

# CULTURAL FLOWS

## GOORAMAN SWAMP CULTURAL FLOW MONITORING & EVALUATION PLAN



NATIONAL  
CULTURAL FLOWS  
RESEARCH PROJECT



For First Nations People, water is a sacred source of life. The natural flow of water sustains aquatic ecosystems that are central to our spirituality, our social and cultural economy and wellbeing. The rivers are the veins of Country, carrying water to sustain all parts of our sacred landscape. The wetlands are the kidneys, filtering the water as it passes through the land.

First Nations Peoples have rights and a moral obligation to care for water under their law and customs. These obligations connect across communities and language groups, extending to downstream communities, throughout catchments and over connected aquifer and groundwater systems.

The project partners acknowledge all of the Traditional Owners across Australia who care for the waterways that sustain our Country. We pay deepest respects to their Ancestors and Elders who have protected and maintained water resources for thousands of years, and passed on the knowledge, stories and lessons through the generations.

We acknowledge the nations of Murray Lower Darling Rivers Indigenous Nations and Northern Basin Aboriginal Nations who continue to fight for their inherent right to water, and who had a pivotal role in creating and directing the National Cultural Flows Research Project.

We thank the Murrawarri and Nari Nari Nations who worked tirelessly as part of the research team to develop the cultural flows assessment approaches for this project.

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Key Abbreviations & Acronyms

AHD – Australian Height Datum

CEWH – Commonwealth Environmental Water Holder

CEWO –Commonwealth Environmental Water Office

FSL – Full supply level

GPS – Global Positioning System

IPA – Indigenous Protected Area

M&E – Monitoring and Evaluation

MDBA – Murray Darling Basin Authority

MERI – Monitoring, Evaluation, Reporting and Improvement

ML - Megalitres

NCFRP – National Cultural Flows Research Project

NNTC – National Native Title Council

NPWS – National Parks and Wildlife Service

NSW – New South Wales

OEH – Office of Environment and Heritage

SSSI – Single Site Single Intervention

SSMI – Single Site Multiple Interventions

QA/QC – Quality Assurance/Quality Control



## Terminology and Definitions

| Term                                     | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Aboriginal</b>                        | The people who are the original inhabitants of the land.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Aboriginal Environmental Outcomes</b> | <p>The term “Aboriginal environmental outcomes” has been proposed to describe and communicate the benefits to Aboriginal people that can be derived from environmental watering. Aboriginal environmental outcomes result from healthier rivers and wetlands, for example improved fish populations, more reeds that can be harvested and increased bird breeding events. In essence, Aboriginal environmental outcomes provide tangible physical benefits to community and country (Definition of Aboriginal environmental outcomes, pamphlet).</p> <p>This definition was endorsed by representatives of the Murray Lower Darling Rivers Indigenous Nations (MLDRIN) and Northern Basin Aboriginal Nations (NBAN) and is recognised by the Murray Darling Basin Authority (MDBA), Victorian Environmental Water Holder (VEWH) and Department of Environment, Land, Water and Planning (DELWP).</p> |
| <b>Authorised Knowledge Holder</b>       | A person, normally a Traditional Owner, who has been provided cultural and/or traditional knowledge of a particular place or thing through customary law and is recognised by the Traditional Owner community to have the authority to speak on or share that particular knowledge where appropriate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Community</b>                         | A group of people living in the same place or having a particular characteristic in common (e.g. people living in a suburb or town).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Cultural flows</b>                    | <p>Water entitlements that are legally and beneficially owned by Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations. This is our inherent right.</p> <p>This definition was endorsed by representatives from thirty-one Indigenous nations at a joint meeting of the Murray Lower Darling River Indigenous Nations (MLDRIN) and the Northern Basin Aboriginal Nations (NBAN) -The Echuca Declaration, September 2010 (NCFRP 2016).</p>                                                                                                                                                                                                                                                                                                                               |
| <b>Environmental flows</b>               | Environmental flows describe the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Key Contact</b>                       | The nominated key contact for each case study area, as provided in the case study area applications to the National Cultural Flows Research Project.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Nation facilitator</b>                | <p>Nominated member from each case study area Nation that will receive support and training to participate in the facilitation of research engagement activities.</p> <p>The nominated Nation Facilitator will support the Project Team to conduct engagement sessions and workshops in a culturally respectful</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |





| Term                            | Definition                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | and appropriate manner, to suit local needs and issues; and the two-way flow of information and ideas between the Project Team and participants / Traditional Owners.                                                                                                                                                                                                                                           |
| <b>Nation</b>                   | An aggregate of people that are united by a shared descent, culture and/or language and who inhabit a particular state or territory and who have a shared body of law and custom.                                                                                                                                                                                                                               |
| <b>The Project</b>              | The National Cultural Flows Research Project.                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Contract Project Manager</b> | Rural Solutions SA (Rowena Brown is the Interim Contract Project Manager).                                                                                                                                                                                                                                                                                                                                      |
| <b>Project Team</b>             | Rural Solutions SA Project Team (including Rural Solutions SA staff and subcontractors).                                                                                                                                                                                                                                                                                                                        |
| <b>Research Committee</b>       | National Cultural Flows Planning and Research Committee.                                                                                                                                                                                                                                                                                                                                                        |
| <b>Research Manager</b>         | National Cultural Flows Research Project – NNTC Research Manager (Alanna Maguire).                                                                                                                                                                                                                                                                                                                              |
| <b>Research partner</b>         | A Traditional Owner, individual of the Research Committee and/or community nominated participant who is recognised as speaking for country. Individuals may be involved in any/all aspects of the National Cultural Flows Research Project.                                                                                                                                                                     |
| <b>Stakeholder</b>              | A person with an interest or concern to any and/or all aspects of the National Cultural Flows Research Project.                                                                                                                                                                                                                                                                                                 |
| <b>Traditional Owner</b>        | The Aboriginal person or people who possess rights, interests and responsibilities for an area of country. These rights, interests and responsibilities are defined by traditional law and custom and are also handed down through this customary law. Traditional Owners are recognized as having a primary interest in the land and their existence is not contingent on recognition of such under white law. |

## Ecological Terms and Definitions

| Term                                                         | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Aquatic ecosystem</b>                                     | <p>Ecosystems that depend on flows, or periodic or sustained inundation/waterlogging for their ecological integrity (e.g. wetlands, rivers, karst and other groundwater-dependent ecosystems, saltmarshes and estuaries) but do not generally include marine waters (defined as areas of marine water the depth of which at low tide exceeds six metres, but to be interpreted by jurisdictions).</p> <p>See also ecosystem</p>                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Assessment (wetland)</b>                                  | <p>The identification of the status of, and threats to, wetlands as a basis for the collection of more specific information through monitoring activities.</p> <p>See also condition and condition assessment</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Benefits</b>                                              | <p>Benefits/services are defined in accordance with the Millennium Ecosystem Assessment definition of ecosystem services as "the benefits that people receive from ecosystems (Ramsar Convention 2005a), Resolution IX.1 Annex A).</p> <p>See also "Ecosystem Services".</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Biodiversity</b>                                          | <p>Biodiversity, or biological diversity, means the variety of life or variety of living things; and living things means plants, and animals, and microbes, and fungi, their DNA, and ecosystems.</p> <p>Biodiversity, in the full sense of the term, is not monitored and is not readily quantified.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Conceptual model</b>                                      | <p>Conceptual models can take a number of forms. They are often defined as a type of diagram which shows of a set of relationships between factors that are believed to impact or lead to a target condition; a diagram that defines theoretical entities, objects, or conditions of a system and the relationships between them. In the context of this project conceptual models will illustrate the response of cultural and ecological values to the delivery of cultural flows.</p>                                                                                                                                                                                                                                                                                                                                                                |
| <b>Condition (ecosystem, vegetation, community, species)</b> | <p>The state or health of individual animals or plants, communities or ecosystems.</p> <p>Condition of an ecosystem, vegetation type, ecological community or species describes whether, and how much, it differs from an unimpacted or reference state.</p> <p>Condition can be described using a number of attributes. For example in assessing vegetation condition, the most commonly-used attributes are abundance or extent, vegetation structural features, species composition, nativeness, age structure and vigour. Condition is referential, meaning the vegetation attributes at a site are compared to a reference condition or benchmark or ideal state for that site.</p> <p>In the case of a species, typically a tree, or a stand of trees, condition means vigour, and condition describes how vigorous the canopy appears to be.</p> |

| Term                        | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | Condition is based on observations of the canopy such as canopy cover, foliage density, and extent of dieback.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Condition assessment</b> | A means to assess long-term changes in natural conditions and to assess long-term changes resulting from widespread anthropogenic activity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Diversity</b>            | <p>Diversity is the number of entities in a sample and the evenness of their abundance; in the case of species diversity, number and evenness are combined into a single value, using a diversity index.</p> <p>Most often diversity means species diversity, but other types of diversity can be described and reported on such as structural diversity, community diversity, genetic diversity and functional diversity in ecological studies: in these cases, 'diversity' is used rather loosely to mean variability, with no standard quantitative measures. The term 'biodiversity' is not the same as species diversity and has its own meaning.</p> |
| <b>Ecological character</b> | The combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time. [Within this context, ecosystem benefits are defined in accordance with the MA definition of ecosystem services as "the benefits that people receive from ecosystems".] (Resolution IX.1 Annex A) (Ramsar 2012).                                                                                                                                                                                                                                                                                                      |
| <b>Ecological community</b> | An assemblage of organisms characterised by a distinctive combination of species occupying a common environment and interacting with one another (ANZECC and ARMCANZ 2000).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Ecosystems</b>           | The complex of living communities (including human communities) and non-living environment (Ecosystem Components) interacting (through Ecological Processes) as a functional unit which provides inter alia a variety of benefits to people (Ecosystem Services) (Millennium Ecosystem Assessment 2005).                                                                                                                                                                                                                                                                                                                                                   |
| <b>Ecosystem components</b> | Include the physical, chemical and biological parts of a wetland.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Ecosystem processes</b>  | Are changes or reactions which occur naturally within wetland ecosystems. They may be physical, chemical or biological. This equates to process such as carbon cycling, denitrification, acidification, sedimentation, migration, breeding, reproduction, etc.                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Ecosystem functions</b>  | Are activities or actions which occur naturally in wetlands as a product of the interactions between the ecosystem structure and processes. Functions as defined by Ramsar include flood water control; nutrient, sediment and contaminant retention; food web support; shoreline stabilization and erosion controls; storm protection; and stabilization of local climatic conditions, particularly rainfall and temperature.                                                                                                                                                                                                                             |
| <b>Ecosystem services</b>   | The benefits that people receive or obtain from an ecosystem. The components of ecosystem services are provisioning (for example food and water), regulating (for example flood control), cultural (for example spiritual, recreational), and supporting (for example nutrient cycling, ecological value). (Millennium Ecosystem Assessment 2005). See also "Benefits"                                                                                                                                                                                                                                                                                     |



| Term                           | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geomorphology</b>           | The study of the evolution and configuration of landforms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Goal</b>                    | <p>A goal is a concise, general statement of the overall purpose of a program.</p> <p>For example:</p> <p>“To ensure that environmental water allocations provide the greatest ecological benefits to receiving waterbodies”</p> <p>“To manage wetlands to provide habitat for breeding migratory birds”</p>                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Indicator (ecological)</b>  | <p>Refers to representative, measurable parameter which conveys useful information concerning ecosystem condition. These can be physico-chemical and/or biological.</p> <p>Ecological indicators assess the condition of the environment, and can provide an early warning signal of changes in the environment. They can also be used to diagnose the cause of an environmental problem. Ideally the suite of indicators used in a monitoring program should represent key information about structure, function, and composition of the ecological system (Dale and Beyer 2001).</p>                                                                                                                                                     |
| <b>Intervention</b>            | <p>A management activity that seeks to change an ecosystem’s state or condition and achieve a management objective. In this case the intervention is the delivery of a cultural flow.</p> <p>See also intervention monitoring.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Intervention monitoring</b> | Supports the evaluation of management interventions by quantifying the response to specific management interventions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Inventory (wetland)</b>     | The collection and/or collation of core information for wetland management, including the provision of an information base for specific assessment and monitoring activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Monitoring (wetland)</b>    | <p>Collection of specific information for management purposes in response to questions derived from assessment activities, and the use of these monitoring results for implementing management. (Note that the collection of time-series information that is not question-driven from wetland assessment should be termed surveillance rather than monitoring).</p> <p>The key aspects of an environmental monitoring program therefore are:</p> <ul style="list-style-type: none"> <li>• It is specific and hypothesis driven (i.e. it answers a specific question);</li> <li>• It involves the collection of information over time (i.e. multiple sampling events); and</li> <li>• It is used to inform ecosystem management.</li> </ul> |
| <b>Richness</b>                | Richness is the number recorded. It is most commonly used to refer to species, as in species richness.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Term                    | Definition                                                                                                                                                                                               |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | See: species richness                                                                                                                                                                                    |
| <b>Species richness</b> | <p>Species richness is the number of species recorded, for example, in a sample.</p> <p>Species richness is sensitive to sampling effort (number of quadrats, size of quadrats, total area sampled).</p> |

## EXECUTIVE SUMMARY

The National Cultural Flows Research Project (“the Project”) is about developing rigorous and defensible knowledge, with the aim of securing water entitlements for the benefit of Aboriginal people across Australia (NNTC, 2014). This research relies on the participation of members of the Aboriginal Nations at two case study sites within the Murray Darling Basin to investigate and measure the cultural values of water to Aboriginal people. The Project will assess both tangible and intangible facets of water delivered to achieve cultural outcomes, with the primary focus of developing methodologies that will record and assess Aboriginal cultural values and uses regarding watering requirements.

The Project consists of the following components (NCFRP 2014):

- **One:** Describe the Indigenous cultural water values and needs across Australia (completed January 2014).
- **Two:** Develop and use methodologies to describe and measure the cultural water uses, values and needs of particular Australian Indigenous communities.
- **Three:** Quantify water volumes to meet cultural values and needs (both Murrawarri and Nari Nari) and scientific assessment of a trial flow at Toogimbie Indigenous Protected Area (IPA), near Hay New South Wales (NSW).
- **Four:** Develop and implement a monitoring methodology of the ecological and socioeconomic, health and wellbeing outcomes of cultural flows and analyse how they compare with environmental flow outcomes.
- **Five:** Recommend policy, legal, and institutional changes that will enable the implementation of cultural flows.
- **Six:** Building the capacity of Aboriginal organisations to build support for cultural water provisions and to implement recommendations for improved local and national water management, planning, policies and laws.

This monitoring and evaluation (M&E) plan is part of Component Three (above) and outlines the key monitoring and evaluation activities that would be conducted by and on behalf of the Murrawarri people at Weilmoringle, northern NSW, should any part of a future cultural flow activity occur at Gooraman Swamp.

**Note: the delivery of a cultural flow to Gooraman Swamp is out of scope of the Project. However, some baseline information and the trial of monitoring methods will be undertaken as part of the Project.**

The use of cultural flows in the future is expected to contribute to meeting the aspirations of the Murrawarri in terms of:

- Integrating Aboriginal cultural and social perspectives, which also include environmental considerations;
- Re-establishing intergenerational links between instruction and cultural practice;
- Fulfilment of spiritual and cultural obligations through landscape management;
- Retaining the indigenous population with quality of life and wellbeing improvements.

Any future cultural flow will focus on Gooraman Swamp near Weilmoringle in northern NSW. Gooraman Swamp is a deflation basin perched on the floodplain of the Culgoa River. The local vegetation consists of river red gum and black box wood within and at the margins of the wetland,



interspersed with coolabah. Gooraman Swamp is approximately 28 hectares in size and has a volume of approximately 320 ML at a full supply level.

The nature of water delivery is yet to be assessed or confirmed, but could include options such as overbank flows from the Culgoa River, or pumping from the river when water levels are above low flow but below overbank flow. Each approach has constraints, such as dependencies on water and flood management within the wider catchment, or the requirement for pumping infrastructure and social acceptance.

Cultural values associated with Gooraman Swamp and its surrounds, including the Culgoa River, have been identified from ongoing discussions meetings and field visits with the Murrawarri Nation. Water is a key feature of the landscape, and integral to maintaining or improving the condition of values at Gooraman Swamp. A detailed description of this process is provided in NCFRP (2016a). Some of the identified values attached to the site include:

- A sense of connection and obligation to culture and country;
- A place to visit and reconnect physically to culture and country;
- The location of sites of significance and associated cultural practices;
- A source of bush medicine food and natural resources that can maintain or improve the health of Murrawarri;
- A source of socio-economic potential for Murrawarri.

The cultural values summarised above are inclusive of environmental values in a western science sense:

- Vegetation diversity, reproduction and condition:
  - Abundance and extent (bush tucker and medicine plants);
  - Vegetation condition (river red gum, black box, coolabah);
- Waterbird diversity, reproduction and population condition:
  - Waterbird condition (harvest of selected species);
  - Diversity and abundance;
- Fish diversity, reproduction and condition:
  - Fish condition (availability and harvest of selected species);
- Water quality and hydrological connectivity:
  - Salinity, pH (water quality for community events such as swimming);
  - Hydrological connectivity (connection of the Culgoa River and Gooraman Swamp).

Cultural flow objectives have been aligned with the aspirations, as well as the intermediate and long-term outcomes expressed by the Murrawarri Nation. Aspirations of the Murrawarri are to:

- Establish Aboriginal cultural, social and environmental perspectives in water management;
- Re-establish inter-generational instruction and cultural practice;
- Fulfil spiritual and cultural obligations through landscape management; and
- Retain the community population with quality of life and well-being improvements.

Overall, the long-term objective set for cultural flows by the Murrawarri (NCFRP 2016b) is to: **re-establish cultural management of country, including cultural practices and wellbeing associated with law, ceremony, trade, education and language.** Cultural water will be used to:





- a) Re-establish a water regime at Gooraman Swamp to match the no-development flood pattern through enhanced flow in the Culgoa River to ensure that it is available for cultural practice and supports cultural economy and wellbeing.
- b) Promote Murrawarri ownership and management of a cultural water allocation including quantities, timing and resource requirements for cultural, socio-economic, and environmental outcomes in place by 2020.

The Murrawarri have further defined the overall objective listed above to (NCFRP 2016b):

1. Re-establish the historical water regime at Gooraman Swamp to match the no-development flood pattern through increasing the flows of the Culgoa River and to ensure Aboriginal law for maintaining longitudinal connectivity to downstream communities is achieved by 2020.
2. Establish an agreement on cultural management of water for cultural, socio-economic and Aboriginal environmental outcomes by 2020.
3. Re-establish and maintain condition of culturally significant ceremonial, spiritual and exceptional value plant species (as per Dykes et al. 2006) to allow continued practice of cultural activities by 2020.
  - a. Improved condition of water dependent riverine and floodplain plant species of exceptional cultural importance, including Wirrara (lignum, *Duma florulenta*), Thawinj-thawinj (Nardoo, *Marsilea drumondii*), Kimay (yam, *Triglochin* sp.).
  - b. Improved condition of floodplain and wetland plant species of ceremonial and spiritual significance by 2020, including Kuruwa (river red gum, *Eucalyptus camaludensis*) and Wumbul (tea tree/swamp paperbark, *Melaleuca trichostachya*).
4. Increased use of country for intergenerational training and community participation in cultural activities by 2020.
  - a. Improved condition of, and access to floodplain food, artefact and medicinal plants including quinine (*Alstonia constricta*), gidgee (stinking wattle – *Acacia cambadgei*), native orange (bumble tree – *Capparis mitchellii*), quandong (*Santalum acuminatum*), willbill (*Eremophila bignoniiflora*) and snotty gobbles (mistletoe – *Lysiana*, *Amyema* and *Dendrophthoe* species) by 2020.
  - b. Increased abundance of key fish harvest species (especially cod (*Maccullochella peelii*), but also yellow-belly (*Macquaria ambigua*), and catfish (*Tandanus tandanus*) by 2020.
  - c. Increased abundance of key terrestrial harvest species (kangaroo, emu including eggs, echidna, and wild turkey) by providing improved floodplain habitat (foraging areas) by 2020.
  - d. Promote seed set of key floodplain plant species to allow seed collection activities (lignum, willbill, gidgee, snotty gobbles, nardoo) by 2025.
  - e. Increased cultural management activity including seed collection and fire management by 2025.
5. Improved water quality in the Culgoa River to increase community use for recreational activities (i.e. swimming and fishing) by 2020.

Should a future cultural flow occur at Gooraman Swamp, it is likely that the potential water will be secured from the Commonwealth Environmental Water Holder (CEWH) holdings, therefore the monitoring of outcomes presented in this report have been aligned to the monitoring, evaluation, reporting and improvement (MERI) framework used by the CEWH for managing its water holdings.



A conceptual understanding of the relationship of cultural flows with Murrawarri aspirations and watering objectives has been used to propose a series of key evaluation questions to be addressed by the M&E plan. Indicators were then selected for monitoring at Gooraman Swamp, including both governance and watering outcome indicators. Indicators include:

- Governance and water delivery:
  - Timing, volume and duration of water delivered;
- Cultural (social and economic) outcomes:
  - Cultural well-being parameters developed in consultation with the Murrawarri;
- Vegetation:
  - River red gum and black box condition;
  - Wetland floristics, including the abundance and extent of key species of interest (quinine bush, quandong, snotty gobblers, gidgee);
- Waterbirds:
  - Abundance of key waterbird species (white and straw neck ibis, royal spoonbill, swans, pacific black duck);
  - Breeding by key waterbird and other bird species (emu, in addition to the above)

Standard methods have been included for each indicator, along with data collection and management standards, and a description of potential data evaluation methods. Potential risks associated with a conceptual delivery of cultural flows have also been included, along with any mitigation measures that might be deployed should a flow occur in the future. Reporting requirements and opportunities for maintaining M&E activities into the future are also discussed.

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# 1 BACKGROUND

The National Cultural Flows Research Project (“the Project”) is about developing rigorous and defensible knowledge, with the aim of securing water entitlements for the benefit of Aboriginal people across Australia (NCFRP 2014). This research relies on the participation of members of the Aboriginal Nations at two case study sites within the Murray Darling Basin to investigate and measure the cultural values of water to Aboriginal people – it’s driven by Aboriginal people and for Aboriginal people. The Project will assess both tangible and intangible facets of water delivered to achieve cultural outcomes, with the primary focus of developing methodologies that will record and assess Aboriginal cultural values and uses regarding watering requirements.

The definition of “cultural flows” was endorsed by representatives from 31 Indigenous nations at a joint meeting of the Murray Lower Darling River Indigenous Nations (MLDRIN) and the Northern Basin Aboriginal Nations (NBAN) - The Echuca Declaration, September 2010 (NCFRP 2014) as:

*...water entitlements that are legally and beneficially owned by the Indigenous Nations of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Nations. This is our inherent right.*

The Project seeks to assess the use of water delivered to achieve cultural outcomes in partnership with two Aboriginal Nations (the Murrawarri and Nari Nari). The approach is outlined in NCFRP (2016a) and is built around the planning required for delivering and evaluating cultural flows, combining cultural, ecological and hydrological components. This includes assessing a watering trial at the Nari Nari land near Hay, New South Wales (NSW), and planning for future cultural flows at Murrawarri land at Weilmoringle in northern NSW. The long-term view is that the information collected from this project will inform future Australian water resource planning and implementation processes more generally and will provide further evidence for the need of a National Cultural Flows Framework.

Oversight of the Project is by the National Cultural Flows Planning and Research Committee (the Research Committee). The Research Committee represents its member organisations: MLDRIN; NBAN and the Northern Australia Land and Sea Management Alliance (NAILSMA) along with representatives from the office of Commonwealth Environmental Water Holder (CEWH), Murray Darling Basin Authority (MDBA), National Native Title Council (NNTC) and nominated State government agencies.

The Project consists of the following components (NCFRP 2014):

- **One:** Describe the Indigenous cultural water values and needs across Australia (completed January 2014).
- **Two:** Develop and use methodologies to describe and measure the cultural water uses, values and needs of particular Australian Indigenous communities.
- **Three:** Quantify water volumes to meet cultural values and needs (both Murrawarri and Nari Nari) and scientific assessment of a trial flow at Toogimbie Indigenous Protected Area (IPA), near Hay NSW.
- **Four:** Develop and implement a monitoring methodology of the ecological and socioeconomic, health and wellbeing outcomes of cultural flows and analyse how they compare with environmental flow outcomes.
- **Five:** Recommend policy, legal, and institutional changes that will enable the implementation of cultural flows.



- **Six:** Building the capacity of Aboriginal organisations to build support for cultural water provisions and to implement recommendations for improved local and national water management, planning, policies and laws.

This monitoring and evaluation (M&E) plan is part of Component Three (above) and outlines the key monitoring and evaluation activities to be conducted by and on behalf of the Murrawarri people as part of any future cultural flow conducted as part of the Project.

Monitoring includes the measurement of indicators that will help confirm that the benefits expected with the delivery of cultural flows occur as anticipated. Being able to demonstrate the benefits of cultural flows at Gooraman Swamp will make it easier to secure cultural flows in the future, both for the Murrawarri and elsewhere.

Monitoring and evaluation within a 'learning by doing' (i.e. adaptive management framework, see Section 3) will also be important should the outcomes expected from cultural flows not occur fully, or as anticipated, particularly within short timeframes. In such circumstances, it will be possible to consider whether factors such as the timing, volume and duration of cultural flows was sufficient, and whether changes to cultural flow delivery might be required over time (e.g. outcomes might be over the medium rather than short term).

This M&E plan has been prepared on the assumption that a cultural flow will be delivered to Gooraman Swamp near Weilmoringle (Figure 1 and Figure 2) at some point in the future (subject to constraints on securing and delivering any potential water in the future).

This plan is structured as follows:

- **Chapter 2:** Includes a summary of Murrawarri community aspirations for the use of water allocations for cultural purposes, as well as summaries of catchment settings and water delivery issues.
- **Chapter 3:** Provides a brief overview of important cultural and environmental values and their relationship to watering objectives and outcomes.
- **Chapter 4:** Summarises the conceptual basis of watering to achieve cultural and environmental outcomes, along with the indicators that will be part of monitoring and evaluation. This chapter will also outline the key monitoring and measurement methods to be applied, as well as describe how monitoring data are to be analysed.
- **Chapter 5:** Outlines the process for assessing risks associated with water delivery and if, necessary, required mitigation measures.
- **Chapter 6:** Details the reporting requirements of any future cultural flow activities.

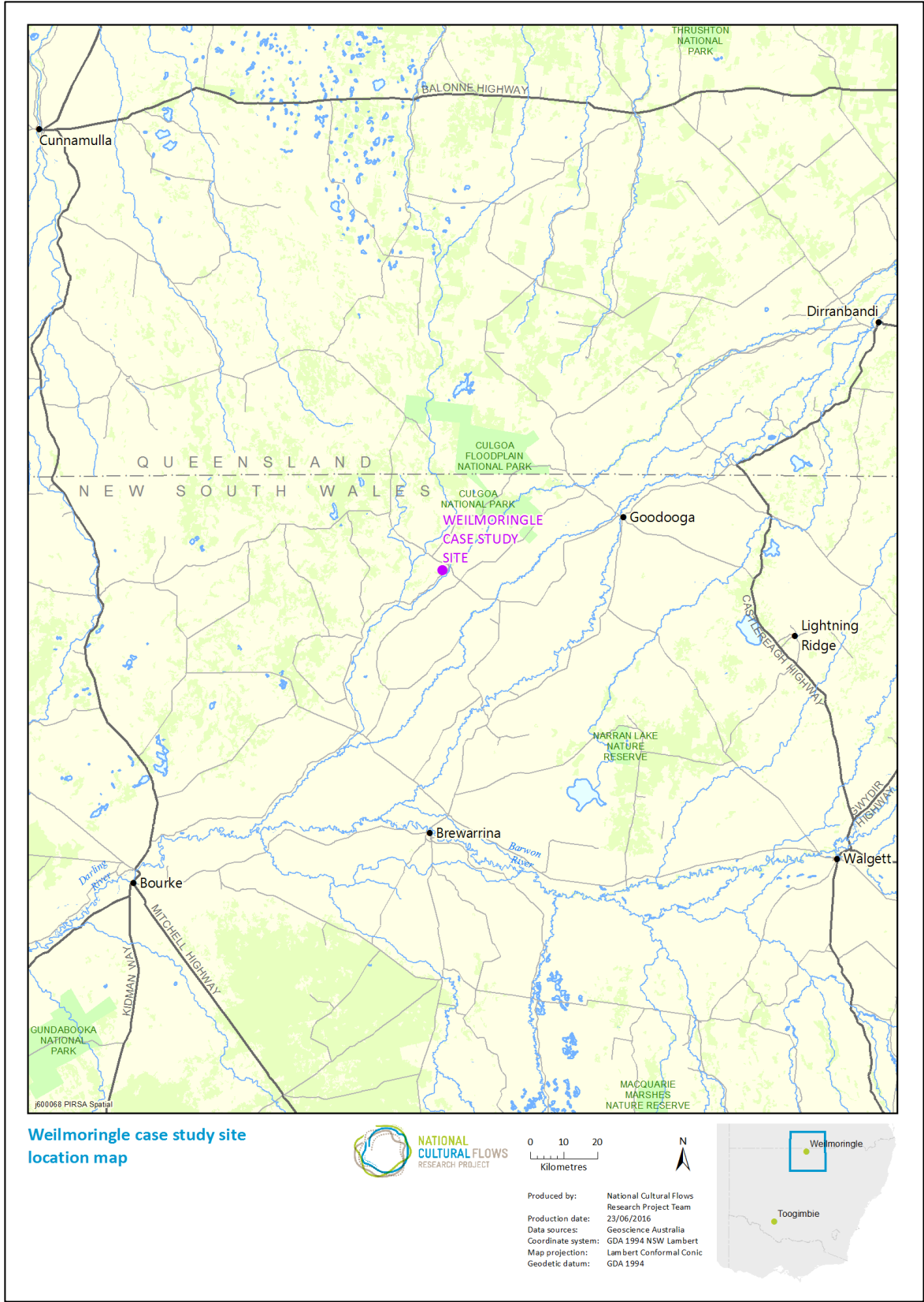
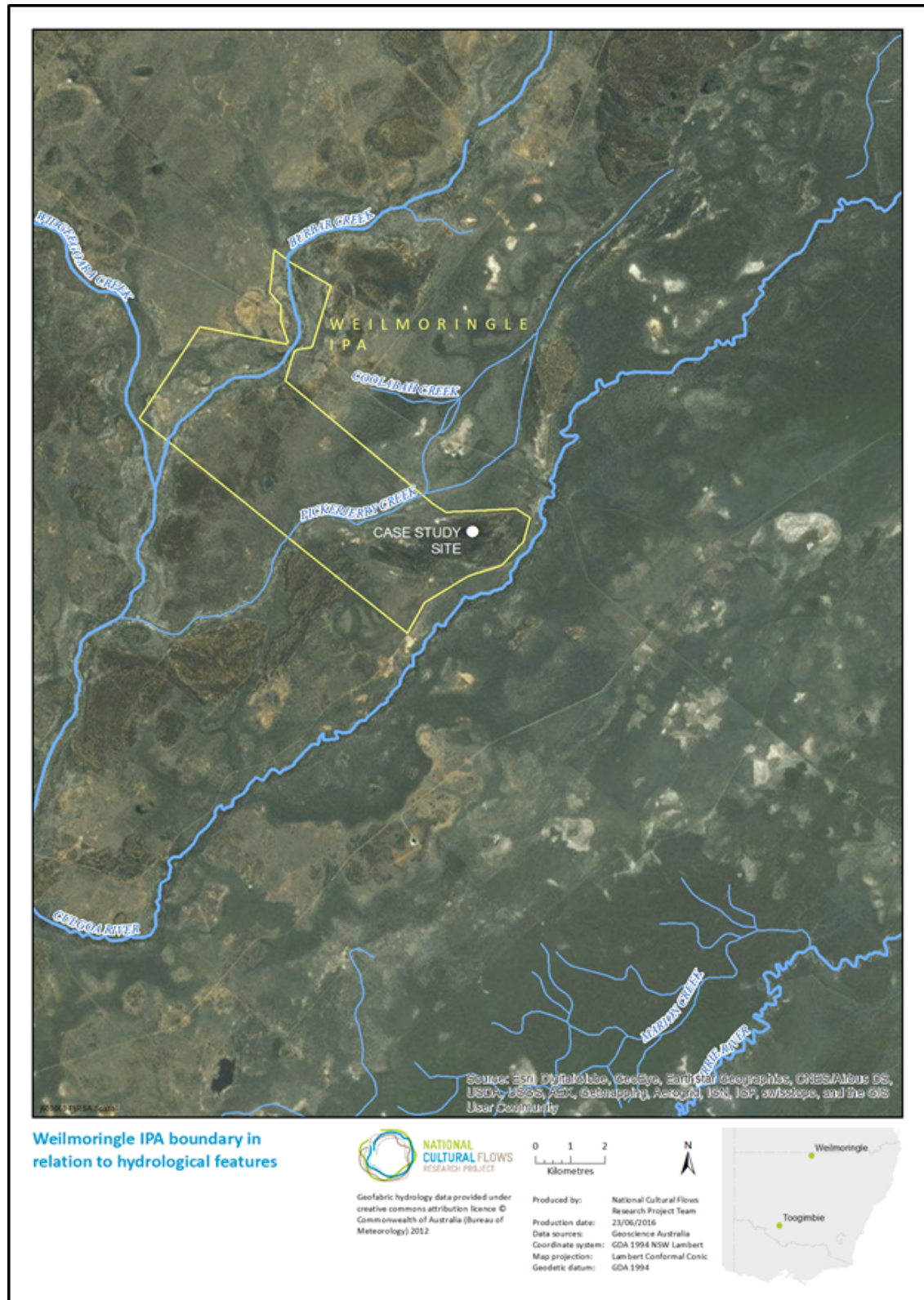


Figure 1: Location of Gooraman Swamp case study site in relation to topographic features





**Figure 2: Gooraman Swamp case study site in relation to Weilmoringle IPA and hydrological features**

## 2 CONTEXT

### 2.1 Murrawarri aspirations

The high-level goals that will be achieved by using cultural flows reflect a mix of cultural, spiritual and environmental outcomes centring on Gooraman Swamp and its connection to the Culgoa River. Ultimately, Murrawarri people aspire to a return of the pre-1990 frequency of natural inundation of Gooraman Swamp. The use of cultural flows is expected to contribute to meeting the aspirations of the Murrawarri in terms of:

- Integrating and strengthening Aboriginal cultural and social perspectives, which also include environmental considerations;
- Maintaining and continuing intergenerational knowledge and cultural practice;
- Fulfilment of spiritual and cultural obligations through landscape management;
- Retaining the Aboriginal population with quality of life and wellbeing improvements.

### 2.2 Cultural Importance of water

Ongoing discussions with the Murrawarri (see NCFRP 2016 for further details) reinforced the cultural importance of water:

- Ownership of a water allocation is pivotal to enable the Murrawarri to actively participate in water planning and management with the same status and on equal terms with other water users in the system.
- Restoration of the water regime at Gooraman Swamp is necessary for Murrawarri Traditional Owners to fulfil cultural obligations to maintain the ecological health of the site. In particular, there is a deep spiritual significance to the health of the river red gums at Gooraman Swamp, which depends on a flow regime that is no longer satisfied in the altered Culgoa River system. There is also deep spiritual connection related to the protection of interconnected water places in the area associated with the movement of *Mundaguddah* (Rainbow Serpent). Each of these sites has associated cultural practices, obligations and established cultural prohibitions linked to water availability.
- Fulfilment of custodial responsibility for vegetation management at the site. Each clan group within the Murrawarri has custodial responsibility for the management of different vegetation types, as part of a holistic cultural management regime. Alterations to water availability in the system limit the fulfilment of those obligations.
- Custodial responsibility of the Murrawarri to other Traditional Owner nations downstream, under Aboriginal law.

### 2.3 Catchment setting

Gooraman Swamp is located on the floodplain of the Culgoa River in northern NSW, approximately 20 kilometers (km) southwest of the Culgoa National Park. The Culgoa River is a branch of the Ballone River that rises in southern Queensland. The river flows in a southwesterly direction for approximately 490 km from downstream of St George in southern Queensland to its confluence with the Darling River in NSW, between Bourke and Brewarrina.

The regional climate is semi-arid, with an average annual rainfall of approximately 410 millimetres (mm) (Bureau of Meteorology data, unpublished), is typified by cool winters and hot





summers. The rainfall pattern is that of a summer-rainfall region, with highest mean rainfall in January and February and lowest rainfall in winter and spring.

Weilmoringle township and surrounding land is situated within the western district of the Darling Riverine Plains Bioregion. The bioregion is characterized by extensive floodplains of 10 major rivers: the Barwon-Darling, Culgoa, Birrie, Bokhara, Narran, Gwydir, Namoi, Castlereagh, Macquarie and Bogan. It has been estimated that 10 to 20% of the native vegetation in the Western Division has been cleared for agriculture, which is less such disturbance than other parts of the bioregion (NPWS 2003, 2003). The area surrounding Weilmoringle is comprised of Northern Riverine Woodlands, which is a habitat type that includes river red gum woodlands along river frontages and extensive coolibah–black box woodlands on the floodplains of the Culgoa River. As noted by the NPWS (2003, 2002) and Hunter (2005), the riverine woodlands on the Culgoa River floodplain (particularly in the nearby Culgoa National Park) are the largest and least disturbed area of contiguous Coolibah woodland left in NSW.

Gooraman Swamp is a deflation basin perched on the floodplain of the Culgoa River. The local vegetation consists of river red gum and black box wood within and at the margins of the wetland, interspersed with coolabah. Gooraman Swamp is approximately 28 hectares in size and has a volume of approximately 320 ML at a full supply level (FSL, 125.6 m AHD) (Figure 3).



**Figure 3: Aerial photograph showing the inundated area of Gooraman Swamp at FSL**

## 2.4 Water delivery

A major cultural water objective identified by the Murrawarri (see section 3.3) is to re-establish the historical water regime at Gooraman Swamp to match the ‘no-development’ flood pattern through increasing baseflows of the Culgoa River and to ensure Aboriginal law for maintaining longitudinal connectivity to downstream communities is achieved. Two water delivery options were considered in terms of watering Gooraman Swamp; of these, Option 1 was considered inadequate as it did not provide for longitudinal connectivity and obligations to downstream communities:

- Option 1: the installation of low footprint infrastructure (e.g. pumps and PVC pipeline) that would enable pumping to Gooraman Swamp when flows in the Culgoa River are above baseflow but below bankfull
- Option 2: reliance on natural overbank flow (flood) events of sufficient magnitude that water enters Gooraman Swamp via flow across the floodplain.

While water delivery to Gooraman Swamp based on overbank flows from the Culgoa River (Option 2) is preferred by the Murrawarri, it is problematical in that any potential delivery of water to the site will require further investigation and agreement with the NSW and Queensland governments, as with upstream and downstream water users and other stakeholders. This will require ongoing consultation and partnerships with the two State governments and other water user groups.

## 3 CULTURAL AND ENVIRONMENTAL VALUES AND WATERING OBJECTIVES

### 3.1 Summary of cultural values

Cultural values associated with Gooraman Swamp and its surrounds, including the Culgoa River, have been identified from ongoing discussions, meetings and field visits with the Murrawarri community. A detailed description of this process is provided in NCFRP (2016b). Values attached to the site are summarised in Figure 4, which is a very simplified depiction of the inter-connection of the Murrawarri people as part of country, and include:

- A sense of connection and obligation to culture and country, both on Murrawarri country and to downstream communities;
- A place to visit and reconnect physically to culture and country;
- The location of sites of significance and associated cultural practices;
- A source of bush medicine, food and natural resources that can maintain or improve the health of Murrawarri;
- A source of socio-economic potential for Murrawarri.

It is important to note that while there may be short-term cultural benefits from the delivery of cultural flows, achieving the overall objectives associated with cultural flows will require a long-term perspective beyond the scope of the Project. While this M&E plan focuses on the on-ground activities required to monitor and assess short to medium-term responses and outcomes, it is desired that it be extended to a long-term project using an adaptive management approach such as that outlined in Section 4 (Figure 6).

## GOORAMAN SWAMP MONITORING AND EVALUATION PLAN

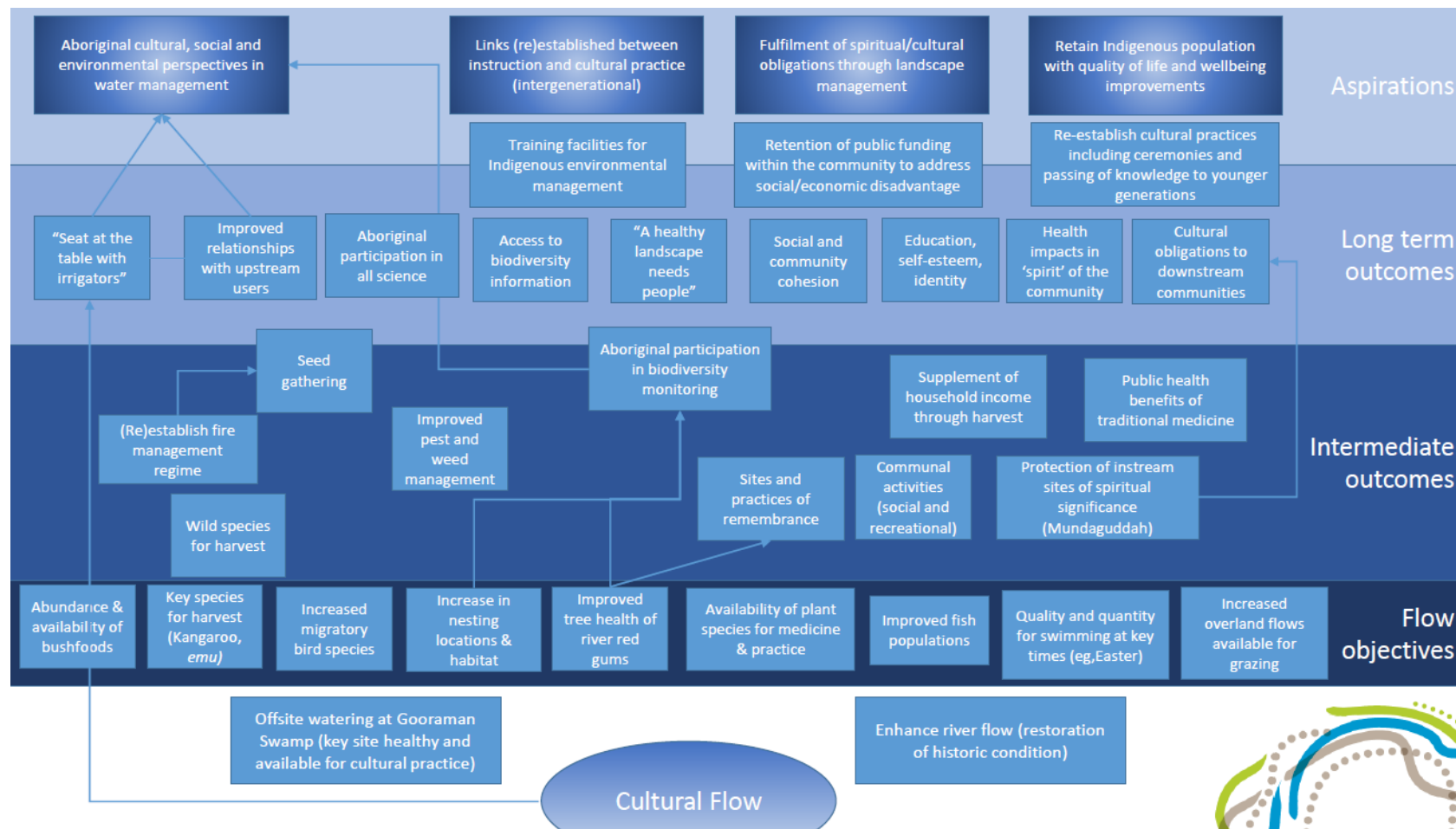


Figure 4: Summary of the inter-relationships between intermediate and long-term outcomes from cultural flows and the aspirations of the Murrawarri people (NCFRPC 2016).

### 3.2 Relationship to environmental values

The cultural watering outcomes described in Section 3.1 above suggest that environmental values (in the western science sense) include:

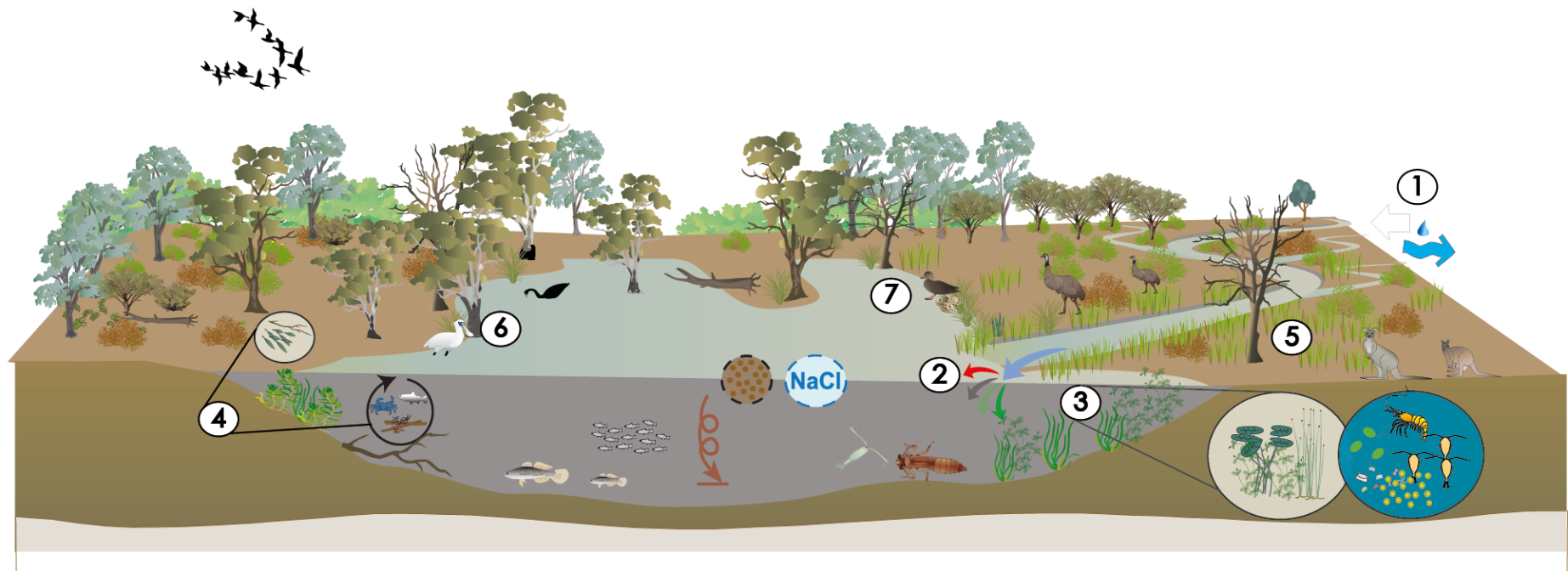
- Vegetation diversity, reproduction and condition:
  - Abundance and extent (bush tucker and medicine plants);
  - Vegetation condition (river red gum, black box, coolabah);
- Waterbird diversity, reproduction and population condition:
  - Waterbird condition (harvest of selected species);
  - Diversity and abundance;
- Fish diversity, reproduction and condition:
  - Fish condition (availability and harvest of selected species);
- Water quality and hydrological connectivity:
  - Salinity, pH (water quality for community events such as swimming);
  - Hydrological connectivity (connection of the Culgoa River and Gooraman Swamp).

The relationship between cultural flows and environmental processes at Gooraman Swamp are outlined further in Figure 5. Given that cultural flows to the site will be delivered as flow pulses (fresches, bankfull, overbank flows), the environmental outcomes expected will be similar to those expected with watering in the northern Murray Darling Basin rivers (Table 1).

**Table 1: Expected outcomes from the use of Commonwealth environmental water in the northern Murray Darling Basin rivers (from Commonwealth of Australia 2014).**

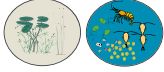
| Flow Type                       | Expected outcomes for 2014–15                               | Contributions to longer term objectives      | Contribution to the following Basin Plan objective |
|---------------------------------|-------------------------------------------------------------|----------------------------------------------|----------------------------------------------------|
| Fresches                        | Salinity<br>Dissolved oxygen pH<br>Dissolved organic carbon | Chemical                                     | Water quality                                      |
| Fresches and bankfull           | Nutrient and carbon cycling                                 | Process                                      | Ecosystem function                                 |
| Fresches, bankfull and overbank | Fish reproduction<br>Fish condition                         | Fish diversity                               | Biodiversity                                       |
| Bankfull and overbank           | Vegetation reproduction<br>Vegetation condition             | Vegetation diversity                         | Biodiversity                                       |
|                                 | Waterbird survival and condition                            | Waterbird diversity and population condition |                                                    |
|                                 | Waterbird chicks<br>Waterbird fledglings                    | Waterbird diversity                          |                                                    |
| All flow types                  | Hydrological connectivity including end of system flows     | Connectivity                                 | Ecosystem function                                 |
|                                 | Biotic dispersal and movement                               |                                              |                                                    |





**Figure 5: Illustration of ecological character of Gooraman Swamp after filling.**

Key to Figure 5:

1.  Overbank flows across the floodplain will promote exchange of nutrients between the Culgoa, floodplain and the wetland. It will also promote regeneration in floodplain vegetation, both grasses and woody vegetation.
2.  Gooraman Swamp fills predominantly from overland flows from the Culgoa River, but also receives inflows from local runoff and direct rainfall. Connectivity with groundwater is possible, but is a knowledge gap. Overland flows transport  nutrients,  sediments, and  organic material from the floodplain and upstream sources.  Biota are also brought into the system on floodwaters, including plant seeds and propagules, invertebrates and fish.
3.  Floodplain systems and intermittent wetlands display a typical boom and bust cycle of seed germination and egg hatching from the seed and egg banks respectively, resulting in a plant and animal community typical of an intermittent semi-arid zone floodplain wetland, with short term high productivity and temporary water specialists.

4.  The dominant food web is detrital based on the floodplain and in the wetland, with large inputs of organic matter accumulated on the dry wetland bed in between flood events aiding the boom of production when water arrives. The woody debris and leaves provide also provide important structural habitat for invertebrates.
5.  Overland flooding promotes floodplain vegetation growth, particularly grasses, along the Culgoa floodplain surrounding the Gooraman Swamp which in turn supports grazing animals and foraging areas for important cultural foods such as emu and kangaroo.
6.  Presence of water supports a diversity of waterbirds, most likely predominantly ducks, grebes, swan, spoonbills, ibis and rails and crakes.
7.  Flooding may support breeding of waterbirds, most likely duck species. Some colonial nesting species may use the wetland but they are likely to only be in small numbers.

Water quality and physical processes characteristic of overland flows in Gooraman Swamp include:



Salinity is low



and turbidity low to moderate, largely reflect levels of the source water. Salinity levels will increase as the wetland dries, some



sedimentation will occur in the wetland and on

the floodplain.   Overbank flows promote transport and dilution of carbon both to and from the floodplain, which contribute to productivity both in-stream and off-stream.

Biological processes characteristic of fully inundated Gooraman Swamp include:



Once full, water remains in the wetland for over a year and supports a productive and complex aquatic ecosystem, with features characteristic of boom and bust ecosystems. Aquatic macrophytes establish from the seed bank and also arrive as propagules from inflows from the Culgoa. Invertebrates hatch from the soils on wetting and establish both micro and macroinvertebrate communities which in turn support a fish.



Periodic flooding of the wetland sustain River Red Gum trees, promoting regeneration in and around the edges of the wetland. Larger floods reaching to the Black Box woodlands are less frequent and water remains on the floodplain for less time.

Combined these components and process represent the ecological character of Gooraman Swamp after flooding.

### 3.3 Cultural watering objectives

Cultural flow objectives have been aligned with the aspirations, as well as the intermediate and long-term outcomes expressed by the Murrawarri Nation. Aspirations of the Murrawarri are to:

- Establish Aboriginal cultural, social and environmental perspectives in water management;
- Re-establish inter-generational instruction and cultural practice;
- Fulfil spiritual and cultural obligations through landscape management; and
- Retain the community population with quality of life and well-being improvements.

Overall, the long-term objective set for cultural flows by the Murrawarri (NCFRP 2016b) is to: **re-establish cultural management of country, including cultural practices and wellbeing associated with law, ceremony, trade, education and language.** Cultural water will be used to:

- c) Re-establish a water regime at Gooraman Swamp to match the no-development flood pattern through enhanced flow in the Culgoa River to ensure that it is available for cultural practice and supports cultural economy and wellbeing.
- d) Promote Murrawarri ownership and management of a cultural water allocation including quantities, timing and resource requirements for cultural, socio-economic, and environmental outcomes in place by 2020.

The Murrawarri have further defined the overall objective listed above to (NCFRP 2016b):

6. Re-establish the historical water regime at Gooraman Swamp to match the no-development flood pattern through increasing the flows of the Culgoa River and to ensure Aboriginal law for maintaining longitudinal connectivity to downstream communities is achieved by 2020.
7. Establish an agreement on cultural management of water for cultural, socio-economic and Aboriginal environmental outcomes by 2020.
8. Re-establish and maintain condition of culturally significant ceremonial, spiritual and exceptional value plant species (as per Dykes et al. 2006) to allow continued practice of cultural activities by 2020.
  - a. Improved condition of water dependent riverine and floodplain plant species of exceptional cultural importance, including Wirrara (lignum, *Duma florulenta*), Thawinj-thawinj (Nardoo, *Marsilea drumondii*), Kimay (yam, *Triglochin* sp.).
  - b. Improved condition of floodplain and wetland plant species of ceremonial and spiritual significance by 2020, including Kuruwa (river red gum, *Eucalyptus camaludensis*) and Wumbul (tea tree/swamp paperbark, *Melaleuca trichostachya*).
9. Increased use of country for intergenerational training and community participation in cultural activities by 2020.
  - a. Improved condition of, and access to floodplain food, artefact and medicinal plants including quinine (*Alstonia constricta*), gidgee (stinking wattle – *Acacia cambadjei*), native orange (bumble tree – *Capparis mitchellii*), quandong (*Santalum acuminatum*), willbill (*Eremophila bignoniiflora*) and snotty gobbles (mistletoe – *Lysiana*, *Amyema* and *Dendrophthoe* species) by 2020.
  - b. Increased abundance of key fish harvest species (especially cod (*Maccullochella peelii*), but also yellow-belly (*Macquaria ambigua*), and catfish (*Tandanus tandanus*) by 2020.

- c. Increased abundance of key terrestrial harvest species (kangaroo, emu including eggs, echidna, and wild turkey<sup>1</sup>) by providing improved floodplain habitat (foraging areas) by 2020.
  - d. Promote seed set of key floodplain plant species to allow seed collection activities (lignum, willbill, gidgee, snotty gobbler, nardoo) by 2025.
  - e. Increased cultural management activity including seed collection and fire management by 2025.
10. Improved water quality in the Culgoa River to increase community use for recreational activities (i.e. swimming and fishing) by 2020.

In addition, the Murrawarri have outlined the following aboriginal environmental objectives to be achieved with the use of cultural flows (NCFRP 2016b):

1. Improved condition of riverine and floodplain river red gum (*Eucalyptus camaldulensis*), black box (*Eucalyptus largiflorens*), river coolabah (*Eucalyptus coolabah*) dominated woodlands at Weilmoringle IPA by 30% by 2025.
2. Restore resilient populations of Murray cod (*Maccullochella peelii*), yellow-belly (*Macquaria ambigua*), and catfish (*Tandanus tandanus*) in the Culgoa River by 2025:
  - a. Increase abundance of yellow-belly by 30% by 2025.
  - b. Recruitment of mature Murray cod by 2020.
  - c. Increase abundance of catfish by 10% by 2025.
  - d. Population age structure of target species includes recent recruits, sub-adults and adults in at least 7 years in 10 for catfish, and 9 years in 10 for cod and yellow-belly.
  - e. Population age structure of target fish species indicates a large recruitment event 1 year in 7, demonstrated by a cohort representing >50% of the population.
3. Improve condition of habitat for waterbirds, including targeted species – including pelicans, water hens, swans, wild turkey, cranes, spoonbills, ibis, wood ducks and grass parrots:
  - a. Increase breeding success of target species (i.e. to fledging), particularly colonial nesting species, with two successful events by 2025.
  - b. Re-habilitate nesting habitat for Australian migratory species with increased abundance recorded in 3 out of 4 targeted surveys by 2025.

Although recognised as inter-connected, for simplicity the intermediate and long-term outcomes from delivering cultural flows have been summarised into the following themes to allow the design of monitoring and assessment activities at the site:

- Cultural (social, spiritual and economic) themes:
  - Source of spiritual significance and inspiration to Murrawarri people
  - Murrawarri community health
  - Leadership and community governance/cohesion
  - Knowledge preservation and regeneration
  - Supplemented income from food and resource harvesting (i.e. coal production, native greens), research and development and artefact production.
- Environmental themes:
  - Native floodplain vegetation

---

<sup>1</sup> Precise species is to be determined – respondents felt that it may be currently classified as endangered.

- Waterbirds
- Native animals (fish, kangaroo and emu).

The cultural flow objectives, key evaluation questions and indicators to be measured to assess the themes listed above are detailed in Chapter 4.



## 4 APPROACH TO MONITORING AND ASSESSMENT

### 4.1 MERI framework

Given that any cultural flow water delivered to Weilmoringle in the future is likely to be sourced from the Commonwealth Environmental Water Holder (CEWH) holdings, the monitoring of outcomes has been aligned to the monitoring, evaluation, reporting and improvement framework used by the CEWH for managing its water holdings (Figure 6). The watering at Gooraman Swamp will initially be operational monitoring of 1 to 5 years, but has the potential to expand to complementary to the CEWH's long-term ecological monitoring should there be resources to continue water delivery and monitoring activities into the future (Figure 7).

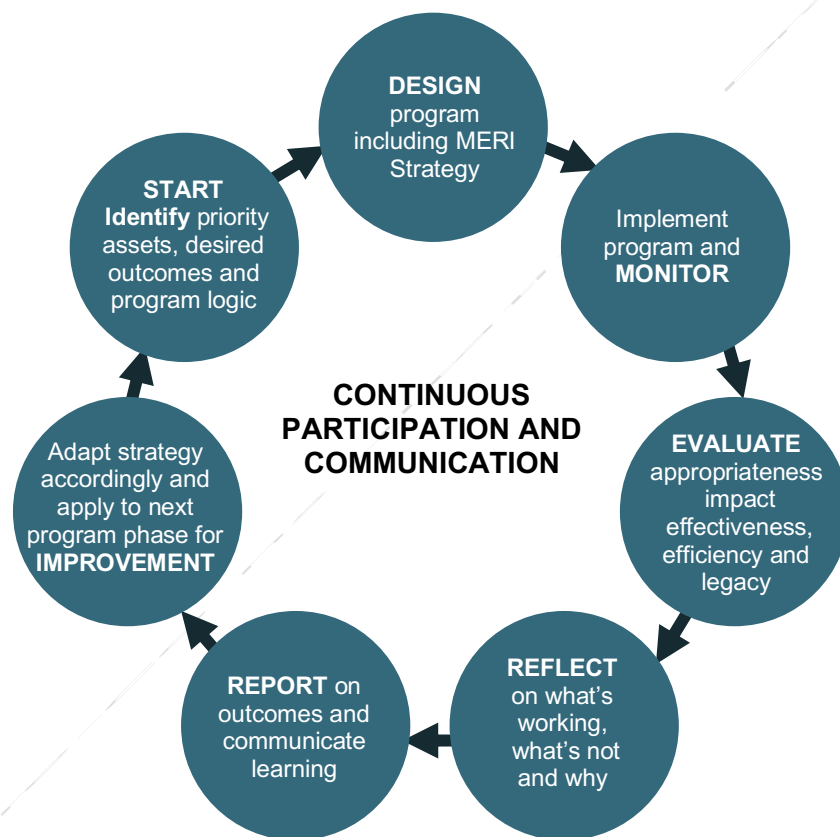


Figure 6: Overview of the Government of Australia MERI framework (CEWO 2013).

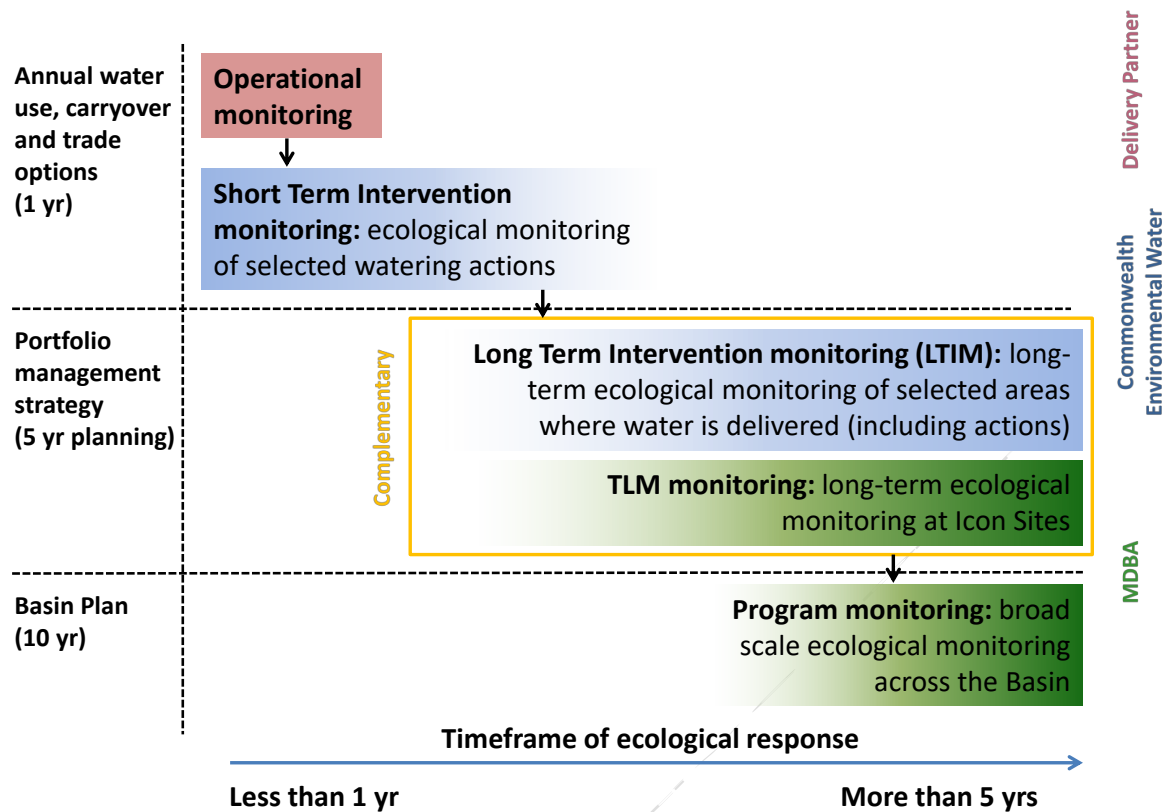


Figure 7. CEWO monitoring framework (TLM = The Living Murray program).

©Commonwealth Environmental Water Office. Accessed from <https://www.environment.gov.au/water/cewo/publications/cew-monitoring-evaluation-reporting-and-improvement-framework>).

The MERI process includes evaluation of both the process/governance of water delivery and of cultural and environmental outcomes. This is necessary so that it is possible to confirm that the water was delivered as intended (i.e. the volume, timing and rate of delivery was as planned), and so that any cultural and environmental outcomes recorded can be assigned directly to water delivery.

## 4.2 Study design

### 4.2.1 Cultural themes

For this Project, cultural themes will be explored in simple before-after assessments that focus on Murrawarri community feedback in relation to:

- Aboriginal cultural, social and environmental perspectives included in water management;
- Links maintained or re-established between instruction and cultural practice;
- Fulfilment of spiritual/cultural obligations through landscape management;
- Retention of the Aboriginal population with quality of life and wellbeing improvements.

#### 4.2.2 Environmental themes

For this Project, the study design (e.g. Cottingham et al. 2005) is one of single-site, single-intervention (SSSI) assessment, with the intervention being the potential delivery of a cultural flow at some time in the future (currently unplanned). Should additional cultural flow allocations become available in the future and the allocation is supported by Murrawarri; the study design would become a single-site, multiple-intervention (SSMI) study. Sampling is proposed to occur at the site, both before a potential flow and after the delivery of cultural flows so that the inference of the cultural flow being responsible for cultural and environmental (in isolation from other conditions or events) outcomes is increased – the study design will be that of before-after-intervention as described in Table 2 and Figure 8.

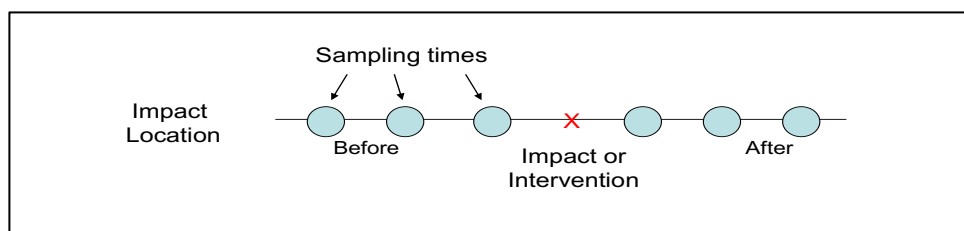
Should there be a wetland nearby to Gooraman Swamp (of a similar nature) that does not receive a water allocation, then the inclusion of monitoring at this site may make it possible to use employ a before-after, control (comparison)-intervention study design. Such a study design would greatly increase the inference associated with cultural flow delivery to Gooraman Swamp.

To adequately characterise the natural variability that occurs in the wetland, it is necessary to monitor parameters both before and after the delivery of cultural flow events. Having an understanding of natural variation is important and in most cases, is built over a number of years collecting data at a site. Depending on the focus of the study and logistics, (e.g. how rapidly changes in the monitored parameter are expected to occur), sampling could be expected to occur yearly, seasonally or more frequently. Sampling frequency is considered in more detail in for the various themes outlined in Chapter 5.

**Table 2. Study design options\* for investigating the impact of interventions on wetlands receiving cultural flows (adapted from Cottingham et al. 2005).**

| Design | Before data | After data | Comparison sites | Impact sites     | Design and Analysis                              |
|--------|-------------|------------|------------------|------------------|--------------------------------------------------|
| 1      | Yes         | Yes        | Y (>1)           | Y ( $\geq 1$ )   | Before-After-Control-Intervention (MBACI)        |
| 2      | Yes         | Yes        | Yes (1 only)     | Yes (1 only)     | Before-After-Control-Intervention Paired (BACIP) |
| 3      | Yes         | Yes        | No               | Yes              | Before-After-Intervention                        |
| 4      | No          | Yes        | Yes ( $\geq 1$ ) | Yes ( $\geq 1$ ) | Control-Intervention                             |
| 5      | No          | Yes        | No               | Yes              | Intervention only                                |

\* Designs are ranked from 1 = most optimal design for detecting expected outcomes, to 5 = least optimal design for detecting expected outcomes.



**Figure 8. Before-After-Intervention study design (from Robinson and Butcher 2016) where the impact or intervention is the potential cultural flow.**

## 5 MONITORING AND ASSESSING CULTURAL FLOW OUTCOMES

### 5.1 Conceptual approach

Discussions with the Murrawarri community have highlighted the inter-connectedness of Culgoa River flows and watering of Gooraman Swamp with community aspirations and objectives associated with cultural flows (shown previously in Figure 4). Importantly, it was recognised that achieving community aspirations, as well as all the cultural flow objectives, will require a long-term view. For example, Figure 9 and Figure 10 links one of the Murrawarri aspirations with a subset of both medium (5 to 15 year) and long-term (15 to 20 year) cultural flow objectives. These objectives also link via key evaluation questions to the indicators that will be included for monitoring, and relate to water governance as well as cultural and environmental outcomes.

It should be noted that limited time and resources means that this M&E plan focuses ***predominantly on monitoring medium-term outcomes directly related to the delivery of a potential cultural flow to Gooraman Swamp in the near future.*** However, this does not preclude other activities (both medium and long-term), particularly those that are not site-based activities, such as liaison with government agencies and water user groups to have cultural flow delivery inserted into watering sharing plans and other water management initiatives.

For simplicity, the watering outcomes identified in Figure 4 have been summarised according to the following monitoring themes:

- Water governance, focusing on the delivery of water to Gooraman Swamp, to match the no-development flood pattern through increasing the flows of the Culgoa River.
  - This theme will also account for the desired outcome of water quality in the Culgoa River. The outcome of increased overland flows is currently beyond the scope of the project, as it will require considerable negotiation with government agencies and upstream and downstream water users.
- Cultural (social, spiritual, economic) outcomes, focusing on the protection of Murrawarri sites of significance at Gooraman Swamp and Culgoa River. Importantly, this will re-establish and maintain condition of culturally significant ceremonial and spiritual values to allow continued practice of cultural activities. It will also increase the use of country for intergenerational training and community participation in cultural activities.
  - This theme will also include measures of community health and activities (e.g. fishing, swimming), knowledge preservation and regeneration.
- Wetland vegetation, focusing on culturally important plant and tree species. Watering will also promote seed set of key floodplain plant species to allow seed collection activities.
  - Improved condition of, and access to floodplain food, artefact and medicinal plants.
- Wetland waterbirds, focusing of species richness and waterbird breeding activity.
  - Monitoring can be expanded to include key bird species for harvest, such as emu eggs.
- Native animals, focusing on increased abundance of key native fish harvest species.
  - Catch per unit effort (e.g. angling hours per fish) in the Culgoa River at Weilmoringle.
  - Monitoring can be expanded to include key animal species for harvest, such as Emu and kangaroo at Gooraman Swamp.

It is anticipated that the monitoring themes outline above will also serve as surrogates for other cultural values, activities and practices.

## 5.2 Water governance theme

### 5.2.1 Objectives and key evaluation questions

The governance objectives, key evaluation questions and indicators are summarised in Table 4. Further details on the indicators is provided in Table 4.

**Table 3: Cultural flow governance objectives, key evaluation questions and indicators**

| Cultural flow objective                                                                                                                                        | Key Evaluation Questions                                                                                   | Indicators                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Murrawarri participation in species richness and abundance monitoring at Gooraman Swamp and along the Culgoa River near Weilmoringle from 2016 onwards.</b> | Have cultural flows been delivered at the agreed frequency, timing, volume and duration?                   | Daily water volume (ML/d) in the Culgoa River at Weilmoringle per cultural flow event.                                                                          |
| <b>Murrawarri continue to participate in all science activities conducted at Gooraman Swamp and the Culgoa River near Weilmoringle beyond 2031.</b>            | Have Murrawarri been directly involved in the design and measurement of water delivery and other outcomes. | Water volume (ML) delivered to Gooraman Swamp per cultural flow event.<br><br>Confirmation of Murrawarri participation in monitoring and assessment activities. |

### 5.2.2 Water delivery indicators

Water delivery indicators are summarised in Table 4.

**Table 4: Summary of water delivery indicators for Gooraman Swamp**

| Feature                                 | Indicator                                                   | Measurement                                             | Data source/management                                                                                                                                                                       |
|-----------------------------------------|-------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cultural flow release</b>            | Flow at gauging station 422017 Culgoa River at Weilmoringle | Daily flow (ML/d)                                       | Water Data Online.<br><a href="http://www.bom.gov.au/waterdata/">http://www.bom.gov.au/waterdata/</a>                                                                                        |
| <b>Water arriving at Gooraman Swamp</b> | Staff gauge level at Gooraman Swamp*                        | Staff gauge height (relative metres and/or metres AHD). | Daily while the wetland is filling and weekly thereafter.<br><br>Data to be entered into MS Excel spreadsheet. A copy is to be provided to the Research Committee and the RSSA project team. |

\*To be installed

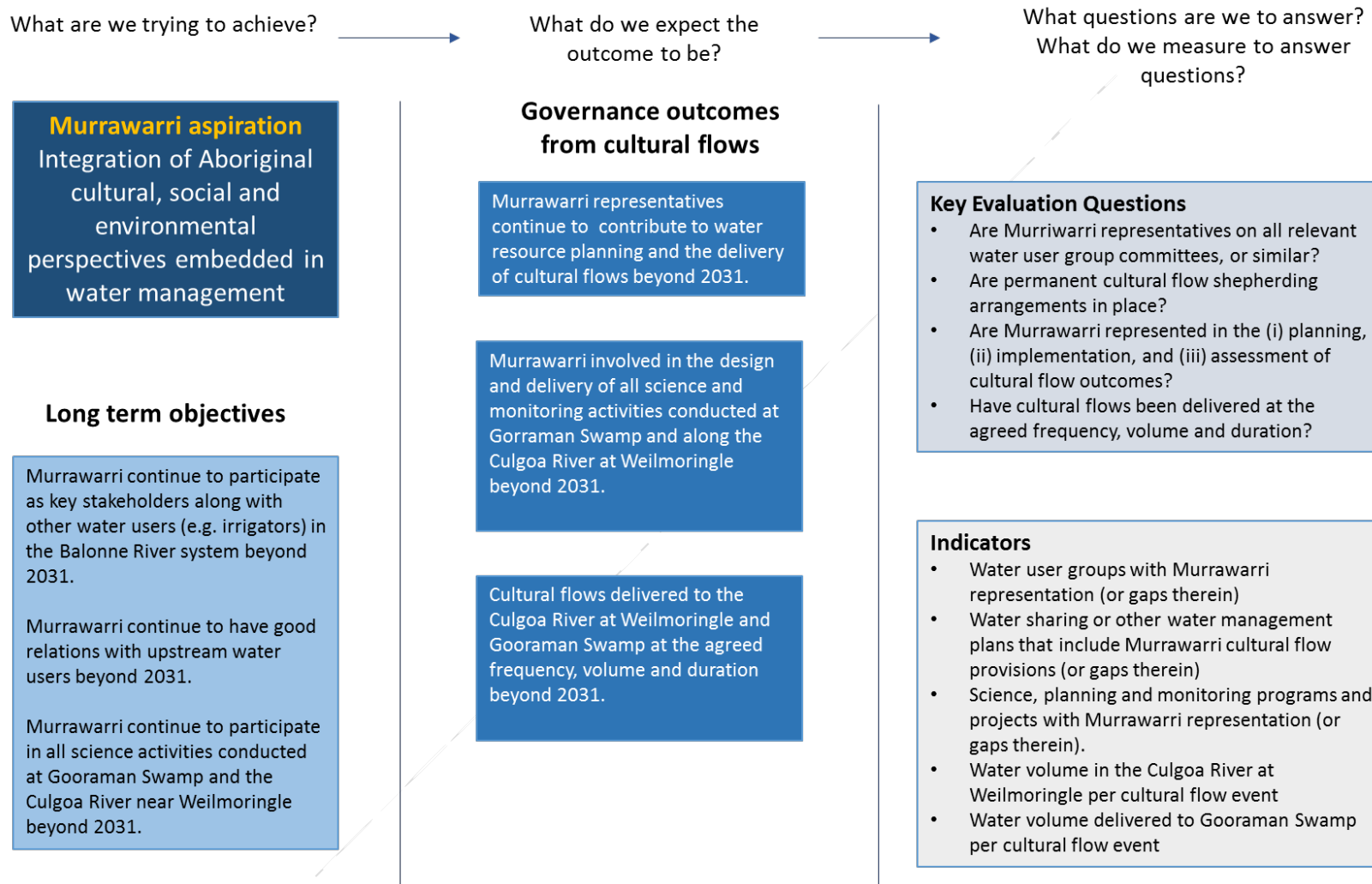


Figure 9: Subset of long-term (15-20 year) objectives related to the Murrawarri aspiration to have Aboriginal cultural, social and environmental perspectives integrated in water management in the Culgoa River catchment.



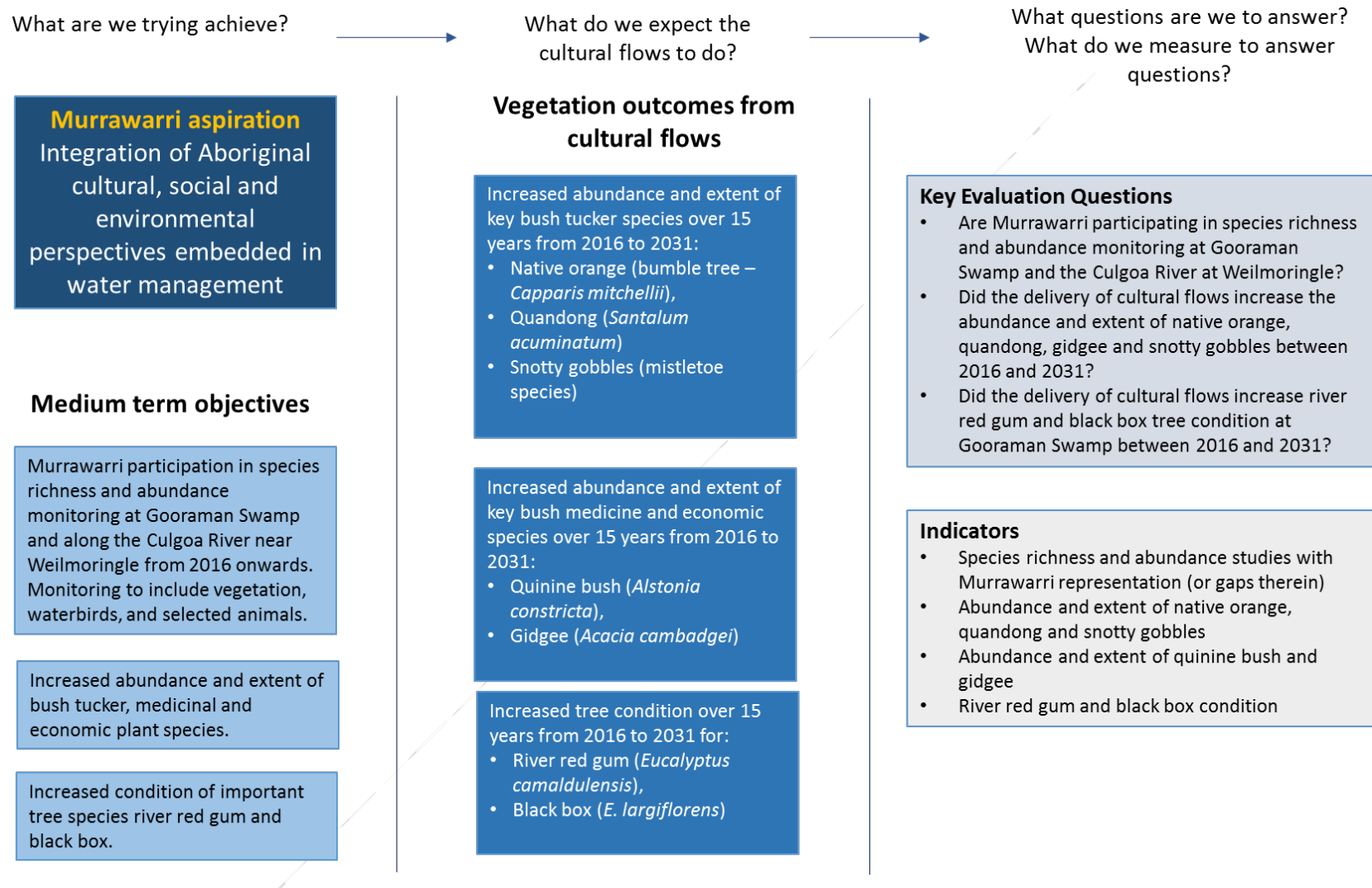


Figure 10: Subset of medium-term (5-15 year) objectives (vegetation only) related to the Murrawarri aspiration to have Aboriginal cultural, social and environmental perspectives integrated in water management in the Culgoa River catchment.

### 5.2.3 Assessment of outcomes

Assessment of water delivery and governance will include simple statements on:

- Whether the volume delivered to Gooraman Swamp was as agreed.
- Whether the water delivered to Gooraman Swamp reached the depth and areal extent predicted.
- Confirmation of Murrawarri involvement in monitoring design and implementation.

Results will be presented as whether the anticipated cultural flow volume was delivered with the requested timing, volume and duration. If there are shortfalls in the amount or timing of water delivery, this will be quantified as far as it possible (e.g. total volume was 80% of that requested; timing was three months later than requested).

## 5.3 Cultural (social, spiritual and economic) outcomes theme

Preliminary cultural objectives and outcomes associated with cultural flows have been identified in consultation with the Murrawarri community. They include:

- Source of inspiration to people – e.g. feeling of place, protection of cultural assets;
- Community health and well-being– e.g. visits or length of stay at healthcare facilities;
- Leadership and community governance – e.g. increased number of young people on country;
- Knowledge preservation and regeneration – e.g. increased inter-generational transfer of Murrawarri knowledge and cultural practices.
- Supplemented income from jobs, resource and food harvesting, research and development, commercial artefact production – e.g. income derived from new jobs, tourism commercial sales, harvesting of natural resources (i.e. Gidgee for clean coal production or native greens for commercial consumptive sale or development of medicinal and beauty products).

### 5.3.1 Objectives, key evaluation questions and indicators

The objectives, key evaluation questions and indicators for the cultural outcomes theme are summarised in Table 5. A medium to long-term view was taken to achieving the stated objectives, hence the objectives are expected to be achieved within a 15-year timeframe (i.e. from 2016 to 2031)

**Table 5: Cultural flow governance objectives, key evaluation questions and indicators**

| Cultural flow objective                                                                                                                                                                    | Key Evaluation Questions                                                                                                             | Indicators                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <p><b>Increased feeling of wellbeing by Murrawarri people due to the improved environmental condition of Gooraman Swamp</b></p> <p><b>Increased health of the Murrawarri community</b></p> | <p>Did cultural flows increase the feeling of well-being by Murrawarri people after visiting Gooraman Swamp or the Culgoa River?</p> | <p>Well-being parameters developed in consultation with the Murrawarri.</p> |

| Cultural flow objective                                                                         | Key Evaluation Questions | Indicators |
|-------------------------------------------------------------------------------------------------|--------------------------|------------|
| Improved community governance due to a greater attachment to country by Murrawarri people       |                          |            |
| Increased knowledge preservation and regeneration between generations of Murrawarri             |                          |            |
| Increased sustenance and income derived from harvesting of plants and animals, and from tourism |                          |            |

### 5.3.2 Assessment of outcomes

Assessment of outcomes will be simple before-after comparisons, based on the indicators collected by or in consultation with the Murrawarri community. Outcomes will be expressed in terms of:

- Community well-being,
- Community health,
- Preservation of traditional knowledge and practice.

## 5.4 Wetland vegetation theme

### 5.4.1 Conceptual approach

The conceptual model shown in Figure 11 below is generic and will be refined once the focus of the monitoring is agreed on with the Murrawarri community. It illustrates the relationships between the following wetland attributes and watering (modified from Butcher and Hale 2016):

- **Implementation modifiers** – the aspects of cultural watering that can, to some degree, be controlled by the management intervention. They include the extent, duration and timing of wetland inundation as well as physical characteristics such as water depth.
- **Intermediate responses** – the direct effects of cultural watering that influence the desired outcome (e.g. water quality changes, habitat and resource availability).
- **Landscape and site modifiers** – covariates at the site or landscape scale that can have positive or negative effects on the desired outcomes of cultural watering (e.g. presence of predators/competitors, past water regime, condition prior to watering).
- **Ecological response** – the expected outcome of cultural watering for vegetation and waterbirds.

This conceptual approach is valuable in identifying features that should be considered in measuring and interpreting the response of cultural flows. For this project, the implementation modifiers outlined in Figure 11 have been captured under the water governance section 3.2. Information on landscape modifiers has been collected in the ecological character description for the site (Butcher and Cottingham 2016) and should be updated prior to the delivery of cultural flows in the future. The ecological responses and their relationship to cultural flow objectives are



outlined in the following section. A similar approach has been taken in the subsequent waterbird and native animal themes also (sections 5.5 and 5.6).

#### 5.4.2 Objectives and key evaluation questions

The governance objectives, key evaluation questions and indicators are summarised in Table 6. Details on the nominated indicators and appropriate sampling methods are provided in the following sections on sampling regime and sampling methods (below).

**Table 6: Cultural flow vegetation objectives, key evaluation questions and indicators**

| Cultural flow objective                                                                                                                                                                                                                                                                                                                                                                                   | Key Evaluation Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Indicators                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Murrawarri participation in species richness and abundance monitoring at Gooraman Swamp and along the Culgoa River near Weilmoringle from 2016 onwards.</b></p> <p><b>Increased abundance and extent of bush tucker, medicinal and economic plant species.</b></p> <p><b>Increased condition of important (icon) tree species, including river red gum, black box and other selected trees.</b></p> | <p>Did Murrawarri participate in vegetation monitoring at Gooraman Swamp between 2016 and 2031?</p> <p>Did cultural flows increase the abundance of key bush tucker, medicinal, economic and icon species between 2016 and 2031?</p> <p>Did cultural flows increase the abundance and extent of key bush tucker, medicinal, economic and icon species between 2016 and 2031?</p> <p>Did cultural flows increase the condition of key icon species between 2016 and 2031?</p> | <p>Confirmation of Murrawarri participation (or gaps therein).</p> <p>Abundance and/or extent of native orange, quandong and snotty gobblers.</p> <p>Abundance and/or extent of quinine bush and gidgee.</p> <p>River red gum and black box condition.</p> <p>Condition of selected, culturally significant trees.</p> |

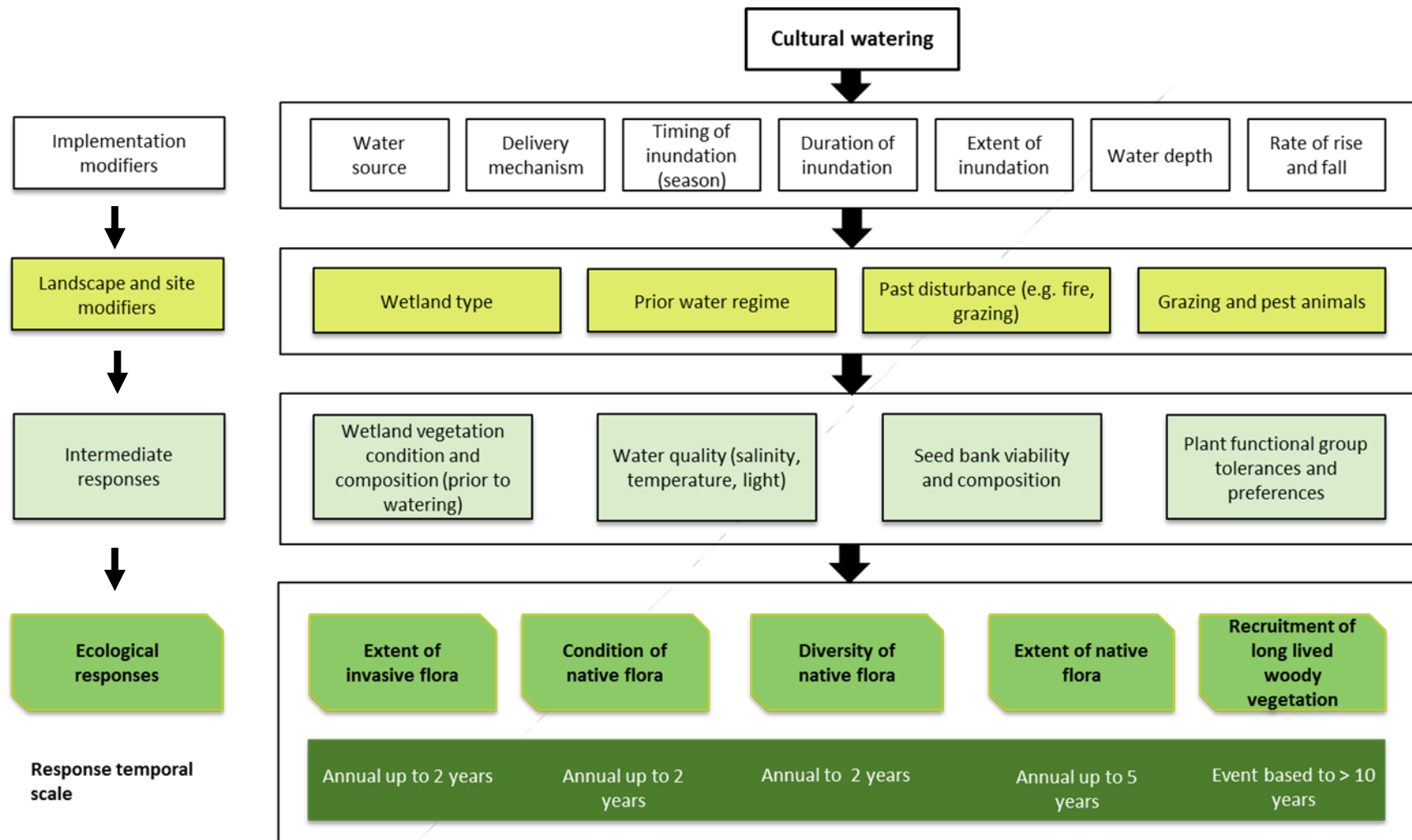


Figure 11: Conceptual model of vegetation ecological response to cultural watering (from Butcher and Hale 2016).

### 5.4.3 Vegetation sampling regime

To adequately characterise the natural variability that occurs in the wetlands such as Gooraman Swamp over time, it is necessary to monitor parameters both before and after the delivery of a cultural flow event(s). Understanding natural variation is important and in most cases, is built over a number of years collecting data at a site. Depending on the focus of the study and logistics, (e.g. how rapidly changes in the monitored parameter are expected to occur), sampling could be expected to occur yearly, seasonally or more frequently. Pre-monitoring data will be limited in this Project, however any previously collected data will help inform the sampling design and analysis of monitoring data.

Note: No post-flow monitoring will be conducted as part of this Project as it is outside of the project scope.

Refer to Appendix 1 for detailed sampling regime.

### 5.4.4 Vegetation monitoring methods

Vegetation monitoring is proposed using the NSW OEH standard methods (OEH 2015), consistent also with the approach used for vegetation surveys and mapping in the Barwon-Darling and Condamine-Balonne floodplain systems (Eco Logical Australia 2015). The methods are detailed in Appendix 1 and based on:

- Measuring the floristics of understory plant species in the river red gum and black box communities. This will involve measuring percentage cover, plant form (e.g. tree, shrub, groundcover) and species within 2 randomly located 20 m by 20 m<sup>2</sup> quadrats at both Gooraman Swamp and on the banks of the Culgoa River.
- Measuring the condition of trees in the river red gum and black box communities at both Gooraman Swamp and on the banks of the Culgoa River. This will involve measuring tree condition at the same random quadrats established for floristics but extended to 50 m by 50 m, or as necessary to provide a minimum of 25 trees.
- Measuring the condition of selected, culturally important trees (e.g. scar trees).

#### ***Frequency and timing***

It is proposed that vegetation sampling occur on a seasonal basis for one year (i.e. from spring 2016 until spring 2017), followed by annual sampling (spring) until the next watering event. This will build a baseline from which to assess the effects of future flow events. Once an event arrives at Gooraman Swamp, vegetation monitoring is to occur once every six weeks for three months (i.e. two sampling events, one six weeks after the flow event, then another six weeks later). Annual sampling (spring) can then be reinstated until the next flow event.

### 5.4.5 Assessment of outcomes

Assessment of the collected data will be based on before-after comparisons of:

- The floristics in both Gooraman Swamp and at selected sites on the Culgoa River.
- The condition of trees in the river red gum and black box communities over time.

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<sup>2</sup> The shape of the quadrats can be altered to fit the shape of the vegetation community. For example, quadrats can be altered to 40 m by 10 m for elongated or linear shaped communities. The intention is to have quadrats of 0.04 hectares.





- The condition of selected culturally important species over time.

Assessment will initially focus on the before-after comparison of extent, floristics and condition in the year immediately following the cultural flow event, and on an annually basis thereafter.

## 5.5 Wetland waterbird theme

Ecological responses of waterbirds to environmental watering has been summarised by Butcher and Robinson (2016) (Figure 12) based on Brandis et al. (2009). This provides the basis for considering waterbird response to cultural flow events also. The distribution, abundance, diversity and breeding by waterbirds are all influenced by elements of the implementation modifiers – the characteristics of the environmental water. Landscape and site modifiers are particularly influential on the response of waterbirds to environmental water allocations, with availability of habitat in the region or past opportunities for breeding being important (Brandis et al. 2009).

### 5.5.1 Objectives and key evaluation questions

The governance objectives, key evaluation questions and indicators are summarised in Table 7. Details on the nominated indicators and appropriate sampling methods are provided in the following sections on sampling regime and sampling methods (below).

**Table 7: Cultural flow waterbird objectives, key evaluation questions and indicators**

| Cultural flow objective                                                                                                                             | Key Evaluation Questions                                                                                                                                                                                                                                                                                                                                                                                                                                              | Indicators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Increased frequency of breeding by culturally significant waterbird species.</b></p> <p><b>Increased species richness of water birds.</b></p> | <p>Did cultural flows increase the frequency of breeding for culturally significant waterbird species between 2016 and 2031, including:</p> <ul style="list-style-type: none"> <li>• Australian pelican</li> <li>• White ibis</li> <li>• Straw-necked ibis</li> <li>• Pacific black duck</li> <li>• Water hen</li> <li>• Black swan</li> <li>• Cranes</li> <li>• Emu</li> </ul> <p>Did cultural flows increase water bird species richness between 2016 and 2031?</p> | <p>Breeding pairs of:</p> <ul style="list-style-type: none"> <li>• Australian pelican (<i>Pelecanus conspicillatus</i>)</li> <li>• White ibis (<i>Threskiornis moluccus</i>)</li> <li>• Straw-necked ibis (<i>Threskiornis spinicollis</i>)</li> <li>• Pacific black duck (<i>Anas superciliosa</i>)</li> <li>• Water hen (<i>Gallinula tenebrosa</i>)</li> <li>• Black swan (<i>Cygnus atratus</i>)</li> <li>• Crane (Brolga?)</li> <li>• Emu (<i>Dromaius novaehollandiae</i>)</li> <li>• Number of emu eggs</li> </ul> <p>Waterbird species richness</p> |

### 5.5.2 Waterbird sampling regime

Pre-cultural flow monitoring data collected as part of this Project will be limited to a single sampling event in the lead up to the delivery of the cultural flow. However, any previously collected data will help inform the analysis of monitoring data collected.

### 5.5.3 Waterbird species, abundance and nest monitoring methods

The limited resources mean that monitoring will be limited to on-ground monitoring of waterbird responses. The method includes timed counts at stop points along a pre-determined 250 to 350 m path (transect) through Gooraman Swamp. The number and locality of stops will be based on local knowledge. It is recommended that four-five such stop points are included in any initial monitoring, assuming that these are located to reduce the risk that birds are double-counted. At each stop, 10 to 15 minutes will be spent to look for and count birds. This method can be altered to include counts of breeding colonies should these occur. The number of stops required can be assessed and refined in light of the first monitoring event.

In addition, the number of bird nests observed along the Gooraman Swamp transect will be counted. Nests are to be counted along a transect of approximately 350 m in length and 50 m in width with participants spaced approximately 10 m apart. Participants are to note the number of nests to their immediate left/right with another individual taking the role of scribe.

#### ***Frequency and timing***

It is proposed that waterbird sampling coincide with that of vegetation surveys and occur on a seasonal basis for one year (i.e. from spring 2016 until spring 2017), followed by annual sampling (spring) until the next watering event. This will build a baseline from which to assess the effects of future flow events. Once an event arrives at Gooraman Swamp, waterbird monitoring is to occur once every six weeks for three months (i.e. two sampling events, one six weeks after the flow event, then another six weeks later). Annual sampling (spring) can then be reinstated until the next flow event.

### 5.5.4 Assessment of outcomes

Assessment of the collected data will be based on before-after comparisons of:

- The abundance of waterbirds and other culturally significant species at Gooraman Swamp and along the Culgoa River;
- The number of waterbird breeding pairs (total, and for each species) at Gooraman Swamp;
- The species richness at Gooraman Swamp and Culgoa River;
- The number of nests counted at Gooraman Swamp.

Assessment will initially focus on the before-after comparison of breeding events and species richness for the year immediately following the cultural flow event, and on an annually basis thereafter.

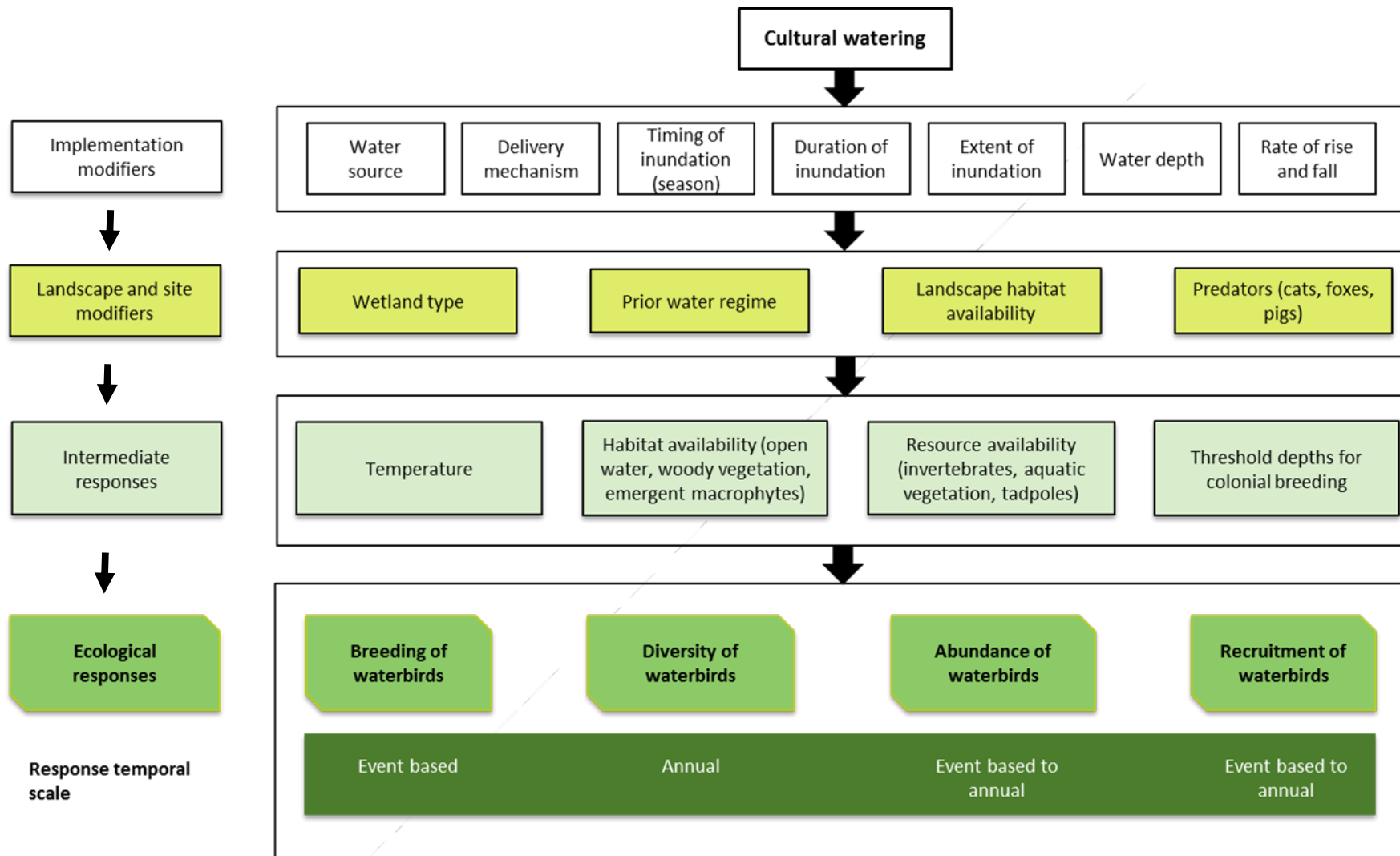


Figure 12. Ecological response conceptual model for the waterbird theme (from Butcher and Hale 2016).

## 5.6 Native animal theme

### 5.6.1 Native fish and kangaroo

Environmental watering can influence fish recruitment and populations in a number of ways, including via the provision of breeding cues, maintenance or creation of habitat, and through influences on food availability (Overton et al. 2014). This provides the basis for assessing native fish response to cultural flows too. The ecological response model for native fish is presented in Figure 13. For this Project, monitoring will focus on the well-being of Murrawarri as they catch fish, and abundance of potential key target species (Murray cod and golden perch) and catch per unit effort (e.g. number of fish caught per hour of angling) at key sites along the Culgoa River identified by the community.

Similarly, monitoring will focus on kangaroo harvest in the vicinity of Gooraman Swamp, and include well-being as well as catch per unit effort (number of kangaroo per hunting hour).

### 5.6.2 Objectives and key evaluation questions

The governance objectives, key evaluation questions and indicators are summarised in Table 7. Details on the nominated indicators and appropriate sampling methods are provided in the following sections on sampling regime and sampling methods (below).

**Table 8: Cultural flow fish and kangaroo objectives, key evaluation questions and indicators**

| Cultural flow objective                              | Key Evaluation Questions                                                                  | Indicators                                                                                                                                                                                               |
|------------------------------------------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Increased well-being from fishing with the community | Did cultural flows increase the feeling of well-being by Murrawarri after fishing?        | Well-being emoticons                                                                                                                                                                                     |
| Increased abundance of large-bodied native fish      | Did cultural flows increase the abundance of native fish caught during community angling? | Abundance of large bodied fish caught per angling hour: <ul style="list-style-type: none"> <li>• Golden perch (<i>Macquaria ambigua</i>)</li> <li>• Murray cod (<i>Maccullochella peelii</i>)</li> </ul> |
| Increased well-being from hunting with the community | Did cultural flows increase the feeling of well-being by Murrawarri after hunting?        | Abundance of kangaroo (e.g. <i>Macropus giganteus</i> )                                                                                                                                                  |
| Increased abundance of kangaroo                      | Did cultural flows increase the abundance of kangaroo caught during community angling?    |                                                                                                                                                                                                          |

### 5.6.3 Fish and kangaroo sampling regime

Limited time and resources meant that not pre-cultural flow monitoring data was collected as part of this Project. Any previously collected data will help inform the analysis of monitoring data collected.

### 5.6.4 Fish and kangaroo monitoring methods

Murrawarri well-being can be measured by the use of emoticons before and after community fishing events. This will be completed by catch per unit effort in terms of the number of target fish, as well as kangaroo, caught per angling hour (or hunting hour) by the community.



### 5.6.5 Assessment of outcomes

Assessment of the collected data will be based on before-after comparisons of:

- Fishing and hunting participant's well-being;
- Number of fish caught per angling hour;
- Number of kangaroo caught per hunting hour.

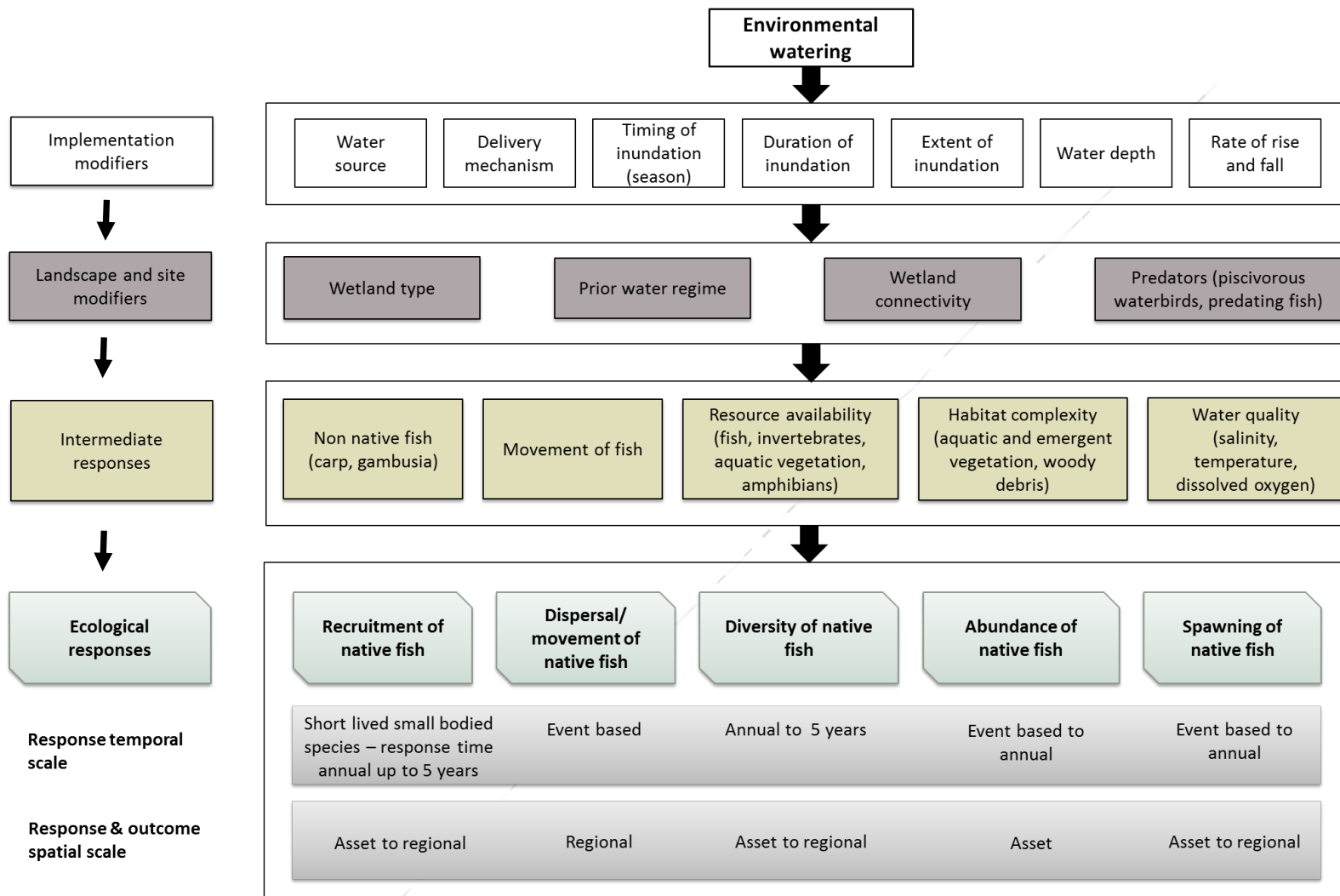


Figure 13. Ecological response conceptual model for the fish theme (adapted from Price and Gawne 2009 and Lester et al. 2014).



## 5.7 Quality control and data management arrangements

Field data sheets are to be copied (electronically scanned or photocopied) and all data entered into MS Excel spreadsheets. Copies of the field sheets and the MS Excel spreadsheets are to be provided to the NCFP Research Committee and the RSSA project team. The RSSA project team will manage the data according to established data storage and management protocols.

## 6 RISK ASSESSMENT AND MITIGATION

Risks associated with the delivery and management of cultural flows are summarised in Table 12, based on the ratings used in Table 9 to Table 11.

**Table 9: Risk likelihood rating**

| Likelihood            | Definition                                  |
|-----------------------|---------------------------------------------|
| <b>Almost certain</b> | Is expected to occur in most circumstances  |
| <b>Likely</b>         | Will probably occur in most circumstances   |
| <b>Possible</b>       | Could occur at some time                    |
| <b>Unlikely</b>       | Not expected to occur                       |
| <b>Rare</b>           | May occur in exceptional circumstances only |

**Table 10: Risk consequence rating**

| Risk                 | Definition                                                                                               |
|----------------------|----------------------------------------------------------------------------------------------------------|
| <b>Critical</b>      | Major widespread loss of environmental amenity & progressive irrecoverable environmental damage          |
| <b>Major</b>         | Severe loss of environmental amenity and danger of continuing environmental damage                       |
| <b>Moderate</b>      | Isolated but significant instances of environmental damage that might be reversed with intensive efforts |
| <b>Minor</b>         | Minor instances of environmental damage that could be reversed                                           |
| <b>Insignificant</b> | No environmental damage                                                                                  |

**Table 11: Risk analysis matrix**

| LIKELIHOOD            | CONSEQUENCE   |        |          |        |          |
|-----------------------|---------------|--------|----------|--------|----------|
|                       | Insignificant | Minor  | Moderate | Major  | Critical |
| <b>Almost certain</b> | Low           | Medium | High     | Severe | Severe   |
| <b>Likely</b>         | Low           | Medium | Medium   | High   | Severe   |
| <b>Possible</b>       | Low           | Low    | Medium   | High   | Severe   |
| <b>Unlikely</b>       | Low           | Low    | Low      | Medium | High     |
| <b>Rare</b>           | Low           | Low    | Low      | Medium | High     |

**Table 12: Risk associated with water delivery at Weilmoringle.**

| Risk type                                                       | Description                                                                                                                                                                                       | Likelihood | Consequence | Risk level | Controls                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Water delivery</b>                                           | Harvesting of water releases by other users.                                                                                                                                                      | Likely     | Major       | High       | There is a potential risk that cultural flow events are extracted by other users. The protection of this water (water shepherding) currently relies on existing water resource management systems including the Murray-Darling Basin Cap on diversions (specified for each valley) and existing rules governing the access of other users to unregulated flows. Additional arrangements for the Northern Unregulated Rivers are also being developed through the Commonwealth's water shepherding projects with the NSW and Queensland governments. Mitigation can be via the announcement procedure in place for flows downstream of St George. |
| <b>Salinity</b>                                                 | Water in the Culgoa River are of good quality in terms of salinity (e.g. general below 400 EC, Smitts et al. 2002).                                                                               | Unlikely   | Minor       | Low        | Salinity will largely reflect that of the water entering the Culgoa River from further up the Balonne River catchment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Invasive species</b>                                         | Carp can enter and breed in Gooraman Swamp if water enters in overbank flows from the Culgoa River.                                                                                               | Possible   | Moderate    | Medium     | The risk of carp will be greatly diminished if water is pumped from the Culgoa River to Gooraman Swamp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Poor water quality in runoff (e.g. low dissolved oxygen,</b> | Water quality will reflect that of catchment processes upstream of Gooraman Swamp and is largely beyond the control of the project. Salinity is unlikely to be a large risk (see above). Nutrient | Possible   | Moderate    | Medium     | If water is pumped to Gooraman Swamp, then pumping can cease should water quality be poor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| Risk type                                                    | Description                                                                                                                                                                                                                                                   | Likelihood | Consequence | Risk level | Controls                                                                                                                                   |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>increased nutrients)</b>                                  | concentrations are likely to be high but largely attached to particulate matter and likely to drop to the sediments of the wetland.                                                                                                                           |            |             |            |                                                                                                                                            |
| <b>Water loss</b>                                            | Level unknown                                                                                                                                                                                                                                                 | Possible   | Minor       | Low        | Additional investigation is required to review losses along the Culgoa River. Allow for losses, if necessary, when estimating allocations. |
| <b>Estimation of water availability and volumes required</b> | Volumes associated with water delivery options depend on modelling. Modelling accuracy may result in underestimation of the volumes actually required. This increases the likelihood of shortfalls in actual volumes of water required to achieve objectives. | Possible   | Moderate    | Medium     | Confirmation that volume(s) released achieve the desired hydrological and ecosystem outcomes.                                              |

## 7 KNOWLEDGE MANAGEMENT AND REPORTING

### 7.1 Future watering trial reporting

Annual reporting will be undertaken to collate and assess the information and data collected as part of the cultural flow delivery process. This will include, but is not limited to, the following:

- General and specific lessons learnt from the planning, delivery and monitoring of cultural flows that will aid the future management of cultural flows.
- Whether cultural flow governance and delivery arrangements were sufficient (was the water delivered as planned?).
- Whether the cultural outcomes expected in the timeframe occurred. If not, any obvious reasons for this will be reported, along with potential mitigation measures.
- Whether the desired environmental objectives expected to be met within the timeframe were met. If not, any obvious reasons for this will be reported, along with mitigation measures.
- Whether the delivery of future cultural flows should be amended or refined to better align with the stated cultural flow objectives.
- Whether the cultural flow objectives require amendment to better align with the aspirations of the Murrawarri community.

### 7.2 Going forward

There are limited resources available to undertake monitoring as part of Project, and no resources currently in place to continue monitoring in the future. This severely limits the monitoring and evaluation that can be undertaken, particularly as the cultural and environmental outcomes expected with water delivery at the site may not fully materialize for months, years or even decades. Should cultural flows be provided in the future, then they will need to be supported by the means (funding, expertise, etc.) to undertake monitoring so that outcomes can be confirmed.

#### 7.2.1 Other opportunities

The following sections outlines other local or regional opportunities that might arise in partnership with state and federal institutions and governing bodies:

- Links to the NSW vegetation mapping exercise – can collect data in the same format and QA/QC so field results can be used for validation of vegetation mapping using remote sensing.
- Links to the CEWO monitoring programs.
- MDBA
- NSW OEH
- Commonwealth Indigenous Protected Area
- Natural Resource Management/Catchment Management Authority/ National Parks and Wildlife Services
- Research Partnerships

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## 9 APPENDIX 1: STANDARD METHODS

### 9.1 Vegetation

The standard method is that proposed by OEH (2015), which was also applied to on-ground validation of vegetation mapping undertaken by Eco Logical (2015). Not all methods listed below will be required for measuring outcomes noted in the previous sections of this report. However, they are retained here should the Murrawarri require guidance or methods for various aspects of vegetation monitoring in the future.

#### 9.1.1 Non-woody submerged and floating aquatic and fringing or dense wetland vegetation (e.g. reeds, club-rush, lignum)

##### **Transect method (Point intercept method)**

One 50 metre transect is placed from fringing edge into water to depth where vegetation no longer occurs or 1.5 metres depth is reached. Photos are taken at each end of the transect.

1. At each 100 centimetre point the species directly below or and/or touching the tape are recorded.
2. Maximum and minimum height of each species is recorded
3. Reproductive status is recorded.
4. Dead plants are recorded.
5. Water depth

Three transects per 500 ha of wetland are the minimum.

#### 9.1.2 Non-woody semi-permanent vegetation and woody low shrub lands - floristic structure, species composition

##### **For non-tree dominated vegetation communities (i.e. non-woody wetlands without standing water bodies and flood dependent open shrub lands)**

1. At each survey location (per wetland) 3 replicate plots of 0.04 hectares are used within each vegetation community. The dimensions of each sample plot are usually 20x20 metres but 40x10 metres can be used in narrow sites (e.g. riverine corridors).
2. The NE corner is marked (permanently if possible) and a GPS point taken.
3. Plot is oriented north/south (i.e. tape is run 20 metres S and 20 metres W, then 20 metres S starting from the NE corner). Alternate orientation is allowable but must be recorded.
4. Corners should be marked (temporarily) with sighting flags. Four site photographs are taken; 1. from the NE corner looking SE, 2. mid-point of N boundary looking S, 3. NE corner looking SW and 4. midpoint of S boundary looking N.

##### **Vegetation diversity and structure**

Recorded for all vascular species and recorded separately for each structural component of the vegetation (tallest stratum (over storey), mid-stratum (>1 metre) and lower (<1 metre, = ground stratum)). Any species not able to be identified in the field is tagged, given a code, recorded and collected for identification.



1. **Species cover** is recorded as **Foliage Cover**<sup>12</sup> (FC) and is the percentage of the sample plot occupied by the vertical projection of *foliage and branches* (if woody). It is recorded for each species in each stratum in which it occurs.
2. **Crown Extent**<sup>3</sup> (CE) and **Canopy openness** (CO) is collected for all tree species in the tallest stratum in treed communities to allow the calculation of FC for the plot for each species (See section on *Tree canopy health* below).
3. **Per cent Litter** is the percentage of the sample plot occupied by litter (nonattached plant matter e.g. leaves and branches less than 10 cm diameter) and is recorded as the sum of submerged and non-submerged litter in flooded plots. Note: where plants are dry or dead but can still be identified to species and are attached to the base of the plant, their cover is included in the species cover not in per cent litter.
4. **Per cent Bare ground** is the percentage of the sample plot occupied by bare earth and is recorded as the sum of submerged and non-submerged bare ground in flooded plots.
  - a. Note: FC for species in the lower (ground) stratum (>1 m) + % litter + %bare ground must = 100% in total, unless lower stratum (ground layer) space is occupied by mid storey emergent tussock form graminoid or spreading shrub species >1m tall (e.g. *Lignum*, rushes or reeds).
  - b. If ground stratum (<1 m) space is occupied by emergent mid storey species then the FC lower (ground) stratum (>1 m) + % litter + %bare ground = 100% - total FC of these mid stratum species.
  - c. In flooded sites total FC lower (ground) stratum includes; submerged vegetation, submerged bare ground and submerged litter.
5. **Species Abundance** (Number of individuals = actual count or estimated number from sub quadrats for superabundant species) in each stratum in which it occurs.
6. **Upper height (average)** of each species is recorded (in metres) in the upper height field.
7. **Lower height (average)** of each species is recorded (in metres) in the lower height field.
8. **Strata type** (T=tallest, M=mid (>1m), L = lower (<1 m) is recorded in the Strata Type field.
9. **Functional Group** (*sensu* Brock and Casanova 1997; Casanova and Brock 2000; Casanova 2011) is the category of water dependency of a species and is generated automatically from species name during data analysis from master list.
10. **Linear length of fallen timber at site** – the total length of fallen timber of diameter >10 cm is recorded.

Floristic data are entered on field data sheets or into the site specific [Site Floristics](#) entry screen on a handheld tablet / PC in Microsoft Excel or other suitable database software or paper datasheet.

A field data sheet template is provided in Table 13.

### 9.1.3 Over storey tree health

For vegetation communities dominated by flood dependent trees in the over storey (river red gum, black box or coolibah).

A 0.1 ha (20x50 metre) survey plot is used. This an extension of the 20x20 metre plot created by extending the eastern and western boundaries by 30 m thus creating a nested 0.04 ha plot within the 0.1 ha survey plot.

The orientation of the plot can be altered to suit the site however the orientation of the plot must be noted in the notes column of the data entry form if other than south.

### Understorey floristics (Vegetation community condition)

Floristic data is collected from the 0.04 hectare subplot as described above.

### Tree size, canopy health and population demographics

For trees >10 cm diameter at breast height (dbh) tree health data and tree size data is collected from the entire 0.1 ha plot. Tree canopy health methods are comparable to those used in the Living Murray (TLM), Tree and Stand condition method of Cunningham et al (2009).

#### Tree size classes

Each tree within the 0.1 ha plot of dbh, greater than 10 cm (live or dead<sup>3</sup>), is numbered starting from the tree closest to the NE corner of the 0.04 ha plot.

1. Each live tree is tagged for future relocation (e.g. numbered aluminium tag and galvanized nails).

**Note. All trees are recorded as being located within the 0.04 ha or within the remainder of the 0.1 ha subplots on the datasheet to allow calculation of values for %CC and %FC for species in the tallest stratum of the 0.04 ha floristic plot.**

2. Data is recorded on the Tree health entry screen or paper datasheet.
3. The height (m) of all over storey trees (live or dead) is estimated and recorded.
4. Diameter at breast height (dbh) (in centimetres) of all over storey trees (recorded as live or dead) over 10 cm dbh is recorded (cm using a dbh tape).
5. For young trees (trees 5-10 cm dbh), a record of the total number of (live and dead) in this size class is recorded separately for the 0.04 ha and remainder of the 0.1 ha plot.

Size classes and number of live and dead trees is recorded on the Tree demographics data entry screen or paper datasheet.

#### Tree canopy health

The following metrics are used assess the size and canopy health of each numbered tree (live or dead<sup>4</sup>):

1. **Canopy Extent - CE<sub>(tree)</sub>**. This is the 2 dimensional lateral spread (length x width) of the branches and foliage of a live tree, or the limbs of a dead tree, measured from the edge to edge of the remaining bare limbs or branches.

<sup>3</sup> Dead trees only numbered for counting and demographic analysis purposes at first monitoring sample point.

<sup>4</sup> Dead trees are only assessed for size class analysis at time of first monitoring.

Note: CE is used to derive Canopy Cover ( $CC_{(plot)}$ ) for the plot<sup>5</sup> (live trees only) and size distribution classes of trees within population at site (all trees).

2. **Canopy openness -  $CO_{(tree)}$** : estimated as the percentage of the sky that is obscured by the canopy (leaves and small branches).

See Appendix 1 for a scale of canopy openness.

3. **Percentage Dead Canopy -  $DC_{(tree)}$** : is the percentage of the tree canopy  $CE_{(tree)}$  that is dead or severely damaged.

For example, a large dead tree with dead spreading branches measuring 10 m x 10 m and no existing foliage would have a remnant CE of 100 m<sup>2</sup> but would have  $CO = 0\%$  and  $DC = 100\%$ . A large live tree with dimensions of 10 m x 10 m would have CE of 100 m<sup>2</sup>, but would have a  $DC < 100\%$  and a  $CO > 0\%$ .

4. **Epicormic growth: yes /no Y/N** is recorded for each numbered tree.
5. **Ratio of dead to live limbs -  $DLL_{(tree)}$** : the number of dead major limbs as a ratio of the total number is recorded. Major limbs are limbs arising from the main trunk or from multiple stems but not branches. For example: a tree with 4 major limbs and one dead,  $DLL = 1$  of 4.

Statistics are derive as outlined in OEH (2015).

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<sup>5</sup> Required for OEH Type Standard method (Sivertsen 2009)

Table 13: Field sheet template for vegetation assessments (from OEH 2015).

|                                                                                                                             |                   |                                                    |             |   |              |           |                                      |  |                              |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------------|-------------|---|--------------|-----------|--------------------------------------|--|------------------------------|
| Full-floristic vegetation Survey Form – 1319 Barwon-Darling and Condamine-Balonne floodplain and wetland vegetation mapping |                   |                                                    |             |   |              |           |                                      |  |                              |
| Location:                                                                                                                   |                   |                                                    |             |   |              | Recorder: |                                      |  |                              |
| Date                                                                                                                        | ...../...../ 2015 |                                                    | Survey Name |   | Plot No.     |           |                                      |  |                              |
| MGA grid reference                                                                                                          | Datum: GDA94      |                                                    | Zone 5...   |   | Easting      |           | Northing                             |  | GPS pos'n: start of transect |
| Base Plot size                                                                                                              | 20 x 20 m         | Plot Orientation (transect bearing from GPS point) |             | ° | Perm. Marker | No        | Photo orientation (bearing of photo) |  | °                            |

|     |  |  |  |
|-----|--|--|--|
| PCT |  |  |  |
|-----|--|--|--|

| Stratum | Species name | % Cover | Height to crown (m)                      |
|---------|--------------|---------|------------------------------------------|
| Upper   |              |         | Upper Stratum Height to crown (m) Mode   |
| Upper   |              |         |                                          |
| Upper   |              |         |                                          |
| Mid     |              |         | Mid Stratum Height to crown (m) Mode     |
| Mid     |              |         |                                          |
| Mid     |              |         |                                          |
| Ground  |              |         | Ground Stratum Height to crown (m) Model |
| Ground  |              |         |                                          |
| Ground  |              |         |                                          |

|             |  |           |  |        |
|-------------|--|-----------|--|--------|
| Cover %     |  | Cover %   |  | Notes: |
| Litter      |  | Cryptogam |  |        |
| Bare ground |  | Rock      |  |        |

|               |                    |                       |                     |                    |            |
|---------------|--------------------|-----------------------|---------------------|--------------------|------------|
| Tree health   | Healthy            | Branchlets dead       | Small branches dead | Main branches dead | Trees dead |
| Age structure | Early regeneration | Advanced regeneration | Uneven age          | Mature             | Senescent  |

| Plot Disturbance           | Severity code | Age code | Observational evidence: | Severity code | Age code | Observational evidence: |
|----------------------------|---------------|----------|-------------------------|---------------|----------|-------------------------|
| Clearing (inc. logging)    |               |          |                         | Grazing       |          |                         |
| Cultivation (inc. pasture) |               |          |                         | Fire damage   |          |                         |
| Soil erosion               |               |          |                         | Storm damage  |          |                         |
| Firewood collection        |               |          |                         | Other         |          |                         |

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe      Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Physiography (from Yellow Book)

|                    |  |                  |   |           |   |           |
|--------------------|--|------------------|---|-----------|---|-----------|
| Morphological Type |  | Landform Pattern |   | Lithology |   | Elevation |
| Soil Type          |  | Slope            | ° | Aspect    | ° |           |

## 9.2 Waterbird methods

The expansive, flat terrain of Toogimbie IPA makes means that a combination of methods will be required to characterise waterbird abundance, species richness and breeding. Aerial surveillance using an unmanned aerial vehicle (UAV or drone) will be used to complement on-ground counts at both random and permanent sites in each of the cells included in the study.

### 9.2.1 On-ground counts

A bird monitoring method based on that established at Toogimbie IPA (Smits 2014) will be included as part of the trial at Gooraman Swamp. The existing monitoring includes timed counts at four-five stops along a meandering 250-350 metre path, with 15 minutes spent at each stop to look for and count birds. This method can be altered to include counts of breeding colonies should these occur.

Bird counts should be for each of the species of significance to the Murrawarri, as well as the categories of 'woodland species' and 'raptors'.

## 9.3 Native fish and emu

An angler survey based on the method used by Giri and Hall (2015) to assess South Australian recreational fishing is proposed to assess fishing outcomes at Weilmoringle. A similar approach to measuring emu hunting success can also be applied.

| Date?     | Times?                                     | Who?                      | Where?     | Species | Catch Anything?     |          | Types of                |
|-----------|--------------------------------------------|---------------------------|------------|---------|---------------------|----------|-------------------------|
|           | (Start time / End time / Total break time) | (Which household members) | (Location) |         | (Number you caught) |          | fishing? (Methods used) |
| day/month | Start / End / Break (hrs/mins)             |                           |            |         | Kept                | Released |                         |
|           |                                            |                           |            |         |                     |          |                         |
|           |                                            |                           |            |         |                     |          |                         |
|           |                                            |                           |            |         |                     |          |                         |
|           |                                            |                           |            |         |                     |          |                         |
|           |                                            |                           |            |         |                     |          |                         |
|           |                                            |                           |            |         |                     |          |                         |
|           |                                            |                           |            |         |                     |          |                         |
|           |                                            |                           |            |         |                     |          |                         |
|           |                                            |                           |            |         |                     |          |                         |

## 10 APPENDIX 2: OPERATIONAL MONITORING REPORT

| Commonwealth Environmental Watering Program                                                                                                                                                                                                                                 |                                                                                                                        |                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Operational Monitoring Report                                                                                                                                                                                                                                               |                                                                                                                        |                                                                                                |
| Please provide the completed form to <insert name and email address>, Environmental Water Delivery Section, DEWHA within two weeks of completion of water delivery or, if water delivery lasts longer than 2 months, also supply intermediate reports at monthly intervals. |                                                                                                                        |                                                                                                |
| Final Operational Report<br>Period: From                                                                                                                                                                                                                                    | To                                                                                                                     | Intermediate Operational Report Reporting                                                      |
| Site name                                                                                                                                                                                                                                                                   | <EWDS to prefill>                                                                                                      | Date                                                                                           |
| Location                                                                                                                                                                                                                                                                    | GPS Coordinates or Map Reference for site (if not previously provided)                                                 |                                                                                                |
| Contact Name                                                                                                                                                                                                                                                                | Contact details for first point of contact for this watering event                                                     |                                                                                                |
| Event details                                                                                                                                                                                                                                                               | Watering Objective(s) <EWDS to prefill>                                                                                |                                                                                                |
|                                                                                                                                                                                                                                                                             | Total volume of water allocated for the watering event<br>CEWH:<br>Other(please specify) :                             |                                                                                                |
|                                                                                                                                                                                                                                                                             | Total volume of water delivered in watering event<br>CEWH:<br>Other (please specify):                                  | Delivery measurement<br>Delivery mechanism:<br>Method of measurement:<br>Measurement location: |
|                                                                                                                                                                                                                                                                             | Delivery start date (and end date if final report) of watering event                                                   |                                                                                                |
|                                                                                                                                                                                                                                                                             | Please provide details of any complementary works                                                                      |                                                                                                |
|                                                                                                                                                                                                                                                                             | If a deviation has occurred between agreed and actual delivery volumes or delivery arrangements, please provide detail |                                                                                                |
|                                                                                                                                                                                                                                                                             | Maximum area inundated (ha) (if final report)                                                                          |                                                                                                |
|                                                                                                                                                                                                                                                                             |                                                                                                                        |                                                                                                |

|                             |                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | Estimated duration of inundation (if known) <sup>6</sup>                                                                                                                                                                                                                                                                                                      |
| <b>Risk management</b>      | <p>Please describe the measure(s) that were undertaken to mitigate identified risks for the watering event (eg. water quality, alien species); please attach any relevant monitoring data.</p> <p>Have any risks eventuated? Did any risk issue(s) arise that had not been identified prior to delivery? Have any additional management steps been taken?</p> |
| <b>Other Issues</b>         | Have any other significant issues been encountered during delivery?                                                                                                                                                                                                                                                                                           |
| <b>Initial Observations</b> | Please describe and provide details of any species of conservation significance (state or Commonwealth listed threatened species, or listed migratory species) observed at the site during the watering event?                                                                                                                                                |
|                             | Please describe and provide details of any breeding of frogs, birds or other prominent species observed at the site during the watering event?                                                                                                                                                                                                                |
|                             | Please describe and provide details of any observable responses in vegetation, such as improved vigour or significant new growth, following the watering event?                                                                                                                                                                                               |
|                             | Any other observations?                                                                                                                                                                                                                                                                                                                                       |
| <b>Photographs</b>          | Please attach photographs of the site prior, during and after delivery <sup>7</sup>                                                                                                                                                                                                                                                                           |

<sup>6</sup> Please provide the actual duration (or a more accurate estimation) at a later date (e.g. when intervention monitoring reports are supplied).

<sup>7</sup> For internal use. Permission will be sought before any public use.