Sunrise Aquaculture EIS-
Freshwater Aquatic Survey

Prepared for: EcOz Environmental Services
Prepared by: EWL Sciences Pty Ltd

Author: Michael Welch

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EWL Sciences Pty Ltd
Darwin Office 482 Stuart Highway, Winnellie NT 0820
PO Box 39443, Winnellie NT 0821

ABN 12 000 955 171 Registered Research Agency No 31639

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EWL Sciences Pty Ltd

Author: Michael Welch

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Project Manager: _____
Michael Welch

Reviewer: _____
A. Zimmermann

General Manager: _____
Dr A R Milnes

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EXECUTIVE SUMMARY

A study of freshwater aquatic habitats and fauna (vertebrates and invertebrates) was conducted for an Environmental Impact Statement being prepared for the proposed Sunrise Aquaculture Estate at Point Ceylon in Bynoe Harbour. The purpose of the study was to collect baseline data that will facilitate a description of the existing freshwater aquatic environments and assess the potential impacts of the proposed development on aquatic habitats and species.

Four sites were surveyed on a small ephemeral stream in the Project Area during late April 2003. Aquatic habitats were described and fauna identified using both capture and observational techniques.

The survey stream supports a healthy population of aquatic plants and a total of 8 species of aquatic/semi-aquatic vertebrates (including 6 fish species) and 30 macroinvertebrate taxa were recorded. The number of species and composition of the fish community recorded in the survey stream are similar to other freshwater systems in the region, as indicated by NT Museum database records. Macroinvertebrate community composition was similar to other coastal systems in the region (Dostine 2002), although diversity is relatively low.

None of the vertebrate or invertebrate aquatic fauna or habitats identified during the survey is listed for conservation significance under local, national or international conventions. The system does not appear to be significant in a regional context, with diversity of both vertebrate and invertebrate fauna being relatively low. However, the permanent waterholes in the vicinity of Site 4 offer refuge habitat to aquatic fauna when most of the stream dries late in the dry season, and are therefore of conservation interest at a local level.

The most likely impacts of the proposed development on this freshwater aquatic system are associated with the construction of roads and a freshwater dam. Unless appropriate erosion and dust control measures are implemented (e.g. silt fences, revegetation of disturbed areas, dust suppression), the initial construction of these infrastructures could lead to increased turbidity and sedimentation in the creek during the first rains following construction. Increased turbidity over a prolonged period could negatively impact macrophytes by reducing their photosynthetic capacity.

The construction of a freshwater dam at the lower freshwater reaches could prevent some marine-breeding species from migrating upstream of the estuarine system. Localised flooding is also likely to result in the loss of riffle (shallow, fast flowing) habitats and invertebrate species that may prefer these habitats. However, a dam may provide more habitats for species of macrophytes (eg waterlilies) and aquatic fauna that prefer deeper water. The construction of a relatively large permanent freshwater body may also have the positive effect of attracting water birds to the area.

1 INTRODUCTION

EWL Sciences was commissioned by EcOz Environmental Services to undertake an aquatic fauna study for an Environmental Impact Statement being prepared for the proposed Sunrise Aquaculture Estate at Point Ceylon in Bynoe Harbour.

The purpose of the study was to collect baseline data that will facilitate a description of the existing freshwater aquatic environments and assess the potential impacts of the proposed development on aquatic habitats and species.

Discussions with EcOz and investigation of proposed infrastructure maps (provided with the project brief) identified only one major freshwater aquatic system that may be affected by the development. A proposed dam is to be constructed on the lower reaches of a creek that flows into Bynoe Harbour (referred to as "The Broads" on topographic maps). Specific information on the location and design of the dam were not provided. EWL Sciences personnel conducted a survey of aquatic biota and habitats in the above creek in late April 2003.

The following report includes a description of the methodologies employed during the survey, a description of the aquatic habitats sampled and a list of species recorded during the survey. There is also discussion of the fauna in a regional context and an assessment of the potential impacts of the proposed development on aquatic species and habitats identified during the survey.

1.1 OBJECTIVES

Specific objectives of the study were to:

- conduct a late wet-season survey of freshwater aquatic fauna (macro-invertebrates and vertebrates) and freshwater aquatic habitats that may be affected by the proposed development;
- provide a list of species / taxa recorded during the survey; and
- assess the potential or anticipated impacts of the proposed development (construction and operation) on aquatic species and habitats identified during the survey.

2 METHODOLOGIES

2.1 SURVEY DESIGN AND LOCATION OF SURVEY SITES

Based on the proposed location of a freshwater dam, sites were selected so that freshwater habitats and fauna were surveyed both downstream and upstream of the proposed dam. Ideally, reference / control sites in a nearby-undisturbed catchment would also be surveyed, in order to assess potential impacts of the development in the future. However, due to the timing of the survey (early dry season), most ephemeral creeks had ceased to flow and accessibility in the area of the proposed development was difficult and thus control sites were not be sampled during the survey.

The survey creek is fed by a relatively small catchment that is less than 4km long from its origin to the start of the tidal influence. The creek is ephemeral, although there are several deep pools on the eastern branch of the creek that are likely to be permanent. At the time of the field survey, the creek was flowing well along a channel of 3-5 m wide, and incised about 1 m below the surrounding area. Four sites were surveyed; one just above the tidal influence (Site 1), one on the western branch of the creek (Site 2) and two on the eastern branch of the creek (Sites 3 & 4) (See Figure 1).

2.2 SAMPLING TECHNIQUES

2.2.1 Vertebrates

Vertebrate surveys were conducted during the day and for 2-3 hours after dark, in order to maximise the number of species (ie diurnal and nocturnal) recorded. The most common aquatic vertebrates are fish, which were mainly sampled using a dip net. Due to the small size of the creek, seine nets were not suitable for sampling. Baited traps and lines were used with limited success. A multi-panelled gill net was also set overnight in one of the deeper pools at Site 4. Other aquatic/semi-aquatic vertebrates (eg water monitors) were identified by visual observations during the daytime (assisted by polarised sunglasses) and with torches at night. Fish sampling techniques were approved by the EWL Sciences Animal Ethics Committee.

2.2.2 Invertebrates

Macroinvertebrate sampling followed national 'AUSRIVAS' methodologies (Lloyd and Cook 2001), developed during a national monitoring program, and considered to be best practice in macroinvertebrate sampling. This involved the collection of macroinvertebrates using a standard 250-micron mesh net. Sampling was undertaken in as many habitats as possible (e.g. edges, sand, macrophytes) in order to maximise the number of taxa recorded. Substrates were disturbed using a rake along a 10 m transect, with the net operated in sweeping motion downstream to capture organisms dislodged from substrate.

Samples were live-sorted in the field. This involved washing the contents of the net through a 250-micron sieve. The fraction of the sample retained in the sieve was then transferred to a white sorting tray and each sample was sorted for 30 minutes each by two operators (total 60 min/sample). Specimens were preserved (70% ethanol) in glass vials for later identification in the laboratory.

2.2.3 Water quality

Water temperature, pH, electrical conductivity (EC), salinity and dissolved oxygen were recorded at each sampling site using a field-calibrated Horiba W-22XD water quality instrument. Visual observations were also made of water clarity (turbidity) and flow.

2.3 FAUNA IDENTIFICATION

All vertebrates were identified in the field and no specimens were retained.

As specified by AUSRIVAS methodologies (Lloyd and Cook 2001), macroinvertebrates were identified to family level, except for Oligochaeta (Class), Acarina (Order) and Chironomidae (sub-Family). Identifications were performed in the laboratory using a dissecting microscope

and appropriate keys. All specimens were lodged with the Natural Resource Management Division, NT Department of Infrastructure, Planning and Environment.

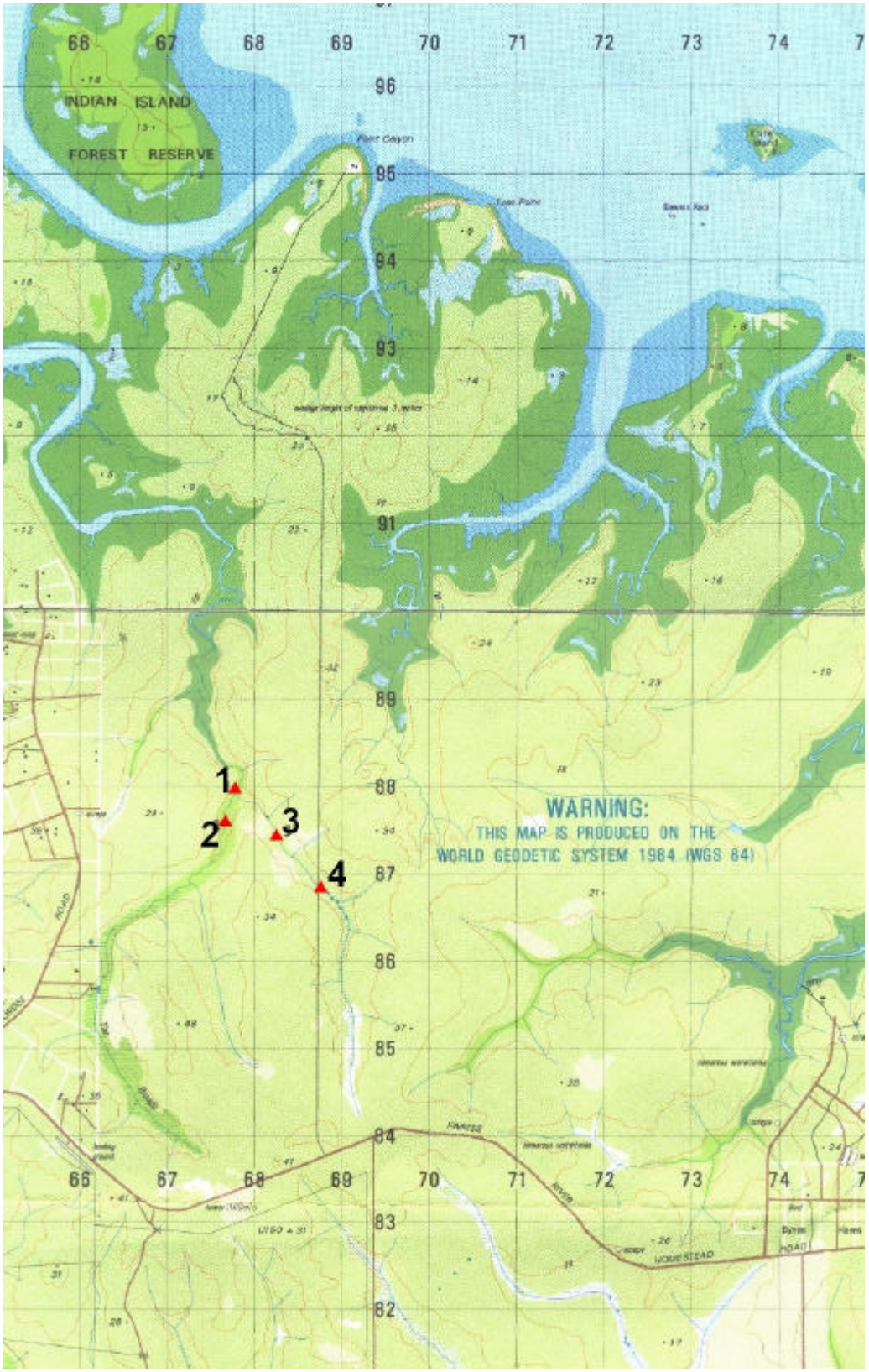

Figure 1. Map showing locations of sites on survey creek.

3 RESULTS AND DISCUSSION

3.1 SITE DESCRIPTIONS

Site 1

Site 1 is located approximately 30m downstream of the confluence of the east and west branches of the survey creek and 30m upstream of the tidal reaches (as indicated by the presence of mangroves). Common riparian elements included *Acacia auriculiformes* and *Melalueca* sp. The site is relatively open (<10 % canopy cover) and the substrate (sandy gravel, cobbles to 150mm) was covered in a dense layer of algae. No macrophytes were recorded at this site. The stream stretch is characterised by shallow (0.1m) runs and riffles. This site may occasionally be influenced by extreme high tides, as indicated by the slightly higher electrical conductivity (EC) recorded (Table 1).

Substrates sampled for macroinvertebrates included gravel beds.

Site 2

Site 2 is located on the west branch of the survey creek, approximately 500m upstream of Site 1 (Figure 1). The riparian zone of this site includes rainforest species, and canopy cover is higher than Site 1 (approx. 50% cover). The stream stretch is characterised by a series of shallow pools (depth to 0.5m) and short gravelly riffles. Macrophytes identified included *Nymphaea* sp. and *Eriocaulon setacuem*.

Substrates sampled for macroinvertebrates included bank edges and macrophyte beds.

Site 3

Site 3 is located on the east branch of the survey creek, approximately 1km upstream of Site 1 and 50m upstream of a shallow swampy area (Figure 1). Common riparian elements include *Pandanus spiralis, Melalueca* sp. and miscellaneous rainforest species. Canopy cover is similar to Site 2. The stream stretch is characterised by a series of shallow pools (depth to 0.5m) and short gravelly riffles. Macrophytes identified included *Eriocaulon setacuem*.

Substrates sampled for macroinvertebrates included bank edges, gravel and macrophyte beds.

Site 4

Site 4 is located on the east branch of the survey creek, approximately 1km upstream of Site 3, in the vicinity of the main access track (Figure 1). The stream stretch is characterised by a series of deep, permanent pools (depth to 2.5m) and shallow gravelly riffles. Common riparian elements include *Pandanus spiralis, Melalueca* sp. and miscellaneous rainforest species. Canopy cover is similar to Site 2. Dense macrophyte beds dominate the shallow areas and species identified include *Nymphaea* sp., *Nymphoides* sp., *Eriocaulon setaceum*, *Persicaria* sp. and *Cyperus* sp.

Substrates sampled for macroinvertebrates included bank edges, gravel and macrophyte beds.

3.2 WATER QUALITY

Table 1. Site locations and water quality parameters measured at sampling sites 1-4.

	1	2	3	4
GPS Coordinates (UTM Zone 52 WGS 84)	667802E 8587976N	667698E 8587603N	668276E 8587441N	668783E 8586847N
pH	6.03	4.73	5.35	4.59
DO	7.97	7.26	7.52	5.73
EC	48	17	17	14
Salinity	0	0	0	0
Temp	27.7	28.9	28.7	27.5

Water quality at all the sites was characterised by high dissolved oxygen levels, low turbidity (<15 NTU) and low EC values (Table 1). Slightly acidic pH levels are typical of Top End streams.

3.3 AQUATIC FAUNA

3.3.1 Vertebrates

A total of 8 species of aquatic/semi-aquatic vertebrates were recorded during the survey, including 6 fish species (Table 2). Site 4 had the highest diversity (5 species), with both non-fish vertebrate observations being at this site. It is likely that the permanent pools observed at Site 4 act as a dry season refuge when the remainder of the creek system dries out. Black-lined rainbowfish were the most abundant species, and were recorded at all sites. Empire gudgeon recorded at Site 1 are common in coastal waters around Australia and are known to tolerate near-brackish conditions (Larson and Martin 1989).

The number of species and the composition of the fish community recorded in the survey creek are similar to other freshwater systems in the region, as indicated by NT Museum database records. The species recorded are common throughout northern Australia and the relatively low diversity is also a common feature of small coastal creek systems in the region.

Table 2. Freshwater vertebrate fauna recorded at sampling sites 1-4

Species	Common Name	Site			
		1	2	3	4
Hypseleotris compressa	Empire gudgeon	✓			
Mogurnda mogurnda	Purple-spotted gudgeon			✓	✓
Melanotaenia nigrans	Black-lined rainbowfish	✓	✓	✓	✓
Toxotes chatareus	Common archerfish		✓		
Megalops cyprinoides	Tarpon		✓		
Neosilurus hyrtlii	Eel-tailed catfish				✓
Liasis fuscus	Water python				✓
Varanus mertensi	Water monitor				✓
	Total species	2	3	2	5

3.3.2 Invertebrates

A total of 30 invertebrate taxa were recorded during the survey, with the insect order Coleoptera (beetles) being the most diverse group (Table 3).

A total of 237 individual animals were collected at the four sites. The most consistently abundant group across all sites were mayflies from the order Baetidae. Diving beetles from the order Dytiscidae were also common at most sites. Site 3 had the highest taxonomic richness of any the sites, with 20 taxa recorded.

Although there have been no known surveys of macroinvertebrates in the Bynoe Harbour catchment, a comparison (at the same taxonomic resolution) with coastal systems surveyed in the Darwin Harbour catchment (Dostine 2002) shows that diversity in the stream surveyed in this study is slightly lower (mean number of taxa = 15) than that recorded from similar systems in the Darwin Harbour catchment (mean number of taxa = 20). However, this may be due to there being some considerably larger systems included in the Darwin Harbour surveys, which generally had higher numbers of taxa than the smaller systems (Dostine 2002).

Table 3. Macroinvertebrate fauna recorded at Sites 1-4.

Taxon	Site			
	1	2	3	4
PHYLUM ARTHROPODA				
CLASS CRUSTACEA				
Order DECAPODA				
Family Atyidae	1	4	5	2
Family Palaemonidae	4			6
Subclass COPEPODA			1	
CLASS ARACHNIDA				
Hydracarina				2
Oribatida				3
CLASS INSECTA				
Order EPHEMEROPTERA				
Family Baetidae	10	10	12	13
Family Caenidae	2		4	
Order DIPTERA				
Family Chironomidae				
Sub-family Chironominae		1	3	9
Sub-family Tanypodinae	2	9	14	2
Family Culicidae			1	1
Order TRICHOPTERA				
Family Hydroptilidae				
Oecetis sp.	4	1		
Family Ecnomidae			2	
Order HEMIPTERA				
Family Pleidae			1	
Family Corixidae	1	3	1	
Family Notonectidae		2		
Family Veliidae			1	
Order COLEOPTERA				
Family Elmidae	2			
Family Dytiscidae	1	13	14	9
Family Hydrophilidae				
Amphiops sp.		1	1	3
Berosus sp.		3	1	
Family Hydrochidae		4	8	6
Family Haliplidae		1		1
Family Hydra enidae			1	
Family Scirtidae				1
Family Gyrinidae	1			
Order ODONATA				
Sub-order ZYGOPTERA				
Family Protoneuridae		9	7	2
Sub-order ANISOPTERA				
Family Libellulidae		2	3	
Order LEPIDOPTERA				
Family Pyralidae				1
PHYLUM ANNELIDA				
CLASS OLIGOCHAETA			1	1
PHYLUM MOLLUSCA				
Class GASTROPODA			3	
TOTAL No. Taxa	10	14	20	16

3.4 AQUATIC SPECIES AND HABITATS OF CONSERVATION SIGNIFICANCE

None of the vertebrate or invertebrate aquatic fauna or habitats identified during the survey is listed for conservation significance under local (PWCNT Threatened Species List), national (EPBC Act – Threatened Species or Ecological Communities) or international (RAMSAR-Directory of Important Wetlands) conventions. The system does not appear to be significant in a regional context, with diversity of both vertebrate and invertebrate fauna being relatively low. However, the permanent waterholes in the vicinity of Site 4 offer refuge habitat to aquatic fauna when most of the stream dries late in the dry season, and are therefore of conservation interest at a local level.

3.5 POTENTIAL IMPACTS ON AQUATIC FAUNA AND HABITATS

The most likely impacts of the proposed development on freshwater aquatic systems are associated with the construction of roads and a freshwater dam. Unless appropriate erosion and dust control measures are implemented (e.g. silt fences, revegetation of disturbed areas, dust suppression), the initial construction of these infrastructures could lead to increased turbidity and sedimentation in the creek during the first rains following construction. Increased turbidity could negatively impact macrophytes by reducing their photosynthetic capacity.

The construction of a freshwater dam at the lower freshwater reaches could prevent some marine-breeding species (eg tarpon - *Megalops cyprinoids;* freshwater prawns - *Macrobrachium* sp.) from migrating upstream of the estuarine system. Localised flooding is also likely to result in the loss of riffle (shallow, fast flowing) habitats and invertebrate species that may prefer these habitats. However, a dam may provide more habitats for species of macrophytes (eg waterlilies) and aquatic fauna that prefer deeper habitats. The construction of a relatively large permanent freshwater body may also have the positive effect of attracting water birds to the area.

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APPENDIX A: SITE PHOTOGRAPHS

Plate 1. Site 1, looking upstream

Plate 2. Site 2, looking downstream

Plate 2. Site 3, looking downstream.

Plate 4. Site 4, showing gill net

Plate 5. Confluence of east and west branches of survey creek, looking upstream.

Plate 6. Macrophytes (*Eriocaulon setaceum*) Site 2.

Plate 7. Trapped water monitor (*Varanus mertensi*) Site 4.

Plate 8. Live-sorting invertebrates.