Environmental Impact Monitoring Program (EIMP) - Spring 2010

Lot 1 on RP804106, Trent Road via Ayr

PREPARED FOR
Pacific Reef Fisheries (Australia) Pty Ltd

March 2011

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1 Introduction

1.1 Background

This report has been prepared for Pacific Reef Fisheries (Australia) Pty Ltd (PRF) by Gassman Development Perspectives to fulfil the requirements of the Environmental Impact Monitoring Program (EIMP) developed by BTEQ in March, 2005. This monitoring program was developed in part to satisfy ongoing licensing requirements determined by the Department of Environment and Resource Management (DERM, formerly Environmental Protection Agency), Great Barrier Reef Marine Park Authority (GBRMPA) and the Department of Environment, Water, Heritage and the Arts (DEWHA, formerly Environment Australia).

This report outlines the results for the initial sampling event which commenced the three year monitoring program. This monitoring occurred on 22nd to 23rd November, 2010. The purpose of the biannual monitoring program is to determine any changes that occur to the receiving environment as a result of adjacent prawn farm activities.

PRF has the following approvals which allow for the discharge of aquaculture of aquaculture waste to the surrounding environments:

- DERM – Integrated Authority NR0280
- GBRMPA – Permit no. G01/352.2
- DEWHA – EPBC 2001/402

1.2 Site description

The farm is located on Trent Road, Alva Beach which is 15km east of Ayr, Queensland (**Figure 1)**. The site consists of 75 operational ponds covering 68 hectares for the production of Marine prawns (*Penaeus monodon*). 30 additional ponds covering 30 hectares are currently under construction. The facility also has a hatchery, processing plant, 10.3 hectares of settlement-treatment ponds and 7 hectares of constructed mangrove wetland designed to reduce contaminants in the aquaculture waste prior to release into the receiving environment. Aquaculture waste generated on-site is treated prior to discharge into Little Alva Creek. An aerial image of the site can be found in **Figure 2.**

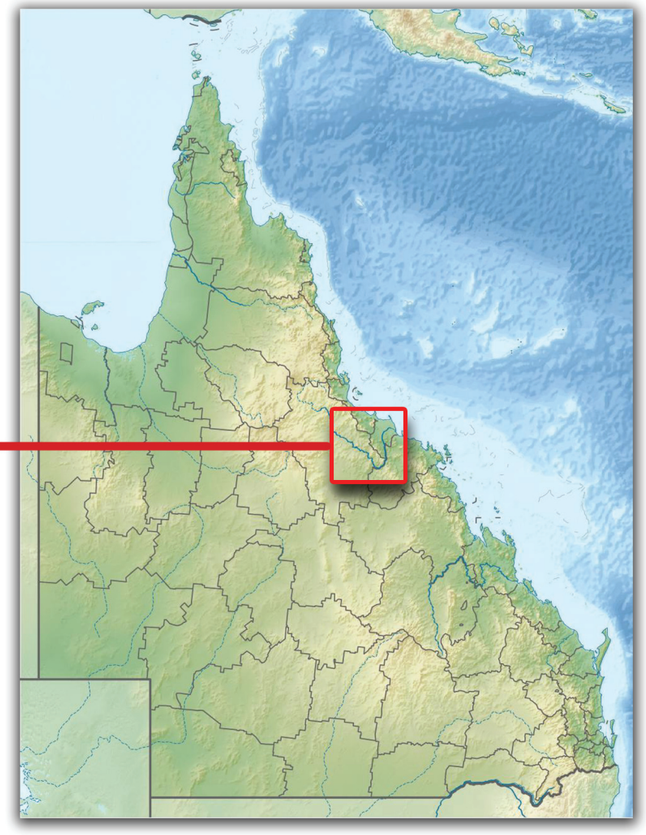

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Figure 2 – Aerial photograph of the Pacific Reef Fisheries Prawn Farm

1.3 Objectives of the monitoring program

The purpose of this monitoring program is to detect any measureable environmental effects on the receiving waters of Little Alva Creek by regularly monitoring sites on both Little Alva Creek and nearby reference sites along Alva Creek. Observed intra-site differences in the following parameters will determine any measurable impacts that aquaculture waste discharge is having upon Little Alva Creek:

- Mangrove health including species composition, canopy cover, canopy height, density of mature trees and density of saplings;
- Abundance and spatial extent of epiphytic algae;
- Abundance and diversity of benthic macro-invertebrates; and
- Total organic carbon and grain-size distribution of benthic sediments

2 Methodology

2.1 Sampling locations

Eight (8) locations have been selected for sampling. They are identified 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 Alva Creek corresponding with G
E Location in Alva Creek corresponding with B
F 250m north of mouth of Alva Creek
G 250m upstream of discharge point in Little Alva Creek
H Location in Alva Creek corresponding with A

Figure 3 shows the locations of all sampling sites.

In contrast to last sampling occasion, all the sites were available due to favourable tides and weather conditions.

2.2 Mangrove health monitoring

Mangrove health was monitored at sites A, B, D, E, G and H. At each site, permanent 400m^2 (20m x 20m) quadrats were established at the water extent of the mangrove edge and extended back into the mangrove stands. At each location the following parameters were measured:

- Species composition;
- Canopy cover;
- Canopy height;
- Density of mature trees (over 3m);
- Density of saplings and small trees (under 3m).

Additionally, three permanent photographic reference points were established at each monitoring location. At each location, three quadrats (0.25cm^2) were used to record the abundance and spatial extent of any epiphytic macoalgae present. Changes in these parameters over time may reflect changing impacts on the waterways.

2.3 Sediment sampling methods

At locations B, C, E and F sediments were sampled for the following parameters:

- Total organic carbon;
- Grainsize distribution;
- Species composition and abundance of benthic macroinvertebrates.

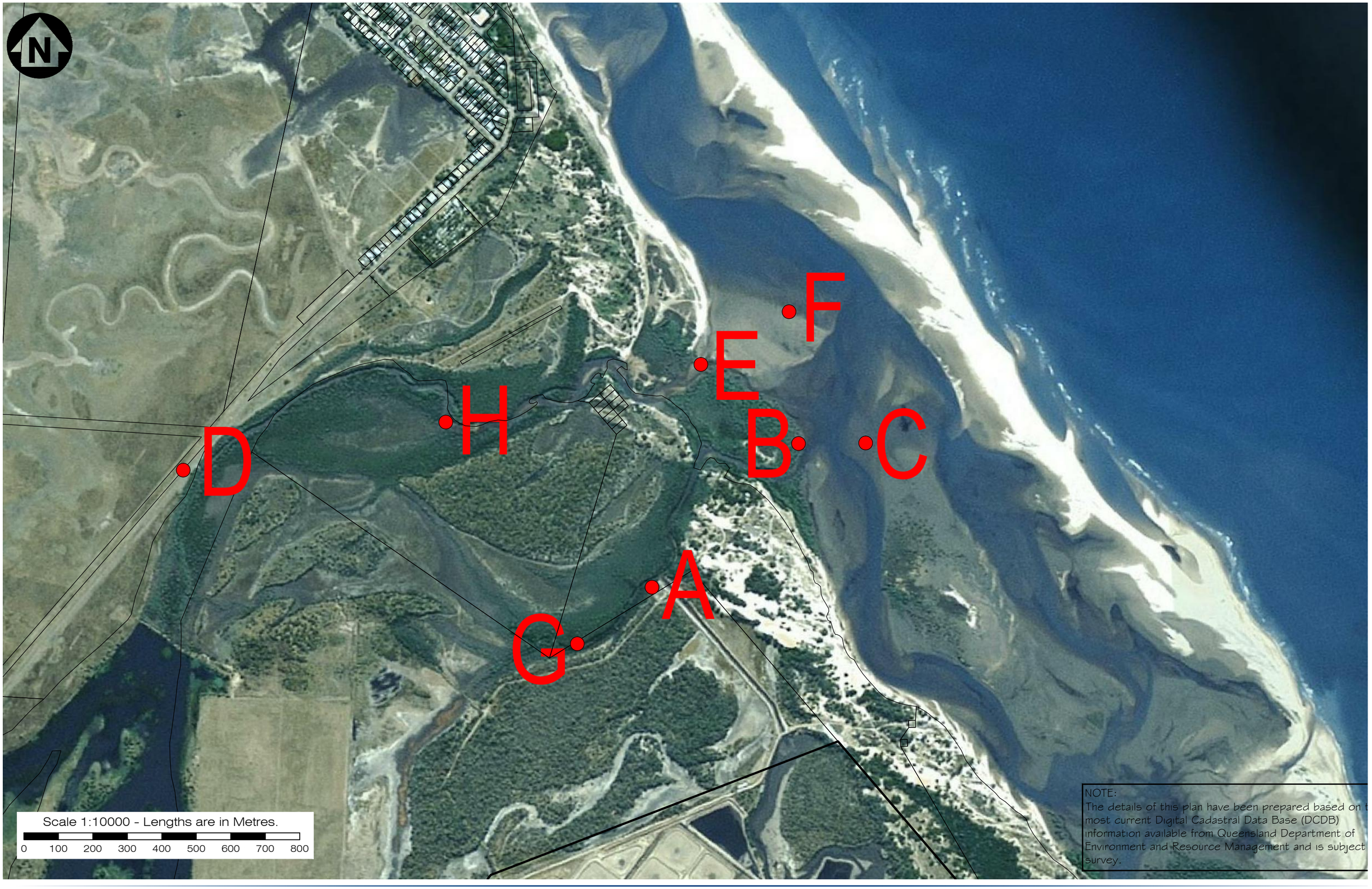

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Figure 1 - EIMP Sampling Locations

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Pacific Reef Fisheries

AMENDMENTS		AMENDMENT DETAILS	DATE
	F		
	E		
	D		
	C		
	B		
	A		
	-	INITIAL RELEASE	24-02-2011

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3 Results and Discussion

3.1 Mangrove health

The results of the mangrove quadrats for the four sites monitored are summarised in **Table 1**. A total of six (6) species of mangroves were detected across the four sites. Trees and saplings under 3m in height outnumbered mature trees at all sites. Site H had the highest density of mature trees (0.5/m^2) whereas the other sites were comparable in density. Site B had a substantially lower density of saplings in comparison with the other sites (0.03). Sites G and H were not sampled on last occasion due to access difficulties caused by tides. Densities of the mangroves in the quadrats monitored on last occasion had not changed.

This will continue to be monitored over time to determine whether lower numbers of saplings are possibly attributable to the effects of prawn farming or simply natural variation that is also observed in the surrounding environment. Densities of both mature and immature mangroves across the sites monitored in the autumn sampling had not undergone any observable changes indicating that the prawn farm has not had significant impacts on the receiving environment.

Epiphytic algae were not observed to be growing on the substrate of any of the monitored sites. Photographs of the quadrats are found in **Appendix 1**.

Table 1 – Mangrove observations for permanent quadrats

Quadrat	Species Present	Density of trees >3m (per m^2)	Density of trees <3m (per m^2)	Epiphytic algae % cover and abundance	GPS coordinates
A	*Ceriops australis; Avicennia marina; Rhizophora stylosa*	0.03	0.75	0	-19.469, 147.486
B	*Avicennia marina; Rhizophora stylosa*	0.02	0.03	0	-19.4654, 147.49
D	*Avicennia marina; Rhizophora stylosa; Ceriops australis*	0.4	1.125	0	-19.4655, 147.473
E	*Avicennia marina; Rhizophora stylosa; Aegalitis annulata*	0.0225	0.75	0	-19.4632, 147.487

G	*Avicennia marina; Rhizophora stylosa*	0.8	0.7	0	-19.4703, 147.4837
H	*Rhizophora stylosa; Avicennia marina; Aegalitis annulata; Osbornia octodonta*	0.05	0.45	0	-19.4644, 147.4802

3.2 Sediment biogeochemistry

3.2.1 Particle size distribution

The results of the particle size distribution (PSD) analysis are presented in **Figure 4** and **Table 2.** The four sampled sites continue to appear to be relatively uniform in the distribution of particle sizes, indicating that the prawn farm has not impacted Little Alva Creek in terms of PSD. In contrast to last sampling occasion, site F was more congruous in particle size distribution to sites B, C and E (average composition particles below 0.03mm was 35% in contrast to 47.33% on last sampling occasion). Sites B, C and E continue to be largely comprised of particles greater than 0.03mm in size. Samples from sites C and E both contained 30.66% of this size class in the sample, whereas site B on this occasion contained a slightly higher ration of particles that were less than 0.015mm in diameter (29.66%).

On this occasion, site C contained a greater proportion of finer sediments. As site C was not tested on last occasion and is the site furthest from the entrances of Little Alva and Alva Creek, it is likely that the finer sediments which remained entrained in the water column were deposited further out to sea following the reduction in water velocities. Signs that the prawn farm is causing impacts on the waterway would be that sites E and F would differ significantly from sites B and C which has not been observed to be occurring.

A minimum of eight (8) samples per site would be required to analyse the data statistically, however visual trends observed from charts such as **Figure 4** are considered to be sufficiently indicative of changing trends over time. **Figure 5** contains the comparison plot from the autumn sampling occasion.

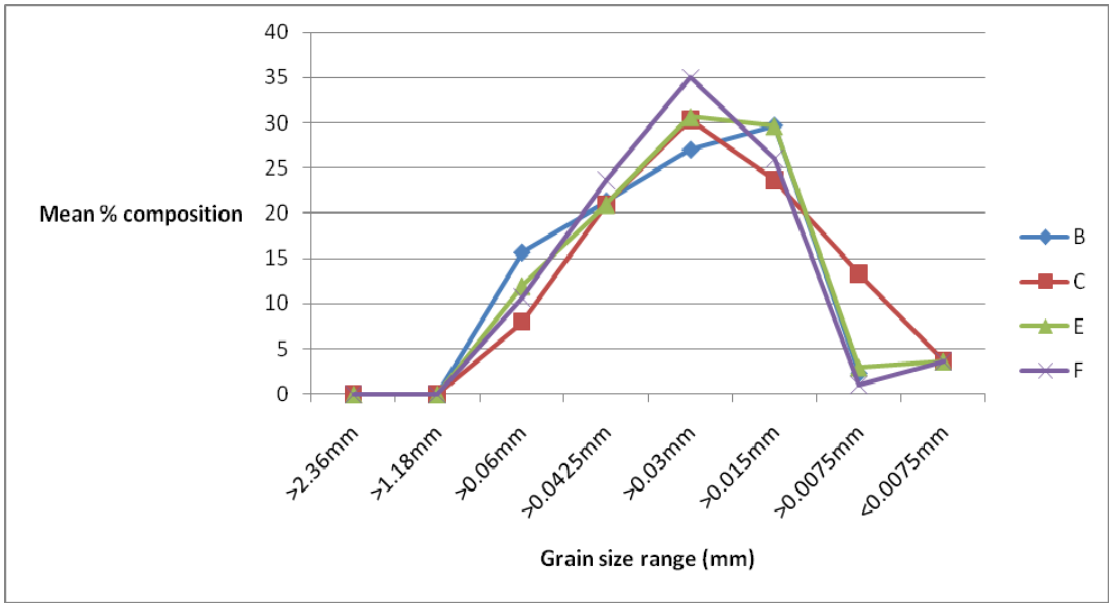

Figure 4 – Particle size distribution chart for sites B, E and F

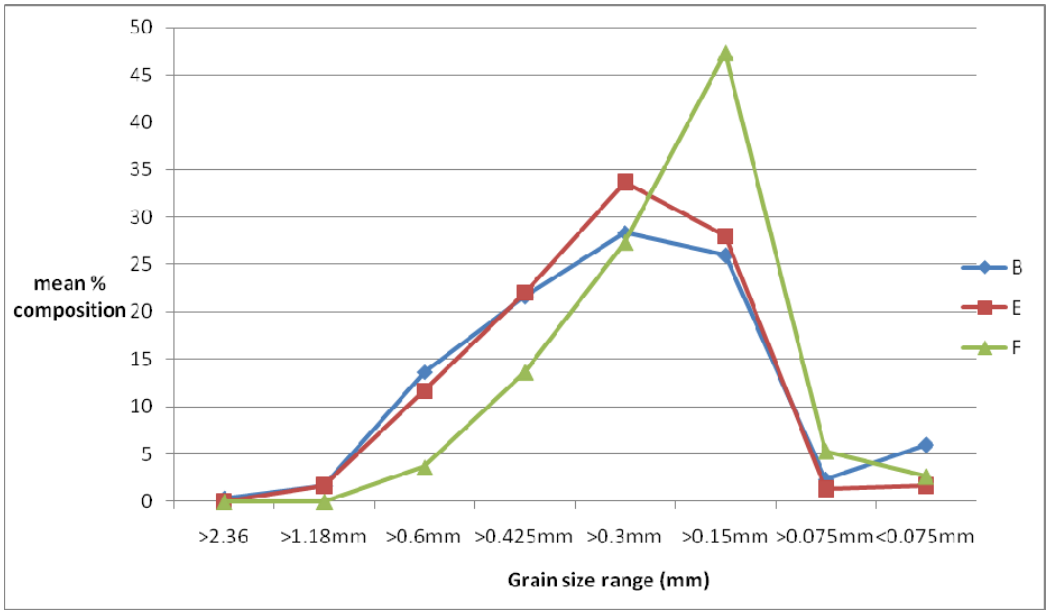

Figure 5 – Comparative Particle size distribution chart for sites B, E and F from Autumn sampling

Table 2 –Particle Size Analysis of Sediments from sites B, E and F

Size parameter	Sampling site											
%	B1	B2	B3	C1	C2	C3	E1	E2	E3	F1	F2	F3
>2.36mm Gravel	0	0	0	0	0	0	0	0	0	0	0	0
<2.36 >1.18mm Coarse sand	0	0	0	0	0	0	0	0	0	0	0	0
<1.18 >0.6mm Coarse sand	13	11	23	5	13	6	7	10	19	12	10	10
<0.6 >0.425mm Medium sand	20	17	2	18	27	1	18	19	26	22	23	26
<0.425 >0.3mm Medium sand	27	26	28	29	31	31	31	30	31	33	36	36
<0.3 >0.15mm Fine sand	34	39	16	28	19	24	36	32	21	27	27	24
<0.15 >0.075mm Fine sand	2	3	2	17	6	17	5	3	1	1	1	1
<0.075mm Silt and clay	4	4	4	3	4	4	3	6	2	5	3	3

3.2.2 Total Organic Carbon

Total Organic Carbon (TOC) is an indicator of organic matter preserved within sediment. Organic matter has a high propensity to be retained in finer grained sediments. In **Table 3** it is represented as a percentage of the total weight of sediment collected. All sites apart from B had very low levels of organic carbon. This is substantially lower than last monitoring occasion and may be in response to heavy rainfall leading up to the sampling event. It would appear that TOC observed at site B is anomalous in comparison with the other sites. It is possible that the sediment sample was taken on a leaf pack of detritus which would elevate TOC readings. It is not considered that this result raises a cause for concern as elevations in TOC were not observed at any other site.

Table 3 – Total Organic Carbon

Site	Total Organic Carbon (%)
B1	0.38
B2	0.25
B3	0.16
C1	<0.02
C2	<0.02
C3	<0.02
E1	<0.02
E2	<0.02
E3	<0.02
F1	<0.03
F2	<0.04
F3	<0.05

3.2.3 Benthic macroinvertebrate assemblages

Communities of benthic macroinvertebrates are a robust indicator of the relative health of an aquatic ecosystem. As they often have narrow environmental tolerances, even minor anthropogenic changes to a receiving environment are reflected in changes to macroinvertebrate communities.

The results of the macroinvertebrate species composition for sites B, C, E and F can be found in **Table 4**. Changes in the diversity and abundance of benthic macroinvertebrates over time are considered to be a reliable indicator of changing environmental conditions which may be attributable to discharge from the prawn farm.

Table 5 provides a comparison in diversity between the previous autumn sampling and this occasion. Diversity has not substantially changed between monitoring events although abundance has notably reduced within various taxa from last monitoring occasion. Whilst this

could be attributable to natural or seasonal variation within the habitats, heavy rainfall leading up to the sampling event caused a large amount of freshwater to enter the system which may have depressed numbers of macroinvertebrates sensitive to salinity tolerances. However, diversity is a stronger indicator of ecosystem health in comparison to abundance so it is therefore unlikely that the prawn farm is causing any discernable impacts on the macroinvertebrate populations in areas surrounding the discharge area.

Table 4 – Diversity and abundance of benthic macroinvertebrates

Site	Class/Order	Family	Species	Habitat	Number counted
B1	Decapoda	Callianassidae	*Callianassa* sp.	Woody, detritus amongst sand	1
B2	Isopoda	Corallanidae	Corallanidae	Woody, detritus amongst sand	1
B3	Decapoda	Callianassidae	*Callianassa* sp.	Woody, detritus amongst sand	1
C1	Brachyura	*Grapsidae*	Grapsidae	Woody, detritus amongst sand	1
C1	Bivalvia	Mactridae	*Mactra* sp.	Woody, detritus amongst sand	1
C2	Bivalvia	Mactridae	*Mactra* sp.	Woody, detritus amongst sand	3
C3	Bivalvia	Mytilidae	*Musculus* sp.	Woody, detritus amongst sand	1
E1	Isopoda	Phoratopodidae	Phoratopodidae	Woody, detritus amongst sand	1
E2	Isopoda	Phoratopodidae	Phoratopodidae	Woody, detritus amongst sand	3
E2	Bivalvia	Medodesmatidae	*Paphies* sp.	Woody, detritus amongst sand	1
E3	No sample recorded				
F1	No sample recorded				
F2	No sample recorded				
F3	Bivalvia	Mactridae	*Mactra* sp.	Woody, detritus amongst sand	1
F3	Bivalvia	Medodesmatidae	*Paphies* sp.	Woody, detritus amongst sand	3

Table 5 – Comparison of diversity in taxa between sampling occasions

Autumn 2010 sampling	Spring 2010 sampling
B = 4 taxa collected	B = 2 taxa collected
C = not sampled	C = 3 taxa collected
E = 3 taxa collected	E = 2 taxa collected
F = 1 taxon collected	F = 2 taxa collected

4 Conclusion

In contrast to the previous sampling occasion, all sites were accessible and were sampled. For all parameters including mangrove densities, particle size distribution, total organic carbon and macroinvertebrate assemblages, no substantial variances were observed. TOC was higher at site C than the other sites, and for all other sites TOC was lower than on last occasion. Comparisons between all sample sites did not detect significant differences between the two sampling occasions and no environmental impacts were detected that could be attributed to activities relating to prawn production. The next sampling event will be in April, 2011 and will focus on observed changes in mangrove densities only.

Appendix 1 – Photoplates

Quadrat A – three photos

Quadrat B – three photos

Quadrat D – three photos

Quadrat E - three photos

Quadrat G – 3 photos

Quadrat H – 1 photo