Adoption of sustainable farm management to improve tailwater quality - A plan for the Ord River irrigation area

Tara Slaven
Rebecca Heath
Jamie Bowyer

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Adoption of sustainable farm management to improve tailwater quality
A plan for the Ord River Irrigation Area

Tara Slaven, Rebecca Heath and Jamie Bowyer
Department of Agriculture and Food, Western Australia
Acknowledgments

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The authors acknowledge the valuable input provided throughout the development of this plan particularly by the growers, Ord Land and Water, the Ord Irrigation Cooperative, Rangelands NRM, the Department of Water and the Department of Environment and Conservation.

In addition, this plan would not have been possible without the openness and cooperation of the growers and individuals from government and non-government organisations, who were willing to answer questions and provide valuable insights.

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3 Baron-Hay Court, South Perth WA 6151
Tel: (08) 9368 3333
Email: enquiries@agric.wa.gov.au
www.agric.wa.gov.au
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgments</td>
<td>ii</td>
</tr>
<tr>
<td>Summary</td>
<td>1</td>
</tr>
<tr>
<td>1. BACKGROUND</td>
<td>2</td>
</tr>
<tr>
<td>1.1 Impacts of irrigated agriculture</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Development of the plan</td>
<td>5</td>
</tr>
<tr>
<td>1.3 Use of the plan</td>
<td>6</td>
</tr>
<tr>
<td>1.4 Anticipated impact from delivery of this plan</td>
<td>6</td>
</tr>
<tr>
<td>2. OBJECTIVES</td>
<td>8</td>
</tr>
<tr>
<td>3. ACTIVITIES</td>
<td>9</td>
</tr>
<tr>
<td>4. ACTIVITY DETAIL</td>
<td>15</td>
</tr>
<tr>
<td>5. COMMUNICATIONS</td>
<td>19</td>
</tr>
<tr>
<td>6. PROJECT MONITORING AND EVALUATION</td>
<td>20</td>
</tr>
<tr>
<td>Monitoring</td>
<td>20</td>
</tr>
<tr>
<td>Evaluation</td>
<td>20</td>
</tr>
<tr>
<td>Reporting</td>
<td>20</td>
</tr>
<tr>
<td>7. REFERENCES</td>
<td>21</td>
</tr>
<tr>
<td>Appendix 1: Operating environment</td>
<td>23</td>
</tr>
<tr>
<td>Ord expansion</td>
<td>23</td>
</tr>
<tr>
<td>External factors</td>
<td>23</td>
</tr>
<tr>
<td>Water availability</td>
<td>23</td>
</tr>
<tr>
<td>Climate change</td>
<td>23</td>
</tr>
<tr>
<td>Increasing demand</td>
<td>24</td>
</tr>
<tr>
<td>Environmental values</td>
<td>24</td>
</tr>
<tr>
<td>Social pressure</td>
<td>24</td>
</tr>
<tr>
<td>Strengths, weaknesses, opportunities and threats</td>
<td>24</td>
</tr>
<tr>
<td>Appendix 2: Stakeholder analysis</td>
<td>27</td>
</tr>
<tr>
<td>Potential partners</td>
<td>27</td>
</tr>
<tr>
<td>Keep informed</td>
<td>29</td>
</tr>
<tr>
<td>Target audience for change – analysis</td>
<td>30</td>
</tr>
<tr>
<td>Target audience for change – further detail</td>
<td>31</td>
</tr>
<tr>
<td>Appendix 3: Intended change analysis</td>
<td>32</td>
</tr>
<tr>
<td>Ultimate intended change</td>
<td>32</td>
</tr>
<tr>
<td>Direct intended change</td>
<td>32</td>
</tr>
<tr>
<td>Other ‘direct intended changes’</td>
<td>32</td>
</tr>
<tr>
<td>Appendix 4: Assumptions and risks to success</td>
<td>33</td>
</tr>
</tbody>
</table>
Summary

The overall purpose of this plan is to provide a clear pathway to improve adoption of sustainable farming practices. The focus of the plan is to develop and encourage adoption of practices that minimise sediment, nutrient and chemical export from agricultural land within the Ord River Irrigation Area (ORIA) (Figure 1). The plan aims to build on the significant work done by growers, government agencies and community groups over the years to manage the off-site impacts of irrigated agriculture.

A broad consultative approach was used to develop the plan. Workshops, meetings and one-on-one discussions were held with the local irrigation community and relevant stakeholders to gain insights into the current situation with regard to sustainable farm management in the ORIA. This information was collated and used to inform the development of this plan. In addition, feedback on the draft plan was sought from these people, and this has shaped the final product.

The key areas of focus are:

- **Participation and collaboration**
  - Encourage stakeholder participation and collaboration

- **Research and development**
  - Develop sustainable options that are adoptable

- **Learning and support**
  - Increase awareness, knowledge and understanding of sustainable irrigated agriculture
  - Support adoption of sustainable options

- **Resource condition monitoring**
  - Monitor and report on the condition of relevant natural resources

The plan encourages a collaborative, participatory approach to improving environmental outcomes from irrigated agriculture in the ORIA. Due to the complexity and scale of the change associated with managers adopting sustainable farm practices, the plan has been developed with a five-year timeframe.
1. Background

The Ord River runs roughly in a south to north direction towards the Kimberley coast (Figure 1). There are two dams on the river. Lake Argyle about 50km south of the township of Kununurra was created by the Ord Dam. The Diversion Dam situated at Kununurra creates a constant water level from water released through the Ord Dam. This water gravity feeds into the main irrigation channel (M1) of the ORIA on the eastern bank of the river. It is also pumped into the Packsaddle irrigation system which is on the western bank. The irrigation water is then distributed to farms through a series of channels. It flows through the farms and out via a drainage system into the Ord River below the Diversion Dam. This part of the river (the lower Ord) flows towards the coast and drains into the Cambridge Gulf.

1.1 Impacts of irrigated agriculture

The irrigation water picks-up sediment, chemicals and nutrients as it flows through the farms and into the lower Ord River. There is currently no infrastructure in place to reduce the amount of sediment, chemicals and nutrients entering the lower Ord River. The quality of the water in the drainage system is dependant on the management of the farm.

This plan targets surface irrigators within the existing irrigation area (Figure 1). Surface irrigators are targeted, as this method of irrigation has a direct impact on the water quality of the lower Ord River.

There are current and potential future issues related to irrigation water coming off farms (tailwater) and the level of risk it poses to water quality in the lower Ord River and the Ord River floodplain Ramsar wetland.

Current issues

Traditional surface irrigation results in tailwater (waste water) that contains sediments, nutrients and chemicals. The design of the current irrigation area means that tailwater flows through a series of drains directly into the river. There are no structures, such as sediment traps or constructed wetlands, to reduce the quantity of sediments, nutrients and chemicals in the waste water. A study by Gardiner & Associates (2000) considered the threat that tailwater posed to the health of the river was low to medium, under current flow conditions.

Since the release of the Ord Land & Water Management Plan 2000 water quality below the irrigation area has been assessed. A preliminary assessment showed that tailwater contained elevated levels of fine sediments and nutrients such as nitrogen (N) and phosphorus (P) (Lund and McCrea 2001). Contaminants such as endosulphan (insecticide) and atrazine (herbicide) have also been recorded in tailwater (Doupe et al. 1998; WRC unpublished data).

In 1997 and again in 2004 fish kills were recorded in the Dunham River and other parts of the irrigation system. These kills were linked with endosulphan contamination.

Regular water samples from various sites within the Ord Catchment were collected between 1998 and 2003 by the Water and Rivers Commission. Analysis of that data showed there was a statistically significant increase (p<0.01) in atrazine levels downstream of the ORIA. There was also an increase in endosulfan levels downstream but the increase was not found to be statistically significant (p=0.15). Atrazine was detectable in 24% of the downstream samples and exceeded guidelines in 6.2% of samples. Endosulfan was detectable in 9.2% of downstream samples and exceeded guidelines in nearly 6.9% of samples. Both atrazine and
endosulfan levels showed declines over the period of sampling. However, in 2005 atrazine still exceeded guideline levels in downstream sites (Fredericks 2006).

The data also showed statistically significant increases in all nutrient levels (N and P, total and dissolved) detected at downstream sites. All nutrients reached levels in excess of ANZECC default guideline values, but the nutrients of most concern were ammonia (91% exceedance) and total phosphorus (90% exceedance) (Fredericks 2006).

Unfortunately, this monitoring program no longer exists. Currently, only the water quality of the drains is monitored as a component of Ord Irrigation Cooperative surface water licence.

Other current key issues that this plan addresses (as identified by Slaven, Heath and Bowyer 2010b) are:

1. **Negligible adoption of sustainable practices that reduce sediments, chemicals and nutrients entering the river.** There are very few sustainable options that are both practical and economically viable from the grower’s perspective.

2. **Growers are comfortable with current farming practices.** Extension of practices to improve tailwater quality has been relatively passive up until now. Growers need to be re-engaged and motivated to trial sustainable practices.

**Future issues**

There is increasing political pressure to expand the size of the ORIA. An expansion of the area will result in a greater demand for water to irrigate. Excess water currently flows through the Diversion Dam and down the river into the Cambridge Gulf. The current flow is greater than the required environmental flow. This means that in the future the amount of water flowing down the lower Ord, below the Diversion Dam, could decrease. This in turn would reduce the dilution factor of waste water entering the river from the irrigation area.

The Ord River Water Management Plan (Department of Water 2006) states that ‘the level of flow may be less than the current flow [of the lower Ord River] as long as water quality can be maintained.’ Minimising the impact of the ORIA on the Ord River will help ensure that the resource will be available for future generations to use and enjoy as well as enhance the environmental outcomes.

Plate 1. **Collecting information from a soil moisture monitoring logger.**
Adoption of sustainable farm management to improve tailwater quality: A plan for the Ord River Irrigation Area

Figure 1 Map of the Ord River Irrigation Area (ORIA) (Department of Water 2006).
1.2 Development of the plan

This plan is part of the ongoing research, development and extension into sustainable irrigation in the ORIA.

The Ord Catchment was recognised as a priority catchment by the Australian Government in 2004, with $8.5 million allocated as part of the National Action Plan (NAP) for Salinity and Water Quality. A number of projects were developed and overseen by the Ord Catchment Reference Group, including the predecessor of this project—a three-year project called ‘Demonstrating sustainable farm management systems’ (Slaven et al. 2009). The project, which was delivered by the Department of Agriculture and Food, Western Australia (DAFWA), identified and demonstrated farm practices that reduced the amount of sediment in tailwater. While the project achieved its objective of demonstrating sustainable practices, there was negligible adoption of the practices by the local irrigation community. It was acknowledged that a plan to increase adoption of sustainable farming practices was required.

Other projects were undertaken to identify ways to reduce the amount of pesticides in tailwater (Oliver & Kookana 2006; Price 2009a), and some projects provided baseline data for tailwater quality (Price, Taylor & Donohue 2009; Price 2009b).

This plan integrates the findings and recommendations from all of these projects.

A lengthy scoping phase was undertaken to ensure the development of a rigorous plan.

This included the following:

- Meetings with key stakeholders to discuss the proposed activities and gauge interest.
- Reviews of the literature to determine the key environmental impacts associated with irrigated agriculture in the ORIA (Slaven & Heath 2009; Slaven, Heath & Bowyer 2010a).
- Workshops with surface irrigators and key stakeholders to identify barriers and drivers, and priority issues.
- An analysis of current recommended practices\textsuperscript{1}, with a focus on practices that improve tailwater quality and reduce or eliminate tailwater. The benefits, barriers, adoptability and gaps in knowledge of each practice were considered (Slaven & Heath 2009; Slaven, Heath & Bowyer 2010a, 2010b).
- One-on-one interviews with surface irrigators to find out the practices currently being used; attitudes toward the current recommended practices and off-site impacts of their farming practices; and their capacity to adopt current recommended practices (Heath, Slaven & Bowyer 2010a, 2010b).
- Analysis of the operating environment, including external trends and potential impact (Appendix 1).
- Stakeholder mapping and analysis to identify the key stakeholders (including the target audiences for change) and their characteristics/needs (Appendix 2).
- Rigorous ‘intended change analysis’—that is, detailed mapping of the logic highlighting what the intended change is and who it is aimed at, and identifying activities designed

\textsuperscript{1} Current recommended practices are the practices recommended by industry and adopted by at least some of the leading producers to achieve land use that is more sustainable from economic, social and environmental perspectives (Clifton et al. 2004).
specifically to those targets (Appendix 3); and

- Assessment of the assumptions and risks to success (Appendix 4).

The information collected helped identify the issues and priority areas for research, development and extension. This process enabled the formulation of the objectives and activities as documented in this plan.

1.3 Use of the plan

Due to the complexity and scale of the change associated with managers adopting sustainable farm practices, the plan has been developed with a five-year timeframe. It is intended to be a ‘working document’. To ensure effective implementation of the plan, it will need to be reviewed and updated on a regular basis. Furthermore, in some cases the strategies/activities within the plan are considered to be projects in their own right, requiring development of their own plans. In developing this plan, the ‘Extension Planning Framework’ (Crisp 2008a, 2008b) was used as a guide, although this plan for the Ord River Irrigation Area uses slight variations on the headings used by Crisp (2008a, 2008b). The ‘Extension Planning Framework’ provided structure and guidance and, with its strong focus on planning for impact; planning for change, was the ideal framework to use for this plan.

1.4 Anticipated impact from delivery of this plan

Ultimate intended change:
(higher-order goal that delivery of this plan will contribute to)
Improved/enhanced environmental outcomes in the lower Ord River.

Direct intended change:
(the change that full implementation of this plan will achieve)
Improved adoption of sustainable farming practices that minimise sediment, nutrient and chemical export from agricultural land within the Ord River Irrigation Area, Kununurra, Western Australia.

Figure 2 depicts the simplified logic. See also Appendix 3.
Stakeholders:

<table>
<thead>
<tr>
<th>Stakeholder group</th>
<th>Individuals, groups, organisations</th>
</tr>
</thead>
</table>
| Target audience for change | • Surface irrigators in the ORIA Stage 1 (horticulture, broadacre and 'year of establishment' perennial crops)  
• Surface irrigators in the ORIA Stage 1 (established perennials)  
• Ord River District Cooperative / consultants |
| Potential partners | • Ord Land and Water  
• Department of Water  
• Department of Agriculture and Food, Western Australia  
• Rangelands NRM  
• Ord Irrigation Cooperative  
• Department of Environment and Conservation |
| Keep informed | • East Kimberley Reference Group  
• Ord Expansion M2 Development Task Force*  
• Ord Expansion Mantinea Task Force*  
• Ord Expansion Industry Development Task Force*  
• Water Corporation  
• General community |

* Report to the Ord Expansion Community Reference Group.

See Appendix 2 for full stakeholder analysis.

Plate 2. **Planting into stubble from a wet season cover crop.**
2. Objectives

*Overall purpose:* To improve adoption of sustainable farming practices that minimise sediment, chemical and nutrient export from agricultural land within the Ord River Irrigation Area.

<table>
<thead>
<tr>
<th>PARTICIPATION AND COLLABORATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Encourage stakeholder participation and collaboration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESEARCH AND DEVELOPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Develop sustainable options that are adoptable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LEARNING AND SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Increase awareness, knowledge and understanding of sustainable irrigated agriculture</td>
</tr>
<tr>
<td>4. Support adoption of sustainable options</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESOURCE CONDITION MONITORING</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Monitor and report on the condition of relevant natural resources</td>
</tr>
</tbody>
</table>
3. Activities

**PARTICIPATION AND COLLABORATION**

*Objective 1: Encourage stakeholder participation and collaboration*

**Background information:** This objective is about engaging all relevant stakeholders to encourage their participation and collaboration, and sustaining this throughout (and beyond) implementation of this plan. A key part of this is encouraging a culture of collaboration, where growers and relevant organisations can come together and share their experiences, ideas and issues with regard to sustainable farm management.

This objective will also contribute to achievement of Objective 3; and activities from Objective 3 will contribute to achievement of this objective.

**Target audience:** Surface irrigators (horticulture, broadacre and perennial), Ord Irrigation Cooperative, Ord River District Cooperative, consultants, Ord Land and Water, Department of Water, Department of Agriculture and Food, Rangelands NRM, Department of Environment and Conservation.

**Strategy 1.1 Build and sustain enthusiasm and a commitment to participate**

**Activity 1** Arrange meetings with target audience to discuss the plan and determine potential collaboration, level of involvement and responsibility. (See activity detail table).

**Activity 2** Hold ongoing meetings at specified intervals to keep target audience up to date and to sustain participation. (See activity detail table).

**Activity 3** Place regular communication/promotional material with local newspaper, radio stations and community events to promote the plan/activities and the good things that are happening in the ORIA with regard to sustainable farm management. (See activity detail table).

**Strategy 1.2 Build and sustain a ‘network’ for sustainable farm management**

**Activity 4** Publish a newsletter that includes information on activities (e.g. on-farm demonstrations; local case studies) and provides an opportunity to promote events (e.g. presentations, field walks). (See activity detail table).

**Activity 5** Hold annual get-togethers to share experiences and ideas, and to provide a venue for networking. (See activity detail table).

**Activity 6** Hold regular ‘group learning’ events such as field walks, workshops, and seminars. (See activity detail table).

**Outcomes:** Participation from stakeholders. Increased awareness of the plan. Development of collaborative partnerships. Improved networking, including the sharing of ideas and experiences.
Adoption of sustainable farm management to improve tailwater quality: A plan for the Ord River Irrigation Area

RESEARCH AND DEVELOPMENT

Objective 2: Develop sustainable options that are adoptable

Background information: There are practices that can decrease sediment and/or chemical and/or nutrient loads in tailwater. While these practices have been shown to improve tailwater quality, they are not being adopted for various reasons. These practices need to be further developed to make them more suitable and adoptable. Furthermore, this objective is about keeping up to date on the practices/technologies being used/developed elsewhere that are relevant to the ORIA. Extension of this research is covered in Objective 3.

Target audience: Surface irrigators (horticulture, broadacre and perennial)

Strategy 2.1 Research and develop options for improving tailwater quality

Activity 7 Produce wet season management package. This would need to include a number of cover crops to fit in with various crop rotations. It would also need to provide different options, such as stubble retention and how to manage it. A number of different options are essential because of the diversity of crops grown and the uncertainty of when the wet will start and finish. (See activity detail table).

Activity 8 Develop the use of polyacrylamide (PAM). Work needs to be done on application rates, different soil types and different crops and how many times to apply in a season. The off-site impacts of PAM also need to be monitored. (See activity detail table).

Activity 9 Research to increase yields on minimum tillage fields. Growing a crop using minimum tillage in a furrow irrigation system is possible. However, local yields suffer. Yields need to be equal or better than current yields to make this an adoptable practice. This is closely linked with wet season management in that a suitable cover crop first needs to be identified (linked to activity 7). (See activity detail table).

Activity 10 Investigate and potentially trial irrigation systems that either reduce or eliminate tailwater, for example tailwater recycling or pressurised irrigation systems. (See activity detail table).

Strategy 2.2 Investigate and develop other sustainable technologies/practices relevant to the ORIA

Activity 11 Review how other irrigation areas, national and international, that have flow-through systems deal with water-quality issues, and identify potential areas of research. (See activity detail table).

Activity 12 Keep up to date with the latest research relevant to sustainable farm management in the ORIA, and identify potential areas of collaborative research. (See activity detail table).

Activity 13 Incorporate identified areas of research as strategies/activities within this plan. (See activity detail table).

Outcomes: Sustainable and adoptable practices to minimise sediment, chemical and nutrient export. Once practices are easy to apply and show some economic benefit, they will be adopted more readily. These activities will also establish networks across northern Australia and around the world.
LEARNING AND SUPPORT

Objective 3. Increase awareness, knowledge and understanding of sustainable irrigated agriculture

Background information: This objective is about building the capacity of the irrigation community with regard to sustainable farm management, giving them a common understanding of the issues and potential solutions. The objective deals with increasing capacity in two areas—the impact of irrigated agriculture on the on- and off-farm environment, and sustainable farm management options (including extension of results, etc. from Objective 2). In addition, this objective can promote the work being done by irrigators within the ORIA to government and non-government organisations. This objective will contribute to achievement of Objective 1; and activities from Objective 1 will contribute to achievement of this objective.

Target audience: Surface irrigators (horticulture, broadacre and perennial)—primary audience, Ord Irrigation Cooperative, Ord River District Cooperative, consultants, Ord Land and Water, Department of Water, Department of Agriculture and Food, Rangelands NRM, Department of Environment and Conservation.

Strategy 3.1 Promote on-farm learning

Activity 14 Coordinate and fund on-farm trials of sustainable practices. This includes one-on-one help/support in implementation, monitoring and maintenance of the practice/system for duration of the trial (linked to objective 2). (See activity detail table).

Activity 15 Encourage an on-farm water quality monitoring program to enable growers to physically ‘see’ the quality of their tailwater (see also Objective 5). (See activity detail table).

Activity 16 Conduct on-farm demonstrations of a) minimum tillage equipment; b) application of PAM; c) wet-season management; and d) other relevant technologies. (See activity detail table).

Strategy 3.2 Promulgate personal accounts

Activity 17 Organise presentations/articles by other stakeholders’, e.g. traditional owners, tour operators, Department of Environment and Conservation—to highlight the benefits of implementing sustainable practices. (See activity detail table).

Activity 18 Have local grower experiences with on-farm trials discussed at workshops/forums, and published as case studies / articles. (See activity detail table).

Activity 19 Coordinate field walks at on-farm trials and research station. These events can be made to coincide with presentations by guest speakers, demonstrations of technologies, etc. (See activity detail table).

Activity 20 Organise presentations/articles by guest speaker/s from interstate/overseas to explore how they manage water quality. (See activity detail table).

Activity 21 Coordinate a study tour to observe irrigation practices that are designed to reduce contamination of tailwater. (See activity detail table).

Strategy 3.3 Maintain watching brief

Activity 22 Organise guest speaker/s to give presentations on specific sustainable practices. (See activity detail table).

Activity 23 Present findings of research at workshops/ forums, and have them published as reports/articles. (See activity detail table).

Activity 24 Review literature on the impact of irrigated agriculture on the health of the lower Ord River, and extension of findings. (See activity detail table).

Activity 25 Present findings from resource condition monitoring (Objective 5) at workshops/ forums, and have them published as reports/articles. (See activity detail table).

Activity 26 Collaborate with next-users\(^2\) to develop useful packages relating to responsible a) chemical use; b) nutrient use; and c) soil management. (See activity detail table).

Outcomes: Surface irrigators have a greater understanding of the importance of implementing the practices. The hands-on experience of having the trial on-farm gives the audience a chance to participate in the research.

\(^2\) The term ‘next-user’ denotes the people that will have an influence on the ‘end-users’. The end-users are the individuals or groups that directly impact on on-ground change.
Adoption of sustainable farm management to improve tailwater quality:
A plan for the Ord River Irrigation Area

development and extension of the practices. The audience's general knowledge and skills base concerning these practices is increased.
LEARNING AND SUPPORT

Objective 4. Support adoption of sustainable options

**Background information:** Isolation is a factor of living and working in the ORIA. That often means that there is no follow-up or support for the use of new or different practices. Providing support to irrigators who are willing to give it a go means a greater chance of a positive outcome from trialling the practice. It is a matter of then building upon the initial success and providing continuing support until it becomes fully integrated into their farming systems. This objective would have the longest timeframe as it will take a number of seasons for the practice to be adapted to suit individual situations, and not all irrigators are going to attempt to use the practices straight away. This is an essential component of the plan, and an area where many initiatives fall down. Support is essential to help growers understand why particular results have occurred—if this support is not available, practices can be dismissed and any future attempts to reintroduce the idea are met with scepticism.

**Target audience:** Surface irrigators (horticulture, broadacre and perennial)

**Strategy 4.1 Provide individual on-farm support**

**Activity 27** Make regular contact with irrigators who are trialling the practices, those that have integrated the practices and those that have indicated a desire to trial a practice. Have time allocated for field visits and chats. (See activity detail table).

**Activity 28** Be prepared to assist irrigators to improve their practices, especially where practices are not giving the desired outcomes. (See activity detail table).

**Strategy 4.2 Recognise grower achievements**

**Activity 29** Provide opportunity for recognition of those irrigators that have significantly decreased the amount of sediment, chemicals and nutrients in their tailwater.

**Activity 30** Give growers the opportunity to present their stories—at field walks and demonstrations, in presentations at forums and in articles published as case studies, etc. (linked to Activities 27 and 28).

**Outcome:** Surface irrigators are supported through the process of adopting and adapting new practices and continue using the practices in the long-term.
RESOURCE CONDITION MONITORING

Objective 5. Monitor and report on the condition of relevant natural resources

Background information: This objective aims to monitor resource condition indicators to see what impact the plan has over time and provide a record for the future. It provides an opportunity to measure how changes in farming practices are impacting on the quality of tailwater, water in the drains and in the river downstream. Monitoring of off-site impacts may provide evidence for continued use of practices and continued funding. Results are to be extended via Objective 3.

To involve the community in monitoring can have benefits.

Target audience: Surface irrigators (horticulture, broadacre and perennial), downstream river users, Ord Irrigation Cooperative, Department of Water, Department of Environment and Conservation, project team, Water Corporation, general community

Strategy 5.1 Identify resource condition indicators and current data sources

Activity 31 Through consultation, review and confirm a set of resource condition indicators that need to be monitored. (See activity detail table).

Activity 32 Identify available datasets and current monitoring activity, and identify gaps against Strategy 5.1, activity 31.

Activity 33 Negotiate with relevant organisation to commence monitoring of relevant indicators (including reporting) and provide funds.

Strategy 5.2 Implement monitoring programs

Activity 34 Determine feasibility of a community-based monitoring program. If feasible, develop and implement the program.

Activity 35 Monitor identified resource condition indicators in tailwater.

Activity 36 Monitor identified resource condition indicators in drain water.

Activity 37 Monitor identified resource condition indicators in water downstream of main drains (see also Strategy 3.1, activity 15).

Activity 38 Monitor other sources as determined in Strategy 5.1, activity 31.

Activity 39 Use data collected from activities 34 to 38 to contribute towards Objective 3.

Outcome: Good data and information on the impact of any changes in land use on resource condition.
4. **Activity detail**

To ensure impact, each activity listed above needs to be planned and documented in much greater detail (referred to as ‘Activity detail’). This was not possible for this plan, as some of the activities require further scoping.

When developing the activity detail, it is useful to keep each as a separate document (perhaps a separate document for each objective). This is because the activity detail should be treated as a ‘working document’—that is, it is likely to change over shorter periods of time (Crisp 2008a).

Various frameworks are available to assist with planning, such as the ‘Extension Planning Framework’ (Crisp 2008a, 2008b) or the ‘Event Planning Framework’ (Crisp & Holt 2008). Crisp (2008a) also provides a selection of tools/publications that can help in developing activity detail.

When scoping/planning the activities, the following key principles should be integrated. These principles are based on information learnt during the scoping phase of the development of this plan (e.g. from grower interviews).

**Key principles**

1. Encourage stakeholder involvement (at all levels, including planning) to build capacity, give ownership, ensure priorities are addressed and move towards continuous improvement.

2. Build trust and relationships to give a high level of credibility so that the key messages are heard and the plan is more influential.

3. Use the stakeholder analysis information to ensure that the right people are involved and their needs are met.

<table>
<thead>
<tr>
<th><strong>Activity</strong></th>
<th><strong>Key points</strong></th>
</tr>
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| *General communications*—untargeted information delivered via avenues such as the media (e.g. newspapers, radio) and community events | • Use to deliver ‘good news’ information.  
• Use to show the community the good things growers are doing—promote a positive image.  
• Avoid using jargon.  
• Include photos. |
| *Newsletter (Activity 4)* | • Use to deliver ‘good news’ information.  
• Use to promote activities, including upcoming events.  
• At least three newsletters per year would be ideal—one at the establishment phase, a progress update, another at the conclusion of the dry season. The last dry season newsletter can introduce wet season practices.  
• If there is already an established newsletter/newspaper, it may be more worthwhile to hook into this by initiating a regular column that has a catchy name. |
| *Annual get-together (Activity 5)* | • Provide plenty of opportunity for networking.  
• Good to have growers present their experiences (see also Strategies 3.2 and 4.2).  
• May be useful to have a guest speaker talk about something of relevance.  
• Best time of year to have this is during November/early December (before the school holidays). |
Adoption of sustainable farm management to improve tailwater quality:  
A plan for the Ord River Irrigation Area

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key points</th>
</tr>
</thead>
</table>
| **Group learning events** (Activities 6, 16, 17–21; Strategy 3.3) | • Monthly irrigator meetings (to be held during acrolein injections, when growers are not allowed to irrigate and are therefore more likely to attend). The meetings could incorporate guest speakers, demonstrations, etc. From past feedback, late afternoon (e.g. 4 pm) is a good time of day to hold these. Regular meetings will help maintain involvement.  
• Other times of year that are conducive to irrigator participation are November / early December, late February / early March and mid-year (between planting and harvesting).  
• Events should be based on what the growers want to learn about.  
• Make events as interactive as possible.  
• Presentations, field walks, guest speakers, etc. can be linked to other events or delivered as ‘stand alone’ events.  
• Events can be advertised 2 weeks in advance and invitations faxed to the target audience and stakeholders 1 week prior.  
• May be useful to hook into existing events (e.g. production-focused events, where grower turnout is guaranteed). |
| **Investigate systems that reduce or eliminate tailwater** (Activity 10) | • For a tailwater recycling system wet season management needs to be considered. That is, a tailwater recycling system will not be able to hold all of the run-off from rainfall events. What impact the first flush of run-off from a rainfall event has on the lower Ord River is not yet known.                                                                                                                                                                                                                                                                                                                                                     |
| **Research and development** (Objective 2)        | • Conduct research into sustainable technologies/practices based on growers’ priorities/interests.  
• Use participatory R&D as much as possible—trials on grower properties encourage hands-on experience.  
• Involve the growers in developing adoptable options. For example, seek input from growers regarding implementation costs and possible ways to make implementation cost-effective.  
• **Wet season management package.** Key issues this research should address (based on grower feedback):  
  o Cost-benefit analysis  
  o Determination of suitable cover crop varieties.  
  o Impact on following crops.  
• **How to use PAM.** Key issues this research should address (based on grower feedback):  
  o Cost-benefit analysis  
  o Off-site impacts of PAM.  
  o Possible sources of product  
  o Application methods.  
• **Increasing yield on minimum-tilled fields.** Key issues this research should address (based on grower feedback):  
  o Cost-benefit analysis.  
• **Irrigation systems to reduce/eliminate tailwater.** Key issues this research should address (based on grower feedback):  
  o Cost-benefit analysis  
  o Environmental impact of this system during the first flush of the season. |
<table>
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<tr>
<th>Activity</th>
<th>Key points</th>
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</table>
| **On-farm learning/support** (Activities 14 and 15; Strategy 4.1) | • Provision of one-on-one support is of utmost importance—helps growers understand why particular results have occurred; provides motivation.  
• Information/data gathered from growers’ properties via on-farm trials or water quality monitoring can be written up as case studies and included in general communications, newsletters, etc. or oral presentation. This can give recognition/pride to the grower.  
• Factors such as the target audience’s level of confidence/motivation, situation-specific knowledge and skills, and availability of resources must always be kept in mind when aiming for practice change. |
| **Study tour** (Activity 21) | • Most suitable times of year for a wet-season study tour are mid-October to mid-December and February to early March. A dry-season study tour can be held mid-season (between planting and harvesting).  
• Tour should be based on what the growers want to learn about.  
• Make tour as interactive as possible.  
• Participants should be given the opportunity to share their experiences from the tour with other irrigators.  
• A tour provides the opportunity for distributing good promotional ‘general communication’ material. |
| **Watching brief** (Strategy 3.3) | • Identify the target audience for each topic and the change you want to achieve. Then identify the best extension mechanisms to use to ensure that the message reaches the target audience and achieves the change. |
| **Impact of irrigated agriculture on the lower Ord** (Activity 24) | • This is the important message to be delivered, as it underpins the whole purpose of the plan.  
• The Department of Water and CSIRO may like to have some input to this review.  
• Check what impact the ORIA will have on the river if there are changes to flow regimes.  
• Identify other sources of contaminants that enter the lower Ord through the irrigation drainage system. |
| **Community-based monitoring program** (Activity 34) | • Can call for volunteers or work out an arrangement with school or community group/s.  
• Community should be involved in all aspects of the program—not just taking the samples but also being made aware of the results (at the very least). If possible, community groups can be involved in analysing the samples. In addition, the results should be explained—why we got the results.  
• At the conclusion of the monitoring, or involvement of that particular group, there could be a special reward to show appreciation for the work done.  
• Good-news stories based on this activity should be put in the local newspaper, newsletters, radio, etc. to give the volunteers recognition for their work. |
| **Extension of practices**, from Crisp & Holt 2008 (Objectives 1 and 3) | • Focus on the positive characteristics of the practice in written material; for verbal presentations, a more balanced approach may be taken.  
• Articulate the benefits of the practice.  
• Explain where the practice is applicable. |
| **Development of extension material**, from Crisp & Holt 2008 (Objective 1 and 3) | • Use appropriate language—avoid using jargon.  
• Ensure an attractive layout.  
• Stick to the key information.  
• Use a ‘hook’ to get the audience’s attention.  
• Ensure credibility of the author. |
### Guest speaker ideas (Objective 3)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key points</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>• HELP basins.</td>
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<td></td>
<td>• Burdekin Bowen Integrated Floodplain Management Advisory Committee.</td>
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<tr>
<td></td>
<td>• Shane Phillips from Biocentral did his PhD on PAM; also Siva Sivaplan (DAFWA) has done research with PAM.</td>
</tr>
<tr>
<td></td>
<td>• Investigate other potential speakers (international and national).</td>
</tr>
</tbody>
</table>

Plate 3. Pumpkin/cucumber production using furrow irrigation.
5. Communications

This section addresses the communications that are required to keep the identified ‘keep informed’ audiences (see Appendix 2) informed. This is in addition to the ‘general communications’ such as newspapers, radio and community events discussed within Objective 1.

<table>
<thead>
<tr>
<th>People, group, organisation</th>
<th>Communication activities</th>
</tr>
</thead>
</table>
| East Kimberley Reference Group | - Include on mailing list for newsletter (see Objective 1).  
- Request berth at their meeting/s to present information about activities, update on outcomes, etc.  
- Invite members to forums, workshops, field walks, etc. |
| Ord Expansion M2 Development Task Force  
Ord Expansion Mantinea Task Force  
Ord Expansion Industry Development Task Force | - Include on mailing list for newsletter (see Objective 1).  
- Invite members to forums, workshops, field walks, etc.  
- Keep up to date with activities, etc. via email or meetings. |
| Water Corporation | - Include on mailing list for newsletter (see Objective 1).  
- Keep up to date with activities, etc. via email or meetings. |
| General community | - See Strategy 1.1, Activity 3: Regular communication/promotional material in local newspaper, radio, community events to promote the plan/activities and the good things that are happening in the ORIA with regard to sustainable farm management.  
- Articles/advertisements in the local newspaper/ radio looking for volunteers for water quality monitoring. May be able to see if local school interested. |
6. **Project monitoring and evaluation**

The project will be monitored and evaluated to:

- record delivery of outputs and milestones
- assess whether the project is achieving the desired results
- make changes to the project, if necessary
- identify overall impact.

The following outlines the monitoring and evaluation activities for the project at a broad level.

**Monitoring**

- A schedule of outputs and milestones will be developed when full project planning is complete.
- Delivery of outputs and milestones will be recorded against planned outputs and milestones using a spreadsheet (or similar).

**Evaluation**

*Project logic*

- The project logic will be reviewed when full project planning is completed.

*Activity level*

- All activities will be evaluated to assess achievement of the desired result. If the desired results are not being achieved, steps will be taken to find out why and changes made to address the issue/s.
- All activities will be evaluated to enable continuous improvement.

*Project level*

- A mid-term review (after 2 years) will be conducted to assess whether the project is achieving the desired results: Are the activities delivering objectives? Are the objectives delivering the overall aim?
- If the desired results are not being achieved, steps will be taken to find out why and changes made to activities and objectives, if needed.
- Final evaluation will be undertaken to assess the extent of delivery of the objectives and overall aim, and to identify the overall impact of the project.

**Reporting**

Reporting will be dependent to a certain extent on the funding organisation’s requirements. However, the following basic reporting should occur:

- Six-monthly report on delivery of outputs and achievement of milestones, including budget expenditure against the proposed expenditure.
- Annual report detailing delivery of outputs, achievement of milestones, budget and progress towards objectives.
- Mid-term evaluation report and recommended changes.
- Final evaluation report.
7. References


Crisp, J 2008a, Extension Planning Framework: Notes and guiding questions, Department of Agriculture and Food, Western Australia, Perth.

Crisp, J 2008b, Extension Planning Framework, Department of Agriculture and Food, Western Australia.

Crisp, J & Holt, C 2008, Event Planning Framework, Department of Agriculture and Food, Western Australia, Perth.


CSIRO 2009, Water in the Timor Sea Drainage Division: Summary of a report to the Australian Government from the CSIRO Northern Australia sustainable yields project, CSIRO, Canberra.


Heath, R, Slaven, T & Bowyer, J 2010a, Sustainable farm management. Findings from consultation with the irrigation community of the Ord River Irrigation Area, Summary report prepared for Rangelands NRM.

Adoption of sustainable farm management to improve tailwater quality: A plan for the Ord River Irrigation Area


Appendix 1: Operating environment

Ord expansion
The Ord River Irrigation Area is located in an area where there is currently both state and national interest because of the proposed ‘Ord Expansion’ (Stage 2). This is part of a wider push to increase agricultural development in the north of Australia. Significant funds have been committed by the Western Australian Government and the Australian Government.

The $415 million investment has two components:
(1) East Kimberley Development Package (EKDP)—$195 million from the Commonwealth Government’s Nation Building stimulus package
(2) Ord Irrigation Expansion Project (OIEP)—$220 million from the Western Australian Government’s Royalties for Regions fund (Department of State Development 2009).

There is pressure from environmental groups such as Environs Kimberley to ensure that development in the area is environmentally sustainable.

This increased focus on and interest in the region will impact the existing irrigation area. Increased development means increased demand for limited water resources and potentially increased pressure on environmental assets such as the Ord River. Anything that can be done to minimise existing and future agricultural impacts will ensure assets like the Ord are available for future generations to use and enjoy.

External factors
The external factors that will impact on water quality and management in the Ord River are:
● Water availability
● Environmental values
● Social pressures.

Water availability
Water availability, both locally and nationally, will be the most significant external factor influencing water management in the Ord and adjacent catchments. Water availability will be subject to climate change and increasing demand.

Climate change
Climate change may not be a local issue. According to a CSIRO report released in August 2009 ‘… rainfall in the future (around 2030) is expected to be similar to conditions of the 1990s, within a range of plus ten to minus twenty percent … Evaporation rates are expected to be slightly higher, increasing between one and six percent.’ However, it may be a significant issue in other parts of Australia. For example, in the Murray–Darling Basin surface water availability is expected to decline due to climate change (CSIRO 2008).

The Murray–Darling Basin is a significant contributor to Australia’s food supply. The basin contains 40 per cent of Australia’s farms and produces one-third of its food supply (Discover Murray n.d.). What happens when the Murray can no longer produce one-third of Australia’s food? Northern Australia may be able to meet the shortfall.
Adoption of sustainable farm management to improve tailwater quality:
A plan for the Ord River Irrigation Area

Increasing demand
Demand for water is increasing in the Ord catchment. Contributing factors include decreasing water availability in southern and eastern Australia, population growth (both locally and nationally) and local development.

According to Curtis (2009): ‘The latest Intergenerational Report predicts Australia’s population will rise to 35 million in 40 years’ time, up from about 21.5 million people at present … There will be impact on the availability of food, water, energy and land.’

The injection of State and Commonwealth funds to the development of Ord Stage 2 and associated social infrastructure will increase the local population. This will not only increase water demand for agricultural, domestic and industrial uses, but also put increasing pressure on the river from recreational users. This may mean more water will be diverted from Lake Argyle and Lake Kununurra to meet increased demand.

Environmental values
Management of water quality of the lower Ord River is important because of its environmental values. According to the Department of the Environment, Water, Heritage and the Arts (2003), the Ord River flood plain and associated wetlands are classified as Ramsar listed wetlands—that is, wetlands of international significance. The Department of Environment and Conservation (n.d.) states that threats to wetlands include water pollution.

Social pressure
One external factor that may pressure surface irrigators into changing their farming practices to improve tailwater quality is consumer demand. Some consumers are concerned about the environmental impacts of the processes used to produce their food. A report by Stringer and Umberger (2008) cited evidence that consumers were concerned about agriculturally-related environmental issues such as the overuse of pesticides. With increasing media coverage of the ORIA, consumers are going to be more aware of how their food is produced and may decide to no longer buy ORIA produce.

Social pressure at a local level will come from campers, recreation fishers and tourist operators. There will also be pressure from Traditional Owners who want to access and use the river for cultural purposes.

Strengths, weaknesses, opportunities and threats

Strengths
Growers agree to the concept of continuous improvement. They want to protect their assets, such as soil and water. This can be maximised by monitoring their progress, as this would allow them to see when they are improving or can identify where they need to improve; and by providing support (advice, financial, etc.) to those who want to adopt practices that improve their tailwater quality.

Giving it a go: ‘We are trying to tackle that [chemical run-off, erosion] all the time as much as possible.’

Awareness: ‘As long as I spray the chemicals and flood irrigate, I still have an impact on the river system.’
Good management practice: ‘[reducing chemicals in tailwater] Well that’s just good management practice.’

Concern: ‘You know we always are concerned about our water quality leaving the farm. And that’s … silt, fertiliser and agro chemicals.’

External pressure: ‘If we don’t behave ourselves and keep that [tailwater] clean there’s a couple of things that … would happen. First would be tailwater return would be forced upon us … at the same time they would strip chemicals such as Atrazine and Endo off us.’ Note: according to Integrated Tree Cropping endosulphan is banned by the Forest Stewardship Council.

The Ord River: ‘… we need to consider everyone who derives a livelihood off it.’

Weaknesses

There are no real incentives for change. Growers believe that they are not having a significant impact on the river from current farming practices; therefore they think they don’t need to change.

Don’t know what is going on: ‘No one has come to me and told me I have got a problem.’ This can be minimised by regular communication about water quality results both from individual farms and from the river.

Don’t think there is a problem: ‘Is there a real problem?’ or ‘I probably don’t acknowledge that we have significant off-site impacts, I suppose.’ This can be minimised by increasing awareness of the problem and opening communication lines between surface irrigators and other stakeholders.

On-site issues are more important than off-site issues: ‘I think the benefits of growing healthy crops and maintaining viability outweigh the minimal off-site impacts that I see’. This can be minimised by developing the current recommended practices so that there are also production benefits.

Nitrogen is okay to release into the river: ‘From an environmental point of view, I’m not overly concerned about putting a little bit of nitrogen into the environment.’ Awareness needs to be increased about the effects of excess nitrogen in an ecosystem, and how much nitrogen the ORIA is adding to the river. There is also a need to increase awareness about the ineffectiveness of applying dissolved urea through siphons.

Threats

Sudden production issues; for example, high pest and disease pressure. This could actually be turned into an opportunity to interact with growers to ensure they are considering natural resource management when dealing with their production issues. For example, reinforcement of the endosulphan guidelines.

Opportunities

The Ord Irrigation Cooperative has verbally expressed interest in participating in implementing the plan. They would be willing (if necessary) to contribute some funds.

This plan provides a platform to bring together the irrigation community to work together to deliver valuable social, environmental and economic outcomes.
Appendix 2: Stakeholder analysis

Stakeholders were grouped into ‘partners’, ‘target audiences for change’ and ‘keep informed’. The target audiences for change are those individuals/groups that are required to ‘change’ their practice/behaviour for this project to be successful and have real on-ground impact. ‘Partners’ are ‘synergistic collaborators’ that provide resources to support project implementation (Crisp 2008a). For this plan the term ‘potential partners’ has been used to identify those people, groups or organisations who do/would have a vested interest in successful delivery of this plan, and thus may potentially provide resources to support implementation. Furthermore, successful delivery of this plan is reliant on improved coordination/collaboration of effort to develop and support adoption of sustainable farm practices. To this end, the partnerships are of critical importance. Stakeholders to ‘keep informed’ are those that have a broader interest in the outcomes of the project. Separating out these groups of stakeholders allowed a focus toward determining the most suitable extension activities required to meet both the stakeholders’ and the projects’ needs.

Crisp (2008a) also identifies another stakeholder group—‘funders’. This group has not been addressed within this analysis because, at the time of writing, the implementation of this plan had not been funded (some potential funders have been noted within the ‘Potential partners’ section below). It is recommended that, once funding is received, the project team identify the ‘funder’ stakeholder group and develop extension activities to meet its needs—for example, good communication planning to ensure reporting requirements are met in full and on time (Crisp 2008a).

### Potential partners

<table>
<thead>
<tr>
<th>Potential partner</th>
<th>Possible contributions to project</th>
<th>Benefits to them</th>
<th>Their potential needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ord Land and Water (OLW)*</td>
<td>Has the potential to be the driver of plan implementation. Promoting sustainable farming practices.</td>
<td>Achievement of project outcomes will directly address some issues and contribute to achievement of stated goals within the O LWMP (2000)—improved/maintained resource condition.</td>
<td>Its funds come from external sources. While they have the ability to get the project up and running, they would need to employ staff to carry out any on-ground work. These staff members may need training to carry out the necessary tasks.</td>
</tr>
<tr>
<td>Department of Water (DoW)*</td>
<td>Has the expertise to do water-quality monitoring.</td>
<td>Increased on-farm water-use efficiency and improved drain-water quality.</td>
<td>While it has the skills necessary to carry out monitoring, it requires funding for staff and analysis of samples.</td>
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Adoption of sustainable farm management to improve tailwater quality: 
A plan for the Ord River Irrigation Area

<table>
<thead>
<tr>
<th>Potential partner</th>
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<th>Benefits to them</th>
<th>Their potential needs</th>
</tr>
</thead>
</table>
| **Department of Agriculture and Food, Western Australia (DAFWA)*  
Priority: High** | Can provide skills, expertise, equipment and other resources. Has the potential to be the driver for getting this plan implemented. May be the primary deliverer of the project. | Has an interest in improving the capacity of growers in the ORIA and improving practices to ensure environmental, economic and social sustainability in the ORIA. | While it has the skills necessary for it to be the primary deliverer of the project, it would require at least operational funds. A contribution to staff expenses would be necessary if the funding body allows it. |
| **Rangelands NRM Coordinating Group*  
Priority: Depending on how funding is administered** | Is a source of advice and has a network of contacts. Can assist with project management and development of collaborative partnerships. | Is looking for partnership-type arrangements (as opposed to ‘funders’) with the projects that it funds. Wants to see environmental gains within the region. | Timely reports. Some operational funds. |
| **Ord Irrigation Cooperative (OIC)*  
Priority: High** | Can provide tailwater monitoring data including levels of pesticides, nutrients and sediment. Can provide groundwater monitoring data. Promotes sustainable farming practices. | Has a vested interest in understanding and addressing all environmental impacts of irrigation. Is enthusiastic for projects that can improve tailwater quality and reduce tailwater quantity. This will help it meet its licence agreement with DoW. Is keen on ensuring the long-term viability of the irrigation industry. | Adoption of sustainable practices that improve tailwater quality. |
| **Department of Environment and Conservation (DEC)*  
Priority: Low** | Monitors health and biodiversity of the riparian zone and wetlands of the lower Ord. This information could be used to demonstrate the broader environmental outcomes from improving water quality. This group would be a partner only if it was decided that health/biodiversity required monitoring. | The success of this project would contribute to DEC’s goal of protecting the integrity of the riparian zone along the lower Ord, which may be compromised by poor water quality. | May require operational funds and funding for staff if there were to be any monitoring of the health of the riparian zone and wetlands. |

* Member of the East Kimberley Reference Group.
** Priorities based on how important the group is in delivery of the plan.

Activities to get these ‘potential partners’ involved in the project should be included in the plan (see Objective 1). Activities can include one-on-one visits, phone conversations, regular ‘base-touching’, identification of the key people to liaise with within organisations.
### Keep informed

<table>
<thead>
<tr>
<th>People, group, organisation</th>
<th>Benefits to us</th>
<th>Benefits to them</th>
<th>Their potential needs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>East Kimberley Reference Group (EKRG)</strong></td>
<td>Could reach a lot of stakeholders and keep them up to date.</td>
<td>Achievement of the outcomes presented in this plan is of interest, and may shape future direction.</td>
<td>Its needs in terms of this project would be negligible.</td>
</tr>
<tr>
<td></td>
<td>Has the potential to be the driver for getting this plan implemented.</td>
<td>Could reach many stakeholders and keep them up to date. It is in the interest of this group to know what is going on in the region. A berth at the group’s meetings would be appropriate contact.</td>
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<tr>
<td><strong>Ord Expansion Community reference group and associated task forces</strong></td>
<td>Tailwater quality will be an issue for tailwater recycling irrigation systems. Many of the practices developed in this project will be relevant to Ord Stage 2, which will open up more funding opportunities.</td>
<td>Sustainable practices that assist with everyday management of a tailwater recycling system.</td>
<td>As Stage 2 will be a newly developed irrigation area, the group will be looking for any relevant information to assist set-up and management. There will also be a need for practices that reduce recharge to the groundwater, as the salt load in the soil profile is high and the watertables are relatively shallow.</td>
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<tr>
<td><strong>Water Corporation</strong></td>
<td>Keeping the Water Corporation informed is simply a courtesy, as it is a fellow water resource user and manager. It is closely affiliated with the Department of Water and Ord Irrigation.</td>
<td>Has a commercial interest in finding out what is happening in the irrigation area because it sells a bulk water allowance to Ord Irrigation.</td>
<td>Its needs in terms of this project would be negligible.</td>
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<tr>
<td><strong>General community</strong></td>
<td>Could engage community support for the project.</td>
<td>Improved water quality of the lower Ord River, which can have many positive spinoffs such as improved conditions for tourism and recreation. Reassurance that everything possible is being done by the irrigators to reduce their impact.</td>
<td>If any of them wanted to assist with monitoring they would need training and resources.</td>
</tr>
<tr>
<td></td>
<td>Could build project profile (including profile of project team and associated organisations). May be interested in assisting with water-quality monitoring.</td>
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<td></td>
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</tbody>
</table>

- Member of the East Kimberley Reference Group.
Target audience for change – analysis

<table>
<thead>
<tr>
<th>Target audience</th>
<th>End- or next-user</th>
<th>Priority</th>
<th>Intended change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface irrigators (horticulture, broadacre and ‘first year establishment’ perennial crops)</td>
<td>End-user</td>
<td>High</td>
<td>Level 3—Change in practice/behaviour. Ideally would like this group to adopt sustainable farming practices that minimise off-site impact. Changing practice/behaviour can be a difficult task, and the change sought through this project is relatively complex. However, given the small number of surface irrigators in the ORIA (less than 15), there is greater opportunity for 1-on-1 contact, which may assist in the changes taking place. The scale of change envisaged is that all surface irrigators will adopt one or more practices that will reduce sediment, chemical and nutrient loads in their tailwater on 50–100 per cent of the area they manage.</td>
</tr>
<tr>
<td>Surface irrigators (established perennials)</td>
<td>End-user</td>
<td>Med*</td>
<td>Level 3—Change in practice/behaviour to improve on their current system.</td>
</tr>
<tr>
<td>Ord River District Cooperative/consultants</td>
<td>Next-user</td>
<td>Med-Hig</td>
<td>Level 2—change in knowledge and understanding. This is about making sure that members of this group are aware of the project, aware of the issues and aware of the sustainable farming practices. In particular, they will have the knowledge and understanding to be able to encourage responsible chemical and fertiliser use with their clients. Achievement of this change should be relatively simple.</td>
</tr>
</tbody>
</table>

* Medium priority as it is a more stable system with less soil disturbance. Less herbicides are required as the canopy shades out the weeds. But pesticides and some fertilisers are used.
## Target audience for change – further detail

<table>
<thead>
<tr>
<th>Target audience</th>
<th>Problems the project will address</th>
<th>Possible contributions to the project</th>
<th>Characteristics/needs</th>
</tr>
</thead>
</table>
| **Surface irrigators** (horticulture, broadacre and ‘first year establishment’ perennial crops) | Poor quality tailwater coming off farm into the lower Ord.  
Quantity of tailwater coming off farm into the lower Ord (or into groundwater).  
Lack of adoptable, sustainable options.  
Isolation of the ORIA limits access/introduction to specialists, etc.                                                                                   | First-hand experiences with the sustainable practices.  
Support network for other growers, and relationships with project team.  
Provision of project direction in terms of priorities for research, development and extension.                                                                 | They view each other as competitors rather than collaborators.  
Diverse group—different farm sizes, crop types, etc.  
Busy people - See activity detail for best time of year to connect with this group.  
Generally try to improve their farm performance.                                                                                     |
| **Surface irrigators** (established perennials)       | Poor quality tailwater coming off farm into the lower Ord.  
Quantity of tailwater coming off farm into the lower Ord (or into groundwater).  
Limited grower network in the ORIA. Limited opportunity for growers to discuss problems/ successes, etc.  
Isolation of the ORIA limits access/introduction to specialists, etc.                                                                                | First-hand experiences with the sustainable practices.  
Support network for other growers, and relationships with project team.  
Provision of project direction in terms of priorities for research, development and extension.                                                                 | This group comprises mainly corporate farms.  
They are competitors rather than collaborators.  
See activity detail for best time of year to connect with this group.                                                                                  |
| **Ord River District Cooperative/ Consultants**        | Aren’t aware of the off-site impacts of irrigated agriculture.                                                                                                                                                                    | Information on what growers are purchasing, questions they are asking, etc. in relation to sustainable farming practices.  
Will be able to pass on the information developed through this project to the end-users (growers).                                                                  | As this group are next-users, their characteristics/ needs relate to their target audience for change (growers).                                                                 |
Appendix 3: Intended change analysis

Ultimate intended change
Improved/enhanced environmental outcomes in the lower Ord River.

This is the change that successful implementation of the plan will contribute to. It is believed that, by changing farming practices, the environmental impact of the irrigation area on the lower Ord River will be reduced.

Direct intended change
The change that this plan intends to directly achieve is improved adoption of sustainable farming practices that minimise sediment, chemical and nutrient export from agricultural land within the ORIA.

The target audience for recommendations that could effect this change are the surface irrigators (horticulture, broadacre and ‘year of establishment’ perennial crops) in Stage 1 of the Ord River Irrigation Area.

The scale of change aimed for is that 100 per cent of this target audience will adopt one or more practices to reduce sediment, chemical and nutrient loads in their tailwater on 50–100 per cent of the area they manage.

The complexity of the change will be high, as it will require change at all levels (from awareness, to knowledge, skill and understanding, through to change in behaviour/practice) for the direct intended change to occur. It will also require cooperation between government (e.g. DoW and DAFWA), non-government (e.g. Ord Irrigation and Ord Land and Water) and the target audience to achieve the change.

Other ‘direct intended changes’

Level 1: Change in awareness up to a point where the target audience is aware that the topic is relevant (or not) to their own situation.

Surface irrigators are aware of what impact their practices have off site.

Surface irrigators are aware of the practices available to reduce sediment, chemicals and nutrients in tailwater.

Scale and complexity: All surface irrigators—low-level complexity as presenting simple messages for a simple change.

Level 2: Change in knowledge, understanding and skills at a generic level. ‘Generic level’ refers to more broadly applicable skills, knowledge and understanding.

End- and next-users have the knowledge, understanding and skills regarding practices available to improve tailwater quality.

Scale and complexity: The target audiences would include end-users (surface irrigators [horticulture, broadacre and ‘first year establishment’ perennial crops]) and next-users (Ord River District Cooperative and consultants). Complexity would be high because the audiences would be learning new skills and the needs of the various audiences differ.
Appendix 4: Assumptions and risks to success

To help analyse the importance of identified assumptions, a probability exercise was applied. The question ‘Is this assumption likely to hold true?’ was asked.

<table>
<thead>
<tr>
<th>What assumptions: Do the success of your project depend upon? Underpin the success of your project?</th>
<th>What are the implications of this assumption not being true for our plan?</th>
<th>How likely is it that this assumption holds true? (see above)</th>
<th>How could we test this assumption?</th>
<th>How could we plan for the implications?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface irrigators adopt new practices.</td>
<td>If practices are not changed there will be no change or even a negative impact on the lower Ord River; or there could even be a limit on water availability.</td>
<td>2</td>
<td>There may be the need to put regulations in place in order to enforce implementation of practices.</td>
<td></td>
</tr>
<tr>
<td>Suitable practices can be developed that reduce contaminants in tailwater.</td>
<td>If suitable practices cannot be developed then change cannot take place and the issue perpetuates.</td>
<td>2</td>
<td>This assumption can be tested by observing irrigation areas that have improved practices and decreased contaminants in their tailwater. May need to consider other irrigation systems, e.g. tailwater recycling or pressurised systems.</td>
<td></td>
</tr>
<tr>
<td>Suitable practices can be found that are at least cost neutral.</td>
<td>Adoption will not occur if the practice costs money without any visible or economic benefit.</td>
<td>2</td>
<td>Financial incentives may be needed to encourage adoption. Or regulations could be put in place to enforce implementation of practices.</td>
<td></td>
</tr>
<tr>
<td>Suitable practices can be found that fit in with the limitations of a furrow irrigation system.</td>
<td>If practices do not fit within the limitations of a furrow irrigation system they will not be adopted.</td>
<td>2</td>
<td>If methods of reducing contamination in tailwater cannot be found to be practical, then other methods such as tailwater recycling or pressurised irrigation systems will need to be investigated and promoted.</td>
<td></td>
</tr>
<tr>
<td>There will be a significant reduction in sediment, chemicals and nutrient entering the lower Ord River from the irrigation area.</td>
<td>Other more suitable practices would need to be found.</td>
<td>2</td>
<td>Methods of reducing contaminants in tailwater would need to be reconsidered.</td>
<td></td>
</tr>
</tbody>
</table>