



Tullaroop Integrated Catchment Management Plan



CENTRAL
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WATER



Dja Dja Wurrung Enterprises Pty Ltd
Trading as Djandak



Environment,
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and Planning



North
Central
CMA

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Acknowledgement of Country

The North Central Catchment Management Authority acknowledges Traditional Owners within the region, their rich culture and spiritual connection to Country. We also acknowledge the contribution and interest of Aboriginal and Torres Strait Islander people and organisations in land and natural resource management, and pay respects to Elders past, present and emerging.

Authors: Geoff Park and Anna Roberts (Natural Decisions), Caitlin Dunolly-Lee and Nathan Wong (Dja Dja Wurrung Aboriginal Clans Corporation)

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Executive summary

The Tullaroop catchment provides a range of additional environmental, social, cultural and economic values to communities in central Victoria. It supplies drinking water for the residents of Maryborough and surrounding localities as well as water resources for downstream irrigation along the Loddon/Murray system.

The catchment has well-recognised and notable values associated with its waterways and surrounding landscapes. This includes highly productive agricultural land that is used for grazing and cropping, significant wetlands and associated terrestrial habitat. The catchment has sites of major significance to the Traditional Owners, the Djaara people.

The catchment faces significant future threats to water quality and the health of aquatic ecosystems from uncontrolled livestock access to waterways and riparian areas. Climate change, through reduced rainfall and higher temperatures is predicted to have a major impact on water yield and river flows; this will exacerbate existing threats to water quality and waterway health.

This Integrated Catchment Management Plan (ICMP) has resulted from a collaborative effort from catchment authorities, water corporations, government agencies, Landcare and other interested community groups. The Dja Dja Wurrung Clans Aboriginal Corporation has played a significant role in identifying significant values of importance to Traditional Owners through an Aboriginal Waterways Assessment. The results of this work have fundamentally shaped the design of the plan and the priorities recommended for implementation.

The Plan has been developed for implementation over 30 years. It incorporates the most cost-effective components of improving river health (fencing the remainder of Birch's and Tullaroop creeks), improved water supply management practices (stock exclusion from the reservoir, septic audit and compliance measures) and includes priority activities informed by an Aboriginal Water Assessment (Wartaka - cultural management and empowerment of landscape, revegetation and weed control at Long, Merin Merin and Middle swamps, Djandak Wi- cultural burning and cultural heritage audits). The development of the ICMP has been underpinned by an environmental benefit: cost analysis using the Investment Framework for Environmental Resources (INFFER). This analysis includes quantified (catchment improvement) and non-quantified benefits (cultural and organisational benefits and perhaps a small reduction in the frequency of algal blooms) at a relatively modest present value of costs of \$7.74M over 30 years, with a benefit: cost ratio of 1.05, which represents a cost-effective investment.

This ICMP has successfully broken new ground through the successful integration of insights, knowledge and techniques from both a western scientific tradition and those of our First Nations people in identifying long-term, practical and meaningful actions to improve catchment health outcomes.

Section 1: Introduction

The Tullaroop catchment has been identified as a key area where better collaboration between Central Highlands Water (CHW), North Central Catchment Management Authority (CMA), Hepburn Shire, Central Goldfields Shire, City of Ballarat, Goulburn Murray Water (GMW) and other stakeholders and the community could improve integrated catchment management outcomes. The catchment, including Tullaroop Reservoir and its feeder waterways, is also of major cultural significance to the Traditional Owners the Djaara people, represented by Dja Dja Wurrung Clans Aboriginal Corporation.

Water reform and predicted future climate change is likely to place an increasing demand on water resources in the north central region as a whole, including the Tullaroop catchment. This will pose significant challenges in balancing the environmental, economic, cultural and social requirements for water, and require an explicit assessment of trade-offs associated with achieving shared catchment goals.

There is significant complexity around the issues in the catchment, and the roles and responsibilities of the different stakeholder organisations involved. There is, therefore, a need to bring all parties together to determine what can feasibly be achieved in the Tullaroop catchment to address the major threats to key catchment values.

The Tullaroop catchment

The Tullaroop catchment is within the Loddon Basin within the Murray-Darling Basin¹. An overview of the catchment has been provided by RMCG (2019). The catchment (71,818 ha in total) is the area inclusive and upstream of Tullaroop Reservoir (including Tullaroop, Birch's and Creswick creeks).

Birch's, Creswick and Tullaroop creeks are the major waterways above Tullaroop Reservoir. Beyond economic and urban water supplies, the creeks sustain the interconnected natural and built environment around it.

The highest parts of the catchment are located in the south-east near Mollonghip where the elevation is over 700 m above sea level. There are considerable differences in climate from south to north across the catchment, with long term average rainfall varying from 747mm/year at Creswick to 525 mm/year at Maryborough. The catchment drains to Tullaroop Reservoir which has a full supply level of 223 m. The entire catchment is a declared potable water supply catchment.

The catchment and its associated waterways and wetlands include many sites of significance to the Djaara people. The cultural values of the landscape are described in the recent Aboriginal Waterways assessment (Djandak, 2021) as:

Dja Dja Wurrung country is a cultural landscape that is more than just tangible objects; imprinted in it are the dreaming stories, Law, totemic relationships, songs, ceremonies and ancestral spirits, which give it life and significant value to Dja Dja Wurrung People. The values Dja Dja Wurrung People hold for their country are shaped from their belief systems that all things have a murrup (spirit) – water,

¹ <https://www.mdba.gov.au/water-management/catchments/loddon-avoca>

birds, plants, animals, rocks and mountains. Dja Dja Wurrung People see all the land and its creatures in a holistic way, interconnected with each other and with the people.

The catchment's waterways and land also support local biodiversity values (e.g. grassy woodlands, native grasslands and associated threatened flora and fauna) and recreation. For example, fishing tourism has grown significantly in the catchment (RMCG 2019).

Highly fertile soils, derived from basalt, are a feature of the catchment, with smaller areas of less fertile soils associated with sedimentary geology around Creswick and the western flank near Talbot. Elevated salinity levels occur in a number of streams in the catchment, a legacy effect of landscape clearing and land management.

The catchment has a number of significant wetlands, notably Long Swamp at Moolort, and Merin Merin and Middle Swamps near Clunes. These wetlands are ecologically significant and of major importance to the Djaara people. Along with the major creeks these wetlands provide food and medicine, and places to camp, hunt, fish, swim and hold ceremonies. They are places that are central to their creation stories, and many of their cultural heritage sites are associated with waterways – burial sites, birthing sites and middens.

A dated but useful detailed overview of the history, geography, soils and land use of the Tullaroop catchment is available². A map of the catchment is shown in Figure 1.

2

[http://vro.agriculture.vic.gov.au/dpi/vro/nthcenregn.nsf/0d08cd6930912d1e4a2567d2002579cb/ceb584de29bd139eca25752800055d62/\\$FILE/Tullaroop.pdf](http://vro.agriculture.vic.gov.au/dpi/vro/nthcenregn.nsf/0d08cd6930912d1e4a2567d2002579cb/ceb584de29bd139eca25752800055d62/$FILE/Tullaroop.pdf)

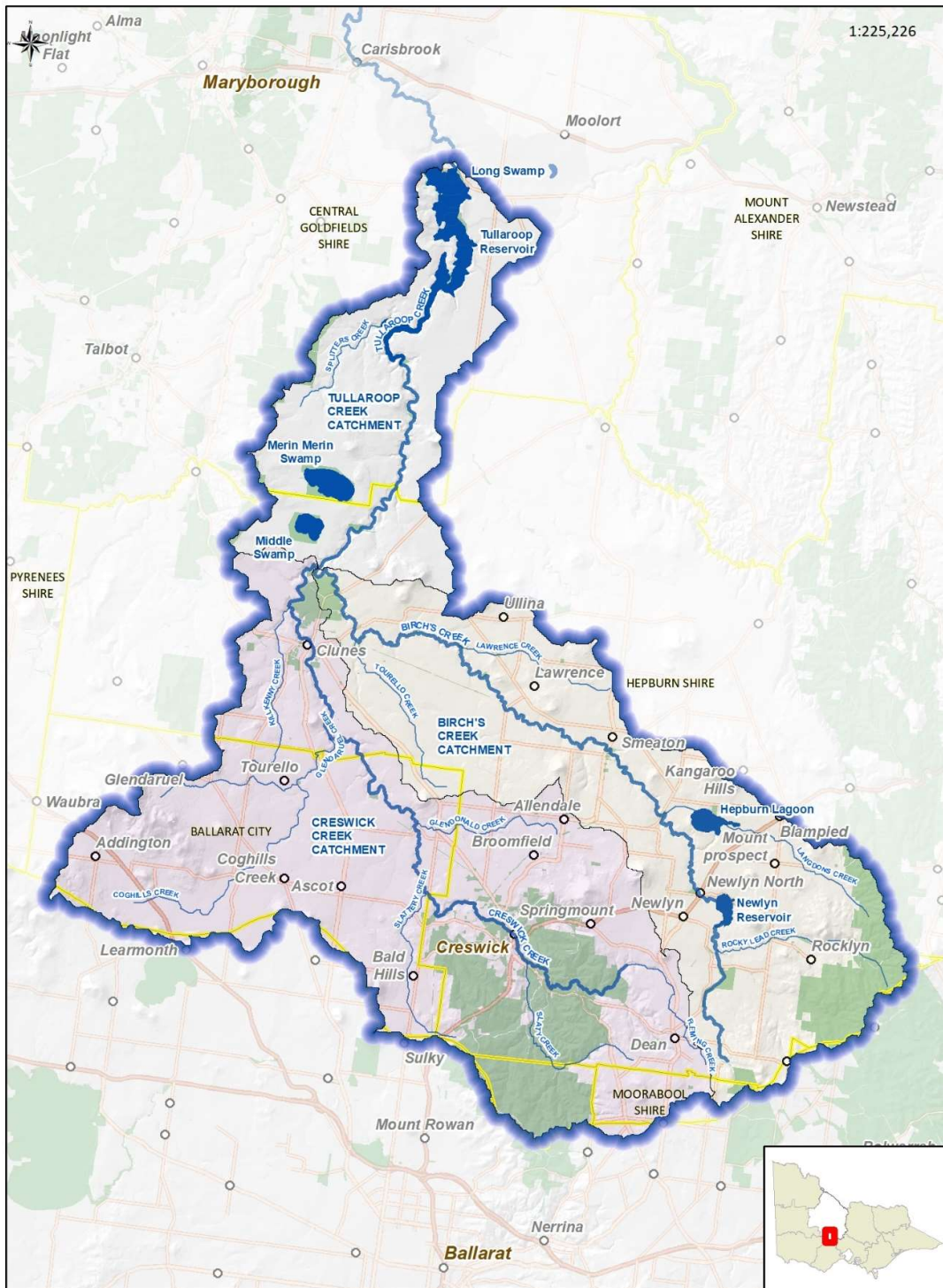


Figure 1: Overview of the Tullaroop catchment

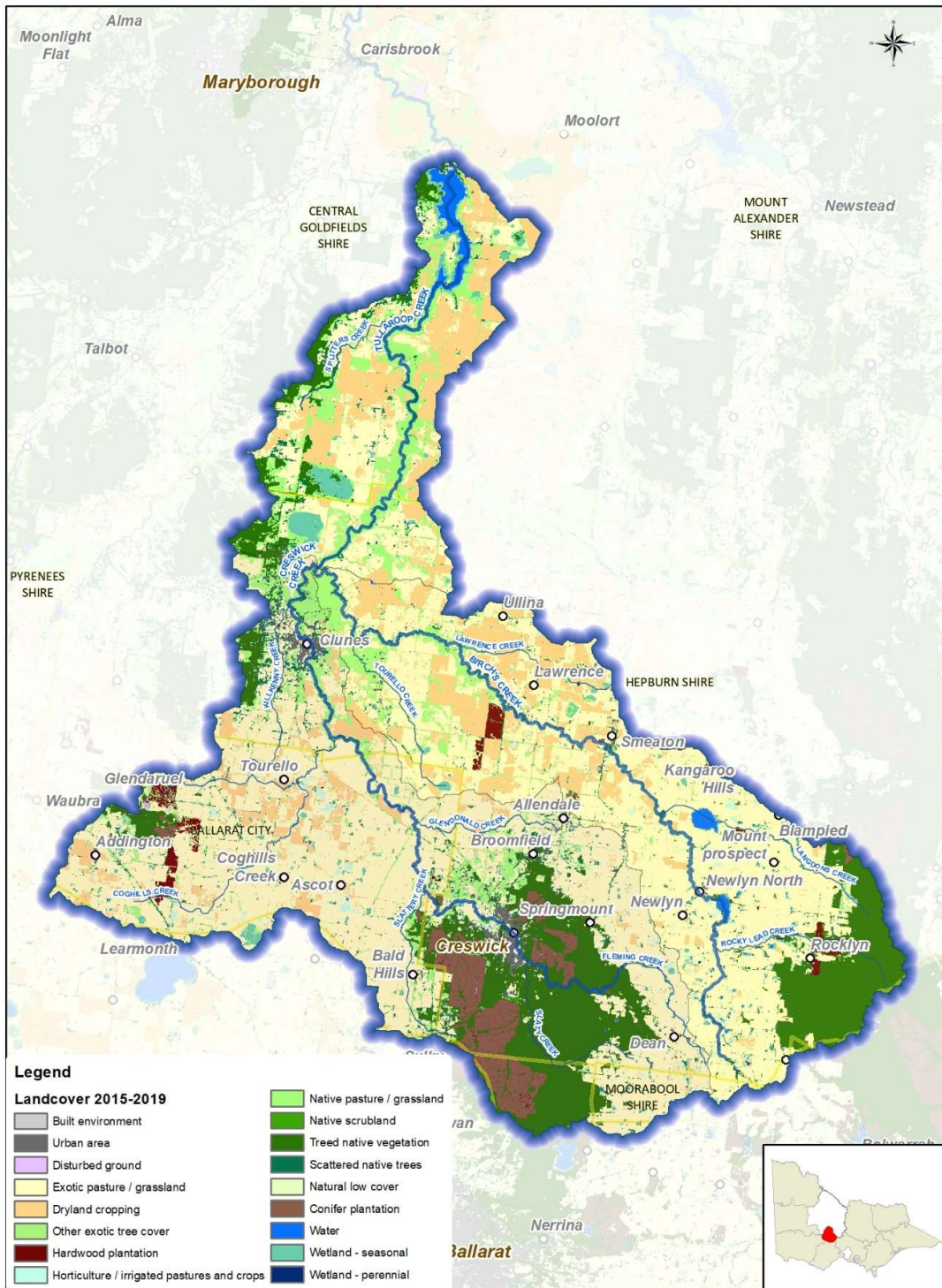


Figure 2: Land use in the Tullaroop catchment

Why is an Integrated Catchment Management Plan needed?

Integrated Catchment Management (ICM) is defined as ...

The coordinated management of land, water and biodiversity resources based on catchment areas. It incorporates environmental, economic and social considerations. This approach seeks to ensure the long-term viability of natural resource systems and human needs across current and future generations. Integrated catchment management requires a partnership between Catchment Management Authorities (CMAs), regional communities and other management partners (DELWP, 2016).

The need for the development of an ICMP was explored by the North Central CMA in 2019 (RMCG, 2019) through a series of workshops that brought together representatives from catchment authorities, water corporations, government agencies, Landcare and other interested community groups. These stakeholders explored the need to develop an ICMP for the Tullaroop catchment, identified focus areas, considered potential barriers and discussed the long-term vision for the catchment.

The catchment faces continued pressure for agricultural intensification, lifestyle development and recreational access which, along with water reform and predicted climate change impacts, place increasing demand on water resources from the Tullaroop system. This has been recognised in part through the development of the Maryborough Integrated Water Management Plan (Anon. 2019).

Central Highlands Water recognises the importance of a sustainable water future and community partnerships and has some key guiding sustainability values³ (CHW, 2013). Central Highlands Water also operates within a range of regulatory obligations (CHW, 2013). This includes complying with the Safe Drinking Water Act and using the Australian Drinking Water Guidelines (ADWG) as a framework to guide in the management of supplying safe drinking water. The Health-Based Target (HBT) approach (WSSA 2015) and application of good catchment management principles of the ADWG are also increasingly strong drivers for CHW. To balance environmental, economic, cultural and social requirements for water, explicit assessment of trade-offs associated with achieving shared catchment goals is needed.

Process used to develop the ICMP

Development of the Integrated Catchment Management Plan commenced in December 2020 with input from key stakeholder organisations, community groups and local community members.

It also included background work to assess available data, monitoring and modelling which is provided in a supporting document 'Background Paper: Tullaroop Integrated Catchment Management Plan' (Park, Roberts, Dunolly-Lee, 2021).

Stakeholder workshops (in February and August 2021) supported the gathering of important background information, informed the development of options and assessed the feasibility of actions to achieve the goal of the Integrated Catchment Management Plan.

³ These include 'conduct its business in a sustainable and responsible manner by responding to climate change, using its water and wastewater resources efficiently and managing its everyday environmental impact' and 'incorporate sustainability principles into its operations and planning to ensure improved long-term efficiency and delivery of water and wastewater services in a sustainable manner'.

The Investment Framework for Environmental Resources (INFFER) was used to assess the benefits and costs of six agreed options over a 30 year period⁴ for an Integrated Catchment Management Plan (ICMP) for the Tullaroop catchment. There are increasing pressures on the catchment from tourist, lifestyle and agricultural land uses. A particular strength of INFFER is that it explicitly and quantitatively captures risk factors (increased risks will reduce the maximum potential benefits) which is important because risks can be very different between options and should inform robust and transparent decision-making.

Aboriginal Waterway Assessment

The Aboriginal Waterway Assessment (AWA) (Djandak, 2021) was conducted in parallel with the INFFER assessment and noting that AWAs serve a range of purposes, objectives and outcomes as detailed in Appendix 3⁵. The AWA tool allows categorisation of the complex relationships that participants have with the assessment sites in order to identify themes and determine the relative importance of various themes between and within sites. Analysing the qualitative data requires subjective interpretation and it is acknowledged that, in many cases, the categories created may not necessarily fit with complex understandings of Country held by Traditional Owners. Nevertheless, organising the qualitative data under categories of values, threats and objectives can help participants to communicate their interests and priorities. By explicitly recognising the subjectivity of this process, transparency of the process is maximised.

The AWA (Djandak, 2021) was used to inform the INFFER analysis in terms of identifying values (waterway health and cultural value/uses) associated with sites visited and to cost activities in the ICMP recommended option. The assessment of waterway health was conducted by participating Traditional Owners answering a questionnaire with questions about the environmental condition of the river or wetland at each site. The individual ratings provided by each assessment team member were averaged to produce a total rating for each assessment place, which was then converted to a percentage score. Given the difference in method, it is important to note that the waterway health values conducted through the AWA are not related to river health methods used by the North Central CMA.

For the assessment of cultural values/uses, assessment team members provided a rating for each site using a table of 13 different categories of values and uses. Similar to the waterway health assessments, these were converted to a percentage score.

Both waterway health and cultural values/use scores were assessed for current condition through percentage scores being assigned into categories of very high, high, moderate, poor or very poor. The potential for improvement in cultural values was also estimated using the same categories.

⁴ Compared with the base-case - current trajectory for the catchment under a 'business as usual' approach.

⁵ Broadly grouped into three categories: 1) Articulating Traditional Owner Perspectives, Aspirations and Goals; 2) To understand and assess a sites history (past), current status (present) and opportunities (future); 3) To develop clear messaging for land managers to inform decision making, prioritisation and resourcing

Benefits and costs for the ICMP

The Investment Framework for Environmental Resources (INFFER) was used to assess the benefits and costs of six agreed options over a 30 year period⁶ for an Integrated Catchment Management Plan (ICMP) for the Tullaroop catchment.

Six options were assessed to identify and describe the preferred option for development of the ICMP. The agreed option incorporates the most cost-effective components of improving river health (fencing the remainder of Birch's and Tullaroop creeks), improves water supply management practices (stock exclusion from Tullaroop Reservoir, septic audit and compliance measures) and includes priority activities informed by an Aboriginal Water Assessment (Wartaka - cultural management and empowerment of landscape, revegetation and weed control at Long, Merin Merin and Middle swamps, Djandak Wi- cultural burning and cultural heritage audits). This option achieves quantified (catchment improvement) and non-quantified benefits (cultural and organisational benefits and perhaps a small reduction in the frequency of algal blooms) at a relatively modest present value of costs of \$7.74M over 30 years, with a benefit: cost ratio of 1.05, which represents a cost-effective investment.

Only catchment health benefits (value of the catchment for economic, social and environmental reasons) could be quantified in this analysis. However, there are also additional non-quantified benefits (benefits for Djaara people, benefits associated with reduction of algal blooms, improved reputations of organisations) which are an important part of deciding which option is most appropriate and can be defensibly argued in development of a business case to fund the ICMP.

Quantified benefits and costs

Using INFFER, catchment health benefits were valued through assessment of the value of the asset (V) and the impact of the works (W).

The Tullaroop catchment was agreed as being valued as INFFER Value (V) score 10 in benchmark condition, which in monetary terms equates to \$200M. In monetary terms each unit of V equates to a value of \$20M as has been outlined by Pannell *et al.* (2011)⁷ and can be considered a conservative valuation. The Tullaroop Catchment INFFER report (see Section 7: Supporting documents) provides a fuller description of how the catchment value was decided including it being benchmarked with other Victorian drinking water supply catchments where INFFER has been applied. In the absence of other non-market valuation studies, the V scoring system has been widely used across Australia and in particular has/is being used to underpin business case development for catchment management works for Melbourne Water, Coliban Water and Barwon Water.

Additional non-quantified benefits

It had been hoped that sufficient information would be available to estimate benefits associated with the reduction of algal blooms. The potential benefits that could be achieved through algal bloom reduction from improved catchment management were recreation benefits, reduced water treatment costs (reduced energy costs, reduced costs associated with disposal of brine waste water) and delayed need for remediation measures for the Maryborough golf course. Ultimately

⁶ Compared with the base-case - current trajectory for the catchment under a 'business as usual' approach.

⁷ Pannell, D.J., Roberts, A.M., Park, G., Alexander, J., Curatolo, A. and Marsh, S. (2011) Integrated assessment of public investment in land-use change to protect environmental assets in Australia, *Land Use Policy*, 29, 377-387.

quantification of benefits was not undertaken for reasons of limited information, likely modest benefits and information uncertainty. In the case of brine disposal CHW also decided that it would need to embark on measures regardless of the ICMP to minimise risks to supply of drinking water. The Tullaroop Catchment INFFER report (see Section 7: Supporting documents) provides further details on this work.

Also not quantified but important for CHW in particular is improved demonstration in meeting some of the 12 elements outlined in the framework for the management of drinking water quality (NHMRC and NRMCC, 2011). Implementation of the preferred option can be used as a basis for CHW to show:

- Commitment to drinking water quality management (element 1) through engagement of stakeholders
- Assessment of the drinking water supply system (element 2) through assessment of water quality data, hazard identification and risk assessment
- Preventive measures for drinking water quality management (element 3) through creating an additional barrier through improved catchment management and source water protection
- Community involvement and awareness (element 8) through community consultation and communication

Benefits for Djaara people

Djaara participants perceive landscapes to be healthier at places they can visually see or hear as healthy (listening for flow, clear water and water passage, animal sounds etc.).

The amount of cultural values present could impact on how waterway health was perceived because Traditional Owners see the two as linked. For example, food and fibre species present in the landscape tended to have some impact on waterway health scores, as well as cultural values/uses. Djaara people see the presence of these species as central to the rehabilitation and ecology of water places.

Scores for cultural values/uses were significantly higher at sites with natural conditions, with lower scores generally being attained to impacts of farming, waterway alteration, human disturbance and other colonial impacts.

Stock exclusion, riparian protection and provision of fish barriers in waterways have been included in the ICMP as priorities for Djaara as well as the CMA and CHW. Additional priority sites for activities for which additional cultural values/uses and waterway benefits could be achieved within the ICMP are Long Swamp, Merin Merin and Middle swamps.

Section 2: The plan of action

The actions required to protect the integrity of the Tullaroop catchment are outlined. Significant additional investment is required, over a sustained time period using a complementary suite of on-ground actions, planning controls, community education and extension activities.

Table 1 describes the actions required to meet the goals, the estimated cost for an initial or upfront 30 year implementation period (costs are expressed as NPV estimated in 2021 dollars) and underlying assumptions. A figure showing the values in the catchment, threats and actions is outlined in Figure 1.

The total costs were estimated to be \$7.74 million dollars (NPV over 30 years). Details about assumptions are further explained in a supporting document ‘Tullaroop catchment INFFER report’ (Park, Roberts, Dunolly-Lee and Wong 2021).

It is important to note that some threats are infeasible to address within the scope of this ICMP. For example remedial action to address elevated stream salinities would require large-scale reinstatement of perennial vegetation across the catchment. This would involve significant trade-offs with agricultural land use and furthermore would involve response times over many decades and longer to generate a measurable difference.

Table 1: Tullaroop Integrated Catchment Management Plan – Implementation Plan summary

Action	Description	Cost (\$M)	Assumptions
Direct on-ground actions (over 10 years unless otherwise stated)			
Waterway fencing – Birch’s and Tullaroop Creeks	Establishment of permanent stock control fencing with 20 metre buffer. Limited, managed grazing to control weeds/biomass.	\$644K	46km @ \$14,000/km
Revegetation – Birch’s and Tullaroop Creek	Revegetation of fenced buffers with local indigenous species	\$460K	92ha @ \$5,000/ha
Off-stream watering – Birch’s and Tullaroop Creeks	Establishment of off-stream watering systems for stock	\$161K	46km @ \$3,500/km
Storage fencing – Tullaroop Reservoir	Establishment of permanent stock control fencing with 20 metre buffer. Limited, managed grazing to control weeds/biomass.	\$504K	36km @ \$14,000/km
Off-storage watering – Tullaroop Reservoir	Establishment of off-storage watering systems for stock	\$126K	36km @ \$3,500/km
Weed control – Birch’s and Tullaroop Creeks	Extensive mechanical removal of willows and other woody weeds using best practice techniques	\$635K	7km @ \$35,000/km (major) 39km @ \$10,000/km (medium)
Weed control - Tullaroop Reservoir	Chemical control of woody and other invasive weeds on exposed areas of the storage	\$22K (annually)	15 ha @ \$1500/ha annually
Addition of Large Woody Habitat - Birch’s and Tullaroop Creeks	Snag piles to improve habitat for fish and aquatic ecosystems	\$200K (over 4 years)	40 snag piles @ \$5,000 per pile
Staff costs (over 10 years)			

Project management/coordination	Responsible for overall project coordination	\$841K	0.5 FTE @ \$112K for years 1-5 and then 0.25 FTE @ 56K for years 6-10
Implementation/Extension support	Provision of technical advice, coordinating on-ground works with landholders	\$1,728K	1 FTE @ \$172K annually for Years 1-10
Enabling actions			
Septic tank auditing and compliance	Inspection, auditing and compliance associated with domestic waste water treatment plants	\$675K	\$35K annually for Years 1-5 then \$20K annually to Year 30
Landholder negotiation/boundary surveys - Tullaroop Reservoir	Required to establish alignment for storage fencing	\$10K	Costs spread over 2 years
Water quality monitoring	Monthly monitoring of six sites (April- Nov)	\$600K	\$20K annually
AWA activities			
Monitoring and Improvement - Wartaka (Cultural Management and Empowerment of Landscape) - All Sites	Engagement, Cultural Advisory, Review and adapting of plan, DEM/LiDAR of landscape to inform decision making, quarterly meetings to include and discuss Mens and Womens roles.	\$1.090K	4 gatherings per year @\$20,000 per gathering (2-3 days) for 3 years with \$80K \$50K for Years 4-10 and \$25K annually thereafter
Implementation/Extension support	Collaboration and support for NCCMA works implementation	\$346K	0.2FTE @ \$35K annually for Years 1-10
Revegetation and weed control - Long Swamp	Site restoration and ongoing management	\$225K	\$20K annually for Years 1-5 and \$5K annually thereafter
Djandak Wi - All Sites	Cultural burning of key sites to improve cultural and ecological values	\$1.032K	\$12k per burn per year - 2 burns in year 1, 4 in year 2, 6 from years 3-10, 2 annually thereafter
Revegetation and weed control - Middle and Merin Merin Swamps	Site restoration and ongoing management	\$225K	\$20K annually for Years 1-5 and \$5K annually thereafter
Cultural Heritage Audit - All Sites	Names of places, Family Groups, Update existing Cultural Heritage Reports (i.e. Long Swamp), record values (tangible and intangible)	\$175K	2-3 sites per year depending on complexity. Cost is between \$10K and \$35K per site.

A range of people and organisations will be involved in the implementation of the Plan. Central Highlands Water, North Central CMA, Goulburn Murray Water and Dja Dja Wurrung Clans Aboriginal Corporation will form a coordinating project steering committee to provide appropriate governance for allocation of resources to particular actions of responsibility (Section 5: Governance and implementation). Where actions are linked to local government responsibilities such as assessment and monitoring of onsite wastewater systems (section 2.2 Staff Requirements) the appropriate level of coordination with the responsible authority will be provided through this Technical Working Group.

It is envisaged that the North Central CMA will continue to be the lead organisation deliver riparian programs and extension activities alongside Dja Dja Wurrung Clans Aboriginal Corporation. Supervision of compliance responsibilities and education program delivery will be decided by Central Highlands Water, Hepburn, Central Goldfields and City of Ballarat Councils. Water quality monitoring or raw water supply will be the responsibility of Central Highlands Water. Landholder practice adoption and riparian activities is likely to be led by the North Central CMA. Successful engagement and participation of community members will be critical to the success of the Plan and maintaining relationships and education is very important.



Figure 3: Link between catchment values, threats and actions

Direct on-ground works

Waterway management

A total of 46 km of fencing for livestock exclusion has been estimated for the main stems of Birch's Creek and Tullaroop Creek (Table 1). This quantity has been estimated by the North Central CMA and Central Highlands Water to achieve both ecosystem health and water quality benefits.

Historical factors associated with the development of agriculture in the Tullaroop catchment have resulted in extensive loss of riparian vegetation along waterways, and consequent impacts on water quality and an overall significant decline in river health. While fencing and controlling stock access to waterways will have benefits for water quality, additional measures, especially revegetation with indigenous plants is required to improve riparian habitat extent and quality. Greater riparian connectivity may also help improve the adaptive capacity of species and habitats in response to climate change challenges. A total of 92 ha of revegetation with indigenous species (including food and fibre plants) of riparian areas associated with the waterway fencing of Birch's and Tullaroop Creeks will be implemented.

Stock exclusion from waterways requires the provision of alternative off-stream water sources and the estimated extent of works and costs are shown in Table 1 for Birch's and Tullaroop Creek. Improved water quality, ease of livestock management and increased livestock performance can all be enhanced by supplying an alternative off-stream water supply.

Weed control is also targeted to the riparian zone along Birch's and Tullaroop Creeks. This focus involves willows (major weed control) and other woody weeds (medium weed control). Table 1 provides estimates of the extent of these works. Most Willows (*Salix* sp.) are Weeds of National Significance (WoNS) as they spread rapidly along waterways causing erosion, reduce water quality and cause blockages from matted root systems. Willows also use large amounts of water. Additionally, the introduced species are a threat to the habitat values and natural hydrology of waterways. Removal of willows will assist in the achievement of multiple goals the connectivity goal outlined above and contribute to an overall improvement on the health of major and minor waterways. Other woody weeds (e.g. Gorse, Blackberry) are found along the main waterways and reduce the integrity of the riparian zone by outcompeting native vegetation and reducing the habitat quality for native fauna and flora.

Targeted addition of large woody habitat will also be undertaken at strategic sites along Birch's and Tullaroop Creek to improve habitat quality for native fish and platypus.

A map of the extent of currently fully fenced waterways is shown in Figure 4.

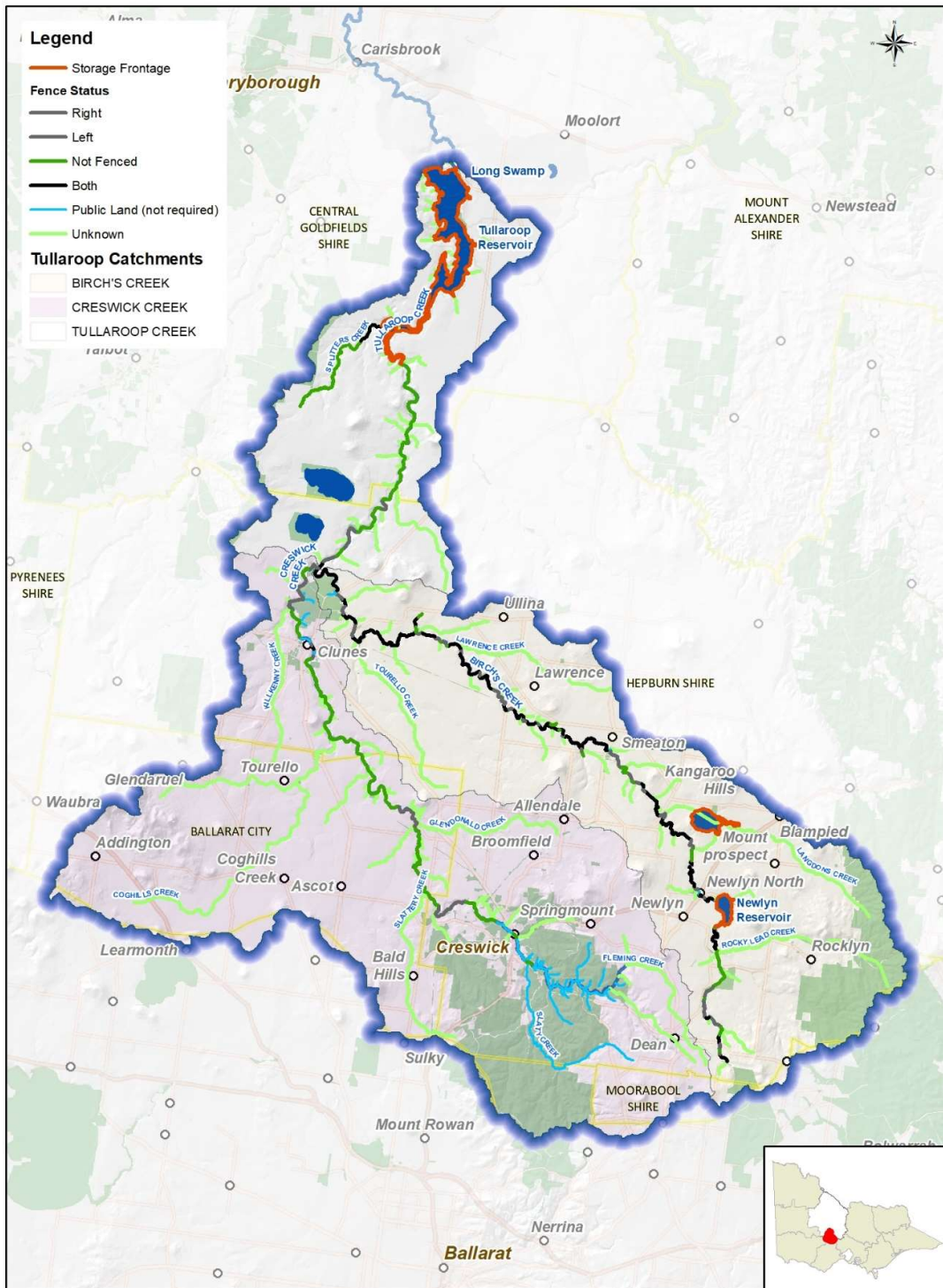


Figure 4: Current extent of waterway fencing in the Tullaroop catchment

Tullaroop reservoir management

At present a small proportion of Tullaroop Reservoir is fenced to manage stock access. 36km of fencing is estimated to achieve complete stock exclusion from the storage; this will contribute to maintaining the water quality benefits achieved through stock exclusion from the main contributing waterways, Birch's and Tullaroop Creek.

Provision of water for stock will be maintained by the installation of off-storage watering systems associated with boundary fencing of the storage.

Wetland management

Freshwater wetlands are a visible and significant feature of the Tullaroop catchment. In particular Long Swamp (private land largely owned by Trust for Nature), Middle and Merin Merin Swamps (public land managed by Parks Victoria) have been identified as high priority sites for this ICMP. Long Swamp⁸ is the 'jewel in the crown' of the Moolort Plains wetland complex, while Merin Merin and Middle Swamps, just north of Clunes, have significant ecological and cultural values. A number of smaller wetlands on private land (e.g. Brolga Swamp) have also been identified as important. Together these wetlands are part of a complex of more than 50 swamps, forming a historically productive, cultural, mosaic, wetland landscape.

The AWA highlighted the opportunity to integrate direct actions, to be led by Traditional Owners, including Djandak Wi (cultural burning), revegetation and weed control on these wetlands (Table 1).

Djandak Wi (cultural burning)

Djandak Wi, the use of cultural fire to heal Dja Dja Wurrung Country, has been identified as a high priority for the ICMP.

"Our fire management practice, which we call Djandak Wi, is an obligation we have to the land and we love to see the greater biodiversity it brings, and the gradual return to health it will bring to Country"

Dja Dja Wurrung Group CEO Rodney Carter

Djandak Wi is recommended for all sites identified in the AWA⁹ with the use cultural burning techniques the key to restoring the ecology of these sites and as a way to bring back Djaara into these areas to Care for Country.

Domestic waste water management

Effluent from waste water management systems contains bacteria, chemicals and high levels of nutrients and can run off into waterways as a result of poorly drained soils; small lot sizes; high usage; ageing septic tanks; and lack of proper maintenance of septic tanks (Hepburn Shire Council 2014). Contamination from effluent runoff has risks for public health and environmental values.

⁸ Long Swamp is filled during localised flooding/high rainfall events/periods and associated surface flow and shallow groundwater (DCNR 1994). The frequency of filling events from rainfall has dropped since the 1970s, consistent with broader climate change observations in Victoria.

⁹ Carisbrook Stone Arrangement, Long Swamp, Mount Cameron Gorge, Merin Merin Swamp, Clunes Common NCR and Bullarook Streamside Reserve

Illnesses that are contracted from effluent contaminated water include Gastroenteritis, Shigellosis, Giardiasis, Cryptosporidiosis and Hepatitis. Septic tanks contribute high rates of nitrogen and phosphorous to water catchments due to surface runoff. Septic tanks create direct bacterial contamination of the environment stimulating algal and weed growth (Hepburn Shire Council 2014).

The ICMP makes provision for an ongoing program of inspection, auditing and compliance by responsible local governments associated with domestic waste water treatment systems.

People resources

This ambitious ICMP to achieve improved water quality, ecosystem health and significant cultural benefits cannot be delivered without effective project management, co-ordination and delivery including engagement, extension and compliance.

The scale of the project requires collaboration and coordination across relevant agencies and local communities. It will be led through a collaborative approach between the North Central CMA, Central Highlands Water, Goulburn Murray Water and DDWCAC.

The ICMP has estimated staff costs over the 10-year initial implementation period. Costs (salaries, on-costs and operating) for project management and delivery are detailed in Table 1. In view of the importance of the Tullaroop catchment as a drinking water supply, increased compliance monitoring to ensure that stock remain excluded from waterways will also be required compared to current riparian programs.

Enabling actions

Cultural Management and Empowerment of Landscape – Wartaka

The purpose of the Aboriginal Waterways Assessment (AWA) is to provide a tool for Aboriginal communities to consistently measure and prioritise river and wetland health, so they are better placed to negotiate for their Country's water needs. Rigorous mechanisms, beyond the usual economic and environmental indicators, are critical for the effective inclusion and empowerment of Djaara in water planning processes. Wartaka – cultural management and empowerment of landscape is central to the ongoing implementation of the ICMP. It provides a framework and mechanism for Traditional Owners to maintain an ongoing connection with Country, to monitor and evaluate the effectiveness of management actions¹⁰ and to provide a means for dialogue and engagement with agencies and community.

Cultural heritage audits

Cultural heritage audits have been identified in the ICMP as a means of building knowledge and understanding of cultural knowledge at key sites across the catchment. This includes research and documentation of place names and family groups as well as recording of tangible and intangible values associated with these sites. It also makes provision for update existing Cultural Heritage Reports (i.e. Long Swamp).

¹⁰ Including contribution to the objectives of the Dja Dja Wurrung Country Plan 2014-2031

Water quality monitoring

Monitoring, catchment modelling and evaluation of landholder practice and behaviour change will be required to ensure the Integrated Catchment Management Plan is implemented and adapted as improved knowledge develops.

Section 3: Roles and responsibilities of key agencies

Stakeholder	Role/responsibility
North Central CMA	The North Central CMA is charged with the responsibility of taking a whole-of-catchment approach to natural resource management in the region. Their primary role is to ensure the protection and restoration of land and water resources, the sustainable development of natural resources-based industries and the conservation of our natural and cultural heritage. Under Part 10 of the Water Act 1989, the North Central CMA is the designated responsible manager of waterways, drainage and floodplains.
Central Highlands Water	Central Highlands Region Water Authority is a regional urban water authority, which supplies urban and rural water and wastewater services to communities across central Victoria. As outlined in the Safe Drinking Water Act (2003) CHW is responsible for ensuring that water storages and adjoining lands are managed in accordance with this legislation along with the Safe Drinking Water Regulations (2015) and the Water Act (1989).
Indigenous community (Dja Dja Wurrung Clans Aboriginal Corporation)	Dja Dja Wurrung CAC are the Traditional Owners of the land covered by the Tullaroop ICMP. DDWCAC have entered into a Recognition and Settlement Agreement in 2013 with the State of Victoria. Traditional Owners with recognised native title rights or formal agreements with the State are important in land and water management. Dja Dja Wurrung is also a member of various confederations such as Murray Lower Darling Indigenous Nations (MLDRIN) and the Federation of Victorian Traditional Owners Committee (FVTOC), actively representing the rights of Traditional Owner groups in water policy and governance across the Murray-Darling Basin and state of Victoria. Dja Dja Wurrung may also be represented by Djandak (the commercial arm of the corporation) and Kapa Gatjin (To Know Water) Advisory Group, the water focused subdivision of Dja Dja Wurrung Enterprises. Kapa Gatjin's purpose is to support and advise the Dja Dja Wurrung Water Unit on the execution of the 'Rivers and Waterways' chapter of the Dja Dja Wurrung 'Dhelkunya Dja' Country Plan.
State Government (Department of Environment, Land, Water and Planning, Parks Victoria, Department of Economic Development, Jobs, Transport and Resources)	The Department of Environment, Land, Water and Planning (DELWP) is the lead agency for water and waterway management. It is responsible for the development of waterway policy, co-ordination of regional delivery and prioritisation of Government investment in waterways. DELWP and DEDJTR are also responsible for aspects of natural resource management relevant to waterways, including: <ul style="list-style-type: none"> ensuring the sustainable management of Victoria's water resources overseeing the catchment planning framework to promote integrated catchment management throughout Victoria managing biodiversity and threatened species management of public land, including Crown frontages bushfire management on public land

	<ul style="list-style-type: none"> • delivering sustainability and environment services at the regional level, including some services that relate to waterway management • managing fisheries and recreational fishing in waterways to optimise economic and social value while ensuring the sustainability of resources • investing in and delivering farming programs on private land where waterways occur • overseeing the management of biosecurity, including invasive aquatic weeds and animals
Local Government (Hepburn, Central Goldfields and the City of Ballarat)	<p>Councils are involved in the management of waterways in Victoria through their role as responsible planning authorities, managers of stormwater drainage and onsite domestic wastewater systems, users of integrated water systems, land managers, emergency management bodies, and supporters of community groups. Specifically with regard to water quality and waterways, local government have the following roles and responsibilities:</p> <ul style="list-style-type: none"> • incorporate waterway and catchment management objectives, priorities and actions into strategic and statutory planning processes • develop and implement urban stormwater plans • manage on-site domestic wastewater systems
Goulburn- Murray Water	<p>Goulburn Murray Water’s statutory functions include irrigation supply and drainage systems, surface water diversions and groundwater in its region. Goulburn Murray Water also promotes best practice land use and development within the catchments to its storages for water quality and biodiversity purposes. GMW’s statutory functions of relevance to the Integrated Catchment Management Plan are licencing of surface and groundwater and operations and maintenance of dams (e.g. Tullaroop Reservoir).</p>
Farmers/land managers	<p>Landholders are vital to the successful implementation of this Integrated Catchment Management Plan, as most works are on privately owned land or affect areas that require private co-operation, and their land management practices have a vital role in catchment health. Under the Catchment and Land Protection Act 1994 landholders are required to:</p> <ul style="list-style-type: none"> • protect water resources • avoid causing or contributing to land degradation which causes or may cause damage to land of another owner • conserve soil • eradicate regionally prohibited weeds and prevent the growth and spread of regionally controlled weeds • prevent the spread of, and as far as possible eradicate, established pest animals.
Landcare Networks and Landcare Groups	<ul style="list-style-type: none"> • Local information sharing and awareness raising • Direct implementation of projects • Community capacity building

Section 4: Information gaps

The science and benefit: cost analysis underpinning the Integrated Catchment Management Plan has used available published and unpublished information including technical expertise and local knowledge. A collaborative and participatory approach has been used and supporting studies have been undertaken. Comment and review have been invited on the component pieces of work.

A number of important information gaps remain, particularly with respect to moving beyond assessing risk to quantifying impacts and assessing the feasibility of addressing these impacts.

The following areas have been identified as significant information gaps:

- Implications of future climate change on catchment water yield and flow-on effects for aquatic ecosystems and water quality
- Detailed and specific understanding of the relationships between nutrient run-off, transport and frequency and duration of blue-green algal blooms in Tullaroop Reservoir and potentially other catchment storages and contributing streams
- The potential costs and benefits, especially to Central Highlands Water in reducing blue green algae impacts on water quality and subsequent treatment and disposal challenges.
- The impact and potential treatment options for localised saline intrusions to some waterways across the catchment.

This said, imperfect information is not a reason for lack of pro-active action. A precautionary approach is well recognised throughout Victoria's natural resource governing frameworks and is particularly important in protecting drinking water supply catchments as has been outlined in previous relevant work (Billington, 2016).

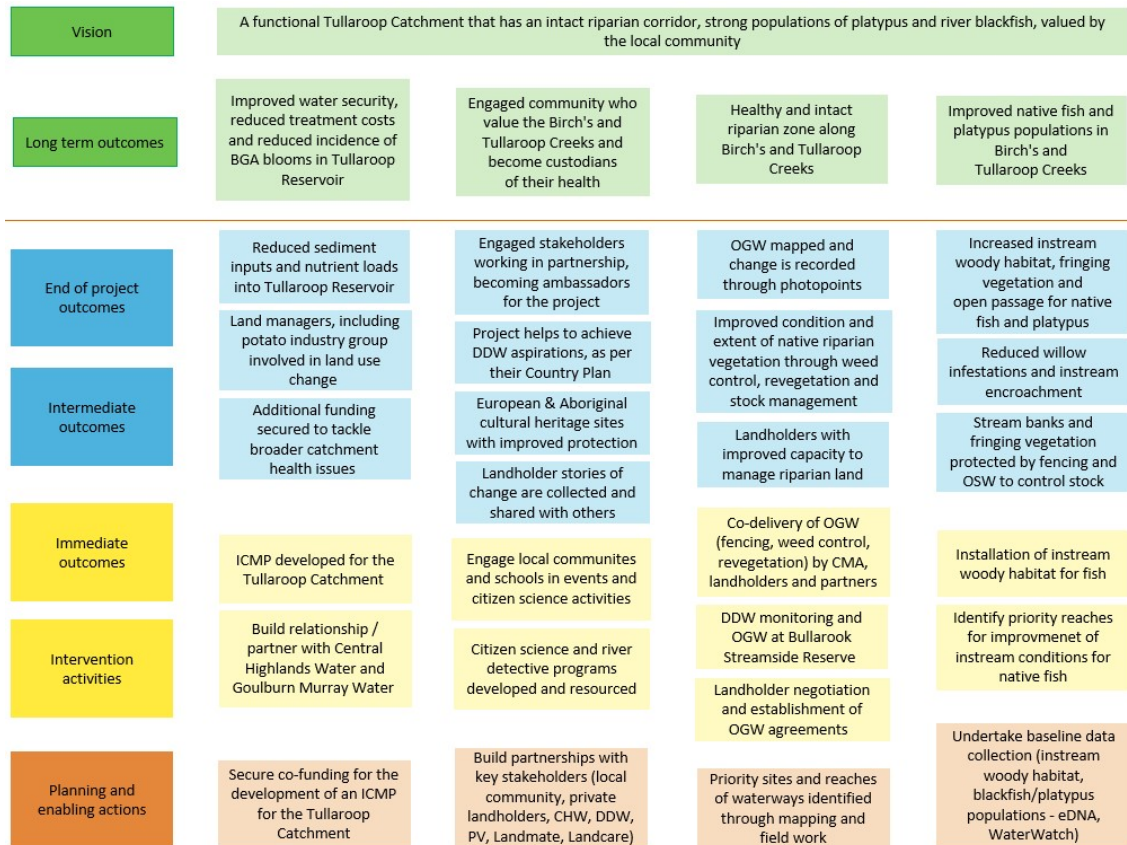
As knowledge improves, some aspects of the Integrated Catchment Management Plan may be updated as part of adaptive management. Adaptive management should occur as a systematic process to improve management effectiveness by adopting an explicit approach to learning and review.

Section 5: Monitoring, evaluation and reporting

Monitoring, Evaluation, Reporting and Improvement (MERI) is ensuring that projects are designed, delivered and reviewed in a way that is transparent, defensible and holistic. Collection of information and reviews should be timely and allow for adaptive management. The basic premise is to ensure that collected information is used as evidence that describes why something was done, what it achieved and how it could be done better.

MERI doesn't require strict adherence to scientific principles. A clearly documented articulation of what was intended (logic) is the initial step. This should enable the design and collection of a targeted, but diverse, set of qualitative and or quantitative data which is used to prove and improve the project.

The following project logic was developed in 2020.



The following minimum MERI requirements for the Tullaroop Catchment Restoration Project will be met according to North Central CMA Monitoring, Evaluation, Reporting and Improvement Policy (MERI001).

Table 2: Overview of MERI requirements for Tullaroop ICMP

MERI action	Minimum requirement
Output mapping	Yes
Photopoint monitoring	At every works 'site' (e.g. wetland, property, etc.)
Event and Advisory Group evaluation	At every event, and annually for project-based working groups
Stories of change	2-3 per year
Project evaluation	Performance Report every two years

Output mapping - involves capturing outputs digitally in the North Central CMA iMap system according to DELWPs Output Data Standards¹¹ (March 2021), which is the core standard for natural resource management reporting in Victoria. Outputs may include fences, revegetation, weed control, management agreements, engagement events, plans, publications, etc.

¹¹ [Output data standard \(water.vic.gov.au\)](http://water.vic.gov.au)

Photopoint monitoring - Taking a series of photos before and after works from the exact same place, at the same time of day and year provides evidence of the works undertaken and the change they generated. This is useful for both auditing and communication purposes.

Event evaluations - To enable projects to demonstrate an improvement in skills or knowledge and an intention to change (a practice, an approach, management, etc.), information from event participants must be recorded from every event North Central CMA coordinates. This enables monitoring (of changes to participant skills, etc.), evaluation of an event (or series of events) and improvement (of delivery, topic, etc.). Additionally, a similar approach is used annually to understand the impacts of advisory groups, through understanding participant's thoughts on their input, any information provision and discussion or potential improvements.

Stories of change - Intended to capture a participant's learning's and any changes influenced directly by a single project. These may be changes in attitude, asset condition, practice, understanding or any aspect around the project produced in either written or digital format (video).

Performance Report – Undertaking a final/mid-term project performance report is intended to provide a comprehensive and single point for documenting a project's delivery processes, adaptive management and achievements. They are written so a project outsider (e.g. funder, member of the public) can read it and understand why the project was developed, how it was delivered, what it achieved and the quality of the evidence to support that information.

Other monitoring

Monitoring of waterway health is also undertaken through the North Central Waterwatch program with community volunteers and River Detectives program through the involvement of local schools. Community involvement in Waterwatch helps to build people's knowledge of waterway health and help create a sense of custodianship of their waterways. Understanding and reporting on the condition of our waterways is important for guiding waterway management decisions and demonstrating management outcomes.

Macroinvertebrates are excellent indicators of river health. This program will also see Waterwatch volunteers receiving training and support to undertake annual macroinvertebrate and habitat monitoring each spring. The data collected will be used to provide an annual River Health Snapshot Report to track the improvements in ecological condition over time, as published for Birch's Creek since 2017.

Additional monitoring is planned through the community collection of water samples for DNA testing alongside experts will provide a hands-on opportunity to understand the distribution of river blackfish and platypus populations in the catchment. Electrofishing at key sites will also add to our understanding of fish life in the catchment's waterways.

AWA monitoring and evaluation

The Dja Dja Wurrung Aboriginal Waterway Assessment (AWA) for Tullaroop Creek and Long Swamp completed in May 2021 provided recommendations supported by comments from the Kapa Gatjin assessment group that can act as a baseline for future monitoring.

The AWA will be repeated in 2022/23. In the interim, a monitoring approach will be developed with Kapa Gatjin to capture progress toward achievement of the recommendations and validation of the approach, both tangible and intangible.

Section 6: Governance and implementation

A key action for the implementation of the plan is to determine long term funding requirements and cost-sharing arrangements across partner organisations.

In April 2020, a Memorandum of Understanding was signed between North Central CMA and Central Highlands Water given the shared interests in the long-term management of water and its importance to the health of the region. Both organisations are committed to working collaboratively on shared opportunities and challenges, including an integrated approach to catchment management. The MoU strengthens the collaborative relationship between the organisations and promotes cooperation and joint action to maintain and improve catchment health.

An important action is to collaborate on shared opportunities to work with Traditional Owners with a particular focus on the Dja Dja Wurrung Recognition and Settlement Agreement. Under Schedule 16 (NRM Participation), Dja Dja Wurrung will have many opportunities for involvement in the implementation of the ICMP through:

- Representation on the Technical Working Group
- Engaging in or gaining skills training in natural resource management research and monitoring
- Incorporation of traditional ecological knowledge, such as Aboriginal Water Assessments informing the development and delivery of on-ground works and community engagement plans
- Employment and procurement to deliver components of the ICMP

The ICMP will be implemented as the North Central CMA-managed Tullaroop Catchment Restoration Project. A two-tiered governance approach will be formalised in 2021/22 through an Expression of Interest process and establishment of Terms of Reference. The groups will comprise:

Technical Working Group (TWG)

The TWG will involve representation from key organisation stakeholders, including Central Highlands Water (CHW), Goulburn Murray Water (GMW) and Dja Dja Wurrung Clans Aboriginal Corporation (DDW). The TWG will be chaired by the North Central CMA Project Manager and will guide the implementation of the ICMP, including the development of an annual communication and engagement plan, highlighting successes and resolving issues through an adaptive management approach. An annual implementation plan will clarify the outputs and target areas for action, including budget, fund source and responsible person/organisation. The draft project logic will also be reviewed to fine-tune MERI requirements. The TWG is envisaged to meet four times per year for the life of the project, both online and visiting key on-ground work sites.

Community Reference Group (CRG)

The CRG will include representation from other organisation stakeholders such as Hepburn Shire, Central Goldfields Shire, Parks Victoria (PV) and DELWP, along with community group representatives and individuals. CRG membership via an Expression of Interest will be revised every four years. The CRG will be chaired by a member of the North Central CMA Community Leaders Group local to the project area. The CRG will be the key source of local information guiding implementation of the ICMP and be the main method of distributing project information to the community and providing feedback regarding the approach. Key feedback will be provided to the TWG to assist them to guide the implementation of the ICMP. The CRG is envisaged to meet three times per year for the life of the project at on-ground work sites and places of interest.

On-ground delivery

Regarding the delivery of on-ground works, targeted landholders will be contacted using existing contacts (i.e. previous participating landholders, neighbours, Landcare groups, GMW, etc.) and, if required, ratepayer mail outs involving local government. Landholder participation in the Tullaroop Catchment Restoration Project is voluntary.

North Central CMA (and/or Djandak) field officers will be the key point of contact with individual landholders. An onsite property visit enables the landholder to explain the site issues, constraints, stock management, vision for the site and their skills and ability to manage their frontage. The field officer will explain the benefits of waterway protection, incentives available, minimum standards for delivery (as per DELWP guidelines) and ongoing landholder management responsibilities. It is important that both parties understand their proposed contribution, timing and responsibilities, and that the project has mutual benefits and commitment.

The approach will differ between landholders along creeks where the fencing is an internal fence, as opposed to Tullaroop Reservoir where the fencing is a boundary fence, e.g. the need for a boundary survey. The approach for fencing and addressing other access/weed management issues around Tullaroop Reservoir will be negotiated between GMW, CHW, North Central CMA and the adjacent landholders using learnings from Coliban Water who have successfully fenced most of the Upper Coliban, Lauriston and Malmsbury reservoirs.

After the initial site visits have been conducted, the DELWP-developed riparian benefit: cost scoring calculator will be used for assessing, scoring and prioritising proposed works sites. It is important to consider approaches that maximise the amount of on-ground public benefit that can be achieved from riparian management projects with a given amount of funding and consider whether these projects represent value for money. The use of this tool is mandatory for all DELWP funded projects, such as the Tullaroop Catchment Restoration Project.

If favourable from a benefit: cost perspective, the agreed activities will be captured in a signed On-ground Works Agreement with the land manager. This Agreement is legally binding and continues to operate in accordance with the outlined ongoing management obligations and responsibilities as long as the landholder owns their property (or holds the Crown land licence) to secure and protect the funding body's investment. The works specifications and ongoing landholder obligations and responsibilities outlined in Agreements will differ according to each landholder's circumstances within the bounds of the incentives offered and minimum standards for delivery.

Where Crown water licences exist along waterways, conversion to a riparian licence will be coordinated with DELWP and reflected in the On-ground Works Agreement.

In recognition of the substantial investment of public funds in riparian protection and improvement projects on freehold and Crown land in Victoria, DELWP has worked with CMAs to develop Riparian Works Review Standards.

These are obligatory standards for riparian works review and landholder evaluation which must be undertaken by CMAs for all new riparian works pre- and immediately post-works, and for an agreed subset of riparian works at three and eight years after completion. Application of the standards commenced state-wide in the 2019/20 financial year and also involve the capture of photo points.

Relevant permits will be obtained by the North Central CMA, including from public land managers where works occur on Crown land and Land Use Activity Agreement notification is required, e.g. revegetation. Other pre-works checks regarding cultural heritage and threatened species will also be completed.

Traditional Owner natural resource management crews, the Loddon Landmate crew and other local contractors will be engaged to undertake on-ground works using local suppliers according to North Central CMA procurement guidelines and riparian management best practice. This will also align with the legislated Recognition and Settlement Agreement procurement strategy for natural resource management for Dja Dja Wurrung Clans Aboriginal Corporation. Contractors will undergo safety and cultural heritage inductions to sites.

Approvals for the installation and licensing of off stream watering are the responsibility of the landholder.

After completion, the quality of the works will be inspected by North Central CMA (and/or Djandak) field officers, outputs mapped, and a post-works Riparian Works Review Standards survey completed (including landholder survey), along with photo points.

Ongoing maintenance of fencing in a stock-proof condition and off stream watering infrastructure provided along waterways is the responsibility of the landholder, with the exception of a natural disaster event where funds to reinstate funded infrastructure would be sought by the North Central CMA. Often, light grazing in autumn is permitted once revegetation has been established is included in the On-ground Works Agreement, where ongoing grazing must not hinder any natural regeneration.

Ongoing maintenance of boundary fencing around Tullaroop Reservoir is assumed to be shared between GMW and the landholder.

On private land, the responsibility for weed control within a fenced waterway frontage remains the landholders under the *Catchment and Land Protection Act 1994*. However, the Tullaroop Catchment Restoration Project is able to assist with the initial weed control using skilled contractors and negotiate follow-up maintenance within one year post control through an additional contractor visit or the provision of appropriate chemical (considering the skills and knowledge of the landholder). This is clearly documented in the On-ground Works Agreement.

Ongoing maintenance of weeds on GMW land around Tullaroop Reservoir is assumed to remain the responsibility of GMW, with access to be provided through the adjacent private land.

Section 7: Supporting documents

The following supporting documents have been developed to support the Integrated Catchment Management Plan. They are referred to in this Plan in relevant sections and provide further detail on the topics covered.

- **Background paper: Tullaroop Integrated Catchment Management Project (Park, Roberts and Dunolly-Lee, 2021)**

This report, commissioned by the North Central Catchment Management Authority (NCCMA) and Central Highlands Water, summarises the available information on which to develop a business case and Integrated Catchment Management Plan (ICMP) for the Tullaroop catchment.

- **Tullaroop Catchment INFFER Report ((Park, Roberts and Dunolly-Lee, 2021)**

The Investment Framework for Environmental Resources (INFFER) was used to assess the benefits and costs of six agreed options over a 30 year period for an Integrated Catchment Management Plan (ICMP) for the Tullaroop catchment.

- **Djandak (2021). Dja Dja Wurrung Aboriginal Waterway Assessment, Tullaroop Creek & Long Swamp - May 2021. Dja Dja Wurrung Enterprises Pty Ltd**

The purpose of the Aboriginal Waterways Assessment (AWA) is to provide a tool for Aboriginal communities to consistently measure and prioritise river and wetland health, so they are better placed to negotiate for their Country's water needs. Rigorous mechanisms, beyond the usual economic and environmental indicators, are critical for the effective inclusion and empowerment of Djaara in water planning processes. The knowledge retrieved from the AWA approach provides important data which can then be used to deliver a holistic management approach in the Tullaroop catchment to inform various projects being developed for the waterway, including preventative and rehabilitative works and key management plans around land, water, fire and biodiversity management. It will also be used to inform Dja Dja Wurrung water policy internally, developing management recommendations and identifying priorities for water management such as delivery, works, weed removal, water testing, revegetation and reintroduction of key species back into the landscape. The decision was made for Dja Dja Wurrung to undertake an AWA throughout the Tullaroop catchment, with the waterway previously being identified by Dja Dja Wurrung as a highly important place that contains a substantial amount of Cultural Heritage and Cultural values. This was supported financially by the Tullaroop Integrated Catchment Management Plan and 'Putting the Swamp Back into Long Swamp' project, both of which also provided in-kind support throughout the AWA fieldwork and site selection processes.

Section 8: References

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