Central Queensland Coal Project

Appendix 9e – Aquatic Ecology Results

Environmental Impact Statement

YEATS CONSULTING

WARATAH COAL MINE PROJECT

STYX RIVER CATCHMENT AQUATIC BASELINE MONITORING PROGRAM

August 2011

The ALS Water Sciences Group is part of the Environmental Division of ALS, one of the largest and most geographically diverse environmental testing businesses in the world.

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1 Introduction

1.1 Background and objectives

Waratah Coal manages a coal lease (ECP1029) within and surrounding the Styx River Catchment. This catchment is located on the Queensland central coast, approximately 180 km south from Mackay and 150km north from Rockhampton.

In 2010 Yeats Consulting was contracted by Waratah Coal to carry out a preliminary assessment of the environmental resources associated with their mine lease. In 2011 Yeats Consulting (YEATS) commissioned ALS Water Sciences (ALS) to carry out an initial aquatic field study to achieve the following objectives (Yeats project brief YBE0002):

- To identify constituents of the natural water environment that may be problematic for Waratah Coal in terms of compliance with DERM's standard water quality limits in the region.
- To provide a snapshot assessment of the key water quality parameters.
- To adequately characterize the main flow channels draining ECP1029, in particular those draining the southern coal resource.
- To allow the identification of priority monitoring areas, and those that have a low priority.
- To correlate AUSRIVAS sampling with water quality.

In June 2011 ALS undertook a baseline survey of the aquatic fauna, flora and physical habitat within and adjacent to the EPC and these data form the basis of this report.

1.2 Scope

The need to progress to a full EIS to support the development of the Waratah Coal Mine has yet to be determined by the Department of Environment and Resource Management (DERM). Prior to this determination Yeats has requested ALS to conduct a baseline aquatic survey in order to provide relevant data that would indicate the need or otherwise to undertake an EIS. Yeats defined the scope of work for the baseline aquatic survey as follows (Yeats project brief YBE0002):

- Cover the 2011 post-wet season period only.
- Focus mainly on aspects of the aquatic environment that are likely to have a strong seasonal component and would, therefore, need to be sampled during the pre-wet season.
- Facilitate the collection of replicate samples to potentially allow for rigorous statistical analysis of the data as part of the EIS phase or beyond, but sample in such a way that sample processing is carried out on a restricted set of samples (to determine presence / absence and distribution patterns), with the remainder preserved and archived for future assessment if required.
- Assume that detailed targeted surveys in relation to any significant flora and fauna likely to occur in the study area are not required at this stage.
- Cover freshwater streams of representative stream orders and representative off-channel wetland habitat as its core focus; and
- Cover freshwater fish, macroinvertebrate and macrophyte communities, aquatic habitat assessment and the presence/likely suitability of aquatic habitat in terms of Platypus and aquatic reptile habitat as its core focus.

2 Site

2.1 The Styx Catchment

The Styx River Catchment is located on the coast in Central Queensland, approximately 180 km south from Mackay and 150 km north from Rockhampton. The catchment is bordered by the Connors Ranges in the Northwest and the Broadsound Ranges to the Southwest and empties into the Coral Sea near Rosewood Island.

The Styx River Catchment covers approximately 302,000 ha, and the main tributaries include: Deep, Granite, Montrose, Stoodleigh, Tooloombah, Waverly and Wellington Creeks. Many of the creeks are poorly documented and observations from the current survey indicate that many of the smaller waterways are intermittent or ephemeral from the late dry season onward.

The main landuse is agriculture which occupies 78% of the catchment, and cattle grazing is the predominant form of agriculture carried out in the region (Melzer et al 2008). Many cleared areas are badly eroded from sheet and gully erosion, particularly in the centre of the catchment and this occurs in association with particular soil types (Melzer et al 2008). In 2006-7 declining ground cover had resulted in 30.3% of the catchment being classified as being in a highly or very highly disturbed condition (Melzer et al 2008). The low level of ground cover condition may have been exasperated by the severe drought that occurred during this 2006-7 period. During the ALS field trip in June 2011 the ground cover was in good condition, possibly due to the extensive rains over the last year, and the low stock numbers present.

The water quality of rivers and streams within the study area is classified as high and the catchment is classified as being only slightly modified from the natural condition (ANRA 2010). Many of the creeks of the region record high turbidity during periods of high flow due to the erodible and dispersive soils present in the catchment (Melzer et al 2008).

2.2 Site Selection and Schedule

A total of 15 sites were originally nominated by Yeats for sampling (see Table 2-1). Due to time constraints only 9 sites were sampled, and these were each sampled for water quality, macroinvertebrates, fish and aquatic reptiles. Physical habitat was also assessed at each site. Sampling was carried out over a five day period (as nominated in the Yeats project brief (YBE0002) between 1/6/2011 and 6/6/2011).

Table 2-1: Site location details for the June 2011 aquatic monitoring Program

Site Code	Site Name	Latitude	Longitude
De1	Deep Creek Site 1	22°43.082’	149°40.211’
De2	Deep Creek Site 2	22° 42.763’	149°40.549’
De3	Deep Creek Site 3	22o39.665’	149°40.418’
To1	Tooloombah Creek Site 1	22° 41.354’	149°37.791’
To2	Tooloombah Creek Site 2	22°40.850’	149°39.210’
St1	Styx River Site 1	22°38.405’	149°39.370
St1(b)	Styx River Site 1(b)	22°37.392	149°39.112
St2	Styx River Site 2	22°37.211’	149°38.909’
Gr1	Granite Creek Site 1	22° 36.536’	149° 32.685'

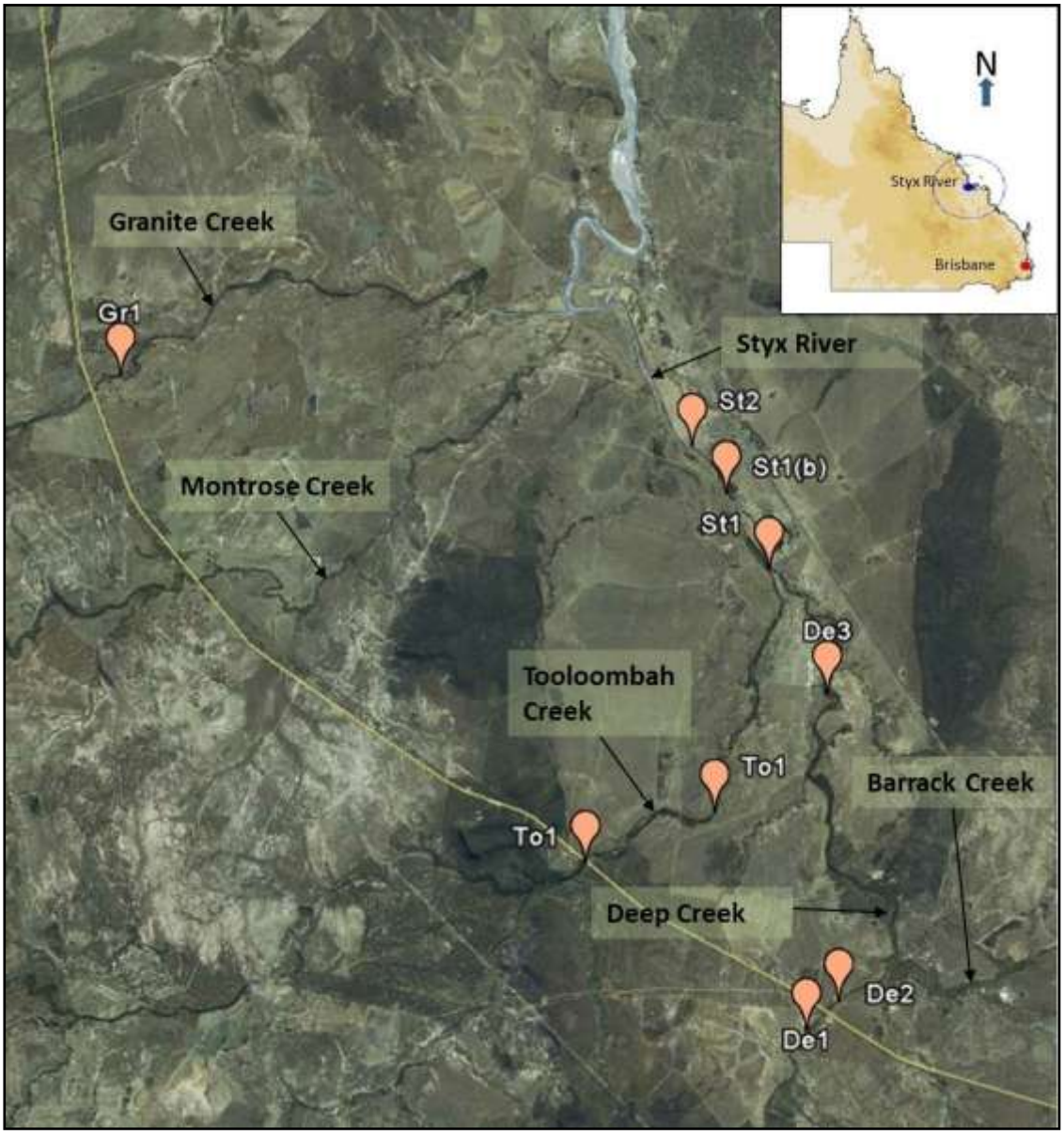

Figure 2-1: Sites sampled during the June 2011 aquatic baseline survey.

2.3 Site Descriptions

The 9 sites sampled were located on four different waterways (Figure 2.1) as follows:

- Deep Creek
- Styx River
- Tooloombah Creek, and
- Granite Creek

2.3.1 Deep Creek

Three sites were sampled along Deep Creek: De1, De2, and De3 (Figure 1-1, Table 2-1).

Plate 1: Deep Creek Pool at Site De1 June 2011

Plate 2: Deep Creek Riffle at Site De3 June 2011

All three sites were sampled for *in situ* water quality, analytical water quality, macroinvertebrates (in the riffle habitat), and fish. Fish were sampled using a back pack electrofishing unit as there was no boat access (fish were sampled in both riffles and shallow pools). Deep Creek at the time of sampling was composed of both small and large pools, with shallow riffles connecting the pools (see Plates 1 and 2). It is likely that latter on in the dry season the system dries to mostly isolated pools.

Deep Creek varied between 1to14m wide with De1 the narrowest site (mode: 2.5m) and De2 the widest site (mode: 8m). Water level was below the watermark at all sites except for De3, which was at the watermark height. Evidence of recent flooding was found with debris in trees found 7-8m above the present water level. The substrate was variable made up of cobbles (0-30%), pebbles (0-40%), and sand (5-38%). A general trend overall was for substrate size to decrease downstream from sites De1 through to De3. Site De2 was unique in having a section of exposed bedrock at the first riffle downstream of the main pool.

Riparian vegetation was well established at most sites and prevented launching of the boat for electrofishing. Riparian tree cover was moderate to extensive (50-100%), with some shrub cover (10-50%), and moderate grass cover (50-75%). The only landuse seen was cattle grazing at all sites, though site De3 was fully fenced it still had cattle within the fenced area.

2.3.2 Styx River

Three sites were sampled along the Styx River: St1, St1(b), and St2 (Figure 1-1, Table 2-1). All three sites were sampled for water quality, macroinvertebrates (in the edge habitat) and fish using boat electrofishing at both St1 (b), and St2.

Plate 3: Styx River Pool at Site St1 June 2011

At site St1normal boat electrofishing was not carried out as the owners did not wish us to drive on their property with our vehicles for fear of spreading weeds, in particular Giant Rats Tail Grass *Sporobolus pyramidalis*. Future sampling should try the property on the opposite side of the river which also had good access for launching a boat. The owners at St1 kindly let us use their boat with the back pack electrofishing unit and we achieved reasonable results with this set up. The Styx River sites at the time of sampling were composed of very long pools of variable depth and very few riffles (see Plates 3 and 4). Tidal influence seems to reach right up to site St1 which is at the confluence of Deep and Tooloombah Creeks. Tidal bores are reported from the Styx River (Melzer et al 2008).

Styx River varied between 4 - 40m wide with the bottom site St2 being the narrowest site (mode: 7m) and St1 the widest site (mode: 18m). Water level was at or above the watermark at all sites. Evidence of recent flooding was found with debris in trees at around 4-6m above the present water level.

The substrate at sites St1 and St1 (b) was variable made up of pebbles (5-50%), sand (5-38%), and silt (10-90%). At site St2 the substrate was composed of 100% silt. Again the general trend overall was for substrate size to decrease downstream from sites St1 through to St2.

Plate 4: Styx River Pool at Site St2 June 2011

Riparian vegetation was well established at most sites. Riparian tree cover was moderate (50-75%) at St1, but reduced dramatically downstream (St1(b): 25%; St2: 1%) possibly due to salt water impact during large tides. Shrub and vine cover was low at 25% at most sites except for the extensive cover of the pest weed Noogoora Burr *Xanthium pungens* which covered approximately 75% of the riparian area at St2. Grass cover ranged from 10% at St1 through to 50% at St1(b) and 25% at St2.

The landuse varied between holiday homes, residential properties, cattle grazing, river reserve and hobby farms.

2.3.3 Tooloombah Creek

Two sites were sampled along Tooloombah Creek: To1 and To2 (Figure 1-1, Table 2-1). Both sites were sampled for *in situ* water quality, analytical water quality, and macroinvertebrates (in the riffle habitat). Fish were sampled using an electrofishing boat at To1in the large pool upstream of the bridge (see Plate 5). At site To2 fish were sampled using an electrofishing backpack as there was no boat access and fish were sampled in both riffles and shallow pools (see Plate 6). Tooloombah Creek at the time of sampling was composed of both small and large pools, with shallow-medium riffles connecting the pools. It is possible that latter on in the dry season Tooloombah Creek may dry up to mostly isolated pools.

Tooloombah Creek contained very large pools at both sites and the widths ranged between 2.5 to35m wide with To1 the narrowest site (mode: 7m) and To2 the widest site (mode: 15m).The water level was at the watermark at all sites. Evidence of recent flooding was found with debris in trees around 15m above the present water level at To1, and at 7m above water level at To2.

Plate 5: Tooloombah Creek Pool at Site To1 June 2011

Plate 6: Tooloombah Creek Riffle at Site To2 June 2011

The substrate was variable made up of bedrock (10-80%), cobbles (5-15%), pebbles (10-35%), gravels (2-40%), and sand (5-60%). Note that the riffles tended to have substrate with larger particles sizes such as bedrock, cobbles and pebbles whereas the pools contained smaller particles including gravels, sand, and some silt. Site To1 had bedrock at all three riffle sites.

Riparian vegetation was well established at both sites. Riparian tree cover was moderate (50-75%) at both sites, with some shrub cover (10-50%) at To1, and moderate shrub (50-75%) cover at To2. Bare rock covered moderate areas (50-75%) of To1, while bare gravel-pebble beds covered some areas (10-50%) of To2. There was moderate grass cover (50-75%) at To1, while limited grass cover (10-50%) occurred at To2. Riparian vegetation at both sites on the left hand bank was in reference condition, while the riparian vegetation on the right hand bank was impaired.

Cattle grazing occurred at both sites, though site To1also had an abandoned caravan park above the creek on the north- western bank, a conservation area upstream and contained a road reserve area. Black sludge was observed at riffle site To1 which may reflect a response to some form of pollution, though this was not apparent from the water quality data obtained as part of this study.

2.3.4 Granite Creek

Due to time constraints only a single site was sampled at Granite Creek: Gr1 (Figure 1-1, Table 2-1). This site was sampled for *in situ* water quality, analytical water quality, and macroinvertebrates (in the riffle habitat).

Plate 7: Granite Creek Pool at Site Gr1 June 2011

Fish were sampled using an electrofishing boat. Granite Creek at the time of sampling was composed of large pools (see Plate 7), with shallow-medium riffles (see Plate8) connecting the pools. It is possible that latter on in the dry season Granite Creek like Tooloombah Creek may dry up to a series of isolated pools.

Granite Creek contained very large pools and the width ranged between 4 to 45m wide (mode: 35m). It should be noted that the narrow measurements were at the riffles (3-4.5m, while the pools varied between 25 – 45m. The water level was below the watermark. Evidence of recent flooding was found with debris in trees at around 3-4m above the present water level.

The substrate was variable made up of cobbles (15-25%), pebbles (40-45%), gravel (30-35%) and sand (5-15%). Note that the riffles tended to have substrate with larger particle sizes such as bedrock, cobbles and pebbles, whereas the pools contained smaller particles including gravel, sand, and some silt.

Plate 8: Granite Creek Riffle at Site Gr1 June 2011

Riparian vegetation was moderate with trees covering only some areas (10-50%) with some shrub cover (10-50%) and extensive grass cover (75-100%). Riparian vegetation was densest at the riffles and thinnest at the edges of the large pools. Bare gravel and pebble beds covered only small parts of the riparian area (1-10%) and these beds were found mainly around the riffle zones.

The major landuse was cattle grazing, however, stock numbers had been reduced by the recent long drought. An excess of fodder was evident with weeds to 1.8m high.

2.3.5 Barrack Creek

Initially Barrack Creek was to be sampled but due to the fact that it had virtually no standing water despite recent rains it was decided to concentrate on the larger and more relevant creeks in the lease area.

Despite this the ALS field team walked up and down Barrack Creek for approximately 200m where it crosses the Strathmuir to Ogmore Road and recorded the following information. Barrack Creek was not flowing and had contracted back to very small shallow pools that would most likely not be present during the dry season. At the time of the field trip (June 2011) only small pools approximately 3-9m long by 30 cm deep were found at about 50m intervals (see Plates 9 and 10). The watercourse was defined by a thin row of Paperbark trees (*Melaleuca sp*) and stock had access to the creek. The substrate was relatively free draining with coarse sands, and a range of gravels and pebbles.

Plate 9: Barrack Creek with shallow drying pool looking upstream in June 2011

Plate 10: Barrack Creek with shallow drying pool looking downstream in June 2011

2.4 Climate and Rainfall

The Styx region is located about 140km north of the Tropic of Capricorn and is subject to a seasonally dry tropical climate. Most rainfall occurs between October and April with the driest months being August-September. Mean monthly temperatures are highest in January and February, and the lowest in June-July.

The year from June 2010 through to May 2011 had extremely high rainfall as can be seen in Figure 2-2. Rainfall from August 2010 through to May 2011 was above mean rainfall in all months except February 2011.

Air temperatures in the study region vary cyclically on a seasonal basis with the lowest mean minimums of around 11 degrees Celsius in winter (July) and the highest mean maximums of around 32 degrees Celsius in summer (December-January period) (Figure 2-3).

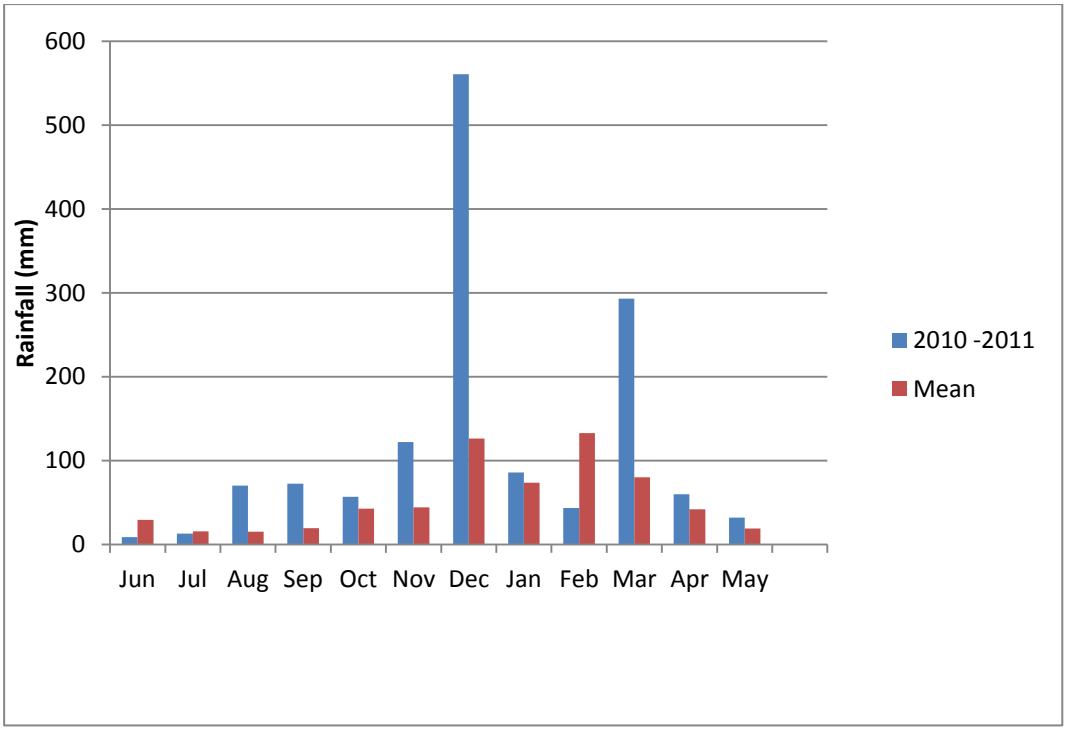

Figure 2-2: Monthly rainfall for the period of June 2010 to May 2011at Styx Catchment: Marlborough (BOM 2011)

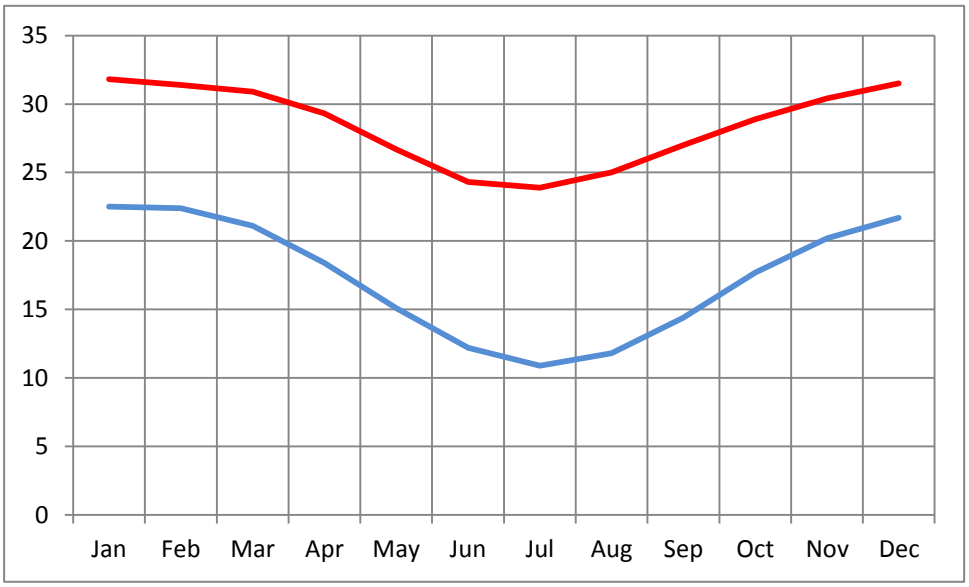

Figure 2-3: Mean Monthly Minimum and Maximum Temperatures at St Lawrence Post Office (BOM: 1938 – 2011) http://www.bom.gov.au/climate/averages/tables/cw_033065.shtml

3 Methodology

3.1.1 Water Quality

Water quality was measured as follows (i) *in-situ* measurements taken while on-site, and (ii) water quality samples collected for laboratory analysis.

In-situ measurements were recorded using a YSI 556 multi-parameter water quality meter and measurements included water temperature (°C), pH, conductivity (µS/cm), and dissolved oxygen (% saturation and mg/L). A TPS multi-parameter meter was also used on several occasions when readings from the YSI meter were being cross-checked. Both meters were calibrated in the laboratory and in the field prior to use. Turbidity was measured separately using a hand held HACH 2100P turbidity meter, while alkalinity (a measure of calcium carbonate concentration that is highly relevant to macroinvertebrate community composition) was measured using Chemetrics titration kits.

Water samples were collected according to procedures outlined in the DERM (2009c) guidelines. Samples were kept chilled in an esky and sent to the ALS laboratory in Brisbane within 24 h of collection to ensure that they were received within sample holding times. Samples were rested for the flowing using appropriate methods and levels of resolution (LOR):

- Aluminium
- Arsenic
- Boron
- Cobalt
- Iron
- Lead
- Manganese
- Molybdenum
- Nickel
- Selenium
- Vanadium
- Cadmium
- Chromium
- Copper
- Silver
- Uranium
- Zinc
- Mercury
- Escherichia coli

Flow velocities were assessed to assist with the interpretation of water quality. Cross-channel flow measurements were originally planned to be taken in the main channel of the creeks sampled, but this was impractical due to a number of conditions including, time available, low flow conditions, estuarine crocodiles, and overhanging vegetation. Instead, flow measurements were taken where macroinvertebrates or fish were collected and not

necessarily where water measurements were taken. Nonetheless this process provided some indication of the relative nature of flow conditions experienced at the time of sampling.

3.1.2 Aquatic Macroinvertebrates

Macroinvertebrate analysis of community structure was required at freshwater sites in accordance with the Queensland AUSRIVAS Sampling and Processing Manual (DNRW 2001). This data was collected at 9 sites during the 2011 fieldtrip.

The sampling methodology followed protocols identified in the "QLD Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual (DNRW 2001)". At each site, habitat sampled was dependant on habitat availability. Two different habitats were sampled, if available, including edge habitat and riffle habitat (with a total of three replicates per site where sufficient habitat was available).

For each sample, the collected material was placed into a sorting tray and macroinvertebrates picked for a minimum of 30 minutes using forceps and pipettes. If less than 200 animals were collected after 30 minutes, sorting continued for a further 10 minutes. If no new taxa (not previously detected in sample) were found after 10 minutes, then processing ceased. If new taxa were found, the 10 minute processing cycle was continued up to a total sorting time of 1 hour. Sampling and picking was conducted by ALS AUSRIVAS accredited field staff.

Samples were preserved in 80% ethanol and clearly labelled with information including site, habitat, sampling method, date and sampler.

Supporting environmental data were collected to allow the running of the Queensland AUSRIVAS models in accordance with the Queensland (AUSRIVAS) Sampling and Processing Manual (DNRW 2001). Field data was recorded on a number of specialist field sheets including:

- Site Information Sheet
- Water Quality Sampling Sheet
- Macroinvertebrate Sampling Sheet
- AUSRIVAS Habitat Assessment Sheet

A key component of the AUSRIVAS methodology is the collection of *in-situ* water quality measurements at each of the freshwater sites. These were measured according to methods described in section 3.1.1.

Aquatic macroinvertebrates were identified in the laboratory to Family level in accordance with the Queensland AUSRIVAS manual, with the exception of lower Phyla (Porifera, Nematoda and Nemertea), Oligochaetes, Acarina and Microcrustacea (Ostracoda, Copepoda, Cladocera). Chironomids were identified to sub-family.

3.1.3 Archived Bulk Macroinvertebrate samples

At each site three macroinvertebrate samples were collected. These replicate samples will be preserved and archived by ALS for future reference if they are required.

3.1.4 Fish Survey

An analysis of fish species diversity and abundance, community composition and community age structure was carried out at freshwater and estuarine sites in accordance with the Queensland Fish Monitoring Standard (Freshwater) and estuarine methods proposed by ALS (2010). Freshwater fish species were identified using Allen *et al* (2002) and estuarine specimens identified using Kuiter (1996).

Community based ecological assessments ideally require that the capture probability of each species is proportional to its absolute abundance at each site. The use of multiple sampling methods increases the probability of capturing all species in heterogeneous habitats. The pooled sample obtained from several methods more closely represents the entire fish assemblage at a site, reducing sampler bias that would be introduced in a single method (Gehrke *et al*, 1999). In the present study, several sampling techniques have been employed in an effort to capture as many different species as possible.

3.1.4.1 Freshwater Fish

The following methods were used to sample freshwater fish:

- Boat electrofishing
- Backpack electrofishing
- Bait traps

Backpack electrofishing was only used in shallow wadeable habitats where the risk of drowning and crocodile attack was considered low. Boat mounted electrofishing was carried out in deeper pools that had reasonable access (i.e. relatively shallow-gradient banks largely free of vegetation comprised of consolidated substratum material). Bait trapping was carried out wherever there was sufficient water depth and currents were slow enough to prevent bait traps being swept off the substratum or washed downstream.

Boat electrofishing

Boat electrofishing was conducted using a Cairns Custom Craft 4.1m boat fitted with a 7.5GPP Smith Root electrofishing unit. The waveform charge is delivered to the water via large electrodes on booms at the front of the boat, thereby producing an electric field in the water by which the fish are immobilised.

Procedures for boat electrofishing include a series of 'shots' during which the boat is slowly driven forward with one operator at the back controlling the boat and electrofishing settings, and a second operator at the front collecting the immobilised fish. The fish were dip-netted from the water and placed into an oxygenated holding tank for identification, measuring and release. Sampling was carried out such that all major habitat types were covered to ensure a representative range of fish species were collected. The amount of 'on time' for each shot was recorded at the end of sampling so that an estimate of catch per unit effort (CPUE) could be obtained and compared between sites.

Backpack electrofishing

Backpack electrofishing was carried out using a Smith-Root Back Pack unit LR24 model. Electroshocking was carried out by an experienced operator according to Australian Electrofishing Code of Conduct procedures while a second team member help collected stunned fish for identification and measurement. Sampling was carried out within a roughly 100m reach from downstream to upstream covering all major habitat types to

ensure a representative range of fish species were collected. The amount of 'on time' was recorded at the end of sampling so that an estimate of catch per unit effort (CPUE) could be obtained and compared between sites.

Bait traps

Five commercial concertina bait traps were deployed for 3-5 hours along the river edge depending on available time. Bait traps consisted of 3mm mesh and were baited with dry pelletised dog food.

All fish specimens were identified using relevant keys, measured (total length to the nearest millimetre), counted and returned to the water unharmed where possible.

3.1.5 Aquatic Reptiles and Platypus

At each site a record was kept of aquatic reptiles and Platypus, including evidence of their presence (e.g. active burrows).

3.1.6 Licences and Permits

ALS conducted macroinvertebrate and fish sampling under Animal Ethics Permit number CA 2007/04/186, and General Fisheries Permit number 91856.

3.1.6.1 Aquatic Habitat Assessment

Aquatic habitat assessment was required at freshwater sites in accordance with the AUSRIVAS protocols. These field sheets covered Site Description, Site Access, Water Quality, Habitat Data, Substrate data, Reach profile, and Reference Condition data.

3.2 Data Analysis

The data analysis techniques employed included a number of univariate and multivariate analyses which endeavour to elucidate upstream/downstream trends in the data and (where possible) to determine the underlying environmental factors responsible for any observed trends. Multivariate techniques were also used to compare sub-catchment data for water quality, macroinvertebrates and fish taxa as well as upstream downstream comparisons. Due to the fact that the data does not contain replicate samples caution must be used when referring to multivariate data.

3.2.1 Water Quality

Water quality data was assessed against Queensland Water Quality Guideline (QWQG, 2009) for slightly to moderately disturbed (SMD) waters of lowland streams of the Central Coast QLD region. This guideline may also refer to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000).

3.2.2 Aquatic Macroinvertebrates

3.2.2.1 Macroinvertebrate Indices

Along with a summary of the macroinvertebrate taxa collected, the macroinvertebrate indices calculated for this program include:

- Taxa Richness

- EPT Taxa Richness
- SIGNAL Version 2
- Queensland AUSRIVAS models

These values were compared to the QWQG (2009) for Central Coast Queensland region biological guidelines for slightly to moderately disturbed (SMD) waters of lowland streams.

Taxa Richness

Taxa Richness refers to the number of macroinvertebrate taxa contained in a sample. This index is commonly used and is generally based on the premise that the better the condition of a site, the more taxa will be found; however, inflated numbers may also result at sites with higher than normal levels of flow and nutrients.

EPT Taxa Richness

The EPT taxa index refers to the proportional representation of key macroinvertebrate taxa belonging to the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) groups. Macroinvertebrates belonging to these three orders are considered to be sensitive to changes in their environment, and therefore EPT taxa richness can be used to assess degradation of habitat.

SIGNAL Version 2

SIGNAL (Stream Invertebrate Grade Number – Average Level) Version 2 (Chessman, 2003) is a biotic index based on pollution sensitivity values (grade numbers) assigned to aquatic macroinvertebrate families that have been derived from published and unpublished information on their tolerance to pollutants, such as sewage and nitrification (Chessman, 1995). Each family in a sample is assigned a sensitivity grade between 1 (most tolerant) and 10 (most sensitive). Families in a sample for which no grade was assigned were excluded from the analysis. The resulting index score is then interpreted by comparison with upstream and/or control sites, or by simply comparing sites.

AUSRIVAS Models

The appropriate Queensland AUSRIVAS (Australian River Assessment System) models and resulting scores and bandings (Table 3-1) were utilised to detect any changes in observed and expected macroinvertebrate communities within the study sites (DNRW 2001). AUSRIVAS generates site-specific predictions of the macroinvertebrate fauna expected to be present in the absence of environmental stress. The expected fauna from sites with a similar set of physical and chemical characteristics are then compared to the observed fauna, and the ratio derived is used to indicate the extent of impact. This ratio can range from zero (0), when none of the expected taxa are found at a site, to approximately one (1), when all of the expected taxa are present. The value can also be greater than one (1) when more families are found at the site than predicted by the model. The ratio scores can be placed in bands which then indicate whether the site is richer than reference, reference quality, below reference quality, well below reference quality, or impoverished. Table 3 contains a brief description of each of the AUSRIVAS bands and an explanation of how to interpret the O/E taxa score and some implications for water and/or habitat quality.

Table 3-1: The division of Observed/Expected macroinvertebrate taxa into bands, the names of the bands refer to the relationship of the index value to the reference condition (Band A)

Band Label	Band Name	Comments
Band X	More biologically diverse than reference sites.	More taxa found than expected. Potential biodiversity hot-spot. Possible mild organic enrichment.
Band A	Reference condition.	Most/all of the expected families found. Water quality and/or habitat condition roughly equivalent to reference sites. Impact on water quality and habitat condition does not result in a loss of macroinvertebrate diversity.
Band B	Significantly impaired.	Fewer families than expected. Potential impact either on water quality or habitat quality or both, resulting in loss of taxa.
Band C	Severely impaired.	Many fewer families than expected. Loss of macroinvertebrate biodiversity due to substantial impacts on water and/or habitat quality.
Band D	Extremely impaired.	Few of the expected families remain. Extremely poor water and/or habitat quality. Highly degraded.

3.2.2.2 Multivariate Analysis

A number of multivariate analyses were undertaken to identify spatial and temporal trends between sites

The following multivariate methods were undertaken on data collected from the 2011 Fieldtrip:

- Classification / Hierarchical agglomerative CLUSTERING
- Non-metric Multi-Dimensional Scaling (NMDS) Ordination
- ANalysis Of SIMilarity (ANOSIM)
- SIMilarity PERcentages (SIMPER)
- BVSTEP

Classification/Hierarchical agglomerative CLUSTERING

Cluster analysis is a means of classifying samples or sites into groups based upon the similarity of variables (i.e. macroinvertebrate community composition). Cluster analysis (or classification) aims to find 'natural groupings' of samples such that samples within a group are more 'similar' to each other than samples in different groups. A hierarchical agglomerative approach was taken which utilises the similarity matrix as its starting point and successively fuses the samples into groups and these groups into larger clusters, starting with the highest mutual similarities then gradually lowering the similarity level at which groups are formed. Hierarchical clustering is performed on the similarity matrix of macroinvertebrate data derived using the Bray-Curtis similarity coefficient. The resultant dendrogram is a graphical representation of the hierarchical groupings within the data set, the x axis defining the distance which two sites or groups are considered to have fused and the y axis representing the full set of sites.

NMDS Ordination

Like classification, ordination provides a representation of the relative similarity of entities (i.e. site samples) based on their attributes (i.e. macroinvertebrate community

composition) within a reduced dimensional space. The more similar sites are to each other, the closer they are located in the ordination space. This procedure is useful to display the samples interrelationships on a continuous scale and allows a check to see how "real" the groups identified in the classification are. A Non-metric Multi-Dimensional Scaling (NMDS) ordination was performed on the similarity matrix for all pairs of samples based on the Bray-Curtis similarity coefficient. The number of axes used in the ordination is based on resultant stress levels. The stress level is a measure of the distortion produced by compressing multi-dimensional data into a reduced set of dimensions and will increase as the number of axes (i.e. dimensions) is reduced.

In addition to classification and multidimensional ordination techniques ECOWISE used additional statistical techniques to interrogate the data. ANOSIM and SIMPER allowed an investigation of spatial and temporal trends within and between sites, whilst BVSTEP and RELATE allowed environmental data associated with the sites to be assessed against the macroinvertebrate data.

ANOSIM

ANOSIM is used to investigate the significance of any temporal change (annual and seasonal) in similarity between and within sites and site groupings (the latter established a priori). ANOSIM, fully described by Clarke and Gorley (2006), compares the similarity of samples within groups to the similarity of samples between groups. The test uses a randomisation procedure to test the hypothesis that there is no difference in community structure between site/sample groups. Each randomisation compares the R test statistic generated from randomly sorted data set with the R-value calculated from the original data set. One thousand randomisations of the data were undertaken for each comparison. An R-value can vary between -1 and 1 and the greater the value, the greater the separation between groups.

SIMPER

The SIMPER procedure was used to investigate the taxa responsible for any observed temporal and spatial changes in macroinvertebrate community structure between and within sites. SIMPER computes the average dissimilarity (Bray-Curtis) between all pairs of inter-group samples (every sample in group 1 with every sample in group 2 etc.) and then breaks this average down into the separate contributions from each taxon. In addition to calculating the average dissimilarity between groups, SIMPER also calculates the average similarity within a group.

3.2.3 Fish

Unlike the macroinvertebrate data analysis, there are no models currently developed for fish communities and as such a 'snap shot' health assessment cannot be made. The focus of the data analysis is on the diversity and composition of fish species collected at each site and the population age structure of the more abundant or key fish species.

Length frequency distribution histograms can provide an insight into the population dynamics of each species and may reveal differences between sites and identify any changes that may have occurred over the sampling events. These graphs can often reveal differences in the fish communities between sites and display temporal changes over time. For example sites that display a large diversity of size classes may indicate species that have a high fecundity and/or a successful recruitment rates and also indicate the years during which reproduction is occurring. Sites that display a low number of smaller size class individuals followed by a year with a considerable increase in the same size class may indicate reproduction has occurred between the two sampling events. This is most effectively conducted where the total number of observations for any one species is greater than 50 individuals identified across both sites and sampling events.

Diadromy is the term used for fish species which migrate between freshwater and saltwater during some stage of their lifecycle. The abundance and number of diadromous fish species can indicate whether upstream and downstream barriers are impeding fish migration. However, there is currently limited knowledge of the lifecycle for the majority of species observed in the Styx River Catchment, and as such only limited analysis of this information can be presented.

3.2.3.1 Multivariate Analysis

Multivariate analysis similar to that used to investigate macroinvertebrate data, including cluster analysis, NMDS, ANOSIM and, SIMPER was performed to reveal spatial trends in fish populations at the freshwater sites. As this data is a combination of all the methods this analysis does not take into account abundance data but like the macroinvertebrate data only assumes the presence of species at each of the sites and sampling events. Due to the unreplicated nature of the sampling the results need to be considered with caution.

3.2.4 Aquatic Reptiles and Platypus

Observational and accidental capture techniques were used to record the presence of aquatic reptiles and Platypus.

4 Water Quality

4.1.1 In situ Water Quality

Only two parameters from the *in-situ* water quality variables were outside the QWQG (2009): DO (%Sat), and pH (Table 4-1).

DO (%Sat) was slightly lower than the QWQG guidelines at Deep Creek Sites De1, and De2 at both riffle and edge habitats, and higher than the guideline value for the Styx River sites St1(b), and St2. Note that dissolved oxygen readings taken in this study represent spot readings recorded at different times of day. Dissolved oxygen levels vary throughout the day, so readings that fell outside guideline levels should not necessarily be considered of concern.

The pH result for site St1 was above the QWQG (2009) with a reading of 9.19, this value was retested after re-calibration of the meter when the pH recorded was 9.8. The pH result for site St1 should therefore be treated with caution.

EC values varied across sites with both Deep and Granite Creek sites having values below the QWQG (2009) 50th percentile value of 640 (µS/cm). In comparison the Tooloombah Creek and Styx River sites were both above the 50 percentile value with the Styx sites ranging from 987 – 1390 (µS/cm). Although the EC at the St2 and St1 (b) sites were high this is not surprising given the proximity of these sites to the estuary. Local landholders advised ALS that large tides pushed well up the river above the Ogmore Bridge.

Broadly the *in situ* water quality values can be separated into 2 groups:

- Group1- (Deep and Granite Creek): EC<500µS/cm, pH<7.3, DO (%Sat) < 90%, Turbidity>7 NTU, Alkalinity<50 – (red font in Table 4-1).
- Group2 - (Tooloombah Creek and Styx River): EC>500µS/cm, pH>7.3, DO (%Sat)>90%, Turbidity<7 NTU, Alkalinity>50 – (blue font in Table 4-1).

Laboratory Water Quality

Laboratory WQ analyses confirmed results from the *in-situ* analyses and supported the water quality groupings outlined above (Table 4-2). The Laboratory WQ analyses highlighted two analytes that recorded exceedances of the Final Model of Water Conditions for Coal Mines in the Fitzroy Basin (2009): total nitrogen, and total phosphorus.

In terms of nutrients total nitrogen marginally exceeded the guidelines at: De1, De3, St1, To2, and Gr1. Total Phosphorus exceeded the guidelines at only De3, and St1. The total nitrogen values ranged from 0.4 - 0.7 mg/L which is only marginally higher than the 0.5mg/L guidelines. The QWQG 2009 state that levels in this range are acceptable and natural if the levels of ammonia and other oxidised nitrogen values are low, which they were in this project with values ranging from <0.01 – 0.03. The only exception to this was for nitrites and nitrates at site De3 which were high at 0.12 mg/L.

Phosphorus levels in general were low (<0.01 – 0.04 mg/L) and ranged below the guideline values for total phosphorus except for sites De3 (P=0.10mg/L), and St1 (P=0.12 mg/L) which were both much higher than the QWQG 2009 guideline value (P=0.05).

Zinc was the only metal that recorded dissolved concentrations above the guideline values. This occurred at sites De1, St1b, St2 and Gr1. Levels at these sites ranged between two and four times the guideline concentration for zinc.

Table 4-1: ***In-situ*** **water quality observed at the Yeats aquatic sites for June 2011, figures highlighted in yellow are outside the QWQG (2009) values for slightly to moderately disturbed lowland streams of Central Coast QLD. The blue and red text indicates group 1 and 2 waterways defined above.**

Site Code	Habitat	Date	Time (24hr)	Temp. (°C)	EC (µS/cm)	pH	DO (mg/L)	DO (%sat)	Turbidity (NTU)	Total Alkalinity
De1	Riffle	1/6/2011	14:30	16.25	461	6.81	8.06	82.3	N/A	N/A
De1	Edge	1/6/2011	14:25	15.71	461	6.92	7.97	80.4	13.1	37
De2	Riffle	2/6/2011	15.55	16.78	475	7.16	8.03	82.7	N/A	N/A
De2	Edge	2/6/2011	16:00	16.68	476	7.06	8.08	83.4	12.9	39
De3	Riffle	3/6/2011	12:00	14.79	447	7.21	8.59	85.8	17.2	41
Gr1	Riffle	5/6/2011	14:55	18.3	324	*6.6	7.84	83.7	7.44	44
St1	Edge	5/6/2011	9:30	16.74	987	9.19	8.82	90.9	5.63	70
St1(b)	Edge	2/6/2011	14:45	19.94	1366	7.61	11.21	123.4	5.83	145
St2	Edge	2/6/2011	14:00	18.49	1390	7.63	10.69	114.6	5.41	65
To1	Riffle	3/6/2011	17:35	16.05	866	7.59	9.32	94.7	5.93	62
To2	Riffle	4/6/2011	10:00	15.64	848	7.4	9.11	92.11	1.67	75
Median Value				**16.68**	**476**	**7.21**	**8.59**	**85.8**	**7.44**	**65**
QWQG (2009)				**N/A**	**N/A**	**6.5 – 8.0**	**N/A**	**85 - 110**	**50**	**N/A**

Table 4-2: **Analytical water quality results for samples collected at Styx Catchment sites in June 2011. (*LOR= limit of reporting). The blue and red text indicates group 1 and 2 waterways defined above.**

Analyte grouping/Analyte	Units	LOR	De1	De2	De3	St1	St1(b)	St2	To1	To2	Gr1	Guidelines (mg/L)**
Total Dissolved Solids @180°C	mg/L	5	536	562	508	850	1140	1080	740	778	182	-
Suspended Solids	mg/L	5	6	6	6	<5	<5	<5	<5	<5	6	-
Dissolved Major Cations												
Calcium	mg/L	1	20	20	17	58	62	64	65	63	18	-
Magnesium	mg/L	1	16	16	16	45	54	55	47	46	16	-
Sodium	mg/L	1	72	73	82	139	214	227	104	104	33	-
Potassium	mg/L	1	3	3	3	2	5	6	2	2	1	-
Hydroxide Alkalinity	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Carbonate Alkalinity	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-
Bicarbonate Alkalinity	mg/L	1	89	88	100	190	204	306	212	209	75	-
Total Alkalinity	mg/L	1	89	88	100	190	204	306	212	209	75	-
Sulphate as SO4	mg/L	1	29	28	24	42	66	68	42	41	2	1000*
Chloride	mg/L	1	116	119	118	291	425	422	232	228	73	-
Fluoride	mg/L	0.1	<0.1	0.1	0.1	0.2	0.2	0.4	0.2	0.2	<0.1	2.0
Nutrients: By Discrete Analyser -												
Ammonia	mg/L	0.01	0.03	0.03	0.02	0.02	<0.01	0.03	0.02	0.02	<0.01	0.90
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.1
Nitrate as N	mg/L	0.01	0.03	0.03	0.12	0.04	0.05	0.04	0.03	0.02	0.05	-
Nitrite + Nitrate	mg/L	0.01	0.03	0.03	0.12	0.04	0.05	0.04	0.03	0.02	0.05	-
Total Kjeldahl Nitrogen	mg/L	0.1	0.7	0.4	0.5	0.5	0.3	0.4	0.4	0.6	0.5	-
Total Nitrogen	mg/L	0.1	0.7	0.4	0.6	0.5	0.4	0.4	0.4	0.6	0.6	0.5
Total Phosphorus	mg/L	0.01	0.04	<0.01	0.10	0.12	<0.01	<0.01	0.03	0.02	0.04	0.05
Reactive Phosphorus	mg/L	0.01	<0.01	<0.01		<0.01		<0.01				0.02
Analyte grouping/Analyte	Units	LOR	De1	De2	De3	St1	St1(b)	St2	To1	To2	Gr1	(mg/L)
* Protection of irrigation environmental value (DERM 2009a)												

Table 4-2 Continued												
* Protection of irrigation environmental value (DERM 2009a)												
** QWQG trigger values for slightly to moderately disturbed waters of the Central Coast QLD region (DERM, 2009b)												
Analyte grouping/Analyte	Units	LOR	De1	De2	De3	St1	St1(b)	St2	To1	To2	Gr1	Guidelines (mg/L)**
Dissolved Metals by ICP-AES												
Aluminium	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.1
Arsenic	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.013
Boron	mg/L	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.37
Cobalt	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.09
Iron	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	0.3
Lead	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Manganese	mg/L	0.01	0.08	0.04	0.04	0.19	0.12	0.08	0.01	0.03	0.02	1.9
Molybdenum	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.034
Nickel	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Dissolved Metals by ICP-MS												
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0002
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.01
Copper	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.02
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	0.001
Zinc	mg/L	0.005	0.029	0.006	<0.005	0.005	0.010	0.026	<0.005	<0.005	0.014	0.008*
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Faecal Coliforms & E.coli by MF												
Escherichia coli	CFU/100mL	1	~90	~30		~10		17				

4.1.2 Multivariate Analysis of Water Quality

Multivariate analysis of the water quality variables collected showed that water quality was broadly dived into two groups: the Styx River-Tooloombah Creek group, and the Granite Creek-Deep Creek group (Figure 4-1, and 4-2).

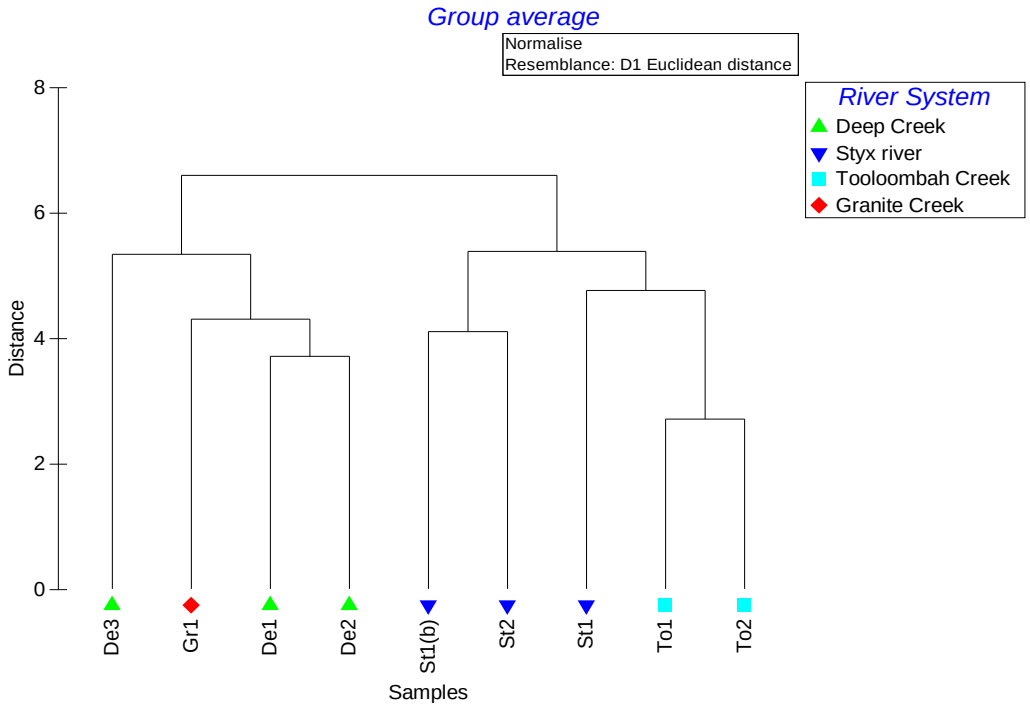

Figure 4-1: Cluster Analysis of all water quality data from Styx Catchment June 2011

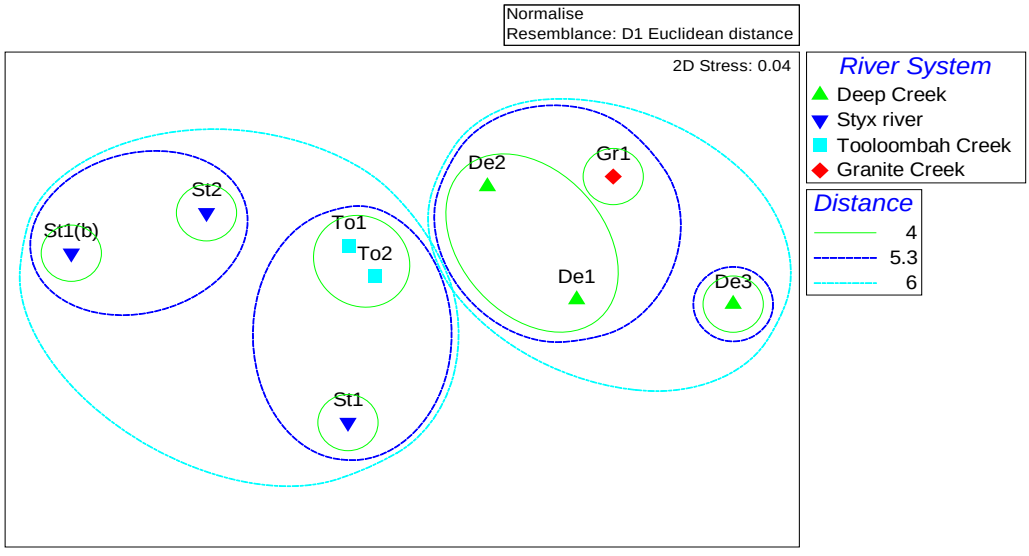

Figure 4-2: MDS Plot of all water quality data from Styx Catchment June 2011, showing distance similarities.

4.2 Aquatic Macroinvertebrates

4.2.1 Diversity

Macroinvertebrates were identified to Family level and diversity was relatively high with 46 taxa (Families) collected across both the riffle and edge sites sampled in the Project.

The riffle habitats sampled in Deep, Tooloombah, and Granite Creeks had a total of 31 taxa across all the riffle sites. The highest diversity in the riffle habitats was found at De2 which had 24 taxa which was the second highest diversity found at any site. The lowest diversity for any riffle sites was found at the Tooloombah Creek site To1 which had only 13 taxa present, this was also the lowest value found at any site.

The Edge Habitats sampled along the Styx River had even higher diversity than the riffle habitats with a total of 35 taxa collected from all edge sites. The highest diversity at any edge site was found at St1which had 26 taxa present, and this was the most diverse site sampled. The lowest diversity of any edge sample was found in St2 which still had 19 taxa.

4.2.2 Sensitive Taxa

EPT Taxa are the taxa belonging to the Orders: Ephemeroptera, Plecoptera, and Trichoptera respectively. These taxa are sensitive to poor water quality and by default are good indicators of healthy waterways, however, some EPT taxa are tolerant of low level pollution. This study has, therefore, presented two separate results:

- EPT richness
- Number of sensitive taxa (i.e. those with a SIGNAL sensitivity rating of 6 or greater)

EPT Taxa

The EPT Taxa Richness value in the riffle habitats was 9 EPT taxa, while the edge habitats had only 6 EPT Taxa. The EPT Taxa Richness in the riffle habitats ranged between 5 and 9 EPT Taxa, with a median of 7 EPT Taxa. In comparison the EPT Taxa Richness in the edge habitats ranged between 3 and 5 EPT Taxa, with a median value of 4 EPT Taxa. In general all riffle habitats had higher EPT Taxa Richness than Edge Habitats (Fig 4-1), which is expected as sensitive taxa are generally more abundant in riffle habitats than edge habitats (Boulton & Brock 1999).

Sensitive Taxa

Overall riffle habitats had a total of 8 sensitive taxa with a range of 3-7 sensitive taxa, and a median value of 5.5 sensitive taxa per site. The edge habitats had a total of 5 sensitive taxa overall, a range of 3-4 sensitive taxa, and a median value of just 4 sensitive taxa per site.

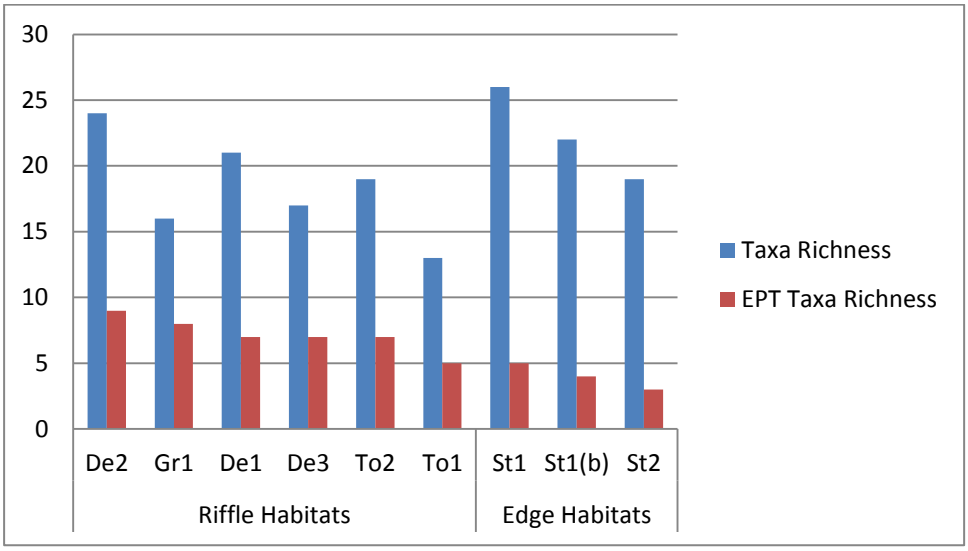

Figure 4-1: Taxa Richness and EPT Taxa Richness at both Riffle and Edge habitats sampled in the Styx Catchment June 2011.

4.2.3 Condition

Condition was measured in terms of:

- AUSRIVAS bandwidths and associated O/E50 scores,
- Comparison against the expected taxa richness, EPT richness and SIGNAL 2 ranges for Central Queensland in DERM (2009b), and
- Mean SIGNAL 2 scores for each site

The AUSRIVAS Model for Coastal Queensland found that nearly all the sites had the expected number of macroinvertebrate families expected at a reference riffle site in this area. The only site that failed to have the expected number of macroinvertebrate families was the site To1 which was classified by the model as 'Significantly Impaired'.

All the edge sites sampled for macroinvertebrates were in similar condition to 'reference condition' (Band A – See Table 4-3). They had the expected number of families of macroinvertebrates that the model predicted for over 80% of such sites. The numbers of expected families that were collected declined as the sites moved downstream towards the estuary, site St1 the most upstream site had more families of macroinvertebrates than was expected by the AUSRIVAS model.

The riffle habitats sampled varied from "More Biologically Diverse than Reference" (De1, De2, Gr1) to "Similar to Reference" (De3, To2), through to "Significantly Impaired" (To1).

The "More Biologically Diverse than Reference" Band means that the riffle sites De1, De2, and Gr1 exceeded the expected number of taxa predicted by the AUSRIVAS model. This result can be caused by a range of conditions including mild organic enrichment or altered flow patterns, although it could also mean that the AUSRIVAS model itself requires further calibration, particularly given the macroinvertebrate of the study area has not been subject to much investigation. The Band "Similar to Reference" means that De3 and To2 both had the range of macroinvertebrate families expected at such sites by the model.

Finally the "Significantly Impaired" site To1 has fewer macroinvertebrate families than expected indicating a decline in the health of the river at this location. A black slime of unknown origin was found in the net while sampling riffle 1 at site To1.

Edge habitats sampled in the Styx River were within the range expected for slightly to moderately disturbed waters of Central Queensland in regards to both EPT taxa richness and SIGNAL2 score (Table 4-3, QWQG 2009). But only site St1was within these guidelines for taxa richness. Note that these guidelines are based on the collection of 22 samples as opposed to the only three samples collected for the Styx Project.

No guideline values for taxa richness, EPT taxa richness or SIGNAL2 scores are given for riffle habitats in Central Queensland.

Table 4-3: Macroinvertebrate indices for both riffle and edge habitats sampled in the Styx Catchment in June 2011. Edge habitats shaded in yellow were within the 20th to 80percentile range of those found in Central Queensland slightly to moderately disturbed waters guidelines.

Habitat Type:	Riffle Habitats							Edge Habitats				
Sites:	De1	De2	De3	To1	To2	Gr1	All Riffle Sites	Edge Guidelines[1]	St1	St1(b)	St2	All Edge Sites
Taxa Richness	21	24	17	13	19	16	31	23-33	26	22	19	35
Taxa Richness of EPT Taxa	7	9	7	5	7	8	9	2-5	5	4	3	6
SIGNAL2 Score	4.76	5.25	5.71	5.77	5.37	6.06	5.48	3.31-4.2	3.65	3.5	3.52	3.56
Mean EPT Taxa SIGNAL 2 Score	6.43	6.22	6.43	6.2	5.86	6.1	6.21		5.8	6	5.3	5.83
Taxa Richness of Sensitive Taxa	6	7	5	3	5	6	9		4	4	3	5
Mean SIGNAL Score of Sensitive Taxa	7	7	7.2	7.33	6.8	7.17	7.08		6	6	6	6
Rare Taxa	0	2	0	0	2	1	5		2	1	1	4
AUSRIVAS Band	X	X	A	B	A	X	N/A		A	A	A	N/A

[1]QWQG 2009 for 20th – 80th percentile range

Figure 4-2 shows the variation in SIGNAL 2and O/E50 scores between sites. O/E50 results reflect AUSRIVAS banding results shown in Table 4-3. Many sites had O/E50 levels greater than 1, reflecting a greater number of taxa being recorded than expected. Site T01 had the lowest O/E50 score and, hence the lowest AUSRIVAS banding. SIGNAL 2 scores were on average higher in riffle habitats than edge habitats, which is somewhat expected given that riffle habitat tends to host a greater number of EPT taxa than edge habitat. Edge habitat SIGNAL 2 scores were broadly similar, albeit that data were only recorded for this habitat at three sites. SIGNAL 2 scores ranged from around 6 at Gr1 to around 4.7 at De2. This suggests that site Gr1 riffle habitat hosted the highest ratio of the number of pollution sensitive macroinvertebrate taxa to pollution – tolerant taxa and riffle habitat at site De1 the lowest. The reasons for this are not known, but a SIGNAL 2 score of 4.7 is

still relatively high and, as reflected in the AUSRIVAS bandings, site De1 had a greater number of taxa than expected, which is not intuitively indicative of a degraded habitat.

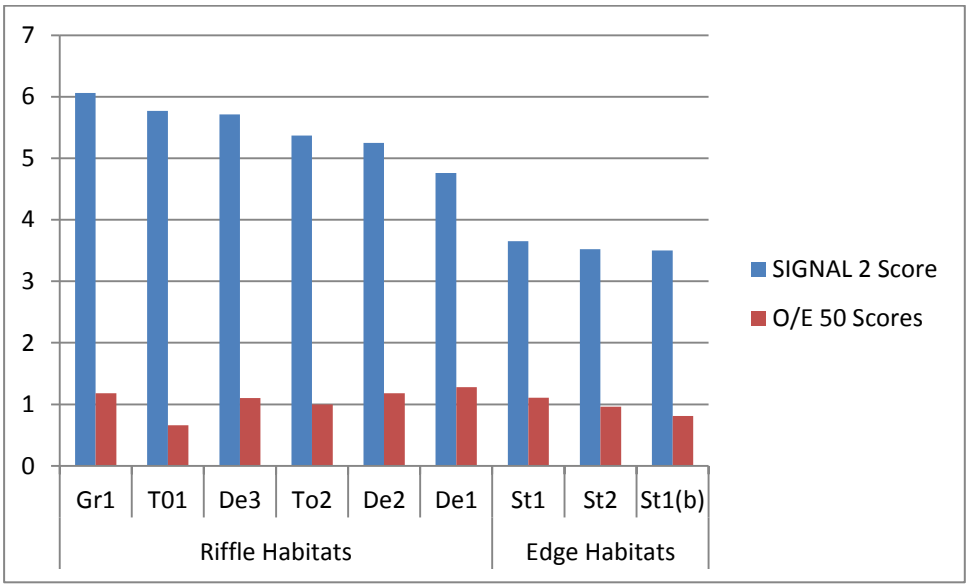

Figure 4-2: SIGNAL 2 score and AUSRIVAS O/E 50 at both Riffle and Edge habitats sampled in the Styx Catchment June 2011

4.2.4 Community Composition and Habitat Association

Multivariate analysis (CLUSTER and MDS) showed that macroinvertebrate communities separated into individual River Systems, except for the high similarity between the Granite Creek Site: Gr1 and the Deep Creek sites, especially De3 (Figures 4-3, 4-4). It should be noted that the Styx River System samples were from Edge samples and not Riffle samples and that is why their macroinvertebrate communities are so dissimilar to the other (Riffle) samples.

4.2.4.1 Multivariate Analysis of Macroinvertebrate Data

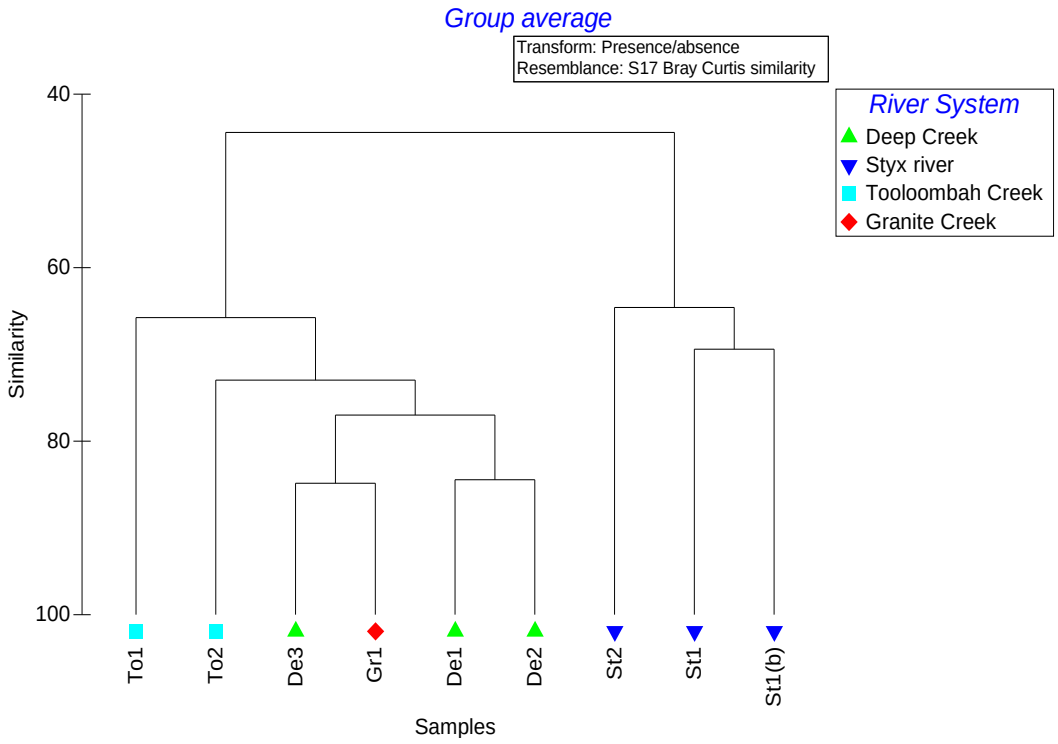

Figure 4-3: Cluster analysis of macroinvertebrate data collected from the Styx Catchment June 2011

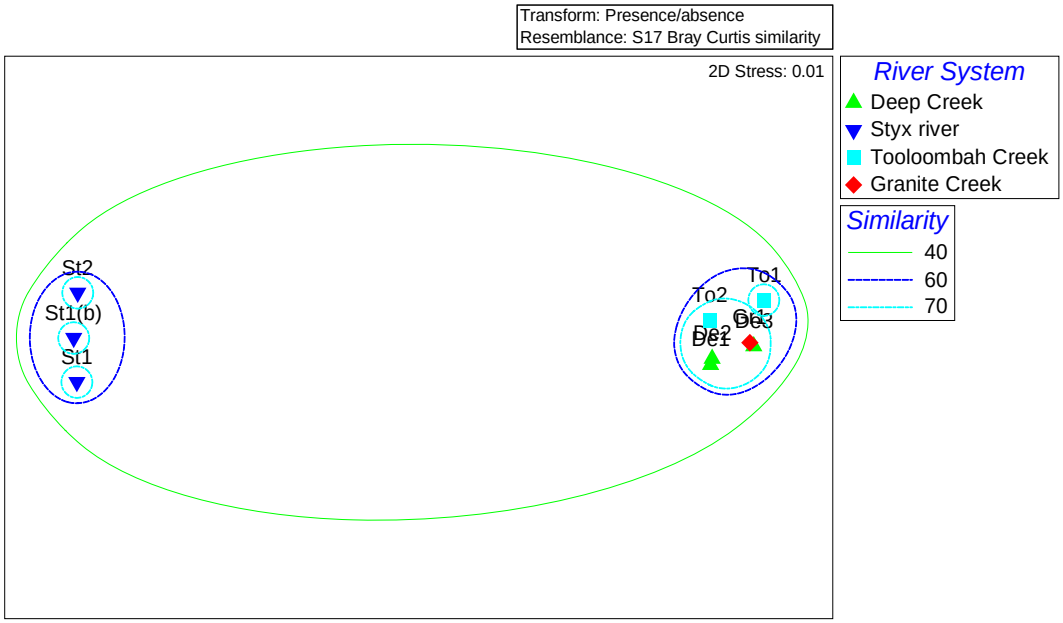

Figure 4-4 MDS Plot showing Similarity levels between macroinvertebrate communities at different sites in the Styx Catchment June 2011

Dissimilarities between sites (SIMPER) reflect the differences between sites and habitat types (Table 4-3). Average Similarity of Macroinvertebrate Communities within river systems was highest within the Deep Creek samples (82.23%), followed by the Styx River (66.18%), and lowest within the Tooloombah Creek Samples (62.50%).

Multivariate analysis (ANOSIM) of all macroinvertebrate data revealed no significant differences based on River Systems (R =0.616, p=0.07), but did show that habitat types were significantly different for Riffle versus Edge macroinvertebrate communities (R = 1, p=0.012). As discussed previously, where data is based on unreplicated sampling then results should be read with caution.

EPT taxa contributing to habitat similarity were most diverse in the riffle habitats (8 taxa) as opposed to the edge habitats (2 taxa) (Table 4-5). In addition, the Caenid mayflies found in both the edge and riffle habitats have a relatively wide pollution tolerance with Caenid mayflies in Queensland having SIGNAL2 scores ranging from 2- 9 in a scale of 1-10 (Suter et al 2002). Once again this reflects the overall higher sensitivity of the macroinvertebrates found in the riffles when compared with those from the edge habitat.

While similarity between edge and riffle macroinvertebrate communities was relatively low (Figure 4-4), the similarity within the riffle sites was high at 65% (Figure 4-5), and even higher for the overall average similarity at 73.19% (Table 4-5). Within the Granite Creek and Deep Creek Sites the similarity was 76%, while the Tooloombah Creek sites did not group together except with the other riffle sites and had a within-creek similarity of 65%.

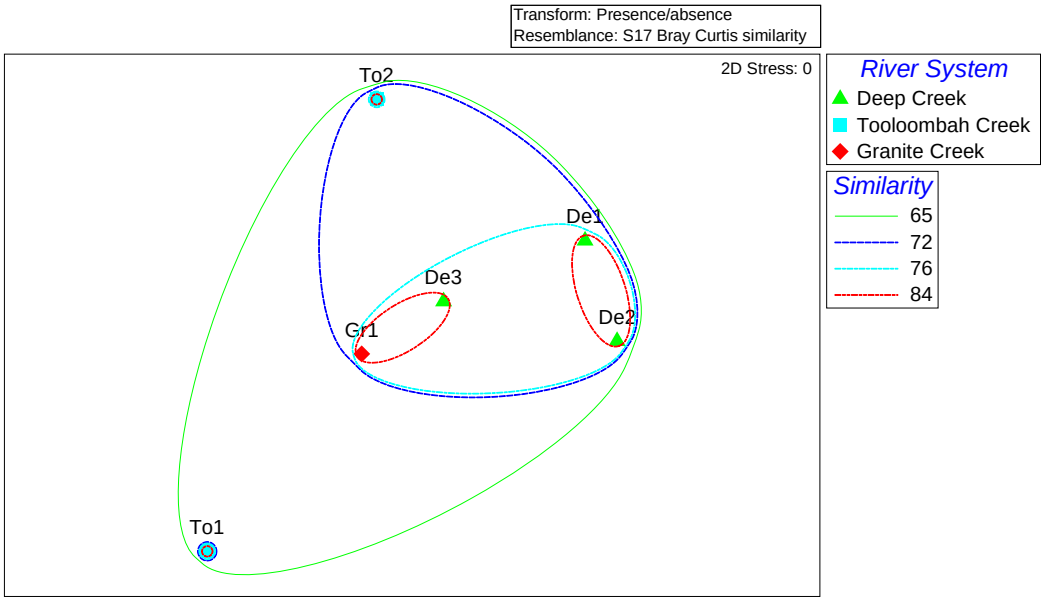

Figure 4-5 MDS Plot showing Similarity levels between riffle macroinvertebrate communities at different sites in the Styx Catchment June 2011

Table 4-5: **Results of SIMPER analysis of the riffle and edge macroinvertebrate data displaying the key macroinvertebrate taxa which contributed to the similarity within each habitat. EPT taxa are highlighted in yellow.**

Riffle Habitat - Average Similarity: 73.19%					
Family/Order	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Palaemonidae	1	5.54	7.75	7.57	7.57
Chironominae	1	5.54	7.75	7.57	15.13
Orthocladiinae	1	5.54	7.75	7.57	22.7
Simulidae	1	5.54	7.75	7.57	30.27
Baetidae	1	5.54	7.75	7.57	37.84
Libellulidae	1	5.54	7.75	7.57	45.4
Hydrobiosidae	1	5.54	7.75	7.57	52.97
Hydropsychidae	1	5.54	7.75	7.57	60.54
Philopotomidae	1	5.54	7.75	7.57	68.11
Tabanadae	0.83	3.73	1.33	5.09	73.2
Caenidae	0.83	3.46	1.35	4.73	77.93
Leptoceridae	0.83	3.46	1.35	4.73	82.67
Hydroptilidae	0.67	2.26	0.78	3.09	85.76
Gomphidae	0.67	2.2	0.79	3.01	88.76
Leptophlebiidae	0.67	2.07	0.78	2.83	91.59
Edge Habitat - Average Similarity: 66.18%					
Family/Order	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Acarina	1	4.44	10.94	6.7	6.7
Dytiscidae	1	4.44	10.94	6.7	13.4
Hydrophilidae	1	4.44	10.94	6.7	20.11
Palaemonidae	1	4.44	10.94	6.7	26.81
Chironominae	1	4.44	10.94	6.7	33.51
Orthocladiinae	1	4.44	10.94	6.7	40.21
Tanypodinae	1	4.44	10.94	6.7	46.92
Caenidae	1	4.44	10.94	6.7	53.62
Corixidae	1	4.44	10.94	6.7	60.32
Gerridae	1	4.44	10.94	6.7	67.02
Notonectidae	1	4.44	10.94	6.7	73.73
Velidae	1	4.44	10.94	6.7	80.43
Leptoceridae	1	4.44	10.94	6.7	87.13
Hydraenidae	0.67	1.63	0.58	2.46	89.59
Protoneuridae	0.67	1.45	0.58	2.19	91.78

Table 4-5: **Results of SIMPER analysis of the macroinvertebrate data displaying the key macroinvertebrate taxa which contributed to the dissimilarity between the riffle and edge habitats. EPT taxa are highlighted in yellow.**

Groups Riffle & Edge - Average Dissimilarity: 55.61						
	Group Riffle	Group Edge				
Species	Av.Abund	Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Hydrophilidae	0	1	2.47	8.13	4.45	4.45
Corixidae	0	1	2.47	8.13	4.45	8.9
Notonectidae	0	1	2.47	8.13	4.45	13.35
Hydrobiosidae	1	0	2.47	8.13	4.45	17.79
Philopotomidae	1	0	2.47	8.13	4.45	22.24
Dytiscidae	0.17	1	2.07	2.08	3.72	25.97
Tabanadae	0.83	0	2.07	2.08	3.72	29.69
Baetidae	1	0.33	1.73	1.35	3.12	32.81
Libellulidae	1	0.33	1.73	1.35	3.12	35.93
Tanypodinae	0.33	1	1.73	1.35	3.11	39.04
Velidae	0.33	1	1.73	1.35	3.11	42.15
Gerridae	0.33	1	1.64	1.36	2.96	45.11
Protoneuridae	0	0.67	1.64	1.34	2.95	48.06
Hydraenidae	0.17	0.67	1.58	1.2	2.84	50.9
Simulidae	1	0.33	1.57	1.35	2.83	53.73
Hydrometridae	0	0.67	1.57	1.35	2.83	56.56
Hydropsychidae	1	0.33	1.57	1.35	2.83	59.39
Dolichopodidae	0.67	0	1.57	1.36	2.82	62.21
Thiaridae	0.17	0.67	1.46	1.2	2.63	64.84
Gomphidae	0.67	0.33	1.37	1.07	2.46	67.3
Acarina	0.5	1	1.33	0.96	2.39	69.69
Oligochaetae	0.5	0.33	1.2	0.97	2.16	71.86
Gyrinidae	0.5	0	1.18	0.96	2.13	73.99
Leptophlebiidae	0.67	0.67	1.14	0.86	2.04	76.03
Hydroptilidae	0.67	0.67	1.12	0.86	2.02	78.04
Mesovelidae	0	0.33	0.9	0.68	1.62	79.66
Pleidae	0	0.33	0.9	0.68	1.62	81.28
Corbiculidae	0.17	0.33	0.9	0.77	1.62	82.9
Culicidae	0	0.33	0.83	0.68	1.5	84.4
Bithyniidae	0	0.33	0.83	0.68	1.5	85.9
Physidae	0	0.33	0.83	0.68	1.5	87.4
Parastacidae	0.33	0	0.74	0.68	1.34	88.73
Atyidae	0	0.33	0.74	0.68	1.33	90.06

4.2.5 Existing Impacts

Pollution Impacts

Overall, all sampling sites visited in June 2011 as part of the baseline survey have been shown to be in a healthy state as evidenced by the generally high water quality results with the only marginal exceedances for total nitrogen, total phosphorus, sulphate and zinc being recorded.

Erosion and Turbidity Impacts

Erosion is a major problem in the Styx Catchment with many of the soils prone to erosion (Australian Agricultural Assessment 2001, Meltzer et al 2008). Many areas of recent and past erosion were noted on this field trip and the highly erodible nature of the soils has worsened by over grazing during periods of drought (Meltzer et al 2008). Despite this susceptibility to erosion, all the water quality analyses showed very low levels of both turbidity, and suspended solids. Riffles in the Deep, Tooloombah, and Granite Creeks also showed no evidence of siltation from erosion; however, pool habitats in the Styx River did show evidence of sand and silt deposition. Pool bed habitat was not sampled for macroinvertebrates as part of this study, but based on this observation should be considered as part of further macroinvertebrate monitoring for this Project.

Aquatic Pest Impacts

While macrophytes and riparian vegetation of any form provide structural habitat for macroinvertebrate colonisation, differences in growth forms of native versus exotic species may potentially support different types of macroinvertebrate fauna. Also, prolific macrophyte growth can affect dissolved oxygen levels through high respiration rates to photosynthesis rates at night and through the decay of plant material. No aquatic weeds were observed other than sedges (Cyperaceae sp.) and rushes (*Juncus* sp.). It is likely that most floating, submerged or emergent aquatic plants would have been removed from the waterways during the floods and high flow conditions that occurred in the wet season.

The Styx Catchment has many areas of ponded pasture and these made accessing sites in the Deep Creek and Tooloombah Creek difficult. Past studies have noted several aquatic weed species in the region including: *Salvinia, Hymenachne*, and the Water Lettuce (*Pistia stratiotes*) though none of these were not observed in this project (Melzer et al 2008).

Riparian Vegetation Modification

The extent of riparian vegetation has implications for macroinvertebrates as riparian vegetation helps stabilise banks and therefore reduces the potential for elevated turbidity and sediment movement. Also, riparian vegetation provides shading that helps reduce water temperatures and also provides a source of leaf litter (food source and habitat) and large woody debris (habitat) for macroinvertebrates. Furthermore, riparian shading affects the amount of light available for photosynthesis and hence algal growth (food source and habitat for macroinvertebrates).

Riparian vegetation was generally of natural appearance, continuous, with mostly moderate (50-75%) tree cover and some shrub cover (10 -50%) in all creeks except for the Styx River. Grass cover was high (75-100%) at most sites except where tree cover was near 100%.

Cattle Access to Creeks

Cattle access to creeks has the potential to degrade instream habitat conditions through the addition of nutrients through cattle defecating in or close to waterways, increased

turbidity through bank erosion and compaction of riffle and edge habitat through trampling, all of which can affect the status of the macroinvertebrate community.

In general the area had very low levels of grazing perhaps due to de-stocking during the recent long drought in the area. Despite this there was evidence of some cattle pugging and droppings in many shallows and riffles though as already noted this did not impact detrimentally on water quality.

5 Fish

5.1 Total Catch

A total of 736 fish from 27 taxa were collected across all the sites. The most abundant catches were in Deep Creek and Granite Creek. The Deep Creek sites were sampled using a back pack electrofishing unit which was ideally suited for this relatively narrow and shallow creek. Deep pools near De2 were not sampled for fish as boat access could not be gained and there was evidence of the presence of estuarine crocodiles. The Granite Creek site was sampled with the electrofishing boat as the creek had very wide pools up to 45m across (Figure 5-1).

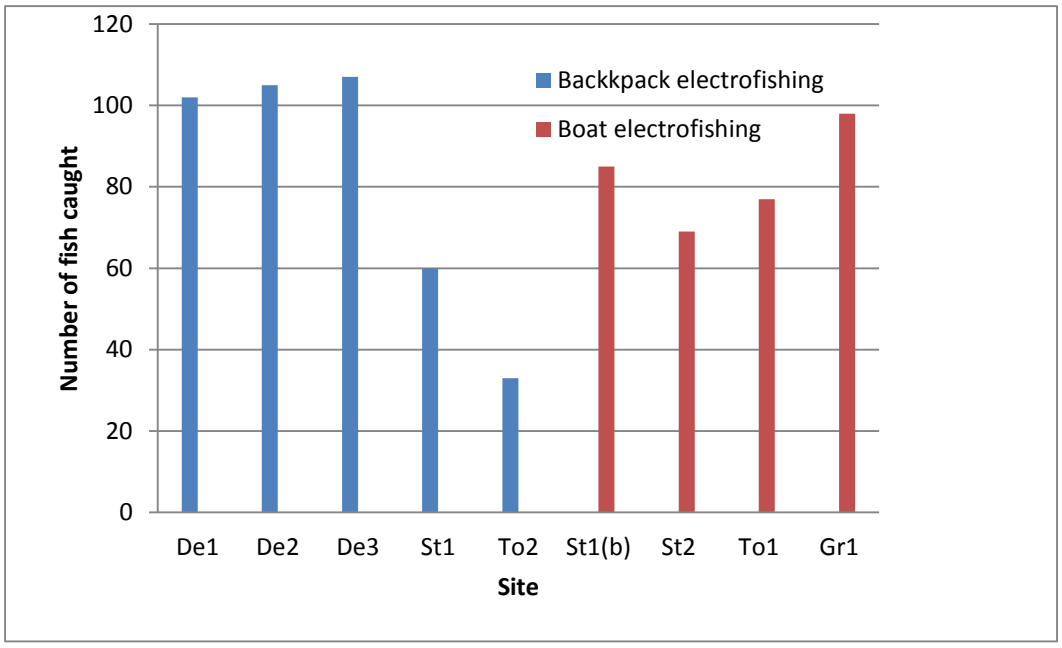

Figure 5-1: Number of fish caught at each site in the Styx Catchment in June 2011.

5.2 Fish Diversity

The highest fish diversity for individual sites was recorded from the Styx River at site St2 and at Tooloombah Creek at site To1, which both recorded 15 species. Both of these sites had large pools that enabled sampling with the boat.

The lowest diversity sites were the Deep Creek site De1, and the Tooloombah Creek site To2. Both of these sites were sampled with a back pack electrofishing unit only (Fig 5-2).

The highest diversity of fish overall was recorded from the Styx River where 22 species were caught over the three sites. This was well ahead of Tooloombah Creek (15 species from two sites), Granite Creek (12 species from a single site), and Deep Creek (11 species from three sites).

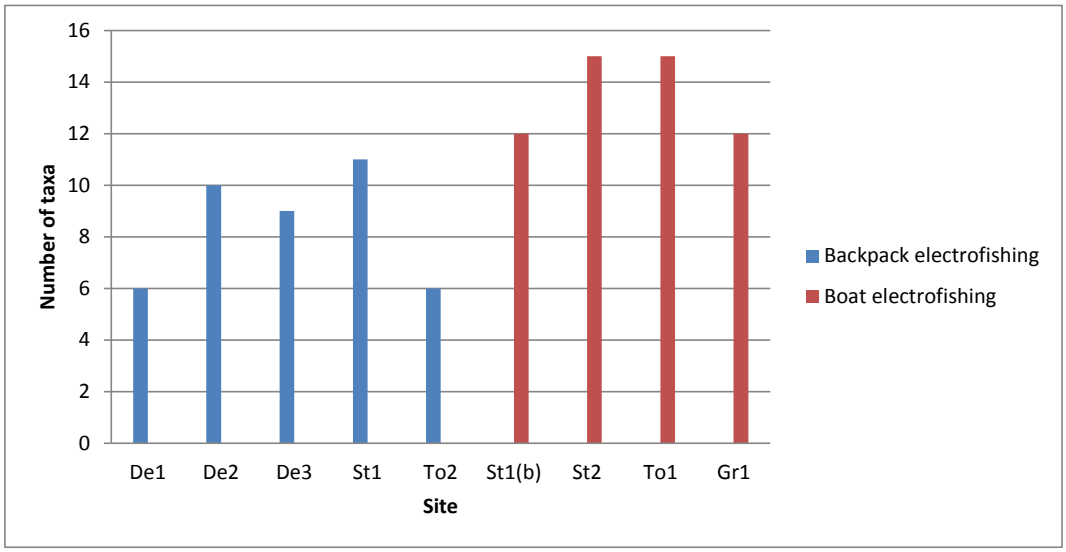

Figure 5-2: Fish taxa diversity caught at each site in the Styx Catchment in June 2011.

5.3 Fish Community Composition and Habitat Association

The fish taxa recorded during the June 2011 sampling round are generally typical of what would be expected to occur in a Central Queensland coastal catchment with some possible exceptions. The main exceptions are that an unidentified eel was recorded at several sites and further details are given in relation to this in section 5.4. The other notable exception is that no exotic species were recorded and this is discussed further in section 5.7.

Table 5-1 shows the number of each species recorded at each site. Eastern Rainbowfish (*Melanotaenia splendida*) and Empire Gudgeon (*Hypseleotris compressa*) were the most commonly caught in terms of both abundance and distribution across all study sites. Agassiz's Glassflsh (Ambassis agassizii), Spangled Perch (*Leiopotherapon unicolour*), Purple Spotted Gudgeon (*Mogurnda adspersa*) and Barramundi (*Lates calcarifer*) were also relatively common, but these did not occur across all sites. Sixteen of the twenty nine species recorded in June 2011 were represented by fewer than 10 individuals across all sites.

There taxa recorded were a mx of freshwater and estuarine / marine associated species with the latter represented by *Elopsh hawaiensis, Gerres filamentosus, Leiognathus equulus, Lates calcarifer, Pomadasys kaakan, Scatophagus argus* and *Selenotoca multifasciata* (see Table 5-3).

Multivariate analysis of the fish community data indicated that Deep Creek had a distinct community from that of the other creek systems assessed, with site scores for Deep Creek forming a tight cluster in the MDS plot in Figure 5-3. This is reflected in the average similarity for Deep Creek sites (73.68%). Fish community composition was more variable in Styx River and Tooloombah Creek with site scores for these creeks more dispersed within the MDS plot in Figure 5-2 and average similarities for these two creeks being 51.15% and 55.28% respectively. While not shown here, further analysis indicated that this related to differences between sites based on the sampling methods (and by extension shallow stream versus deep pool habitat). Hence the data potentially highlight differences in fish fauna found in shallow stream versus deep pool habitat, though further sampling would be required to confirm this. Granite Creek fish fauna most closely matched that of To1, though this is based on only one sample from that creek system.

Table 5-2 shows the results of SIMPER analysis, which highlight which fish species characterised which creek systems. Differences in the fish fauna between the four creek systems assessed were attributed to some taxa being found in some creeks and not in others and some fish species being more abundant in some creeks than others. Deep Creek contained Spangled perch and Hyrtls Tandan, while these species were not recorded in the Styx River. At the same time, Barramundi, Sea mullet, Pacific blue eye, the Goby *Glossogobius giurus* and Pacific Short-Finned Eel were found in the Styx River but not in Deep Creek. Differences between Deep Creek and Tooloombah Creek fish communities largely related to the presence of Midgely's Carp Gudgeon in Deep Creek, but not in Tooloombah Creek and the presence of Pacific short-finned eel, barramundi, bony bream and Forktailed Catfish in Toolombah Creek, but not in Deep Creek. Granite Creek contained mainly freshwater associated fish species and was similar to site To1 in that it had Forktailed Catfish and Flyspecked Hardyhead present, which were not recorded at the other sites. These data confirm that there is variability in fish community composition between waterways in the study area. This is at least partly driven by proximity to the estuary based on the species contributing to the differences between Deep Creek and Styx River and Tooloombah Creek.

Table 5-1: Fish species caught at each site in the Styx Catchment in June 2011

Species Name	Common Name	De1	De2	De3	St1	St1(b)	St2	To 1	To 2	Gr 1	Tota ls
Ambassis agassizii	Agassiz's Glassfish	20	28	3	4	2	4	4		20	85
Amniataba precoides	Barred Grunter	1									1
Anguilla reinhardtii	Marbled (Longfinned) Eel		1	1	14	1	4	6	5	13	45
Anguilla obscura	Pacific Short Finned Eel					4	1	3	1		9
Arius graeffei	Forktailed Catfish							1		1	2
Craterocephalus stercusmuscarum	Flyspeckled Hardyhead							1		4	5
Elopsh awaiensis	Giant Herring						3				3
Gerres filamentosus	Threadfin Silver Biddy						2				2
Glossamia aprion	Mouth Almightly				1						1
Glossogobius giurus	Goby				1	3	3				7
Hypseleotris compressa	Empire Gudgeon	7	12	40	20	8	2	9	3	7	108
Hypseleotris klunzingeri	Western Carp Gudgeon		1				2				3
Hypseleotris species 1	Midgley's Carp Gudgeon		7	1	1					8	17
Lates calcarifer	Barramundi				9	12	8	8		14	51
Leiognathus equulus	Common Ponyfish					4	4				8
Leiopotherapon unicolour	Spangled Perch	16	18	18				6	2	3	63
Megalops cyprinoides	Tarpon		2	3			2	6		3	16
Melanotaenia splendida	Eastern Rainbowfish	38	18	20	3	20	20	20	20	19	178
Mogurnda adspersa	Purple-spotted Gudgeon	20	15	13	1			1	2		52
Mugil cephalus	Sea Mullet					20	12	1			33
Nematalosa erebi	Bony Bream					4	1	8		5	18
Neosilurus hyrtlii	Hyrtl's tandan		3	8				2		1	14
Pomadasys kaakan	Javelin Fish						1				1
Pseudomugil signifer	Pacific blue-eye				5						5
Redigobius bikolanus	Speckeled Goby					1					1
Scatophagus argus	Spotted Scat										
Selenotoca multifasciata	Banded Scat					6					6
Unidentified eel	Unidentified eel				1			1			2
Total Catch		102	105	107	60	85	69	77	33	98	736
Taxa Richness		6	10	9	11	12	15	15	6	12	27

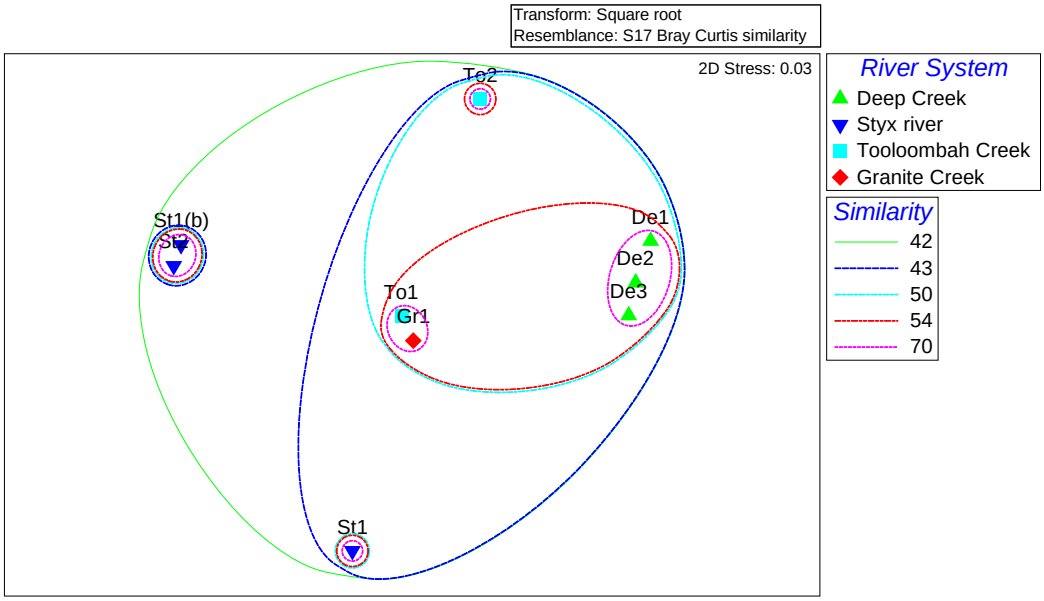

Figure 5-3: MDS plot representation variation in fish community composition between sites in the Styx Catchment in June 2011.

Table 5-2: SIMPER analysis results highlighting which fish species characterised each creek system in June 2011

Deep Creek				
Average similarity: 73.68				
Species	Av.Abund	Av.Sim	Contrib%	Cum.%
Melanotaenia splendida	4.96	16.54	22.45	22.45
Leiopotherapon unicolour	4.16	15.59	21.16	43.61
Mogurnda adspersa	3.98	14.14	19.19	62.8
Hypseleotris compressa	4.14	11.1	15.06	77.87
Ambassis agassizii	3.83	10.16	13.79	91.66
Styx River				
Average similarity: 52.15				
Species	Av.Abund	Av.Sim	Contrib%	Cum.%
Lates calcarifer	3.1	10.88	20.86	20.86
Melanotaenia splendida	3.56	9.69	18.58	39.45
Hypseleotris compressa	2.9	7.18	13.76	53.21
Ambassis agassizii	1.8	6.09	11.68	64.89
Anguilla reinhardtii	2.25	5.07	9.73	74.62
Glossogo biusgiurus	1.49	4.61	8.85	83.47
Mugil cephalus	2.65	4	7.67	91.14
Tooloombah Creek				
Average similarity: 55.28				
Species	Av.Abund	Av.Sim	Contrib%	Cum.%
Melanotaenia splendida	4.47	20.85	37.73	37.73
Anguilla reinhardtii	2.34	10.43	18.86	56.59
Hypseleotris compressa	2.37	8.08	14.61	71.2
Leiopotherapon unicolour	1.93	6.59	11.93	83.13
Anguilla obscura	1.37	4.66	8.44	91.56

5.4 Rare Taxa

The only rare taxa found was an eel that has been tentatively identified as a Swamp Eel (Family – Synbranchidae). Two specimens were sent to the QLD Museum (Dr Jeff Johnson) for positive identification.

Unidentified Eel

The unidentified eel may be a member of the swamp eels Family Synbranchidae, and includes the genera *Ophisternon.* To date the Family Synbranchidae including the Genera *Ophisternon* has not previously been recorded from the Styx River (Allen et al 2002). Identification of the eel beyond Genera is not currently possible as this group of eels has been poorly studied and there is limited taxonomic information available. The find is interesting in that the eel may be either a new species or it will enable the known geographic range to be extended.

The Synbranchidae have a single fused gill, and have reduced or non-existent fins in adults. Often the eyes are covered by thick skin as an adaptation of their life living and feeding in burrows within soft sediments. Little is known about the biology of the Australian species which are poorly studied though they are able to breathe air through lung like organs (Allen et al 2002).In at least one South American species the eggs are laid in a muddy burrow and the nest is cared for by the male until the eggs hatch. The Family Synbranchidae is present throughout the tropical and subtropical regions of Africa, South East Asia, Asia, and the Americas (Allen et al 2002).

5.5 Migratory Fish

While most freshwater fish in Australia have some migratory behaviour during their lifespan this can vary substantially from entirely within freshwater systems through to catadromous taxa such as the Barramundi (*Lates calcarifer*) which breeds in estuaries but migrates upstream into freshwater as yearlings.

The migratory nature of most Australian fish means that connectivity within the rivers and estuaries is important to maintain healthy breeding populations. The migratory aspect of fish observed in the Styx project in June 2011 is shown in Table 5-3. Connectivity within the waterways of the study area was observed to be generally good as discussed earlier. This could change if creeks are diverted as part of the Project.

Table 5-3: Migratory behaviour of fish species caught in the Styx River catchment in June 2011

Species Name	Common Name	Preferred Habitat/ Water Type	Migratory Aspect (from Allen et al,2002)
Ambassis agassizii	Agassiz's Glassfish	Estuarine-Fresh	Within upper estuary and
Amnitaba percoides	Barred (Striny) Grunter	Estuarine-Fresh	Within upper estuary and
Anguilla reinhardtii	Marbled (Longfinned) Eel	Fresh	Catadromous
Anguilla obscura	Pacific Short Finned Eel	Fresh	Catadromous
Arius graeffei	Forktailed Catfish	Estuarine-Fresh	From freshwater to coastal
Craterocephalus sp.	Flyspeckled Hardyhead	Fresh	Within freshwater only
Elops hawaiensis	Giant Herring	Estuarine	From marine to lower
Gerres filamentosus	Threadfin Silver Biddy	Estuarine-Fresh	From marine to lower
Glossogobius aurius	Goby	Estuarine-Fresh	Adults freshwater- Juvenile is
Hypseleotris compressa	Empire Gudgeon	Fresh	Within upper estuary and
Hypseleotris klunzingeri	Western Carp Gudgeon	Fresh	Within upper estuary and
Hypseleotris species 1	Midgley's Carp Gudgeon	Fresh	Within freshwater only
Lates calcarifer	Barramundi	Estuarine-Fresh	Catadromous
Leiognathus equula	Common Ponyfish	Estuarine-Fresh	From marine to lower
Leiopotherapon unicolour	Spangled Perch	Fresh	Within freshwater only
Megalops cyprinoides	Tarpon	Estuarine-Fresh	Catadromous
Melanotaenia splendida	Eastern Rainbowfish	Fresh	Within upper estuary and
Moqurnda adspersa	Purple-spotted Gudgeon	Fresh	Within freshwater only
Mugil cephalus	Sea Mullet	Estuarine-Fresh	From marine to lower
Nematalosa erebi	Bony Bream	Fresh	Within upper estuary and
Neosilurus hyrtlii	Hyrtl's tandan	Fresh	Within freshwater only
Pomadasys Kaakan	Javelin Fish	Estuarine	From marine to lower
Pseudomugil signifer	Pacific blue-eye	Estuarine-Fresh	From marine to lower
Redigobius bikolanus	Speckeld Goby	Estuarine-Fresh	From marine to lower
Scatophagus argus	Spotted Scat	Estuarine-Fresh	From marine to lower
Selenotoca multifasciata	Banded Scat	Estuarine-Fresh	From marine to lower
Unidentified eel	Unidentified eel	Estuarine	Unknown but found in

5.6 Fisheries Target Taxa

The two main commercially targeted fish taxa are the Sea Mullet (*Mugil cephalus*), and the Barramundi (*Lates calcarifer*).

5.6.1 Sea Mullet

The Sea Mullet (*Mugil cephalus*) was only caught at the two lowest Styx River sites: St1(b), and St2. This was expected as the site was in the upper reaches of the estuary and was made up of long pools over 200m which provides ideal habitat for this species.

5.6.2 Barramundi

A total of 50 Barramundi were caught across all sites. The single most abundant catch was at the Granite Creek site Gr1 where 14 Barramundi were caught and measured. Barramundi (*Lates calcarifer*) were caught in all creeks sampled except the Deep Creek sites. This is most likely due to the fact that Barramundi were only captured in large pools and no large pools were sampled from within the Deep Creek. Barramundi ranged in size from 150mm to 610mm with smaller fish in the range 150-500mm accounting for 86% of the catch. The largest Barramundi caught was at the Toolombah Creek site To1 and was

610mm long. A key finding, as indicated in Figure 5-4, is that where Barramundi were recorded, a range of size classes were represented. This indicates that the study area is a nursery area for juvenile Barramundi and that there have been successive cohorts utilising the study area.

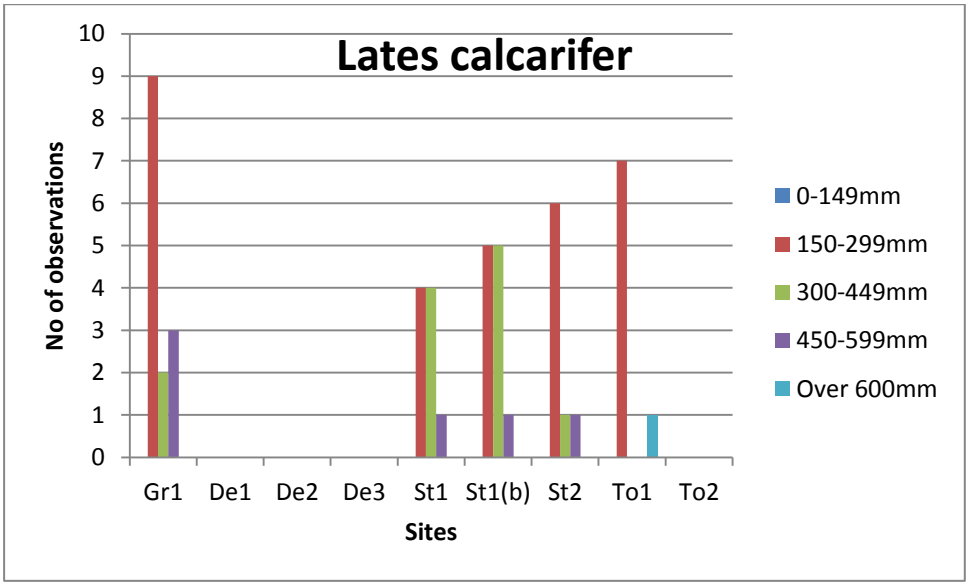

Figure 5-4: **Size class frequency distribution of the Barramundi (*Lates calcarifer*) across all sites sampled for the Styx project in June 2011**

5.7 Introduced Fish

No introduced species were collected in this project which indicates that the region may be relatively free of introduced taxa such as Tilapia (*Oreochromis sp.),* Mosquito fish (*Gambusia sp*.), or Guppies (*Poecilia sp*.). In addition no translocated taxa such as the Red-Claw Crayfish (*Cherax quadricarinatus*) were collected during sampling in June 2011.

5.8 Existing Impacts

Erosion and Turbidity Impacts

While erosion is an issue in the Styx Catchment there was no evidence that siltation was impacting on the substrate in any of the riffles as cobbles and large pebbles were found at most riffle sites. In addition turbidity remained low and water clarity remained high throughout the region. This is important as some species, such as the Rainbow fish (*Melanotaenia sp*.) use visual colour cues in its courtship display (Allen et al 2002), though personal observations by ALS have shown that Purple Spotted Gudgeon can occur in turbidity levels of over 1000 NTU in ephemeral streams.

Connectivity Impacts

At present no weirs or dams were found in the Styx Catchment and this means that connectivity is good in most of the creeks, though the old road at Montrose Creek has

culverts which form a distinct barrier to all fish movement upstream of the Bruce Highway except in times of very high flow. This situation may change if creeks are diversity as part of the Project.

Riparian Vegetation

The extent of riparian vegetation has implications for fish as riparian vegetation helps stabilise banks and therefore reduces the potential for elevated turbidity and sediment movement. Also, riparian vegetation provides a source of large woody debris (habitat) for fish and in some cases, fruit for frugivorous or omnivorous species.

Riparian vegetation cover was high and mostly continuous throughout most of the region and large woody debris was in good supply at most sites monitored.

Fishing Pressure Impacts

No evidence of fishing pressure was noted in this study, but the study area is within a remote area on private land, not readily accessed by vehicle or boat.

River Works Impacts

There was no evidence of de-snagging or other major river works found during this project. Snags were present in most reaches including the Styx River sites. The only river work noticed was the foundations and groyne work carried out for the new Ogmore Bridge.

5.9 Aquatic Reptiles and Platypus

Turtles

The main sightings of aquatic reptiles were of turtles which occurred at the following sites: Gr1, De2, De3, To1, and To2. Turtles were most abundant at sites To1 and Gr1 which were both large pools sampled late in the day (17:25pm). These two sites recorded a total of 26 turtles that were observed during routine sampling (Table 5-4).

Deep Creek sites (De2 and De3) recorded 2 turtle sightings and Tooloombah Creek site To1 recorded 1 sighting in a pool.

Four turtles were caught and photographed and were positively identified as follows:

- Granite Creek 1: *Emydura kreffti*
- Tooloombah Creek: *Emydura Kreffti, Chelodina longicollis*
- Deep Creek 2: *Elseya albagula*

Estuarine Crocodiles

During the June 2011 sampling event evidence of the presence of estuarine crocodiles was observed at the following Styx River sites: St1(b), and St2. Anecdotal evidence for the presence of estuarine crocodiles was also noted for the following sites: Deep Creek, Granite creek, and the Styx River (Table 5-3). Local amateur fishermen observed four

crocodiles downstream of St2 in June 2011. It is likely that estuarine crocodiles are present in parts of the Tooloombah Creek.

Platypus

No Platypuses were observed during the 2011 sampling event although this may have been due to the time of day that sampling was undertaken (i.e. daylight hours rather than true dusk or dawn) and the fact that substantial noise was created during sampling activity.

Table 5-4 Turtles, Crocodiles and Platypus spotted in June 2011

Sites:		Gr1	De1	De2	De3	St1	St1(b)	St2	To1	To2
Habitat Type		*Large Pool	Riffles and small pools**	Riffles and small pools	Riffles and small pools	Large Pool	Large Pool	Large Pool	Large Pool	Riffles and small pools
Turtles	Turtles Caught and identified	1 *Emydura kreffti*	0	*1 Elseya albagula*	0	0	0	0	2 -*Emydura Kreffti, Chelodina longicollis*	0
	Turtles Spotted	7	0	2	1	0	0	0	19	1
Estuarine Crocodiles	Direct evidence	No	No	No	No	No	Yes	Yes	No	No
	Anecdotal evidence	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Platypus		None	None	None	None	None	None	None	None	None
*Large Pools => More than 8m wide and over 50m long, **Small pools => Less than 5m wide and less than 8m long										

5.10 Habitat Assessment

5.10.1 Habitat Diversity

Habitat diversity varied throughout the catchment. The main aquatic habitats noted were rocky pools, sandy pools, rocky runs, sandy runs, riffles, Large Woody Debris (LWD), and undercut banks.

Rocky pools were found at all sites except Deep Creek site De3, while sandy pools were found at all sites except for Tooloombah Creek site 1, and Granite Creek site Gr1. Run habitats were rare and rocky runs were only found at the Tooloombah sites To1, and To2. Sandy-gravel runs only occurred on the Styx River at site St1. LWD was found at all sites, indicating there has been little if any de-snagging in the catchment.

5.10.2 Site Integrity

As indicated in Table 5-4 below all sampling sites within the study area scored highly in terms of physical habitat assessment indicating high structural integrity at both a site and catchment level. This outcome was reflected in the biological and water quality indices which indicated a health aquatic ecosystem.

Table 5-4 Site impact scores noted in June 2011. Each criteria ranked from 1-5 with 1 being extremely degraded and 5 being close to natural appearance.

Site Impacts	De1	De2	De3	Gr1	To1	To2	St1	St1(b)	St2
Agriculture and forestry	3	3	4	3	4	3	3	3	3
Sand and Gravel extraction	5	5	5	5	5	5	5	5	4
Upstream urban areas	5	5	5	5	5	5	5	4	4
Point source pollution	5	5	5	5	4	5	5	5	4
Dams or weirs	5	5	5	5	5	5	5	5	5
Flow regime alteration	5	5	4	5	5	5	5	3	3
Streamside vegetation alteration	4	4	4	4	5	5	5	3	3
Riparian or stream bank erosion	3	4	4	4	5	3	3	3	3
Geomorphic change	5	3	3	5	5	4	3	4	3
Instream habitat alteration	4	5	4	5	4	5	4	4	3
Totals:	44	44	43	46	47	45	43	39	35

5.10.3 Riparian Zone

While riparian vegetation is in good condition there are areas which have been invaded by weed pests. The Noogoora Burr (*Xanthium strumarium*) is an annual pest species that is well established along the left bank of the Styx River around site St2. It produces burrs which can tangle in sheep's wool, and produces seeds that are poisonous to stock. Its impact on the riparian vegetation is relatively minor and of nuisance value except to farmers. The main ecological pest weed is the Rubber Vine (*Cryptostegia grandiflora*) which is a serious threat to rainforest and in particularly dry-land rainforests. This exotic vine from Madagascar was found along parts of both Deep Creek and the Styx River and it is likely to be found throughout the catchment. If not controlled there is a serious threat that it will strangle riparian vegetation including sites such as the Tooloombah Creek sites which have areas of pristine riparian rainforest.

The present habitat condition within the Styx Catchment is typically composed of cleared land for grazing with a narrow band of riparian vegetation alongside the creeks and rivers. Despite wide spread erosion throughout the catchment the riparian vegetation was in good condition. Riparian vegetation varied with Deep creek having medium sized *Eucalyptus* and *Melaleucas* trees and steep banks that were eroding in parts. The shrubs were generally the Bottlebrush (*Callistemon sp.*) and other sclerophyllous taxa. In the Tooloombah Creek both sites had left bank riparian vegetation in close to pristine

condition which was in strong contrast to the right bank that was eroded badly and had patchy riparian tree and shrub cover. The riffles at both Tooloombah Creek sites had dense stands of the Bottlebrush (*Callistemon sp.*) The Granite Creek site had excellent riparian cover with riffles well shaded and a wide pool that was shaded in parts by large Eucalyptus and Melaleuca trees. The riparian vegetation was relatively poor along virtually all of the Styx River and condition decreased downstream so that at site St2 the majority of riparian vegetation was of Noogoora Burr. It is likely that tidal impact may reduce tree and shrub cover at the lower Styx River Sites.

Riparian trees were largely composed of Eucalyptus and Melaleuca trees with a variety of other native trees. Of special mention is the left hand bank of the Tooloombah Creek especially at the To2 site which was in pristine condition with large Eucalyptus species rising through mixed rainforest tree species. This To2 site and the Granite Creek site had the best riparian vegetation sampled in the project. Erosion levels were high throughout the region and at present there is no strong evidence for siltation and sedimentation

6 Discussion

This study represents a preliminary, one-off assessment of the aquatic ecosystem of the Waratah Coal's Exploration Permit for Coal (EPC 1029) in the Styx Catchment and was carried out in the post-wet season period following the exceptional wet season of 2011. Further, it became clear that some of the site conditions were different from that observed in previous years by Melzer et al. (2008), particularly with regards to grass coverage and the extent of cattle grazing. As such, the findings of this study may not necessarily be completely representative of what might normally be expected during an average post-wet season period or at other times of the year. Nonetheless, the findings of this study highlight that the waterways within the study area have some tremendous intrinsic value in terms of the integrity of aquatic habitat and associated flora and faunal communities. These include, but are not necessarily limited to, the following:

- High integrity instream and riparian habitat with relatively few anthropogenic influences affecting habitat quality or the ecology of these systems
- On the whole good water quality across the sites monitored
- A diverse macroinvertebrate community consisting of a number of pollution-sensitive taxa and a greater number of taxa present at many of the sites than expected under the QLD AUSRIVAS model
- A diverse fish community containing no exotic or translocated species, a mix of estuarine and freshwater-associated species and a potentially new species of eel
- The presence of a breeding population of an iconic fisheries species in Barramundi, with the waterways of the study area providing a nursery area for this species.
- The presence of a protected species in estuarine crocodile, as well as a number of turtle species (a more thorough and targeted survey might find more than the species recorded as part of this study).

Another key finding of this study was the variability among sites in terms of water quality and the composition of aquatic fauna. This variation was largely attributed to differences in stream order and proximity to the estuary, but there were also more subtle differences in faunal composition associated with riffle versus edge habitat (for macroinvertebrates) and deep pool versus wadeable streams (for fish), though the latter may be partly an artefact of differences in sampling method for wadeable stream and deep pool habitat. Nonetheless this variability will have to be considered as part of the EIS should it go ahead as if some waterways are permanently altered as part of the Project, there may not necessarily be similar habitat conditions or fauna represented in unaffected streams. Also, the Project may affect different habitats in different ways and to various degrees, so it is important that the habitat associations identified in this study be further investigated and verified as part of any EIS –related monitoring.

The number of study sites visited was limited due to time availability and site access logistics. For future monitoring, this could be countered by:

- Confirming site access with land owners well in advance of being on site and having the opportunity to talk directly to land owners about the best possible access routes to sites and getting them to provide keys to locked gates where required
- Separating the water quality monitoring from the aquatic ecology monitoring. A greater number of sites could be sampled and holding times met if sites were sampled for water quality via helicopter

- Extending the time available in the field so that additional waterways not monitored as part of this study (including off river water bodies, which were identified as being present during this study, and streams in the northern part of the EPC1029) can also be monitored.

The presence of the yet to be identified eel species in the study area means that targeted surveys separate to general aquatic ecology surveys will need to be carried out to determine whether this species is also found outside the EPC1029 that will not be affected by the Project. A key first priority is to try to collect up to 20 specimens within the study area so that it can be formally identified.

7 Conclusions

The main objectives of this aquatic survey were to determine the constituents of the aquatic environment so as to be able to characterise the main creeks and rivers draining the Waratah Coal's Lease Area ECP1029. It was hoped that this would allow the establishment of high and low priority monitoring areas, and to correlate water quality with AUSRIVAS sampling.

Originally a total of 15 sites were selected for survey, however, a range of issues including access and time constraints meant that only 9 sites could be sampled for water quality, aquatic macroinvertebrates, fish, physical habitat, and aquatic reptiles. This excluded sites to the north of the study area and off river water bodies, which do occur within the study area.

The main conclusions from the June 2011 aquatic baseline survey are:

- That water quality was good with very low turbidity and with all water quality parameters below the QWQG 2009 guidelines levels except for marginally low DO in the Deep Creek sites, and marginally elevated nitrogen and phosphorus and zinc levels at some sites.
- Based on water quality results the waterways could be classified into two separate groupings: (i) the Deep and Granite Creek sites, and (ii) the Tooloombah creek and Styx River sites. These largely fall along the lines of relative stream size and connectivity with the estuary.
- Most macroinvertebrate communities exhibited high taxa richness especially in the edge habitat and that EPT taxa diversity was high in riffle habitats.
- That the AUSRIVAS model for Central Coastal Queensland classified all sites bar one in "reference condition" or "more biologically diverse than reference condition". The site classified as "significantly impaired" was close to the estuary and this may have affected the AUSRIVAS model rating of this site.
- Fish diversity was high throughout the sites and varied mainly due to habitat type and collection method. There was some distinction in community composition between Deep Creek and the two creeks with better connectivity to the estuary (Styx River and Tooloombah Creek) largely attributed to the presence or absence of certain freshwater and estuarine associated species in the respective systems. There was also some distinction between fish assemblages in deep pool and wadeable stream habitat based on comparisons between sites in the same system sampled by the two different electrofishing methods, though this may be an artefact of the different sampling methods.
- There was a wide range in Barramundi sizes caught in the Styx catchment, with results indicating a number of cohorts present and that the study area is being used as a nursery for this iconic fisheries species.
- An unidentified species of eel was discovered that could either be a new species or an extension to the range of an existing species.
- The region features good connectivity within the creeks and rivers sampled, and the aquatic habitats present are relatively intact. However, gully head erosion, which was observed in parts of the study area, poses a potential threat to both the riparian and aquatic habitats in the region, and that caution should be used in concentrating runoff and disturbing the ground cover as the soils in this region are highly erodible. At present the region has good quality rocky aquatic habitats that are vulnerable to any increase in sedimentation which would have the potential to send a sand-silt "slug" down the creek systems and obliterate these highly vulnerable rocky habitats.

- The above features will potentially trigger an EIS or will at least be important considerations as part of an EIS for the Project should one go ahead.

8 Recommendations

The Styx Project was a survey of an area where little if any work had been done prior to this study. This resulted in the following recommendations:

- That the monitoring sites be extended to include sites further to the north of the region as originally suggested and also be extended to ensure that off river water bodies are sampled.
- That greater coordinator with landowners is carried out as part of future monitoring to streamline site access and to obtain the best possible set of anecdotal information possible about the study area.
- That the study would benefit by the analysis of the replicate macroinvertebrate samples as unreplicated data lacks statistical rigor and reduces the range of statistical methods that can legitimately be used on the data collected. Replicate sampling would allow better estimation of populations and communities and permits better monitoring of potential impacts.
- That fish sampling should aim to use the boat electrofishing in all large pools where practical as this method provided the best results for both abundance and taxa richness in these habitats and also allowed an ideal time to observe and spot turtles present.
- That there is a need to determine the extent of the population of the unidentified eel and to further identify this species to determine if it a new species, or an extension to the range of an existing eel species.
- That a targeted survey for the unidentified eel is carried out to determine the extent of the distribution and abundance of this species within the EPC and in areas north and south of the EPC that will not be affected by the Project.
- That targeted surveys are recommended to assess the presence and distribution of platypus and turtles in the waterways.

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Appendix A - Macroinvertebrate Data

Macroinvertebrates from Styx River Project June 2011										
Family	De1	De2	De3	St1	St1(b)	St2	To1	To2	Gr1	Totals
Acarina	4	9	0	1	1	1	0	2	0	18
Curculionidae	0	1	0	0	0	0	0	0	0	1
Dytiscidae	0	0	0	4	13	13	0	2	0	32
Elmidae	0	0	0	0	0	0	0	0	3	3
Gyrinidae	0	5	6	0	0	0	0	3	0	14
Hydraenidae	1	0	0	0	1	1	0	0	0	3
Hydrochidae	0	0	0	0	0	0	1	0	0	1
Hydrophilidae	0	0	0	1	9	3	0	0	0	13
Atyidae	0	0	0	4	0	0	0	0	0	4
Palaemonidae	7	2	2	5	17	9	9	7	1	59
Parastacidae	2	1	0	0	0	0	0	0	0	3
Chironominae	13	16	8	6	1	5	44	17	1	111
Culicidae	0	0	0	0	1	0	0	0	0	1
Dolichopodidae	1	6	13	0	0	0	0	1	0	21
Orthocladiinae	30	31	22	1	1	1	11	24	11	132
Simulidae	79	111	57	0	0	1	139	113	83	583
Tabanadae	1	3	8	0	0	0	1	0	1	14
Tanypodinae	1	4	0	3	1	2	0	0	0	11
Baetidae	20	28	76	2	0	0	19	52	18	215
Caenidae	20	12	8	1	1	1	0	8	13	64
Leptophlebiidae	8	3	4	3	1	0	0	0	4	23
Bithyniidae	0	0	0	0	2	0	0	0	0	2
Corbiculidae	0	0	0	3	0	0	0	1	0	4
Physidae	0	0	0	0	2	0	0	0	0	2
Planorbidae	0	0	0	1	0	0	0	0	0	1
Thiaridae	0	0	0	9	12	0	0	1	0	22
Corixidae	0	0	0	7	13	14	0	0	0	34
Gerridae	0	1	0	1	2	1	1	0	0	6
Hydrometridae	0	0	0	1	1	0	0	0	0	2
Mesovelidae	0	0	0	0	0	2	0	0	0	2
Naucoridae	0	0	0	1	0	0	0	0	0	1
Nepidae	0	0	0	2	0	0	0	0	0	2
Notonectidae	0	0	0	11	1	2	0	0	0	14
Pleidae	0	0	0	0	0	2	0	0	0	2
Veliidae	2	3	0	1	2	2	0	0	0	10
Gomphidae	1	0	1	0	2	0	0	1	1	6
Libellulidae	8	7	18	3	0	0	10	12	4	62
Protoneuridae	0	0	0	2	0	1	0	0	0	3
Oligochaetae	1	2	2	1	0	0	0	0	0	6
Calamoceratidae	0	1	0	0	0	0	0	0	0	1
Hydrobiosidae	3	1	9	0	0	0	5	1	2	21
Hydropsychidae	68	85	112	0	0	1	92	32	37	427
Hydroptilidae	0	2	0	1	1	0	5	3	1	13
Leptoceridae	6	8	4	17	9	4	0	2	7	57
Philopotomidae	8	2	6	0	0	0	5	12	77	110
Unidentified Trichoptera	0	0	0	1	0	0	0	0	0	1
Totals	**284**	**344**	**356**	**93**	**94**	**66**	**342**	**294**	**264**	**2137**

Appendix B
Fish data

B.1 Fish data for Deep Creek and Granite Creek

Species Name	Common Name	Gr1		De1		De2		De3	
		Method	Length	Method	Length	Method	Length	Method	Length
Ambassis agassizii	Agassiz's Glassfish	EF	44	BPEF	33	BT	33	BPEF	45
Ambassis agassizii	Agassiz's Glassfish	EF	38	BPEF	30	BT	31	BPEF	47
Ambassis agassizii	Agassiz's Glassfish	EF	39	BPEF	44	BT	31	BPEF	32
Ambassis agassizii	Agassiz's Glassfish	EF	27	BPEF	26	BT	22		
Ambassis agassizii	Agassiz's Glassfish	EF	25	BPEF	31	BT	36		
Ambassis agassizii	Agassiz's Glassfish	EF	50	BPEF	29	BT	37		
Ambassis agassizii	Agassiz's Glassfish	EF	47	BPEF	32	BT	37		
Ambassis agassizii	Agassiz's Glassfish	EF	44	BPEF	27	BT	39		
Ambassis agassizii	Agassiz's Glassfish	EF	44	BPEF	29	BT	37		
Ambassis agassizii	Agassiz's Glassfish	EF	32	BPEF	30	BT	24		
Ambassis agassizii	Agassiz's Glassfish	EF	44	BT	34	BT	32		
Ambassis agassizii	Agassiz's Glassfish	EF	47	BT	45	BT	40		
Ambassis agassizii	Agassiz's Glassfish	EF	55	BT	40	BT	31		
Ambassis agassizii	Agassiz's Glassfish	EF	42	BT	40	BT	29		
Ambassis agassizii	Agassiz's Glassfish	EF	40	BT	41	BPEF	54		
Ambassis agassizii	Agassiz's Glassfish	EF	41	BT	40	BPEF	46		
Ambassis agassizii	Agassiz's Glassfish	EF	26	BT	42	BPEF	45		
Ambassis agassizii	Agassiz's Glassfish	EF	29	BT	32	BPEF	28		
Ambassis agassizii	Agassiz's Glassfish	EF	50	BT	31	BPEF	51		
Ambassis agassizii	Agassiz's Glassfish	EF	40	BT	35	BPEF	38		
Ambassis agassizii	Agassiz's Glassfish					BPEF	32		
Ambassis agassizii	Agassiz's Glassfish					BPEF	36		
Ambassis agassizii	Agassiz's Glassfish					BPEF	39		
Ambassis agassizii	Agassiz's Glassfish					BPEF	38		
Ambassis agassizii	Agassiz's Glassfish					BPEF	41		
Ambassis agassizii	Agassiz's Glassfish					BPEF	35		
Ambassis agassizii	Agassiz's Glassfish					BPEF	30		
Ambassis agassizii	Agassiz's Glassfish					BPEF	30		
Amniataba percoides	Barred Grunter			BPEF	45				
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	250			BPEF	440	BPEF	280
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	500						
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600						
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600						
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600						

Species Name	Common Name	Gr1		De1		De2		De3	
		Method	Length	Method	Length	Method	Length	Method	Length
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600						
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600						
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600						
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600						
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	1000						
Arius graeffei	Forktailed Catfish	EF	435						
Craterocephalus	Flyspeckled Hardyhead	EF	43						
Craterocephalus	Flyspeckled Hardyhead	EF	40						
Craterocephalus	Flyspeckled Hardyhead	EF	40						
Craterocephalus	Flyspeckled Hardyhead	EF	37						
Hypseleotris compressa	Empire Gudgeon	EF	66	BPEF	33	BT	44	BPEF	27
Hypseleotris compressa	Empire Gudgeon	EF	74	BPEF	30	BT	31	BPEF	22
Hypseleotris compressa	Empire Gudgeon	EF	52	BPEF	36	BT	36	BPEF	23
Hypseleotris compressa	Empire Gudgeon	EF	58	BPEF	29	BT	36	BPEF	21
Hypseleotris compressa	Empire Gudgeon	EF	50	BPEF	28	BT	30	BPEF	26
Hypseleotris compressa	Empire Gudgeon	EF	51	BPEF	29	BT	24	BPEF	22
Hypseleotris compressa	Empire Gudgeon	EF	44	BPEF	25	BT	28	BPEF	23
Hypseleotris compressa	Empire Gudgeon					BT	25	BPEF	63
Hypseleotris compressa	Empire Gudgeon					BT	31	BPEF	25
Hypseleotris compressa	Empire Gudgeon					BT	26	BPEF	30
Hypseleotris compressa	Empire Gudgeon					BPEF	32	BPEF	33
Hypseleotris compressa	Empire Gudgeon					BPEF	30	BPEF	21
Hypseleotris compressa	Empire Gudgeon							BPEF	20
Hypseleotris compressa	Empire Gudgeon							BPEF	22
Hypseleotris compressa	Empire Gudgeon							BPEF	20
Hypseleotris compressa	Empire Gudgeon							BPEF	33
Hypseleotris compressa	Empire Gudgeon							BPEF	24
Hypseleotris compressa	Empire Gudgeon							BPEF	27
Hypseleotris compressa	Empire Gudgeon							BPEF	23
Hypseleotris compressa	Empire Gudgeon							BPEF	24
Hypseleotris compressa	Empire Gudgeon							BT	21
Hypseleotris compressa	Empire Gudgeon							BT	27

Species Name	Common Name	Gr1		De1		De2		De3	
		Method	Length	Method	Length	Method	Length	Method	Length
Hypseleotris compressa	Empire Gudgeon							BT	32
Hypseleotris compressa	Empire Gudgeon							BT	25
Hypseleotris compressa	Empire Gudgeon							BT	19
Hypseleotris compressa	Empire Gudgeon							BT	27
Hypseleotris compressa	Empire Gudgeon							BT	26
Hypseleotris compressa	Empire Gudgeon							BT	20
Hypseleotris compressa	Empire Gudgeon							BT	24
Hypseleotris compressa	Empire Gudgeon							BT	21
Hypseleotris compressa	Empire Gudgeon							BT	18
Hypseleotris compressa	Empire Gudgeon							BT	26
Hypseleotris compressa	Empire Gudgeon							BT	21
Hypseleotris compressa	Empire Gudgeon							BT	25
Hypseleotris compressa	Empire Gudgeon							BT	27
Hypseleotris compressa	Empire Gudgeon							BT	23
Hypseleotris compressa	Empire Gudgeon							BT	19
Hypseleotris compressa	Empire Gudgeon							BT	27
Hypseleotris compressa	Empire Gudgeon							BT	18
Hypseleotris klunzingeri	Western Carp Gudgeon					BT	36		
Hypseleotris species 1	Midgley's Carp Gudgeon	EF	26			BT	35	BPEF	31
Hypseleotris species 1	Midgley's Carp Gudgeon	EF	29			BT	32		
Hypseleotris species 1	Midgley's Carp Gudgeon	EF	26			BT	34		
Hypseleotris species 1	Midgley's Carp Gudgeon	EF	28			BPEF	37		
Hypseleotris species 1	Midgley's Carp Gudgeon	EF	27			BPEF	38		
Hypseleotris species 1	Midgley's Carp Gudgeon	EF	32			BPEF	36		
Hypseleotris species 1	Midgley's Carp Gudgeon	EF	21			BPEF	35		
Hypseleotris species 1	Midgley's Carp Gudgeon	EF	36						
Lates calcarifer	Barramundi	EF	530						
Lates calcarifer	Barramundi	EF	265						
Lates calcarifer	Barramundi	EF	211						
Lates calcarifer	Barramundi	EF	245						
Lates calcarifer	Barramundi	EF	510						
Lates calcarifer	Barramundi	EF	236						
Lates calcarifer	Barramundi	EF	245						
Lates calcarifer	Barramundi	EF	415						
Lates calcarifer	Barramundi	EF	407						
Lates calcarifer	Barramundi	EF	503						

Species Name	Common Name	Gr1		De1		De2		De3	
		Method	Length	Method	Length	Method	Length	Method	Length
Lates calcarifer	Barramundi	EF	245						
Lates calcarifer	Barramundi	EF	227						
Lates calcarifer	Barramundi	EF	254						
Leiopotherapon unicolour	Spangled Perch	EF	136	BPEF	108	BPEF	101	BPEF	85
Leiopotherapon unicolour	Spangled Perch	EF	138	BPEF	109	BPEF	90	BPEF	72
Leiopotherapon unicolour	Spangled Perch			BPEF	92	BPEF	69	BPEF	94
Leiopotherapon unicolour	Spangled Perch			BPEF	89	BPEF	84	BPEF	74
Leiopotherapon unicolour	Spangled Perch			BPEF	57	BPEF	51	BPEF	66
Leiopotherapon unicolour	Spangled Perch			BPEF	76	BPEF	50	BPEF	73
Leiopotherapon unicolour	Spangled Perch			BPEF	94	BPEF	77	BPEF	64
Leiopotherapon unicolour	Spangled Perch			BPEF	58	BPEF	89	BPEF	65
Leiopotherapon unicolour	Spangled Perch			BPEF	55	BPEF	80	BPEF	63
Leiopotherapon unicolour	Spangled Perch			BPEF	87	BPEF	75	BPEF	59
Leiopotherapon unicolour	Spangled Perch			BPEF	60	BPEF	66	BPEF	134
Leiopotherapon unicolour	Spangled Perch			BPEF	71	BPEF	88	BPEF	126
Leiopotherapon unicolour	Spangled Perch			BPEF	57	BPEF	44	BPEF	82
Leiopotherapon unicolour	Spangled Perch			BPEF	55	BPEF	90	BPEF	83
Leiopotherapon unicolour	Spangled Perch			BPEF	51	BPEF	92	BPEF	55
Leiopotherapon unicolour	Spangled Perch			BPEF	52	BPEF	65	BPEF	66
Leiopotherapon unicolour	Spangled Perch					BPEF	79	BPEF	67
Leiopotherapon unicolour	Spangled Perch					BPEF	56	BPEF	75
Megalops cyprinoides	Tarpon	EF	270			BPEF	66	BPEF	66
Megalops cyprinoides	Tarpon	EF	350			BPEF	89	BPEF	57
Melanotaenia splendida	Eastern Rainbowfish	EF	60	BPEF	75	BT	41	BPEF	55
Melanotaenia splendida	Eastern Rainbowfish	EF	63	BPEF	63	BT	40	BPEF	49
Melanotaenia splendida	Eastern Rainbowfish	EF	46	BPEF	62	BT	42	BPEF	49
Melanotaenia splendida	Eastern Rainbowfish	EF	55	BPEF	51	BT	44	BPEF	51
Melanotaenia splendida	Eastern Rainbowfish	EF	48	BPEF	40	BT	32	BPEF	53
Melanotaenia splendida	Eastern Rainbowfish	EF	51	BPEF	52	BT	45	BPEF	44
Melanotaenia splendida	Eastern Rainbowfish	EF	64	BPEF	42	BT	31	BPEF	52
Melanotaenia splendida	Eastern Rainbowfish	EF	56	BPEF	34	BPEF	59	BPEF	50
Melanotaenia splendida	Eastern Rainbowfish	EF	76	BPEF	41	BPEF	49	BPEF	46
Melanotaenia splendida	Eastern Rainbowfish	EF	54	BPEF	42	BPEF	44	BPEF	50
Melanotaenia splendida	Eastern Rainbowfish	EF	41	BPEF	30	BPEF	38	BPEF	52
Melanotaenia splendida	Eastern Rainbowfish	EF	64	BPEF	21	BPEF	34	BPEF	49
Melanotaenia splendida	Eastern Rainbowfish	EF	40	BPEF	24	BPEF	52	BPEF	47

Species Name	Common Name	Gr1		De1		De2		De3	
		Method	Length	Method	Length	Method	Length	Method	Length
Melanotaenia splendida	Eastern Rainbowfish	EF	56	BPEF	85	BPEF	40	BPEF	40
Melanotaenia splendida	Eastern Rainbowfish	EF	55	BPEF	43	BPEF	44	BPEF	46
Melanotaenia splendida	Eastern Rainbowfish	EF	45	BPEF	56	BPEF	27	BPEF	56
Melanotaenia splendida	Eastern Rainbowfish	EF	72	BPEF	42	BPEF	38	BPEF	36
Melanotaenia splendida	Eastern Rainbowfish	EF	20	BPEF	27			BPEF	58
Melanotaenia splendida	Eastern Rainbowfish			BPEF	20			BPEF	62
Melanotaenia splendida	Eastern Rainbowfish			BT	50				
Melanotaenia splendida	Eastern Rainbowfish			BT	57				
Melanotaenia splendida	Eastern Rainbowfish			BT	52				
Melanotaenia splendida	Eastern Rainbowfish			BT	61				
Melanotaenia splendida	Eastern Rainbowfish			BT	55				
Melanotaenia splendida	Eastern Rainbowfish			BT	49				
Melanotaenia splendida	Eastern Rainbowfish			BT	44				
Melanotaenia splendida	Eastern Rainbowfish			BT	51				
Melanotaenia splendida	Eastern Rainbowfish			BT	54				
Melanotaenia splendida	Eastern Rainbowfish			BT	43				
Melanotaenia splendida	Eastern Rainbowfish			BT	50				
Melanotaenia splendida	Eastern Rainbowfish			BT	50				
Melanotaenia splendida	Eastern Rainbowfish			BT	46				
Melanotaenia splendida	Eastern Rainbowfish			BT	41				
Melanotaenia splendida	Eastern Rainbowfish			BT	52				
Melanotaenia splendida	Eastern Rainbowfish			BT	70				
Melanotaenia splendida	Eastern Rainbowfish			BT	40				
Melanotaenia splendida	Eastern Rainbowfish			BT	42				
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	83	BPEF	55	BPEF	48
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	72	BPEF	51	BPEF	45
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	94	BPEF	61	BPEF	40
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	51	BPEF	74	BPEF	36
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	60	BPEF	81	BPEF	39
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	61	BPEF	52	BPEF	41
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	63	BPEF	67	BPEF	45
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	64	BPEF	78	BPEF	34
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	78	BPEF	84	BPEF	50
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	50	BPEF	70	BPEF	45
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	52	BPEF	77	BPEF	32
Moagurnda adspersa	Purple-spotted Gudgeon			BPEF	37	BPEF	55	BPEF	40

Species Name	Common Name	Gr1		De1		De2		De3	
		Method	Length	Method	Length	Method	Length	Method	Length
Moaurnda adspersa	Purple-spotted Gudgeon			BPEF	46	BPEF	67		
Moaurnda adspersa	Purple-spotted Gudgeon			BPEF	41	BPEF	34		
Moaurnda adspersa	Purple-spotted Gudgeon			BPEF	34				
Moaurnda adspersa	Purple-spotted Gudgeon			BPEF	37				
Moaurnda adspersa	Purple-spotted Gudgeon			BT	77				
Moaurnda adspersa	Purple-spotted Gudgeon			BT	61				
Moaurnda adspersa	Purple-spotted Gudgeon			BT	79				
Nematalosa erebi	Bony Bream	EF	295						
Nematalosa erebi	Bony Bream	EF	315						
Nematalosa erebi	Bony Bream	EF	289						
Nematalosa erebi	Bony Bream	EF	276						
Nematalosa erebi	Bony Bream	EF	235						
Neosilurus hyrtlii	Hyrtl's tandan	EF	263			BPEF	83	BPEF	108
Neosilurus hyrtlii	Hyrtl's tandan					BPEF	99	BPEF	128
Neosilurus hyrtlii	Hyrtl's tandan					BPEF	94	BPEF	92
Neosilurus hyrtlii	Hyrtl's tandan							BPEF	104
Neosilurus hyrtlii	Hyrtl's tandan							BPEF	111
Neosilurus hyrtlii	Hyrtl's tandan							BPEF	105
Neosilurus hyrtlii	Hyrtl's tandan							BPEF	91
Neosilurus hyrtlii	Hyrtl's tandan							BPEF	107

B.2 Fish data for Tooloombah Creek and Styx River

Species Name	Common Name	St1		St1(b)		St2		To1		To2	
		Method	Length	Method	Length	Method	Length	Method	Length	Method	Length
Ambassis agassizii	Agassiz's Glassfish	EF	30	EF	34	EF	34	EF	46		
Ambassis agassizii	Agassiz's Glassfish	EF	31	EF	32	EF	37	EF	40		
Ambassis agassizii	Agassiz's Glassfish	EF	35			EF	36	EF	40		
Ambassis agassizii	Agassiz's Glassfish	EF	34			EF	28	EF	36		
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	350	EF	400	EF	200	EF	600	BPEF	300
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	350			EF	400	EF	400	BPEF	500
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	350			EF	600	EF	900	BPEF	450
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	350			EF	600	EF	900	BPEF	180
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	350					EF	700	BPEF	120
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	450					EF	300		
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	450								
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	450								
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600								
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600								
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600								
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	600								
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	700								
Anguilla reinhardtii	Marbled (Longfinned) Eel	EF	700								
Anguilla obscura	Pacific Short Finned Eel			EF	600	EF	800	EF	400	BPEF	300
Anguilla obscura	Pacific Short Finned Eel			EF	700			EF	600		
Anguilla obscura	Pacific Short Finned Eel			EF	900			EF	600		
Anguilla obscura	Pacific Short Finned Eel			EF	900						
Arius graeffei	Forktailed Catfish							EF	452		
Craterocephalus	Flyspeckled Hardyhead							EF	31		
Elops hawaiensis	Giant Herring					EF	253				
Elops hawaiensis	Giant Herring					EF	280				
Elops hawaiensis	Giant Herring					EF	236				
Gerres filamentosus	Threadfin Silver Biddy					EF	62				
Gerres filamentosus	Threadfin Silver Biddy					EF	58				
Glossamia aprion	Mouth Almightly	EF	74								
Glossogobius aiurus	Goby	EF	75	EF	200	EF	175				
Glossogobius aiurus	Goby			EF	75	EF	206				
Glossogobius aiurus	Goby			EF	175	EF	182				
Hypseleotris compressa	Empire Gudgeon	EF	54	EF	18	EF	31	EF	66	BPEF	62

Species Name	Common Name	St1		St1(b)		St2		To1		To2	
		Met	Lengt	Met	Len	Met	Len	Meth	Len	M	Length
Hypseleotris compressa	Empire Gudgeon	EF	46	BT	19	EF	20	EF	75	B	26
Hypseleotris compressa	Empire Gudgeon	EF	42	BT	32			EF	72		
Hypseleotris compressa	Empire Gudgeon	EF	15	BT	26			EF	51		
Hypseleotris compressa	Empire Gudgeon	EF	75	BT	25			EF	85		
Hypseleotris compressa	Empire Gudgeon	EF	57	BT	28			EF	36		
Hypseleotris compressa	Empire Gudgeon	EF	19	BT	34			EF	38		
Hypseleotris compressa	Empire Gudgeon	EF	72					EF	20		
Hypseleotris compressa	Empire Gudgeon	EF	69								
Hypseleotris compressa	Empire Gudgeon	EF	53								
Hypseleotris compressa	Empire Gudgeon	EF	42								
Hypseleotris compressa	Empire Gudgeon	EF	60								
Hypseleotris compressa	Empire Gudgeon	EF	58								
Hypseleotris compressa	Empire Gudgeon	EF	17								
Hypseleotris compressa	Empire Gudgeon	EF	18								
Hypseleotris compressa	Empire Gudgeon	EF	52								
Hypseleotris compressa	Empire Gudgeon	EF	23								
Hypseleotris compressa	Empire Gudgeon	EF	19								
Hypseleotris compressa	Empire Gudgeon	EF	20								
Hypseleotris	Western Carp Gudgeon					EF	55				
Hypseleotris	Western Carp Gudgeon					EF	50				
Lates calcarifer	Barramundi	EF	260	EF	360	EF	465	EF	246		
Lates calcarifer	Barramundi	EF	252	EF	415	EF	201	EF	280		
Lates calcarifer	Barramundi	EF	180	EF	440	EF	242	EF	286		
Lates calcarifer	Barramundi	EF	192	EF	402	EF	173	EF	227		
Lates calcarifer	Barramundi	EF	440	EF	255	EF	236	EF	238		
Lates calcarifer	Barramundi	EF	520	EF	460	EF	192	EF	610		
Lates calcarifer	Barramundi	EF	435	EF	422	EF	385	EF	245		
Lates calcarifer	Barramundi	EF	405	EF	238	EF	265	EF	227		
Lates calcarifer	Barramundi	EF	390	EF	156						
Lates calcarifer	Barramundi			EF	453						
Lates calcarifer	Barramundi			EF	252						
Lates calcarifer	Barramundi			EF	272						
Leiopotherapon unicolor	Common Ponyfish			EF	83	EF	70				
Leiopotherapon unicolor	Common Ponyfish			EF	69	EF	65				
Leiopotherapon unicolor	Common Ponyfish			EF	57	EF	61				
Leiopotherapon unicolor	Common Ponyfish			EF	71	EF	55				

Species Name	Common Name	St1		St1(b)		St2		To1		To2	
		Method	Length	Method	Length	Method	Length	Method	Length	Method	Length
Leiopotherapon unicolour	Spangled Perch					EF	65	EF	225	BPEF	80
Leiopotherapon unicolour	Spangled Perch					EF	61	EF	152		
Leiopotherapon unicolour	Spangled Perch					EF	55	EF	170		
Leiopotherapon unicolour	Spangled Perch							EF	146		
Leiopotherapon unicolour	Spangled Perch							EF	160		
Megalops cyprinoides	Tarpon					EF	205	EF	212		
Megalops cyprinoides	Tarpon					EF	265	EF	196		
Megalops cyprinoides	Tarpon							EF	328		
Megalops cyprinoides	Tarpon							EF	396		
Megalops cyprinoides	Tarpon							EF	385		
Megalops cyprinoides	Tarpon							EF	352		
Melanotaenia splendida	Eastern Rainbowfish	EF	41	EF	43	EF	38	EF	101	BPEF	46
Melanotaenia splendida	Eastern Rainbowfish	EF	42	EF	56	EF	35	EF	42	BPEF	50
Melanotaenia splendida	Eastern Rainbowfish	EF	31	EF	51	EF	36	EF	43	BPEF	32
Melanotaenia splendida	Eastern Rainbowfish			EF	49	EF	29	EF	35	BPEF	70
Melanotaenia splendida	Eastern Rainbowfish			EF	47	EF	27	EF	34	BPEF	58
Melanotaenia splendida	Eastern Rainbowfish			EF	54	EF	18	EF	41	BPEF	35
Melanotaenia splendida	Eastern Rainbowfish			EF	44	EF	36	EF	52	BPEF	67
Melanotaenia splendida	Eastern Rainbowfish			EF	40	EF	30	EF	46	BPEF	63
Melanotaenia splendida	Eastern Rainbowfish			EF	45	EF	47	EF	36	BPEF	54
Melanotaenia splendida	Eastern Rainbowfish			EF	45	EF	35	EF	43	BPEF	46
Melanotaenia splendida	Eastern Rainbowfish			EF	54	EF	45	EF	41	BPEF	48
Melanotaenia splendida	Eastern Rainbowfish			EF	42	EF	42	EF	35	BPEF	60
Melanotaenia splendida	Eastern Rainbowfish			EF	34	EF	41	EF	41	BPEF	61
Melanotaenia splendida	Eastern Rainbowfish			EF	48	EF	41	EF	16	BPEF	42
Melanotaenia splendida	Eastern Rainbowfish			EF	42	EF	40	EF	41	BPEF	73
Melanotaenia splendida	Eastern Rainbowfish			EF	52	EF	38	EF	30	BPEF	61
Melanotaenia splendida	Eastern Rainbowfish			EF	36	EF	32	EF	47	BPEF	54
Melanotaenia splendida	Eastern Rainbowfish			EF	27	EF	28	EF	29	BPEF	32
Melanotaenia splendida	Eastern Rainbowfish			EF	46	EF	34	EF	52	BPEF	20
Melanotaenia splendida	Eastern Rainbowfish			EF	37	EF	42	EF	30	BPEF	52
Moagurnda adspersa	Purple-spotted Gudgeon	EF	34					EF	48	BPEF	38
Moagurnda adspersa	Purple-spotted Gudgeon									BPEF	42
Mugil cephalus	Sea Mullet			EF	159	EF	194	EF	254		
Mugil cephalus	Sea Mullet			EF	129	EF	182				
Mugil cephalus	Sea Mullet			EF	103	EF	193				

Species Name	Common Name	St1		St1(b)		St2		To1		To2	
		Meth	Len	Met	Length	Met	Len	Meth	Len	Met	Len
Mugil cephalus	Sea Mullet			EF	115	EF	169				
Mugil cephalus	Sea Mullet			EF	138	EF	210				
Mugil cephalus	Sea Mullet			EF	133	EF	160				
Mugil cephalus	Sea Mullet			EF	122	EF	185				
Mugil cephalus	Sea Mullet			EF	140	EF	194				
Mugil cephalus	Sea Mullet			EF	143	EF	176				
Mugil cephalus	Sea Mullet			EF	132	EF	221				
Mugil cephalus	Sea Mullet			EF	118	EF	180				
Mugil cephalus	Sea Mullet			EF	134						
Mugil cephalus	Sea Mullet			EF	137						
Mugil cephalus	Sea Mullet			EF	126						
Mugil cephalus	Sea Mullet			EF	160						
Mugil cephalus	Sea Mullet			EF	118						
Mugil cephalus	Sea Mullet			EF	142						
Mugil cephalus	Sea Mullet			EF	144						
Mugil cephalus	Sea Mullet			EF	130						
Nematalosa erebi	Bony Bream			EF	205	EF	224	EF	290		
Nematalosa erebi	Bony Bream			EF	175			EF	316		
Nematalosa erebi	Bony Bream			EF	138			EF	270		
Nematalosa erebi	Bony Bream			EF	130			EF	330		
Nematalosa erebi	Bony Bream							EF	260		
Nematalosa erebi	Bony Bream							EF	294		
Nematalosa erebi	Bony Bream							EF	282		
Nematalosa erebi	Bony Bream							EF	290		
Neosilurus hyrtlii	Hyrtl's tandan							EF	200		
Neosilurus hyrtlii	Hyrtl's tandan							EF	160		
Pomadasys kaakan	Javelin Fish					EF	75				
Pseudomugil signifer	Pacific blue-eye	EF	34								
Pseudomugil signifer	Pacific blue-eye	EF	27								
Pseudomugil signifer	Pacific blue-eye	EF	23								
Pseudomugil signifer	Pacific blue-eye	EF	26								
Pseudomugil signifer	Pacific blue-eye	EF	26								
Redigobius bikolanus	Speckeld Goby			EF	20						
Scatophagus argus	Spotted Scat										
Selenotoca multifasciata	Banded Scat			EF	57						

Species Name	Common Name	St1		St1(b)		St2		To1		To2	
		Method	Length	Method	Length	Method	Length	Method	Length	Method	Length
Selenotoca multifasciata	Banded Scat			EF	61						
Selenotoca multifasciata	Banded Scat			EF	70						
Selenotoca multifasciata	Banded Scat			EF	61						
Selenotoca multifasciata	Banded Scat			EF	68						
Unidentified Eel	Unidentified eel	EF	240					EF	165		

FIELD SHEET

ROJECT NAME: STYX **SITE CODE:** DE1

SITE NAME: UPPER DEEP CREEK

DATE: 1 / 6 / 11 **TIME (24hrs): [** 13:20 **] PARTY:** MD / TJ

LATITUDE: 22° 43.082 **LONGITUDE:** 149 40.211

EASTING: 0774277 **NORTHING:** 7485223 **Mobile Coverage:** (Y) / N

MAP NAME: – **MAP SCALE:** – **Sat. Phone Coverage:** (Y) / N

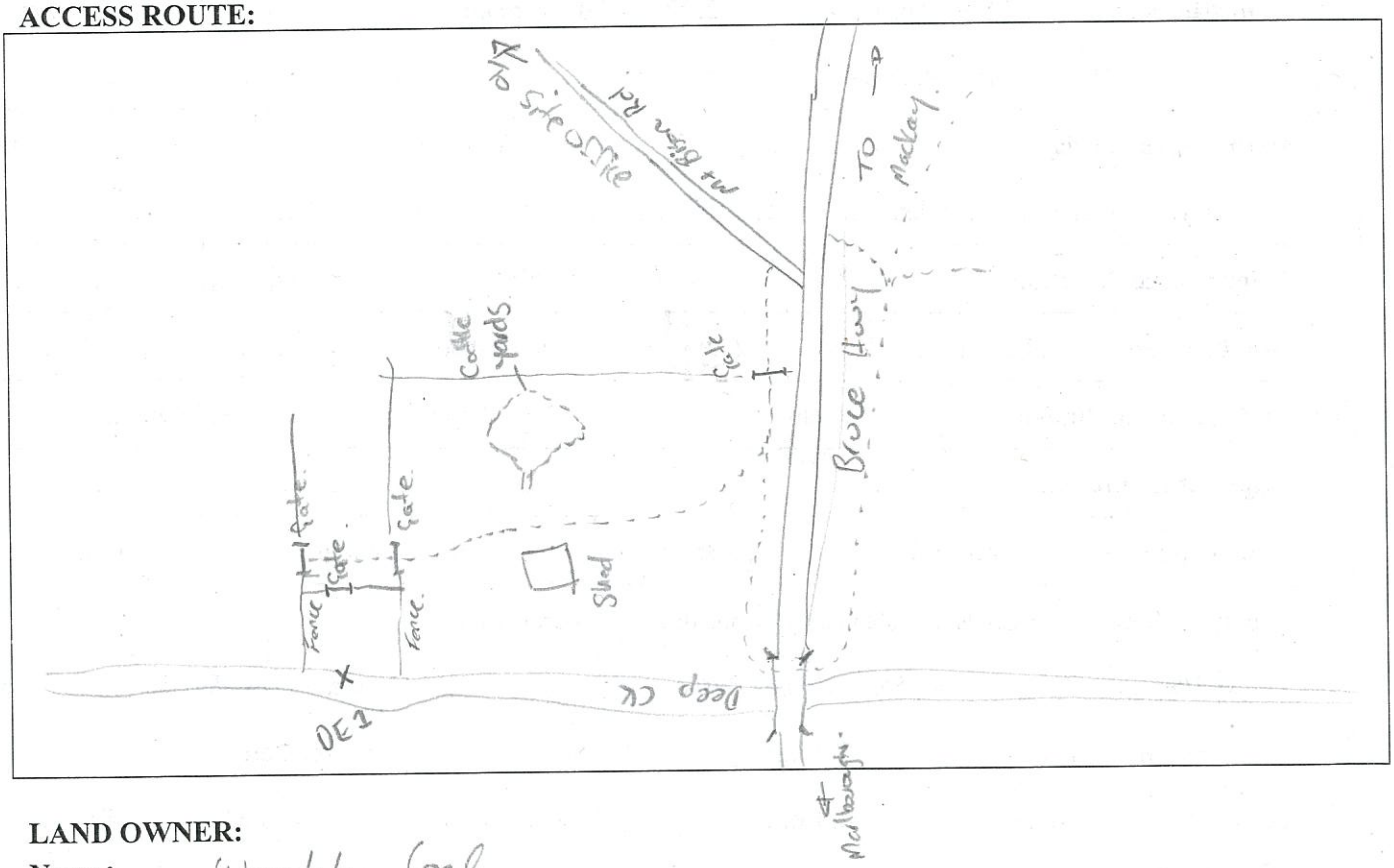
DATUM (i.e. GDA94): WGS 84. **PHOTO #'s:** – **Key required:** N

Water samples collected: on 5/6/11

ACCESS DETAILS: Property owned by Waratah Coal. Access via MT BISON RD, (see sketch below) 27 Km north of Marlborough.

NB. Crocodiles have been seen in Deep Ck in the past - local stockman. Barramundi caught in wet season.

ACCESS ROUTE:



LAND OWNER:

Name: Waratah Coal

Address:

Phone:

Permission Requirements: Contact Site office

Office Use:	Data Entered By:	Mark Dahm	Date:	8.10 16/6/11

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME DE2 - Upper Deep Creek **DATE:** 1 / 06 / 11

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)	0.5	0.2	DO (mg/L)	7.97	8.06
Gauge Height (m)	—	—	DO (% sat)	80.4 %	82.3
Water Temperature (°C)	15.71	16.25	Turbidity (NTU)	13.1	—
Conductivity (µS/cm)	461	461	Total Alkalinity (mg/L)	37.0	—
pH	6.92	6.81	**Time Collected**	14:25 pm	14:30 pm

Habitat's Present (circle if present) (1. Pool-K) (2. Pool-S) 3. Run-K 4. Run-S (5.Riffle) (6.LWD) 7. Macrophyte 8. Other

Stream Width Max 5 m Min 1 m Mode 2.5 m

Water Level 1. No Flow 2.Dry/Isolated (3.<Watermark) 4. Normal 5. >Watermark

Shading of River None Low Moderate (High)

Type of River System (Intermittent) Permanent Details. Still very low flow/pretest but unusual year to very wet until few weeks ago

Bank Erosion 1. None 2. Little 3.Some (4. Moderate) 5. Extensive

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream (3. No) 4. Don't Know

Dam/Barrier details..... Think none but can't be sure .....

Hydrological Variation 1. None 2. Little 3.Some 4. Moderate (5. Extensive)

Hydrological Variation details:..... Flood debris ~ 7m above bed .....

Point Source Pollution 1. Yes (2. No) 3. Don't Know Details.....

Non Point Source Pollution (1. Yes) 2. No 3. Don't Know Details..... Cattle station.....

Position in Catchment 1. Upland (2. Midland) 3. Lowland

Adjacent Landuse..... Cattle grazing .....

Geomorphology 1. Steep Valley (2. Broad Valley) 3. Floodplain 4. Other.....

Riparian Zone (zone extends for 100m upstream and downstream from sampled area)

Trees<10m 50 % cover *Shrubs/Vines/Rushes* 20 % cover *Grasses/Ferns/Herbs* 80 % cover

Bare Ground	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Grass	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Shrubs	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees<10m	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Trees>10m	1. None	2. Little	3. Some	4. Moderate	(5. Extensive)

Comments:

MACROINVERTEBRATE FIELD SHEET 1

SITE CODE/NAME DE 2 - Upper Deep Creek **DATE:** 1/06/2011

HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)

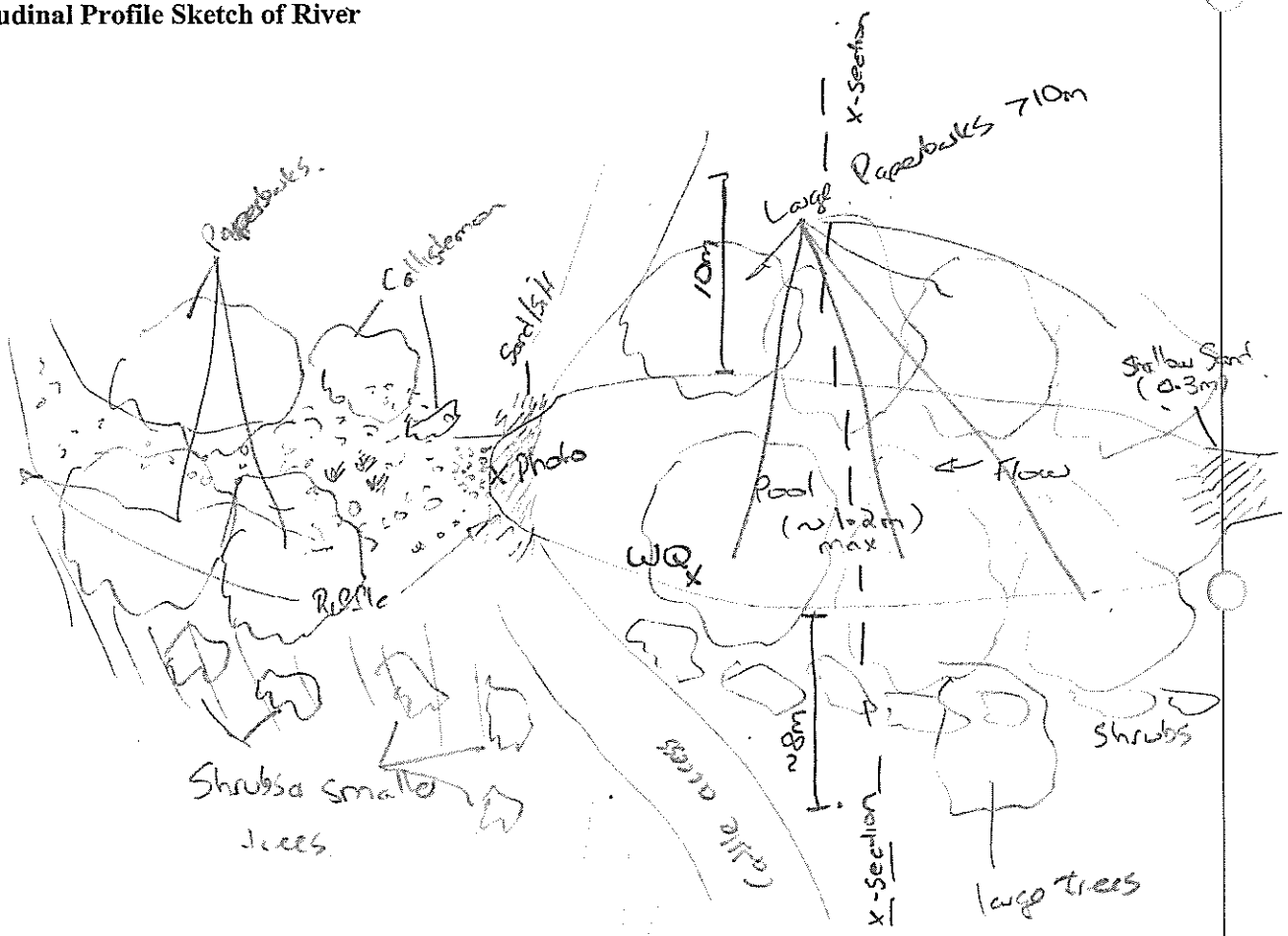
KEY HABITAT FEATURES	Rif 1			Rif 2			Rif 3			Pool *			Pool *		
Vel count	4m/10s	4m/10s	4m/11s	4m/12.8	4m/13.1	4m/12.9	4m/15.3	4m/15.7	4m/15.8	17s	16s	18s	17s	15s	15s
Vel depth mm	100	100	100	100	100	100	100	100	100	1.5m	1.5m	1.5m	2.0m	2.0m	2.0m
Vel m/sec	0.37	0.40	0.36	0.31	0.30	0.31	0.26	0.25	0.25	.06	0.06	0.05	0.06	0.06	0.06
Vel (average) (m/sec)	0.38			0.31			0.25			0.06			0.06		
Mean Sample Depth (m)	0.100			0.100			0.100			N/A			N/A		
Mean Wetted Width (m)	3			3			3			6			6		
% Bedrock	0			0			0			0			0		
% Boulder (>soccer ball)	0			0			0			0			0		
% Cobble (tennis ball - soccer ball)	15			15			15			3			3		
% Pebble (marble - tennis ball)	35			35			35			10			10		
% Gravel (2 - 4mm)	37			37			37			47			47		
% Sand (0.005 - 2mm)	8			8			8			35			35		
% Silt/Clay (< 0.005 mm)	5			5			5			5			5		
% Detritus (leaves/twigs)	5			5			5			5			5		
% Sticks (<2cm)	5			5			5			5			5		
% Branches	2			2			2			2			2		
% Logs (>15cm)	3			3			3			3			3		
% Algae	0			0			0			0			0		
% Macrophytes	0			0			0			0			0		
% Overhanging habitat (e.g. vegetation, roots)	0			0			0			30			30		
% Blanketing silt (indicated by plume)	2			2			2			2			2		
% Shading	55			55			55			55			55		
Sampled By:	MD			MD			MD			Fish only TJ			Fish only TJ		
Picked By:	N/A			N/A			MD			N/A			N/A		

Comments:

MACROINVERTEBRATE FIELD SHEET 2

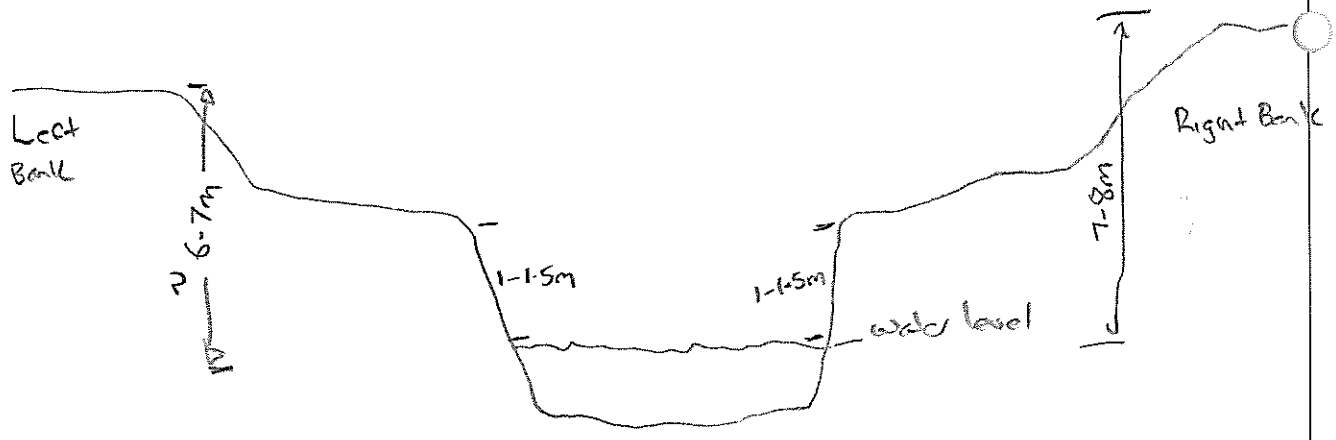
SITE CODE/NAME DE1 - Upper Deep Creek **DATE:** 1 / 06 / 2011

Longitudinal Profile Sketch of River



Please Indicate:
1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:
1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments:

Some lantana present. Prickly Acacia also present above riparian zone though mostly small shrubs. Plenty of lomandra sp. present along banks

REFERENCE CONDITION SELECTION SHEET

SITE CODE: DE1 **Date:** 11/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	3	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	5	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	5	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	5	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered	Flow regime obviously altered	Flow regime highly modified	5	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification	Highly modified vegetation	Severe modification	4	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	3	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	5	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	4	
					Total		

NOTE: When applicable, write down in the comments section the type and approx. distances from the impact
If a score given differs from the previous score, state the reason why they are different in the comments section

COMMENTS

SC1:
SC2:
SC3:
SC4:
SC5:
SC6:
SC7:
SC8:
SC9:
SC10:

FISH SAMPLING SHEETS

PROJECT NAME: SHX **SITE CODE:** De 2

SITE NAME: Upper Deep Ck.

DATE: 01 / 6 / 11 **TIME (24hrs): [** 14:10 **] PARTY:** TV / MD

Site Summary

Species Name	Common Name	Count	Abundance Score

Method Details

Electrofishing (EF)	
Operator:	TV
Assistant:	MD
Start Time:	14:30
Finish Time:	14:55
No. EF Seconds:	341
EF Settings:	
Nets and Traps	
# Fyke Nets (FN):	N/A
# Seine Passes (SN):	N/A
# Bait Traps (BT):	5 x 4hrs

Fish abundance scale

Approx # Observed	Abundance Score
1	(1)
2-9	(2)
10-50	(3)
51-100	(4)
101-500	(5)
501-1000	(6)
1001-5000	7
>5000	8

Species: Margarida adspersa (Purple spot gudgeon) (3)

	Method	LHS (J/I/A)	Length
1	EF		83
2	"		72
3	"		94
4	"		51
5	"		60
6	"		61
7	"		63
8	"		64
9	"		78
10	"		50
11	"		52
12	"		37
13	"		41
14	"		46
15	"		41
16	"		34
17	"		37
18			
19			
20			

Species: Leptheropon unicolor (Sp Perch) (4)

	Method	LHS (J/I/A)	Length
1	EF		108
2	"		109
3	"		92
4	"		89
5	"		57
6	"		76
7	"		94
8	"		58
9	"		55
10	"		87
11	"		60
12	"		71
13	"		57
14	"		55
15	"		51
16	"		52
17			
18			
19			
20			

Species: Mel splendida (Rainbow) (5)

	Method	LHS (J/I/A)	Length
1	EF		75
2	"		63
3	"		62
4	"		51
5	"		40
6	"		52
7	"		42
8	"		34
9	"		41
10	"		42
11	"		30
12	"		21
13	"		24
14	"		88
15	"		85
16	"		43
17	"		56
18	"		42
19	"		27
20	"		26

Count → + 6

Fish Sampling Field Sheet Cont.

Species: Ambassis agassizii				Species: Hyp. compressa				Species: Amniataba percoides			
(3)	Method	LHS (J/I/A)	Length	(3)	Method	LHS (J/I/A)	Length	(1)	Method	LHS (J/I/A)	Length
1	EF		33	1	EF		33	1	EF		45
2	"		30	2	"		30	2			
3	"		44	3	"		36	3			
4	"		26	4	"		29	4			
5	"		31	5	"		28	5			
6	"		29	6	"		29	6			
7	"		32	7	"		25	7			
8	"		27	8				8			
9	"		29	9				9			
10	"		30	10				10			
11	BT		34	11				11			
12	"		45	12				12			
13	"		40	13				13			
14	"		40	14				14			
15	"		41	15				15			
16	"		40	16				16			
17	"		42	17				17			
18	"		32	18				18			
19	"		31	19				19			
20	"		35	20				20			
21											

Species: Mel Splen				Species: Mog adv				Species:			
(5)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	BT		50	1	BT		77	1			
2	"		57	2	"		61	2			
3	"		52	3	"		79	3			
4	"		61	4				4			
5	"		55	5				5			
6	"		49	6				6			
7	"		44	7				7			
8	"		51	8				8			
9	"		54	9				9			
10	"		43	10				10			
11	"		50	11				11			
12	"		50	12				12			
13	"		46	13				13			
14	"		41	14				14			
15	"		52	15				15			
16	"		70	16				16			
17	"		40	17				17			
18	"		42	18				18			
19				19				19			
20				20				20			

Fish Sampling Field Sheet Cont.

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

FIELD SHEET

PROJECT NAME: STYX **SITE CODE:** DE2

SITE NAME: DEEP CREEK BELOW HWY

DATE: 2 / 6 / 11 **TIME (24hrs):** [8:05] **PARTY:** TV/MO

LATITUDE: 22° 42.763 **LONGITUDE:** 149° 40.549

EASTING: 077 4870 **NORTHING:** 7485803 **Mobile Coverage:** (Y) / N

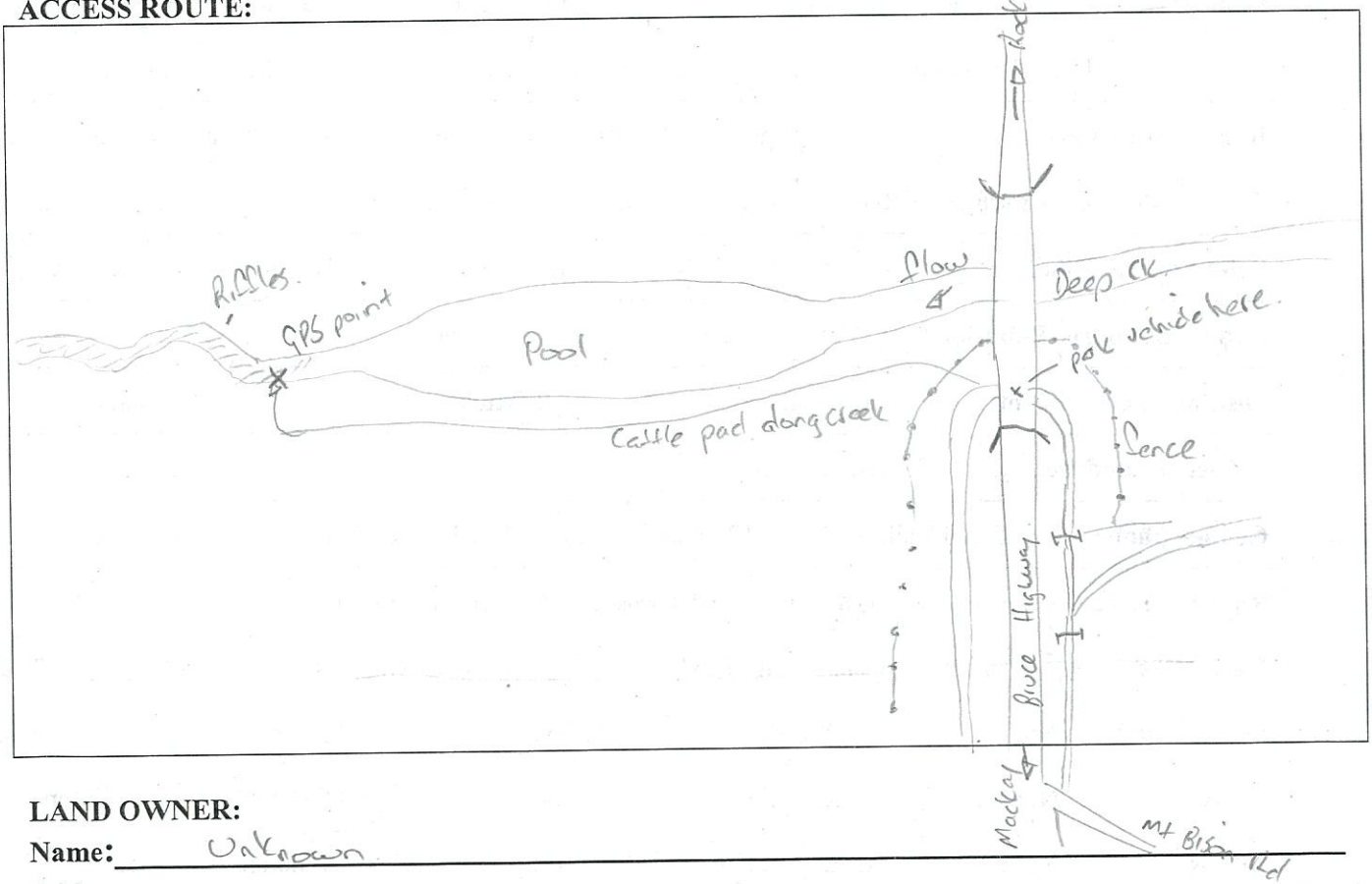
MAP NAME: — **MAP SCALE:** — **Sat. Phone Coverage:** (Y) / N

DATUM (i.e. GDA94): WGS 84 **PHOTO #'s:** — **Key required:** N

Water samples collected: ✓

ACCESS DETAILS: Access site from Mt Bison Rd 27km North of Marlborough. Site is NOT on Waratah Coal owned land so do NOT enter paddocks with vehicle unless prior permission is sought. Turn immediate left after entering Mt Bison Rd from Bruce Hwy. Go straight through 2 gates and park under highway bridge. Keep clear as some waratah vehicles use this route as well. Walk downstream N 400-500m to end of large pool.

ACCESS ROUTE:



LAND OWNER:

Name: Unknown

Address:

Phone:

Permission Requirements:

Office Use:	Data Entered By:	Mark Dahm	Date:	8:40am 16/6/11

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME De 2 - Stynz **DATE:** 1/6/16

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)	0.50	0.2	DO (mg/L)	8.08	8.03
Gauge Height (m)	N/A	N/A	DO (% sat)	83.4	82.7
Water Temperature (°C)	16.68	16.78	Turbidity (NTU)	12.9	—
Conductivity (µS/cm)	476	475	Total Alkalinity (mg/L)	39	39
pH	7.06	7.16	**Time Collected**	16.00	15.55

Habitat's Present (circle if present) (1. Pool-K) (2. Pool-S) 3. Run-K 4. Run-S (5.Riffle) (6.LWD) 7. Macrophyte 8. Other

Stream Width Max 14 m Min 7 m Mode 8 m

Water Level 1. No Flow 2.Dry/Isolated (3.<Watermark) 4. Normal 5. >Watermark

Shading of River None Low (Moderate) High

Type of River System (Intermittent) Permanent Details.....with pools.....

Bank Erosion 1. None 2. Little (3.Some) 4. Moderate 5. Extensive

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream 3. No, (4. Don't Know)

Dam/Barrier details.....

Hydrological Variation 1. None 2. Little 3.Some (4. Moderate) 5. Extensive

Hydrological Variation details:.....

Point Source Pollution 1. Yes (2. No) 3. Don't Know Details.....

Non Point Source Pollution (1. Yes) 2. No 3. Don't Know Details.....Cattle.....

Position in Catchment 1. Upland (2. Midland) 3. Lowland

Adjacent Landuse.....grazing.....

Geomorphology 1. Steep Valley (2. Broad Valley) 3. Floodplain 4. Other.....

Riparian Zone (zone extends for 100m upstream and downstream from sampled area)

Trees<10m 15 % cover *Shrubs/Vines/Rushes* 5 % cover *Grasses/Ferns/Herbs* 75 % cover

Bare Ground	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Grass	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Shrubs	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Trees<10m	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees>10m	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive

Comments: old crossing point. Pool u/s, Riffle D/S

MACROINVERTEBRATE FIELD SHEET 1

SITE CODE/NAME DE2 **DATE:** 2/6/11

HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)

KEY HABITAT FEATURES	R1			R2			R3								
Vel count	4m/13.1	4m/13.3	4m/13.0	4m/12.7	4m/12.4	4m/12.1	4m/15.4	4m/15.4	4m/15.1						
Vel depth	0.1	0.1	0.2	0.15	0.15	0.15	0.1	0.1	0.1						
Vel m/sec	0.31	0.30	0.31	0.31	0.32	0.33	0.26	0.26	0.26						
Vel (average) (m/sec)	0.31			0.32			0.26								
Mean Sample Depth (m)	0.2			0.1			0.1								
Mean Wetted Width (m)	1.2			1.0			1.5								
% Bedrock	–			–			25								
% Boulder (>soccer ball)	2			–			25								
% Cobble (tennis ball - soccer ball)	30			30			15								
% Pebble (marble - tennis ball)	10			40			15								
% Gravel (2 - 4mm)	35			10			10								
% Sand (0.005 - 2mm)	20			20			10								
% Silt/Clay (< 0.005 mm)	3			–			–								
% Detritus (leaves/twigs)	20			20			40								
% Sticks (<2cm)	10			10			20								
% Branches	10			10			5								
% Logs (>15cm)	5			–			5								
% Algae	40			25			60								
% Macrophytes	–			–			–								
% Overhanging habitat (e.g. vegetation, roots)	5			–			20.								
% Blanketing silt (indicated by plume)	1			–			–								
% Shading	50			–			50.								
Sampled By:	MD.			MD			MD								
Picked By:	MD			Lab reps.			Lab reps								

Comments:

.....

.....

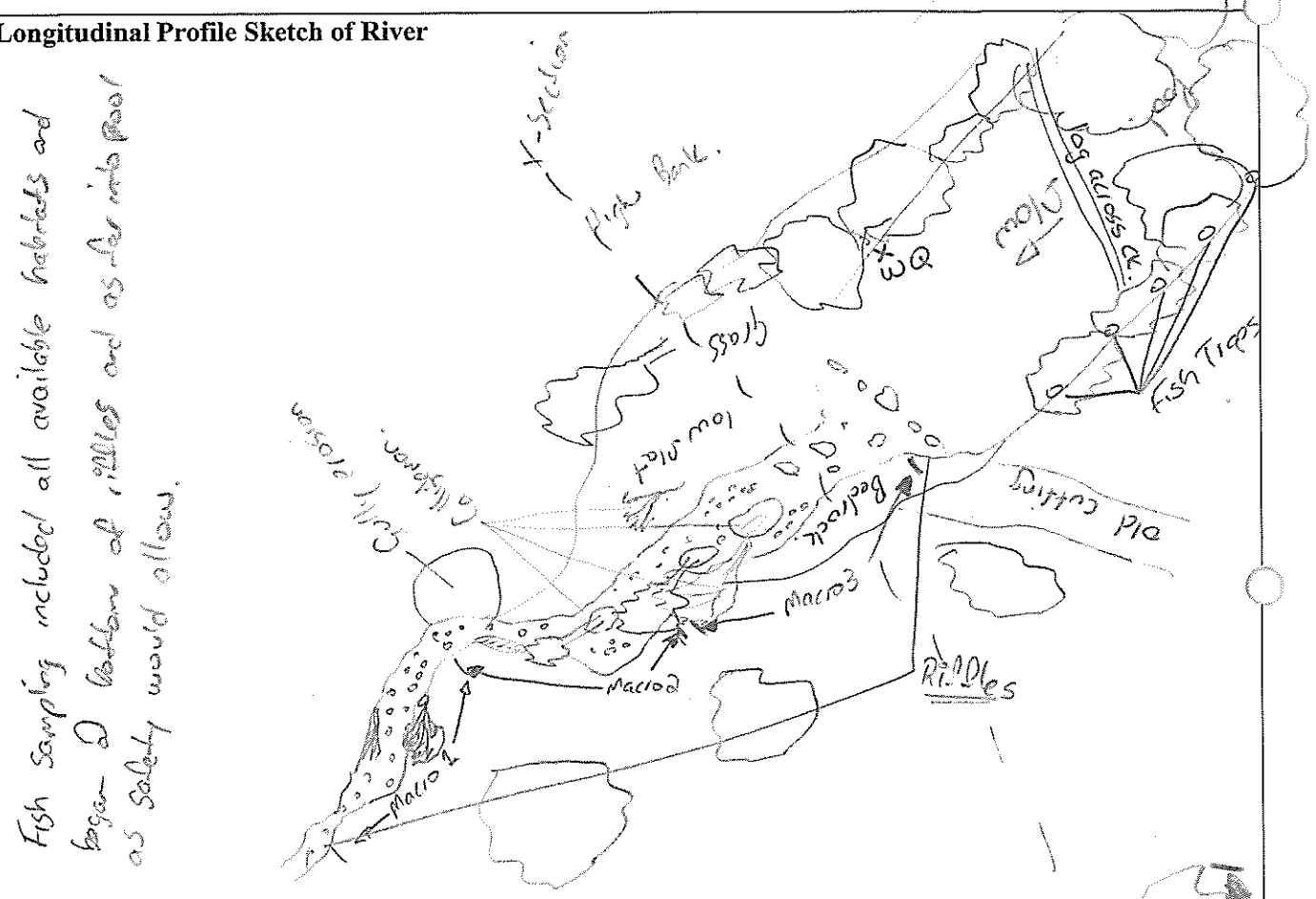
.....

.....

MACROINVERTEBRATE FIELD SHEET 2

SITE CODE/NAME De 2 **DATE:** 2/6/11

Longitudinal Profile Sketch of River

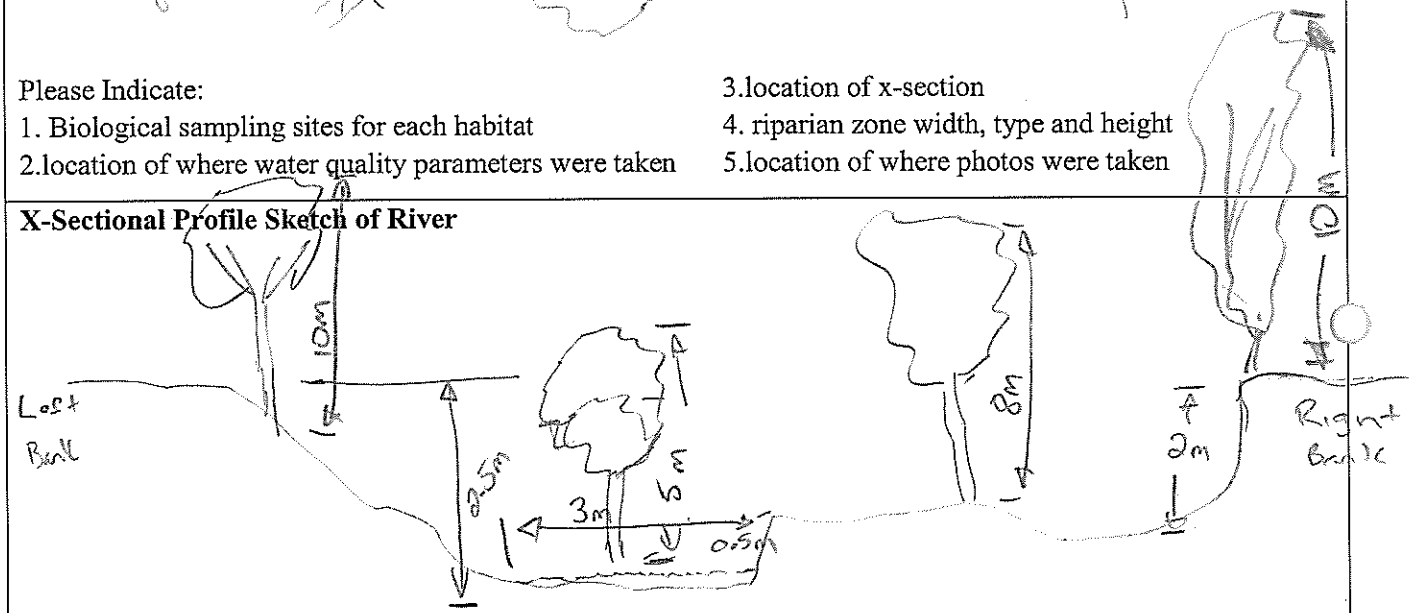


Fish sampling included all available habitats and began D bottom of riffles and as far into pool as safety would allow.

Tracks on map no longer exist D some sites

Please Indicate:
1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:
1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments:

Riffles likely to cease within 1 month. Pool upstream may be only permanent water until next wet season. Too deep to wade using backpack EF and no access for boat due to steep banks (90° & over 1m drop)

REFERENCE CONDITION SELECTION SHEET

SITE CODE: D2 2 **Date:** 1/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	3	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	5	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	3	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	3	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered	Flow regime obviously altered	Flow regime highly modified	5	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification	Highly modified vegetation	Severe modification	4	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	4	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	3	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	5	
NOTE: When applicable, write down in the comments section the type and approx. distances from the impact If a score given differs from the previous score, state the reason why they are different in the comments section					**Total**		

COMMENTS	
	SC1:
	SC2:
	SC3:
	SC4:
	SC5:
	SC6:
	SC7:
	SC8:
	SC9:
	SC10:

FISH SAMPLING SHEETS

PROJECT NAME: Styx **SITE CODE:** De2

SITE NAME: De 2

DATE: 1/6/11 **TIME (24hrs): [** 16·05 **]** **PARTY:** MD & TV

Site Summary

Species Name	Common Name	Count	Abundance Score

Method Details

Electrofishing (EF)	
Operator:	TV
Assistant:	MD
Start Time:	16·05
Finish Time:	16·32pm
No. EF Seconds:	342
EF Settings:	—
Nets and Traps	
# Fyke Nets (FN):	N/A
# Seine Passes (SN):	N/A
# Bait Traps (BT):	5 x 4 hrs

Fish abundance scale

Approx # Observed	Abundance Score
1	1
2-9	2
10-50	3
51-100	4
101-500	5
501-1000	6
1001-5000	7
>5000	8

Species: Hyp Com				Species: Hyp Kln				Species: AMB AGA				EF cont'd
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length	
1	BT		44	1	BT		36	1	BT		33	38
2	"		31	2				2	"		31	32
3	"		36	3				3	"		31	36
4	"		36	4				4	"		22	39
5	"		30	5				5	"		36	32
6	"		24	6				6	"		37	41
7	"		28	7				7	"		37	35
8	"		25	8				8	"		39	30
9	"		31	9				9	"		37	30
10	"		26	10				10	"		24	
11	EF		32	11				11	"		32	
12	"		30	12				12	"		40	
13	"			13				13	"		31	
14				14				14	"		29	
15				15				15	EF		54	
16				16				16	"		46	
17				17				17	"		45	
18				18				18	"		28	
19				19				19	"		51	
20				20				20	"			

Species: Hyp Sp 1				Species: Mel spl				Species: Mog ads			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	BT		35	1	BT		41	1	EF		55
2	"		32	2	"		40	2	"		51
3	"		34	3	"		42	3	"		61
4	EF		37	4	"		44	4	"		74
5	"		38	5	"		32	5	"		81
6	"		36	6	"		45	6	"		52
7	"		35	7	"		31	7	"		67
8				8	EF		59	8	"		78
9				9	"		49	9	"		84
10				10	"		44	10	"		70
11				11	"		38	11	"		77
12				12	"		34	12	"		55
13				13	"		52	13	"		69
14				14	"		42	14	"		67
15				15	"		40	15	"		34
16				16	"		44	16			
17				17	"		27	17			
18				18	"		38	18			
19				19				19			
20				20				20			

Species: Ang Rein				Species: Lei uni				Species: Nea hyr			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		440	1	EF		101	1	EF		83
2				2	"		90	2	"		99
3				3	"		69	3	"		94
4				4	"		84	4			
5				5	"		51	5			
6				6	"		50	6			
7				7	"		77	7			
8				8	"		89	8			
9				9	"		80	9			
10				10	"		75	10			
11				11	"		66	11			
12				12	"		88	12			
13				13	"		44	13			
14				14	"		90	14			
15				15	"		92	15			
16				16	"		65	16			
17				17	"		79	17			
18				18	"		56	18			
19				19	"	+	66	19			
20				20	"		89	20			

many with Ulcers

Fish Sampling Field Sheet Cont.

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

FIELD SHEET

PROJECT NAME: Styx **SITE CODE:** De3

SITE NAME: Lower Deep Ck

DATE: 3 / 6 / 11 **TIME (24hrs): [** 10:00 **] PARTY:** MD MV

LATITUDE: 22° 39.665 **LONGITUDE:** 149° 40.418

EASTING: 0774747 **NORTHING:** 7491526 **Mobile Coverage:** (Y) / N

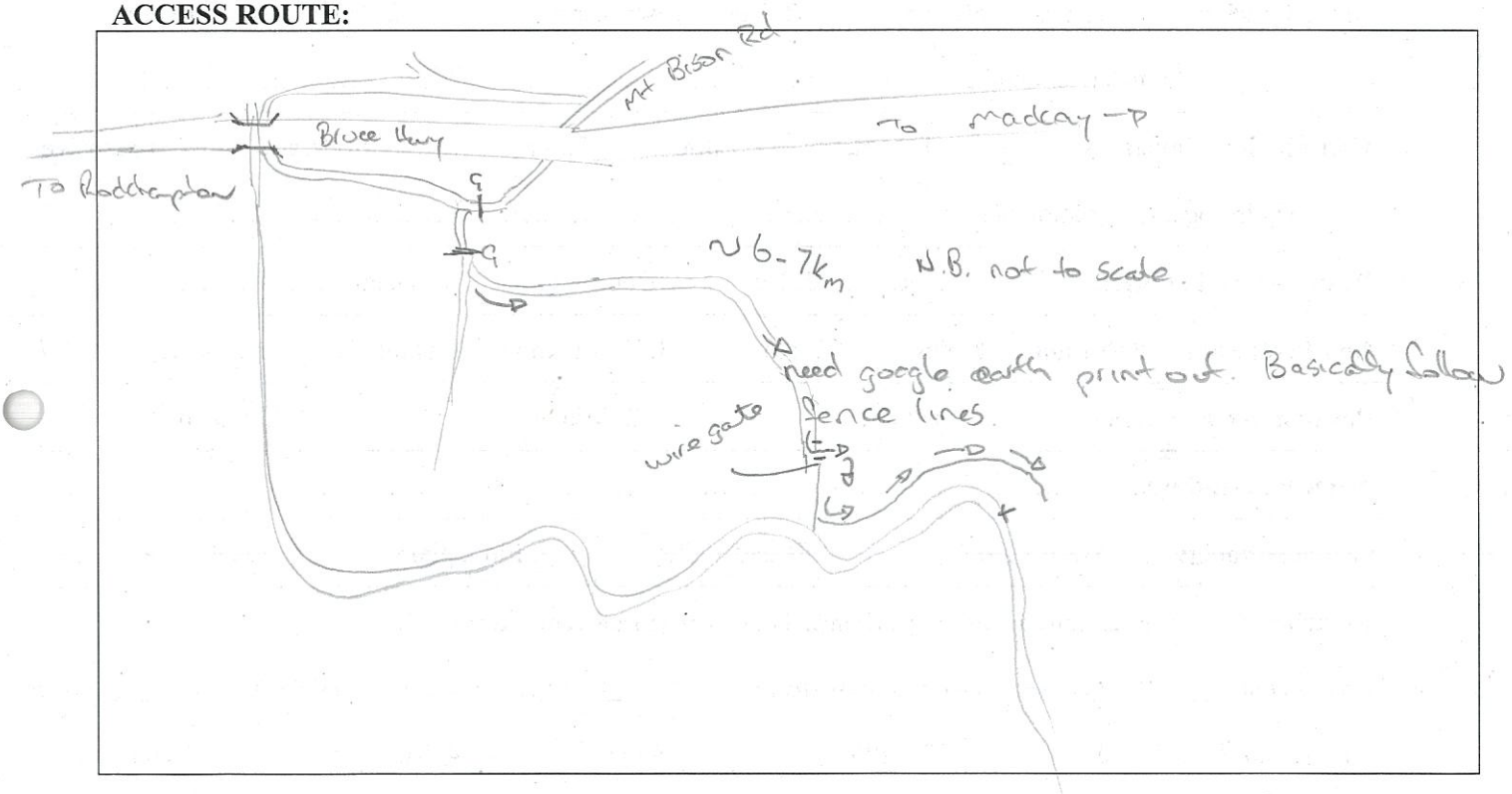
MAP NAME: - **MAP SCALE:** - **Sat. Phone Coverage:** (Y) / N

DATUM (i.e. GDA94): WGS 84 **PHOTO #'s:** - **Key required:** N

Water samples collected:

ACCESS DETAILS: Access is via right turn opposite Mt Bison Rd when arriving from Marlborough. Go through wire gate then through steel gate and veer left following fence line. See track recorded on Mark Dahm's Google Earth. You cannot drive to waters edge. Need the GPS to find place to stop, then climb through fences and walk ~100m to creek bank. Steep bank here!! Tracks has many "soft" spots & damp patches!!

ACCESS ROUTE:



LAND OWNER:

Name: Waratah Coal

Address:

Phone:

Permission Requirements: See site office

Office Use:	Data Entered By:	Mark Dahm	Date:	9:15 16/6/11

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME De3 **DATE:** 3 / 6 / 11

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)		0.2	DO (mg/L)		8.59
Gauge Height (m)		—	DO (% sat)		85.8%
Water Temperature (°C)		14.79	Turbidity (NTU)		17.2
Conductivity (µS/cm)		447	Total Alkalinity (mg/L)		41
pH		7.21	**Time Collected**		12:10

Habitat's Present (circle if present) 1. Pool-K (2. Pool-S) 3. Run-K 4. Run-S (5.Riffle) (6.LWD) 7. Macrophyte (8. Other) - Undercut banks

Stream Width Max 10 m Min 1.8 m Mode 4.5 m

Water Level 1. No Flow 2.Dry/Isolated 3.<Watermark (4. Normal) 5. >Watermark

Shading of River None Low Moderate (High)

Type of River System (Intermittent) Permanent Details. Assume that flow would have ceased in a "normal" year

Bank Erosion 1. None 2. Little 3.Some (4. Moderate) 5. Extensive

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream (3. No) 4. Don't Know

Dam/Barrier details.....

Hydrological Variation 1. None 2. Little 3.Some 4. Moderate (5. Extensive)

Hydrological Variation details: Flood height (debris) up to 8m above bed

Point Source Pollution 1. Yes (2. No) 3. Don't Know Details.....

Non Point Source Pollution (1. Yes) 2. No 3. Don't Know Details. Cattle faeces

Position in Catchment 1. Upland 2. Midland (3. Lowland)

Adjacent Landuse..... Cattle grazing

Geomorphology 1. Steep Valley 2. Broad Valley (3. Floodplain) 4. Other.....

Riparian Zone (zone extends for 100m upstream and downstream from sampled area)

Trees<10m 60 % cover *Shrubs/Vines/Rushes* 30 % cover *Grasses/Ferns/Herbs* 30 % cover

Bare Ground	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Grass	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Shrubs	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees<10m	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Trees>10m	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive

Comments: Rubbervine very thick in places, reaching canopy of some trees

MACROINVERTEBRATE FIELD SHEET 1

SITE CODE/NAME De3 **DATE:** 3/6/11

HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)

KEY HABITAT FEATURES	Riffle 1			Riffle 2			Riffle 3											
Vel count	3m / 9.6	3m / 9.5	3m / 9.6	3m / 7.9	3m / 8.1	3m / 7.7	3m / 6.4	3m / 6.6	3m / 6.9									
Vel depth	0.1	0.1	0.1	0.15	0.15	0.15	0.15	0.15	0.15									
Vel m/sec	0.31	0.31	0.31	0.38	0.37	0.39	0.47	0.45	0.47									
Vel (average) (m/sec)	0.31			0.38			0.46											
Mean Sample Depth (m)	0.1			0.2			0.2											
Mean Wetted Width (m)	1.2			2.0			1.5											
% Bedrock	—			—			—											
% Boulder (>soccer ball)	—			—			—											
% Cobble (tennis ball - soccer ball)	—			—			—											
% Pebble (marble - tennis ball)	—			5			30											
% Gravel (2 - 4mm)	60			90			60											
% Sand (0.005 - 2mm)	38			5			10											
% Silt/Clay (< 0.005 mm)	2			—			—											
% Detritus (leaves/twigs)	10			10			2											
% Sticks (<2cm)	10			10			10											
% Branches	5			5			—											
% Logs (>15cm)	2			5			5											
% Algae	—			2			2											
% Macrophytes	—			—			2											
% Overhanging habitat (e.g. vegetation, roots)	10			—			—											
% Blanketing silt (indicated by plume)	2			2			2											
% Shading	80			90			50											
Sampled By:	MD			MD			MD											
Picked By:				—			MD											

Comments:

.....

.....

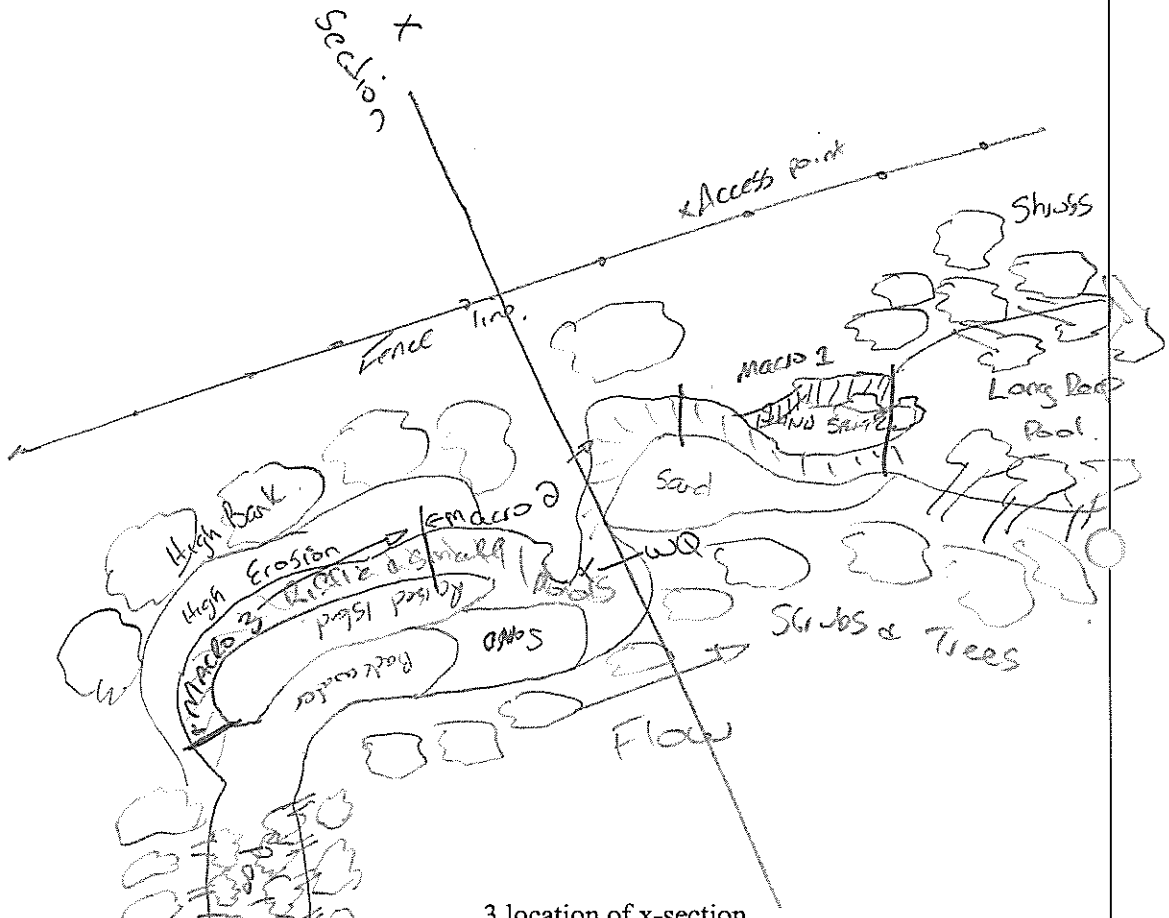
.....

.....

MACROINVERTEBRATE FIELD SHEET 2

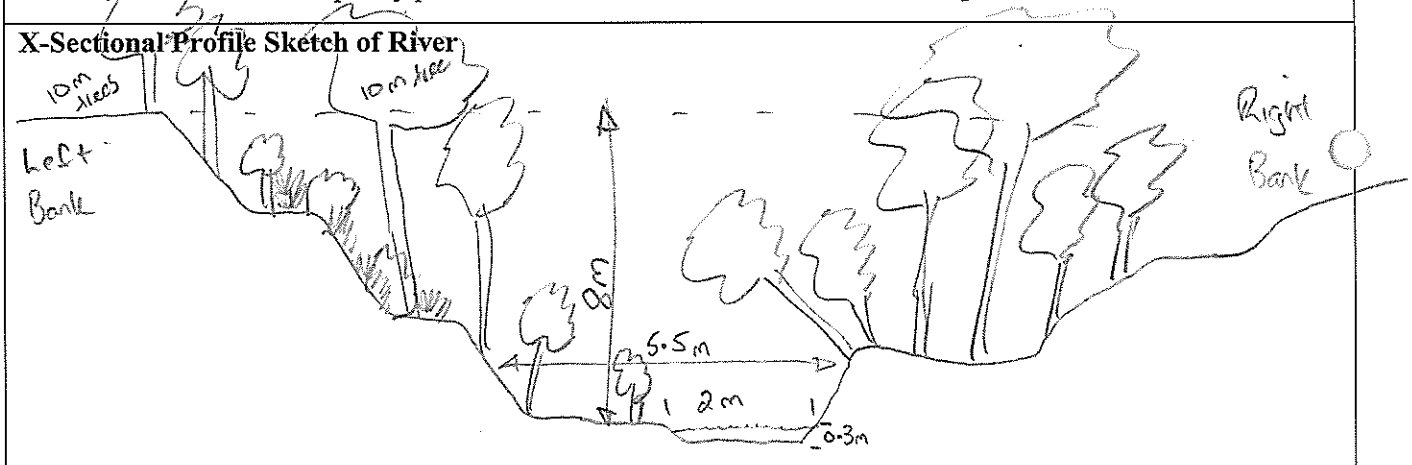
SITE CODE/NAME 3 B3 **DATE:** 3 / 6 / 11

Longitudinal Profile Sketch of River



Please Indicate:
1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:
1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments: Lots of large woody debris in riffles and pools. Pools have undercut banks. Pool likely to be permanent and is noted barrando nursery area

REFERENCE CONDITION SELECTION SHEET

SITE CODE: De 3 **Date:** 3/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	4	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	5	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	5	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	5	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered	Flow regime obviously altered	Flow regime highly modified	4	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification	Highly modified vegetation	Severe modification	4	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	4	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	3	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	4	
NOTE: When applicable, write down in the comments section the type and approx. distances from the impact If a score given differs from the previous score, state the reason why they are different in the comments section					**Total**		

COMMENTS

SC1:
SC2:
SC3:
SC4:
SC5:
SC6:
SC7:
SC8: Year appears to be a moderate change due to large flood this year
SC9: Habitat changes mostly due to rubbish infestation
SC10:

FISH SAMPLING SHEETS

PROJECT NAME: Styx **SITE CODE:** De3

SITE NAME: Deep Creek

DATE: 3/6/11 **TIME (24hrs): [** 12:30pm **]** **PARTY:** MD & TV

Note: All habitats sampled except deep pool

Site Summary

Species Name	Common Name	Count	Abundance Score

Method Details

Electrofishing (EF)	
Operator:	TV
Assistant:	MD
Start Time:	1200
Finish Time:	12:30
No. EF Seconds:	495
EF Settings:	—
Nets and Traps	
# Fyke Nets (FN):	—
# Seine Passes (SN):	—
# Bait Traps (BT):	5 x 3 hrs (930-1230

Fish abundance scale

Approx # Observed	Abundance Score
1	1
2-9	2
10-50	3
51-100	4
101-500	5
501-1000	6
1001-5000	7
>5000	8

Species: Neo kyr				Species: Mel sple				Species: lei uni			
(3)	Method	LHS (J/I/A)	Length	(4)	Method	LHS (J/I/A)	Length	(5)	Method	LHS (J/I/A)	Length
1	EF		109	1	EF		55	1	EF		85
2	"		128	2	"		49	2	"		72
3	"		92	3	"		49	3	"		94
4	"		104	4	"		51	4	"		74
5	"		111	5	"		53	5	"		66
6	"		105	6	"		42	6	"		73
7	"		91	7	"		52	7	"		64
8	"		107	8	"		50	8	"		65
9				9	"		46	9	"		63
10				10	"		50	10	"		59
11				11	"		52	11	"		134
12				12	"		49	12	"		126
13				13	"	>	47	13	"		82
14				14	"		36	14	"		83
15				15	"		40	15	"		55
16				16	"		46	16	"		66
17				17	"		56	17	"		67
18				18	"		36	18	"		75
19				19	"		58	19	"		66
20				20	"		62	20	"		57

Fish Sampling Field Sheet Cont.

Species: Ang rei				Species: Amb aqa				Species: Hyp com			
(1)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length	4	Method	LHS (J/I/A)	EF Length
1	EF		280	1	EF		45	1	EF	IST 21	27
2				2	"		47	2	"	27	22
3				3	"		32	3	"	26	23
4				4				4	"	32	21
5				5				5	"	25	26
6				6				6	"	19	22
7				7				7	"	27	23
8				8				8	"	26	63
9				9				9	"	20	25
10				10				10	"	24	30
11				11				11	"	21	33
12				12				12	"	18	21
13				13				13	"	26	20
14				14				14	"	21	22
15				15				15	"	25	20
16				16				16	"	27	33
17				17				17	"	23	24
18				18				18		19	27
19				19				19		27	23
20				20				20		18	24

total=43

Species: Mog ads				Species: Hyp Sp 1				Species:			
(4)	Method	LHS (J/I/A)	Length	(1)	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		49	1	EF		31	1			
2	"		45	2				2			
3	"		40	3				3			
4	"		36	4				4			
5	"		39	5				5			
6	"		41	6				6			
7	"		45	7				7			
8	"		34	8				8			
9	"		50	9				9			
10	"		45	10				10			
11	"		32	11				11			
12	"		40	12				12			
13	"		29	13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Fish Sampling Field Sheet Cont.

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

FIELD SHEET

PROJECT NAME: Styx **SITE CODE:** Gr 1

SITE NAME: Granite Creek

DATE: 5 / 6 / 11 **TIME (24hrs): [** 2-55 **] PARTY:** MD + TV

LATITUDE: S 22° 36-536' **LONGITUDE:** E 149° 32·685

EASTING: 55K 076 1596 **NORTHING:** mH 749 7536 **Mobile Coverage:** (Y) / N

MAP NAME: _____ **MAP SCALE:** _____ **Sat. Phone Coverage:** (Y) / N

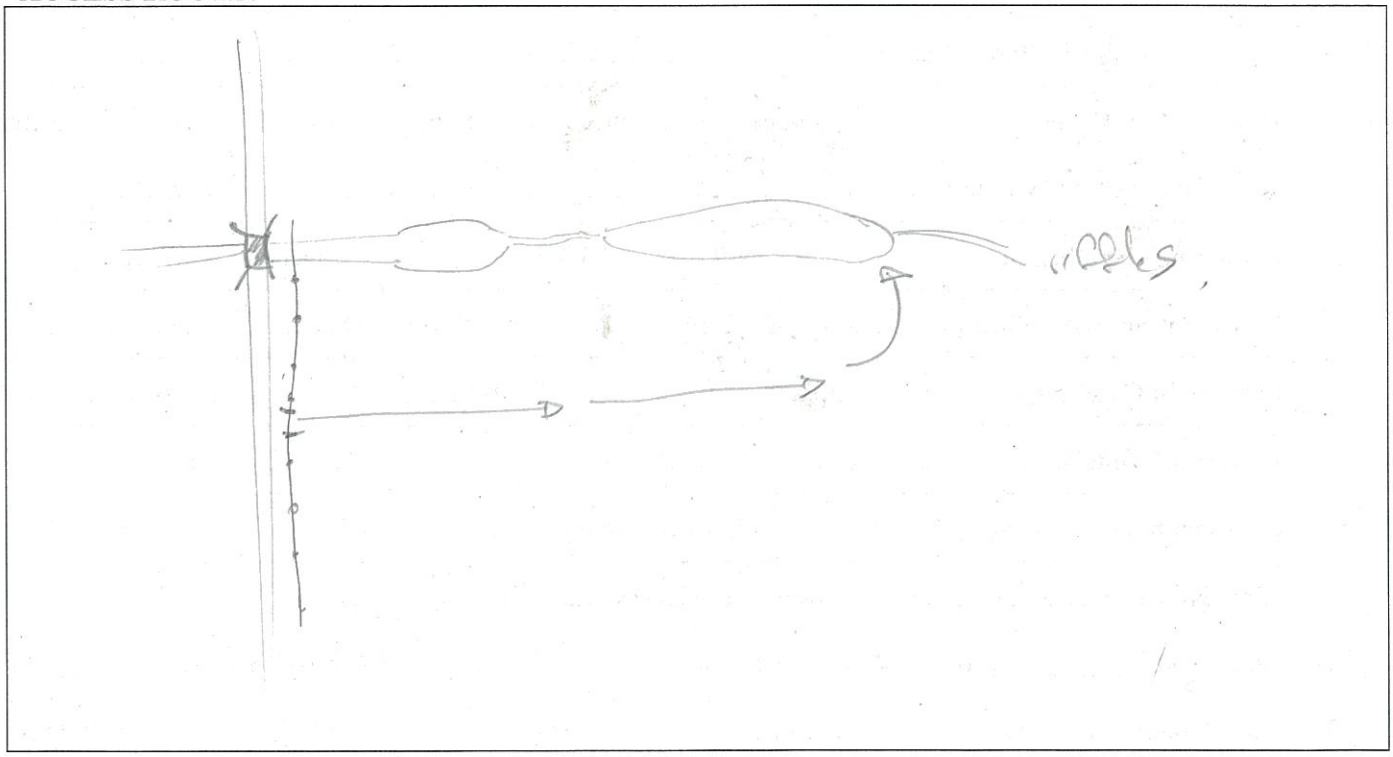
DATUM (i.e. GDA94): WGS 84 **PHOTO #'s:** _____ **Key required:** N

Water samples collected: ✓

ACCESS DETAILS: Gate on right just before Granite Ck bridge heading towards Mackay. Drive N 1 km overland down creek to bottom of large hole. Great boat launch.

See Mark Dahm "GPS track"

ACCESS ROUTE:



LAND OWNER:

Name: Joe & Rachael Olive

Address: Nullegai Station

Phone: 07 4937 3516, M: 0438 380 124

Permission Requirements: See Mark Dahm before contacting

Office Use:	Data Entered By:	Mark Dahm	Date:	6-11pm 14/6/11

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME Granite Creek Gr 1 **DATE:** 5/6/11

* pH reading taken on 6/6/11 @ approx 6:15 am using T.U meter

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)	0.5	—	DO (mg/L)	7.84	—
Gauge Height (m)	N/A	—	DO (% sat)	83.7	—
Water Temperature (°C)	18.30	—	Turbidity (NTU)	7.44	—
Conductivity (µS/cm)	324	—	Total Alkalinity (mg/L)	44	—
pH *	6.6	—	**Time Collected**	2:55 pm	—

Habitat's Present (circle if present) (1. Pool-K) 2. Pool-S 3. Run-K 4. Run-S (5.Riffle) (6.LWD) (7. Macrophyte) (8. Other)

Stream Width Max 45 m Min 25 m Mode 35 m

Water Level 1. No Flow 2.Dry/Isolated (3.<Watermark) 4. Normal 5. >Watermark

Shading of River None (Low) Moderate High

Type of River System Intermittent (Permanent) Details... permanent pools

Bank Erosion 1. None (2. Little) 3.Some 4. Moderate 5. Extensive

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream (3. No) 4. Don't Know

Dam/Barrier details.....

Hydrological Variation 1. None 2. Little (3.Some) 4. Moderate 5. Extensive

Hydrological Variation details: litter 3m above present level

Point Source Pollution 1. Yes (2. No) 3. Don't Know Details.....

Non Point Source Pollution 1. Yes (2. No) 3. Don't Know Details.....

Position in Catchment 1. Upland (2. Midland) 3. Lowland

Adjacent Landuse..... Grazing .....

Geomorphology 1. Steep Valley (2. Broad Valley) 3. Floodplain 4. Other.....

Riparian Zone (zone extends for 100m upstream and downstream from sampled area)

Trees<10m 5 % cover *Shrubs/Vines/Rushes* 15 % cover *Grasses/Ferns/Herbs* 90 % cover

Bare Ground	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Grass	1. None	2. Little	3. Some	4. Moderate	(5. Extensive)
Shrubs	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees<10m	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees>10m	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive

Comments:

MACROINVERTEBRATE FIELD SHEET 1

SITE CODE/NAME Gr 1 **DATE:** 5/6/16

HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)

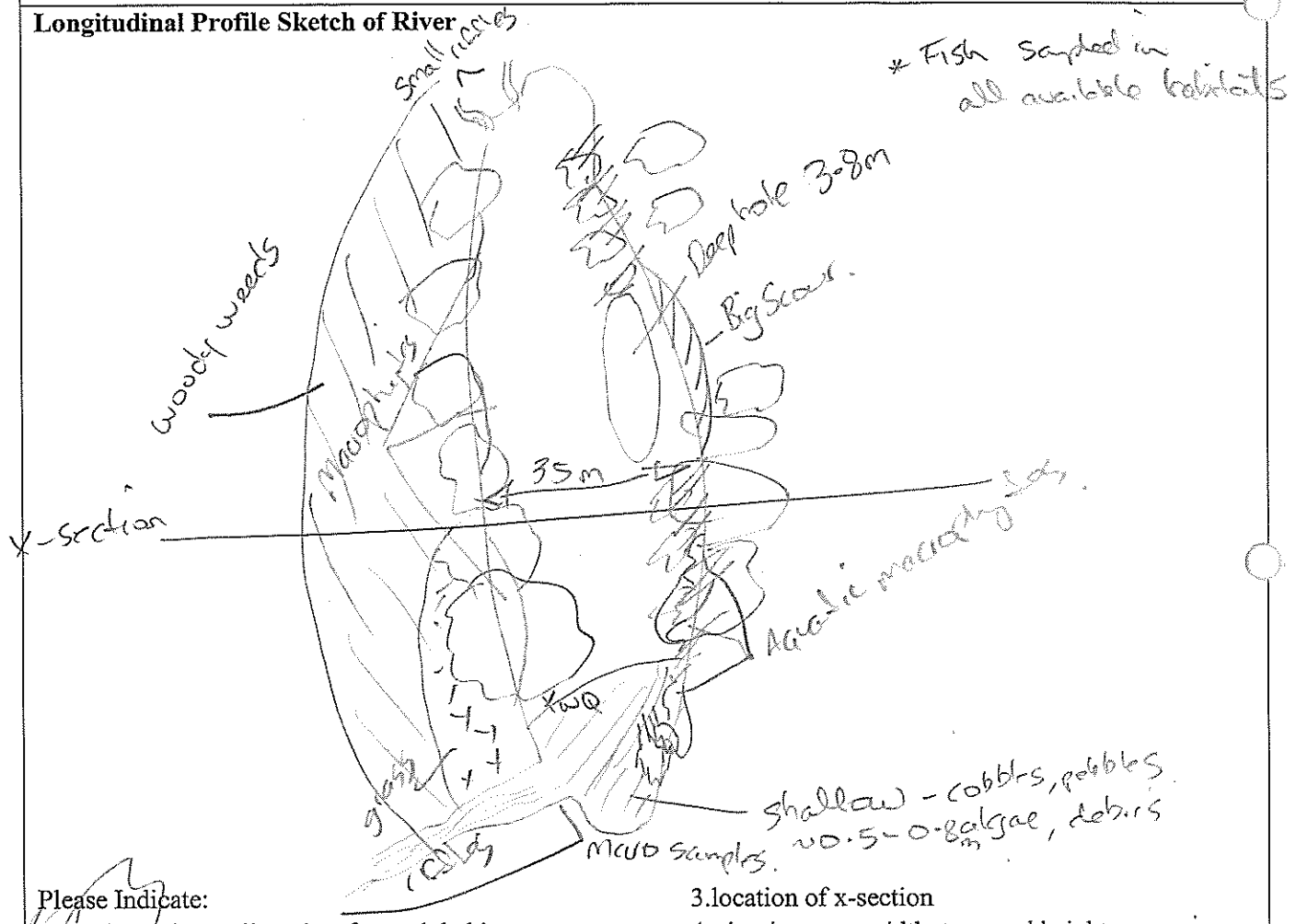
KEY HABITAT FEATURES	Riffle 1			Riffle 2			Riffle 3			Edge 1					
Vel count	3m 3-7	3m 3-7	3m 3-6	3m 3-7	3m 3-5	3m 3-8	3m 3-5	3m 3-4	3m 3-6	—	—	—			
Vel depth	0-2	0-2	0-2	0-2	0-2	0-2	0-3	0-3	0-3	0-25	0-25	0-25			
Vel m/sec	0-81	0-81	0-83	0-81	0-86	0-79	0-86	0-89	0-83	—	—	—			
Vel (average) (m/sec)	0-82			0-82			0-86			<0-1					
Mean Sample Depth (m)	0-2			0-2			0-3			0-25					
Mean Wetted Width (m)	4-0			3-5			4-0			N/A					
% Bedrock	—			—			—			—					
% Boulder (>soccer ball)	—			—			—			—					
% Cobble (tennis ball - soccer ball)	25			20			15			30					
% Pebble (marble - tennis ball)	40			40			45			25					
% Gravel (2 - 4mm)	30			35			35			25					
% Sand (0.005 - 2mm)	5			5			5			15					
% Silt/Clay (< 0.005 mm)	—			—			—			5					
% Detritus (leaves/twigs)	15			10			5			3					
% Sticks (<2cm)	10			10			5			3					
% Branches	5			—			—			2					
% Logs (>15cm)	5			5			5			1					
% Algae	—			—			5			15					
% Macrophytes	—			—			—			—					
% Overhanging habitat (e.g. vegetation, roots)	—			—			—			—					
% Blanketing silt (indicated by plume)	3			3			3			10					
% Shading	65			45			15			5					
Sampled By:	MD			MD			MD			MD					
Picked By:	—			—			MD			—					

Comments:

MACROINVERTEBRATE FIELD SHEET 2

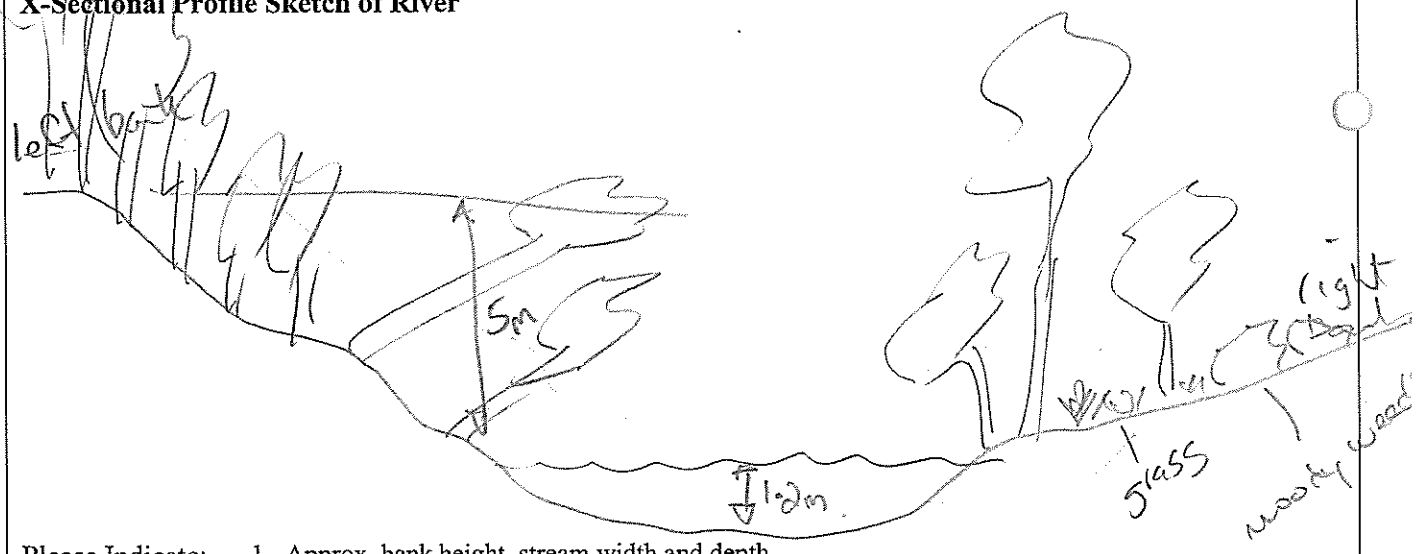
SITE CODE/NAME CR1 **DATE:** 5 / 6 / 11

Longitudinal Profile Sketch of River



Please Indicate:
1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:
1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments:

.....

.....

.....

REFERENCE CONDITION SELECTION SHEET

SITE CODE: GR1 **Date:** 5/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	3	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	5	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	5	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	5	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered	Flow regime obviously altered	Flow regime highly modified	5	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification	Highly modified vegetation	Severe modification	4	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	4	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	5	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	5	
NOTE: When applicable, write down in the comments section the type and approx. distances from the impact If a score given differs from the previous score, state the reason why they are different in the comments section					**Total**		

COMMENTS	
	SC1: Lots of weeds
	SC2:
	SC3:
	SC4:
	SC5:
	SC6:
	SC7:
	SC8:
	SC9:
	SC10:

FISH SAMPLING SHEETS

PROJECT NAME: Styx **SITE CODE:** Gr 1

SITE NAME: Granite Creek 1

DATE: 5/6/11 **TIME (24hrs): [** 15:00 **]** **PARTY:** MD & TV

Site Summary

Species Name	Common Name	Count	Abundance Score

Method Details

Electrofishing (EF)	
Operator:	TV
Assistant:	MD
Start Time:	3:00pm
Finish Time:	4:00pm
No. EF Seconds:	592 seconds
EF Settings:	
Nets and Traps	
# Fyke Nets (FN):	—
# Seine Passes (SN):	—
# Bait Traps (BT):	— No time

Fish abundance scale

Approx # Observed	Abundance Score
1	1
2-9	2
10-50	3
51-100	4
101-500	5
501-1000	6
1001-5000	7
>5000	8

Species: Latus Cal

(4)	Method	LHS (J/I/A)	Length
1	EF		530
2	"		265
3	"		211
4	"		245
5	"		510
6	"		236
7	"		245
8	"		415
9	"		407
10	"		503
11	"		296
12	"		245
13	"		227
14	"		254
15			
16			
17			
18			
19			
20			

Species: Mog cyp

(2)	Method	LHS (J/I/A)	Length
1	EF		270
2	"		350
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Species: Nem ere

(3)	Method	LHS (J/I/A)	Length
1	E		295
2	"		315
3	"		289
4	"		276
5	"		235
6			
7			
8			
9			
10			
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19			
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Fish Sampling Field Sheet Cont.

Species: Neo hyp.				Species: Mel spl				Species: Hyp com			
(1)	Method	LHS (J/I/A)	Length	(4)	Method	LHS (J/I/A)	Length	(4)	Method	LHS (J/I/A)	Length
1	EF		263	1	EF		60	1	EF		66
2				2	"		63	2	"		74
3				3	"		46	3	"		52
4				4	"		55	4	"		58
5				5	"		48	5	"		50
6				6	"		51	6	"		51
7				7	"		64	7	"		44
8				8	"		56	8			
9				9	"		76	9			
10				10	"		54	10			
11				11	"		41	11			
12				12	"		64	12			
13				13	"		40	13			
14				14	"		36	14			
15				15	"		56	15			
16				16	"		55	16			
17				17	"		45	17			
18				18	"		72	18			
19				19	"		20	19			
20				20				20			

Species: Cra ste				Species: Ang. vei				Species: Ari gra			
(2)	Method	LHS (J/I/A)	Length	(3)	Method	LHS (J/I/A)	Length	(1)	Method	LHS (J/I/A)	Length
1	EF		43	1	EF		250	1	EF		435
2	"		40	2	"		500	2			
3	"		40	3	"	10 x	(600)	3			
4	"		37	4	"		1000	4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Fish Sampling Field Sheet Cont.

Species: Lei uni				Species: Anb aqa				Species: Hyp sp1			
(2)	Method	LHS (J/I/A)	Length	(4)	Method	LHS (J/I/A)	Length	(3)	Method	LHS (J/I/A)	Length
1	EF		136	1	EF		44	1	EF		26
2	"		138	2	"		38	2	"		29
3				3	"		39	3	"		26
4				4	"		27	4	"		28
5				5	"		25	5	"		27
6				6	"		50	6	"		32
7				7	"		47	7	"		21
8				8	"		44	8	"		36
9				9	"		44	9			
10				10	"		32	10			
11				11	"		44	11			
12				12	"		47	12			
13				13	"		55	13			
14				14	"		42	14			
15				15	"		40	15			
16				16	"		41	16			
17				17	"		26	17			
18				18	"		29	18			
19				19	"		50	19			
20				20	"		40	20			

Species: Turtle				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	7 spotted x 1			1				1			
2	scooped - see photo.			2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

FIELD SHEET

PROJECT NAME: Styx **SITE CODE:** ST 1

SITE NAME: UPPER STYX RIVER

DATE: 5 / 6 / 11 **TIME (24hrs):** [0900] **PARTY:** TV / MD

LATITUDE: 22° 38.405' **LONGITUDE:** 149° 39.736'

EASTING: 0773634 **NORTHING:** 7493872 **Mobile Coverage:** (Y) / N

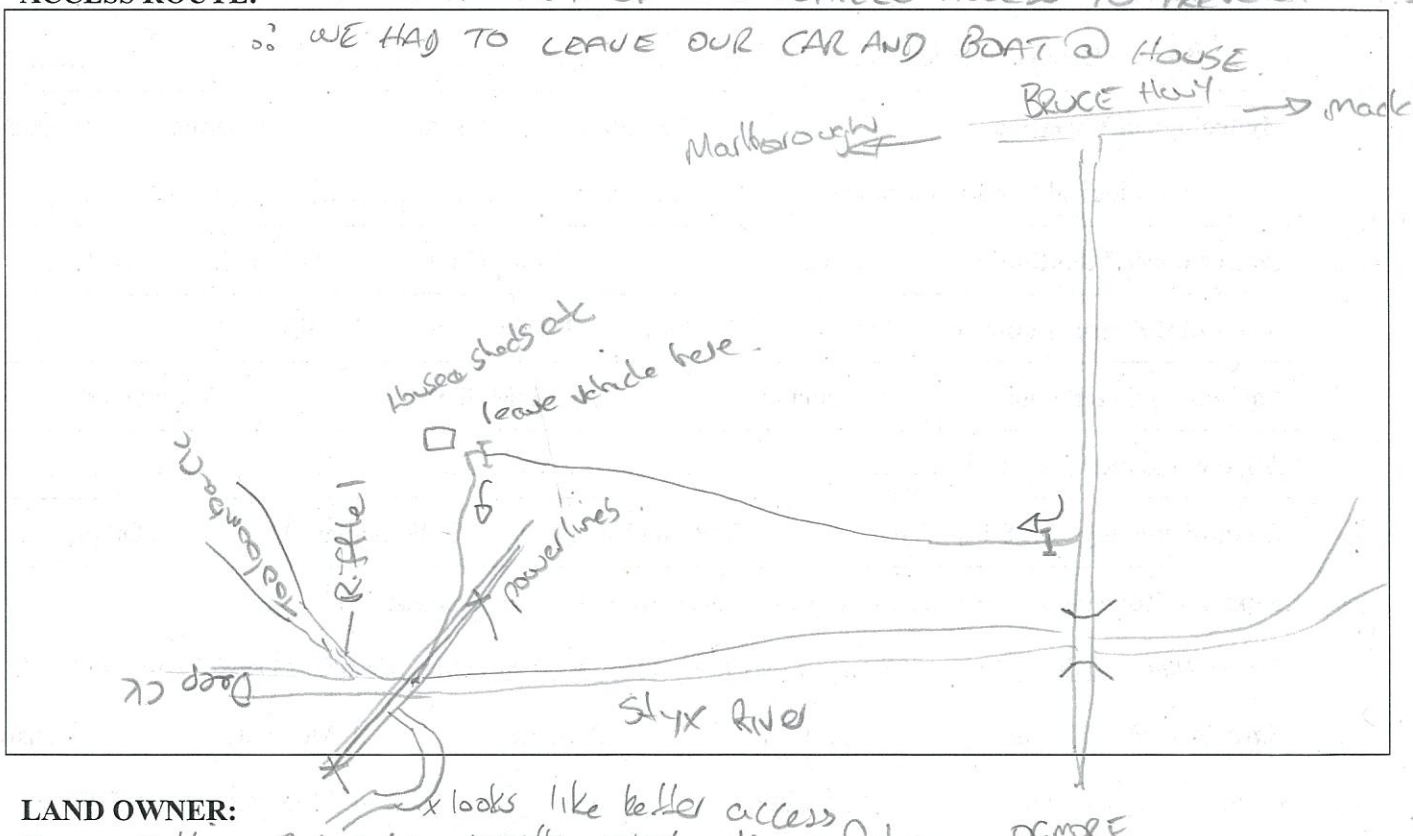
MAP NAME: — **MAP SCALE:** — **Sat. Phone Coverage:** (Y) / N

DATUM (i.e. GDA94): WGS 84 **PHOTO #'s:** ✓ **Key required:** N

Water samples collected: Many - E.coli etc

ACCESS DETAILS: There are 2 access tracks to this site. As usual the grass was greener on the other side of the river, however we didn't have contact details or the time to negotiate access on this trip. HOWEVER we strongly recommend trying to get access from the EASTERN BANK for any future survey as Boat EF launch site is excellent!!

ACCESS ROUTE: ~~*~~ This site was accessed from the Western Bank on Rubetski's property. The property road is ~200m before the Styx Bridge coming from the Bruce Hwy to Ogmore. The house is about 1.5km in. From there we used one of their Polaris buggies and their tinnie to drive a short stadium track to the river. THEY HAVE A STRICT POLICY OF NO VEHICLE ACCESS TO PREVENT WEEDS ∴ WE HAD TO LEAVE OUR CAR AND BOAT @ HOUSE.



LAND OWNER:

Name: Debbie Rubetski x looks like better access worth investigating in future.

Address: See Mark Dahm notes

Phone:

Permission Requirements: No vehicle or boat access to prevent weed intro.

Office Use:	Data Entered By:	Mark Dahm	Date:	9:50 16/6/11

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME ST1 **DATE:** 5/6/11

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)	0.5m	ASW Cal. ↓	DO (mg/L)	8.82	
Gauge Height (m)	-	↓	DO (% sat)	90.9	
Water Temperature (°C)	16.74		Turbidity (NTU)	5.63	
Conductivity (µS/cm)	987		Total Alkalinity (mg/L)	70	
pH	9.49 *	9.80	**Time Collected**	0930	

* Seems high? Re-calibrated

Habitat's Present (circle if present) 1. Pool-K (2. Pool-S) 3. Run-K (4. Run-S) (5.Riffle) Too low on bank very (6.LWD) (7. Macrophyte) 8. Other

Stream Width Max 40 m Min 5 m Mode 18 m

Water Level 1. No Flow 2.Dry/Isolated 3.<Watermark 4. Normal (5. >Watermark)

Shading of River None (Low) Moderate High

Type of River System (Intermittent) Permanent Details: Flow will cease in next month or 2

Bank Erosion 1. None 2. Little 3.Some (4. Moderate) 5. Extensive

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream 3. No (4. Don't Know)

Dam/Barrier details.....

Hydrological Variation 1. None 2. Little 3.Some 4. Moderate (5. Extensive)

Hydrological Variation details: Flood plain very wide and debris up 6m plus

Point Source Pollution 1. Yes 2. No (3. Don't Know) Details.....

Non Point Source Pollution (1. Yes) 2. No 3. Don't Know Details: Cattle

Position in Catchment 1. Upland 2. Midland (3. Lowland)

Adjacent Landuse: Grazing

Geomorphology 1. Steep Valley 2. Broad Valley (3. Floodplain) 4. Other.....

Riparian Zone (zone extends for 100m upstream and downstream from sampled area)

Trees<10m 65 % cover *Shrubs/Vines/Rushes* 25 % cover *Grasses/Ferns/Herbs* 10 % cover

Bare Ground	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Grass	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Shrubs	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees<10m	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Trees>10m	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive

Comments: Rubber Vine thick in places, lots of weeds

MACROINVERTEBRATE FIELD SHEET 1

SITE CODE/NAME ST 1 **DATE:** 5 / 6 / 11

HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)

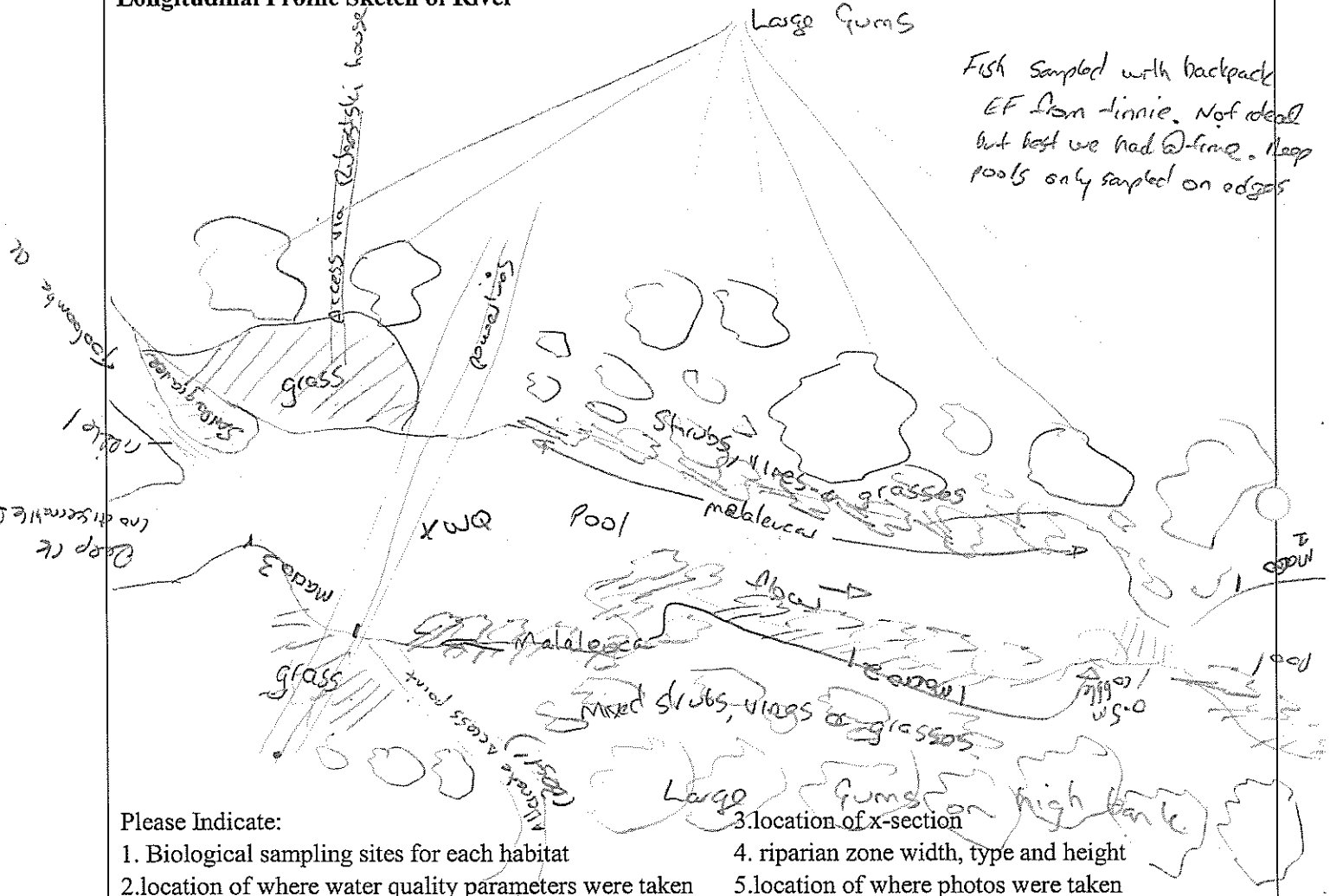
KEY HABITAT FEATURES	Edge 1			Edge 2			Edge 3			Riffle			Toolachibal Creek		
Vel count 5/m	–	–	–	–	–	–	–	–	–	4m 3.9	4m 3.7	4m 3.7			
Vel depth	0.6	0.7	0.5	0.6	0.6	0.6	0.3	0.7	0.4	0.2	0.3	0.2			
Vel m/sec	–	–	–	–	–	–	–	–	–	1.02	1.08	1.08			
Vel (average) (m/sec)	<0.10m/s			<0.10m/s			0.10m/s			1.06					
Mean Sample Depth (m)	0.6			0.6			0.466			0.266					
Mean Wetted Width (m)	25			22			26			1.5					
% Bedrock	0			0			0			0					
% Boulder (>soccer ball)	0			0			0			0					
% Cobble (tennis ball - soccer ball)	0			0			0			15					
% Pebble (marble - tennis ball)	10			10			10			30					
% Gravel (2 - 4mm)	30			30			40			40					
% Sand (0.005 - 2mm)	50			50			40			10					
% Silt/Clay (< 0.005 mm)	10			10			10			5					
% Detritus (leaves/twigs)	2			2			2			–					
% Sticks (<2cm)	3			3			3			–					
% Branches	–			–			–			1					
% Logs (>15cm)	1			1			1			–					
% Algae	30			30			30			30					
% Macrophytes	1			1			1			–					
% Overhanging habitat (e.g. vegetation, roots)	30			30			30			10					
% Blanketing silt (indicated by plume)	10			10			10			5					
% Shading	10			10			10			5					
Sampled By:	MD			MD			MD			MD					
Picked By:	N/A			N/A			MD			N/A					

Comments:

MACROINVERTEBRATE FIELD SHEET 2

SITE CODE/NAME ST 1 **DATE:** 5 / 6 / 11

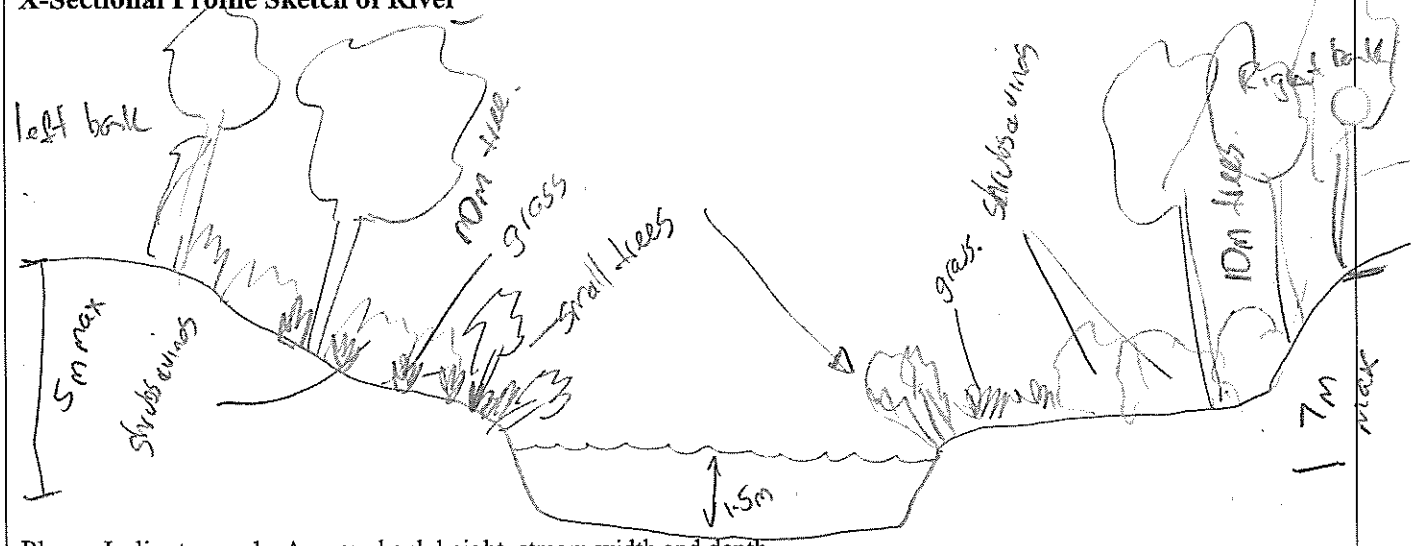
Longitudinal Profile Sketch of River



Please Indicate:

1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:

1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments:

.....

.....

.....

REFERENCE CONDITION SELECTION SHEET

SITE CODE: ST 1 **Date:** 5/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	3	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	5	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	5	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	5*	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered	Flow regime obviously altered	Flow regime highly modified	5	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification	Highly modified vegetation	Severe modification	5*	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	3	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	3	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	4	
NOTE: When applicable, write down in the comments section the type and approx. distances from the impact If a score given differs from the previous score, state the reason why they are different in the comments section					**Total**		

COMMENTS

SC1:
SC2:
SC3:
SC4: Can't be sure
SC5:
SC6:
SC7: Hasn't been clearing, however weeds may have increased tree loss in floods??
SC8:
SC9:
SC10:

FISH SAMPLING SHEETS

PROJECT NAME: STYX **SITE CODE:** ST 1

SITE NAME: UPPER STYX RIVER

DATE: 5/6/11 **TIME (24hrs): [** **]** **PARTY:** TV/MD

*N.B. Backpack EF used from tinnie. Better sampling possible using EF boat launched from Easter Bank. Need to negotiate access and future sampling.

Site Summary

Species Name	Common Name	Count	Abundance Score

Method Details

Electrofishing (EF)	
Operator:	TV
Assistant:	MD
Start Time:	
Finish Time:	
No. EF Seconds:	740
EF Settings:	
Nets and Traps	
# Fyke Nets (FN):	—
# Seine Passes (SN):	—
# Bait Traps (BT):	5 ✓ 3hrs

Fish abundance scale

Approx # Observed	Abundance Score
1	1
2-9	2
10-50	3
51-100	4
101-500	5
501-1000	6
1001-5000	7
>5000	8

Species: Ang rei

	Method	LHS (J/I/A)	Length
1	EF		350
2	"		350
3	"		350
4	"		350
5	"		350
6	"		450
7	"		450
8	"		450
9	"		600
10	"		600
11	"		600
12	"		600
13	"		700
14	"		700
15			
16			
17			
18			
19			
20			

Species: Late calf

	Method	LHS (J/I/A)	Length
1	EF		260
2	"		252
3	"		180
4	"		192
5	"		440
6	"		510
7	"		435
8	"		405
9	"		390
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Species: Hyp com

	Method	LHS (J/I/A)	Length
1	EF		54
2	"		46
3	"		56
4	"		42
5	"		15
6	"		75
7	"		57
8	"		19
9	"		72
10	"		69
11	"		53
12	"		42
13	"		60
14	"		58
15	"		17
16	"		18
17	"		52
18	"		23
19	"		19
20	"		20

+5

Fish Sampling Field Sheet Cont.

Species: Glo aur				Species: Pse sig				Species: Amls aga			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		74	1	EF		34	1	EF		30
2				2	"		27	2	"		31
3				3	"		23	3	"		35
4				4	"		26	4	"		34
5				5	"		26	5	"		
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species: Mel spp				Species: Goby				Species: unidentified eel			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		41	1	EF		75	1	EF		240
2	"		42	2				2			
3	"		31	3				3			
4	"			4				4			
5	"			5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Fish Sampling Field Sheet Cont.

Species: Mog ada				Species: Hyp sp1				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		34	1	EF		35	1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

FIELD SHEET

PROJECT NAME: Styx **SITE CODE:** St 1(b)

SITE NAME: upstream of bridge

DATE: 2 / 6 / 11 **TIME (24hrs): [** 12:30 **] PARTY:** MD & TV

LATITUDE: 22°37.392 **LONGITUDE:** 140° 39.112

EASTING: 0772584 **NORTHING:** 7495764 **Mobile Coverage:** (Y) / N

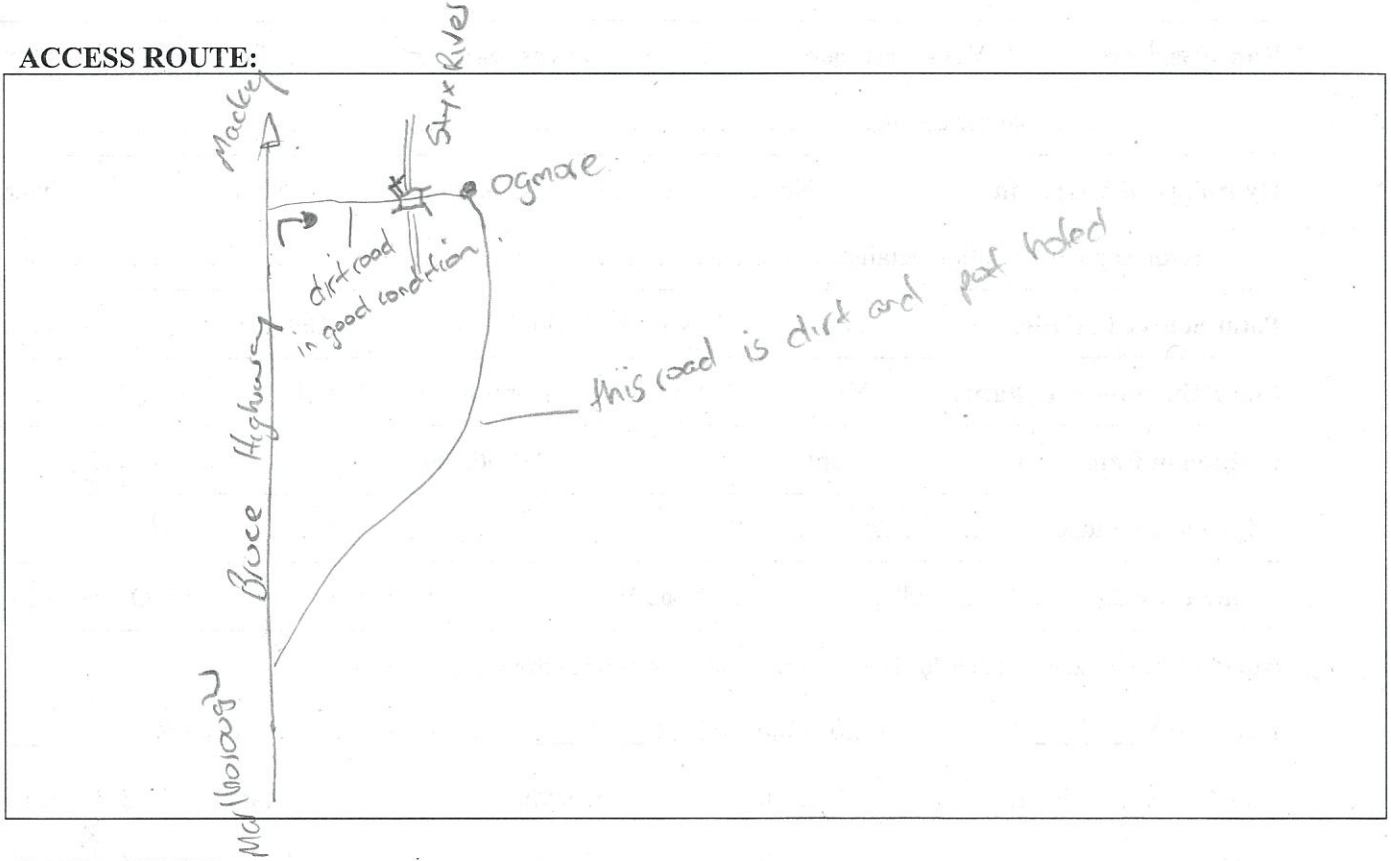
MAP NAME: - **MAP SCALE:** - **Sat. Phone Coverage:** (Y) / N

DATUM (i.e. GDA94): WGS 84 **PHOTO #'s:** _____ **Key required:** N

Water samples collected: _____

ACCESS DETAILS: From Marlborough take the 2nd turnoff to Ogmore from the Bruce Highway. Follow the road until you get to a concrete bridge across Styx River. Launch boat on downstream side beside bridge. Good access.

ACCESS ROUTE:



LAND OWNER:

Name: N/A

Address: _____

Phone: _____

Permission Requirements: _____

Office Use:	Data Entered By:	Mark Dahm	Date:	1044 16/6/11

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME ST 1 B **DATE:** 2 / 6 / 11

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)	0.5m		DO (mg/L)	11.21	
Gauge Height (m)	–		DO (% sat)	123.4%	
Water Temperature (°C)	19.94		Turbidity (NTU)	5.83	
Conductivity (µS/cm)	1366		Total Alkalinity (mg/L)	145	
pH	7.61		**Time Collected**	14:45	

Habitat's Present (circle if present) (1. Pool-K) (2. Pool-S) 3. Run-K 4. Run-S

5.Riffle minimal (6.LWD) (7. Macrophyte) 8. Other

Stream Width Max 12 m Min 6 m Mode 8 m

Water Level 1. No Flow 2.Dry/Isolated 3.<Watermark (4. Normal) 5. >Watermark

Shading of River (None) Low Moderate High

Type of River System Intermittent (Permanent) Details. Currently small flow in

Bank Erosion 1. None 2. Little 3.Some (4. Moderate) 5. Extensive

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream (3. No) 4. Don't Know

Dam/Barrier details.....

Hydrological Variation 1. None 2. Little 3.Some 4. Moderate (5. Extensive)

Hydrological Variation details:.....

Point Source Pollution 1. Yes (2. No) 3. Don't Know Details:.....

Non Point Source Pollution (1. Yes) 2. No 3. Don't Know Details... Cattle faeces..

Position in Catchment 1. Upland 2. Midland (3. Lowland)

Adjacent Landuse..... Cattle grazing.....

Geomorphology 1. Steep Valley 2. Broad Valley (3. Floodplain) 4. Other... Tidal flats

Riparian Zone (zone extends for 100m upstream and downstream from sampled area)

Trees<10m 25 % cover *Shrubs/Vines/Rushes* 25 % cover (*Grasses/Ferns/Herbs* 50 % cover)

Bare Ground	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Grass	1. None	2. Little	3. Some	4. Moderate	(5. Extensive)
Shrubs	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Trees<10m	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees>10m	(1. None)	2. Little	3. Some	4. Moderate	5. Extensive

Comments: Occasional large tides inundate parts of riparian zone preventing tree growth.

MACROINVERTEBRATE FIELD SHEET 1

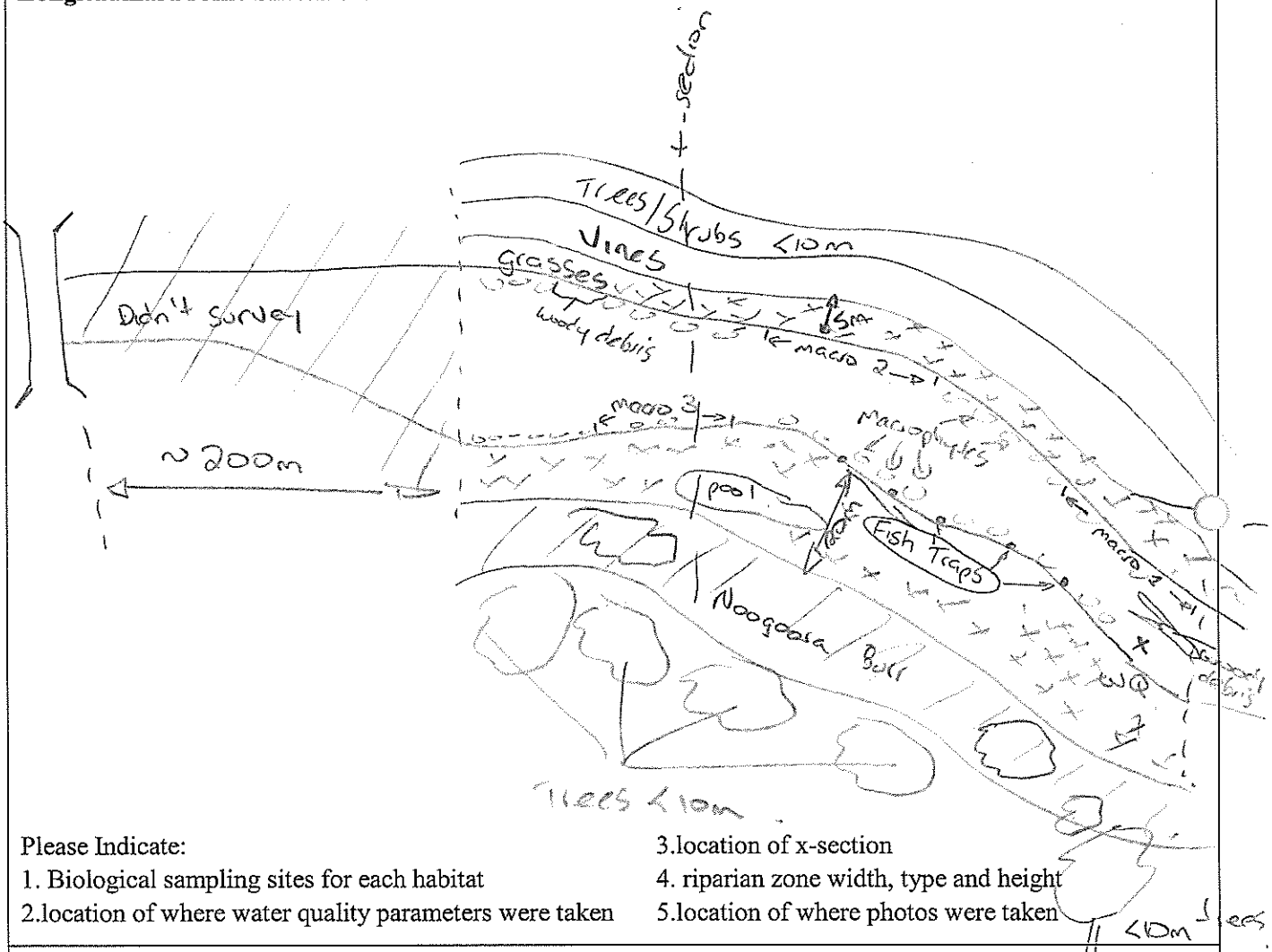
SITE CODE/NAME ST 1 B														**DATE:** 2/6/11			
HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)																	
KEY HABITAT FEATURES	E			E			E										
Vel count	–	–	–	–	–	–	–	–	–								
Vel depth	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5								
Vel m/sec	–	–	–	–	–	–	–	–	–								
Vel (average) (m/sec)	<0.1			<0.1			<0.1										
Mean Sample Depth (m)	0.5			0.5			0.5										
Mean Wetted Width (m)	12			11			13										
% Bedrock	–			–			–										
% Boulder (>soccer ball)	–			–			–										
% Cobble (tennis ball - soccer ball)	–			–			–										
% Pebble (marble - tennis ball)	–			5			50										
% Gravel (2 - 4mm)	–			5			10										
% Sand (0.005 - 2mm)	–			–			–										
% Silt/Clay (< 0.005 mm)	100			90			40										
% Detritus (leaves/twigs)	2			2			2										
% Sticks (<2cm)	–			–			–										
% Branches	–			–			–										
% Logs (>15cm)	–			–			–										
% Algae	80			80			40										
% Macrophytes	75			75			50										
% Overhanging habitat (e.g. vegetation, roots)	10			10			5										
% Blanketing silt (indicated by plume)	90			90			50										
% Shading	5			5			5										
Sampled By:	MD			MD			MD										
Picked By:	Lab Rep			Lab Rep			MD										

Comments: Flow not measurable against breeze

MACROINVERTEBRATE FIELD SHEET 2

SITE CODE/NAME ST1 B **DATE:** 2 / 6 / 11

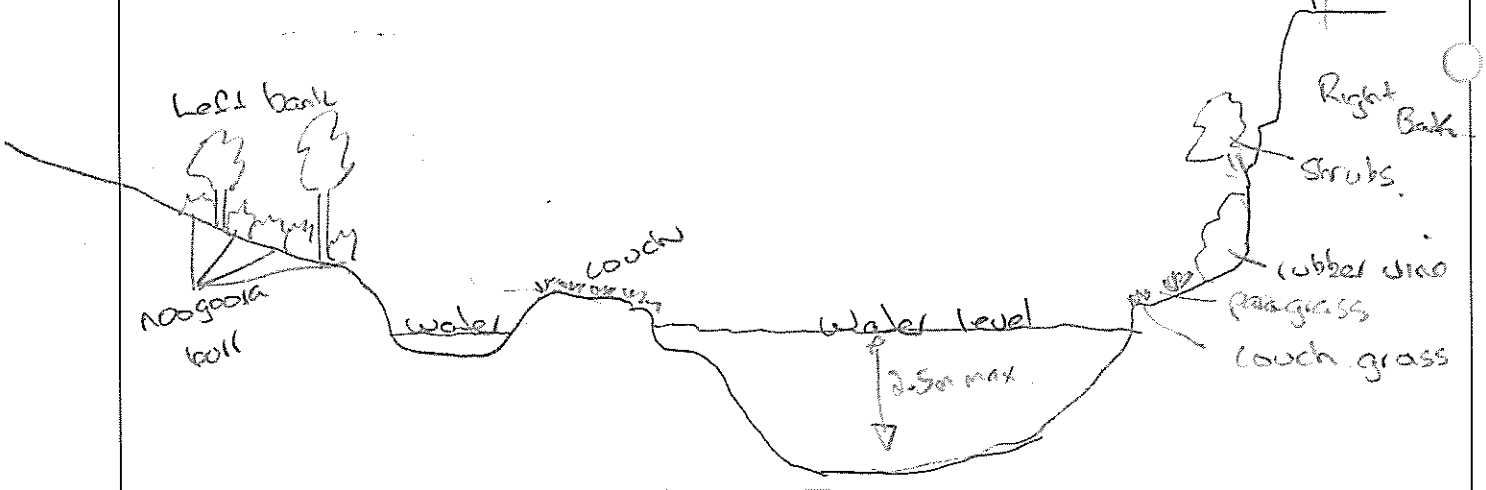
Longitudinal Profile Sketch of River



Please Indicate:

1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:

1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments:

.....

.....

.....

REFERENCE CONDITION SELECTION SHEET

SITE CODE: ST1B **Date:** 2/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	3	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	5	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	4	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	5	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered Tidal	Flow regime obviously altered	Flow regime highly modified	3	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification Tidal	Highly modified vegetation	Severe modification	3	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	3	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	4	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	4	
NOTE: When applicable, write down in the comments section the type and approx. distances from the impact If a score given differs from the previous score, state the reason why they are different in the comments section					**Total**		

COMMENTS

SC1: Riparian clearing

SC2:

SC3: Small town of Ogmore

SC4:

SC5:

SC6: Occassionly tidal ⇒ alters flow & salinity 35‰ River has tidal zones

SC7: Occassionly tidal ⇒ tidal affects on vegetation

SC8:

SC9:

SC10:

FISH SAMPLING SHEETS

PROJECT NAME: Stix **SITE CODE:** ST 1B

SITE NAME: Ogmore v-ing upstream

DATE: 2/6/11 **TIME (24hrs): [** 13:20 **]** **PARTY:** TV / MD

Site Summary

Species Name	Common Name	Count	Abundance Score

Method Details

Electrofishing (EF)	
Operator:	Tony Wallace (Boat)
Assistant:	mO
Start Time:	13:00
Finish Time:	14.45
No. EF Seconds:	562
EF Settings:	
Nets and Traps	
# Fyke Nets (FN):	—
# Seine Passes (SN):	—
# Bait Traps (BT):	5 x 4hrs

Fish abundance scale

Approx # Observed	Abundance Score
1	1
2-9	2
10-50	3
51-100	4
101-500	5
501-1000	6
1001-5000	7
>5000	8

Species:				Species: Mel. spl.				Species: Marsh cray.			
	Method	LHS (J/I/A)	Length	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length	
1	EF			EF		43	1	EF		33	
2	"			"		56	2	"	(2)	40	
3	"			"	(3)	51	3	"			
4	"			"		49	4	"			
5	"			"		47	5	"			
6	"			"		54	6	"			
7	"			"		44	7	"			
8	"			"		40	8	"			
9	"			"		45	9	"			
10	"			"		45	10	"			
11				"		54	11				
12				"		42	12				
13				"		34	13				
14				"		48	14				
15				"		42	15				
16				"		52	16				
17				"		36	17				
18				"		27	18				
19				"		46	19				
20				"		37	20				

Species: Sel mud				Species: Mug cap				Species: Red bic (Goby)			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		57	1	EF		159	1	EF		20
2	"		61	2	"		129	2			
3	"		62	3	"	(5)	103	3		(1)	
4	"	(3)	70	4	"		109	4			
5	"		61	5	"		115	5			
6	"		68	6	"		138	6			
7				7	"		133	7			
8				8	"		122	8			
9				9	"		140	9			
10				10	"		143	10			
11				11	"		132	11			
12				12	"		118	12			
13				13	"		134	13			
14				14	"		137	14			
15				15	"		126	15			
16				16	"		160	16			
17				17	"		118	17			
18				18	"		142	18			
19				19	"		144	19			
20				20	"		130	20			

Species: Amb egg				Species: Glos giu				Species: Lates Calc			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		34	1	EF		200	1	EF		360
2	"		32	2	"		75	2	"		415
3	"	(2)		3	"	(2)	175	3	"		440
4	"			4				4	"		402
5	"			5				5	"	(3)	255
6				6				6	"		460
7				7				7	"		422
8				8				8	"		238
9				9				9	"		156
10				10				10	"		453
11				11				11	"		252
12				12				12	"		272
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Fish Sampling Field Sheet Cont.

Species: Nem cve				Species: Leiog equ				Species: Hyp con			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		205	1	EF		83	1	EF		18
2	"		175	2	"		69	2			
3	"		138	3	"	(2)	57	3		(2)	
4	"	(2)	130	4	"		71	4			
5				5				5	Bait		19
6				6				6	Bait		32
7				7				7	Bait		32
8				8				8	"		26
9				9				9	"		25
10				10				10	"		28
11				11				11	"		34
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species: Ang Rhe				Species: Ang obs				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		400	1			600	1			
2		(1)		2			700	2			
3				3		(3)	900	3			
4				4			900	4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

FIELD SHEET

PROJECT NAME: Styx **SITE CODE:** St 2

SITE NAME: Lower Styx - below bridge (tidal zone)

DATE: 2 / 6 / 11 **TIME (24hrs): [** 15:45 **]** **PARTY:** TV/MD

LATITUDE: 0772243 **LONGITUDE:** 7496104

EASTING: 220 37.211 **NORTHING:** 1490 38.909 **Mobile Coverage:** Y / N

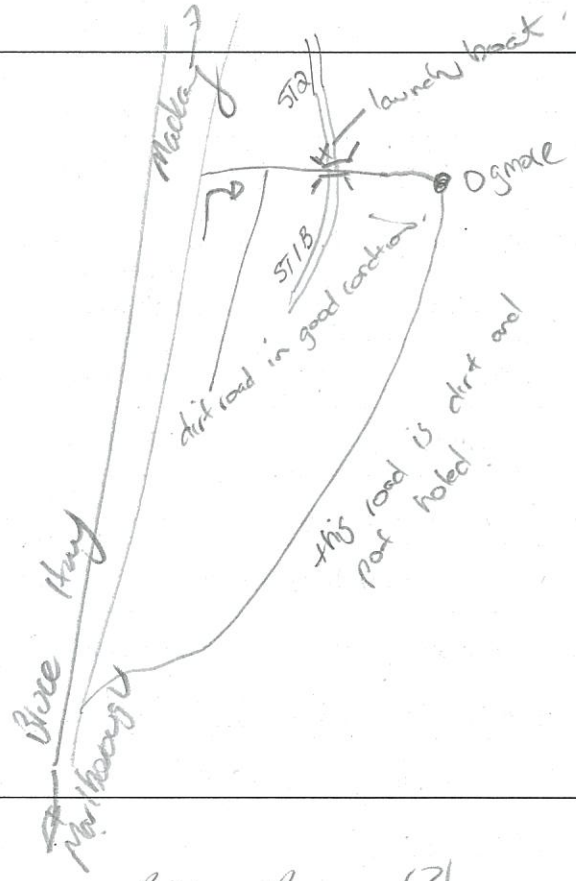
MAP NAME: — **MAP SCALE:** — **Sat. Phone Coverage:** Y / N

DATUM (i.e. GDA94): WGS 84 **PHOTO #'s:** ✓ **Key required:** N

Water samples collected:

ACCESS DETAILS: From Marlborough take the 2nd turnoff to Ogmore from the Bruce Highway. Follow the road until you get to a concrete bridge across Styx R. Launch boat on d/s side beside bridge. Good access

ACCESS ROUTE:



LAND OWNER:

Name: River Reserve(?)

Address: —

Phone: —

Permission Requirements: No

Office Use:	Data Entered By:	Mark Dale	Date:	10:51	16/6/11

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME ST2 **DATE:** 2/6/19

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)	0.5m		DO (mg/L)	10.69	
Gauge Height (m)	-		DO (% sat)	114.6	
Water Temperature (°C)	18.99		Turbidity (NTU)	5.41	
Conductivity (µS/cm)	1390		Total Alkalinity (mg/L)	65	
pH	7.63		**Time Collected**	14:00	

Habitat's Present (circle if present) (1. Pool-K) (2. Pool-S) 3. Run-K 4. Run-S 5.Riffle (6.LWD) (7. Macrophyte) 8. Other

Stream Width Max 10 m Min 4 m Mode 7 m

Water Level 1. No Flow 2.Dry/Isolated 3.<Watermark (4. Normal) 5. >Watermark

Shading of River (None) Low Moderate High

Type of River System (Intermittent) Permanent Details... pool tidal & permanent according to locals

Bank Erosion 1. None 2. Little 3.Some 4. Moderate (5. Extensive)

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream (3. No) 4. Don't Know

Dam/Barrier details..... Not likely.....

Hydrological Variation 1. None 2. Little 3.Some 4. Moderate (5. Extensive)

Hydrological Variation details:..... Flooding is very high above bed.....

Point Source Pollution 1. Yes 2. No (3. Don't Know) Details.. Ogmore close by..

Non Point Source Pollution (1. Yes) 2. No 3. Don't Know Details.. Cattle / pigs / urban

Position in Catchment 1. Upland 2. Midland (3. Lowland)

Adjacent Landuse..... Urban / hobby farm / grazing.....

Geomorphology 1. Steep Valley 2. Broad Valley 3. Floodplain (4. Other) Estuary and intertidal

Riparian Zone (zone extends for 100m upstream and downstream from sampled area) Noogoora Burr = 75% cover

Trees<10m 1 % cover *Shrubs/Vines/Rushes* 75 % cover *Grasses/Ferns/Herbs* 24 % cover

Bare Ground	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Grass	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Shrubs	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Trees<10m	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Trees>10m	(1. None)	2. Little	3. Some	4. Moderate	5. Extensive

Comments: Very little in the way of trees or shrubs as tide often covers riparian zone (Spring tide). Extensive Noogoora Burr all bed bank.

MACROINVERTEBRATE FIELD SHEET 1

SITE CODE/NAME ST2 - Sl4x **DATE:** 4 / 6 / 11

HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)

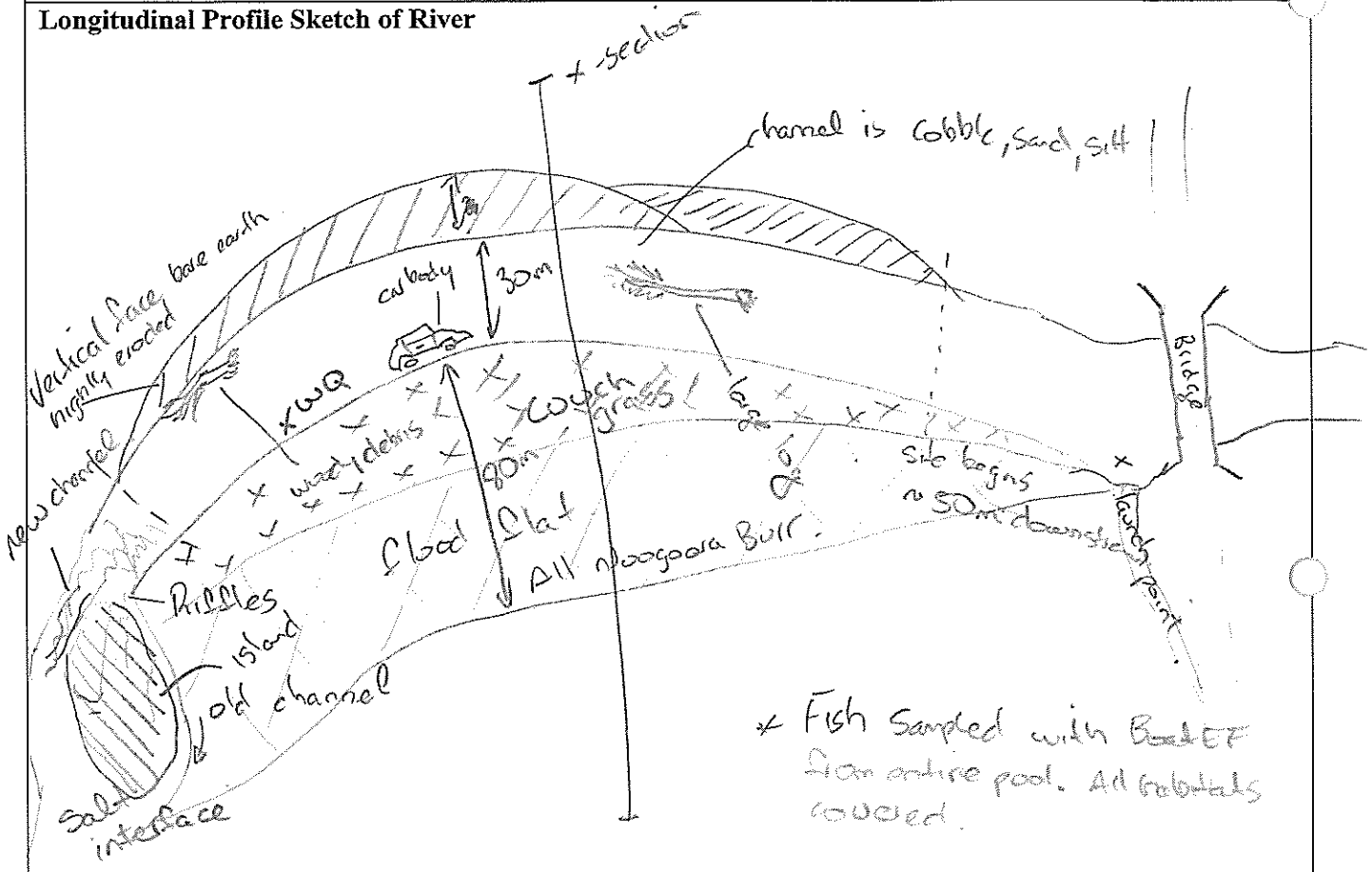
KEY HABITAT FEATURES	E1			E2			E3		
Vel count	–	–	–	–	–	–	–	–	–
Vel depth	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vel m/sec	–	–	–	–	–	–	–	–	–
Vel (average) (m/sec)	<0.1			<0.1			<0.1		
Mean Sample Depth (m)	0.5			0.5			0.5		
Mean Wetted Width (m)	14			13			16		
% Bedrock	–			–			–		
% Boulder (>soccer ball)	–			–			–		
% Cobble (tennis ball - soccer ball)	–			–			–		
% Pebble (marble - tennis ball)	–			–			–		
% Gravel (2 - 4mm)	–			–			–		
% Sand (0.005 - 2mm)	–			–			–		
% Silt/Clay (< 0.005 mm)	100			100			100		
% Detritus (leaves/twigs)	1			1			1		
% Sticks (<2cm)	–			–			–		
% Branches	–			–			–		
% Logs (>15cm)	–			–			–		
% Algae	90			90			90		
% Macrophytes	9			9			9		
% Overhanging habitat (e.g. vegetation, roots)	–			–			–		
% Blanketing silt (indicated by plume)	10			10			10		
% Shading	–			–			–		
Sampled By:	MD			MD			MD		
Picked By:	–			–			MD		

Comments: All the edge is clay bank with algae. Out further is cobble etc but not sampled.

MACROINVERTEBRATE FIELD SHEET 2

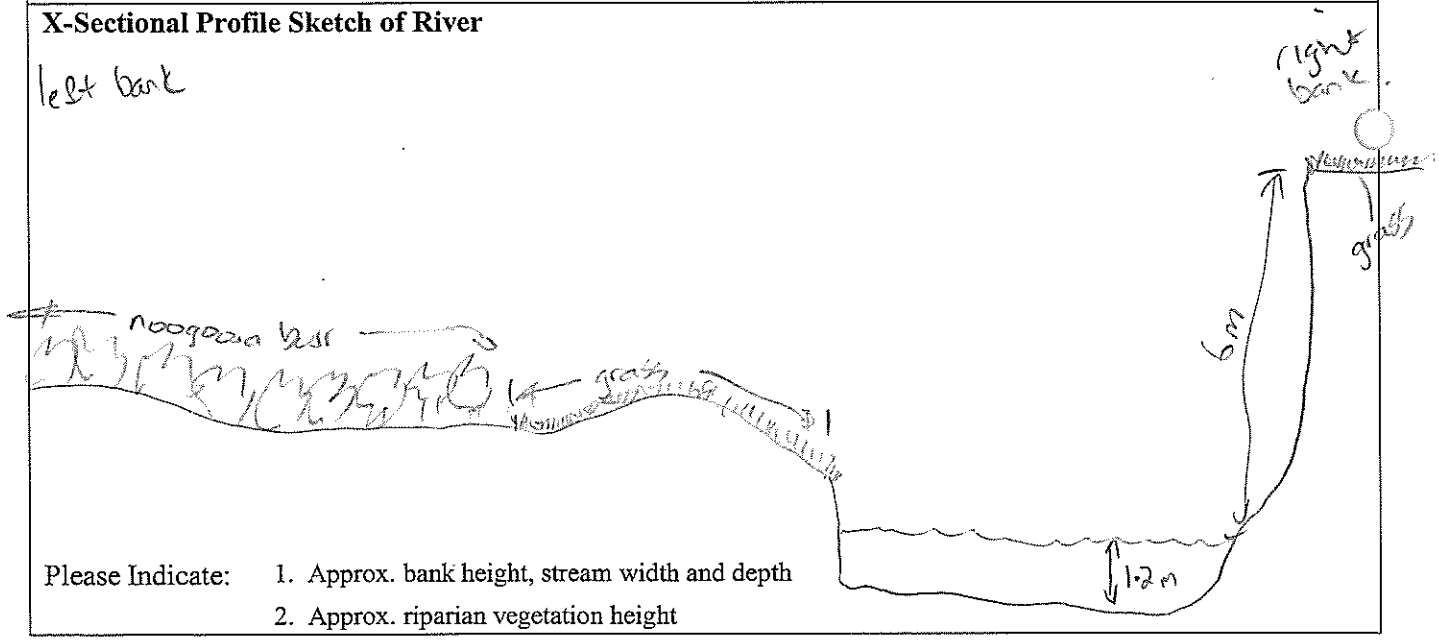
SITE CODE/NAME S42 **DATE:** 2 / 6 / 11

Longitudinal Profile Sketch of River



Please Indicate:
1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:
1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments:

.....

.....

.....

REFERENCE CONDITION SELECTION SHEET

SITE CODE: St2 **Date:** 2/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	3	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	4	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	4	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	4	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered	Flow regime obviously altered	Flow regime highly modified	3	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification	Highly modified vegetation	Severe modification	3	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	3	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	3	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	3	
NOTE: When applicable, write down in the comments section the type and approx. distances from the impact If a score given differs from the previous score, state the reason why they are different in the comments section					**Total**	35	

COMMENTS

SC1:
SC2:
SC3:
SC4: An educated guess only.
SC5:
SC6:
SC7:
SC8:
SC9: Local advice suggested river has altered course since flood
SC10: Probably a combination of natural and human influence. Flood appears to have removed significant amounts of LWD from area

FISH SAMPLING SHEETS

PROJECT NAME: Stage **SITE CODE:** St 2

SITE NAME: St 2

DATE: 2/6/11 **TIME (24hrs): [** 15-50 **]** **PARTY:** TV/MD

Site Summary

Species Name Fish Code	Common Name	Count	Abundance Score
Ang rei	—	3	3
—	Giant Herring	3	2
Mug cep	—	12	6
Meg cyp	—	2	3
Mel spl	—	20	5
Lates cal	—	8	3
Nem ere	—	1	2
Glo giu	—	3	2
Hyp kin	—	2	2
Ger fil	—	2	2
Lei uni	—	4	3

Method Details

Electrofishing (EF)	
Operator:	TV
Assistant:	MD
Start Time:	15:50
Finish Time:	16:45
No. EF Seconds:	542
EF Settings:	—
Nets and Traps	
# Fyke Nets (FN):	-
# Seine Passes (SN):	-
# Bait Traps (BT):	5 x 2.5 hrs due to time constraints

Fish abundance scale

Approx # Observed	Abundance Score
1	1
2-9	2
10-50	3
51-100	4
101-500	5
501-1000	6
1001-5000	7
>5000	8

Species: Ang rhei				Species: Elo haw				Species: Mugil cephi			
(3)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length	(6)	Method	LHS (J/I/A)	Length
1	EF	*	206	1	EF		253	1	EF		194
2	"	*	400	2	"		280	2	"		192
3	"	*	600	3	"		236	3	"		193
4	"	*	600	4				4	"		180
5				5				5	"		169
6				6				6	"		210
7				7				7	"		160
8				8				8	"		185
9				9				9	"		194
10	Ang	obs.	800	10				10	"		176
11				11				11	"		221
12				12				12	"		180
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

* est.

Species: Tanpam Meg cyp				Species: Lates Calc				Species: ncm eve			
(2)	Method	LHS (J/I/A)	Length	(3)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length
1	EF		205	1	EF		465	1	EF		224
2	"		265	2	"		201	2			
3	"			3	"		242	3			
4	"			4	"		173	4			
5	"			5	"		236	5			
6				6	"		192	6			
7				7	"		385	7			
8				8	"		265	8			
9				9				9			
10	Mel	Sple	1	10				10			
11	EF	38	45	11				11			
12	"	35	42	12				12			
13	"	36	41	13				13			
14	"	29	41	14				14			
15	"	27	40	15				15			
16	"	18	38	16				16			
17	"	36	32	17				17			
18	"	30	28	18				18			
19	"	47	34	19				19			
20		35	42	20				20			

Species: Glossiogobius giurus (non-native distribution)				Species: Hyp Klu				Species: Terr: Fill			
(2)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length
1	EF		175	1	EF		55	1	EF		62
2	"		206	2	BT		50	2	"		58
3	"		187	3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10	Lei	aqu		10	Jave	Ly/Gru	Jor
11				11	EF		70	11	EF		75
12				12	"		65	12			
13				13	"		61	13		(1)	
14				14	"		55	14			
15				15				15			
16				16		(2)		16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species: AMB Agg				Species: Hyp Com				Species:			
(3)	Method	LHS (J/I/A)	Length	(3)	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		34	1	EF		31	1			
2	"		37	2	"		20	2			
3	"		36	3				3			
4	"		28	4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

FIELD SHEET

PROJECT NAME: Styx **SITE CODE:** To 1

SITE NAME:

DATE: 3 / 6 / 11 **TIME (24hrs): [** 17-25 **]** **PARTY:** MD / TV

LATITUDE: 22° 41.354 **LONGITUDE:** 149° 37.791

EASTING: 0770192 **NORTHING:** 7488488 **Mobile Coverage:** (Y) / N

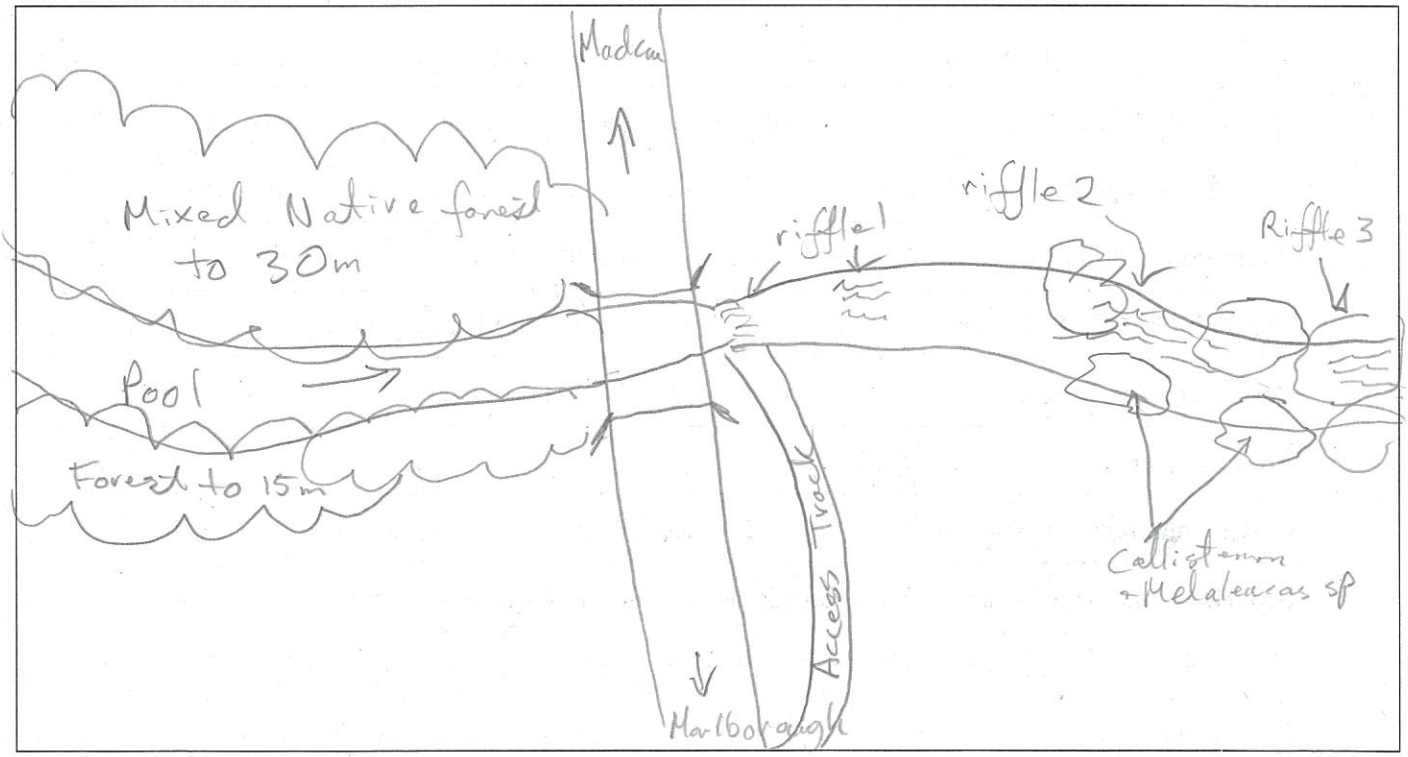
MAP NAME: – **MAP SCALE:** – **Sat. Phone Coverage:** (Y) / N

DATUM (i.e. GDA94): WGS 84 **PHOTO #'s:** ✓ **Key required:** N

Water samples collected:

ACCESS DETAILS: Down side of bridge on Marlborough end. Bottom half of track is over bedrock

ACCESS ROUTE:



LAND OWNER:

Name: Road Reserve

Address:

Phone:

Permission Requirements:

Office Use:	Data Entered By:	Mark Dalm	Date:	15/6/11 5:35p

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME To 1 **DATE:** 3/6/11

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)	0-3m		DO (mg/L)	9.32	
Gauge Height (m)	—		DO (% sat)	94.7	
Water Temperature (°C)	16.05		Turbidity (NTU)	5.93	
Conductivity (µS/cm)	866		Total Alkalinity (mg/L)	62	
pH	7.59		**Time Collected**	17:35	

Habitat's Present (circle if present) 1. (Pool-K) 2. Pool-S 3. (Run-K) 4. Run-S

(5.Riffle) (6.LWD) (7. Macrophyte) 8. Other

Stream Width Max 17 m Min 5 m Mode 7 m

Water Level 1. No Flow 2.Dry/Isolated 3.<Watermark (4. Normal) 5. >Watermark

Shading of River None Low (Moderate) High

Type of River System Intermittent (Permanent) Details: likely to be permanent some years & not in others

Bank Erosion (1. None) 2. Little 3.Some 4. Moderate 5. Extensive

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream (3. No) 4. Don't Know

Dam/Barrier details.....

Hydrological Variation 1. None 2. Little 3.Some (4. Moderate) 5. Extensive

Hydrological Variation details: Flood Height @ least 6m above bed

Point Source Pollution (1. Yes) 2. No 3. Don't Know Details: minor - from bridge

Non Point Source Pollution 1. Yes (2. No) 3. Don't Know Details: no evidence of cattle

Position in Catchment 1. Upland (2. Midland) 3. Lowland

Adjacent Landuse: Grazing

Geomorphology 1. Steep Valley (2. Broad Valley) 3. Floodplain 4. Other.....

Riparian Zone (zone extends for 100m upstream and downstream from sampled area)

Trees<10m 30 % cover *Shrubs/Vines/Rushes* 25 % cover *Grasses/Ferns/Herbs* 20 % cover

Bare Ground	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Grass	1. None	(2. Little)	3. Some	4. Moderate	5. Extensive
Shrubs	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees<10m	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Trees>10m	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive

Comments: Lots of bare bedrock

MACROINVERTEBRATE FIELD SHEET 1

SITE CODE/NAME To 1 **DATE:** 3 / 6 / 11

HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)

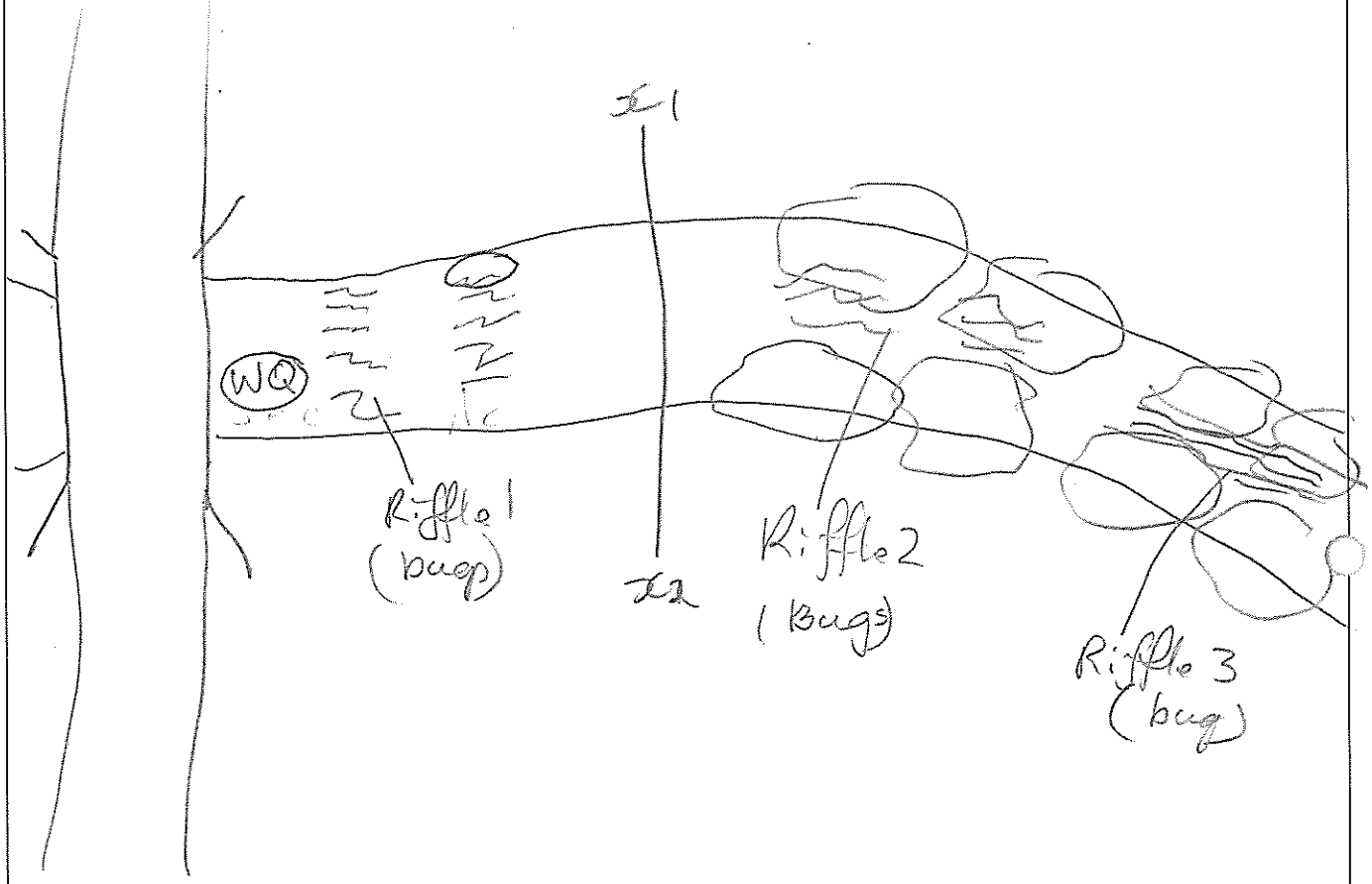
KEY HABITAT FEATURES	Riffle 3			Riffle 2			Riffle 1			Pool					
Vel count	4m/3S	4m/3S	4m/3S	5m/4S	5m/4S	5m/4S	3m/2S	3m/2S	3m/2S	1m/10s	1m/10s	1m/10s			
Vel depth	0.6	0.6	0.6	0.3	0.3	0.3	0.25	0.25	0.25	1.5	1.8	1.6			
Vel m/sec	1.33	1.32	1.33	1.25	1.25	1.25	0.75	0.75	0.75	0.1	0.1	0.1			
Vel (average) (m/sec)	1.33			1.25			0.75			0.1					
Mean Sample Depth (m)	0.6			0.3			0.25			1.5					
Mean Wetted Width (m)	4m			4m			4.5			15m					
% Bedrock	80			10			80			10					
% Boulder (>soccer ball)	5			15			—			5					
% Cobble (tennis ball - soccer ball)	5			15			—			5					
% Pebble (marble - tennis ball)	3			30			10			—					
% Gravel (2 - 4mm)	2			25			10			5					
% Sand (0.005 - 2mm)	5			5			—			80					
% Silt/Clay (< 0.005 mm)	—			—			—			—					
% Detritus (leaves/twigs)	5			5			2			25					
% Sticks (<2cm)	5			5			2			10					
% Branches	2			2			5			5					
% Logs (>15cm)	3			5			—			5					
% Algae	20			20			60			10					
% Macrophytes	—			—			—			—					
% Overhanging habitat (e.g. vegetation, roots)	—			—			—			25					
% Blanketing silt (indicated by plume)	—			—			—			—					
% Shading	80			45			15			20					
Sampled By:	MD			MD			MD			MD/TV					
Picked By:	N/A			N/A			MD			N/A					

Comments: Flowing clear water. large pool u/s approx 1 Km long. Riffle/pools D/S

MACROINVERTEBRATE FIELD SHEET 2

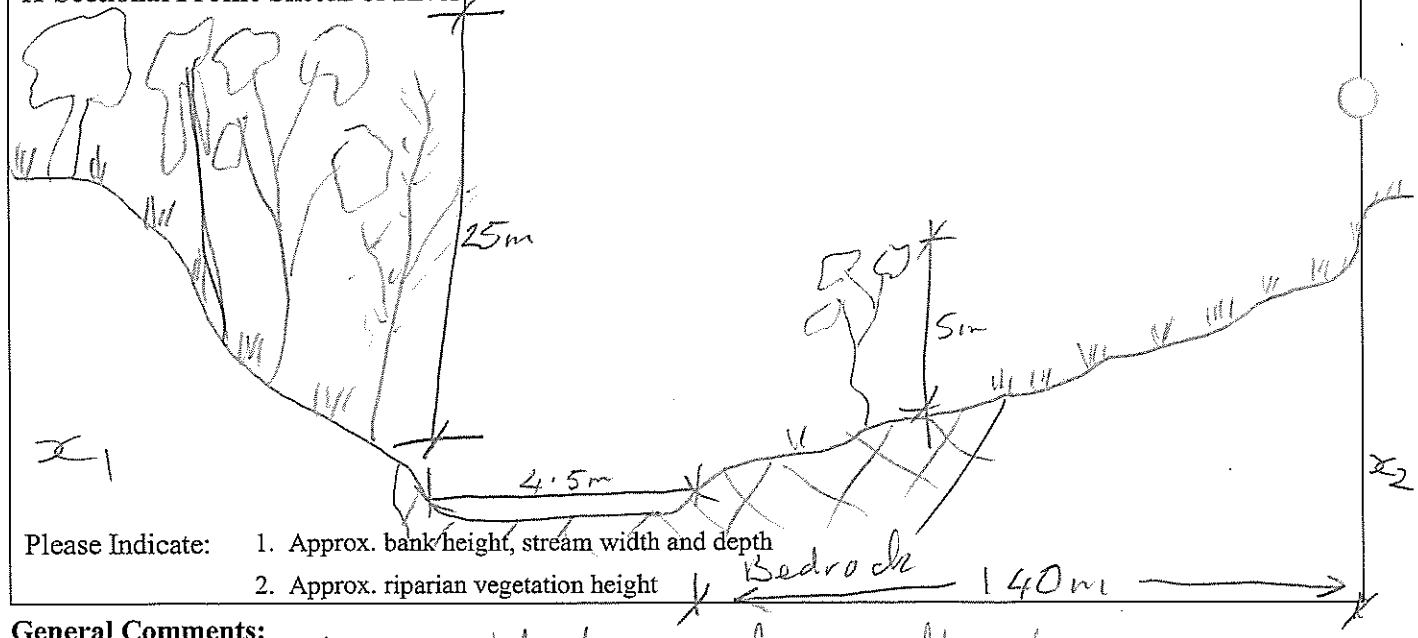
SITE CODE/NAME Stax – To1 **DATE:** 3 / 6 / 11

Longitudinal Profile Sketch of River



Please Indicate:
1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:
1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments:

Steep bank on Mudray Side, gentle slope on Marlborough side

REFERENCE CONDITION SELECTION SHEET

SITE CODE: T01 **Date:** 3/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	4	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	5	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	5	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	4	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered	Flow regime obviously altered	Flow regime highly modified	5	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification	Highly modified vegetation	Severe modification	5*	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	5	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	5	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	4*	
NOTE: When applicable, write down in the comments section the type and approx. distances from the impact If a score given differs from the previous score, state the reason why they are different in the comments section					**Total**		

COMMENTS

SC1:
SC2:
SC3:
SC4: Bridge on Bruce Highway at site. would be some pollution from road when it rains, also some rubbish
SC5:
SC6:
SC7: Have 6 @ bridge but not @ site pristine
SC8:
SC9:
SC10: Bridge footings only impact

FISH SAMPLING SHEETS

PROJECT NAME: Styx Project SITE CODE: To 1

SITE NAME: Toolombah Creek @ Bruce Highway

DATE: 3 / 6 / 11 TIME (24hrs): [ ] PARTY: MD & TV

Site Summary

Species Name	Common Name	Count	Abundance Score

Method Details

Electrofishing (EF)	
Operator:	TV
Assistant:	MD
Start Time:	
Finish Time:	
No. EF Seconds:	482
EF Settings:	—
Nets and Traps	
# Fyke Nets (FN):	—
# Seine Passes (SN):	—
# Bait Traps (BT):	4 x 3 hrs

Fish abundance scale

Approx # Observed	Abundance Score
1	1
2-9	2
10-50	3
51-100	4
101-500	5
501-1000	6
1001-5000	7
>5000	8

Species: Nem ere				Species: Lates Cal				Species: Any rhe			
(4)	Method	LHS (J/I/A)	Length	(3)	Method	LHS (J/I/A)	Length mm	(3)	Method	LHS (J/I/A)	Length
1	EF		290	1	EF		246	1	EF		600
2	"		316	2	"		280	2	"		400
3	"		270	3	"		286	3	"		900
4	"		330	4	"		227	4	"		900
5	"		260	5	"		238	5	"		700
6	"		294	6	"		610	6	"		300
7	"		282	7	"		245	7			
8	"		290	8	"		227	8			
9				9	"			9			
10				10	"			10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Fish Sampling Field Sheet Cont.

Species: Meg Cyp				Species: Lei uni				Species: Neo syr			
(2)	Method	LHS (J/I/A)	Length	(4)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length
1	EF		212	1	EF		182	1	EF		200
2	"		196	2	"		225	2	"		160
3	"		328	3	"		152	3			
4	"		396	4	"		170	4			
5	"		385	5	"		146	5			
6	"		352	6	"		160	6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species: Mel spl				Species: Cra sile				Species: Hyp Com			
(6)	Method	LHS (J/I/A)	Length	(1)	Method	LHS (J/I/A)	Length	(3)	Method	LHS (J/I/A)	Length
1	EF		101	1	EF		31	1	EF		66
2	"		42	2				2	"		75
3	"		43	3				3	"		27
4	"		35	4				4	"		72
5	"		34	5				5	"		51
6	"		41	6				6	"		25
7	"		52	7				7	BT		36
8	"		46	8				8	"		38
9	"		36	9				9	"		20
10	"		43	10				10			
11	"		41	11				11			
12	"		35	12				12			
13	"		41	13				13			
14	"		16	14				14			
15	"		41	15				15			
16	"		30	16				16			
17	"		47	17				17			
18	"		29	18				18			
19	"		52	19				19			
20	"		30	20				20			

Species: Amb aqa				Species: ari gra				Species: Mug cep			
(2)	Method	LHS (J/I/A)	Length	(1)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length
1	EF		46	1	E		452	1	EF		254
2	"		40	2				2			
3	"		40	3				3			
4	"		36	4				4			
5	"			5				5			
6	"			6				6			
7	"			7				7			
8	"			8				8			
9	"			9				9			
10	"			10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species: Mog adsp				Species: Turtles				Species: Ang obs			
(1)	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length
1	BT		48	1	scoop	x 2		1	EF		600
2				2				2	"		600
3				3	spotted & counted a			3	"		400
4				4	further 19 turtles			4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10	Unidentified eel			10				10			
(1) 11	EF		220	11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

FIELD SHEET

PROJECT NAME: STX **SITE CODE:** T02

SITE NAME: Toobomba Ck DS

DATE: 4/6/11 **TIME (24hrs):** [10:00] **PARTY:** TV (MD)

LATITUDE: 22°40-850' **LONGITUDE:** E149° 39·210'

EASTING: 55K 0772638 **NORTHING:** 7489375 **Mobile Coverage:** (Y) / N

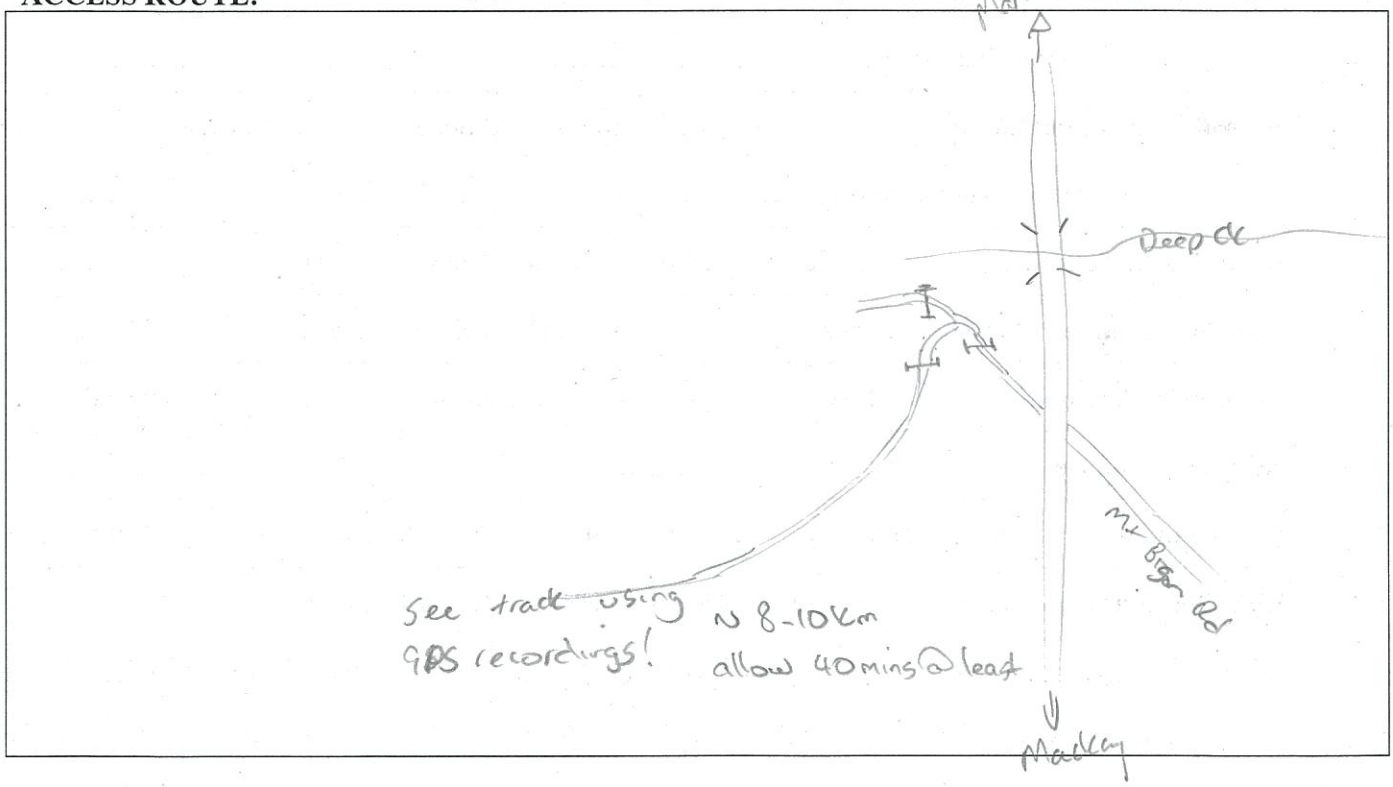
MAP NAME: _____ **MAP SCALE:** _____ **Sat. Phone Coverage:** (Y) / N

DATUM (i.e. GDA94): WGS 84 **PHOTO #'s:** _____ **Key required:** N

Water samples collected: Yes.

ACCESS DETAILS: Access via complex track starting opposite Mt Bison Rd. Site is on Marulan station (Warataah owned). GPS track recorded and stored by Mark Dahm. The final few kilometres is following fence lines (no track) then the last 500m is across the paddock to a small cutting down the high bank. Some erosion cuts present with hollow ground underneath (BEWARE!!) EF boat launch is possible but wasn't done this time as we used too much time looking for access to the river. NB There are many wet "sink holes" across the landscape. Proceed across paddocks with caution.

ACCESS ROUTE:



LAND OWNER:

Name: Warataah Coal — Gerry

Address: Mt Bison Rd

Phone: _____

Permission Requirements: _____

Office Use:	Data Entered By:	Mark Dahm	Date:	15/6/11 6·17pm

FIELD OBSERVATIONS AND WATER QUALITY SHEET

SITE CODE/NAME TO2- Toolooma Ck **DATE:** 4/6/11

WQ Parameter	Edge	Riffle	WQ Parameter	Edge	Riffle
Sample Depth (m)	0-25		DO (mg/L)	9.11	
Gauge Height (m)	-		DO (% sat)	92.1	
Water Temperature (°C)	15.64		Turbidity (NTU)	1.67	
Conductivity (µS/cm)	848		Total Alkalinity (mg/L)	75	
pH	7.40		**Time Collected**	10:00	

Habitat's Present (circle if present) (1. Pool-K) (2. Pool-S) (3. Run-K) 4. Run-S (5.Riffle) (6.LWD) 7. Macrophyte 8. Other

Stream Width Max 35 m Min 2-5 m Mode 15 m

Water Level 1. No Flow 2.Dry/Isolated 3.<Watermark (4. Normal) 5. >Watermark

Shading of River None (Low - pool) (Moderate - riffle) High

Type of River System (Intermittent) (Permanent) Details Depends on season, still flows a) present

Bank Erosion 1. None 2. Little 3.Some (4. Moderate) 5. Extensive

Dams/Barriers 1. Yes - Upstream 2. Yes - Downstream (3. No) 4. Don't Know

Dam/Barrier details.....

Hydrological Variation 1. None 2. Little 3.Some 4. Moderate (5. Extensive)

Hydrological Variation details:... Flood Height @ least 15m above bed.....

Point Source Pollution 1. Yes (2. No) 3. Don't Know Details.....

Non Point Source Pollution (1. Yes) 2. No 3. Don't Know Details. Cattle Dacco

Position in Catchment 1. Upland (2. Midland) some where between (3. Lowland)

Adjacent Landuse.....Grazing.....

Geomorphology 1. Steep Valley 2. Broad Valley (3. Floodplain) 4. Other.....

Riparian Zone (zone extends for 100m upstream and downstream from sampled area)

Trees<10m 40 % cover *Shrubs/Vines/Rushes* 20 % cover *Grasses/Ferns/Herbs* 30 % cover

Bare Ground	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Grass	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive
Shrubs	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Trees<10m	1. None	2. Little	3. Some	(4. Moderate)	5. Extensive
Trees>10m	1. None	2. Little	(3. Some)	4. Moderate	5. Extensive

Comments:

MACROINVERTEBRATE FIELD SHEET 1

SITE CODE/NAME T02 - Toloomba Ck **DATE:** 4 / 6 / 11

HABITAT TYPE (E=Edge; R=Riffle; K=Rocky Bed; S=Sandy Bed; M=Macrophytes; N=Run; C=Composite)

KEY HABITAT FEATURES	Riffle 1			Riffle 2			Riffle 3								
Vel count	4m / 3.6s	4m / 3.8	4m / 3.8	4m / 3.2	4m / 3.1	4m / 3.3	4m / 4.5	4m / 4.5	4m / 4.7						
Vel depth	0.2	0.2	0.2	0.3	0.3	0.3	0.15	0.15	0.15						
Vel m/sec	1.11	1.05	1.05	1.25	1.29	1.2	0.89	0.89	0.85						
Vel (average) (m/sec)	1.07m			1.25			0.88								
Mean Sample Depth (m)	0.2			0.3m			0.15								
Mean Wetted Width (m)	3.5m			4.0			2.8m								
% Bedrock	—			—			—								
% Boulder (>soccer ball)	—			5			2								
% Cobble (tennis ball - soccer ball)	5			10			5								
% Pebble (marble - tennis ball)	35			35			18								
% Gravel (2 - 4mm)	40			40			45								
% Sand (0.005 - 2mm)	20			10			25								
% Silt/Clay (< 0.005 mm)	—			—			5								
% Detritus (leaves/twigs)	2			5			2								
% Sticks (<2cm)	3			3			3								
% Branches	10			10			5								
% Logs (>15cm)	—			15			5								
% Algae	5			5			5								
% Macrophytes	—			—			—								
% Overhanging habitat (e.g. vegetation, roots)	2			5			2								
% Blanketing silt (indicated by plume)	3			3			3								
% Shading	35			65			25								
Sampled By:	MD			MD			MD								
Picked By:	—			—			MD								

Comments:

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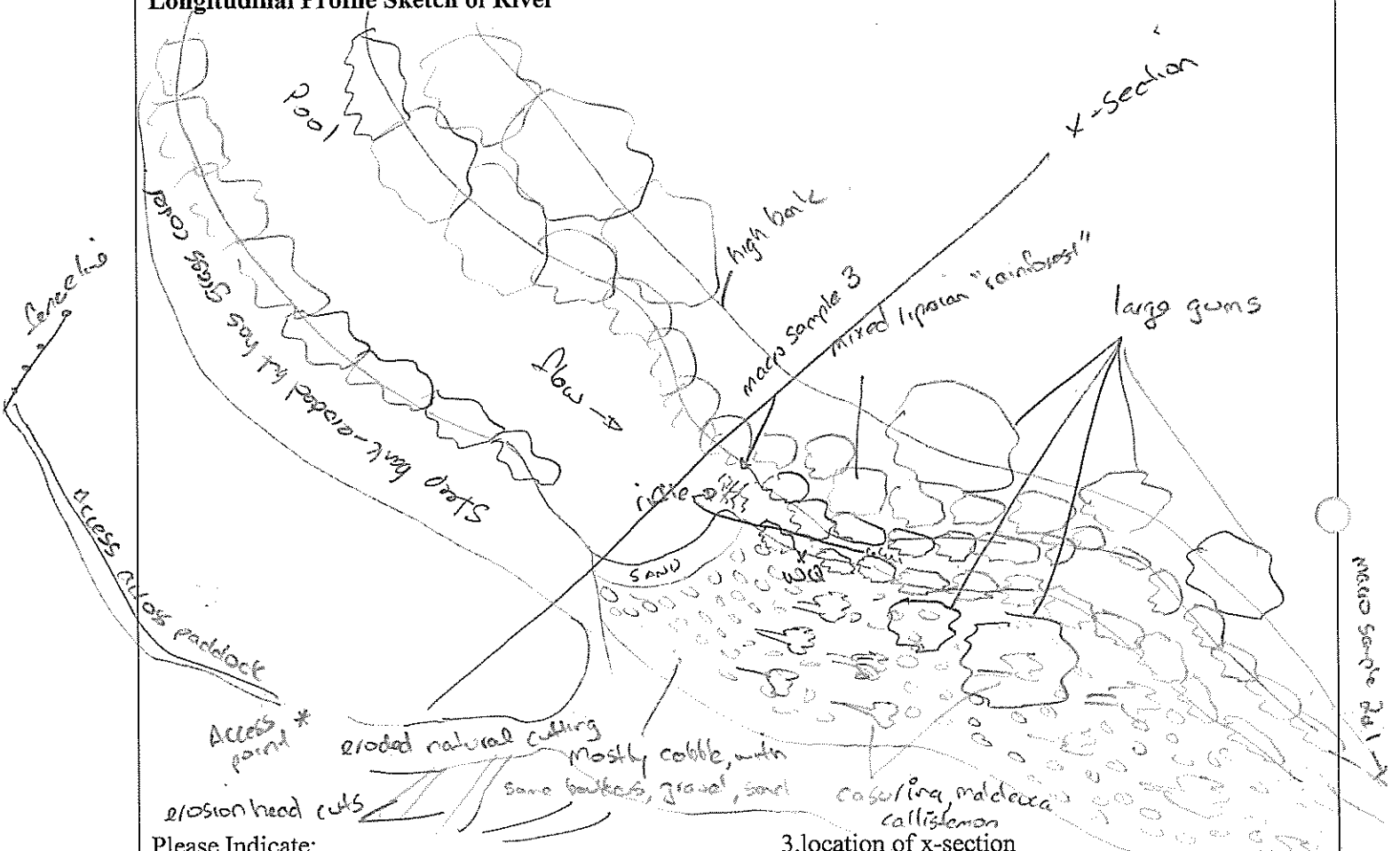
MACROINVERTEBRATE FIELD SHEET 2

SITE CODE/NAME TO2 - Tooloomba Ck **DATE:** 4 / 6 / 11

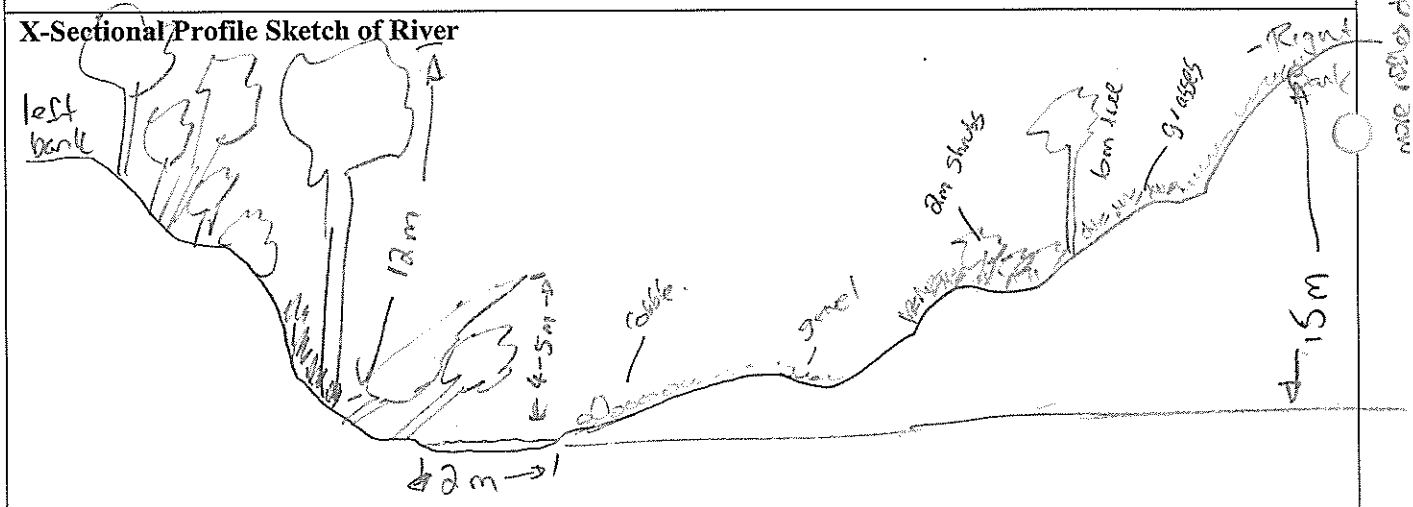
Longitudinal Profile Sketch of River



Please Indicate:

1. Biological sampling sites for each habitat
2. location of where water quality parameters were taken
3. location of x-section
4. riparian zone width, type and height
5. location of where photos were taken

X-Sectional Profile Sketch of River



Please Indicate:

1. Approx. bank height, stream width and depth
2. Approx. riparian vegetation height

General Comments:

Stream in very good condition except for rubbish and erosion on right bank

REFERENCE CONDITION SELECTION SHEET

SITE CODE: T02 **Date:** 4/6/11 **(If the impacts are unknown, seek further information before scoring; more than one person must complete this form)**

Possible Impacts	5 (No Impact)	4 (Minor Impact)	3 (Moderate Impact)	2 (Major Impact)	1 (Extreme Impact)	Score	Previous Score
1. Agriculture and forestry*	No impact	Present but level of impact is barely discernible	Evident, however, not severe and/or widespread	Obvious impact to stream, moderate and/or widespread	Severe and widespread, impact obvious	3	
2. Sand/gravel extraction*	No evidence or prior knowledge of extraction	Small scale historical extraction	No current extraction; large historical extraction	Current small scale/localised extraction	Current and widespread extraction	5	
3. Upstream urban areas*	No impacts from urbanisation	Possible impacts caused from urbanisation	Definite impacts caused from urbanisation	High impacts caused from urbanisation	Extreme impacts caused from urbanisation	5	
4. Point source pollution*	Nil point source pollution	Low volumes of point source pollution discharged	Low to moderate volumes of point source pollution discharged	Moderate to high volumes of point source pollution discharged	High to extreme volumes of point source pollution discharged	5	
5. Dam/weir*	No artificial barriers in basin which will affect the site	Few small upstream barriers; not within impoundment	Many small barriers; site not within impoundment	Multiple small barriers; Large barriers upstream; within small impoundment	Large barriers upstream; within large impoundment	5	
6. Flow regime alteration*	Seasonal flow regime natural	Seasonal flow regime not obviously altered	Flow regime altered	Flow regime obviously altered	Flow regime highly modified	5	
7. Streamside veg. alteration@	Streamside vegetation unaltered	Vegetation slightly modified	Obvious modification	Highly modified vegetation	Severe modification	5	
8. Riparian zone/ streambank erosion	No evidence of erosion beyond natural	Slightly more than natural levels of erosion	Moderate levels of unnatural erosion	High levels of erosion	Extreme erosion	3	
9. Geomorphic change@	No evidence	Slight geomorphic change	Moderate change	High changes	Extreme alteration	4	
10. Instream habitat alteration@	Instream habitats of natural appearance and diversity	Barely discernible impacts	Moderate modifications to instream habitats	Highly modified modifications to instream habitats	Severe modification of instream habitats	5	
NOTE: When applicable, write down in the comments section the type and approx. distances from the impact If a score given differs from the previous score, state the reason why they are different in the comments section					**Total**		

COMMENTS	
	SC1:
	SC2:
	SC3:
	SC4:
	SC5:
	SC6:
	SC7: Rubber Vine is impacting on riparian vegetation
	SC8:
	SC9:
	SC10:

FISH SAMPLING SHEETS

PROJECT NAME: Styx **SITE CODE:** TO2

SITE NAME: Tooloomba Creek - d/s.

DATE: 4/06/11 **TIME (24hrs):** [12.20 pm] **PARTY:** TV/MD

Site Summary

Species Name	Common Name	Count	Abundance Score

Method Details

Electrofishing (EF)	
Operator:	TV
Assistant:	MD
Start Time:	11.15
Finish Time:	11.35
No. EF Seconds:	404
EF Settings:	—
Nets and Traps	
# Fyke Nets (FN):	—
# Seine Passes (SN):	—
# Bait Traps (BT):	— N.B. Didn't set due to time constraints

Fish abundance scale

Approx # Observed	Abundance Score
1	1
2-9	2
10-50	3
51-100	4
101-500	5
501-1000	6
1001-5000	7
>5000	8

Species: Lei ceni (3)				Species: Ang vei (2)				Species: Mel spl (5)			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		156	1	EF		300	1	EF		46
2	"		80	2	"		500	2	"		50
3				3	"		450	3	"		32
4				4	"		180	4	"		70
5				5	"		120	5	"		58
6				6				6	"		35
7				7				7	"		67
8				8				8	"		63
9				9				9	"		54
10				10				10	"		46
11				11				11	"		48
12				12				12	"		60
13				13				13	"		61
14				14				14	"		42
15				15				15	"		73
16				16				16	"		61
17				17				17	"		54
18				18				18	"		32
19				19				19	"		20
20				20				20	"		52

Fish Sampling Field Sheet Cont.

Species: Hyp Com				Species: Mog ads				Species: Ang obs			
(3)	Method	LHS (J/I/A)	Length	(2)	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	EF		62	1	EF		38	1	EF		200
2	"		26	2	"		42	2			
3	"		41	3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
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16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species: Turtle				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1	Spatial approx			1				1			
2		200mm long		2				2			
3	in pool	above	Riffle 2	3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
14				14				14			
15				15				15			
16				16				16			
17				17				17			
18				18				18			
19				19				19			
20				20				20			

Fish Sampling Field Sheet Cont.

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
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17				17				17			
18				18				18			
19				19				19			
20				20				20			

Species:				Species:				Species:			
	Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length		Method	LHS (J/I/A)	Length
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
10				10				10			
11				11				11			
12				12				12			
13				13				13			
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