USING CONSERVATION TENDERS FOR WATER QUALITY IMPROVEMENTS IN THE BURDEKIN RESEARCH REPORTS

# Designing a metric for conservation tenders at different levels of scope and scale

***RESEARCH REPORT No 3.***

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# 1. Introduction

Conservation tenders generate economic efficiencies in several ways. At a primary level they are more cost-effective than many other funding allocation methods because they focus on selecting the most efficient proposals from landholders to generate desired outcomes. As well, conservation tenders can generate other efficiencies by providing more appropriate incentives to landholders to innovate and search for better ways of achieving outputs. While these advantages are well understood in theoretical terms, a particular challenge in the performance of a conservation tender is to achieve them in practice.

To achieve efficiencies from the performance of a conservation tender, three key tasks need to be performed. The first is to have an appropriate auction design in place so that feasible and cost-effective proposals are submitted by landholders. The second is to have an adequate selection process in place so that when the different proposals are evaluated, the ones that generate efficient outcomes are chosen. The third is to ensure that the auction design, metric design and contract design stages generate appropriate incentives for landholders, and do not create (or at least minimise) perverse incentives.

The focus of this research report is on the second of those goals: the metric design and selection process stage. However, metric design can not be considered in isolation from the other key tasks, particularly the auction design process. Like dance partners in a performance, the information needed to select the cost-efficient proposals depends on the way that the auction process has been designed, the rules for entry and engagement, the conditions that will be employed, and the reactions of different participants to the opportunities that can be presented. This means that the selection process between landholder proposals is dependent on the context and rules under which proposals have been submitted, and these need to be at least implicitly considered in the design of an auction metric.

The bid selection process can also be influenced by the frame of a conservation tender, particularly in terms of scale and scope issues. Issues of scale relate to the size of a program because the proportion of fixed administration and operating costs tend to reduce as the funding level increases. Issues of scope relate to the coverage of a program across geographic and industry types, as well as to coverage over institutional and political boundaries. There is often commonality in scale and scope issues, with larger scale programs often encompassing increased scope. Increases in scope tend to generate greater challenges in the assessment of proposals because they increase the range of different actions and outputs that may need to be evaluated and compared when bids are being evaluated.

Differences in the way in which auctions are framed and implemented suggest that the bid selection process needs to vary between different conservation tenders. As well, metric design needs to vary according to the environmental improvements being purchased. Conservation tenders focused on the purchase of biodiversity (e.g. Stoneham et al. 2003) will differ from other auction formats that purchase a different suite of environmental improvements. The challenge is to develop a bid selection process that is relevant to the auction design and the environmental issue that is being addressed.

In this report the task of developing a metric for assessing water quality improvement proposals is outlined. The context in which these proposals are to be evaluated is the application of a water quality improvement tender in the Lower Burdekin region in North Queensland.

The report is structured in the following way. In the next section, the background to the case study is provided, followed by an overview of tender, contract and metric design issues in Section 3. A review of the metric design undertaken for this project is provided in section 4, followed by conclusions in Section 5.

## 2. Water quality issues in the Lower Burdekin region

The conservation tender is being implemented within the Burdekin Dry Tropics, with a specific focus on two main agricultural industries (cattle grazing and sugarcane production) in areas within the Lower Burdekin region (Figure 1).

The Lower Burdekin region includes the lower part of the Burdekin catchment, which is below the Burdekin Falls Dam, as well as two smaller coastal catchments: the Haughton River and Barratta Creek catchments. The three adjacent waterways share the coastal floodplains and are hydrologically linked through the Burdekin Irrigation Area.

The Lower Burdekin region is characterised by a range of soil types and topographic conditions which support an array of land uses. Beef cattle are grazed primarily in the upper reaches of the Lower Burdekin catchment in sloping country, with intensive irrigated cropping, primarily sugarcane production, cultivated in the highly fertile soils of the delta area (Beare et al. 2003). Land use in the Haughton and Barratta catchments are similar to the Lower Burdekin, with grazing and sugarcane production the dominant agricultural land uses.. Characteristics of the relevant catchments are outlined in Table 1.

**Table 1. Characteristics of the catchment**

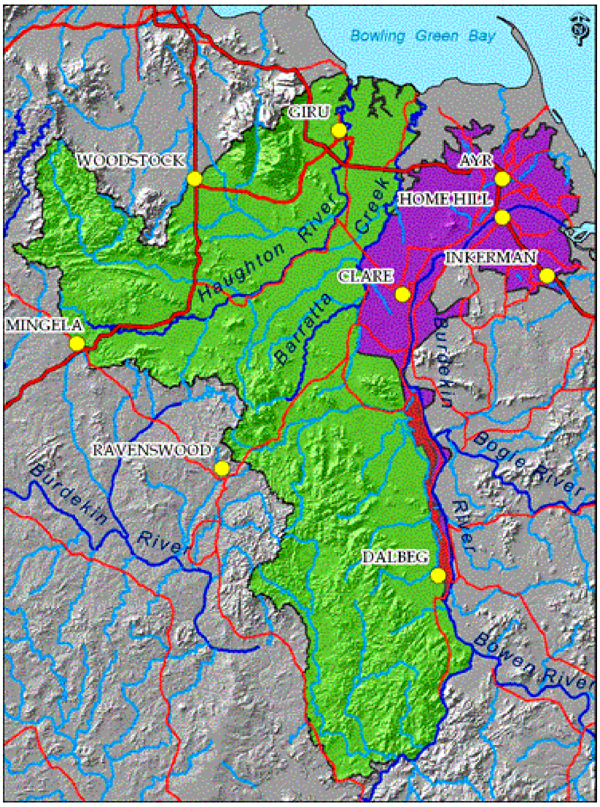
| | Burdekin River Catchment[1] | Haughton River and Barratta Creek Catchments |
|---|---|---|
| Area ($km^2$) | 130,126 | 4, 044 |
| Population | 17, 497 | 10, 343 |
| % Cleared | 73 | 77 |
| Area under grazing ($km^2$) | 128, 640 | 3, 441 |
| Area under sugar ($km^2$) | 193 | 528 |

*Source:* GBRMPA 2001

[1] Information relates to the entire catchment area, The Lower Burdekin section is only a small proportion (<5%) of total catchment area.

Landholders from the grazing and sugar cane industries are eligible to participate in the water quality tender, specifically: all sugar cane growers in the Lower Burdekin and graziers in the Haughton River, Barratta Creek, Landers Creek and Stones Creek catchments.

**Figure 1. Map of eligible areas in the conservation tender**




Being sub-tropical, inter-seasonal variability in rainfall in the area is very high and results in a significant flood event happening in the Burdekin catchment only every two or three years. This flood regime results in higher runoff and pollutant discharge rates from the Burdekin River in comparison to other Great Barrier Reef catchments (Science Panel 2003). Summary details are provided in Table 2.

**Table 2. Rainfall and runoff data by catchment**

| | Burdekin Catchment | Haughton and Barratta Catchments |
|---|---|---|
| Mean Discharge Yr ($km^3$) | 10.3 | 0.7 |
| Mean Rainfall (mm) | 727 | 888 |
| Mean Runoff ($mm/m^3$) | 79 | 183 |
| Runoff/Rainfall Ratio | 11 | 21 |

Source: GBRMPA 2001

Environmental pressures in the Lower Burdekin region are the result of extensive agricultural use, land clearing and landscape modification, which have taken place to support agricultural production within the catchment areas, namely beef cattle, sugarcane and horticulture.

These land-use changes have resulted in widespread erosion, increased the risk of dryland salinity outbreak and promoted the invasion of weeds and pests. The application of nutrients and pesticides in the floodplain areas has increased the risk of offsite contamination in surface and groundwater resources (GBRMPA 2001). The presence of elevated nutrient levels has reduced water quality within groundwater aquifers and the unmetered extraction of groundwater for agricultural production has led to saltwater intrusion (GBRMPA 2001). Only a small percentage of land within the catchments is under any form of conservation protection, accounting for one per cent of the entire Burdekin and eight per cent of the Haughton and Barratta systems (GBRMPA 2001).

The aspects of water quality, which are most important to the health of the Great Barrier Reef are suspended sediment as well as nutrient and pesticide concentrations. Quantifying the exact contributions to the Great Barrier Reef lagoon from catchments and establishing targets for these contributions is a complex task given the variables to be addressed. There are a number of projects underway to attempt to establish this data, however, the best available guidelines at the present are those set by the Great Barrier Reef Marine Park Authority (GBRMPA 2001) in a report to the Ministerial Council on targets for pollutant loads. Pesticide application rates in the catchments are recorded in Table 3, with target reduction levels set at 50%. The current and targeted sediment and nutrient contributions from the catchments are detailed in Table 4.

**Table 3. Pesticide application rates (Kg active ingredient/yr)**

| Pesticide | Lower Burdekin Catchment | Haughton and Barratta Catchments |
|---|---|---|
| Atrazine | 19, 300 | 24, 299 |
| Diuron | 3, 272 | 4, 123 |
| 2-4D | 5, 465 | 6, 887 |
| Chlorpyritos | 207 | 285 |
| MEMC | 196 | 247 |

Source: GBRMPA 2001

**Table 4. Sediment and nutrient exports and targets for the catchments**

| | Burdekin Catchment | | | Haughton and Barratta Catchments | | |
|---|---|---|---|---|---|---|
| | 2001 Tons/year | 2011 Target Tons/year | Reduction Target | 2001 Tons/year | 2011 Target Tons/year | Reduction Target |
| Sediment export | 2, 442, 232 | 1, 221, 616 | 50% | 172, 454 | 115, 544 | 33% |
| Total N export | 11, 134 | 7, 460 | 33% | 801 | 401 | 50% |
| Total P Export | 2, 438 | 1, 219 | 50% | 175 | 88 | 50% |

Source: GBRMPA 2001

GBRMPA has recently released the Annual Marine Monitoring Report (Prange et al. 2007) which identifies declining water quality due to nutrients and sediment runoff as one of the four key natural resources management issues in the Burdekin region (which in the report includes both the Herbert and Burdekin catchments). More specifically, data collected from the Burdekin River indicated:

- There were an estimated 437,300 tonnes of sediment exported from the Burdekin River in 2005/06; and
- Queensland Water Quality Guideline values for all nutrient concentrations (except Dissolved Organic Nitrogen) were exceeded in samples collected in the 2004/05 wet season from the Burdekin River.

In addition:

- Pesticides were detected in inshore areas in the Burdekin region. Pesticides detected included diuron and hexazinone.
- Mud crabs collected from the Burdekin region contained traces of the pesticides DDT, dieldrin and heptachlor.
- Median nearshore Burdekin regional seawater total phosphorus values exceeded Queensland water quality guidelines.
- Marine water chlorophyll *a* concentrations were higher in inshore waters than offshore areas in the Burdekin Region. Chlorophyll *a* is a measure of nutrient availability in the water column.

(Prange et al. 2007)

**The sugarcane industry**

The sugarcane industry within the Burdekin region is recognised as the major sugar producing region in Australia, supporting four sugar mills operated by CSR Sugar. Average farm size in the region is 105 hectares. There are approximately 695 growers in the Lower Burdekin (Morgan 2007).

The availability and affordability of water is a key production issue for the sugarcane industry in the Lower Burdekin as cane is being irrigated, predominately through furrow irrigation. Furrow irrigation is often associated with high application rates which can lead to excess surface runoff and leaching into groundwater resources. The off-farm movement of water containing nutrients and pesticides can be expected to have an adverse impact on water quality. The industry is recognised as a contributor of nutrient exports to the Great Barrier Reef (Beare et al. 2003).

**The grazing industry**
Beef cattle production has a much lower level of economic importance in the Lower Burdekin compared to sugarcane, even though the area of land available for grazing exceeds the irrigation area. There are approximately 30 commercial graziers and a number of recreational and mixed grazing enterprises.

Grazing is recognised as having the potential to do considerable damage to land and waterway condition, with increased sedimentation from erosion the main threat to water quality. A total of 868, 000 hectares within the Lower Burdekin and Haughton Barratta catchments have been deemed ‘hot spot’ locations, on the basis that they are contributing one tonne or more of sediment per hectare a year to the coast (Beare et al. 2003).

## 2.1 Industry best management practices to address water quality

The focus of the conservation tender is to generate improvements in water quality across the sugarcane and grazing industries.

The Coastal Catchments Initiative (through the Burdekin Dry Tropics NRM Group) has developed a number of industry-specific best management practices (BMPs) for the Burdekin region to improve water quality. The following tables summarise these practices for sugarcane production (Table 5) and grazing industry (Table 6).

**Table 5. BMPs in Sugarcane**

| BMP Objectives | Management Practices | Infrastructure Options |
|---|---|---|
| Water Management<br>*Minimise water excess* | • Time irrigation applications and control water application | • Improve irrigation system ie. furrow, overhead, trickle etc<br>• Recycling pits |
| Nitrogen Management<br>*Minimise Nitrogen Surplus* | • Soil test and leaf analysis to match crop Nitrogen requirements | • Improved and calibrated fertiliser box<br>• Recycling pits |
| Herbicide Management<br>*Minimise Herbicide losses* | • Reduce seed bank – effective fallow weed control<br>• Apply at registered rates<br>• Time applications to minimise runoff – irrigations and rain forecast | • Improved and calibrated spray rig<br>• Recycling pits |
| Sediment Management<br>*Minimise erosion* | • Crop in fallow<br>• Maximise trash retention<br>• Minimum till management | • Zero tillage machinery and operations<br>• Recycling pits |

Source: Adapted from Thorburn, Davis and Attard 2007

**Table 6. BMPs in Grazing**

<table>
<tr><th colspan="2">Best Management Practice</th><th>Description</th></tr>
<tr><td rowspan="3">Fence location</td><td>Large well defined rivers</td><td>Fence the ridge just above the floodplain and on the high bank levee.</td></tr>
<tr><td>Braided rivers and tributary streams</td><td>Fence the ridge above the floodplain, excep if it is not practical to fence the immediate riparian area. Erodible, vulnerable and important channels/waterholes should be fenced and cattle excluded</td></tr>
<tr><td>Smaller rivers and streams</td><td>Fence the ridge above the floodplain and at the start of the immediate riparian area.</td></tr>
<tr><td colspan="2" rowspan="4">Grazing and spelling</td><td>Grazing should be at light-moderate utilisation rages (15-20% of annual pasture growth)</td></tr>
<tr><td>Riparian paddocks should be spelled from before the first summer rains until the middle to end of the wet season.</td></tr>
<tr><td>Poor condition land will require an increased frequency and duration of spelling to assist in recovery</td></tr>
<tr><td>Frequency and duration of wet season spelling will depend on land condition indicators including:<br>• Ground cover kept at >60% at end of the dry<br>• Drought cover to not fall below 40%<br>• Pasture yield 1000kgDM/ha at end of dry season<br>• Minimum standard to aim for is ‘B’ condition<br>• River and waterhole banks should be stable and vegetated</td></tr>
<tr><td colspan="2" rowspan="7">Water lanes – should only be used as a temporary measure</td><td>Restrict stock to designated water points within the stream</td></tr>
<tr><td>Selection of water point site that has low erosion hazard, is relatively flat and has easy access for stock</td></tr>
<tr><td>Harden access point surface with gravel or alternative to minimise erosion and provide better footing for stock</td></tr>
<tr><td>Do not select a shady site to minimise stock camping and loitering in the riparian area</td></tr>
<tr><td>Allow stock to watering points only – exclude from rest of watercourse through fencing</td></tr>
<tr><td>Locate site on the inside of a bend, and utilising slower watercourse movement to minimise erosion</td></tr>
<tr><td>Angle access point in a downstream direction</td></tr>
<tr><td colspan="2" rowspan="7">Gully management</td><td>Actively regenerate and manage cattle and vehicular tracks to minimise gully formation and convergence of flow</td></tr>
<tr><td>Stream side vegetation not to be distured</td></tr>
<tr><td>Minimise further exposure of erodible subsoils</td></tr>
<tr><td>In existing gullies, increase ground cover to minimise surface flow and starve existing water networks</td></tr>
<tr><td>Riparian fencing should include existing gullies and exclude stock</td></tr>
<tr><td>Fence existing gullies outside of fenced riparian zone and exclude stock</td></tr>
<tr><td>Undertake mechanical repair with care – professional advice may need to be sought</td></tr>
<tr><td colspan="2" rowspan="5">Vegetation structure</td><td>Maintain native vegetation where practical and possible</td></tr>
<tr><td>Manage frontage country to maximise ground cover with uniform cover at minimum heights of 10-15cm</td></tr>
<tr><td>Dense, continuous grass filters are important and should be maintained to minimise erosion</td></tr>
<tr><td>Maintain effective forested strips by managing tree shading or competition to enable an understorey of dense grass</td></tr>
<tr><td>Promote deep rooted species to protect against streambank erosion</td></tr>
</table>

Source: Adapted from Coughlin, Nelson and O’Reagin 2007

Based on the recognised best management practices to improve water quality leaving farm, in this case study, the types of actions that can be considered to improve water quality in the Burdekin can be grouped into the following broad groups of potential actions:

1. Nutrient management
   - *such as better nutrient budgeting and fertiliser application processes leading to lower application rates and reductions in N and P.*
2. Waste water management
   - *such as sediment traps, drain design, road design, tailwater management, riparian and wetland management, buffer zones.*
3. Pesticide management
   - *such as reductions in the application of key herbicides and pesticides*
4. Sediment management
   - *such as improved ground cover, minimum tillage, reduced stocking rates.*

The groups of actions that are relevant to sugarcane growers are nutrient management, waste water management and pesticide management. As sugarcane is cultivated in very flat areas of the Burdekin, soil erosion is not considered to be an issue of environmental concern. This means that sediment reduction will not be assessed as an environmental benefit in project proposals from sugarcane growers. Similarly, phosphorus reductions will not be assessed in sugarcane projects as phosphorus emissions are principally related to soil movement.

For grazing enterprises, sediment management is likely to be the only action that will be relevant as soil erosion and associated sediment (and phosphorus) loads are the key impacts on water quality. There are very low levels of nitrogen and pesticides emitted from grazing.

## 3. Issues to address in the tender, contract and metric design

The auction system to be trialled falls within a wider set of conservation auction mechanisms. These are a form of price-based mechanisms within the general family of market-based instruments.

A recommended approach to auctioning funding for environmental improvements involves the following steps (see Strappazzon et al. 2003; Latacz-Lohmann and Van der Hamsvoort 1997):

1. Government agency sets desired quantity for environmental improvement, and wants to minimise the cost of achieving the quantity,
2. Agency calls for bids from farmers to provide environmental improvements,
3. Farmers submit expressions of interest,
4. Agency visits each interested farmer to determine the units of land that would be suitable,
5. The agency prepares a contract template that specifies the units of land involved and the management actions (if any) that a farmer would provide,
6. The agency gives each contract a score using a metric or environmental index according to the amount of environmental improvements achieved and other factors,

7. Farmers place bids in a tender system to supply environmental services and ask for funding to provide the services,
8. Agencies arrange farmer's bids from highest to lowest according to the environmental metric (maximising the environmental improvements received per dollar paid),
9. The agency chooses bids that supply the desired amount of environmental improvement by selecting from the lowest bid values upwards,
10. Contracts are established with successful bidders and the actions are performed.

This tender process is essentially a process of auctioning off Government support (in the form of incentive payments) to landholders. Auction theory and other inputs into the design of auctions can therefore help to design the most efficient form of the tender process (Klemperer 2002). Among the key aims for conducting a tender process are:
1. To ensure that there is enough participation to ensure a competitive bidding system,
2. To ensure that there is adequate information for bid construction purposes,
3. To minimise opportunities for collusive or strategic behaviour among participants and,
4. To ensure that optimal outcomes are generated (in terms of reallocating resources efficiently).

There are three key stages in a conservation tender that govern the process and influence the final outcomes. They need to be designed carefully and effectively. The processes include:
- Auction design, involving tender rules and process design, which will help to determine:
  - The environmental services to be purchased,
  - Who is eligible to participate;
  - How likely they are to participate (participation rates); and
  - The process for engaging and accepting proposals;
- Contract design, which will determine the rules of the agreement between buyers and sellers and may also have an impact on participation rates.
- Metric design, which will determine which bids are selected and what environmental benefits are being purchased.

There are three broad categories of costs involved in the implementation of conservation auctions. It is important to recognise and minimise them in the design process:
- Direct design and administration costs,
- Transaction costs for both the landholders and the implementing agencies to find and achieve successful agreements; and
- Indirect impacts on participation and other relevant factors.

As the complexity of a conservation tender increases, the different costs involved in implementing and performance of a tender are likely to rise. The challenge in designing a tender typically involves balancing the trade-off between achieving more detailed and efficient outcomes on the one hand, and minimising the different costs involved on the other hand. These trade-offs are often reflected in the metric, where the level of precision involved in assessing proposals is balanced against the costs involved in gaining extra precision.

Auctions are typically tailored to suit the situation in which they are being applied (Klemperer 2002). This means that the design of the tender process, and the subsequent design of the metric for bid assessment have to be sensitive to the frame in which the tender is applied. In the next section, the design of the tender process and metric design for the Burdekin case study is reported.

## 3.1 The design of the auction process for the Burdekin case study

The key issues relevant to designing the water quality tender for the Burdekin were

- Establishing the target outputs,
- Identifying the scope of the auction,
- Identifying the scale of funding and application,
- Designing a process that was consistent with the current institutional structure.

The **target outputs** were identified as those relevant to improving water quality. Water quality would be improved through the reduction in emission of diffuse source pollutants

- Sediments (from grazing land)
- Nutrients (primarily nitrogen, from sugarcane land)
- Residual pesticides (pesticides, herbicides, fungicides)

Other impacts on water quality were not considered because the additional costs of measuring them and including them in the metric would not have been productive.

Some consideration was given to also including biodiversity impacts into the incentive program. There were three major difficulties with this option; water quality improvement strategies did not necessarily generate biodiversity improvements, the bid assessment process would have been more complex, and it would have been difficult to weight biodiversity impacts against water quality improvements. Instead, biodiversity impacts were addressed in the auction design stage by ruling that bids with substantial (potentially negative) biodiversity impacts would not be eligible to participate in the tender.

The **scale of the auction** (the size and intensity of the process) was largely driven by funding availability. In the initial stages of development, when only $200,000 in incentive funding was being considered, the intention was to restrict the project to the Haughton River and Barratta Creek catchments. The catchments are clearly defined areas which would make it easy to verify landholder eligibility. They are also located next to each other which minimises geographic and climate heterogeneity, and helps to minimise the logistical issues involved in conducting a tender.

However, two factors led to an extension of the project area. First, the Burdekin Dry Tropics NRM group were about to implement an incentive scheme with Burdekin sugarcane growers and decided to incorporate the two schemes together. This meant that the project area was expanded to include sugarcane growers across the Lower Burdekin and available funding for landholder incentives was increased to $600,000.

The second factor was the low number of cattle properties in the Haughton-Barratta area (less than 20). To provide a larger pool of potential grazier bidders, the project area was expanded to include the Stones and Landers Creek catchments.

The total funding has been allocated across two sections of the Lower Burdekin as a part of the experimental design of the project. One half ($300,000) will be available for both cattle and cane projects in the Haughton River, Barratta Creek, Landers Creek and Stones Creek catchment areas (green area in Figure 1), while the other half ($300,000) will be available for sugarcane growers in the remainder of the Lower Burdekin area (purple area in Figure 1).

The **scope of the auction** (the coverage across a range of factors) was set with reference to both scale and institutional factors. As noted above, the geographic scope of the tender is more or less identical with the Lower Burdekin region. In the planning stages, consideration was given to allowing all landholders in the region to participate. However, industry eligibility was restricted to only sugarcane production and cattle grazing. While horticultural production is also an important industry in the region, it was not included in the tender because the industry was in the process of implementing another incentive scheme. Running parallel schemes might have caused confusion. As well, peri-urban landholders on smaller lifestyle blocks were not targeted because of the limited contributions that were possible and the high level of administrative cost that would have been incurred.

A **range of institutional factors** was considered in the design of the tender mechanism. There was potential for the incentive program to overlap with two other funding mechanisms in the region, which respectively targeted sugarcane and horticultural industries. For practical reasons and in terms of having a robust experimental design for the research it was deemed important to avoid program overlap. The MBI incentive program was therefore merged with the water quality program for sugarcane producers in the Lower Burdekin (i.e. the MBI incentive program effectively subsumed the other incentive), while any overlap with the horticultural incentive program in the same region was avoided.

The scope and institutional setting influenced the number of stakeholders involved and the transactions costs involved in overall project design. In this case, both the Burdekin Dry Tropics NRM group (the implementing agency) and industry stakeholder groups (particularly in the sugar industry where there are a number of key organisations involved) had invested considerable time and effort into developing relationships with each other and in turn with landholders. As expert opinion and field officers were to be drawn from a range of different organisations, the project design had to involve these different stakeholders rather than being a completely separate process.

Once the major parameters had been set, there were a number of other structural elements of a tender design that had to be identified. These are summarised in Table 7. The first four issues in the table have already been explored in theory and practice and have become standard features in the conservation tenders in Australia (e.g. Latacz-Lohmann and van der Hamsvoort 1997, 1998; Latatcz-Lohman and Schilizzi 2005; Rolfe and Windle 2006; Stoneham et al. 2003; Windle and Rolfe 2007).

**Table 7. Issues in tender design**

| Issue | Considerations | Implementation |
|---|---|---|
| The number of bidding rounds | Multiple rounds can result in cost efficiencies and are more suitable if coordination between landholders is required. But, more time is needed and they adds to the complexity of process | Single bidding round |
| Sealed or open bid | Landholders more likely to participate if their bid details are confidential | Sealed bid |
| Discriminatory or uniform pricing | With discriminatory pricing, winning bidders get paid their asking level. With uniform pricing, winning bidders get paid the value of the highest bid. With uniform pricing, there needs to be more control over what actions are offered | Discriminatory bid pricing |
| Reserve price | Reserve price may be necessary to reject over-priced bids, particularly if there is limited competition. | An unspecified reserve price applies |
| Efficiency and participation | Maximum bid levels can be set to ensure maximum involvement by landholders. Having no caps on bid levels means a small number of efficient bids may get most of the funding. Landholders may increase their chances of success by entering multiple bids. | Multiple bids allowed<br>No cap on bid levels |
| Cost share arrangement | Fixed-price grant schemes often incorporate a cost share principle which generally does not exist in a conservation tender. | A cost share component will be recorded but will not affect the assessment. |

A number of process elements of a tender design were also identified as important. Specifically, there was a need to encourage participation and therefore increase efficiency of the tender. Where competition is “thin” because of a limited pool of participants, encouraging landholders to enter multiple bids can help to improve the overall efficiency of the tender. In this case study, some of the strategies used to encourage participation included:

- keeping the process as simple as possible;
- keeping the paperwork simple and easy to complete;
- providing all eligible applicants with a field visit for information exchange so that:
    - the tender process and objectives could be explained in more detail;
    - advice could be provided on potential projects and their relative merits;
    - assistance with the paperwork could be provided; and
    - additional information to enter into the metric could be collected.

- ensuring the tender was focused on projects that were acceptable to landholders and were well aligned with their property management plans;
- ensuring support for the project from local industry organisations, representatives and extension officers.

## 3.2 Contract design

The contract determines the details of any management agreement and is designed to ensure the projects are completed as stated. As in tender design, it is important that the contract is designed to achieve the desired environmental outcomes, avoiding any adverse impacts on tender participation. There needs to be a balance between contract detail and practical effectiveness. If the arrangements are too complex they might be hard for landholders to understand and might then be viewed suspiciously. On the other hand, it is important that measures are in place to ensure works are completed. There should be no disproportionate risk to either party if there is a breach of contract. The key issues that were considered in the contract design are summarised the in Table 8.

**Table 8. Issues in contract design**

| Issue | Considerations | Implementation |
|---|---|---|
| Time period for contract | Longer time periods preferred, but there are government constraints on funding period available. | One year contracts April 08 to April 09 |
| Payment periods | There are benefits in tying funding to performance, but also in minimising the number of payments. Some up-front payment may be needed for projects with high capital costs. | Two payment periods. 60% upfront and 40% on successful completion. |
| Form of security | Some conservation tenders have involved high levels of security, such as covenants over land titles. Simpler agreements are more likely to be accepted by landholders. | Simple contracts to be used. |
| Form of contracts | Preferable to have simple form of contract that is easy to understand. | Standard simple contract to be used, with bid forms to be attached as a schedule when signing agreements. |
| Monitoring | Very simple process preferred | Simple report and evidence based monitoring process with agreed conditions attached as a schedule when signing agreements.<br>All projects will be subject to a random audit |

If contract design and/or enforcement of contracts are weak, then more effort has to go into auction and metric design to avoid adverse selection. In this project, some of the industry representatives were concerned about compliance issues and it was considered important that projects should be only accepted when there was a high likelihood that landholders would complete the actions. This meant that some assessment of the risk of adverse selection had to be included in the metric, which is discussed in more detail in the next section.

## 3.3 Issues to consider in metric design

A key step in the development of a conservation tender is the development of the metric, which provides the tool for assessing the environmental benefits of a proposal and comparing it to the asking bid value. The metric is important because it:

(a) represents the process for evaluating bids, and
(b) provides clarity to bidders about the evaluation process.

Some of the key elements to consider in metric design are summarised in Table 9.

**Table 9. Key elements of metric design**

| | | |
|---|---|---|
| 1. | Quantity / quality | Assessing the quantity and quality of environmental benefits associated with a proposal, and registering any tradeoffs between those factors. |
| 2. | Spatial relations | Impact of spatial coordination in regards to management changes yielding greater outcomes, including the specific areas to be included in the tender. |
| 3. | Relative change | The extent to which marginal improvements register as having significant environmental impact. |
| 4. | Location | The specific location of the proposal and how this may affect the environmental benefits generated. |
| 5. | Timing | The timeframe in which the management action will deliver its objective and/or the time taken to achieve that outcome. |
| 6. | Implementation risk | The commitment from the landholder that the funded management action will actually be implemented. |
| 7. | Outcome uncertainty | The probability of success of the action in achieving its objective. |
| 8. | Irreversibility / thresholds | How the proposals might contribute to meeting or avoiding particular thresholds. |
| 9. | Spillover impacts | How to ensure that there are no negative impacts or problems created by the management action adopted. |

Source: Adapted from Whitten 2006

In a broadly scoped industry tender there is a broad range of management activities that landholders might adopt to achieve the required environmental outcomes. In a small scale tender, there might only be a limited range of potential management activities, where the limited variation between projects makes the metric design simpler. Expanding the scale and scope of a tender normally makes the metric more complex. In the Burdekin tender the challenge was to design an evaluation tool which could compare projects:

- Across different industries;
- Across different management activities;
- Across areas with different environmental pressure;
- Across type – where type can include infrastructure or land management-- some projects are more verifiable and therefore the expected outcomes are more likely to be realised;
- Across time – where some project may be more permanent structures that will continue providing environmental benefits well after the completion of the one year contract; and
- Across the scope of management approaches, ie from a single uncoordinated action to one that is part of a more integrated farming systems approach.

To address these issues and ensure consistency in the bid evaluation process, a set of guiding principles were established as outlined in Table 10.

There were two major challenges to address in the design of the metric. The first was to compare different types of emissions in different catchments.. Comparability was achieved by estimating the proportional reduction that each bid proposal made against the specific catchment targets. Some draft guidelines for water quality targets (e.g. GBRMPA 2001) have been set for major catchments such as the Burdekin and Haughton/Barratta systems. These targets for reductions in sediment, nutrient and pesticide loads were then used as a basis for evaluating how well different landholder proposals will help to achieve the desired target.

The second major challenge was to develop some consistency between the desired auction design/metric design process and a more traditional approach of simply scoring the different proposals. An important and influential group of stakeholders in the sugar industry (the Lower Burdekin Sugar Working Group) have been active in the development and promotion of best management practices in the region. They have developed a farm level BMP 'scorecard', which assesses how well a cane grower does in minimising diffiuse source pollution from his land. The scorecard involves a range of different management activities being assessed under the following six broad categories:

- Management Skills & Property Planning
- Land Preparation & Management
- Crop Management
- Water Management
- Nutrient Management
- Pesticide Management

**Table 10. Principles guiding the evaluation of projects**

| Design principle | Explanations |
|---|---|
| Environmental outcomes | Proposals to be assessed against the types and extent of estimated improvement in water quality they achieve. The metric will estimate the reduction of farm emissions in the key areas of<br>* sediments<br>* nutrients (nitrogen, phosphorus)<br>* pesticides (pesticides, herbicides, fungicides, etc)<br>Emission reductions of the various pollutants to be compared on the basis of their relative contribution of improvements to regional (Lower Burdekin and Haughton/Barratta) water quality targets. |
| Total emissions | For the purpose of this market based incentive the avenue of emission is not relevant. While sediment can only be lost through lateral flows, nutrients may be lost through lateral flows (surface water), leaching (ground water) or denitrification (atmosphere). Bids will be assessed on the predictions for total emission reduction and its contribution to achieving regional water quality targets. |
| Value | Proposals from landholders will stipulate a bid amount, i.e. the amount of money that the bidder would like to receive from BDTNRM to facilitate implementation of the proposed activity/infrastructure. Bids will be rated on the basis of $/unit of water quality improvement, as calculated from total emission reduction. |
| Implementation risk[1] | Proposals need to be verifiable. Verification can include photographic evidence, invoices and farm/paddock records. To demonstrate improvement it is essential that the prior situation can be demonstrated, e.g. through at least two years of fertilizer purchase invoices. Verification provides confidence to the participating landholder as well as the BDTNRM that contract conditions have been met. |
| Permanency | Proposals which offer lasting improvements will rate higher than temporary changes. For example, the construction of sediment traps and the establishment and fencing of riparian filter strips will generate benefits in years to come while a one-year reduction in fertilizer application yields water quality benefits in that year only. |

[1] Some elements in the verification process are incorporated in the contract monitoring process and some in the metric.

Under the scorecard approach each activity within a category is assigned a score, which are then summed and weighted by category to generate a total score (see Appendix 1 for details). The idea behind the scorecard is to be able to use it as both an extension and assessment tool. It can be used to discuss a range of different BMPs with landholders as well as collecting information for a performance based assessment. For the latter, the scorecard can be used to make an initial assessment which will set a benchmark for a landholder’s management practices, upon which any further management changes which improve water quality can be assessed.

Members of the Lower Burdekin Sugar Working Group had committed considerable time and resources into the development of the BMP Scorecard and it was their expectation that this would be used to assess projects for the proposed incentive scheme. However, there were several factors that limited the use of the scorecard in the Burdekin Water Quality tender:

- The scorecard is used to measure inputs to the farm system, not outputs as required by the tender;
- The scorecard has an internal reference point: an ‘optimal’ farming system achieves a score of 100.
- No equivalent tool had been developed for the grazing industry, impeding the comparison of scores between cattle and cane submissions;
- No benchmark assessments had been made on which to base any improvements. This would require two assessments to be made; one to set the benchmark and another based on the proposed management changes;
- Some activities have a wide range of potential scores, ie. 0-100, making it harder to assure consistency in valuations across different field assessors; and
- The scorecard is quite lengthy and takes considerable time to complete.

While there were some difficulties associated with using the scorecard approach as a primary method of project assessment, it could still be used to:

- help determine some of the adjustment factors;
- assist in the contract monitoring process; and
- remain part of the important on-going extension activities.

An overview of the bid assessment process is provided in Appendix 2 and full details of the key elements in the metric design are presented in the next section.

## 4. Bid assessment metric

There is an extensive suite of management actions and infrastructure establishment that landholders could conceivable undertake and submit as proposals to improve water quality. These can be grouped into four main categories:

- Nutrient management
- Pesticide management
- Water management
- Sediment management

Evaluating the environmental benefits associated with each of these management practices was the primary objective in the metric design. However, two other critical components, shown in Table 9, were also considered.

- Effectiveness factors – which include an assessment of the permanency of the project (projected time span of benefits). Other influential factors that might detract from the project effectiveness also needed to be considered.
- Implementation risk factors – these form an assessment of the likelihood that landholders can implement the actions and verify that they have occurred.

Each of these six metric components is discussed in more detail below. The process for assessing bids (see Appendix 2) can be outlined as follows:

1. Collect relevant information for each bid;
2. Assess potential reductions in nutrients, pesticides and sediment emissions for each bid;

3. Make **effectiveness** adjustments where
    a. benefits are likely to occur over longer periods of time,
    b. other factors may reduce the effectiveness of the project;
4. Identify proportional reductions for emissions for each bid against GBRMPA regional targets (**Environmental score**);
5. Sum proportional reductions and adjust for **implementation risk** factors (**Total assessment score**); and
6. Compare to Total Assessment Score to costs (**Relative bid value**)

or

1. **Environmental benefits** = Reduced emissions * Effectiveness adjustments

2. **Environmental score** = Environmental benefits / GBRMPA target

3. **Total Assessment Score** = (Σ Environmental scores) * Implementation risk score

4. **Relative Bid Value** = Bid price ($) / Total Assessment Score

The most notable part of the metric is the way in which the environmental scores are generated by calculating the proportion of reductions against catchment targets. This allows reductions for different factors such as nutrients and sediments to be compared and then summed. After this critical step, bids can be assessed and ranked in terms of their relative bid value, followed by the selection process until the budget funding limit has been reached.

## 4.1 Assessing nutrient management

While excessive phosphorus emissions have been identified as a key water quality issue in the Burdekin there is a general recognition in the sugar industry that the source of emissions are soil based rather than fertiliser based.

For the purpose of this project, the key variable to be included in the metric is:
(a) changes in the amount of nitrogen resulting from a reduction in fertilizer use,

Information will be collected on potential reduction in phosphorous resulting from a reduction in fertilizer use for research related purposes, but will not be used to evaluate the environmental benefits of the bids.

There are a number of sources of nitrogen emissions, including a range of different industries and natural processes. In the sugar industry (as in other intensive farming industries), the key input of these nutrients is through fertilizer applications. Higher levels of inputs through fertilizer lead to higher losses, through a range of different outputs such as waste water runoff and trash disposal. Reductions in fertilizer application rates should lead to diminished losses, and thus are a convenient indicator of the potential lowering of nutrient loads.

A change in the amount of nitrogen entering the farm (through lower levels of fertilizer applications) will not lead to an equivalent reduction of nitrogen leaving the farm in water bodies, for two reasons. First, nitrogen is a highly soluble nutrient, which moves readily below the root zone and into ground water systems. In some regions, there are relatively rapid movements between ground water systems and drainage lines, while in other regions the systems remain quite distinct. The second reason is that some forms of nitrogen may dissolve into the atmosphere.

Even when nutrients leave a farm boundary in a water body, they may not necessarily reach the mouth of the river or stream. Some nutrients are bound up in mud or other deposits, while others are utilised by vegetation. This means that only a proportion of the inputs of nutrients into streams become outputs to the Great Barrier Reef lagoon.

To design the metric, the following assumptions have been made:

- A reduction in nitrogen inputs will translate to a reduction in nitrogen exports;
- Transfers into ground water systems are included as well as transfers with surface movements; and
- There is no diffusion of nitrogen into the atmosphere.

In designing nutrient management systems, it is important to identify at the farm level:

- baseline emission levels from current management actions (current fertilizer use and fertilizer budgeting); and
- changes in emissions from proposed actions (changes in fertilizer use, changes in application methods and fertilizer budgeting).

For example, a bid to change a fertiliser system might involve consideration of:

(a) propensity of existing system to deliver nutrients to waterways (i.e. excess nutrients in current system);
(b) Changes in application methods and timing;
(c) Reductions in the volume of fertilizer inputs to the farm; and
(d) Net reductions in N and P likely to enter waterways.

## 4.2 Assessing pesticide management

There are a number of sources of pesticide emissions. In the sugarcane industry (as in other intensive farming industries), pesticide emissions result from herbicide and pesticide applications. Higher levels of inputs lead to higher losses, through a range of different outputs such as waste water runoff and trash disposal. Reductions in pesticide application rates should lead to diminished losses, and thus are a convenient indicator of the potential lowering of pesticide loads.

Not all pesticides are potential pollutants that transfer off farm. Key pesticides that may have environmental impacts are listed in Table 3. Some pesticides may move vertically through soils into groundwater systems, while others will transfer with surface water movements. Even when pesticides leave a farm boundary in a water body, they may not necessarily reach the mouth of the river or stream, as some pesticides may be bound up in mud or other deposits. This means that only a proportion of the inputs of nutrients into streams become outputs to the Great Barrier Reef lagoon.

To design the metric, the following assumptions have been made:

- A reduction in inputs of key pesticide types will translate to a reduction in pesticide exports,
- Transfers into ground water systems are included as well as transfers with surface movements,

In designing pesticide management systems, it is important to identify at the farm level:

- baseline emission levels from current management actions (current pesticide use),
- changes in emissions from proposed actions (changes in pesticide use)

For the purpose of this project, the key variables to be included in the metric are:

- changes in the amount of pesticide inputs resulting from a reduction in pesticide use for specified pesticides.

## 4.3 Assessing water management

There are a range of activities that can limit the movement of sediments, nutrients and pesticides off a farm after storm or excess irrigation events. These include actions such as sediment traps, drain design, road design, tailwater management, riparian and wetland management, changes in irrigation practices and the establishment of buffer zones.

The types of benefits that can be expected are:

(a) changes in the amount of nitrogen that enters waterways,
(b) changes in the amount of phosphorous that enters waterways,
(c) changes in the amount of pesticides that enters waterways, and
(d) changes in the amount of sediments that enters waterways.

In the Lower Burdekin, soil erosion is not an environmental management issue in the cane growing areas and sediment reduction will not be assessed in this category. In addition, there is a lack of information available that might help assess the extent of pesticide reduction associated with waste water management. Consequently only the nutrient related benefits will be evaluated.

In some cases, there may be some interactions between other initiatives and waste water management, so where there are combinations of actions (e.g. reduced fertilizer use and stormwater structures), it will be important to calculate the net effects rather than simply add the different calculations.

In designing waste water management systems, it is important to identify at the farm level:

- the drainage area above the structure;
- the volume of water draining past the structure;
- the quantity of nutrient emissions contained in the run-off;
- the water holding capacity of the structure; and
- the effectiveness of the structure (ie the proportion of water settled/pumped out each year).

For the purpose of this project, the key variable to be included in the metric is:

- changes in the amount of nitrogen inputs resulting from a reduction in waste water leaving the farm.

Information will be collected on potential reductions in sediment and phosphorous for research related purposes, but will not be used to evaluate the environmental benefits of the bids.

### 4.4 Assessing sediment management

Sediment management issues were restricted to activities in the grazing industry, where levels of sediment movement are likely to be reduced by changes in soil cover, particularly in riparian areas.

In designing sediment or soil management systems, it is important to identify at the property level:

- the average rainfall for the area;
- the current level of ground cover;
- the predicted level of ground cover from management improvements;
- the soil type in terms of erodibility relative to average soils in the area;
- the slope of the land in the project area;
- average rainfall for the area; and
- proportion of stream/river frontage included in the project area.

For the purpose of this project, the key variables to be included in the metric are:

- changes in the amount of sediment inputs resulting from a reduction in the sediment leaving the farm.

### 4.5 Assessing effectiveness factors

Management proposals involving changes in farming systems and infrastructure management are likely to be capital intensive. These actions may also have longer term benefits because they are more likely to be continued after the life of the agreement. In contrast, fertilizer and pesticide actions may not continue past the agreement and the funding cycle. Where capital costs are involved, bids will be more expensive per change in emissions than for simple management actions. To take account of this, it is proposed to sum the projected emission reductions from such projects over a longer time period. For example, changes to more permanent structures can be allocated benefits for a period of up to five years while projects involving costly equipment changes maybe allocated benefits for up to three years.

Other factors that may detract from the effectiveness of a particular action will also be considered. For example, if a tailings dam is located in or close by a watercourse, a flood event could flush out the dam and reduce its effectiveness.

### 4.6 Assessing implementation risk

There is some risk that landholders may not perform the management actions as specified in their bid proposals. While the tender contract can be designed to incorporate specific monitoring and evaluation conditions, it cannot be deal with the issue of adverse selection. In order to minimise the risk of moral hazard, implementation risk factors will be incorporated into the metric design and selection process.

Some management actions proposed by landholders, such as the construction of physical infrastructure are easily verified, but other actions might have important environmental benefits but not be so readily substantiated. For example, an applicant might submit a proposal that states they will reduce their fertiliser use, but without some kind of evidence-based verification, there is no way of knowing if the project will really be implemented. The implementation risk score was designed in part to assess the likelihood that any stated action could be validated and subsequently tracked in the monitoring process.

However, the second aspect of the implementation risk score related to the likely effectiveness of the proposed actions in terms of the applicants' management capacity. For example, a single action such as building a tail water dam may be better designed and lead to better environmental outcome if the applicant has good management skills and training, and/or who adopts a farming systems approach. Five components will be considered in the implementation risk score:

1. **Monitoring systems and record keeping**: e.g. paddock records, monitoring sites, pasture budgeting records. Consider both existing systems and proposals for new ones will be considered.
2. **Farming systems management**: e.g. extent to which the adjustment is part of a holistic strategy or a one-off attempt, which may not be well coordinate with other farm management practices.
3. **Track record:** e.g. extent to which the applicant has been involved with conservation organisations and/or extent of participation/compliance in previous schemes.
4. **Physical evidence**: e.g. ability to provide physical evidence such as photos, records and invoices to demonstrate outcomes. The challenge is will be with management change, as capital change is easy to verify.
5. **Management skills, capacity and accreditation** e.g. extent to industry participation and training.

## 5. Summary

There are a number of notable features of the metric design that has been outlined in this report. Metric design, like auction design, needs to be tailored to each case study. In this case, the challenges of designing a conservation tender that was a relatively large scale and was scoped across different targets, industries and catchments created a number of metric design issues.

Much of the underlying variability between different industries and catchments was addressed by focusing on the relative outputs of the landholder proposals. Focusing on the contributions that proposals could make to reducing sediment, nutrient and pesticide movement into waterways increased the potential for a variety of different proposals to made, including those from different systems and industry types.

There are four notable features of this metric that differentiate it from other similar assessment tools. First, variations between the river/creek catchments within the Lower Burdekin region have been addressed by comparing predicted physical reductions against target reductions in each catchment. This provides a basis for identifying the relative contributions at a catchment level.

Second, the difficulties of comparing reductions in different outputs have also been addressed by comparing predicted physical reductions against target reductions in each catchment. The conversion of physical outputs into proportional gains provides a mechanism for consolidation into a single score. The relative importance of the different types of physical properties are weighted according to the catchment targets that have been set by external bodies.

Third, the use of adjustment factors allows other important influences to be considered in the bid assessment. The most important of these relate to the expected time scale of potential benefits, where capital works might deliver more certainty and duration in environmental improvements.

Fourth, the variation in landholder circumstances, both within and across industries, meant that some account needed to be taken of the likelihood that landholders would not be able to deliver on the proposals that were being made. A variety of categories have been nominated to assess the likelihood that projects will be undertaken and can be verified.

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## Appendix 1. Extract from the sugarcane BMP scorecard

| Phase | Management Considerations | Management Options | Phase Weighting | MO rating |
|---|---|---|---|---|
| **Management Skills & Property Planning** | ***Management Capacity*** | Accreditation (Chemcert, progrow, LWMP's etc) | **5** | 0-20 |
| | | Record keeping (Economics, farm operations etc). | | 0-10 |
| | | Communication with R&D activities | | 0-2.5 |
| | ***Farm design*** | Match row length and slope for soil type. | | 0-40 |
| | | Separate farm into discrete soil units in blocks. | | 0-15 |
| | | Vegetate riparian zones and waterways. | | 0-2.5 |
| | ***Infrastructure*** | Water outlets, pipelines provision for recycling | | 0-10 |
| | | | | Max 100 |
| **Land Preparation & Management** | ***Land preparation*** | Laser level blocks and fallow plots as required. | **2.5** | 0-20 |
| | | Treat each soil type discretely. | | 0-10 |
| | | Adopt GPS controlled traffic technology. | | 0-10 |
| | ***Fallow management*** | Maintain a weed free fallow. | | 0-10 |
| | | Use appropriate fallow crops. | | 0-10 |
| | ***Tillage operations*** | Adopt a minimum or zero tillage system. | | 0-10 |
| | | March row width to machinery. | | 0-10 |
| | ***Soil amelioration*** | Use appropriate soil ameliorant | | 0-20 |
| | | | | Max 100 |
| **Crop Management** | ***Crop husbandry*** | Maximize crop potential with good husbandry. | **2.5** | 0-40 |
| | | Spray out to eradicate crop on permanent beds. | | 0-10 |
| | ***Harvesting*** | Green cane harvest (GCTB) where appropriate. | | 0-40 |
| | | Optimize harvester efficiency. | | 0-10 |
| | | | | Max 100 |
| **Water Management** | ***Irrigation management/ control*** | Match water use to crop requirements. | **30** | 0-15 |
| | | Use water meters to know water application volume. | | 0-5 |
| | | Adjust inflow rates (furrow) | | 0-2.5 |
| | | Adopt efficient application methods (OHLP,drip) | | 0-30 |
| | | Customize furrow shape to maximize efficiency. | | 0-2.5 |
| | | Minimize runoff by management & infrastructure. | | 0-40 |
| | | Minimize run-off from post harvest irrigations. | | 0-2.5 |
| | | Mix groundwater with surface water appropriately. | | 0-2.5 |
| | | | | Max 100 |

| Phase | Management Considerations | Management Options | Phase Weighting | MO rating |
|---|---|---|---|---|
| | ***Irrigation timing & scheduling*** | Employ tools to improve irrigation efficiency. | **10** | 0-70 |
| | | Irrigate prior to fertilizing in burnt cane system. | | 0-10 |
| | | Delay irrigation after fertilizer application. | | 0-20 |
| | | | | Max100 |
| **Nutrient Management** | ***Fertilizer rate*** | Soil testing to optimize nutrient application. | **30** | 0-10 |
| | | Nutrient budgeting to apply optimum rate. | | 0-90 |
| | | | | Max 100 |
| | ***Fertilizer timing*** | Time application to maximise efficiencies. | **10** | 0-100 |
| | | | | Max 100 |
| | ***Fertilizer placement*** | Place fertilizer to maximise efficiency & uptake | **10** | 0-100 |
| | | | | |
| **Pesticide Management** | ***Product*** | Use low risk products where possible. | **10** | 0-50 |
| | ***Rate*** | Adopt an integrated pest management strategy. | | 0-15 |
| | | Use at recommended label rate. | | 0-20 |
| | ***Application*** | Use most efficient methods for spraying. | | 0-10 |
| | | Ensure effectively functioning spray rigs. | | 0-5 |
| **WQ points** | | | **110** | MAX100 |

## Appendix 2. Project assessment and evaluation overview