Carbon Ready Plan

a healthy Wimmera catchment where a resilient landscape supports a sustainable and profitable community.

Australian Government

Wimmera CMA

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The level of government investment in this strategy is contingent on budgets and government priorities.

All photos in this document are by David Fletcher, except where acknowledged.

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Tree planting is a key climate change mitigation activity as trees capture carbon. If done strategically, they can also provide buffers and links to remnant vegetation which can be a climate change adaptation activity.

Introduction

Context

Many scientific experts are predicting as a result of climate change, as a society we will experience extreme temperatures, increasing storm intensity and greater risk of fire, flood, and drought at an international, national and regional scale. It is widely accepted that the Wimmera has experienced many of these predictions through long periods of below average rainfall, extreme temperatures and large scale natural disasters. A more detailed description of the likely climate change impacts for the Wimmera is outlined throughout the document.

Governments, of all persuasions in Australia, have committed to dealing with climate change by investing in a range of actions and creating policies that aim to minimise future impacts. For the purpose of this document, climate change action is described as mitigation and adaptation.

Mitigation includes actions to limit the magnitude and/or rate of long-term climate change and generally involves reductions in human (anthropogenic) emissions of greenhouse gases. Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation.

Adaptation includes actions taken to manage the eventual (or unavoidable) impacts of global warming, for example, by building pipelines to save and provide potable water supply.

The Wimmera Mallee Pipeline is an example of a local action that allows the region to adapt to a changing climate.
Photo: Wimmera CMA

The challenge for our region is to:

- Maximise emerging carbon investment in terms of economic, social and environmental benefit.
- Prepare the environment, our community and economy for the predicted scenarios.
- Minimise predicted risks.

The Wimmera Carbon Ready Plan (CRP) aims to achieve this.

Australian Government investment in NRM bodies

The Australian Government has provided funding to all regional natural resource management (NRM) bodies to produce regional specific plans that address climate change (adaptation) and contribute to emission abatement (mitigation). The Wimmera's CRP establishes processes and actions to maximise the environmental, economic and community benefits of NRM investment including:

- Identifying regional priorities for adaptation and mitigation.
- Standards for where and under what conditions large-scale. biodiversity or carbon planting takes place.
- Mechanisms for protecting high quality agricultural land from perverse outcomes.
- Promoting 'no regret' actions such as improving soil management and health.

Note: Whilst the CRP doesn't give financial advice or information on potential economic returns it does identify logic for and location of priorities for investment under the Australian Governments programs. For example, with regard to native vegetation, the plan identifies areas where tree plantings yields capture the largest carbon rates per hectare. The carbon plan does not factor in the cost of the establishment, ongoing management, opportunity cost or the price per tonne of carbon.

Purpose of CRP

The Wimmera Carbon Ready Plan is also the strategic planning document for the long-term management of the Wimmera's soils, native vegetation and habitat for wildlife. The CRP is an action plan under the 2013 Regional Catchment Strategy (RCS) and compliments and adds to actions in the 2014 Wimmera Waterway Strategy (WWS) for wetlands, rivers and streams (Figure 1). As a package, these documents outline the priority actions for NRM in the Wimmera.

The CRP has been developed in consultation with a wide range of stakeholders and the broader community. It aims to provide sound planning that prioritises actions to deliver maximum and multiple benefits, whilst minimising risks. Based on community feedback a series of maps are used to identify areas of highest priority for on ground action. These maps will be on the Wimmera Catchment Management Authority (Wimmera CMA) website and continuously update as new information becomes available.

Figure 1: Regional NRM Planning hierarchy in the Wimmera.

Approach and methodology

The CRP identifies priority areas for investment and also establishes conditions for these activities to ensure that the benefits are maximised and that any potential adverse impacts are managed or avoided.

The CRP is flexible and sets the priorities for action in a regional context that can meet the needs of evolving government policy and investment. The CRP can also assist implementation of incentive based, compliance based or market based mechanisms for dealing with climate change and the management of natural assets.

The CRP is intended to act as a reference document for NRM activities and investment in the Wimmera. Ideally all NRM projects are consistent and consider the objectives of the CRP were appropriate.

Components of the CRP are based on spatial modelling. There will always be an element of field validation required when potential projects are planned.

Spatial modelling focuses on activities that maximise biodiversity and carbon capture benefits while being compatible with other regional land uses. Activities that seek Wimmera CMA and/or Australian Government climate change funding should align with the CRP. Other project activities are encouraged to follow the CRP as it will help deliver multiple benefits and manage potential conflicts.

Local Government chapters have been included that have priorities for these sub-regions. This allows for communities to focus their efforts and indicates the key priorities for climate change actions for those locations as they differ across the regions as a result of landform and vegetation extent.

CRP development

Below is a summary of the CRP development process.

Review of previous work

1. A desktop review of the RCS 2013-2019 was undertaken to determine where there were potential areas for development to take into account climate change.
2. Consideration of the information and objectives developed through the WWS.
3. Information collected from previous Charles Sturt University Social research study (Curtis & Mendham, 2012), was reviewed in relation to climate change related matters. This is the longest running longitudinal survey related to NRM in Australia.
4. Literature review of new policy and legislation and science relating to natural resource management with a focus on climate change.

Development process.

1. Wimmera CMA Advisory Committees meeting to seek feedback on CRP discussion draft, project plan, information sources and the regional principles to be applied.
2. Community involvement - 35 meetings occurring with numerous stakeholders and community-based organisations. These meetings discussed issues, tested concepts/logic and mapping outputs.
3. New climate change literature was constantly reviewed as it was made available.
4. Data was collected in relation to native vegetation assets and the potential limitations to revegetation projects in the region from stakeholders.
5. Climate change vulnerability data was developed and assessed including collaborative projects undertaken by seven CMAs in Victoria and work conducted by the CSIRO.
6. Biodiversity assets were mapped across the region using NaturePrint and prioritised based on value for money.
7. Multi-criteria analysis to determine high priority native vegetation actions and protection of other values.
8. Development of priority soils actions from the feedback received from key stakeholders.
9. Follow up consultation occurred with specific stakeholders to clarify points and retest concepts.

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Review

The CRP runs for the life of the RCS and will undergo a formal review at the end of 2018.

In addition, the CRP will be updated periodically to take into account new information, science and policy. Updated information will be electronically available at:

www.wcma.vic.gov.au/CarbonReadyPlan

Spatial modelling to develop mitigation priorities for native vegetation and waterway mitigation modelling

The CRP uses a multi-criteria analysis to determine the priority of actions across the Wimmera region.

Figure 2: Mitigation priority modelling methodology for waterways and native vegetation.

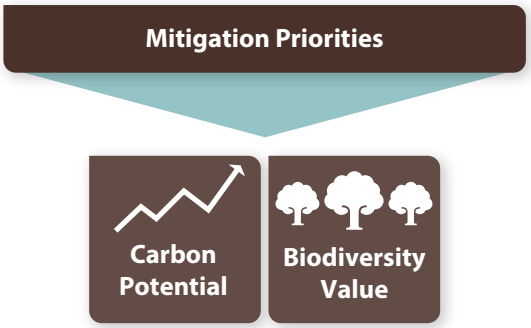
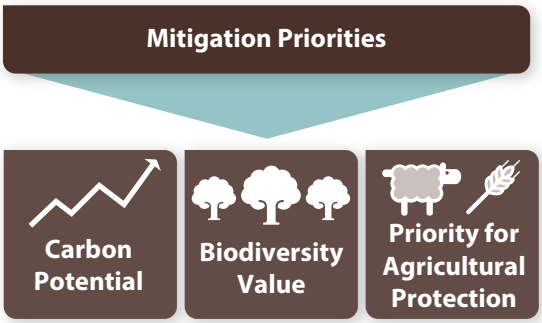


Figure 3: Mitigation priority modelling methodology for revegetation.



Multi-criteria analysis combines a range of datasets. Waterways and native vegetation uses carbon potential and biodiversity datasets (Figure 2). Revegetation uses carbon potential, biodiversity and agricultural protection datasets (Figure 3). The process generates a series of spatial layers, which represent the priority for action. These layers are displayed through the maps in the CRP and are provided via the above link in a higher resolution format. A detailed methodology for the generation of spatial layers is provided in Wimmera CMA, 2015a-c.

Collaborative CMA climate change vulnerability assessment

Seven of Victoria's CMAs, including Wimmera CMA, commissioned Spatial Vision to undertake a spatial climate change impact assessment that considers multiple asset classes and values using the latest available data.

This project used preliminary climate predictions known as CMIP5, which were released by CSIRO in March 2014. This data includes projected climate change relative to the 1986-2005 period. This data has since been updated, but it was determined that for the purpose of this modelling the changes would make a negligible difference to the results.

Carbon emission assumptions used in this project were:

- Representative Central Pathways 4.5 (RCP 4.5) – Moderate scenarios (in terms of future emissions).
- Representative Central Pathways 8.5 (RCP 8.5) – Extreme scenarios (in terms of future emissions).

In considering which model to apply the RCP 8.5 scenario was the preferred model as it provided a greater delineation in vulnerability over a shorter time period in the Wimmera, allowing for greater and earlier prioritisation.

As government and industry around the world are introducing new technologies, regulations and incentives that may result in a reduction of emissions meaning that RCP 4.5 is potentially achievable, Wimmera CMA has decided to use scenario RCP 8.5 as it provides a better prioritisation tool and could be seen as a precautionary approach.

The Spatial Vision project took into account vulnerability over four periods; 2030, 2050, 2070 and 2090.

While all vulnerability periods have been considered the emphasis is on the 2070 time line as it clearly shows discernible variation in vulnerability across our region (see Map 4).

In application the vulnerability assessment for native vegetation is combined with mitigation mapping for native vegetation management (Figure 3 & Figure 4) to create a CRP climate change priority map for native vegetation management.

Figure 4: Climate change priority logic - Climate change priorities are determined by combining mitigation and vulnerability priorities.

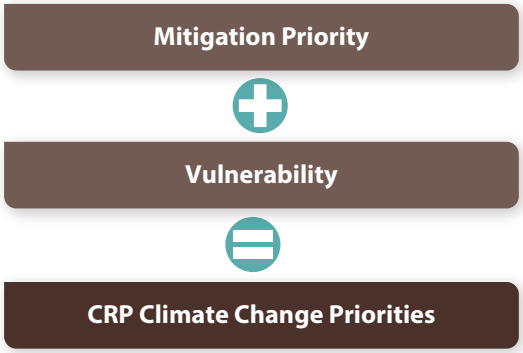
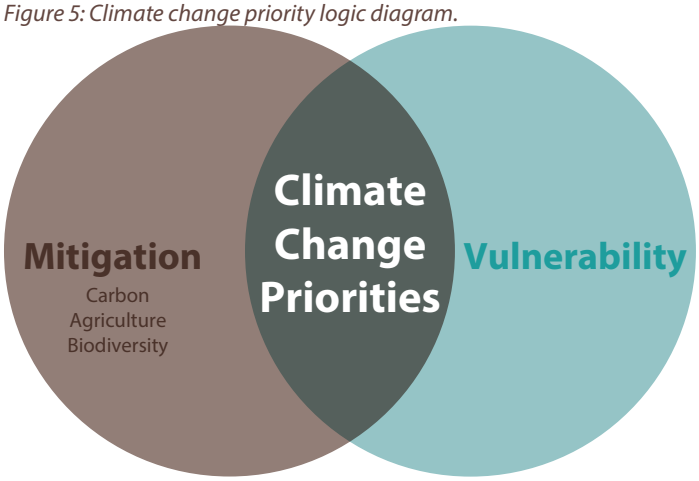


Figure 5: Climate change priority logic diagram.



Mapping

The CRP provides a number of maps based on the above logic and modelling. These maps provide priority locations for climate change mitigation and adaptation activities. Maps identifying areas of 'special interest' for example, fire management, are accompanied with protocols for communication with relevant authorities. Protocols are designed to ensure that appropriate communication, risks and opportunities are addressed as soon as possible.

Depending on the priorities of the investor and the proposed on-ground action the value of specific attributes can be increased and decreased, which will modify priorities. In many cases the algorithms that support the mapping can be included in decision metrics to determine value.

The methodology to develop the mapping for native vegetation revegetation priority areas combines biodiversity, carbon capture potential and agricultural land and in doing so weights them equally. However, if for example, an investor seeks to maximise the biodiversity benefit the weighting for that attribute may be increased. For example, an investor's first priority may be biodiversity and carbon as a secondary concern.

The maps can also be combined with other 'special interest' priority mapping to refine priorities. For example, the native vegetation mapping could be combined with priority mapping from the *Trust for Nature State-wide Conservation Plan* (Trust for Nature, 2013) or the *Habitat 141 Landscape Conservation Plan* (Koch, 2015).

Combined mitigation and vulnerability maps are provided in local government chapters.

Roles and responsibilities

The following sections have been adapted from 'Climate Change Adaptation: National Adaptation Priorities and Roles and Responsibilities' (Council of Australian Governments, 2013).

The Australian Government

Note: Governments will provide a range of financial mechanisms to facilitate climate change adaptation and mitigation. The CRP does not discuss these mechanisms. Individuals will need to seek guidance from the relevant government bodies on these mechanisms and seek financial advice where necessary.

The Australian Government has stewardship of the national economy and is responsible for promoting Australia's national interests more broadly. As climate change impacts on virtually every sector of the economy and society, the Commonwealth will take a leadership role in positioning Australia to adapt to climate change impacts that may affect national prosperity or security. By exercising its role, the Commonwealth facilitate adaptive capacity and build climate resilience. In some cases this will require targeted action, for example the Australian Government manages some important assets – including natural assets – that are vulnerable to the impacts of climate change. In other cases the Commonwealth will play a role in driving and coordinating national reform efforts.

In general the Commonwealth will:

- Provide national science and information.
- Manage Commonwealth assets and programs.
- Provide leadership on national adaptation reform.
- Maintain a strong, flexible economy.

State and Territory Governments

State and Territory Governments deliver a broad range of services and administer a significant body of legislation. They also manage a substantial number of significant assets and infrastructure that will be impacted by climate change. The focus for State and Territory Governments will be on ensuring appropriate regulatory and market frameworks are in place, providing accurate and regionally appropriate information and delivering an adaptation response in areas of policy and regulation that are within the jurisdiction of the State. This includes key areas of service delivery and infrastructure, such as emergency services, the natural environment, planning and transport.

In general States and Territories will:

- Provide local and regional science and information.
- Manage State and Territory assets and programs.
- Work with the Commonwealth to implement the national adaptation reform.
- Encouraging climate resilience and adaptive capacity.

Victorian Government policy supports landholder engagement with emerging carbon market opportunities. The Victorian *Climate Change Act 2001* provides a legal framework for landholder engagement with the carbon market.

Councils

Local Governments are responsible for a broad range of services, the administration of a range of Commonwealth, State and Territory legislation and the management of a substantial number of assets and infrastructure, including assets and infrastructure of local, regional, state and national significance.

Local Governments are on the frontline in dealing with the wider impacts of climate change. They have a critical role to play in ensuring that the local community is actively involved in mitigation and adaptation. They are strongly positioned to inform State and Commonwealth Governments about the on-the-ground needs and to respond appropriately and in a timely manner to local changes.

Local Governments will:

- Administer relevant state and territory and / or Commonwealth legislation to promote adaptation as required including the application of relevant codes, such as the *Building Code of Australia*.
- Manage risks and impacts to public assets owned and managed by local governments.
- Manage risks and impacts to Local Government service delivery.
- Collaborate across councils and with State and Territory Governments to manage risks of regional climate change impacts.
- Ensure policies and regulations under their jurisdiction, including local planning and development regulations, incorporate climate change considerations and are consistent with State and Commonwealth Government adaptation approaches.
- Facilitate building resilience and adaptive capacity in the local community, including through providing information about relevant climate change risks.
- Work in partnership with the community, locally-based and relevant NGOs, business and other key stakeholders to manage the risks and impacts associated with climate change.

Together they aim to build capacity and planning in the areas of emergency management, social and community services, planning and building, infrastructure and environment.

In addition, they are working towards reducing energy consumption and increased energy efficiency.

Wimmera CMA

Amongst other things, Wimmera CMA has responsibility under the Victorian *Catchment and Land Protection Act 1994* for facilitating and coordinating the management of the Wimmera catchment in an integrated and sustainable manner. The CRP will assist in achieving this objective by prioritising activities across the catchment for the management and improvement of soils, native vegetation and habitat for native plants and animals.

Non-government organisations

There are many non-government organisations in the Wimmera that are conducting activities that tackle climate change. These groups support the community in many ways including the protection and enhancement of our native vegetation, waterways and habitat for wildlife, soils and agricultural practices.

These groups also work in partnership with Wimmera CMA to deliver collaborative and integrated projects which supports landholder to deliver multiple benefits including climate change actions.

Community

Like the Wimmera RCS the CRP recognises that community input and involvement will be vital in achieving its objectives and targets.

The Wimmera community has practical experience dealing with variations in climate and extreme events like floods and droughts. The agricultural sector has continually adapted practices and technology to strive for a more resilient and profitable industry.

While governments and industry often provide funding and set policy objectives, community groups and landholders roles often involve implementation of on ground change to maintain and improve natural assets.

Community consultation, conducted in developing the CRP, has been vital in ensuring the targets and objectives align with those of the community so we maximise the opportunities for participation and implementation.

Climate change and extreme events

The Wimmera Southern Mallee economy is dominated by agriculture, which is highly dependent on favourable climatic conditions. Many parts of the region, including those most attractive to residents and visitors, are susceptible to extreme events such as flooding and bush fire. Future climate predictions suggest the region may experience longer periods of drought and that bush fire and high rainfall events will be more severe. Such changes have significant environmental, economic and social implications. Careful management of new land use and development is required to minimise risk to life and property and to ensure that environmental values are not compromised by inappropriate development.

Wimmera Southern Mallee Regional Growth Plan, 2013.

Agriculture may face significant challenges under climate change.

Our catchment - preparing & responding

Introduction

Given the importance of agriculture, climate is a significant factor in the productivity and prosperity of the Wimmera. The Wimmera naturally has extreme climatic variations. Very hot and dry conditions in summer months, to temperatures below zero in winter. Drought, fire and floods are part of the natural landscape. Whilst often the negative aspects of climate change are the focus, it will be important to understand and take advantage of any opportunities or benefits it may bring. A report by the University of Melbourne commissioned by World Wildlife Fund (WWF) in 2015, suggests significant impacts to food production in Australia including our region.

Resilience

With climate change and its associated events, it is vital that we build resilience of our natural assets so they can respond, evolve and recover. Our community, on the other hand, has for many decades, adapted to a variable climate. For example, changes in farming techniques, plant breeding and fire management practices.

Climate change predictions

Lower winter rainfall, higher summer rainfall, temperature increases and extremes in all seasons, more hot days and fewer very cold days are all future predictions for the Wimmera region from the *Victorian Climate Change Adaptation Program 2008*. This has been confirmed in the CSIRO's Climate change modelling for the Murray Cluster (CSIRO, 2013).

Key messages from the climate change projections under current emission rates to 2090 for the Murray cluster area include:

- Average temperatures will continue to increase in all seasons (*very high confidence*)
- More hot days and warm spells are projected with *very high confidence*. Fewer frosts are projected with *high confidence**.
- By late in the century, less rainfall is projected during the cool season, with *high confidence*. There is *medium confidence* that rainfall will remain unchanged in the warm season.
- Even though mean annual rainfall is projected to decline, heavy rainfall intensity is projected to increase, with *high confidence.*
- A harsher fire-weather climate in the future (*high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

Climate change and frost

Current research suggests frost frequencies (and associated year-to-year variability) will remain largely unchanged until at least 2030 irrespective of emission rates.

It is also understood that across the southeastern parts of the continent the season for frosts has broadened. That is, they start earlier and end later in a season.

CSIRO modelling suggests that depending on the emission scenarios, there is likely to be a strong reduction in frost incidences by 2090.

While experts acknowledge that assessing frost using global climatic models can significantly under report frost occurrence, there is general consensus that if emission continue to accumulate in the atmosphere at current rates, that the resultant warming is likely to reduce the number of frost events but there is uncertainty about changes in the length of the frost season and the severity of frost events.

So while in the longer term the number of frosts may reduce, in the short term we will continue to have a similar frost number and season length.

There is a need to continue to better understand frost occurrence and the impact of frost severity and to continue to develop management and technology to ensure our natural assets can cope with frost.

Our community

Understanding the Wimmera community's values and beliefs

The Wimmera CMA commissioned Charles Sturt University to undertake a social survey, Understanding the Social Drivers of Catchment Management in the Wimmera 2011. This is a continuation of the previous surveys conducted in 2002 and 2007. This is the longest running social survey of rural landholders in Australia and another survey is planned in 2016.

Data from the latest survey indicated that around 80% of landholders agreed that they should manage their properties in expectation of extreme weather events. 47% of landholders agreed that changing rainfall patterns could impact on property viability. This supports the assumption that many Wimmera landholders are conscious of the impacts changing climate can have and the need to prepare for it. This is further supported by results showing that over 50% of respondents had implemented current recommended practices related to minimum tillage, adaptive no-till and precision farming in cropping system which to a large extent is designed to retain moisture, nutrients and structure in soils. These are all considered to be climate change adaptation actions.

About one third of landholders agreed there would be carbon farming opportunities on their property. This indicates, at present, carbon farming may not be seen as a widespread commercial opportunity compared to other income options and/or landholders do not understand the opportunities. As such, part of the CRP focus will be to ensure landholders are aware of the opportunities available and the economics of these so they can assess their options.

Around one third of landholders agreed that the use of land for carbon farming/biofuels will lead to food shortages. This is an important focus point of the CRP. The CRP has used a range of inputs from spatial analysis and community feedback to ensure high quality agricultural land is not prioritised for large-scale tree planting activities associated with carbon farming or biodiversity. In these areas, there is a need for other potential activities that could improve the quality of the land without impacting on its ability to grow food.

Faba beans emerging in a no-till cropping system.

Climate change action priorities

Native vegetation and habitat

Background

Native vegetation comprises plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses. Native vegetation provides habitat for wildlife and delivers a range of ecosystem services that make land more productive and contribute to human wellbeing.

There are generally two types of activities that take place to directly improve the extent and resilience of native vegetation. These include the planting or seeding of native plants to re-establish native vegetation where is does not currently occur or where it is degraded and the management of native vegetation in a manner that allows it to grow and regenerate naturally.

All vegetation can provide two direct climate change outcomes by:

- Providing greenhouse mitigation through carbon storage; and
- Adaption by providing ecosystem habitat for plants and animals.

On ground native vegetation works that are landscape scale, cross tenure and use multiple actions provide a better long term outcome. The CRP acknowledges and supports this approach.

Note: Forestry or monoculture plantations should occur on areas of low priority for native vegetation revegetation and management. The same standards will apply as outlined on pages 15 and 16 for revegetation.

Mitigation

Biosequestration is a climate change mitigation activity. It is the capture and storage of the atmospheric greenhouse gas carbon dioxide by biological processes (Parliament of Australia, 2010). Investment in native vegetation establishment and management for biosequestration provides opportunities to improve our environment and can also provide adaptation benefits. If this is not well planned it can also pose risks, for example, fire, water availability and pest management. The challenge is to maximise the benefits and minimise the impacts from any investment in this area.

Adaptation

By understanding the potential impacts of climate change on ecosystems and the wildlife that inhabit them, we can potentially develop resilience in these assets so they can withstand the predicated impacts. This is an area of uncertainty and limited knowledge which requires ongoing monitoring and research.

The CRP addresses the adaptation of native plants and animals to climate change through its native vegetation actions. The logic is that if we protect and enhance native vegetation in priority locations it will support the resilience of our native flora and fauna.

Tenure

A large proportion of the region's native vegetation in located on public land. Despite this around 90% of rare and endangered ecosystems are located on private land meaning private land plays a significant role in the provision of habitat for wildlife.

The prioritisation of actions in the CRP generally focuses on private land. Government agencies responsible for the management of National Parks, State Forest and Crown reserves have mechanisms in place for the management of native vegetation in consideration of climate change. It is intended that the CRP will complement these efforts.

Managing vegetation under a conservation covenant can contribute to climate change mitigation and adaptation. Photo: Trust for Nature

Mitigation - biosequestration

Native vegetation can capture carbon in two ways:

1. **Revegetation** – Planting or direct seeding land with minimal or no native vegetation. This activity involves significant intervention and cost.
2. **Management (Protection and Restoration - managing what currently exists)** – The protection and restoration of native vegetation for biodiversity and carbon activities enables ecosystem functionality to be maintained or increased whilst providing carbon storage capacity. This usually involves moderate to minimal intervention and cost.

The difference between restoration and protection can in many cases be impossible to differentiate. For this reason in the CRP Wimmera CMA have identified the highest priority for each in one map and will be known as native vegetation management. The separation of the two will be provided on the Wimmera CMA website which will allow for more specific prioritisation should it be required for a specific project.

During the consultation for the CRP some of the challenges and opportunities identified relating to using vegetation for biosequestration included:

- Increased fire risk.
- Impacts on water resources.
- Improved biolinks.
- Protection of public infrastructure and development opportunities.
- Protection of high quality agricultural land.

With uncertainty about the operation of and commitment to carbon markets, it is challenging to understand and compare the commercial benefits of investments in revegetation for carbon in our region compared to other agricultural ventures. Past research has indicated that there is little profitability potential from carbon forests in the Murray Darling Basin under a range of scenarios. This may be the case in most of the Wimmera, although some areas in the south and south-west of the region, with higher rainfall, may have potential. These geographical areas need to be carefully managed to ensure that other values are not impacted such as ground water aquifers and surface water resources.

Recent work, conducted by Greening Australia and Alcoa, consisted of direct measurements in the field to compare actual carbon capture rates with modelling estimates generated from the Australian Government's Reforestation Modelling Tool (RMT). In some cases, in the Wimmera, the field measurements are providing significantly greater carbon volumes than the RMT, particularly in the south. In the north of the region, they are comparable. This data provides a useful indicator that there may be high yielding locations in the region and that further peer review and research should be conducted to provide more comprehensive information.

Priority actions:

- Support the ongoing collection of data to better understand the carbon yielding capacity of land under various silviculture regimes across the region.
- Support the peer review of the Greening Australia and Alcoa report.

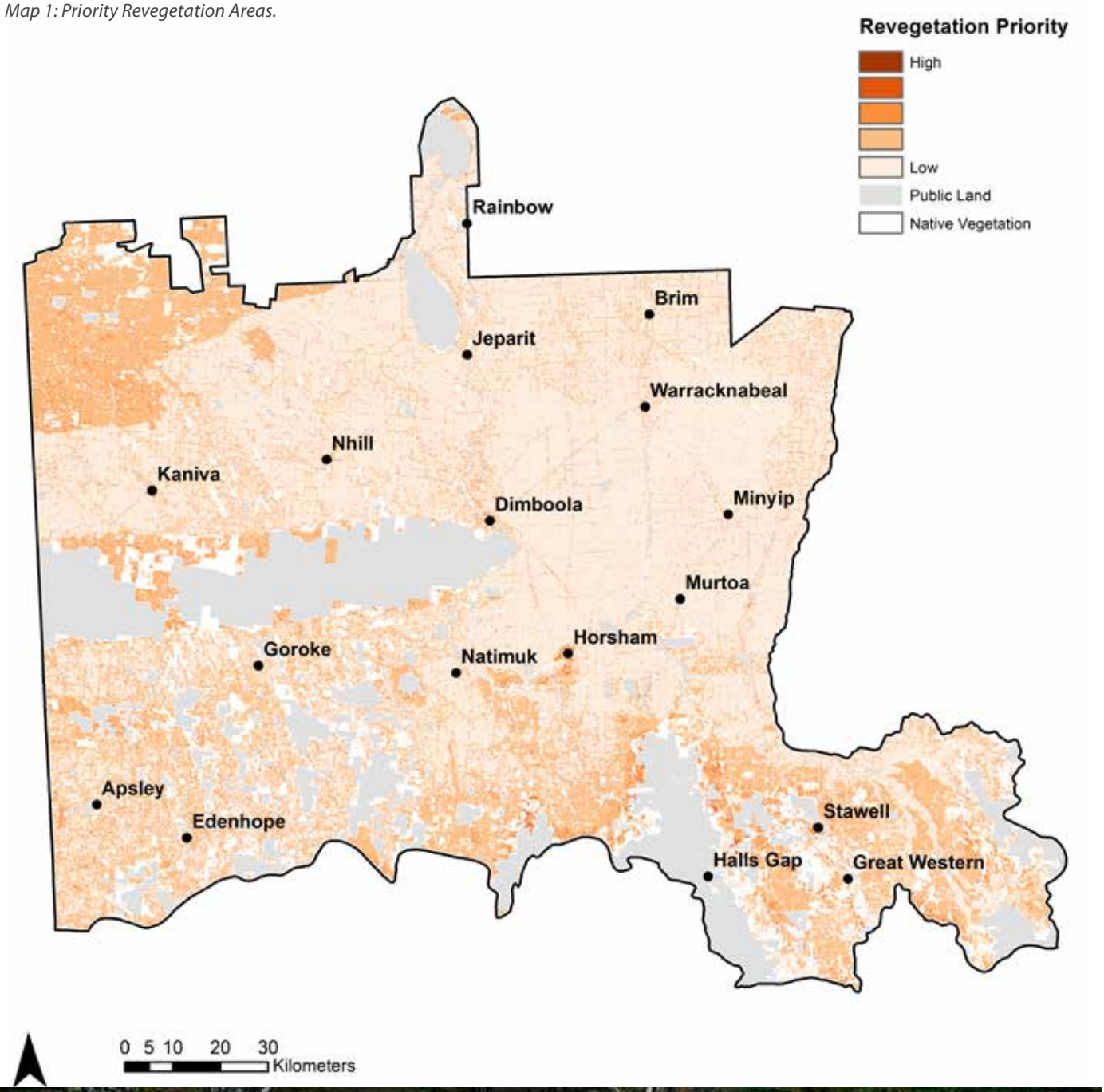
Priority native vegetation conditions

The following conditions are mechanism to maximise the benefits of large scale biosequestration activities and minimise the impacts. A series of maps accompany these mechanisms providing prioritised locations for native vegetation revegetation and management.

Native revegetation activities will:

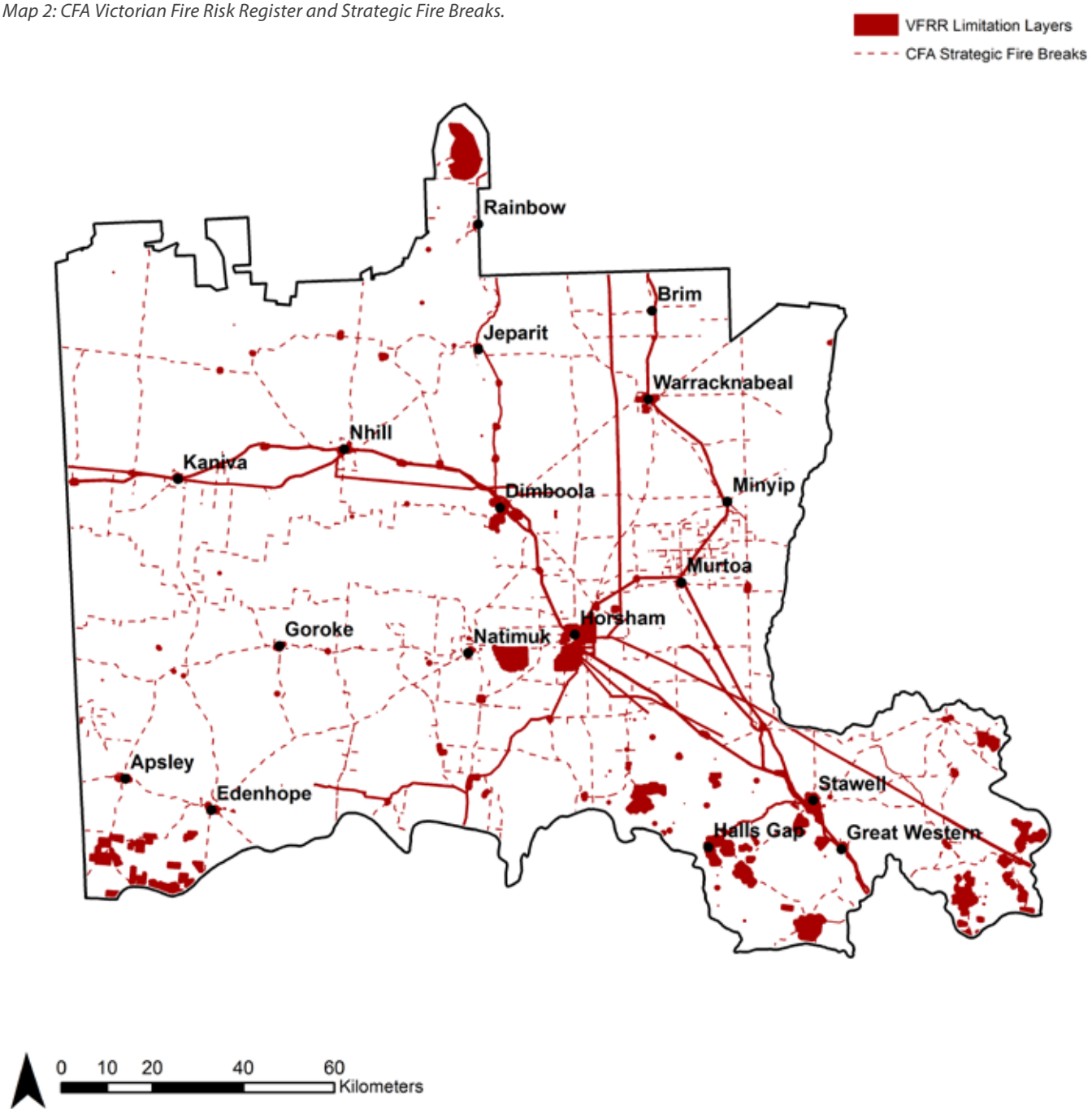
- Occur in prioritised areas (see Map 1). More detailed mapping is provided in the local government sections.
- Includes a local species mix that can cope with varying climates. For example on floodplains a mix of blackbox and redgum may need to be planted with appropriate understorey species.
- Occur on strategic fire breaks and roads (see Map 2) where approval has been given by the relevant authority for example the Country Fire Authority (CFA) and relevant Local Government.
- Only occur within the prescribed distances for relevant assets identified in the *Victorian Fire Risk Register* (VFRR) with the support of the CFA (see Map 2). (A description of the methodology for this mapping is in Appendix B.
- Not occur on road reserves or road easements unless approved by the relevant authority.
- Not occur near powerlines (within 50 metres).
- Occur adjacent to National Parks, State Forest and other public land parcels with the approval of Department of Environment, Land, Water and Planning and the relevant CFA Region.
- Not occur on easements for example, railway lines, gas lines or telecommunication easements.
- Not occur within 500 metres of a Neighbourhood Safer Place.
- Not occur within the distance specified by the relevant Local Government planning scheme for airports and aerodromes or 1km where a planning scheme does not specify.
- Follow the following conditions in relation to GWM Water infrastructure:
    - No trees within channel reserves or access tracks.
    - No trees within 5 metres of the toe of a channel bank.
    - No large species of trees within 20 metres of the centre line of a channel.
    - No trees on a pipeline easement (most of the drinking water pipelines, for example, Dimboola to Nhill have easements across rural land).
    - No trees within 5 metres of a pipeline (most of the Wimmera Mallee Pipeline is not covered by an easement).
    - No large species of trees within 20 metres of a pipeline.
    - No trees within 5 metres of a GWM Water facility / fence / structure.
- Be culturally sensitive and comply with the Victorian *Aboriginal Heritage Act 2006*.

Map 1: Priority Revegetation Areas.



Revegetation activities, besides capturing carbon can have multiple benifits including erosion control.

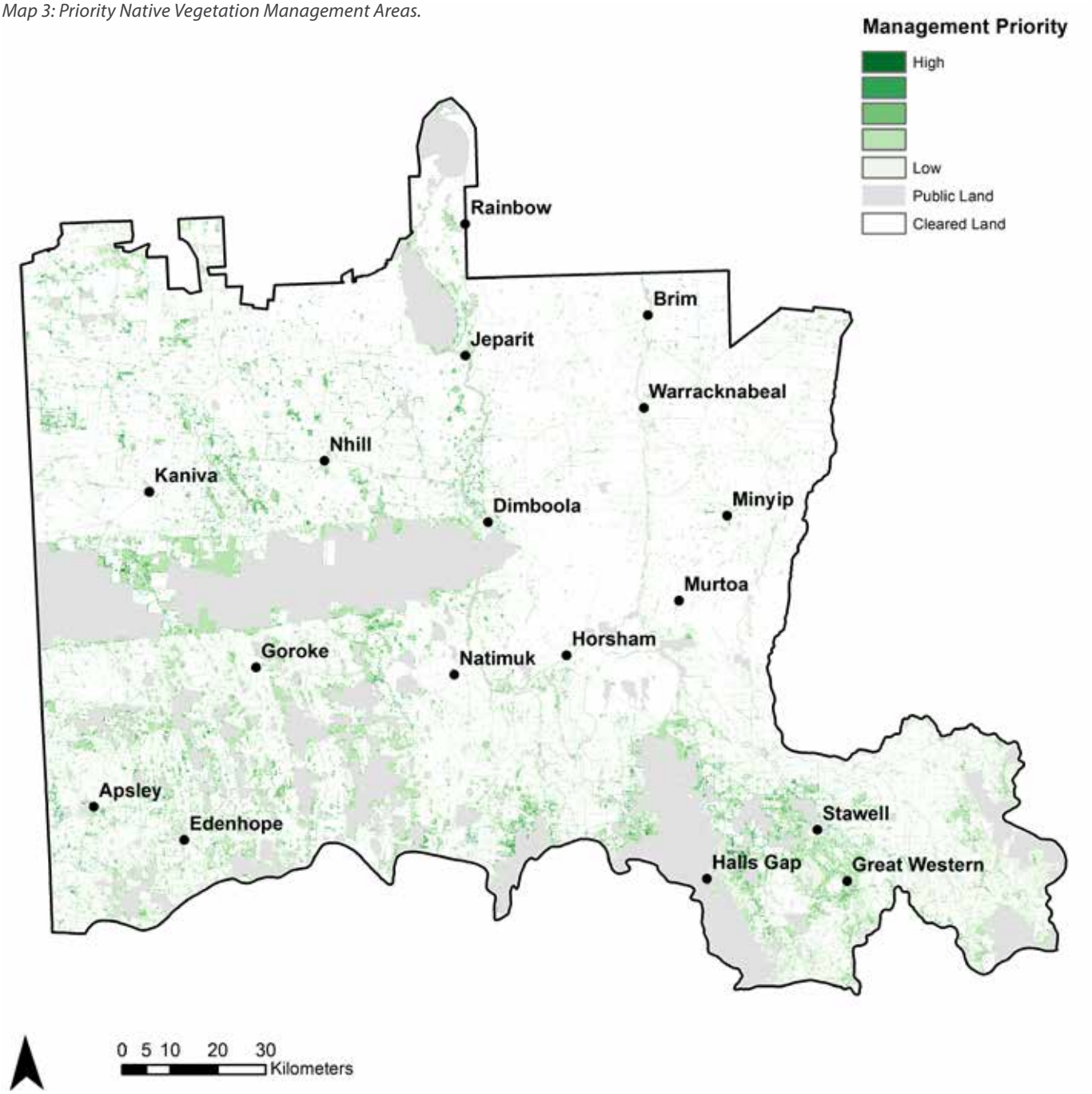
Map 2: CFA Victorian Fire Risk Register and Strategic Fire Breaks.



Native vegetation management (**Protection and Restoration - enhancing what current exists**):

- May occur in prioritised areas (see Map 3). More detailed mapping is provided in the local government sections.
- Covenants or vegetation management agreements made adjacent to National Parks, State Forests or other public land parcels should be developed with the collaboration and consultation of DELWP and/or Parks Victoria so that fire management, pest plant and animal and any other cross property issues are addressed to advantage both landholders.

Map 3: Priority Native Vegetation Management Areas.



Adaptation – native vegetation

Adaptation in relation to native vegetation will focus on providing resilience of assets against the likely consequences of climate change. The climate change vulnerability mapping shows that some ecosystems are likely to be more vulnerable than others as a result of direct impacts of two factors: increases in temperature and reduction in rainfall.

Native vegetation types that are most sensitive are generally those associated with waterways or those evolved in cooler wetter climates, for example wet sclerophyll forests on south-east slopes of the Grampians. Of these the most vulnerable will be those that are degraded or fragmented, with a lower adaptive capacity.

There are also likely to be indirect impacts, such as increases in fire threats in some areas, pest plants and changes in land use, such as cropping of wetlands.

In the Wimmera, where feasible, the key to reducing the vulnerability of native vegetation to climate change will be achieved by improving the adaptive capacity of ecosystems. This complements RCS objectives by:

- Improving connectivity through strategic revegetation and native regeneration.
- Protecting and managing high quality ecosystems.
- Enhancing degraded ecosystems through pest plant and animal management, appropriate fire and grazing management and encouraging natural regeneration.
- Increasing patch size and buffers around remnant vegetation through revegetation and natural regeneration.

Climate change vulnerability is shown below in Map 4. These identify areas for priority climate change adaptation action.

Given that the priority setting process for native vegetation mitigation is based on multiple benefits, they have then been combined with the climate change vulnerability maps to identify the highest priority areas for native vegetation management, assuming both are equal. These are shown in more detail in the council chapters.

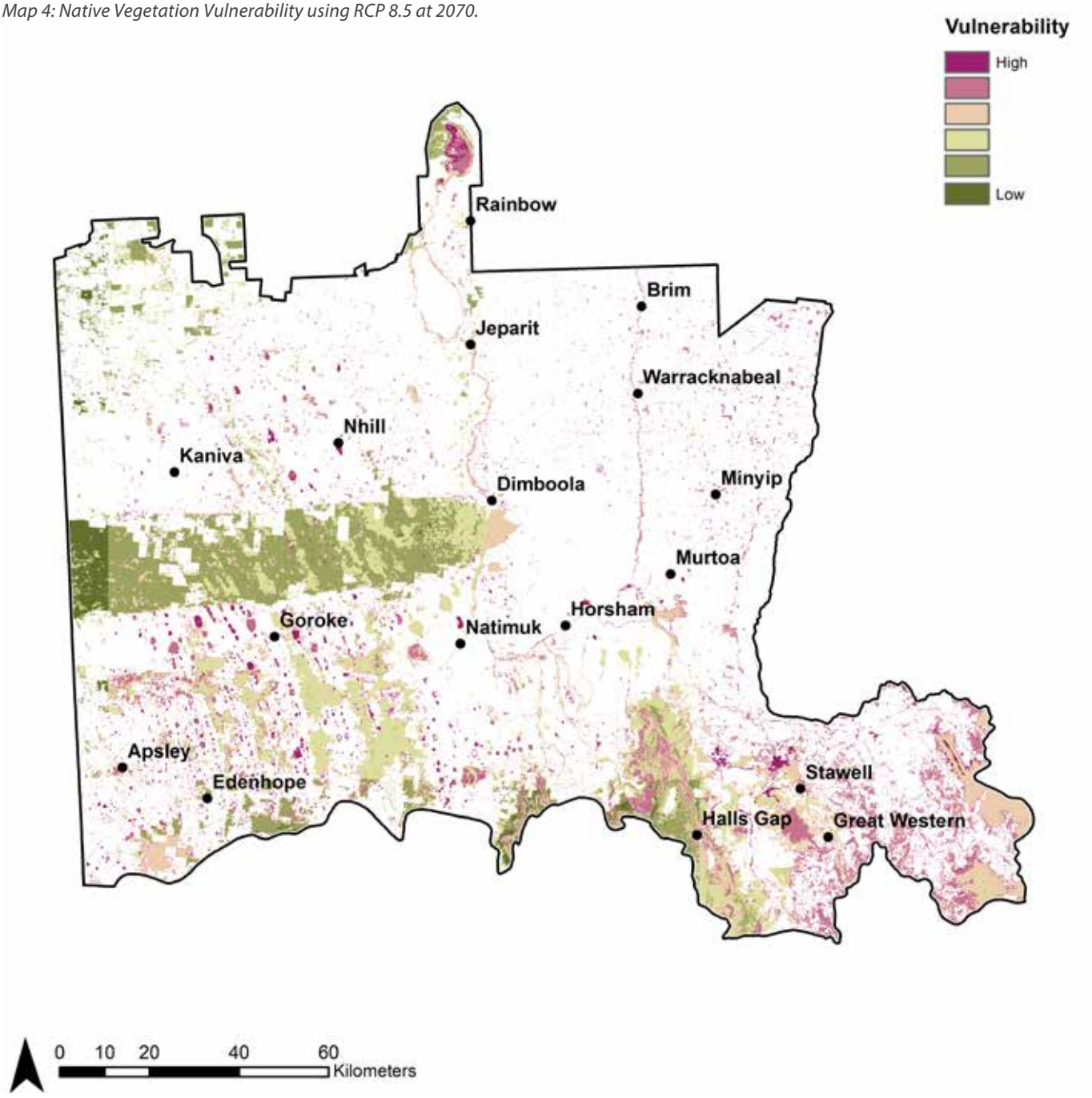
The following actions will provide a greater focus on climate change adaptation of native vegetation while considering other benefits and impacts.

Priority actions include:

- Revegetate in priority areas indicated in Map 1.
- Actively protect and manage high conservation value native vegetation from threatening processes and sustain its conservation values in priority areas indicated in the management priority maps for each council section, below.
- Review and implement the *Wimmera Invasive Plant and Animal Strategy* (Wimmera CMA, 2010), taking into account the likely influences of climate change and communicate information on activities and success to the broader community.
- Conduct at least one regional engagement activity each year to encourage stakeholders, Traditional Owners and the community to:
  - Prioritise native vegetation and habitat actions in accordance with the CRP.
  - Discuss and implement best practice native vegetation management.
- Develop capacity of and tools for landholders, including Traditional Owners, to manage native vegetation on private land including:
  - Information about managing native vegetation in a changing climate.
  - Conducting appropriate native vegetation fire management on private land.
  - Monitoring condition and trend of native vegetation.

Managing existing native vegetation in the right way means it can continue to regenerate and increase its capacity as a carbon store.

Map 4: Native Vegetation Vulnerability using RCP 8.5 at 2070.



Australian Government

Wimmera CMA

Weeping Pittosporum (Pittosporum angustifolium).

RCS Native Vegetation

Twenty year RCS objectives

1. Improve the management of existing native vegetation classes.
2. Strategically revegetate with indigenous species.
3. Bring 30,000 ha (45 percent) of endangered vegetation on private land under ongoing and recognised best practice management standards.

Six year RCS management measures

Taking into consideration the condition, trends and threats to native vegetation, the following six–year management measures have been developed to deliver the twenty–year objectives for native vegetation health:

1. Update and review the Wimmera Native Vegetation Plan, with an aim to provide greater flexibility and strategic thinking in offset requirements under planning schemes, particularly for single paddock trees, connectivity and biolinks.
2. Actively protect high conservation value native vegetation from threatening processes and sustain its conservation values.
3. Ensure current biosecurity approaches adequately address disease threats.
4. Improve coordination with government agencies, local governments, industry groups, landholders and others for landscape–scale planning and planting of native vegetation, including revegetation activities.
5. Continue to implement the Wimmera Invasive Plant and Animal Strategy, and communicate information on activities and success to the broader community.
6. Implement recommendations of the report by the independent working group on roadside management.
7. Develop an action plan that will address potential increase in carbon sequestration activities through native vegetation actions.

Finger Orchid (Caladenia carnea).

RCS Threatened Species

Twenty year RCS objectives

1. Demonstrate actions leading to improving the status of 20 percent of listed species occurring in the region.
2. Improve community awareness of local threatened species.
3. Improve coordination of communication and availability of information between agencies and the community to maximise benefits for threatened species.

Six year RCS management measures

Taking into consideration the condition, trends and threats to threatened plants & animals, the following six–year management measures have been developed to deliver the twenty–year objectives for threatened species:

1. Continue to support on–ground actions to reduce threats at specific sites.
2. Participate in the development of a statewide framework to improve the prioritisation of threatened species work and the communication of successes.
3. Continue to implement WIPAMs to manage pest plant and animals and disease.
4. Ensure current biosecurity approaches adequately address disease threats.
5. Undertake educational programs to improve community involvement and awareness of threatened plants and animals and the relevant threatening processes.
6. Identify flagship species and ecological communities to promote landscape–scale habitat protection and improvement work.
7. Support and participate in existing networks to maximise information flow between agencies (e.g. recovery teams).
8. Establish and maintain a regional threatened species advisory committee that reports to the Wimmera CMA board and includes representatives from key agencies.
9. Ensure that spatial information on threatened species is accessible and used by local governments and fire managers, so that these species are routinely accounted for in planning and operations.
10. Implement actions that directly lead to improving the status of listed threatened species, with a focus on propagating and reintroducing listed flora species.

Soils and agricultural practices

Background

The Wimmera community is inherently linked to agriculture. Twenty five percent of Wimmera residents rely directly on agriculture for income. One third of residents live on farms or in small townships of less than 2,000 people. Eighty four percent of our region is private land, most of which has been developed for agriculture.

Given the significance of this link, Wimmera people are well placed to make a contribution to positive climate change action but are also vulnerable to the challenges that climate change may bring.

Mitigation

Climate change mitigation with regards to soil is generally focused on soil carbon capture and the reduction of greenhouse gas emissions. The CRP focuses on the emissions from soil and its ability to capture greenhouse gases within the soil/plant interface. The CRP does not consider emissions from machinery or animals.

Adaptation

Adaptation to climate change, with regards to soils, is generally about management techniques and farming 'practice change' that can assist in dealing with the predicted impacts of climate change. For example, this includes preparing for more droughts, extreme heat and managing the potential side effects of farming activities, for example, weeds, pests and soil erosion.

Priority soil and agricultural actions for climate change adaptation mitigation and adaptation and conditions

There are currently a range of products, concepts and farming practices that may have merit in dealing with climate change. Consultation during the development of the strategy has indicated that there is still a strong demand for research, experimentation and demonstration. This includes appropriate trials that demonstrate how different land management practices can influence farm productivity. As technology and innovation progress it is important to demonstrate how they can be applied for multiple benefits, so any lag time for full adoption can be reduced and equally any risks can be assessed. Community feedback strongly supports the need for greater collaboration and coordination on research, demonstration trials and experimentation.

The following actions and conditions are high level actions to assist with climate change adaptation and mitigation across our region. In particular, they address the coordination of research, demonstration trials and extension.

When conducting soil related activities, particularly at depth, we need to be mindful of the requirements of the Victorian *Aboriginal Heritage Act 2006*.

Seeder operating in a no-till system.

General priority actions for soil and agricultural practices:

Theme	Actions	Parameters and targets
Research	Establish triennial processes to review regional research priorities. Determine how the region will contribute to the implementation of the *National Soil Research, Development and Extension Strategy* (Australian Government, 2014). Maintain current relevant research projects. Ensure the results of relevant research projects are published and packaged for use by the local industry.	Research will focus on: Assessing viability (cost/benefit). Work that has not been published previously. Cooperation locally.
Knowledge sharing through collaboration	Improve the understanding of climate change mitigation and its relationship with farm productivity by establishing a regional network of soil health agencies and industry bodies.	Bring together all recent data and gained knowledge whether that be scientific or anecdotal (field observations) for discussion. Discuss priorities for engaging the farming community, in particular communicating the findings of relevant new research conducted. Discuss priority demonstrations and research that the region will seek funding for. Supporting at least two community engagement activities per year focused on improving landholder's knowledge and skills of how climate change mitigation or adaptation can improve farm planning and productivity. Supporting one activity per year focused on building the relationship between soil health agencies and agricultural consultants.
Monitoring	Continue to develop and implement monitoring mechanisms to measure outcomes and practice change, for example Department of Economic Development, Jobs, Transport and Resources ground cover transects.	Soil transect monitoring continues in the north and south of the region. Other innovative monitoring techniques are explored and implemented.
Demonstrations and trials	Establishing on farm demonstrations into the storage and accumulation of carbon and the reduction of soil emissions. Where possible maintain current demonstration trials into the benefits of soil amelioration, for example composting and nitrous oxide emissions.	Priority will be given to demonstration trials that are: For a period that is appropriate to provide a result. Large scale. Conducted across variable soil types and climatic conditions. Supported by local industry groups. Involve multiple partners (collaborative work). Based on previous research findings. Relevant to Wimmera conditions. Focused on farm profitability. Priority themes for demonstration trials include the investigation of the management of: • Snails, slugs, mice, kangaroos and corellas. • Herbicide resistant pest plants. • Perennial pastures and crops. • Soil improvement. • Water use efficiency. • Climate change resilient farming systems for example moving from cropping to cropping and pasture.

With all of this work including research, demonstrations and trials there will need to be a collaborative effort. No one organisation will be able to deliver these in isolation. Wimmera CMA will work with industry groups, government organisations and researchers to help coordinate this effort across the region.

Mitigation - soil carbon storage and capture in agriculture

There are three types of carbon in soil. These include:

- Particulate organic carbon – plant and animal material between 0.05 and 2mm.
- Humus – decomposed material less than 0.05mm that are dominated by molecules attached to soil minerals.
- Recalcitrant organic carbon – this is biological stable, typically in the form of charcoal.

During the consultation process for the CRP, there was general consensus that agricultural practices that result in sequestration of carbon and improve productivity, should be encouraged where it has no significant impact on the environment or profitability. The challenge is to understand, measure and apply the techniques that deliver the maximum benefits. This can only be achieved through research, demonstration trials, experimentation and extension.

Incorporating organic matter

Increased soil organic matter can increase the availability of nitrogen, phosphorous and sulphur for plants. It can also increase cationic exchange capacity and the water holding capacity of soil. Where appropriate, adding organic material can result in improved productivity of soils. It can be seen as both a mitigation activity and an adaptation activity as it can increase the levels of carbon in soil and in the right situations improve the productivity of soil.

Note: In agricultural soils, using organic matter with a high carbon to nitrogen ratio can cause problems. To complete the nitrogen cycle and continue decomposition the microbial cells will draw any available soil nitrogen, in the proper proportion, to make use of available carbon. This can reduce available nitrogen as a fertiliser for growing plants until some later season when it is no longer being used in the life-cycles of soil bacteria.

When the energy source, carbon, is less than that required for converting available nitrogen into protein, organisms make full use of the available carbon and get rid of the excess nitrogen as ammonia. This release of ammonia to the atmosphere produces a loss of nitrogen from the compost pile and should be kept to a minimum.

It is extremely important for land managers to understand what ratio best suits their situation when considering using compost.

There have been a number of trials and experiments undertaken that have attempted to incorporate organic matter, for example, manure top spreading and application at depth to improve soil structure and deal with subsurface soil constraints. These activities have the potential to impact on the environment, particularly groundwater and surface water if not managed correctly. When conducting these activities proponents should:

- Incorporate appropriate setbacks from rivers, streams and wetlands, for example 50 metres.
- Monitor water quality of nearby waterways.
- Consult the Environmental Protection Authority (EPA).

To date, many of the demonstration trials that have been conducted have had variable results. It is unsure if the practice is only suited to certain soil types and seasonal conditions. There is also uncertainty if it is more profitable to incorporate material into soil or to top-dress. These are questions that require further investigation.

Many demonstrations have shown that the practice is cost prohibitive unless landholders can access a cheap source of compost close to their property. Given the amount of residue from crops, techniques and management practices to fully maximise the use of this resource could be further investigated. This may be an opportunity for further research and demonstration techniques to increase the soils carbon cycling capacity.

Priority demonstration trials will be based on:

- Assessing suitability and efficacy of techniques of retaining farm crop residues to improve productivity, at relevant scale in the Wimmera agricultural environment.

Mitigation – greenhouse gas soil emissions in agriculture

Emissions of carbon dioxide and nitrous oxide from soil are considered greenhouse gases. The loss of carbon and nitrogen via these compounds can have negative impacts on soil fertility. It is important to understand these processes if we are to understand how farm management can influence farm productivity, reduce emissions and mitigate climate change.

There are currently demonstration trials in the Wimmera investigating how different farming techniques and conditions influence rates of nitrous oxide and carbon dioxide loss. These demonstrations are relatively short term (three years) and there is consensus that we will gain a better understanding if these trials were maintained over longer periods where the influence of seasonality could be understood and loss rate calculated with more certainty.

Priority action:

- Maintain carbon and nitrous oxide emission trials for as long as possible.

Retaining harvesting residues could be beneficial to soil health while retaining carbon stores.

Farm trials have been used to great success to demonstrate the challenges and benefits of new farming practices in the Wimmera.

Nitrogen emission trials have been in place in the Wimmera for the past three years.

Nitrogen use efficiency

Different farming practices can influence nitrogen use inefficiency and emissions of nitrous oxide to the atmosphere. This can pose a cost or benefit to a farming system.

Nitrogen use efficiency refers to the ability to convert soil nitrate into plant material nitrate, for plant growth. The nitrate-N comes from fertiliser, crop residues, manures and soil organic matter, but it is the efficiency of conversion of fertiliser into grain or plant growth that is generally of greatest concern to growers. Efficiency is reduced by seasonal conditions, crop diseases, losses of N from the soil as gases, N leaching or immobilisation of N into organic forms.

Priority action:

- Support the promotion of practices that result in nitrogen use efficiency.

Adaptation - maintaining profitability in agriculture

Changes in climate have and will continue to present challenges and opportunities for agricultural production in the Wimmera. The Wimmera farming community is renowned for its ability to innovate and adapt to its climate and market forces. This continual adaption and innovation has led to new crops and pastures, new varieties and changes to planting times and planting and management techniques. Many of these innovations are being driven by the agricultural industry and include plant breeding, chemical fertiliser development and machinery design.

Priorities for adapting to climate change for the Wimmera while maintaining profitability include:

- Maintaining research and development of plant breeding to cope with extreme and variable climatic conditions and to maximise benefits from increased atmospheric CO_2 levels.
- Increased farm trials and research that test and demonstrate farm practices that allow farmers to adapt their practices to cope with climate extremes, for example:
  - Composting.
  - Crop and pasture breeding.
  - New species of crops, pasture and fodder.
  - Crop cycles.
  - Planting time variations.
  - Controlled traffic farming.
  - Crop spacing, plant population.
  - Clay topping in appropriate areas to improve water retention and fertility and soil organic carbon.
- Farm planning.
- Make farming community aware of how to obtain and use the latest CSIRO and Bureau of Meteorology (BOM) climate predictions through the regional soil health agencies forum.
- Improved access to high quality weather seasonal forecasting.
- Increased engagement with Agribusiness.

Cropping

Potential impacts of climate change on cropping are:

- Potential increase in growth and yields as a result of increased atmospheric carbon dioxide.
- Without adaption, it is expected that increases in temperature could impact flowering and reduce grain yield which could counter the yield increase derived from higher levels of CO_2.
- Potentially large reductions in rainfall could also reduce yields.
- Increases in CO_2 could lead to reductions in grain nitrogen.
- Higher temperatures may lead to faster drying of grain which could reduce grain quality.
- Increased frequency of drought could reduce soil moisture and increase risk of crop failure.

Crop Breeding

Crop breeding and genetic modifications are potential solutions to these predicted impacts. Given limited funding there is a need to focus this effort into the most beneficial areas.

Suggested crop breeding priorities may include:

- Maintaining varieties with similar or earlier flowering characteristics to allow grain fill in cooler wetter parts of the year.
- Drought tolerance.
- Flower retention.
- Grain protein.
- Disease and pest resistance.
- Heat shock resistance.
- Reduced dry down time.
- CO_2 trait selection.

CO_2 Trait selection – AGFACE

Background

Atmospheric carbon dioxide (CO_2) is predicted to rise above 550 ppm (parts per million) within this century with consequent changes to agricultural productivity. Because CO_2 is critical to plant growth, the rise could offset some of the negative impacts of climate change on crop production by acting as a fertiliser to increase growth and yields.

To successfully adapt crop production practices and agro-ecosystem management in the face of increasing CO_2, plant production must be studied in a range of environments under field conditions.

What is FACE and AGFACE?

The Australian Grains Free Air CO_2 Enrichment (AGFACE) facility enables the exposure of field grown crops to elevated CO_2 levels under dryland field conditions.

The FACE (Free Air CO_2 Enrichment) technique is used internationally at more than 30 sites, investigating a multitude of ecosystems including cropping systems, pastures, and forests.

AGFACE is a collaborative effort by the partner organisations of the Primary Industries Climate Challenges Centre (PICCC) - the Department of Environment and Primary Industries Victoria and the University of Melbourne. It is also supported by funding from the Grains Research and Development Corporation and the Australian Government's Department of Agriculture. AGFACE is proud to attract and enlist collaborators worldwide.

Crop cycles

Methods such as growing crops all year round and under sowing promote carbon being fixed into the soils for a longer period. Under sowing is the sowing of a secondary crop underneath the primary cash crop. For instance, a cereal can be undersown with green feed or pasture species which should be well established by the time the cereal is harvested in mid to late summer. This can be considered as an adaptation and mitigation action as it can increase the storage of carbon and nitrogen (mitigation) and can also create a diversity of income from crops or pasture at various times of year (adaptation).

With climate change predictions suggesting lower winter rain and higher summer rain for the Wimmera, opportunities may emerge to grow two crops per annum. For example, growing a legume, followed by a cereal, one at a traditional time (April/May) and the other immediately after harvest when and if summer rainfall occurs or opportunistically during wet late spring. This may be limited to higher rainfall areas or where available soil moisture is present. Examples include sorghum, maize, and corn. There are other potential species grown in others areas of Australia that may become suitable in a changing climate.

Priority action:

- Support farmers to experiment with various crops and crop cycles across the Wimmera where this is based on good science.
- Investigate the opportunities and challenges of double cropping in the Wimmera.

Clay topping

Clay topping or claying is a practice that has been utilised in the Wimmera for about 20 years and is known to increase productivity and yields in some soil types. Sandy soils have low fertility levels due to low cationic exchange capacity (CEC) and low levels of organic carbon. Raising the clay content changes soil texture, which increases the capacity for the soil to store water and nutrients, increase cationic exchange capacity and soil organic carbon. Given this activity is somewhat focused on soil moisture retention this could impact on water availability for waterways if not managed correctly.

Claying trials are being conducted by a number of soil agencies, across the Wimmera, in a range of locations with different soils types and rainfall.

Priority action:

- Develop and disseminate best practice information to landholders about clay topping in the Wimmera, to maximise profitability and minimise negative impacts, including waterway impacts.

Grazing

The focus on this section is to address the potential impacts from climate change on soil and pasture rather than animal husbandry and emissions. For example it does not deal with the potential impacts on animals from heat stress or parasites.

CSIRO suggest that some of the potential impacts of climate change on grazing are:

- Declines in pasture productivity – as a result of changes in rainfall amounts and times.
- Reduced forage quality – as a result of changes in protein levels due to CO_2 increases.
- Increased problems with pests, disease and weeds.
- More frequent and longer droughts.
- More intense rainfall events.
- Greater risk of soil erosion.

Community feedback has indicated that there is still much to learn and do to build the resilience of our grazing systems to cope with climate change. There are many theories about the potential impacts that the range of climate scenarios will have on grazing that require further investigation in real life situations.

C3 and C4 plants

Plants can be divided into different categories by the way in which they utilise carbon dioxide and their carbon fixation pathway and can be C3 or C4 or CAM (Crassulacean Acid metabolism) plants. Some research indicates C3 plants typically respond better to atmospheric CO_2 enrichment than do C4 plants in terms of increasing their rates of photosynthesis and biomass production.

A warming climate is predicted to favour warm-season, or C4 grasses while rising CO_2 should favour C3, or cool-season plants.

Combined warming and CO_2 enrichment stimulates above-ground growth of C4 grasses most years when soil moisture most limits plant productivity.

There may be great opportunity for different C3, C4 or CAM pastures or fodder shrubs to be utilised as agricultural industries adapt to climate changes and the new and varied conditions. These plants may be annual or perennial and be grass, legume, shrub or tree. More research and trials will need to occur to provide some certainty to land managers about the intricacies of these theories and how pasture systems can be manipulated to deliver profitability.

Pasture breeding and genetic modification are potential solutions to the predicted impacts. Given limited funding there is a need to focus this effort into the most beneficial areas.

The same logic for C3 and C4 plants can also be applied to weeds. Some weeds may become more vigorous meaning greater effort will be required for their control. Others may become climate stressed, providing an opportunity for greater control or eradication. This is discussed further in Section 2.5.

The need for further research and trials has been highlighted as a high priority during stakeholder consultation.

Priority actions for research and trials for grazing include:

- The use of legumes and other nitrogen fixing plants in perennial pasture systems to improve nutrient cycling and ground cover.
- The economic benefits of perennial pasture/fodder systems in a range of soil types and rainfalls.
- Breeding opportunities in a broader range of species including:
  - Drought tolerance.
  - Summer dormancy of perennial pastures.
  - Plant persistence of perennial pastures.
  - The challenges and benefits for pasture productivity and quality in real life situations from increases in CO_2 levels.
  - C3 and C4 plants and their benefits and challenges in a changing climate.
  - The use of native grasses in a climate change environment in the Wimmera.

Extension

There was consensus, during stakeholder consultation, that landholders need to have access to information about practices that can help them adapt their grazing systems to variations in the climate while remaining profitable.

Priority extension activities include demonstrations and workshops on:

- Pasture management.
- Incorporation of legumes.
- New plant varieties.
- Sub-surface soil management.

There is also a need to deliver information through a range of mechanisms including, media, consultants and other landholders.

Soil pit field day Photo: Wimmera CMA

RCS Soils

Twenty year RCS objectives

The overall outcome for soils will be to ensure that land managers have the capacity, skills and knowledge to improve soil productivity and resilience to environmental change. Resilient soils will in turn, support a productive farming system and a healthy environment and community that is prosperous in the face of climatic and economic challenges.

This outcome will be achieved by increasing the number of landholders (80 percent) adopting best management practices that improve soil:

1. Productive capacity.
2. Resilience against extreme weather events and economic perturbations.
3. Rainfall use efficiency and water holding capacity.
4. Environmental amenity (e.g. reduced greenhouse gas emissions).
5. Organic matter and biological activity.
6. Resilience against degradation on other natural assets.

Six year RCS management measures

Taking into consideration the condition, trends and threats to soil, the following six–year management measures have been developed to deliver the twenty–year objectives for soil health:

1. Maintaining or improving ground cover.
2. Increasing soil organic matter (including soil carbon).
3. Improving beneficial soil biological activity.
4. Recovering areas of dryland salinity.
5. Improving nutrient efficiencies.
6. Enhancing landholder knowledge of soil health.
7. Supporting research and development.
    - Improving partnerships between landholders and soil health agencies.

Well managed waterways can store massive loads of carbon.

Waterways – Wetlands, Rivers & Streams

Background

The Wimmera has historically experienced fluctuations in rainfall, with long periods of drought, huge floods and everything in between. Climate change predictions suggest that we may experience drier winters, wetter summers and more extreme weather events. This may have implications for water availability for our waterways.

Waterways, in particular wetlands, have a huge ability to store carbon if managed correctly.

Given the Wimmera contains 25 percent of Victoria's wetlands; there is great potential for the Wimmera to protect waterways as a climate change mitigation activity by capturing carbon. The challenge will be to continue to manage these areas so they can remain resilient and adapt to climate change.

Mitigation - carbon fixing in waterways

Waterways are important in cycling of carbon. Waterways cover about one twelfth of the Earth's area yet contain approximately one third of the world's terrestrial carbon. Clearing and drainage of waterways can lead to large losses of stored organic carbon to atmospheric carbon dioxide. As a result the importance of waterways in carbon sequestration and storage is significant. The Wimmera has the highest concentration of waterways in Victoria. This provides great opportunities to better protect waterways for carbon storing benefits as well as biodiversity and farm productivity through a broader range of funding opportunities.

While there has been a significant amount of research into carbon and marine ecosystems the same cannot be said for terrestrial waterways. There is some uncertainty about the best waterways for carbon capture and storage and management techniques to maximise it.

It is believed that rivers and streams do not have the same ability to store carbon as wetlands, however the vegetation both instream and in riparian areas has significant potential to store large volumes of carbon.

Priorities actions include:

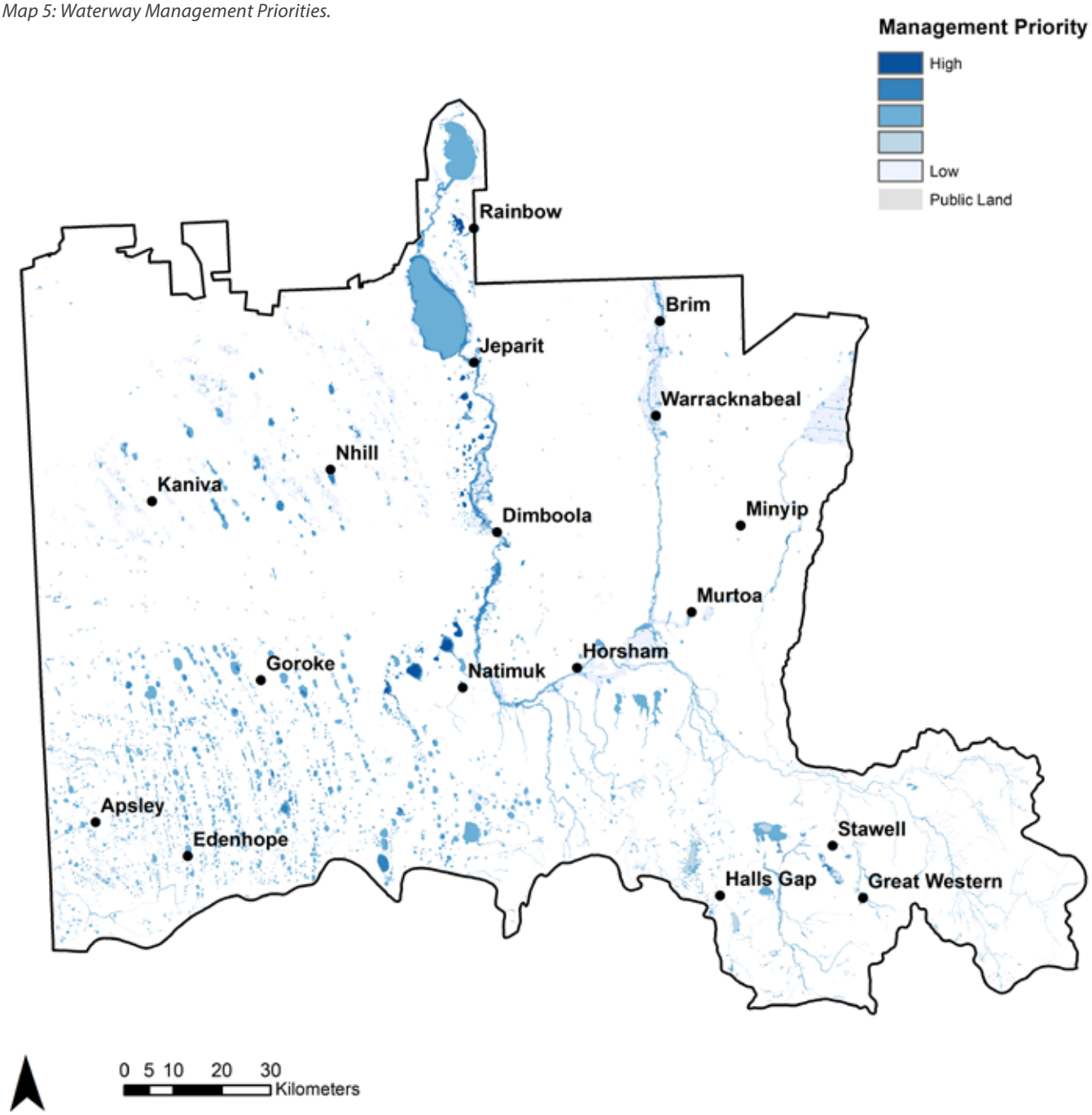
- Seek funding to research the carbon capture potential of the range of waterway types in the Wimmera.
- Promoting carbon benefits to landholders along with the other benefits of managing waterways.
- Implement actions from the WWS.

In the interim, Wimmera CMA have developed a model based on a report produced by the Danone Fund for Nature (DFN) discussing potential carbon offsets through wetland ecosystems (Danone Fund for Nature, 2009).This model is discussed in *NRMPCC Modelling – Waterways* (Wimmera CMA, 2015).

Priority actions include:

- Where appropriate, incorporate high carbon storage waterways into investment decision matrices for Wetland Management (see Map 5).

Map 5: Waterway Management Priorities.



Fencing off waterways can reduce grazing pressure and help them become more resilient to climate change.

Adaptation

Substantial water savings and overall water security has occurred through the construction of the Wimmera Mallee Pipeline. This is one of the most significant adaptation actions the Wimmera has taken.

Previously climate change modelling has been used to assist in determining water availability and water planning in the Wimmera. This information has been used to determine environmental flow regimes under a range of scenarios. As new information becomes available, time passes and experience grows there may be opportunities to revise this modelling.

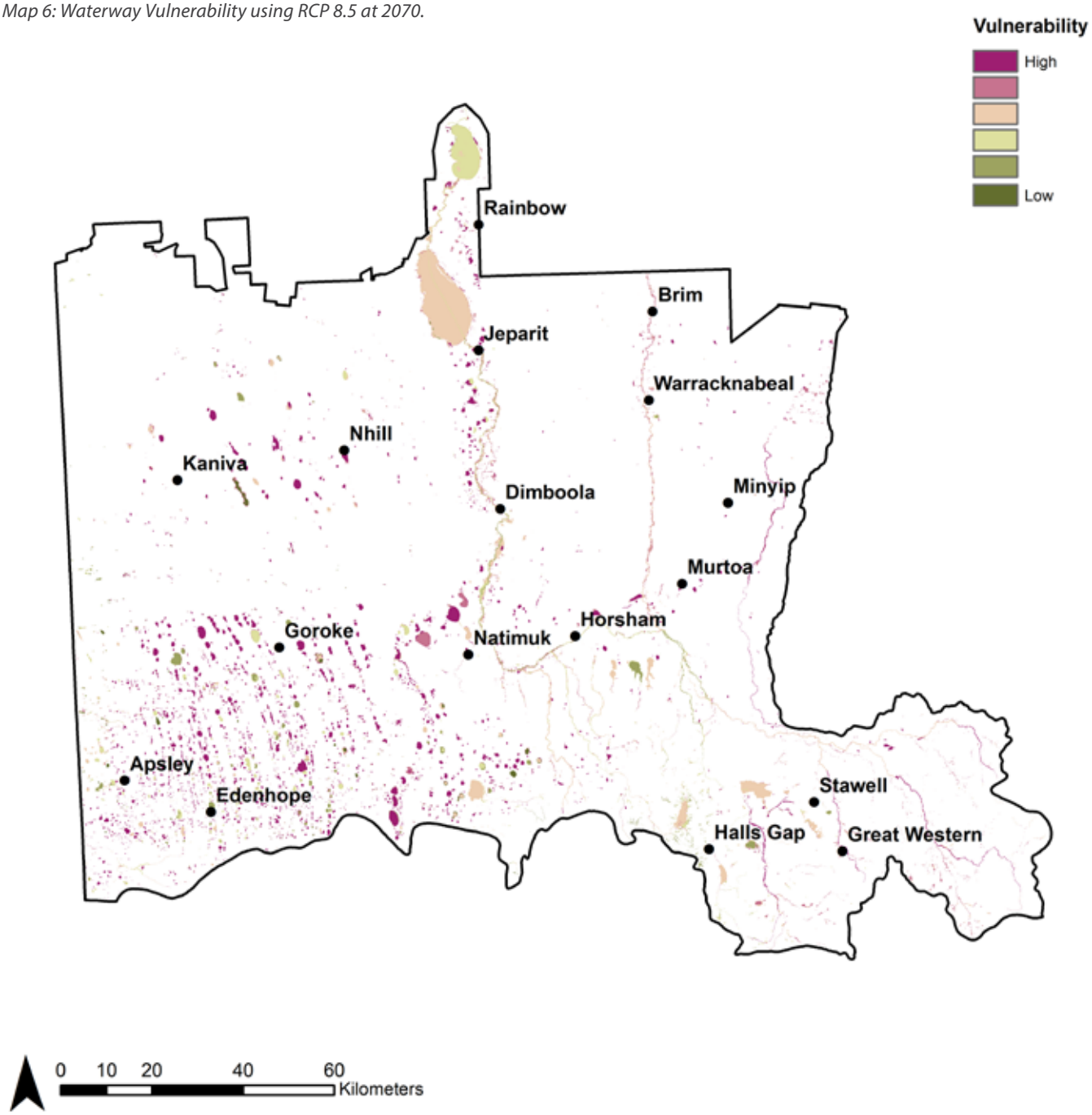
As with other assets, our waterway's ability to deal with climate change will be aided by our ability to adapt our management to suit the situation. The WWS establishes an approach for this whereby actions are prioritised based on the risks and opportunities associated with a particular climatic situation. For example if conditions are very dry efforts will be focused on protecting refuge pools rather than the whole river system. Storm events are predicted to become more common so actions will focus on repairing flood damage when this occurs.

The priority actions for adapting to climate change are outlined in the WWS.

Other priority actions include:

- Support the review of the Bulk Entitlement using updated climate change scenarios.
- Focus waterway management actions in areas of highest vulnerability identified in Map 6.

Map 6: Waterway Vulnerability using RCP 8.5 at 2070.



Redgum Swamp, Edenhope.

RCS Wetlands

Twenty year RCS objectives

Wetlands with recognised conservation significance are protected and sustained. These include:

- Lake Albacutya Ramsar site.
- Fourteen wetlands listed on the Directory of Important Wetlands in Australia.
- Wetlands that are known to provide habitat for migratory birds and threatened species.
- Seasonal herbaceous wetlands (freshwater) of the temperate lowland plains.

The rate of decline in freshwater meadows and shallow freshwater marshes is decreased, as these meadows and marshes are under the greatest threat.

Wetlands continue to provide social, environmental and economic benefits valued by the community.

Six year RCS management measures

Taking into consideration the condition, trends and threats to wetlands, the following six–year management measures have been developed to deliver the twenty–year objectives for wetland health:

1. Review, update and implement waterway strategies.
2. Actively protect wetlands with recognised conservation significance from threatening processes and sustain their conservation values.
3. Actively promote wetland protection.
4. Assist land managers to permanently protect and manage freshwater meadows and shallow freshwater marshes according to best practice.
5. Increase the number of land managers implementing best practice wetland management.
6. Prevent negative impacts to wetlands from new developments and land-use change by working with local governments and Department of Transport, Planning and Local Infrastructure to implement wetland–specific, planning scheme overlays.
7. Review, update and implement the Lake Albacutya Ramsar Site Strategic Management Plan.

RCS Rivers and Streams

Twenty year RCS objectives

1. No decline in rivers and streams classified as good or excellent in the 2004 Index of Stream Condition.
2. Improvements in the condition of rivers and streams classified as poor to moderate in the 2004 Index of Stream Condition.
3. Rivers and streams classified as having high social or economic values in the Wimmera Waterway Health Strategy 2006–2011 will be maintained in value.
4. Eighty percent of riverine floodplain areas have accurate modelled flood mapping incorporated into council planning schemes. Such information is included in council and community supported emergency response plans.
5. Net gain in extent and quality of floodplain Ecological Vegetation Class.

Six year RCS management measures

Taking into consideration the condition, trends and threats to rivers & streams, the following six–year management measures have been developed to deliver the twenty–year objectives for river and stream health:

1. Review, update and implement waterway strategies.

For riparian land:

1. Establish a network of managed and maintained riparian zones with high environmental value.
2. Apply best practice management in riparian zones to improve flora and fauna habitat.

For instream habitat and channel form:

1. Undertake on–ground management actions targeting bed and bank erosion, sedimentation, gully erosion and potential landslips.
2. Restore diversity, habitats, connectivity and movement of instream material, through stabilisation and restoration of channels, banks, substrate and riparian vegetation.
3. Apply best practice management for instream habitat, including adequate structural woody habitat to help native aquatic species such as native fish.

For water quality:

1. Reduce the impact of salinity on river and stream health.
2. Limit nutrients, sediments and other pollutants entering and being remobilised.
3. Work towards meeting State Environment Protection Policy (Waters of Victoria) 2003 criteria for water quality.
4. Coordinate water quality management projects to improve the quality of water in rivers and streams.
5. Provide information on the trends in river and stream health in relation to water quality.

For adequate flows:

1. Deal adaptively to climatic impacts on streamflows.
2. Achieve minimum environmental water needs of priority rivers and streams under historic climatic conditions.
3. Provide environmental water releases to improve water quality and enable diversity of aquatic and water dependent flora and fauna ecosystems and maintain channel form.
4. Seek additional environmental water where available such as through improving efficiency of water delivery or other water recovery activities.
5. Prevent additional flow–stress impacts, such as intense water extraction or land–use change activities (e.g. concentrated areas of new farm dams or forestry development) by acknowledging the recommendations of the Western Region Sustainable Water Strategy 2011.

For aquatic ecosystems:

1. Reduce impacts of exotic species on aquatic ecosystems.

For the floodplain:

1. Improve knowledge of floodplains and their flood characteristics, including the improvement of flood overlays.
2. Manage floodplains to minimise flood risk and damage to people and property.
3. Enhance ecological values of floodplains.
    - Achieve a balance between social, economic and environmental values on floodplains.

Weed of National Signifance Boneseed/Bitou Bush (Chrysanthemoides monilifera) Photo: Ivan Carter

Invasive plant and animals

Background

It is anticipated that with climate change some pest plant species will expand their range and density and flourish especially with increased carbon dioxide levels. There may be other species that will decline. Climate change factors that will affect whether plants flourish or decline are:

- Increased temperature.
- Changed rainfall.
- Elevated CO_2 levels.
- More extreme weather events.
- Land-use change.

The main factors that will change the current balance are new plant introductions and the spread of naturalised colonising plants that may explode in distribution and density (i.e. sallow wattle, prickly acacia). Weed species distribution trends for the Wimmera under predicted climate change scenarios are outlined in Appendix C.

Similarly with invasive animals it is possible that under certain circumstances there may be opportunities to strategically intensify efforts. For example as waterways dry out in times of drought, local efforts to capture and dispose of carp may be possible. Fox, feral cats and rabbit numbers may also reduce in dry times allowing for control efforts to be more effective.

Government agencies, land managers and the community will need to be alert and have a vigil approach to weed spread outbreak and control or eradication.

Biosecurity is becoming regionally focused and will result in more collaboration and working relationships with all stakeholders and partners who deal with this issue.

The Wimmera Invasive Pest Plant and Animal Strategy (Wimmera CMA, 2010) is the key strategic document that prioritises actions for the Wimmera.

Priorities to deal with these risks include:

- Continue to implement and review the Wimmera Invasive Plant and Animal Strategy.
- Continue to conduct regional agency forums around the strategy.
- Inform the community as new invasive plant and animal threats become apparent.
- Support research into the impact of climate change on invasive plants and animals.

Local Government priorities

The following sections are designed to provide more detailed discussion and guidance on priorities for each Local Government area. This will allow Local Government and communities to focus their efforts in developing programs for mitigation and adaptation.

Note: The Charles Sturt University (CSU) survey, Understanding the Social Drivers of Catchment Management in the Wimmera, commissioned by the Wimmera CMA in 2011 (CSU, 2011) provides some interesting insights into the values and beliefs of landholders in the Wimmera in relation to climate change and mitigation and adaptation.

There are text boxes in each Council section explaining some of the relevant findings.

Horsham Rural City

Native vegetation and habitat

Horsham Rural City Council (HRCC) area is largely cleared but has some of the Region's best vegetation in and around waterways. Examples include, the Wimmera River, MacKenzie River, Burnt Creek and Mt William Creek. Large tracts of high quality vegetation also occur in the south and west of HRCC contained within public and private land.

Remnant vegetation can be revegetated and managed to contribute as biolinks between the Grampians, Wimmera River, Little Desert and the tributaries. In general, these will be the best locations for investment in native vegetation management, whether that be enhancing degraded ecosystems or protecting those with high value. There are opportunities to re-establish vegetation as biolinks between these areas but also adjacent to areas such as National Parks and other Crown land.

CSU 2011

26% of landholders thought the use of land for carbon and fuels would lead to a food shortage.

Through our consultation we understand that our community desires to protect its high value agricultural land.

High value agricultural production areas will be a lower priority for investment in revegetation activities. Small scale planting such as shelterbelts and riparian planting will continue to provide multiple benefits.

Proposed actions

- Native vegetation management activities will occur in priority areas identified in Map 7.
- Revegetation activities will occur in priority areas identified in Map 8.

Soils and agricultural practices

The shire is predominately a broad acre cropping area. Practices such as No Till and Minimum Till farming have been actively occurring for decades and this continued practice contributes to higher Soil Organic Carbon content and also has benefits in creating resilience against dry climatic conditions.

The HRCC area has a relatively diverse range of soil types meaning that different agricultural practices have different outcomes in some cases. The challenge is to understand and apply the management actions that result in the most profitable and sustainable outcome.

CSU 2011

In the Horsham Rural City area 82% of landholders agree it is important that they should manage their properties in expectation of extreme weather events. This would suggest that people are aware of extreme weather event impacts and the need to adapt. A priority in this region will be to create engagement activities that educate the community of what adaption techniques are available and appropriate.

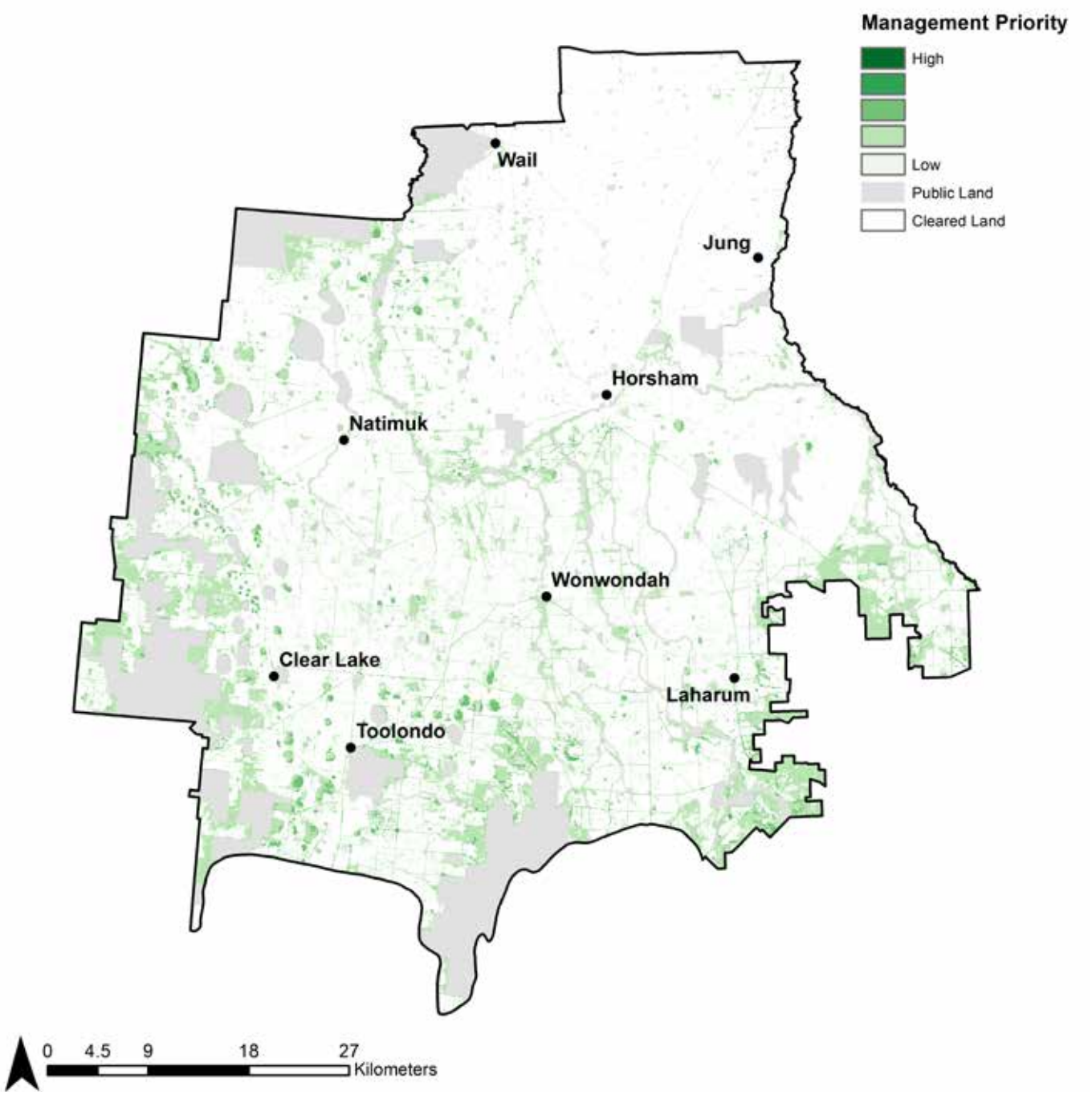
35% and 36% of people believed the impact of changing rainfall patterns on property viability was important and unimportant respectively. This would indicate that there may need to be further work done to understand and where necessary demonstrate how changing rainfall patterns may influence property viability. Alternatively landholders may believe that it is not an issue because of the management practices that they have put in place or the science and technology that the industry is developing.

Proposed actions

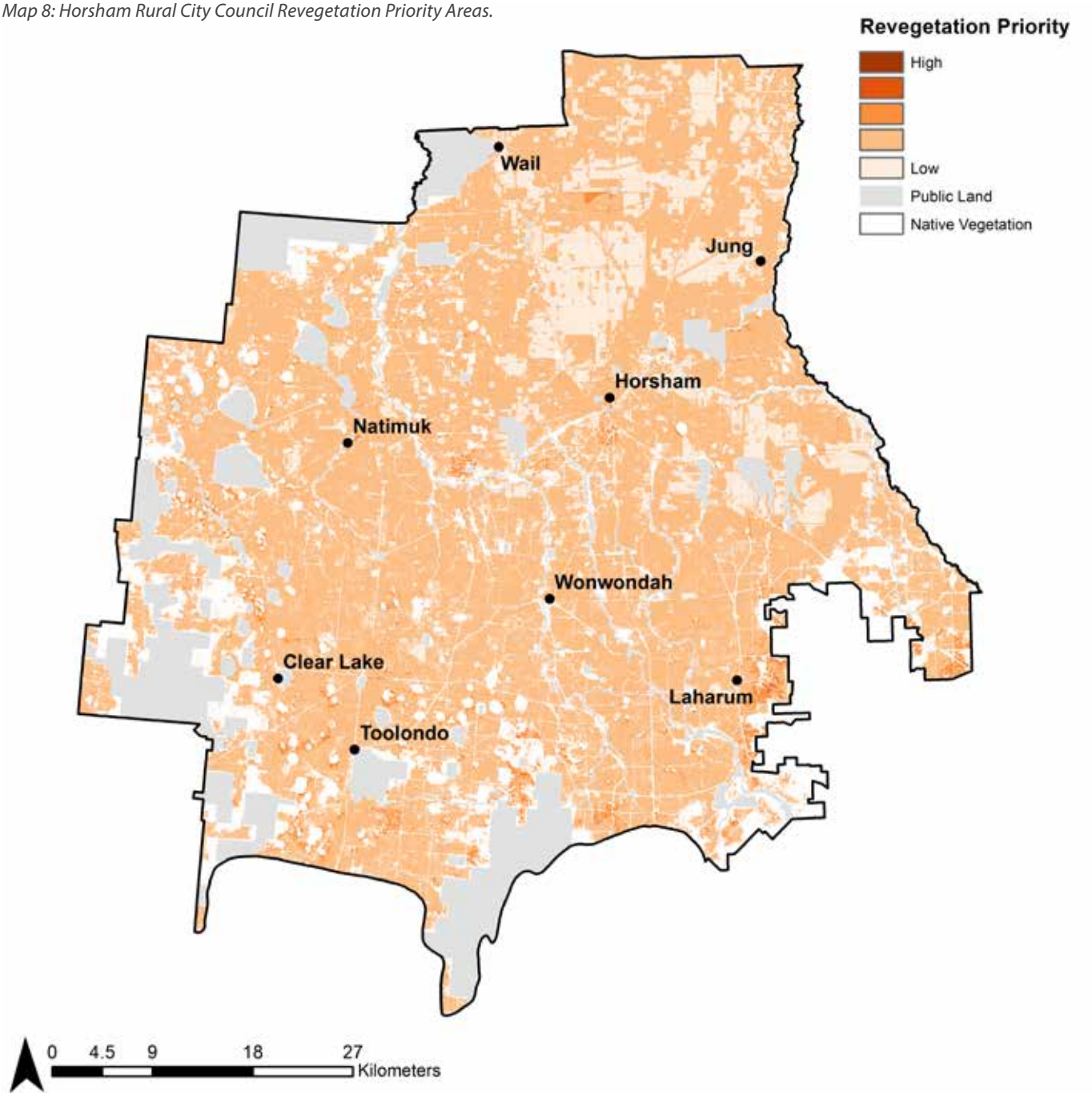
Develop an ongoing engagement program for the HRCC area that educates the community of priority mitigation and adaptation techniques for soil and agricultural practices including:

- Maintaining ground cover.
- Cropping techniques to maximise water use efficiency and nutrient application.
- Modifying crop management techniques to take account of annual climate predictions.
- Understanding the economics of various management practices in a range of soil types.

Map 7: Horsham Rural City Council Native Vegetation Management Priority Areas.



Map 8: Horsham Rural City Council Revegetation Priority Areas.



Waterways

A number of waterways traverse HRCC including the Wimmera and MacKenzie Rivers, Mt William, Burnt, Natimuk, Norton and Bungalally Creeks. In the south and west of the HRCC area there are a high density of diverse wetlands. The Natimuk-Douglas chain of lakes is a unique group of alternating salt and freshwater wetlands that are important for migratory birds.

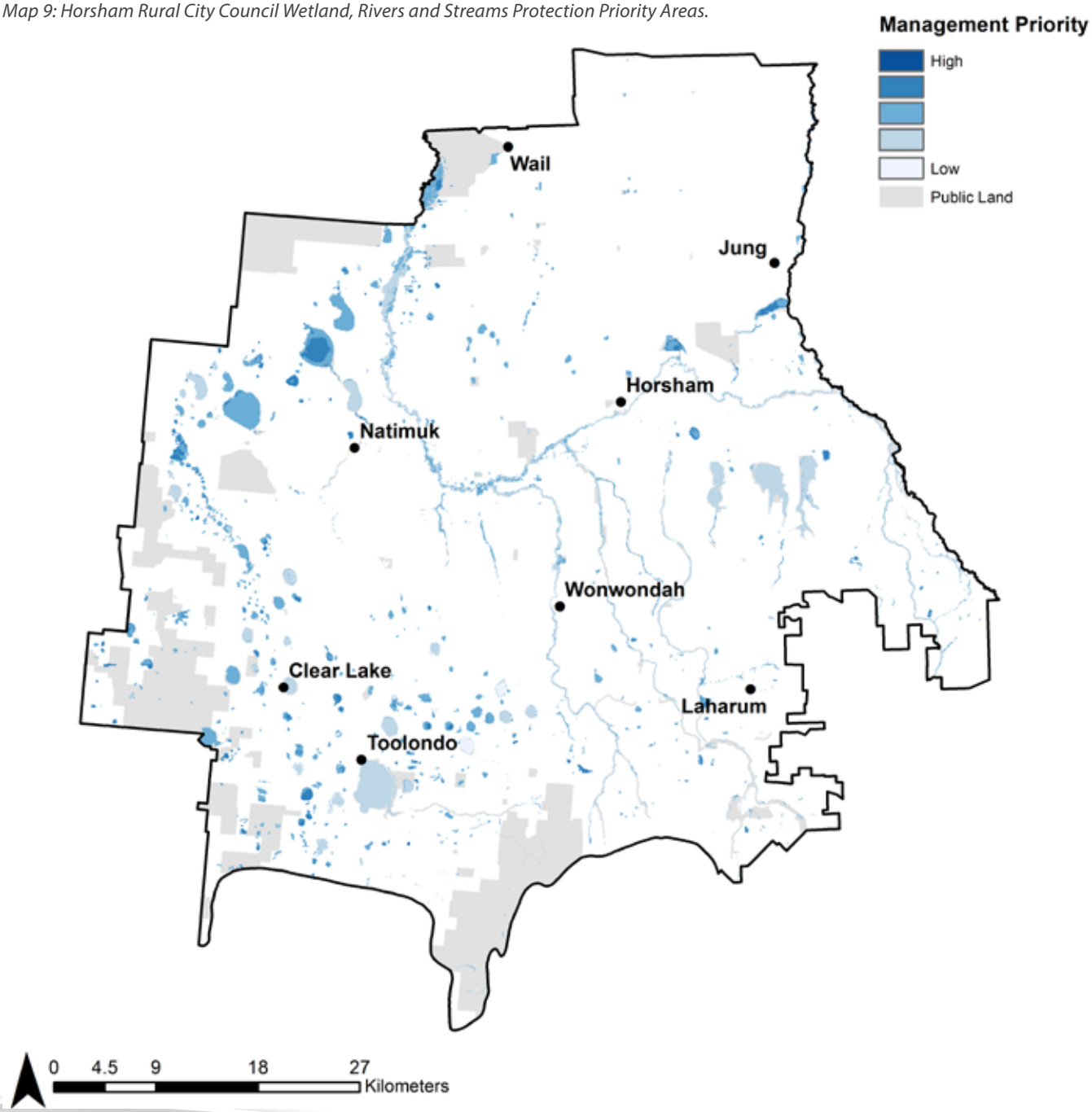
In relation to mitigation riparian and wetland vegetation provide an opportunity to protect and enhance the carbon storage capacity of these areas possess. The maps provided below show the areas prioritised for waterway (Map 9).

With the completion of the Wimmera Mallee Pipeline and the return of environmental flows to waterways as a result, the adaption work is largely complete in the Wimmera. There is still room for greater improvements in the efficient and effective use of environmental water. The goals and targets for the waterways in HRCC our outlined in the WWS. They are designed to build resilience to threats including a variable climate. In some cases it is necessary to revegetate areas that strategically link waterways with other vegetation and to build buffers around those areas.

Proposed actions

- Implement the actions for in the WWS relevant to HRCC.
- Prioritise waterways management based on those identified in Map 9.

Map 9: Horsham Rural City Council Wetland, Rivers and Streams Protection Priority Areas.



Yarriambiack and Buloke shires

Native vegetation & habitat

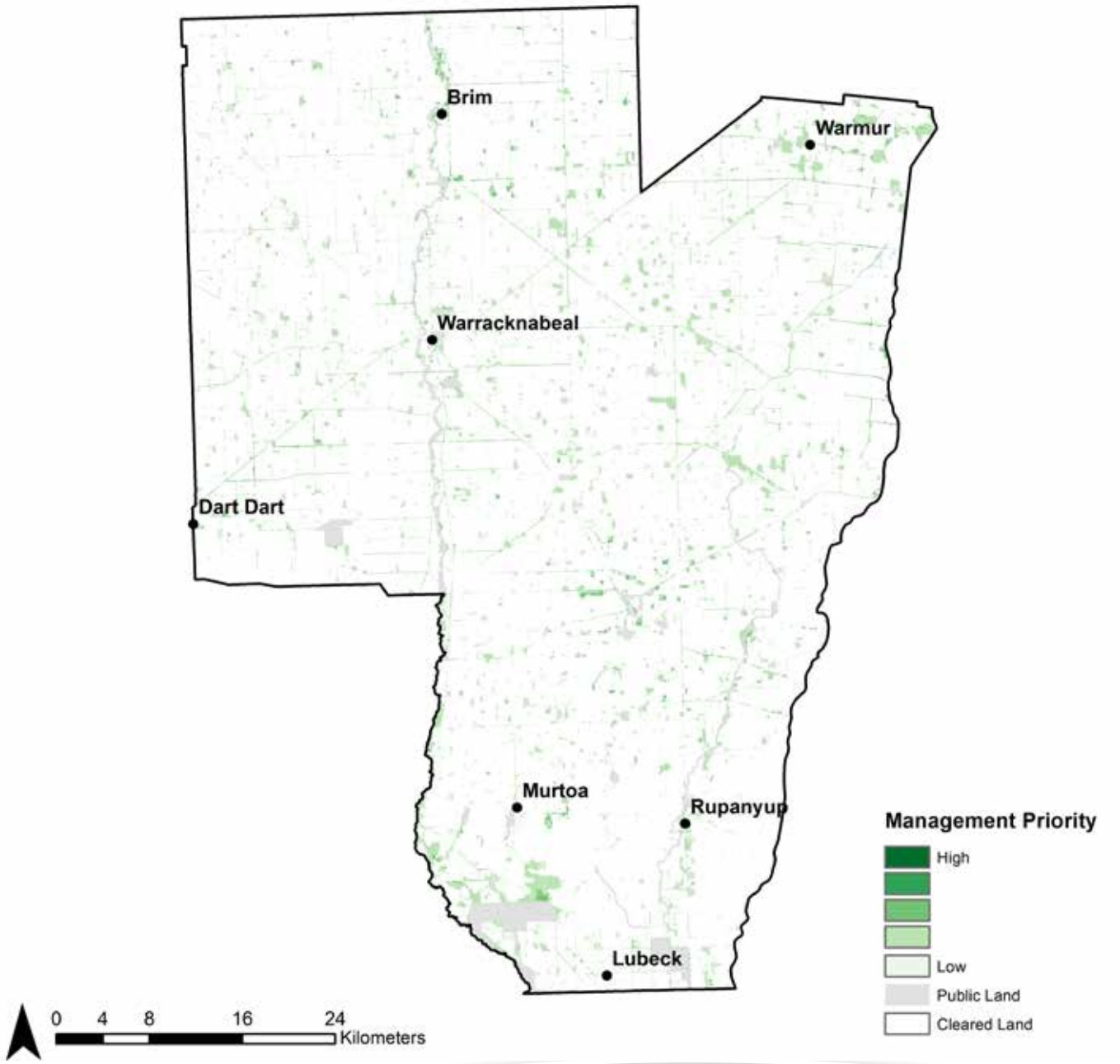
Yarriambiack and Buloke Shires are largely cleared with less than 20% remaining as remnant vegetation. There are many private stands of Buloke Woodlands and Black Box that remain in isolated locations. The quality ranges from very good to very poor. The management and improvement of these areas continues to be a priority for the protection of biodiversity and threatened species habitat but it can also benefit carbon capture. Activities to control threats such as invasive plant and animals will continue to be a priority.

Most of the agricultural land in this area is of high quality. As a result, where there is land with no vegetation, priorities for revegetation will only include small-scale riparian revegetation, shelterbelts and small biolinks between existing vegetation in most cases. There may be some cases for prioritising large-scale planting in areas that are prone to erosion or salinity. This could include fodder plantations such as saltbush or native revegetation.

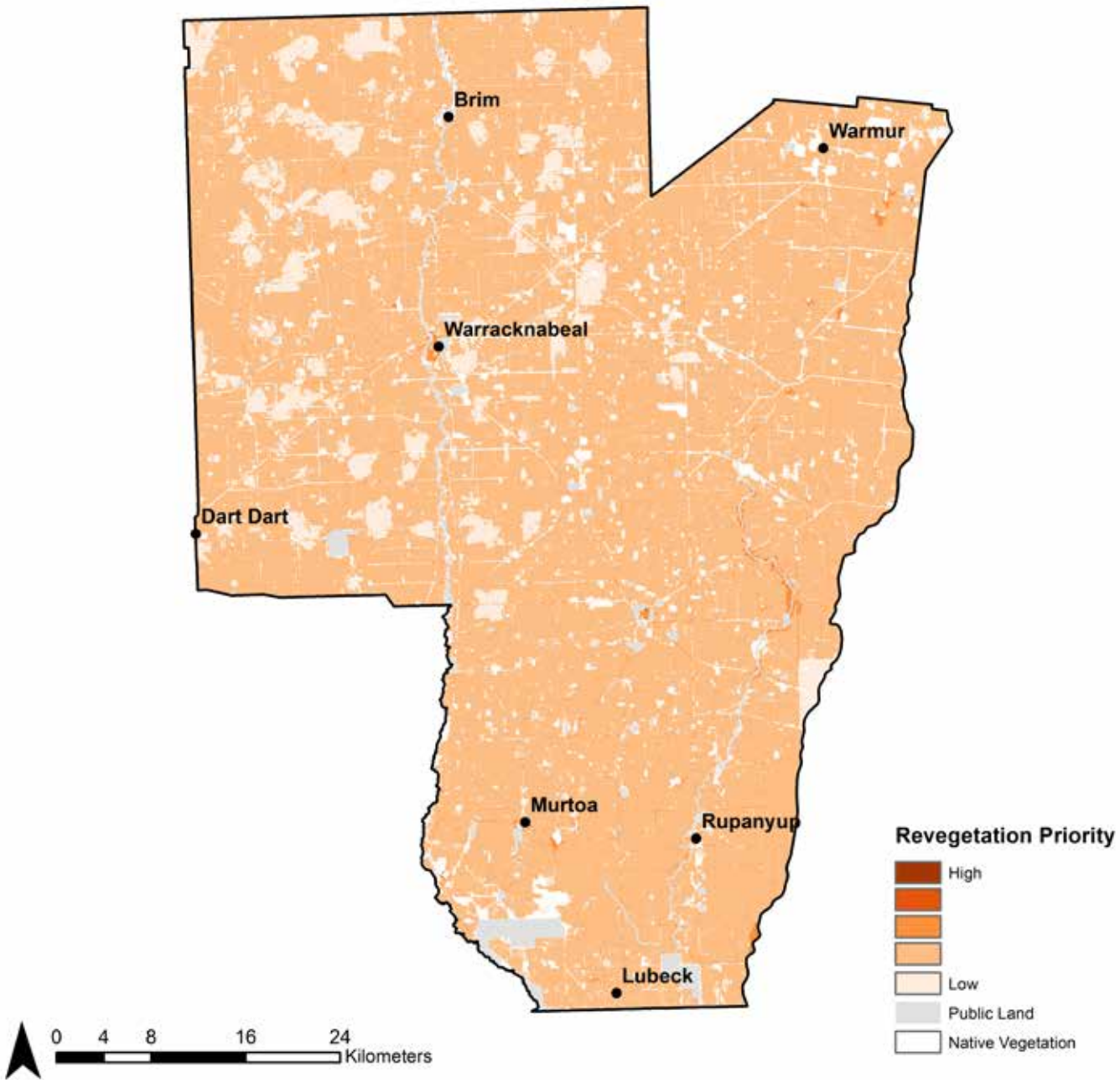
Proposed actions

- Native vegetation management activities will occur in priority areas identified in Map 10.
- Revegetation activities will occur in priority areas identified in Map 11.

Map 10: Yarriambiack and Buloke Shire Council Native Vegetation Management Priority Areas.



Map 11: Yarriambiack and Buloke Shire Council Revegetation Priority Areas.



Soils

Yarriambiack and Buloke Shires have traditionally been areas that have been susceptible to wind erosion and, as a result, there has been uptake of techniques to maintain ground cover such as minimum and no till cropping systems. These systems also allow more carbon residue to remain in paddocks, which in turn breaks down to produce soil organic carbon.

Given these shires contain predominantly agricultural land there are great opportunities to further explore techniques to both improve farm profitability and the retention and storage of greenhouse gas elements in soil. The converse of this is that this land is vulnerable to the impacts of climate change as a result of a drier and hotter climate.

The priorities will be to provide opportunities and mechanisms for landholders to continue to learn and adapt approaches to soil management and agricultural practices that maintains or improves profitability.

CSU 2011

The CSU study revealed in these shires that 79% of landholders, thought it important they should manage their properties in expectation of extreme weather events. 60% of landholders thought the impact of changing rainfall patterns on property viability was important. This would suggest that people are aware of the extreme weather event and rainfall change impacts and the need to adapt. A priority in this region will be to create engagement activities that educate the community of what adaptation techniques are available and appropriate.

The notion that using land for carbon and biofuels will lead to food shortages were agreed by 32% of landholders suggesting that there is some concern about the loss of productive land to these activities.

Proposed action:

Develop an ongoing engagement program for the Yarriambiack/Buloke area that educates the community of priority adaptation techniques including:

- Maintaining ground cover.
- Modifying crop management techniques to take account of annual climate predictions.
- Adopting cropping techniques to maximise water use efficiency and nutrient application.

Waterways

The Yarriambiack and Dunmunkle Creeks are the predominant natural waterways in the area and provide two lines of connected riparian vegetation running north-south. They are episodic, only flowing when the Wimmera River is experiencing substantial flows. There are small wetlands dotted across the shire. There are opportunities to improve the value and carbon capture potential of these areas through revegetation riparian areas, reducing stock grazing pressure and managing threats from invasive plants and animals.

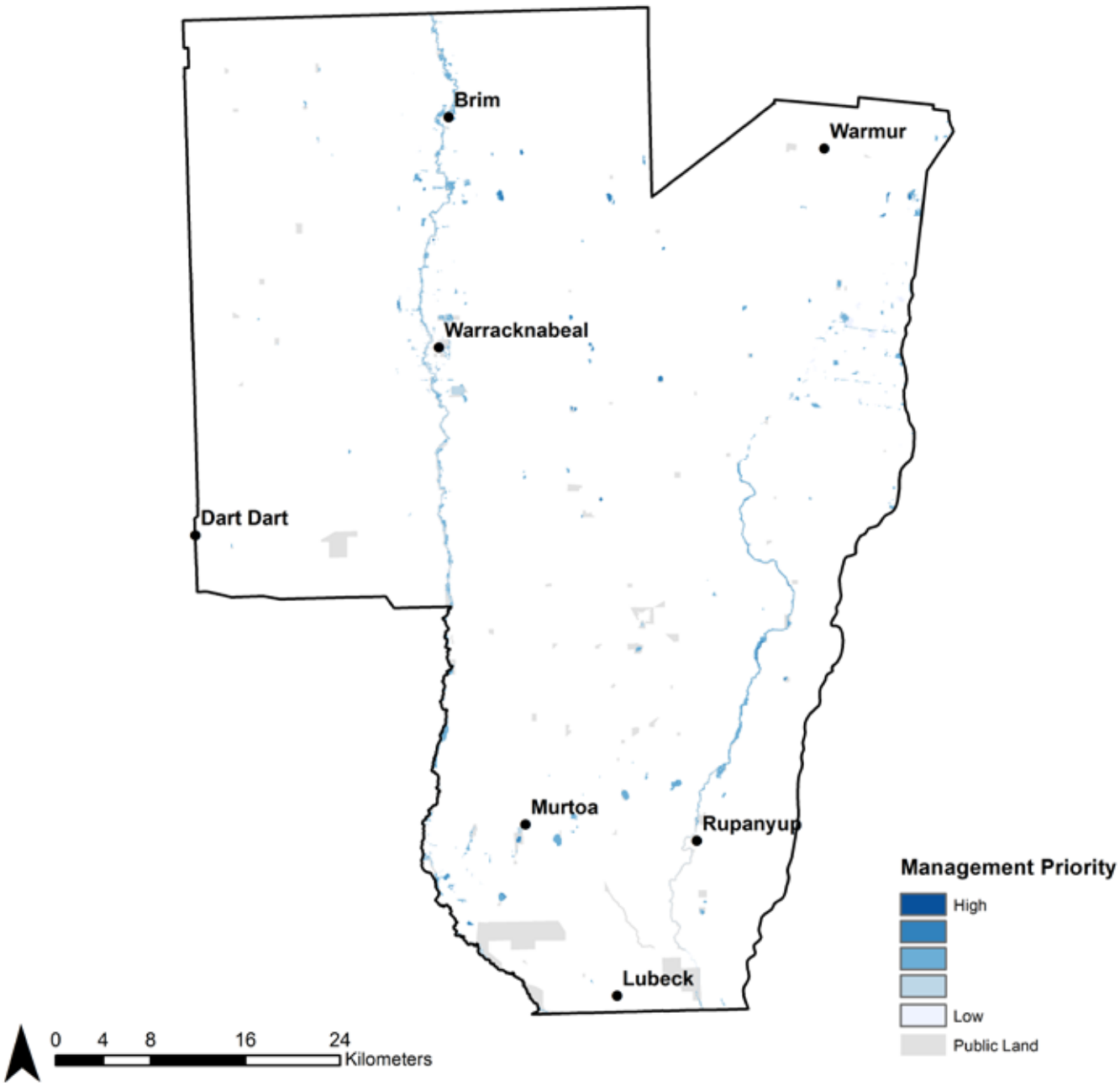
A drying climate has the potential to reduce the occurrences of water in these waterways. Environmental water has been made available to selected wetlands in the region via the Wimmera Mallee pipeline to provide habitat for native wildlife.

The map provided below show the areas prioritised for wetland management (Map 12).

Proposed actions

- Implement the actions for in the WWS relevant to YSC.
- Prioritise waterways management based on those identified in Map 12 below.

Map 12: Yarriambiack and Buloke Shire Council Wetland, Rivers and Streams Protection Priority Areas.



West Wimmera Shire

Native vegetation & habitat

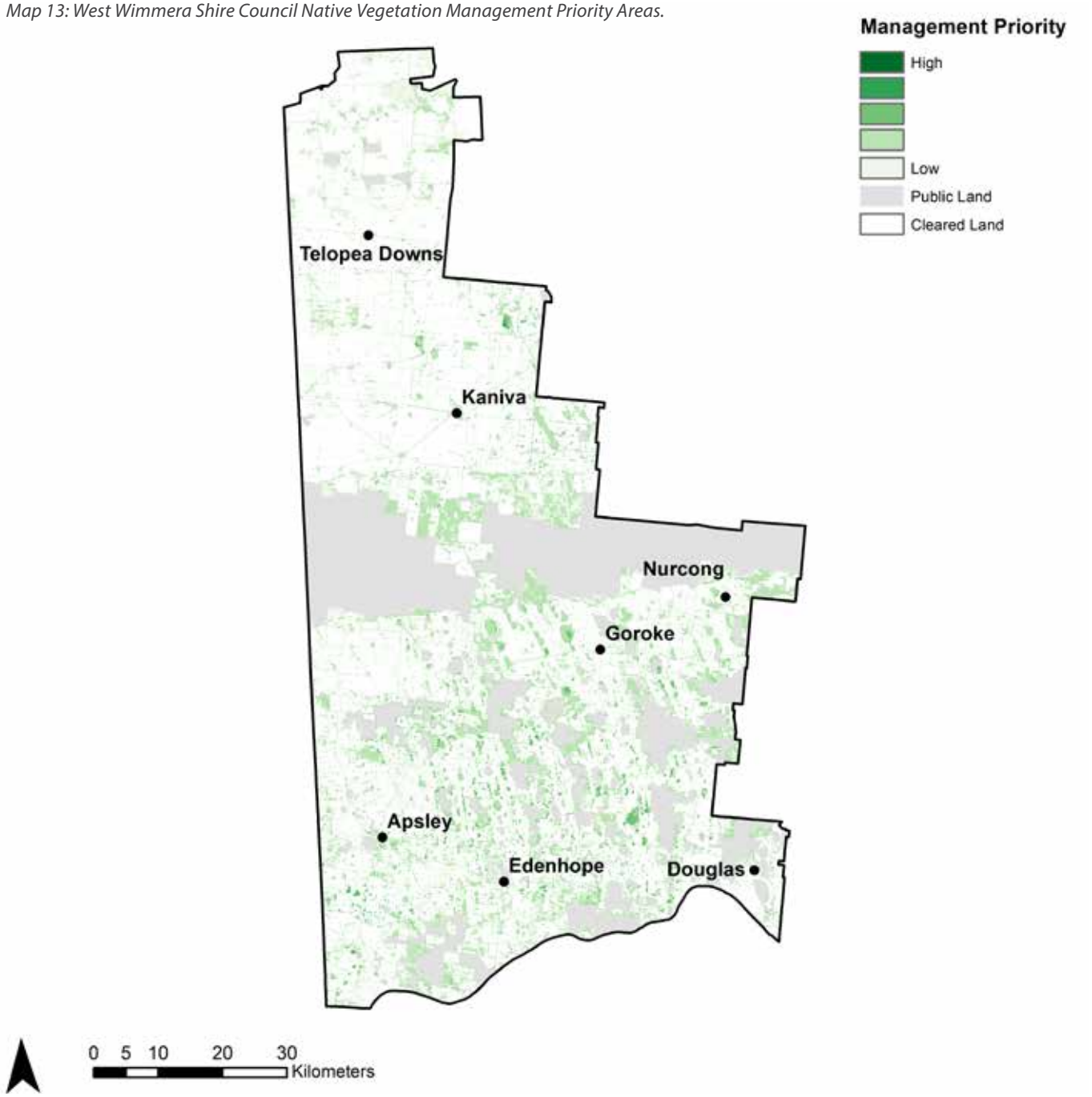
West Wimmera Shire has native vegetation cover of around 38% across both private and public land. Roadsides are generally well vegetated. A large tract of the Little Desert divides the area geographically and is an important east-west biolink for the Region, linking areas of native vegetation in South Australia through to the Wimmera River.

As a result of the extent of native vegetation and wetlands on private land there are opportunities for the protection and enhancement of these assets. This will be a priority for this area through the establishment of management agreements with land owners.

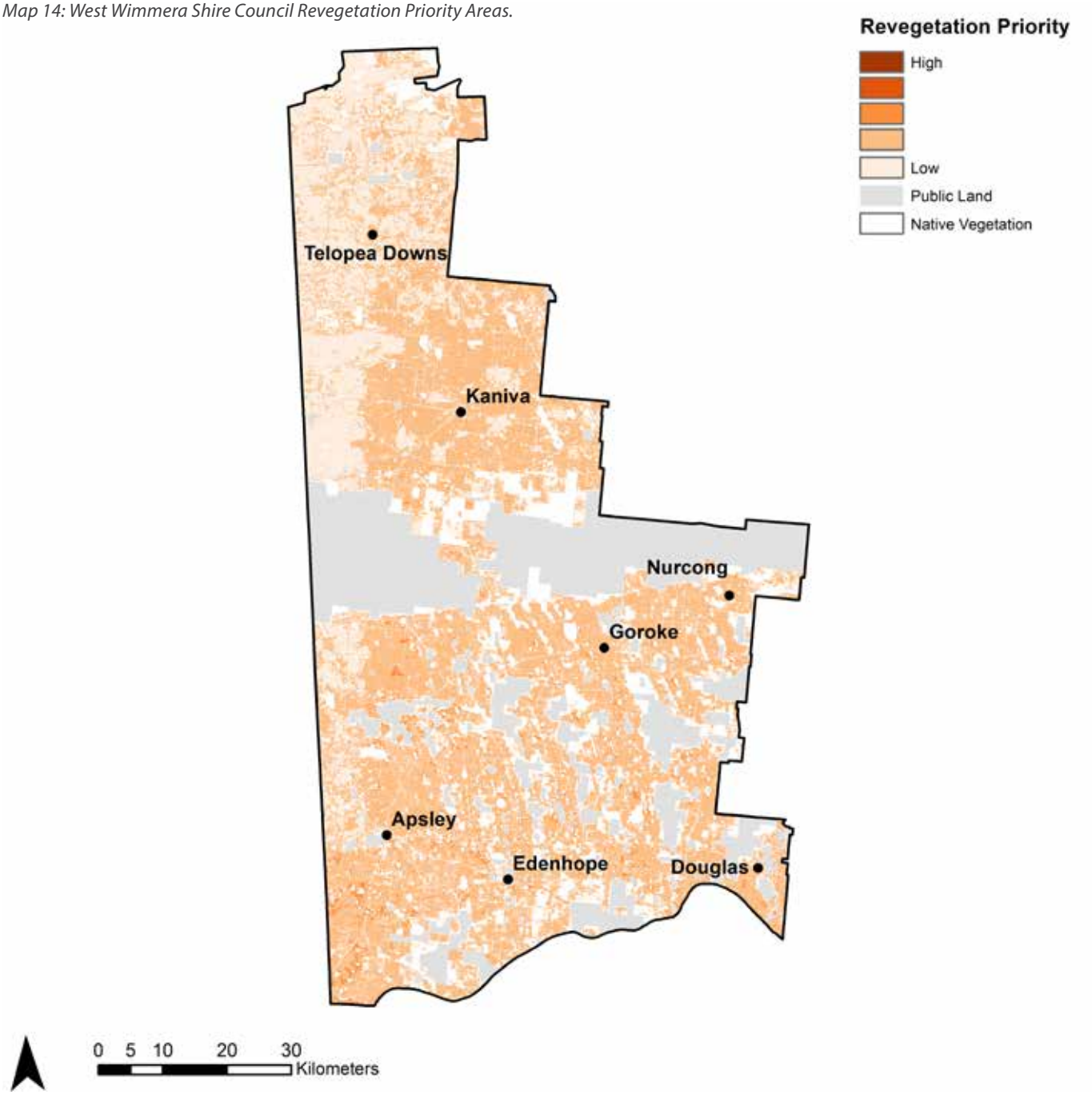
Most of the agricultural land in this area is of high quality. As a result, where there is land with no vegetation, priorities for revegetation will only include small-scale riparian revegetation, shelterbelts and small biolinks between existing vegetation. There may be some cases for prioritising large-scale planting in areas that are prone to erosion or salinity. This could include fodder plantations such as saltbush or native revegetation.

There has been extensive revegetation activity in this area since the mid-1990's with well-established connections between wetlands, remnants and the large area of state forest in this shire. Areas less utilised for production of grain, livestock and

Map 13: West Wimmera Shire Council Native Vegetation Management Priority Areas.



Map 14: West Wimmera Shire Council Revegetation Priority Areas.



horticulture lend themselves to larger strategic revegetation activities where they provide buffers or connectivity to existing native vegetation.

There is a significant number of centre pivots relying on the groundwater table in this area and any large carbon sequestration revegetation activities that potentially impinge on this resource may be subject to planning controls. Revegetation activities will be not be prioritised on these areas.

Proposed actions

- Native vegetation management activities will occur in priority areas identified in Map 13.
- Revegetation activities will occur in priority areas identified in Map 14.

Soils

Whilst the southern higher rainfall parts of the West Wimmera have traditionally been predominately grazing, the middle and northern parts are large cropping areas with some highly productive areas. Mixed farming continues to be the norm with landholders desiring to adopt innovation and understand the benefits they bring.

The landscape form is made up of ancient dune systems with swales in between. The swales had traditionally provided the best grazing and cropping country with their heavier clay soils. The lighter sandy country, on the dunes, has to some extent, been relatively undeveloped. Where these dunes have been cleared, particularly in the north they have been subject to wind erosion and it is sometimes a challenge to hold moisture. Clay topping has been used to some effect, in the north, to manage these issues and techniques to manage ground cover have been adopted for many years and continue to be a priority.

Proposed action

Develop an ongoing engagement program for the West Wimmera Shire that educates the community of priority management techniques including:

- Maintaining ground cover.
- Modifying crop management techniques to take account of annual climate predictions.
- Adopting cropping techniques to maximise water use efficiency, particularly north of the Little Desert.
- Understanding the benefits and challenges of mixed farming.

Waterways

The West Wimmera is also home to a significant amount of the Wimmera and the states natural wetlands. Many are still intact and some are somewhat degraded or have been lost completely due to drainage or land use change.

Some wetlands store massive amounts of carbon when well managed. Given the extent of wetlands in the shire there are huge opportunities to work with landholders to manage wetlands to improve carbon capture but also to provide biodiversity benefits for the region.

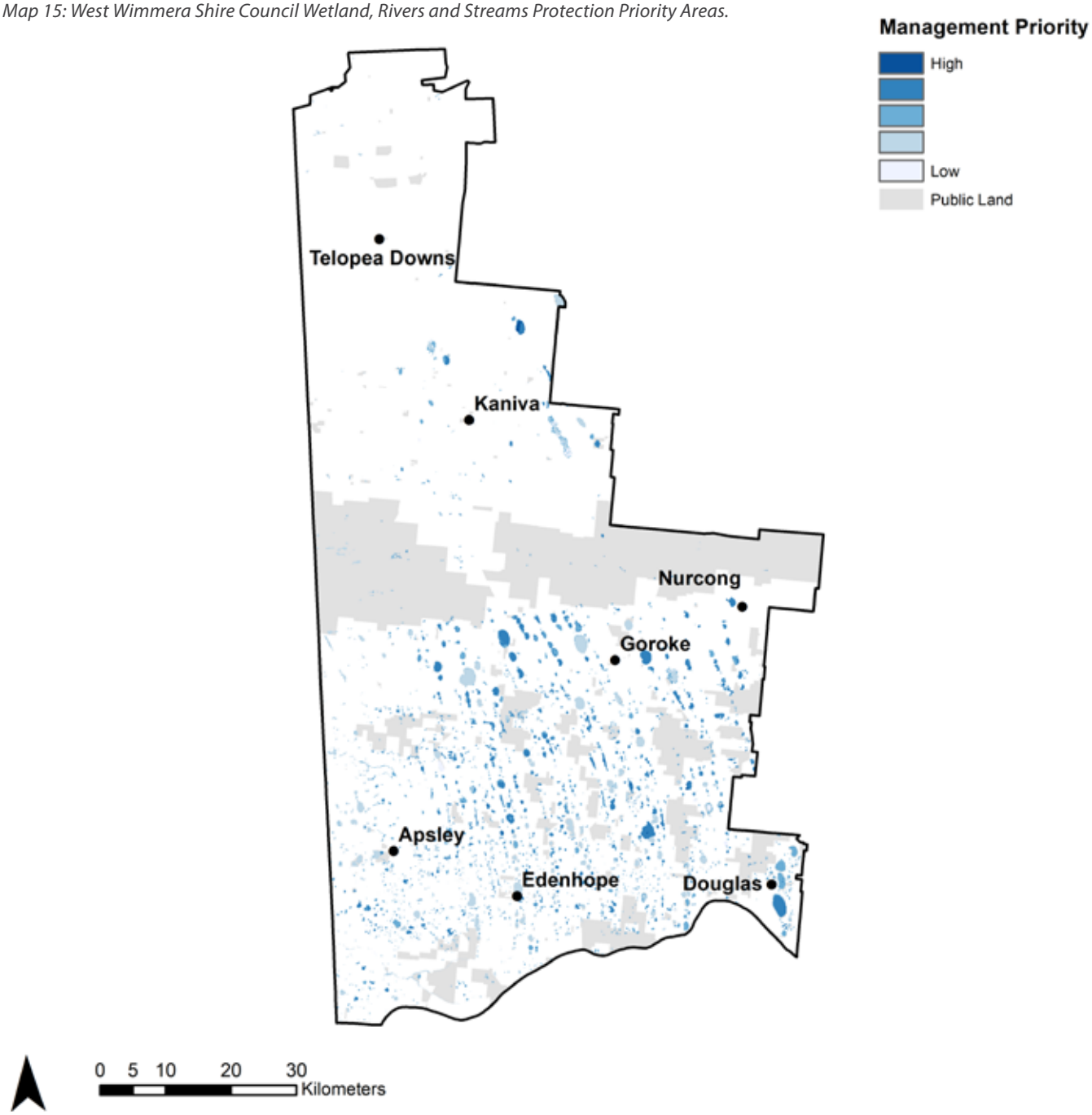
Mosquito Creek feeds into the Ramsar-listed Bool Lagoon in South Australia, making it a high priority stream for the district. This stream supports Growling Grass Frogs and native fish, including the Yarra Pygmy Perch, Blackfish and Dwarf Galaxias. Previous blue gum plantations have impacted on flows to the creek. Vegetation activities, in this area, will only be for high priority strategic purposes.

The maps provided below show the areas prioritised for wetland management (Map 15).

Proposed actions

- Implement the actions for in the WWS relevant to West Wimmera.
- Prioritise waterways management based on those identified in Map 15.

Map 15: West Wimmera Shire Council Wetland, Rivers and Streams Protection Priority Areas.



Hindmarsh Shire

Native vegetation & habitat

Apart from West Wimmera Shire, Hindmarsh Shire possibly has the region's best linear remnants and wide vegetated roadsides which have been enhanced over the last 20 years as part of the nationally recognised Hindmarsh Landcare Biolink. There has been a focus on linking remnant vegetation via roadside revegetation as a result of mapping that indicated some 2000km of continuous vegetation could occur by filling in the gaps and doing some important revegetation linking work.

Most of the agricultural land in this area is of high quality. As a result, where there is land with no vegetation, priorities for revegetation will only include small-scale riparian revegetation, shelterbelts and small biolinks between existing vegetation in most cases. There may be some cases for prioritising large-scale planting in areas that are prone to erosion or salinity. This could include fodder plantations such as saltbush or native revegetation.

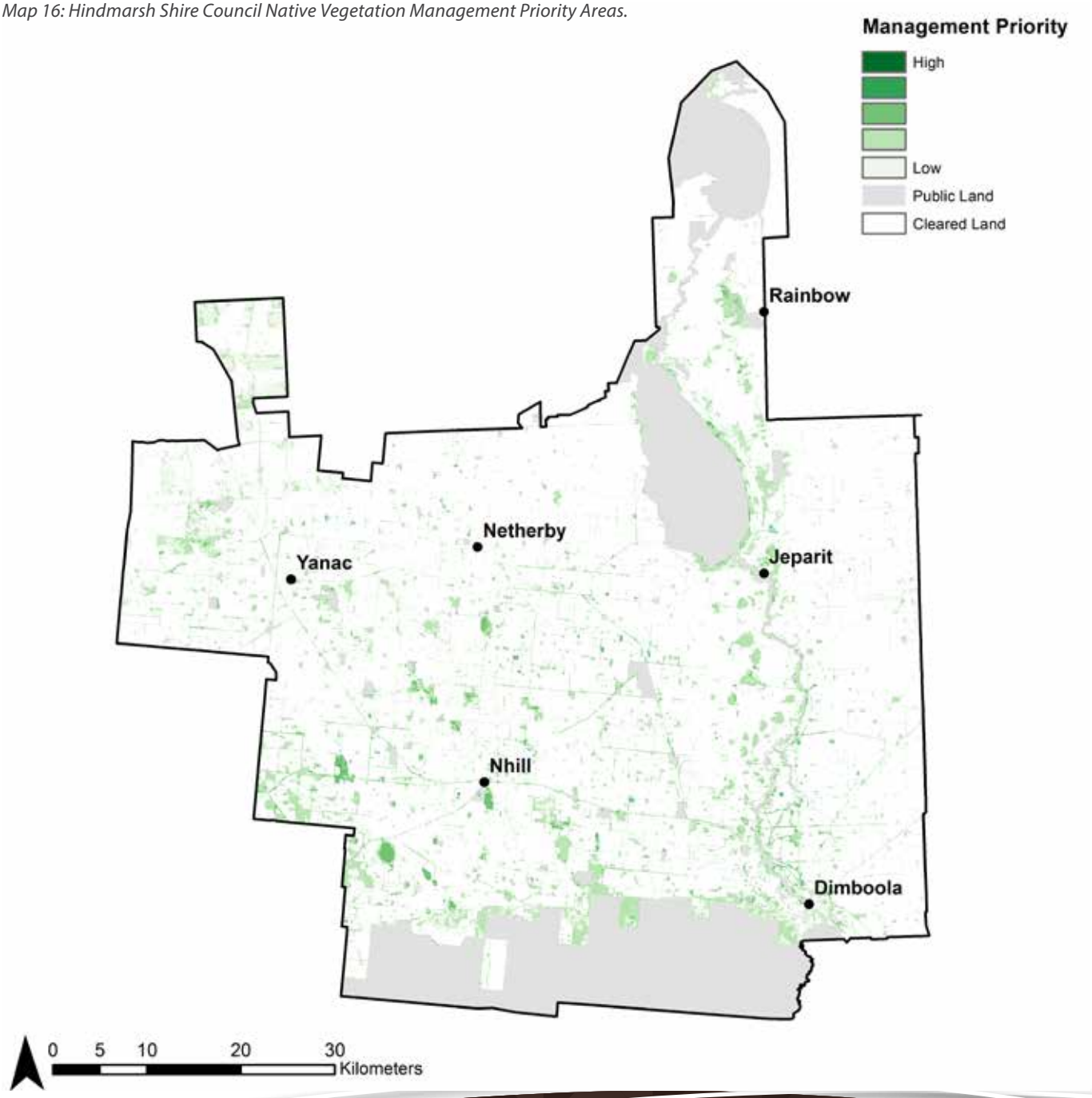
Remnant Buloke Woodlands still remain in parts and will continue to be a priority for management and revegetation work. Native grasslands support critically endangered Golden Sun Moth and, elsewhere, Mallee Fowl are still able to find a home in public and private native forests.

The maps provided below show the areas prioritised for native vegetation management (Map 16) and revegetation (Map 17).

Proposed actions

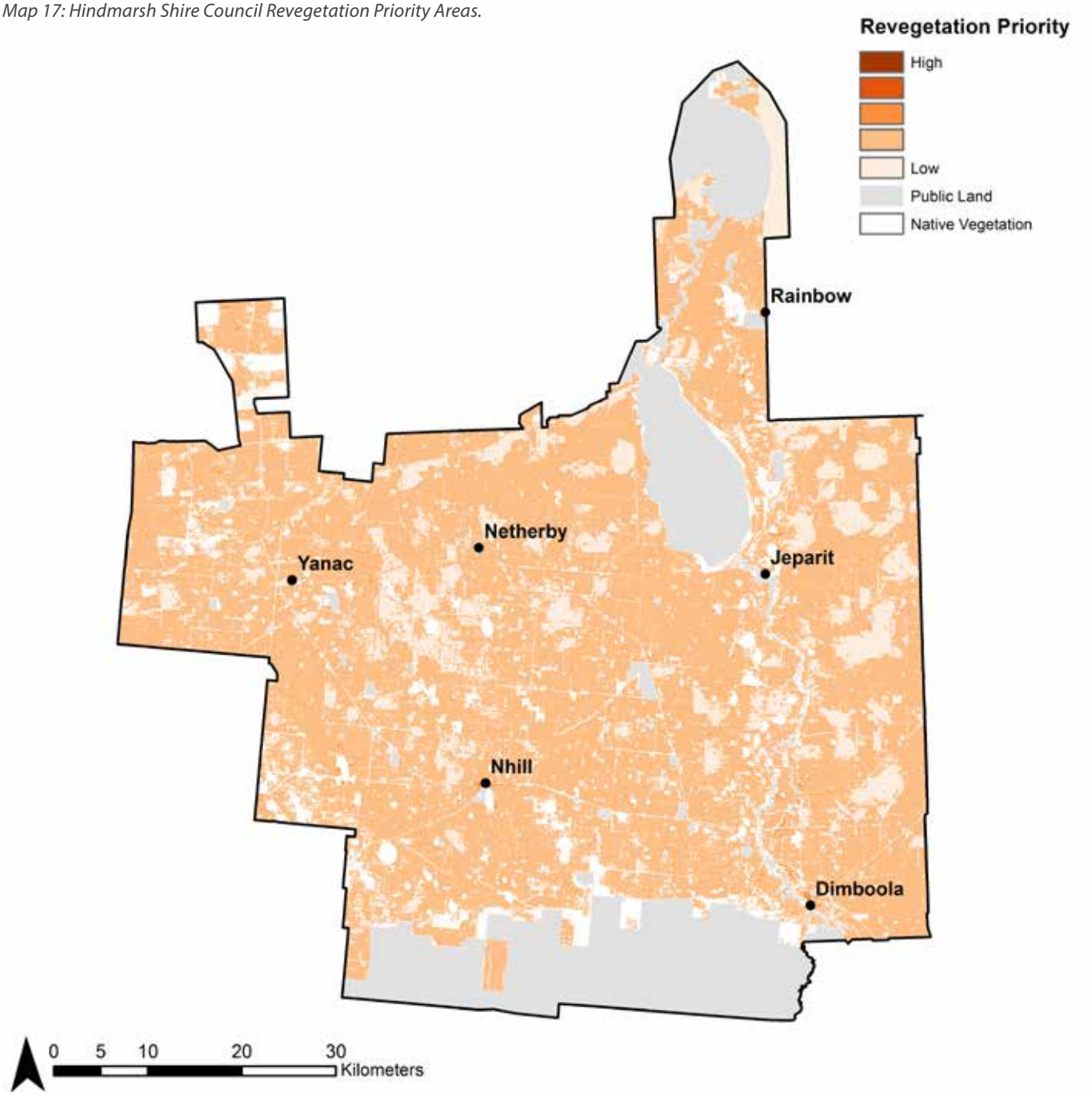
- Native vegetation management activities will occur in priority areas identified in *Map 16.*
- Revegetation activities will occur in priority areas identified in *Map 17.*

Map 16: Hindmarsh Shire Council Native Vegetation Management Priority Areas.



Australian Government
Wimmera CMA

Map 17: Hindmarsh Shire Council Revegetation Priority Areas.



Soils

Hindmarsh Shire is largely a cropping area and has a great range of soils located between the Big and Little Deserts. It also contains the floodplains of the Wimmera River which are fertile and receive an input of carbon when the river floods. Many of the soils are susceptible to wind erosion although more recent farming practices have improved this. There are areas of dryland salinity.

Like the other main cropping shires, priorities will be to provide opportunities and mechanisms for landholders to continue to learn and adapt approaches to farming that maintains and improves profitability.

CSU 2011

The CSU survey revealed 82% of landholders agree, it is important that they should manage their properties in expectation of extreme weather events. Impact of changing rainfall patterns on property viability was seen as important by 54% of landholders and only 17% considered it unimportant. This would suggest that people are aware of the extreme weather event and rainfall change impacts and the need to adapt.

A priority in this region will be to create engagement activities that educate the community on what adaptation techniques are available and appropriate.

Proposed action

Develop an ongoing engagement program for the Hindmarsh area that educates the community of priority adaptation techniques including:

- Adopting cropping and management techniques to maximise water use efficiency.
- Maintaining ground cover though improved cropping practices and planting vegetation in degraded areas.
- Cropping techniques to maximise water use efficiency.

Waterways

All of the Wimmera River within Hindmarsh Shire, is recognised under the *Heritage Rivers Act 1992,* and along with its floodplain waterholes, support a rich variety of riparian vegetation and aquatic species. The huge terminal lakes of Hindmarsh, Victoria's largest freshwater lake and Ramsar-listed Lake Albacutya are the venue for massive breeding events of migratory wetland birds. These lakes, and the scattered smaller ephemeral wetlands, provide habitat for water birds, and support endangered flora and fauna, including a salt-tolerant subspecies of River Red Gum. These waterways have provided food and recreation for many generations and their shores are rich in Indigenous heritage. They are hubs for tourism and provide income to towns like Jeparit, Dimboola and Rainbow.

Reduced rainfall has impacted the river in recent times, with environmental water release's being vital to ensure salinity does not remain at threatening levels. There continues to be impacts from invasive plants and animals. Management of riparian areas remains a priority.

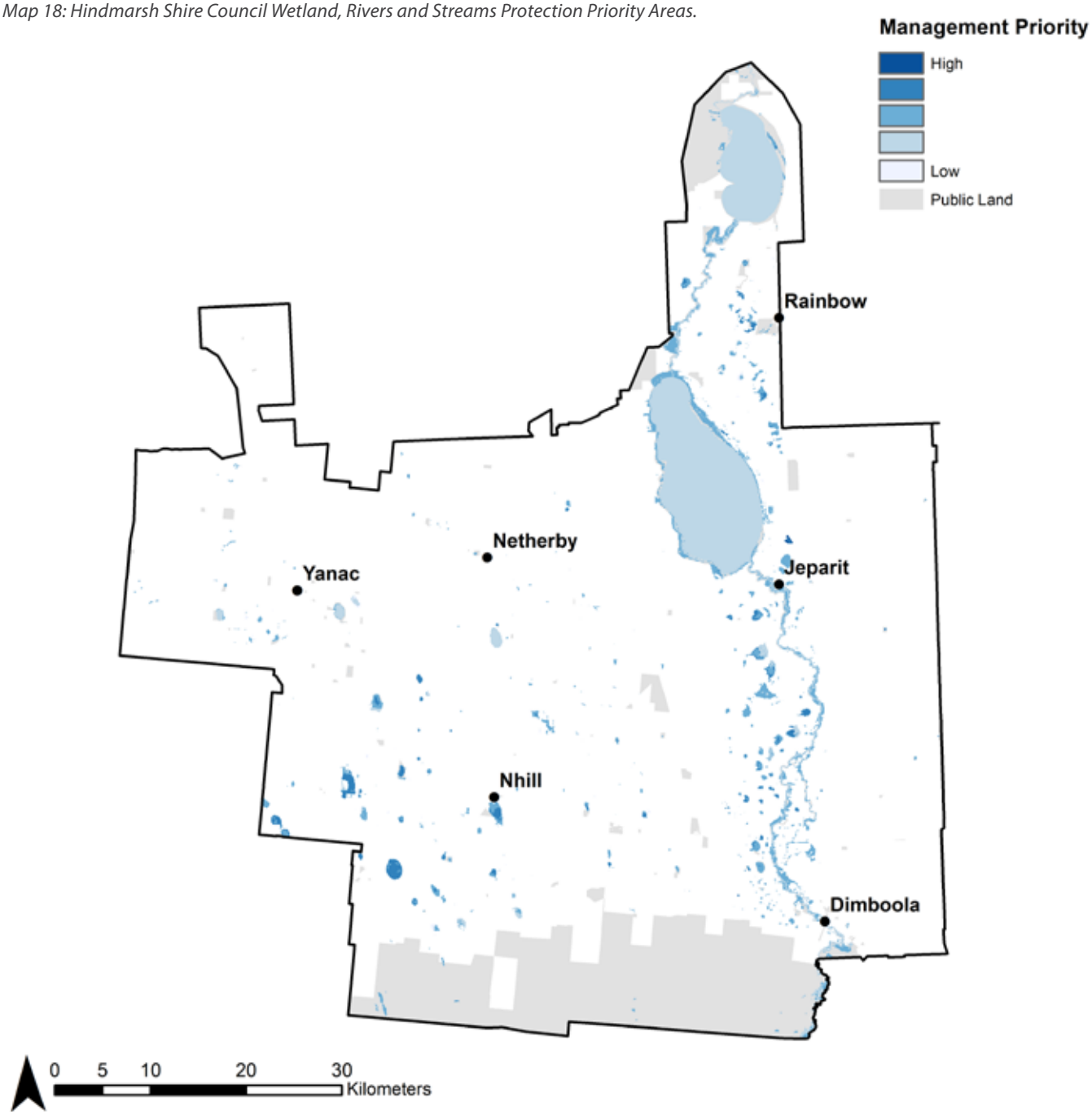
Opportunities exist to take advantage of the carbon storage potential of the shires wetlands through management agreements with landholders that will also result in improvements in wetland health and biodiversity.

The maps provided below show the areas prioritised for wetland management (Map 18).

Proposed actions

- Implement the actions for in the WWS relevant to HSC.
- Prioritise waterways management based on those identified in Map 18.

Map 18: Hindmarsh Shire Council Wetland, Rivers and Streams Protection Priority Areas.



Upper catchment (Northern Grampians Shire, Pyrenees Shire and Ararat Rural City)

Native vegetation & habitat

There are large areas of native vegetation on public land in these areas including the Grampians National Park and the Black and Pyrenees Ranges. In between there are large patches of intact native vegetation on private land including; River Red Gum, Box and Box–Ironbark Forest. These areas will be a priority for management. Invasive pest plant and animal control remain important activities as does appropriate fire and grazing management.

The Upper Catchment has long been a revegetation priority for multiple benefits including salinity, erosion control and biodiversity. Native vegetation activities in this area will be prioritised in less productive soil types. In higher productive areas small scale planning may occur in riparian areas and for shelterbelts and erosion control.

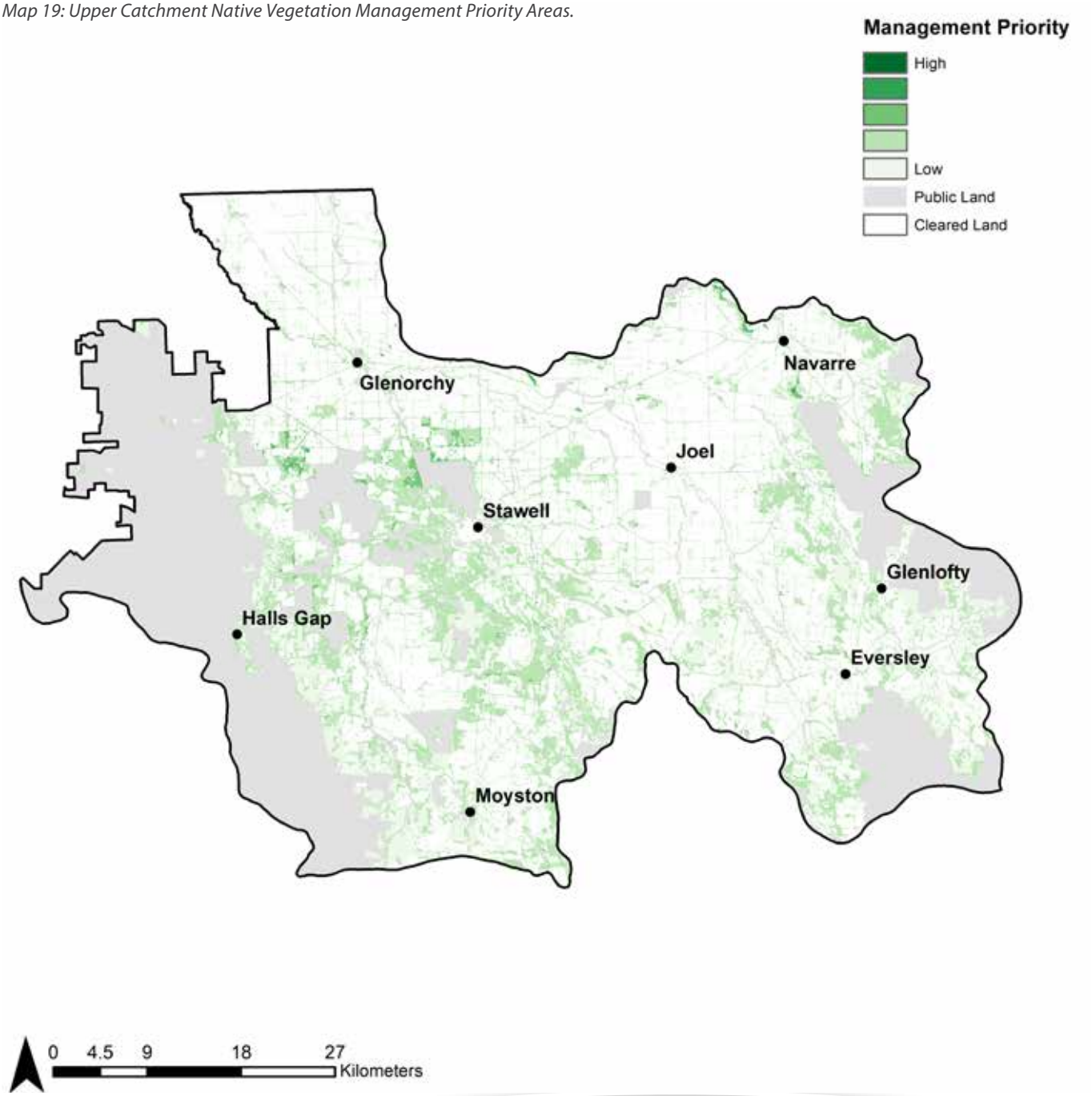
Fire is always a risk in these areas given the amount of vegetation in contains. As a result any revegetation activities need to carefully consider the risks they may pose to fire management agencies.

The maps provided below show the areas prioritised for native vegetation management (Map 19) and revegetation (Map 20).

Proposed actions

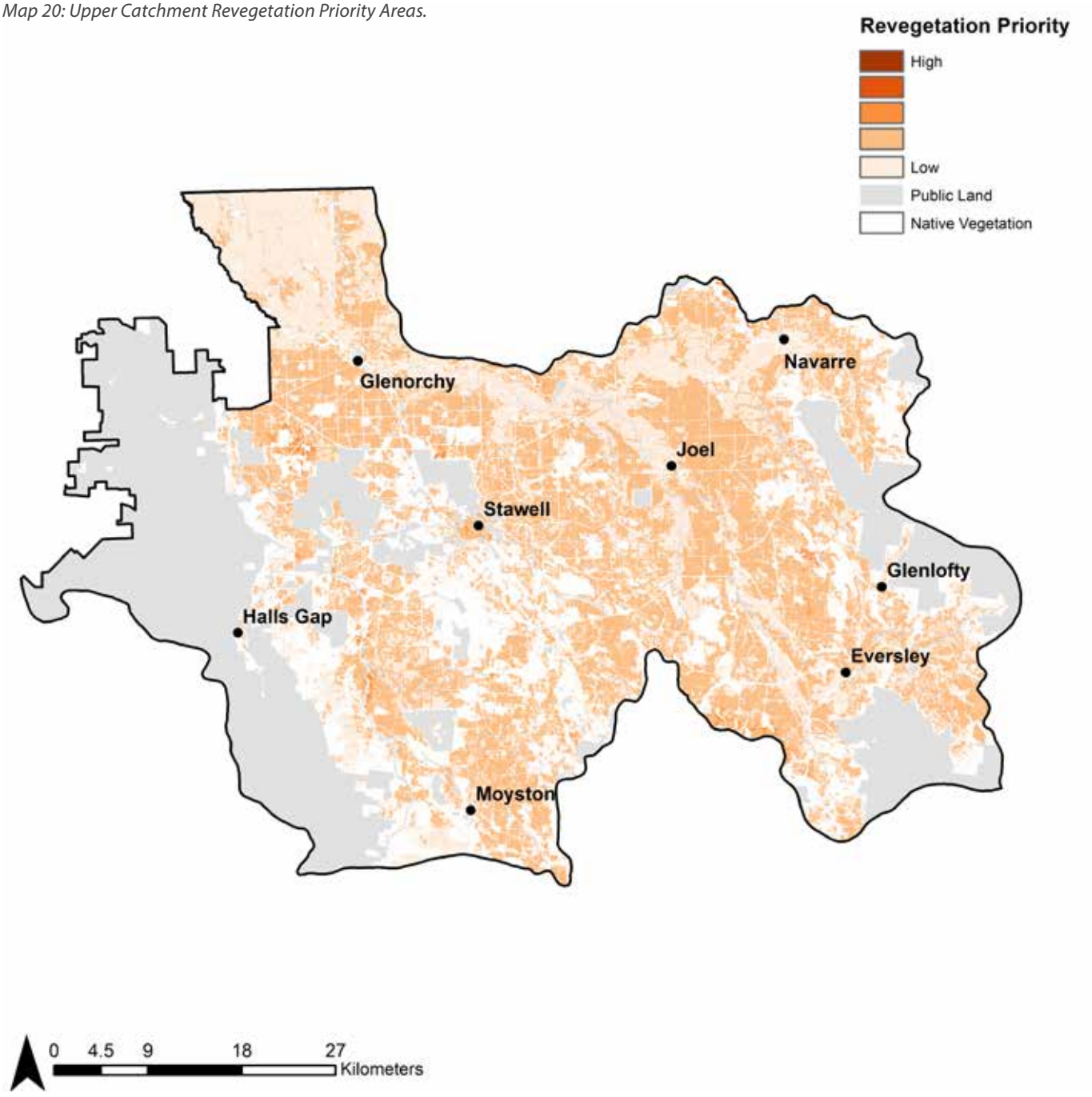
- Native vegetation management activities will occur in priority areas identified in Map 19.
- Revegetation activities will occur in priority areas identified in Map 20.

Map 19: Upper Catchment Native Vegetation Management Priority Areas.



Australian Government
Wimmera CMA

Map 20: Upper Catchment Revegetation Priority Areas.



Soils

The Upper Catchment soils have great variation due to its geology with the fertile alluvial river and creek flats being suitable for cropping and intensive livestock production.

The steep gradients of the hill country are prone to water erosion, particularly if the soil is exposed. Landholders and farmer groups have made massive inroads in developing techniques to retain ground cover while maintaining profitability. Perennial pasture research and experimentation continue to be a priority as it may help adapt to a drier and warmer climate.

There is an ongoing need to understand and mitigate the effects of salinity on natural assets, including environmental, social and economic impacts.

CSU 2011

This area, surveyed by CSU, had the highest percentage (84%) of landholders agree it is important that they should manage their properties in expectation of extreme weather events. The background to this is not known but this area was severely affected during the millennium drought with regard to pastures and crop biomass and water for livestock in dams and waterways. This was followed by some large flooding events in September 2010 and January 2011 causing severe top soil, creek and gully erosion and loss of fences and livestock.

A priority in this region will be to create engagement activities that educate the community on what adaptation techniques are available and appropriate.

Proposed action

Develop an ongoing engagement program for the Upper Catchment area that educates the community of priority adaptation techniques including:

- Continuing implementation of perennial systems.
- Maintaining ground cover.
- Erosion control.
- Riparian management and off stream watering.
- Cropping and grazing techniques to maximise water use efficiency and nutrient application.

Waterways

The lakes and water storages in and around the Grampians are heavily used for recreation. The Wimmera River has its headwaters in the Pyrenees. Stream condition varies considerably, with some streams reasonably intact in forested areas, while the majority have eroding banks and beds. This has caused a loss of habitat and a decline in water quality, as well as impacts downstream.

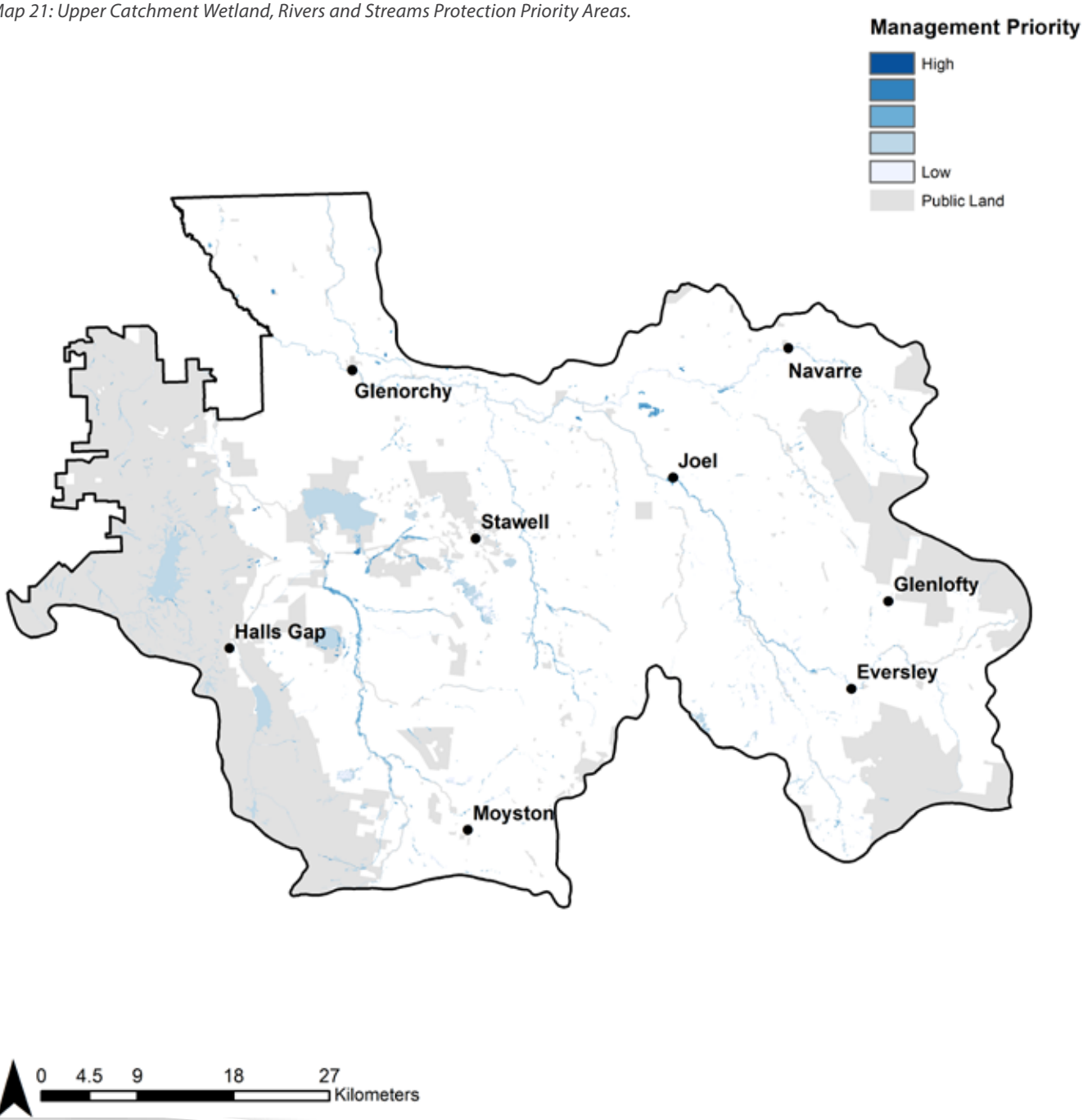
With the support of Wimmera CMA and Landcare, there has been a great deal of revegetation work and hundreds of kilometres of waterways have been fenced to manage stock over the past 10 years. Instream bed and bank erosion control works have been supported by this revegetation activity, which is also reducing gully and stream erosion into waterways and improving in stream habitat and water quality. All of these activities remain a priority under the WWS and will assist with building resilience against climate change. The revegetation activities also contribute to climate change mitigation through carbon storage.

The community, in many rural parts of the Upper Catchment, rely on catchment dams for water for stock and domestic supply. The expansion of a pipeline network by GWM Water into some parts of the community will provide some adaptive capacity against the lower rainfall predicted under climate change in the Wimmera.

Proposed actions

- Implement the actions for in the WWS relevant to HRCC.
- Prioritise waterways management based on those identified in Map 22.

Map 21: Upper Catchment Wetland, Rivers and Streams Protection Priority Areas.



Guidelines for suitable land class activities in the Upper catchment

The following describe the appropriate activities for various land classes in the Upper Catchment to protect agricultural land. They have been developed for the Upper Catchment as it is very diverse in terms of soil types and landforms. Once we have received feedback on this approach we may develop the same for other shires.

Public Land

- Continue to manage under Public Land management plans.

Native vegetation

- Refer to the protection and enhancement priority maps.

Steep slopes

- Ground cover is crucial.
- Large scale tree planting.
- Strategic fencing and grazing regimes.

Granite country

Includes granitic land with rocky outcrops and significant slope.

- Grazing preferred over cropping.
- Minimise ground disturbance and cultivations.
- Native pastures.
- Biodiversity plantings.

Towns and exotic vegetation

N/A.

Undulating hills

Typically grazing land.

- Annual or perennial ground cover maintained.
- Increased trials for perennial pastures.
- Where cropping occurs minimal or no till practices should be implemented.
- Revegetation for erosions control and shelter belts.

Rising open undulating land

Grazing and cropping land. Erodible soil with localised scours.

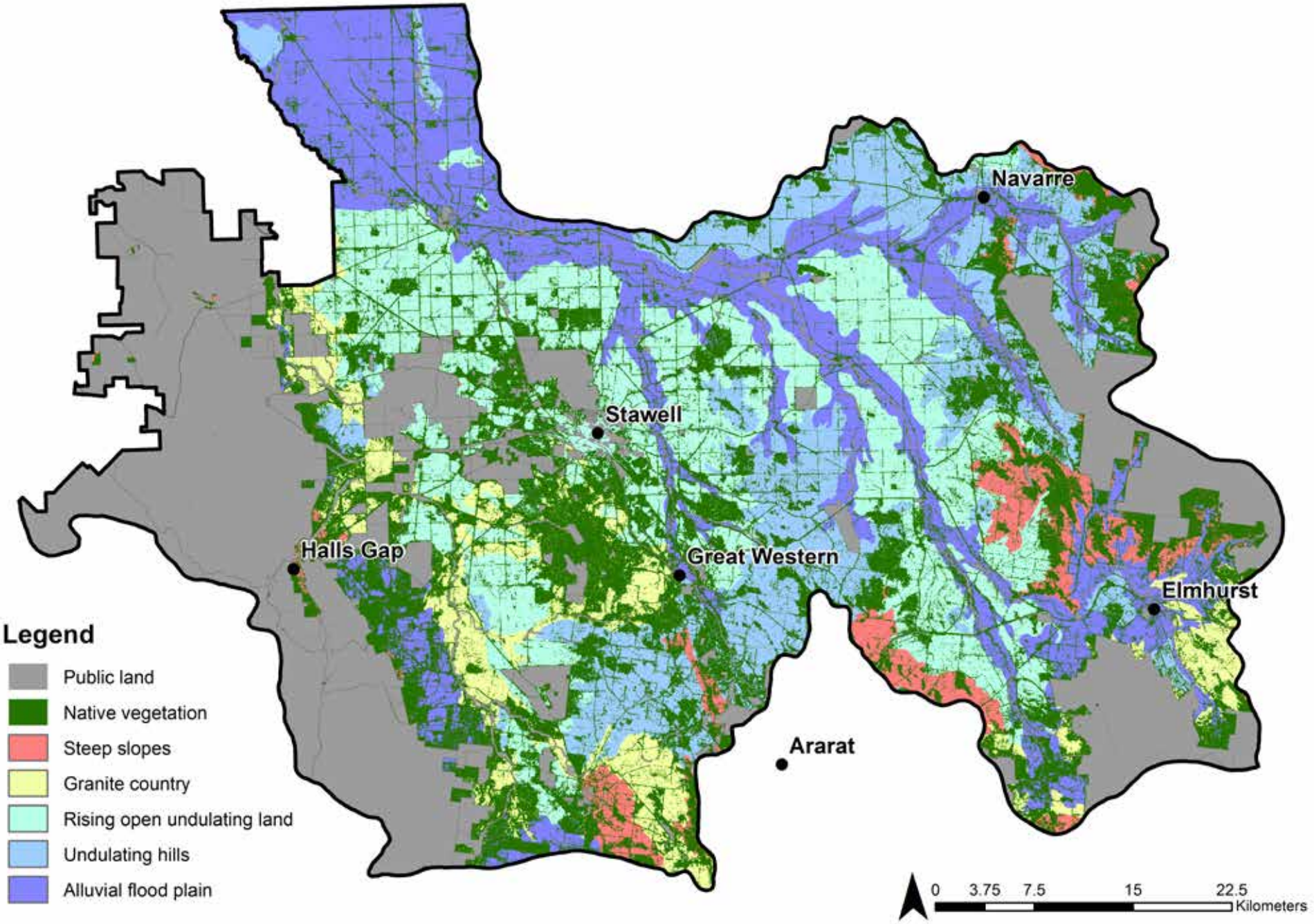
- Ground cover is important via minimum till and pasture cover.
- Revegetation for erosion control, shelter and enhancing existing vegetation.
- Increase trial of perennial pastures to maintain ground cover to reduce nitrate leaching.

Alluvial flood plain

Alluvial plains that are generally subject to cropping or grazing.

- Ground cover through minimal or no till cropping techniques.
- Lucerne and perennials for pasture production.
- Riparian protection, enhancement and revegetation.
- Revegetation for shelter belts and erosions control.

Map 22: Suitable land class activities in the Upper Catchment.



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APPENDIX A

STAKEHOLDER CONSULTATION

- Ararat Rural City Council
- Birchip Cropping Group
- Barengi Gadjin Land Council
- Conservation Farmers Network
- Country Fire Authority
- DEDJTR-Land Management Services & Productive Soils | Farm Services Grains
- DEDJTR-Agriculture Productivity Team
- DEDJTR-Whole Farm Planning
- DELWP Biodiversity Team - Horsham
- DELWP Fire Management - Horsham
- Environmental Protection Authority
- Greening Australia
- GWM Water
- GWM Water West Wimmera Groundwater Committee
- Hindmarsh Shire Council
- Horsham Municipal Fire Management Planning Committee
- Horsham Rural City Council
- Individual landholders and agronomists
- Northern Grampian Shire Council
- Parks Victoria
- Perennial Pasture Systems
- Powercor
- Project Platypus Landcare Network
- Pyrenees Shire Council
- Trust for Nature
- Vic No Till Farming Association
- West Wimmera Shire Council
- Wimmera Development Association
- Yarriambiack Shire Council
- Yarrilinks Landcare Network

APPENDIX B

CFA VICTORIAN FIRE RISK REGISTER (VFRR) – WIMMERA REVEGETATION BUFFER METHODOLOGY

Using AS 3959- Determination of Bush fire Attack Level, Bush fire Attack Assessor Tool and Bush fire Management Overlay Planning requirements as a guideline an average buffer zone has been determined. The buffer zone is not predicated on any vegetation class it is singularly aimed at triggering a referral where plantings may elevate risk in the future. The buffer is then applied to the VFRR spatial mapping layer.

VFRR asset data is developed at a municipal and regional level. This data identifies the following data sets:

- Human Settlement
- Economic
- Cultural and Heritage
- Environmental

The assets are then assigned a priority classification as follows:

- Extreme risk: 1A, 1B, 1C
- Very high Risk: 2A, 2B, 2C
- High Risk: 3A, 3B, 3C, 3D
- Medium Risk: 4
- Low: N/A

The data is then used to inform and support bush fire planning.

In applying the buffer zones priority is given to human settlement and consequently this zone would be weighted to apply a greater degree of risk analysis and a higher safety margin.

VFRR Class	Buffer Distance (metres)	Human Settlement Weighed Distance(metres)	Ember Attack Distance
Extreme Risk: 1A, 1B, 1C	300	450	600
Very High Risk: 2A, 2B, 2C	250	375	525
High Risk: 3A, 3B, 3C, 3D	200	300	450
Medium Risk: 4	150	225	375
Low: N/A	100	100(No Weighing Low Risk)	250

Where the considering the vegetation planting type and there is going to be the creation of a woodland or forested area in excess of .25ha, an additional 150m will be applied to the buffer zone to mitigate the impact from ember attack. The buffering will apply to any direction and not be reduced due to aspect.

APPENDIX C

WEED SPECIES

CSIRO's Adapt NRM program provides a report on weeds and climate change, outlining present and potential distributions of weeds species under climate change. The report uses the CSIRO Mk3 projections for 2070 based on the A1B SRES emissions scenario (Scott, et al., 2015).

The datasets accompanying the CSIRO report have been summarised for the Wimmera CMA CRP focusing on species distribution trends. The trends are outlined in the table, below, and are summarised by comparing 1975 and 2070 ecoclimatic indices (EI) (see (Pratique, 2011)). The change in EI is then averaged across the Wimmera CMA region. The following table summarises the change in EI for selected species, indicating the change in the potential for a species to thrive.

Species	EI Change
Acacia cyclops	↓
Acacia karroo	↓
Acacia pycnantha	↓
*Alternanthera philoxeroides**	↑↑
Arundo donax	↓
Asparagus aethiopicus	↑↑↑
Asparagus africanus	↓
Asparagus asparagoides	↓
*Asparagus asparagoides (western Cape)**	↑
Asparagus asparagoides (widespread)	↓
*Asparagus declinatus**	↑↑
*Asparagus scandens**	↑
Baccharis halimifolia#	↓↓
Baccharis pingraea	↓↓
Bassia scoparia	↓↓
Buddleja davidii#	↓
Calluna vulgaris#	↓↓
Cannabis sativa	↓↓
*Cenchrus ciliaris**	↑↑
*Cenchrus ciliaris**	↑↑
Centaurea eriophora	↓↓
Centaurea solstitialis	↓
Chloris truncata	↓
Crupina vulgaris	↓↓
Cuscuta suaveolens	↓↓↓
Cynodon dactylon	-
Cynoglossum creticum#	↓
Cyperus teneristolon#	↓↓
Cytisus multiflorus	↓↓
Cytisus scoparius#	↓
Dactylis glomerata	↓↓
Dittrichia viscosa	↓↓
Eleocharis parodii#	↓↓
Emex australis	↑↑
Emex spinosa	↑
Equisetum arvense	↓↓
Eucalyptus globulus	↓
Froelichia floridana#	↓↓
Gymnocoronis spilanthoides	↓
Hieracium aurantiacum#	↓↓↓
Hypericum tetrapterum	↓↓↓
Imperata cylindrica	↓
Kyllinga pulchella#	↓↓
Lachenalia aloides	↓↓
Lachenalia reflexa	↓↓
Lagarosiphon major	↓↓
Lycium ferocissimum	↓↓
Medicago sativa	↓
Miscanthus sinensis	↓
Nassella charruana#	↓↓
Nassella hyalina	↓
Nassella neesiana	↓
Nassella trichotoma#	↓↓
Nicotiana tabacum	↓↓
Oenanthe pimpinelloides	↓↓↓
Olea europaea ssp. europaea	↓
Onopordum tauricum#	↓↓
Opuntia robusta	↑
*Parkinsonia aculeata**	↑↑
Parthenium hysterophorus	↓
Pennisetum clandestinum	↓
Pereskia aculeata#	↓
Phalaris aquatica	↓
Phalaris arundinacea	↓↓
Phoenix dactylifera	↑↑↑
Phyla canescens	↓
Rapistrum rugosum	↓
Retama raetam	↑
Rubus anglocandicans	↓↓
Senecio glastifolius#	↓
Solanum elaeagnifolium	↓
Solanum eleagnifolium	↓
Solanum hoplopetalum	↑↑
Sonchus oleraceus	↓
Sorghum bicolor	↓
Sorghum halepense	↓
Stevia ovata	↓
Thunbergia laurifolia	-
Tipuana tipu	↑

APPENDIX C

WEED SPECIES

Species	EI Change
Triadica sebifera	↓
Trianoptiles solitaria	-
Zantedeschia aethiopica	-

Key	Symbol
Large Decrease (20+ ei)	↓↓↓
Moderate Decrease (10-20 ei)	↓↓
Small Decrease (1-10 ei)	↓
Little or No Change	-
Small Increase (1-10 ei)	↑
Moderate Increase (1-10 ei)	↑↑
Large Increase(1-10 ei)	↑↑↑

Acacia catechu, Acacia nilotica, Aeschynomene paniculata, Asparagus densiflorus, Asparagus officinalis, Asparagus plumosus, Asparagus virgatus, Asystasia gangetica ssp. micrantha, Barleria prionitis, Brillantaisia lamium, Chromolaena odorata, Cryptostegia grandiflora, Gmelina elliptica, Hyparrhenia hirta, Jatropha curcas, Koelreuteria elegans ssp. formosana, Lantana camara, Macfadyena unguis-cati, Melaleuca quinquenervia, Mikania micrantha, Mimosa pigra, Pelargonium alchemilloides, Pennisetum purpureum, Piptochaetium montevidense, Praxelis clematidea, Pueraria lobata, Ranunculus acris ssp. acris, Rorippa sylvestris, Saccharum officinarum & Senna obtusifolia were assessed but deemed not to be suited to the Wimmeras environment in either 1975 or 2070 modelling (2070 & 1975 EI < 5). As this is the case they have been omitted from the table, above.

* Species not suited to the Wimmera in 1975 but suited in 2070 (2070 EI > 10 & 1975 EI < 5). This represents a potential for these species to become a new and emerging invasive species in the region.

Species suited to the Wimmera in 1975 but not suited in 2010 (2070 EI < 10 & 1975 > 5). This represents a potential for a reduction in this species status in the region.

Australian Government
Wimmera CMA

TABLE OF MAPS

Wimmera CMA is one of 10 Catchment Management Authorities (CMA) working in Victoria under an integrated catchment management approach to achieve sustainability across the state. Each CMA supports the role that communities and government play in protecting and enhancing local natural environments.

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