SUNWATER

NATHAN DAM AND PIPELINES PROJECT

POST-WET SEASON FIELD SURVEY: AQUATIC FLORA AND FAUNA COMPONENT

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1 Introduction

1.1 Background

The Nathan Dam and Pipelines Project is the construction and operation of Nathan Dam at 315.3 km AMTD on the Dawson River (approx 25° 29'S 150° 09'E) in central Queensland. The Project also includes a pipeline to the Surat Basin to supply the coal mining and power generation sectors.

An Impact Assessment Study (IAS) on the site was released in October 1997. At that stage a number of Full Supply Levels (FSLs) were still being considered, from 170 m to 185 m. Further, the dam wall location was originally at 314 km AMTD, but was moved to 315.3 km AMTD in order to avoid sensitive areas near the proposed wall.

The 185 m AHD FSL option at 315.3 km AMTD has been selected as the preferred option for the current investigation. This will create an 880,000 ML storage which will flood 75 km of the Dawson River.

This report outlines field survey and data reporting tasks of the 'Post-Wet Season Aquatic Flora and Fauna' component of the Project. The data and report will provide the basis for possible replication of the work and will serve as input to the Existing Environment component of the EIS.

1.2 Project Aims

The aim of the 'Post-Wet Season Aquatic Flora and Fauna' component of the Project was to undertake standard field surveys across the range of parameters, including:

- Aquatic habitat
- Water quality
- Macrophytes
- Fish
- Turtles
- Aquatic mammals, and
- Macroinvertebrates.

The survey design and reporting was designed by SunWater to allow replication at a future date without the need to refer to other information. Representative habitats from sites within, upstream, and downstream of the dam sites provided semi-quantitative or quantitative data where possible and were appropriate to the species or community, using standard approaches.

The habitats surveyed included instream main channel and tributary habitats as well as offstream and floodplain habitats such as lakes, billabongs or other wetland types if they exist.

2 Survey Design Description

2.1 Study Area

Eighteen permanent or intermittent tributaries enter the proposed inundation area, the largest being Cockatoo Ck. These tributaries include:

- Kungay Mungay Ck
- Palm Tree Ck
- Scotchy Ck
- Grass Tree Ck
- Blackboy Ck
- Double Stable Yard Gully
- Scrubby Ck
- Bentley Ck
- Binghi Ck
- Spring Gully
- Cockatoo ck
- Spring Ck

The natural river channel of the Dawson River is characterised by a series of long and deep relatively permanent pools. The middle and lower reaches are long and winding and are characterised by very low gradient (from the upstream limit of the proposed dam to its junction with the Fitzroy River, the fall is 150 m over 425 km).

The Nathan Gorge area is not related to falls or rapids, but to a narrowing of the floodplain as the river cuts through different bed material. The existing Glebe Weir would be flooded by the dam. Gyranda Weir and Orange Creek Weir exist some 30 and 45 km downstream respectively. When full, Gyranda Weir backs up through the gorge to the dam site. The weirs are not fitted with fishways.

The storage will back up to the town of Taroom, the only town in the immediate catchment, and will extend into several tributaries.

2.2 Site Locations

Sixteen sites were chosen for survey, representing habitats in the main Dawson River channel, tributaries, and floodplain wetlands, within and outside the inundation area.

The following sites were intended to be sampled:

- 1 site above the inundation area on the main channel (site 1)
- 4 sites within the inundation area on the main channel (sites 2 – 5)
- 2 sites below the dam on the main channel (sites 6 & 7)
- 4 sites on tributaries above the inundation area (sites 8 –11)

- 4 sites on tributaries within the inundation area (site 12 – 15)
- 1 site below the dam on a tributary (site 16)

Sites were selected in consultation with relevant agencies and researchers that work in the area. The same site locations shall be used for the post wet season sampling. Several sites could not be sampled during the pre wet season program due to the presence of both dry and flooded sites due to extreme weather conditions.

Site locations are presented in Figure 1, and access information is presented in Table 1.

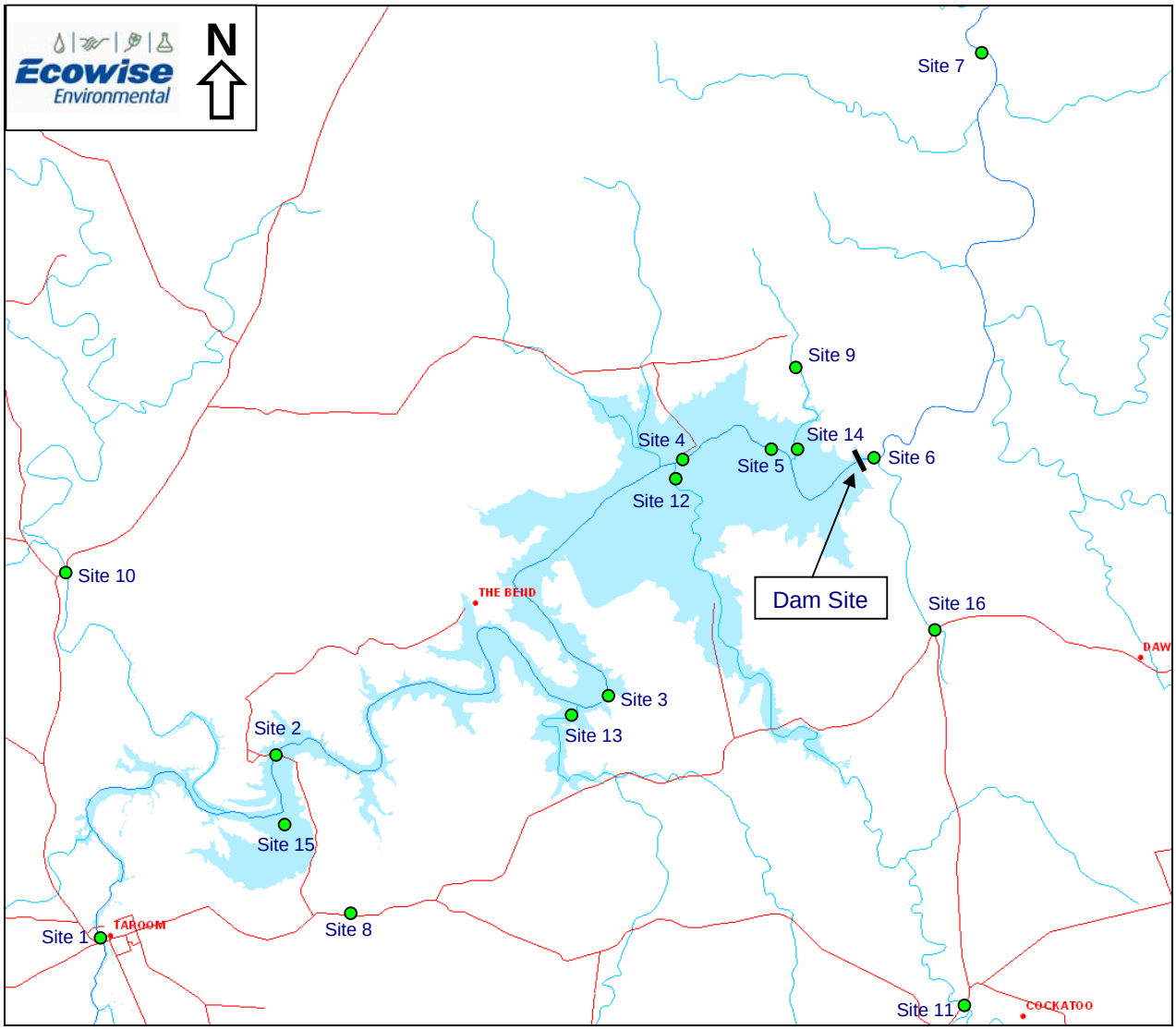

Figure 1: Site locations for the Aquatic Flora and Fauna Component of the Post Wet Season Field Survey for Nathan Dam and Pipelines, 2008.

Table 1: Site locations and access details, Post-Wet Season Aquatic Flora and Fauna Survey Sites – June 2008.

Site	Site Name	Driving Directions	GPS Position (UTM WGS 84 Zone 55/56)	
			Easting	Northing
1	Dawson River upstream of inundation area	Travel along Dawson St south out of Taroom, heading towards Theodore. Turn right before the Leichhardt Highway intersection, onto the old road (past a truck rest area with garbage bins etc.). Follow the road down to the old bridge crossing for access to the river. Site is downstream from the bridge	780340 (25º 38' 35")	7160879 (149º 47' 32")
2	Dawson River within of inundation area.	Follow Taroom St (Main St of Taroom) to the east. Veer left onto Cracow Rd at the end of Taroom St (where it takes a hard right-hand turn towards Wondoan). Follow Cracow Rd for approximately 8 km before turning left into Bundulla Rd, which is signposted. Follow Bundulla Rd to the River Crossing (site lies both upstream and downstream of the crossing).	787792 (25º 34' 20")	7168572 (149º 51' 53")
3	Dawson River at 'The Bend'	Travel along Dawson St south out of Taroom, turning right at the Leichhardt Highway intersection (heading towards Theodore). Follow the Leichhardt Highway for approximately 27 km before turning right onto Glebe Weir Rd (signposted). Follow Glebe Weir Rd for approximately 8.2 km before turning right onto The Bend Rd (signposted). Follow The Bend Rd for approximately 8.9 km, before veering left at the entrance to 'The Bend' property. Drive on the track 7.4km to site past the homestead, sheds and horse yard, and access the paddock on the right-hand (southern) side via a steel gate. Follow the farm track down to the river.	198844 (25º 33' 06")	7170601 (149º 58' 27")
4	Dawson River at Glebe Weir	Travel along Dawson St south out of Taroom, turning right at the Leichhardt Highway intersection (heading towards Theodore). Follow the Leichhardt Highway for approximately 27 km before turning right onto Glebe Weir Rd (signposted). Follow Glebe Weir Rd for approximately 26 km to the Glebe Weir camping facilities and boat ramp.	201694 (25º 27' 52")	7180309 (150º 02' 00")
5	Dawson River at Becker Property	Travel along Dawson St south out of Taroom, turning right at the Leichhardt Highway intersection (heading towards Theodore). Follow Glebe Weir Rd for approximately 20 km to the point where the paved Glebe Weir Rd veers to the right. Continue straight ahead on Spring Ck Rd (dirt road). Follow this road for 3.1 km, and then veer right onto the driveway of the Becker's property. Access river via farm tracks through gates past the house and shed.	205539 (25º 27' 35")	7180895 (150º 04' 18")
6	Dawson River at Forrest Site	Travel along Dawson St south out of Taroom, turning right at the Leichhardt Highway intersection (heading towards Theodore). Follow Glebe Weir Rd for approximately 20 km to the point where the paved Glebe Weir Rd veers to the right. Continue straight ahead on Spring Ck Rd (dirt road). Follow this road for 3.1 km, and then veer right	210022 (25º 27' 58")	7180291 (150º 06' 58")

Site	Site Name	Driving Directions	GPS Position (UTM WGS 84 Zone 55/56)	
			Easting	Northing
		onto the driveway of the Becker's property. Access river via farm tracks through gates past the house and shed. Go through gate into an area of remnant vegetation, turn right toward river, along fenceline to intersection, turn left to site. Walk approx 200m downstream to site.		
7	Dawson River at Gyranda Weir	This site is on jprivate property and prior access must be organised to borrow key from Gyranda Homestead for locked gates. Follow Taroom St (Main St of Taroom) to the east. Veer left onto Cracow Rd at the end of Taroom St (where it takes a hard right-hand turn towards Wondoan). Follow Cracow Rd to the township of Cracow. Turn left (west) onto Eidsvold Theodore Rd. Follow for approximately 11 km, turn left (west) onto Gyranda Rd and follow to the Gyranda homestead. Get key from owner and head back out onto road. Access trac is through locked gates on right.	216080 (25º 17' 09")	7200419 (150º 10' 50")
8	Blackboy Creek at Cracow Rd	Follow Taroom St (Main St of Taroom) to the east. Veer left onto Cracow Rd at the end of Taroom St (where it takes a hard right-hand turn towards Wondoan). Follow Cracow Rd for approximately 11.5 km. Site is downstream from the Cracow Rd Crossing.	792221 (25º 37' 59")	7161742 (149º 54' 37")
9	Spring Creek at Becker Property	Travel along Dawson St south out of Taroom, turning right at the Leichhardt Highway intersection (heading towards Theodore). Follow Glebe Weir Rd for approximately 20 km to the point where the paved Glebe Weir Rd veers to the right. Continue straight ahead on Spring Ck Rd (dirt road). Follow this road for 3.1 km, and then veer right onto the driveway of the Becker's property. Access river via farm tracks through gates past the house and shed. Go through gate and follow track to pumping station, which is at the site.	207094 (25º 26' 11")	7183533 (150º 05' 16")
10	Palm Tree Creek at Leichhardt Hwy	Travel along Dawson St south out of Taroom, turning right at the Leichhardt Highway intersection (heading towards Theodore). Follow the highway for approximately 15 km. Site is downstream of the bridge crossing of Palm Tree Creek. Site can be accessed from the bridge crossing, or by turning right (east) onto a dirt road and walking from there.	779241 (25º 29' 52")	7177001 (149º 46' 40")
11	Cockatoo Creek at Nathan Rd	Follow Taroom St (Main St of Taroom) to the east. Veer left onto Cracow Rd at the end of Taroom St (where it takes a hard right-hand turn towards Wondoan). Follow Cracow Rd for approximately 13.5 km. Turn right onto Cockatoo Rd, follow this road until it ends in a T-intersection. Turn left at the T-intersection onto Nathan Rd. Follow Nathan Rd for approximately 1.5 km to the Cockatoo Creek Crossing. Site is	213986 (25º 40' 28")	7157268 (150º 09' 02")

Site	Site Name	Driving Directions	GPS Position (UTM WGS 84 Zone 55/56)	
			Easting	Northing
		downstream from the bridge.		
12	Cockatoo Creek upstream confluence with Dawson River	Travel along Dawson St south out of Taroom, turning right at the Leichhardt Highway intersection (heading towards Theodore). Follow the Leichhardt Highway for approximately 27 km before turning right onto Glebe Weir Rd (signposted). Follow Glebe Weir Rd for approximately 26 km to the Glebe Weir camping facilities and boat ramp. Travel by boat approximately 500 m upstream from the mouth of Cockatoo Creek to the site (be careful of submerged logs).	201530 (25º 28' 13")	7179656 (150º 01' 54")
13	Bentley Creek at Bentley Property	Follow Taroom St (Main St of Taroom) to the east. Veer left onto Cracow Rd at the end of Taroom St (where it takes a hard right-hand turn towards Wondoan). Follow Cracow Rd for approximately 21 km, then turn left onto 'The Bentley' property. Follow the driveway to the homestead. Proceed through gates and follow farm track along fenceline. Track turns left thru gates, go through then turn right. Travel through tall grass approximately 10m out from fenceline. Track not visible fro about 20m. Follow to site, left fork immediately before site.	800482 (25º 33' 38")	7169597 (149º 59' 26")
14	Spring Creek at farm track	Travel along Dawson St south out of Taroom, turning right at the Leichhardt Highway intersection (heading towards Theodore). Follow Glebe Weir Rd for approximately 20 km to the point where the paved Glebe Weir Rd veers to the right. Continue straight ahead on Spring Ck Rd (dirt road). Follow this road for 3.1 km, and then veer right onto the driveway of the Becker's property. Access river via farm tracks through gates past the house and shed (refer to Figure 2.2). Head south along the track, turn left (east) at the river near Site 5. Follow the track to the crossing of Spring Creek.	207210 (25º 27' 40")	7180795 (150º 05' 18")
15	Scotchy Creek	Follow Taroom St (Main St of Taroom) to the east. Veer left onto Cracow Rd at the end of Taroom St (where it takes a hard right-hand turn towards Wondoan). Follow Cracow Rd for approximately 5 km, then turn left onto Brae Lane and enter 'The Brae' property. Go through a double gate and follow the track north towards the river. Before the river (with a pump), enter a wire gate and drive east along the fence line (following the Dawson River) until you reach the creek. The site will be on your left.	788041 (25º 35' 45")	7165967 (149º 52' 04")
16	Price Creek at Cracow Rd	Follow Taroom St (Main St of Taroom) to the east. Veer left onto Cracow Rd at the end of Taroom St (where it takes a hard right-hand turn towards Wondoan). Follow Cracow Rd for approximately 40 km. The site is upstream of the road, just past the Nathan Rd turn-off to the right.	212761 (25º 31' 54")	7173085 (150º 08' 31")

3 Methodology

The methods used were based upon the project brief (No. 08SW3512) developed by SunWater. Wherever possible, the field team aligned field sampling methods with those used during the dry season sampling program to allow for direct comparability of data.

Blank copies of the Ecowise fieldsheets used during the survey are presented in **Appendix A**.

3.1 Aquatic Habitat Description

The field team used standardised habitat assessment procedures to describe habitat characteristics at all sites, including those sites found to be dry. The field sheets used included:

- State of the Rivers fieldsheets 3, 4, 5, 7, 8, 9 & 10, and
- Modified QLD AUSRIVAS field sheets.

A copy of all completed State of the Rivers fieldsheets is presented in **Appendix B**.

Digital photographs were taken at a number of locations at each site to provide a broad overview and also to highlight the main habitats present.

Sites surveyed were also GPS located and marked in both latitude/longitude and eastings/northings in WGS 84 format.

3.2 Water Quality

Water quality was measured at each site in terms of *in situ* spot measurements, vertical profiles at greater water depths, short term (minimum 12 hours) data logging at selected sites, and laboratory analysed samples at selected sites.

3.2.1 *In situ* spot measurements

In situ water quality measurements were collected by the field team at each site using a current model Hydrolab Minisonde MS5a multiparameter water quality meter coupled to Surveyor 4 display. This unit was calibrated in the laboratory in accordance with Ecowise quality systems requirements and the manufacturers specifications prior to deployment in the field. Calibration standards were also carried with the field team to conduct spot checks on the unit throughout the course of the field program to ensure accuracy and reliability of the results.

In-situ measurements included:

- water temperature (ºC),
- pH,
- electrical conductivity (µS/cm),
- dissolved oxygen (mg/L and %saturation) and
- turbidity (NTU).

In addition, several other measurements were recorded at each site, including:

- Secchi depth (m) was measured using a standard secchi disk, where possible.
- Velocity was measured using a calibrated hand held OTT C velocity meter, within the flowing water riffle/run habitats.

3.2.2 Vertical profile measurements

Vertical profile measurements were collected using the Hydrolab water quality meter at regular depth increments of 0.5m, commencing as near as possible to the surface, at each site.

3.2.3 Short term data logging

Logger-based measurements were collected at selected sites overnight using the Hydrolab water quality meter. The Hydrolab was mounted on a stake or tied to a secure object to ensure the probes were no deeper than 30cm from the water surface, and configured to log all parameters at a minimum frequency of 30 minutes for a minimum of 12 hours overnight (24 records).

3.2.4 Laboratory analysed measurements

Samples were collected from a selection of sites across one day and couriered overnight to the laboratory for analysis. The Australian Laboratory Service (ALS) in Brisbane was sub-contracted to complete the sample analysis. The samples were analysed for the following:

- Electrical Conductivity (µS/cm),
- Total Suspended Solids (mg/L),
- Salinity (Estimated TDS via calculation, mg/L),
- Turbidity (NTU),
- Total Hardness (Calcium Hardness & Magnesium Hardness, mg/L),
- Alkalinity ($CaCO_3$, mg/L),
- Total Nitrogen (inc. NO_X & TKN) plus NO_2, NO_3, NH_3,
- Total Phosphorus and Reactive Phosphorus,
- Phenoxy Acid herbicides (µ/L), Glyphosate &AMPA (µ/L),
- Organo-chlorine (OC) and Organo-phosphorus (OP) pesticides (µg/L),
- Faecal Coliforms (MPN),
- a full total metal scan (ICP/MS) , and
- Mercury.

Water samples were collected from approximately 20 cm below the water surface in the appropriate bottles supplied by ALS.

3.3 Macrophytes

Macrophytes were recorded as per the project brief and using assessment methods developed by Queensland Department of Natural Resources and Mines, and included

- emergent, submerged and floating macrophytes (as defined in Sainty and Jacobs, 2003),
- macroscopic algae, and
- the presence of any introduced or pest plants.

Macrophyte diversity and abundance was limited at all sites, therefore, the full application of sampling methods was reduced. The belt transect method (10m x 100m) was not used at any river or creek site due to a lack of macrophyte cover. All sites were assessed via observation only across the reach.

Each site was assessed for:

1. Total area covered by aquatic macrophytes at each site;
2. Total area covered by submerged, emergent and floating aquatic vegetation at each site;
3. Percent cover of any of the listed rare and threatened aquatic macrophyte species under the Queensland *Nature Conservation Act (1992)* as listed in the Nature Conservation (Wildlife) Regulation (2006), or under the Commonwealth *Environment Protection and Biodiversity Conservation Act (1999)*;
4. Percent cover of all noxious aquatic weeds under the Queensland *Land Protection (Pest and Stock Route Management) Act 2002*;
5. Percent cover of all species with cover exceeding 10% of the area of each site (defined as the area of the channel);
6. Characteristics of the site e.g. depth, substrate and morphology; and
7. Pictorial record of each site.

Percent cover refers to the area of substrate (bed or bank) covered by vegetation. Due to the physical overlap of emergent, floating and submerged growth forms, total percent cover could exceed 100%.

Photographs of macrophytes were taken at each site and species were identified in the field, where possible. Where confirmation of a species was required, a representative sample was collected and pressed for later identification in the laboratory. The Census of Queensland Flora 2007 (Queensland Herbarium 2007) was used to classify macrophytes as native or exotic.

3.4 Macroinvertebrates

3.4.1 Sample collection

Only QLD AUSRIVAS accredited biologists were used to collect aquatic macroinvertebrate samples. Sampling was conducted using ISO (1983) design dip nets and a surber sampler with 250 micron mesh for sample collection. Nets were washed thoroughly between sampling events to remove any macroinvertebrates retained on them. Macroinvertebrates were collected from four main habitats, including:

- Macrophytes,
- Tree Root,
- Riffle and/or glide, and

- Edge.

Macrophyte and tree root samples were collected separately using a dip net. Samples were collected by sweeping the dip net in and around the habitat for approximately 20 seconds. Two samples were collected from each of these habitats, where available.

Riffle and/or glide habitat samples were collected using the dip net, with a kicking motion ("square foot samples"). The net was placed immediately downstream of the sample area. The sampler then kicked their feet disturbing the substrate, making sure to dislodge stones and other debris. Animals dislodged by this process were carried by the current into the net. Five replicate samples were collected from this habitat type, where available.

Edge samples were collected using the surber sampler. The surber sampler was placed in the watercourse approximately a few centimeters from the edge adjacent to deep pools. Samples were collected by disturbing the substrate by hand within the surber enclosure and sweeping dislodged animals into the net attached to the side. Five replicate samples were collected from this habitat type.

Samples were wholly preserved in isopropyl alcohol in the field, bagged and clearly labelled with information including site, habitat, sampling method, date and sampler. Samples were then transferred to the Ecowise Brisbane Laboratory for processing and identification.

3.4.2 Sample Tracking

Upon return to the laboratory, each sample was logged into Ecowise's sample registration system and allocated a unique identifying number so that each sample could be traced through the laboratory.

3.4.3 Sample Identification

Macroinvertebrates were examined using Leica MZ9 stereo-dissection microscopes with planachromat objectives and a zoom capability between 6.3x and 60x. A digital camera is also attached to allow for the production of a photographic reference collection, should this be required.

Macroinvertebrates were identified to Family level with the exception of Oligochaeta (to class), Ostracoda, Cladocera, Copepoda (to subclass), Acarina (to order), Nematoda (to phylum) and Chironomidae (to subfamily) in accordance with QLD AUSRIVAS protocols (NR&M, 2001). Ecowise has an extensive library of reference texts and published identification guides following Hawking (2000), as well as in-house working keys.

Samples which were particularly bulky with debris and organic matter were sub-sorted using a Marchant subsampler (Marchant, 1989). The sub-sampling box comprises 100 cells and the sample was placed into the box and agitated until evenly distributed. The contents of individual, randomly selected cells were then removed via a vacuum pump and sorted. Every effort was made to sub-sort a minimum of 25%, although 4 of the 66 samples collected contained a very high portion of animals or debris therefore resulting in the selection of a smaller percentage to be sub-sampled and processed within a reasonable time frame (maximum 4 hours).

Macroinvertebrate data was directly entered into a Microsoft ® Excel spreadsheet by use of laboratory laptops and specialised Ecowise counting software. This process is the preferred method of entering data (as opposed to manual hard copy sheets) as it removes several steps where errors can occur when transcribing the data.

Upon completion of identification, all samples were returned to 70% ethanol plus 5% glycerol for long-term archiving. This process allows samples to be re-examined at a later date if required. This may be important, particularly if the taxonomy changes significantly in the future under a long-term monitoring program.

Opportunistic sightings and/or by-catch from other aquatic sampling methods (i.e. bait traps) of macroinvertebrates were also recorded, such as large freshwater mussels and crustaceans.

3.5 Fish

Sampling for fish included a number of methods:

- Electrofishing – boat and backpack
- Fyke nets
- Gill nets
- Bait traps
- Seine nets

Only gear types appropriate to the characteristics of each site being sampled were deployed.

3.5.1 Electrofishing – boat and backpack

Queensland DPI – Mackay (Queensland Fisheries Service) were sub-contracted to conduct the electrofishing component of the Aquatic flora and fauna survey work for Ecowise which was undertaken in strict accordance with the Australian Code of Electrofishing Practice (1997).

Sampling methods were as follows:

- Boat Electrofishing method: 12 passes of 5 minutes each duration, totaling 60 minutes of effort.
- Backpack Electrofishing method: 8 passes of 10 minutes each duration, totaling 80 minutes of effort.

Once immobilised, fish were collected from the water using a dip net or equivalent, and temporarily stored for identification, examination and recovery before being released. All visible fish were collected, and “blind netting” was used to overcome the limited visibility of fish in the turbid waters of some sites. The total numbers per species of fish was recorded, along with fork lengths (or total lengths for species with convex or truncate caudal fins) for a minimum of the first 20 of each species caught.

3.5.2 Fyke nets

Up to two fyke nets were used at sites with sufficient width of waterway and a depth of between 0.5m-1m. Nets were set with the entrance facing downstream, parallel to the bank, and as independently as possible. Nets were set as close as possible to dawn or dusk, and were removed after 4 hours of operation so as to standardise the data as catch per unit effort. Fish captured were identified and processed immediately as discussed below in Section 3.5.6 Data collection for all gear types.

3.5.3 Gill nets

Two weighted multipanel gill nets (25m long x 3m drop) were used at sites with sufficient depth and width. Gill nets were set as close as during dusk and/or dawn. Sampling effort will be in align with the pre-wet survey.

The field team remained in sight of the gill net, and regularly cleared the net of fish, ensuring no turtles or other air-breathing species became trapped. Fish were identified and processed immediately as discussed below in Section 3.5.6 Data collection for all gear types.

3.5.4 Bait traps

Ten collapsible bait traps were used at sites with suitable water depths. They were baited with cat biscuits and set adjacent to the bank and suitable fish habitats (i.e. vegetation, snags etc.). The nets were set for a period of 4 hours so as to standardise the data as catch per unit effort.

Any fish, prawns or crayfish caught in the traps were identified and the number of each species recorded. Catches from each trap were recorded separately.

3.5.5 Seine Netting

Seine netting was carried out at suitably shallow sites, contingent upon substrate type and the amount of snags present. The field team used a 7m x 2m long seine net with a mesh size of 5mm.

The seine netting technique involved a person wading out into the water with one end of the net then turning back into the shore in a horseshoe formation, while a second person remained on the shore holding the other end of the net. The net was then slowly dragged into the shore, and fish and other by-catch removed for identification and processing. Up to 5 seines were collected depending on site characteristics and the ability to use other methods.

3.5.6 Data collection for all gear types

For all gear types, all fish caught were identified and counted, with up to 20 individuals of each species measured (fork length) and wounds, lesions and deformities recorded if present. Native fish were released alive wherever possible. If introduced fish were collected, they were euthanased and disposed of in accordance with the Ethics Permit.

Ecowise (CA 2007-104-186) and DPI have current Ethics Permits for the scientific collection of fish using all the techniques described above. Ecowise is also a “Scientific Use” registered company with DPI (#36) under the QLD *Animal Care and Protection Act (2001)*.

3.6 Turtles

Turtles were targeted at all sites using large hoop-net baited turtle traps, set for a standard 2 hour period generally late afternoon. A total of 5 traps were set throughout each site and were closely monitored to ensure turtles or other air-breathing species did not become entangled or trapped.

At each site attempts were made to deploy the traps within a variety of habitats present. This generally involved placing the traps in the vicinity of snags, overhanging vegetation, rock outcrops, weed beds in the main channel, and in backwater ponds characterised by limited flow and extensive weed beds. Preference was given to deeper pools although traps were also set in shallower areas, including in the vicinity of runs/glides.

At each site traps were baited with sardines. Sardines were placed in a stocking and hung within the trap. Captured turtles were removed from the traps and placed in cotton bags where they were kept for a maximum of 30 minutes until processed before returning to their point of capture.

Turtles were identified using the key to freshwater turtles provided by Cogger (2000), and supported by historical data present in the pre-wet aquatic survey conducted by FRC. Taxonomy followed that of Georges and Adams (1992).

Ecowise have a current Ethics Permit (CA 2008-04-261) for the scientific collection of turtles using the technique described above.

3.7 Aquatic mammals and other reptiles

While they were not directly targeted during this field program, aquatic mammals and other reptiles were recorded by opportunistic sightings or incidental capture only.

4 Data Summaries

4.1 Sampling Effort

A comparison of the sampling effort applied to each pre- and post-wet sampling program is presented in Table 2.

Table 2: Comparison of field methods sampling effort for both pre- (Dec 2007) and post-wet (May 2008) field surveys.

Site	Date	SOR Fieldsheets	Water Quality				Macroinvertebrates				Fish						Turtles
			In situ	Vertical Profile	O/N Logging	Lab. analysis	Edge	Riffle	Tree Roots	Macrophytes	Fyke Netting	Bait Traps	Seine Netting	Gill Netting	EF Boat	EF Backpack	Traps
1	Nov-2007		✓	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	17-Jun-08	✓	✓	✓	✓	✓	5				1	10			✓	·	
2	27-Nov-07	✓	✓				5	5	2	2		10	3		·	✓	5
	21-Jun-08	✓	✓	✓	✓	✓	5	5	1		1	10	3		·	✓	5
3	Nov-2007		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	18-Jun-08	✓	✓	✓		✓	5					10		2	✓	·	5
4	29-Nov-07	✓					5					10			✓	·	5
	22-Jun-08	✓	✓	✓	✓	✓	5		1	1	1	10	3	1	✓	·	5
5	Nov-2007		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	24-Jun-08	✓	✓	✓	✓	✓	5		1			10			✓		5
6	Nov-2007		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	23-Jun-08	✓	✓	✓		✓	5		2			10					5
7	Nov-2007		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	19-Jun-08	✓	✓	✓			5		1		1	10	3		✓		5
8	30-Nov-07	✓	✓				5		2			10	2			✓	5

Site	Date	SOR Fieldsheets	Water Quality				Macroinvertebrates				Fish						Turtles
			In situ	Vertical Profile	O/N Logging	Lab. analysis	Edge	Riffle	Tree Roots	Macrophytes	Fyke Netting	Bait Traps	Seine Netting	Gill Netting	EF Boat	EF Backpack	Traps
	20-Jun-08	✓	✓				2					4					
9	Nov-2007		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	24-Jun-08	✓	✓	✓			5					10	2			✓	2
10	Nov-2007		✓	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	18-Jun-08																
11	Nov-2007	✓															
	21-Aug-08																
12	29-Nov-07	✓					5		2	2		10			✓		5
	22-Jun-08	✓	✓	✓	·	✓	5					10		1	✓		5
13	Nov-2007		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	20-Jun-08	✓	✓	✓	✓	·	5		2			10	2		✓		5
14	Nov-2007		**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
	23-Jun-08																
15	Nov-2007	✓															
	21-Jun-08																
16	Nov-2007	✓															
	21-Jun-08																

Note:

	Site dry	**	Site flooded, unsafe to sample

4.2 Aquatic Habitat Description

A summary of the aquatic habitat present at each site as recorded on the State of the Rivers fieldsheets is presented in Table 3.

Table 3: A summary of the State of the Rivers fieldsheets for each site, Post-Wet Season Aquatic Flora and Fauna Survey Sites – May 2008.

Reach	Description	Photograph
Site 1 Dawson River upstream of inundation area, at the Leichhardt Hwy crossing	This site comprised a relatively narrow (11m) but deep (2m) pool. Both banks were currently stable with gentle sloping banks, good vegetation coverage, and no obvious erosion or slumping present. The riparian vegetation was relatively wide (30m) with Eucalypts and Melaleuca's dominating. No macrophytes were present, however, water clarity was very low. Overhanging vegetation provided some shade and a source of organic matter to the river.	 Facing upstream to old bridge (17/06/2008)
Site 2 Dawson River within of inundation area, at the Bundulla Rd crossing..	This site recorded the greatest diversity of habitats across all sites, including slow flowing pool environments, fast flowing riffle/run/glide zones, and backwaters, Some erosion was evident around fallen logs within the river, and along the banks where stock have access. The riparian zone was narrow (avg. 5m both sides) and was dominated by a variety of Eucalypts and Melaleuca's. Few macrophyte species and the presence of filamentous algae were recorded at this site. There were a variety of substrate classes including boulders and cobbles in the riffle section, to sand and silt deposits along the edges and in the backwater zones.	 Facing downstream at riffle zone (21/06/2008)

Reach	Description	Photograph
Site 3 Dawson River within the inundation area, at 'The Bend'	This site comprised a large (estimated 50m wide) deep (+3.5m) pool habitat and small backwater. Moderate disturbance was recorded at this site due to much of the adjacent land cleared for grazing. Although there is a general reduction of natural vegetation, the gentle slope of the banks reduces the degree of instability and erosion potential at this site. There was a general lack of a range of aquatic habitat types at this site.	 Facing downstream (18/06/2008)
Site 4 Dawson River within the inundation area, at Glebe Weir	Essentially a pool habitat with relatively stable water levels existed at this site due to the impoundment from the weir. The banks showed slight signs of degradation around fallen trees, and aggradation along the bank edges. A boat ramp exists at this site suggesting a popular recreational area, therefore the site may be regularly impacted by visitors. No macrophytes were recorded from this site within the water column although water clarity was very poor.	 Facing downstream (22/06/2008)
Site 5 Dawson River within the inundation area at Becker Property, downstream of Glebe Weir.	Downstream of the weir there was a large pool habitat of approximately 9m wide. Essentially most of the riparian vegetation had been cleared, more so on the left bank than the right, leaving much of the banks bare of vegetation. Evidence of erosion and aggradation was observed at irregular points along the site and around fallen trees and branches instream. Water clarity was poor, and only rushes/sedges were observed growing along the edge in a small patch, no other macrophyte species.	 Facing downstream (23/06/2008)

Reach	Description	Photograph
Site 6 Dawson River within the inundation area at Forrest Site	A pool environment exists at this site, with a large section of the reach as a backwater. The banks support Eucalypts and Meleleuca species reducing the potential for erosion, and providing some canopy cover and shade over the river channel. No macrophyte species were recorded for the site, although fallen branches and logs provide some aquatic habitat.	 Facing upstream (23/06/2008)
Site 7 Dawson River downstream of proposed dam site at Gyranda Weir	This site comprised of a large (80m wide) and very deep (+6m) pool, with a lack of a variety of aquatic habitats. Many dead tree trunks are standing within the pooled water. The banks remained stable, with gentle slopes and a high cover of Eucalypt and Meleleuca species. Very limited macrophtye growth was observed at this site.	 Facing upstream (19/06/2008)
Site 8 Blackboy Creek at Cracow Rd	This site recorded two isolated drying pools only during the post-wet survey. Very poor habitat instream exists at this site, although exposed tree roots, fallen logs, cobble/pebble substrates observed above the existing water mark would provide habitat during higher water levels. Grasses dominate the understorey in the riparian zone.	 Facing downstream (20/06/2008)

Reach	Description	Photograph
Site 9 Spring Creek at Becker Property	The site was not flowing at the time of the post-wet survey, with only an isolated pool recorded. Eucalypts and Casuarinas dominate the riparian vegetation at this site, providing some canopy cover to the channel, Some erosion was evident, although this appeared to be isolated to the lower bank region.	 Facing upstream (24/06/2008)
Site 10 Palm Tree Creek at Leichhardt Hwy	This site was dry during the post-wet sampling program.	 Facing upstream (18/06/2008)
Site 11 Cockatoo Creek at Nathan Rd	This site was dry during the post-wet sampling program.	 Facing upstream (21/06/2008)

Reach	Description	Photograph
Site 12 Cockatoo Creek within current inundation area from Glebe Weir, upstream confluence with Dawson River	A large pool environment exists at this site which is the result of the impounded water from Glebe Weir, with many dead tree trunks scattered throughout the pool. A high percentage of the lower bank is devoid of vegetation, although most of this section of bank was observed to have minimal evidence of erosion. No macrophytes were recorded from this site.	 Facing upstream (22/06/2008)
Site 13 Bentley Creek within inundation area at Bentley Property	A large long pool existed at this site with no restriction to fish passage observed during the field survey. Limited riparian vegetation existed adjacent to the site, dominated by Eucalypt species. No macrophyte species were recorded, and overall aquatic habitat assessment was poor.	 Facing upstream (20/06/2008)
Site 14 Spring Creek at farm track	This site was dry during the post-wet sampling program	 Facing upstream (23/06/2008)

Reach	Description	Photograph
Site 15 Scotchy Creek	This site was dry during the post-wet sampling program	 Facing upstream (21/06/2008)
Site 16 Price Creek at Cracow Rd	This site was dry during the post-wet sampling program	 Facing downstream (21/06/2008)

4.3 Water Quality

4.3.1 On-site measurements

4.3.1.1 Water Temperature

Water temperature was recorded between 12°C and 19°C at the sites surveyed during the post-wet field sampling program. All sites recorded a decreasing trend in water temperature through the vertical profiles. A slight decrease in water temperature was recorded at each site when logged overnight.

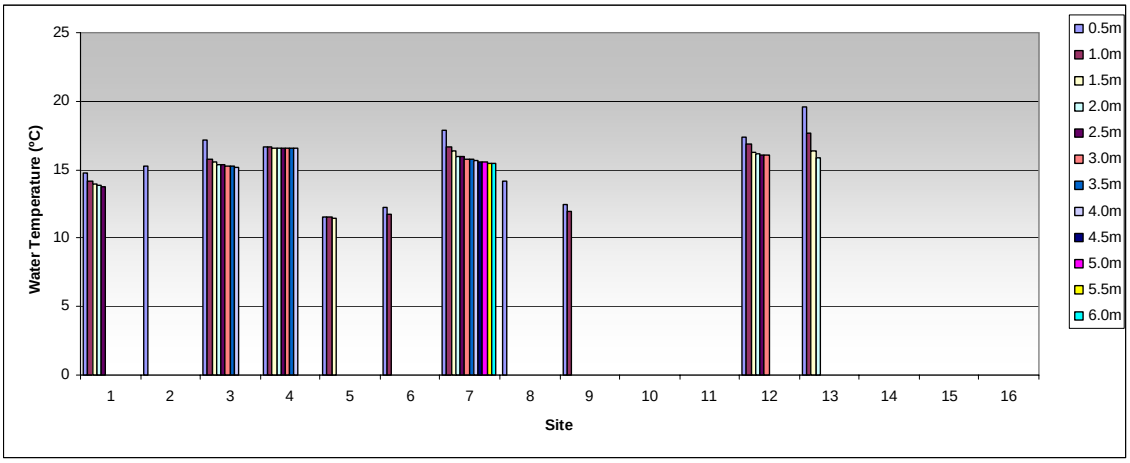

Figure 2: Water temperature at each site, recorded in 0.5m depth increments.

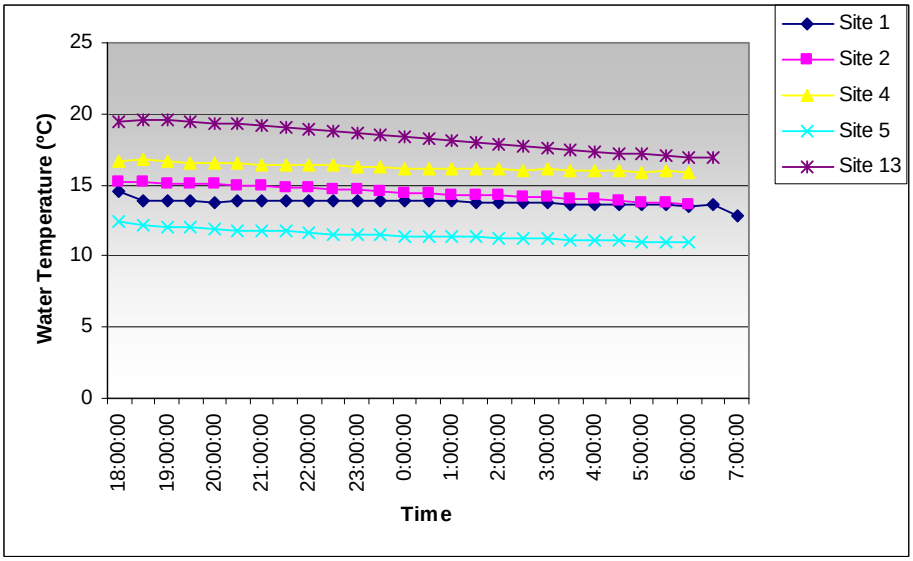

Figure 3: Surface water temperature logged overnight for 12 hours at 5 sites.

4.3.1.2 pH

Records for pH ranged between 6.7 at Site 9 to 7.7 at Site 13. Fluctuations in pH were recorded during the vertical profiles, with some sites recording a slight decreasing trend (Site 1, 7 and 13), and others recording a slight increasing trend (Site 2, 4 and 6). pH remained relatively stable during the period between 6pm and 7am at all sites logged.

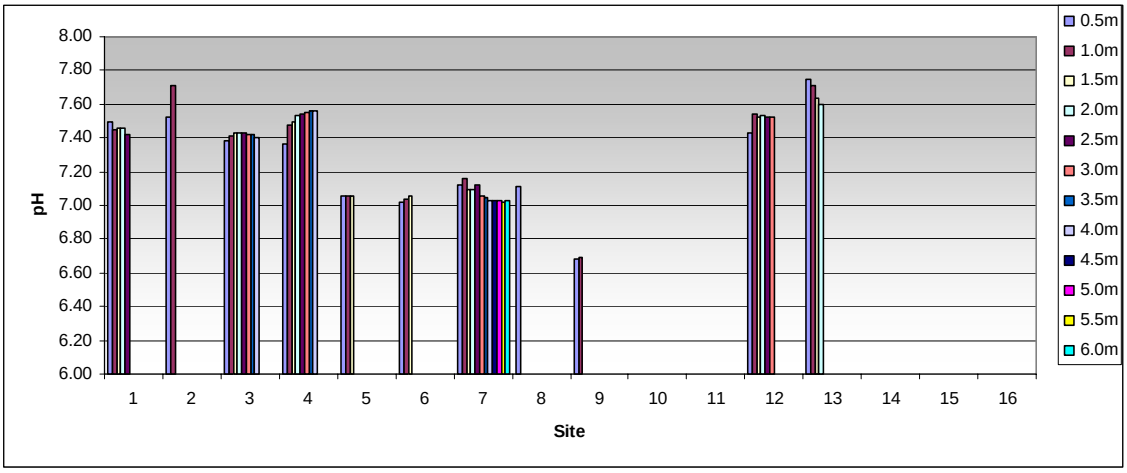

Figure 4: pH measurements at each site, recorded in 0.5m depth increments.

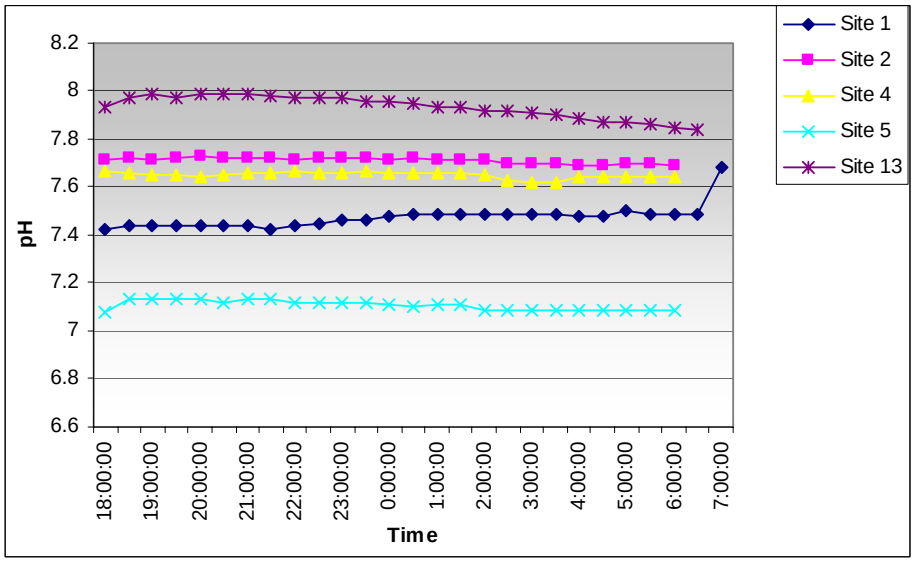

Figure 5: Surface pH logged overnight for 12 hours at 5 sites.

4.3.1.3 Electrical Conductivity

EC measurements remained relatively stable when measured throughout the water column and also at the surface when logged overnight. Results ranged from around 170µS/cm at Site 7 to average 350µS/cm at Site 13.

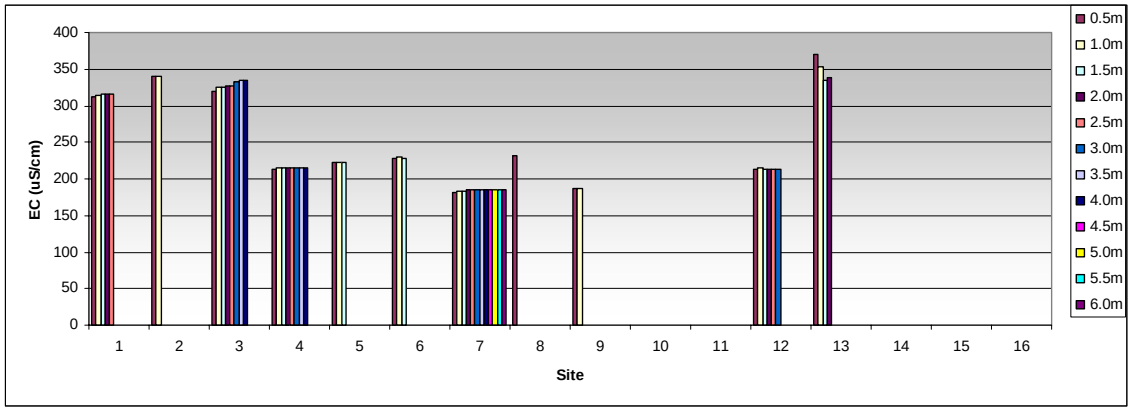

Figure 6: EC measurements at each site, recorded in 0.5m depth increments.

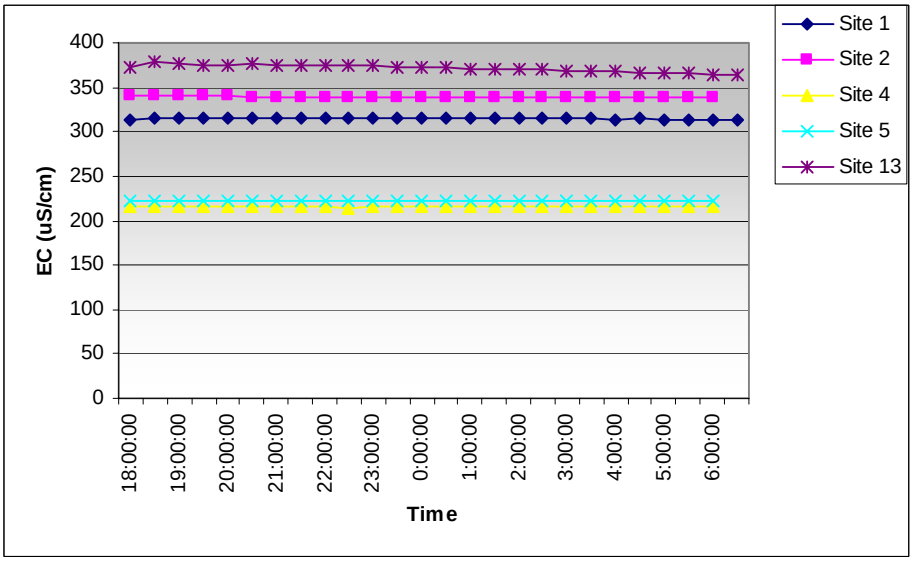

Figure 7: Surface EC logged overnight for 12 hours at 5 sites.

4.3.1.4 Dissolved Oxygen

DO (mg/L and % saturation) followed a similar pattern to the water temperature results, with decreasing DO with increasing depth increments. The lowest record was at Site 8 with 1.9mg/L and 19% saturation, although there was only a drying shallow pool at this site. DO remained stable over the 12 hour logged period for all sites.

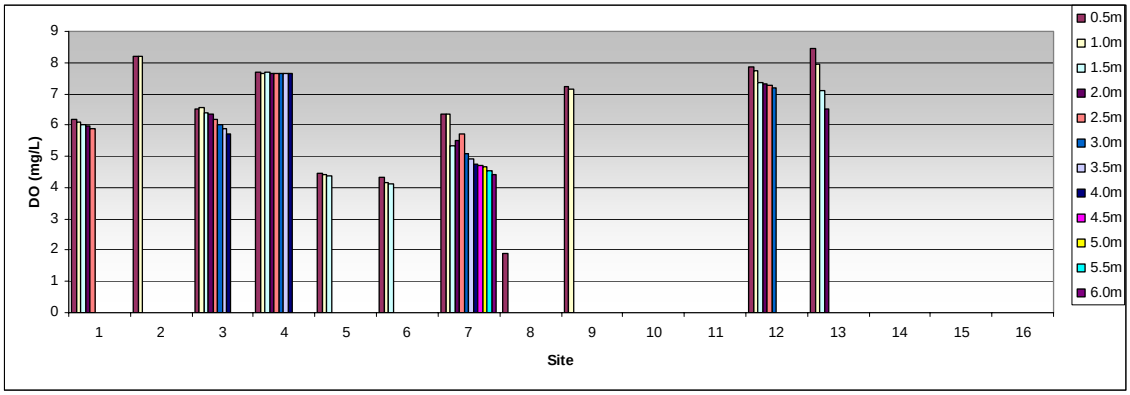

Figure 8: **DO (mg/L) measurements at each site, recorded in 0.5m depth increments.**

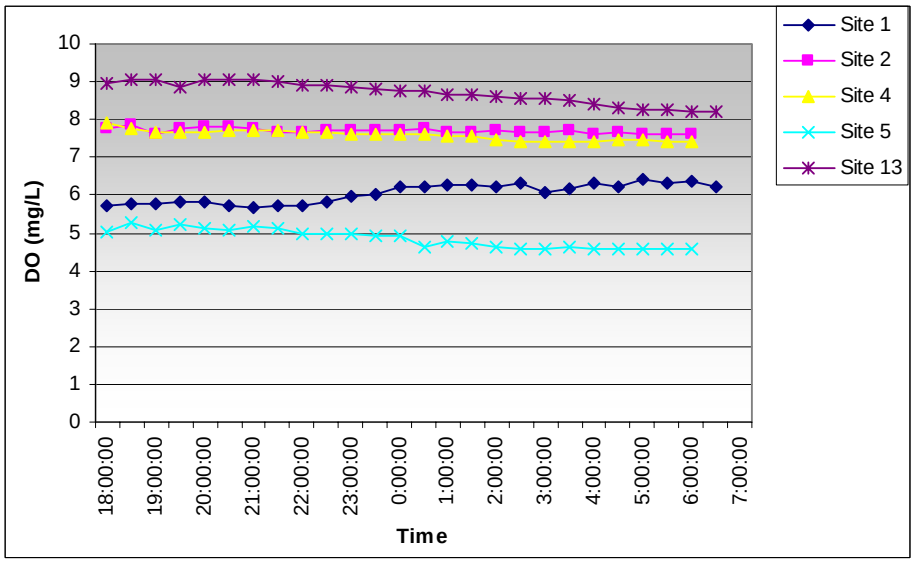

Figure 9: **Surface DO (mg/L) logged overnight for 12 hours at 5 sites.**

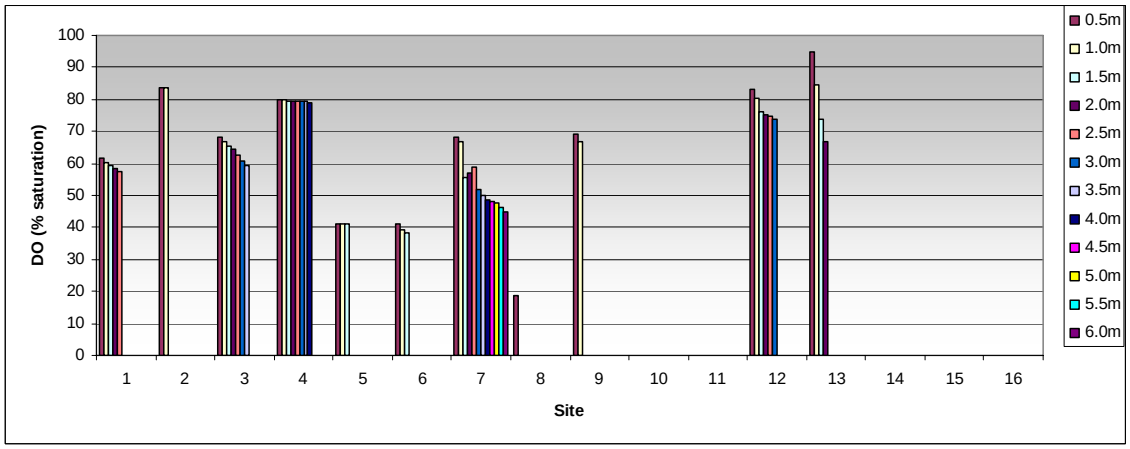

Figure 10: **DO (% saturation) measurements at each site, recorded in 0.5m depth increments.**

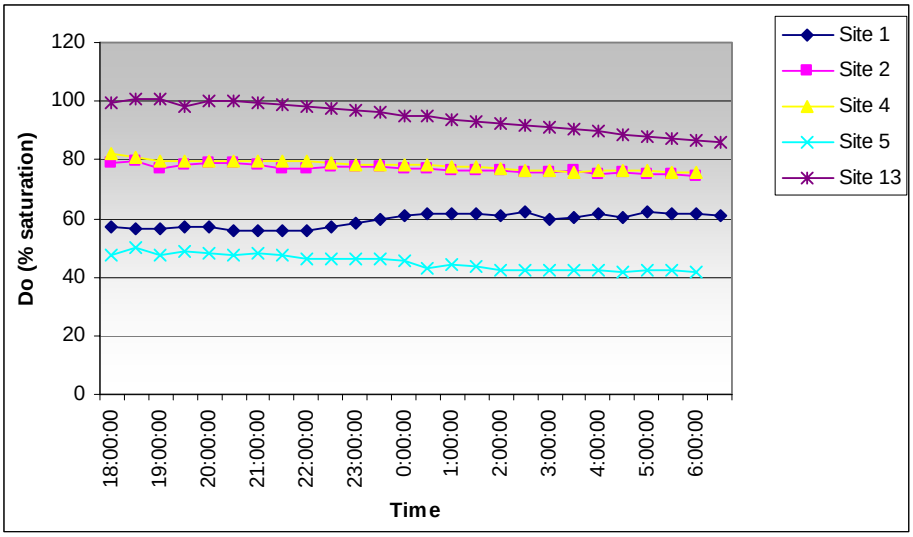

Figure 11: Surface DO (% saturation) logged overnight for 12 hours at 5 sites.

4.3.1.5 Turbidity

Turbidity was measured at the surface only at all sites, and 3 of the 10 sites (Site 4, 7 and 12) recorded results in excess of 120NTU. The logged results at Site 4 also showed the site to remain stable around 60NTU overnight.

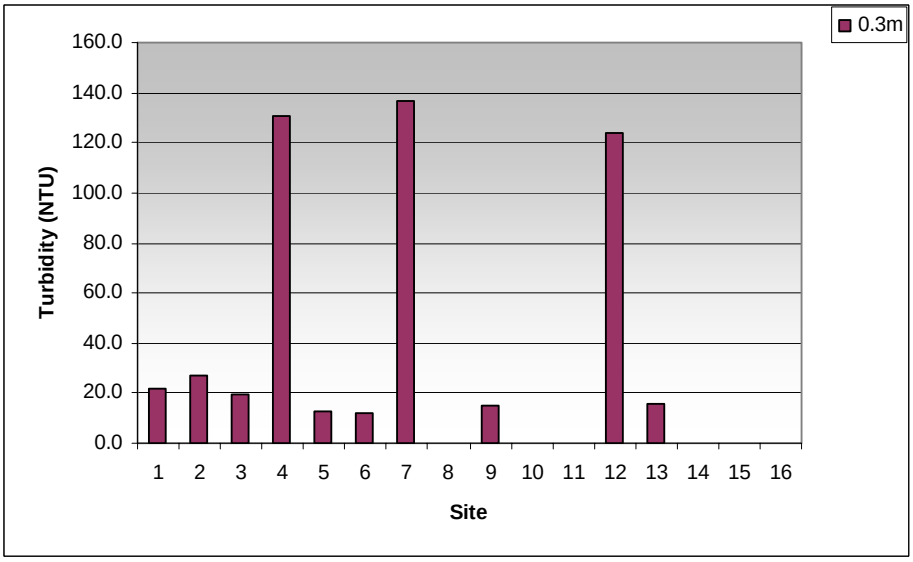

Figure 12: Turbidity measurements at each site, recorded at 0.5m depth increments.

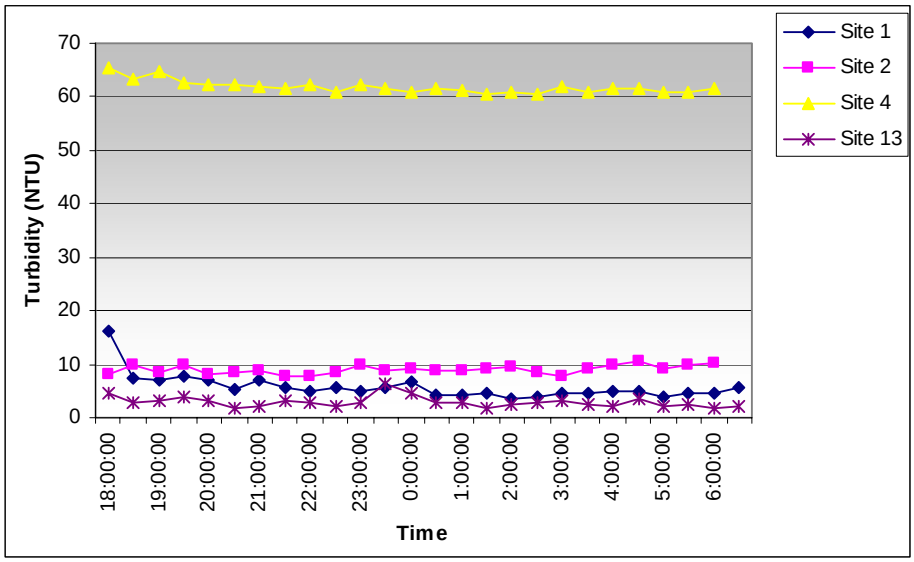

Figure 13: Surface turbidity logged overnight for 12 hours at 5 sites.

4.3.2 Laboratory analysed measurements

The raw laboratory analysed water quality data for the 7 sites sampled is presented in **Appendix C**.

4.4 Macrophytes

4.4.1 Presence/Absence and Richness

A total of 7 different macrophyte species were observed during the post-wet sampling program, of which no more than 3 were recorded at any 1 site.

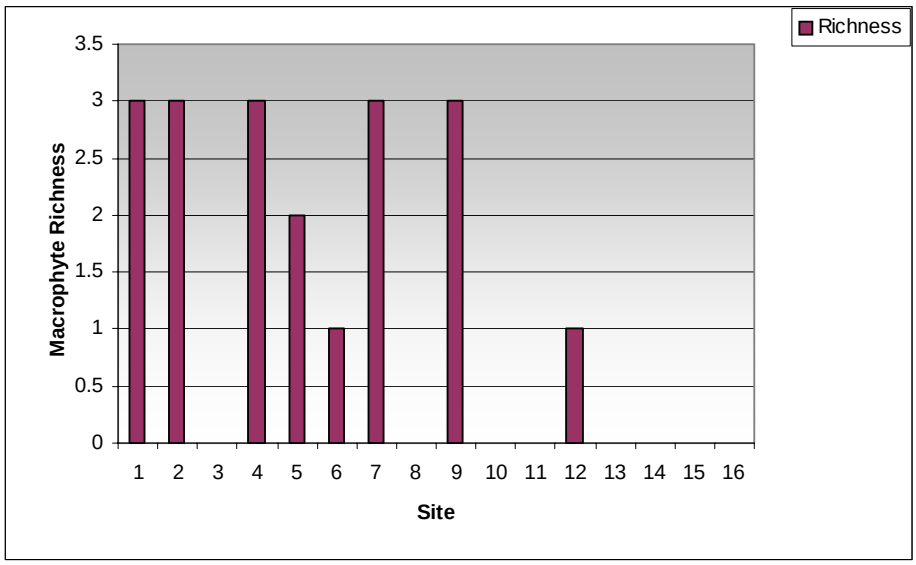

Figure 14: Number of aquatic macrophyte species observed at each site.

4.4.2 Total Cover of Macrophytes

No macrophytes were recorded to cover more than 10% of any site during the post-wet sampling program.

4.4.3 Native, Exotic and Noxious Species

All recorded aquatic macrophytes were native as per the QLD Herbarium (2007) classification, and no species were listed as rare or threatened.

4.5 Macroinvertebrates

A total of 73 different macroinvertebrate taxa and over 23,000 individuals were collected across 66 samples from the 10 sites surveyed. The most common taxa were the Insects, with 16 Diptera (non-biting midges), 8 Odonata (dragonflies and damselflies), 8 Hemiptera (true aquatic bugs), and 6 Trichoptera (caddisflies).

Ceratopogonidae was the most common Family, collected in all samples from all habitats. Other common families included Chironominae (97% of samples), Tanypodinae (82% of samples), and Caenidae (74% of samples). Chironominae and Ceratopogonidae were also the most abundant of all taxa, recording over 47% of the total number of individuals collected.

4.5.1 Community richness and abundance

The macroinvertebrate abundance and richness results for samples collected in the edge habitat are presented. The highest taxa richness was recorded at Site 6 with an overall record of 31 taxa across the 5 replicate samples, while in comparison Site 8 recorded the lowest richness of only 11 taxa. The highest abundance of taxa was recorded from Site 5, with Chironominae dominating the sample.

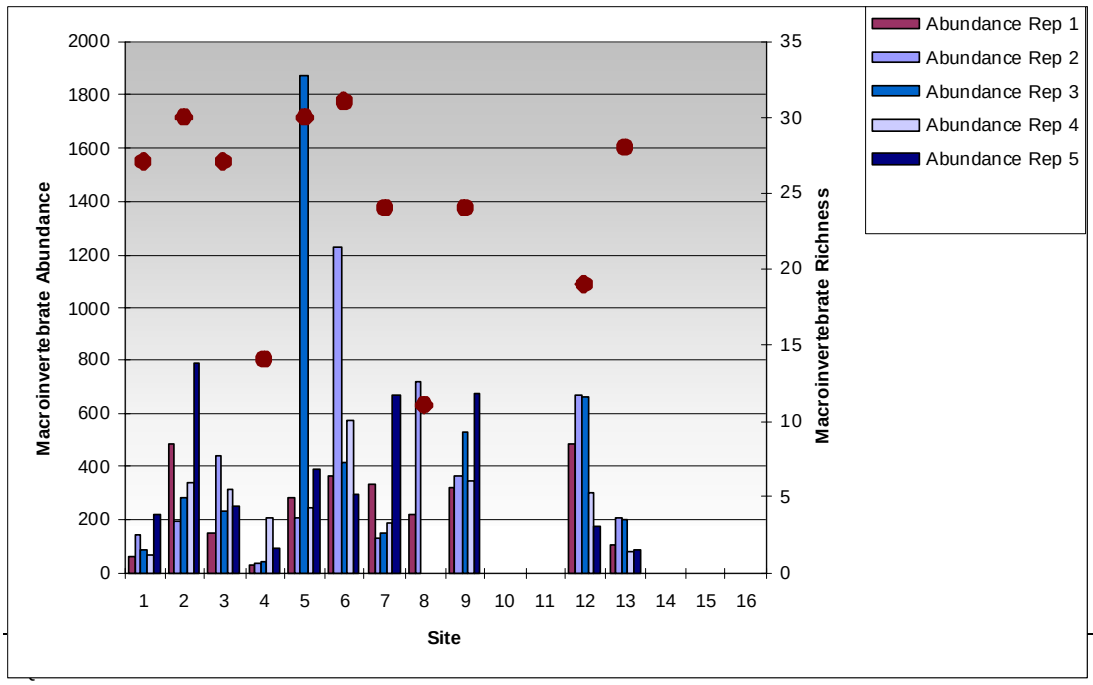

Figure 15: Abundance and richness results across all replicates at each site from the edge habitat.

Riffle samples were collected from Site 2 only, with 29 different taxa and over 3000 individuals recorded. The dominant taxa at this site included Orthocladiinae and Simulidae.

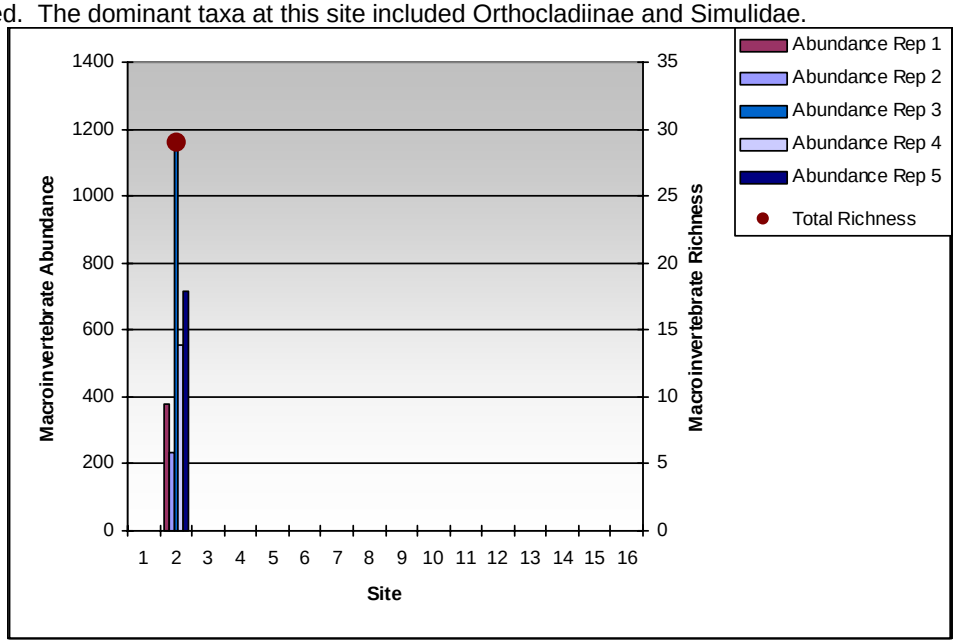

Figure 16: Abundance and richness results across all replicates at each site from the riffle habitat.

A single macrophyte sample was collected during the post-wet field program from Site 4, with 13 taxa and 33 individuals recorded.

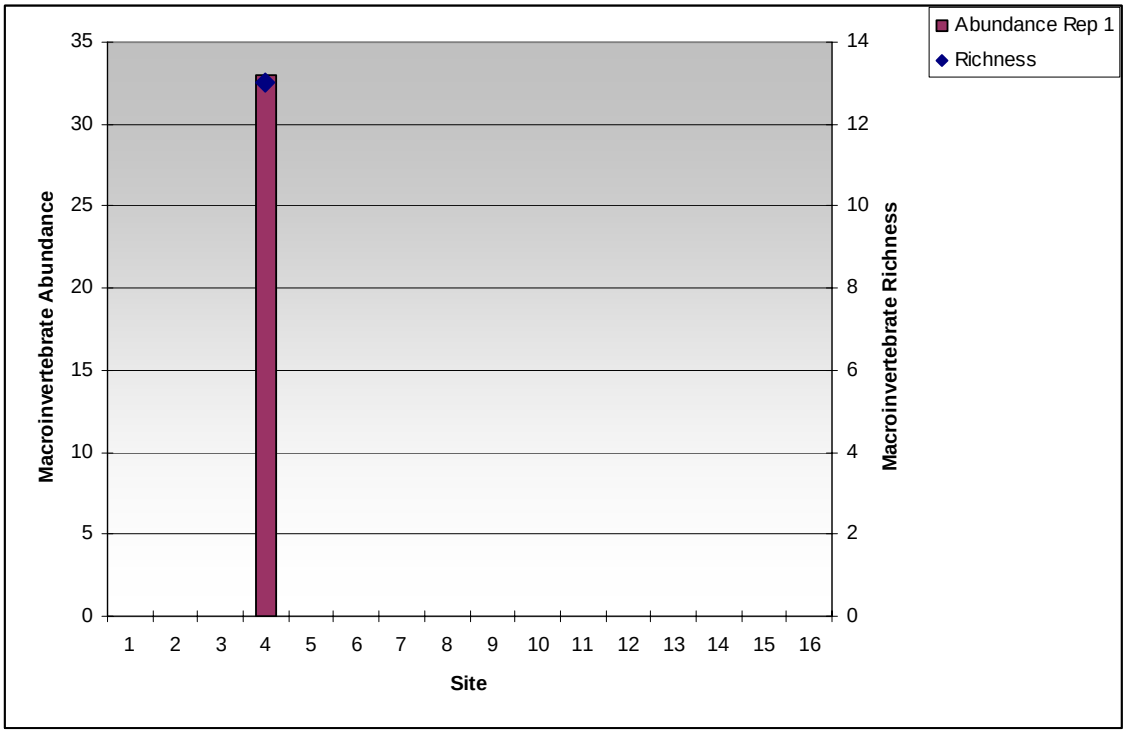

Figure 17: Abundance and richness results present within the single replicate sample from the macrophyte habitat.

Tree root habitat was sampled from 6 sites, with Site 6 recording the highest taxa richness and Site 5 the highest taxa abundance.

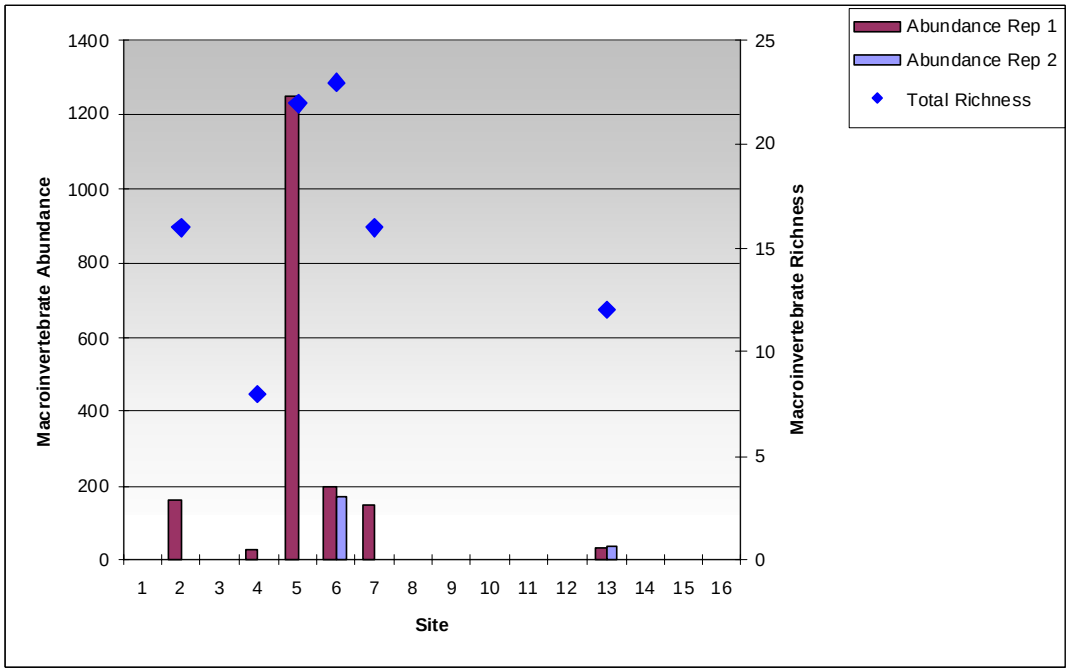

Figure 18: Abundance and richness results across all replicates at each site from the tree root habitat.

4.5.2 Observations of Macroinvertebrates

Freshwater mussels were observed as shells on the banks (Family: Hyriidae and Corbiculidae) at Site 6 only.

Figure 19: Corbiculidae shells (Freshwater Bivalves) observed at Site 6 along the bank.

4.6 Fish

4.6.1 Fish Species Captured

A total of 481 fish across 20 species were captured over the 11 sampling sites (Table 4 and Figure 20). Bony Bream (*Nematalosa erebi*) was recorded as the most abundant across the sites. Other abundant and wide spread taxa included Spangled Perch (*Leiopotherapon unicolour)* and Yellowbelly (*Macquaria ambigua*).

Site 2 was found to have the highest richness of all sites, recording 9 different taxa during the survey. Conversely, Site 6 and Site 8 recorded only 1 taxa during the post-wet survey.

Introduced Mosquitofish (*Gambusia holbrooki)* was captured at 5 of the 11 sites surveyed. Mosquitofish are declared a noxious species in Queensland under the Fisheries Regulation 2008.

Table 4: Total abundance results from all sampling methods, for each fish species captured at each site.

		Site															
Common Name	**Species Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Agassiz's Glassfish	*Ambassis agassizii*	2						1									
Goldfish	*Carassius auratus*				1	3		1									
Fly-speckled Hardyhead	*Craterocephalus stercusmuscarum*							2									
Mosquitofish	*Gambusia holbrooki*				4	3		8					2	15			
Western Carp Gudgeon	*Hypseleotris klunzingeri*	2	3							15							
Unidentified gudgeon	*Hypseleotris sp.*	4	1				1			12				2			
Midgley's Carp Gudgeon	*Hypseleotris* species 1			2													
Spangled Perch	*Leiopotherapon unicolor*	9	27	2	22			1	1	3			1	5			
Golden Perch (Yellowbelly)	*Macquaria ambigua*	8	1		5	2		1					1	2			
Eastern Rainbowfish	*Melanotaenia splendida*	2				5		1		16			1	1			
Purple-spotted Gudgeon	*Mogurnda adspersa*									8							
Bony Bream	*Nematalosa erebi*	5		51	18	1		9		10			31	86			
Hyrtl's Tandan	*Neosilurus hyrtlii*		19		2					1							
Sleepy Cod	*Oxyeleotris lineolata*			1		1		1					4	1			
Flathead Gudgeon	*Philypnodon grandiceps*		3														
Rendahl's Catfish	*Porochilus rendahli*		1														
Saratoga (Spotted Barramundi)	*Scleropages leichardti*			1		1		1						1			

Leathery Grunter	*Scortum hillii*	3	8		2												
Freshwater Catfish	*Tandanus tandanus*		9														
Gudgeon, Juvenile				1													

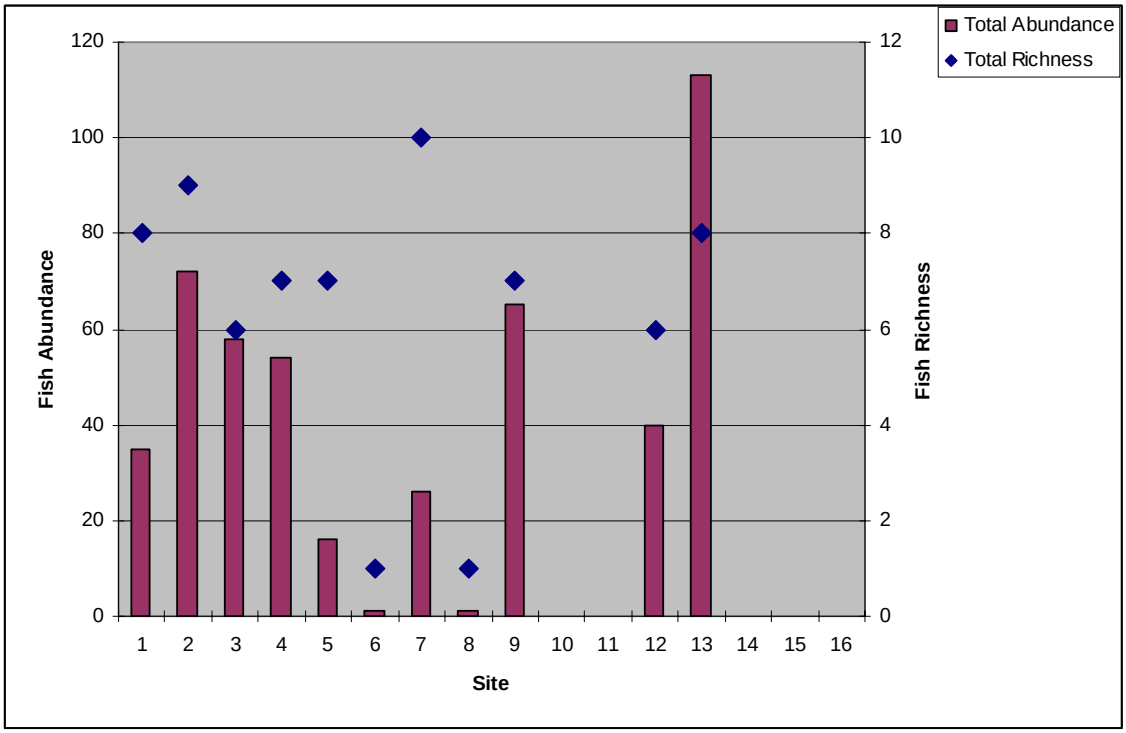

Figure 20: **Combined sampling methods abundance and richness results for fish captured during the post-wet survey.**

4.6.2 Fish Lengths

The largest fish species collected was the Saratoga (*Scleropages leichardti)* averaging 636.3mm (±73.6mm), and the smallest species was the Agassiz's Glassfish (*Ambassis agassizii)* averaging 29mm (±5.6mm) (Table 5).

Table 5: **Average fish lengths of each species across all sites.**

Common Name	Species Name	Total count*	Average Length (mm)	SE (mm)
Agassiz's Glassfish	*Ambassis agassizii*	3	29.0	5.6
Goldfish	*Carassius auratus*	5	208.6	60.4
Fly-speckled Hardyhead	*Craterocephalus stercusmuscarum*	2	43.5	2.1
Mosquitofish	*Gambusia holbrooki*	32	31.5	7.6
Western Carp Gudgeon	*Hypseleotris klunzingeri*	20	32.2	5.4
Gudgeon, Juvenile		1	24.0	
Unidentified gudgeon	*Hypseleotris sp.*	21	33.3	5.3
Spangled Perch	*Leiopotherapon unicolor*	69	63.1	24.1
Golden Perch (Yellowbelly)	*Macquaria ambigua*	18	246.8	126.2
Eastern Rainbowfish	*Melanotaenia splendida*	26	43.1	9.5
Midgley's Carp Gudgeon	*Hypseleotris species 1*	2	39.0	1.4
Purple-spotted Gudgeon	*Mogurnda adspersa*	8	44.9	10.6
Bony Bream	*Nematalosa erebi*	117	83.2	47.9
Hyrtl's Tandan	*Neosilurus hyrtlii*	22	76.8	14.0

Common Name	Species Name	Total count*	Average Length (mm)	SE (mm)
Sleepy Cod	*Oxyeleotris lineolata*	8	137.8	96.1
Flathead Gudgeon	*Philypnodon grandiceps*	3	62.3	11.8
Rendahl's Catfish	*Porochilus rendahli*	1	82.0	
Saratoga (Spotted Barramundi)	*Scleropages leichardti*	4	636.3	73.6
Leathery Grunter	*Scortum hillii*	13	95.3	10.3
Freshwater Catfish	*Tandanus tandanus*	28	115.0	91.0

* Note: Based upon a maximum total of 20 individuals measured for all trapping methods, and 20 individuals measured for both Electrofishing methods for each site.

4.6.3 Fish Health

All fish captured were examined for lesions, parasites and abnormalities. No abnormalities were observed.

4.6.4 Bycatch During Fish Surveys

A total of 57 macroinvertebrates were captured in the bait traps and one fyke net during the fish survey component of the program (Figure 6). Freshwater prawns (*Macrobrachium sp*.) were the most abundant across 7 of the 11 sites sampled, with Site 3 capturing the most.

Table 6: Abundance of macroinvertebrates collected in fish bait traps and fyke nets.

			Site															
Common Name	**Family**	**Genus**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Yabbie	Parasticidae	*Cherax sp.*								2	4							
Freshwater Shrimp	Palaemonidae	*Macrobrachium sp.*		2	23			12	1	6	5				2			

4.7 Turtles

4.7.1 Turtle Richness and Abundance

No turtles were captured in traps or observed alive during the post-wet field survey in June 2008. Two decomposing turtle carcasses were observed on the banks at Site 1.

4.8 Aquatic mammals and other reptiles

No aquatic mammals were observed during the field survey.

5 Survey Quality Assurance

The Hydrolab MS5 water quality meter was calibrated in the laboratory in accordance with Ecowise quality systems requirements and the manufacturers specifications prior to deployment in the field. Calibration standards were also carried with the field team to conduct spot checks on the unit throughout the course of the field program to ensure accuracy and reliability of the results. However, even with these regular checks, the turbidity sensor failed to record reliable turbidity results during the vertical profiles, with readings regularly fluctuating. The Hach field turbidimeter was used to measure surface turbidity results at all sites. This was the only malfunction of equipment during the field program.

6 References

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APPENDICES

Appendix A – Ecowise fieldsheets - blank

Appendix B – ‘State of the Rivers’ fieldsheets - complete

Appendix C – Laboratory Analysed Results from ALS