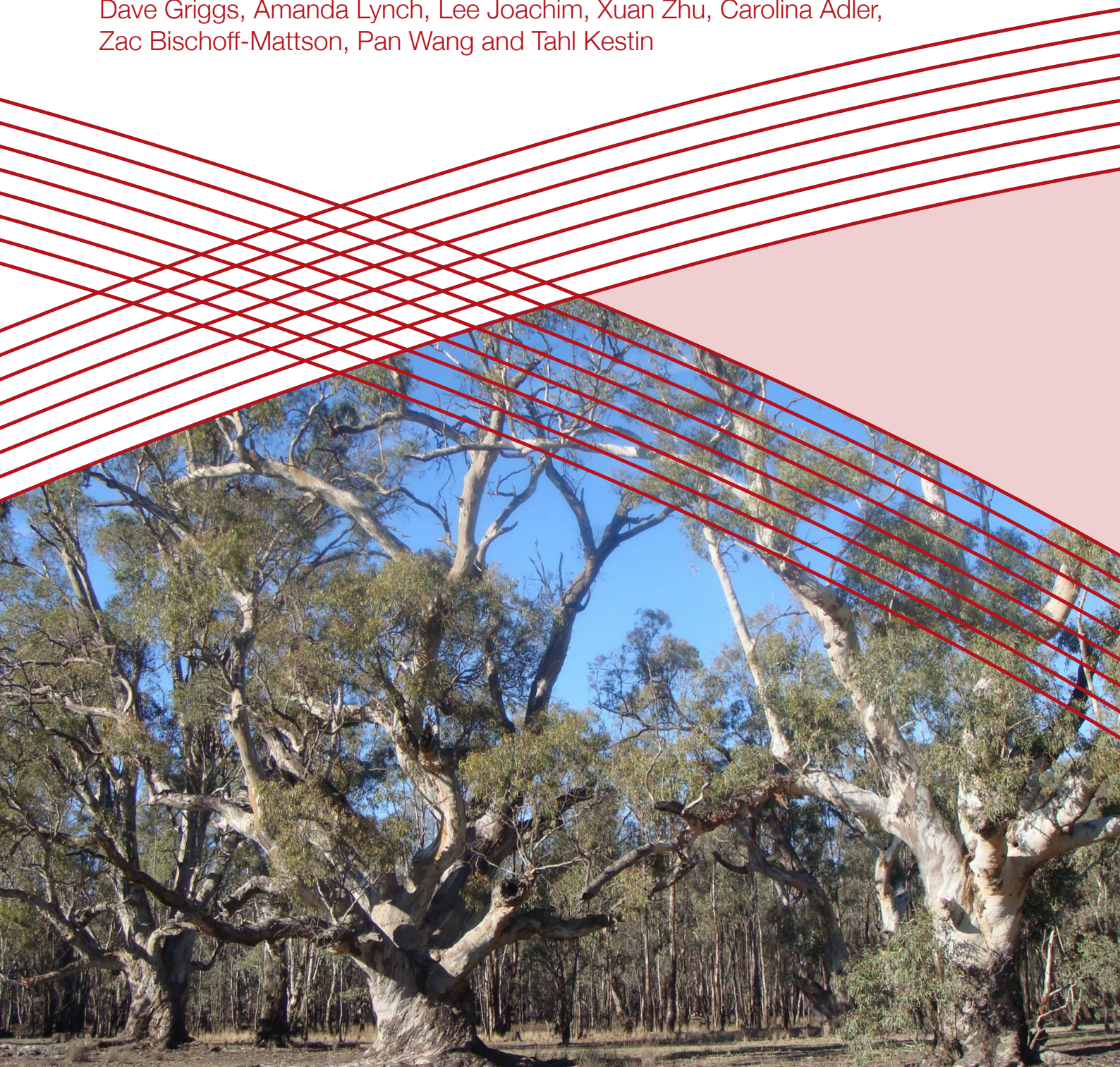


# Indigenous voices in climate change adaptation: Addressing the challenges of diverse knowledge systems in the Barmah-Millewa

Final Report

Dave Griggs, Amanda Lynch, Lee Joachim, Xuan Zhu, Carolina Adler,  
Zac Bischoff-Mattson, Pan Wang and Tahl Kestin



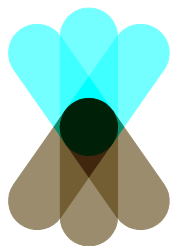
# **Indigenous voices in climate change adaptation: Addressing the challenges of diverse knowledge systems in the Barmah-Millewa**

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**NCCARF**

National  
Climate Change Adaptation  
Research Facility

Published by the National Climate Change Adaptation Research Facility

ISBN: 978-1-925039-64-1 NCCARF Publication 93/13

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**Please cite this report as:**

Griggs, D, Lynch, A, Joachim, L, Zhu, X, Adler, C, Bischoff-Mattson, Z, Wang, P, Kestin, T 2013 *Indigenous voices in climate change adaptation: Addressing the challenges of diverse knowledge systems in the Barmah-Millewa*, National Climate Change Adaptation Research Facility, Gold Coast, pp.71.

**Acknowledgements**

This work was carried out with financial support from the Australian Government (Department of Climate Change and Energy Efficiency) and the National Climate Change Adaptation Research Facility.

The role of NCCARF is to lead the research community in a national interdisciplinary effort to generate the information needed by decision makers in government, business and in vulnerable sectors and communities to manage the risk of climate change impacts.

The project team gratefully acknowledges the Yorta Yorta Climate Change Committee and the Yorta Yorta Elders Council for their vision and leadership throughout this project. We would also like to acknowledge the Yorta Yorta community for their enthusiastic participation in the project.

Additional funding for the project was provided by the Victorian Climate Change Centre for Adaptation Research (VCCCAR) and the Office of the Commissioner for Environmental Sustainability Victoria. In-kind contributions were provided by the Yorta Yorta Nation Aboriginal Corporation (YYNAC) and Brown University.

We would like to thank the following people who participated in developing and undertaking parts of this project: Jackie Walker and Sonia Cooper (YYNAC), Nicholas C. Howard (World Bank), Kate Auty (Office of the Commissioner for Environmental Sustainability), Rowan Foley (Aboriginal Carbon Fund), and Cathy Robinson (CSIRO).

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## ABSTRACT

This project investigated how the deep knowledge of the Yorta Yorta people can be used to strengthen their participation and influence in the complex national and regional processes that determine how their traditional lands, which are in the highly-contested Murray-Darling Basin, are managed, leading to improved adaptation decisions both for the Yorta Yorta and the wider community.

Through discussions with the Yorta Yorta over several years, the approach developed for the project was the creation of a Geographical Information System (GIS) mapping framework containing both Yorta Yorta knowledge and more conventional knowledge. GIS allows for mapping and layering of different types of data, allowing the Yorta Yorta to access and present their knowledge in ways that relate to Western decision-making processes.

To do this, the project had four components:

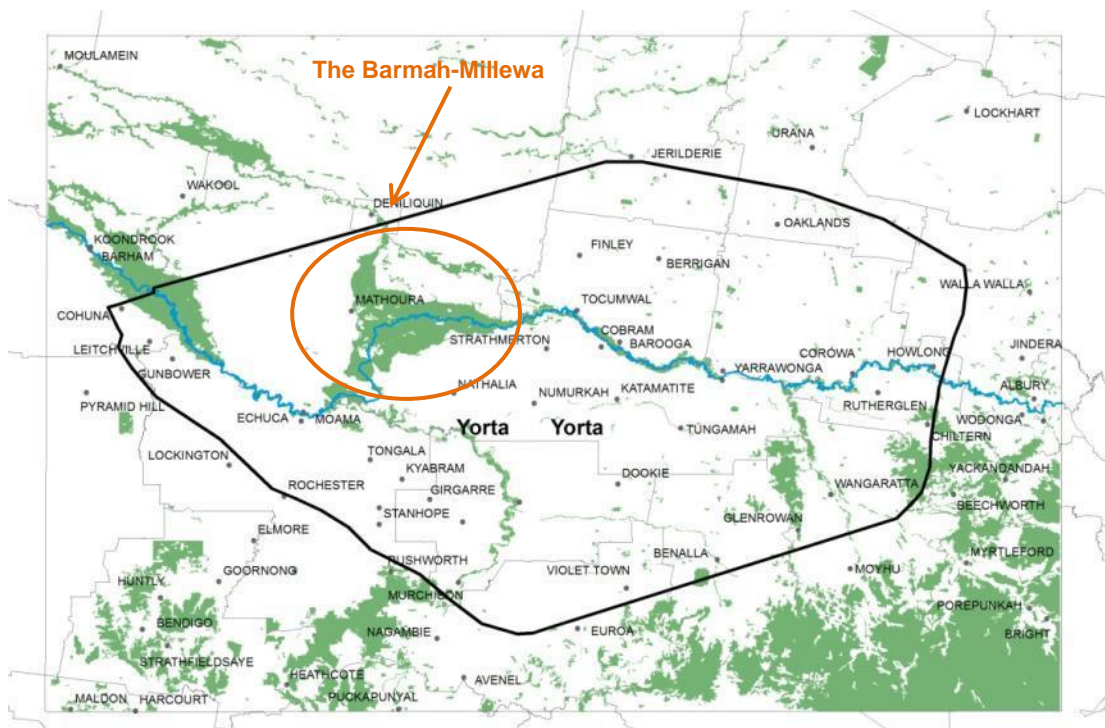
1. Development and testing of protocols and methodology for the collection and protection of Yorta Yorta knowledge. This was carried out through an intergenerational process, whereby Yorta Yorta youth were trained in cultural data collection techniques, and they interviewed Elders to capture the knowledge.
2. Building of a GIS framework to integrate both the Yorta Yorta knowledge and more conventional data about the climate, hydrology and biodiversity of the Yorta Yorta area. For the first time this pulled together all of the conventional information normally used as a basis for natural resource management decisions. In addition, because the GIS database has been created and is owned by the Yorta Yorta means that they have something of value to bring to the discussions, so that they are able to participate in those discussions on equal terms.
3. Exploration of the views of the broader community in the region regarding management of the region and adaptation alternatives through a stakeholder consultation process. The consultation identified the potential for greater use of science as a neutral arbiter in issues such as management of the Murray-Darling Basin, but even more important is the need for genuine, deep, open-minded dialogue with the community at all stages of decision-making, particularly at an early stage before proposals are put forward and views become entrenched.
4. Identification of broader lessons for improving adaptation of First Nations communities in Australia from the experience of the Yorta Yorta and other communities around the country, through a national workshop. The key conclusion of the workshop was the urgent need to empower First Nation communities to make their own assessments and decisions on the best ways for them to respond to climate change.

The project raised community awareness and knowledge and energised the Yorta Yorta youth to take an interest in their history and culture, and in the climate challenges facing their community. Overall the project has been a successful pilot demonstration of the utility of a GIS database to integrate Indigenous and conventional knowledge for better natural resource management outcomes and the project has increased the knowledge and capacity of the Yorta Yorta to engage in effective natural resource management and decision-making.

## EXECUTIVE SUMMARY

This project investigated how the deep knowledge of the Yorta Yorta people of their traditional lands on the Murray River (see figure below) can be used to strengthen their participation and influence in the complex national and regional management processes that determine how their traditional lands evolve, leading to improved adaptation decisions both for the Yorta Yorta and the wider community.

The Yorta Yorta people consider the Murray River, or *Dhungala*, as their life source and spirit. The Barmah-Millewa region on the floodplain of the Murray is the heart of Yorta Yorta Traditional Tribal Lands, and also an area of significant international ecological value.



### The Yorta Yorta traditional lands

Sources: Geoscience Australia and Australian Bureau of Statistics

In the past century, the Barmah-Millewa has suffered considerable damage from human use (such water diversions for agriculture, channel re-routing and the introduction of invasive pests). However the ability of the Yorta Yorta community to respond has been curtailed by their limited access to the complex and contested policy and management processes surrounding the Murray-Darling Basin.

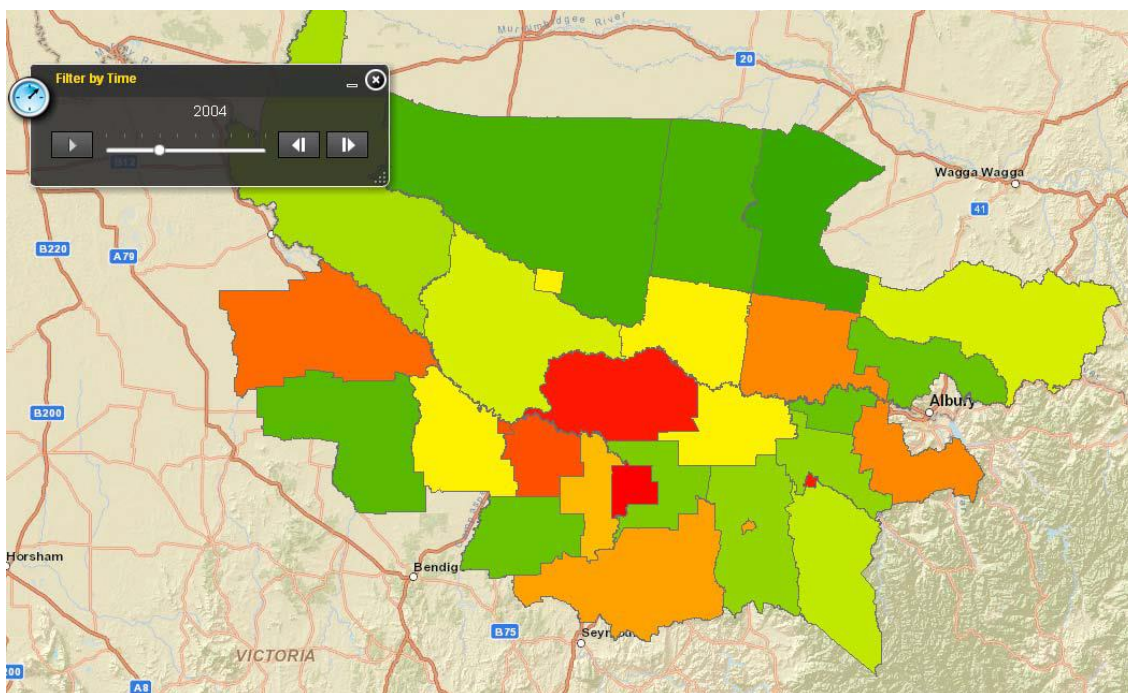
This project is a product of several years of conversations between the Yorta Yorta and sustainability scientists on climate change and what it may mean for the Yorta Yorta. Out of those many conversations a clear need emerged to find ways to facilitate Yorta Yorta knowledge to be taken into account and for their voice to be heard in discussions with policymakers and the community.



The solution developed in partnership with the Yorta Yorta was the creation of a Geographical Information System (GIS) mapping framework containing both Yorta Yorta knowledge and more conventional knowledge. GIS allows for mapping and layering of different types of data, while providing a secure place for the knowledge to be stored. The system allows the Yorta Yorta to access and present their knowledge in ways that relate to Western decision-making processes.

To do this, the project had four components:

1. Development and testing of protocols and methodology for the collection and protection of Yorta Yorta knowledge. As part of this process, Yorta Yorta youth were trained in cultural data collection techniques, and they were the ones who interviewed Elders to capture the information required for the project – so at the same time knowledge was passed from one generation to the next.
2. Building of a GIS framework to integrate both the Yorta Yorta knowledge and more conventional data about the climate, hydrology and biodiversity of the Yorta Yorta area. For the first time this pulled together all of the conventional information normally used as a basis for natural resource management decisions. In addition, because the GIS database has been created by and is owned by the Yorta Yorta means that they have something of value to bring to the discussions, so that they are able to participate in those discussions on equal terms.



**Example of a GIS map showing Australian Bureau of Statistics population data for the Yorta Yorta area**

3. Exploration of the views of the broader community in the region regarding management of the region and adaptation alternatives through a stakeholder consultation process. The consultation identified the potential for greater use of

science as a neutral arbiter in issues such as management of the Murray-Darling Basin, but even more important is the need for genuine, deep, open-minded dialogue with the community at all stages of decision-making, particularly at an early stage before proposals are put forward and views become entrenched.

4. Identification of broader lessons for improving adaptation of First Nations communities in Australia from the experience of the Yorta Yorta and other communities around the country, which we did through a national workshop. The National Workshop on Indigenous Knowledge for Climate Change Adaptation, which was held in Echuca, highlighted the importance of climate change and the challenge of adaptation for First Nations communities. A number of important conclusions and recommendations came out of the workshop, including:
  - Programs aimed at adaptation for First Nations communities must focus on empowering communities to identify and implement their own responses to climate change.
  - Meaningful engagement by government, academia and others with First Nations is the key to supporting them implement effective climate change adaptation solutions
  - First Nations communities need to take a stand and assert their rights and needs in regards to climate change adaptation and be proactive about taking action.
  - There is a strong need for increased focus on helping First Nations communities adapt to climate change, beginning with access to information and scientists, through to capacity building within communities, so that they are able to control their own destiny.

The project also resulted in many other direct and indirect benefits.

The process of having the Yorta Yorta youth collect the Indigenous knowledge raised community awareness and knowledge and energised the Yorta Yorta youth to take an interest in their history and culture, and the climate challenges facing their community. This has resulted in a community which is much more informed and knowledgeable about climate change and which is now taking action to adapt and even to provide leadership to other First Nations communities to start them on the journey of understanding the potential impacts of climate change on their community. In fact, the whole research process has increased the knowledge and capacity of the Yorta Yorta to engage in effective natural resource management and decision-making.

# 1 INTRODUCTION

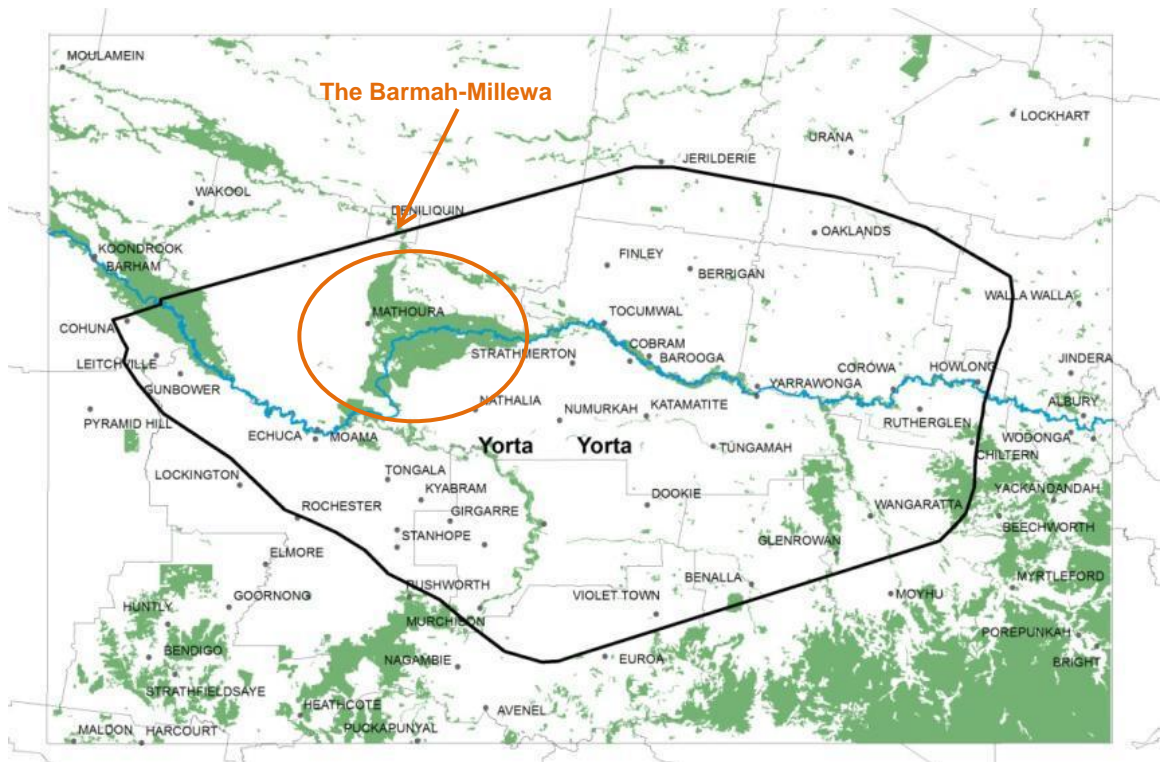
The project “Indigenous<sup>1</sup> voices in climate change adaptation: Addressing the challenges of diverse knowledge systems in the Barmah-Millewa” investigated how the deep knowledge of the Yorta Yorta people of their traditional lands on the Murray River can strengthen their participation and influence in the complex national and regional management processes that determine how their traditional lands evolve, leading to improved adaptation decisions both for the Yorta Yorta and the wider community. The project is a component of an ongoing partnership between the Yorta Yorta Nation Aboriginal Corporation (YYNAC), Monash University and Brown University (USA), and was undertaken jointly by these organisations.

The Yorta Yorta people consider the Murray River, or *Dhungala*, with its rich network of lagoons, creeks, and wetlands, as their life source and spirit. The Barmah-Millewa region on the floodplain of the Murray is the heart of Yorta Yorta Traditional Tribal Lands (Figure 1). The Barmah Choke is a region where constricted flows lead to more frequent flooding events, supporting the internationally significant river red gum forests and wetlands. The Yorta Yorta assert their inherent rights and have shown through oral, documentary, and material evidence that their social, spiritual, economic, and cultural links with country have never been broken.

The Barmah-Millewa, however, is in the middle of the Murray-Darling Basin (MDB), which supports an agricultural industry worth more than \$9 billion per year. Water diversions for agriculture and hydroelectricity, channel re-routing and de-snagging, managed changes to seasonal river flow regimes, cattle grazing, commercial firewood collection and the introduction of invasive pests, among others, have all caused significant damage to the environment of the Barmah-Millewa area. This damage was recently compounded by the decade-long Millennium Drought (1997–2009), which saw record low streamflows in the MDB, and the extreme flooding that followed it in 2010 and 2011.

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<sup>1</sup> At the request of NCCARF we adopted for this report the recent advice of the National Congress of Australia’s First Peoples on appropriate terminology. Following this terminology we use the terms “First Nations” and “First Nations of Australia” to refer to Aboriginal and Torres Strait Islander Peoples, and the term “Indigenous” to reference the formal title of an office, document, organisation, program or Indigenous peoples world-wide. The title of this project, the titles of some of the events we ran, and some of the materials we produced during the project and quote here were created before the request was made and use the term “Indigenous” to refer to Aboriginal and Torres Strait Islander Peoples.



**Figure 1: The Yorta Yorta and Barmah-Millewa areas with towns, local government areas (grey lines), native vegetation areas (green), and the Murray River / Victoria-NSW border (blue line).**

Sources: Geoscience Australia and Australian Bureau of Statistics

Seeing their land decline has brought great suffering to the Yorta Yorta, and the prospect of climate change with further impacts from more climatic extremes was of great concern to them. However the ability of the Yorta Yorta community to respond to these changes – to save and restore culturally important plants, animals and places, and share the wisdom they have gained through generations of better ways of managing the land – has been severely curtailed by their limited access to the complex and contested policy and management processes surrounding the MDB.

These processes are made complex by the myriad of stakeholders and agencies involved in the management of the region. In addition to being part of the MDB, the Barmah-Millewa and the Yorta Yorta region span two states and several catchment management authorities. The Barmah-Millewa is a Living Murray Icon Site, a Ramsar wetland, and includes several national parks. The fact that the region lies within both Victoria and New South Wales effectively doubles the state organisations involved. Within each state many different government departments – such as water, environmental protection, primary industries, planning and communities – and state agencies – such as Landcare groups, park management, Aboriginal affairs and the essential services commission – are involved. Many Federal government departments and agencies are also involved, including the Murray-Darling Basin Authority, National Water Commission and several Catchment Management Authorities. Layered on top of these are many additional stakeholders, such as research providers, local interest groups, regional partnerships, First Nations organisations, task forces and industry associations. Management of the region and its natural resources are governed by a

wide array of acts and policies, rules targets and procedures, guidelines, plans, permits and allocations.

This project is a product of several years of conversations between the Yorta Yorta and sustainability scientists on climate change and what it may mean for the Yorta Yorta. Out of those many conversations a clear need emerged to find ways to facilitate Yorta Yorta knowledge to be taken into account and for their voice to be heard in discussions with policymakers and the community.

The Yorta Yorta knowledge is a form of “Indigenous” knowledge – a body of knowledge built by a group of people through generations living in contact with a particular geographic location. This knowledge may include but is not limited to a set of empirical observations about the local environment, a formal or informal system of classification, and/or a formal or informal system of self-management which may or may not be operationalised.

An increasing number of researchers are eager to find ways to support the inclusion of insights arising from Indigenous knowledge into a better understanding of climate change and variability, and the development of robust adaptation alternatives. Local, national, and international organisations have recognised Indigenous knowledge as essential to addressing complex environmental problems (Whitehead et al. 2003; Mercer 2007). Many have demonstrated that such knowledge often facilitates decision-making in ways that are diversified, risk-averse and cost-effective (Vanek 1989; Hansen and Erbaugh 1987; Dei 1993; Agrawal, A. 1995; ISDR 2008; Beckford et al. 2010; Veland et al. 2010).

The solution developed in partnership with the Yorta Yorta to facilitate their participation in regional processes was the creation of a Geographical Information System (GIS) containing both Yorta Yorta knowledge and more conventional knowledge. GIS is a framework that encodes many types of data with location information, allowing for mapping and layering of different types of data (Figure 1 is an example). The use of a GIS database was selected because it met a primary purpose for the Yorta Yorta of having a place where their knowledge could be stored with appropriate levels of security and it provided way of integrating different types of knowledge that had not been collected in one place previously. The aim of this integration was to allow the Yorta Yorta to access and present their knowledge in ways that relate to Western decision-making processes.

The process, as developed with Yorta Yorta, was to

1. Develop and test protocols and methodology for the collection and protection of Yorta Yorta knowledge through a process of transgenerational transfer. This work is described in Section 2. Given that only a fraction of the Yorta Yorta’s knowledge could be captured in such a short project, the focus of this work was to equip the Yorta Yorta to continue the data collection on their own.
2. Build a GIS framework to integrate both the Yorta Yorta knowledge and more conventional data about the climate, hydrology and biodiversity of the Yorta Yorta area. This work is described in Section 3.



3. Explore the views of the broader community in the region regarding management of the region and adaptation alternatives. This work is described in Section 4.
4. Identify broader lessons for improving adaptation of First Nations communities in Australia from the experience of the Yorta Yorta and other around the country. This was done through a national workshop, and is described in Section 5.

However, there are a number of challenges to this approach that mean that the full benefits of the Indigenous knowledge are not realised and which this project aims to overcome, namely:

- How to protect the Indigenous knowledge from inappropriate exploitation
- How to integrate the Indigenous knowledge with more conventional forms of knowledge
- How to present the integrated knowledge in the form of actionable information for the Yorta Yorta, local stakeholders, policymakers and others etc.
- How to involve communities in ongoing management decisions.

The project responds to the following priorities identified by NCCARF's National Climate Change Adaptation Research Plan for Indigenous Communities (Langton et al. 2012):

- Topic 1: Understanding how interactions between social, cultural, institutional, economic and biophysical processes make Indigenous individuals, households, communities, businesses and institutions sensitive to climate risks, and the identification and evaluation of strategies to reduce this sensitivity.
- Topic 4: Understanding the capacity of Indigenous individuals, households, businesses and institutions to adapt to climate change, and the identification of strategies to enhance this capacity.

The Yorta Yorta face multiple natural and human-related challenges in their efforts to care for the future of their lands and heritage, including climate change and its uncertain regional impacts. Greater access to and say in regional decision making and policy processes are crucial in providing them with the flexibility to develop and implement the best responses to these complex challenges for their community. Furthermore, assisting them in bringing their deep knowledge of the Barmah-Millewa to these policy and decision-making processes will directly lead to improved river and forest management decisions that are better adapted to climate change.

## **2 COLLECTION AND PROTECTION OF YORTA YORTA KNOWLEDGE**

This component of the project aimed to develop effective and robust approaches to the collection of Yorta Yorta knowledge, and to test and refine them through the collection of actual cultural data to be integrated into the GIS framework (Section 3). In addition to the data collected (Section 2.1), a Cultural Data Collection Protocol was produced (Section 2.2) to support and guide the collection of Yorta Yorta knowledge for ongoing use by the Yorta Yorta.

The principles for the data collection were determined through consultation with the Yorta Yorta Elders Council, who emphasised maintaining the traditional method of transferring the knowledge across generations. The overall approach was for trained volunteers from the local community to accompany Elders to places of cultural significance in the Barmah-Millewa National Forest and record knowledge associated with these places with voice recordings, photography and Global Positioning System (GPS) data. These methodologies, chosen by and endorsed by the Yorta Yorta Elders Council, are also largely employed as community and participatory tools in Indigenous research (Chilisa, 2012) and are described in more detail in the following sections.

### **2.1 Cultural data collection campaign**

An intensive data collection campaign was undertaken to test the Protocol and to collect cultural data for integration into the GIS framework. The campaign took place in May 2012 in and around the Barmah-Millewa Forest after considerable preparations, including:

- Several rounds of training for the youth volunteers in cultural interview techniques and use of audio recorders, cameras and GPS devices.
- Refinement of explanatory and consent documents for the participants
- The signing of confidentiality agreements documents by all team members

Attempts to run pilot interviews were hampered by poor weather and ongoing flooding in the Barmah-Millewa area.

The campaign was a major logistical operation by the YYNAC to line up Elders, youth, drivers and vehicles for the campaign and involved 13 Yorta Yorta Elders and 6 Yorta Yorta youth. Members of the research team were on hand to support the participants. There was considerable enthusiasm within the community for this exercise, and the Yorta Yorta have conducted several follow-up interviews since.

The campaign yielded around 25 hours of audio recordings. The recordings were transcribed, coded, and uploaded with the other data collected for input into a GIS framework, for the Yorta Yorta community to access and use. All the data was archived at YYNAC. Some of the data was passed on to other members of the team for analysis, but was deleted when it was no longer in use. This initial data collection campaign was intended to not only support capacity building in data collection but, more importantly, initiate an on-going and long-term practice that supports inter-generational oral history

tradition. This approach is congruent with best practices that uphold community values and by definition are ethically robust in context (Chilisa, 2012).

## **2.2 Cultural data collection protocol**

The “*Yorta Yorta Cultural Data Collection Protocol*” (see Appendix A) outlines this framework and describes the process for Yorta Yorta cultural data collection under the auspice of this project.

The protocol was designed to address the specific needs of the Yorta Yorta for the purposes of this project. Development of the protocol began in June 2011 and involved members of the research team and the Yorta Yorta Elders Council. It has since been refined through several rounds of volunteer training and fieldwork occurring from November 2011 to June 2012.

Intellectual Property (IP) requirements and legal safeguards for cultural data are central to this Protocol and have been emphasized at every stage of project development and implementation (see also Section 3.1). The Protocol is a living document that will continue to be refined as experience grows and needs demand it.

Great care has been taken throughout the project to safeguard the Intellectual Property of the Yorta Yorta. With pro-bono assistance from the World Bank Institute an Intellectual Property Protocol was developed. This turned out to be an extremely complex legal document and the Yorta Yorta have sent it to law firms that they have a relationship with to receive professional legal advice on the Protocol.

The process of cultural data collection involves trained Yorta Yorta youth volunteers from the local community. These volunteers accompany Elders to places of cultural significance in and around the Barmah-Millewa Forest to record knowledge associated with these places. Data collection includes voice recordings, photography, and GPS mapping. The cultural data collection process aims to maintain traditional methods of transferring knowledge across generations and to reinforce capacity for knowledge creation and transmission within the Yorta Yorta community.

The following sections describe the principal components of this Protocol, namely volunteer training (Section 2.2.1) and fieldwork (Section 2.2.2). It is important to note that the full Protocol document should be referenced and referred to in order to provide context for these descriptions (see Appendix A).

### **2.2.1 Volunteer Training**

Volunteer training comprises general instruction and guidance on a number of sequential tasks that are generally described as: introduction; background; interview process; the “Fieldwork Equipment Kits”; use of equipment; outdoor fieldwork exercise; and **conclusion. These tasks are summarised as follows:**

- **Introduction.** Trainer(s) and trainees introduce each other to the group, and instructions are provided on principles and procedures for obtaining consent from interviewees (the Elders).

- **Background.** Trainees are addressed by an Elder on the importance and objectives of the project for Yorta Yorta with respect to upholding and supporting cultural traditions as part of data collection.
- **Interview process.** This task emphasises the importance of the volunteers' roles as interviewers, providing guidance on the types of questions to be asked and how interviews should be conducted.
- **Fieldwork Equipment Kits.** In this part of the training session, trainees are introduced to the recording devices used during interviews (voice recorders, GPS units, digital cameras, etc.), including checklists for equipment maintenance and data handling.
- **Use of equipment.** During this task, trainees familiarise themselves with the mechanics and various functions of the equipment.
- **Outdoor fieldwork exercise.** Trainees are introduced to the interview and data collection process in a "learn by doing" exercise, working in pairs to help negotiate the interview process whilst maintaining a meaningful dialogue with the Elder interviewee.
- **Conclusion.** In this final part of the training session, trainees reconvene to reflect on and discuss the day's activities. Instructions for saving and uploading data are also provided.

Training is planned and scheduled on a case-by-case basis, depending largely on the number and background of trainees as well as time constraints and the availability of training resources including trainers and infrastructure.

### **2.2.2 Fieldwork**

Once training is complete, volunteer youths are ready to engage in fieldwork activities for cultural data collection. Fieldwork activity is generally conducted in three stages: pre-fieldwork, interview process; and post-interview processing (continuous, as data is collected). These are briefly described as follows:

- **Pre-fieldwork.** In this phase, the interviewer(s) prepare for the interview by taking into consideration tasks such as scheduling the interview, preparing the equipment, and preparing a script or 'journey' for the interview process.
- **Interview process.** The interview process itself is largely based on the principles and procedures described in detail in the Protocol (see YYNAC, 2012). To facilitate the interview process, interviewer(s) may refer to and/or use a Fieldwork Template provided in the equipment kits, which prompts the gathering of basic information such as: location(s), time and dates, participants.
- **Post-interview processing.** In this phase, the interviewers follow guidelines for data storage and upload into digital repositories for archiving, processing and analysis. This is also an opportunity for reflection and feedback to inform future data collection and to refine the Data Collection Protocol. Responsibility for data storage, management and safe keeping ('keeping place') rests with YYNAC on behalf of Yorta Yorta.

### **2.3 Concluding statements**

Experiences with the initial data collection campaign have been effective in engaging the Yorta Yorta community, for example through instances of verbal recommendations from trained Yorta Yorta youth to their peers resulting in new requests for training and outreach to other Yorta Yorta families. On a more personal level, one of the youth participating in the collection campaign has put together a YouTube video<sup>2</sup> describing her experience in participating in this exercise and its impact on her.

Development of a Cultural Data Collection Protocol is a response to a self-identified Yorta Yorta need. Evaluation on the effectiveness of this Protocol rests on the extent to which it has helped to serve this need.

Refinement of a robust Cultural Data Collection Protocol is an important foundation for current *and future* research partnerships. The approaches to cultural data collection outlined in the Protocol emphasize 'living culture' and the Yorta Yorta community's enduring connection to country. This integrated approach to data collection, processing and analysis will be an ongoing resource for Yorta Yorta as the community continues to develop capacity and products of value.

A robust and secure platform for cultural data storage, analysis and transmission, providing appropriate security and access control, is an important extension of Protocol IP safeguard objectives (see Section 3.1). The GIS framework also reflects Protocol objectives by providing a platform for community engagement and dialogue as well as a catalyst for intra-community discussion and education.

Initial success in the adoption and implementation of this multi-method approach and protocol suggests a certain degree of utility and confidence in its appropriateness in supporting self-identified needs, which can be transferable and adapted to other contexts.

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<sup>2</sup> My Learning Country by Berneice Joachim, <http://www.youtube.com/watch?v=ycB2E3HwJDI>.



### **3 DEVELOPMENT OF A GIS FRAMEWORK FOR INTEGRATING YORTA YORTA AND CONVENTIONAL KNOWLEDGE**

Out of many conversations a clear need emerged to find ways to facilitate the Yorta Yorta knowledge collected as described in Section 2 to be taken into account and for their voice to be heard in discussions with policymakers and the community. The aim of this integration was to allow the Yorta Yorta to access and present their knowledge in ways that relate to Western decisions-making processes. One of the key aims of this project was to develop a framework that would provide a secure storage place where Yorta Yorta knowledge could be stored with appropriate levels of security and to integrate Yorta Yorta knowledge with conventional information in a way that would allow the Yorta Yorta to develop new ways of understanding and articulating their needs and insights about the Barmah-Millewa area, as input to policy and management processes affecting the region. Given the limited time and resources this was not intended to be comprehensive but was intended to provide a proof of the concept.

Through ongoing discussions with the Yorta Yorta, it was decided to implement this framework as a GIS database. GIS encodes data with location information, allowing for mapping and layering of different types of data. It can accommodate the many different types of data that we wanted to combine, including the data on the geographical, ecological, climatic, cultural, political, social and economic environment of the region, and the images, photos, audio recordings and other types of text and multimedia-based data that relate to Yorta Yorta knowledge. Hence a GIS database was selected because it provided a way of integrating different types of knowledge that had not been collected in one place previously. The development of this framework involved several components, and these are detailed in the following sections:

- Development of an GIS Protocol to guide how the framework would be developed (Section 3.1)
- Development of the GIS framework (Section 3.3)
- Integration of Yorta Yorta and conventional data about the Yorta Yorta area into the database (Section 3.2)

#### **3.1 GIS protocol**

The design and development of the GIS database was governed by a GIS Protocol (YYNAC, 2013), which was developed by the project team with YYNAC. The protocol specifies the principles for the development of the GIS framework, as well as how the knowledge, data and images under the custodianship of YYNAC that is collected or accessed as part of this project (hereinafter referred to as the “data”) will be stored, protected and presented within it.

The GIS Protocol included the following key principles:

1. The collection of Yorta Yorta traditional knowledge is a priority within this framework and continual maintenance is a cultural protocol and a digital form of security.
2. YYNAC is to be consulted on the GIS database at all stages of planning, design and development.
3. The ownership and copyright of cultural data and Indigenous knowledge contained in the GIS database is always held by the Yorta Yorta person from whom it was collected.
4. The right of Yorta Yorta people to keep secret and sacred their cultural knowledge will be respected.
5. YYNAC has the right to determine the contents of the GIS database, the accessibility to the database and the way in which the data and information are to be accessed, presented and delivered.
6. YYNAC has the right to control exploitation of their cultural and intellectual property contained in the GIS database.
7. An approval process and IP agreement with YYNAC will be implemented for the use of the GIS database.

Hence the contents, management strategy and access control of the database were designed through consultation with YYNAC.

### **3.2 Data collection**

The data in the GIS database were collected from many different sources. Foundation geographical data, including administration, cadastre, topography, hydrology, geology, vegetation, biodiversity, address points, infrastructure, planning and transport, are mainly from Vicmap, the Victorian spatial data infrastructure owned by the Victorian Department of Sustainability and Environment (DSE); and from the NSW Digital Cadastral Database, the NSW equivalent of Vicmap, owned by the NSW Land and Property Information Division. Additional data was provided by the NSW Office of Environment and Heritage, DSE, the Victorian Department of Primary Industries, Goulburn-Broken Catchment Management Authority, Murray Catchment Management Authority, the Murray-Darling Basin Authority, the Australian Bureau of Meteorology, the Australian Bureau of Statistics, the Arthur Rylah Institute for Environmental Research, and other sources.

Indigenous knowledge is the core component of the GIS database. The Indigenous knowledge collected as part of this project (Section 2.1) included voice recordings, photographs and GPS locations. All the data collected during this process were first checked for accuracy and endorsed for use by Yorta Yorta Elders. This was then followed by geocoding and organising into the GIS database, searchable and viewable via links to the places of cultural significance. Also included in the database were data from the Yorta Yorta Use and Occupancy Mapping undertaken by YYNAC in 2008 with the support of the Murray Lower Darling Rivers Indigenous Nations, the Murray-Darling Basin Commission and Ecotrust Canada.

A full list of the datasets included is provided in Appendix A.

### **3.3 GIS framework**

In order to facilitate Yorta Yorta knowledge being taken into account and their voice heard in discussions with policymakers and the community a number of possible ways were investigated in partnership with the Yorta Yorta. The use of a GIS database was selected because it met a primary purpose for the Yorta Yorta of having a place where their knowledge could be stored with appropriate levels of security and it provided way of integrating that knowledge with more conventional forms of knowledge that had not been collected in one place previously.

The extraordinary complexity required to provide the fundamental data and information detailed in Section 3.2, in an intuitive, comprehensive and easily accessible way further highlights the value of the GIS database to provide a common framework for consolidation both conventional and Indigenous knowledge so that all these bodies are working from the same starting point.

Together with YYNAC, it was decided to provide access to the GIS database through the Web. As a result, a Web portal was developed to provide a gateway to the database with password protection to restrict the access to culturally sensitive data and Indigenous knowledge. The choice of the Web as a means of access to the database is based on two considerations: security and accessibility. First, the management of the GIS database requires it to be centralised so that the data are secured, and the data quality can be easily maintained. Second, the GIS database is a data resource, which needs to be easily accessible to relevant stakeholders who are located in different places, and who usually do not have GIS expertise to use the database. Third, each user can be granted different access rights depending on what data they are permitted to view. In this way, the GIS database can be secured and centrally controlled and at the same time can be accessed with a Web compatible user interface without the need of GIS knowledge.

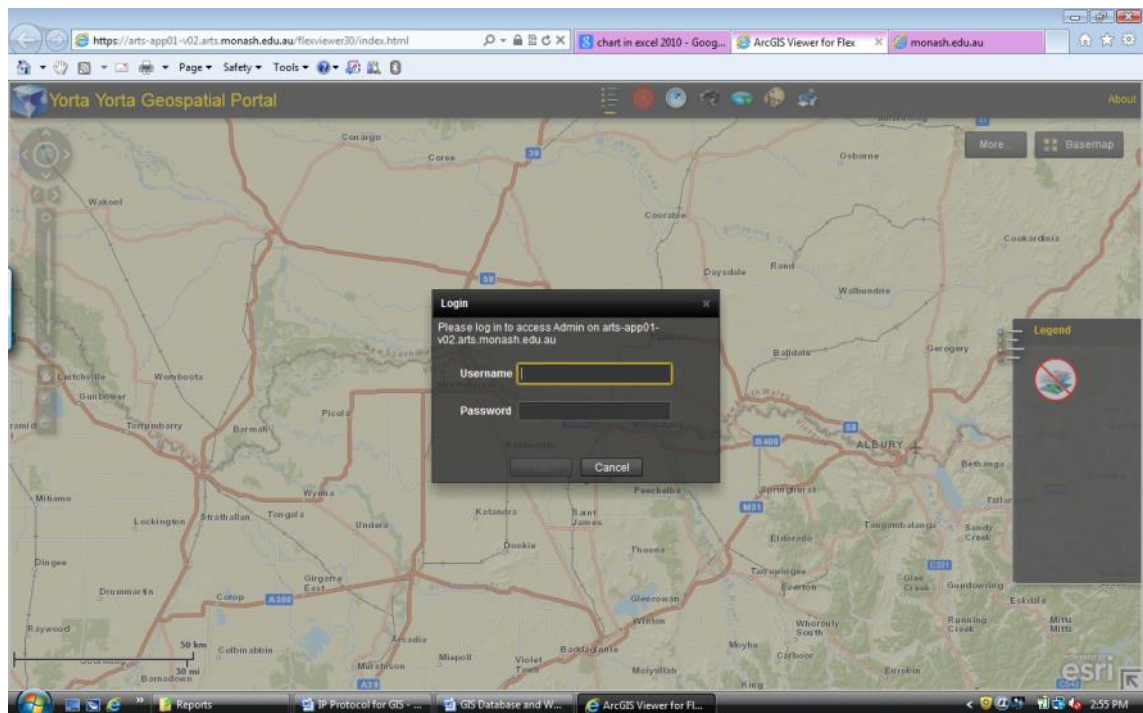
The GIS database was built using ESRI ArcGIS 10. All the data are georeferenced in GDA1994 MGA Zone 55 coordinate system. All the vector data are in ESRI shapefile format and remote sensing images are in TIFF format.

The GIS database is currently managed by Monash University. Only a dedicated administrator has direct access to the database, and has the right to edit, update and maintain the database in order to protect culturally sensitive data and maintain the consistency and quality of the data. The database is in the process of being transferred to YYNAC.

#### **3.3.1 Access control**

The Web portal is password protected. The users need to sign an agreement with YYNAC who decides which datasets they can access and issues usernames and passwords. Users are assigned to different groups. Each group has a specific level of access determined by YYNAC. Generally, foundation geographical data are accessible to all users. Full access can only be granted to YYNAC. Personal story data from interviews can only be accessed by participating individuals and families. Other user

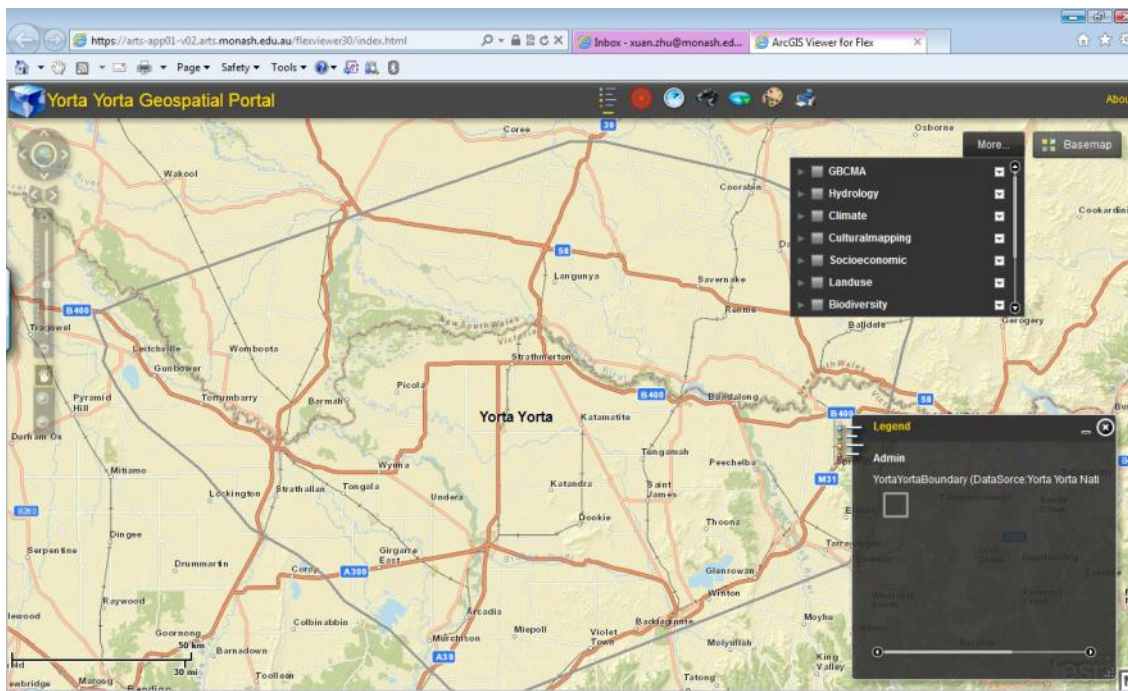
groups can only access a particular subset of data layers in addition to the foundation geographical data. Figure 2 shows the login page of the Web portal.



**Figure 2: Login page**

### **3.3.2 User interface**

The ArcGIS server provides an easy-to-use out-of-box Web mapping capability. The screen capture in Figure 3 shows the Web-based user interface, which consists of the map view and a few widgets for retrieving, browsing, querying, mapping and manipulating the data from the GIS database. Below are descriptions of the functions of the portal accessible through the widgets.



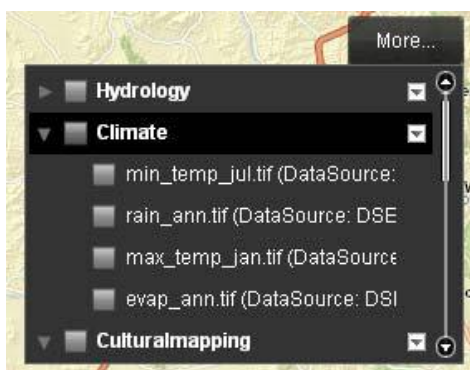
**Figure 3: User interface**

### 3.3.3 Functionality

The portal was designed to provide the functions for data retrieval, mapping and map browsing, map query, chart, time-series animation, measurement and printing.

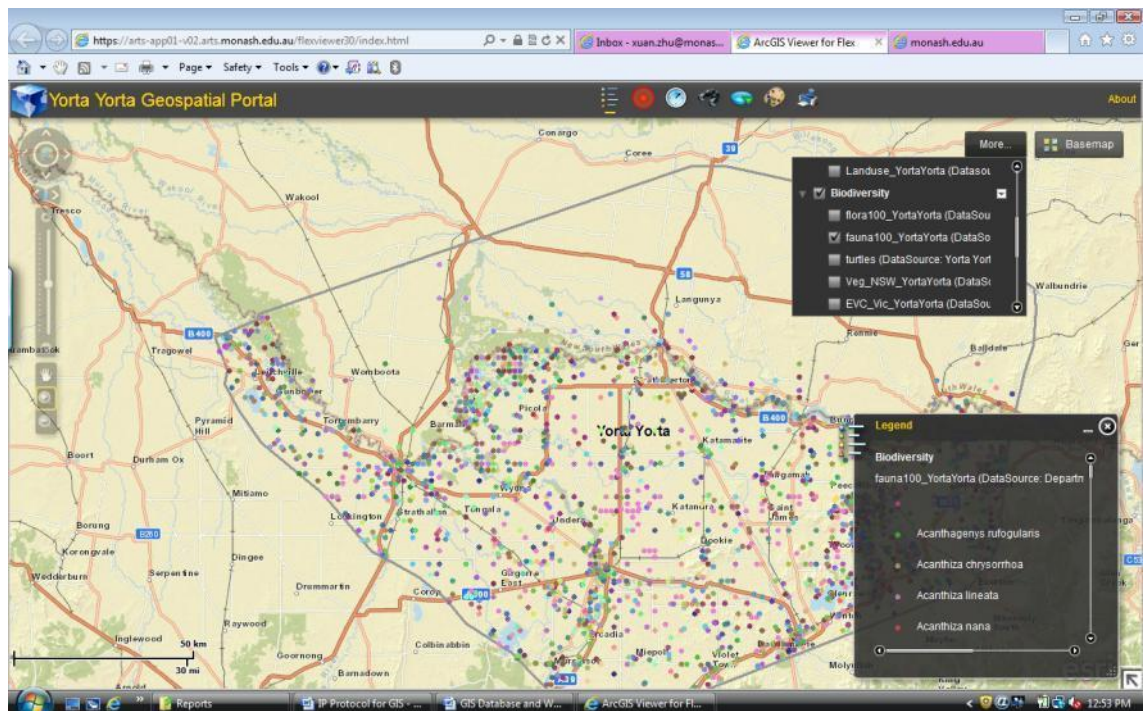
#### Data retrieval

The data from the GIS database can be retrieved and displayed with the Layer control widget (Figure 4). In the widget, each group (theme) and/or map layer has a checkbox to toggle visibility on or off. To retrieve and display a particular data layer, the user can expand the group or theme the data belongs to by clicking the expand/collapse button and checking the checkbox besides the data layer. At the same time the map legend of the data layer is displayed in the Legend panel. Figure 5 gives an example, which shows the distribution of the major fauna in the region.



**Figure 4: Layer control widget**





**Figure 5: An example of data retrieval with the Layer control widget**

### **Map browsing**

There are two widgets for browsing maps: navigation and map overview. The navigation widget is located on the left side of the map view. It allows users to zoom and pan the map. Users can also use the mouse scroll wheel to zoom in or out the map and the arrow keys on the keyboard to drag the map to different directions.

The map overview widget is located at the lower right corner of the map view, indicated by the arrow symbol. When you click the arrow symbol, a map inset will open to show the current extent and location of the area in the map view, as shown in Figure 6. The area of interest can be changed by dragging the red rectangle to a different location. By clicking the arrow symbol again, the inset will be hidden.

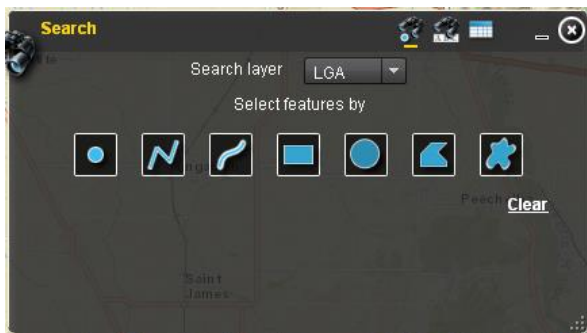


**Figure 6: Overview map**

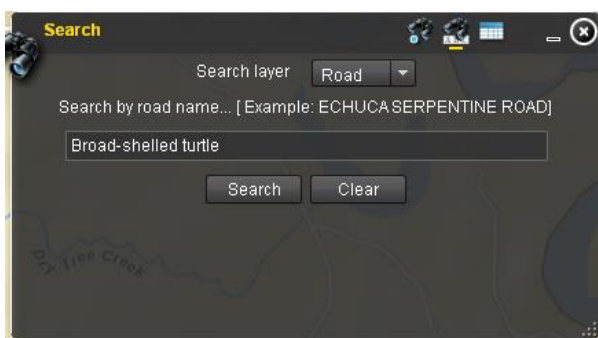
## Map query

Map queries can be made through the Search widget and the Find address widget, located on the top of the map view.

The Search widget allows users to select features on a particular data layer according to location and retrieve the attribute data about the selected features (Figure 7a), or retrieve the features from a particular data layer which have the attributes specified by users (Figure 7b).



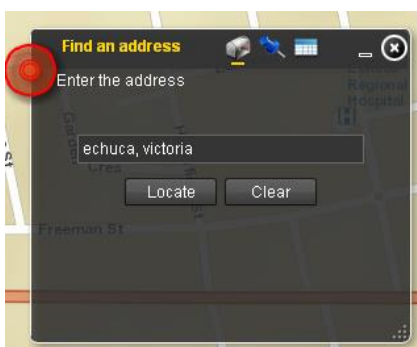
(a) Select features by location



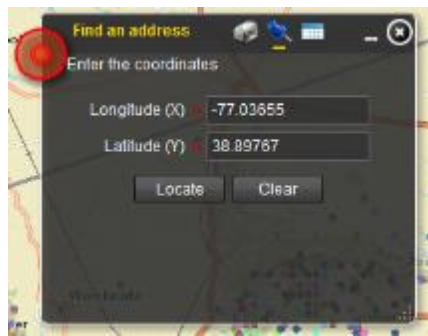
(b) Select features by attribute

**Figure 7: Search widget**

The Find address widget allows user to find a location by address (Figure 8a) or by geographical coordinates (Figure 8b).



(a) Find a location by address

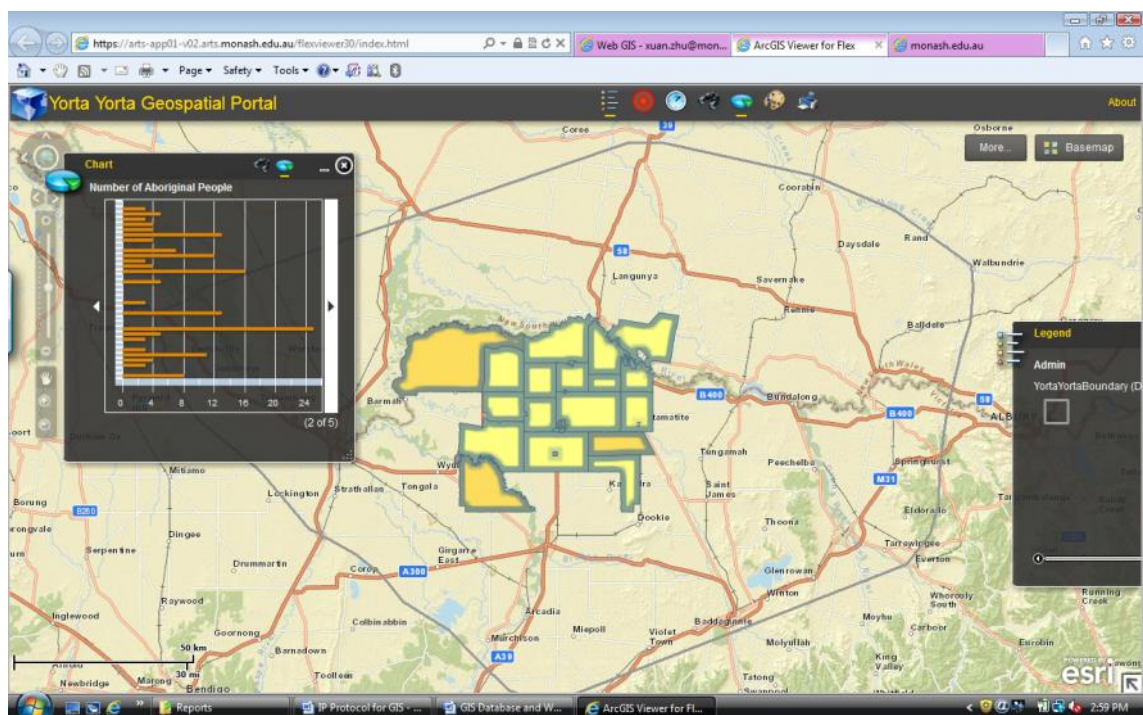


(b) Find a location by geographical coordinates

**Figure 8: Find address widget**

### **Chart**

The Chart widget is used to create charts to summarise the numerical attributes associated with the features selected from a particular data layer, for example, to create a bar chart showing the total number of the First Nations population in each of the selected census collection districts (Figure 9). At the moment, the system can generate two types of chart: bar chart and pie chart.

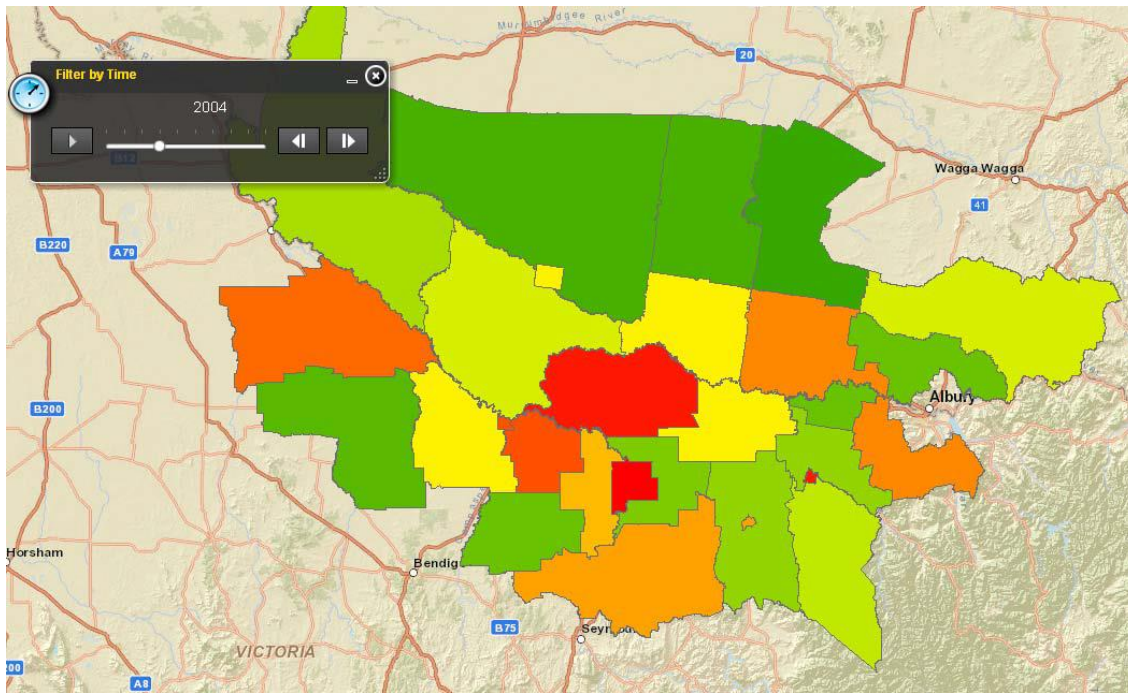


**Figure 9: Chart widget**

### **Time-series animation**

Time series data can be animated using the Time slider widget. It allows users to specify a particular timeframe and time steps to show dynamic changes in the form of maps. Figure 10 shows an example. We have used this tool to show regional population changes and the movement of turtles along Murray River in the study area.

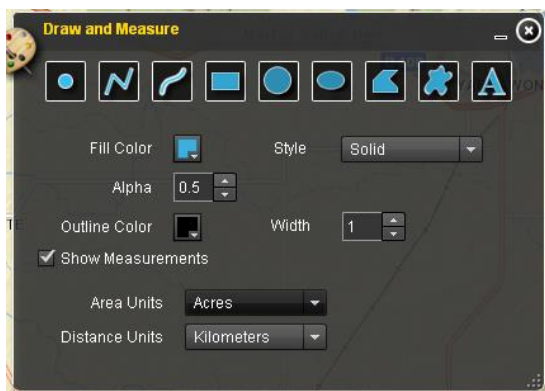




**Figure 10: Animation of time-series data (Population 2001 to 2010)**

### **Measurement**

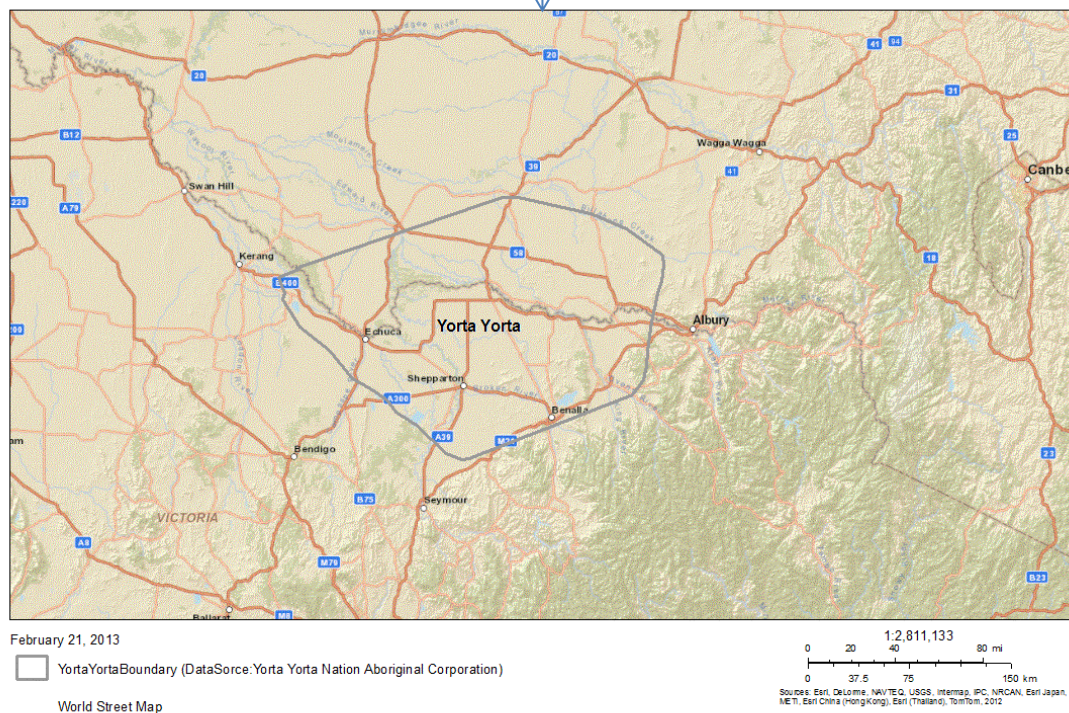
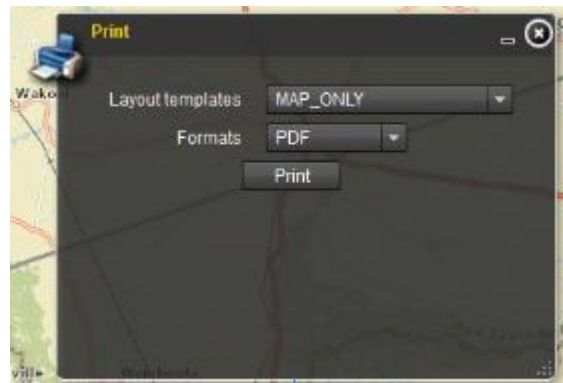
Distance and area can be measured on the map using the Draw and measure widget (Figure 11).



**Figure 11: Draw and measure widget**

### **Printing**

The portal also provides a printing function which allows users to select a map template to print the map shown in the map view in PDF, GIF and other image formats (Figure 12).



**Figure 12: Print function**

### **3.3.4 Future development and maintenance**

The GIS database and Web portal are currently maintained by the project team at Monash University. Our team will continue to work with YYNAC to refine the database and Web portal, and transfer the whole system to YYNAC. Recommendations are:

- To further develop the access control mechanism for the Web portal to automate the process of user registration, access right assignment and user account set-up;
- To refine the user interface and functions by engaging potential users more widely;
- To train YYANC personnel to take over the management and maintenance of the database and portal;



- To provide technical support for the system transfer;
- To develop new applications with YYNAC for the use of the GIS database.

### **3.4 Conclusions**

Because of the pilot nature of the project it has only been possible to begin to explore ways of integrating Indigenous and conventional knowledge. Simply putting them in the same framework is a useful first step but there is much more potential for truly integrated products.

The GIS system will hopefully become a useful tool for the Yorta Yorta into the future. However, there are risks to this ongoing utility. Firstly the data in the database will become out of date unless resources are found to maintain it appropriately. The full GIS database operates under ArcGIS and this requires a software licence and some skill to operate. This can be partially overcome by also keeping the data separately but then significant functionality is lost. Finally data licence issues have proven to be complex and often restrictive. This has significantly hindered utility through restrictions on what data can be made available publicly.

Although the GIS database could directly be a useful tool, for example for the MDBA, the various CMAs, local governments, and the National Water Commission, data security and software licence issues greatly increase the difficulty of making the GIS database widely available. In any case use of the GIS database will never replace the need for direct and meaningful dialogue and engagement with the Yorta Yorta. What the GIS database does is provide a common framework for the data inputs into such a dialogue.

## **4 COMMUNITY PERSPECTIVES OF ADAPTATION ALTERNATIVES**

### **4.1 Objectives**

Persistent severe drought and extreme flooding episodes have presented new challenges in the region. Chief among these challenges is the establishment of a legitimate framework to sustainably manage water resources that finds common ground between environmental, First Nations and commercial interests. The objective of this component of the project is to explore how the broader community understands the potential for different perspectives to inform development of adaptation alternatives.

Here, we use Q methodology (Section 4.3), an approach that elucidates patterns of subjectivity, to explore the perspectives of residents, workers and decision-makers in the region. We address the inherent diversity of viewpoints with an aim to identify the potential for common ground.

We apply this approach through an online survey tool where participants in the region anonymously respond to a series of statements of opinions on a single topic, in this case the topic centres on the Murray Darling Basin Authority (MDBA)'s proposed environmental flows policy.

The main rationale for this methodological approach was two-fold: (1) an anonymous online survey, as opposed to a single stakeholder workshop or focus group, allows for a broader engagement with the regional community by focusing more on views concerning these current policy interventions, rather than the actual individuals; and (2) distilling empirical evidence on views and opinions that point towards a common interest, as well as those that are divergent or contested, can serve as input towards further in-depth investigations with concerned participants through other forms of future participatory engagement.

Following advice from research partners, such as the office of the Victorian Commissioner for Environmental Sustainability and the YYNAC, it was considered that the level and extent of internet use and accessibility in the region would be adequate for a broad dissemination of and participation in an online survey, thus easing concerns over potential inadvertent exclusion of some groups in the community.

### **4.2 Conceptual framework**

To guide the study, we adopted a conceptual framework that directs attention towards issues of innovation and diffusion of actions carried out in the community on topics such as environmental flows, climate change adaptation, as well as Indigenous participation in decision-making processes. This conceptual framework also structures and guides the sampling strategy that was carried out to select statements of opinion on each of 27 categories on issues of innovation and diffusion (see Section 4.3.2).

In general terms, this study has sought to combine conceptual frameworks and theoretical underpinnings that illustrate the concept of decentralised diffusion and adaptation of innovations as it relates to adaptive governance in climate change (see Brunner and Lynch, 2010). Within this theme, concepts looked at include the role of

networks (e.g. Wenger, 1998; Wenger and Snyder, 2000; Slaughter, 2009), robustness and redundancies in decision-making (e.g. Landau, 1969), as well as political symbols and myths that underpin preferred actions (e.g. Lasswell and Kaplan, 1950; Lasswell, *et al.*, 1952).

In this study, we structured these theoretical concepts into a framework in the form of a matrix. In this matrix, elements of innovation and diffusion are addressed across the three main areas of interest for this study and for the project in general: environmental flows and drought management, climate change adaptation and extreme events (e.g. floods); and Indigenous participation in decision making and policy process (see

Table 1). This matrix provides three general classifications of statements, each with three sub-classifications, effectively generating 27 dimensions on the general topic of natural resource management in the Barmah-Millewa (see Table 1). The three general classifications on innovation and diffusion are described as follows:

1. **Who innovates:** how do experts, practitioners and individuals convey potential innovations across environmental flows, climate change adaptation and Indigenous knowledge? These statements provide respondents with concrete proposals and ask them to rank them according to self-perceived viability (and likely with a value judgment by the stakeholder conveying the innovation);
2. **What promotes innovation:** what forms of engagement are most likely to see innovation proposals 'taken-up' by stakeholders, including shared experiences, multi-level interaction, and individual initiative? These statements ask respondents who has the most credibility in conveying potential modalities to improve water use efficiencies; and
3. **What determines diffusion:** how are innovations proven – through observable success, on the basis of credibility, or the perception that inaction is much worse? These statements seek to elicit reactions and opinions from participants on means of conveying an idea that most resonate with their ability to try something new.

### **4.3 Methodology – Data generation and collection**

#### **4.3.1 Q methodology – a brief introduction**

First developed by psychologist William Stephenson in 1935 (see Stephenson, 1935a), Q methodology represents an ensemble of technique, method, and philosophical framework that facilitates a scientific study of subjectivity (Brown, 1999).

Methodologically, this analytical tool gives “substance to the logic of preference” (Brown, 1980: 53). The results of a Q study describe a population of viewpoints, which is helpful in exploring key influences on behaviour such as preferences, motives and goals (Stephenson, 1935b; 1964; van Exel and de Graaf, 2005), and therefore how preferences reflect on likely patterns of adoption of innovations and their dissemination. Q methodology has been applied in climate change adaptation research in various contexts such as public perception and responses to climatic change (e.g. Hobson and Niemeyer, 2011; Niemeyer, *et al.* 2005; Wolf, *et al.* 2009; Lorenzoni, *et al.* 2007) and to elicit perspectives on management and policy options (e.g. Raadgever, *et al.* 2008;

Ockwell, 2008). This study seeks to contribute to this emerging body of knowledge by applying this tool in a new and novel context and to fulfil the need for empirical evidence that supports the policy process on natural resource management in the Barmah-Millewa.

In general terms, the following steps are normally carried out when applying Q methodology and were also adopted as part of this study (adapted from Watts and Stenner, 2012):

1. Identify concourse – volume of debate on a given topic;
2. Refine a Q sample – a set number of statements that portray the spectrum of opinions within a concourse;
3. Select P sample – selection of participants that conduct a Q sort, or relative ranking of preferences within a fixed grid scaled from *most agree* to *most disagree*;
4. Administer Q sort and additional data collection;
5. Run factor analysis; and
6. Interpret and report operant factors.

#### **4.3.2 The Q sample – Concourse development**

The concourse development process began with an extensive literature and media review – of both printed material and electronic sources accessible over the internet – on material that would depict the MDBA's proposed Basin Plan and responses to it.

Approximately 140 files and document sources were reviewed, including:

- MDBA reports and press releases;
- Ministerial media releases (NSW and VIC government agencies),
- Local newspaper articles – both in print and online – including responses and comments therein (Shepparton News, Campaspe News, Country News, Weekly Times, Stock and Land, etc.);
- Other media outlets (e.g. ABC Rural, The Age, Sydney Morning Herald, The Australian);
- NGO media releases and reports/blogs;
- Associations websites, media releases (such as from the National Irrigators Council, Farmers Federation, etc.)
- Minutes and notes on council and local government public meetings; and
- Victorian Commissioner for Sustainability reports on community and stakeholder engagements in the region.

In reviewing the material, statements of opinions were selected and catalogued in an Excel spread sheet repository that also included other information attributes such as citation of source and its cross-reference with the conceptual framework matrix.

Table 1 illustrates this matrix, with corresponding number of statements selected by the study team as representing best fit for purpose.

**Table 1: Concourse Framework for Q-Study: Number of statements**

Innovation Diffusion	Environmental flows during droughts	Perception of and adaptation to flood	Indigenous participation in decision-making
<b>Who innovates?</b>			
Expert	4	9	9
Practitioner	5	3	3
Individual	8	5	3
<b>What promotes innovation?</b>			
Shared experience	1	1	3
Multi-level interaction	5	1	3
Individual creativity	2	1	1
<b>What determines diffusion?</b>			
Perceptions of success	5	2	1
Perceptions of formal and informal power	5	1	3
Perception of threat	10	2	4
Where <i>n</i> = number of most fitting statements found in/derived from reviewed sources.			

After extracting approximately 100 statements, the team convened and through an iterative process checked and validated on whether coverage of the possible ‘spectrum’ of opinions had been reached (or concourse saturation point). This process involved looking for duplications or recurring patterns on themes. From this pool of approximately 100 or so statements (or ‘raw’ sampling), we could then condense further and group these into a final set of 27 statements that both capture the general themes and spectrum of these opinions as well as reflect the analytical framework. In other words, it reflected a theory-led sampling strategy. Appendix C contains the conceptual framework matrix with the final corresponding 27 statements used in the Q study (the Q deck).

Once a Q deck was finalised, a decision was made by the team to select the most appropriate Q grid, or layout of the fixed pattern (forced distribution) in which participants place and rank all 27 statements relative to one another across a scale from *most agreed* to *most disagree* (see Appendix D). Selection for this Q grid pattern suited the recommended +4/-4 scale for the number of statements that fill the

framework matrix, as well as providing a relatively good spread across the range, limiting the number of neutral responses at “0”. Furthermore, four statements can be fitted into the “extremes” views categories, allowing participants to select many versus only one option.

Optional additional questions regarding demographics were also programed into the survey, to be able to add further information on views expressed. These additional questions included:

1. Post code of where participant lives, from a selection (drop-down menu): using postcodes within the Local Government Areas of Moira, Murray, Campaspe, Greater Shepparton, and Deniliquin. If the participant does not live in the designated area, an option to select “other” was provided;
2. How long has the participant lived there, in months and years;
3. Post code of place of work (as above);
4. How long they have worked at this place of work, in months and years;
5. Where does the participant work or his/her occupation, chosen from the following broad category options: Local, State, Federal Government; small business, large enterprise, NGO, Education, or Other with free text available to make specific remarks; and
6. Any associations or memberships to local community groups.

#### **4.3.3 The P (Person) Sample – stakeholders involved**

The P sample represents the participants in the study, the individuals who conduct a Q sorting exercise. For the purposes of this study, we were primarily interested in soliciting views and opinions from a relatively small number of residents and/or individuals who work in the Barmah-Millewa region and surrounding districts. In Q methodology, a small number of participants is appropriate, typically ranging from 25 through to 60 (Watts and Stenner, 2012) given that “all that is required are enough subjects to establish the existence of a factor for purposes of comparing one factor with another. What proportion of the population belongs in one factor rather than another is a wholly different matter and one about which Q technique as such is not concerned” (Brown 1980: 192).

Once the survey tool was programmed using FlashQ, and hosted at a Monash University server, invitations to conduct the survey (the Q sorts) were prepared. Through the assistance from the Office of the Commissioner for Environmental Sustainability and YYNAC, it was deemed important that the survey invitation be distributed through their specific networks in the region in a semi-targeted approach. In total, three versions of the invitation letter were prepared (see Appendix E: (1) a brief email version for direct communication with potential participants; (2) a more general invitation suitable for posting on social media outlets such as the Commissioner’s personal blog and Facebook page; and (3) a brief email invitation for dissemination by YYNAC to their networks in the region. The survey was available online for a period of three weeks, closing on Friday 3 August 2012. A total of 37 valid and complete

responses were collected, with one discarded for an erroneous duplication in the online submission stage.

Given that the online survey tool was to be completed anonymously by participants, ethics approvals by corresponding ethics committees from the research institutions involved were not required.

#### **4.3.4 Administering the Q Sorts (the survey)**

The online survey tool takes the participant through a series of steps, which can be summarised as follows:

1. First, participants are asked to read every one of the 27 statements as each appears on the screen and to drag and place into one of three piles: AGREE, DISAGREE, or NEUTRAL;
2. Second, participants are presented with the sorting grid and asked to place all the statements within the AGREE pile and select the two statements they find they AGREE with the most and place them inside a blank box below the "+4" range of the scale;
3. Third, respondents are asked to read statements in the "DISAGREE" pile, and just like before, select the two statements they find they DISAGREE with the most and place each one inside a blank box below the "-4";
4. Next, participants are asked to continue with this procedure for all statements in the "AGREE" and "DISAGREE" pile, until finally the "NEUTRAL" statements can be arranged in the remaining open boxes of the score sheet;
5. Once all statements are placed on the score sheet, the participant is asked to go over their distribution and swap statements if they wish;
6. Finally, the survey tool asks the participant to explain their rationale for their choice of statements in the two boxes that they ranked +4 and -4. Once complete, the survey then moves on to the optional questions on demographics, and the participant is then able to submit their Q sort and exit the survey.

Out of all 37 completed Q sorts, the majority of respondents chose to elaborate on their most agree/most disagree choices; however fewer opted to complete the demographic questions. We also found that most people were able to follow the survey instructions correctly, except in two cases where participants requested further instruction and clarification on how to complete the survey. In both cases, the respondents had more "agree" statements for the number of boxes available in the "agree" scale of the grid, and felt reluctant to force a spread of responses past the "neutral" and towards the "disagree" end of the scale. In these instances, we were able to reassure respondents that the agree and disagree value they place on a statement is relative to the rest of the other statements, and not an absolute value ranking.

#### **4.4 Methodology – Data analysis**

The 37 completed Q-sorts were cluster analysed using principal component analysis (PCA) and through a k-means clustering approach, thus two approaches were used to



check the robustness of the clusters obtained. The clusters or principal components so derived are termed “factors” in Q methodology.

The principal tool for data analysis in this study was the use of the software package PQMethod. The software package computes inter-correlations amongst Q-sorts, which can then be cluster analysed using either Centroid or Principal Component Analysis (PCA). In addition to PQMethod, we also employed an application of the Kohonen Self-Organizing Feature Map (SOFM or SOM), which is a clustering and data visualization technique based on a neural network viewpoint. The final output of the SOM technique is a set of centroids that implicitly define clusters. However, there was insufficient data for an effective application of SOM; therefore a k-means clustering approach was employed. The intended use of this clustering output is to compare with the results of the clustering output from PQMethod to guide on the number of significant factors that should be selected for the analysis.

The aim of the Q methodology analysis is to arrive at a ‘factor solution’ for the collected completed Q sorts. This is achieved through correlation of persons (pairwise comparison of their sorts), followed by a factor analysis – the production of number of composite factor arrays (“model Q sort”). Finally, factor scores are assigned by designating Q sorts that load significantly on a given factor, revealing significant characteristic and distinguishing items for each factor.

The PQMethod workflow followed can be generally described as follows:

1. Entered the list of 27 statements (produced a “.STA” file);
2. Entered all 37 Q sorts (produced a “.DAT” file);
3. Extract factors and decide how many to rotate using VARIMAX. Given that the SOM analysis generated approximately 5 factors, the decision was made to keep this consistent and also extract and rotate 5 factors using the PCA approach in PQMethod (produced a “.UNR” file);
4. Flag sorts loading significantly and exclusively on factors (used the PQRot tool within PQMethod to generate a matrix table of statements and factors, with significant loadings marked or flagged with a “X” symbol); and
5. Run the final analysis (produced a “.LIS” file).

## **4.5 Results**

After applying the criteria for assessing the admissibility of factors, a total of three factors were identified. The first factor presents a viewpoint that promotes protecting the river through government regulation, and supports both the Commonwealth water buyback scheme to underpin environmental flows, and the engagement with traditional owners through co-management agreements. Participants who load into the second factor support government investment in the Murray-Darling Basin but demonstrate very low respect for the Murray-Darling Basin Plan, First Nations participation, the federal government, and its experts in developing appropriate policies. Participants who held the viewpoints characterized by the third factor, of whom less than half self-identified as First Nations, considered that legitimate engagement with the Yorta Yorta

perspective should largely outweigh broader economic, social or environmental outcomes.

An aspiration in this first analysis of the preferences and viewpoints of those most affected by the Murray-Darling Basin planning process was to determine if there was common ground that could serve as a starting point for a more positive discourse. The one statement in the concourse about which most (97%) people broadly agreed, or at least, didn't strongly disagree, was:

“Decisions about who gets the water should be informed by the best available science, but they also require community input and political deliberation.”

While this statement could be said to contain 'something for everyone', it does indicate that substantive community engagement is desired, and perhaps has not been observed, in the planning process so far. The consensus statement reveals an implicit understanding across all respondents that government will ultimately be the final determinant of policy. The Water Act of 2007 and the establishment of the Murray-Darling Basin Authority has opened the conversation for a more scientifically informed and inclusive process. However, what is apparent from the results of this study is that while the former aspiration is being fulfilled, the latter is still sufficiently contested that it remains an open question as to whether the Plan will survive judicial scrutiny.

## **5 NATIONAL WORKSHOP ON INDIGENOUS KNOWLEDGE FOR CLIMATE CHANGE ADAPTATION**

This part of the project sought to extend and generalise the conversations and learnings from the project in order to develop a national understanding of appropriate approaches and methodologies for the inclusion of insights arising from Indigenous knowledge to support adaptation planning by First Nations.

This was done through the two-day National Workshop on Indigenous Knowledge for Climate Change Adaptation, which was held on 14–15 November 2012 in Echuca, Victoria, on Yorta Yorta country. An associated event was a public panel discussion on “global perspectives on Indigenous participation in decision making for natural resource management”, which was held in Melbourne on 12 November 2012. Both events were co-hosted by YYNAC and Monash University.

### **5.1 Workshop development**

The workshop program was built around the key issues for the use of Indigenous knowledge in climate change adaptation that were identified through the experience of the project, namely:

- What is climate change, how might it affect the First Nations in Australia and how can Indigenous knowledge improve climate change adaptation
- Methods, tools and approaches for First Nations communities to collect their traditional knowledge.
- Ensuring knowledge ownership and confidentiality
- Research by First Nations for First Nations
- Current approaches to natural resource management by First Nations of their traditional lands
- Meaningful participation by First Nations communities in natural resource management and adaptation policy processes

The sessions revolved around these issues, and were structured to have three short presentations and plenty of time for discussion. The organising committee and members of the project team worked to identify and invite national and international experts to present on particular topics and share their general experiences. The final programs of the workshop and of the pre-workshop panel discussion are provided in Appendix F.

The organisers also worked to identify and invite First Nations participants, aiming for a regional, gender and age balance, and a range of experience and familiarity with climate change. Many from the Yorta Yorta community were also invited to attend. In addition, key stakeholders involved in climate change adaptation or related work with First Nation communities were also invited. A total of over 90 participants attended the workshop, of which the majority were First Nations people. The other participants came

from federal and state government organisations, academia, the private sector, media, and non-profit organisations. Several overseas experts and representatives of overseas Indigenous communities also attended the workshop. The final list of participants can be found in Appendix G.

Section 5.2 provides as a summary of the workshop conclusions and recommendations. Some of the discussion in this session, together with other information, has also been produced as a separate Workshop Report, which can be found with other workshop materials and links on the Monash Sustainability Institute website<sup>3</sup>. This report was sent out to all participants, stakeholders, and others interested in this work. In addition, a short film about the workshop, “Nhawul Bultjubul Ma - To See with Both Eyes”<sup>4</sup>, was produced by YYNAC with filmmaker Michael O’Dwyer, with funding from NCCARF and the Victorian Centre for Climate Change Adaptation Research Centre (VCCCAR). The film includes interviews with many of the participants and has been viewed over six hundred times at the time of writing.

## **5.2 Workshop conclusions and recommendations**

This section provides a summary of the discussion at the workshop. While the workshop started out aiming to understand how Indigenous knowledge can help the First Nations of Australia adapt to climate change, the actual discussions that emerged during the meeting focussed on the more general issue of how these communities can have a greater say in matters affecting their community and their country, of which climate change is one such matter. It is clear that currently this is a more pressing issue for these communities, and reflects that their engagement with climate change adaptation is at a relatively early stage. While climate change presents a serious challenge to First Nations communities, supporting communities to adapt can only be achieved by acknowledging and addressing the wider reality and context in which they live.

### ***Climate change is a serious issue for the First Nations of Australia.***

A range of factors – including socioeconomic circumstances, multiple disadvantages and remote locations – make the First Nations of Australia more vulnerable to the projected impacts of climate change than the general Australian population. These include vulnerability to projected increases in heat stress, extreme weather events, and vector-borne diseases. Already inadequate infrastructure and services in remote communities will be adversely affected by temperature increases, sea level rise, storms and floods. There is also growing evidence that exposure and sensitivity of First Nations to climate change will be increased because of their high dependence on climate-vulnerable economic activities connected to the land.

Aside from these tangible impacts, climate change is likely to carry a spiritual and cultural toll on First Nations by significantly hampering their ability to practice cultural traditions that have been passed down through countless generations. These impacts include the destruction of cultural sites (for example, as a result of sea-level rise); the disappearance of spiritually important species (such as totem animals) and of plants

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<sup>3</sup> [www.monash.edu/research/sustainability-institute/programs/indigenous/ikcc-workshop.html](http://www.monash.edu/research/sustainability-institute/programs/indigenous/ikcc-workshop.html).

<sup>4</sup> Nhawul Bultjubul Ma - To See with Both Eyes: [www.youtube.com/watch?v=LlpJu4VfY9Q&feature=share](https://www.youtube.com/watch?v=LlpJu4VfY9Q&feature=share)

and animals used for traditional food, medicine and other cultural practices; rapid changes to culturally-significant environmental patterns, indicators, and calendars; and the suffering brought by experiencing the decline of their lands, for which they have a moral obligation to care.

Supporting First Nations communities to respond to climate change should therefore be a high priority area for adaptation-related research and policy.

***Programs aimed at adaptation for First Nations communities must focus on empowering communities to identify and implement their own responses to climate change.***

Responses to climate change must come from within each community, not be determined or imposed by external parties. Only communities are in a position to determine the best solutions for their unique needs, interests, and circumstances. Solutions imposed externally are likely to be ineffective, inappropriate or unsustainable.

However, in order for communities to be able to identify the best adaptation options, they need support to:

- Access good information and research and develop the necessary skills within their communities to understand what climate change means for them and determine the best adaptation options.
- Implement their choice of adaptation options within their communities and establish meaningful access to regional and national policy and decision making processes affecting their lands
- Develop opportunities for knowledge sharing between First Nations communities in Australia and Indigenous people overseas

Access to good information is a key prerequisite for communities to start considering climate change and its implications. The issue of health impacts was a particular concern brought up by workshop participants. While some communities are advanced on this journey, most are not; there is therefore an urgent need to develop ways to reach communities and help start this discussion. This could be done through:

- Development (and ongoing maintenance) of a web portal for climate change information relevant to First Nations communities
- Linking of communities with scientists who can help them understand climate change and explore its implications.
- Higher priority and funding for research with First Nations communities on the impacts of climate change.
- Further opportunities for knowledge sharing, hosted by First Nations for First Nations, such as this workshop.

Academia can provide crucial support to First Nations communities to understand and respond to climate change by assisting with information and research. However, the current institutional structures for academic funding and promotion are not conducive to

the formation of long-term partnerships between communities and academics to identify community needs and undertake research that responds to their particular needs.

Even when First Nations communities have identified their climate change adaptation needs, many have limited say about what programs are implemented in their communities and limited influence over national and regional policy and decision-making processes affecting their traditional lands.

This situation can only be remedied by reforming policy processes so that First Nations people are considered in how their country is evolving. Governments need to move away from top-down prescriptive approaches to develop shared decision making and joint management arrangements. They also need to ensure that First Nations perspectives are meaningfully incorporated and represented in wider policy “consultations”, which often take place after substantive decision-making has already taken place.

***Meaningful engagement by government, academia and others with First Nations is the key to supporting them implement effective climate change adaptation solutions.***

Meaningful engagement by government, academia and others is the basis of effective collaboration, consultation, and dialogue with the First Nations of Australia. Currently, there is a profound amount of distrust and bitterness colouring these interactions, stemming from a long history of disrespect, betrayal, exclusion, marginalisation, exploitation, and top-down control. While the treatment of First Nations by government and academia is improving, there is a long way to go. As was made clear by the participants at the workshop, providing First Nations communities with the support they need to adapt to climate change can only be done by acknowledging and addressing this wider reality through the development of meaningful engagement.

Meaningful engagement is founded on trust, respect, and the recognition that the concerns, standpoints, needs and knowledge of all involved are legitimate. It is based on robust interpersonal relationships and durable frameworks of engagement that take time and mutual effort to develop. Face-to-face interactions are very important.

The kinds of frameworks and relationships needed to can be developed through “encounters of mutual enrichment”, that provide, in a sense, training in both directions and a cross-cultural exchange. These encounters bring together all parties to develop an understanding of how each party works, recognise common ground and differences, develop a shared vernacular, and negotiate common principles for further interactions.

***First Nations communities need to take a stand and assert their rights and needs in regards to climate change adaptation and be proactive about taking action.***

A strong message coming from the participants at the workshop was that, regardless of a community’s Native Title status, taking ownership of the authority to determine what is right for the community through community governance and monitoring leads to self-determination. They urged First Nations communities to take a proactive and assertive approach to ensure that their communities are ready to respond to climate change, and

not be passive in the face of lack of external support or imposition of inappropriate solutions.

Communities can be proactive by:

- Initiating and undertaking research projects and community-development programs that address community needs. Communities can draw on the skills and support of open and sensitive academics and lawyers, and can work to build the necessary research, legal or other skills within the community.
- Defining how academics and others work with the community. Communities can take a proactive approach to ensure appropriate outcomes from projects by being informed and empowered participants. This can be done through the preparation of rigorous cultural protocols that ask questions such as “Why do you want the data? What will be done with it? Will it come back to us?”. Communities can draw on the best practice guidance for knowledge transfer protocols developed for the Northern Territory Indigenous Ecological Knowledge program. In addition communities should read the fine print on external contracts and be unafraid to negotiate better terms and conditions.
- Educating people outside the community, particularly policy makers and academics, about appropriate ways to engage with the community.
- Developing connections with other Indigenous communities in Australia and around the world around the issue of climate change to support knowledge sharing and the development of a unified voice to government. Although communities come from different contexts, and have somewhat different beliefs and traditions, their issues with the environment, climate and water are nearly all the same. They all share a love for their land and an overall vision for it. Sharing this diversity of perspectives is a powerful way to build ideas, unite people, and have a stronger advocacy higher up the policy food chain.

***Indigenous knowledge can be a useful tool for climate change adaptation, and has many other benefits to communities.***

Capturing Indigenous knowledge and presenting it in the form of maps can be a powerful legitimisation and translation tool for First Nations communities in terms of land management for climate change and in general to policymakers. It can provide ways of measuring and demonstrating changes to traditional lands; ways of targeting land management to ensure cultural continuity; ways of emphasising the living culture and attachment to country; and ways of building evidence-based arguments.

Indigenous knowledge and its mapping can also provide a way of educating and informing policymakers in better ways of thinking about climate change adaptation and sustainability in general. The First Nations of Australia have survived the highly variable and often extremely harsh conditions on the Australian continent for tens of thousands of years by learning to live within the limits of sparse natural resources. They could only do this by developing a deep understanding of the rich complexity of the environment, a strong connection and sensitivity to land, and a strong moral imperative to look after it.



On the other hand, current environmental research and management is often fatally reductive. Indigenous knowledge and its mapping allow communities to construct a nuanced and sophisticated picture of their country that can convey to policymakers a comprehensive and integrative way of seeing the land and appreciating its holistic complexity.

While First Nations communities are keen to have their knowledge taken on board, they have also experienced (and still do) a troubling history where their information has been taken without proper permission or inappropriately transmitted, and of economic benefits from the information not flowing on to communities. This can only be remedied through the establishment of meaningful engagement as discussed earlier, and appropriate legal ways to protect the information. However, the legal regimes for protecting Indigenous knowledge are deficient as they are limited to individual properties rights but not community property rights, which is the reality for First Nations communities. New legislation is needed to properly protect Indigenous knowledge. In the meantime, communities can protect their knowledge through cultural protocols and IP clauses in contracts, as mentioned earlier.

Recording and preserving history, culture, land use and ecological knowledge are also an important way of strengthening relationships and cultural identity within the community. They are a way of strengthening intergenerational bonds and recognising that Elders are a part of the community's future as much as youth are. They also provide a way for communities to examine their own epistemology – tying cultural stories to other tools and deconstructing them, as part of a broader process of education and capacity-building in the community. The value of these projects will increase exponentially over time.

### **5.3 Other lessons**

In addition to the conclusion and recommendations arising from the discussions at the workshop, the organisers would like to offer a few recommendations for any future workshops on climate change for First Nations people.

- Hosting or co-hosting (including in the shaping of the workshop) by a First Nations community: The involvement of the Yorta Yorta community in the workshop was an absolutely critical factor in its success. Their welcome, leadership, and willingness to share their experiences created an open and comfortable atmosphere conducive for sharing and discussion.
- Holding the workshop on country: Holding the workshop in Echuca, on Yorta Yorta country, was logistically challenging but a special and memorable experience for the visitors and the hosts.
- Limit the number of non-Indigenous participants, particularly academics, and allow the discussion to go in whatever direction it needs to go. It was in these discussions that the real issues arose.

Through conversations with the Yorta Yorta and other First Nations leaders it became very apparent that the workshop must be led and controlled by First Nations people – that is “by First Nations people for First Nations people”. The

participants felt that only they fully understood the issues facing them and also that they had the responsibility to tackle those issues. So while they were quite happy to take information and advice from non-First Nations participants it was clear that the ownership and responsibility must lie with the First Nations community.

## 6 CONCLUSIONS

This project aimed to understand how the deep knowledge of country of the Yorta Yorta people could combine with state of the art climate science to strengthen their participation and influence in national and regional management processes and how climate adaptation could be incorporated in those decisions to deliver improved management outcomes.

At the outset of the project it was anticipated that main tool through which this would be carried out was a GIS database. Into this database as much information as possible would be collected from conventional sources to capture the current state of knowledge within the region. Although data was often disparate and difficult to obtain the resulting database has succeeded in pulling together in a common framework, in a single system, a vast array of climate, hydrology, biodiversity, administrative, imagery, socioeconomic and cultural data.

Given the limited time and resources this project was intended to provide a proof-of-concept rather than be comprehensive. This aim has been achieved and there have been additional benefits. The engagement of the youth in the interview-taking has engaged them enthusiastically with their history, culture and knowledge and the close involvement of members of the Yorta Yorta throughout the project has increased their knowledge and capacity to engage irrespective.

### **Conclusion 1**

Lack of coherent information accessible to all greatly hinders the ability to make sound management decisions regarding management of natural resources within a region. Hence, even without any Indigenous information a GIS database of the type developed here is a valuable tool as a basis for sound decision making, including on climate adaptation.

The next step was to collect and also incorporate into the database Indigenous knowledge from the Yorta Yorta. In order to do this it was planned that the research team would walk with Elders, recording location information, voice and imagery. However, as Yorta Yorta community awareness of the project grew it became clear that there was also a strong desire to use this exercise as a means of also passing on this knowledge within the community, in particular from the Elders to the Yorta Yorta youth. So, the project was adjusted so that the Yorta Yorta youth were trained in the use of the GPS, voice recorders and cameras and they walked with the Elders capturing the information required for the project but also passing on the knowledge from one generation to another.

### **Conclusion 2**

The process of using the Yorta Yorta youth to collect the Indigenous knowledge raised community awareness and knowledge and energised the Yorta Yorta youth to take an interest in their history and culture, but also in the climate challenges facing their community. This has resulted in a community which is much more informed and knowledgeable about climate change and which is now taking action to adapt and even to provide leadership to other First Nations communities to start them on the journey of understanding the potential impacts of climate change on their community.

The capturing and use of this Indigenous knowledge also raised the important issue of how to protect the Intellectual Property of the Yorta Yorta. In order to ensure appropriate protections were put in place a Cultural Data Collection Protocol was developed in partnership with the Yorta Yorta. Interviews with Elders are held in individual password protected layers within the GIS system and are only accessible to the owner of that interview until they decide what information can be released more widely and to whom. Not even the research team have access to any part of the interviews until permission has been given.

### **Conclusion 3**

Putting in place the Cultural Data Protection Protocol was an essential element in building trust between the research team and the community. However, it also raised an important issue for the Yorta Yorta. They rightly wish to protect their intellectual property from inappropriate use, but they also wish the data to be used to improve the way natural resources are managed. Creating the right balance between these two competing requirements has been recognised as an important issue in the collection and use of Indigenous knowledge.

As indicated earlier it was originally anticipated that the GIS database would be the main tool through which increased First Nations participation in management processes and decision-making would be made. While the GIS database will undoubtedly be a useful tool there turned out to be more important factors. The fact that the GIS database has been created by and is owned by the Yorta Yorta means that they have something of value to bring to the discussions, so that they are able to participate in those discussions on equal terms. Also, the increased knowledge and capacity developed within the community now means that they are much better informed and confident in those discussions. This is valued both by the Yorta Yorta and State government equally, the latter now feeling they are able to have a more informed dialogue about shared management of natural resources.

### **Conclusion 4**

The whole research process has increased the knowledge and capacity of the Yorta Yorta to engage in effective natural resource management and decision-making.

As might be expected the Q-methodology used to gauge community perspectives of the use of water resources in the region identified a wide range of often conflicting views. However, one statement stood out as the one which the vast majority of participants agreed on, namely:

“Decisions about who gets the water should be informed by the best available science, but they also require community input and political deliberation.”

While this statement could be said to contain ‘something for everyone’, it does indicate that substantive community engagement is desired, and perhaps has not been observed, in the planning process so far.

There is the potential for greater use of science as a neutral arbiter in issues such as the Murray-Darling, but even more important is the need for genuine, deep, open-

mindful dialogue with the community at all stages of decision-making, particularly at an early stage before proposals are put forward and views become entrenched.

### **Conclusion 5**

The National Workshop on Indigenous Knowledge for Climate Change Adaptation highlighted the importance of climate change and the challenge of adaptation for First Nations communities. A number of important conclusions and recommendations came out of the workshop, including:

- Programs aimed at adaptation for First Nations communities must focus on empowering communities to identify and implement their own responses to climate change.
- Meaningful engagement by government, academia and others with First Nations is the key to supporting them implement effective climate change adaptation solutions
- First Nations communities need to take a stand and assert their rights and needs in regards to climate change adaptation and be proactive about taking action.

### **Conclusion 6**

There is a strong need for increased focus on helping First Nations communities adapt to climate change, beginning with access to information and scientists, through to capacity building within communities, so that they are able to control their own destiny.

This research project has been an enormous learning process, both for the research team and the Yorta Yorta. Prior to the research project beginning there had been a two year period where both parties simply talked together about issues, each learning to see things from the others perspective and building trust. Even then when the project started it was viewed with suspicion by many within the community and this suspicion has only been eased as the research project has progressed and the community have seen that their concerns have been respected. Even though the project has lasted 18 months this has only been enough time to begin to scratch the surface of the joint research that could be done.

### **Conclusion 7**

Conventional project-type research funding is not ideal for carrying out work with First Nations communities. The building of trust and the establishing of long term relationships and friendships is an important part of First Nations culture. Some way must be found to enable longer term research relationships to be established and maintained.

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APPENDIX A   YORTA YORTA CULTURAL DATA COLLECTION  
PROTOCOL

Yorta Yorta Cultural Data Collection Protocol

For the project Learning from Indigenous Knowledge  
July 2012

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## APPENDIX B SUMMARY OF DATA IN GIS FRAMEWORK

### *Hydrology*

Dataset Name	Description	Geographic Extent	Data Source
Hydrological features	Includes watercourses, connectors, lakes, dams, flats wetlands, rapids, waterfalls, shorelines, junctions, and springs, wells, navigation features, water-related structures	Victoria	DSE, Vic
Groundwater measurements	Water level and salinity measurements from State Observation Network bores	Yorta Yorta area	DSE, Vic
Hume dam management	Time series of Hume Dam releases and storage levels	Hume Dam	NSW Office of Water
Surface water measurements	Includes time series of water flow and level, electrical conductivity, temperature and dissolved oxygen	Yorta Yorta area - NSW	NSW Office of Water
Surface water measurements	Includes time series of water flow and level, electrical conductivity, temperature, dissolved oxygen, water quality	Yorta Yorta area – Victoria	DSE, Vic
Blackwater monitoring	Weekly measurements of dissolved oxygen from Nov 2010 to April 2011	Murray-Darling Basin	MDBA
Phytoplankton counts	Measurement time series, 1980–2008	MDB	MDBA
Water bodies	Locations of water bodies	Barmah-Millewa Area	DSE, Vic
Regulators in Barmah area		Barmah-Millewa Area	DSE, Vic

### *Meteorology*

Dataset Name	Description	Geographic Extent	Data Source
Estimated mean climate variables	Estimated long-term mean monthly evaporation, monthly maximum temperature, monthly minimum temperature, monthly rainfall and annual rainfall. Interpolated to a 500m grid cell using the DEM250 layer and the ESOCIM software	Victoria	DSE, Vic
Long-term climate time series	Time series of maximum temperature, minimum temperature and rainfall since 1930 in Deniliquin, Echuca and Rutherglen.	Yorta Yorta Region	Bureau of Meteorology / Brown University
Seasonal probability density functions of daily climate variables	Seasonal probability density functions of daily maximum temperature, minimum temperature and rainfall for Rutherglen, Deniliquin and Echuca over the		

## ***Biodiversity***

<b>Dataset Name</b>	<b>Description</b>	<b>Geographic Extent</b>	<b>Data Source</b>
Native vegetation, 2005	Modelled dataset of native vegetation and major water-based habitats in 2005. Includes extent, quality, and the Bioregional Conservation Status of Ecological Vegetation Classes (EVCs)	Victoria	DSE, Vic
Barmah Dissolved EVCs	Ecological vegetation classes	Barmah area (Victorian side only)	DSE, Vic
Victorian bioregions	Includes areas designated as rainforests, wetlands, Ramsar wetlands, areas of significance	Victoria	DSE, Vic
Victorian Biodiversity Atlas	Snapshot of data as at July 31, 2011, including fauna and flora taxa	Victoria	DSE, Vic
Tree cover and tree cover change	Woody vegetation greater than 2 metres in height and with a crown cover greater than 10%, and it's change over the period 1990 and 1995	Victoria	DSE, Vic
VicMap vegetation	Vegetation features within the VicMap dataset. Includes tree density levels and presence/absence of tree cover	Victoria	DSE, Vic
Vegetation maps of the Barmah-Millewa	Includes Vegetation map of the Barmah National Park DRAFT data (2010) and Vegetation map of Murray Valley National Park DRAFT data (Millewa) (2010)	Barmah-Millewa area	NSW OEH
Murray vegetation mapping	Native Vegetation of the Murray Catchment Management Authority Area	North Yorta Yorta areas (in NSW)	NSW OEH
Annual ground surveys of waterbird communities	Seasonal monitoring results for waterbirds and bush birds within Barmah-Millewa from 1999-2012	Barmah-Millewa area	Rick Webster, Ecosurveys and NSW NPWS via MDBA
Monitoring of fish species and abundance	Fish monitoring over 2007-2011	Barmah-Millewa area	Vic DSE Arthur Rylah Institute via MDBA
Turtle distribution in the Barmah-Millewa		Barmah-Millewa Area	DSE, Vic

***Administrative, cadastre, planning, addresses and infrastructure***

<b>Dataset Name</b>	<b>Description</b>	<b>Geographic Extent</b>	<b>Data Source</b>
Administrative areas in Victoria	Vicmap Administrative Dataset, including local government areas, locality boundaries, postcodes, township boundaries, parish boundaries, state electoral boundaries (1991 and 2001), wards and region boundaries	Victoria	DSE, Vic
Australian Standard Geographical Classification	Boundaries of administrative and statistical areas used in Census 2006, Census 2011 and other ABS publications	Victoria and NSW	ABS
Planning	Land-use zones and overlay controls for planning.	Victoria	DSE, Vic
VicMap Property dataset	Includes land parcels and property boundaries	Victoria	DSE, Vic
Vicmap Address	Includes number, road name and locality details.	Victoria	DSE, Vic
NSW Digital Cadastral Database	Includes parcels, roads, water features, administrative boundaries, crown land, corridors	Murray-Murrumbidgee	NSW LPI
VicMap Features of Interest dataset	Includes Register of Geographic Name, build-up areas, utility features, buildings, fences and landmarks	Victoria	DSE, Vic
VicMap Transport dataset	Includes rail infrastructure, road infrastructure, ferry routes, airport infrastructure	Victoria	DSE, Vic

***Satellite and aerial imagery***

<b>Dataset Name</b>	<b>Description</b>	<b>Geographic Extent</b>	<b>Data Source</b>
SPOT5 satellite imagery	2.5 m resolution satellite imagery for 2006, 2008 and 2010	NSW	SPOT Image via NSW OEH
Colour infrared aerial orthophotography	Taken in March-May 1996	Barmah-Millewa Area	GBCMA
Aerial imagery	25cm resolution aerial image for Barmah-Millewa Area from 2007	Barmah-Millewa Area	GBCMA
Aerial imagery	50 cm resolution aerial imagery from the Digital Image Acquisition System	Murray Murrumbidgee (NSW)	NSW LPI
Infrared aerial photography		Barmah-Millewa Area	GBCMA

### **Land features**

<b>Dataset Name</b>	<b>Description</b>	<b>Geographic Extent</b>	<b>Data Source</b>
VicMap elevation dataset	Includes elevation, morphology features, ground type, relief features	Victoria	DSE, Vic
Digital elevation mapping (DEM)	5m pixel DEM of Barmah-Millewa Area	Barmah-Millewa Area	GBCMA
Salinity	The extent of dryland salt-affected soil and statewide coverage of dryland salinity discharge sites	Victoria	DPI, Vic
GeoVic maps	Includes geology and geological and structural features, mine and mineral areas, minerals, petroleum and groundwater boreholes	Victoria	DPI, Vic

### **Socio-economic**

<b>Dataset Name</b>	<b>Description</b>	<b>Geographic Extent</b>	<b>Data Source</b>
Statewide Land Use		East-Victoria	DPI, Vic
Catchment-scale land use		Yorta Yorta area	Australian Government, Department of Agriculture, Fisheries and Forestry
Public land management		Victoria	DSE, Vic
Census Data 2011	Data from the 206 and 2011 Census, including total population, population density, Indigenous population, Indigenous language spoken population	Yorta Yorta area	ABS
Regional population growth, Australia (3218.0)	Population estimates by Statistical Local Area, 2001 to 2011, including growth rates and population density	Yorta Yorta area	ABS

***Cultural data***

<b>Dataset Name</b>	<b>Description</b>	<b>Geographic Extent</b>	<b>Data Source</b>
Yorta Yorta Use and Occupancy Mapping 2008		Barmah-Millewa Area	YYNAC
Cultural data 2012	Cultural interview data including GPS points, photos, audio and transcripts.	Barmah-Millewa Area	YYNAC
Murray CMA Aboriginal assets	Cultural assets in the NSW Murray CMA area identified through community workshops run by Murray CMA and OEH in 2010.	Murray CMA Area	Murray CMA



## APPENDIX C THE Q SET WITHIN THE THEORETICAL FRAMEWORK: FINAL LIST OF 27 STATEMENTS USED FOR THE Q SORTING TASK (THE SURVEY)

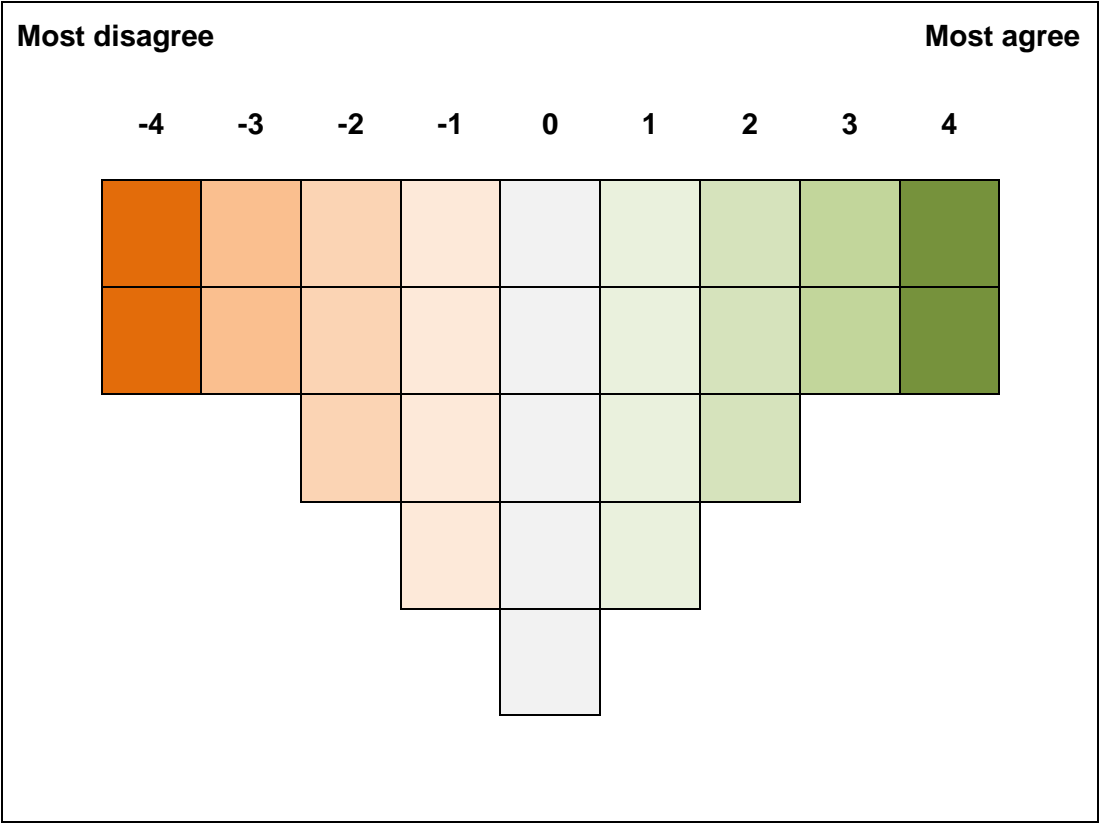
Innovation Diffusion	Environmental flows during droughts	Perception of and adaptation to flood	Indigenous participation in decision-making
	Who innovates?		
Expert	1. The proposed Murray-Darling Basin Authority Basin Plan hardwires in the need to optimise social, economic, and environmental outcomes.	2. The Murray-Darling Basin Authority ignores the potential impacts from record breaking flood waters by refusing to include new flows in scientific modelling for its water planning measures.	3. The Australian Government should engage with Aboriginal people around the country to develop a legislative framework that provides for protection of their traditional knowledge, such as knowledge on rivers.
Practitioner	4. Both NSW and Victoria should not agree to support the Basin Plan, given the Murray-Darling Basin Authority's failure to explore other options available for achieving environmental outcomes.	5. If floods are too high they will damage the river banks. Protecting the banks is more important than protecting the environment.	6. The conversion of state forest into national park, with some co-management by local Aboriginal people, has been a successful strategy for managing public lands.
Individual	7. Farmers need access to reliable information on regional seasonal outlooks and farm management practices based on specific needs so they can decide what's best for their own business.	8. The Murray-Darling Basin Authority should listen to practical alternatives offered by farmers, such as the offer of land for flood easements to enable increased environmental flows.	9. Aboriginal people should be supported in their efforts to quantify the amount of water needed to keep their cultural and spiritual legacy intact.
What promotes innovation?			

Innovation Diffusion	Environmental flows during droughts	Perception of and adaptation to flood	Indigenous participation in decision-making
<b>Shared experience</b>	10. Farmers should work together to monitor and compare weather and soil conditions that yield good crop outputs for their region.	11. There is sufficient information from professional associations like Dairy Australia for farmers to rely upon for information on how to cope with floods.	12. Indigenous peoples have managed these lands and waters in a sustainable manner for many thousands of years.
<b>Multi-level interaction</b>	13. Decisions about who gets the water should be informed by the best available science, but they also require community input and political deliberation.	14. The relationship between the Commonwealth and the States regarding the River Murray is the single biggest water management issue to be resolved.	15. Co-management of the Murray River between Government and Aboriginal people could provide a mechanism for negotiating both environmental and cultural objectives.
<b>Individual creativity</b>	16. It is better for individual dairy farmers to respond to drought with their own efficiencies that balance the cost of growing grass and using water with that of buying feed.	17. Buying up cheap water during floods when the prices are low helps to moderate the volatility of water price.	18. Water should be allocated to Aboriginal communities directly to promote environmental management and economic development.
<b>What determines diffusion?</b>			
<b>Perceptions of success</b>	19. Flexible farm management, using for example crop diversification and soil monitoring, provides effective insurance against variable seasons.	20. Farmers can take advantage of changing rainfall patterns by adapting their management of pastures and calving programs.	21. There are economic benefits for Aboriginal people from eco-tourism and cultural tourism.
<b>Perceptions of formal and informal power</b>	22. There should be Government assistance available to improve the efficiency of water use. Where there is public benefit, there should be public investment.	23. Rivers should be protected by Government regulations from abuse and overuse.	24. Elders are held in Aboriginal society with respect, and this needs to be given empowerment by Government through an effective decision-making role.

<b>Innovation</b>  <b>Diffusion</b>	<b>Environmental flows during droughts</b>	<b>Perception of and adaptation to flood</b>	<b>Indigenous participation in decision-making</b>
<b>Perception of threat</b>	25. Milk production in the Goulburn Murray Irrigation District could dip to drought-like levels of 1.6 billion litres if the Federal Government pursues further general water buyback tenders.	26. The red gum forest and its wetlands have come back naturally after the drought and so concerns about environmental flows are unfounded.	27. Pursuing legal avenues, such as Native Title Claims, divert Aboriginal people from participating in mainstream Australian economic activity.



APPENDIX D THE Q GRID: DISTRIBUTION LAYOUT FOR THE Q SORT



## APPENDIX E Q-STUDY INVITATIONS

### ***Extended version used by the Commissioner***

[Subject] *Invitation to participate in an online survey on the management of the Murray-Darling River Basin*

[Body]

*A team from the Monash Sustainability Institute, Monash University, is currently conducting a study on opinions regarding the management of the Murray-Darling River Basin, specifically in the region along the border of Victoria and New South Wales. You have been approached as a potential participant in this study given your association with this region, whether by residing, working, or conducting business in this region. This study consists of a short online survey (a connection to the internet is required), which should take approximately 15 minutes to complete. Please note that your participation in this survey is entirely voluntary and your answers will be confidential and anonymous. The study team hopes that the information gathered will be useful in developing new approaches to managing the Murray-Darling River Basin, and thank you very much in advance for your participation. If you have any specific questions for the study team, please email them at [murrayqstudy@monash.edu](mailto:murrayqstudy@monash.edu)*

*The survey is now available, and will remain open for three weeks until Friday 3 August 2012. Should you wish to proceed and complete the survey, please follow this external link (further instructions will be provided there): [www.monash.edu/murray-study](http://www.monash.edu/murray-study).*

### ***Generic invitation (used on Facebook)***

*A team from the Monash Sustainability Institute, Monash University, is currently conducting a study on opinions regarding the management of the Murray-Darling Basin, specifically in the region along the border of Victoria and New South Wales. The team would like to invite people living or working in the region to complete a short online survey on their opinions of MDB management. The survey takes about 15 minutes and all responses are confidential and anonymous. The study team hopes that the information gathered in this study will be useful in developing new approaches to managing the Murray-Darling Basin, and would like to thank all participants in advance. To take part in the survey please go to [www.monash.edu/murray-study](http://www.monash.edu/murray-study) (available until Friday 3 August 2012).*

### ***YYNAC stakeholders***

[Subject] *Invitation to participate in an online survey on the management of the Murray-Darling River Basin*

[Body]

*A team from the Monash Sustainability Institute, Monash University, is currently conducting a study on opinions regarding the management of the Murray-Darling River Basin, specifically in the region along the border of Victoria and New South Wales. You have been approached as a potential participant in this study given your association with this region, whether by residing, working, or conducting business in this region. This study consists of a short online survey (a connection to the internet is required), which should take approximately 15 minutes to complete. Please note that your participation in this survey is entirely voluntary and your answers will be confidential and anonymous. The study team hopes that the information gathered will be useful in developing new approaches to managing the Murray-Darling River Basin, and thank you very much in advance for your participation. If you have any specific questions for the study team, please email them at [murrayqstudy@monash.edu](mailto:murrayqstudy@monash.edu).*

## **APPENDIX F PROGRAMS FOR NATIONAL WORKSHOP AND ASSOCIATED EVENTS**

### ***Public panel discussion: Monday, 12 November 2012***

#### **Global perspectives on Indigenous participation in decision making for natural resource management**

Indigenous people have a fundamental spiritual connection to the land, often expressed as “connection to Country”. For Indigenous people the health of land and water is central to their culture. Through this connection to Country Indigenous people have developed a deep care for the land, only taking what was necessary to support themselves and making sure there was always enough left for the future. In modern terminology this could be described as sustainable land management in a highly variable climate.

Indigenous people have thousands of years of data, knowledge and practice relating to the diverse landscapes that span the country. Their understandings of species variation, the seasons and natural events are embedded within culture, people, landscapes and tradition. However, much more could be done to utilise this Indigenous knowledge in land and water management practices and policy in a changing climate.

In this event, a panel of international and local experts will discuss their experiences and offer their insights:

- Lee Joachim – Yorta Yorta Nation Aboriginal Corporation
- Kekuhi Kealiikanakaolehailani – Edith Kanakaole Foundation & University of Hawaii
- Chris Heider – Watershed Professionals Network
- Ximena Traa-Valarezo – World Bank
- Peter Appleford – Department of Sustainability and Environment

The panel will be chaired by Dave Griggs, Monash Sustainability Institute.

### ***Workshop day 1: Wednesday 14 November 2012***

#### **Session 1: Welcome and scene-setting**

Chair: Lee Joachim (Yorta Yorta Nation Aboriginal Corporation)

- **Welcome to Country** – Colin Walker (Yorta Yorta)
- **Opening address** – Denise Morgan-Bulled & Rochelle Patten (Yorta Yorta)
- **Starting the conversation** – Kate Auty (Victorian Commissioner for Environmental Sustainability)



- **Aims and objectives of the workshop** – Lee Joachim (Yorta Yorta Nation Aboriginal Corporation) and Dave Griggs (Monash University)
- **Introductions**

## **Session 2: Indigenous knowledge for climate change adaptation**

*Overview of how Indigenous knowledge can contribute to improved climate change adaptation for Indigenous communities and the Australian community in general*

Chair: Tom Day (Gunditj Mirring)

- **What is climate change and adaptation** – Dave Griggs (Monash University) & Rowan Foley (Aboriginal Carbon Fund)
- **Climate change adaptation and Indigenous people in Samoa** – Leota Pepe Pa'i (Sili Community, Samoa)
- **National Cultural Flows Research Project** – Alistair Webster (National Native Title Council)
- **Group discussion**

## **Session 3: Building a community archive of Indigenous knowledge**

*What methods and tools can Indigenous communities use to collect traditional knowledge as a basis for climate change adaptation?*

Chair: Rowan Foley (Aboriginal Carbon Fund)

- **Tracker Program** – Erica McCreedy (North Australian Indigenous Land and Sea Management Alliance Ltd)
- **NT Indigenous Ecological Knowledge Program** – Nikki Brannigan (Central Land Council)
- **Girringun cultural heritage mapping, environmental planning & GIS** – Phil Rist (Girringun Aboriginal Corporation)
- **Group discussion**

## **Session 4: Research by Indigenous people for Indigenous people**

*How can Indigenous people develop their own research agenda by initiating, developing, undertaking, controlling and owning the research?*

Chair: Sonia Cooper (Yorta Yorta)

(Held in the Dharnya Centre in the Barmah Forest, with an open invitation to the Yorta Yorta community)

- **Learning for Indigenous knowledge in the Barmah-Millewa** – Jackie Walker and Ebony Joachim (Yorta Yorta Nation Aboriginal Corporation)

- **A geographical information system (GIS) for the Yorta Yorta** – Pan Wang (Monash University)
- **Turtle tracking in the Barmah-Millewa** – Leah Beesley and Katie Howard (Arthur Rylah Institute for Environmental Research)
- **Group discussion**

**Guided walk by Yorta Yorta Elders around the Dharnya Centre and the Barmah Lakes**

**Workshop dinner & cultural presentation at the Dharnya Centre**

**Day 2: Thursday, 15 November 2012**

### **Session 5: Ensuring Indigenous knowledge ownership and confidentiality**

*What levels and types of protection need to be instituted to allow for appropriate Indigenous knowledge to be shared with and benefit the wider community?*

Chair: Kate Auty (Victorian Commissioner for Environmental Sustainability)

- **Panel discussion** – Kate Auty (Victorian Commissioner for Environmental Sustainability), Mark Harris (La Trobe University), Anne Sheehan (Barrister), Louise Kyle (Deakin University)
- **Group discussion**

### **Session 6: Indigenous natural resource management**

*How can Indigenous communities participate in managing natural resources on their traditional lands?*

Chair: Amanda Lynch (Brown University)

- **The Waipuni Kahalu'u (Hawai'i) project** – Chris Heider (Watershed Professionals Network, USA), Matt Hamabata (Kohala Center, Hawaii, USA) and Kekuhi Kealiikanakaoleohaililani (Edith Kanakaole Foundation & University of Hawaii, USA)
- **Kowanyama NRM programs** – Viv Sinnamon (Kowanyama Lands Office)
- **Approaches to natural and cultural resource management on Gunditjmarra Country** – Tom Day (Gunditj Mirring)
- **Group discussion**

### **Session 7: Aboriginal participation in adaptation-related decision making**

*How can Indigenous communities participate in larger-scale adaptation and natural resource management decision and policy processes affecting their communities and traditional lands?*

Chair: Rueben Berg (Indigenous Architecture Victoria)

- **Stakeholder viewpoints of Indigenous participation in decision making in the MDB** – Amanda Lynch (Brown University, USA) and Carolina Adler (ETH Zurich, Switzerland)
- **How to engage with government and use Indigenous knowledge for better policy outcomes** – Ximena Traa-Valarezo (World Bank)
- **Indigenous engagement at the Department of Climate Change and Energy Efficiency** – Jeremy Dore (Department of Climate Change and Energy Efficiency)
- **Group discussion**

### **Session 8: Closing Plenary**

Chair: Dave Griggs (Monash University)

- **Panel discussion** – What have we learnt regarding how can we strengthen the contribution of Indigenous knowledge to improved climate change adaptation for Indigenous communities and the Australian community in general?
- **Workshop recommendations & next steps**

**Close**

## **APPENDIX G LIST OF PARTICIPANTS AT THE NATIONAL WORKSHOP**

Trevor Adamson – Anangu Pitjantjatjara Yankunytjatjara

Dr Carolina Adler – ETH Zurich, Switzerland

Ray Ahmat – Parks Victoria

Jayne Atkinson – Yorta Yorta Nation

Neville Atkinson – Yorta Yorta Nation Aboriginal Corporation

Rachel Atkinson – Palm Island Community Company Ltd

Iloauala Aumua – Ministry of Finance, Samoa

Prof Kate Auty – Commissioner for Environmental Sustainability

Anton Baker – Anangu Pitjantjatjara Yankunytjatjara

Dr Leah Beesley – Victorian Department of Sustainability and Environment

Rueben Berg – Indigenous Architecture Victoria

Teddy Bernard – Abm Elgoring Ambung

Zac Bischoff-Mattson – Brown University, USA

Nikki Brannigan – Central Land Council

Possum Clark-Ugle – Framlingham Aboriginal Trust

Brian Cohen – Filmmaker

Sonia Cooper – Yorta Yorta Nation Aboriginal Corporation

Keicha Day – Gunditj Mirring

Tom Day – Gunditj Mirring

Stephen Deed – Victorian Department of Sustainability and Environment – North East

Jeremy Dore – Australian Government Department of Climate Change and Energy Efficiency (DCCEE)

Anna Dwyer – Kimberley Land Council

Peter Ferguson – Yorta Yorta Nation Aboriginal Corporation and University of Melbourne

Simon Fjell – Ecoso P/L

Debbie Flower – Yarkuwa Indigenous Knowledge Centre

Rowan Foley – Aboriginal Carbon Fund

Anzac Frank – Abm Elgoring Ambung

Emily Gerrard – Allens

Ari Goring – Kimberley Land Council

Prof Dave Griggs – Monash University

Bianca Haas – Monash University

Matt Hamabata – Kohala Center, Hawaii, USA

Mark Harris – La Trobe University

Ted Hart – Gnaala Karla Booja Native Title Charitable Trust

Russell Hawkins – Filmmaker

Chris Heider – Watershed Professionals Network, USA

Katie Howard – Victorian Department of Sustainability and Environment

Doug Humann – Anangu Pitjantjatjara Yankunytjatjara

Berniece Joachim – Yorta Yorta Nation

Ebony Joachim – Yorta Yorta Nation

Lee Joachim – Yorta Yorta Nation Aboriginal Corporation

Kekuhi Kealiikanakaoleohaililani – Edith Kanakaole Foundation & University of Hawaii, USA

Dr Tahl Kestin – Monash University

Louise Kyle – Deakin University

Jennifer Lauber Patterson – Frontier Carbon

Reverend Reupena Leau – Samoa Umbrella for NGOs (SUNGO)

Prof Amanda Lynch – Brown University, USA

Erica McCreedy – North Australian Indigenous Land and Sea Management Alliance Ltd (NAILSMA)

Robert McLean – Journalist

Leanne Miller – Koorie Women Mean Business Incorporated

Patrick Moore – Yarkuwa Indigenous Knowledge Centre

Denise Morgan – Yorta Yorta Nation

Greta Morgan – Parks Victoria

Damian Morgan-Bulled – Yorta Yorta Nation Aboriginal Corporation

Janice Muir – Yorta Yorta Nation

Michelle Nelson-Cox – South West Aboriginal Land and Sea Council

Ronni O'Donnell – Murray Catchment Management Authority

Michael O'Dwyer – Filmmaker

Tracey O'Keefe – Parks Victoria

Leota Pepe Pa'i – Sili Community, Samoa

Rochelle Patten – Yorta Yorta Nation

Ann Penny – National Climate Change Adaptation Research Facility (NCCARF)

Kyeema Penrith – Framlingham Aboriginal Trust

Dr Digby Race – CRC for Remote Economic Participation

Kaleana Reyland – Murray Catchment Management Authority

Grant Rigney – Murray Lower Darling Rivers Indigenous Nations (MLDRIN)

Phil Rist – Girringun Aboriginal Corporation

Simon Rowntree – Monash University

Anne Sheehan – Victorian Bar

Viv Sinnamon – Kowanyama Aboriginal Land and Natural Resources Management Office

Eleanor Sobey – Yorta Yorta Nation Aboriginal Corporation / Australian Government Department of Sustainability, Environment, Water, Population and Communities

Hilda Stewart – Yorta Yorta Nation Aboriginal Corporation / Parks Victoria

Aaron Stuart – Arabana

Lyn Thorpe – Kaiela Institute

Rex Tjami – Anangu Pitjantjatjara Yankunytjatjara

Ximena Traa-Valarezo – World Bank

Wanda Victores – Filmmaker

Uncle Colin Walker – Yorta Yorta Nation

Jackie Walker – Yorta Yorta Nation Aboriginal Corporation

Joanne Wallace – Victorian Department of Sustainability and Environment

Dr Pan Wang – Monash University

Jodie Warren – Arabana

Millie Warren – Arabana

Alistair Webster – National Native Title Council

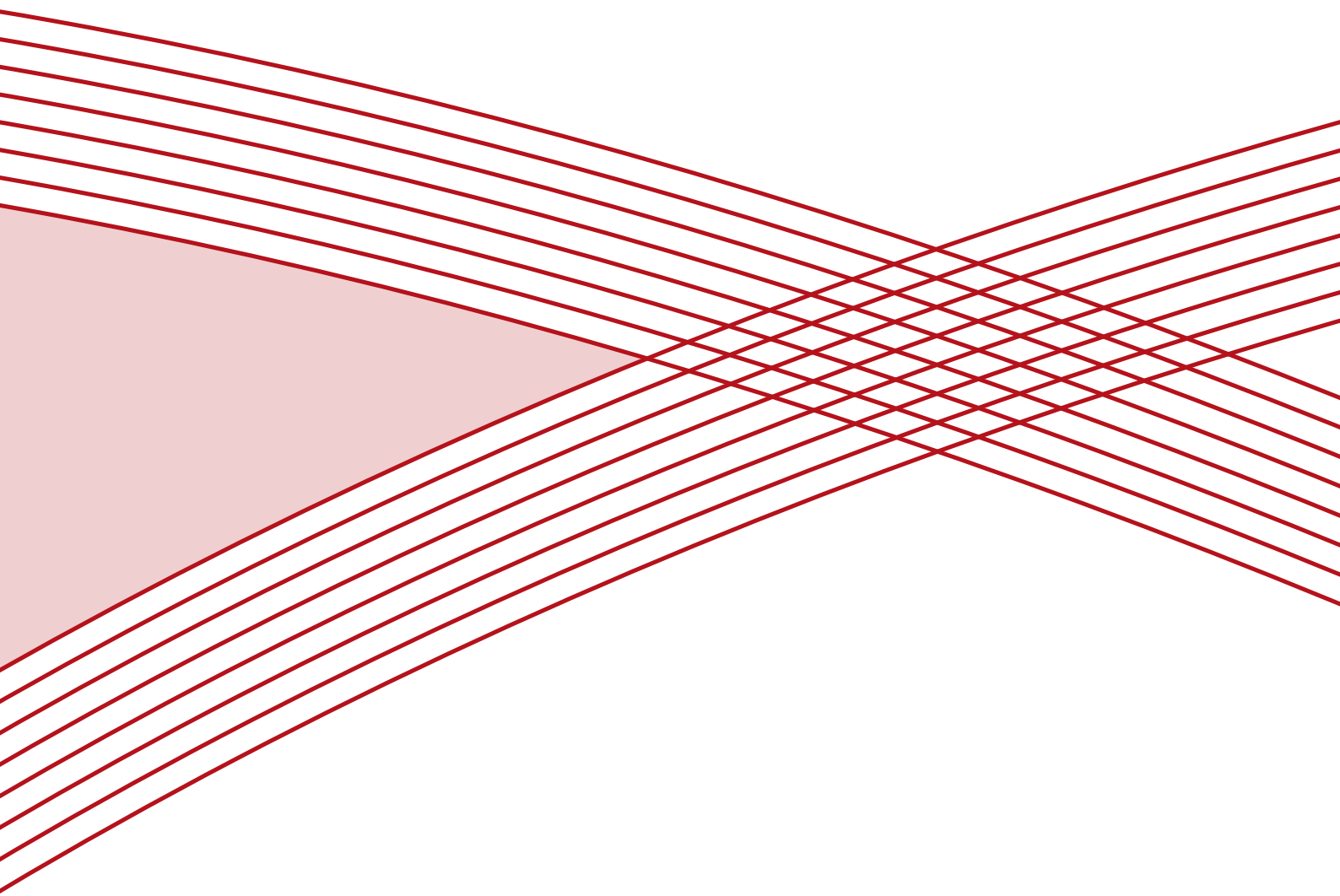
Glen Wingfield – Arabana

Aunty Margaret Wirrapunda – Yorta Yorta Nation

Reg Yarran – South West Aboriginal Land and Sea Council

Dr Xuan Zhu – Monash University





MONASH University



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Climate Change Adaptation  
Research Facility