Government of **Western Australia**
Department of **Water and Environmental Regulation**

SOUTH WEST
INDEX OF RIVER CONDITION

River Science

technical series

South West Index of River Condition

Module 2 – method summary: collection and analysis of aquatic biota

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Cover art: Themes of the South West Index of River Condition

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Preface

The South West Index of River Condition (SWIRC) is a toolkit to assess river health in South-West Western Australia. It has been designed to take into account the region's various system types, conditions and management needs. The SWIRC incorporates standardised methods for collecting field and desktop data, and a suite of indicators to help describe and interpret river condition.

The SWIRC condition assessments have been designed to:

- identify important ecological values and the threats to these values
- provide outputs that are easy to interpret, using indicators that respond predictably to impacts caused by humans
- work at spatial and temporal scales that are appropriate for management
- be cost-effective, easily replicated and scientifically defensible.

This is the standard assessment method for rivers within the department's *Healthy Rivers* program. For further information on the program go to rivers.dwer.wa.gov.au or contact the department's River Science team.

This document summarises the development, intended use and general principles of aquatic biota assessments within the SWIRC, which is the second module in a series describing the data collection and analysis methods across each of the SWIRC themes, outlined below.

Figure 1 Modules in the SWIRC method series

1 Introduction

This document summarises the standard methods to collect and analyse data on aquatic communities under the aquatic biota theme of the South West Index of River Condition (SWIRC).

As aquatic biota responds to a range of environmental conditions, it is recommended that any assessments of aquatic biota include collection and analysis of data across the other SWIRC themes, covered in modules 3 to 8. Note: Module 8 includes guidance on how to collect field data for all SWIRC themes.

1.1 Why aquatic biota?

Assessment of aquatic biota is an integral component of the SWIRC, providing a diagnostic measure of stream condition (as biota respond to a range of environmental changes in predictable ways) and a representation of the values we are striving to protect.

A key attribute of aquatic biota is the critical role they play in the proper functioning of ecosystems, which includes maintaining water quality at the levels needed to support social and economic uses.

Aquatic communities are also closely associated with cultural values for many of our waterways, and some South West species are highly valued for fishing, including the world's third-largest freshwater crayfish, the marron.

The South West's aquatic biota is also a key element in the region's recognition as an international biodiversity hotspot, with 80 per cent of its freshwater fish and 100 per cent of its freshwater crayfish are found nowhere else in the world.

2 The SWIRC aquatic biota theme

The SWIRC aquatic biota theme currently has two sub-themes:

- fish and crayfish
- macroinvertebrates.

The department may add new sub-themes – such as amphibians, phytoplankton or surface-water-dependent reptiles and mammals – when sufficient information becomes available to enable interpretation of river condition based on changes in those groups.

See the following sections for the reasons the current themes and the methods to collect and analyse data were included in the SWIRC.

Note: Licences are required to collect fish and permission may be needed to access sites. Contact the department's River Science team for advice on contemporary licensing requirements.

3 Fish and crayfish sub-theme

Fish and crayfish community data provides an integrated measure of river condition, with data able to reflect a range of different types and combinations of environmental changes. This is due to fish and crayfish species:

- occurring towards the top of aquatic food webs – thus they can reflect changes occurring at different points within the trophic structure
- being relatively long-lived and mobile – thereby representing conditions occurring over a wider area than an individual assessment site and over an extended period
- responding in specific ways to changes in their environment, such as in water quality, habitat and flow – thus allowing diagnosis of potential conditions responsible for an observed change in species or communities
- being widely distributed – therefore assessments in one area can be used to help predict changes in other areas within the range of a species (i.e. between different river systems).

Fish and crayfish are also relatively easy to identify and sample, which means practitioners with different levels of experience and budget can conduct the assessments.

Condition assessments that include fish data are also easy to explain to a broad range of audiences, as many of the species are well-known and valued for recreation and/or conservation. As such, the management recommendations that arise from the assessments attract greater support.

The following information summarises the standard SWIRC method for collecting fish and crayfish and for generating condition assessments based on the observed communities.

3.1 Field collection of fish and crayfish

The standard SWIRC method for collecting fish and crayfish involves:

- the deployment of fyke nets and box traps over 24 hours, spread across an approximate 100-metre length of river (standard length of a SWIRC site)
- five small and five large box traps (see the specifications in Section 3.3 *Trap dimensions*), each baited with about 15 grams of chicken pellets
- two dual-wing or three single-wing fyke nets (see options in Section 3.3 *Deployment strategies*), with floats placed in tail and optional screens (dependent on sampling objectives) placed over the entry (see Section 3.2 *Protecting trapped animals*).

Several other techniques are available for collecting fish and crayfish, however for various reasons these were not incorporated in the standard SWIRC method. For instance, electrofishing and gill and seine netting can have negative physical impacts on fauna if not conducted by trained officers, and/or are not suitable across the range of system types found in the South West (e.g. due to factors such as depth, flow and turbidity).

3.2 Protecting trapped animals

Field officers must take care not to expose trapped species to adverse conditions. They should avoid areas of poor water quality (e.g. low oxygen or high temperatures that can occur in localised areas within an assessment site) and minimise stress related to the risk of predation, which can occur when species are held in open/exposed areas through the day (perceived risk). Similarly, handling of fish should be limited.

Several methods have been developed to reduce risks to air-breathing species; that is, to prevent them drowing in submerged traps. These are:

1. Place floats in the end of the fyke nets to provide access to the surface. The department has designed specialised floats (Figure 2) that not only provide access to air but also a platform in which certain species (e.g. rakali [water rats]) can rest and escape the water. For species caught in traps, both low water temperatures and the continuous effort to stay above water have been linked to mortality.
2. Place screens on the fyke-net openings to reduce the entry of species such as rakali, turtles and birds, which can predate on fish and crayfish. The use of screens will depend on whether capture of these species is important to the sampling program's objectives. The department has developed specialised screens to suit standard fyke nets, which still permit target fish and crayfish species to enter (Figure 2). Note: screens may impede entry of some larger fish (e.g. freshwater cobbler, trout and redfin).
3. Use box traps with small openings (< 100 mm) to limit access of the species listed above (see trap dimentions in Section 3.3).

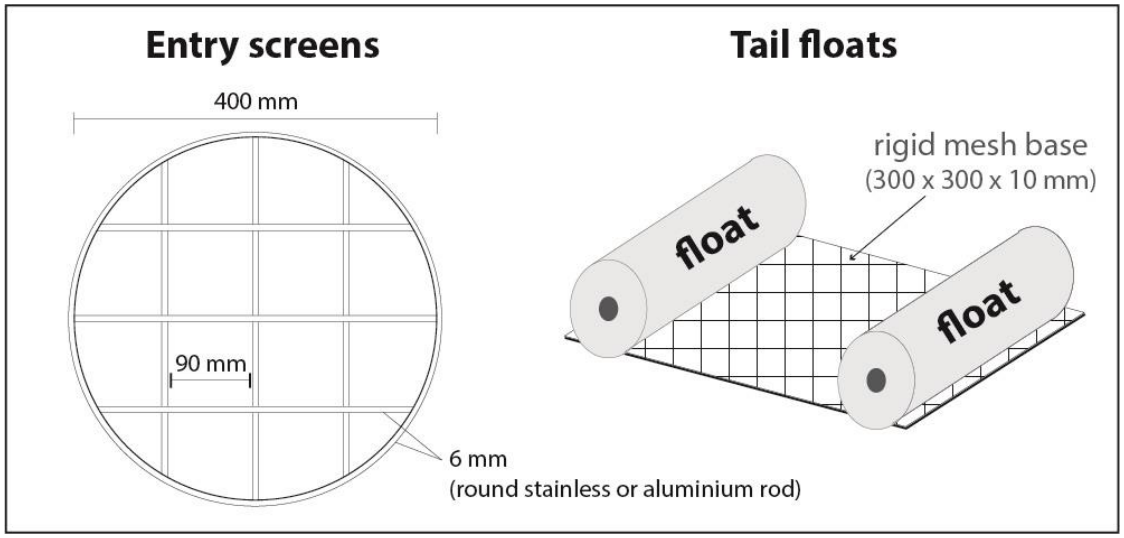


Figure 2 Floats and screens used in fyke nets to protect air-breathing animals

3.3 Deployment strategies – box traps

Crayfish and some fish reside in holes or shelter in complex habitat (e.g. woody debris), particularly during daylight. Methods that rely on active movement through the water column (e.g. short-term deployment of gill nets or fyke nets) or that require a snag-free benthos (e.g. a haul-seine net) may not be well-suited to their capture. Similarly, electrofishing methods are less effective when species are within complex habitat, where stunned fish may not be detected or may not be accessible with scoop nets. The use of baited box traps is particularly effective for these conditions: field officers can easily place them within or around shelter, from where the bait will entice the species out.

Under the SWIRC, box traps should be set in different areas across the site to represent the different habitats present; for example, woody debris, macrophytes, open channel, edge, deeper and shallower zones, and draping vegetation.

The standard SWIRC method uses two trap types:

1 **'Small traps'** – smaller opening (around 40 mm diameter) and finer mesh – to target smaller fish and crayfish species and life stages. Traps should be placed in the preferred habitat of target species; for example, most species prefer complex shelter such as under woody debris, among macrophytes or under overhanging banks. The smaller openings restrict the larger predatory species that can reduce the number of smaller species capture due to both predation and as prey species may avoid traps containing predators or larger individuals.

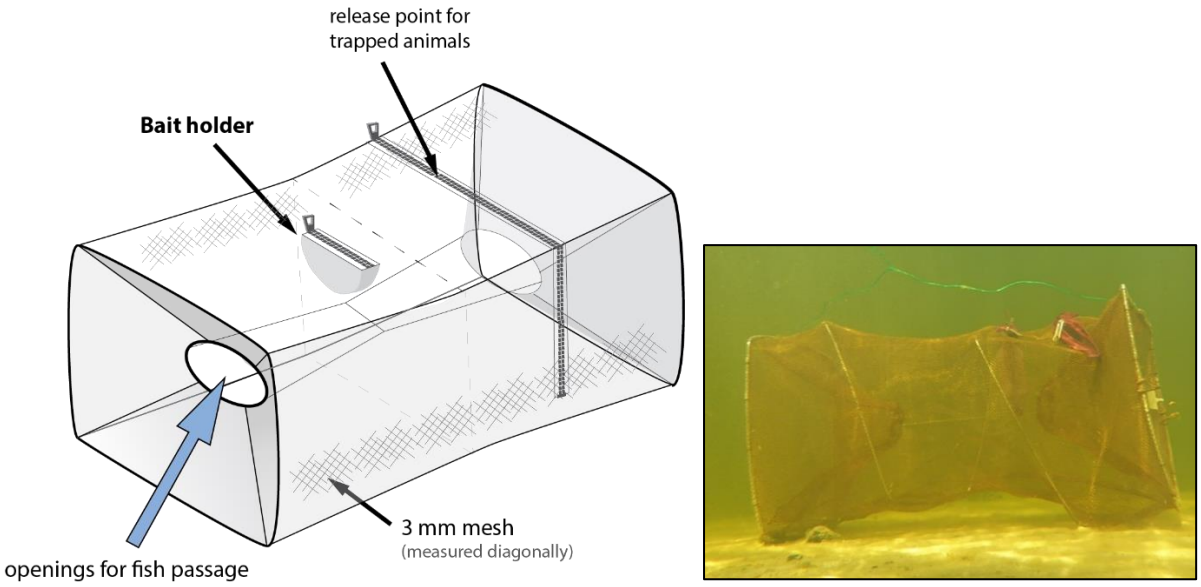


Figure 3 Small box traps used in standard SWIRC method

‘Large traps’ – larger openings (up to 100 mm diameter) and coarser mesh – to target larger crayfish. Note: the entry-hole size is still sufficient to reduce the risk of capturing larger air-breathing species such as turtles and water rats; however, smaller individuals can still enter traps. As such, if the presence of these species is likely, the traps should be deployed with access to air.

Figure 4 Large box traps used in standard SWIRC method

Table 1 Specifications for small and large box traps

Box trap type	Frame height (m)	Frame width (m)	Frame length (m)	Size of opening (diameter, m)	Netting gauge (m)
Small box trap	0.25	0.25	0.40	0.04	0.003
Large trap	0.3 (max)	0.5 (max)	0.8	0.1	0.02

3.4 Deployment strategies – fyke nets

Fyke nets are large sock-style traps designed to catch free-swimming fish and crayfish. They have two funnel sections to reduce escape (Figure 5). Fyke nets are unbaited under the standard SWIRC method.

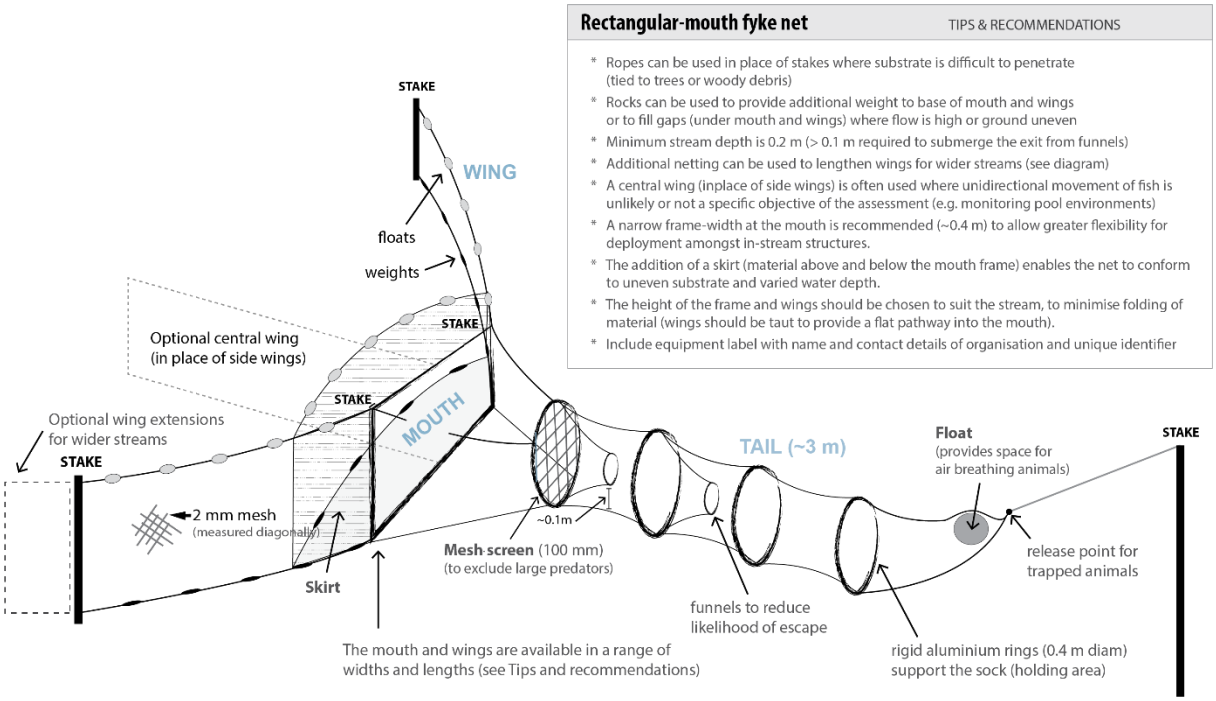


Figure 5 Fyke-net design

The effectiveness of fyke nets is influenced by depth and flow rate, which varies between systems and over time. Field officers can use either of the following two methods depending on the conditions (see below).

Shallower, slower-flowing systems (wadeable)

Two dual-wing fyke nets are used for rivers with a maximum depth across the channel of less than 1.5 m and flow less than about 0.5 m/s (deeper systems will result in gaps around the net, and flows over 0.5 m/s are likely to dislodge nets).

Nets should cover the entire water column across the river (Figure 6), with extension nets for wings used as needed to cover the area. An ‘upstream net’ is deployed facing upstream and a ‘downstream net’ facing downstream (capturing species moving into the site from both directions). Nets are typically set around 100 m apart, though may need to be closer together to suit site conditions (see examples of deployment in Figure 7 and Figure 8).

Figure 6 Dual-wing fyke net

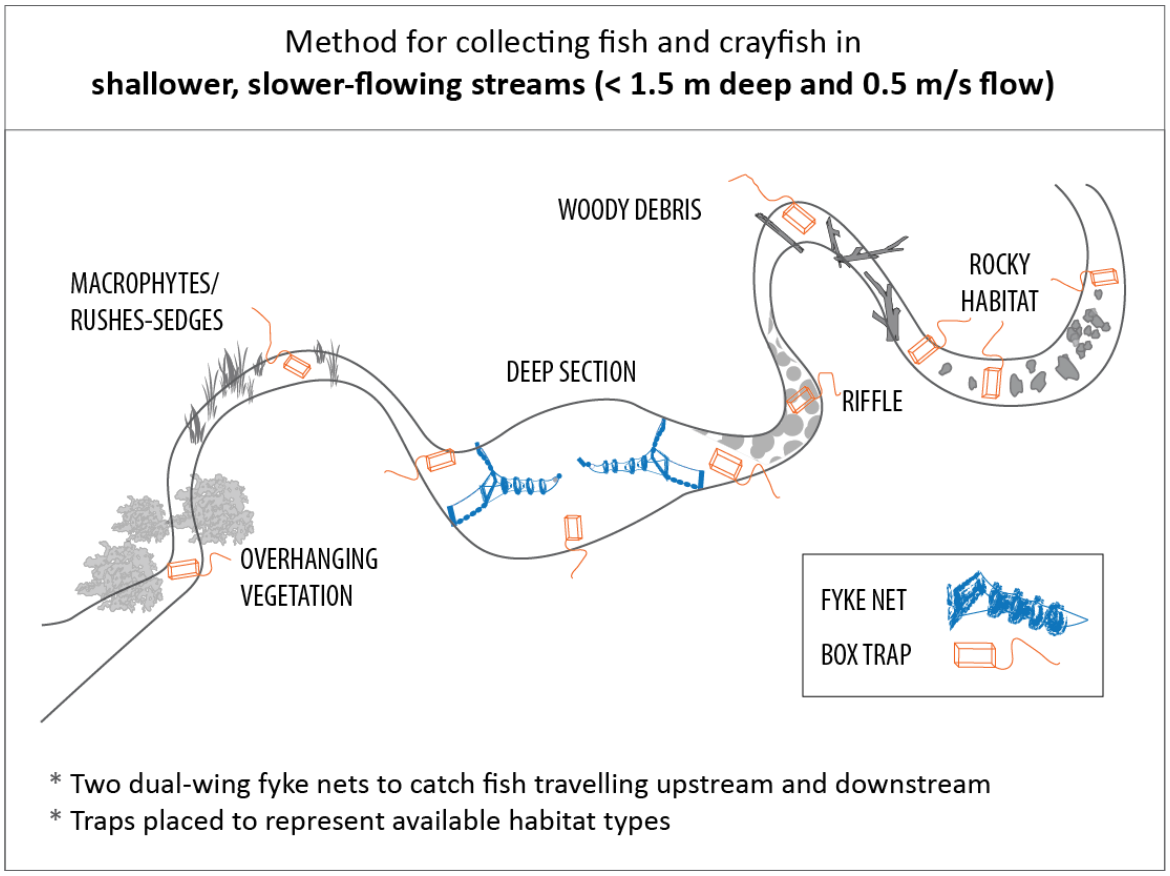


Figure 7 Deployment of dual-wing fyke nets in shallower systems

Figure 8 Two dual-wing fyke nets, tail-to-tail across stream

Deeper and/or faster-flowing systems

Three single-wing fyke nets (Figure 9) are used for rivers with a maximum depth across the channel of more than 1.5 m and/or a flow rate greater than about 0.5 m/s (as these nets can be placed in shallower areas and outside of high flow zones). The single-wing nets are deployed as standard in pool habitats where we expect fish to move in random or circular patterns, as opposed to their more linear movements in connected rivers and streams.

Figure 9 Single-wing fyke net

Nets should be placed perpendicular to the bank (tail extending into the river) with the depth of wing covering the water column (see concept in Figure 10).

In deeper systems, the angle of the net from the bank may need to be reduced to allow for the end of the tail to reach the surface and the funnelled sections of the fyke net (first two sections) to remain on the bottom (see example in Figure).

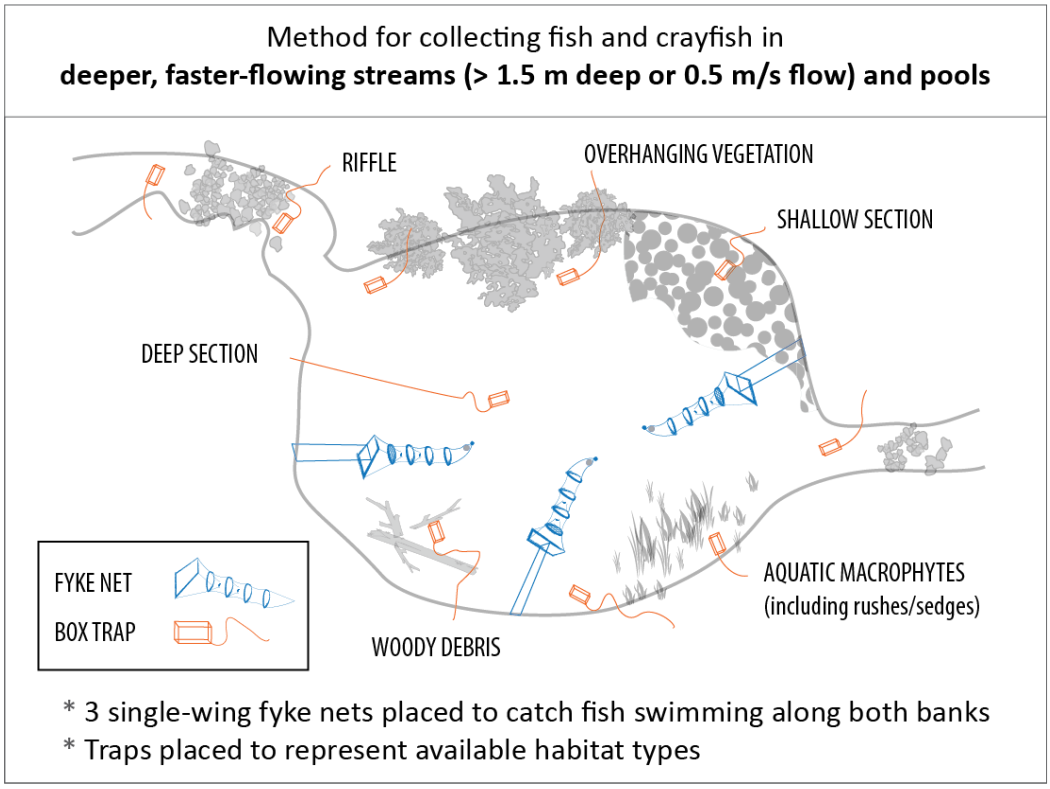


Figure 10 Deployment of single-wing fyke nets in shallower systems

Figure 11 Single-wing fyke net set at an angle to the bank to allow access to air without lifting the funnelled section (first two rings) off the trap off the bottom.

3.5 Field measurements

The field measurements should describe the fish and crayfish captured and include information to interpret their presence, absence or physical condition.

Measurements of fish and crayfish include:

- abundance of each species within a range of size classes[1]
- signs of recruitment (presence of juveniles and reproductive condition)
- physical condition of individuals (injury, parasites or disease).

The information needed to support interpretation includes measures of habitat type and abundance, physical form, connectivity, hydrology, water and sediment quality, weather conditions, catchment disturbance and fringing zone.

Appendix A has the field sheets for all the SWIRC field measurements. This includes the data needed to calculate the condition indicator scores (see Section 3.6). For guidance on how to collect and record this data accurately, see Module 8 – *SWIRC method summary: aquatic habitat and a guide to collecting field data for all SWIRC themes*.

The department may adapt the SWIRC field sheets over time. For a current version of the field sheets, contact our River Science team.

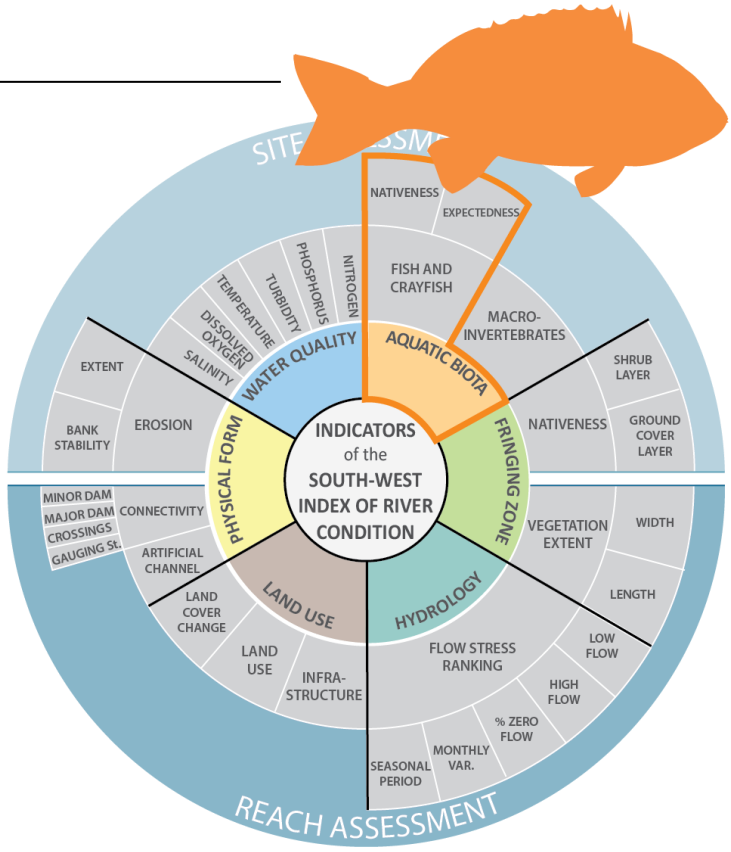
[1] Recording size of individuals within size classes (rather than exact measurements for each individual) reduces the time taken and thus minimises holding and handling stress to fish. However, if time permits and you can hold species without significant stress, then exact measurements are preferred.

3.6 Indicators of the SWIRC fish and crayfish sub-index

Practitioners can use the collected fish and crayfish community data in various ways to assess river condition. This includes analysing the direction of movement (based on which fyke net most animals were caught in), looking at changes in species and abundance between sites and overtime, and assessing the reproductive condition and physical health of individuals.

Condition indices are also calculated to represent the general condition of the fish and crayfish community.

At present the SWIRC has two indices to calculate the fish and crayfish sub-index:



Expectedness indicator

Ratio of observed to expected native fish species based on species expected under minimal disturbance to the system

Nativeness indicator

Proportion of native to non-native fish, incorporating abundance and richness

These condition indices were chosen as they apply across most system conditions in the South West (enabling comparison between sites); however, complementary analysis of recruitment and physical condition is recommended to support an assessment, and likewise interpretation should assess the tolerances (e.g. water quality) and preferences (e.g. habitat and flow) of individual species.

As with all SWIRC indicators, scores are calculated on a scale from 1 (largely unmodified) through to 0 (severely modified) and can be categorised into one of five condition bands reflecting the degree of departure from conditions expected under minimal disturbance (for further explanation, see Section 5).

See Figure 12 for an explanation of the condition scores for the fish sub-index indicators.

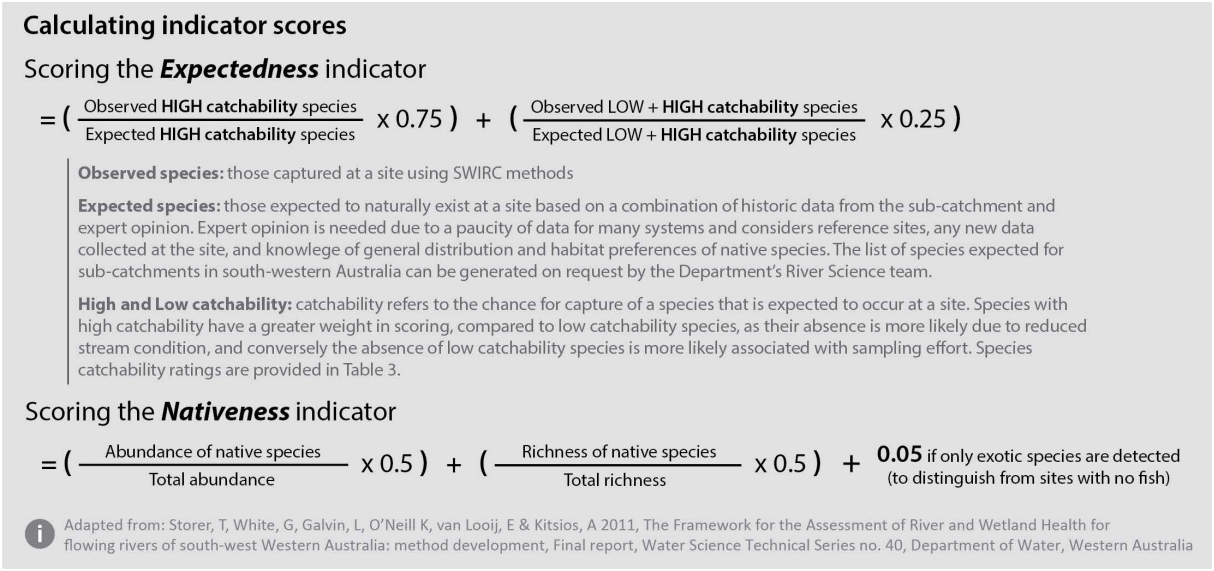


Figure 12 Calculating fish sub-index condition scores

To calculate the expectedness score for the fish and crayfish sub-index, the species expected to occur at a site must be determined and then weighted according to their catchability (chance of capture using the standard SWIRC collection methods).

The species expected to occur at a site are determined based on presence of species recorded in historic catch data within the corresponding subcatchment[2] and using expert opinion to fill in gaps in data based on knowledge of habitat preferences and biology[3].

Catchability is related to several factors, including:

- **abundance** – some species naturally occur in low densities within their range and therefore the chance of interacting with traps is low
- **habitat specialisation** – some species target specific localised habitats and thus a small change in site location within a subcatchment may significantly impact results
- **natural tendency for species to enter traps** – some species appear to actively avoid traps or due their general behaviour have a low chance of interacting with traps (e.g. low activity within water column).

Catchability is assigned to each species based on Table 2, with some species requiring site-specific assessment given localised variability in their distribution associated with habitat (particularly hydrology).

[2] Species expectations for subcatchments are provided by the SWIRC fish expectation tool (based on data provided to the Department of Primary Industries and Regional Development [Fisheries] as a requirement of fauna collection permits); and including interpolation.

[3] Expert opinion is needed due to the paucity of data for many systems. This is based on comparison of habitat at an assessment site against reference sites, any new data collected at the site and knowledge of habitat preferences of species.

Table 2 Species catchability categories – for calculating the fish and crayfish sub-index

<table>
<tr><th>Category[4]</th><th>Description</th><th colspan="2">Fish and crayfish species used in scoring the expectedness indicator</th></tr>
<tr><td rowspan="3">High catchability</td><td>Generally expected to be captured within their range.

Abundance may vary due to migration, but the species retains presence in the area.</td><td>Cherax tenuimanus
C. cainii
C. quinquecarinatus
C. crassimanus
Bostockia porosa
Nannoperca vittata</td><td>Galaxias occidentalis
G. maculatus
G. truttaceus
Pseudogobius olorum
Afurcagobius suppositus
Leptatherina wallacei</td></tr>
<tr><td rowspan="3">Requires site-specific habitat assessment (ecohydrology).</td><td colspan="2">Tandanus bostocki
Not generally expected in small/shallow first-order streams, or only present under high water levels.</td></tr>
<tr><td colspan="2">Cherax preisii and C. glaber
Typically expected in seasonally inundated sections of the subcatchment only.</td></tr>
<tr><td colspan="2">Nannatherina balstoni
Typically found around permanent and semi-permanent pools within seasonal, acidic, tannin-stained creeks. In wetter periods, can be found in low numbers within reaches connecting separate populations.</td></tr>
<tr><td>Low catchability</td><td>Lower chance of capture within their range.

Species that live in naturally low densities or do not readily enter traps, or occur in only localised areas within a subcatchment that are not easily identified by habitat.</td><td colspan="2">Galaxiella munda
Nannoperca pygmaea
Geotria australis</td></tr>
<tr><td>N/A</td><td>Species predominantly occurs outside of river channels, or insufficient data exists to support expectation.</td><td colspan="2">Galaxiella nigrostriata
Lepidogalaxias salamandroides
Engaewa sp. (seven species)
Palaemons australis</td></tr>
</table>

[4] Catchability (and associated weighting) may be updated as knowledge of species distribution and catchability improves. Weighting changes could be made for the purposes of a specific project; however, any change should be clearly identified in reporting to enable comparison between projects.

4 Macroinvertebrates

Aquatic macroinvertebrates are included in river health assessments for many reasons. They are widely distributed, easily identified, easily sampled, and data on community structure provides an integrated measure of river condition, with species responding to a range of different changes in their environment in predictable ways, allowing for interpretation of changes.

Macroinvertebrates have typically short life cycles and are relatively immobile, which means that communities can reflect acute changes in the immediate environment. For example, they may show a rapid change in population structure due to a sudden change in water quality or habitat. Macroinvertebrates may also respond to environmental conditions in different ways than fish, so analysis involving both groups is complementary and provides a more robust overall assessment.

The following information summarises the standard SWIRC methods for generating condition assessments based on macroinvertebrate communities and includes standard methods for collecting macroinvertebrates.

4.1 Field collection of macroinvertebrates

The SWIRC method for collecting macroinvertebrates is based on the standard Australian River Assessment System (AUSRIVAS) collection method outlined in van Looij (2009) and tailored to South West conditions.

As composition of the aquatic macroinvertebrate community changes in response to season and habitat, both the timing and location of sampling are important. Under the SWIRC, sampling during spring and in channel habitat is recommended (see **Season** and **Habitat** below). Though field officers can obtain useful data from sampling in other habitats and seasons (and this may be appropriate for some project objectives), sampling in spring and channel habitat enables the use of the Western Australian AUSRIVAS spring-channel model to assess condition (see Section 4.5).

Consistency in sampling time and habitat allows comparison of sites and years. As such, field officers should document any changes to the standard methods to ensure this is considered for future use of the data.

Note: for targeted assessment of Carters freshwater mussels (*Westralunio carteri*), see Klunzinger et al. (2011); adapted from Strayer and Smith (2003).

Season

Spring is when the largest diversity of macroinvertebrates is typically recorded and also when the community composition is generally most stable. In comparison, winter communities can vary considerably due to the effect of higher flows. Another advantage of spring sampling is that many of the larval aquatic macroinvertebrates are at their largest size and therefore easier to identify. In comparison, many species turn into their terrestrial, adult forms in summer, or are only present as eggs or very small individuals that are difficult to identify.

Habitat

Channel habitat is targeted for SWIRC assessments as this habitat is present across most South West systems, therefore allowing direct comparison between sites. Conversely, habitats such as macrophytes or riffles do not naturally occur in all systems and may only be present in some years or at certain times of the year.

Sampling of other habitats, such as macrophytes and riffles, may be important for certain assessments (e.g. determining total biodiversity). If multiple habitats are to be assessed, the channel sample should be analysed separately to permit comparison against other sites.

When sampling channel habitat, all sub-components of the habitat must be represented in the final sample. Sub-components include deep and shallow areas, bare banks (if present), and any detritus or leaf packs. Depths of over 1 metre are not sampled as the deeper water limits the ability to maintain enough forward movement of the net to prevent the macroinvertebrates from escaping.

A description of habitat features and other environmental conditions is required for analysis. This information is provided on SWIRC field sheets (see Module 8 – *SWIRC method summary: aquatic habitat and a guide to collection of all SWIRC field data*).

4.2 Sampling

Macroinvertebrate samples are collected using a D-frame, 250-micron mesh net (dimensions: 35 cm wide x 25 cm high opening; 50–75 cm long tail; 1–1.5 m long handle) (Figure 13).

Sampling is conducted over a 10 m^2 area, aiming to cover a transect(s) across the stream width. However, sampling several shorter stretches within a site may be required (e.g. if depth exceeds 1 metre or to avoid macrophytes or riffles).

Figure 13 D-frame macroinvertebrate sweep net

Figure 14 Sweep sampling for macroinvertebrates with D-frame net

Sweep sampling is generally used but if the water is shallow and fast-moving, then kick sampling may be more appropriate.

Sweep sampling: Collect the sample while moving upstream. Use short, vertical lifts to disturb the sediment and sweep the net through the debris that has been suspended. Keep the net moving upstream at all times. Ensure the whole water column is sampled.

Kick sampling: Face downstream, holding the net facing upstream in front of your feet. Move backwards, into the flow of water, disturbing the sediment with your feet so that the resulting debris is swept into your net.

Note: Fine sediment can block water flow through the netting and result in the sample being pushed out of the net. If this occurs, the mesh can be unblocked by holding the net horizontally and swirling the contents around to dislodge the fine sediment. In systems with high levels of fine particles, multiple samples may be required.

4.3 Processing

Ideally, samples should be processed using a box sub-sampler (Figure). This reduces the time it takes to process samples with large numbers of invertebrates (via sub-sampling) and maximises the chance of detecting the range of species present (e.g. cryptic species).

The box sub-sampler separates a sample into multiple cells. The sample from the D-frame net is transferred directly to the sub-sampler and the lid is secured. The sub-sampler is gently rolled and inverted until the sample appears to be homogenous across the cells.

The following method is based on an 8 x 8 cell box sub-sampler (64 cells):

- randomly choose the cells (one at a time) by throwing an eight-sided dice representing the rows and columns of the sub-sampler
- remove the contents of each cell from the sub-sampler using a venturi pump (Figure)
- transfer to a sorting tray to separate macroinvertebrates from unwanted material, such as detritus
- process until 200 or more individuals are collected or the entire sample is picked
- collect all individuals from the cell that contains the 200th animal.

Where 200 individuals are obtained from a sub-set of the cells, the number of macroinvertebrates in the total sample is estimated using the following equation:

$$= \text{Number of macroinvertebrates collected} \times \left(\frac{64}{\text{Number of cells counted}} \right)$$

If a sample is relatively clear of detritus and sediment and there appears to be a low number of animals (200 individuals or less), it may save time to do a live pick of the entire sample. See van Looij (2009) for additional options for picking samples.

See Section 4.4 for the method to pick macroinvertebrates.

Figure 15 Box sub-sampler for macroinvertebrates

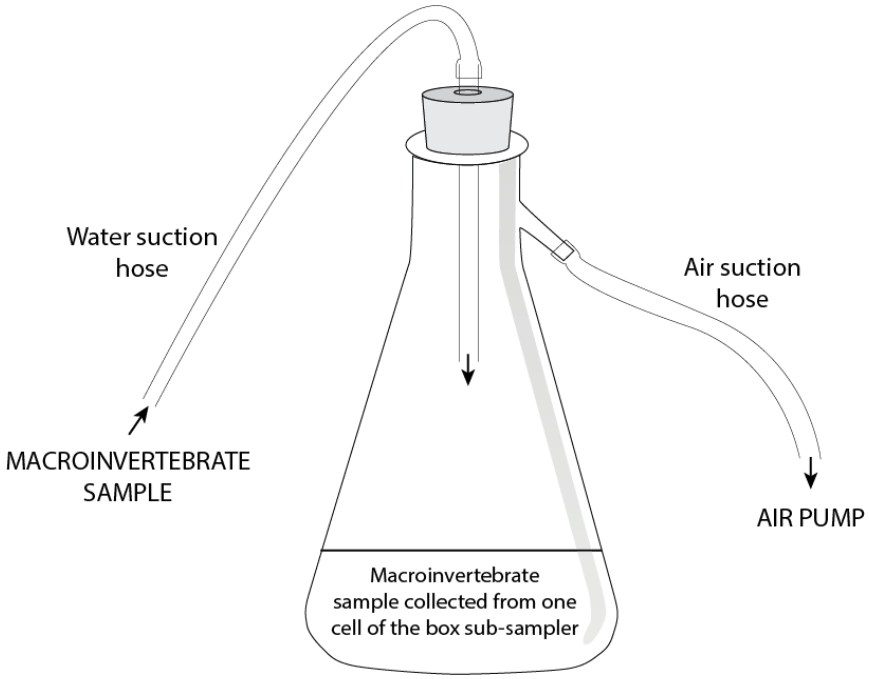


Figure 16 Venturi pump used to extract sample from box sub-sampler

4.4 How to pick and identify macroinvertebrates

Field officers need to be trained to ensure they detect all species. Some species, particularly cryptic species such as caddisflies, riffle beetles, springtails and limpets, can be easily missed.

White trays (Figure 17) are recommended for picking to improve detection of macroinvertebrates. Forceps and pipettes are used to collect macroinvertebrates. Care should be taken not to damage macroinvertebrates as this makes them more difficult to identify in the laboratory.

Field officers need to be trained to ensure all species are detected. Some species, particularly cryptic species such as caddisflies, riffle beetles, springtails and limpets, can be easily missed.

Each macroinvertebrate is transferred directly from trays to a sealable container half-filled with 100 per cent ethanol to preserve the sample prior to laboratory analysis. The lid of the container must be kept on while picking to prevent jumping and flying species from escaping. When all macroinvertebrates are collected, the jar is filled to the top with ethanol and sealed for transport using Parafilm.

Copepods, amphipods and ostracods are not retained in the standard SWIRC assessment, but their presence should be recorded on field sheets. The SWIRC macroinvertebrate indicator does not include these microcrustaceans because populations exhibit a high degree of natural variability over short periods, and thus are difficult to associate with impact. However, their presence can be useful in interpretation (e.g. as part of the diet of fish).

Species such as freshwater crayfish (*Cherax* species), freshwater shrimp (*Palaemons australis*) or freshwater mussels (*Westralunio carteri*) may be too large for cells or sample containers and may not preserve well. For example, mussels can close up and prevent ethanol from reaching internal tissues. Information on these species can be recorded on field sheets and individuals returned to the water (assuming a positive identification can be made). When using a box sub-sampler, these species should be counted for the entire sample (all cells) and then combined with the final estimate of numbers for other macroinvertebrates within the sample.

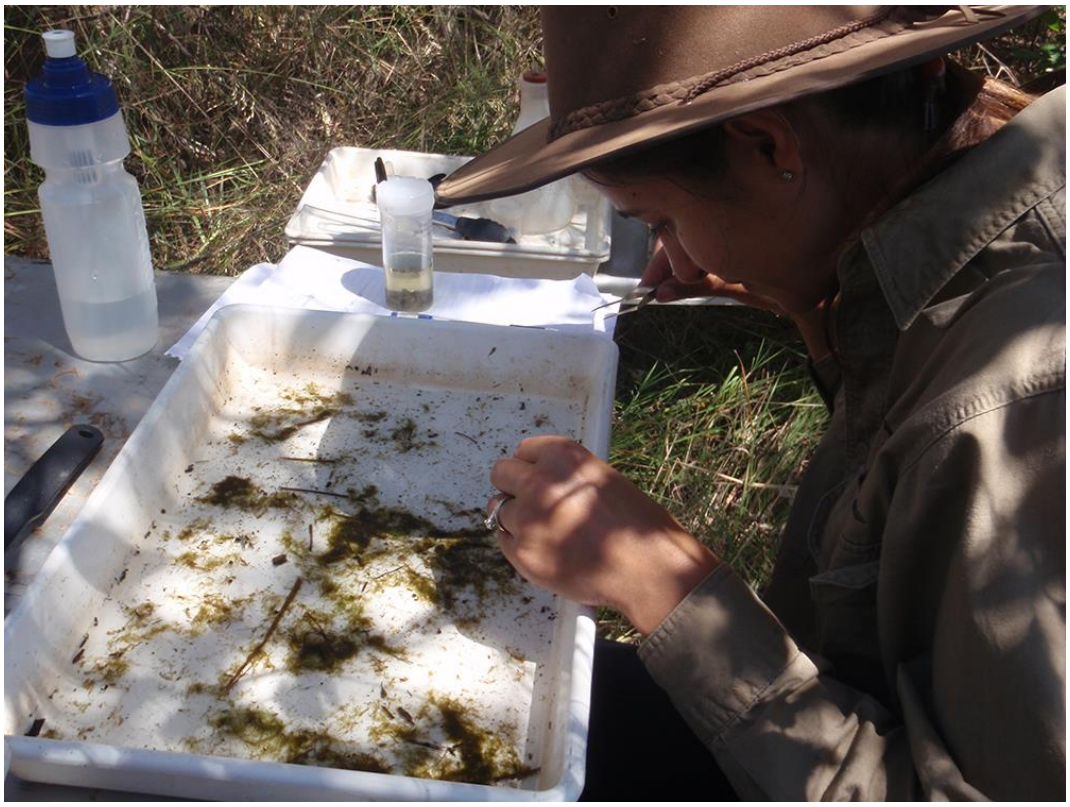


Figure 17 Field picking of macroinvertebrates

Raw data

The laboratory provides species and abundances of macroinvertebrates in the sample. If larger individuals were excluded from laboratory analysis (i.e. returned to the water) or only a sub-set of cells was counted from a sub-sampler, this must be clearly identified on the raw data. Final counts for the entire sample should be: the numbers of each of the species detected by the laboratory (if a sub-sample was used, total numbers are estimated using the equation in Section 4.3) added to the number of any individuals returned to the water when in the field.

Laboratory identification

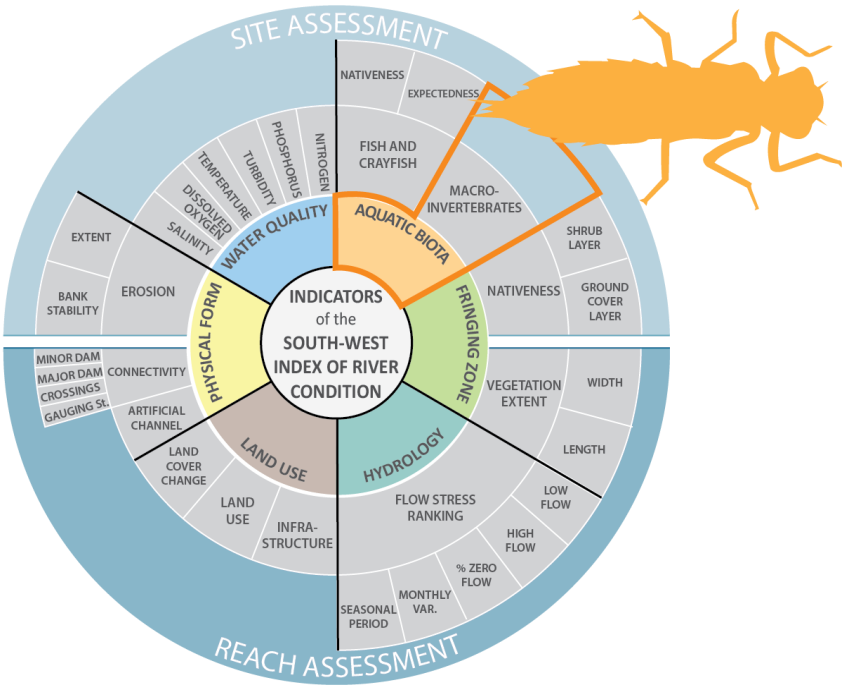
To calculate the SWIRC macroinvertebrate condition index (see Section 4.5) the taxonomic resolution is: oligochaetes and acarinids assessed to order, chironomids identified to subfamily and all others assessed to family. Assessment at higher taxonomic resolution will allow for greater levels of interpretation and a better representation of biodiversity value; however, species-level identification can be expensive and may not be required for all project objectives. Other types of analysis (including those requiring a high level of identification) are discussed in **Additional analysis** below.

SWIRC macroinvertebrate field sheets

See Appendix A for the macroinvertebrate field sheets, including the information needed for habitat assessment. The department may adapt the SWIRC field sheets over time. For a current version of the field sheets, contact our River Science team.

4.5 Indicators of the macroinvertebrate sub-index

The SWIRC macroinvertebrate scores are assigned using the WA spring-channel AUSRIVAS model. This model compares the collected macroinvertebrate taxa with those expected in spring under minimal disturbance, based on expectations from a set of minimally disturbed reference sites (in the model).



This model provides a score between 0 and 1.15, with scores greater then 1 reflecting abundance over natural expectations, typically due to factors such as eutrophication.

To calculate the SWIRC macroinvertebrate indicator for a site that scores greater than 1 using the WA spring-channel AUSRIVAS model, subtract the portion of the score greater than 1 from 1. For example, if a site returns a score of 1.09, the final SWIRC macroinvertebrate score is 1 – 0.09 = 0.91. This ensures that factors such as eutrophication are reflected as a departure from natural conditions.

The WA spring channel model can be used to calculate scores for invertebrates collected in different seasons or habitat; however, results should only be compared with other sites assessed under the same conditions.

Additional analysis

Several other methods can be used to analyse the macroinvertebrate data collected, including where a sample is collected outside of spring or in habitat other than the channel. These include (but are not limited to) the following:

1. Taxonomic composition and richness
2. Functional feeding groups
3. EPT (Ephemeroptera, Plecoptera and Trichoptera) taxa (abundance and richness)
4. Abundance and presence of tolerant/intolerant taxa
5. The presence of rare or endangered species and species with Gondwanic affinities
6. The presence of known introduced species (e.g. *Pseudosuccinea collumella* (American ribbed fluke snail) and *Physa acuta* (freshwater snail)

7. Stream Invertebrate Grade Number – Average Level (SIGNAL) grades and overall scores
8. Multivariate data analysis
9. Comparing the sites with others in the same area

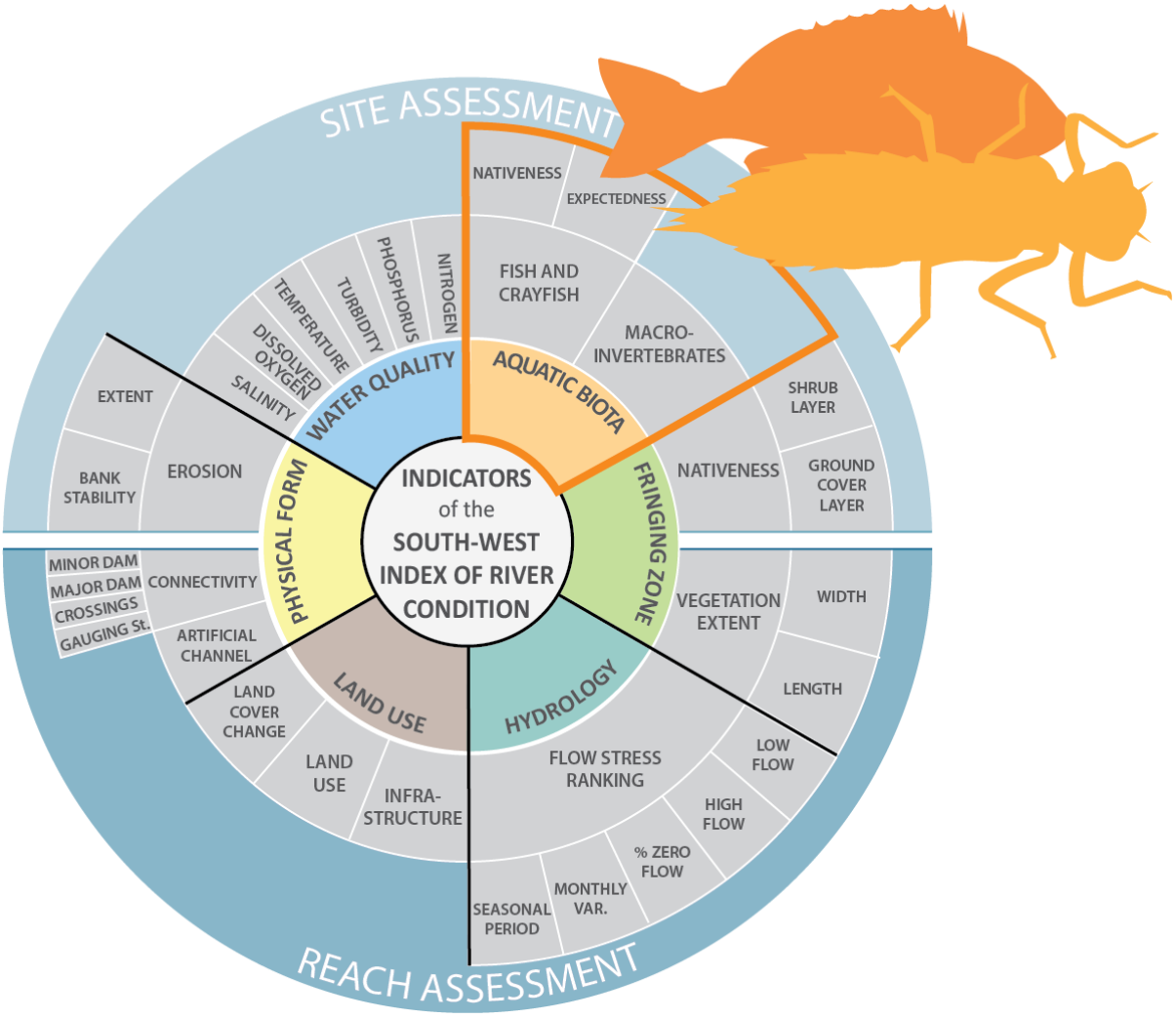
It is also important to examine the information captured on the SWIRC field sheets when interpreting macroinvertebrate data, including habitat, fish community and water quality data (see Module 8 – *SWIRC method summary: aquatic habitat and a guide to collecting field data for all SWIRC themes*).

For more information about these methods, contact the department's River Science team.

5 Calculating the aquatic biota index

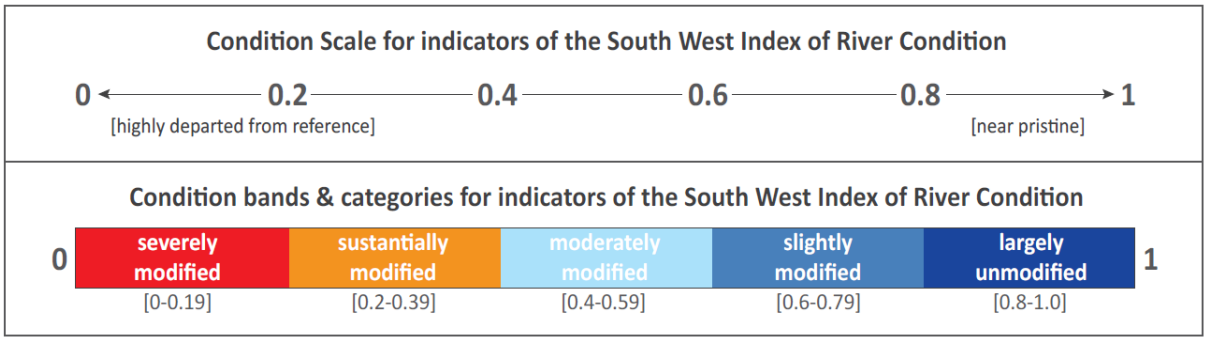
The SWIRC aquatic biota index is calculated on a scale from 1 (largely unmodified) to 0 (severely modified) and can be categorised into one of five condition bands that reflect the degree of departure from conditions expected under minimal disturbance (see Section 0).

The aquatic biota index is based on an equal-weighting average of the scores from the fish and crayfish sub-index and the macroinvertebrates sub-index. To calculate the scores for these sub-indices, see sections 3.6 and 4.5.



5.1 SWIRC condition scores

The SWIRC condition scores provide a simple way to compare between sites and over time. Scores are commonly used to identify broad relationships between pressures, stressors and responses, and to prioritise areas needing management or more detailed assessment (e.g. rivers under high stress). The SWIRC scoring categories (see below) are described in more detail in Module 1 – *SWIRC method overview* (Storer et al. 2021).



References

Klunzinger MW, Strebel D, Beatty SJ, Morgan DL & Lymbery AJ 2011, *Baseline assessment of freshwater mussel populations within the urban waterways renewal project*, Report to South East Regional Centre for Urban Landcare

Storer T, White G, O'Neill K, Galvin L, van Looij E 2020, South-West Index of River Condition, Method overview, River Science Technical Series 1, Healthy Rivers program, Department of Water and Environmental Regulation, Perth

Storer T, White G, Galvin L, O'Neill K, van Looij E & Kitsios A 2011, *The Framework for the Assessment of River and Wetland Health (FARWH) for flowing rivers of south-west Western Australia: method development, final report*, Water Science Technical Series, report no. 40, Department of Water, Perth.

Strayer DL & Smith DR 2003, *A guide to sampling freshwater mussel populations*, American Fisheries Society Monograph 8, Bethesda, Maryland.

van Looij E 2009, *WA AUSRIVAS sampling and processing manual*, Water Science Technical Series, report no. 13, Department of Water, Perth

Appendix A – SWIRC field sheets

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION
FIELD SHEETS FOR SHORT-TERM ECOLOGICAL ASSESSMENT
COVER SHEET

Project code (WIN)		**Site code (TEXT REF)**	
Surface water allocation area		Site code (AWRC)	
River system		Site name	
River name		Short name	

Sampling event details			
Date at start of sampling period		Date at end of sampling period	
Organisation		Project manager(s)	
Field samplers			

This sampling event includes maintenance of WQ loggers deployed for long-term monitoring at this site	**Yes**	**No**

Site location & access details				***Existing site: use co-ordinates already registered with WIN***		**Yes**	**No**
Latitude (°S) *or* Northing (m)				Longitude (°E) *or* Easting (m)			
GPS accuracy (m)				Coordinate system - *include Zone for Northing & Easting*		GDA94	
Access details: *including street address and/or or nearest cross-road*							
Property owner				Phone / email			
Permission required	Yes	No	Details				
Notify before each visit	Yes	No	Details				
Key required	Yes	No	Details				
Send landholder data	Yes	No	Details				

	Site conditions that may affect interpretation of results *(tick)*		
	None		
	Increase in water level over sampling period	*Approx. increase in level (cm)*	
	Decrease in water level over sampling period	*Approx. decrease in level (cm)*	
	Change in flow (see *General site description* field sheet [page 4 of 4])		
	High rainfall during sampling period		
	High rainfall within the week prior to sampling		
	Evidence of recent fire at site		
	Evidence of recent fire in catchment		
	Obvious pollution		
	Traps set with access to air due to low DO (e.g. < 4 mg/L where traps are set)		
	Other (specify):		

	Site-specific equipment *(tick)*
	None
	Boat
	Kayaks
	Other (specify):

General comments

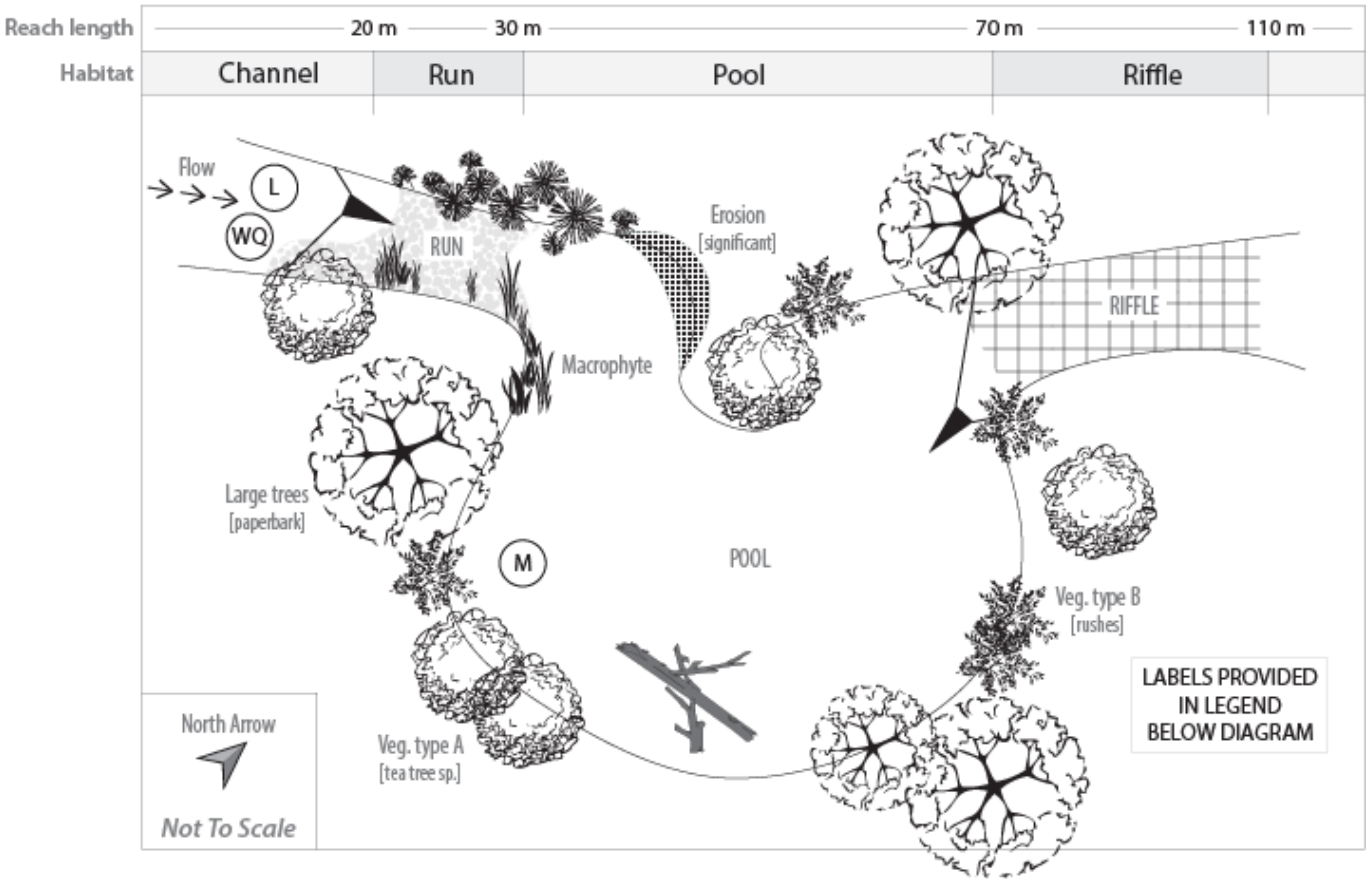
	Field sheets completed within this sampling event *(tick)*
	General site description
	Connectivity
	Aquatic habitat
	Vegetation
	Physical form & potential pollution
	Fish and crayfish
	Macroinvertebrates
	Water quality – in-situ readings & grab samples
	Water quality – logger deployment & retrieval [1]
	Water quality – logger maintenance [2]

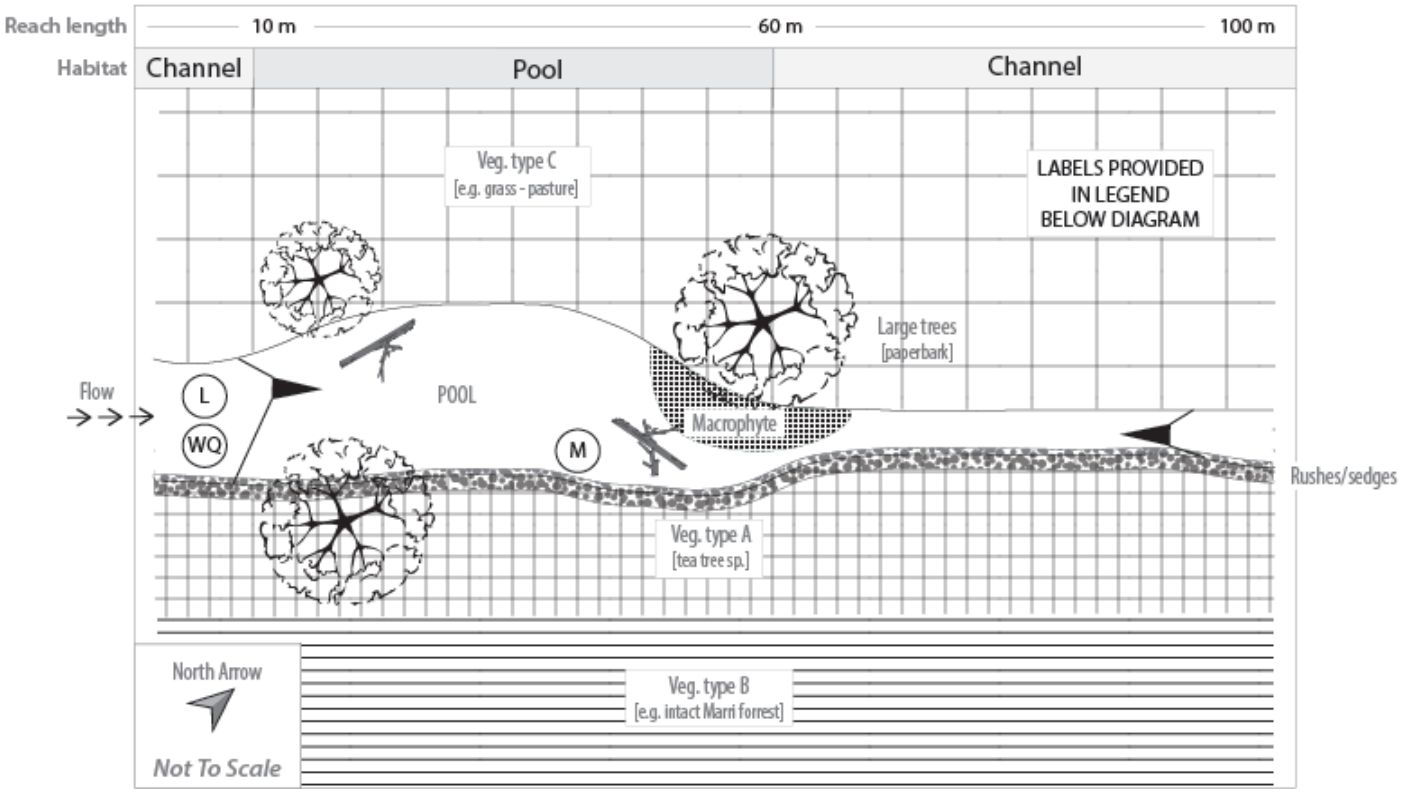
	Site photo checklist *(tick)*
	Upstream and downstream photos (top, middle, bottom)
	Representative site photos
	Representative site video
	Macroinvertebrate sampling area (if sampled)
	Connectivity and artificial structures
	Water quality logger site
	Water quality logger & probes at retrieval

[1] logger deployed & retrieved within the short-term ecological assessment period

[2] logger already deployed as part of long-term monitoring

EXAMPLE LONGITUDINAL DIAGRAM (AERIAL VIEW) – *two different drawing styles shown*





Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
GENERAL SITE DESCRIPTION

LONGITUDINAL DIAGRAM (AERIAL VIEW)

Artists name _____

Essential features		Legend
Flow direction		→ → →
Water quality loggers		L
Macroinvertebrate sample		M
Water quality sample		WQ
Fyke nets	Dual wing	
	Single wing	
North arrow		↑ N

Possible features	DIY legend	Possible features	DIY legend
Macrophyte habitat			
Woody debris			
Significant erosion			
Natural or artificial barriers			
Riffles			
Pools			
Sandbars/sediment deposits			
Vegetation type A:			
Vegetation type B:			
Vegetation type C:			

If the species of vegetation is known, write this on the diagram or in the related box

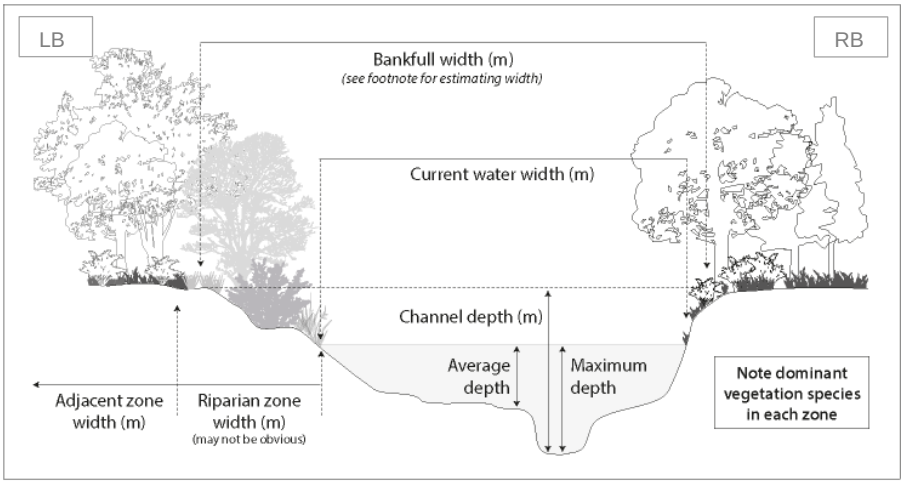
Date ___ / ___ / ___ Site code _____ Recorder name _____

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
GENERAL SITE DESCRIPTION

CROSS SECTION DIAGRAM

Artists name _____

Two diagrams may be required where high variability exists across a site (s*uggested information to include is shown in the diagram below*).



Bankfull width: Width of the channel at its maximum capacity; above which flooding of the surrounding area would occur. Measured perpendicular to the course of the river, with extent estimated based on vegetation type, high water marks on trees/rocks (including material carried by previous high-water events) and gradient of the bank.

Channel depth: The height of the banks from the base of the sediment (standing in the middle of the stream) to the top of the tallest bank.

Riparian zone: an area dominated by typically riparian-dependent vegetation species (refer to field guide for riparian species common in the south-west of WA), the width encompasses the extent of the canopy cover of riparian vegetation. Note: a distinct riparian is not always expected or obvious (e.g. rivers flowing through channels in bedrock or within intact forested catchments it may be narrow).

Adjacent zone: The area extending beyond the riparian zone – indicate the type and width of vegetation or land use present (as a guide, include up to 100 m width of adjacent vegetation or land use on each bank).

LB / RB: denotes the left bank (LB) and right bank (RB) of the river from a downstream-facing orientation

Date ___ / ___ / ___ Site code _____ Recorder name _____

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
GENERAL SITE DESCRIPTION

STREAM WIDTH MEASUREMENTS

	Top (upstream end)	**Middle**	**Bottom** (downstream end)
Bankfull width (m)			
Current water width (m)			

WATER DEPTH

Depth (m)	**Average water depth** (*tick one for each habitat type*)			
	Channel	**Pool**	**Riffle**	**Run**
Not present				
0 - 0.049				
0.05 - 0.24				
0.25 - 0.49				
0.5 - 0.99				
1.0 - 1.49				
1.5 - 2.00				
> 2.00				

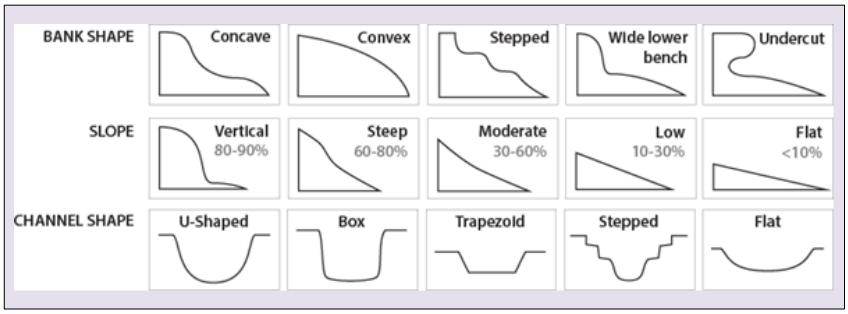
Depth (m)	**Maximum water depth** (*tick one for each habitat type*)			
	Channel	**Pool**	**Riffle**	**Run**
Not present				
0 - 0.049				
0.05 - 0.24				
0.25 - 0.49				
0.5 - 0.99				
1.0 - 1.49				
1.5 - 2.00				
> 2.00				

Water depth (*circle one*)		
Uniform	Moderately varied	Varied

CHANNEL DEPTH

Depth (m)	**River bed to top of bank** (*tick one for each bank*)	
	Left bank	**Right bank**
0 - 0.049		
0.05 - 0.24		
0.25 - 0.49		
0.5 - 0.99		
1.0 - 1.49		
1.5 - 2.00		
> 2.00		

BANK AND CHANNEL SHAPE *(circle all applicable for each category)*



CHANNELISATION - ARTIFICIAL

Signs of channelisation (*circle*)	**No**	**Yes** (*complete table below*)

If yes, is channelisation due to (*circle & describe below*)**:**	**Direct causes**	**Indirect causes**

Direct causes: deepening and straightening by humans to increase water flow (e.g. to reduce flooding).
Indirect causes: deepened systems with more vertical banks due to bank erosion and bed scouring; a result of increased flows from changes such as catchment clearing or hydrological modifications.

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
GENERAL SITE DESCRIPTION

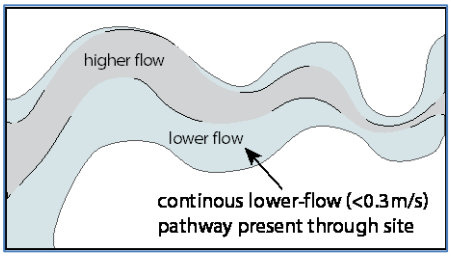
FLOW CONDITIONS

Flow meter/method used	

Flow conditions (flow in m/s)		**Record**						**Date**	**Comment**
Assessment site *(circle)*									
Flow category *(see description in table below)*		A	B	C	D	E			
Upper flow range		N/A	<0.1	0.1-0.3	0.3-0.6	0.6-1.5	>1.5		
Lower flow range		N/A	<0.1	0.1-0.3	0.3-0.6	0.6-1.5	>1.5		
For sites with flows > 0.3 m/s	Presence of rest areas [1]	No			Yes				
	Presence of flow pathway below 0.3 m/s *(see diagram below)*	No		<0.1		0.1 - 0.3			
Macroinvertebrate sampling location									
Minimum flow									
Maximum flow									
Water quality logger location									
Flow at deployment/maintenance									
Flow at retrieval *(for short-term assessments)*									

[1] Rest areas are areas of low-flow (<0.1m/s) where aquatic fauna can reside or recover when negotiating higher flows. These habitats are often seen in wider and/or deeper sections (e.g. pools), edges of streams (outside of main flow pathway) or around in-stream structures (backwaters).

Flow category	Description
A	Dry section(s) present (disconnected)
B	Flow not observed or detected with flow meter
C	Flow observed but below 0.1m/s (lower detection limit of meter)
D	Uniform flow (e.g. common in drains or under flood conditions)
E	Variable flow (flows recorded across multiple flow-ranges)



FLOW CONDITIONS – ADDITIONAL OBSERVATIONS OR ANECDOTAL EVIDENCE

e.g. abstraction pump or pipes observed, landholder mentioned changes in flow over time

Source (name/reference)	**Date**	**Comment**

WEATHER CONDITIONS

Rain							**Cloud cover (%)**	
Sample day 1		**Sample day 2**		**In past week**			**Sample day 1**	**Sample day 2**
Yes	No	Yes	No	Yes	No	Unknown		

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

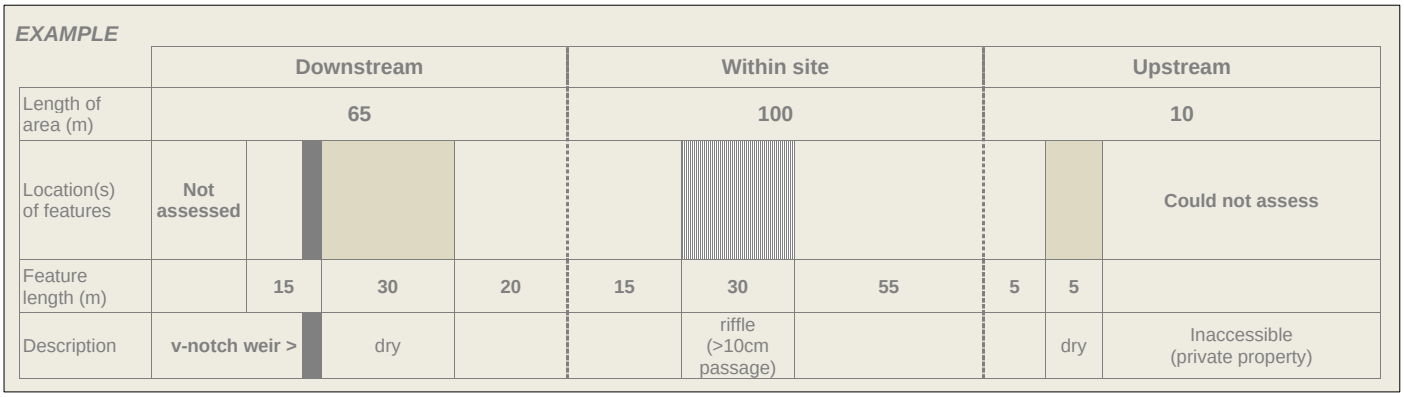
SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
CONNECTIVITY

CONNECTIVITY ASSESSMENT DIAGRAM

Include any features (artificial and/or natural structures) that may affect connectivity e.g. v-notch weir, culvert, dry sections, riffle.
See example diagram below. Examples of feature are provided in the SWIRC field guide.

	Downstream of site	Within site	Upstream of site
Approx. length of area assessed (m)			
Location(s) of features			
Feature length (m)			
Description of feature(s)			

EXAMPLE



ARTIFICIAL STRUCTURES

Complete this table for any artificial features (e.g. weirs, culverts) within the total area assessed above.
NOTE: This information is required for the in-stream structure geodatabase only, not for RiverBank.

GPS Device ID		**Coordinate system** *include Zone for Northing & Easting*	

Structure type #	**Latitude (-°S) or Northing (m)**	**Longitude (°E) or Easting (m)**	**GPS Accuracy (m)**	**Way-point [1]**	**Increase in natural bed height (cm)** *[refer to diagram A in field guide]*						**Comments** (e.g. effect of structure on flow/turbulence, presence of bypass, part of gauging station)	**Photo & diagram [2] (*tick*)**
					<2	2-10	10-30	30-100	100-500	>500		
					<2	2-10	10-30	30-100	100-500	>500		
					<2	2-10	10-30	30-100	100-500	>500		
					<2	2-10	10-30	30-100	100-500	>500		
					<2	2-10	10-30	30-100	100-500	>500		

 # Structure types: weir or flow control structure (describe type of structure and whether it forms part of a gauging station), ford/causeway, culvert (box or pipe), dam, bridge, other (describe). Refer to the SWIRC field guide for examples of the different structure types.

[1] Way-point code as stored in GPS

[2] Photo taken & position indicated on Connectivity assessment diagram above

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
CONNECTIVITY

CONDITIONS AFFECTING FISH PASSAGE *(at time of sampling)*

DOWNSTREAM OF SITE (based on area assessed in Connectivity diagram)

	Circle category						**Comment**
Shallowest water depth along thalweg [1] (cm) *[refer to diagram B & C in field guide]*	Dry	Fall [2]	<2[3]	2-5[3]	5-10[3]	>10[3]	
Type of feature(s) at shallowest point along thalweg (natural or artificial) *Examples provided in field guide*	Sandy bed		Rock or Riffle		Weir (describe)		
	Culvert		Ford/ causeway		Other (describe)		

If the assessment area contained **a DRY SECTION** or **FALL, complete the table below**

Maximum vertical jump along thalweg *[refer to diagram E in field guide]*					**photo A**	**Comment**
Maximum vertical jump at obstacle (cm)	N/A	<2	2-10	10-30	>30	
Horizontal jump at obstacle (cm)	N/A	<2	2-10	10-30	>30	
Turbulence[4] below obstacle	Low		Moderate		High	

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

Maximum horizontal jump along thalweg - if greater than horizontal jump in A above *[refer to diagram E in field guide]*					**photo B**	**Comment**
Maximum horizontal jump at obstacle (cm)	N/A	<2	2-10	10-30	>30	
Vertical jump at obstacle (cm)	N/A	<2	2-10	10-30	>30	
Turbulence[4] below obstacle	Low		Moderate		High	

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

If an alternative route exists around the obstacle(s) described above, comment on any constraints to passage (e.g. depth/jump) *[refer to diagram C & F in field guide]*	**photo C**	**Comment**

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

[1] *thalweg: The deepest path along the assessment area (the line connecting the lowest points along a series of cross sections)*
[2] *fall: Where water flows over vertical drop resulting in an interruption of the water column (see Diagram D in field guide)*
[3] *cascade: if cascade is present (see Diagram D in field guide) describe length, slope, and velocity of feature and take a photo*
[4] *turbulence: **Low**: unbroken or mostly unbroken water surface; **Moderate**: areas of white-water and unbroken water; **High**: extensive white-water across entire cross-section of channel (refer to photo's in field guide)*
[5] *photos: include photo of the **label** (labels A to C above) when photographing the feature*

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
CONNECTIVITY

CONDITIONS AFFECTING FISH PASSAGE *(at time of sampling)*

WITHIN SITE (based on area assessed in Connectivity diagram)

	Circle category						**Comment**
Shallowest water depth along thalweg [1] (cm) *[refer to diagram B & C in field guide]*	Dry	Fall [2]	<2[3]	2-5[3]	5-10[3]	>10[3]	
Type of feature(s) at shallowest point along thalweg (natural or artificial) *Examples provided in field guide*	Sandy bed		Rock or Riffle		Weir (describe)		
	Culvert		Ford/ causeway		Other (describe)		

If the assessment area contained **a DRY SECTION** or **FALL, complete the table below**

Maximum <u>vertical</u> jump along thalweg *[refer to diagram E in field guide]*						**photo D**	**Comment**
Maximum vertical jump at obstacle (cm)	N/A	<2	2-10	10-30	>30		
Horizontal jump at obstacle (cm)	N/A	<2	2-10	10-30	>30		
Turbulence[4] below obstacle	Low		Moderate		High		

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

Maximum <u>horizontal</u> jump along thalweg - if greater than horizontal jump in A above *[refer to diagram E in field guide]*						**photo E**	**Comment**
Maximum horizontal jump at obstacle (cm)	N/A	<2	2-10	10-30	>30		
Vertical jump at obstacle (cm)	N/A	<2	2-10	10-30	>30		
Turbulence[4] below obstacle	Low		Moderate		High		

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

If an alternative route exists around the obstacle(s) described above, comment on any constraints to passage (e.g. depth/jump) *[refer to diagram C & F in field guide]*	**photo F**	**Comment**

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

[1] *thalweg:* *The deepest path along the assessment area (the line connecting the lowest points along a series of cross sections)*

[2] *fall:* *Where water flows over vertical drop (waterfall or cascade of water) resulting in an interruption of the water column (see Diagram D in field guide)*

[3] *cascade:* *if cascade is present (see Diagram D in field guide) describe length, slope, and velocity of feature and take photo*

[4] *turbulence:* ***Low**: unbroken or mostly unbroken water surface;*
***Moderate**: areas of white-water and unbroken water;*
***High**: extensive white-water across entire cross-section of channel (refer to photo's in field guide)*

[5] *photos:* *include photo of the **label** (labels D to F above) when photographing the feature*

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
CONNECTIVITY

CONDITIONS AFFECTING FISH PASSAGE *(at time of sampling)*

UPSTREAM OF SITE (based on area assessed in Connectivity diagram)

	Circle category						**Comment**
Shallowest water depth along thalweg [1] (cm) *[refer to diagram B & C in field guide]*	Dry	Fall [2]	<2[3]	2-5[3]	5-10[3]	>10[3]	
Type of feature(s) at shallowest point along thalweg (natural or artificial) *Examples provided in field guide*	Sandy bed		Rock or Riffle		Weir (describe)		
	Culvert		Ford/ causeway		Other (describe)		

If the assessment area contained **a DRY SECTION** or **FALL, complete the table below**

Maximum <u>vertical</u> jump along thalweg *[refer to diagram E in field guide]*					**photo G**	**Comment**
Maximum vertical jump at obstacle (cm)	N/A	<2	2-10	10-30	>30	
Horizontal jump at obstacle (cm)	N/A	<2	2-10	10-30	>30	
Turbulence[4] below obstacle	Low		Moderate		High	

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

Maximum <u>horizontal</u> jump along thalweg - if greater than horizontal jump in A above *[refer to diagram E in field guide]*					**photo H**	**Comment**
Maximum horizontal jump at obstacle (cm)	N/A	<2	2-10	10-30	>30	
Vertical jump at obstacle (cm)	N/A	<2	2-10	10-30	>30	
Turbulence[4] below obstacle	Low		Moderate		High	

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

If an alternative route exists around the obstacle(s) described above, comment on any constraints to passage (e.g. depth/jump) *[refer to diagram C & F in field guide]*	**Photo I**	**Comment**

Position recorded on Connectivity diagram ☐ Photo taken [5] ☐

[1 - 4] *see notes below table on previous page (page 3 of 4 of Connectivity field sheet)*

[5] *photos – include photo of the **label** (labels G to I above) when photographing the feature*

FISH PASSAGE – SUMMARY ASSESSMENT

Fish passage summary assessment *(circle)*			
Connected	Potentially affected by flow *	Potentially affected by depth *	Impassable
Comments			

**for some/all fish species*

CONNECTIVITY - ANECDOTAL EVIDENCE

e.g. hydrographer said site is always connected; landholder mentioned changes in connectivity

Source (name/reference)	**Date**	**Comment** (e.g. location, time and connectivity)

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
AQUATIC HABITAT

STREAM HABITAT DIVERSITY

Habitat area (% cover)	
Channel	
Pool	
Riffle	
Run	
Total	**100 %**

Aquatic plants and macroalgae (excluding filamentous) (% cover)		
Area of site covered		**Species** (take photos if unknown)
Proportion emergent & inundated rushes/sedges		
Proportion submerged		
Proportion floating		
Total	**100**	

Woody debris *(circle one in each column)*			
Diversity		**Abundance**	
Expected (i.e. pre-European)	**Observed**	**Expected (i.e. pre-European)**	**Observed**
Unknown	None	Unknown	None
Wood of similar size	Wood of similar size	Sparse (few pieces)	Sparse (few pieces)
2-3 different sizes	2-3 different sizes	Moderate	Moderate
Variety of sizes	Variety of sizes	Dense (throughout most of site)	Dense (throughout most of site)

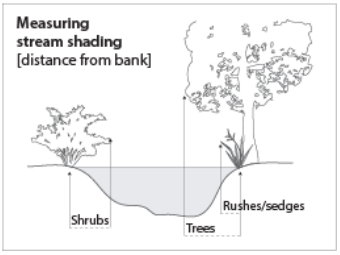
Types of biological substrate and sizes of wood present *(circle all relevant types and all applicable sizes of wood present)*								
Epiphytes	Algae	Detritus	Leaves	**Wood diameter (cm):**	< 5	5-9	10-49	≥ 50

Biological substrate cover	**Density** *(circle)* *[1= sparse, 5 = dense]*
0 - 9%	0 1 2 3 4 5
10 - 29%	1 2 3 4 5
30 - 59%	1 2 3 4 5
60 - 100%	1 2 3 4 5

Physical substrate *(circle all relevant categories)*	
Bedrock	Gravel (4 -16mm) [raw sugar - marble]
Boulders (> 256 mm) [soccer ball]	Sand (1 – 4 mm)
Cobble (64 - 256 mm) [cricket - soccer ball]	Silt (<1 mm)
Pebble (16 - 64 mm) [marble - cricket ball]	Clay (0.002mm)

% Bank length *(circle one in each category)*											
Overhanging roots draped in water				**Overhanging banks**				**Bank vegetation draped in water** *Relates to habitat (not shading)*			
None	1 - 9	10 - 49	50 - 100	None	1 - 9	10 - 49	50 - 100	None	1 - 9	10 - 49	50 - 100

Stream shading	**Percentage of bank length (%)**		**Average distance from bank (m)**	
Avg. stream width _____ m	**LB**	**RB**	**LB**	**RB**
Tree overhang				
Shrub overhang				
Grass/sedges/rushes overhang				



WATER AND SEDIMENT *(circle the appropriate description for each category)*

Sediment deposition	None or minor	Not obvious	Obvious

Type of sediment	Sand	Silt	Other:

Water odours	**Water Oils**	**Turbidity**	**Tannin staining ***		**Algae in water column**	**Algae on substrate**	**Sediment Plume ****	**Sediment oils**	**Sediment odours**
Normal/None	None	Clear	Clear		0%	0%	Small	Absent	Normal/None
Anaerobic	Slick	Slight	Slight		1 to 9%	1 to 9%	Moderate	Light	Anaerobic
Sewage	Sheen	Turbid	Light tea		10 to 49%	10 to 49%	Large	Moderate	Sewage
Petroleum	Globs	Opaque	Dark tea		50 to 74%	50 to 74%		Profuse	Petroleum
Chemical	Flecks		Black		75 -100%	75 -100%			Chemical

** tannin staining can be confused with turbidity when combined with systems containing fine suspended sediment (if hard to assess use filtered water sample)*
*** relates to amount of fine sediment generated and time take to settle (i.e. a large plume may extend for over one meter diameter)*

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
VEGETATION

RIPARIAN VEGETATION - NATIVE

Riparian layers present *	*(circle)*			**Width of riparian zone:**	Left bank _____ m	Right bank _____ m
Ground layer (rushes/sedges)	yes	no	reduced	**Dominant riparian species** *(tick)* *Add others not listed. If species is not known take photos and write 'refer to photos'.*		
Shrub layer (woody)	yes	no	reduced	Rushes/sedges	Paperbark tree	
Tree layer	yes	no	reduced	Teatree	Flooded gum	
				Peppermint tree		

Riparian zone* absent or reduced due to: *(tick)*	natural feature (e.g. bedrock)		human impact		fire/flood		unknown	
	other *(describe)*							

** For riparian zone definition see General site description field sheet (cross-section diagram) [page 2 of 4]*

STREAMSIDE ZONE VEGETATION (FIRST 10 m from edge of river) – NATIVE AND EXOTIC

	Left bank (% cover)					**Right bank** (% cover)				
	0	**1-9**	**10-49**	**50-74**	**75-100**	**0**	**1-9**	**10-49**	**50-74**	**75-100**
Bare ground (not bedrock)										
Ground cover/grasses/sedges/rushes										
Shrubs (woody, multi-stem) *										
Trees < 10m										
Trees > 10m										

** Shrubs include blackberry, tea-trees*

STREAMSIDE ZONE VEGETATION (FIRST 10 m) – PROPORTION OF EXOTIC

Record as a proportion of the total amount of vegetation present e.g. the left bank has 10-49% ground cover of which 75-100% is exotic.

	Left bank (% of total present)					**Right bank** (% of total present)				
	0	**1-9**	**10-49**	**50-74**	**75-100**	**0**	**1-9**	**10-49**	**50-74**	**75-100**
Ground cover/grasses/sedges/rushes										
Shrubs (woody, multi-stem) *										
Trees < 10m										
Trees > 10m										

** Shrubs include blackberry, tea-trees*

List exotic species (if known)	

STREAMSIDE ZONE VEGETATION (FIRST 10 m) – ORGANIC LITTER

Total organic litter (% cover) *(circle one)*					**Of organic litter present, how much is native (%)** *(circle one)*				
None	1-9	10-49	50-74	75-100	None	1-9	10-49	50-74	75-100

STREAMSIDE ZONE VEGETATION (FIRST 10 m) – RECRUITMENT of NATIVE WOODY VEGETATION *(circle one in each category)*

Recruitment evidence	**Recruitment type**	**Extent of recruitment**	**Recruitment health**
None	Trees	Limited	Poor
Natural	Shrubs	Moderate	Moderate
Planted	Both	Abundant	Healthy

BEYOND THE STREAMSIDE ZONE VEGETATION (10 to 100 m from edge of river)

DOMINANT FEATURE in each zone *(tick)*	**Left bank** (m from bank)			**Right bank** (m from bank)		
	10-49	**50-99**	**>100**	**10-49**	**50-99**	**>100**
Minimal vegetation – typical of urban / industry / mining						
Weeds/Grasses/Crops – typical of agriculture, may have a few scattered trees						
Remnant vegetation – mostly native trees/shrubs (may have exotic understorey)						
Forest – native trees, shrubs & understorey (few or no exotics)						
Plantations *(describe type)*						
Other *(describe)*						

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
PHYSICAL FORM and POTENTIAL POLLUTION

AMOUNT OF EROSION

Length of bank affected (irrespective of severity)	*Tick one for each bank*	
	LB	**RB**
0 - 4 %		
5 - 19 %		
20 - 49 %		
50 - 100 %		

EROSION AND BANK STABILITY

SEVERITY of erosion and bank stability [over the 100m site]	*Tick one for each bank*	
	LB	**RB**
Severe: LITTLE TO NO STRUCTURAL INTEGRITY Banks are predominantly bare. Significant sections of erosion on outside bends (undercutting/slumping) and straight stretches (sediment deposits). Exposed roots obvious (where applicable), with significant loss of vegetation in eroding areas. Channel & bank shape and depth likely to change in near future.		
High: POOR STRUCTURAL INTEGRITY Evidence of bank instability (undercutting/slumping); with signs of soil loss from banks, and areas of sedimentation (sandbars/toes) and scouring. Some exposed roots (where applicable), with loss of vegetation in eroding areas. Erosion typically around outside bends.		
Low-Moderate: GOOD STRUCTURAL INTEGRITY Banks relatively stable – exposed and superficially eroding bank (erosion doesn't penetrate deeply into bank wall) or stabilised by only exotic grasses. Little likelihood of significant change to channel/bank shape, depth or loss of bank material in near future.		
Minor: EXCELLENT STRUCTURAL INTEGRITY Banks stable and mostly intact (minor slumping, undercutting or bare banks expected naturally): stabilised by vegetation or bedrock.		

Factors affecting bank stability	*Tick one or more for each bank*	
	LB	**RB**
None		
Feral animals		
Livestock access [*complete table below*]		
Human access		
Cleared vegetation		
Runoff		
Drain pipes		
Flow and waves		
Culvert, bridge, dam		
Other (specify)		

Stabilisation works	*Tick one or more for each bank*	
	LB	**RB**
None		
Rock wall protection		
Bank matting		
Logs/planks strapped to bank		
Concrete lining		
Revegetation plantings		
Fenced human access (deterrent)		
Fenced livestock access		
Fenced stock watering points		
Other (specify)		

LIVESTOCK ACCESS *(tick impacts (minor or major) observed for each category)*

CATEGORY	**Minor**	*Tick*	**Major**	*Tick*
Vegetation damage	Only small patches of vegetation grazed		Most groundcover vegetation grazed	
Bank damage	Isolated areas (1 or 2) of livestock damage		Near continuous livestock damage to stream	
Pugging	Isolated (1or 2) areas of pugging		Extensive pugging along the stream length	
Manure	≤2 significant manure deposits per site		>2 significant manure deposits per site	
Tracks	≤1 track per site		>1 track per site	
Types of livestock present				

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
PHYSICAL FORM and POTENTIAL POLLUTION

POTENTIAL POLLUTION SOURCES

Record sources of potential pollution (actual pollutants may not be present / visible).

POINT SOURCES of potential pollution	**Within site** *Tick all applicable*	**Source** O / A / P *
None		
Pipe or drain - flowing		
Pipe or drain - not flowing		
Drum(s) or container(s)		
Dead (large) animal in river		
Livestock access to river bed		
Road crossing - sealed		
Road crossing - unsealed		
Road works - crossing /bridge		
Road bridge		
Railway bridge		
Other (describe)		

POINT SOURCES of potential pollution Ad-hoc notes and observations
Upstream from site

NON-POINT SOURCES of potential pollution	**Within site, <50m from banks** *Tick all applicable*	**Source** O / A / P *
None		
Agriculture (Ag) - crops		
Ag - turf/nursery/market garden		
Ag - vineyard/orchard		
Ag - horses		
Ag - cattle - dairy		
Ag - cattle - meat		
Ag – cattle/sheep - feed lot		
Ag - sheep/goat/lamas etc		
Ag - chickens		
Ag - pigs		
Plantation - pine		
Plantation - blue gums		
State forest – recently logged		
Waste disposal - landfill		
Road along river - sealed		
Road along river - unsealed		
Road works along river		
Railway along river		
Residential - urban		
Residential - rural		
Commercial - office/shop		
Education establishment		
Recreation - park/oval		
Recreation - water-based		
Industry - heavy/light/rural		
Industry - mining		
Sewage treatment plant		
Other (describe)		

NON-POINT SOURCES of potential pollution Ad-hoc notes and observations
Within site but > 50m from banks
Upstream from site

** Source: O = field officer observed during sampling, A = anecdotal (general knowledge, landholder information), P = aerial photo*

Date ___ / ___ / ___ Site code ______________________ Recorder name ____________

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
FISH AND CRAYFISH – FYKE NET DEPLOYMENT

DPIRD* (1800 815 507) Call Record #:		**Exemption # used**	

Department of Primary Industries and Regional Development (DPIRD) (pre July 2017 was Department of Fisheries).
Call at least 1hr prior to deployment (need exemption # and other details listed on exemption). Only need to call once per sampling trip.

Time deployment started (24 hr)	

	Deployment conditions *Circle appropriate response*															
Fyke net code *(see table below)*	**screen N or Y (&size)**		**Major habitat type**			**Water depth at frame (cm)**	**Stream cross section covered by fyke (%) ***			**Gaps (wings and frame)** *(see table below)*		**Distance between Fyke nets (m)**		
	N	Y	Channel	Pool	Riffle		0-9	10-49	50-89	None	AWF	<10m	10-80	80-120
			Run	Lake			90-94	95-99	100	BWF	EW	>120	N/A	
	N	Y	Channel	Pool	Riffle		0-9	10-49	50-89	None	AWF	<10m	10-80	80-120
			Run	Lake			90-94	95-99	100	BWF	EW	>120	N/A	
	N	Y	Channel	Pool	Riffle		0-9	10-49	50-89	None	AWF	<10m	10-80	80-120
			Run	Lake			90-94	95-99	100	BWF	EW	>120	N/A	
	N	Y	Channel	Pool	Riffle		0-9	10-49	50-89	None	AWF	<10m	10-80	80-120
			Run	Lake			90-94	95-99	100	BWF	EW	>120	N/A	
	N	Y	Channel	Pool	Riffle		0-9	10-49	50-89	None	AWF	<10m	10-80	80-120
			Run	Lake			90-94	95-99	100	BWF	EW	>120	N/A	
	N	Y	Channel	Pool	Riffle		0-9	10-49	50-89	None	AWF	<10m	10-80	80-120
			Run	Lake			90-94	95-99	100	BWF	EW	>120	N/A	

***** *'Stream cross section covered by fyke' includes gaps at edges, & above & below frame, wings & nets. If both wings are fully extended to edge of bank = 100%. Estimate coverage if spaces exist.*

Fyke net code	
Dual-wing fyke code	
UF-RA	Upstream – rectangle – type A [no skirting *]
DF-RA	Downstream – rectangle – type A [no skirting *]
UF-RB	Upstream – rectangle – type B [skirting *]
DF-RB	Downstream – rectangle – type B [skirting *]
UF-RC	Upstream – rectangle – type C [skirting, net & skirting mesh 12 mm]
DF-RC	Downstream – rectangle – type C [skirting, net & skirting mesh 12 mm]
UF-DD	Upstream – dome – type D [double wing *]
DF-DD	Downstream – dome – type D [double wing *]
Single-wing fyke code	
LF1-DE	Left bank fyke # 1 – dome – type E [single wing *] – most US left bank fyke
LF2-DE	Left bank fyke # 2 – dome – type E [single wing *]
LF3-DE	Left bank fyke # 3 – dome – type E [single wing *]
RF1-DE	Right bank fyke # 1 – dome – type E [single wing *] – most US right bank fyke
RF2-DE	Right bank fyke # 2 – dome – type E [single wing *]
RF3-DE	Right bank fyke # 3 – dome – type E [single wing *]

** Mesh of fyke net including skirting is 2 mm except for type C (12mm)*

Gaps (wings and frame) – also applicable to stop nets	
None	No gap above or below wing(s) & frame
AWF	Gap above wing(s) &/or frame
BWF	Gap below wing(s) &/or frame
EW	Gap at end of wing(s)

Additional information
Fyke net code:
Fyke net code:
Fyke net code:
Fyke net code:
Fyke net code:
Fyke net code:

Date ___ / ___ / ___ Site code ______________________ Recorder name ____________

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
FISH AND CRAYFISH – BOX TRAP DEPLOYMENT

DPIRD* (1800 815 507) Call Record #:		**Exemption # used**	

Department of Primary Industries and Regional Development (DPIRD) (pre July 2017 was Department of Fisheries).
Call at least 1hr prior to deployment (need exemption # and other details listed on exemption). Only need to call once per sampling trip.

Time deployment started (24 hr)	

☐ Bait: Chicken pellets
☐ Bait: Other ______________

☐ Traps set with access to air

Biological habitat type *(tick all applicable, within approx. 2 m of trap)*

					Vegetation			**Macrophytes**			**Other**						**Other information**
Box trap code[1]	Left bank (L) Right bank (R) Centre (C)	Major habitat type: C = channel, P = pool, Ri = riffle, Ru = run, L = lake	Water depth (cm)	Set between fykes (Y or N, NA)	Over-hanging water	Draped in water	Terrestrial (e.g. grass)	Emergent	Submerged	Floating	Algae	Overhanging banks	Tree roots	Detritus	woody debris (<5 cm)	woody debris (>5 cm)	- Location to aid collection - Habitat types not listed
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
ADDITIONAL TRAPS – *state reason for deploying additional traps*																	
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															
		C P Ri / Ru L															

[1] **Box trap code**	
S	Small trap
L	Large trap
O	Large opera-house trap

Example of format			
code	S	L	O
# (label on trap)	14	152	101

NOTE: If trap does not have a number, use trap code e.g. S, L or O, followed by a letter starting with A, e.g. S-A, then L-B (if there are multiple traps with no numbers.

Date ___ / ___ / ___ Site code ______________________ Recorder name ____________

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
FISH & CRAYFISH – CONDITION OF BOX TRAPS & FYKES NETS AT COLLECTION

Time collection started (24 hr)	

BOX TRAPS

Box trap code	**Condition of box trap at collection** *(tick all applicable)*										
	No change	**Missing**	**Open**	**Hole or tear**	**Opening obstr-ucted**	**Upside down or on end**	**Opening out of water**	**All out of water**	**Covered in material**	**In anoxic sediment**	**Other collection notes**

FYKE NETS

Fyke net code	**Condition of fyke net at collection** *(tick all applicable)*											
	No change	**Missing**	**Water level risen**	**Access limited**	**Access prevented**	**Tail open**	**Tail hole or tear**	**Skirting or wings hole or tear**	**Skirting or wings fallen or detached**	**Stream cross section covered by fyke (%)**		
										0-9	10-49	50-89
										90-94	95-99	100
		Notes:										
										0-9	10-49	50-89
										90-94	95-99	100
		Notes:										
										0-9	10-49	50-89
										90-94	95-99	100
		Notes:										
										0-9	10-49	50-89
										90-94	95-99	100
		Notes:										
										0-9	10-49	50-89
										90-94	95-99	100
		Notes:										
										0-9	10-49	50-89
										90-94	95-99	100
		Notes:										

Date ___ / ___ / ___ Site code _____ Recorder name _____

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
FISH & CRAYFISH - SUPPORTING INFORMATION

LIST SPECIES OBSERVED VISUALLY BUT NOT CAUGHT IN TRAPS *(comment on numbers and size classes where possible)*	
Species	**Comment**

DOCUMENT ANY ADDITIONAL EVIDENCE OF SPECIES IN THE AREA, incorporating:
- **observations of nests/burrows or tracks** (e.g. from water rats or Engaewa (burrowing) crayfish)
- **anecdotal evidence** (e.g. from landholders, field officers, catchment management groups)

Species	**Comment** *(including source of information where relevant)*

SPECIES CODE

(Alphabetised by common name)

NATIVE FISH SPECIES	**Common name**	**Code**
Large fish *		
Acanthopagrus butcheri	Black bream	ABUT
Tandanus bostocki	Freshwater cobbler	TBOS
Geotria australis	Pouched lamprey	GAUS
Mugil cephalus	Sea mullet	MCEP
Aldrichetta forsteri	Yelloweye mullet	AFOR
Small fish *		
Nannatherina balstoni	Balston's pygmy perch	NBAL
Galaxiella nigrostriata	Black-stripe minnow	GNIG
Galaxias maculatus	Common jollytail	GMAC
Atherinosoma elongata	Elongate hardyhead	AELO
Nannoperca pygmaea	Little pygmy perch	NPYG
Bostockia porosa	Nightfish	BPOR
Lepidogalaxias salamandroides	Salamanderfish	LSAL
Afurcagobius suppositus	South-western goby	ASUP
Pseudogobius olorum	Blue-spot goby	POLO
Galaxias truttaceus	Trout minnow	GTRU
Leptatherina wallacei	Western hardyhead	LWAL
Galaxias occidentalis	Western minnow	GOCC
Galaxiella munda	Western mud minnow	GMUN
Nannoperca vittata	Western pygmy perch	NVIT
NATIVE CRAYFISH SPECIES	**Common name**	**Code**
Engaewa sp.	Burrowing crayfish	ENGA
Cherax quinquecarinatus	Gilgie	CQUI
Cherax crassimanus	Gilgie - restricted	CCRA
Cherax preissi	Koonac	CPRE
Cherax glaber	Koonac - glossy	CGLA
Cherax cainii	Marron - smooth	CCAI
Cherax tenuimanus	Marron - hairy	CTEN

EXOTIC FISH SPECIES	**Common name**	**Code**
***Large fish ***		
Salmo trutta	Brown trout	STRU
Cyprinus carpio	Common carp	CCAR
Oncorhynchus mykiss	Rainbow trout	OMYK
Perca fluviatilis	Redfin perch	PFLU
Small fish *		
Gambusia holbrooki	Eastern gambusia	GHOL
Carassius auratus	Goldfish	CAUR
Phalloceros caudimaculatus	One-spot livebearer	PCAU
Geophagus brasiliensis	Pearl cichlid	GBRA
Leiopotherapon unicolor	Spangled perch	LUNI
EXOTIC CRAYFISH	**Common name**	**Code**
Cherax quadricarinatus	Redclaw	CQUA
Cherax destructor **	Yabby	CDES
OTHER SPECIES (BY-CATCH)	**Common name**	**Code**
Westralunio carteri	Carter's freshwater mussel	WCAR
Chelodina colliei	Long-necked turtle	CCOL
Palaemonetes australis	South-west glass shrimp***	PAUS
	Shrimp (unknown sp.)***	SHRIMP
Caridina indistincta	Indistinct river shrimp***	CIND
Hydromys chrysogaster	Water rat (Rakali)	HCHR
Anura	Unknown frog or tadpole	ANUR
Heleioporus eyrei	Moaning frog	HEYR
Litoria moorei	Motorbike frog	LMOO
ADD ANY SPECIES NOT LISTED		

** Fish size categories relate to size class recorded on collection pages.*
*** Don't distinguish between sub-sp. C. destructor albidus and C. destructor destructor.*
**** The exotic species Caridina indistincta* has been found in SW rivers, it's very similar to PAUS. If unsure what species just write "SHRIMP"

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
FISH & CRAYFISH - BOX TRAP & FYKE NET COLLECTION

Time collection started (24 hr)		Reminder: record condition of trap on page 3 of *Fish & crayfish - Condition of traps & nets at collection* field sheet

Trap or fyke code	Species code *	Size class / Size ranges (mm)*					Gender (tick if present) check until one of each found		Condition of individuals F = few, M = many, A = all								Comments e.g. – Size of largest over 'normal' range (see field guide) – Disease/injury symptoms – Type of parasites or commensals & infestation levels
		Cray-fish: 0-20	20 - 50	50 - 76	76 - 100	100+											
		Small fish: 0-20	20 - 50	50 - 100	100 +	other											
		Large fish: 0-100	100-200	200-400	400+	-	F	M	Signs of breeding: (1) Nuptial colours (2) Urogenital papillae (3) Reddened vents (4) Gravid		Soft shell	Parasite or commensal	Injured	Lethargic	Dead	Disease	
Example: S 14	GOCC	III	(32)	~~IIII~~ II	II		✓	✓	1								largest 120 mm
									2				F			F	injured by CCAI
									3								White spot
									(4)	M							Distended bellies
									1								
									2								
									3								
									4								
									1								
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** Species codes and size categories are listed on Fish & crayfish field sheet [page 4 of 8], if nothing was caught in the trap place a dash in the Species code column.*

Date ___ / ___ / ___ Site code ______________________ Recorder name ____________

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
FISH & CRAYFISH - BOX TRAP & FYKE NET COLLECTION

Reminder: record condition of trap on page 3 of *Fish & crayfish - Condition of traps & nets at collection* field sheet

Trap or fyke code	Species code *	Size class	**Size ranges (mm)***					**Gender** *(tick if present)* *check until one of each found*		**Condition of individuals** F = few, M = many, A = all								**Comments e.g.** – Size of largest over 'normal' range (see field guide) – Disease/injury symptoms – Type of parasites or commensals & infestation levels
		Cray-fish	0-20	20 - 50	50 - 76	76 - 100	100+											
		Small fish	0-20	20 - 50	50 - 100	100 +	other											
		Large fish	0-100	100-200	200-400	400+	-	F	M	Signs of breeding: (1) Nuptial colours (2) Urogenital papillae (3) Reddened vents (4) Gravid		Soft shell	Parasite or Commensal	Injured	Lethargic	Dead	Disease	
										1								
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** Species codes and size categories are listed on Fish & crayfish field sheet [page 4 of 8], if nothing was caught in the trap place a dash in the Species code column.*

Date ___ / ___ / ___ Site code ______________________ Recorder name ____________

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
FISH & CRAYFISH - BOX TRAP & FYKE NET COLLECTION

Reminder: record condition of trap on page 3 of *Fish & crayfish - Condition of traps & nets at collection* field sheet

Trap or fyke code	Species code *	Size class	Size ranges (mm)*					Gender (tick if present) check until one of each found		Condition of individuals F = few, M = many, A = all								Comments e.g. – Size of largest over 'normal' range (see field guide) – Disease/injury symptoms – Type of parasites or commensals & infestation levels
		Cray-fish	0-20	20 - 50	50 - 76	76 - 100	100+											
		Small fish	0-20	20 - 50	50 - 100	100 +	other											
		Large fish	0-100	100-200	200-400	400+	-	F	M	Signs of breeding: (1) Nuptial colours (2) Urogenital papillae (3) Reddened vents (4) Gravid		Soft shell	Parasite or Commensal	Injured	Lethargic	Dead	Disease	
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** Species codes and size categories are listed on Fish & crayfish field sheet [page 4 of 8], if nothing was caught in the trap place a dash in the Species code column.*

Date ___ / ___ / ___ Site code ______________________ Recorder name ____________

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
FISH & CRAYFISH - BOX TRAP & FYKE NET COLLECTION

Reminder: record condition of trap on page 3 of *Fish & crayfish - Condition of traps & nets at collection* field sheet

Trap or fyke code	Species code *	Size class	**Size ranges (mm)***					**Gender** *(tick if present)* *check until one of each found*		**Condition of individuals** F = few, M = many, A = all								**Comments e.g.** – Size of largest over 'normal' range (see field guide) – Disease/injury symptoms – Type of parasites or commensals & infestation levels
		Cray-fish	0-20	20 - 50	50 - 76	76 - 100	100+											
		Small fish	0-20	20 - 50	50 - 100	100 +	other											
		Large fish	0-100	100-200	200-400	400+	-	F	M	Signs of breeding: (1) Nuptial colours (2) Urogenital papillae (3) Reddened vents (4) Gravid		Soft shell	Parasite or Commensal	Injured	Lethargic	Dead	Disease	
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** Species codes and size categories are listed on Fish & crayfish field sheet [page 4 of 8], if nothing was caught in the trap place a dash in the Species code column.*

Date ___ / ___ / ___ Site code _____ Recorder name _____

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SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
MACROINVERTEBRATES

SAMPLE COLLECTION

Time collected (24 hr)		Collected by	
Picked by			
Chain of custody #		Sample #	

MACROINVERTEBRATE HABITAT SAMPLED - 10 m macroinvertebrate sample area only

Habitat	***Tick one***	**Habitat description *(as per AUSRIVAS sampling guide)***
Channel		Margins and central part of main channel, can sample along edges of bank; in leaf packs; woody debris; detritus (excludes riffles, macrophytes, fringing vegetation draped in water)
Macrophyte		Areas of submerged/floating/emergent and fringing vegetation draped in the water
Pool		Deeper areas with very slow-flowing water
Riffle		Areas of flowing, broken water over gravel, pebble, cobble or boulders

MACROINVERTEBRATE HABITAT TYPE OVER ENTIRE 100 M SITE

See above for habitat description, this is different to stream habitat on the *Aquatic Habitat* field sheet [page 1 of 1]

Habitat	**% of 100m site**
Channel	
Macrophyte	
Pool	
Riffle	
Total	**100%**

SAMPLE DEPTH

Average depth sample taken *(circle one)*			
< 25 cm	< 50cm	< 100 cm	< 200 cm

MINERAL SUBSTRATE AND HABITAT SURFACE AREA OF 10m MACROINVERTEBRATE SAMPLING AREA

Mineral substrate	**%**
Bedrock	
Boulders (> 256 mm or soccer ball)	
Cobble (64 - 256 mm or cricket to soccer ball)	
Pebble (16 - 64 mm or 5c piece to cricket ball)	
Gravel (4 -16 mm or raw sugar to 5c piece)	
Sand (1 – 4 mm)	
Silt (<1 mm)	
Clay (<0.002 mm)	
Total	**100%**

Habitat surface area	**%**	**Density** *(circle)* [1= sparse, 5 = dense]
Mineral substrate	100	N/A
Detritus		1 2 3 4 5
Leaves		1 2 3 4 5
Algae		1 2 3 4 5
Woody debris (all sizes)		1 2 3 4 5
Riparian veg draped in water		1 2 3 4 5
Emergent macrophytes		1 2 3 4 5
Submerged macrophytes		1 2 3 4 5
Floating macrophytes		1 2 3 4 5
Total (may be > 100%)		

WATER VELOCITY (FLOW) AT MACROINVERTEBRATE SAMPLING SITE

Flow recorded on *General site description* field sheet [page 4 of 4] *(circle)*	Yes	No *(complete table below)*

Meter or method used		Min velocity (m/s)		Max velocity (m/s)	
Where flow was below the detection limit of the flow meter, was flow visually observed			Yes		No

Date ___ / ___ / ___ Site code _____ Recorder name _____

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SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
MACROINVERTEBRATES

SAMPLING AND PICKING CONDITIONS *(circle)*

Circle any applicable issues encountered in either sampling or picking that could affect results (add others if needed)

Sampling	None	Lots of woody debris	High flow	Steep inundated banks	Habitat not clearly defined or limited	Silty sediment	Lots of floating macrophytes	Other:
Picking	None	Raining	Debris/algae in sample	Low water clarity	Other:			

MICROCRUSTACEANS *(tick)*

Estimate the abundance in the whole sample (note: microcrustaceans are NOT included or counted in the sample picked)

Tick one for each taxa	**None observed**	**1 - 9 individuals**	**10 – 99 individuals**	**100 – 999 individuals**	**> 1000 individuals**
Copepods					
Ostracods (seed shrimp)					
Cladocerans (water flea)					

METHOD USED TO PICK SAMPLE

WHOLE SAMPLE PICKED	Yes (*tick)*	
	Approximate number of macroinvertebrates picked	

OR

BOX SUB-SAMPLER USED	Yes *(tick)*	
	Number of cells picked	
	Number of cells in box	
	Approximate number of macroinvertebrates picked	

Use this space to keep count of individuals picked

INDIVIDUALS NOT PRESERVED

List any individuals found in the sample / box sub-sample that were not preserved in ethanol e.g. freshwater mussels
Include comments about number and size of individuals

Species name (or code*)	**Comments**

* *Use species codes and size classes from Fish & crayfish field sheet [pages 4 and 5] if applicable*

ADDITIONAL COMMENTS

Date ___ / ___ / ___ Site code _____ Recorder name _____

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SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
WATER QUALITY – IN-SITU READINGS & GRAB SAMPLES

IN-SITU READINGS

Instrument Type		**Instrument Number**	

Pre-use calibration		**Date:**		
	SpC (mS/cm)	**pH 7 ***	**pH 10 ***	**DO** (100%)
		Temp (°C) =		
Pre–cal				
Post–cal				

Calibration notes

** pH varies with temperature, ensure pH is calibrated to the correct value with respect to temperature (see field guide for pH - temperature variations). Not necessary for YSI pro plus as it automatically calibrates for pH - temperature variations.*

In-situ reading and observations *(one surface reading [~0.1 m under the surface] taken to represent conditions at the site)*						**Date:**
Additional readings (taken for contextual or investigative purposes) can be recorded on page 2						
Flow code [1]	**Depth below surface** (m)	**Comments** – *observations about water quality sample location (e.g. iron floc, oil sheen, tannin staining)*				
Time on probe (24 h)	**Temperature** (°C)	**pH**	**SpC** (mS/cm)	**Salinity** (ppt)	**DO** (mg/L)	**DO** (% sat)

[1] *Flow at location of in-situ reading: D = dry, S = stationary, F = flowing*

Post-use check		**Date:**	
SpC (mS/cm)	**pH 7**	**pH 10**	**DO** (100%)

GRAB SAMPLE (*samples taken for laboratory analysis)*

Samples should be collected at the same time and location as the in-situ readings.
The list of analytes and the data collection, storage and analytical procedures are provided in the Sampling Analysis Plan for the project.

Grab samples taken		**Date**	**Time** (24 h) *	**Chain of Custody #**	**Sample #**
Yes	No				

** use the same time as recorded on the insitu reading*

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
WATER QUALITY – IN-SITU READINGS & GRAB SAMPLES

ADDITIONAL IN-SITU READINGS

Ad hoc data collected for contextual or investigative purposes

Purpose of additional data collection (e.g. to determine variability across a site)

Date	**Location within site**	**Time** (24 h)	**Depth** (m)	**Flow code**[1]	**Comments** [2]	**Temp** (°C)	**pH**	**SpC** (mS/cm)	**Salinity** (ppt)	**DO** (mg/L)	**DO** (% sat)

[1] *Flow at location of in-situ reading: D = dry, S = stationary, F = flowing*

[2] *Observations about water quality sample location (e.g. iron floc, oil sheen, tannin staining)*

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
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SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
WATER QUALITY - LOGGER DEPLOYMENT & RETRIEVAL
(short-term assessment only)

CALIBRATION OF LOGGER & PREPARATION FOR DATA RECORDING

Logger Type		**Logger #**		**Logger Name**	

Pre-use calibration			**Date:**		
	SpC (mS/cm)	**pH 7** ☐ ref soln changed	**pH 10**	**DO** (0%) *	**DO** (100%)
Pre–cal					
Post–cal					

** DO (0%) calibration is only required for Mantas with a Logger # starting with MM*

Initiating data recording (on computer)		
Logger formatted (to clear existing data)	Yes	No
Logging enabled	Yes	No
Log file name		
Log interval (mins)		

Calibration notes	

CALIBRATION OF ADDITIONAL WATER QUALITY INSTRUMENT *(used to check consistency with data from logger)*

Calibration information completed on *Water Quality – in-situ readings & grab samples* field sheet [page 1 of 2] *(Tick)*	

LOGGER LOCATION & DEPLOYMENT INFORMATION

Attach battery pack and ensure 5 red flashes occur	Battery pack #	

Logger deployment	Date (dd/mm/yyyy)		Time (24h)	

Logger location information *(circle all applicable)*					
Location in stream	In main flow		Off main flow		Other
Canopy cover over loggers (%)	0	1-9	10-49	50-74	>75
In-stream vegetation (within 1 m from loggers)	None	Emergent	Submerged	Floating	
Density of in-stream vegetation (1 m from loggers)	N/A	Sparse	Medium	Dense	
Density of algae in water column (1 m from loggers)	None	Sparse	Medium	Dense	
Riffles/cascades (within 50 m upstream of loggers)	Yes	No	If yes, record meters upstream:		

Water depth and flow				
Water Depth	Beside stake (cm)	Upstream:	Downstream:	
	Water surface to top of sensor cage (cm)			
	River bed to top of sensor cage (cm)			
Flow	Flow information captured on *General site description* field sheet [page 4 of 4] *(circle)*		Yes	No *(complete table below)*
	Meter or method used		Velocity (m/s)	
	Where flow was below the detection limit of the flow meter, was flow visually observed		Yes	No

Post-deployment in-situ WQ reading at logger location (additional water quality instrument)					
Time (24h)	**Temp** (°C)	**pH**	**SpC** (mS/cm)	**DO** (mg/L)	**DO** (%)

Record any additional WQ readings on the *Water Quality – in-situ readings & grab samples* field sheet [page 2 of 2] (e.g. to determine representativeness of the data logger site)

Species observations		
Any species observed are recorded on the ***'Fish & crayfish – supporting information'*** field sheet [page 4 of 8]	Yes	None observed

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
WATER QUALITY – LOGGER DEPLOYMENT & RETRIEVAL
(short-term assessment only)

LOGGER RETRIEVAL INFORMATION

Pre-retrieval in-situ WQ reading at logger location (additional water quality instrument)					
Time (24h)	**Temp** (ºC)	**pH**	**SpC** (mS/cm)	**DO** (mg/L)	**DO** (%)

Record any additional WQ readings on the *Water Quality – in-situ readings & grab samples* field sheet [page 2 of 2] (e.g. to determine representativeness of the data logger site)

Logger retrieval (Time entered water)	Date (dd/mm/yyyy)		Time (24h)	

Changes in conditions		
Any changes to site conditions over the sampling period, in particular flow or water depth, are recorded on the *Cover Sheet*	Yes	None observed

Species observations		
Any species observed are recorded on the *Fish & crayfish – supporting information* field sheet [page 4 of 8]	Yes	None observed

Additional notes:

Disturbance of logger - record any times the logger may have been disturbed (e.g. during fish sampling)	
Date: Time/s:	Description of disturbance
Date: Time/s:	Description of disturbance

POST USE CHECKS & DOWNLOAD

Post-use check - additional water quality instrument	
Recorded on *Water Quality – in-situ readings & grab samples* field sheet [page 1 of 2] *(tick)*	

Post-use check - logger		**Date:**	
SpC (mS/cm)	**pH 7**	**pH 10**	**DO** (100%)

Data download - logger	**Download successful** *(circle)*	Yes	No
Notes			

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
WATER QUALITY – LOGGER MAINTENANCE
(where logger already deployed for long-term monitoring)

Logger Type		**Logger #**		**Logger Name**	

CALIBRATION OF ADDITIONAL WATER QUALITY INSTRUMENT *(used to check consistency with data from logger)*

Calibration information completed on *Water Quality – in-situ readings & grab samples* field sheet [page 1 of 2] *(tick)*	

PRE-REMOVAL IN-SITU READING AT LOGGER LOCATION - ADDITIONAL WATER QUALITY INSTRUMENT

Pre-removal in-situ WQ reading at logger location (additional water quality instrument)					
Time (24h)	**Temp** (°C)	**pH**	**SpC** (mS/cm)	**DO** (mg/L)	**DO** (%)

Record any additional WQ readings on page 2 of *Water Quality – in-situ readings & grab samples* field sheet (e.g. to determine representativeness of the data logger site)

LOGGER DOWNLOAD AND MAINTENANCE

Time entered the water (24 hr)	

Data downloaded successfully	Yes	No	Notes:

Maintenance and re-calibration of logger						
	SpC (mS/cm)		**pH 7**	**pH 10**	**DO** (0%)	**DO** (100%)
Pre–cal reading						
Post–cal reading						
Reason for calibration *(circle)*	4 month		reference solution changed		4 month	4 month
			reference junction changed			
	other		4 month		other	other
			other			
Batteries replaced:	Yes	No	Battery voltage:		Battery pack #:	
Calibration notes						

Redeployment of logger				
Log file name (new)			Log interval (mins):	
Logger re-deployed	Yes	(5 red flashes observed after battery pack was attached)		
	No	State reason:		
	If new logger/battery pack used, record #	Logger:	Battery pack:	

POST-REDEPLOYMENT IN-SITU READING AT LOGGER LOCATION - ADDITIONAL WATER QUALITY INSTRUMENT

Post-deployment in-situ WQ reading at logger location (additional water quality instrument)					
Time (24h)	**Temp** (°C)	**pH**	**SpC** (mS/cm)	**DO** (mg/L)	**DO** (%)

Date ___ / ___ / ___ Site code _____ Recorder name _____

Government of Western Australia
Department of Water and Environmental Regulation

SOUTH WEST INDEX OF RIVER CONDITION - FIELD SHEETS
WATER QUALITY – LOGGER MAINTENANCE
(where logger already deployed for long-term monitoring)

LOGGER RE-DEPLOYMENT INFORMATION

Logger location information *(circle all applicable)*					
Location in stream	In main flow	Off main flow	Other		
Canopy cover over loggers (%)	0	1-9	10-49	50-74	>75
In-stream vegetation (within 1 m from loggers)	None	Emergent	Submerged	Floating	
Density of in-stream vegetation (1 m from loggers)	N/A	Sparse	Medium	Dense	
Density of algae in water column (1 m from loggers)	None	Sparse	Medium	Dense	
Riffles/cascades (within 50 m upstream of loggers)	Yes	No	If yes, record meters upstream:		

Water depth & flow				
Water Depth	Beside stake (cm)	Upstream:	Downstream:	
	Water surface to top of sensor cage (cm)			
	River bed to top of sensor cage (cm)			
Flow	Flow information captured on *General site description* field sheet [page 4 of 4] *(circle)*		Yes	No *(complete table below)*
	Meter or method used		Velocity (m/s)	
	Where flow was below the detection limit of the flow meter, was flow visually observed		Yes	No

Time exited the water (24 hr)	

Weather conditions (circle)								
Rain today	Yes	No	Rain in past week	Yes	No	Unknown	Cloud cover (%)	

Changes in conditions		
Any changes to site conditions over the sampling period, in particular flow or water depth, are recorded on the *Cover Sheet*	Yes	None observed

Species observations		
Any species observed are recorded on the *Fish & crayfish – supporting information* field sheet [page 4 of 8]	Yes	None observed

Additional notes:

Disturbance of logger - record any times the logger may have been disturbed (e.g. during fish sampling)	
Date: Time/s:	Description of disturbance
Date: Time/s:	Description of disturbance

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