sign in/out from site and follow company policies	Wayne/Brad	
Does staff transportation cause Fumes, Chemical Spills, Noise, Dust, Accidents?	Yes	Yes	B	1	L+	Training and reporting of incidents Speed limits in place Ensure regular maintenance is performed on vehicles (maintenance logs in place)	Wayne/Brad	
23. Storage and Handling of Fuels and Oils								
Is there potential for Leaks and Spills?	Yes	Yes	C	3	M	SDS's available Fuel stored in bunded areas with sumps to contain leaks and spills Bunded pallets for oil drums Spills kits available Training of staff	Trevor	
Is there potential for Fire and Explosion?	Yes	Yes	C	5	H+	Emergency evacuation plans in place Fire Extinguishers available and staff are trained in their correct use	Kylie	
24. Staff Facilities								
Is there potential for septic leakage and contamination of domestic water?	Yes	Yes	E	3	L-	Septic levels monitored Contractors employed to remove waste No. of staff per facility monitored	Wayne/John	
Is there potential for smoking to cause fire?	Yes	Yes	C	4	H-	Staff aware of designated areas Litter bins provided for butts	Brad/Wayne	
25. Fire								

Aspect	Yes/No	Impact	Risk Grading Criteria		Risk Rating Code	Action Planned and Time Frame	Person Responsible	Notes
			Likelihood	Impact				
Are grounds kept neat and tidy?	Yes	Yes	B	1	L+	Rubbish contained in bins Grass cut regular	Brad/Wayne	
26. Machinery, Vehicles and Plant								
Is regular servicing undertaken?	Yes	Yes	C	3	M	Service logs kept on all vehicles	Trevor	
Is there correct Disposal of decommissioned units?	Yes	Yes	B	1	L+	Oil is removed from decommissioned machinery Local contractors remove decommissioned units	Trevor	
27. Wild-Caught Broodstock								
Does taking wild stocks to use for commercial breeding affect wild populations?	Yes	Yes	D	5	H-	Translocation permits in place Domestication programme in place to reduce pressure on wild stocks	Bastein	

Pacific Reef Fisheries Risk Matrix

Table 1 Likelihood Scale

Code	Description	
A	Certain to Occur	Expected to occur in most circumstances. At least once every 3 months
B	Likely	Will probably occur in most circumstances. At least once ever 12 months
C	Possible	Might occur occasionally. At least once every 1-5 years
D	Unlikely	Could happen at some time. At least once ever 5-25 years
E	Rare	May happen only in exceptional circumstances. Less frequently than once in every 100 years

Table 2 Impact/ Consequence Categories

Code	1	2	3	4	5
Description	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Health and saftey	Minor injury or minor first aid injury	Medically treated injury and back on normal duties	Alternate work or lost time injury for less than 4 days	Serious or permanent injury. The injured person is absent from work for more than 4 working days	Grievous bodily injury/permanent disability/death. Likely safety prosecution
Environment	Technical issue involving regulations with no impact or localised impact requiring minimum clean up	Minor non-recurring issue typically with localised impact requiring clean up and no long term damage. Costs < $10,000	Recurring issue typically with localised impact with significant clean up and medium term damage with minimal loss of flora and fauna. Reportable to EHP. Costs $10,000 - $50,000	Significant issue typically with localised impact with sinficant clean up and long term damage with large loss of flora and fauna. Reportable to EHP. Possible prosecution, Total costs > $50,000	Regional impact and serious long term damage with major loss of flora and fauna. Reportable to EHP. Likely prosecution resulting in fines. Total costs > $50,000
Farm performance	Minor affect on growth and/or survival (potential losses less than $10,000/annum)	Minor affect on growth and/or survival (potential losses $10 000-$50 000 /annum)	Significant affect on growth and/or survival (potential losses $50 000-$250 000 /annum)	Major affect on growth and/or survival (potential losses greater than $250,000 /annum)	Catastrophic affect on growth and/or survival (potential to destroy the business)

Table 3 Risk Ranking Matrix

	Impact/ Consequence				
Likelihood	**1**	**2**	**3**	**4**	**5**
A	M-	M+	H+	E	E
B	L+	M+	M+	H+	E
C	L-	L+	M	H-	H+
D	N	L-	L+	M-	H-
E	N	N	L-	M-	M-

RISK	RANKING	DESCRIPTION
E	Extreme	Those risks that pose sufficent danger that the risk ranking must be reduced to below High before projects/activities can commence
H	High	Those risks that pose sufficent danger that plans must be in place to reduce the risk ranking below High before further commitments to proceed can be made
M	Medium	Those risks sufficent to require the activity to be managed in keeping with the cost to benefit ratio of remedial actions proposed.
L	Low	Those risks that are generally managed through monitoring the situation and addressing remedial actions as part of the normal management process
N	Negligible	Those managed as part of normal management process.

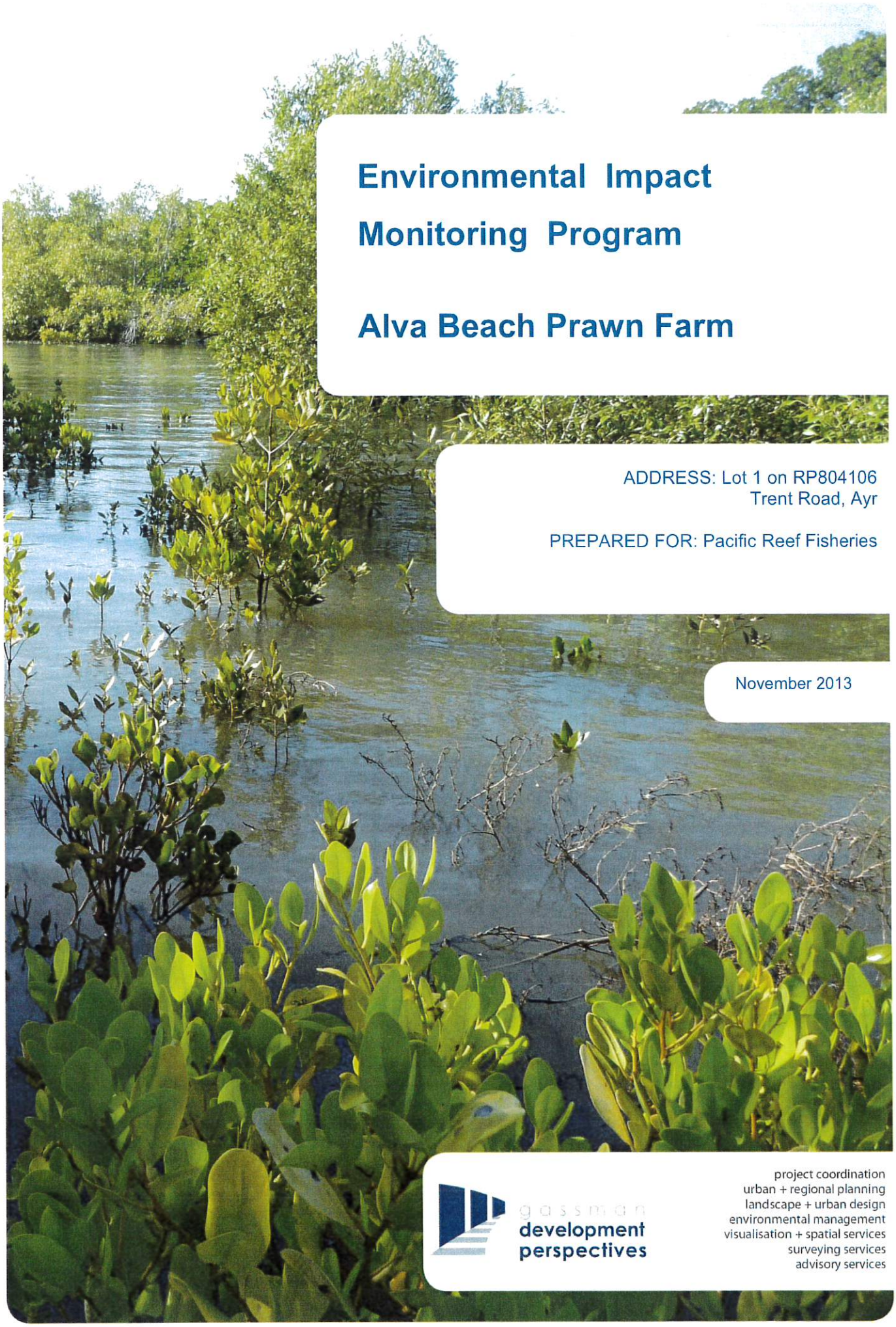
Table 4 Risk Responsibility/ownership

Risk Ranking	DESCRIPTION
Extreme	Detailed investigation (Department manager and 2 other management representatives) and development of a Risk Management Plan

	with approval from General Manager
High	Detailed investigation (Department manager and another management representative) and development of a Risk Management Plan with approval from General Manager
Medium	Must be addressed by Department Manager - Monitoring plan and Work Procedure Required
Low	Can be addressed by individual as part of Management procedures
Negligible	Can be addressed by individual as part of Management procedures

Table 5 Hierarchy of Control

Control	Description
1. Elimination	Eliminating the hazard by removing it completely or eliminating the need to perform the task. Should aim for this - and manage where this is not practical
2. Substitution	By switching to a less hazardous process, material, plant, tool or equipment
3. Engineering	By ensuring complete separation of the hazard from people or re-engineer by making changes to the process, equipment, plant, tool. Introduce safety devices, switches, guards, etc.
4. Administrative	By providing procedures, training, job rotation, scheduling, information, etc.
5. PPE	PPE provide personal protective equipment., boots, gloves, glasses, earplugs, respirators, etc.



Environmental Impact Monitoring Program

Alva Beach Prawn Farm

ADDRESS: Lot 1 on RP804106
Trent Road, Ayr

PREPARED FOR: Pacific Reef Fisheries

November 2013

gassman
development
perspectives

project coordination
urban + regional planning
landscape + urban design
environmental management
visualisation + spatial services
surveying services
advisory services

TABLE OF CONTENTS

1. Introduction

1.1. Background

Pacific Reef Fisheries (PRF) Alva Beach aquaculture facility is located at Lot 1, Trent Road, 15km east of Ayr, North Queensland. This facility has approvals allowing for the discharge of aquaculture waste to the surrounding environment. These approvals have been issued by the following governing authorities:

- Department of Environment and Heritage Proection (EHP) - Environmental Authority EPPR00864913
- Environment Australia (EA) - EPBC 2001/402

PRF consists of 98 hectares of grow-out ponds (Stages 1 to 5) for the production of Marine prawns *(Penaeus monodon)* (see Figure 1). In addition, the facility has a hatchery, processing facilities, 10.3 hectares of settlement-treatment ponds and a total of approximately 20 hectares of wetland areas intended to reduce contaminants in the aquaculture waste prior to release into the receiving environment. Treated aquaculture waste is discharged into Little Alva Creek. Little Alva Creek is a well flushed tidal estuary with seasonal freshwater influences. The catchment of Little Alva Creek is subject to agricultural use, primarily sugarcane production, which has the capacity as a potential source of nutrients and suspended sediments in runoff events. Aquaculture discharge is discharged through a point located approximately 600m from the mouth of Little Alva Creek. Intake water for PRF is sourced from Kalamia Creek, on the southern boundary of the property.

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Issue	Date	Description	SJH	BRQ
-	04-12-13	ORIGINAL ISSUE	DRN	CHK

Project: Trent Road, Alva Beach
Lot 1 on RP804106

Client: Pacific Reef Fisheries

NOTE
The details of this plan have been prepared based on the most current Digital Cadastral Data Base (DCDB) information available from Queensland Department of Environment and Resource Management and is subject to survey.

N

Scale at A3: -
Date: 04-12-13
Design: MDS
Drawn: SJH
Checked: MDS

Drawing Title:
FIGURE 1
Site Location Plan

Drawing No: FIGURE 1
Revision No: -

2. Purpose of Monitoring

The EHP authority and EA permit all contain conditions for water quality compliance and environmental impact monitoring programs to confirm that the receiving environment is not being adversely impacted by the release of aquaculture waste.

This Environmental Impact Monitoring Program (EIMP) has been developed to focus on potential impacts that may occur as a result of the discharge of aquaculture waste to the receiving environment. Of particular concern are the following potential impacts:

- Eutrophication of estuarine and near shore ecosystems;
- Changes to estuarine and near shore ecosystem function due to physical alterations in hydrological regimes; and
- Potential loss of coastal habitat for migratory species.

The purpose of the monitoring program is to detect any measurable environmental effects of the discharge through water column concentration changes and the use of biological indicator organisms. The program aims to assess whether the effluent is assimilated and dissipated within the nominated mixing zone.

2.1. Methods of Minimisation of Impacts

In accordance with Department of Environment Permit number 2001/402, aquaculture waste will only be released during the ebbing tide and only via discharge point W1. Monitoring of this discharge will ensure that discharge limits and parameters will comply with the Department of Environment Permit in addition to those prescribed in the EHP and GBRMPA permits.

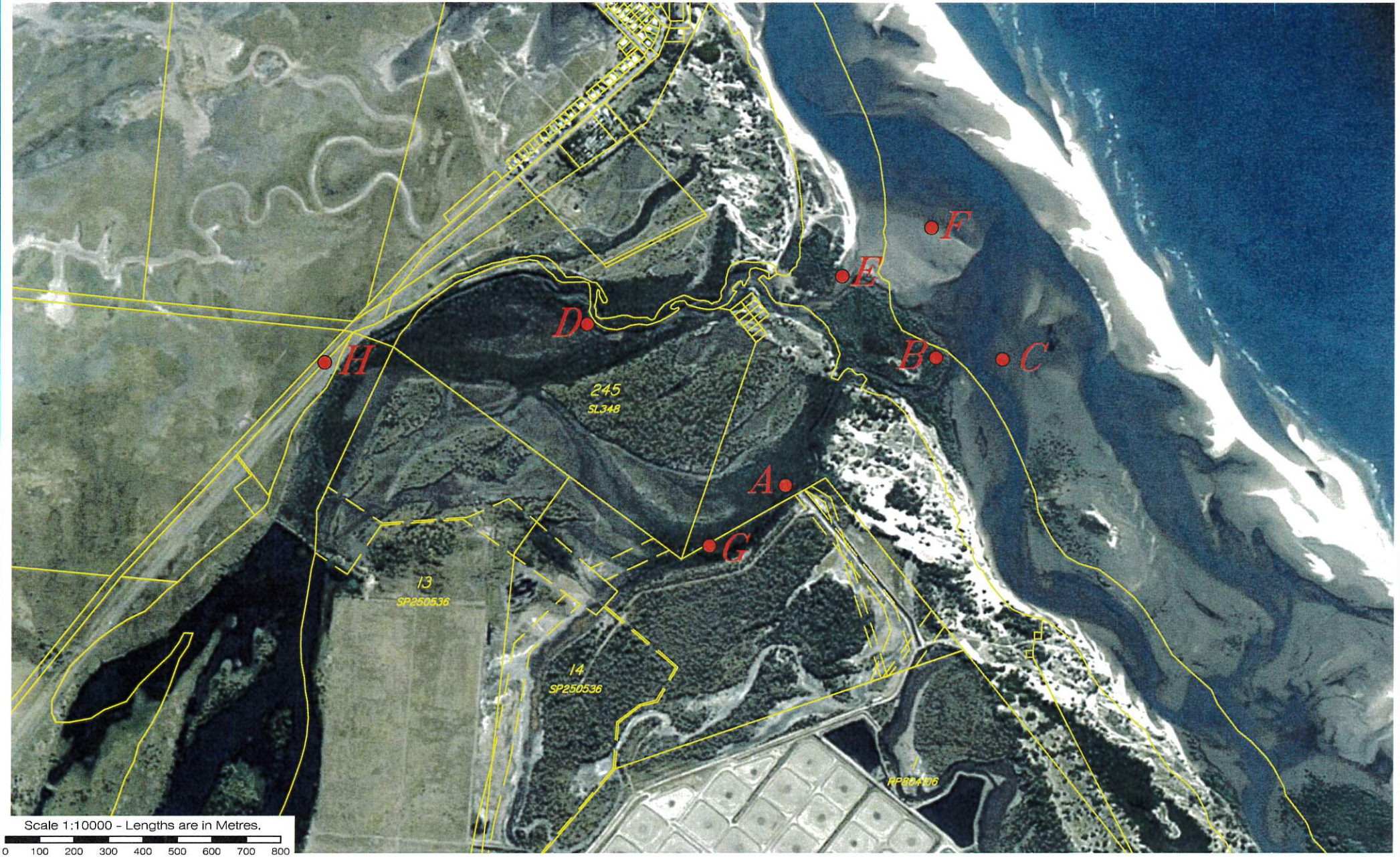
A discharge limit of 60ML per day will be complied with except during 1 in 5 Average Recurrence Interval (ARI) events where it may be exceeded.

3. Experimental Design

Little Alva Creek is a small coastal creek system. The catchment is dominated by sugarcane agriculture and numerous man made agricultural drains discharge into this system. During most of the year, Little Alva Creek is almost completely dominated by tidal flows with typical salinities above 33ppt. During periods of high rainfall, the system experiences freshwater runoff and much of the surrounding sugarcane growing area can become inundated by floodwaters. This can create additional impacts on the coastal creek environments as significant freshwater runoff can introduce large quantities of suspended sediments and nutrients to the estuarine system. Due to the location of the discharge point and the relatively small size of Little Alva Creek, it has been determined that Alva Creek, approximately 1 km to the north of Little Alva Creek, will be used as the reference creek (See Figure 2). This reference creek has been chosen as it fulfils the following criteria in comparison to the impact sites:

- Similar geomorphology
- Similar land-use on adjacent sub-catchment
- Similar mangrove communities; and is
- Located outside of the influence of the impact to be monitored.

The relatively small size and the geomorphology of Little Alva Creek has resulted in impact monitoring sites being chosen between the discharge point and the mouth of the creek (except for mangrove health monitoring). Reference sites in Alva Creek will correspond to those in Little Alva Creek. All sampling procedures for the collection and analysis of water quality and sediment monitoring will be carried out in accordance with methods described in the *Queensland Environmental Protection Agency Water Quality Sampling Manual, 2009* or more recent editions as they become available. Furthermore, this sampling must also conform to conditions specified in the EHP Authority (EPPR00864913) and EA permit (EPBC 2001/402). All sampling may be undertaken by staff of PRF, providing they have suitable qualifications and experience to perform the particular measurements.



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Rev	Date	Description	Init.	Chkd
Draft	06-12-13	ORIGINAL ISSUE	SJH	MDS

Project: Trent Road, Alva Beach
Lot 1 on RP804106

Client: Pacific Reef Fisheries

NOTE:
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Scale at A3:	1:10,000
Date:	22-01-14
Design:	MDS
Drawn:	SJH
Checked:	MDS

Drawing Title:
Figure 2
EIMP sampling locations

Drawing No: FIGURE2
Revision No:

3.1. Sampling Locations

Impact monitoring sampling locations are as follows:

A. Discharge point into Little Alva Creek
B. 500m downstream in Little Alva Creek
C. 250m north of mouth of Little Alva Creek
D. Location in reference creek (Alva Creek), corresponding to A
E. Location in reference creek (Alva Creek), corresponding to B
F. 250m north of mouth of reference creek
G. 500m upstream of discharge point in Alva Creek
H. Location in reference creek (Alva Creek), corresponding to G M1, M2, M3, M4 Discharge points immediately before discharge into sedimentation basin.

Regular water quality monitoring also occurs in Kalamia Creek, although this is not required by statutory authorities.

Figure 2 outlines the approximate positions of the impact monitoring sampling locations required as part of the EIMP.

3.2. Water Quality Monitoring

The proposed water quality monitoring contained within this EIMP will confirm compliance with the permit conditions of all agencies at the discharge location and monitor whether modifications to the physical and chemical conditions of the receiving waters have occurred at the boundary of the mixing zone (i.e. 500m downstream).

3.2.1. Frequency and Parameters of Monitoring

The following parameters will be monitored at location W1 only (the release point) at the following frequencies in accordance with EHP environmental authority EPPR00864913:

Parameter	Location	Frequency
Dissolved Oxygen,	W1, M1, M2, M3,	Daily on discharge days

Parameter	Location	Frequency
Turbidity, pH, Temp	M4	
Total Ammonia	W1, M1, M2, M3, M4	Weekly
Dissolved Oxygen, Turbidity, pH, Temp	A, B, D, E	Monthly
Total Nitrogen, Total Phosphorous, Total Suspended Solids, Chlorophyll *a*	W1	Monthly
Total Nitrogen, Total Phosphorous, Total Suspended Solids	A, B, D, E	Monthly
Total Suspended Solids	W1	During the high, ebbing and low tides. Combined into one composite sample.
Turbidity	W1	During the high, ebbing and low tides. Combined into one composite sample.

3.2.2. Sampling Procedure

In accordance with EA licence condition 19, each sample collected is to be immediately frozen and stored at -20°C or below in an air tight container free from contamination by any organic matter. The samples are to be clearly labelled and kept continually frozen until September of the same year, and upon request made available for analysis of total nitrogen.

For Total Nitrogen, Total Phosphorous and Total Suspended Solids, three Composite Samples are to be collected on one day within each month in which discharge occurs; and three Composite Samples are to be collected on each of an additional three days during each Harvest Period.

The monthly sampling must occur at a during the ebbing tide. Sampling must also occur during the discharge cycle.

Ideally, the sampling in the discharge and the control creek should occur on the same day. If this is operationally impossible, sampling must be carried out on two successive days.

At location A, M1, M2, M3, M4, single water samples will be collected. At locations A, B, D and E, three samples will be combined into one composite sample the sampling will be from across the cross-section of the creek.

Locations A, B, D, E, M1, M2, M3, and M4 must be permanent sites, to be located by GPS positions. In addition, positions have to be supported by natural landmarks or markers on the creek banks. Maintenance and calibration records of the equipment used, such as automated and handheld meters, have to be provided as part of the monitoring report.

Samples from sites A, B, D and E will be submitted to EHP with the EIMP report on an annual basis.

These records are to be kept on file for a minimum of 8 years to be made available for inspection, to show that the appropriate calibrations have been conducted.

3.3. Mangrove Health Monitoring

Mangrove ecosystem health data will be utilised to provide an integrated ecosystem approach to assess whether any measurable short and/or long-term biological impacts on the receiving environment have occurred, that may be associated with the discharge of aquaculture waste from the facility.

3.3.1. Sampling Procedure

At each location A, B, D, E, G and H, permanent quadrats (400m^2) will be established. Each 20m x 20m quadrat will start at the water extent of the mangrove edge and extend back into the mangrove stands. At each location, the following parameters will be measured:

- Species composition;
- Canopy cover;
- Canopy height;
- Density of mature trees (i.e. over 3m, of each species); and
- Density of saplings and small trees (i.e. less than 3m, of each species).

In addition;

- Three permanent photographic reference points will be established at each location.

3.3.2. Frequency of Sampling

Biannually in spring and autumn for the first two years to allow for consideration of seasonal influences. Following this, frequency will revert back to annually for two years and then biennially after this time.

3.4. Sediment Monitoring

Sediment biogeochemistry parameters are used to assess whether measurable medium to long-term modifications to the physical and chemical conditions of the receiving waters have occurred at the boundary of the mixing zone (500m downstream) and at the mouth of the discharge creek.

Community composition of sediment macro-invertebrates will be utilised to provide an integrated ecosystem approach to assess whether any measurable medium to long-term biological impacts on the receiving environment have occurred , that may be associated with the discharge of aquaculture waste from the facility.

3.4.1. Parameters

The following parameters will be monitored in sediments at locations B, C, E, F:

- Total organic carbon;
- Grainsize distribution;
- Species composition of macro-invertebrates; and
- Abundance of macro-invertebrates.

Locations B, C, E, and F must be permanent sites, located by GPS positions. In addition, positions have to be supported by natural landmarks or markers on shore.

3.4.2. Frequency of Sampling

Annually in spring.

3.4.3. Sampling Procedure

At the specified sampling locations three replicate sediment samples will be collected from the creek bed either by hand if the tide allows access, or using a Van Veen Grab or similar device. The sampling will be replicated spatially across the cross-section of the creek/mouth of the creek i.e. one core approximately in the middle of the creek and two cores further towards either creek bank.

The grab sites must be located in depositional areas at each sampling location.

For each location, all three sediment samples (taken from the cross section of the creek) are to be analysed.

3.5. Sediment Monitoring

Sediment of each sample core will be analysed by a NATA approved laboratory for the required parameters.

3.5.1. Sampling Procedure

Data derived from each field monitoring program will be graphed using an appropriate program. Graphs for each parameter will be presented side by side within the report for the purposes of visually assessing differences in the graphed curves for each parameter. An average value will be calculated from the three replicate samples taken at each site for the point to be graphed.

3.6. Macroinvertebrates

At the specified sampling locations three replicate sediment samples will be collected. Sediments should be sampled to a depth that allows for the collection of both epibenthos and in-benthos. The sediment will be sieved through a 1 mm screen. All infauna collected on this screen will be collected and sorted to the highest taxonomic level possible by a suitably experienced and qualified organisation. For taxa that are not sufficiently described, a higher order taxonomic identification (Family, order, class) will be adequate.

3.6.1. Sampling Procedure

Macroinvertebrate data including abundance and diversity of taxa observed will be recorded and compared between the discharge creek and the reference creek. Where large differences in abundance and diversity of taxa are observed between the two creeks, further investigation will be undertaken to determine the likely cause of the differences between sites.

4. Summary of EIMP Requirements

Parameter	Location	Frequency
Dissolved Oxygen, Turbidity, pH, Temp	W1, M1, M2, M3, M4	Daily on discharge days
Total Ammonia	W1, M1, M2, M3, M4	Weekly
Dissolved Oxygen, Turbidity, pH, Temp	A, B, D, E	Monthly
Total Nitrogen, Total Phosphorous, Total Suspended Solids, Chlorophyll *a*	W1	Monthly
Total Nitrogen, Total Phosphorous, Total Suspended Solids	A, B, D, E	Monthly
Total Suspended Solids	W1	During the first, last and median hour of draining during harvest for three harvests per year
Mangrove Health	A, B, D , E, G, H	Biannually for first two years reverting back to annually for two years, then biennially ongoing.
Sediment biogeochemistry, and macroinvertebrates	B, C, E, F	Annually

N.B. DO = dissolved oxygen , Turb = turbidity, Sal = salinity, Temp =temperature, TN = total nitrogen, TP = total phosphorus and TSS = total suspended solids

5. Reporting Requirements

In accordance with Department of Environment Permit number EPBC 2001/402, PRF will submit a report each year on 1 July which summarises the following:

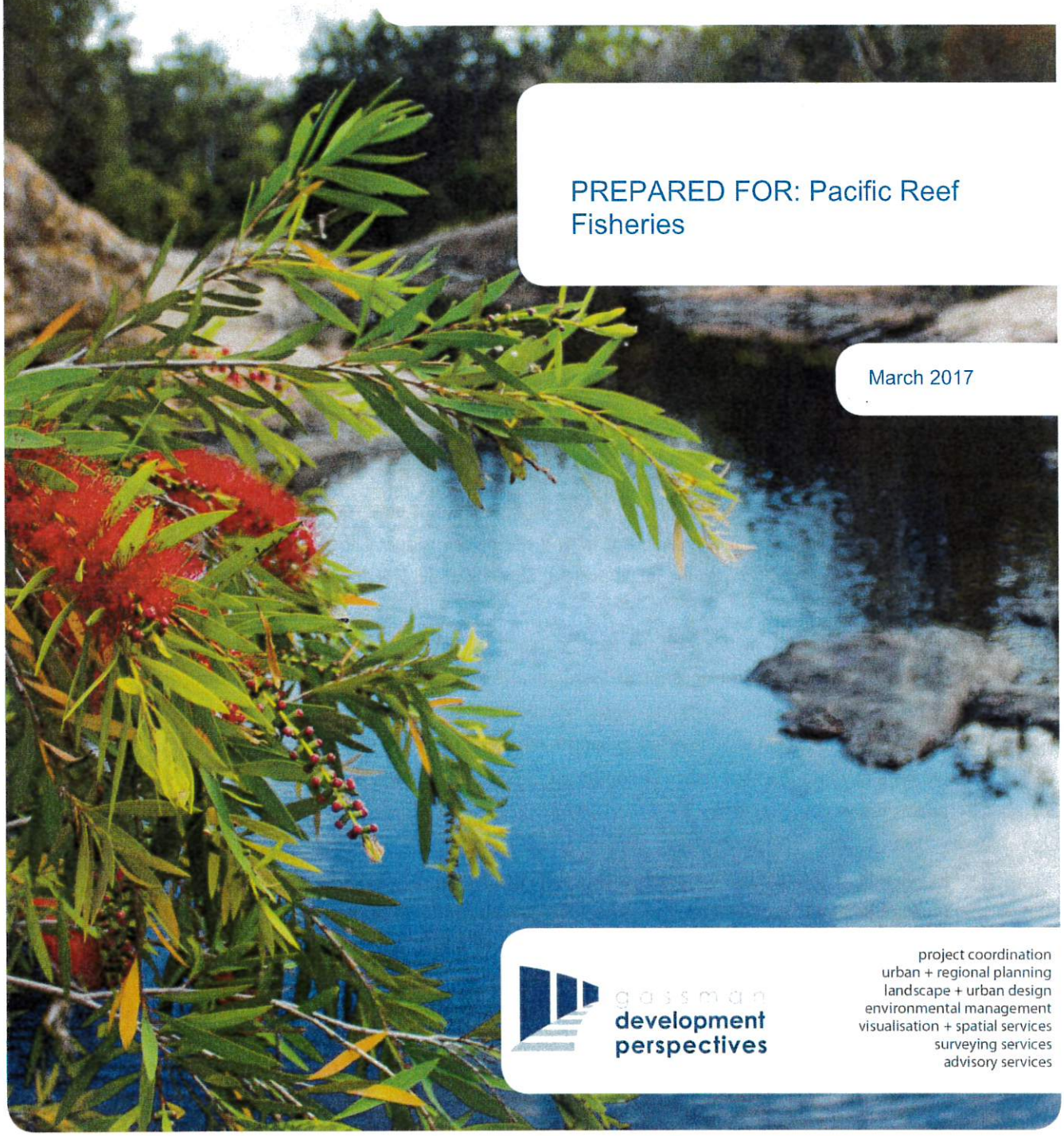
a. The total volume of Aquaculture Waste discharged from the aquaculture facility daily and in the year;
b. Discharge volumes which exceed the daily limit of 60ML for reasons allowable under the licence;
c. Results of the discharge and sediment monitoring as required in the licence;
d. The results of monitoring under this EIMP;
e. Any contraventions of these conditions of approval; and
f. Details of disease outbreaks, incidents of escape farmed stock from the aquaculture facility, monitoring of possible impacts of disease on Little Alva Creek and the Great Barrier Reef attributable to farm operations.

If the data collected for the EIMP over a three year period reflects no measurable impacts resulting from aquaculture activities, the frequency of sampling will be reviewed and reduced if deemed appropriate.

MANGROVE OFFSETS REVIEW

ADDRESS: Lot 1, Trent Road, Alva Beach

LOT 1 ON RP804106



PREPARED FOR: Pacific Reef Fisheries

March 2017

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project coordination
urban + regional planning
landscape + urban design
environmental management
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surveying services
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GDP Document Control

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Revision / Checking History

No.	Author	Reviewer
1. V1.0	Mark Spears	Brian Gassman

Approval for Issue

Version	Name	Position	Signature	Date
V2.0	Brian Gassman	Director		26th March, 2017

Final Distribution

Pacific Reef Fisheries	1 electronic copy

TABLE OF CONTENTS

1. Introduction

1.1. Background

Mangrove Offsets Review has been prepared in response to the ASC Shrimp Standard requirement outlined in point 2.2.2 which states:

Criterion 2.2: Conservation of protected areas or critical habitats

2.2.2. Allowance for siting in mangrove ecosystems and other natural wetlands, or areas of ecological importance as determined by the B-EIA or national/state/local authority plans/list.	None for farms built (with or without permits) after May 1999, except for pumping stations and inlet/outlet canals provided they have been permitted by authorities and an equivalent area is rehabilitated as compensation. For farms built or permitted before May 1999, farmers are required to compensate/offset impacts via rehabilitation as determined by the B-EIA, or the national/state/local authority plans/list, or 50% of the affected ecosystem (whichever is greater).

This Review seeks to outline measures which have been undertaken by Pacific Reef Fisheries since they took control of the subject land at Lot 1, Trent Road, Alva Beach in 1998 with respect to the compensation for and offset of impacts to mangrove ecosystems.

2. Pre-development Conditions

Whilst little data is available with respect to the conditions of the site prior to initial construction of the first stages of the farm, detailed ecological reporting was undertaken by SKM in 2000 which is two (2) years following the acquisition of the site by Pacific Reef Fisheries. Consequently, this data is considered to be a reliable indicator of site conditions in 1998 when Pacific Reef Fisheries acquired the site.

An assessment of vegetation type of Stage V of the farm in an Initial Advice Statement prepared by SKM in May, 2000 indicated that the vegetation proposed to be impacted by that expansion was largely represented by permanent freshwater vegetation, some aquatic vegetation and areas of bare ground in addition to a small amount of salt tolerant vegetation (Figure 1).

The SKM (2000) report indicates that the site was initially dominated by exotic rubber vine and chinee apple. These weed infested areas were cleared and made way for bare ground. Some Pandanus and Melaleuca were observed in addition to 2-3 individual *Avicennia marina*, *Excoecaria agallocha* and *Lumnitzera* sp. (20 individuals for each of these species). No significant mangrove stands were observed or reported.

Aerial photography of the pre-development Stages III and IV of the farm appears to indicate that the vegetation types which occurred in those areas are consistent with that described above for Stage 5.

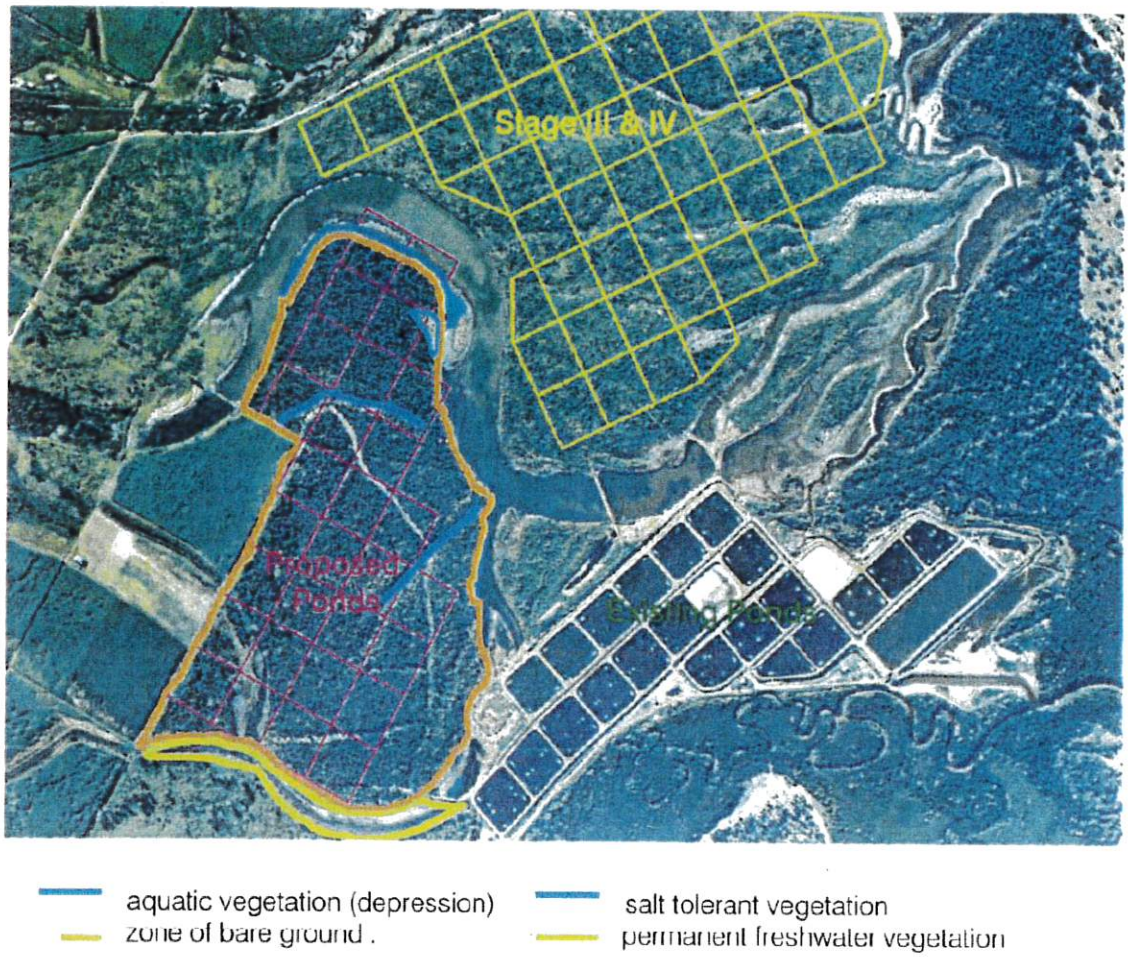


Figure 1 – Vegetation Communities relating to Stage V (SKM, May 2000).

3. Development Impacts on Mangroves

Works associated with Stage V assessed a total impact of fewer than 50 individual mangrove species, as outlined in the previous section. Whilst detailed reporting for Stages III and IV is not available, aerial photography and anecdotal information sought in relation to pre-development conditions indicate that vegetation removed as part of Stages II and IV was very likely to be consistent with the vegetation assessed as part of Stage V.

To this end, it is assumed that up to an additional 100 individual mangroves may have been removed to facilitate Stages III and IV. Stages I and II were already existing prior to the acquisition of the site by Pacific Reef Fisheries, so no assumptions have been made about the pre-clearing conditions of these areas.

Consequently, it is assumed that up to approximately **150 individual mangroves** were likely impacted upon by the current footprint of the Pacific Reef Fisheries aquaculture facility.

4. Mangrove Restoration Measures

4.1. Rehabilitation undertaken

Since the development of the Pacific Reef Fisheries facility, significant rehabilitation of previously unvegetated areas has been facilitated. These areas total approximately 20.75 ha. A comparison of aerial photography between 1998 and 2016 is provided in Appendix 1 indicating the extent of previously unvegetated areas which have now been rehabilitated.

Previous reporting undertaken by Gassman Development Perspectives in May, 2016 made a detailed assessment of the total mangroves found to be growing in these previously unvegetated areas. This reporting can be found in Appendix 2 to this report.

This reporting found that at an average total density of 5,323 stems per hectare. Consequently, rehabilitation measures have resulted in a gain of approximately **110,465 stems**.

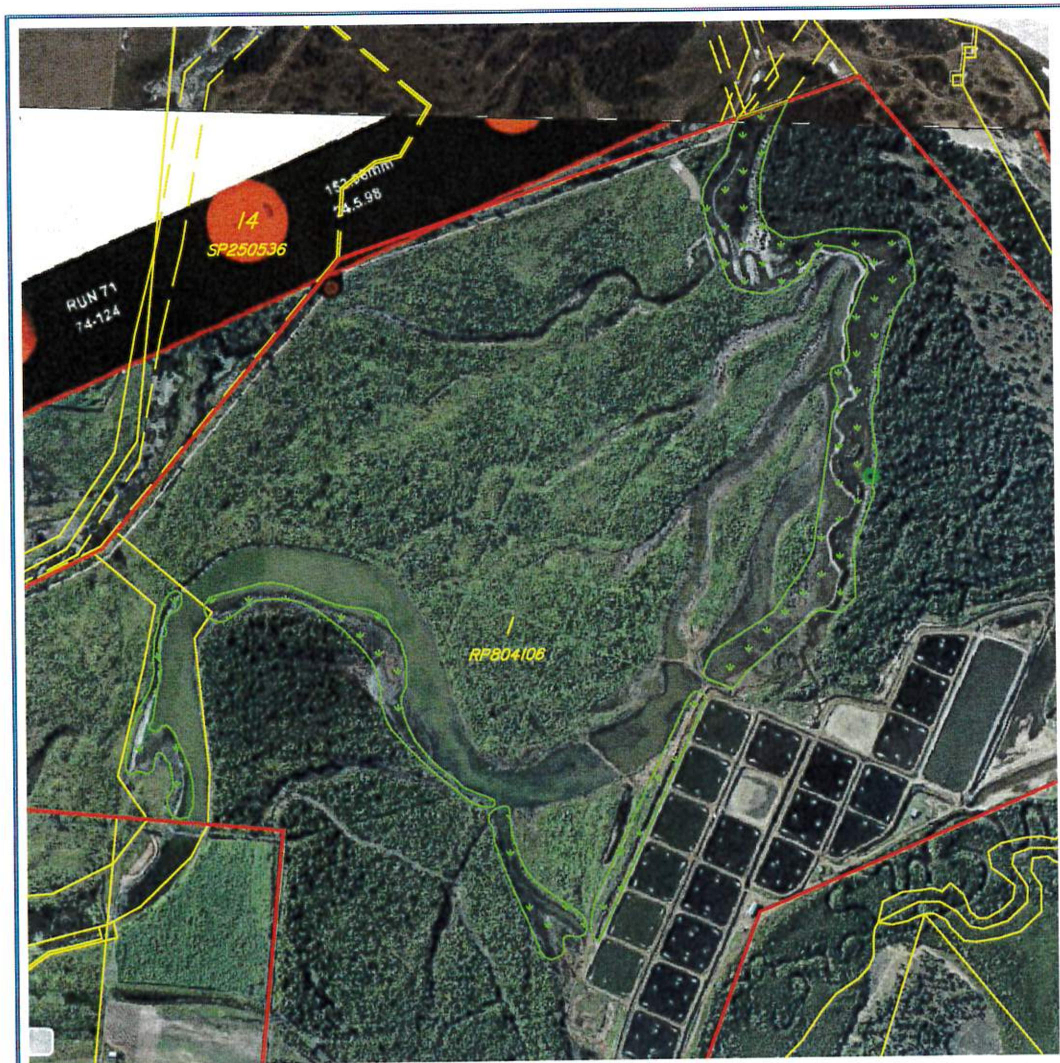
In comparison with the estimated 150 mangrove stems removed as part of construction, this net gain is considered to adequately compensate the relatively small numbers of mangroves impacted.

5. Conclusion

This Mangrove Offsets Review has included an investigation into the pre-development ecological conditions of the subject site. The purpose of this review is to estimate the number of mangroves which are likely to have been removed as part of the development of the site, and compare against the number of mangroves estimated to have been regenerated since development.

The site was found to have facilitated over 20ha of regenerated mangroves, in contrast with the estimated 150 individual mangrove stems removed as part of the development. This was a result of the selected site being heavily modified prior to being acquired by Pacific Reef Fisheries. Consequently, it is considered that the natural regeneration of mangrove areas significantly outweighs the relatively small number of mangroves originally removed.

Appendix 1 – Aerial Photograph Comparison



1998 – BEFORE MANGROVE REHABILITATION
SCALE: 1:10,000 @ A3

LEGEND

LOT BOUNDARY

AREA OF MANGROVE REHABILITATION
(20.75 Ha TOTAL)

2017 – AFTER MANGROVE REHABILITATION
SCALE: 1:10,000 @ A3

LEGEND

LOT BOUNDARY

AREA OF MANGROVES
(20.75 Ha TOTAL)

Scale 1:10000 - Lengths are in Metres.
0 100 200 300 400 500 600 700 800

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Issue	Date	Description	Drn	Chk
	28-03-17	ORIGINAL ISSUE	RGM	MDS

Project: Trent Road, Alva Beach
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Client: Pacific Reef Fisheries

Scale at A3: 1:10,000
Date: 28-03-17
Design: MDS
Drawn: RGM
Checked: MDS

Drawing Title: MANGROVE REHABILITATION COMPARISON

Drawing No: 4541 E RB MRC 00

Revision No:

Appendix 2 – Mangrove Biomass Report

Study of mangrove biomass at Pacific Reef Fisheries Prawn Farm: Alva, Queensland.

Mark Spears, Gassman Development Perspectives. May 2016.

Introduction

Gassman Development Perspectives (GDP) was commissioned by Pacific Reef Fisheries to undertake a broad scale assessment of the approximate total biomass of mangroves present on the Pacific Reef Fisheries Alva prawn farm located at Lot 1, Trent Road, Alva (Figure 1). The purpose of this assessment was to continue to collect data on the biomass of mangroves present on the farm to continue to track the changes in approximate mangrove biomass present on the farm.

The mangrove communities present on the land occupied by the farm have been artificially established and form part of the Pacific Reef Fisheries discharge water treatment system. Prior to the construction and operation of the aquaculture facility, the mangrove cover on the subject land was minimal.

Methodology

The same four (4) mangrove areas were investigated as last monitoring occasion for consistency. These areas were considered to represent a robust cross section of different mangrove communities present on the subject site. The locations of these study areas are represented in Figure 2. At each location, a permanent quadrat was established of an appropriate size considered the surrounding waterways and infrastructure. The dimensions of each quadrat are outlined in Table 1 below.

Table 1 – Size and dimensions of sample quadrats

Quadrat Number	Quadrat Size
1	11x20m = 220m2
2	8x40m = 320m2
3	20x20m = 400m2
4	60x5m = 300m2

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Project: Trent Road, Alva Beach
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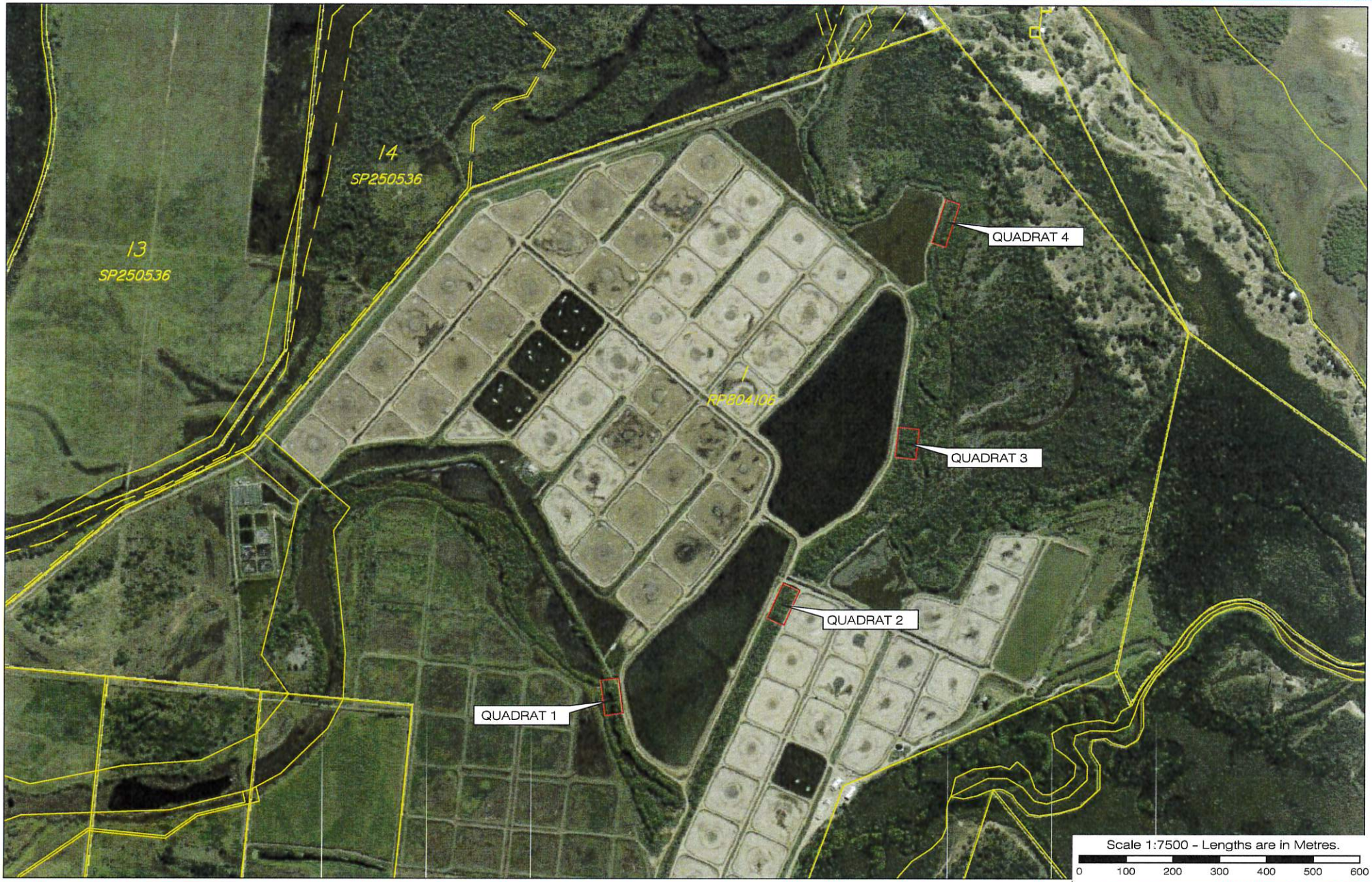
Scale at A3: -
Date: 05-05-14
Design: MDS
Drawn: SJH
Checked: MDS

Drawing Title:
Figure 1
Aerial Map

Drawing No: FIGURE1
Revision No:



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A	05-05-14	ORIGINAL ISSUE	SJH	MDS

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Date:	05-05-14
Design:	MDS
Drawn:	SJH
Checked:	MDS

Drawing Title:
Figure 2
Location of Study Quadrats

Drawing No: FIGURE2
Revision No:

The same quadrats utilised for the baseline survey were examined on this occasion. A GPS location was taken at each of the quadrats. At each location, all mangroves present were identified to species level and individual trees counted. Counts were divided into trees over 4m in height and trees under 4m in height. The dominant canopy height was also recorded. Photographs taken at each quadrat is included in Appendix 1.

This study was only commissioned at a broad scale and as a result, specific measurements such as diameter at breast height (DBH), individual tree heights and wood biomass were not collected. The basis of estimating the average biomass of individual trees was calculated using data collected by Fromer et al. (1998) whose study investigated aboveground biomass of mangrove genera which were comparable to those present on the Pacific Reef Fisheries property.

The site based survey determined that the majority of trees over 3m in height displayed a DBH of between 13 to 16cm. Trees under 3m in height generally displayed a DBH of between 3 to 5cm. Consequently, the biomass of trees of these sizes as quantified by Fromer et al. (1998) were used as the basis for the estimation of biomass at Pacific Reef Fisheries.

Results

The results of each of the four quadrats sampled are included below in Table 2. Stem counts for each quadrat were undertaken for trees over and under 3m in height, and the density calculated on a per hectare basis.

Table 2 – Results of quadrat data

Quadrat	Area of quadrat surveyed	Species Present	Canopy height	Number trees over 3m	Density of trees over 3m	Number of trees under 3m	Density of trees under 3m
1	220m^2	*Avicennia marina*	5m	44	2000/ha	84	3818/ha
2	320m^2	*Avicennia marina, Exocoeria agallocha*	6m-8m	40	1250/ha	34	1063/ha
3	400m^2	*Avicennia marina, Aegilitis annulata*	7m	62	1550.5/ha	64	1600/ha
4	300m^2	*Avicennia marina, Rhizophora stylosa, Ceriops sp., Aegilitis annulata*	6m	85	2833/ha	183	6100/ha
Average					**1908.375/ha**		**3415.25/ha**

According to Fromer et al. (1998), the aboveground biomass weight of mangroves in their study for *Avicennia* mangroves which measured 13cm in DBH was 71.8kg and 15.5cm was 87.6kg. An average figure of these two biomass weights was calculated to be 79.7kg. As the majority of mangroves over 3m in height ranged between these DBH values, this average weight reported by Fromer et al. (1998) is used as the basis for calculating mangrove biomass at Pacific Reef Fisheries.

Also according to Fromer et al. (1998), the aboveground biomass weight of *Avicennia* mangroves in their study which measured 3.5cm and 4.5cm DBH weighed 2.8kg and 5.7kg respectively. The average weight between these two values of 4.25kg has been utilised as the value for trees under 3m in height.

Consequently, the average mangrove biomass per hectare was calculated using these values and the average stem count for trees over and under 3m in height across all four (4) quadrat sites. The results are outlined in Table 3 below.

Table 3 – Calculation of total biomass of mangroves per hectare

	Average weight of tree	Stems per hectare	Total biomass per hectare
Trees over 3m	79.7kg	1908.375	152.10 t/ha
Trees under 3m	4.25kg	3415.25	13.37 t/ha
			165.47 t/ha

This biomass of 165.47 t/ha is comparable to the findings of Fromer et al. (1998) who reported two (2) stands of mature coastal mangroves in French Guiana as containing 180 t/ha and 315 t/ha respectively. It has also not varied significantly with only a 2.32t difference from the baseline result of 168.13 t/ha taken a year earlier, although it continues a slight downward trend from initial surveys in 2014 which recorded 170.45 t/ha.

This average biomass for mangroves found on the Pacific Reef Fisheries farm was then multiplied by the number of hectares of mangroves present on the subject site.

A total of 23.37 hectares of mangroves were found to be occurring on the Pacific Reef Fisheries farm site (Figure 3). A total of 3867.03 tonnes of mangrove biomass was estimated to currently

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Area of Mangroves
23.37Ha Total

Scale 1: 12,500 – Lenghts are in Metres

0 100 200 300 400 500 600 700 800 900 1000

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Client: Pacific Reef Fisheries

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Date:	12-05-14
Design:	MDS
Drawn:	SJH
Checked:	MDS

Drawing Title:
Figure 3
Area of Mangroves

Drawing No: FIGURE3

Revision No:

occur on the Pacific Reef Fisheries farm site (Table 4) in contrast to 3983.42 tonnes of mangrove biomass estimated to be occur in April 2014 and 3929.20 tonnes in April 2015 (Table 5). Acorss all sites, trees over 3m in height had either remained constant or slightly reduced and trees under 3m in height had increased at Quadrats 1 and 3, and decreased at Quadrats 2 and 4. This represents a total reduction in biomass of only 1.53% from last year's results which is considered to be negligible.

Table 4 – Total biomass of mangroves for Pacific Reef Fisheries Farm

Total biomass per hectare	Total hectares of mangroves	Total biomass for entire farm
165.47 t/ha	23.37 ha	**3867.03 tonnes**

Table 5 – Total biomass of mangroves for Pacific Reef Fisheries Farm (baseline results, April 2014, April 2015)

Year	Total biomass per hectare	Total hectares of mangroves	Total biomass for entire farm
2014	170.45 t/ha	23.37 ha	**3983.42 tonnes**
2015	168.13 t/ha	23.37 ha	**3929.20 tonnes**

Conclusion

This study has estimated the approximate biomass of mangroves present on the Pacific Reef Fisheries site. This information is important to monitor changes in mangrove biomass which may in turn impact upon the rates of uptake of nitrogen, phosphorous and other elements over time.

In consideration of the minimal mangrove biomass previously present on the subject land prior to the construction and operation of the aquaculture farming activities, the establishment and maintenance of approximately 3929.20 tonnes of mangrove biomass is considered to be a

substantial improvement in the environmental condition of the marine habitat surrounding this locality.

Additionally, the minimal reduction of 1.53% in biomass is likely to indicate that with the exception of natural variations, no significant or sudden changes in biomass were observed or could cause any potential concerns.

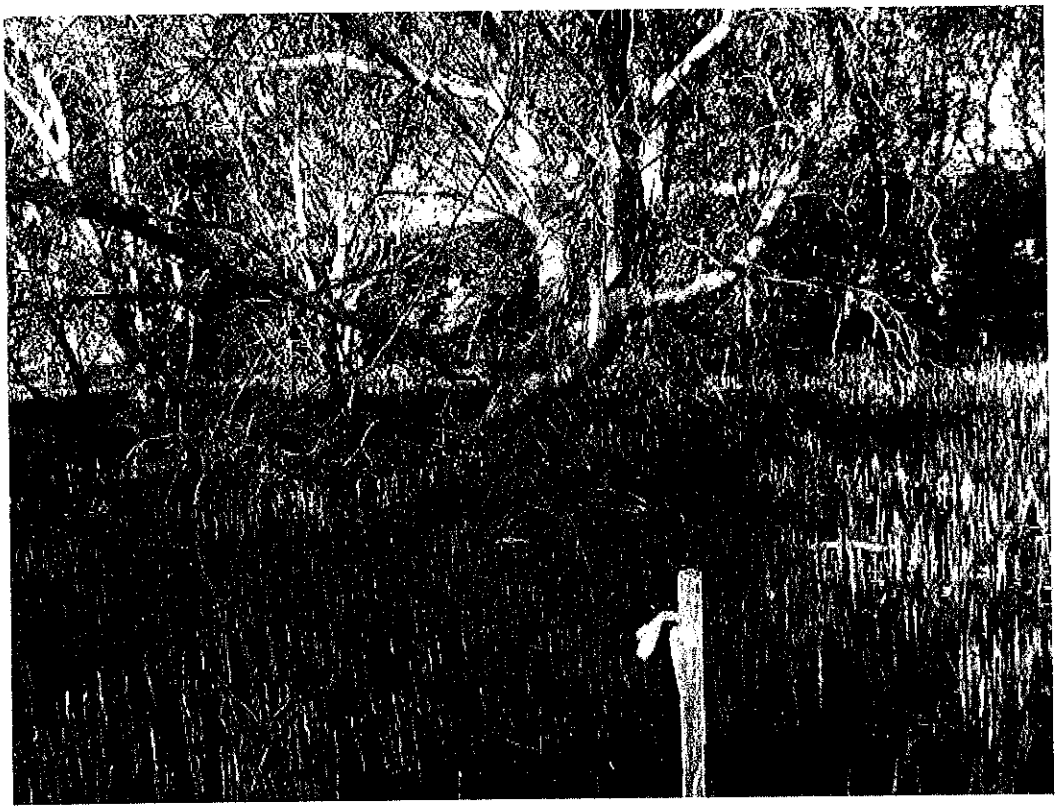
It is recommended that monitoring of mangrove biomass utilising the permanent quadrats established on this initial baseline monitoring occasion occur every year to ensure the ongoing health and viability of mangroves is maintained within the farm site.

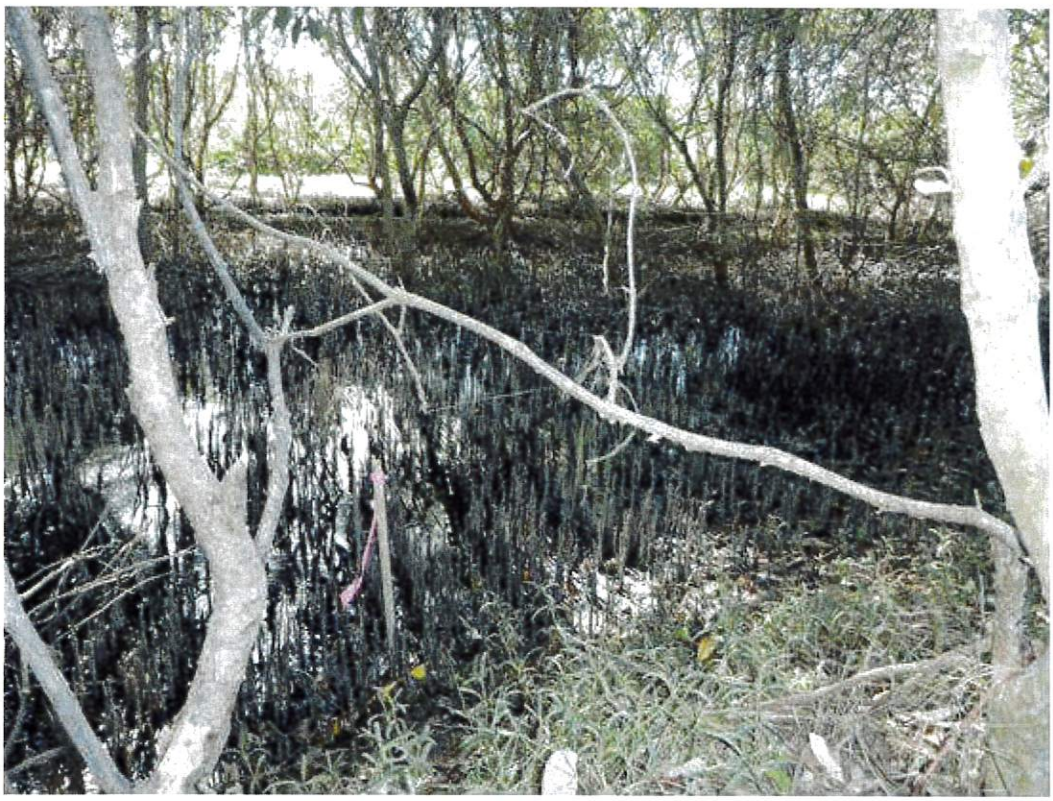
References

Fromer et al. (1998). Structure, above-ground biomass and dynamics of mangrove ecosystems: new data from French Guiana. Oecologia 115: 39-53.

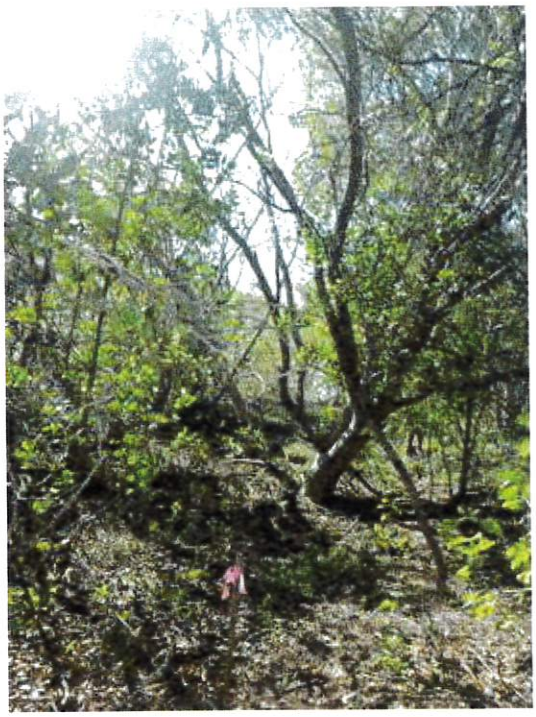
Appendix 1 – Photographs of Mangrove Quadrats

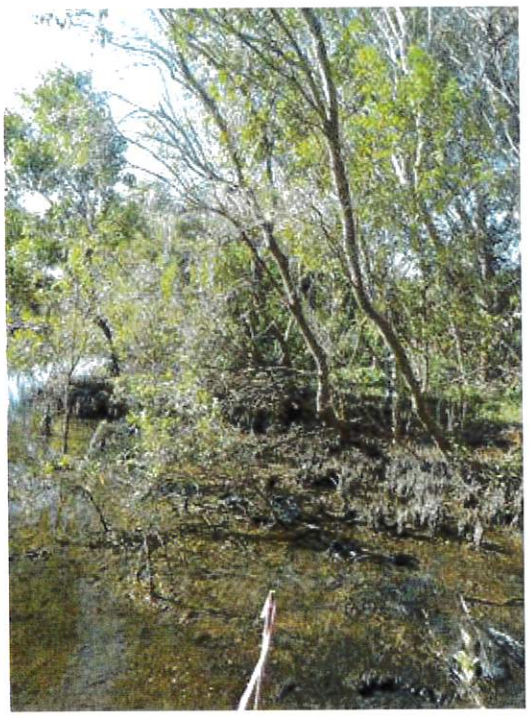
Quadrat 1 – 4 photos





Quadrat 2 – 4 photos





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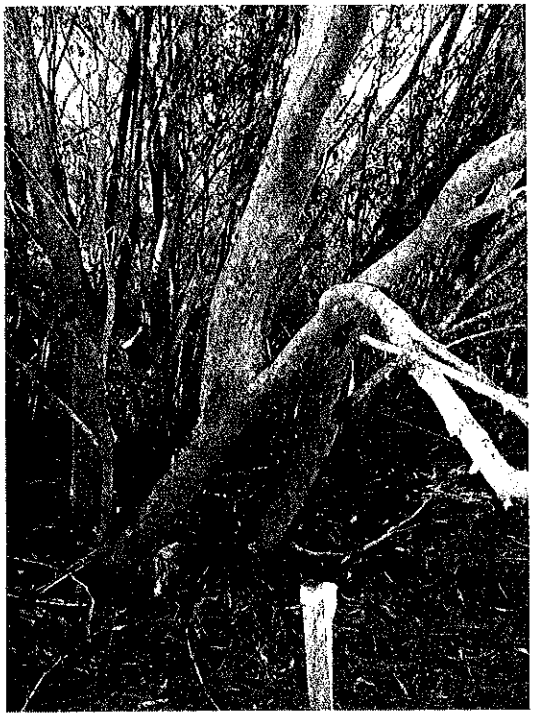

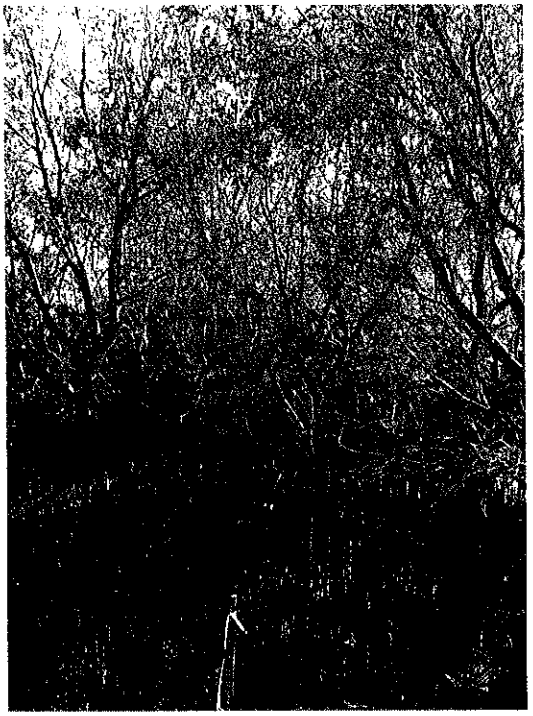

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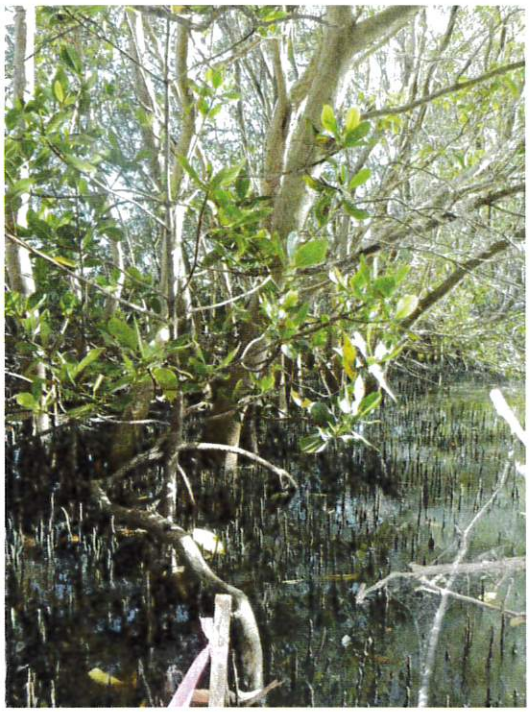

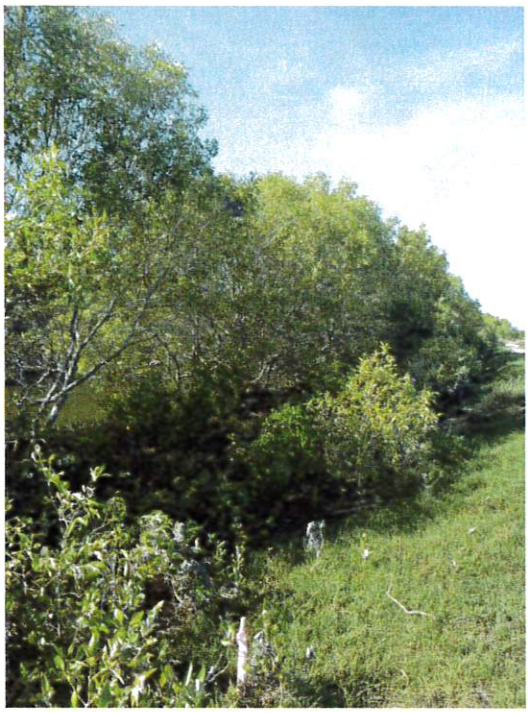

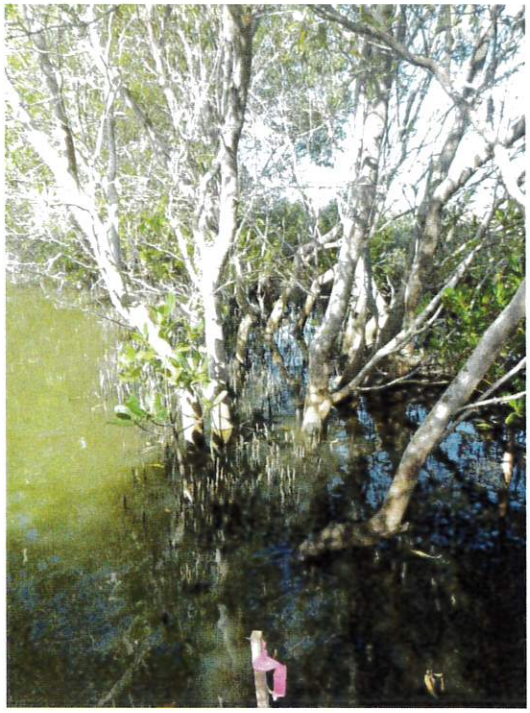

ENDANGERED SPECIES MANAGEMENT PLAN

ADDRESS: Lot 1, Trent Road, Alva Beach

LOT 1 ON RP804106

PREPARED FOR: Pacific Reef Fisheries

March 2017

gassman development perspectives

project coordination
urban + regional planning
landscape + urban design
environmental management
visualisation + spatial services
surveying services
advisory services

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GDP Document Control

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Approval for Issue

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V2.0	Brian Gassman	Director		30th March, 2017

Final Distribution

Pacific Reef Fisheries	1 electronic copy

TABLE OF CONTENTS

1. Introduction

1.1. Background

Criterion 2.3.2 of the ASC Shrimp Standard requires the following considerations:

Criterion 2.3: Consideration of habitats critical for endangered species

Indicator	Requirement
2.3.2. Maintain habitats critical for endangered species within farm boundaries and implement protection measures of such areas.	Implement protection measures of habitats identified by the B-EIA process.

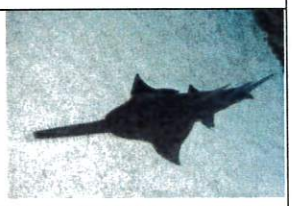
Consequently, Pacific Reef Fisheries is required to implement a procedure outlining methodologies proposed to be employed to avoid negative impacts on listed IUCN endangered species.

This purpose of this report is to outline these procedures.

2. Endangered species in vicinity of site

The requirement within the ASC guideline is to manage and mitigate the impacts on IUCN-listed endangered species specifically. Consequently, this section seeks to summarise the species which are considered likely to occur within the vicinity of the subject site. Only Endangered and Critically Endangered species as listed under the IUCN or the Queensland *Nature Conservation (Wildlife) Regulation 2006* are included in the list below.

Species common name	Scientific name	IUCN red list category	Habitat	Identification photo
Northern Quoll	*Dasyurus hallucatus*	Endangered	Nesting locations in the GBRWHA (Limpus, 1997)	
Loggerhead Turtle	*Caretta caretta*	Endangered	Shallow coastal waters and estuaries with sandy/rocky substrates occurring amongst algae and seagrass (Pagonski et al. 2002)	
Eastern Curlew	*Numenius madagascariensis*	Endangered	Beaches particularly near mangroves	
Great knot	*Calidris tenuirostris*	Endangered	Coastal Areas	

Hawksbill turtle	*Eretmochelys imbricata*	Critically endangered	Coastal wetlands, inland reaches of major rivers and estuaries	
Dwarf Sawfish	*Pristis clavata*	Endangered	Estuaries, mudflats, mangroves	
Green sawfish	*Pristis zijsron*	Endangered protected	Estuaries, mudflats, mangroves	
Freshwater Sawfish	*Pristis miscrodon*	Critically endangered + protected	Coastal wetlands and rivers, mudflats, saltmarsh. Mangroves	
Leatherback Turtle	*Dermochelys coriacea*	Endangered	Mangrove forests	

3. Proposed impact avoidance measures

Pacific Reef Fisheries has sought to implement procedures to ensure that impacts to endangered species potentially occurring on or near the subject site are minimised as far as reasonably possible. This section seeks to outline individual impact mitigation measures specific for each species considered likely to occur within a vicinity of the subject site.

Species common name	Scientific name	Habitat	Impact management measures
Northern Quoll	*Dasyurus hallucatus*	Nesting locations in the GBRWHA (Limpus, 1997)	Northern Quoll habitat is not considered likely to occur on the subject site. No further works are proposed within potential habitat areas located on the farm outside of the existing footprint. This will ensure that any Northern Quoll habitat present on the site is not impacted upon by operations of the farm.
Loggerhead Turtle	*Caretta caretta*	Shallow coastal waters and estuaries with sandy/rocky substrates occurring amongst algae and seagrass (Pagonski et al. 2002)	This species may occur in tidal waters surrounding the farm. Vessels used for environmental monitoring will be limited to 10 knots water speed with all operators instructed to keep close visual observation for Loggerhead Turtles and other marine life.
Eastern Curlew	*Numenius madagascariensi*	Beaches particularly near mangroves	Quad bikes and four wheel drive vehicles will be limited in speed

Species common name	Scientific name	Habitat	Impact management measures
	s		to 20km/hr when traversing beaches or other possible Eastern Curlew habitat. Due care and vigilance will be taken to observe this species when traversing possible nesting areas in vehicles.
Great knot	*Calidris tenuirostris*	Coastal Areas	Quad bikes and four wheel drive vehicles will be limited in speed to 20km/hr when traversing beaches or other possible Great Knot habitat. Due care and vigilance will be taken to observe this species when traversing possible nesting areas in vehicles.
Hawksbill turtle	*Eretmochelys imbricata*	Coastal wetlands, inland reaches of major rivers and estuaries	This species may occur in tidal waters surrounding the farm. Vessels used for environmental monitoring will be limited to 10 knots water speed with all operators instructed to keep close visual observation for Hawksbill Turtles and other marine life.
Dwarf Sawfish	*Pristis clavata*	Estuaries, mudflats, mangroves	No activities currently undertaken by Pacific Reef Fisheries are considered to represent a risk to this species. The primary risk to this species is net fishing which is not employed by Pacific Reef Fisheries.
Green sawfish	*Pristis zijsron*	Estuaries, mudflats,	No activities currently

Species common name	Scientific name	Habitat	Impact management measures
		mangroves	undertaken by Pacific Reef Fisheries are considered to represent a risk to this species. The primary risk to this species is net fishing which is not employed by Pacific Reef Fisheries.
Freshwater Sawfish	*Pristis miscrodon*	Coastal wetlands and rivers, mudflats, saltmarsh. Mangroves	No activities currently undertaken by Pacific Reef Fisheries are considered to represent a risk to this species. The primary risk to this species is net fishing which is not employed by Pacific Reef Fisheries.
Leatherback Turtle	*Dermochelys coriacea*	Mangrove forests	This species may occur in tidal waters surrounding the farm. Vessels used for environmental monitoring will be limited to 10 knots water speed with all operators instructed to keep close visual observation for Leatherback Turtles and other marine life.

4. Conclusion

A number of IUCN listed Endangered and Critically Endangered species were considered possible occurrences within a vicinity of the Pacific Reef Fisheries site. This report has outlined management measures to ensure that risks of death or injury to listed IUCN endangered species is minimised or eliminated. This report should be referred to as a management plan and provided to commencing staff who will be operating equipment, vehicles or working in areas which are considered to possibly contain endangered species.

Work Instruction

Escapee Recovery of Cultured Prawns

WI: 73

The Job: Farm-wide installation and management of trapping devices to sample for the existence of prawn escapees.

What you need to achieve: To prevent escapees from exiting the farm.

What you need to know: Escapees from aquaculture facilities have found to have significant impacts on native wild species by establishing non-native populations in areas where they are farmed and in some cases, they can transfer exotic pathogens from the farm to the wild environment. It is therefore important that we monitor through data collection and record keeping, any escaped prawns to eliminate transfer into the natural environment.

To help identify the existence of escapees. PRF have set Prawns Traps at various locations around the PRF Alva Beach site (see Figure 1.). These traps are to be inspected weekly.

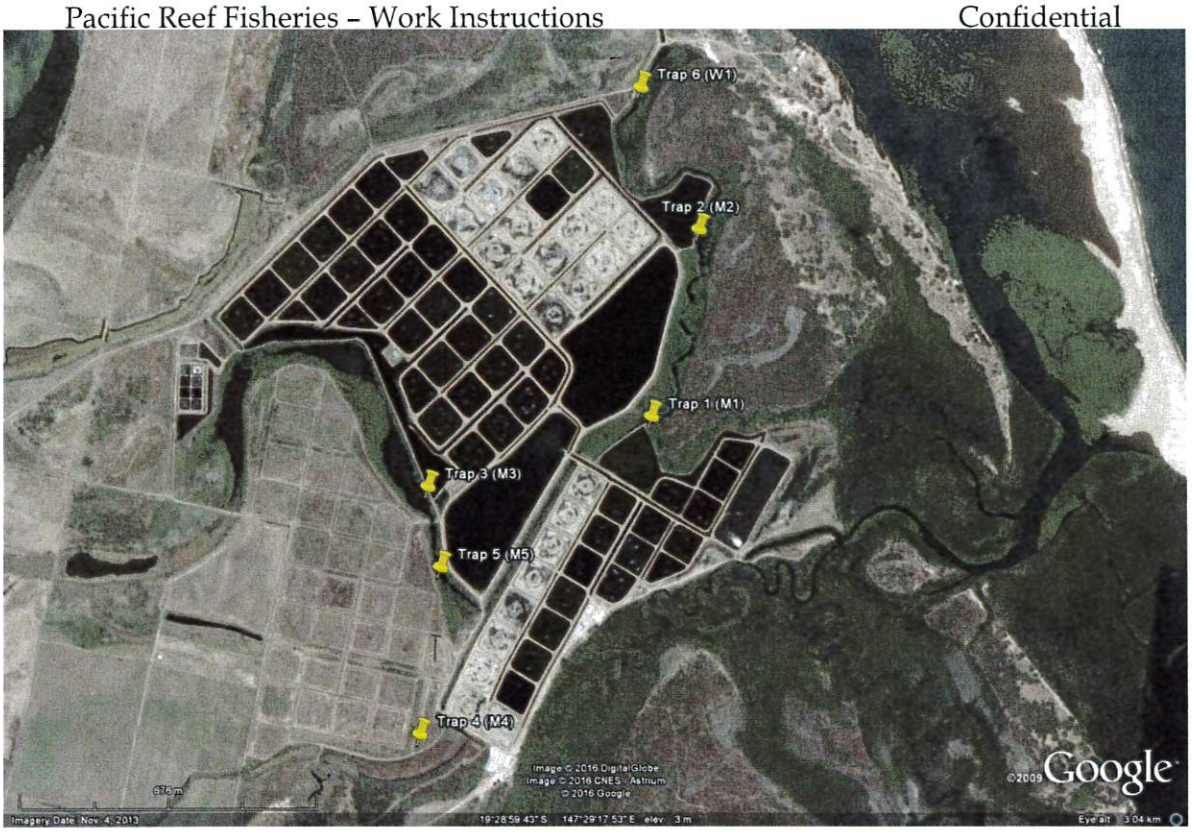


Figure. 1 Map of trapping devices at Pacific Reef Fisheries

Staff Responsible:

- Environmental Officer
- Water Quality technicians
- Pond technicians

How you do it:

1. Record and visually inspect pond outlet weekly.
   a) Record the integrity of the screens and repair or replace as necessary.
   b) Notify Environmental Officer and Grow-out Manager if noticeable release of escapees.

2. During the Daily Discharge run, inspect Prawn Traps at each location, and record the number of escaped cultured prawns. Once counted remove prawns from trap and dispose of them at the waste disposal site (.
   a) If escapees are present in traps stop discharging effluent water by placing boards in monks
   b) Re-check the quality of each outlet screen that releases into that discharge point and if any are damaged, ensure replacement.
   c) Check for leakages in pond walls or noticeable water height differences on waternote
   d) If all are adequate contact Pond Managers, Grow-Out Manager and Environmental Officer
3. If the source of the problem cannot be found, cease all discharge until the issue is resolved.
4. Enter the data recorded into the *Discharge Report* as well as any actions taken to prevent reoccurrence.

Safety Issues:

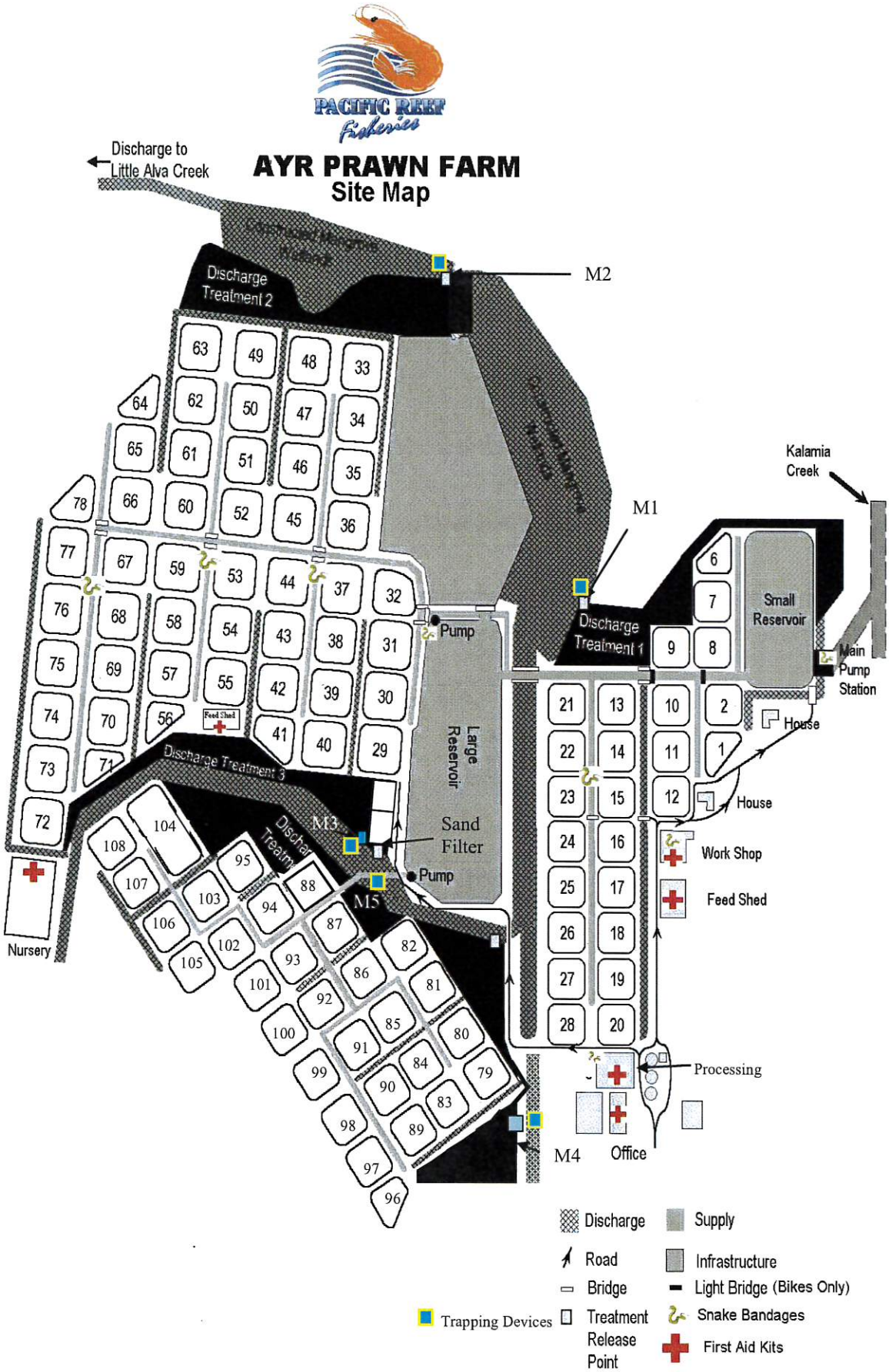
- Ensure responsible use of Bikes.
  - 40 km/ hr Speed limit.
- Watch your step when walking out onto monks.
  - Keep your balance.
- Be aware of Snakes in the area.
  - See Snake Bite bandage kit Location Map.

Environmental Issues:

- Ensure Bike is not leaking any fluids.

- Stop discharging effluent water if a significant amount of escapees are found in traps to prevent harm to receiving environment

Figure 1.


PACIFIC REEF Fisheries
AYR PRAWN FARM
Site Map
Discharge to Little Alva Creek
Discharge Treatment 2
M2
Kalamia Creek
M1
Discharge Treatment 1
Small Reservoir
Main Pump Station
House
Pump
Large Reservoir
Sand Filter
Pump
Discharge Treatment 3
M3
M5
Nursery
Work Shop
Feed Shed
Processing
M4
Office
Discharge
Supply
Road
Infrastructure
Bridge
Light Bridge (Bikes Only)
Trapping Devices
Treatment Release Point
Snake Bandages
First Aid Kits

Work Instruction

OUTLET PREPARATION

WI: 04

The Job: Preparing the outlet for installation of screens and boards.

What you need to achieve: To ensure the outlet is secure to prevent the escape of prawns into the environment and to ensure boards are in good condition for easy removal during required water exchanges.

What you need to know: Outlet screens prevent the loss of prawns into the environment. Breaches in these screens can therefore reduce yields and has the potential to introduce disease and affect genetic lines in wild stocks.

Staff Responsible:

- Pond Managers
- Pond Staff

How you do it:

1) Prior to filling the pond, clean the outlet floor and grooves.
2) Scrape the outlet screen and re-cover with 12mm oyster mesh and 1mm fly screen.
    a) Secure oyster mesh to screen with cable ties.
    b) Secure fly screen to screen with window tubing.
        (i) Both the oyster mesh and fly screen are important tools to prevent escapees.
3) Ensure outlet has enough boards and that boards are equipped with coates screws (lifting bolts) of good condition.
    a) Back Boards = 12
    b) Front Boards = 10
4) Place back boards into outlet with lifting bolts facing to the outside of the pond.
5) Place front boards into outlet with the lifting bolts facing towards the outlet screen.
6) Place outlet screen into outlet and secure with rope.

Safety Issues:

- No safety concerns.

Environmental Issues:

- Ensure outlet screen is secure and has oyster mesh and fly screen in good condition and free of any breaches.

2. Pond Preparation

The aims of pond preparation are:

1) To prevent disease transfer to subsequent crops

2) To adequately condition pond soils

3) To optimise water quality, and

4) To optimise natural food supply

Adequate pond preparation is crucial to the growth and survival of the crop. Conditions should optimise the PL's chances of survival and performance by minimising stress as they go from controlled hatchery conditions to their new pond environment.

2.1 Pond Disinfection (see **WI: 1**)

After harvest allow ponds to dry completely and remove waste. Pond wastes from the previous crop should be well centralised (if there were enough aerators and they were positioned properly), as a 10-50cm thick pile of black sediment. Depending on the thickness and weather conditions this organic enriched sediment will normally take 2-4 weeks to dry enough to allow removal with heavy machinery. The drying process can be hastened by tilling with a shallow digging implement, such as a stick rake, behind the tractor.

There is debate over the need to remove this sediment. More than 95% of this material is simply eroded soil from the pond walls and floor and deposited marine sediments from the incoming water, and the organic content decomposes over time. Moisture and oxygen availability will hasten this decomposition so tilling the soil a number of times during the dry-out is essential. Viruses should be killed if the pond is allowed to sun dry adequately (including tilling the soils), however it is difficult to ensure all potential disease-causing viruses and bacteria and eggs of potential predators are destroyed. It is

also uncertain how the remaining organic matter in the waste pile will affect the subsequent crop, or if there is a cumulative effect over a number of years, so (as a precaution) we are removing these wastes each year.

All barnacles should be scraped from jetties, outlet monks, aerators, boards and screens and all should be allowed to adequately sun dry to minimise the risk of disease carry-over. Boards should be placed back in the outlet monk to prevent warping.

Pond banks can be sprayed with hydrated lime at a rate of 500-1000kg per ha as a further disinfection measure, using the lime spreader. Reasons for disinfection are as follows:

- if ponds fail to dry properly
- poor or unwanted phytoplankton blooms from previous crops
- or known health issues

2.2 Soil Conditioning and Other Preparation

- Tilling and Flattening (see **WI: 2**).
    - The pond floor should be tilled at least three times to ensure the bottom is sun dried as much as possible and to help oxidise any organic matter. The ponds should then be flattened using a roller or dragging the 'railway-line' behind the tractor.
- Aeration (see **WI: 3**).
    - Aerator poles and Aerators are left in position each season to improve labour efficiency. Each pole should be inspected for quality and placement and should be replaced if required. Aerators are to be scraped to remove barnacels and gear oil is to changed.

2.3 Outlet Preparation (see **WI: 4**)

Prior to filling, the outlet should be cleaned, any sediment in the floor of the outlet should be cleaned out and grooves cleaned to ensure adequate positioning of the boards. The outlet screen should be scraped down and re-covered with oyster mesh and fly screen. The fly screen is fixed to the screen using the standard tubing used for fixing to window and door screens, so that it can easily be removed when the prawns are big enough (usually around 10g ABW). With the low water exchange systems adopted for prawn production, no water is exchanged from a pond unless a health issue warrants an exchange. By the time any water is released the animals have grown to a size larger than the screen sizes used. Is more than sufficient to prevent escapism.

When the pond is ready to be filled the back boards should be placed so that all lifting bolts are facing to the outside of the pond (to prevent barnacles fouling them). The front boards should be suspended from the bottom at a height approximately 40 cm from the pond floor (this enables exchange water to be drawn from the bottom of the pond) with the lifting bolts facing towards the outlet screen. The outlet screen should be placed before the initial fill (to ensure adequate positioning) and it should be secured with rope to prevent it lifting during the crop.

2.4 Water conditioning (see **WI: 6)**

All water added to the pond should be passed through the 500*u*m inlet screens (socks) to prevent predator entry and pipes should be inspected for leaks. Outlet boards should be sealed using grass clippings or barnacle scrapings to prevent water losses due to seepage.

The pond should be filled to 1m depth and fertilised to promote algal development. This is an application of Easy-N (Nitrogen Based Liquid Fertiliser). It should be remembered that initially there will be nutrients available from the pond soils so there is no urgency to add the first fertilisation, however once the bloom becomes established it

is essential that the fertiliser be added regularly. Every pond is different and the fertiliser requirement needs to be judged on a pond by pond basis every day.
The feed added to the pond after stocking will act as an important source of nutrients for bloom maintenance. Fertiliser additions are to be given until feed rates are at 30kg/ha/day.

Regular top-ups with water are also important in providing other essential nutrients and maintaining algal health, however no more than 5% should be added at once and pond depth should be maintained at around 1-1.2m.

If the bloom is not established adequately or if it crashes, blue dye should be added to compensate for the bloom and to prevent benthic algal growth.

Target water quality conditions prior to stocking are:

- a secchi reading of 30-40cm if possible, but no greater than 50-60cm.
- pH <8.7 with a daily fluctuation <0.5.
- water temperature >24°C.
- water depth of 1m at outlet side of pond.

Remember that a thick secchi reading may be due to high suspended silt levels rather than phytoplankton. Samples should be inspected under the microscope for algal species determination.

Water depth should be slowly increased over the first 4-6 weeks of the crop until it is 1.3 m deep. Adding 5-10 cm every two to three days will usually compensate for seepage and evaporation as well as fill the pond gradually.

Pacific Reef Fisheries has started to move away from the traditional high exchange systems and are working towards zero to low water exchange systems. This is to conserve water use during the wet season when the water quality within the Kalamia Creek system is unusable and to create a balance between a microalgae bloom and a strong bacterial population in the water column. For biofloc systems to be successful the objective is to establish a stable diatom based floc, and to manage the bloom and ammonia levels within the ponds. The type of microalgae system present is important and if the wrong species has developed the floc will not work. Studies have proven that there is a clear association between diatoms and a good healthy floc and therefore it is essential that a good diatom bloom is established early in the season. A characteristic feature of a diatom is that they are encased within a unique cell wall made of silica called a frustule. This frustule has a large surface area and forms the nucleus in which enables the bacteria to attach to.

The key time in the biofloc system is during the first 4-6 wks after filling the ponds. Normal water conditioning practices still apply, however the one main difference is the early addition of molasses to the ponds to help promote healthy bacterial colonies and reduce pH levels.

The chaining of the pond floor prior to stocking is a valuable tool to use to utilise the nutrients already available in the pond and aid the water conditioning process. Chaining helps to prevent benthic algae from growing on the pond floor and stops the build up of organic matter that might have been missed during the pond preparation process. At least two weeks after stocking and depending on the strength of the PL's, the ponds are to be chained regularly (once a week) to recycle nutrients and keep the flocs in suspension. The chaining of ponds should be avoided when the prawns are going through a known moulting period and 2 hours after feeding. (See **WI: 50**)

2.5 Viral or Bacterial Disease Problem (see WI: 7)

If a viral or bacterial disease problem was suspected in the previous crop and the pond has not been sufficiently dried, the pond should be chlorinated. The pond is filled to 30cm depth and chlorine is added at a dosage rate of 100ppm. This usually equates to 3000L of 10% sodium hypochlorite for a 1 ha pond. The chlorine is sprayed into the pond using the contract supplier's equipment and the paddle wheels are turned on to spread the chlorine around the pond.

The contract supplier should provide test kits to measure concentration in the ponds. The following day the pond should be filled to 1m with all four aerators left to run to help dissipate the chlorine. The pond will remain clear for 5-10 days due to the effects of the chlorine. Water should be added to maintain the depth at 1m however no fertiliser should be added to the pond until the chlorine has fully dissipated (usually 3-4 days). Once this has happened the pond should be fertilised to encourage an algal bloom.

Cobia Cage plan

Cage Size (m3)	Small mesh (S)	11
	Large mesh (L)	22

Number stocked/cage **3200**

Plan							Action	
Day	**ABW (g)**	**Cage**	**Biomass (kg/m^3)**	**Screen Size (mm)**	**Outlet Screen Mesh Type/Size (mm)**	**Action**	**Date**	**Comments**
0	<10	S	<3	70% shade cloth	Oyster Mesh/22	**Insert used**		Shade Cloth insert used if fingerlings arrive from hatchery <10g
0	10	S	3	12	Oyster Mesh/22			Fingerlings stocked directly into cage if ≥ 10g
3	>10	S	>3	70% shade cloth	Oyster Mesh/22	**Replace or Remove**		Replace if fouled, Remove if fingerlings are >10g
7	20	S	6	12	Oyster Mesh/22			
14	35	S	10	12	Oyster Mesh/22	**Transfer**		
21	60	S	17	12	Oyster Mesh/22			
28	90	L	13	20	Oyster Mesh/22	**Transfer**		
35	120	L	17	20	Oyster Mesh/22			
42	150	L	22	20	Oyster Mesh/22	**Transfer**		
49	180	L	26	20	Oyster Mesh/22			
56	220	Net	32	25	Oyster Mesh/22	**Release**		Fish released into net enclosure within pond
>56.	>220	Net	>32	25	Oyster Mesh/22			
~365	3000	Free range		-	Security Mesh/67 x 84	**Remove net**		