Queensland
Australian River Assessment System
(AusRivAS)
SAMPLING AND PROCESSING MANUAL

August 2001

Queensland Department of Natural Resources and Mines

Environment Australia
Department of the Environment and Heritage

Natural Heritage Trust
Helping Communities Helping Australia

Land & Water Resources Research & Development Corporation

Queensland Government
Natural Resources and Mines

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This document is updated from the documents entitled 'Biological Monitoring and Assessment of Freshwaters using Macroinvertebrates' by the Department of Natural Resources (1997) and 'Queensland Australian River Assessment System (AusRivAS) SAMPLING AND PROCESSING MANUAL' (2000). It was edited by Diane Conrick and Bernie Cockayne.

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INTRODUCTION

Defining a healthy river is a challenge, despite the fact that we have some idea what it should look like. A healthy river can be described as one that is similar to an unimpacted river of the same type in its natural state (in terms of its water quality, biological diversity and ecological functioning), its condition is stable and it has the capacity for self-repair when disturbed. Although the concept of river health is not new, it is only recently that methods of assessing it have been developed. It extends the traditional approach of using chemical and physical measurements which are often difficult to interpret in biological terms. River health assessment is a way of examining the waterway using tools such as water quality, habitat descriptions, biological monitoring, and flow characteristics to create an overall picture of the ecological health of that waterway. Impacts on the waterway can be varied: chemical spills, riparian vegetation removal, sand and gravel extraction, or stock access. All of these things can upset the balance e.g. a chemical spill might kill a large proportion of the macroinvertebrate community, which is a major component of some fish diets. Consequently, the fish population will be affected.

Water quality and, subsequently, river health has traditionally been assessed solely on the chemical analysis of water samples. In recent years there has been a realisation that the structure of plant and animal communities of the rivers can give us a far more accurate picture of the condition or health of our waterways. Of these biological communities, macroinvertebrates (i.e. animals without backbones, large enough to be seen with the naked eye, e.g. prawns, shrimps, crayfish, snails, mussels and insects such as dragonflies, damselflies and mayflies) are most widely used because they are abundant and diverse, and are sensitive to changes in water quality, flow regime and habitat conditions. Impacts on these animals are relatively long lasting and can be detected for some time after the impact occurs.

The AusRivAS (Australian River Assessment Scheme) model protocol (Simpson et al. 1997) for the MRHI river bioassessment program adapts the RIVPACS (River Invertebrate Prediction and Classification Scheme) methods applied by Wright et al. (1984), Moss et al. (1987), Marchant et al. (1994) and aspects of protocols developed by Chessman (1995). It allows rapid sampling methods to be used for the development of predictive models for macroinvertebrate communities within each state/territory, using a 'reference' site database. Comparisons may then be made between predicted and observed taxonomic compositions of macroinvertebrate communities in different habitats at a site in order to indicate the presence and magnitude of an impact on the site's ecological health. This approach can assess biological responses to changes in water quality and/or habitat condition in rivers and can be integrated with the existing network of physico-chemical water quality monitoring sites.

This document describes the bioassessment methodology adopted by the Freshwater Biological Monitoring Unit of the Department of Natural Resources and Mines, Queensland. It is the protocol used by the Queensland AusRivAS models and is adapted from the River Bioassessment Manual (Davies 1994).

The approach to assessing river health adopted by the National River Health Program (NRHP) (comprising the Monitoring River Health Initiative (MRHI) and First National Assessment of River Health (FNARH)) has generated a lot of interest in the use of biological monitoring of freshwaters in Queensland. Since the Program's inception in 1994, numerous enquiries from public and private agencies on how to develop and implement a biological monitoring program have been made. This manual is intended to provide this information and to encourage the use of standardised methods. The actual protocol used (e.g. sampling design, number of sites, subsampling, replication, frequency of sampling, etc.) should be based on the objectives of the monitoring or assessment program. The protocol outlined in this manual is meant for broad scale monitoring (e.g. catchment or regional basis). For smaller scale and specific issues, other methods using control and replicate sites (such as BACIP and multivariate equivalents) may be more appropriate (see Underwood 1993; ANZECC 2000).

The development of a standardised tool for broad scale bioassessment is dependent on three factors:

- use of the same biota;
- use of the same approach to sampling and sample processing; and
- use of the same analytical methods for model development and use.

The data can also be analysed in different ways and used for other purposes such as impact assessments, condition and trend reporting, biodiversity and biogeographic studies.

It should be noted that this protocol is for use in freshwater reaches of rivers only and not for use in estuaries or tidal reaches of lowland rivers. Although the general approach may be valid, substantial additional work must be performed prior to its adoption in estuarine and marine conditions.

SAMPLING PROGRAM

The sampling program described below was followed by the Queensland Department of Natural Resources and Mines (QNR&M) in developing the AusRivAS predictive models for Queensland rivers. Anyone intending to utilise the models for assessing riverine sites must follow this procedure. Data can then be input into the model and the model run by QNR&M. Those not intending to use the models but still interested in developing and implementing a broad scale biological monitoring and assessment program for their streams and rivers can also follow this procedure. The advantage of doing so is that a standard method is followed which would permit direct temporal and spatial comparisons of data, and allow sites to be compared with existing MRHI and FNARH reference and test sites.

SITE SELECTION

Reference and test sites in Queensland were initially selected for the MRHI program using protocols outlined in the River Bioassessment Manual (Davies 1994).

Reference sites were those 'least disturbed' sites sampled for the production of a database used in the construction of predictive bioassessment models (e.g. RIVPACS of Wright et al. 1984). Test sites were those sites identified to be of importance in assessing the condition of a river known or perceived to be experiencing an impact from water quality or habitat degradation. These protocols were adapted by QNR&M into a list of criteria to which each site was subjected. Table 1 lists the 10 selection criteria currently used to determine whether or not sites are in reference condition.

The input of additional information from outside sources may potentially result in modifications to these assessments. This method will provide a better characterisation of the sites based on numerical categorisation bringing the assessments into line with other programs undertaken by QNR&M. Each criterion relates to an aspect of human activity that impacts on freshwater ecosystems, where impact is defined as a 'change from natural condition'. Each criterion is given a score according to the following categories:

1. Very major impact
2. Major impact
3. Moderate impact
4. Minor impact
5. Indiscernible impact

Table 1. **Selection criteria used to determine eligibility for reference site status.**

No.	Reference Condition Selection Criteria
1	Influence of intensive agriculture upstream.* Intensive agriculture is that which involves irrigation, widespread soil disturbance, use of agrochemicals and pine plantations. Dry-land grazing does not fall into this category.
2	Influence of major extractive industry (current or historical) upstream.* This includes mines, quarries and sand/gravel extraction.
3	Influence of major urban area upstream. This will be relative to population size, river size and distance between the site and the impact.
4	Influence of significant point-source waste water discharge upstream.* Exceptions can be made for small discharges into large rivers.
5	Influence of dam or major weir* Sites within the ponded area of impoundments also fail. Sites failing this criterion automatically fail the overall assessment.
6	Influence of alteration to seasonal flow regime This may be due to abstraction or regulation further upstream than the coverage by Criterion 5. Includes either an increase or decrease in seasonal flow.
7	Influence of alteration to riparian zone Riparian vegetation should be intact and dominated by native species.
8	Influence of erosion and damage by stock on riparian zone and banks. Stock damage to the stream bed may be included in this category.
9	Influence of major geomorphological change on stream channel Geomorphological change includes bank slumping, shallowing, braiding and unnatural aggradation or degradation.
10	Influence of alteration to instream conditions and habitats This may be due to excessive algal and macrophyte growth, by sedimentation and siltation, by reduction in habitat diversity by drowning or drying out of habitats (e.g. riffles) or by direct access of stock into the river

* Note: the level of impact at a site will generally decrease as the distance from the source of impact increases.

Sites are assessed using the total score for the ten criteria. Currently, those sites that have a total greater than 44 are deemed to be reference sites. Sites that are given a score of '1', '2' or '3' for Criterion 5 (no dam or major weir upstream) cannot be reference sites.

SAMPLING FREQUENCY

Any program that attempts to standardise sampling protocols across Australia must take into account the occurrence of rivers encompassing a wide range of predictability and seasonality in river hydrology, life histories of biota and river habitat types. Whether a strong seasonality occurs or not, a minimum number of samples must be taken over time to allow collection of adequate macroinvertebrate taxa information for reference site classification.

The overall aim of the sampling protocol is to ensure that the broadest range of biota are captured at a site by sampling a number of habitats and on a number of occasions. To ensure standardisation and compatibility of data sets, the following protocol was followed for all sites - whether reference or test sites.

The sampling protocol for Queensland rivers and streams requires a minimum of two sample sets in one year. These are sampled on a 'seasonal' basis from October - December (early wet - when flow has been established for at least four weeks) and May - July (late wet - recessional baseflows when flow had declined to a sampleable level, without significant flood peaks). The early wet samples are identified as Spring samples; the late wet as Autumn.

For the model development, each site was sampled twice in one year and the data from the two sample sets were used separately to develop seasonal models, and combined to develop an annual model.

HABITATS SAMPLED

Each reach of stream may have several habitats. If a habitat accounts for more than 10% of the stream reach then it should be considered for sampling. The predominant habitat types are identified at each site and appropriate ones sampled separately. In Queensland, only two habitats are sampled, an edge sample and a bed sample. The first choice of bed habitat is a riffle; failing this a rocky bed is sampled and, finally, a sandy bed. Ensure that the type of bed sampled is recorded on the field sheet.

Separate sampling of distinct habitat types is prescribed because each habitat has a potentially distinct fauna. The performance of the predictive models will therefore not be confounded by differences in habitat availability between sites and times. AusRivAS models have been developed for edge and pool habitats in Queensland for autumn and spring seasons, as well as a combined season annual model. Riffle models will also be developed in the near future.

In Queensland, the habitats most likely to be encountered are:

Riffle

This is a reach of relatively steep, shallow (<0.3 m), fast flowing (>0.2 m/s) and broken water over stony beds. (Plate 1)

Plate 1. Riffle habitats.

Run

A run is a reach of relatively deep and fast flowing, unbroken water over a sandy, stony or rocky bed. They are features of streams during a flood event, below dams where riffles have been 'drowned' or in steep gradient streams flowing through gorges. Under normal flow conditions, it is best to avoid sampling this type of reach. However, pools and riffles may become runs during flood events (e.g. in April) and it may be necessary to sample the area. If possible, delay sampling until flow recedes. (Plate 2)

Plate 2. Run habitat.

Pool bed

Pool bed habitats are zones of relatively deep, stationary or very slow flowing water over silty, sandy, stony or rocky beds. This habitat occurs in the main channel and should not be confused with backwaters, which occur as indentations of the bank. Waterholes are generally pools with silty/sandy beds whilst pools with rocky/gravel beds are often found in steep areas. The velocity will indicate whether it is a pool or run. The classification factor is the bed type i.e sandy/silty beds and rocky/gravel beds. (Plate 3)

Plate 3. Sandy bed and rocky bed habitats.

Edge/backwater

Edges (or banks and underbank areas) are along the bank where there is little or no current and extend to approximately 0.50m from the bank. There may be some terrestrial vegetation (e.g. paragrass, sedges), tree roots or the area may be bare (e.g. waterholes in drier areas). A backwater is a zone where the bank indents and a pool of water forms away from the main channel (e.g. ox-bow, off-cut channel). The backwater may have a circular or back flow, and a silty bed with accumulated plant litter (leaves, twigs etc.). (Plate 4)

Plate 4. Edge habitats

Macrophytes

Macrophyte habitats are areas where emergent, submergent and floating macrophytes or aquatic plants are present and can occur in slow to fast flowing areas. Macrophytes that you are likely to encounter include Milfoil (*Myriophyllum* spp.), Hornwort (*Ceratophyllum demersum*), Waterfern (*Azolla* spp.), Salvinia (*Salvinia molesta*), Duckweed, Water Thyme (*Hydrilla verticillata*), Water Primrose (*Ludwigia* spp.), Water Hyacinth (*Eichhornia crassipes*), Waterlilies (*Nymphaea* spp.), Pondweeds (*Potamogeton* spp.) and Ribbonweed (*Vallisneria* spp.). These areas are designated on the field data sheet as 'Macrophytes' (Plate 5). Although reference and some test site sampling has been done it is not envisaged that a model will be developed for this habitat. Therefore, this habitat is no longer sampled as part of the AusRivAS approach, although it may still be sampled for other purposes e.g. nutrient enrichment studies and flow assessments.

Plate 5. Macrophyte habitats

PREPARING FOR A FIELD TRIP

Before embarking on a field trip, some preparation is needed. Appendix 1 and Plates 6 and 7 outline a list of the equipment needed for macroinvertebrate sampling.

Plate 6. Monitoring and sampling gear.

Plate 7. Monitoring and bug picking gear.

WATER QUALITY SAMPLING

All water quality measurements and water samples are required to be collected upstream of the biological sampling area and of the water sample collector. They should be taken from a representative section of the stream, slightly flowing if possible, at a depth of 10-20cm (Plate 7). Care must be taken to avoid sampling too close to the edge and too close to aquatic plants. Appropriately calibrated meters are to be used for temperature, conductivity, dissolved oxygen, pH and turbidity (Plate 6). Field alkalinity measurements are taken using a titration kit (Plate 7). The results are recorded on the Water Quality Sampling Field Sheet (Appendix 3).

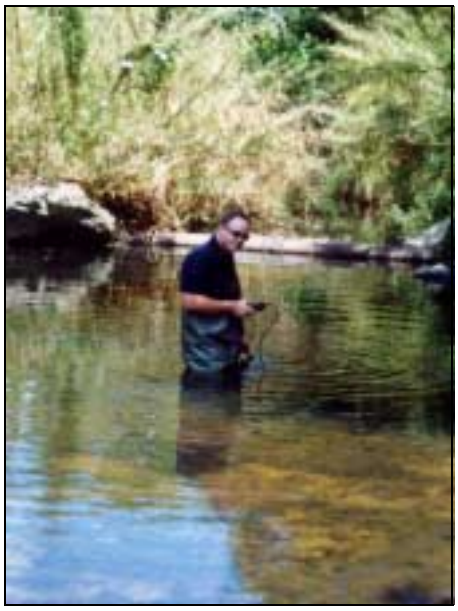


Plate 7. Taking field water quality measurements, water quality samples and doing an alkalinity titration test.

The water quality samples are collected in prepared bottles, details completed on the sample bottles, samples preserved correctly, external paperwork completed and samples cross referenced on the Water Quality Sample Field Sheet (Alexander 2000). QNR&M routinely collects 2 water samples: one for major ions analysis (1L bottle, detergent washed) and one for nutrient analysis (nitrogen and phosphorus; 250ml, reverse osmosis washed bottle). The samples are analysed by Queensland Health and Scientific Services (QHSS) laboratories in Brisbane or another appropriate laboratory.

Guides such as Alexander (2000) and EPA (1999) can be used to determine water quality sampling methodologies.

BIOLOGICAL SAMPLING

General Considerations

Sampling should not be conducted when streams are in flood unless the impact of flood is being investigated. If, during the scheduled sampling period, sites are consistently in flood, sampling should resume 4-6 weeks after floods have subsided. The study site is a 100 m length of stream (50 m upstream and 50 m downstream of the point of entry).

All macroinvertebrate samples should be collected with a standard 250 µm mesh dip net. Recommended dimensions are triangular 250 mm x 250 mm x 250 mm opening, 50-75 cm depth and with a 1-1.5 m aluminium handle. The net should be checked for damage prior to a sampling trip and washed thoroughly after sampling each habitat to remove animals left from previous sampling. Sample a total distance of 10 m, covering a variety of velocities, if possible, and different examples of the habitat. (Nets are available from the Australian Centre for Tropical Freshwater Research, James Cook University).

Sampling the Habitats

Riffle

While holding the net downstream with its mouth facing the sampling area, disturb the substratum by digging the foot well into the stones and turning them over. Turn and rub stones by hand to dislodge organisms. Continue this process working upstream over a total distance of 10 m, covering both the fastest and slowest flowing sections of the riffle. Do not include material from macrophytes and/or wood debris located in the riffle. It may be necessary to collect the sample from more than one riffle if the first riffle is less than 10 m in length.

Pool/Bed

Disturb the substratum by kicking with your feet. If the stream is flowing, hold the net downstream with the mouth facing the disturbed area. If there is no discharge you will have to use a short sweeping action with the net whilst stirring up the bed. The suspended benthic animals are captured as the net sweeps through the cloud of suspended matter (Plate 9).

Silty/sandy beds: preferably select an area with plant litter (not macrophytes) rather than an area of clean sand.

Plate 8. Sampling the riffle.

Rocky/gravel beds: if the rocks are too large to kick over without damaging your foot, wash about 10 rocks of a range of sizes, scrubbing gently with the hands or a light brush into the net. Leave the rocks out of the water to allow cryptic specimens to emerge. These can then be hand picked. Be careful, leaving the rocks in the sun for too long will dry out and kill the animals. Again, avoid areas where macrophytes are present.

Plate 9. Sampling the pool bed.

Plate 10. Sampling the edge.

Edge

Locate an edge area with little or no current or aquatic vegetation (stands of Paragrass are acceptable as edge habitat). An alcove or backwater with abundant benthic leaf litter is preferable. Suitable areas include fine organic/silt deposits and/or trailing vegetation and are often indicated by the presence of surface-dwelling insects. In waterholes you may have no choice but to sample the bare edges, perhaps with some tree roots. Using short upward sweeping movements at right angles to the bank, sample a total bank length of 10 m. Stir up the bottom while doing so, ensuring that benthic animals are suspended and then caught when sweeping through the cloud of suspended material (Plate 10). There may be aquatic plants (macrophytes) along the banks and in backwaters. Avoid sampling these areas.

Macrophytes

Locate an area with dense aquatic vegetation (if present). Vigorously sweep the net within the aquatic vegetation over a length of 10 m (Plate 11). Aim to sample the upper, middle and lower portions of the plants. A combination of short lateral sweeps with vertical lifts will aid in dislodging and catching suspended organisms. (This habitat was not modeled for AusRivAS.)

Plate 11. Sampling the macrophytes.

Picking the sample

Nationally, two methods are used for collecting organisms: field picking and laboratory picking. Either method may be used, although it is preferable to maintain the same technique for all sites. For Queensland, the field picking option has been chosen.

The choice of which method to adopt should primarily be influenced by considerations of the objective of the study, precision required, time, cost and balance of effort in the field versus laboratory. Field picking (Plate 12) significantly reduces time in the laboratory while laboratory picking reduces the length of time spent at each site in the field. Live picking is considered to be more subjective. However, with sufficient training, care and objectivity, it does provide a cost effective alternative to laboratory picking.

Plate 12. Picking the sample in the field.

Live Picking

Treat samples from each habitat separately unless it is part of the project design to have composite samples. It is recommended that the sample is initially separated into 2 fractions (the small organic and substrate material and large rocks and leaf litter) using a 1 cm panning sieve (cheap aluminium ones are available from local camping stores). Sort through these fractions, a small amount at a time, retaining the residue for QA/QC requirements (see below). Work progressively through the sample, replacing picked material with remaining parts of the sample as picking progresses.

- Half fill a vial with 70% alcohol (methylated spirits). Ensure the container you use is large enough. If the animals you collect take up more than 30% of the volume, use a larger container. Use alcohol stable vials to avoid vial cracking and sample loss.
- Pick for a minimum of 30 minutes, using tweezers and pipettes, and record the total abundance using a hand held counter.
- Collect only 10 of any one type (family and, in some cases, order) of animal. If you are not sure of the identity, then collect all of the uncertain ones. At least 30 midge larvae (Chironomidae) should be collected to ensure adequate representation of the sub-families.
- At the start of your live pick, the common and abundant taxa should be picked for about the first 5 minutes. After that, the major picking effort should be directed at finding the less common, inconspicuous taxa. After 10 minutes no more common taxa should be picked unless it is suspected that a particular common form contains more than one family, or it was a common taxon overlooked initially.
- If you get 200 animals (about 10 of each type plus at least 30 Chironomidae) then stop at the end of this 30 minutes. If, at the end of the 30 minutes, you have not collected 200 animals then you should collect for a further 10 minutes. If any NEW taxa are found in that 10 minutes, extend the picking time by another 10 minutes. Follow this procedure until either no new taxa are found, 200 animals have been collected or 60 minutes have been spent on picking. Note the picking time on the field sheet.
- Particular care should be taken to search for the groups that can be commonly missed when live sorting (cryptic taxa):

Corbiculidae (juveniles)	Oligochaeta (including broken bits)
Chironomidae (larvae and pupae)	Elmidae (larvae)
Empididae (larvae)	Hydrophilidae (larvae and adults)
Hydroptilidae (larvae)	Simuliidae (larvae)
Ceratopogonidae (larvae)	

- If it is a really poor sample (i.e. urban tributary or sandy stream) with very few animals in total, then stop at 60 minutes. Make it clear on the field sheet that it was a poor quality site or sample and why that is so. A poor sample may also result from a bad collection e.g. a sample taken during high flows over areas which were dry a few days before.
- If it is raining or cold, or conditions of poor light exist due to cloud cover or approaching twilight, the sample must be taken back to the vehicle/motel/camp etc. for sorting undercover and with improved light conditions.

- Ensure a completed label is placed in the vial noting the project name, site number and name, sampling date, habitat sampled, sample collector and picker and any relevant notes (Plate 13).
- Remove some of the diluted alcohol in the vial using a mesh-covered syringe and replace with fresh 70% alcohol. Fill to top and ensure the lid is tightly screwed on.

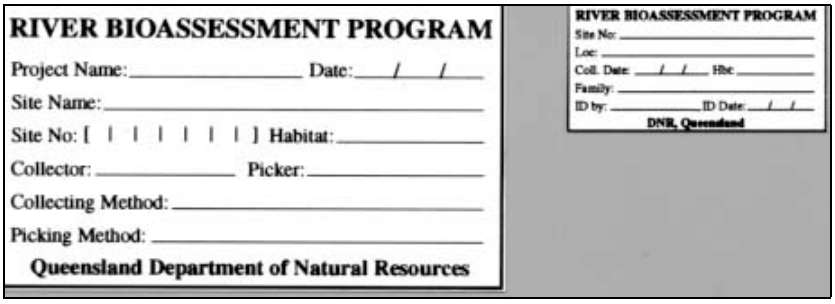


Plate 13. Labels for the field sample and laboratory sample.

Laboratory Picking

The entire sample is preserved in the field using 70% methylated spirits, a completed label included and the sample adequately stored for transport to the laboratory. Large plastic screw-top jars or heavy-duty plastic bags, stored in a polydrum are suitable containers for residues.

Field Picking Quality Assurance/Quality Control (QA/QC)

The residues of ten percent of all samples taken in the field are retained for analysis. The entire residue is preserved in the field using 70% methylated spirits, a completed label included and the sample adequately stored for transport to the laboratory. Half of these samples are put aside for external analysis; the other half are subsampled and 10% of each sample is analysed by the unit's staff. The data is analysed, compared to the sample picked in the field, and reports written.

Handy tips

- Use waterproof paper for field sheets.
- Only use pencil to fill in field sheets and sample labels; ink and felt tip pens smudge and run.
- Some macroinvertebrate groups are fairly cryptic i.e. difficult to detect, particularly in the first 15-30 minutes after collection. To counteract this phenomenon and ensure that you pick a representative sample from the habitat, it is suggested that all the habitats be sampled before picking begins. (Don't forget to label each sample as you put it into the tray or bucket.) The first sample will then have had sufficient time to rest and the animals will have become more active and easier to see (although not necessarily easier to pick).

- Labels - place inside the vial;
  - preferably, DO NOT use gummed (stick on) labels; and
  - if you have to use gummed labels, DO NOT remove the backing paper (the animals stick to the label and are irretrievable).
- Buckets are always useful - to carry rinsing water, to put your rock collection in, to split your sample if it is too big. Ensure that you take at least two per person, preferably more. A couple of buckets with lids are also useful if samples need to be transported before picking.
- It is advised that at least two people conduct the field sampling for safety reasons. As a result, time in the field can be better utilised with one person conducting the macroinvertebrate and water quality sampling and the other filling out the field sheets. Once the samples are collected, these can be live picked in the field by each person, hence saving time.

FIELD SHEETS

Prior to water or macroinvertebrate sampling, information must be recorded on field sheets about the site (Plate 14). This includes information about the whole reach (100 m section of the river), the habitats sampled and the surrounding terrestrial environment. There are four types of field sheets used by QNR&M to record information about a site (Appendices 2-5). The parameters are described in the following paragraphs.

Plate 14. Filling out the field sheets.

Every sheet has some common information which is essential:

Site Number. All QNR&M sites are allocated a site number, based on the catchment, subcatchment and whether it is a hydrographic gauging station or a 'miscellaneous' site. These numbers contain 7 alphanumeric characters: the first three numbers indicate which catchment the sites are in (e.g. 136); the fourth digit, the subcatchment; and the final 3, the site. For example, a site with the site code 136017B shows that this site is in the Burnett River Catchment (136), within the 0 subcatchment, and the

site number within this subcatchment is 17B. Sites with a letter as the final character indicates that these sites have or have had a flow gauging station nearby.

Site Name describes where the site is on the river eg. Burnett River at Gayndah Flume.

The water quality, macroinvertebrate and habitat assessment sheets also record the date, time and project name.

Queensland Site Information Sheet

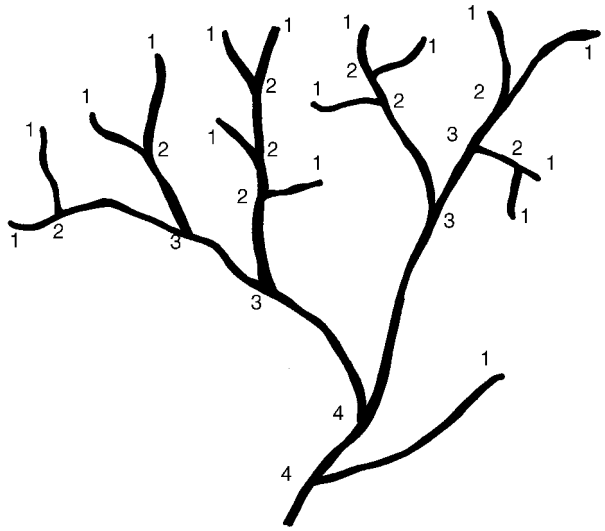
This sheet (Appendix 2) can be completed at any stage of the program. Some information maybe required prior to the trip. Some is collected during the trip and the rest is done afterwards when the site has been confirmed. This sheet only needs to be completed on the first visit to a site. Note: 1:100 000 topographic maps are used for the following information, where they are available. In some areas of Queensland only 1:250 000 topographic maps are available.

Latitude and Longitude. Use GPS (Global Positioning System) and confirm readings on a 1:100 000 topographic map.

Altitude. Use 1:100 000 topographic maps.

Stream Order. Hierarchical ordering system based upon the degree of branching (Strahler 1957). Stream orders should be determined using 1:100 000 scale maps. A second-order stream is formed by the joining of two first order-streams; the junction of two second-order streams forms a third order stream etc. (Figure 1).

FIGURE 1. Method used by QNR&M to determine stream order (Strahler 1957).



Slope (m/m). $\frac{\text{contour distance (m)}}{\text{distance of stream between contour lines (m)}}$

e.g. 6.5km between 20m and 40m contour lines = 20m/6500m = 0.0031m/m

Distance from Source (km). Distance from the site to longest thread of stream source.

AMTD (km). (Adjusted Middle Thread Distance). The distance from the mouth of stream (i.e. at the ocean or where it joins another stream) to the site.

Reach. An assessment of where in the catchment a site lies with relation to the watershed. Note that this does not necessarily correlate to the altitude.

Catchment Area (km^2) The area of land above the site being assessed from which the water drains towards the stream.

Reference or Test Assessment. Determined using the Reference Condition Selection Criteria (Table 1 and page 3 of Site Information Sheet).

Nearest Rainfall Station. Within QNR&M, a departmental database called DRF is used. The same information can be extracted from the Bureau of Meteorology website (www.bom.gov.au). Recording the station name eliminates searches for the closest station when there is a need to verify/update data.

Nearest Weather Station. Temperature information can be extracted from the Bureau of Meteorology website (see above). Again, recording the station name eliminates searches for the closest station when there is a need to verify/update data.

Water Quality Sampling Field Sheet

This field sheet (Appendix 3) is intended to record information about the water quality parameters (DO, conductivity, water temperature. etc) and factors that may have an influence on the water quality parameters (eg. adjacent landuse, bank erosion etc). The information on the sheet refers to the entire site (100 m reach) at the time it is sampled.

The front side of this sheet is a generic departmental water quality sheet which enables QNR&M officers to record information on the water quality sample collection site and field measurements, as well as noting the relevant samples and paperwork for external laboratory analysis. The reverse side of this sheet records observations of factors that may influence the water quality from the entire reach. Information on the types of macrophytes present can also be recorded as well as any notes.

Macroinvertebrate Sampling Field Sheet

This sheet (Appendix 4) contains information about the macroinvertebrate habitats sampled (water depth and velocity, substrate description etc) with longitudinal and cross sectional sketches of the 100 m reach.

Most of the values derived for this field sheet are estimated, apart from the water velocity, mean depth and the mean channel width. The mean channel width is the distance between left bank water's edge and right bank water's edge.

The sketches are important for helping to assess the sites after they have been visited. These should include where the water and macroinvertebrate samples were taken, where any photos were taken, the approximate bank height (measured from the water level to the top of the bank), bank width, stream width and depth, where each of the different aquatic habitats are and indicate the width and composition of the riparian vegetation.

Habitat Assessment Field Sheet

This field sheet (Appendix 5) is important in the assessment of the 100 m reach of river. Nine criteria are numerically assessed from excellent to poor (max. 20 to 0), with the final habitat assessment being the numerical score.

Task Sheet

When all the work is completed, the task sheet (Appendix 6) is filled in and signed. This is a check list of all the jobs that should be done at a sampling site.

LABORATORY MACROINVERTEBRATE SAMPLE PROCESSING

It is recommended that a registration system be set up for all samples collected. A standard form is recommended for this purpose. These sheets should be filled out for all samples within 24 hr of return from field trips. Cross-checking should be performed so that samples recorded on field sheets are present, labels are accurate and legible and bottles filled with preservative. Labels should have the site name, location code, habitat, sampling method, collector's name, picker's name and date on them (Plate 13).

All registration sheets should be filed appropriately and samples stored in labelled lidded containers (to minimise evaporation) in an approved fire-proof storage area. Each box should contain a logical group of samples to facilitate sample identification and handling.

Software for sample registration and archiving should enable integration with the sample database (see below).

Sample identification and enumeration

Live Picked Samples

Ensure adequate ventilation in the workplace. Rinse the sample with gently running water through a 250 µm sieve. Flush the sieve contents into a large petri dish with water from a squeeze bottle. Always use water when working with the sample. When finished, replace the water with preservative.

Place the petri dish under a stereomicroscope which is correctly adjusted for your vision and work posture (refer to manufacturer's instructions). Use a vial of suitable size to take the collection of specimens in the petri dish with label inserted. The label should have the following information: collection number, location code, site name, collection date, habitat, sample identifier and the identification date (Plate 13). Use pencil or alcohol-proof ink to fill in details. Half fill the vial with 70% ethanol.

A dedicated tally sheet (Appendix 7) should be developed for recording the identities and numbers of all taxa in a sample. The sheet should allow listing of the taxonomic key used for identification for each family, the person making the identification, the site, date and sample code.

Organisms are identified to family level with the exception of lower Phyla (Porifera, Nematoda, Nemertea, etc.) Oligochaetes (freshwater worms), Acarina (mites), and microcrustacea (Ostracoda, Copepoda, Cladocera) for which family level identification is optional (it may improve resolution but is time consuming). Chironomids should be identified to sub-family level. Appendix 8 lists the keys used by QNR&M.

Select specimens and follow the appropriate taxonomic keys to family level. If uncertain about the identity obtain a second opinion from a colleague/local specialist. If a new family is suspected or other significant problems arise in taxonomic identification, contact the relevant national taxonomic specialist.

Identify each specimen, place in the vial and mark the tally sheet. When all specimens have been counted record the total tally for each taxon. Place the vial, filled with preservative, in an evaporation-proof container (e.g. a large screw-top glass jar) in a suitable storage location.

Transfer the collected data to an electronic spreadsheet or database. At the completion of the sample series, the database should be cross-checked against the data sheets to ensure that there are no transcription errors.

All sorted collections should be archived, preferably lodged with a regional or state/territory museum, so that any future taxonomic revisions or more detailed identifications can be conducted if required. The relevant museum staff should be consulted well in advance of submission of specimens.

Fully Preserved Samples

Tip the preserved sample into a series of 10 mm and 250 µm sieves and thoroughly wash the sample. If there are large coarse fractions (sticks, leaves etc) wash these over the sieves and place them into a sorting tray. Examine these coarse fractions,

preferably using a magnifying glass, for approximately 10 minutes, ensuring that any macroinvertebrates attached to the coarse fractions are collected. Note: keep an eye out for stick and leaf-cased Trichoptera.

Evenly distribute the remaining smaller fractions from the sieves into a subsampler. The subsampler used and recommended by QNR&M is a modified Marchant subsampler (Marchant, 1989) (Plate 15). This subsampler contains 100 circular cells, each 3.5 cm diameter x 3.5 cm deep. Fill the subsampler until the water level reaches the top of the cells, secure the lid, and rotate vigorously in both directions until the sample is distributed throughout the cells. Using a vacuum pump, subsample 10% (10 cells) of the whole sample, ensuring every 1% (1 cell) of the subsample is stored in separate containers.

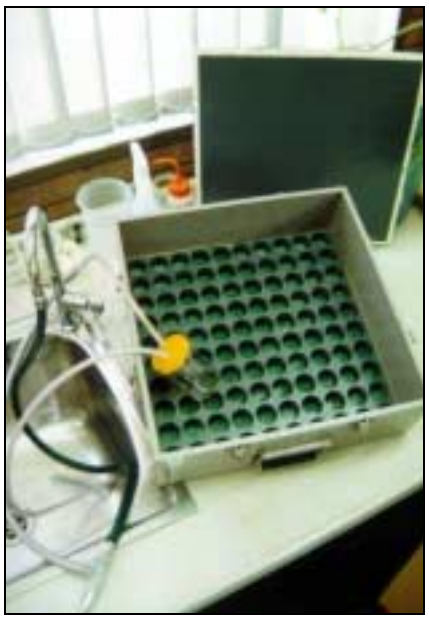


Plate 15. Modified Marchant sub-sampler

Proceed sorting and identifying the subsamples in the procedure described above (see Live Picking), noting how many new taxa there are in every 1% subsample sorted. If this procedure is used for internal QA/QC checks on field picking, only 10-15 organisms of each family is identified and recorded. However, if the subsampling is required for quantitative sampling, sort and identify all taxa from the subsamples.

The long-term aim in the development of this protocol is to further identification of samples to genus and/or species level, in order to improve the predictive power of the resultant models. Thus, a high emphasis should be placed on the development of a systematic and well designed data entry and sample archiving system. For certain objectives such as impact assessments, it is advisable to identify the animals to the lowest possible taxonomic level, preferably species, although, at present, AusRivAS models are available only for family level assessment. Identifications made at species/genus level can be converted into family level data and run through the models, but the converse is not possible without re-identification.

Laboratory Identifications QA/QC

Internal QA/QC checks on laboratory identifications are performed on staff, by staff, on a regular basis. At each round of QA/QC, a person is assigned to analyse a sample identified by another. Samples identified during the previous fortnight are selected at random and re-identified. The resultant taxa lists are compared and discrepancies in identification checked by other staff in the unit. Any errors are discussed with the original identifier (both misidentifications and errors of enumeration) and a report prepared which is read and signed by all members that underwent the QA/QC check. Under NRHP guidelines, error rates greater than 10% in identification and counting are not acceptable.

DATABASE ENTRY AND SOFTWARE SUPPORT

A dedicated database should be established to allow for entry, storage, checking and distribution of data and for manipulation of data for subsequent analysis. No specific software package is recommended, though consideration should be given to the ultimate size of the database, the need for ongoing addition of data as the protocol develops into a usable tool, and compatibility with existing systems and software. The database must allow data files to be translated into ASCII format. Data can be entered by a standard spreadsheet (e.g. Excel) and exported to the database (e.g. ACCESS).

Anyone wishing to utilise the AusRivAS model will have to comply with data formatting indicated in the AusRivAS Manual (visit www.ausrivas.canberra.edu.au or Simpson et al. 1997). The appropriate predictor variables should also be considered. Appendix 9 lists the predictor variables used for the Queensland models.

Biological data

An appropriate data entry spreadsheet has been designed as recommended by Simpson et al. (1997). Enter all sample data into a unique file and all sets must match exactly. When data is entered it must be cross-checked against data entry sheets. Use the national taxonomic codes for all families (Appendix 10). Use of this coding will allow compatibility between data sets at the agency, state/territory and national levels and will greatly expedite comparisons and future taxonomic efforts.

Habitat data

Design a data entry spreadsheet. Perform all calculations to the raw data to conform with the data requirements for later analysis. Enter this processed data for a site into a unique file. Cross-check the data against field sheets. Use the same site code and the relevant date and sample coding to allow integration of habitat data with the biological samples for later statistical analysis.

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APPENDIX 1

Checklist of equipment needed for macroinvertebrate field sampling

	Tick when collected
Macroinvertebrate sampling equipment	
250µm macroinvertebrate sampling net	
Buckets x 4	
Sorting tray x 4	
Coarse sieve (10mm)	
Tweezers and pipettes x 4	
Vials, vial labels and plastic bags	
Waders	
70% methylated spirits	
Squirt bottles	
Water quality equipment	
Alkalinity kit (check contents)	
Conductivity meter (ensure charged and calibrated)	
Dissolved Oxygen meter (ensure charged and calibrated)	
pH meter (ensure charged and calibrated)	
Turbidity meter (ensure charged and calibrated)	
Water sample bottles (1 L and 250 mL)	
General equipment	
Site, habitat, water quality and macroinvertebrate field sheets	
Tape measure	
Waterplant and macroinvertebrate field identification books	
Current meter, staff and prop	
GPS	
Maps	
Sunscreen	
Car fridge or esky	
Drinking water	
Card table and chairs, beach umbrella or tarp and poles	
Camera and film	
Pens, pencils, erasers and clipboards	
Phone/radio	
First Aid Kit	
Shovel, 4WD recovery kit	

APPENDIX 2

Queensland Site Information Sheet

QUEENSLAND SITE INFORMATION SHEET

Queensland Government

SITE NUMBER ……...

SITE NAME ……..……...

LATITUDE …… **LONGITUDE** ……

GRID REFERENCE ……

MAP NAME …… **MAP NUMBER** …… **SCALE** ……

ALTITUDE (m) ……. **STREAM ORDER** ……

SLOPE (m/m) …… **DISTANCE FROM SOURCE (km)** ……..

AMTD (km)…… **REACH** **upland** **midland** **lowland**

CATCHMENT AREA (km^2) …….

REFERENCE or TEST **ASSESSMENT** (see last page)……..…

NEAREST RAINFALL STATION ……

NEAREST WEATHER STATION ……...

ACCESS DETAILS

Directions ……
……
……
……
……
Property Owner …… **Phone No.** ..……
Contact ..…… **Phone No.** ..……..…..
Access Instructions ..……
……
……
……
Notify before each visit? **[ ] Yes** **[ ] No**
Permission required? **[ ] Yes** **[ ] No**
Key required? **[ ] Yes** **[ ] No**
Key available from ……...
……

MUDMAP OF ACCESS ROUTE

SKETCH OF REACH

No.	Reference Condition Selection Criteria	Level of impact *
1	Influence of intensive agriculture upstream.* Intensive agriculture is that which involves irrigation, widespread soil disturbance, use of agrochemicals and pine plantations. Dry-land grazing does not fall into this category.	
2	Influence of major extractive industry (current or historical) upstream.* This includes mines, quarries and sand/gravel extraction.	
3	Influence of major urban area upstream. This will be relative to population size, river size and distance between the site and the impact.	
4	Influence of significant point-source waste water discharge upstream.* Exceptions can be made for small discharges into large rivers.	
5	Influence of dam or major weir* Sites within the ponded area of impoundments also fail. Sites failing this criterion automatically fail the overall assessment.	
6	Influence of alteration to seasonal flow regime This may be due to abstraction or regulation further upstream than the coverage by Criterion 5. Includes either an increase or decrease in seasonal flow.	
7	Influence of alteration to riparian zone Riparian vegetation should be intact and dominated by native species.	
8	Influence of erosion and damage by stock on riparian zone and banks. Stock damage to the stream bed may be included in this category.	
9	Influence of major geomorphological change on stream channel Geomorphological change includes bank slumping, shallowing, braiding and unnatural aggradation or degradation.	
10	Influence of alteration to instream conditions and habitats This may be due to excessive algal and macrophyte growth, by sedimentation and siltation, by reduction in habitat diversity by drowning or drying out of habitats (e.g. riffles) or by direct access of stock into the river	
	SITE ASSESSMENT	/50

* Note: the level of impact at a site will generally decrease as the distance from the source of impact increases.

Each criterion relates to an aspect of human activity that impacts on freshwater ecosystems, where impact is defined as a 'change from natural condition'. Each criterion is given a score according to the following categories:

1. Very major impact
2. Major impact
3. Moderate impact
4. Minor impact
5. Indiscernible impact

Sites are assessed using the total score for the ten criteria. Those sites that have a total greater than 44 are deemed to be reference sites. Sites that are given a score of '1', '2' or '3' for Criterion 5 (no dam or major weir upstream) cannot be reference sites.

APPENDIX 3

Water Quality Sampling Field Sheet

WATER QUALITY SAMPLING FIELD SHEET

NATURAL RESOURCES Queensland Government

**** Site Number***
**** Date***
**** Time*** EST
**** Project Name***
**** Collecting Authority***
**** Sample Source***

Site Name _____
Gauge No.
Party ***and***

Analysis No.

TYPE ***Submitted*** / ***Received***

A	B	C	D	E	F	G	H	I	J	K	L	M	N

Parameter	Value	Quality	Variable
Gauge Height m			*100.*
Air Temperature ^0C			*2065.5*
Water Temperature ^0C			*2080.5*
Conductivity $\mu S/cm@25^0$			*2010.5*
pH			*2100.5*
Dissolved O_2 mg/l			*2351.5*
Turbidity NTU			*2030.5*
Phenol. Alkalinity mg/l			*2114.5*
Total Alkalinity mg/l			*2113.5*
Transparency *(secchi)* m			*2046.5*
Velocity m/s			*240.*
Discharge m^3/s			*140.*
Discharge Method: *measured* ☐ *estimated* ☐ *rating curve* ☐			

Observations at Water Sampling Site

Rain in past week:	Yes [ ]	No [ ]			
Weather:	No rain [ ]	Showers [ ]	Heavy rain [ ]		
	Sunny [ ]	Some Cloud [ ]	Over cast [ ]		
	Calm [ ]	Breeze [ ]	Strong Wind [ ]		
Water Odour:	None [ ]	Effluent [ ]	Anoxic [ ]	Algae [ ]	
Water Foaming:	None [ ]	Detergent [ ]	Surf. Spot [ ]	Scum [ ]	
Algae: } ON SUBSTRATE:	None [ ]	Little [ ]	Moderate [ ]	Lot [ ]	
} IN WATER COLUMN:	None [ ]	Little [ ]	Moderate [ ]	Lot [ ]	
Macrophytes: } EMERGENT:	None [ ]	Little [ ]	Moderate [ ]	Lot [ ]	
} SUBMERGED:	None [ ]	Little [ ]	Moderate [ ]	Lot [ ]	
} FLOATING:	None [ ]	Little [ ]	Moderate [ ]	Lot [ ]	

Presence of Pastoral Animals [ ] ***Presence of Non-Pastoral Animals*** [ ]

Any Human Activity .....

Plant Types (aquatic only) .....

Animal Life (eg fish, prawn) .....

Comments: .....
.....
.....

(Office use only) ENTERED INTO HYDSYS ON / / BY .....
CHECKED ON / / BY .....

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***** Compulsory Fields

Reach Observations

Water odours: 1. normal 2. sewage 3. petroleum 4. chemical 5. none [ ]

Water oils: 1. slick 2. sheen 3. globs 4. flecks 5. none [ ]

Turbidity: 1. clear 2. slight 3. turbid 4. opaque [ ]

Plume: 1. little 2. some 3. lots [ ]
(amount of fine sediment generated when kick sampling)

Sediment oils: 1. absent 2. light 3. moderate 4. profuse [ ]

Sediment odours: 1. normal 2. sewage 3. petroleum 4. chemical
5. anaerobic 6. none 7. other ..... [ ]

Flow level: (relative to 'watermark' i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).
1. no flow (dry/isolated) 2. low (<water mark) 3. moderate (=) 4. high (>water mark) 5. flood [ ]

Bare ground above water mark: area in riparian zone expected to be vegetated but bare. left bank . . . . . %
right bank . . . . . %

Bank erosion: 1. extreme 2. extensive 3. moderate 4. limited 5. none [ ]

Are the undersides of stones, which are not deeply embedded, black? 1. yes 2. no [ ]

Sediment deposits: 1. none 2. sludge 3. sawdust 4. paper fibre
5. sand 6. relict shells 7. other ..... [ ]

Local catchment erosion: 1. none 2. some 3. moderate 4. heavy [ ]

Local non-point source pollution: 1. no evidence 2. potential . . . . . 3. obvious . . . . . [ ]

Local point source pollution: 1. no evidence 2. potential . . . . . 3. obvious . . . . . [ ]

Dams/barriers: 1. absent 2. present upstream/downstream [ ]
discharge: >natural flow/<natural flow [ ]

Hydrologic deviation: 1. none 2. some extraction 3. minor dams, weirs etc
4. extensive extraction 5. major dams 6. other . . . . . [ ]

Site position in catchment: 1. upland 2. midland 3. lowland [ ]

Site classification (of the reach): 1. steep valley 2. broad valley 3. wetland/bog 4. heath
5. levees present 6. stream bars 7. natural riparian meadow [ ]

Adjacent landuse: 1. urban 2. semi-urban 3. irrigated cropping
(indicate L &/or R bank if different) 4. non-irrigated cropping 5. light grazing 6. moderate grazing
7. heavy grazing 8. forestry 9. native forest 10. other . . . . . [ ]

Upstream catchment development: 1. >75% 2. 50-75% 3. 25-50% 4. 0-25% 5. none [ ]

Bars: (bed surface protruding from normal water level & forming a bar) . . . . . %

Macrophytes

Indicate whether the following common taxa are present in the reach:

NATIVE

Azolla . . . . . .
Duckweed . . . . . .
Hornwort *(Ceratophyllum)* . . . . . .
Stoneworts (*Chara or Nitella*) . . . . . .
Hydrilla . . . . . .
Water Milfoil (*Myriophyllum*) . . . . . .
Pondweeds (*Potamogeton*) . . . . . .
Ribbonweed (*Vallisneria*) . . . . . .
Water Ribbon (*Triglochin*) . . . . . .
Water Lettuce (*Pistia statiotes*) . . . . . .
Water Primrose (*Ludwigia*) . . . . . .
Sedge (*Cyperus*) . . . . . .
Common Rush (*Juncus*) . . . . . .
Typha/Cumbungi . . . . . .
Slender Knotweed (*Persicaria*) . . . . . .
Other . . . . . .
. . . . . .
. . . . . .

EXOTIC

Water Hyacinth *(Eichhornia)* . . . . . .
Salvinia . . . . . .
Alligator Weed *(Alternanthera)* . . . . . .
Egeria . . . . . .
Elodea . . . . . .
Para Grass (*Urochloa*) . . . . . .
Other . . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

APPENDIX 4

Macroinvertebrate Sampling Field Sheet

River Bioassessment Program

MACROINVERTEBRATE SAMPLING FIELD SHEET

NATURAL RESOURCES Queensland Government

SITE NUMBER: [| | | | | |] **SITE NAME:** _____

Project Name: _____ **Date:** ___/___/___ **Time (24 hrs):** [| | |] **GPS:** _____

EDGE/BACKWATER: Y [ ] N [ ] Collected by: [| |] Picked By: [| |] No. vials: [ ]

Velocity (m/sec): max [| • | |] min [| • | |]

Mean Depth: [| • | |] m

Mean Channel Width: [| | | • |] m

Method: 10 m sweep [ ]
60 min random pick [ ]
Other _____ [ ]

Canopy Cover: [| |] %

Width of Riparian Zone: LB [| |] m RB [| |] m

Composition of Riparian Zone:
Native [| |] % Exotic [| |] %

***Riparian Vegetation:**
Grass [| |] % Trees <10 m high [| |] %
Shrubs [| |] % Trees >10 m high [| |] %

Substrate Description:

Bedrock	[| |] %	Gravel (4 - 16 mm)	[| |] %
Boulder (> 256 mm)	[| |] %	Sand (1 - 4 mm)	[| |] %
Cobble (64 - 256 mm)	[| |] %	Silt/Clay (< 1mm)	[| |] %
Pebble (16 - 64 mm)	[| |] %		

Substrate Cover:

Periphyton	0	1	2	3	4
Moss	0	1	2	3	4
Filamentous algae	0	1	2	3	4
Macrophytes	0	1	2	3	4
Detritus	0	1	2	3	4

0 = <10% 1 = 10-35% 2 = 35-65% 3 = 65-90% 4 = >90%

Bank Overhang Vegetation:
extensive [ ] moderate [ ] slight [ ] nil [ ]

Trailing Bank Vegetation:
extensive [ ] moderate [ ] slight [ ] nil [ ]

BED: Y [ ] N [ ] Collected by: [| |] Picked By: [| |] No. vials: [ ]
TYPE: Riffle [ ] Rocky/Gravel Bed [ ] Sandy/Silty [ ]

Velocity (m/sec): max [| • | |] min [| • | |]

Mean Depth: [| • | |] m

Mean Channel Width: [| | | • |] m

Method: 10 m kick only [ ]
10 m kick & gleaning rocks of different sizes (5) [ ]
60 min random pick [ ]
Other _____ [ ]

Canopy Cover: [| |] %

Width of Riparian Zone: LB [| |] m RB [| |] m

Composition of Riparian Zone:
Native [| |] % Exotic [| |] %

***Riparian Vegetation:**
Grass [| |] % Trees <10 m high [| |] %
Shrubs [| |] % Trees >10 m high [| |] %

Substrate Description:

Bedrock	[| |] %	Gravel (4 - 16 mm)	[| |] %
Boulder (> 256 mm)	[| |] %	Sand (1 - 4 mm)	[| |] %
Cobble (64 - 256 mm)	[| |] %	Silt/Clay (< 1mm)	[| |] %
Pebble (16 - 64 mm)	[| |] %		

Substrate Cover:

Periphyton	0	1	2	3	4
Moss	0	1	2	3	4
Filamentous algae	0	1	2	3	4
Macrophytes	0	1	2	3	4
Detritus	0	1	2	3	4

0 = <10% 1 = 10-35% 2 = 35-65% 3 = 65-90% 4 = >90%

Bank Overhang Vegetation:
extensive [ ] moderate [ ] slight [ ] nil [ ]

Trailing Bank Vegetation:
extensive [ ] moderate [ ] slight [ ] nil [ ]

* Can add to > 100%

Adjacent Landuse:

Upstream Landuse:

****Percent of habitat types in 100 m reach:**

Riffle [| |] % Run [| |] % Macrophytes [| |] %
Pool (rocky) [| |] % Pool (sandy) [| |] % Dry [| |] % Edge [| |] %

** Riffle + Run + Pool + Macrophyte + Dry = 100%; Edge is % of habitat available to sample from L and R banks

TOTAL NO. VIALS: **OTHERS:**

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1. LONGITUDINAL PROFILE SKETCH OF STREAM REACH

Scale: _____

Please indicate
1. Biological sampling sites for each habitat type and % of reach.
2. Water quality measurement and water sample collection sites.
3. Location from where photograph(s) taken.
4. Location of cross-sectional profile sketch.

2. CROSS-SECTIONAL PROFILE SKETCH OF STREAM REACH

Scale: _____

Please indicate
1. Approx. bank height/bank width (overflow), stream width and depth.
2. Approx. riparian vegetation height.

3. COMMENTS

(Office use only) **Entered into Hydsys on** ____/____/____ **By** _____

Checked on ____/____/____ **By** _____

APPENDIX 5

Habitat Assessment Field Sheet

River Bioassessment Program

HABITAT ASSESSMENT FIELD SHEET

SITE NUMBER: [| | | | | |] **SITE NAME:** _____

Date: ____/____/_____ **Time (24 hrs): [| | |]** **GPS:** _____ **Project Name:** _____

Habitat Variable	CATEGORY			
	Excellent	**Good**	**Fair**	**Poor**
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat. 20, 19, 18, 17, 16	30-50% rubble, gravel or other stable habitat. Adequate habitat. 15, 14, 13, 12, 11	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 10, 9, 8, 7, 6	Less than 10% rubble, gravel or stable habitat. Lack of habitat is obvious. 5, 4, 3, 2, 1, 0
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment. 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25% & 50% surrounded by fine sediment. 15, 14, 13, 12, 11	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment. 10, 9, 8, 7, 6	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment. 5, 4, 3, 2, 1, 0
3. Velocity/depth category	Slow deep (<0.3 m/s & >0.5 m); slow shallow; fast deep; fast shallow; habitats all present. 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools). 15, 14, 13, 12, 11	Only two of the four habitat categories present (missing riffles/runs receive lower score). 10, 9, 8, 7, 6	Dominating by one velocity/depth category (usually pool). 5, 4, 3, 2, 1, 0
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation. 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present. 11, 10, 9, 8	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled with silt; and/or embankments on both banks. 7, 6, 5, 4	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation. 3, 2, 1, 0
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition. 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools. 11, 10, 9, 8	30-50% affected. Deposits and scours at obstructions and bends. Some deposition in pools. 7, 6, 5, 4	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 3, 2, 1, 0

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River Bioassessment Program

HABITAT ASSESSMENT FIELD SHEET cont.

Habitat Variable	CATEGORY			
	Excellent	**Good**	**Fair**	**Poor**
6. Pool/riffle, run/bend ratio. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools. 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat. 11, 10, 9, 8	15-25 Occasional riffle or bend. Bottom contours provide some habitat. 7, 6, 5, 4	>25 Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 3, 2, 1, 0
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 8, 7, 6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme/high flows. 5, 4, 3	Unstable. Many eroded areas. Side slopes > 60% common. 'Raw' areas frequent along straight sections and bends. 2, 1, 0
8. Bank vegetative stability	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 8, 7, 6	25-49% of the streambank covered by vegetation, gravel or larger material. 5, 4, 3	Less than 25% of the streambank surfaces covered by vegetation, gravel or larger material. 2, 1, 0
9. Streamside cover	Dominant vegetation is of tree form. 10, 9	Dominant vegetation shrub. 8, 7, 6	Dominant vegetation is grass, sedge, ferns. 5, 4, 3	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 2, 1, 0

Column Totals				

Score

○ ○ ○ ○

APPENDIX 6

Task Sheet

NATURAL RESOURCES
Queensland Government

River Bioassessment Program

FIELD SAMPLING TASKS TO BE COMPLETED

*** Please check off each item before leaving a sampling site. ***

SITE NO. ..... **SITE NAME** .....

[ ] Plan sketch of 100 m stream reach to be sampled; to include:

- [ ] location of different habitats, macrophytes and other vegetation
- [ ] location of biological sampling sites
- [ ] location of water quality measurement sites
- [ ] location of water collection sites for GCL samples
- [ ] location of x-sectional profile sketch
- [ ] location from where photograph (s) taken
- [ ] scale

[ ] X-sectional profile sketch; to include:

- [ ] stream width
- [ ] bank heights
- [ ] riparian vegetarion heights

[ ] Photograph(s)/video of sampling site

[ ] Biological sampling of the different habitats and 60 min. random picking for each

[ ] Biological samples preserved in 80% methylated spirit, labelled and stored upright

[ ] Water quality measurements taken

[ ] Water quality samples for GCL collected, labelled and stored appropriately

[ ] Field sheets 1, 2 and GCL water analysis input sheets completed, checked and initialled

[ ] Gauge height/flow recorded

[ ] GPS recorded

Date .....

Signed .....

A4502677RSC.P65 (LM3883) 20/8/98

APPENDIX 7

Macroinvertebrate Identification Tally Sheet

MACROINVERTEBRATE IDENTIFICATION SHEET

Site Number [| | | | | |]
Site Name _____
Run No. [| | | |] **Collection Date / /**

	Edge	Bed [ ]
Sheet No.		
Completed (init)		
Date		
No. vials		

		Edge	Bed [ ]			Edge	Bed [ ]			Edge	Bed [ ]
1	Rotifer			56	Anisoptera			111	Brentidae		
2	Nemertea			57	Aeshnidae			112	Curculionidae		
3	Porifera			58	Gomphidae			113	Diptera		
4	Hydridae			59	Corduliidae			114	Chironomidae (unid.)		
5	Temnocephalidea			60	Libellulidae			115	s-f Podonominae		
6	Nematoda			61	Zygoptera			116	s-f Aphroteniinae		
7	Dugesiidae			62	Coenagrionidae			117	s-f Tanypodinae		
8	Nematomorpha			63	Isostictidae			118	s-f Orthocladiinae		
9	Oligochaeta			64	Protoneuridae			119	s-f Chironominae		
10	Hirudinea			65	Lestidae			120	Simuliidae		
11	Glossiphoniidae			66	Hypolestidae			121	Ceratopogonidae		
12	Richardsonianidae			67	Megapodagrionidae			122	Culicidae		
13	Ornithobdellidae			68	Synlestidae			123	Tipulidae		
14	Erpobdellidae			69	Diphlebiidae			124	Tabanidae		
15	Physidae			70	Plecoptera			125	Empididae		
16	Planorbidae			71	Eustheniidae			126	Stratiomyidae		
17	Lymnaeidae			72	Gripopterygidae			127	Dolichopodidae		
18	Hydrobiidae			73	Hemiptera			128	Dixidae		
19	Thiaridae			74	Corixidae			129	Psychodidae		
20	Ancylidae			75	Naucoridae			130	Blephariceridae		
21	Viviparidae			76	Nepidae			131	Chaoboridae		
22	Bithyniidae			77	Belostomatidae			132	Muscidae		
23	Neritidae			78	Notonectidae			133	Athericidae		
24	Sphaeriidae			79	Pleidae			134	Syrphidae		
25	Corbiculidae			80	Hydrometridae			135	Ephydridae		
26	Hyriidae			81	Gerridae			136	Sciomyzidae		
27	Acarina			82	Veliidae			137	Thaumaleidae		
28	Copepoda			83	Hebridae			138	Tanyderidae		
29	Cladocera			84	Mesoveliidae			139	Trichoptera		
30	Ostracoda			85	Gelastocoridae			140	Leptoceridae		
31	Branchiura			86	Saldidae			141	Hydropsychidae		
32	Conchostraca			87	Ochteridae			142	Ecnomidae		
33	Isop-Cirolanidae			88	Corydalidae			143	Hydroptilidae		
34	Isop-Sphaeromatidae			89	Sialidae			144	Calamoceratidae		
35	Isop-Oniscidae			90	Sisyridae			145	Helicopsychidae		
36	Isop-Janiridae			91	Neurorthidae			146	Hydrobiosidae		
37	Amph-Talitridae			92	Osmylidae			147	Glossosomatidae		
38	Amph-Ceinidae			93	Coleoptera			148	Philopotamidae		
39	Amph-Corophiidae			94	Gyrinidae			149	Polycentropodidae		
40	Amph-Eusiridae			95	Dytiscidae			150	Psychomyiidae		
41	Amph-Melitidae			96	Elmidae			151	Philorheithridae		
42	Atyidae			97	Psephenidae			152	Calocid/Helicophidae		
43	Palaemonidae			98	Hydrophilidae			153	Odontoceridae		
44	Parasticidae			99	Ptilodactylidae			154	Conoesucidae		
45	Sundathelphusidae			100	Hydraenidae			155	Dipseudopsidae		
46	Grapsidae			101	Noteridae			156	Atriplectidae		
47	Collembola			102	Scirtidae			157	Tasimiidae		
48	Ephemeroptera			103	Carabidae			158	Antipodoeciidae		
49	Leptophlebiidae			104	Haliplidae			159	Pyralidae		
50	Baetidae			105	Hygrobiidae			160	Hymenoptera		
51	Caenidae			106	Microsporidae			161	Anostraca		
52	Ameletopsidae			107	Staphylinidae			162	Clavidae		
53	Prosopistomatidae			108	Chrysomelidae						
54	Ephemerellidae			109	Heteroceridae				**Entered**		
55				110	Limnichidae				**Checked**		

APPENDIX 8

Keys Used for Identification of Queensland Macroinvertebrate Fauna

Order	Author/Editor	Year	Key
General Keys	Hawking, J.H.	1999	A preliminary guide to keys and zoological information to identify invertebrates from Australian freshwaters
General Keys	Merritt, R.W. & Cummins, K.W.	1996	An Introduction to the aquatic insects of North America (third edition)
General Keys	Hawking, J.H.	1995	Monitoring River Health Initiative taxonomic workshop handbook
General Keys	CSIRO	1991	The Insects of Australia (second edition) Volume 2
General Keys	CSIRO	1991	The Insects of Australia (second edition) Volume 1
General Keys	CSIRO	1999	Interactive Guide to Australian Aquatic Invertebrates Edition 2 (CD ROM)
General Keys	Williams, W.D.	1980	Australian Freshwater Life
Acarina	Harvey, M.S. & Growns, J.E.	1998	A guide to the identification of families of Australian water mites (Arachnida: Acarina)
Coleoptera	Glaister, A.	1999	Guide to the identification of Australian Elmidae larvae (Insecta: Coleoptera)
Coleoptera	Watts, C.	1998	Preliminary guide to the identification of adult and larval Dytiscidae and Adult aquatic Hydrophilidae (Insecta: Coleoptera)
Coleoptera	Davis, J.	1998	A guide to the identification of larval Psephenidae water pennies (Insecta: Coleoptera)
Crustacea	Sheil, R.	2000	Cladocera (Crustacea)
Crustacea	Wilson, G.D.F.	1999	Phreatoicidae (Isopoda, Crustacea)
Crustacea	Bradbury, J	1999	Described Australian Amphipoda
Crustacea	Griggs, J.A., Shiel, R.J. & Croome, R.L.	1999	A guide to the identification of Chydorids (Branchiopoda: Anomopoda) from Australian inland waters
Crustacea	Horwitz, P., Knott, B. & Williams, W.D.	1995	A preliminary key to the Malacostracan families (Crustacea) found in Australian inland waters
Crustacea	Horwitz, P.	1995	A preliminary key to the species of Decapoda (Crustacea: Malacostraca) found in Australian inland waters
Crustacea	Shiel, R.J.	1995	A guide to identification of rotifers, cladocerans and copepods from Australian inland waters
Crustacea	De Deckker, P.	1995	Notes to help identify ostracods from Australian inland waters and a guide to ostracod dissection/Attempt at keying Australian ostracods for their identification
Diptera	Cranston, P.	1997	Identification guide to the Chironomidae of New South Wales
Diptera		1995	Key to aquatic diptera families
Ephemeroptera	Suter, P.J.	1999	Illustrated key to the Australian Caenid nymphs (Ephemeroptera: Caenidae)
Ephemeroptera	Suter, P.J.	1997	Preliminary guide to the identification of nymphs of Australian Baetid mayflies (Insecta: Ephemeroptera) found in flowing waters
Ephemeroptera	Dean, J.C. & Suter, P.J.	1996	Mayfly nymphs of Australia - a guide to genera
Hemiptera	Moller Andersen, N. & Weir, T.A.	1994	Austrobates rivularis, gen. Et sp. Nov., a freshwater relative of Halobates Eschscholtz (Hemiptera: Gerridae), with a new perspective on the evolution of sea skaters
Hemiptera	Moller Andersen, N. & Weir, T.A.	1994	The Girrine water striders of Australia (Hemiptera: Gerridae): Taxonomy, distribution and ecology
Hemiptera	Moller Andersen, N. & Weir, T.A.	1994	The sea skaters, genus Halobates Eschscholtz (Hemiptera: Gerridae), of Australia: Taxonomy, Phylogeny and Zoogeography
Megaloptera	Theischinger, G.	2000	Australian Alderfly larvae and adults (Insecta : Megaloptera) a preliminary guide to the identification of larvae and survey of adults of Australian Alderflies.
Mollusca	Ponder, W. F., Clark, S. A. & Dallwitz, M. J.	2000	Freshwater and Esturine Molluscs: An interactive, illustrated key for New South Wales

Order	Author/Editor	Year	Key
Mollusca	Miller, A. C., Ponder, W. F. & Clark, S. A.	1999	Freshwater snails of the genera Fluvidona and Austropyrgus (Gastropoda, Hydrobiidae) from Northern New South Wales and southern Queensland, Australia
Mollusca	Smith, B.J.	1996	Identification keys to the families and genera of bivalve and gastropod Molluscs found in Australian inland waters
Mollusca	Sheldon, F. & Walker, K.F.	1993	Shell variation in Australian Notopala (Gastropoda: Prosobranchia: Viviparidae)
Mollusca	Smith, B.J.	1992	Zoological catalogue of Australia - non-marine Mollusca
Mollusca	Walker, J.C.	1988	Classification of Australian buliniform planorbids (Mollusca: Plumonata)
Mollusca	Stoddart, J.A.	1985	Analysis of species lineages of some Australian thiarids (Thiaridae, Prosobranchia, Gastropoda) using the evolutionary species concept
Mollusca	Kuiper, J.G.J.	1983	The Sphaeriidae of Australia (extract only)
Mollusca		1966	Studies on Ancylidae
Mollusca	Stoddart, J.A.		Western Australian Viviparids (Prosobranchia: Mullusca)
Mollusca	Brown, D.S.		Observations on Planorbinae from Australia and New Guinea
Odonata	Hawking, J. & Theischinger, G.	1999	Dragonfly Larvae (Odonata) - a guide to the identification of larvae of Australian families and identification and ecology of larvae from New South Wales
Odonata	Theischinger, G.	2000	Preliminary keys for the identification of larvae of the Australian Gomphides (Odonata)
Plecoptera	Yule, C.	1997	Identification guide to the stonefly nymphs of New South Wales and northern Victoria
Plecoptera	Tsyrlin, E.	1999	Preliminary key to mature nymphs of Leptoperla stoneflies in Victoria
Trichoptera	St.Clair, R.M.	2000	Preliminary keys for the identification of Australian Caddisfly larvae of the family Leptoceridae
Trichoptera	St.Clair, R.M.	2000	Preliminary keys for the identification of Australian Caddisfly larvae of the families Odontoceridae, Kokiriidae and Oeconesidae
Trichoptera	Dean, J.C.	2000	Preliminary keys for the identification of Australian Caddisfly larvae of the families Antipodoeciidae, Atriplectididae, Limnephilidae and Plectrotarsidae
Trichoptera	Dean, J.C. & St Clair, R.M.	1999	Taxonomy of immatures of selected families of Ephemeroptera and Trichoptera
Trichoptera	Dean, J.C.	1999	Preliminary keys for the identification of Australian Trichoptera larvae of the family Hydropsychidae
Trichoptera	Cartwright, D.I.	1998	Preliminary guide to the identification of late instar larvae of Australian Polycentropodidae, Glossosomatidae, Dipsuedopsidae and Psychomyiidae (Insecta: Trichoptera)
Trichoptera	Jackson, J.	1998	Preliminary guide to the identification of late instar larvae of Australian Calocidae, Helicophidae and Conoesucidae (Insecta: Trichoptera)
Trichoptera	St Clair, R.M.	1997	Preliminary guide to the identification of late instar larvae of Australian Philorheithridae, Calamoceratidae and Helicopsychidae (Insecta: Trichoptera)
Trichoptera	Dean, J.C.	1997	Larvae of the Australian Hydrobiosidae (Insecta: Trichoptera)
Trichoptera	Wells, A.	1997	A preliminary guide to the identification of larval Hydroptilidae (Insecta: Trichoptera)
Trichoptera	Cartwright, D.I.	1997	A key to species of late instar larvae of Australian Trichoptera (Families Dipseudopsidae, Glossosomatidae, Polycentropodidae, Psychomyiidae, Ecnomidae, Philopotamidae and Tasmiidae)
Trichoptera	Dean, J.C., St Clair, R.M., Cartwright, D.I. & Wells, A.	1996	Identification of late instar larvae of Australian Trichoptera genera

APPENDIX 9

List of Predictor Variables Used for the Mark I and Mark II Models

Mark I			
Spring Edge	**Spring Bed**	**Autumn Edge**	**Autumn Bed**
Depth (m)	Bedrock (%)	Alkalinity (mg/L)	Altitude (m)
Distance from source (km)	Cobble (%)	Distance from source (km)	Cobble (%)
Latitude [1]	Gravel (%)	Latitude [1]	Gravel (%)
Longitude [1]	Latitude [1]	Longitude [1]	Maximum velocity (m/s)
Water body description [2]	Macrophyte cover [3]	Minimum velocity (m/s)	Water body description [2]
Water temperature (°C)	Minimum velocity (m/s)	Stream slope (m/m)	Sand (%)
	Water body description [2]		Silt (%)
	Stream slope (m/m)		Stream order
			Stream slope (m/m)
			Stream wetted width (m)
			Water temperature (°C)
Mark II			
Spring Edge	**Spring Pool**	**Autumn Edge**	**Autumn Pool**
		Alkalinity (mg/L)	Alkalinity (mg/L)
		Cobble (%)	Bedrock (%)
		Number of habitats	Cobble (%)
		Latitude [1]	Distance from source (km)
		Longitude [1]	Latitude [1]
		Mean annual rainfall (mm)	Longitude [1]
		Slope (m/m)	Mean dry season monthly rainfall (mm)
		Soil class [4]	(MDMR)
		Stream order	Pebble (%)
		Water temperature (°C)	Ratio of mean wet to mean dry season
		Range in wet season monthly	monthly rainfall (mm) (RAWD)
		rainfall means (mm) (WETR)	Reach category [5]
			Stream wetted width (m)
			Substrate categories [6]

1 Decimal degrees.

2 (reflow) 1: some part of water body flowing; 2: No flow-surface area<100 m^2; 3: No flow-surface area >100 m^2.

3 Measured in the habitat: 0: none (0%); 1: little (5-30%); 2: moderate (40-60%); 3: extensive (>70%).

4 Soil class number (1-11) – attained from GIS map overlay

5 0: lower; 1: middle; 2: upper.

6 Number of substrate categories in reach (Bedrock, boulder, cobble, pebble, gravel, and and silt/clay – 7 categories in total)

APPENDIX 10

National Taxonomic Codes for Macroinvertebrate Families Collected in Queensland

Order	Family	National Taxon Code	Order	Family	National Taxon Code
Porifera	Porifera	IA999999	Amphipoda	Melitidae	OP099999
Hydrozoa	Hydridae	IB019999	Isopoda	Cirolanidae	OR129999
Hydrozoa	Clavidae	IB029999	Isopoda	Sphaeromatidae	OR139999
Temnocephalidea	Temnocephalidea	IF499999	Isopoda	Janiridae	OR189999
Turbellaria	Dugesiidae	IF619999	Isopoda	Oniscidae	OR259999
Nemertea	Nemertea	IH999999	Decapoda	Atyidae	OT019999
Nematoda	Nematoda	II999999	Decapoda	Palaemonidae	OT029999
Nematomorpha	Nematomorpha	IJ999999	Decapoda	Parasticidae	OV019999
Tardigrada	Tardigrada	IR999999	Decapoda	Sundathelphusidae	OX519999
Rotifera	Rotifer	JZ999999	Decapoda	Grapsidae	OX619999
Gastropoda	Viviparidae	KG019999	Crustacea	Crustacea	OZ999999
Gastropoda	Hydrobiidae	KG029999	Collembola	Collembola	QA999999
Gastropoda	Bithyniidae	KG039999	Coleoptera	Microsporidae	QC039999
Gastropoda	Thiaridae	KG049999	Coleoptera	Carabidae	QC059999
Gastropoda	Lymnaeidae	KG059999	Coleoptera	Haliplidae	QC069999
Gastropoda	Ancylidae	KG069999	Coleoptera	Hygrobiidae	QC079999
Gastropoda	Planorbidae	KG079999	Coleoptera	Noteridae	QC089999
Gastropoda	Physidae	KG089999	Coleoptera	Dytiscidae	QC099999
Gastropoda	Neritidae	KG109999	Coleoptera	Gyrinidae	QC109999
Gastropoda	Gastropoda	KG999999	Coleoptera	Hydrophilidae	QC119999
Bivalvia	Hyriidae	KP019999	Coleoptera	Hydraenidae	QC139999
Bivalvia	Corbiculidae	KP029999	Coleoptera	Staphylinidae	QC189999
Bivalvia	Sphaeriidae	KP039999	Coleoptera	Scirtidae	QC209999
Bivalvia	Bivalvia	KP999999	Coleoptera	Elmidae	QC349999
Hirudinea	Glossiphoniidae	LH019999	Coleoptera	Limnichidae	QC359999
Hirudinea	Ozobranchidae	LH029999	Coleoptera	Heteroceridae	QC369999
Hirudinea	Richardsonianidae	LH039999	Coleoptera	Psephenidae	QC379999
Hirudinea	Ornithobdellidae	LH049999	Coleoptera	Ptilodactylidae	QC399999
Hirudinea	Erpobdellidae	LH059999	Coleoptera	Chrysomelidae	QCAH9999
Hirudinea	Hirudinea	LH999999	Coleoptera	Brentidae	QCAM9999
Oligochaeta	Oligochaeta	LO999999	Coleoptera	Curculionidae	QCAN9999
Polychaeta	Polychaeta	LP999999	Coleoptera	Coleoptera	QCZZ9999
Arachnida	Acarina	MM999999	Diptera	Tipulidae	QD019999
Anostraca	Anostraca	OD999999	Diptera	Tanyderidae	QD039999
Conchostraca	Conchostraca	OF999999	Diptera	Blephariceridae	QD049999
Cladocera	Cladocera	OG999999	Diptera	Chaoboridae	QD059999
Ostracoda	Ostracoda	OH999999	Diptera	Dixidae	QD069999
Copepoda	Copepoda	OJ999999	Diptera	Culicidae	QD079999
Branchiura	Branchiura	OK999999	Diptera	Ceratopogonidae	QD099999
Amphipoda	Talitridae	OP019999	Diptera	Simuliidae	QD109999
Amphipoda	Ceinidae	OP029999	Diptera	Thaumaleidae	QD119999
Amphipoda	Eusiridae	OP039999	Diptera	Psychodidae	QD129999
Amphipoda	Corophiidae	OP059999	Diptera	Athericidae	QD229999
Amphipoda	Paramelitidae	OP069999	Diptera	Tabanidae	QD239999

Order	Family	National Taxon Code	Order	Family	National Taxon Code
Diptera	Stratiomyidae	QD249999	Neuroptera	Osmylidae	QN039999
Diptera	Empididae	QD359999	Neuroptera	Neurorthidae	QN049999
Diptera	Dolichopodidae	QD369999	Neuroptera	Sisyridae	QN059999
Diptera	Syrphidae	QD439999	Zygoptera	Coenagrionidae	QO029999
Diptera	Sciomyzidae	QD459999	Zygoptera	Isostictidae	QO039999
Diptera	Ephydridae	QD789999	Zygoptera	Protoneuridae	QO049999
Diptera	Muscidae	QD899999	Zygoptera	Lestidae	QO059999
Diptera	s-f Aphroteniinae	QDAA9999	Zygoptera	Hypolestidae	QO069999
Diptera	s-f Diamesinae	QDAB9999	Zygoptera	Megapodagrionidae	QO079999
Diptera	s-f Telmatogetoninae	QDAC9999	Zygoptera	Synlestidae	QO089999
Diptera	s-f Podonominae	QDAD9999	Zygoptera	Diphlebidae	QO099999
Diptera	s-f Tanypodinae	QDAE9999	Anisoptera	Aeshnidae	QO129999
Diptera	s-f Orthocladiinae	QDAF9999	Anisoptera	Gomphidae	QO139999
Diptera	s-f Chironominae	QDAJ9999	Anisoptera	Petaluridae	QO159999
Diptera	Chironomidae (unid.)	QDAZ9999	Anisoptera	Corduliidae	QO169999
Diptera	Diptera	QDZZ9999	Anisoptera	Libellulidae	QO179999
Ephemeroptera	Baetidae	QE029999	Zygoptera	Zygoptera	QO999997
Ephemeroptera	Ameletopsidae	QE049999	Anisoptera	Anisoptera	QO999998
Ephemeroptera	Leptophlebiidae	QE069999	Plecoptera	Eustheniidae	QP019999
Ephemeroptera	Ephemerellidae	QE079999	Plecoptera	Gripopterygidae	QP039999
Ephemeroptera	Caenidae	QE089999	Plecoptera	Plecoptera	QP999999
Ephemeroptera	Prosopistomatidae	QE099999	Trichoptera	Hydrobiosidae	QT019999
Ephemeroptera	Ephemeroptera	QE999999	Trichoptera	Glossosomatidae	QT029999
Hymenoptera	Hymenoptera	QG999999	Trichoptera	Hydroptilidae	QT039999
Hemiptera	Mesoveliidae	QH529999	Trichoptera	Philopotamidae	QT049999
Hemiptera	Hebridae	QH539999	Trichoptera	Hydropsychidae	QT069999
Hemiptera	Hydrometridae	QH549999	Trichoptera	Polycentropodidae	QT079999
Hemiptera	Veliidae	QH569999	Trichoptera	Ecnomidae	QT089999
Hemiptera	Gerridae	QH579999	Trichoptera	Psychomyiidae	QT099999
Hemiptera	Saldidae	QH609999	Trichoptera	Tasimiidae	QT139999
Hemiptera	Nepidae	QH619999	Trichoptera	Conoesucidae	QT159999
Hemiptera	Belostomatidae	QH629999	Trichoptera	Antipodoeciidae	QT169999
Hemiptera	Ochteridae	QH639999	Trichoptera	Helicopsychidae	QT179999
Hemiptera	Gelastocoridae	QH649999	Trichoptera	Calocidae/Helicophidae	QT189999
Hemiptera	Corixidae	QH659999	Trichoptera	Philorheithridae	QT219999
Hemiptera	Naucoridae	QH669999	Trichoptera	Odontoceridae	QT229999
Hemiptera	Notonectidae	QH679999	Trichoptera	Atriplectidae	QT239999
Hemiptera	Pleidae	QH689999	Trichoptera	Calamoceratidae	QT249999
Hemiptera	Hemiptera	QHZZ9999	Trichoptera	Leptoceridae	QT259999
Mecoptera	Nannochoristidae	QK019999	Trichoptera	Dipseudopsidae	QT269999
Lepidoptera	Pyralidae	QL019999	Trichoptera	Trichoptera	QT999999
Lepidoptera	Lepidoptera	QL999999	Unidentified	Unidentified	XX999999
Megaloptera	Corydalidae	QM019999			
Megaloptera	Sialidae	QM029999			