

Review of Existing Decision Making Processes and Decision Support Tools in Environmental Watering



Report for the Murray-Darling Basin
Environmental Water Knowledge and
Research Project

February 2015

Final

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Summary

CONTEXT

This Review was undertaken to inform the planning phase of the Murray-Darling Basin Environmental Watering Knowledge and Research (MDB EWKR) project.

The purpose of the MDB EWKR project is to provide the best science information available to support the evolving needs of environmental water managers within the framework of adaptive water management use in the Murray-Darling Basin.

MDB EWKR is a collaborative \$10million Australian Government funded project to be delivered over five years and led by the Murray Darling Freshwater Research Centre (MDFRC).

The Review was undertaken by analysing the results of an on-line survey and interviews with environmental water managers across State and Commonwealth jurisdictions.

The roles of the participants varied from being involved in strategy and policy to planning to water delivery to performance monitoring within the environmental watering sector.

The information was analysed against three key areas of interest for MDB EWKR:

1. The current decision making processes and how knowledge and information is used within that process.
2. How decision support tools (DSTs) are used within the decision making process and what influences the use of DSTs?
3. What environmental water managers would recommend for the MDB EWKR project in order to improve the knowledge base and DSTs.

How the findings will be used:

1. To inform the development of an engagement strategy, by better understanding how science informs current decision making processes and where the opportunities lie to improve the knowledge base.
2. To inform the development of a DST strategy based on the demand and requirements for DSTs.
3. To provide information that will assist in the implementation of the MDB EWKR project based on additional feedback, insights and issues sourced from participants.

KEY FINDINGS

The key findings for each of the areas of interest can be summarise as follows:

The decision making process

Decision making

- Jurisdictions undertake similar decision making processes when planning for environmental water, with the dominant planning phase at present being annual water plans. All are comfortable with the annual planning process and do not believe it will change greatly into the future.
- The roles and responsibilities for annual planning vary from state jurisdiction to jurisdiction, with the range of variation including the process being relatively contained within a single central agency to regional NRM organisations taking responsibility for annual planning.
- There is a positive outlook for the introduction of longer term watering plans as it is thought that these will provide a more strategic and outcome focus for achieving environmental watering outcomes.
- Information for all types of planning is accessed from multiple sources and incorporate a combination of technical, corporate and local knowledge, with a strong reliance on corporate knowledge across all jurisdictions.
- There was concern expressed about the potential to lose corporate knowledge that comes with organisational change and limited succession planning. This knowledge is relied upon in the planning

stage and particular during watering events.

Knowledge use

- Hydrographic information is at the centre of the decision making process and from this point the access to and use of scientific information becomes quite variable across assets and jurisdictions.
- The timing for decision making and access to information as well as the type of information sourced varies with planning stages such as annual planning versus an actual watering event.
- A paradox exists between the comfort in the annual planning process and the identified knowledge gaps and assumptions made when planning.
- There was a sense that the best decisions are being made with the existing knowledge and information but general concern on the budget pressures for monitoring programs.

Opportunities to improve the knowledge base

- Application of a systems approach to improve the understanding of the impacts of environmental watering decisions to downstream, next valley or other ecological responses that aren't monitored for.
- Better informed determination of trade-offs when making environmental watering decisions and the likely impact of the trade-off.
- Improve the understanding of cumulative impacts of environmental watering decisions.

- Better integrate the knowledge regarding the impact of the broader NRM issues on environmental watering outcomes.
- The tools and information to inform longer term environmental water planning decisions.

The use of DSTs

The definition of DST was quite variable across the water managers. For example water managers identified the DSTs used as varying from spreadsheets, to decision trees, to hydrological models to ecological response models. Regardless of the definition, DSTs in the context of flow response models are rarely used and the reasons for this primarily included difficulties of the complexity of the issues being addressed and the application of the same model to various sites.

The factors that were identified as being crucial to whether a DST would be used or not included:

- The DST needed to be applicable to the users assets and conditions.
- Development needed to include the end users / intended audience.
- The DST needed to be transparent, logical and add value to the decision making process.
- The DST needed to be easy to use and not be reliant on large sources of data.

It was stated that the MDB EWKR project would do better to focus on addressing the research questions rather than development of DSTs given the budget and timeframes. Also the research questions need to be addressed first as they would frame whatever tool may be generated. It was expressed that alternative DSTs to quantitative models could be

developed that would have broader application across various assets.

Water Manager's recommendations for MDB EWKR

From the feedback on how the MDB EWKR project could improve the decision making process, two significant factors stand out:

- MDB EWKR must maintain the collaborative process it started with and maintain engagement throughout. This was particularly expressed by the State jurisdictions.
- MDB EWKR must facilitate knowledge transfer in terms of knowing what information exists, how to access it and how to apply the knowledge within the decision making process.

In addition it was thought that the MDB EWKR project should:

- Assist managers to demonstrate the benefits of environmental watering and help quantify outcomes.
- Contribute to a process of transparency in decision making.
- Compliment existing programs of jurisdictions and other researchers.
- Focus on addressing the research gaps rather than investing in computer based models.



IMPLICATIONS FOR MDB EWKR PROJECT

The implications of the Review findings on the MDB EWKR project have been summarised under several themes as outlined below,

noting that each theme is closely related to one another and therefore should not be considered in isolation.

More detail on findings and implications can be found within the main report.

Engagement and collaboration:

- There is a strong desire that the jurisdictional collaboration that the MDB EWKR project commenced with is maintained throughout. Given the diffuse sources of knowledge to inform decision making, and the strong reliance on personal relationships and corporate knowledge, effective collaboration will be essential in supporting uptake of research outcomes.
- Engagement is two way and therefore the roles of jurisdictions within the project implementation will need to be agreed and communicated.
- The MDB EWKR will need to utilise a variety of techniques to maintain engagement and collaboration over the longer term. These should be developed further within the engagement strategy and the engagement strategy should be developed in partnership with the primary stakeholders.

Knowledge transfer:

- There is not a single audience typology for the project, even amongst water managers, therefore the MDB EWKR project needs to understand who their primary and secondary stakeholders are and how they access and utilise new knowledge.
- The research is being undertaken in the form of themes at various sites within the Basin (cases). This raises challenges for the MDB EWKR project of sharing knowledge and experiences across cases and how best to share this to a broader audience.

Aligning research to changing scales:

- There is a shifting focus from annual to longer term planning. This requires knowledge of watering or non-watering impacts over longer planning horizons as well as the ability to identify and prioritise assets and a means of defining appropriate objectives and strategies.
- It was commonly acknowledged that MDB EWKR had to be relevant to the broader Basin but questions were still raised about the ability to apply information and tools to a broader Basin scale while they maintain relevance at an asset scale.

The use of DSTs:

- It was recommended that the development of quantitative computer based models was not the best use of MDB EWKR's time and budget. It was expressed that the relevant research needed to be undertaken first.
- DSTs of various styles exist and the MDB EWKR project may need to reconsider the format of a decision tool that is more easily applicable across various scales.
- The factors that influence the uptake of a DST are universal regardless of the format of the DST and therefore these should be embedded as principals within the DST strategy to be developed by MDB EWKR

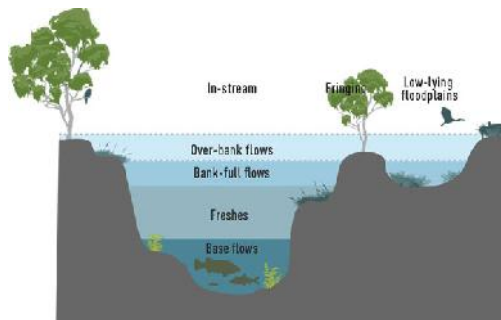


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Acronyms Used

| | |
|----------|---|
| BEWS | Basin Environmental Watering Strategy |
| BP | Murray-Darling Basin Plan |
| CEWH | Commonwealth Environmental Water Holder |
| CEWO | Commonwealth Environmental Water Office |
| CMA | Catchment Management Authority |
| CSIRO | Commonwealth Scientific Industrial Research Organisation |
| DEPI | Department of Environment and Primary Industries |
| DEWNR | SA Department of Environment Water and Natural Resources |
| DNRM | Queensland Department of Natural Resources and Mines |
| DoE | Commonwealth Department of Environment |
| DPI | NSW Department of Primary Industries |
| DSITIA | Queensland Department of Science, Information Technology, Innovation and the Arts |
| DSS | Decision Support Systems |
| DST | Decision support tools |
| EWAGs | Environmental Water Advisory Groups |
| MDB EWKR | Environmental Watering Knowledge and Research Project |
| EWPP | Environmental Watering Plan |
| FCNSW | NSW Forestry Corporation |
| LLS | NSW Local Land Services |
| TLM | The Living Murray |
| MDB | Murray-Darling Basin |
| MDBA | Murray-Darling Basin Authority |
| MDFRC | Murray-Darling Freshwater Research Centre |
| NoW | NSW Office of Water |
| NRM | Natural Resource Management |
| OEH | NSW Office of Environment and Heritage |
| VEWH | Victorian Environmental Water Holder |

Section 1: Purpose of the Review

About MDB EWKR

The purpose of the MDB EWKR project is to provide the best science information available to support the evolving needs of environmental water managers within the framework of adaptive water management use in the Murray–Darling Basin.

The project, funded by the Australian Government’s Department of the Environment, is a collaborative \$10 million project to be delivered over five years, with the delivery to be managed by The Murray-Darling Freshwater Research Centre (MDFRC).

Objectives of the Review

The review of existing decision making and decision support tools in environmental watering (the Review) forms part of planning phase of the Murray-Darling Basin Environmental Water Knowledge and Research (MDB EWKR) project.

The priority activities requested of the Review included:

- Exploring current decision making in environmental water management, including:
 - key steps or decision making points in the process for planning and delivery of environmental water - from long term planning and annual planning to the delivery of watering actions
 - the processes by which decisions are made at each step or decision point
 - knowledge used or required to inform decisions
 - current knowledge acquisition processes.
- Identifying where decision support tools (DSTs) are currently used to inform decision making.
- Evaluating the characteristics of existing DSTs that influence adoption, including in relation to design, functionality, and user interface features.
- Seeking recommendations from environmental water managers for improving the knowledge base and decision support tools available to them.

To achieve these activities, the Review has sought input from all relevant organisations at State and National scale involved in the management of environmental watering within the Murray-Darling Basin, with a focus mostly on those associated with the planning for and delivery of environmental water.

The Review did not seek the input of researchers as this was agreed to be out of scope for the Review purpose. Researcher input to the planning phase has been sought by MDFRC.

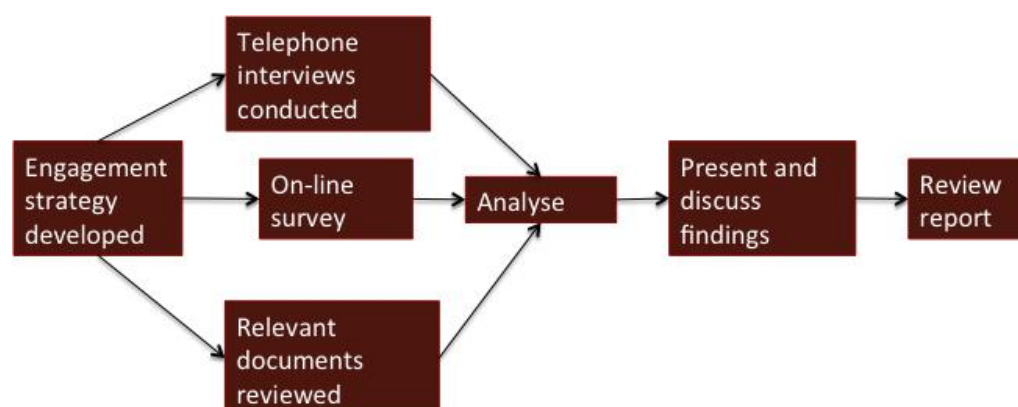
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|--|---|
| Environmental Watering | where it is sourced |
| Section 4: The Use of Decision Support Tools | To provide findings on the use of decision support tools, the factors that influence their use and thoughts regarding MDB EWKR's development of the tools |
| Section 5: Environmental Watering Managers' Recommendations for MDB EWKR | To provide the findings from survey participants and interviewees on how the knowledge base and decision support tools could be improved and more general comments on the MDB EWKR project. |
| Section 6: Implications for the MDB EWKR | To conclude how the Review findings can be applied to the MDB EWKR project |
| Section 7: Appendices: | To provide more detailed information relevant to the sections within the report |

Outline of the approach to the review

While multiple lines of evidence informed the Review, it was primarily a qualitative evaluation. The evidence was sourced from an on-line survey and telephone interviews and supplemented by relevant documentation.

Figure 2 provides a summary of the approach to undertaking the Review and more specific information can be found within Appendix 2.

Figure 2: Overview of the approach to the Review



A series of key evaluation questions were developed in consultation with the MDFRC and reflect the scope of work required by the Review activities. These questions provided a foundation for the Review by informing:

- An engagement strategy that included interview protocols and the on-line survey.
- The structure of the report.

Table 1 encapsulates the key evaluation questions and the section within the report that the findings are presented.

Table 1: Key evaluation questions developed for the Review

| Key Evaluation Question | Specific Evaluation Question | Section for Findings |
|---|---|----------------------|
| What is the decision making process for environmental water management? | What are the key steps or decision making points in the process? | Section 3 |
| | What are the processes by which decisions are made at the key steps? | |
| | What knowledge is used or required to make decisions? | |
| | How do you acquire the knowledge? | |
| | What are the strengths and weaknesses in the decision making process? | |
| | What are the foreseeable changes? | |
| Are DSTs used in the decision making process? | Where in the decision making process are DSTs used? | Section 4 |
| | What DSTs are used? | |
| What influences the adoptions of DSTs? | What are the characteristics of DSTs that influence adoption, including in relation to design, functionality and user interface features? | |
| What would environmental water managers recommend to improve the knowledge base and decision support tools? | How could the knowledge base for environmental watering be improved for managers? | |
| | Could decision making be improved with DSTs and how could they be improved? | Section 5 |
| | Is there a role for DSTs in MDB EWKR? | |
| | Are there any other comments for the MDB EWKR project? | |

The verification process for the Review involved triangulation of the evidence. Triangulation is the process of looking at a point from various perspectives. There are different approaches to triangulation and all support the underlying premise that no single method will be sufficient for any

evaluation (Patton, 2002; Creswell & Clark, 2011). The triangulation approaches applied to this Review include:

- Sources triangulation – by interviewing different and varied stakeholders
- Methods triangulation - by generating information from different collection methods such as surveys, interviews and the literature
- Reviewers triangulation – by using different evaluators to collect and discuss findings as well as using different reviewers not closely involved in the conduct of the Review.

It should be noted that one of the critical uses of qualitative information is to look for, and understand, the diversity in responses as this can often yield the greatest learnings. Therefore triangulation of evidence is not just about finding common patterns within the responses, but distinguishing where the diversity of views may also lie (Patton, 2002).

Considerations for interpreting the findings

The Review findings, presented in Sections 3, 4 and 5, need to be considered within the following contexts:

- The findings are primarily based on the responses to the on-line survey and the telephone interviews and supplemented with reports or web page information where that information addressed gaps (for example process charts)
- MDFRC nominated key contacts from each of the Commonwealth and State jurisdictions within the Basin that have responsibilities for environmental watering. These key contacts in turn nominated others from within their jurisdiction who may be able to participate
- Stakeholder representation was received from across all jurisdictions in both the on-line survey (28 completed out of 59 invitees) and telephone interviews (27 interviews out of 33 invited). Figure 3 illustrates the numbers from each jurisdiction that participated in the survey and interviews, noting that people who were interviewed may have also completed a survey.
- Participants were classified according to the primary role that they identified with. The classifications included strategy / policy; long term planning; annual planning; water delivery/operations; technical / DST developer. All participants had multiple roles but the majority identified that their main role in environmental watering was annual planning (refer to Figure 4). This has more than likely lead to most responses provided with an annual planning mind set.

Figure 3: Stakeholder representation in on-line survey and telephone interviews

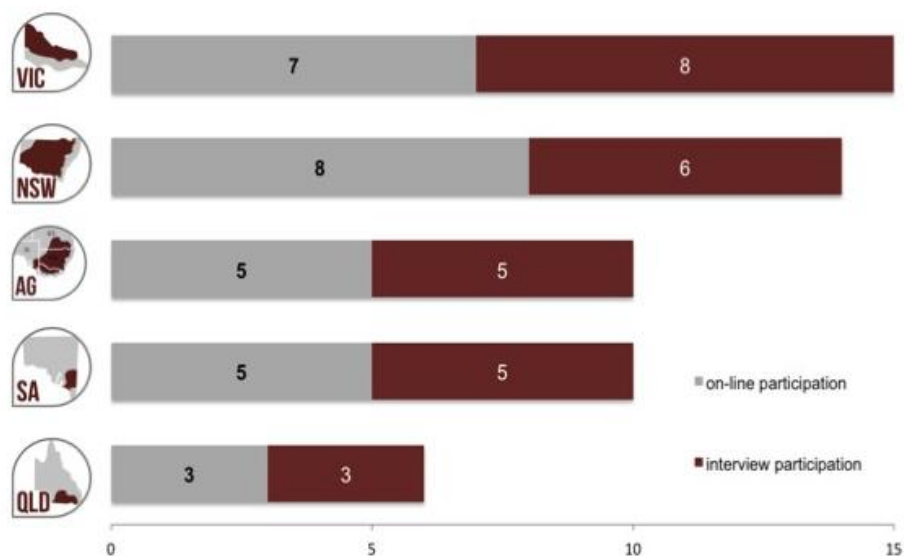
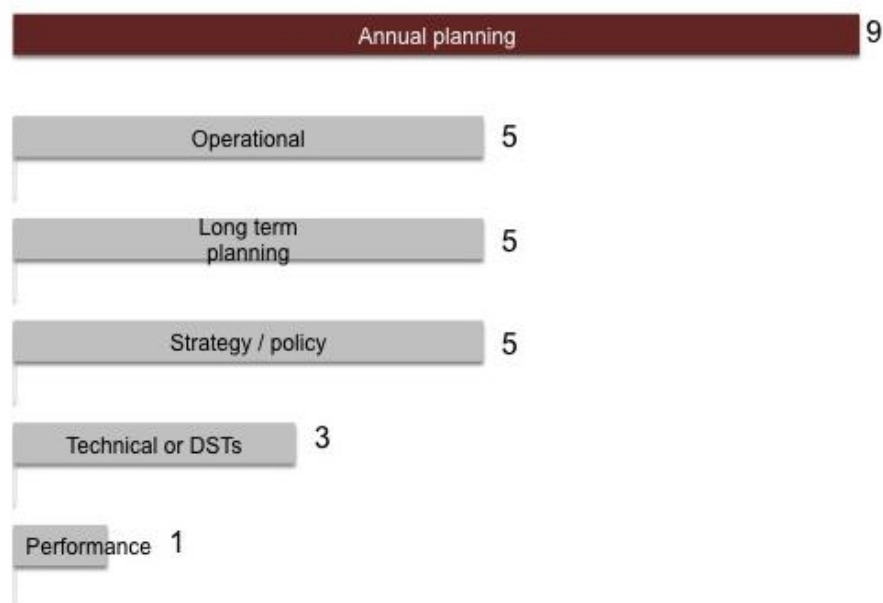


Figure 4: Identification of main role within environmental watering



Section 2: Context for the Review

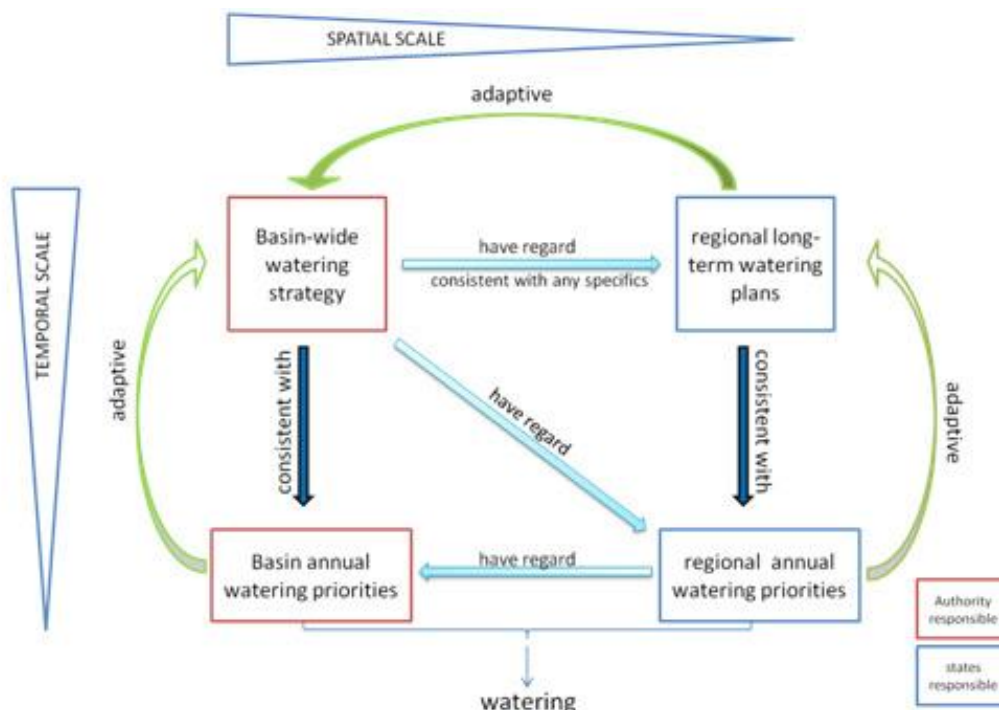
The purpose of this section is to summarise background information on environmental watering under the Basin Plan as well as outline how the MDB EWKR project intends to support the Basin Plan.

Environmental watering and the Basin Plan

The Murray-Darling Basin Plan (Basin Plan) was signed into law by the Commonwealth Parliament in November 2012, providing a co-ordinated approach to water management across the Basin. While a key component of the Basin Plan is the sustainable diversion limits for consumptive use the, there are many other elements to the Basin Plan, one which is of relevance to the MDB EWKR project is the Environmental Watering Plan (EWP). The EWP provides a framework for planning and coordinating environmental water management across the Basin. Another relevant element of the Basin Plan for the MDB EWKR project is the Evaluation Framework, particularly in terms of contributing to the evaluation of the effectiveness of the Plan's environmental outcomes.

Figure 5 summarises the Environmental Water Management Framework, illustrating the relationship between the planning processes that occur at different temporal and spatial scales and are undertaken by either MDB states or the Murray-Darling Basin Authority.

Figure 5: The Environmental Management Framework for Environmental Watering (source http://www.mdba.gov.au/what-we-do/environmental-water/ewp/ewp_ch3)



While a significant body of knowledge from various sources has guided environmental watering to date there is acknowledgement of the need to be able to refine and further evolve the environmental watering knowledge base to:

- Assist in explaining Basin Plan outcomes
- Support future environmental watering and natural resource management (NRM) decision making under the Basin Plan's Environmental Management Framework for Environmental Watering

The establishment of the MDB EWKR Project is one of the mechanisms funded through the Australian Government to further enhance the knowledge base.

The MDB EWKR Project

The MDB EWKR project is a five year collaborative research project that will be delivered through the Murray Darling Freshwater Research Centre (MDFRC).

The major body of research will focus on:

- Improved identification, assessment and understanding of the links between ecological responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition
- Medium- and long-term changes in ecological condition, including the effects of threats (hydrological, aquatic and terrestrial) which may reduce or prevent the ecological improvement expected
- Queensland floodplain vegetation watering requirements.

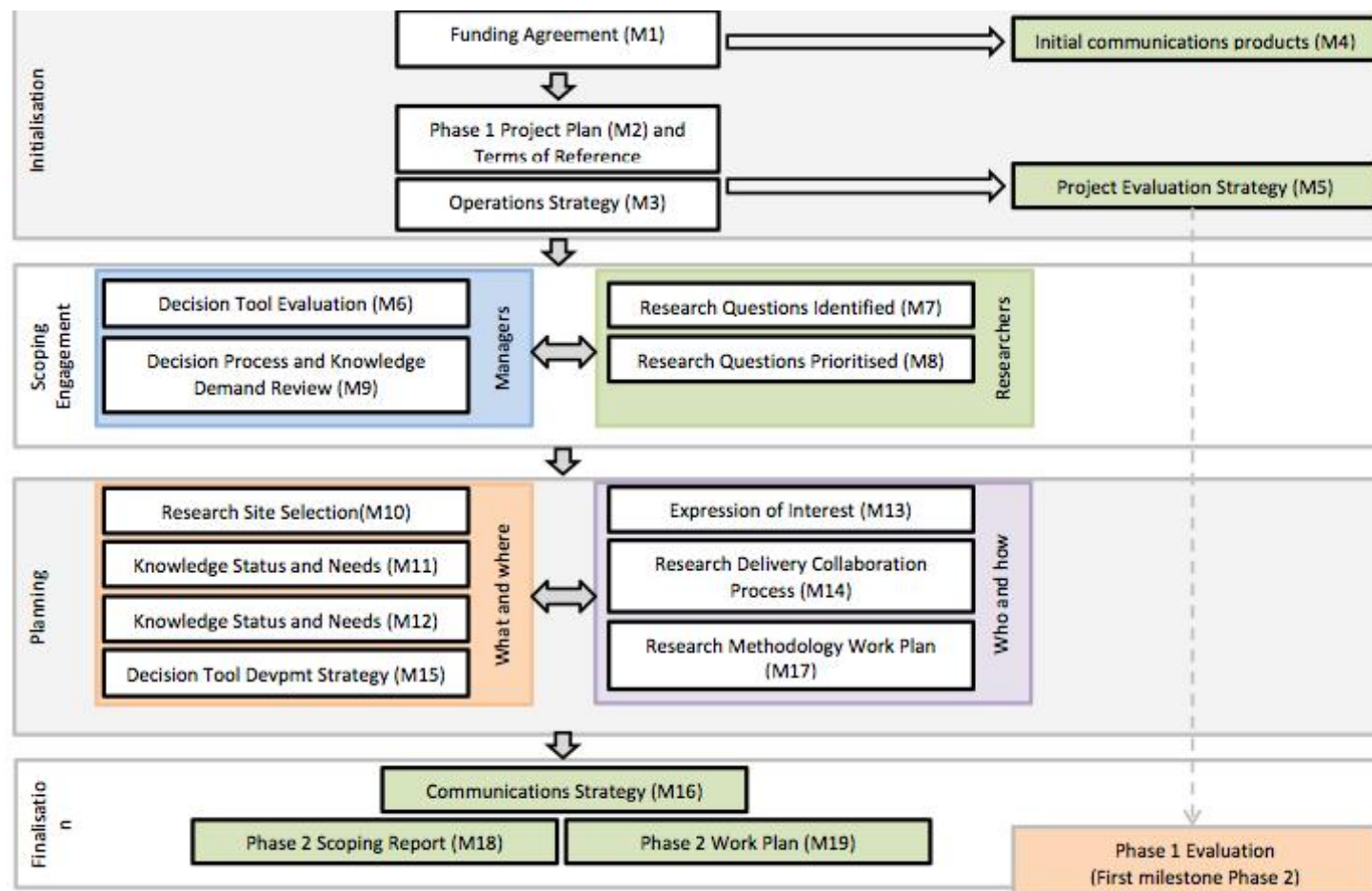
The MDB EWKR project will promote collaboration among research institutions which will be important in generating new knowledge about the complex responses of aquatic ecosystems to changes in flows across a range of spatial and temporal scales. In addition to collaborating with research institutions the project will engage with water managers in the Basin to influence ownership and adoption of research findings within the decision making processes.

The MDB EWKR project will be delivered over two phases:

- Phase 1 - scoping and planning (June 2014 to Feb 2015)
- Phase 2 - implementation (2014-15 to 2018-19)

Figure 6 illustrates the structure for Phase 1 of the MDB EWKR project. As described in section 1, this Review project is one of the activities being delivered within Phase 1.

Figure 6: MDB EWKR Project Structure for Phase 1 (source MDFRC, 2014)



Section 3: The Current Decision Making Processes for Environmental Watering

The purpose of this section is to provide the findings of the Review associated with the evaluation questions clustered under the current decision making process for environmental watering.

A summary of the on-line survey and interviews related to decision making processes are presented in Appendix 3 and 4 respectively.

What are the current decision making processes?

Understandably at a gross scale the fundamental elements for planning for environmental watering all exist and include to varying degrees the common elements of:

- collation of information
- consultation
- prioritisation process
- approval of plans
- delivery of environmental water
- monitoring and reporting
- feedback into the next planning phase

Of most interest to the MDB EWKR project are the variations of the planning processes across jurisdictions where the notable differences were associated with:

- Existing planning frameworks that are quite varied from State to State and based on State legislation and policy.
- Governance arrangements and responsibilities that are again influenced by State legislation and policy and it can be quite variable across each of the States where the responsibility lies for environmental watering from a policy planning or delivery perspective. Except for Victoria, the planning responsibilities lie with a central agency whereas in Victoria the role is with the regional natural resource organisations. The governance arrangements will also influence who is consulted and the methods of consultation.
- Landscape condition, delivery infrastructure and assets of focus naturally vary from region to region within States.

Each of the differences are discussed further within the following sub-sections and a summary of each of the jurisdictional decision making processes has also been captured in Figures 7-12. All of the figures, except for Queensland, have been adapted from process charts that were provided by the jurisdictions. The Queensland figure (Figure 9) was developed following interviews and a review of material on relevant Department web sites (www.dnrm.qld.gov.au and www.ehp.qld.gov.au).

Commonwealth

The two Commonwealth agencies (CEWO and MDBA) responsible for environmental water are:

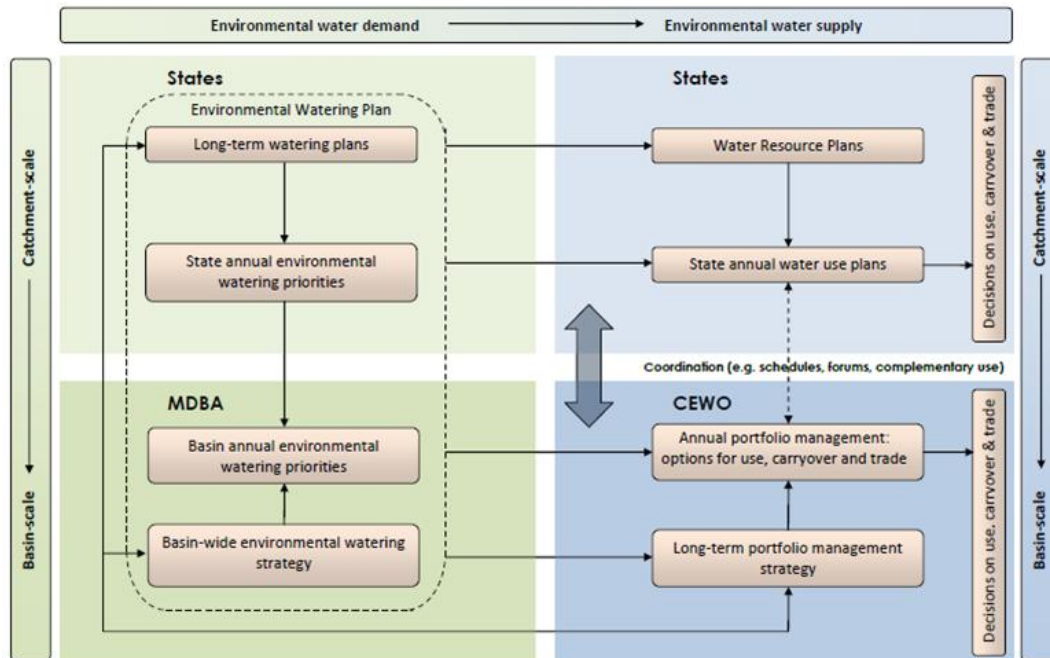
- Interested in environmental watering outcomes at a Basin scale
- Involved in planning that is long term, annual and for the Murray-Darling Basin Authority (MDBA) event based.
- Their decision making timeframes are driven by legislation

Commonwealth Environmental Water Office (CEWO)

Following the ratification of the Murray Darling Basin Plan in 2012, the Commonwealth Environmental Water Holder's (CEWH) decisions on water use, carryover and trade have been made in the context of, and consistent with, the Basin Plan's Environmental Watering Plan, and annual priorities (Australian Government, ND). The "Framework for Determining Environmental Water Use" (Commonwealth Environmental Water Office, 2013), is a long-term framework for determining Commonwealth environmental watering actions by matching prioritised actions with available water.

Figure 7 illustrates CEWO's relationship to the State and Basin planning processes, with their focus on achieving outcomes at a Basin scale through the provision of environmental water to priority sites.

Figure 7: The relationship of CEWO to the Basin and catchment-scale planning for environmental water supply and demand



The CEWO Framework describes the use of environmental water held by the Commonwealth as being driven by the longer term¹ and annual plans determined by the Basin States and Murray Darling Basin Authority (MDBA).

Murray Darling Basin Authority

The MDBA is responsible for the overall environmental watering framework and its contribution to the objectives of the Basin Plan. The MDBA's role for environmental watering covers more roles than the CEWO as highlighted by:

- Strategy development such as the Basin Environmental Watering Strategy (BEWS)
- Receipt of Basin State annual environmental watering priorities and development of annual Basin environmental watering priorities
- In the future, the approval of the Water Resource Plans and Long Term Environmental Watering Plans
- Annual planning and co-ordination of The Living Murray Program
- Contribution to planning for and delivery of water in the Murray for environmental watering events
- Monitoring and evaluation regarding the above processes that the MDBA are responsible for

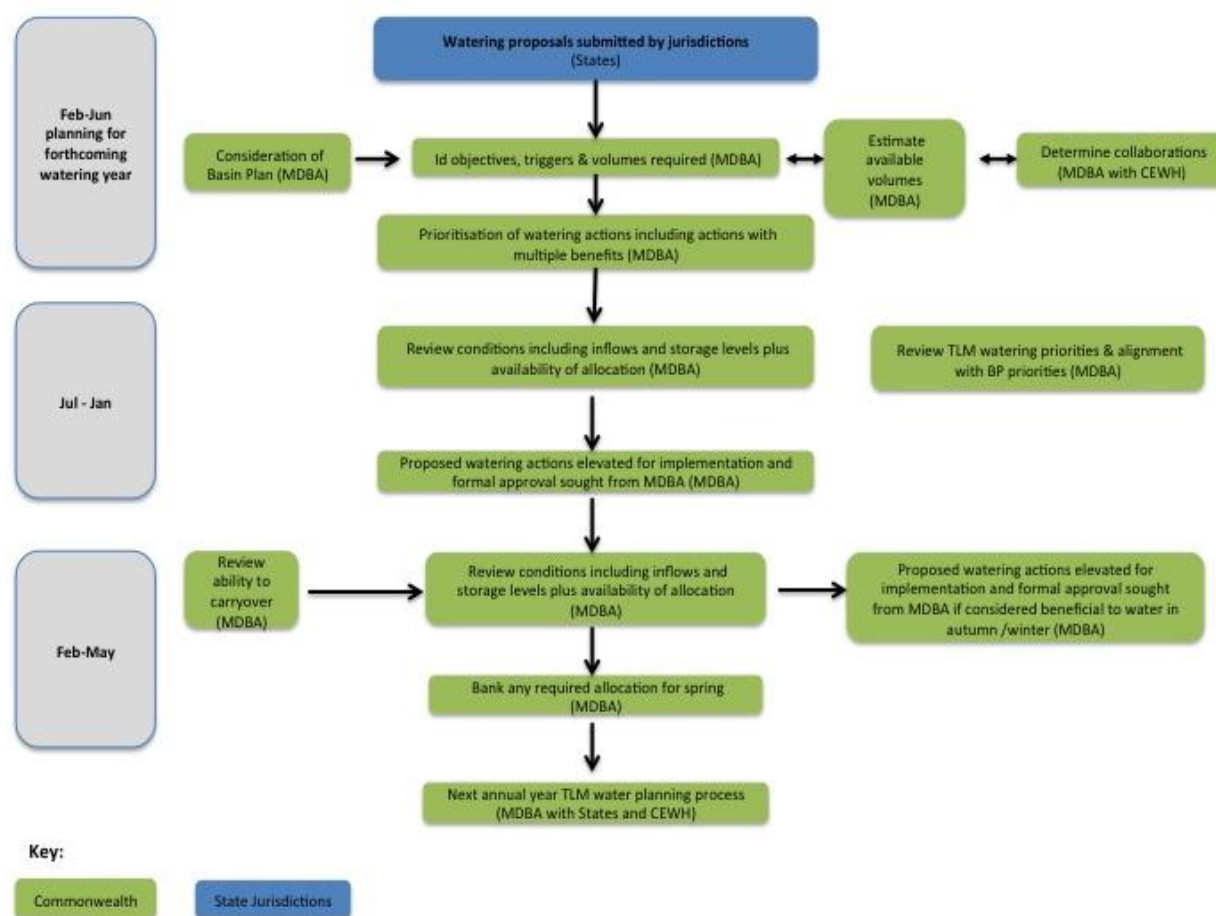
As previously mentioned, the MDBA is responsible for the overall framework for environmental watering as a key element within the Basin Plan. Chapter 8 Part 4 of the Basin Plan (Commonwealth of Australia, 2012) specifies the statutory requirements of the environmental management framework, enabling the planning and co-ordination of environmental water within the Basin.

The Environmental Watering Plan (EWP) provides for Basin wide co-ordination of environmental watering through the environmental management framework illustrated in Figure 5.

Environmental watering was being undertaken prior to ratification of the Basin Plan in 2012. The Living Murray (TLM) aims to improve, through the use of environmental water, the health at six icon sites along the River Murray. The Living Murray environmental watering plan is developed annually and the planning and implementation process is illustrated in Figure 8. This process influences the planning process for a number of the Basin States (eg South Australia), as they need to develop and commit their environmental watering proposal via more than one approval process.

¹ At the time of this Review the Basin States were not developing Long Term Environmental Watering Plans in the context of the Basin Plan. All Basin States were developing Annual Watering Plans for approval by the MDBA.

Figure 8: Annual planning and implementation process for TLM (Murray Darling Basin Authority, 2014)



Both Figure 5 and Figure 7 highlight the new planning arrangements that will need to be undertaken by the Basin States as part of Basin Plan implementation. All Basin States have legislation, policy and planning processes that were in place before the ratification of the Basin Plan in 2012. As such there will generally be an alignment of planning processes related to environmental watering in the future. The following discussion for each of the Basin States is based on their current decision making processes.

Queensland

The Queensland catchments that are within the Murray-Darling Basin have limited capacity to regulate flow using in-stream infrastructure plus the catchments are characterised by ephemeral and intermittent watercourses and wetlands. Therefore environmental water is provided and managed through a rules based approach that is encapsulated within the Queensland water resources plans that cover the Queensland component of the Basin.

"Held" environmental water within the Queensland Murray-Darling Basin context is owned by the CEWH, mostly as unsupplemented water allocation (Department of Natural Resources and Mines, 2014).

The current water resource plans that are developed under the Queensland legislation do not directly provide for annual planning for environmental water. The water resource plans are 10 year plans that aim to balance ecological, social and economic outcomes through the provision of a water resource management framework that outlines the strategies to achieve the defined outcomes. The resource operations plans are the implementation instruments for the plans, specifying the day to day rules and management arrangements. The establishment of ecological outcomes within the water resource plans provides for environmental watering priorities.

The Queensland Department of Natural Resources and Mines (DNRM) is responsible for the policy, planning, reporting and adaptive management. They work closely with the:

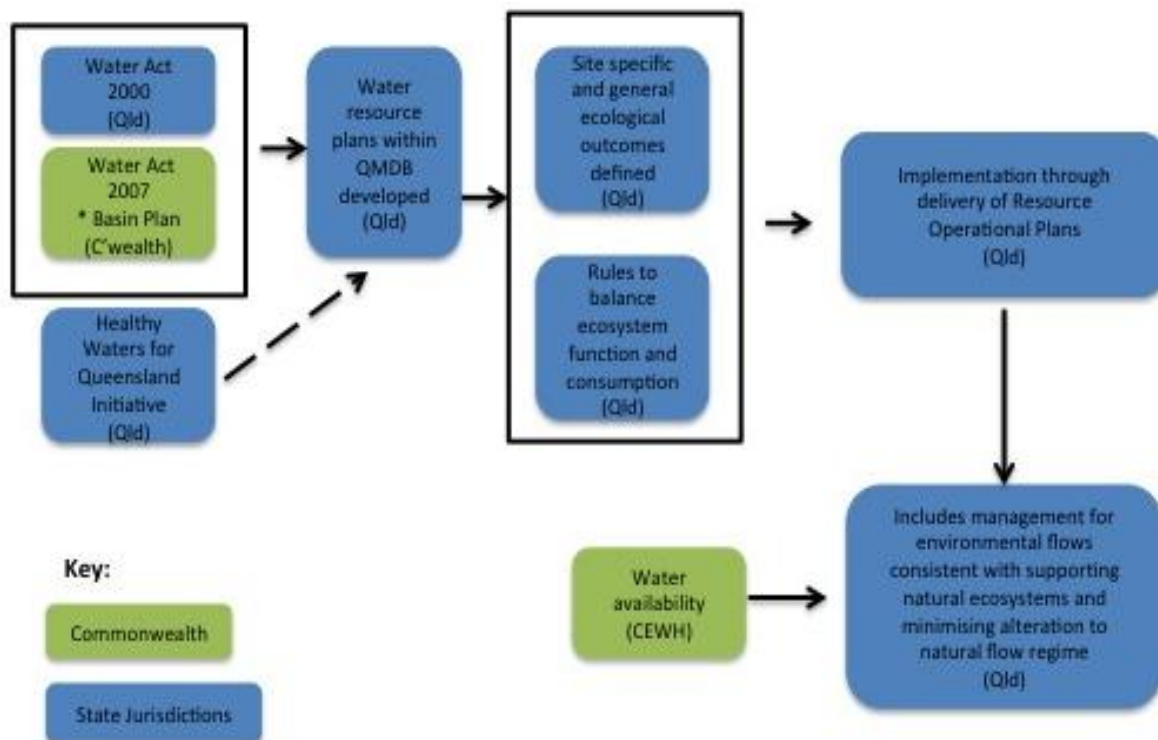
- Queensland Department of Science, Information Technology, Innovation and the Arts (DSITIA) who provide information and technical expertise
- Queensland Department of Environment and Heritage Protection (DEHP) who co-ordinate the Queensland Healthy Waters Management Plans under the Environment Protection (Water) Policy 2009.

Extensive consultation more broadly occurs at plan development and review.

At the time of the Review, a case study was being undertaken in Queensland as part of a Water Resource Plan review to ensure the updated plan meets the accreditation requirements under the Basin Plan.

Figure 9 illustrates the process for environmental water decision making within Queensland and the linkages to the statutory and non-statutory planning processes.

Figure 9: Queensland Murray-Darling Basin environmental watering planning process



New South Wales

There are several agencies with responsibilities for environmental watering in NSW and some interviewees described these responsibilities as fractured, as there is no legislated environmental water holder. The two main agencies are the NSW Office of Water (NoW) within the NSW Department of Primary Industries and the NSW Office of Environment and Heritage (OEH). Other agencies contribute to the planning and decision making process via their contribution to regional committees that are referred to as Environmental Watering Advisory Groups (EWAGs).

NoW is responsible for the development of water sharing plans and the approval of adaptive environmental water use plans. Water sharing plans, prepared under the Water Act 2000, establish rules for sharing water between the environment and consumptive users. Where additional water has been recovered for environmental use it is held as water access licences. OEH develop adaptive environmental water use plans to manage for this water.

In addition, OEH prepare annual environmental watering plans and will be responsible for the future long term environmental watering plans, both plans are a requirement under the Basin Plan. The annual plans are statements of priorities for how environmental water will be used in the coming watering year (generally July to June) and are based on the annual environmental watering plans that have been developed under the NSW Riverbank Program². These plans are prepared for:

- Gwydir
- Macquarie
- Lachlan
- Murrumbidgee
- Murray and Lower Darling.

Historically, the focus of these systems for environmental watering has typically been wetlands rather than also considering in-stream.

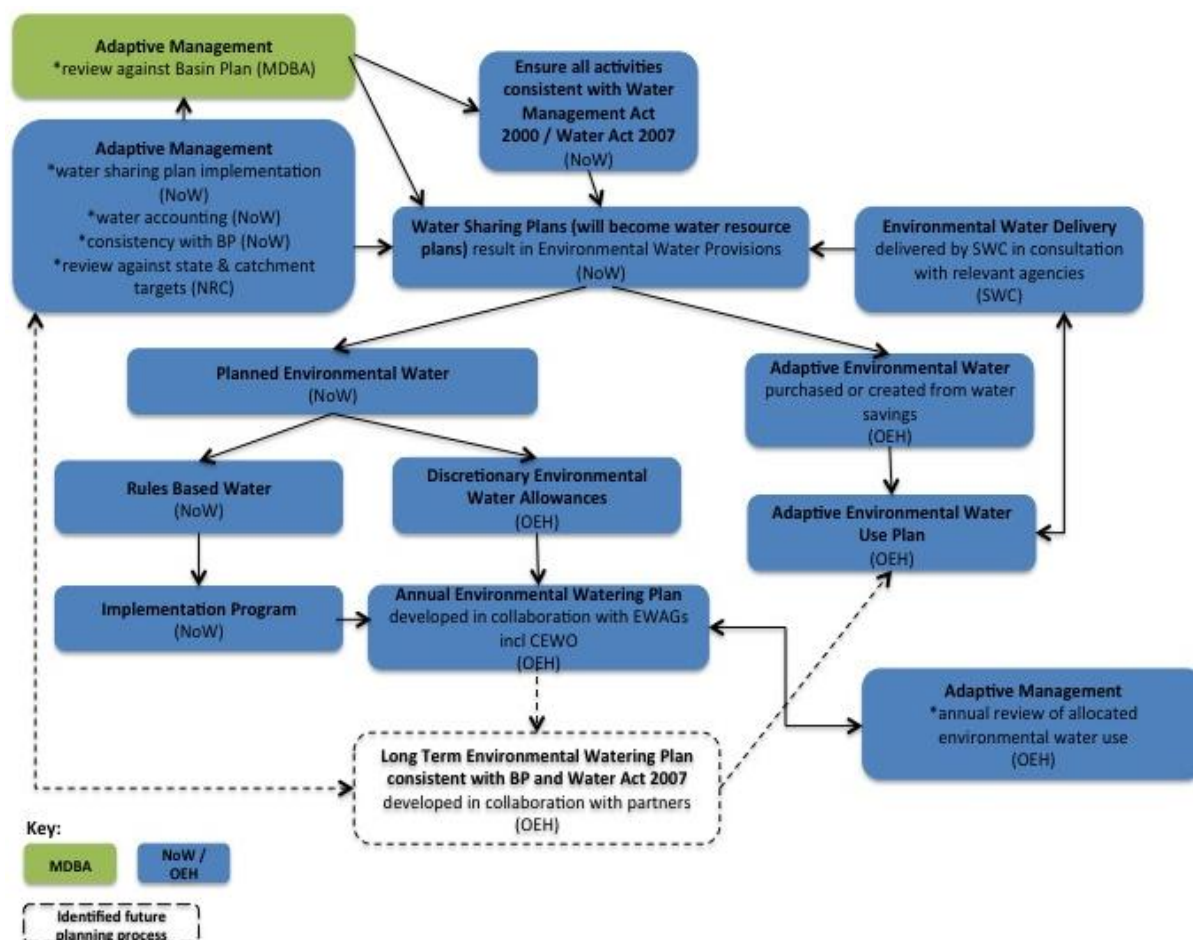
OEH consult with EWAGs in the development of these plans, where the EWAGs role is advisory. EWAGs are regionally based and the membership varies across the different committees but generally includes representatives from:

- OEH
- NoW
- State Water Corporation (bulk water delivery in NSW)
- MDBA
- CEWO
- Local Land Services (formerly Catchment Management Authorities)
- Various local interest group and agricultural industry representatives

² Riverbank is a NSW water recovery program that was established in 2005 to buy back water for the most stressed inland rivers and wetlands in NSW.

Figure 10 outlines the planning and decision making process in NSW

Figure 10: New South Wales environmental watering planning process



Victoria

The responsibilities for environmental water planning and decisions within the Victorian Murray-Darling Basin are dispersed between State agencies and the regionally based Catchment Management Authorities (CMAs):

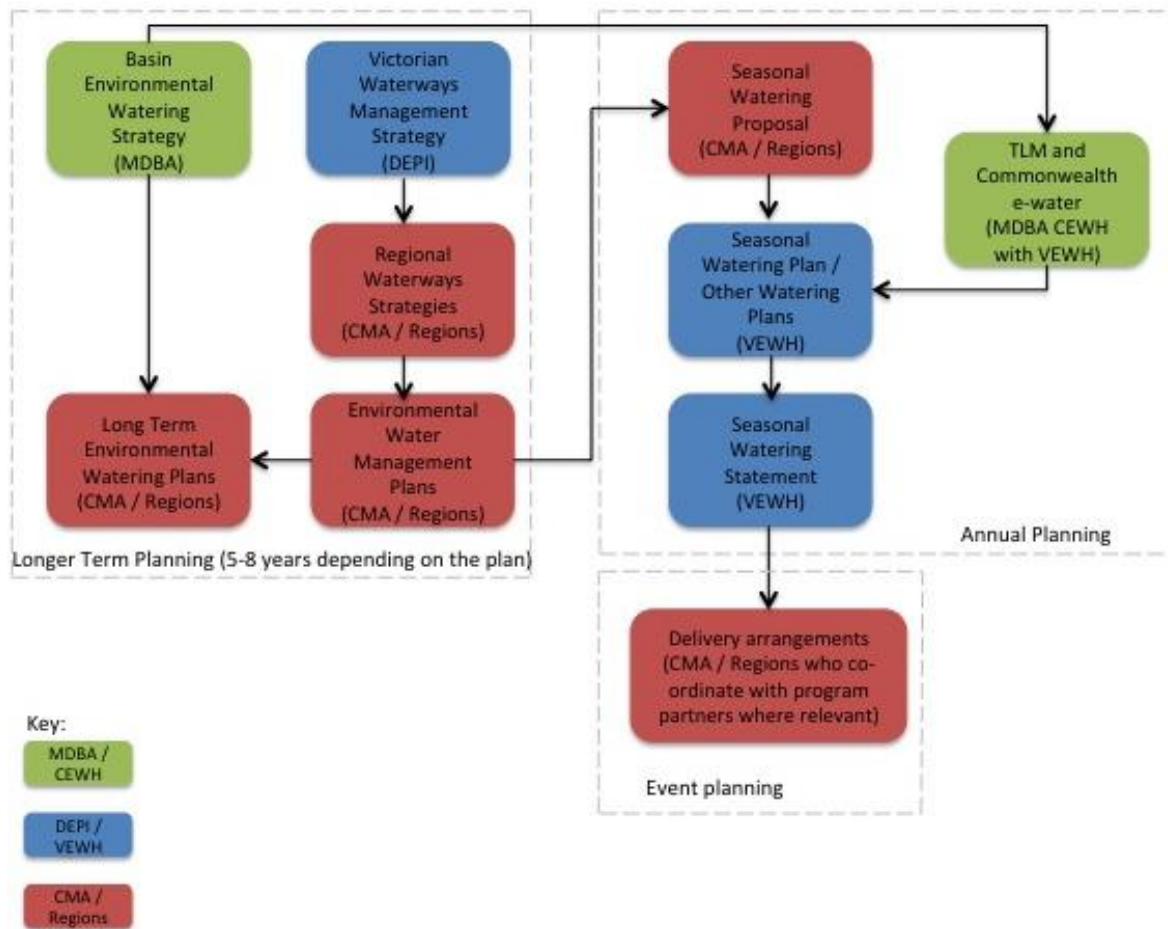
- The former Department of Environment and Primary Industries³ (DEPI) oversees the development and implementation of state wide strategy. One of the important strategies is the Victorian Waterways Management Strategy that incorporates quality and quantity issues. The CMAs need to develop Regional Waterways Strategies, consistent with the State strategy.
- Victorian Environmental Water Holder (VEWH), an independent statutory body, is responsible for holding and managing Victoria's environmental water entitlements and liaising with CMA's on the best use of the water holdings

³ Since conducting the Review, the Department changed names to Department of Environment, Land, Water and Planning.

- CMAs who work under the State statutory framework to deliver regionally based environmental outcomes including the planning and management of approved environmental water. The CMAs undertake the annual planning process for environmental watering in partnership with other relevant organisations. The CMAs also co-ordinate environmental watering events with other program partners such as State owned water corporations.

Figure 11 illustrates the planning and decision making process in Victoria.

Figure 11: Victoria environmental watering planning process

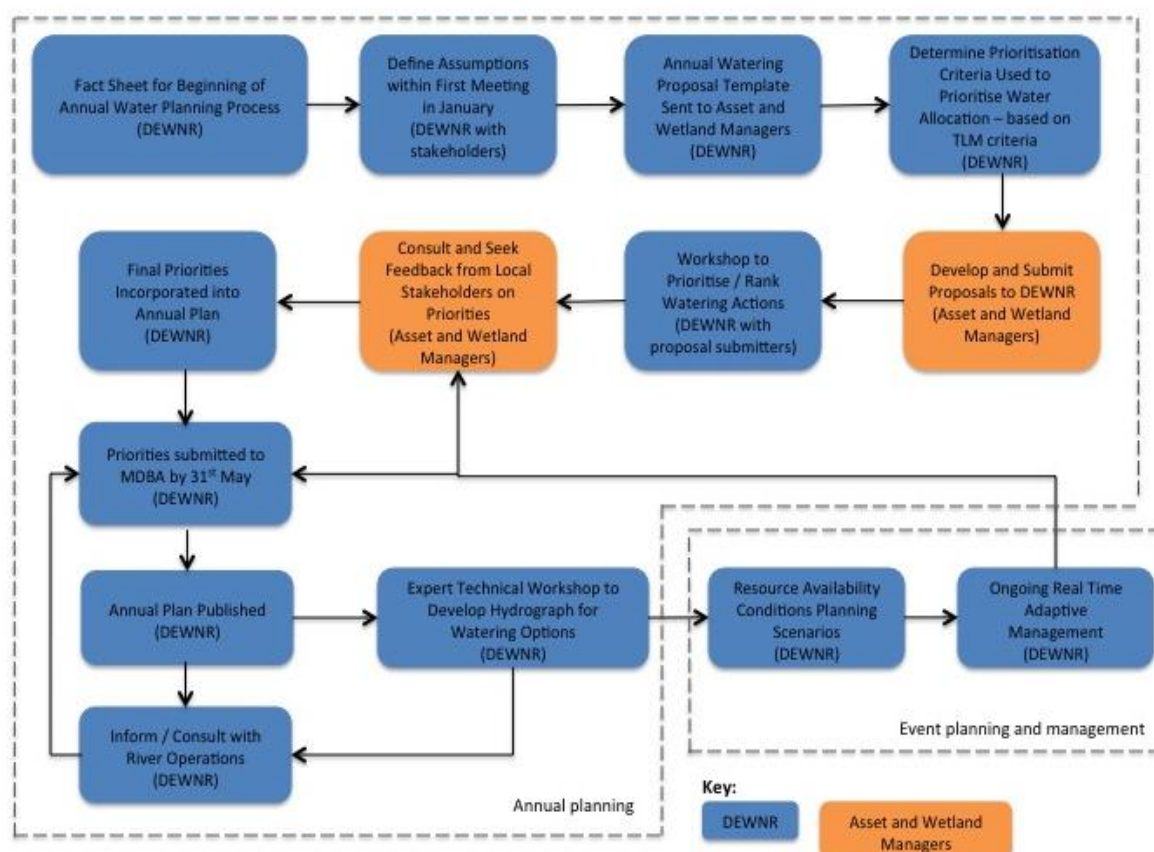


South Australia

The South Australian Department of Environment, Water and Natural Resources (DEWNR) is responsible for planning and management of the delivery of environmental water within South Australia. Interviews indicated that although undertaken within DEWNR the roles are dispersed across the organisation and that this is a disadvantage. In addition there is no capacity for the State to hold environmental water in storage and these holdings remain with the CEWH. Therefore annual planning priorities require consultation with TLM, MDBA and the CEWO.

Figure 12 illustrates the planning and decision making process in South Australia.

Figure 12: South Australian environmental watering planning process



What are the key decision making points and the processes by which decisions are made?

A number of common key decision making points across jurisdictions and broad environmental watering roles were identified. They included:

- The process of prioritisation as part of annual planning. This is also closely linked to other common decision making points of determining best ecological outcomes with the available water and trade-offs.
- Real time delivery during an event as decisions needed to be made on best available information from a variety of sources (including on the ground observations) and in short time horizons in collaboration with a small team of partner organisations.
- The process of facilitating the decision making process and the approval of annual plans.

Furthermore it was acknowledged that in the near future there was to be an added focus on longer term planning for environmental water and therefore the potential of refinement of the current planning frameworks. These refinements are discussed in more detail within this section under the question of foreseeable changes.

Even though Basin States are required to collect information to inform Basin scale outcomes, a point of difference between the Australian Government agencies and Basin states was the need to make

decisions or ensuring annual planning proposed by the states had basin-wide significance in terms of the Basin Plan.

When the on-line survey information was filtered by roles many of the common decision making points, listed above, were consistent but points of difference that emerged due to roles included:

- Planning (annual and long term):
 - being able to justify the decisions
 - the need to consider the broader natural resource management (NRM) issues
- Delivery of environmental water
 - multiple agency considerations of how best to manage the water in real time
 - managing and adaption of infrastructure to achieve planning outcomes
- Strategy / Policy
 - the impacts of strategy on landholders
 - the balance of environment, social and economic outcomes in the broader context of the Basin Plan
- Technical Information / Tools / Monitoring and Evaluation
 - provision of and access to real-time information
 - determining outcomes

What knowledge is used and how is it acquired?

Questioning within the Review was not focussed on identifying *specific* knowledge gaps or knowledge requirements as MDFRC were running a parallel process with water managers and researchers to identify research knowledge gaps for consideration under the MDB EWKR portfolio. The line of enquiry within the Review was more concerned with what type of knowledge was sourced, from where it was sourced and the strengths and weaknesses of that knowledge in terms of environmental watering decision making.

There are many varied sources of information and various providers that are accessed to make environmental watering decisions. Regardless of jurisdiction or environmental watering roles, it was evident that decisions were based mostly on a combination of technical information, corporate knowledge and local knowledge. Also broad consultation occurred involving scientific experts, water managers and local stakeholders.

Consultants and external technical experts or research organisations were mostly identified as contributors to the strategy and planning roles.

The interviews identified that hydrographic information provided the foundation to decision making and this was combined with climatic information (for example through the Bureau of Meteorology),

and other contextual information (for example available water). Condition information used was most commonly for vegetation and sometimes birds and fish but this was asset specific.

There appeared to be a reliance on grey and peer reviewed literature to gain a greater understanding of response to environmental flows and this would supplement event monitoring as part of the adaptive management and forthcoming planning cycle.

The type of information and providers was dependent on where in the planning cycle it was to be used. For example event management would be more heavily reliant on real-time information and water deliverers (such as State owned Water Corporations) than annual planning information that relied more on historical information and input from a wider pool of sources who contributed local and corporate knowledge.

Figure 13 illustrates how the on-line survey participants responded to a question regarding who they consulted with and Figure 14 illustrates the types of information sourced.

Figure 13: Organisations consulted with by environmental water managers

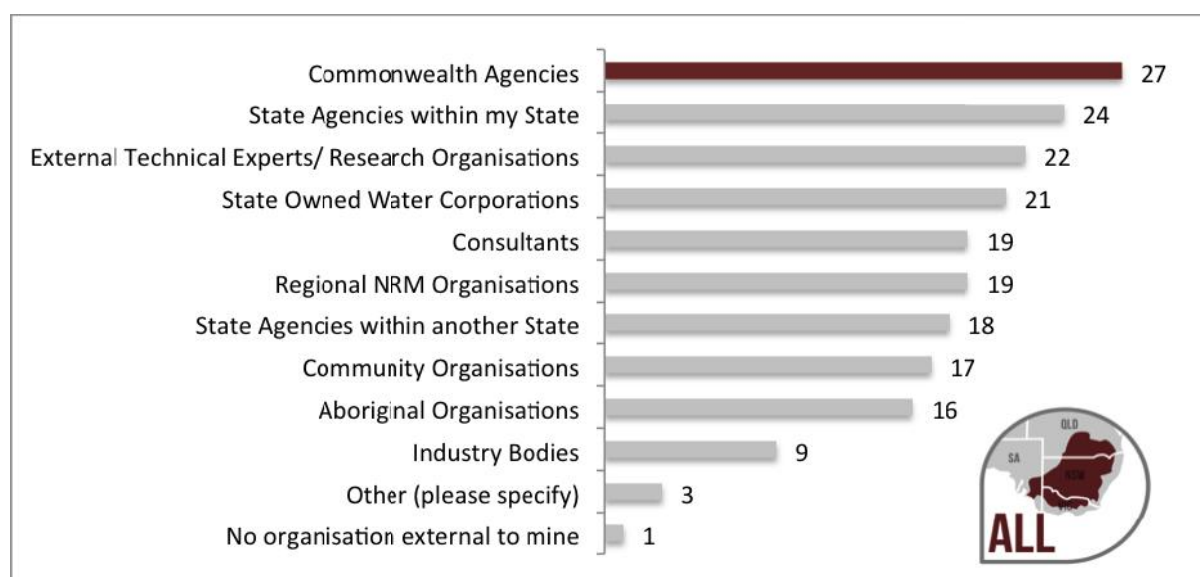


Figure 14: Sources of information for decision making



The interviews enabled some more detail to be provided in terms of the type of information sourced and from where it was sourced. The responses listed below are mostly focussed on the annual planning phase of the environmental watering cycle, unless the text indicates:

- A lot of the responses indicated that the type of information was more skewed towards knowledge and information rather than data and analysed data. This information was sourced from:
 - reports
 - consultants working either directly or indirectly on the asset in question
 - research organisations or expert scientific knowledge
 - peer reviewed literature
 - corporate and local knowledge from either internal or external to the responsible organisation
 - observations, particularly associated with events
 - some community groups
- Strong reliance on flow data (planning and events) that is either accessed directly from telemetered systems or based on hydrological models
- Some water quality data such as salinity is used where it is available, but the use of water quality data was not broadly represented across the responses.
- There is some ecological information used (e.g. fish, vegetation extent and in some cases condition, and birds). Generally the reliance for this information appeared to come from other sources (e.g. reports) or comments were made in terms of the monitoring programs decreasing or the mining of old data.
- In one situation satellite imagery was identified as a source of information, but it appears as though its use across the jurisdictions is limited.
- Other standard sources included water accounts and climatic information from Bureau of Meteorology.

There was numerous responses that referred to accessing information from external sources such as reports that may have been a result of a watering event for the asset or more general in nature (e.g. state-wide monitoring reports), other forms of grey literature and peer reviewed literature. None of the respondents were forthcoming or implied that they applied a formal approach to synthesising this information for their application.

One of the participants summed up the responses when they stated " *it depends on the process and who is running it, but at the heart there will be some science*". Basically the source and use of scientific information and the use of scientific data is variable in terms of what is used, how extensive it is and how it is sourced.

What are the strengths and weaknesses in the current decision making processes?

The interview process enabled more discussion on what was considered the strengths, weaknesses and critical gaps with the knowledge base for environmental watering decisions.

The strengths commonly identified by jurisdictions include:

- The body of knowledge that has now been established through an environmental watering process and water resource planning process that pre-dates the Basin Plan.
- That the fundamental information is strong.
- There is good collaboration and partnerships have been established.
- A strong understanding of some specific sites has been established.

There was comfort with the annual planning process often because it was a relatively stable process and had good buy-in and collaboration from other stakeholders. Concerns were raised though across several jurisdictions about making annual planning decisions on the basis of some assumptions. The assumptions were related to knowledge gaps and include:

- Making decisions regarding trade-offs without understanding the consequences, for example:
 - the best option provided by scientific input may be to water for three months but can only water for two months
 - deciding whether to spread the available water across two wetland assets or just provide it to the one asset
- Surrogates used in the absence of a better understanding of the effect of watering on some assets, for example:
 - have a lot of knowledge of watering impacts on wetland vegetation without necessarily understanding benefits or timing detriments to other assets.

Other weaknesses that were commonly identified across the jurisdictions include:

- The ongoing monitoring pressures due to budget constraints.
- The loss of skills and corporate knowledge, with comments indicating that the public service is not very good at succession planning.
- As indicated under strengths, some sites have sound knowledge bases, but more broadly there is limited information.
- Several comments related to science / research noted:
 - science programs that were ad-hoc or based on personal interests
 - the imbalance between the time required to undertake research versus the need to make decisions
 - planning is shifting towards longer term planning so how to identify and priorities assets
 - don't understand the cumulative impacts of environmental watering decisions, including those associated with trade-offs.
- The lack of synthesis of all the existing knowledge and information. While a significant body of research and information is available, knowledge that is more tacit also exists and there appears to be an ad-hoc means of sharing, networking or accessing available information beyond your existing network.

There was a general sense of "there is still a lot we don't know and the implications for decisions being made" with a common response around the theme of a need for basic research and understanding. The common knowledge gaps across all jurisdictions were identified as:

- How to meaningfully upscale site information or catchment information to the Basin scale.
- Confounding factors beyond environmental water (for example other NRM practices that together with environmental watering will contribute to environmental outcomes).
- Better understanding of the implications of trade-offs.

In addition, some participants commented on the need to better understand issues related to inter-valley and downstream benefits and costs. One example provided by a NSW participant related to bird breeding events in two valleys and how to make the best use of environmental water. A similarly comment was made in Victoria, that to make decisions around watering for bird breeding events it was necessary to understand what was happening in the northern basin.

A knowledge gap that was also raised, which is of relevance to the long term planning, was associated with cumulative impacts and not understanding such issues as impacts on assets of multiple years with or without watering or implications associated with changing elements of a watering event. For example shortening a flow event from six to four weeks or reducing the magnitude of a watering event in response to wetter than anticipated conditions. There is uncertainty around how such decisions will affect the achievement of targets and outcomes.

What are the foreseeable changes to the decision making process?

The most common foreseeable change in the decision making process will be the alignment of State jurisdiction planning frameworks to meet the Basin Plan requirements. For example the development of water resource plans that incorporate Basin Plan requirements and any existing State legislation requirements. At the time of the Review, Queensland were undertaking a pilot of their legislation and planning framework and examining this in the context of the Basin Plan requirements as well as State Government objectives. By comparison, Victoria is proposing that their current planning framework and plan contents will meet the requirements of the Basin Plan⁴.

For most jurisdictions their focus has been on annual watering plans and under the Basin Plan they will need to introduce Long Term Environmental Watering Plans. Generally this was thought to be a positive step as the longer term plans would result in a better statement of environmental outcomes and therefore result in more strategic approaches to environmental watering.

At the annual planning scale there was generally a sense that current processes may be "tweaked", mostly in terms of governance, but overall the process wouldn't change greatly.

It was also commonly stated across all jurisdictions, including the Commonwealth that the forthcoming changes should lead to some form of efficiencies and strategic gain. For example Victoria thought that there would need to be a streamlining of processes and decision making, the Commonwealth thought that there would be a shift in some governance arrangements and NSW felt that the alignment of planning would result in a more coherent and strategic process.

All jurisdictions acknowledged that changes occur outside of the environmental watering domain such as organisational changes. A common response to this was that "this will still need to be done regardless of organisation or titles".

As the Basin Plan elements for environmental watering are implemented an element of change that is common across all jurisdictions and of particular relevance to the MDB EWKR project is the need to be able to demonstrate environmental watering benefits. Research findings therefore should not only influence planning decisions but also form another line of evidence to support evaluations of environmental watering outcomes.

Concluding comments

The purpose of the Review was to obtain from participants information regarding how they currently make environmental watering decisions and the information used to inform those decisions. While the MDB EWKR project wants to maintain awareness of the environmental watering decision process and

⁴ It should be noted that since that statement was made a State election was held in Victoria in November 2014. The election resulted in a change of government and at the time of concluding this Review it was not known whether policy changes would be introduced that may influence this statement.

any future changes within each jurisdiction, the team indicated that their main interest at the planning phase is in the knowledge used for decision making and how it is acquired.

From the information presented within this section it can be concluded that:

- Jurisdictions undertake similar decision making processes when planning for environmental water, with the dominant planning phase at present being annual water plans. All are comfortable with the annual planning process and do not believe it will change greatly into the future.
- The roles and responsibilities for annual planning vary from state jurisdiction to jurisdiction.
- There is a positive outlook for the introduction of longer term watering plans as it is thought that these will provide a more strategic and outcome focus for achieving environmental watering outcomes.
- Information for all types of planning is accessed from multiple sources and are typically a combination of technical, corporate and local knowledge, with a strong reliance on corporate knowledge across all jurisdictions.
- There was concern expressed about the potential to lose corporate knowledge that is relied upon in the planning and event processes.
- Hydrographic information is at the centre of the decision making process and from this point the access to and use of scientific information becomes quite variable across assets and jurisdictions.
- The timing for decision making and access to information as well as the type of information sourced varies with planning stages such as annual planning versus an actual watering event. For example, an event is more reliant on real time data and local expert / agency knowledge.
- A paradox exists between the comfort in the annual planning process and the identified knowledge gaps and assumptions made when planning.
- There was a sense that the best decisions are being made with the existing knowledge and information but general concern on the budget pressures for monitoring programs.

The "big picture" knowledge gaps included:

- The ability to scale up to Basin scale while maintaining local relevance.
- Application of a systems approach to improved understanding of environmental watering decisions and outcomes so there is a better understanding of what may happen downstream or in another valley or other ecological responses.
- Determination and justification of trade-offs when making environmental watering decisions.
- Lack of understanding of cumulative impacts of environmental watering decisions.
- The impact of the broader NRM issues on environmental watering outcomes.
- Shifting focus from annual to longer term planning and the fact that this will require longer planning horizons, ability to identify and prioritise assets and a means of defining appropriate objectives and strategies.

Section 4: The Use of Decision Support Tools

The purpose of this section is to provide findings on the use of decision support tools (DSTs) and the factors that would influence their use.

A summary of the on-line survey and interviews related to DSTs are presented in Appendix 3 and 4 respectively.

Definition of DSTs for the purpose of the Review

MDFRC requested that for the purpose of this Review we considered DSTs in terms of quantitative flow response model, that is an ecological response model. While the evaluation team expressed this definition to participants we did not exclude responses that sat outside of this definition as it was felt that it would provide broader context in terms of:

- The extent and type of DSTs used.
- Limitation in the use of ecological response models.

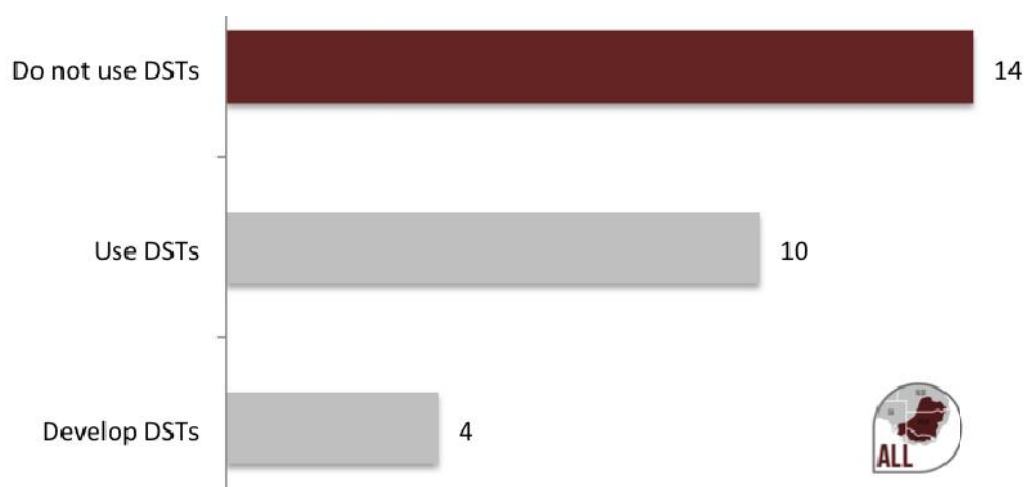
As the application of the definition has varied the findings below identify whether it is in the context of the review definition or a broader definition of DSTs.

Are DSTs used in the decision making process and what DSTs are used?

Overall the respondents to both the on-line survey and interviews claimed that the use of DSTs play a minimal role in decision making for environmental water. Figure 15 presents the results of all respondents to the question in the on-line survey about whether DSTs are used or not. This response is given in the broader definition of DSTs.

Many of the interviewers indicated that model outputs might provide one source of information that was then analysed in a value judgement approach to decision making.

Figure 15: On-line survey response as to whether DSTs are used in environmental watering decision making



As alluded to above, that respondents had varying definitions of what a DST was and often used the term in the broadest definition of a tool that contributed to the decision making process. Therefore, the range of DSTs identified as being used included a mix of types of models, with few using ecological response models:

- Hydrological models
- Hydraulic models
- Empirical relationships between river discharge, hydraulics and variables of interest
- IQQM
- eWater Source
- Hydrodynamic model and BIGMOD
- MDFRC blackwater risk assessment tool
- MDFRC blackwater dilution tool
- Models, mapping systems, planning systems
- Development of Bayesian Network Model for Regional NRM planning including Water Management
- Prioritisation tool for Wimmera Glenelg
- Environmental watering decision frameworks and databases
- Quantitative criteria to prioritise watering proposals
- Multi Criteria Analysis tool for use in asset identification for resource operations plan monitoring.
- Documented process/procedure for decision-making, including criteria for prioritisation of watering actions

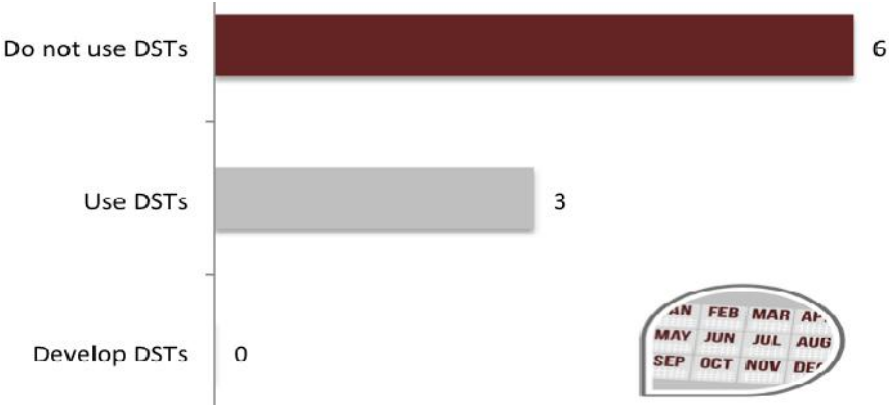
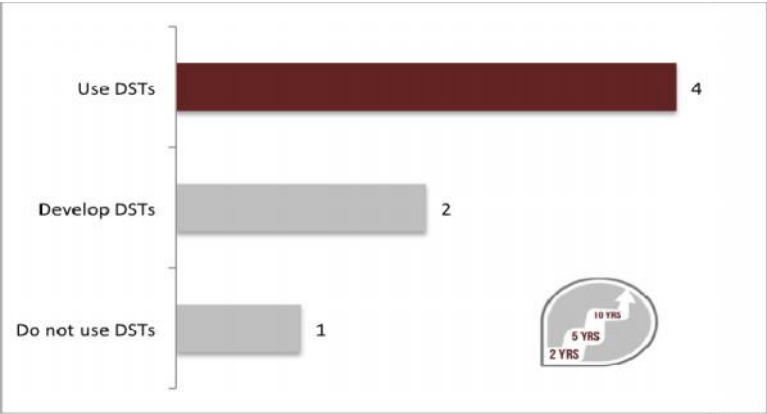
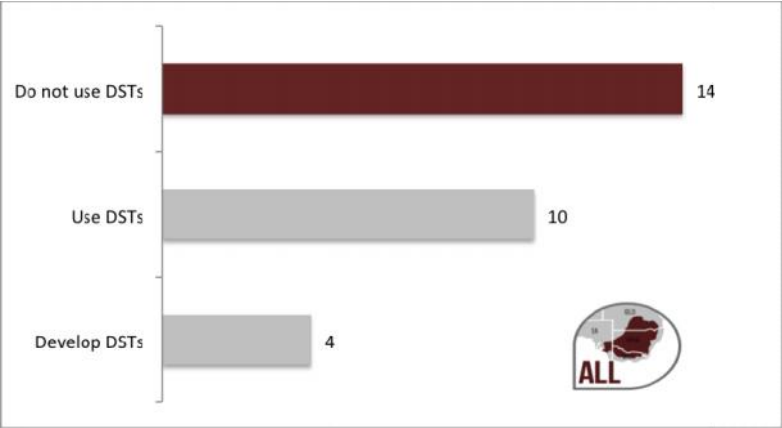
There was a common theme from both the interviews and on-line survey that emerged regarding the use of DSTs. This common theme was that the decision making process was too complicated to have a reliable ecological flow response DST to inform the environmental watering decisions. It was common that the output from different types of models, such as those listed above, formed one input

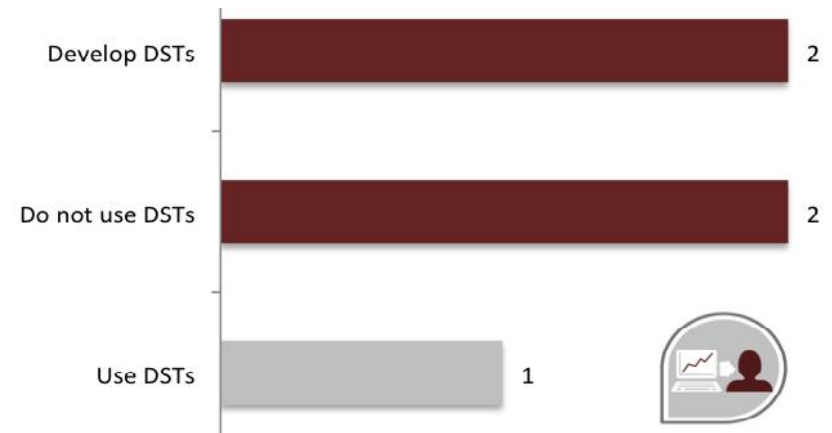
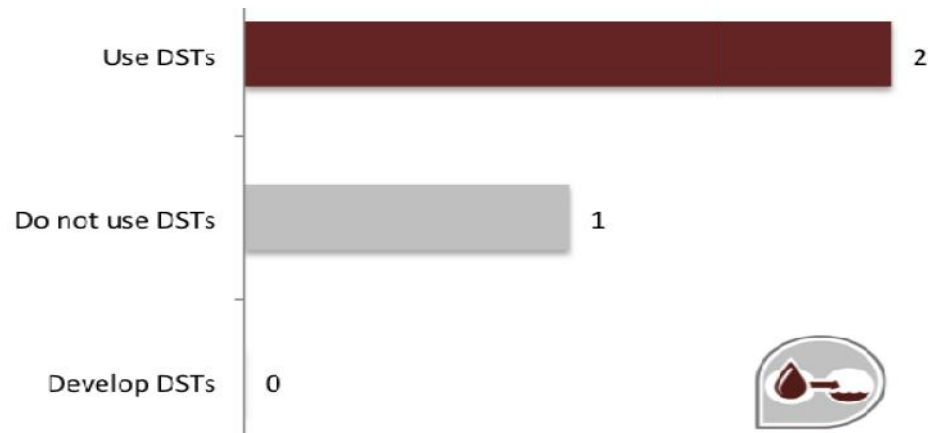
to the decision making process. Examples of some of the feedback from both the survey and interviews regarding the use or limited use of DSTs included:

- There isn't a formal DST used in the process.
- The adaptive prescriptions in some of our statutory water plans could be called a DST.
- An understanding of how some of the DSTs work (i.e., through involvement with having seen them develop) has improved the knowledge base that is used in decision making, rather than having actually used the formal tool once they were completed.
- Limited usage is based on lack of time, lack of quantitative data for input, and/or lack of experience with operating the model.
- Modellers are engaged to model potential outcomes, but we join the dots regarding what the decision is.
- Some systems are too complicated and have too many variables/too many unknowns to develop a reliable ecological response DST.
- If we are going into a (ecological monitoring) data-limited future, need to question the reliability of such tools.
- They form one of a number of outputs.
- Will still make informed judgements about what can or cannot be achieved.
- Not used consistently.

When the results were reviewed based on the categorisation of roles used for the Review (i.e. strategy, long term planning, annual planning and events/delivery), it was difficult to distinguish whether DSTs are more likely to be used across the different planning roles. The results of the on-line survey were filtered by the main role that respondents identified with and the low numbers within each category make it difficult to draw any conclusions. These responses also need to be viewed in the broad context of how participants defined DSTs. Having said that, Figure 16 implies that of the current DSTs in use, long term planners and those involved in water delivery are more likely to use DSTs.

Figure 16: On line survey responses to whether DSTs are used or not (filtered by primary role)





Key:



All responses



Long term planning



Environmental water delivery



Strategy and policy



Annual Planning



Provision of information / development of DSTs

What would influence the use of DSTs?

The responses to what would influence the use of DSTs again resulted in some common themes emerging associated with the need for a DST. Some examples of common themes include:

- A DST had to answer their question and address their specific needs or be applicable to their landscape / catchment. This theme was linked to other feedback on the need for the DST development or requirements to be driven internally.
- A DST had to be accurate and for there to be confidence in the outputs.
- A DST needed to be easy to use, the "mechanics" understandable and be transparent, therefore not a "black box".

Other feedback from the interviews included:

- It would be challenging to make a DST accurate at a local scale but also applicable to many areas.
 - The DST must add value to their decision making process.
 - The DST needs to provide timely output and not be so information heavy or "grunty".
 - The users could run the DST and there wasn't reliance on external providers to run it for them.
- There were also responses that were comfortable with external organisations running a DST. This appeared to be a result of the external or partner organisations being responsive to needs and involved in the watering process (for example MDBA running models for TLM sites).

The feedback provide a conflict for the MDB EWKR project as potential users have highlighted that a DST would be useful if it is site/issue specific and is precise for their needs as well as adding value to decision making but, one of the MDB EWKR project objectives is to provide knowledge that is useful across the Basin.

The responses to the question about what would influence the use of DSTs have been broadly categorised against issues of functionality, design and user interface in Table 2. The responses are from both the on-line survey and interviews and have been given in the context of ecological flow response models. Interestingly the responses across jurisdictions do not diverge regarding the factors that would influence the use of a DST.

Table 2: Summary of responses to factors that would influence the use of a DST

| Category | Response |
|---------------|--|
| Functionality | Has to address our questions Must suit the local situation Must add value to our decision making process Must involve the end user in the scoping stage for "buy-in" |
| Design | The DST must be developed in a collaborative process How would a DST be developed that is local enough but also applicable to many areas? Must be logical, reliable and accurate |

| Category | Response |
|----------------|---|
| | <p>There is enough data for it to be useful</p> <p>Needs to be able to deal with constraints and risks confronted in decision making</p> <p>Can inform long term planning by analysing long term data sets and delivery options</p> <p>Must not be resource inefficient</p> <p>Needs to have an error band tolerance</p> <p>The outputs from the model can't be too generic or it will not be used</p> <p>Must be built around existing expertise and platforms</p> <p>There are existing models that could be further enhanced</p> |
| User interface | <p>The DST is not difficult to use or be trained in</p> <p>Must be confident in the output</p> <p>An external provider could run the DST without the need for payment for several years as part of model development. This would increase confidence in use of the model.</p> <p>Retraction of budgets would preclude external providers running the model.</p> <p>Can not be a "black box" - users have to be able to communicate the model logic</p> <p>For timeliness reasons the user must have direct access to the DST</p> <p>There are varied levels of technical expertise for users to runs DSTs</p> |

An evaluation of the models developed for the NSW Rivers Environment Restoration Program (RERP⁵) reported findings that were consistent with the feedback received during this Review regarding the use of DSTs. One of the projects under RERP was the development of decision support systems (DSSs) so that the use of environmental water could be improved through application of the tools to better understand ecological response scenarios.

The RERP DSS evaluation project reported that some barriers to the uptake and use of the modelling included (INCA Consulting, 2011):

- The complexity of some of the tools and the energy required to become familiar with them
- The limited accuracy of first generation models, especially when compared with existing tools
- A lack of clarity around the process and funding arrangements for calibrating the models
- Long processing times and limited human resources to perform the required analyses

⁵ RERP was a NSW and Australian Government funded program to mitigate the decline of significant wetlands in the NSW Murray-Darling Basin. It allowed for the purchase of environmental water, improved understanding of ecosystem responses to gain the best use of environmental water and infrastructure to improve delivery of environmental water.

- A lack of engagement of managers during their development which resulted in persevering cynicism about their utility

During this Review, members of different NSW EWAGs provided feedback that there was not the uptake in the use of these DSSs as they were highly technical, required too much data and time to run. It should also be noted that feedback from some of the interviews in NSW indicated there was more potential to use these DSSs for long term planning rather than annual planning.

Concluding comments

One of the purposes of the Review was to obtain information on the use of DSTs within the decision making process and what would influence the use of DSTs.

From the information analysed the key findings could be summarised as:

- Generally DSTs are not a common tool in the decision making framework.
- The DSTs that are applied come in a variety of forms from procedures, to spreadsheets, to hydrographic models to some flow response models. They are also acknowledged as one input to the decision making process.
- DSTs in the context of quantitative ecological response models are generally not used.
- It was thought that the issues are too complex to develop models that can be applied in one location let alone transferred to others.

It was expressed that the MDB EWKR project would do better to focus on addressing the research questions rather than development of DSTs given the budget and timeframes. Also the research questions need to be addressed first as this would inform any tool development. Finally a number of responses indicated that the issues of transparency and application could be enhanced through the development of other tools such as decision support trees.

Section 5: Environmental Watering Managers' recommendations for MDB EWKR

The purpose of this section is to provide the findings on how the knowledge base and decision support tools could be improved as well as any other comments that were forthcoming regarding the MDB EWKR project.

How could the knowledge base for environmental watering be improved?

One of the activities for the Review was to seek input from the participants on how they thought the MDB EWKR project could contribute to the environmental watering knowledge base. The responses were diverse across both the on-line survey and interviews and they have been clustered under the following themes:

- Collaboration
- Knowledge delivery / transfer
- How it needs to assist the resource manager
- Specific information needs

Table 3 presents the responses aligned under each of the above themes.

Table 3: Responses to how EWKR could improve the environmental watering knowledge base

| Category | Response |
|---------------------------------|--|
| Collaboration | <ul style="list-style-type: none">• Science is more targeted to needs if it is scoped in partnership• Ongoing engagement• Communication and fostering local ownership• Management of expectations• How will the knowledge base be funded into the future• Need to address and manage potential for duplication of effort |
| Knowledge delivery and transfer | <ul style="list-style-type: none">• How best to retain and access the information• The information and knowledge should be made as widely accessible as possible. The communities in the Murray-Darling Basin generally do not understand why environmental flows are needed and what they achieve. By making the information open and understandable to all (as much as possible), there could be much better communication within the communities and much greater public acceptance of environmental flows.• Create a common understanding or language between Water Managers and Natural Resource Managers on the potential impact of interventions• Accessible, easy to understand information in a variety of formats and useful for a range of audiences• Need to improve two-way knowledge transfer between scientists and managers• Make an easy to access matrix containing the autecology of flora, fauna and water chemistry upon which DSTs are based, and then offer direct |

| Category | Response |
|--------------------------------|--|
| | <p>assistance in running the models for particular planning scenarios requested by EWA Managers</p> <ul style="list-style-type: none"> • Web based storage and search tools for different levels of documentation for public, policy, operations and technical needs • Easy and plain English access to most up to date findings • Links across agencies for best available information readily accessible • Normal summary report to allow people to identify information of value to them, backed by a thorough technical report to refer to to get detailed information • Environmental water managers prefer simple products/outputs that can be incorporated as one input into complex decision making process. • There can be a limit on how much information can be absorbed by a committee, so how information is provided and awareness that there are various audiences is important |
| Assisting the resource manager | <ul style="list-style-type: none"> • Research to compliment existing monitoring programs • Need to have complimentary programs and add value to existing state based processes • Specific to water manager's needs • Will lose support for environmental water if social and economic benefits are not also considered and communicated • To clearly demonstrate the relevance to management of environmental allocations at both Basin and valley scale. • Relevant and practical for on-ground management rather than academic • Want more than research papers out of the process as it needs to be applicable • Need to be conscious that a lot of information will be generated and how best this can be fed into the decision making processes • Clearly expressed relationships between the things that can be controlled (flow rate, timing) and expected ecological outcomes • The strength for researchers is research that fills information gaps that routine monitoring cannot provide and which supports current decision making procedures. • Assist in demonstrating transparency in decision making outwards to the broader community and industry as well as across jurisdictions. • Need to contribute to the basic research needs as manager's are mining existing (and old) data. |
| Specific Information Needs | <ul style="list-style-type: none"> • Focus on longer term and larger scale • The extent to which it could establish some focus around how best to consider environmental watering in highly variably flowing unregulated systems. • The need to make trade offs when prioritising watering and therefore the need for more help with this process - particularly at the system scale.e.g. It would be good to have a better understanding of the impacts of delaying or undertaking smaller waterings or undertaking waterings earlier or later rather than the 'ideal' watering regime recommended by scientists. • The need to have information and transparency so that the justification for trade offs can be made. |

Would DSTs improve some of the decision making?

While DSTs are not consistently used and there was genuine concern raised about the ability to develop suitable DSTs that would be broadly applicable and deal with complex issues, there was a majority⁶ feedback that some decisions could be improved through DSTs. The common decision that could be enhanced were based on:

- DSTs could provide greater transparency or justification in the decision making process.
- DSTs could enhance scenario testing and trade-offs associated with where to water or not.

Some of the other comments included responses that were both in and out of scope of the MDB EWKR project. Examples include:

- Determining effectiveness of environmental watering (provision of knowledge and or tools that would aid this is considered in scope).
- Determination of risks particularly in association with third party impacts on land and infrastructure due to flooding (out of scope for MDB EWKR)
- Hydrodynamic models to better manage events (out of scope for MDB EWKR).

Regardless, there was still an undertone in the responses that it needed to be useful in their application and concerns were expressed about how a DST could be applied in such complex systems and decision making processes.

The role of DSTs in MDB EWKR

The feedback to a question about whether MDB EWKR should invest in flow response DSTs was mostly met with negative responses. Some of the reasons for this response include:

- Already have a lot of models and other DST development processes occurring within this field (for example Melbourne University ARC grant) and did not want to start again with models.
- Need to do the research before there is focus on DST development
- General agreement that the work will be quite complex to develop models that are easily transferable to other sites or scales, particularly as there are quite site specific issues
- DSTs aren't generally being used and the reasons for this need to be addressed first
- Maybe more beneficial to develop other forms of DSTs (ie not quantitative models) such as decision trees that can then be adapted using local knowledge to suit local issues. This would still provide transparency in decision making.
- Concern about the cost to produce a suitable DST and the timeframe for its production.
- It was though that it may be more cost-effective to co-invest in improving existing models rather than starting again

⁶ 72% of responses (18 out of 25) stated yes decision making could be improved by DSTs.

Are there other comments regarding the MDB EWKR project?

The responses to the on-line survey and interviews were also examined for other responses that may have been provided in relation to MDB EWKR that were outside the scope of the line of questioning. These have been provided for the project team as they may provide additional insight to project design, delivery and expectation management.

The feedback has been summarised as:

- Governance:
 - the governance structures and roles for all the partners (including jurisdictions) need to be clear
 - there may be constraints related to resources or timing of input to the implementation from some partners
 - not all partners may have the resources to contribute in the same way
- Broader social and economic benefits of environmental watering:
 - over time the social benefits will need to be considered and communicated, otherwise there is the likelihood that support for environmental water will be lost
 - is there a role for the use or inclusion of Aboriginal knowledge
- Co-ordination and relationships:
 - groups that haven't been well co-ordinated in the past have the benefit of being brought together
 - the building of long term relationships will be important and this is an on-going process
 - there is significant intellectual resources across various organisations (including jurisdictions) and this needs to be brought together in a collaborative manner
- It will be beneficial to be able to demonstrate the relationship between plans and decisions and how they have been informed by science.
- The whole environmental watering process should be quite open in what can and can not be done in practical terms regarding environmental watering, recognising that there are societal and political constraints to the decisions that are made.

Concluding comments

The purpose of the Review was to obtain from participants information regarding how they currently make environmental watering decisions, the information used to make the decisions and the use of DSTs within that process. The analysis of this information could then be used to assist with the further scoping of the research as well as inform strategies for ongoing engagement and tools to aid decision making.

From the feedback on how the MDB EWKR project could improve the decision making process, two critical factors stand out:

- The need for collaboration from the start and on-going two-way engagement was important and this was particularly expressed by the State jurisdictions.
- Knowledge transfer in terms of knowing what information exists and how to access it and apply the knowledge to the decision making process.

In addition it was thought that the MDB EWKR project should:

- Assist managers to demonstrate the benefits of environmental watering and help quantify outcomes.
- Contribute to a process of transparency in decision making.
- Compliment existing programs of jurisdictions and other researchers.
- Focus on addressing the research gaps rather than investing in computer based models.

The emphasis on issues associated with knowledge transfer and how it is presented to various audiences clearly identified the need for MDB EWKR to be aware of the various audiences and how they will use the information but there is also a role for the jurisdictions in defining these needs and contributing to knowledge transfer process more broadly within their jurisdictions and with their local partners and community.

Section 6: Implications for MDB EWKR

The purpose of this section is to discuss the implications for the MDB EWKR project, based on the key findings presented in Sections 3, 4 and 5.

Adoption of research

The responses to the Review highlighted the desire for not just research questions to be addressed but for the research to be undertaken in a way that enables knowledge transfer from the MDB EWKR project to application across the jurisdictions. This is consistent with one of the desired outcomes of the MDB EWKR project to influence the adoption of research findings.

Figure 17 is the current version of an outcomes hierarchy that has been developed for the MDB EWKR evaluation strategy. It has been included to illustrate that the MDB EWKR project aims to influence the adoption of research findings through a variety of strategies.

It is not practical for the MDB EWKR project to respond to all the desires expressed by the participants as some of these contradict the contractual requirements for the project by being out of scope for the research project.

The critical messages from the respondents that are consistent with MDB EWKR project are:

- The need to be collaborative and maintain ongoing engagement.
- To add value by assisting managers to demonstrate the benefits of environmental watering and help quantify outcomes through the transfer of research findings that are practical in nature.
- Contribute to a process of transparency in decision making.
- Compliment rather than duplicate existing programs.

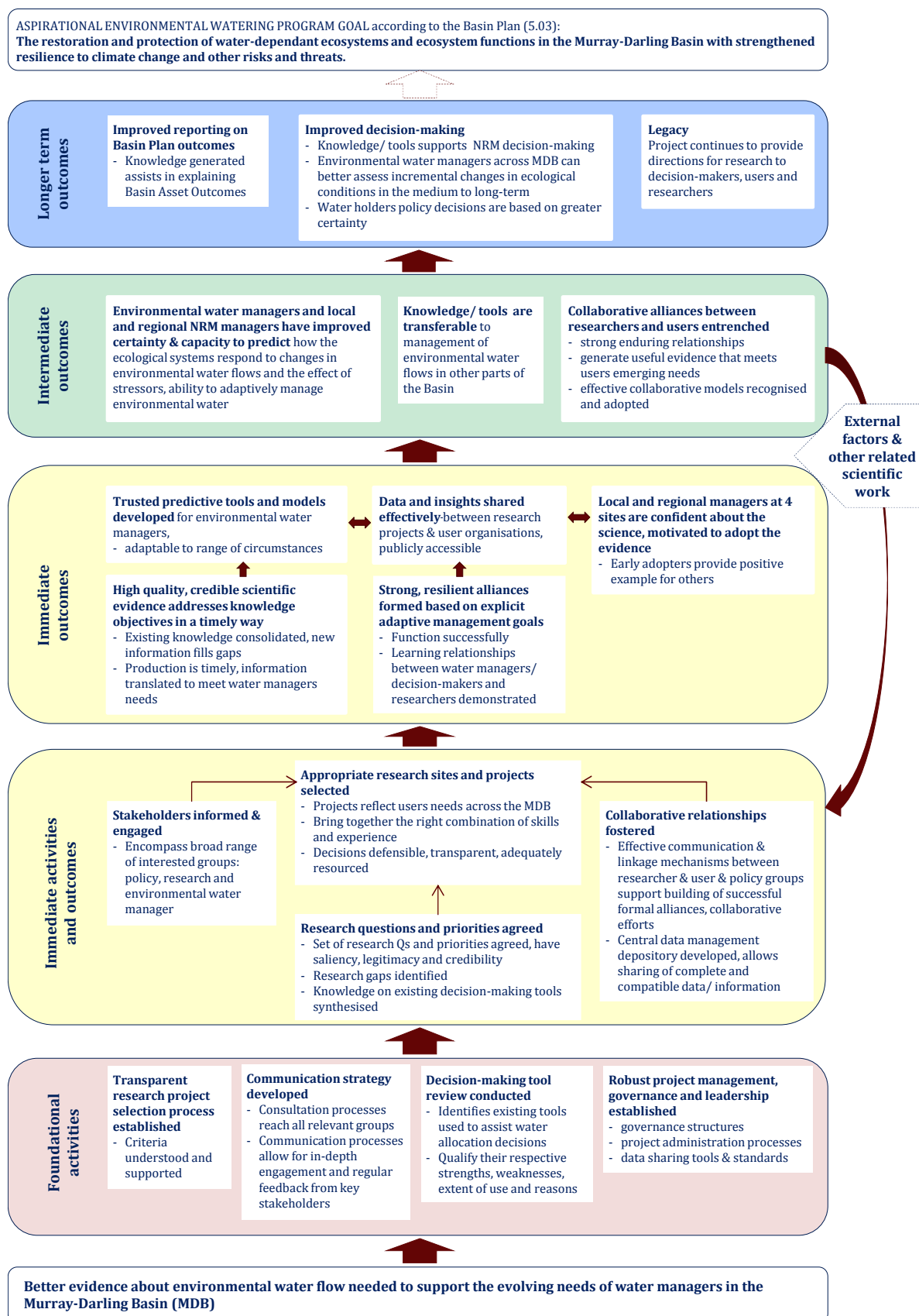
In addition the research undertaken and any tools developed, whilst being relevant at a Basin scale needs to be useable by water managers within their own scale of operations otherwise they are not likely to be applied.

One of the other confounding aspects that the MDB EWKR team will need to consider during implementation is that the continuing process of Basin Plan implementation is shifting the water planners' focus towards long term environmental watering plans and that this may result in further demands of the project.

The ability to influence the adoption of research will require the MDB EWKR project to develop effective relationships with end-users, and collaboratively develop and implement appropriate engagement strategies. The project can not rely on reports, peer reviewed papers, or development of quantitative computer based model DSTs alone to communicate the project results. Some factors that should assist the project deliberation on the engagement strategy have been discussed below under four themes that are closely related to one another and therefore should not be considered in isolation:

- Engagement and collaboration
- Knowledge transfer
- Aligning research to changing scales
- Use of DSTs

Figure 17: Draft outcomes hierarchy model for the MDB EWKR project (ARTD Consultants, 2014)



Engagement and collaboration

When conducting interviews for this Review and when attending a workshop with the jurisdictional working group in November 2014, the term engagement was used more than communication. The MDB EWKR project will not only need to change the terminology to reflect engagement but also implement this in practice.

A potential definition for engagement for the MDB EWKR project has been adapted from a community engagement definition (Gottlieb, 2006):

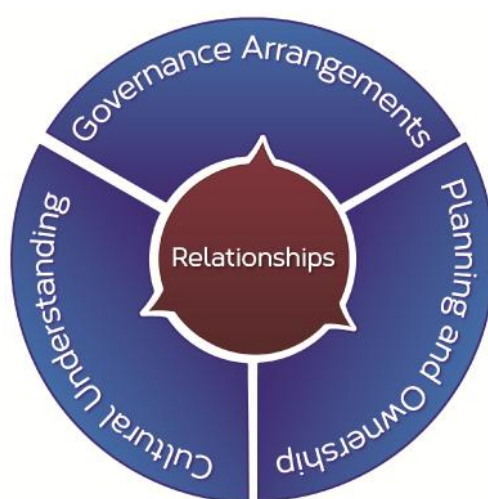
Engagement can be defined as the process of building relationships with researchers and water resource organisations that will work side-by-side with one another as an ongoing partner.

The critical terms here are:

- Building relationships.
- On-going.

A previous evaluation project undertaken by Evaluation and Sustainability Services looked at the effectiveness of an organisation's engagement with their Aboriginal community, as there was not strong uptake in NRM project opportunities. The first part of the evaluation required a review of the literature to determine what good and appropriate engagement was. This led to the development of a model based on common themes that emerged from a broad range of literature. While the model presented in Figure 18 includes cultural awareness it could just as easily be applied to the MDB EWKR project as understanding "cultural" differences between researchers and officers within a resource organisation as described further under the knowledge transfer discussion below.

Figure 18: Conceptual model depicting the relationship between the four emergent themes for successful engagement (Watts, 2013)



The relationship theme appears in the centre because it ties the other themes together. Without a sound foundation of a two-way relationship and trust, the other elements will ultimately falter.

The four themes could be considered as guiding principles to inform strategies or protocols regarding successful engagement where:

- Relationships - between parties should be long term and provide for a strong two-way relationship that results in respect and trust.
- Planning and Ownership (of the projects or activities) – recognises that partners need to be involved in the planning process from the start and throughout as well, everyone owns the benefits and the issues that may emerge.
- Governance Arrangements - ensures that clearly worded arrangements are developed and reviewed by all relevant stakeholders.
- Recognising diversity in working cultures (replaces cultural understanding) - recognise the differing working environments and understand how to best work across the two different cultures. The different working cultures between researchers and water managers are discussed under knowledge transfer below.

Another strategy for collaboration is to utilise the opportunities for co-generation of knowledge, particularly with the delivery model proposed by MDB EWKR. Pohl (2008) discusses transdisciplinary research as a way of bridging any divides between science and resource management organisations. Transdisciplinary research refers to the process of collaborative research with the various stakeholders resulting in the process of co-production of knowledge. The "cultural" differences described below still need to be recognised as everyone involved will still organise knowledge and actions in accordance with their time scales and the way they can best use the knowledge and information.

Knowledge transfer

Overall the respondents were comfortable with the local planning process as there were strong local networks and the annual planning processes have been stable for a period of time. The main issue was the recognition that decisions are being made without the strength of scientific evidence. There were numerous reasons provided for this with the most common being:

- Budget constraints impacting on basic research as well as agency monitoring programs
- Time delay between the research question being posed and the timeframes for planning decisions to be made within.

This has resulted in a strong reliance on expert knowledge at either a corporate or local scale or sourced from scientific experts. The sourcing of this expertise is often based on a reliance on known existing networks and raises the risk of what may occur over time as this knowledge is not retained or accessible or kept up to date. This issue was also combined with the sense that there is a lot of expertise and information that is not being sourced because people don't know where to start. Therefore the need for relevant information that is provided in a useable format is consistent with MDB EWKR's desired for the research findings to be adopted.

Various strategies will need to be employed to influence knowledge transfer and these will need to be developed by understanding who the primary and secondary users of the research knowledge is targeted at and how they access and use knowledge. This recognises that not all water managers are a single typology.

Recognition of different working cultures

A review of some literature on the adoption of research across environment sectors have identified that one of the barriers is the need to recognise the differences between researchers and their target audience which may include policy makers, planners and resource managers (Bielak, et al. 2008; Briggs 2006; Cook, et al. 2013; Roux, et al. 2006).

Briggs (2006) went on to identify impediments to research integration:

- Researchers and their target audiences work to different decision making timeframes.
- The origins of problem identification can be quite different where it maybe externally driven for say policy or planners but normally the goals of a researcher may be internally driven and influenced by how crowded the research space is, funding and their appeal towards the topic.
- The feedback for work undertaken for scientists is often slow as it is often a result of peer reviewed publication, whereas, within a resource management organisation the feedback may be more rapid as the tasks finish quicker.
- Often career goals can be quite different as reflected by the different career structure of officers within a resource organisation compared to research organisation.
- The implementation of new policy or plans will have a short timeframe and will often require compromise, minimal controversy and a pragmatic approach to implementation. Whereas for researchers new scientific ideas will involve a lot of detail, can take time to be adopted within the scientific community and are often openly debated.

Overcoming the potential for the "push-pull" model to emerge

A number of other researchers in the field of research adaption discussed the "push-pull model" (Bielak, Campbell, Pope, Schaefer, & Shaxson, 2008; Roux, Rogers, Biggs, Ashton, & Sergeant, 2006). This is where scientific information that is created is "pushed" to a management domain without the recognition that there are various audiences who receive scientific information in different ways. Similarly officers within resource organisations will "pull" the knowledge that they need from the scientific domain. These push and pull strategies may not be complimentary and overcoming the limitations that may arise can involve:

- Improving push strategies through involving the end users in the "knowledge creation" process, ensuring credibility and confidence in the science, recognising different audiences and packaging the information accordingly (ie one size does not fit all).
- Improving the pull strategies through better articulation of the information needs and being involved in the definition phase, maintaining involvement in the research program and improving how information is sought.

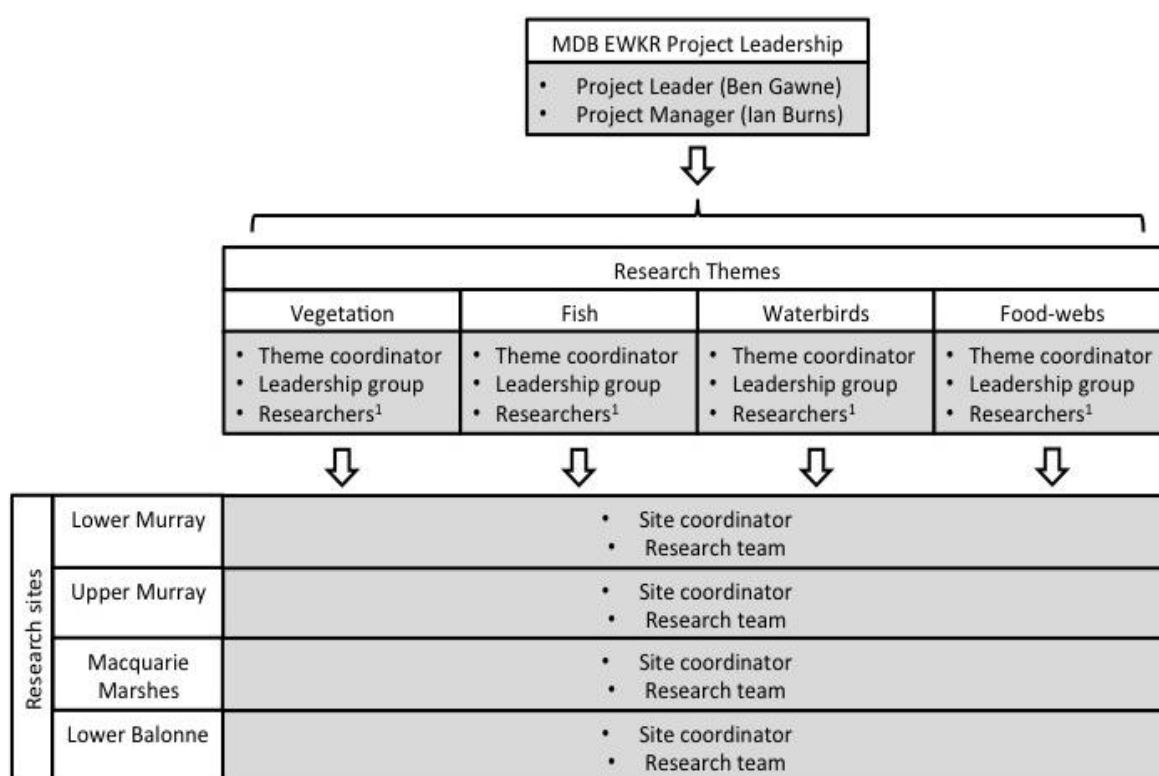
Reliance on third parties to engage

The structure of the research under MDB EWKR will involve research being undertaken at different sites and with different researchers who may or may not be part of MDFRC. Similarly, the MDB EWKR project has identified and to date relied upon key stakeholders within jurisdictions who are their main contacts to discuss research needs and were the key contacts provided to us as part of this Review. While MDFRC has the responsibility for the delivery of the MDB EWKR project they cannot be expected to be consulting deeply into each jurisdiction or undertaking all of the research.

Therefore a third party model of engagement is emerging and is not uncommon in many forms of program delivery. How the MDB EWKR project structures this in a beneficial way could be significant for knowledge transfer over the timeframe of the project as well as to the benefit of water managers beyond the selected cases.

Figure 19 illustrates the proposed structure of the project teams as of the time of documenting the Review. It should also be noted that beyond the structure for the research teams below there is a jurisdictional steering committee and technical working group, jurisdictional representatives that may be associated with each of the sites and then water managers who need to know these findings but are not part of the "project hub".

Figure 19: Relationship between MDB EWKR management team, research sites and research themes (source Ian Burns, 2015)



There are risks in this model if it is not established and managed appropriately from the start. For example MDFRC need to ensure their jurisdictional key contacts are speaking on behalf of their

organisations and not promoting personalised knowledge gaps or that the research case studies are remaining engaged with the whole MDB EWKR project.

Two techniques that have been documented as a means of assisting in the engagement-research interface are boundary organisations or knowledge brokering.

Sometimes "boundary organisations" have been used to bridge a knowledge-action boundary (Cook, Mascia, Schwartz, Possingham, & Fuller, 2013). Boundary organisations are described as operating in both the scientific and management spheres, facilitating the communication and engagement, but retaining distinct lines of accountability to each group. An example of a boundary organisation includes Healthy Reefs for Healthy Catchments in the Caribbean who facilitates partnerships between research organisations, government and non-government organisations. The South East Queensland Healthy Waterways is another example of a boundary organisation. Alternatively there are many examples of the facilitation role being placed within a key organisation in the form of a "knowledge broker". The knowledge broker still provides that intermediary role in the translation and packaging of the knowledge to suit the different audiences (Bielak, Campbell, Pope, Schaefer, & Shaxson, 2008) but they are based within a central organisation rather than using a boundary organisation to undertake such work. Examples of two Australian organisations responsible for environmental research programs that incorporated knowledge brokering within their organisations are the former Cooperative Research Centre for Aquatic Ecology and the former Land and Water Australia (Bielak, Campbell, Pope, Schaefer, & Shaxson, 2008).

The brief discussion under engagement and knowledge transfer highlights that there is a body of existing research and experience associated with achieving knowledge transfer and influencing adoption of research. It is evident that to achieve true collaboration and engagement, as desired by the Review participants, that they need to recognise they also have a significant role in MDB EWKR. That is, it shouldn't be seen as a client (water jurisdiction) and service provider (researchers) arrangement as this may further encourage issues associated with "cultural diversity" that was previously discussed. At the same time the MDFRC needs to find the balance with how much jurisdictions can contribute. Ultimately all stakeholders need to collaboratively define their roles within the knowledge transfer process.

Many organisations develop a "corporate" style communication strategy, but as with the experience of Land and Water Australia, it may not do justice to the knowledge transfer and adaption that the MDB EWKR project is aiming to achieve. Furthermore the engagement strategy is only as good as the process of implementation.

Therefore as part of the collaboration it would be worthwhile for the engagement strategy to be developed with research partners and jurisdictional representatives and for these partners to remain engaged throughout its implementation, including discussion associated with the effectiveness of the strategy and its adaption.

Aligning research to changing scales

The Review surfaced numerous comments regarding issues of scale - both temporal and spatial.

While there was comfort in the annual planning process the shift to long term planning was regularly raised by participants. Long term planning was seen in a positive light as it was seen as providing a strategic approach to annual planning and should assist in the delivery of environmental watering outcomes. Having said that, there was some uncertainty about what the long term planning process would specifically require from the State jurisdictions. In addition, long term planning outcomes are influenced by cumulative effects of environmental watering events (or non events). The issue of cumulative effects and the impact of trade-offs were both raised as issues that planners need to gain a greater understanding in.

This may result in the MDB EWKR project focussing its research on understanding longer term responses to environmental watering rather than short term responses.

Spatial scale was another issue that arose particularly in terms of:

- The ability to scale up research findings from research sites to the Basin scale.
- Knowledge gaps related to the positive or negative impacts regarding downstream or inter-valley watering or non watering events.

The spatial scale issues were sometimes referred to as the need to have a better system understanding.

Consequently the MDB EWKR project will need to give consideration to spatial scaling issues and incorporate the communication of approach and then on-going findings as part of managing expectation.

The use of DSTs

The sources of information described by participants are "synthesised" or analysed in a value judgement process where the approach to this step is variable from jurisdiction to jurisdiction. Within this decision making process, ecological flow response models are rarely used and while other forms of DSTs are used, they are all seen as one input to the decision making process due to the complex nature of the decisions being made.

There was a negative reaction to the MDB EWKR project developing quantitative flow response models. The negative reactions expressed concerns based on:

- The project needs to firstly focus on the research as this understanding is required before models are developed
- The budget and timeframe is insufficient to do both the research and computer model development

- There was doubt that a model(s) could be developed that had a Basin focus but be applicable to specific sites. This raised concerns that any flow response model developed may be too generic to add value to any application.
- There was doubt that model(s) could be developed that could handle the complexity of the decision making
- There is history of investment in models that have then not been used

The findings demonstrated that DSTs come in many forms and not just quantitative models, therefore the form of any DST developed as a result of the MDB EWKR project should be considered in collaboration with the intended users. Equally, the factors that influence the uptake of a DST are universal regardless of the format of a DST.

The MDB EWKR project intends to develop a DST strategy that will need to consider form of the DST and factors of design and development that will influence the adoption of the DST.

Section 7: Appendices

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Appendix 2: Approach to Undertaking the Review

This appendix provides more information on how the Review was undertaken and includes extracts from both the Engagement Strategy and the Interview Protocol. The Interview Protocol is a document that sits under the Engagement Strategy and provides more specific instructions to all interviewers.

Inception Meeting

An inception meeting was held with MDFRC (Dr Ben Gawne and Ian Burns) at the commencement of the project. The aim of the meeting was to primarily:

- seek further background on the MDB EWKR project
- discuss stakeholders and key contacts for the review
- define the review's key evaluation questions and expectations related to the questions
- identify other background information relevant to the review

This discussion and further reading of background reading then enabled the development of an Engagement Strategy that outlined the approach to interviewing participants and a more detailed work plan for the Review.

Selection of Participants

MDFRC provided a list of key contacts from across the Commonwealth and State jurisdictions who have responsibility for environmental watering within the MDB. Prior to contacting these people via telephone, the MDFRC had had an opportunity to mention the Review project within their workshops. The purpose of contacting each of the key contacts was to discuss the review in more detail and then to ask them to identify people within their organisation who we could contact to invite them to participate within the Review.

Sourcing Information

Information to address each of the key evaluation questions (refer to Table 1) was primarily sourced from on-line survey responses and telephone interviews. This information was then supplemented by background information that may have been sourced from jurisdictional web pages or on-line peer reviewed literature sources.

On-line Survey

An invitation that included background information to MDB EWKR, the Review and a URL link for the survey was prepared and sent from MDFRC to all participants that had been nominated by key contacts. The on-line survey was conducted using SurveyMonkey™. The survey was open for the three weeks, closing on the 14 October 2014 and a reminder sent to all invitees one week before closure.

A total of twenty eight responses were received from fifty nine invitations, and not all participants answered all questions. The survey questions as seen on-line are presented in Appendix 5.

Telephone Interviews

The main focus of the information gathering was through the telephone interviews as more depth of response can be sourced through the interviews. A sub set of all participants was randomly selected for the interviews to ensure there was a mix of jurisdictions and people that had been categorised as either policy, planners, operational.

A total of twenty seven interviews were conducted out of planned thirty three.

The interviews were never conducted as "cold calls". That is, an initial call was made to introduce the interviewer, describe the project and request if they would like to participate. If they agreed then a suitable date and time was arranged and confirmed via email with the questions attached. The interview questions varied slightly between those that were identified as being able to add greater detail to the discussion regarding process and other participants. For those that were identified as adding greater input / insight to the process chart an existing chart was often used to facilitate the discussion or the chart was developed post interview. These are the process charts that appear in the body of the document.

It should be noted that one additional interview was undertaken with a person who had developed DSTs for environmental watering and had an evaluation undertaken of the DST uptake.

Interviews were not recorded and therefore the interviewee took notes regarding responses to questions.

The interview questions for the various categories of participants appear in Appendix 6.

The list of potential participants in the Review is presented in Appendix 7.

Collation and Analysis

The on-line survey information was exported to excel for analysis either in total or filtered on the basis of the primary role identified by the participant.

The interview notes were collated on the basis of codes that were defined on the basis of the key evaluation questions. The purpose of coding is to organise information into a more structured format that will aid analysis.

Analysis then took the form of addressing each of the key evaluation questions based on the primarily qualitative information sourced from the survey and interviews. Appendix 3 and 4 provide a summary of the findings from the on-line survey and interviews.

Appendix 3: Graphical summary from on-line survey

The following key applies to the graphs that follow in this appendix:












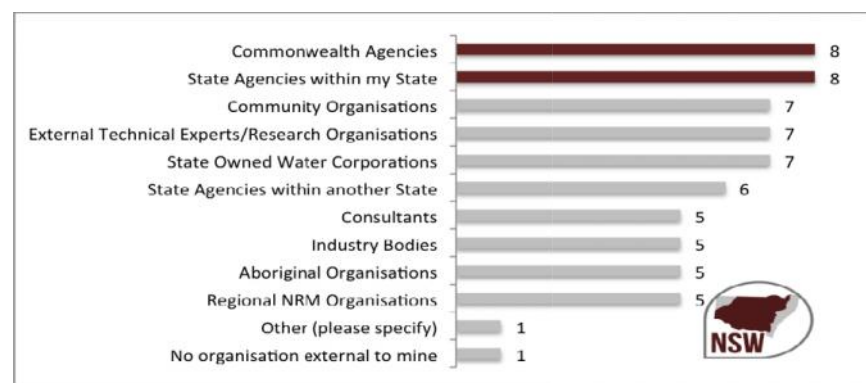
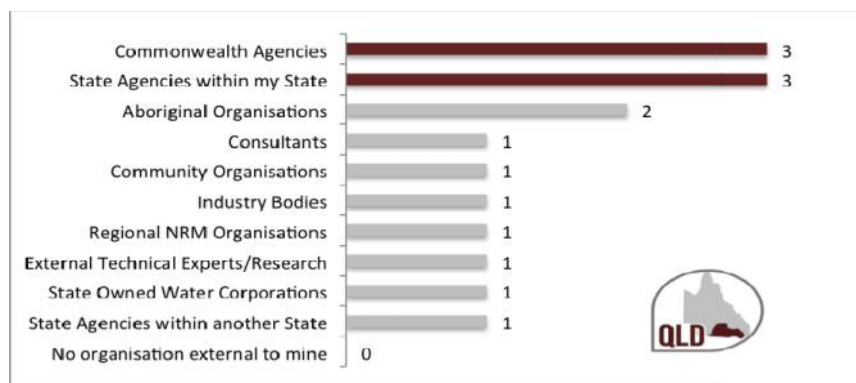
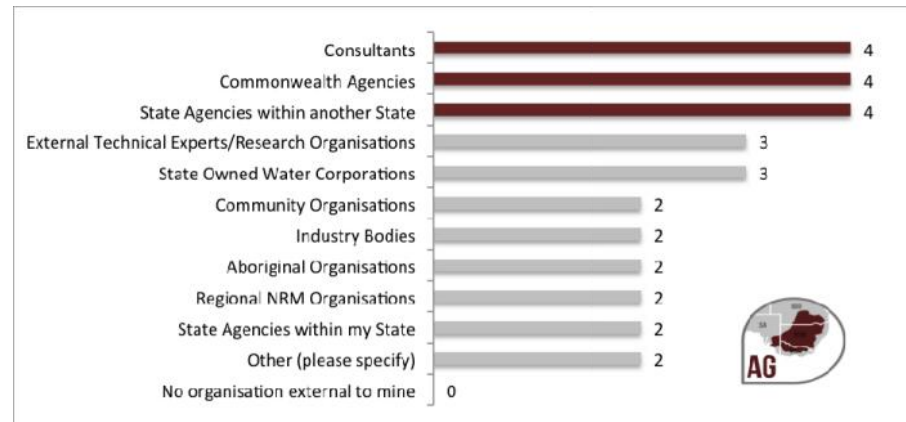
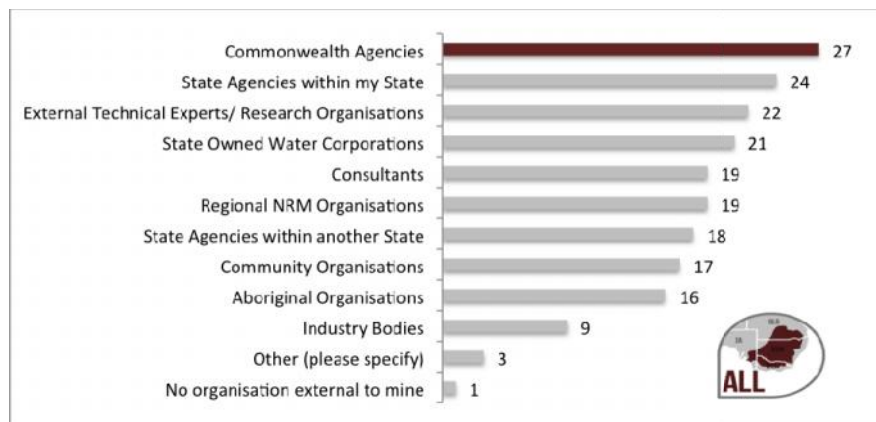
| | | | |
|---|------------------------------|---|--|
|  | All responses |  | Commonwealth agencies |
|  | Queensland organisations |  | NSW organisations |
|  | Victorian organisations |  | South Australian organisations |
|  | All responses |  | Strategy and policy |
|  | Long term planning |  | Annual Planning |
|  | Environmental water delivery |  | Provision of information / development of DSTs |

Figure 20: Who they consult with for environmental watering (by jurisdiction)



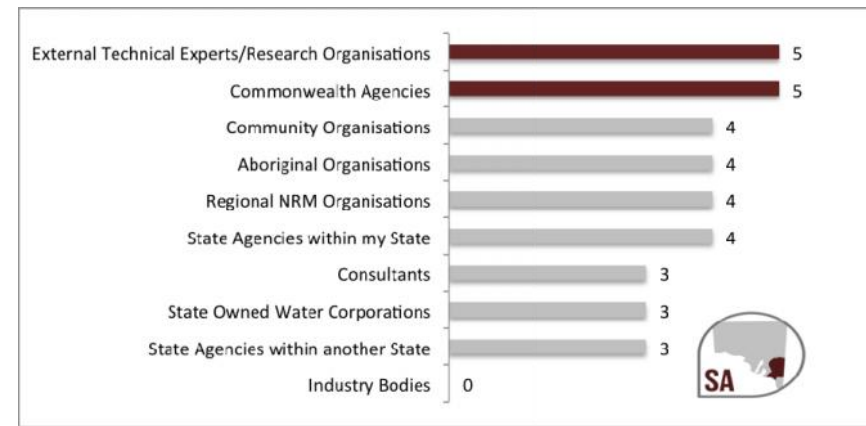
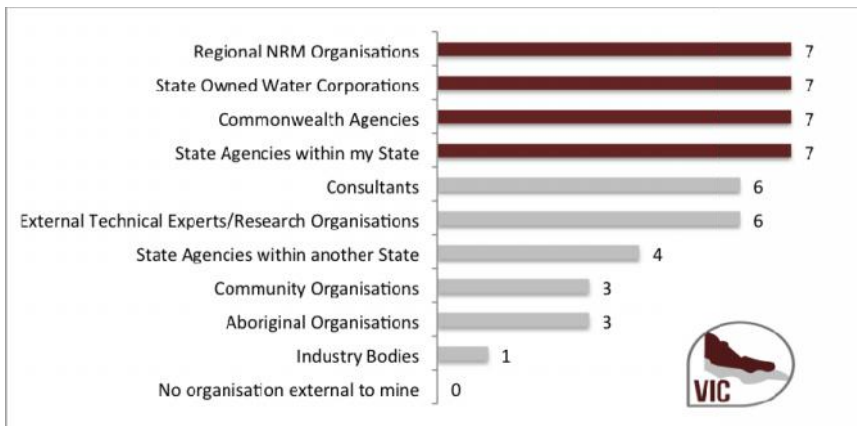
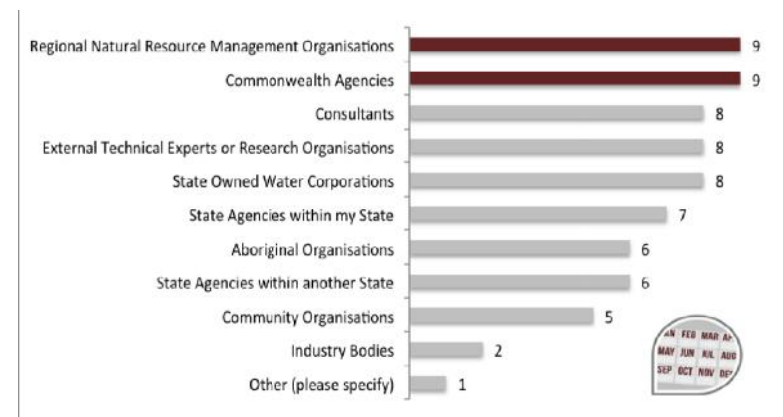
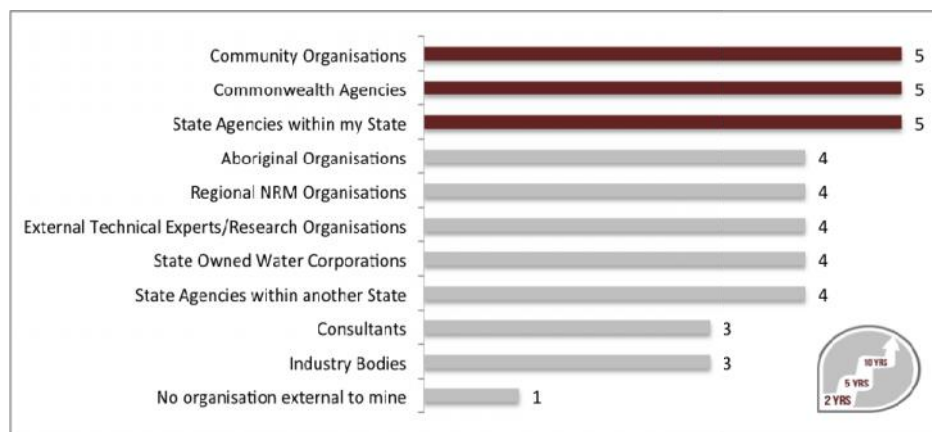
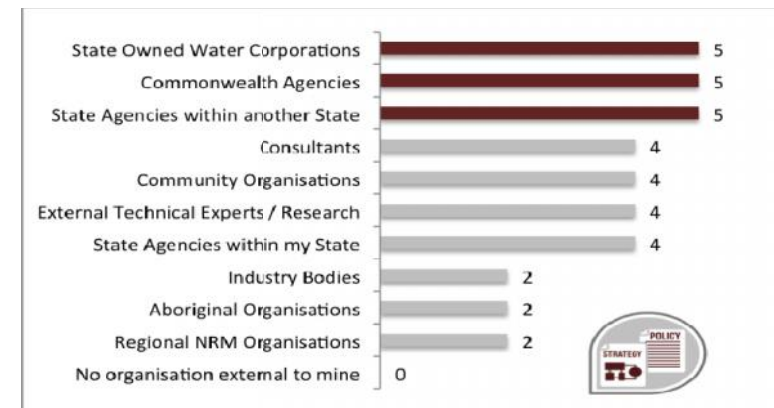
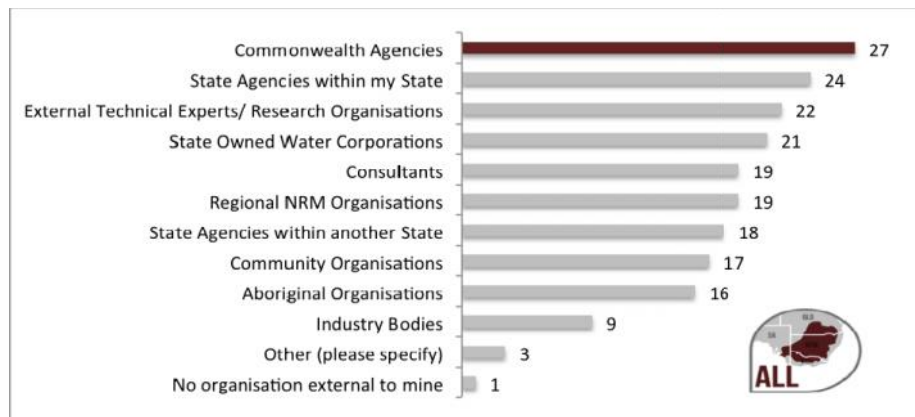


Figure 21: Who they consult with for environmental watering (by role)



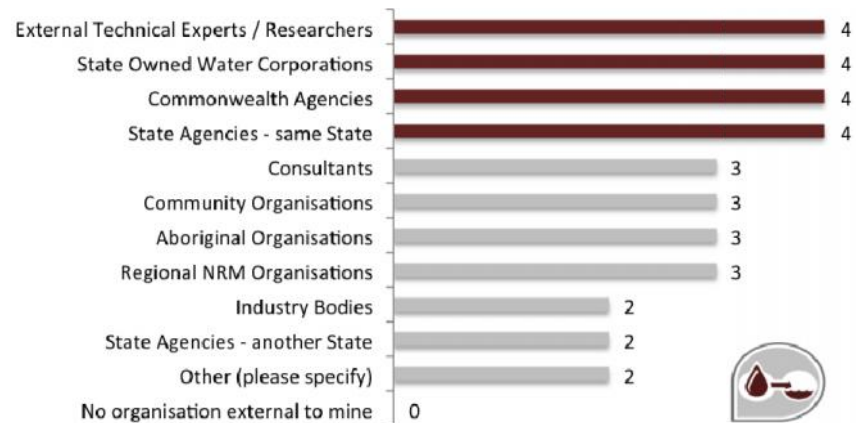
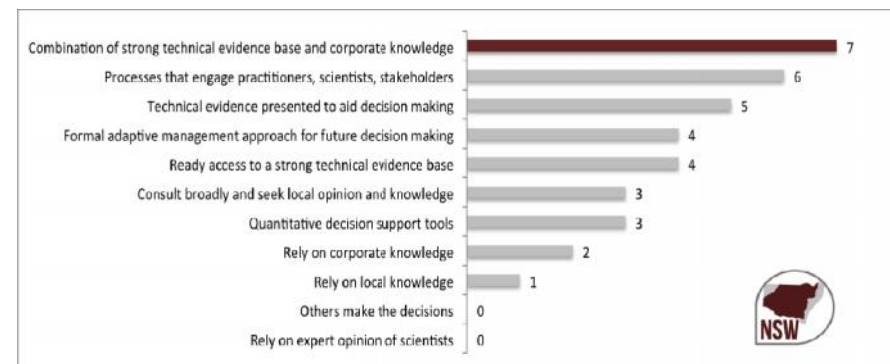
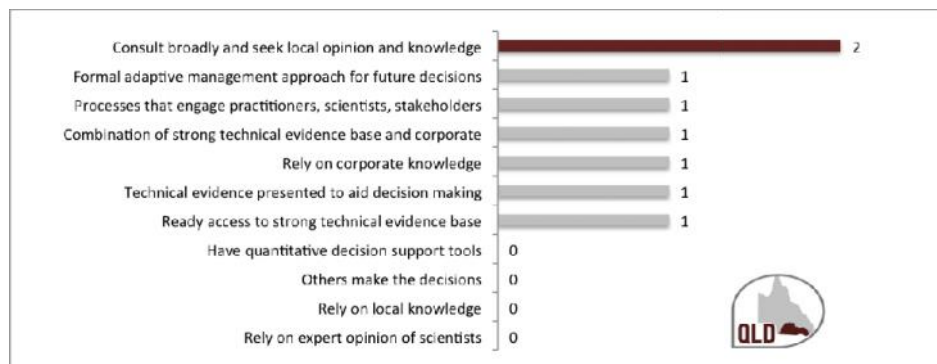
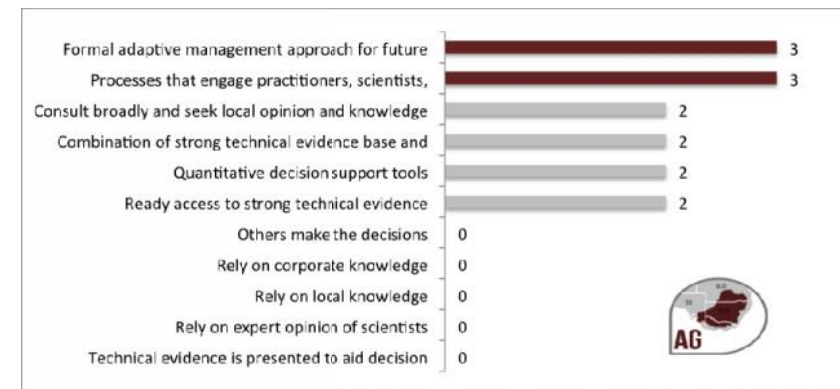


Figure 22: Sources of information to make decisions (by jurisdiction)



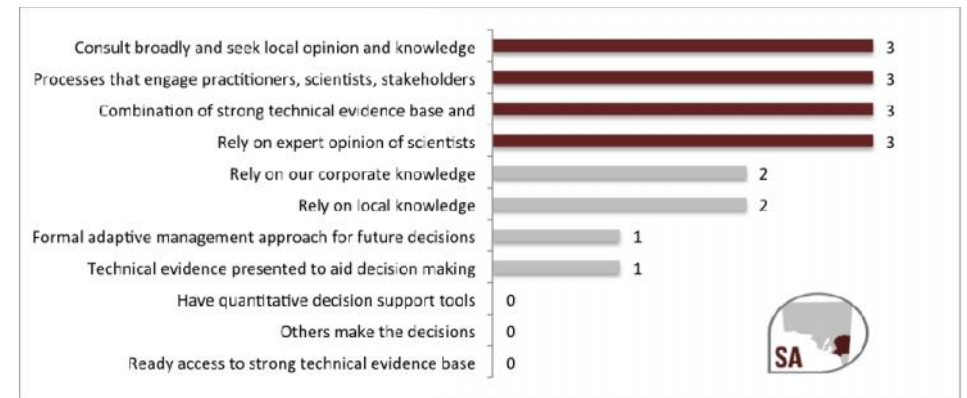
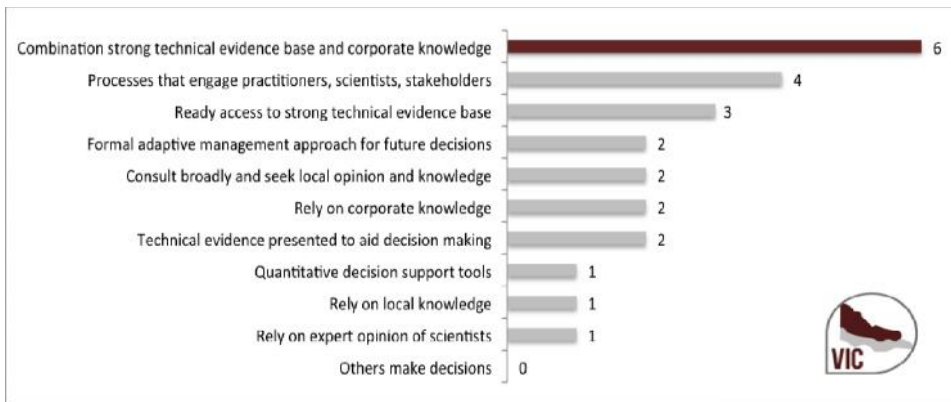
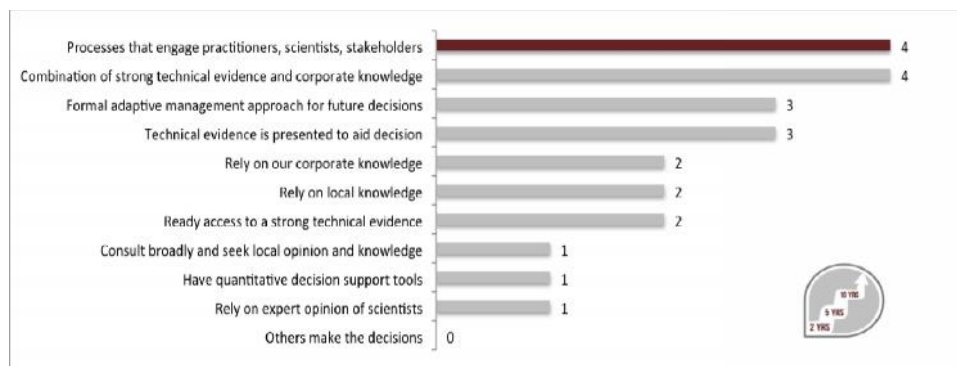
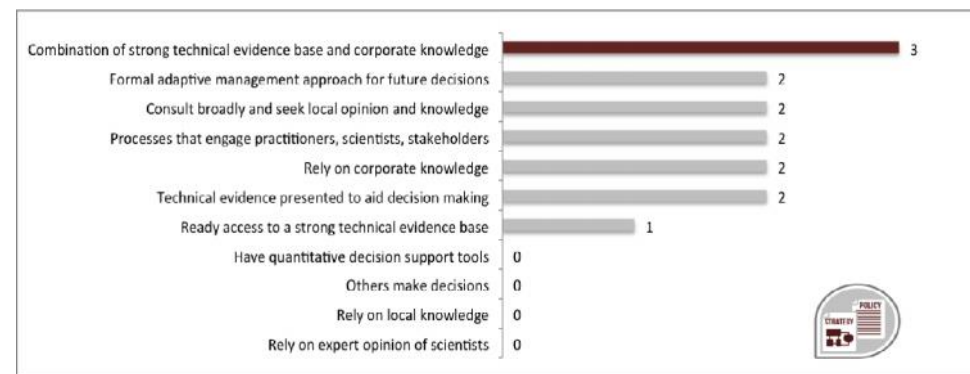
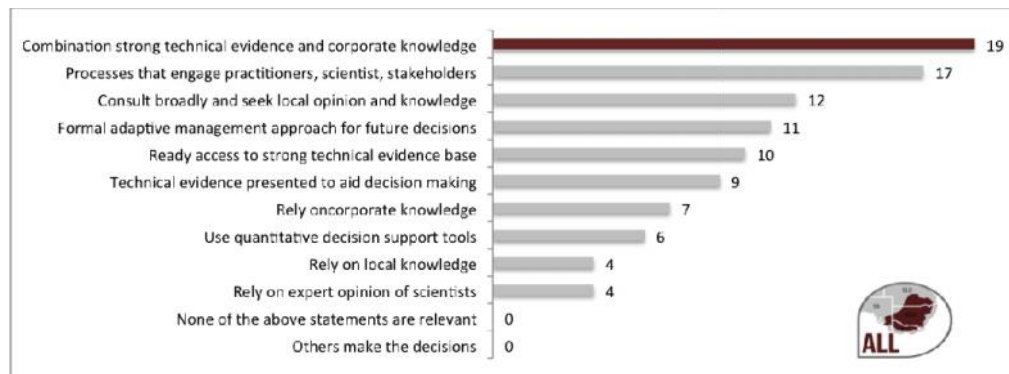


Figure 23: Sources of information for decision making (by roles)



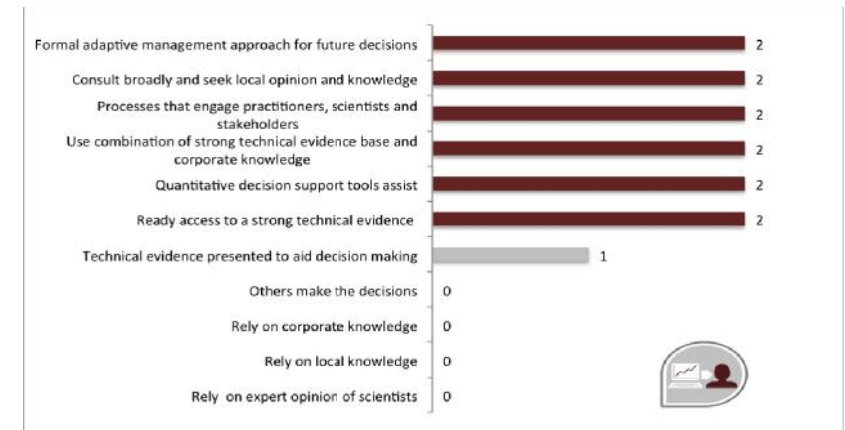
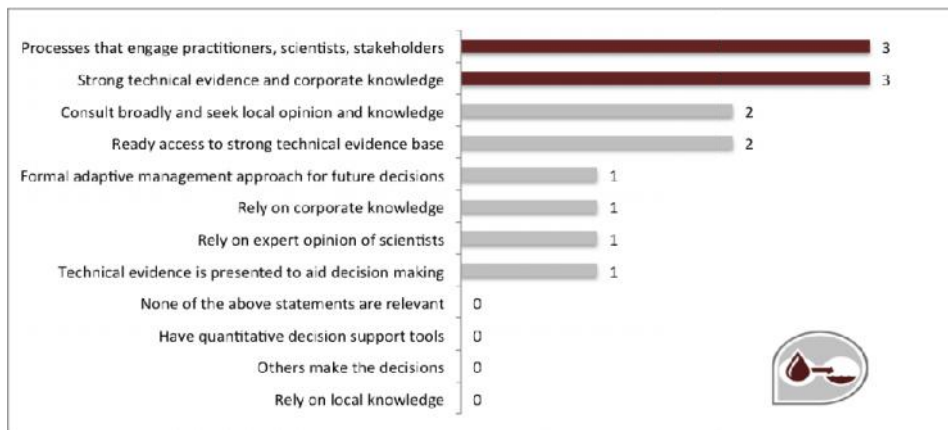
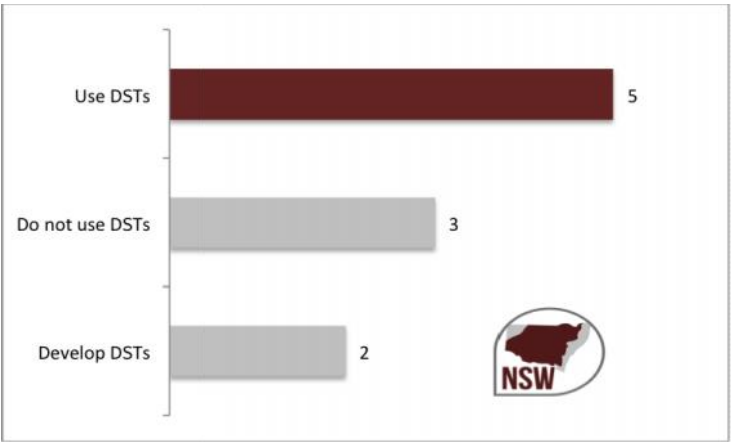
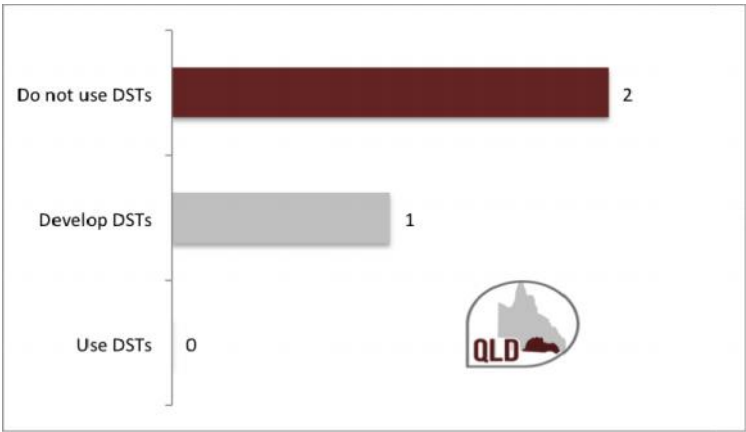
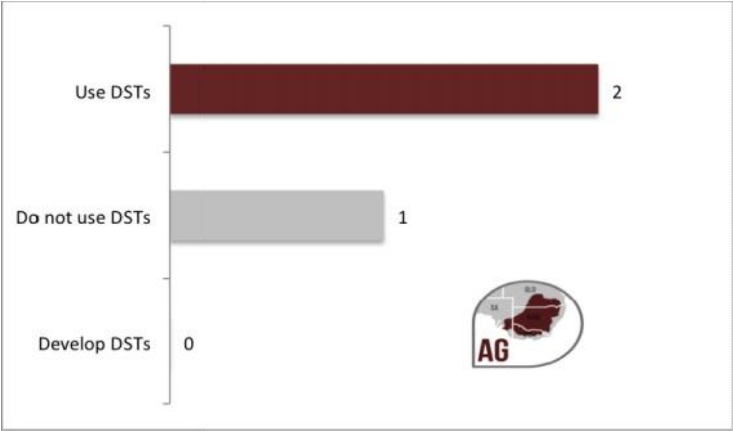
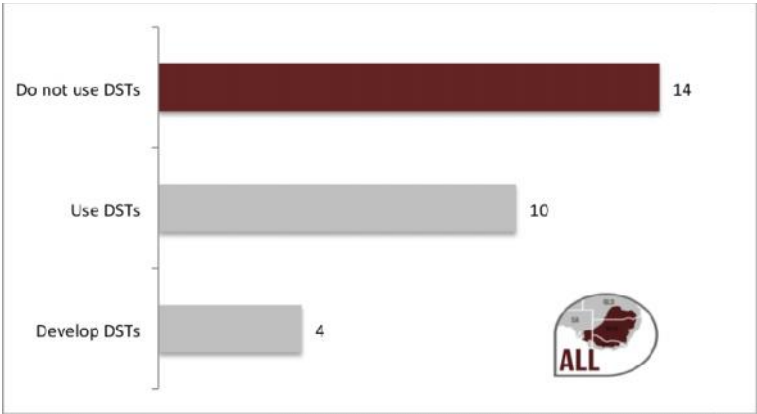


Figure 24: Use of DSTs (by jurisdictions)



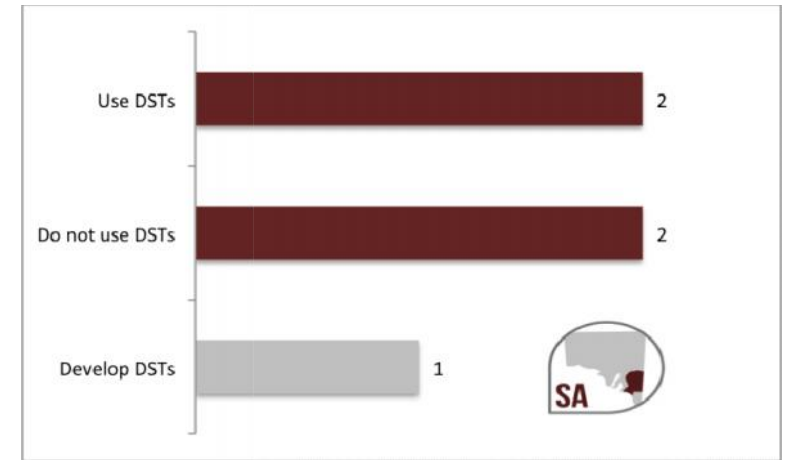
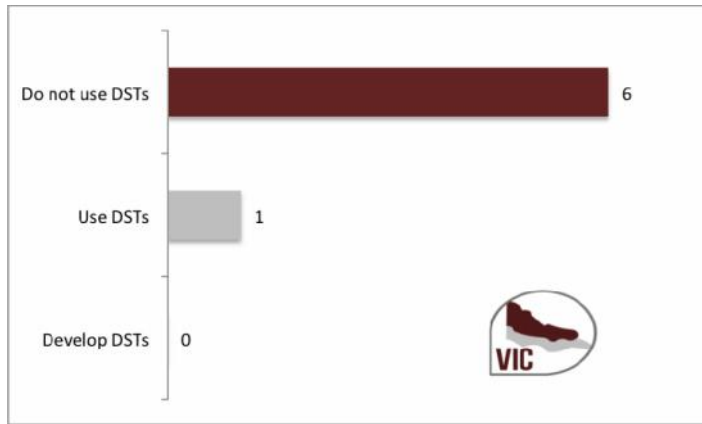
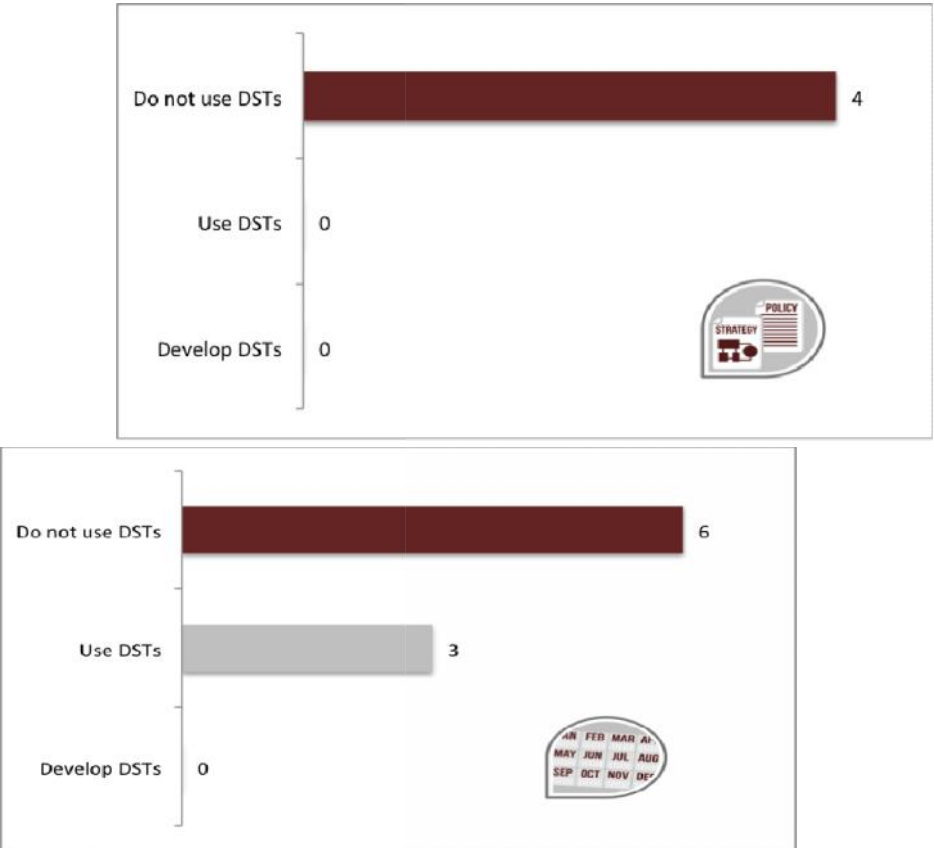
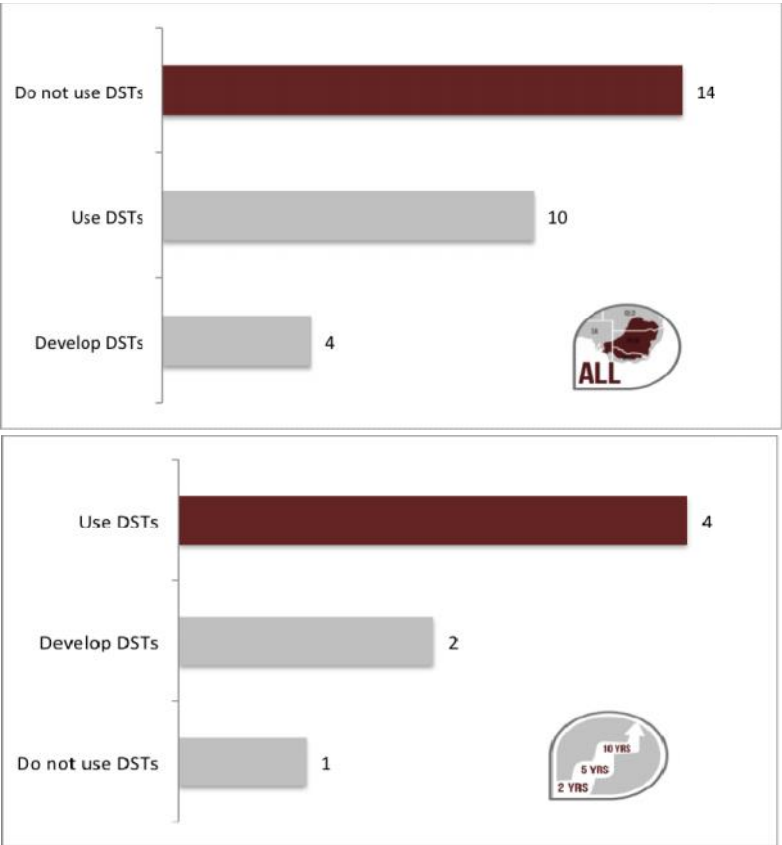
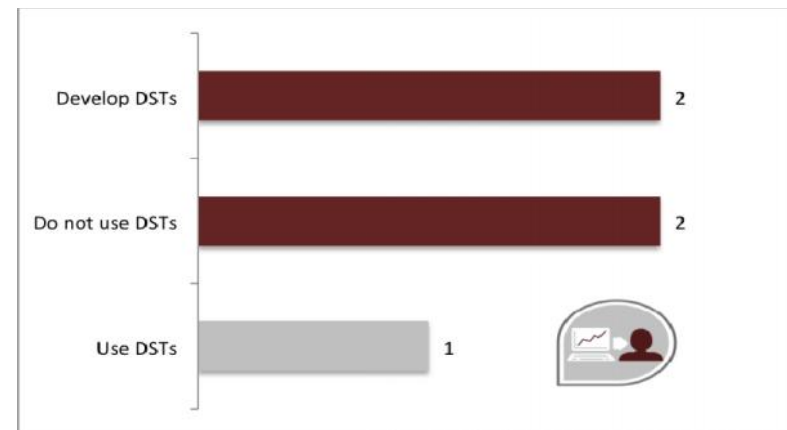
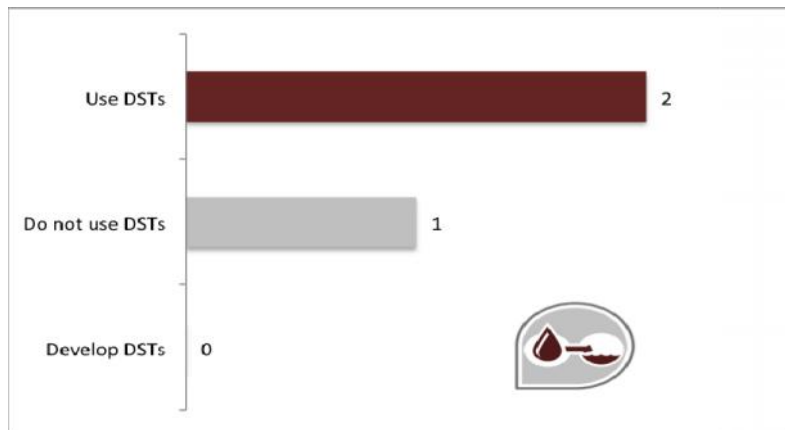


Figure 25: Use of DSTs (by role)





Appendix 4: Summary of coded responses from interviews

Table 4: What is the current decision making process and who is involved (interview questions 3, 4b, 4c, 5a, 6a)

| AG | Qld | NSW | Vic | SA |
|--|---|--|--|---|
| <ul style="list-style-type: none"> CEWO wears multiple hats as supplier and decider (planner) MDBA wear multiple hats - policy, strategy, delivery, information, program funding spatial scale of interest is primarily whole of Basin needs specific programs have icon site interests (e.g. MDBA's TLM) temporal scale interests include long term planning, annual planning and events decision making timeframes are driven by legislation engage with state jurisdictions, CEWH, MDBA hope to streamline some of the forums as BP implementation settles down | <ul style="list-style-type: none"> no specific annual planning allowed for under the rules with WRPs dealing with ephemeral so environmental water management under rules during flows DNRM – policy and planning and knowledge DSITIA – knowledge and information DEH NRM organisations MDBA and CEWO | <ul style="list-style-type: none"> develop delivery strategy from Annual Plans use EWAGs – focus has mostly keen on wetlands assets – prioritise based on water scenarios opportunities built in EWAGs are advisory annual debrief process can vary with program and group and therefore technical input opportunities implied in annual planning WSPs provide guiding framework where fractured responsibilities – no stated environmental water manager OEH, NOW, S/W, LLS on EWAGs. Also MDBA, CEWH, external researchers EWAGs include interest groups | <ul style="list-style-type: none"> Do LT plans as well as annual also develop seasonal delivery plan which is finer in detail DEPI, VEWH, CMAs, Water Authorities, MDBA, CEWO, Parks Vic, landholders, cross border interaction for some annual plans | <ul style="list-style-type: none"> annual planning is the focus (10 years) starts in January info local input / stakeholder agreements submit proposals and assessed against scenario planning check legitimacy with river ops Plan adapted through the year to reflect emergent issues, climatic changes etc reporting back on delivery driven by policy and legislation CEWO, DoE, MDBA, DEWNR, NRM Boards PIRSA, SARDI, SA Water, ERA, LAPs, wetland groups, NGOs, landholders research, science groups (Science Advisory Group) |

Table 5: Key decision making points in the process (interview questions 4a)

| AG | Qld | NSW | Vic | SA |
|----|-----|-----|-----|----|
|----|-----|-----|-----|----|

| AG | Qld | NSW | Vic | SA |
|---|---|--|--|---|
| <ul style="list-style-type: none"> • prioritisation process • facilitating decision making process • risk assessment • real time delivery decisions • getting agreement • determining basin wide significance | <ul style="list-style-type: none"> • sometimes need to interpret some of the rules under different conditions – requires analysis of information • during plan making | <ul style="list-style-type: none"> • shift to longer-term planning • how to bring new information and science • refinement /alignment of current planning process • real time • adequacy of annual plan to deliver on longer-term ecological outcomes | <ul style="list-style-type: none"> • trade-offs between regions to get best outcomes • understanding third party impacts • working with delivery constraints • forecasting seasonal conditions early in the year | <ul style="list-style-type: none"> • real time management • determining best ecological outcomes with available water / delivery profile • priorities • trade-offs • defining assumptions • getting agreement |

Table 6: What are foreseeable changes in the process and impact of changes on outcomes (interview questions 5b,6b,6c,6d)

| AG | Qld | NSW | Vic | SA |
|---|--|--|--|--|
| <ul style="list-style-type: none"> governance roles restructures resourcing constraints shift to long-term planning under the BP don't believe much will change at the regional annual planning scale – will still need to be done no matter the changes | <ul style="list-style-type: none"> state already going through legislative reform unlikely but stakeholder engagement may vary don't believe there are inconsistencies with current process aims and Basin Plan may get more efficiencies but as there are no real changes can't foresee any impacts | <ul style="list-style-type: none"> shifting to wetland and in-stream at the regional scale fairly robust – won't change the concept of an EWAG may get additional resources under Basin Plan implementation agency always changing re external reasons more reporting requirements alignment of planning processes no fundamental changes at regional scale except for tweaking MDBA may be more involved regardless of any changes, someone needs to be responsible transitioning re planning and relationships changes are still restricted by how much water is in the bucket basin rather than valley flows alignment of planning, more strategic and coherent not sure whether changes will impact at the regional scale Shift to long term planning will better focus on desired outcomes and will better | <ul style="list-style-type: none"> general sense of business as usual looking for more collaboration across CMAs almost like last 3 years scaled trial and working out what can / can't do some committee changes may occur – may lead to governance changes need to streamline processes and decision making to increase efficiencies need to mitigate decision conflict between State and CEWH role changing from planning confidence increasing over time cost of losing corporate knowledge generally no but expect incremental improvements process should constantly evolve over time | <ul style="list-style-type: none"> uncertainty around TLM and funding changes – constrains inputs into planning Agency may change fragmented arrangement in and looking for certainty in environmental water clarify role CEWO/CEWH BP driving changes don't feel major local changes increasing local input evolution rather than change change thinking approach more robust and generally positive varied responses to whether positive or negative impacts from changes |

| AG | Qld | NSW | Vic | SA |
|----|-----|---|-----|----|
| | | <p>prioritise within Annual Plans.</p> <ul style="list-style-type: none"> • Become more strategic and take system approach | | |

Table 7: What information is used for key decision making (interview questions 7a, b, c, d)

| AG | Qld | NSW | Vic | SA |
|---|---|---|--|---|
| <ul style="list-style-type: none"> The Living Murray – there has been a fair investment in modelling | <ul style="list-style-type: none"> hydro modelling foundation of all plans various sources and types – corporate, local in-house and other agencies how information is used will depend on where in the cycle (i.e. planning versus review) | <ul style="list-style-type: none"> varied for regional – includes corporate; landholders/local hydrometric, inundation mapping, veg condition, historical, rainfall etc collated and presented for annual planning will depend on committee as to what they require rely on a combination of knowledge and science variety of sources not resourced for formal monitoring – keep mining existing data that's out of date states used to dominate monitoring but decreases in funding have decreased monitoring committee uses their experience and knowledge to arrive at consensus rather than DSTs rely on group process for transparency DST's weren't picked up by EWAGs | <ul style="list-style-type: none"> process is becoming more structured under VWMS and RWS last 10 years of watering has been like adaptive management various types of data – hydro and ecological data – corporate knowledge, expertise, literature, grey literature developing ecological watering guides CMAs do most of monitoring and data analysis VEWH reports on outcomes | <ul style="list-style-type: none"> data and corporate knowledge use experts and hydrological modelling combine hydrological modelling with scientific experts variety sources including external scientific groups some sites (Chowilla) have more extensive monitoring monitoring under pressure LTIM will assist specific works and reports mix of agencies and contracting out informed judgements |

Table 8: What are the gaps, issues, constraints, weaknesses and strengths with knowledge base (interview questions 7e, 9a, 9b)

| AG | Qld | NSW | Vic | SA |
|---|--|---|---|---|
| Strengths | | | | |
| <ul style="list-style-type: none"> existing information has added significant value to understanding of what can be delivered – growing body of information robust information and reliable strong understanding of specific areas but larger scale is weak | <ul style="list-style-type: none"> process going 10 years so have learnt a lot and got good foundation, got better know how to get best value in filling gaps good collaboration diversity of researchers shift from condition/trend to asset and threat high level of engagement of communities | <ul style="list-style-type: none"> with limited budget tend to better target what we rely on for wetlands in quite robust and timely | <ul style="list-style-type: none"> good collaboration and partnerships good buy-in consistency in flow study approach access to real-time data increasing confidence as have been doing this for a while now access to scientific information solid planning platform | <ul style="list-style-type: none"> small well-connected pool of experts with good participation and good knowledge good variety of data at key sites good community engagement multi-disciplined teams strong corporate knowledge accessibility to information |
| Weaknesses | | | | |
| <ul style="list-style-type: none"> strong understanding of specific areas but larger scale is weak (w) can't always respond quantitatively to emerging issues public service is not good at succession planning so lose knowledge information not always fit for purpose cause – effect gaps no central repository piecemeal approach to improving understanding | <ul style="list-style-type: none"> budgets and resources are limited for monitoring | <ul style="list-style-type: none"> make a lot of assumptions resourcing issue and skills set lack of knowledge sharing – what else is going on and learning from others time taken to do the science may mean the groups has moved on – expectations management no long terms data programs there is still science that is based on personal interest ad hoc science programs that do not talk to one another current models do not reflect how the system is managed | <ul style="list-style-type: none"> judgements around certain assumptions strong data in some places but lack of data other areas issue around time to do quality science versus the need to make decisions training in hydraulics limited hydrographic network and limited satellite imagery | <ul style="list-style-type: none"> data on floodplain and vegetation responses to watering outside the key sites there is less knowledge dollars are spread thin annual planning time constraints mixed message re environmental watering responsibilities transparency re CEWO decisions |

| AG | Qld | NSW | Vic | SA |
|---|--|---|--|---|
| Gaps | | | | |
| <ul style="list-style-type: none"> • how to upscale site information; better understanding of system • understanding implications of trade-offs; • many general knowledge gaps and don't know where to start so seek expert opinion for some • gaps in the northern basin | <ul style="list-style-type: none"> • confounding factors in catchment beyond environmental water e.g. may be good to water floodplain for vegetation but that may be ineffective due to pest pigs; • still a lot don't we don't know and this is an issue when decision impacts on communities | <ul style="list-style-type: none"> • decisions being made with little understanding • knowledge of in-stream functioning is limited due to focus having been on wetlands • cross valley impacts/relationships • still plenty of questions | <ul style="list-style-type: none"> • scaling up without losing local relevance • confounding factors beyond environmental water • synthesis isn't occurring • better linking of environmental water response to hydraulic models | <ul style="list-style-type: none"> • scaling up • capacity of staff to use DSTs • trade-off of impacts • function of carbon cycling |
| How addressing gaps | | | | |
| | <ul style="list-style-type: none"> • confounding factors are outside portfolio • prioritise knowledge gaps and implement small projects but can't resource all | <ul style="list-style-type: none"> • basic knowledge on population dynamics | | |

Table 9: Are DSTs used? What are their strengths, limitations? What would influence adoption and should EWKR invest in DSTs (interview questions 8a, 8b, 8c, 9c)

| AG | Qld | NSW | Vic | SA |
|---|---|---|--|---|
| <ul style="list-style-type: none"> limited use in CEWO one of a number of outputs not used in strategy | <ul style="list-style-type: none"> latest iteration of risk assessment is quantitative eco-modeller with IQQM forms the basis of assessment will still make informed judgement about what can or cannot be achieved and still go to stakeholders | <ul style="list-style-type: none"> not used consistently hydrological models – IQQM but out of date some empirical models re bird breeding flow and biota Used Bayesian for scoping RERP models but these models probably better for long-term planning used for scenario testing – often feeds into other processes EWAGs do not use models developed through RERP as too much data and time to run (grunty) and technical | <ul style="list-style-type: none"> not using Mallee CMA uses environmental water database use risk assessment spreadsheet | <ul style="list-style-type: none"> not using except for hydrology, salinity - not for ecology / e-water ones used are for scenario testing re watering decisions in e-watering are too complex Need to understand the basics before a DST is built generally lack of confidence in ecological DSTs Not enough dollars to invest in DST couldn't cope with the level of complexity re e-water |
| Influencing factors | | | | |
| <ul style="list-style-type: none"> challenge is to make a DST local enough but applicable to many areas need to be fit for purpose need to be reliable and accurate can't be black box must be useable in-house must have good reputation and be proven, transparent, flexible must be able to be driven internally if outcome/output is too generic then it will not be useful | <ul style="list-style-type: none"> would have to suit the northern basin have error band tolerance | <ul style="list-style-type: none"> must value add; direct access to timeliness needs to be easy to use documentation of assumptions well tested designed to answer your questions | <ul style="list-style-type: none"> logical accurate user friendly driven internally ability to address systems needs to be able to deal with constraints / risks | <ul style="list-style-type: none"> confidence in the tool need to understand it - easy to use / user friendly capacity to run a DST internally transparent purpose built Scenario runs must be timely If too complicated less confident in outputs needs to be useful needs to increase confidence in decision making |

| AG | Qld | NSW | Vic | SA |
|--|---|---|---|--|
| MDB EWKR investment in DSTs | | | | |
| <ul style="list-style-type: none"> do not want to start again with DSTs investment would best to focus on the research needs | <ul style="list-style-type: none"> would need to provide a consistent tool from which decisions can be made but must still suit the landscape applied in | <ul style="list-style-type: none"> want to see more information of the program before a call on DSTs is made uncertain - may be beneficial but key stakeholders need to be involved some very site specific desires - can these be addressed? lot of existing intensive models not being used would depend on costs and how predictive | <ul style="list-style-type: none"> note Melbourne Uni ARC grant waste for EWKR to invest in | <ul style="list-style-type: none"> No Lack of information and conceptual understanding - need to address this first still a lot we don't know maybe if the right type of tool - need to be able to answer questions at different scale DST may help explain some of the CEWH decisions - transparency Don't know but could spend a lot of dollars to get a DST so probably better to address the fundamental knowledge gaps first Decision support trees would be good Probably not able to have something applicable at Basin scale |

Table 10: Other information relevant to EWKR (Interview questions 10 and 11 specifically and from across other responses)

| AG | Qld | NSW | Vic | SA |
|---|---|--|--|---|
| <ul style="list-style-type: none"> need more transparency in decision making even between jurisdictions Decision making process relies on other things beyond science Good knowledge and relationships are essential | <ul style="list-style-type: none"> cannot transfer southern basin experience to the northern basin | <ul style="list-style-type: none"> when scoped and developed in partnership the science is more targeted expectation management ongoing engagement research to compliment existing | <ul style="list-style-type: none"> how best to maintain all the information ongoing funding of knowledge base communication and fostering local ownership | <ul style="list-style-type: none"> Need to improve information sharing Workshops are a quick way to exchange and discuss recent findings Address duplication |

| AG | Qld | NSW | Vic | SA |
|--|-----|--|--|--|
| <ul style="list-style-type: none"> • ease of access to knowledge • there needs to be acceptance that errors will be made but won't move forward if try to achieve perfection | | <p>monitoring programs</p> <ul style="list-style-type: none"> • focus on longer-term, larger scale • currently keep mining old data that's now out of date • need to have complimentary program | <ul style="list-style-type: none"> • lose support for environmental water if social and economic benefits are not considered and communicated | <ul style="list-style-type: none"> • Whole adaptive management process - how effective have we been • aid transparency in decision making • Ongoing process of building relationships across jurisdictions - currently personality driven |

Appendix 5: On-line survey questions

MDB EWKR: Review of Environmental Watering Decision Making and

As part of the MDB Environmental Water and Knowledge Research (EWKR) project being managed by the MDFRC, you are invited to participate in this brief survey regarding how knowledge is used to inform environmental watering decision making, and the use of decision support tools in that process.

If you are unfamiliar with the MDB EWKR project there is a brief overview at the end of this page, including a link to the project website.

This on-line survey is being undertaken as part of a Review of decision making processes and the use of DSTs for environmental watering in the Murray Darling Basin (MDB). The MDFRC have engaged Helen Watts (Evaluation and Sustainability Services) who is collaborating with Rhonda Butcher (Water's Edge Consulting) to undertake the Review. The Review forms part of the planning phase for the MDB EWKR project with the outcomes to help inform the direction and outputs for the Phase 2 of the project. Therefore the outcomes of the Review will help inform how EWKR should best present information to help support environmental water decision making, including through the potential use of DSTs by investigating current processes and the knowledge base.

Some of the recipients of this survey may also be contacted over the next fortnight to also participate in a telephone interview. The purpose of the telephone interviews is to gain deeper insight into the environmental watering decision making process and the knowledge base required to inform it.

Please note that all survey responses are anonymous.

The Review findings should be made available through the the MDB EWKR project's jurisdictional reference group process.

We would like to thank you in advance for participating in this survey and request if it could be completed by 5pm on the 14th October 2014.

If you have any general questions regarding the MDB EWKR project, please do not hesitate to contact Ian Burns, MDFRC on 02 6024 9645 or if you have any questions about the Review, please contact myself, Helen Watts, on 03 5728 7348.

Regards
Helen Watts
Director, Evaluation and Sustainability Services

About MDB EWKR:

The Commonwealth Department of Environment has engaged MDFRC to deliver the MDB EWKR project. This is a 5 year, \$10million collaborative project to improve the science available to support environmental water management, and therefore contribute to achieving the Basin Plan objectives. This includes a better understanding of the links between flow and ecology and the impacts of multiple threats and pressures on the achievement of environmental outcomes.

The project will collaborate with water managers, asset managers, water planners, scientists and relevant community groups to identify research priorities and undertake research targeted at addressing those priorities. Phase 1 through to February 2015 is a planning phase to identify research priorities, develop research project plans and agree on collaborative arrangements to undertake the work. Phase 2, the delivery of the research, will commence in early 2015 and run through to 2018/19.

The project web site can be found at <http://www.mdfr.org.au/project/ewkr/>

MDB EWKR: Review of Environmental Watering Decision Making and

2. What option would best describe your role in environmental watering? Please note only one response can be provided.

- ☐ Strategy / policy
- ☐ Long term planning
- ☐ Annual planning
- ☐ Operational
- ☐ Monitoring performance of environmental watering outcomes
- ☐ Provision of technical information or DSTs to assist in decision making

Other (please specify)

3. Please list other roles that you may also undertake that are linked to environmental watering?

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***4.** Please indicate your level of experience regarding the role you identified in question 2?

- ☐ <1 year
- ☐ 1-5 years
- ☐ 6-10 years
- ☐ >10 years

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***5.** For the role you selected in question 2, can you identify what other organisations and / or stakeholder groups you would typically engage with?

These may include those that make a request for input from you, those that partner with you, those that you provide information or tools to or those that you consult with.

Please note that more than 1 response can be provided.

- ☐ State Agencies within my State
- ☐ State Agencies within another State
- ☐ Commonwealth Agencies
- ☐ State Owned Water Corporations
- ☐ External Technical Experts or Research Organisations
- ☐ Regional Natural Resource Management Organisations
- ☐ Aboriginal Organisations
- ☐ Industry Bodies
- ☐ Community Organisations
- ☐ Consultants
- ☐ No organisation external to mine

Other (please specify)

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***6.** Based on the role you selected in question 2, please outline the significant decision points in environmental water planning and delivery that you inform and / or participate in?



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*7. From the list below please select up to 5 statements that best describe what you currently use to make decisions as per your response in Q6:

- ☐ We have ready access to a strong technical evidence base to make decisions
- ☐ Our technical evidence is presented in a way that aids decision making
- ☐ We rely mainly on expert opinion of scientists
- ☐ We rely mainly on local knowledge
- ☐ We rely mainly on our corporate knowledge that we have gained through experience
- ☐ Others make the decisions and we are provided with the results
- ☐ We have quantitative decision support tools that assist in the process
- ☐ We use a combination of a strong technical evidence base and corporate knowledge
- ☐ We have formal processes that engage practitioners, scientists and stakeholders in decision making
- ☐ We consult broadly and seek local opinion and knowledge
- ☐ We use a formal adaptive management approach to enhance future decision making processes
- ☐ None of the above statements are relevant

8. Please outline any other elements that you currently use in your decision making process that wasn't listed above?

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Questions 9 to 11 are about the use of decision support tools (DSTs) in supporting environmental water decision making and what influences their use.

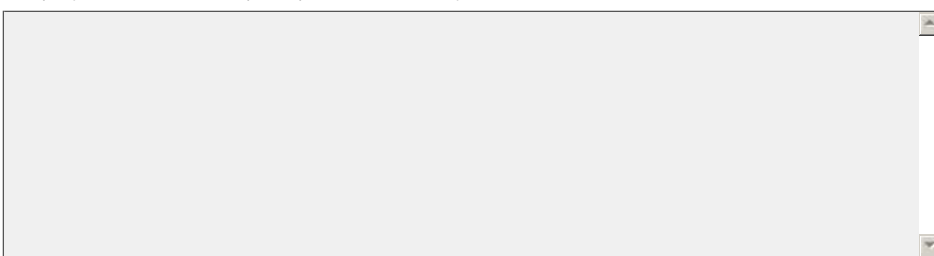
***9.** Please select whether you currently use or develop DSTs for the purpose of environmental water decision making:

☐ Do not use DSTs

☐ Use DSTs

☐ Develop DSTs

Can you please list the tools that you may have used or developed:

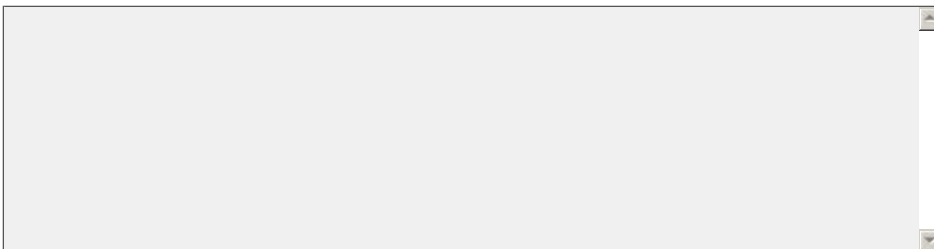


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*10. Please indicate up to 5 statements that influence your use of or would influence your use of DSTs:

- ☐ The DST is developed in-house
- ☐ The DST is specific to our needs
- ☐ The DST is based in a software platform I am familiar with
- ☐ The DST is developed through a collaborative process
- ☐ After an initial brief on the DST, we just want to be delivered the end product and shown how it works
- ☐ The DST can be updated in-house
- ☐ The DST is not difficult to use or be trained in
- ☐ The DST is cloud-based
- ☐ The DST can integrate with our existing systems
- ☐ The DST is not reliant on others outside of our organisation for its on going application
- ☐ The DST is not data intensive to calibrate
- ☐ I am confident in the output
- ☐ I understand the underpinning algorithms and relationships
- ☐ The DST has on-going development and training support
- ☐ The DST is cost-effective
- ☐ The DST can inform long term planning by analysing historic data sets and past delivery options
- ☐ The DST can inform short term planning by analysing current situations and future delivery scenarios

Please add any other factors that are important to you regarding DSTs that are not covered in the list above:



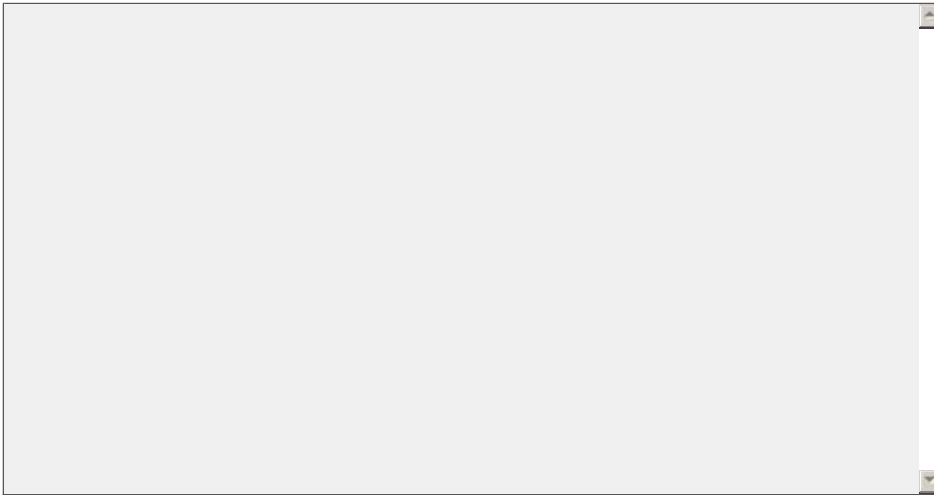
MDB EWKR: Review of Environmental Watering Decision Making and

*11. Are there current environmental water decisions made that would benefit from the use of DSTs?

☐ Yes

☐ No

Please provide further comments to your response:



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12. If you could make one recommendation about how MDB EWKR could present knowledge and information to support environmental watering, please outline what it would be?

13. Do you have any other comments you would like to make regarding environmental water decision making?

MDB EWKR: Review of Environmental Watering Decision Making and

Thank you for your time in completing the survey.

Please do not hesitate to contact Helen on 03 5728 7348 if you have any questions about the Review.

Please hit the "done" button to submit and exit the survey.

Appendix 6: Interview questions

Interview questions for "key interviewees"

1. Please briefly outline what your role is in environmental watering?
2. How long have you been in this role?
3. Can you outline what the planning and delivery process is for environmental watering within your jurisdiction?

For questions 4-6 we are going to look at the process discussed in question 3:

- 4a Please identify where the significant decision making processes/points are in the process? and why you consider them significant?
- 4b For the decision making processes identified in the previous question, please indicate what the timeframes are, and what drives those timeframes?
- 4c Are there different decision making processes for opportunistic events?
- 5a. Have the significant key decision making processes recently changed and can you provide reasons for the change?
- 5b. Do you see the significant key decision making processes changing in the foreseeable future and can you provide reasons for change?
- 6a. Can you please identify what other organisations are involved in the current decision making process, where they fit in to the process and their roles?
- 6b. Do you see the involvement of other organisations changing over the foreseeable future? If so how will they change and why?
- 6c. Do you see your organisation's role changing in the foreseeable future? If so how will it change and why?
- 6d. What impact do you see that these changes will have on environmental watering outcomes?

For question 7-8 we are going to just focus on your / your team's role stated in question 1:

- 7a. What knowledge, information and / or data is used to make decisions for environmental watering?

For your information:

knowledge = corporate knowledge, experience

information = analysed data (eg statistical, graphical, modelled, synthesised qualitative information)

data = raw / quality controlled

- 7b. How do you acquire that information?

- 7c. Where do you acquire it from?

- 7d. How do you use that knowledge, information and / or data in the decision making process?
- 7e. Can you identify any strengths and weaknesses associated with the knowledge, information and / or data including knowledge transfer?
- 8a. Are decision support tools used within your role's decision making process? Please note we define DSTs as formalised quantitative tools. If so, can you briefly describe the tool?
- 8b. How is the output from the DST used?
- 8c. Please describe the key features that would influence you / your team's adoption of DSTs?

The remainder of the questions will consider both the whole process and your specific role:

- 9a. Can you identify any gaps in the knowledge base or gaps for DSTs that are impacting on the decision making process for environmental watering?
- 9b. How are these gaps currently addressed?
- 9c. Do you think there are particular decisions that could be improved by DSTs?
10. Is there anything that you would like to see improved that would aid the decision making process?
11. Do you have any other comments you would like to make regarding decision making for environmental watering that you don't think we have covered?

Interview questions for "other interviewees"

1. Please briefly outline what your role is in environmental watering?
2. How long have you been in this role?

For questions 3 we are going to look at the draft process chart that was forwarded:

- 3a. Can you please identify where your role sits in this diagram?
- 3b. How do you see you / your team relating with the other processes in the diagram?
- 4a. For your / your team's role, please identify what the significant decision making processes are and why you consider them significant?
- 4b. For the decision making processes identified in the previous question, please indicate what the timeframes are and what drives those timeframes?
- 4c. Are you / your team involved in decision making processes for opportunistic events?
- 5a. Have the significant key decision making processes recently changed and can you provide reasons for the change?
- 5b. Do you see the significant key decision making processes changing in the foreseeable future and can you provide reasons for change?

6a. Can you please identify what other organisations are involved in the current decision making process, where they fit in to the process and their roles?

6b. Do you see the involvement of other organisations changing in the foreseeable future? If so how will they change and why?

6c. Do you see your / your team's role changing in the foreseeable future? If so how will it change and why?

6d. What impact do you see that these changes will have on environmental watering outcomes?

7a. What knowledge, information and / or data is used to make decisions for environmental watering?

Please note:

knowledge = corporate knowledge, experience

information = analysed data (eg statistical, graphical, modelled, synthesised qualitative data)

data = raw or quality controlled

want a sense of what it is they use including combination of the above and whether it is used for multiple decision points within their role

7b. How do you acquire that information?

7c. Where do you acquire it from?

7d. How do you use that knowledge, information and / or data in the decision making process?

7e. Can you identify any strengths and weaknesses associated with the knowledge, information and / or data, including knowledge transfer?

8a. Are decision support tools used within your role's decision making process? Please note we define DSTs as formalised quantitative tools. If so, can you briefly describe the tool?

8b. How is the output from the DST used?

8c. Please describe the key features that would influence you / your team's adoption of DSTs?

9a. Can you identify any gaps in the knowledge base or gaps for DSTs that is impacting on the decision making process for environmental watering?

9b. How are these gaps currently addressed?

9c. Do you think there are particular decisions that could be improved by DSTs?

10. Is there anything that you would like to see improved that would aid the decision making process?

11. Do you have any other comments you would like to make regarding decision making for environmental watering that you don't think we have covered?

Interview questions for "DST interviewee"

1. Please briefly outline what your role is with respect to environmental watering?

2. How long have you been in this role?

For questions 3 we are going to look at the draft process chart that was also forwarded:

3. Can you please identify where your role contributes, based on this diagram?

4a For your / your team's role, please identify what significant decision making processes you contribute to?

4b For the decision making processes identified in the previous question, please indicate what timeframes you had to work to and what drove those timeframes?

4c. Are you / your team involved in decision making processes for opportunistic events?

If so are there different decision making needs that you need to support for these events?

5. Can you please identify what organisations you engaged with as part of your contribution to the current decision making process, previously described?

6a. What knowledge, information, data and/or DSTs have you provided as part of the decision making process described (for environmental watering)?

6b. Who asks for that information / tool?

6c. How is it provided?

6d. How does the acquirer use that knowledge, information data or tool in the decision making process?

6e. Can you identify any strengths and weaknesses associated with the knowledge, information, data, tool or transfer process?

7. Can you describe the key features that would influence the adoption of DSTs?

8a. Can you identify any gaps in the knowledge base or gaps for DSTs that is impacting on the decision making process for environmental watering?

8b. Can you comment on how these gaps could be addressed?

9. Do you think there are particular decisions that could be improved by DSTs?

10. Do you see any of the key decision making processes or roles changing, in the foreseeable future and can you provide reasons for change?

11. Is there anything that you think would further assist the decision making process for environmental watering?

12. Do you have any other comments you would like to make regarding decision making for environmental watering that you don't think we have covered?

Appendix 7: Potential participants

The following list of names was provided by the key contacts for each of the jurisdictions. All of those on the list were sent an invitation to undertake the on-line survey and only a subset were randomly selected to be invited to participate in a telephone interview. It should be re-emphasised that participation was voluntary.

On some occasions additional people also sat in on interviews as participants.

Table 11: Potential participants in the on-line survey and / or telephone interviews

| Organisation / State | Name | Organisation / State | Name |
|----------------------|-------------------|----------------------|-------------------|
| DoE | John Foster | NSW | Justen Simpson |
| DoE | Bruce Campbell | NSW | Neil Saintilan |
| DoE | Andrew Warden | NSW | Paula Dsantos |
| DoE | Jane McClintock | NSW | Debbie Love |
| MDBA | David Bell | NSW | Michael Maher |
| MDBA | Bill Johnson | Vic | Paulo Lay |
| MDBA | Paul Carlile | Vic | Peter Kelly |
| MDBA | Lindsay White | Vic | Greg Fletcher |
| MDBA | Sue Buckle | Vic | Shar Ramamurthy |
| MDBA | Damian Green | Vic | Mark Bailey |
| MDBA | Neville Garland | SA | Chris Wright |
| Qld | Ross Krebs | SA | Heather Hill |
| Qld | Diana Wood | SA | Tracey Steggle |
| Qld | Suzi Johnson | SA | Tony Herbert |
| Qld | Steve Goudie | SA | Adrienne Rumbelow |
| Qld | Peter Brownhall | SA | Jan Whittle |
| Qld | Glenn McGregor | SA | Jarrold Eaton |
| Qld | Craig Johansen | SA | Tumi Bjornsson |
| Qld | James Fewings | SA | Rebecca Turner |
| Qld | Geoff Penton | | |
| Qld | Phil McCullough | | |
| Qld | Bernard Holland | | |
| NSW | Lyndal Betteridge | | |
| NSW | Neal Foster | | |
| NSW | Lorraine Hardwick | | |
| NSW | Patrick Driver | | |
| NSW | Simon Williams | | |
| NSW | Paul Simpson | | |
| NSW | Brian Graeme | | |
| NSW | Linda Broekman | | |
| NSW | Bob Creese | | |
| NSW | Craig Copeland | | |