Burnett Mary regional biopass strategy

Reconnecting the Dreamtime’s Rainbow Serpent
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About this report

This report has been produced to provide guidance to government, councils, industry and community stakeholders interested in promoting sustainable fisheries management and the conservation of aquatic biodiversity in the Burnett Mary region. The publication aims to guide natural resource management groups, infrastructure providers and others as to priority measures that can be taken to improve waterway and wetland connectivity to enhance the passage of fish and other aquatic fauna throughout the region.

The information has been published on behalf of a range of project partners and has been funded by the Natural Heritage Trust through the Burnett Mary Regional NRM group.

Australian Government

Project partners include:

- Burnet Catchment Care Association
- Mary River Catchment Coordination Association
- Wide Bay Conservation Council
- Fraser Coast Branch of Wildlife Preservation Society Qld
- Lake Macdonald Catchment Care Association

Effect of the Traveston Dam proposal

This strategy covers the whole of the Burnett Mary Region except for those waterways potentially directly impacted by the proposed Traveston Dam due to the uncertainty regarding this proposal. This strategy addresses existing and not proposed barriers, however, the proposed impoundment area and the main trunk of the Mary downstream to the confluence of the Amamoor Creek have not been assessed as part of this strategy.

The assessment of the potential environmental impacts of the proposed dam require far more in-depth and more specific assessment than the regional and subcatchment level assessment conducted by this project. Nothing within this document is intended to make any comment regarding the potential biopassage impacts should the dam proceed, which is a matter for separate consideration by others. In developing this strategy the project partners have agreed to support this proactive initiative by the BMRG on these terms.
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Executive summary...

It is now recognised that all freshwater fish and some other aquatic organisms need to be able to move freely between various areas of their habitat. However, the modes and scales of these movements do differ between species.

The purpose of this strategy is to prioritise measures that improve waterway and wetland connectivity to enhance the passage of fish and other aquatic fauna in the Burnett Mary region.

Passage for aquatic organisms within the Burnett Mary region has been greatly compromised by man-made barriers. The cumulative effect of such barriers can result in local extinctions or significant reductions in the abundance and diversity of aquatic organisms such as fish, turtles, and platypus. These barriers not only include physical barriers such as dams, weirs, levy banks, and inappropriately designed stream crossings, but also behavioural barriers such as cold-water pollution or acid sulphate drainage.

Strategies such as this frequently focus solely on fish passage; however, different species have different life cycle requirements in terms of movement within aquatic systems. The term Biopassage has therefore been coined to describe the retention or restoration of waterway and wetland connectivity and the maintenance of aquatic conditions in order to facilitate the passage of all mobile aquatic species throughout their life cycle.

This strategy provides recommendations and decision support tools to assist the BMRG and its member organisations and agencies to efficiently and strategically invest in actions designed to maximise the improvement of biopassage at minimum cost.

The first steps of developing the strategy involved the formation of a steering committee and expert panel who were crucial to the development of draft assessment criteria and evaluation frameworks. Targeted consultation then occurred at a series of small stakeholder presentations where participants were encouraged to complete questionnaires assessing their preferences with respect to the importance of various values and assessment criteria.

The upgraded Mary River Barrage fishway provides passage over a wide tidal range.

The values that the regional community identified as being highly relevant to biopassage were then used to prioritise the region in a two stage process. These values span cultural heritage (as alluded to in the strategy mission statement 'Reconnecting the Dreamtime’s Rainbow Serpent') in addition to a range of environmental, social and economic attributes.

Initially the region has been divided into subcatchments which have been classified in a five class system from priority 1 - high value reaches which are recommended for protection and conservation, through to low scoring priority 5 reaches where no immediate action to restore passage is recommended but where it may be appropriate to reassess when values or technology change in the future.

Secondly, rapid assessment and barrier prioritisation was undertaken in four priority 1, 2 and 3 subcatchments. Simultaneously demonstration sites were evaluated in each of these catchments and one has been completed with seed funding. A range of remediation sites were evaluated using a cost benefit analysis tool developed by the project, which provides a comparative assessment of the relative economic efficiency of investing in a range of scenarios.

Recommendations in the report span from the on-ground priorities for action suitable for investment by the Burnett Mary region and key stakeholders to the policy and institutional reforms needed to avoid the loss of biopassage values of the region through the cumulative impact of many small decisions.
1.0 Introduction

1.1 Definition of biopassage

Many of Australia’s native aquatic organisms such as fish, platypus, turtles, water rats, crustaceans (i.e. crayfish, shrimp, etc.) and some frog species undertake migrations/movements for a range of reasons:

- to access new habitats or established spawning areas
- to search for food
- to avoid predators
- to defend their territory
- for part of their breeding cycle
- for juvenile recruitment to habitat areas.

Man-made structures evident in and beside our streams create a barrier to the movement of aquatic organisms. Blockage to the passage of aquatic organisms has been identified as one of the major threatening processes affecting aquatic biodiversity and instream habitats.

This strategy therefore aims to prioritise actions which improve the passage of fish and other aquatic fauna through protecting existing connectivity and reducing existing barriers.

This project will conduct desk top and field analysis to develop plans which mitigate the impacts of such barriers which include:

- dams and weirs
- minor in-stream engineering structures (small bridges, culverts, fjords, and other crossings)
- poor water quality (e.g. as a result of aquatic weed “chokes” or acid sulphate soils).

Strategies such as this frequently focus solely on fish passage, however different species have different life cycle requirements in terms of movement within aquatic systems. The term biopassage has therefore been coined to describe the retention or restoration of waterway and wetland connectivity and maintenance of aquatic conditions to facilitate the passage of all mobile aquatic species throughout their life cycle.

1.2 An overview of passage requirements and the impacts of barriers

Providing passage to different organisms should take into consideration the reasons for movement. These can vary between species.

Fish movements can be characterised as follows:

- local movement – food search, predator avoidance etc.
- daily movement – food search, predator, defend territory
- seasonal movement – breeding cycle stimulated by rising water levels or temperatures
- upstream movement – access to new habitats or established spawning areas
- downstream movement – post-spawning movement and avoid predators
- lateral movement – food search, breeding cycle and juvenile recruitment to habitat areas.

Turtles mainly migrate across land from ephemeral ponds to more permanent water bodies during dry seasons and droughts, however, recent studies indicate that cloacal-breathing species such as the Burnett River snapping turtle and the Mary River turtle migrate to mass-nesting sites on alluvial banks within the main river and occasionally in major tributaries. Associated distances have been recorded in excess of ten kilometres. Other species may need to cross instream barriers within their habitat range.

Male platypus movement is much greater than females. Tagging has shown home ranges of males to extend more than seven kilometres, and females more than four kilometres.
Movement mainly occurs in the weeks just before and during the breeding season during which time adult males are known to travel more than fifteen kilometres.

Information available for water rats is limited, although habitat requirements are known to be similar to platypus. However they are likely to have a greater ability to move across land. Similarly data on crustaceans is sparse, although crustaceans in Western Australia are known to seasonally migrate from mainstream channels into tributaries. Upstream mass-migrations of small fresh-water crustaceans have also been observed.

It only takes small changes to the aquatic environment to create barriers to biopassage. A drop of just ten centimetres can block fish passage. Similarly the high velocity water through a pipe or narrow channel can prevent movement of species upstream. There are numerous impacts arising from barriers including:

- restricting migration of fish for spawning
- reducing dispersal of juvenile fish and other small organisms
- creating isolated populations and reduce gene flow between aquatic populations
- limiting passage of organisms between feeding grounds
- causing fish to congregate at a barrier leaving them open to disease or predators
- causing platypus and turtles to cross roadways leaving them vulnerable to predation and road-kill
- creating unsuitable living or breeding conditions
- causing the extinction of upstream or downstream migrating species, and
- altering species diversity because of the local disappearance of some species and changes to the abundance of remaining species.

Impacts can be minimised by considering some key factors in the construction of remedial works such as:

- natural stream flow and velocity should be maintained or mimicked as closely as possible
- the surface level of a causeway should be the same, or lower than the natural level of the streambed
- habitat within a culvert should be as natural as possible (ie allow rocks and streambed material to infill the base)
- light penetration should be as great as possible, and
- reinstating natural stream bed, bank and wetland character (slope, substrate, vegetation and connectivity).

Solutions must be designed to suit the barrier, the river processes, and species preferences of the locality. Solutions vary depending on the scale of the structure.

Fishways for large structures include:

- fish lifts
- fish locks
- fish ladders
- rock ramps

There are many competing pressures and drivers which lead to the creation of barriers and complicate the restoration of connectivity. Figure 1 shows the range of values provided by our waterways and gives a broad indication of how they compete with or support the rehabilitation of biopassage.

1.3 The Burnett Mary regional context

The Burnett Mary Regional Group (BMRG) is the body responsible for planning and coordinating natural resource management initiatives under the joint Federal and Queensland Government Natural Heritage Trust and National Action Plan programs. BMRG collaboratively developed the Regional Natural Resource Management Plan – Country to Coast. The plan identified that aquatic ecosystems and species of high value and diversity that contain habitats of a number of rare and threatened species. The plan identified several specific management actions to address biopassage based on the findings and recommendations of the ‘Freshwater biodiversity technical paper’ (Stockwell et al. 2005). This paper identified a range of ecosystem dynamics which led to the need to have active conservation strategies in place for aquatic biodiversity. It described the key aquatic fauna in the following terms.

The region is at an interzone between southern temperate coastal freshwater fish species (e.g. Australian bass, Australian smelt, short-finned eel, striped gudgeon) and northern tropical freshwater species (e.g. barramundi, mangrove jack, Rendahl’s catfish, jungle perch, barred grunter). It also contains some endemic groups either restricted to the Burnett-Mary region or restricted to sub-tropical Queensland and northern New South Wales (e.g. Mary River cod, Australian lungfish, honey blue-eye, Oxleyan pygmy perch, Duboulay’s rainbowfish and Marjorie’s hardyhead) as well as species with a wide distribution in eastern Australia
Mary River cod were once so abundant that they were harvested for pig food (Simpson and Jackson 1996). The decline of cod has been dramatic. Simpson and Jackson (1996) estimated there were less than 600 adult cod remaining in the core areas of distribution in Tinana-Coondoo Creeks, Six Mile Creek and the Obi Obi Gorge. Lungfish occur in both the Mary and Burnett systems, they are listed as threatened species and of scientific interest under the Nature Conservation Act. There is evidence for only limited recruitment of juvenile lungfish in recent years in the Burnett system (Brooks and Kind 2002). The long life span of lungfish will make declines difficult to detect in the short to medium term if surveys focus on adults.

Oxleyan pygmy perch inhabit soft water wallum streams and swamps. In the region (e.g. purple spotted gudgeon, Tandanus catfish, bully mullet, long-finned eel). Therefore the diversity of freshwater fishes in the region is high by Australian standards (Unmack 2001). The freshwater fauna is composed of fish entirely resident in freshwater, diadromous (fish that have essential migrations between fresh and salt water) species and estuarine species that opportunistically move into freshwaters. The life strategies and associated habitat influences and preferences are outlined in Appendix 1. A number of fish species that are classified as threatened under the Environment Protection and Biodiversity Conservation Act (EPBC) occur in the region. These are Mary River cod (endangered), Australian lungfish (vulnerable), honey blue eye (vulnerable), and Oxleyan pygmy perch (vulnerable).

Positive Relationship – more of one leads to more of the other

Negative Relationship – more of one leads to less of the other

Width of connecting arrow indicates importance of the relationship assessed by the Steering committee (note perimeter relationships are not weighted)

Figure 1. Influence diagram indicating dynamics and relationships between environmental values and enhancement of biopassage
pygmy perch occur in the Tinana Creek catchment, coastal streams in Tin Can Bay and on Fraser Island (Arthington and Marshall 1995, Lowe 1998, Hydrobiology 2003, R. Hobson, EPA pers. com.). Within the region the honey blue eye is also largely confined to wallum country in the Tin Can Bay region and Fraser Island (Arthington and Marshall 1996; Lowe 1998; Hobson pers. com.). Some other species have declined dramatically in the Burnett Mary region. Of concern are jungle perch (Hutchison et al 2002) which has declined to very low numbers in most catchments south from Mackay and freshwater mullet (Kind and Brooks 2003, Stuart and Berghuis 2002) which has virtually disappeared from the Burnett, Kolan, Gregory, Burrum and Isis Rivers. Low abundance of barramundi in the Burnett catchment is also of concern (Lupton and Heidenreich 1999; Heidenreich and Lupton, 1999; Stuart and Berghuis 2002).

The Burnett, Mary and Fitzroy catchments have the highest level of endemic turtle species in Australia. Two of the six species of turtles in the Mary system (Elseya albagula – Burnett River snapping turtle and Elusor macrurus – Mary River turtle) appear to have a declining population and a restricted distribution. Four other species common within the Burnett catchment are Emydura kreftii, Cheirolina expansa, Elseya latisternum and Cheolodina longicollis.

The Burnett/Mary and Fitzroy catchments are the remnants of an ancient river system that existed 10 000 years ago. Some relics of this ancient river system still exist, such as the three endemic turtles:

- Burnett River snapping turtle Elseya albagula – Fitzroy/Burnett/Mary catchments
- Mary River turtle Elusor macrurus (listed as vulnerable by state, endangered by commonwealth) – Mary catchment
- Fitzroy River turtle Rheodytes leukops (vulnerable) – Fitzroy catchment

These three turtles are also the most likely to disappear as we change the functioning of streams.

Queensland Parks and Wildlife Service and community fauna survey data reveal that both platypus (Ornithorhynchus anatinus) and water rats (Hydromys chrysogaster) have broad distributions across the region. While the abundance of these species has declined significantly since European settlement, indications are that they are resilient to a range of disturbances to aquatic ecosystems and maintain viable populations within their habitat range.

The region also contains two crayfish entered on the IUCN’s red list of endangered fauna (Euastacus hystricosus – vulnerable and Euastacus urospinus – endangered). The giant spiny crayfish (Euastacus hystricosus) is restricted to upland streams located in wet sclerophyll forests and rainforests throughout the Conondale and Blackall Ranges. Adults of this species grow up to more than 30 centimetres in length and weigh over two kilograms. Little is known about the giant spiny crayfish, despite being regarded as excellent indicators of ecological health.

Considering these values the Regional NRM Plan identified actions to:

- identify and develop plans to mitigate the impact of barriers to fish movement and or management regimes for water by 2006 (FB 1.3.1)
- identify significant barriers to fish movement and species affected (FB1H)
- identify methods for removal or mitigation of significant barriers to fish movement (including cost benefit analysis and environmental flow requirements) (FB1I)
- strategically restore fish passages (FB 1J).

The Department of Primary Industries and Fisheries along with its project partners Mary River Catchment Coordination Association, Burnett Catchment Care Association, Fraser Coast Branch of the Wildlife Preservation Society of Queensland, Wide Bay Conservation Council Inc. and the Lake Macdonald Fish Hatchery were commissioned by BMRG to develop this strategy to satisfy the first three actions.

This strategy provides recommendations and decision support tools to assist the BMRG and its member organisations and agencies to efficiently and strategically invest in actions designed to maximise the improvement of biopassage for the minimum cost. The following chapters outline how it has achieved this through participative development of a vision and mission and subsequent derivation of priorities based on the values and preferences of a range of key stakeholders consulted in its preparation. Later chapters outline the result of expert assessment against these criteria and resulting classification of subcatchments and priorities within them.
2.0 Summary of vision, mission and desired outcomes

2.1 Vision
Reconnecting the Dreamtime’s Rainbow Serpent
This vision draws upon the mythology of the traditional owners of the land. In the story line of many of the aboriginal groups the Rainbow Serpent was the creative spirit for the waterways of the region. As the serpent slid through the landscape waterways flowed in its path. This strategy therefore envisages reconnection of these undisturbed pathways that are such an integral component of our shared landscapes.

2.2 Mission
To prioritise measures that improve waterway and wetland connectivity to enhance the passage of fish and other aquatic fauna from coast to country.

Ecosystem restoration encompasses a large number of strategies. This mission identified the specific aspect of ecosystem restoration the work is focussed on – increasing connectivity for the passage of aquatic organisms. In some cases priorities in this strategy may need to be balanced against those derived from broader conservation, recreation or development strategies.

2.3 Desired outcomes
A long-term strategy which guides the restoration of passage for fish, turtle and other aquatic organisms across the Burnett Mary Region.

Identification of priority blockages to passage and recommendations based on principles of environmental triage and cost benefit analysis for their remediation.

The key objectives to achieve these outcomes are:

- To develop and get shared agreement of specific vision, aims and prioritisation principles for the strategy within key stakeholder organisations.
- To develop a preliminary ‘model’ of fish and other migratory aquatic organisms in the study area.
- To identify priority subcatchments through a process of region-wide aquatic biodiversity assessment which identifies passage requirements across the region, using the full range of data sources within and outside government.
- To conduct targeted consultation with community and key stakeholders to validate and enhance data capture, and visions, aims, and prioritisation principles.
- To build the capacity and understanding of key participants and potential strategy implementers in government, councils and NRM groups.
3.0 Outline of strategy development process

Catchment approaches toward mitigating, remediating, and removing barriers to passage are already being implemented elsewhere in Australia e.g. New South Wales and northern Queensland. These approaches typically utilise prioritisation processes based on assessment of barriers across a whole catchment or region. This strategy has developed a two stage prioritisation process where initially subcatchments are prioritised using ecological risk assessment methodology and then barriers within them are ranked based upon values that the regional community has identified as being important to improving passage.

Two levels of prioritisation were identified as being essential components of the strategy:

1. Regional level prioritisation
   A prioritisation of all the subcatchments across the Burnett Mary Region.

2. Subcatchment level prioritisation
   A prioritisation of all barriers within a subcatchment. (Due to the size of the region, this has only been undertaken for a few selected subcatchments which had ranked highly in the regional level prioritisation as part of this project.)

A local scale project level prioritisation was also developed and undertaken by the project. This stage involved prioritisation of those barriers ranking highly in the subcatchment level prioritisation to select suitable demonstration sites. This local level prioritisation was augmented by the development of a cost benefit analysis tool as a further guide to investors.

3.1 Process of prioritisation

The first steps involved the formation of a steering committee and expert panel. The project team identified suitable experts from key government departments and universities to participate on an expert panel. Similarly, representatives from the project partners and collaborator organisations identified suitable representatives from key stakeholder groups to join them on the steering committee (local government, state government departments, water utilities, traditional owners, recreational and commercial fishing groups and natural resource management groups).

The first steering committee meeting identified seven key values associated with the prioritising of biopassage in the region, including:

- maintenance of biodiversity
- protection of threatened species
- water resource value
- scenic, cultural and aesthetic values
- traditional fisheries and values
- commercial fisheries

The meeting also identified fifteen criteria relevant to the prioritisation process based on the above key values:

<table>
<thead>
<tr>
<th>Connectivity</th>
<th>Rare species</th>
<th>Ease to fix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>Species richness</td>
<td>Icon species</td>
</tr>
<tr>
<td>Length of stream</td>
<td>Recreation</td>
<td>Bang for buck</td>
</tr>
<tr>
<td>Trajectory</td>
<td>Fish catch</td>
<td>Social capacity</td>
</tr>
<tr>
<td>Species at limit of climatic range</td>
<td>Demonstration suitability</td>
<td>Linking high value ecosystems</td>
</tr>
</tbody>
</table>
Information and consultation events followed and were held throughout the region targeting key stakeholder groups including natural resource management groups, recreational fishers, rural landholders, local governments, and traditional owners. Unfortunately, it proved very difficult to indulge the participation of commercial fishing groups despite concerted efforts.

The consultation events involved:

- A preliminary presentation that provided participants with background information regarding the importance of passage in maintaining sustainable populations of native aquatic organism, the impacts of man-made barriers; and available options for the remediation or removal of barriers.
- A questionnaire that primarily focused participants documenting their assessment of the relative importance of the values and associated prioritisation criteria identified by the steering committee.
- The provision of additional relevant resources from NSW Department of Primary Industries ‘Why do fish need to cross the road? Fish passage requirements for waterway crossings’ and ‘7 key tips for a fish friendly farm’.

The opinions gathered from the completed questionnaires and the first steering committee meeting regarding the importance of the above values and criteria are summarised in the results section (see Figures 3 and 4). These results became the basis for determining the weightings to be applied against the criteria in both the regional level prioritisation and the subcatchment level prioritisation.

### 3.2 Prioritisation hierarchy

The values and criteria were also reviewed by the expert panel, and from their comments a hierarchy of the assessment criteria was developed to determine at which stage of prioritisation specific criteria should be applied. This included some simplification of the values and criteria, and identification of criteria which were relevant to determining either the magnitude of the impact or likelihood of a consequence arising from remediation/removal of barriers.

#### Regional scale subcatchment prioritisation

An ecological risk assessment model was used at the regional scale to determine priorities. This approach is based on a principle of gaining the maximum impact in areas of the highest likelihood of achieving a positive consequence (i.e. as opposed to the highest risk). The criteria to undertake this assessment were:

1. **Magnitude of impact criteria**
   - the biodiversity value of the subcatchment (weighting very high) – presence of threatened species; abundance/spatial extent of habitat; ecosystem diversity
   - the fisheries values of the subcatchment (weighting moderate) – recreational, commercial, and traditional fishing values
   - The scenic, cultural and aesthetic values (weighting moderate) – including indigenous, historical and contemporary cultural values, and amenity and recreational values

2. **Likelihood of consequence**
   - The level of stress in the subcatchment – including the extent of impoundment and water infrastructure; the extent of blockages; the condition of habitat

#### Subcatchment scale barrier prioritisation

A multi-criteria decision support system was developed to assess barriers within the priority subcatchment. The criteria used in this process included:

1. **Connectivity**
   - Including connectivity beneath the subcatchment, connectivity within the subcatchment and hydrological connectivity.

2. **Length of stream**
   - The extent of habitat accessible after remediation.

3. **Condition**
   - The quality of upstream and downstream connected if barrier is remediated.

4. **Species richness**
   - Scored using a stream classification index based on the size and hydrological characteristics of the waterway as a surrogate.

5. **Ease to fix**
   - The likely effectiveness of remediation considering the degree of barrier significance.
Local scale project site prioritisation
This process sort to assist in the selection of which of the priority barriers identified at the above scale to invest in particular circumstances.

At this scale priorities can depend on investor/policy preferences and therefore prioritisation tools need to be adaptable. The criteria deemed relevant to assessment for this purpose by the expert panel included:

1. Bang for buck
   - The quantity of desired environmental value/s enhanced/protected per unit of expenditure; level of potential partners’ investment and in-kind support; trajectory and recovery potential (is investment required now or will the situation improve or get no worse if investment is delayed).

2. Social support
   - Level of broad community support and enthusiasm for project; level of adjoining landholder support for the project (with or without incentives); capacity of local groups to assist in implementation and/or maintenance; good win/win situation outcomes – e.g. raised above flood level.

3. Accessibility and demonstration suitability
   - The accessibility of the site to machinery and people.
   - Visibility and visual impact for demonstration purposes.

4. Cost effectiveness
   - Ease of implementation and likely ongoing maintenance costs etc – e.g. retrofit versus reconstruction.

Table 1. Data sources applied to subcatchment prioritisation

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Data sources</th>
<th>Relevant catchment</th>
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<tr>
<td>Biodiversity</td>
<td>AquaBamm diversity and richness</td>
<td>Burnett</td>
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<td>AquaBamm threatened species and ecosystem value</td>
<td>Burnett</td>
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<td>State of the rivers conservation value</td>
<td>Mary &amp; Baffle</td>
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<td></td>
<td>Mary River rehabilitation plan</td>
<td>Mary</td>
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<td></td>
<td>Threatened fish species</td>
<td>Whole region</td>
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<td>Expert opinion – A. Berghuis and M. Hutchison</td>
<td>Whole region</td>
</tr>
<tr>
<td>Scenic and cultural values</td>
<td>Opinion – core project team</td>
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</tr>
<tr>
<td>Recovery potential</td>
<td>State of the rivers aquatic habitat</td>
<td>Whole region</td>
</tr>
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<td></td>
<td>Fish survey – expert opinion as per fisheries</td>
<td>Whole region</td>
</tr>
<tr>
<td>Water resources</td>
<td>Burnett basin water resource plan</td>
<td>Burnett</td>
</tr>
<tr>
<td></td>
<td>Mary basin water resource plan</td>
<td>Mary</td>
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<td>Burnett basin ROP</td>
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<td>Burnett River catchment study</td>
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<td></td>
<td>Gauging station data</td>
<td>Whole region</td>
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<td>Mary basin land and water resources assessment</td>
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<tr>
<td>Overall barriers</td>
<td>State of the rivers barrier listings</td>
<td>Burnett &amp; Mary</td>
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<td>DNRW gauging weir locations</td>
<td>Whole region</td>
</tr>
<tr>
<td>Extent of other blockages</td>
<td>Expert opinion – B. Stockwell and S. Bratby</td>
<td>Whole region</td>
</tr>
</tbody>
</table>
Cost effectiveness was assessed in two ways. Firstly, cost criteria were appended to subcatchment multi-criteria analysis and a weighting factor applied to the final score to determine a cost effectiveness rating. Secondly, a more sophisticated cost benefit analysis was undertaken which utilised ‘willingness to pay’ for fisheries and water quality values from NSW to assess the relative value to the community of remediaion of each barrier.

### 3.3 Regional level assessment

The steering committee finalised the division of the region into subcatchments (Map 1) and the prioritisation criteria for the regional level assessment (prioritisation of subcatchments) and associated weightings at the second steering committee meeting. Selection of appropriate data sources (Table 1) to score subcatchments against these criteria were determined by the project team, and each subcatchment was scored. The scoring process is outlined in Appendix 2.

### 3.4 Subcatchment level assessment

The criteria and weightings for the subcatchment level assessment (i.e. prioritisation of barriers within the subcatchment were finalised at the third steering committee meeting. Several subcatchments were then selected as priorities for assessment at that meeting. The selection
Figure 2. Decision tree supporting subcatchment selection and priority objectives

followed the step-wise process outlined in the 'decision tree' (Figure 2). The rapid assessment process involved:

- Conducting a desk top audit using licensing data, aerial photography and/or GIS or web-based imagery to identify potential road crossings and other in stream infrastructure that may impede longitudinal movement of aquatic organisms.
- Undertaking rapid appraisal of all barriers in higher values reaches and determining necessity to further assess lower value tributaries e.g. defer detailed assessment in streams with numerous barriers.

Detailed data collection sheets (Appendix 3) were developed based on the previous work of expert panel members (esp. Gordos and Marsden). Data collection was conducted by the project officer (Baffle, Burnett and Isis) and the Mary River Catchment Coordination Association (Middle Mary).
4.0 Results

4.1 Results of consultation

The consultation process was successful in gaining the participation of a mix of key stakeholder representatives, local interest groups, individuals and specialist technical advisers. A total of 116 people provided input from around the region, with presentations being conducted in Noosa, Baffle Creek, Nanango, Hervey Bay, Howard, Wondai, Bundaberg (2), Gympie, and Eidsvold. The results obtained from this process provided a clear direction for the project and facilitated informed decision making at steering committee meetings. The sequential process facilitated meaningful deliberations at each steering committee meeting which strongly guided the prioritisation process.

Consistent and clear trends were obvious across engaged groups in regard to the relative importance of various environmental values. Maintenance of biodiversity and protection of threatened species ranked highly across all groups, with the value of water resources also considered important. The summarised results are shown in Figure 3 which identifies the perceived relative importance of specific values of aquatic environments in terms of assessing the impact of potential improvements to biopassage.

Similarly, the level of ‘connectivity’, ‘habitat condition’, ‘presence of rare species’ and the ‘length of stream’ that would be reconnected if a barrier was removed were all considered to be important assessment criteria across participating stakeholders involved in workshops and questionnaires. Criteria such as ‘species richness’, ‘trajectory’, ‘ease to fix’, ‘bang for buck’ and ‘linking areas of high ecosystem value’ were rated highly by some.

Very few fish can navigate European-designed fish ladders such as this one on Teddington Weir, Tinana Creek.

Figure 3. Relative importance of value that the biopass project should target
sectors only achieved a moderate rating overall. Figure 4 identifies the results of the perceived relative importance of specific potential criteria for prioritising biopassage.

**4.2 Results of regional analysis**

A matrix was developed to score the ecological risk assessment criteria (see section 3.2). The relative weightings derived from the results of consultation (Figures 3 and 4) were used to assign weighting factors to each criterion within this matrix. Reach by reach analysis of published data (Table 1) was augmented by the expert opinion within the project team to score each subcatchment against the criteria. The resultant scores (detailed in Appendix 4) ranked subcatchments from those with the greatest likelihood that remediation would have a large positive impact (high scores) to those with the greatest level of ecological risk and least chance that intervention would achieve significant biodiversity outcomes (low scores). The scoring provided a useful tool to facilitate decisions about the ranking of various subcatchments in terms of investment priority.

Table 2 provides the ranking of the subcatchments as a result of the regional scale analysis. This table includes a potential range for the total score which is based on an assessment of the level of confidence in each scored criterion. Due to the diversity of data sources, and at times fragmented coverage across the region, the confidence placed upon the individual scores varies. Consequently a system of calculating error margins and confidence intervals was also developed to give some indication of a potential range of scores for each subcatchment.

Sensitivity testing was also conducted by running a number of different scenarios e.g. increasing the weighting of biodiversity and recovery potential criteria; reducing the importance of water resource and other blockage criteria. While scores changed with each of the four scenarios tested there was no significant alteration in the ranking of the majority of subcatchments, suggesting the ranking result is reasonably robust.

![Figure 4. Relative importance of prioritisation criteria](image)
4.3 Results of targeted subcatchment analysis

Subcatchment scale barrier prioritisation was conducted on a sample of subcatchments in the region including the Baffle Creek, Baffle Coast, Burnett Estuary, Isis River and Middle Mary subcatchments. Detailed data was collected by the rapid assessment protocol throughout these catchments (Appendix 5). Field observations were initially used to re-assessment of subcatchments using the decision tree depicted in Figure 2.

As a result some subcatchments assessed at a regional scale were broken into smaller subcatchments to allow for more accurate prioritisation of effort. This resulted in:

- Deepwater Creek being rated lower than other parts of the Baffle Coast subcatchment, due to the presence of a tidal barrage.
- Baffle Estuary being rated higher than the freshwater section of the creek due numerous small barriers in the latter.
- Bundaberg Creek being rated lower than the balance of the Burnett estuary subcatchment as a result of the tidal barrage and numerous barriers in the upper catchment.
- Six Mile Creek below Lake Macdonald being rated higher than the rest of the Middle Mary subcatchment considering its high values and a number of minor barriers only.

A matrix was then developed to undertake the multi-criteria analysis which utilised the relative weighting derived during consultation of for each of the subcatchment scale prioritisation criteria (see section 3.2). Each barrier was rated based on the relative quantity and quality of fish habitat connected as a result of barrier rehabilitation and the likely effectiveness of this rehabilitation. The results of this analysis and resultant prioritisation scores are contained in Appendix 5. The rating score was derived from the following formula:

Rating score = USC x (l + HQ) + DSC x (l +HQ) + RE

- USC – upstream stream class (relative fish habitat potential)
- DSC – downstream stream class (relative fish habitat potential)
- l - length of stream connected after rehabilitation
- HQ - quality of habitat connected
- RE – remediation effectiveness (of nominated rehabilitation approach)

This process highlighted some clear priorities within subcatchments and some relative importance of different barriers across the region. The removal of the stream gauging weir on the Mary River at Gympie scored the highest (100) followed by removal of the weed choke on Splitter’s Creek (70), the derelict causeway on the Six Mile Creek at Pomona (64.5) and Heales Road Crossing rehabilitation (64.5) in Splitters Creek. Two other small causeway structures in Six Mile Creek were identified as high priorities (56.5 and 50.5). The removal of the Isis Weir (59.5) and the upstream private orchard irrigation weir (55) scored highly. There was slight reduction in these scores if the barriers were remediated with rock ramps rather than removed considering the reduced effectiveness of this approach. On the Baffle Coast a tidal barrage providing irrigation water on Deepwater Creek was identified as a high priority, although it was not scored considering it was the only significant barrier identified in the subcatchment.

This assessment was then used as the basis for barrier prioritisation. Barrier prioritisation applied a cost effectiveness weighting to the above assessment ratings as discussed in the next session. In addition a more detailed cost benefits analysis was undertaken to further inform investment decisions.
Table 2. Prioritisation ranking of subcatchments after regional scale analysis

<table>
<thead>
<tr>
<th>Subcatchment</th>
<th>Magnitude of impact score</th>
<th>Likelihood of consequence score</th>
<th>Total score</th>
<th>Lower confidence limit</th>
<th>Upper confidence limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baffle Coast</td>
<td>37.0</td>
<td>34.5</td>
<td>1276.5</td>
<td>960.0</td>
<td>1386</td>
</tr>
<tr>
<td>Cooloola Coast</td>
<td>37.0</td>
<td>31.0</td>
<td>1147.0</td>
<td>848.0</td>
<td>1367</td>
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<tr>
<td>Cherwell River</td>
<td>29.0</td>
<td>36.0</td>
<td>1044.0</td>
<td>756.0</td>
<td>1284</td>
</tr>
<tr>
<td>Baffle Creek</td>
<td>32.0</td>
<td>32.5</td>
<td>1040.0</td>
<td>756.0</td>
<td>1208</td>
</tr>
<tr>
<td>Isis River</td>
<td>29.0</td>
<td>34.0</td>
<td>986.0</td>
<td>708.0</td>
<td>1181</td>
</tr>
<tr>
<td>Gregory River</td>
<td>31.0</td>
<td>30.5</td>
<td>945.5</td>
<td>676.0</td>
<td>1173</td>
</tr>
<tr>
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<td>29.0</td>
<td>32.5</td>
<td>942.5</td>
<td>672.0</td>
<td>1138</td>
</tr>
<tr>
<td>Burnett Estuary</td>
<td>29.0</td>
<td>32.5</td>
<td>942.5</td>
<td>672.0</td>
<td>1138</td>
</tr>
<tr>
<td>Elliot River</td>
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<td>29.5</td>
<td>885.0</td>
<td>625.0</td>
<td>1139</td>
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<tr>
<td>Mary Estuary</td>
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<td>840.0</td>
<td>587.5</td>
<td>1056</td>
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<td>Burrum Coast</td>
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<td>1007</td>
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<td>Burrum River</td>
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<td>27.0</td>
<td>756.0</td>
<td>517.5</td>
<td>900</td>
</tr>
<tr>
<td>Cadarga</td>
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<td>28.5</td>
<td>741.0</td>
<td>504.0</td>
<td>944</td>
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<tr>
<td>Kolan River</td>
<td>33.0</td>
<td>22.0</td>
<td>726.0</td>
<td>490.0</td>
<td>914</td>
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<tr>
<td>Tinana Lower</td>
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<td>23.0</td>
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<td>682.0</td>
<td>455.0</td>
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<td>Auburn River</td>
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<td>885</td>
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<tr>
<td>Mary Lower</td>
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<td>26.0</td>
<td>650.0</td>
<td>430.0</td>
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<tr>
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<tr>
<td>Burnett Lower</td>
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<td>22.0</td>
<td>616.0</td>
<td>402.5</td>
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<tr>
<td>Tinana Upper</td>
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<td>21.0</td>
<td>609.0</td>
<td>396.0</td>
<td>829</td>
</tr>
<tr>
<td>Burnett Middle</td>
<td>30.0</td>
<td>20.0</td>
<td>600.0</td>
<td>387.5</td>
<td>787</td>
</tr>
<tr>
<td>Burnett Upper</td>
<td>28.0</td>
<td>21.0</td>
<td>588.0</td>
<td>379.5</td>
<td>803</td>
</tr>
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<td>Western Mary</td>
<td>21.0</td>
<td>25.0</td>
<td>525.0</td>
<td>328.0</td>
<td>723</td>
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<td>Boyne River</td>
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<td>492.0</td>
<td>304.0</td>
<td>660</td>
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<td>Reid Creek</td>
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<td>Boonara Creek</td>
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<td>221.0</td>
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<td>Barambah Creek</td>
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<td>Nogo River</td>
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<td>17.0</td>
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<td>150.0</td>
<td>441</td>
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<tr>
<td>Stuart River</td>
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<td>270.0</td>
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<td>Three Moon Creek</td>
<td>20.0</td>
<td>12.0</td>
<td>240.0</td>
<td>112.5</td>
<td>388</td>
</tr>
</tbody>
</table>
5.0 Regional biopass priorities

As a result of regional scale prioritisation across all subcatchments and subsequent rapid subcatchment scale assessment in targeted waterways the Burnett Mary region has been classified according to the above framework (Map 2). Implementation strategies include adaptive management provisions to amend classifications as further detailed assessment is conducted. However, the priorities below represent the result of best available knowledge.

5.1 Priority classification of subcatchments

Priority 1 – Conserve and protect connectivity

Four catchments have been identified as priority 1. This priority is given to subcatchments (and reaches) where very little alteration has occurred to pre-disturbance connectivity and where catchment and habitat values are sufficiently high to retain very good aquatic biodiversity. These four sub-catchments are:

- Baffle Coast
- Cooloola Coast
- Cherwell River
- Baffle Estuary

Strategies for priority 1 subcatchments

Undertake rapid reconnaissance of subcatchment to identify any blockages to biopassage and their severity. If a number of barriers are identified downgrade classification.

If no significant barriers exist for the majority of flow conditions, retain priority 1 classification and negotiate with approval and planning authorities to increase awareness of the need to prevent future infrastructure and land management impacting on connectivity and biodiversity values.

Invest in restoration to reinstate any insignificant barriers to near pre-disturbance conditions.

Priority 2 – Rehabilitate connectivity

Nine catchments (and reaches) have been identified as priority 2. This priority is given to subcatchments (and reaches) where there has been a range of minor disturbances to connectivity and catchment condition, but where the aquatic ecology may not have experienced any significant threshold change from pre-disturbance condition. These nine subcatchments are:

- Isis River
- Gregory River
- Burnett Coast
- Burnett Estuary
- Elliot River
- Mary Estuary
- Six Mile Creek (downstream of dam)
- Deepwater Creek (Baffle Coast)
- Baffle Creek

Strategies for priority 2 subcatchments

Undertake rapid subcatchment appraisal to identify the relative level of disturbance and potential for rehabilitation to a condition not dissimilar to pre-disturbance condition in terms of connectivity and habitat. If rehabilitation not feasible downgrade classification.

If conditions suitable for rehabilitation exist retain priority 2 classification and undertake detailed assessment of each barrier.

Progressively assess individual barriers on a priority rank order basis with a view of reinstating connectivity so passage is provided for most (but not necessarily all) flow conditions and for most (but not necessarily all) of the time.

Piped culvert impeded by debris in Six Mile Creek, Cooroy.
Invest in rehabilitation to reinstate passage as far as possible to all blockages in priority 2 subcatchments and reaches. Where this is not feasible, minor barriers in low order streams in this priority can be left providing current impacts are minor.

Negotiate with approval and planning authorities to increase awareness of the need to prevent future infrastructure and land management impacting on connectivity and biodiversity values in all priority 2 subcatchments and reaches.

**Priority 3 – Remediate for most conditions**

Thirteen subcatchments (and reaches) have been identified as priority 3. These catchments have at least one major barrier and/or numerous minor to moderate barriers. It is unlikely that these subcatchments can be economically rehabilitated to restore conditions similar to pre-disturbance connectivity and habitat. However within these subcatchments there may be higher value reaches which could be rehabilitated and others where investment could remediate the severity of existing blockages to biopassage. The aim of remediation is to achieve a lesser state than rehabilitation in that connectivity and habitat

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**Map 2. Subcatchment prioritisation**
is reinstated to provide passage for important flow conditions especially for most important time periods (e.g. fish migration) These thirteen subcatchments (and reaches) are:

- Burrum Coast
- Burrum River
- Cadarga River
- Kolan River
- Tinana Lower
- Mary Upper
- Auburn River
- Mary Lower
- Mary Middle
- Burnett Lower
- Tinana Upper
- Burnett Middle
- Bundaberg Creek

**Strategies for priority 3 subcatchments**

Undertake subcatchment prioritisation assessment to identify the relative level of disturbance and determine whether remediation is the likely to achieve passage during important flow periods. If this is unlikely to be feasible downgrade classification.

If subcatchment prioritisation identifies higher scoring reaches which could be rehabilitated then upgrade classification (e.g. reaches or tributaries that contain good habitat and barriers that are only minor to moderate).

Assess individual barriers in priority 3 subcatchments and reaches in the following circumstances:

- consequent to strategies for priority 1 and 2 areas having been substantially implemented
- where funding sources are forthcoming and tied to action in these areas
- where a local demonstration site is desirable.

Progressively assess individual barriers on a priority rank order basis with a view of reinstating connectivity to provide passage for important flow conditions especially for most important time periods.

Where this is not feasible, minor to moderate barriers in low order streams and even major barriers in upper catchments can be managed and not rehabilitated in priority 3 catchments.

**Priority 4 – Improve local connectivity**

From our regional scale analysis five subcatchments have been identified as priority 4. These catchments are likely to have numerous moderate to major barriers and significantly degraded in-stream habitat. It is unlikely to be economically feasible to either rehabilitate or remediate these subcatchments and reaches particularly in-terms of linking country to coast. It may however be possible to restore local connectivity. These five catchments are:

- Burnett Upper
- Western Mary
- Boyne River
- Reid Creek
- Boonara Creek

**Strategies for potential priority 4 subcatchments**

Assess individual barriers in priority 4 subcatchments and reaches in the following circumstances:

- consequent to strategies for priority 1, 2 and 3 areas having been substantially implemented
- where funding sources are forthcoming and tied to action in these areas
- where a local demonstration site is desirable.

Where individual barrier assessment produces poor scores in reaches and subcatchments and it is unlikely even local connectivity can be reinstated downgrade classification.

**Priority 5 – Reassess when values or technology changes**

From our regional scale analysis five subcatchments have been identified as priority 5 regional assessment suggests it is unlikely to be economically feasible to reinstate connectivity with any meaningful biodiversity outcome in these catchments due either to the level of infrastructure within or downstream from the subcatchment, or due to the significant level of degradation of the instream habitat.

*Narrow pipes create a velocity barrier to passage at this Amamoor Creek Road crossing.*
Priority 5 subcatchments are:

- Barambah Creek
- Nogo River
- Stuart River
- Three Moon Creek

Strategies for potential priority 5 subcatchments

Take no action on priority 5 subcatchments until information is received which suggests a reassessment of aquatic values is desirable, or when technological advances suggest that significant improvement can be economically achieved.

5.2 Priority barriers to be remediated

Subsequent to the rapid appraisal and barrier assessment in the Baffle Creek, Burnett Estuary, Isis River and the Middle Mary subcatchments individual barriers were prioritised. Prioritisation was based on an analysis of the cost effectiveness of remediation considering the barrier assessment rating outlined in section 4.3. From this assessment the barriers listed in Table 3 have been identified as high priorities for remediation. A full list of barrier prioritisation scores is contained in Appendix 6.

A more detailed cost benefit analysis of priority structures supports these recommendations (Appendix 8).

5.3 Priority regional demonstration sites

Consequent to finalising the prioritisation of the subcatchments, the Steering Committee identified suitable barriers within higher ranking subcatchments that may be appropriate demonstration sites. Additional factors considered included criteria outlined for local scale project site prioritisation including: ‘bang for buck’, ‘social support’, ‘accessibility and demonstration suitability’, ‘visibility and visual impact for demonstration purposes’ the ease of implementation and likely ongoing maintenance costs considering the project budget and timeline.

Mary basin

- Middle Mary subcatchment - Gympie Gauging Weir, near Kidd Bridge on the Mary River
- Six Mile Creek subcatchment – a small redundant concrete pathway immediately downstream of the Pomona cemetery - a concrete trail crossing in disrepair at old Ringtail Ck road bridge

Burnett & Baffle basins

- Burnett estuary subcatchment - Baldwin Swamp, Bundaberg Creek, Bundaberg. A small weir separating the swamplands from the estuarine section of this creek.
- Isis River subcatchment - Isis Weir, upstream of the railway bridge over the Isis River, Buxton. A small redundant barrage.
- Baffle coast subcatchment - Deepwater Creek. A small barrage used by the nearby macadamia farm.
- Burnett estuary subcatchment – Splitter’s Creek, Kenzler’s Road crossing. A pipe culvert with very small diameter pipes.
- Burnett estuary subcatchment – Splitter’s Creek, Heale’s Road. A box culvert with poor hydraulic design and hydraulic jump caused by old bridge works. This is downstream of the Kenzler’s Road crossing.

Due to the strong support of the local council, the relative ease of remediation the Heales Road culvert was the first demonstration site completed as part of this project. Ross Kapitzke from the School of Engineering, James Cook University was contracted to develop the design which included the treatment of the culverts with baffles and replacement of in-stream blockages with a rock ramp. A separate comprehensive design report was completed for this project (Appendix 9).

The Sunshine Coast Council is currently drawing up designs for the two priority structures in the Six Mile Creek which will also be remediated as part of this project.
### Table 3. Priority barriers identified for remediation.

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Barrier prioritisation score</th>
<th>Cost per km of all habitat connected ($)</th>
<th>Cost per km of high quality habitat connected ($)</th>
<th>Benefit-cost ratio all habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Vertical slot fishway]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Splitters Creek weed choke</td>
<td>70</td>
<td>not assessed</td>
<td>not assessed</td>
<td>not assessed</td>
</tr>
<tr>
<td>Old causeway - Six Mile Creek near Pomona cemetery</td>
<td>60.3</td>
<td>162</td>
<td>203</td>
<td>223.91</td>
</tr>
<tr>
<td>Orchard weir - Isis River (removal)</td>
<td>55</td>
<td>31</td>
<td>82</td>
<td>97.29</td>
</tr>
<tr>
<td>Isis River weir (removal of tidal barrage)</td>
<td>53.55</td>
<td>443</td>
<td>44288</td>
<td>9.97</td>
</tr>
<tr>
<td>Heales Road crossing - Splitter’s Creek</td>
<td>51.6</td>
<td>561</td>
<td>5671</td>
<td>27.96</td>
</tr>
<tr>
<td>Old Ringtail Bridge causeway - Six Mile Creek</td>
<td>50.85</td>
<td>284</td>
<td>405</td>
<td>247.09</td>
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<td>Temp bridge bypass Lake Macdonald Drive - Six Mile Creek</td>
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<td>11.39</td>
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<td>9777</td>
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<tr>
<td>Tidal barrage - Deepwater Creek</td>
<td>not assessed</td>
<td>not assessed</td>
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</tr>
</tbody>
</table>
6. Conclusions & recommendations

6.1 Conclusions

While aquatic connectivity and instream habitats across the Burnett Mary region have been substantially modified, this strategy identifies a range of subcatchments and reaches that retain high environmental values.

Using the outcomes of ecological risk assessment and priorities from multiple objective decision support and cost benefit analysis tools investment can be targeted to strategically rehabilitate barriers to biopassage in a methodical and planned way. Following the recommended priorities and strategies will increase the likelihood that the resource condition targets of the regional plan will be achieved.

From this initial development phase of the strategy a number of ‘best bet’ recommendations can be made, however, it is important to recognise that ongoing subcatchment and barrier evaluation is required to ensure practical and sustainable investment options and rehabilitation solutions are identified to help ‘reconnect the dreamtime rainbow serpent’.

It is also important not to isolate biopassage strategies from broader aquatic ecosystem conservation measures. The survival and sustainability of our native aquatic species does not depend solely upon the restoration of passage, and concurrent and complimentary habitat restoration and species conservation need to be undertaken in the region.

This strategy should be seen as part of an adaptive management process with periodical reviews, especially after detailed rapid subcatchment analysis is undertaken and as new information from other studies comes to hand.

Under current legislation fish passage is only mandatory for new structures or when an existing structure is to be raised or modified. In many situations, the cost of removing or remediating existing barriers is high, and they often have other positive values attached. Consequently implementing this strategy will require an ongoing awareness and engagement campaign to achieve the support of the community and decision makers, the positive participation of structure’s owners, local government and catchment and conservation groups; and a dedicated funding stream.

This document and the appended technical information and decision support tools provide the basis for the key stakeholders to implement a long-term strategy which guides the restoration of passage for fish, turtle and other aquatic organisms across the Burnett Mary region. Priority barriers to biopassage have been identified and based on principles of environmental triage and cost benefit analysis the following actions are recommended for their remediation.

6.2 Recommendations

It is recommended that the Burnett Mary Regional NRM Group and its partners adopt the biopassage priorities outlined in section 5 of this strategy and implement these through the following actions.

Investment guidelines for on-ground strategy implementation

1. The Burnett Mary Regional Group initiate a cross regional consortium to develop an ongoing biopassage program and funding submissions modelled on the New South Wales Catchment Management Authority model ‘Bringing back the fish’, featuring strong partnerships between catchment groups, government and landholders.

2. Until effective rehabilitation is achieved 80% of future biopassage funding be allocated to assessment and rehabilitation of priority 1 and 2 catchments.

3. The balance of funding during this time be allocated to priority 3 subcatchments and reaches for demonstration purposes and to achieve local connectivity.
Revision of resource condition and management action targets
4. The Regional NRM Plan FB 1.3 targets be amended along the following lines:
- by 2012 connectivity and in stream habitat is protected and conserved in all priority 1 subcatchments
- by 2012 biopassage is rehabilitated in all priority 2 subcatchments and reaches
- by 2010 subcatchment barrier prioritisation be undertaken in all priority 2 and 3 subcatchments
- by 2010 instream aquatic habitat rehabilitation priorities be developed for priority 1 and 2 subcatchments and reaches.

Facilitating development of supportive policy and institutional capacity
5. The Burnett Mary Regional Group coordinate multi-agency dialogue to identify planning and approval processes and guidelines to achieve:
- the review of current statutory and policy guidelines for the assessment and approval of fish passage with a view to utilising regional biopassage prioritisation as a guide to barrier approval assessment
- the review of various agency approval processes associated with barrier infrastructure approvals, and the policy assumptions and potential facilitation of incrementalism within these processes, with a view to adopting more rigorous protection and conservation culture within the State along the lines of current NSW Fisheries legislative approach.

6. Implement training for regional council staff and other infrastructure authorities in appropriate instream and wetland habitat management and biopassage design.

7. Facilitate continuous improvement and innovation in the design and construction of instream and wetland biopassage rehabilitation through ongoing action research involving tertiary institutions and government.
References


