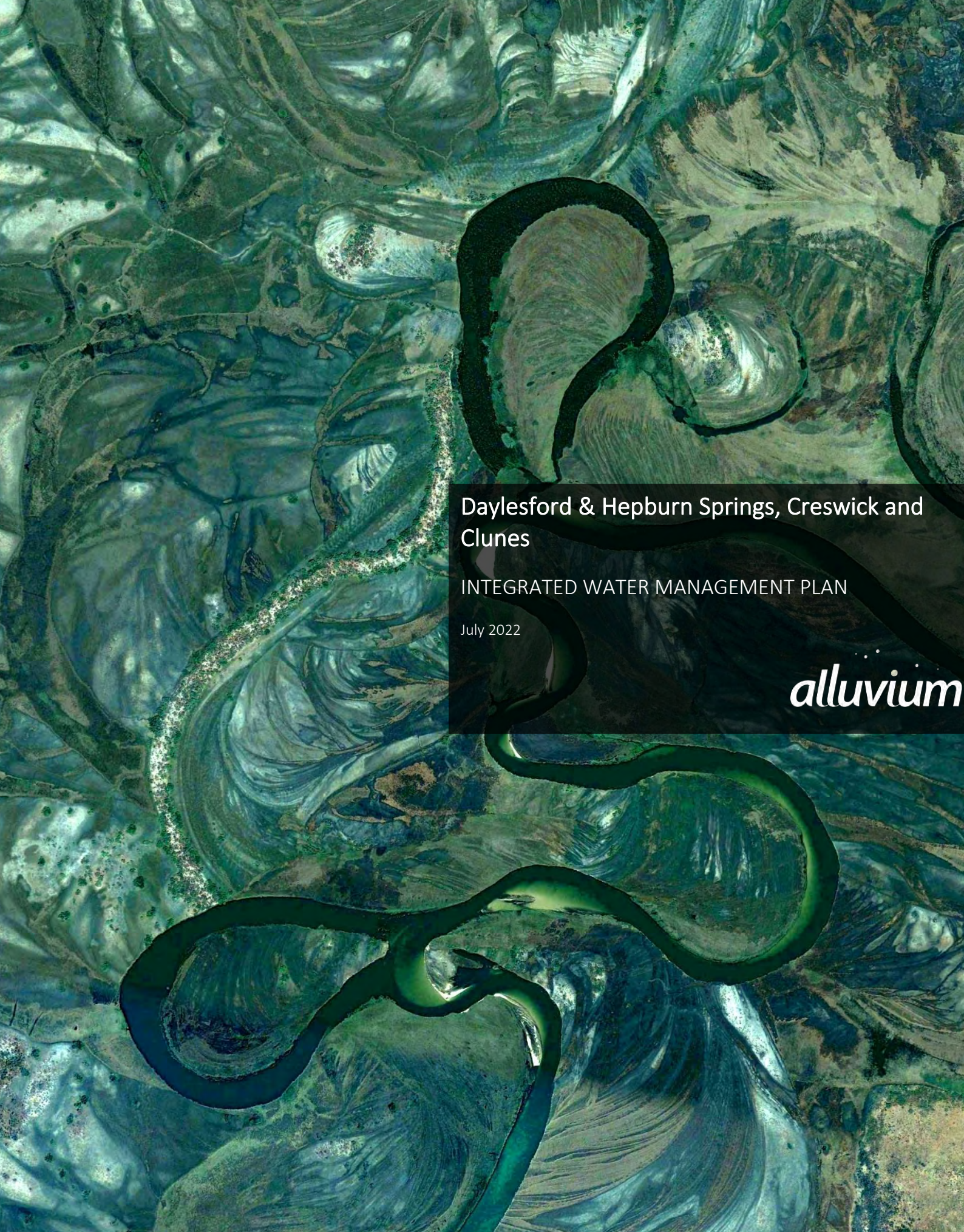

Daylesford & Hepburn Springs, Creswick and Clunes

INTEGRATED WATER MANAGEMENT PLAN

July 2022

alluvium

CENTRAL HIGHLANDS WATER

Hepburn SHIRE COUNCIL

Alluvium recognises and acknowledges the unique relationship and deep connection to Country shared by Aboriginal and Torres Strait Islander people, as First Peoples and Traditional Owners of Australia. We pay our respects to their Cultures, Country and Elders past and present.

Artwork by Vicki Golding. This piece was commissioned by Alluvium and has told our story of water across Country, from catchment to coast, with people from all cultures learning, understanding, sharing stories, walking to and talking at the meeting places as one nation.

This report has been prepared by Alluvium Consulting Australia Pty Ltd for *Central Highlands Water* under the contract titled *Daylesford & Hepburn Springs, Creswick and Clunes Integrated Water Management Plan*.

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1. Introduction

Integrated water management (IWM) is a *"collaborative approach to water planning and management that brings together organisations with an interest in all aspects of the water cycle, including waterways and bays, wastewater management, alternative (non-potable) and potable water supply, stormwater management and water treatment. It considers environment, social and economic benefits." (Integrated Water Management Framework for Victoria [DELWP, 2018]).*

IWM considers how the delivery of water, wastewater and stormwater services can contribute to a range of water cycle issues including water security, environmental health, community health and well being and amenity across the urban environment. An IWM approach fundamentally shifts the way in which water cycle management, land use planning and community development are undertaken in Victoria.

Water is fundamental to the viability of the region and the health and wellbeing of its communities. As our climate changes, intense rainfall, flooding, extreme heat events and drought are becoming more common in Victoria and across the world. Future proofing water supplies for the basic human needs it provides and the quality of life it enables, is more important now than ever before.

The Daylesford & Hepburn Springs, Creswick and Clunes IWM Plan has been developed with stakeholders to establish a basis for ongoing collaboration and a clear direction for water management in these three townships. The plan will provide guidance on how an IWM approach can meet broader environmental and social objectives while ensuring that these towns continue to be great places to live, work and visit.

The need for this plan was identified within the Central Highlands Strategic Directions Statement [SDS, 2018] that was published by the Central Highlands IWM Forum. While originally identifying Daylesford as the priority for an IWM plan, subsequent consultation concluded that the study should be extended to include two additional townships within the Shire: Creswick and Clunes. The vision, outcomes and objectives defined within the SDS for the Central Highlands region have formed the strategic basis for the plan, while investigations, analysis and engagement tasks have led to the plan responding to the unique characteristics of each town and their communities.

Figure 1. *Russells Reservoir, Creswick*

1.1. Hepburn Shire

Hepburn Shire is located about 100km northwest of Melbourne on the lands of the Dja Dja Wurrung people. It is within the Central Highlands region and near the edge of the Great Dividing Range and the upper catchment of the Loddon River (see Figure 2 above). The Hepburn Shire Council Plan (2021-2025) estimates that the Shire had a population of 16,157 in 2021 that is expected to grow moderately to 17,700 by 2036 with that growth spread relatively evenly over the Shire. Of the total population, it is estimated that approximately 1,300 are part of the Indigenous population (Dja Dja Wurrung, 2014).

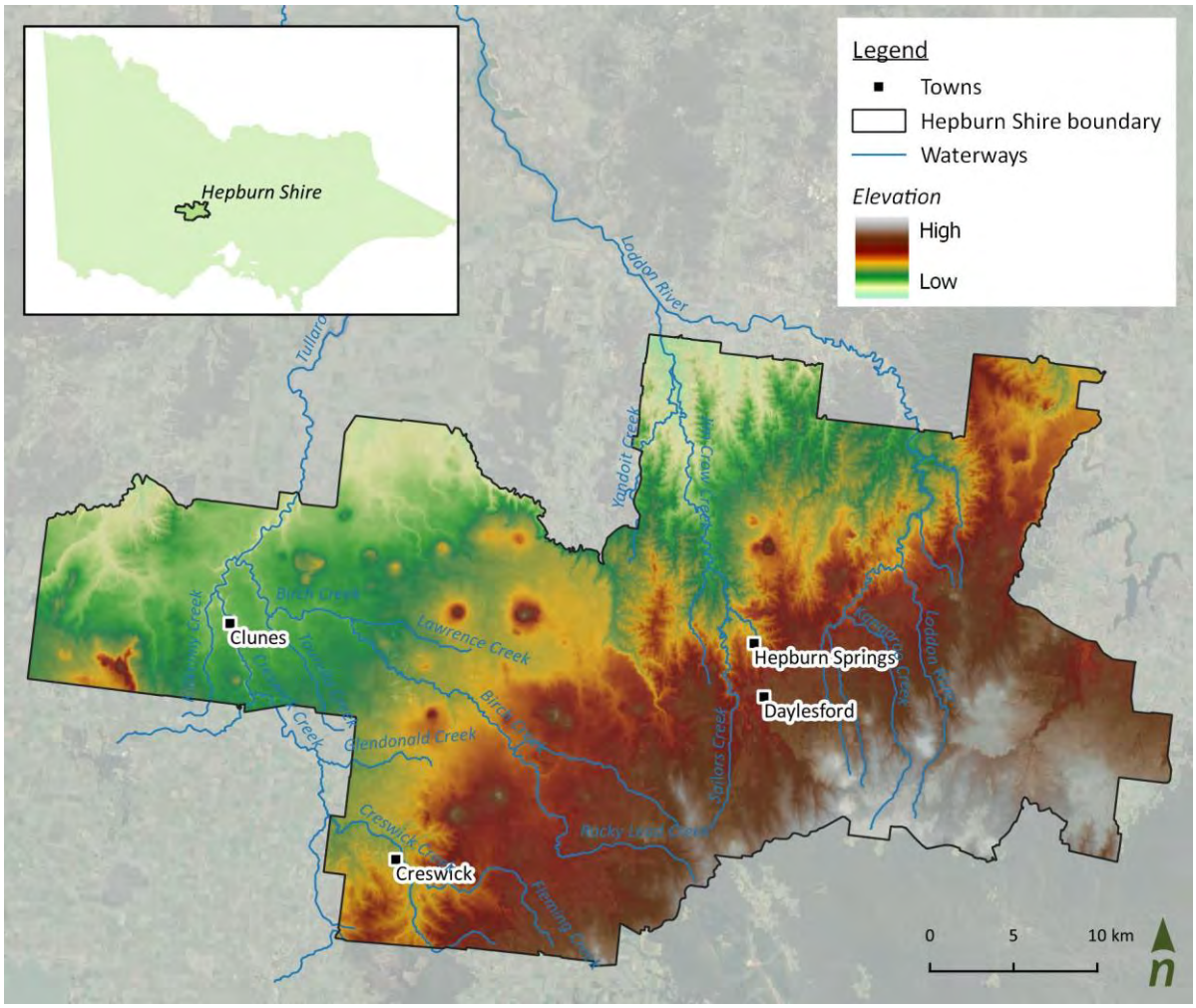


Figure 2. *Location of Hepburn Shire, Daylesford & Hepburn Springs, Creswick and Clunes, and major waterways*

Traditional Owners and their relationship to water

"Dhelkunya Dja" - Dja Dja Wurrung Country Plan (2014 – 2034) notes that Dja Dja Wurrung country is "some of the most profoundly altered landscapes in Victoria", noting "unsustainable development, changed fire regimes and mining" as being drivers behind the significant and detrimental impact to Country. In terms of waterways, land clearing and gold mining have had a significant impact on waterway health and form. Relatively recent challenges, such as expanded urban development and climate change will continue to present challenges to efforts to repair land and water across the region.

Goal 5 of the Dhelkunya Dja - Dja Dja Wurrung Country Plan addresses Rivers and Waterways noting: *"The land and its waterways remain central to the Dja Dja Wurrung's cultural identity and aspirations. The rivers are the veins of Country, and provide food and medicine, and places to camp, hunt, fish, swim and hold ceremonies. They are places that are central to creation stories, and many cultural heritage sites are associated with waterways – burial sites, birthing sites and middens. Waterways are places where Dja Dja Wurrung connect with their ancestors and pass traditional knowledge on to their children and grandchildren".* The specific objectives of that plan are discussed further in Section 2.3 below.

European settlement

While European history across these townships is steeped in gold mining, today the region has a predominantly rural and agricultural character. Within that context however, the three townships each have distinctive characters and communities. From a water cycle perspective, their locations within the catchment, water sources, landscapes, elevations and geography mean that each town has a distinct relationship with their water cycle.

Clunes was established on the site of Victoria's first gold strike in 1851. It is situated on the Creswick Creek with a population of about 1,700 (ABS, 2016). Its streetscapes retain a uniquely 19th century feel that is reflected in the architecture of the store fronts lining main streets like Fraser Street (Figure 3). It is also well known for the 'Booktown' Festival each May which draws a large number of tourists to the area.

Figure 3. *Historical architecture preserved on Fraser Street, Clunes*

Creswick was established soon after Clunes through the discovery of gold, with many of the historic buildings in the main streets dating back to that period. Also situated on Creswick Creek, the town is surrounded by pine and eucalyptus plantations, some of which date back to the when the Victorian School of Forestry opened in 1910. Today the Creswick township has a population of approximately 3,170 (ABS, 2016).

Daylesford & Hepburn Springs, also founded in the 1850's, are best known for their mineral springs and spa developments making it a notable tourist destination and weekend escape from Melbourne. The springs have driven the Shire's tourism industry since the 1860's with the town accounting for 80% of Victoria's mineral spring reserves. Daylesford is also characterised by its lakes such as Lake Daylesford and Lake Jubilee that are highly valued by the community for recreation and the iconic visual amenity. Daylesford has a population of approximately 2,550 (ABS, 2016).

As well as natural springs, the Hepburn Shire is known for its pristine lakes and waterways, rural lifestyle, unique heritage and community spirit. As with many regional centres, the COVID-19 pandemic has driven population growth, with an influx of new residents calling the Shire home.

1.2. What is IWM?

IWM is first and foremost a collaborative approach to water cycle planning. There are a number of organisations involved in water cycle management including:

- Department of Environment, Land, Water and Planning (DELWP) that implements policy and sets the strategic direction for water management,
- Local government that is responsible for establishing planning requirements as well as the management of stormwater, drainage and open spaces
- Water and catchment management authorities charged with managing water, sewerage, waterways, catchments and groundwater services
- Traditional Owners of the region's land and water, and
- Communities themselves.

The aim of a IWM approach is for these stakeholders to collaboratively identify opportunities to benefit the health of the water cycle, the community and environment. Typically, the opportunities identified as part of IWM plans do not neatly align with any one organisation's responsibilities. They therefore need to be delivered collaboratively. While there may be a logical lead agency, IWM projects usually require the support of other stakeholders. This is illustrated by the overlapping area on the Venn diagram shown in Figure 4 below. The additional heading either side of that Venn diagram illustrate that while examples like groundwater, water security, onsite wastewater and flooding are all critical aspects of the water cycle, they are the legislated responsibility of one agency and are managed through well-established processes.

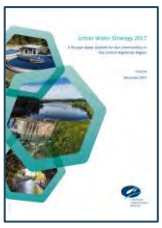
This plan does not seek to reinvent or redefine those processes but rather to improve water cycle management in those examples where stakeholders objectives overlap, presenting opportunities to realise a range of benefits.

An IWM opportunity can be applied in a range of contexts and scales, from regional to street scale across a range of budgets. In this plan, given the unique character of each town, it is important that the opportunities align with each town's character and while ambitious opportunities are welcome, there is also a need for them to be economically feasible and affordable.

Groundwater
Goulburn Murray Water's Central Victorian Mineral Springs Groundwater Management Area Local Management Plan (2013) defines sustainable extraction rates for groundwater aquifers in the region.

On-site wastewater
Hepburn Shire Council Domestic Wastewater Management Plan (DWMP, 2014) manages on-site wastewater and septic tank approvals and maintenance requirements.

Water security
Central Highlands Water's (CHW) Urban Water Strategy (2017) is a document prepared every 5 years with a 50-year outlook to examine water security considering issues like climate change and population growth to define infrastructure requirements



Flooding
North Central Catchment Management Authority (NCCMA) manage flood management and works. Plans like the Creswick Flood Mitigation and Urban Drainage Plan (2012) are being implemented in response to flood events over 2010/11.

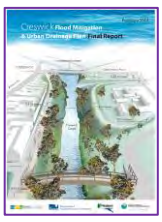


Figure 4. *IWM Venn diagram showing that IWM opportunities reside in the overlap between agency responsibilities (Courtesy of DELWP).*

1.3. Developing the IWM plan

The IWM Plan was developed in close consultation with water agencies stakeholders over 2020 / 21. Consultation with the community was largely undertaken online and through Council representatives which was not the original intent of the project and largely due to travel and meeting restrictions brought about by the COVID-19 pandemic.

The Project Working Group

A project working group (PWG) was established at project inception. It was independently chaired by Jessie Harman who was also appointed as the Chair of the Central Highlands Integrated Water Management Forum. The PWG also included representatives from Central Highlands Water (CHW), Hepburn Shire Council (HSC), Goulburn Murray Water (GMW), North Central Catchment Management Authority (NCCMA) and the Department of Land, Water and Planning (DELWP).

The PWG met monthly over the course of the project to review work in progress and project deliverables and discuss next steps. The PWG shared an understanding of roles and responsibilities, contributed to 'fleshing out' opportunities and identifying areas for collaboration as well as problem solving over the course of the project. Table 1 below describes each agency that was part of the PWG and their responsibilities.

Table 1. Project Reference Group agencies and their water cycle responsibilities

Central Highlands Water (CHW)	Hepburn Shire Council (HSC)	Goulburn Murray Water (GMW)	North Central Catchment Management Authority (NCCMA)	Department of Environment, Land, Water and Planning (DELWP)
Headworks management	Urban stormwater management	Rural water	Waterway health	Legislation, policy and regulation
Urban water supply	Parks and gardens	Irrigation services	Floodplain management	IWM policy development
Wastewater management	On-site domestic wastewater	Groundwater management and licenses	Environmental water (e.g. for waterways)	Land use planning and development approvals and the state level
Recycled water	Urban planning and approvals			

Traditional Owners (Dja Dja Wurrung)

Under a 'Recognition and Settlement Agreement' entered into by the Victorian Government and the Dja Dja Wurrung Clans Aboriginal Corporation (DDWCAC) (on behalf of the Dja Dja Wurrung traditional owner group), the Dja Dja Wurrung are formally recognised as Traditional Owners for this part of Central Victoria.

As Traditional Owners, the Dja Dja Wurrung are important IWM stakeholders. Their role is to:

- provide their expertise in land and water management
- assisting in identifying potential commercial opportunities, and
- to guide the IWM plan and ensure that it aligns with their priorities and aspirations.

Engagement activities with Dja Dja Wurrung centred on a visit to a number of sites where the potential value of IWM opportunities was discussed. This was a valuable experience for the project team and opened up a number of considerations, hitherto unthought of. Since that visit, the report has been reviewed and updated to incorporate those learnings in the hope that it provides a more complete foundation for further engagement with the Dja Dja Wurrung as proposed projects are progressed.

Agency engagement

Input was also received from members of stakeholders organisations, beyond those individuals represented at PWG meetings. While face to face engagement was challenging over the course of the project, a stakeholder workshop involving a broader representation of agency staff was held in Clunes on 4 May, 2021. The aim of the workshop was to

- introduce a broader range of individuals to the project
- establish a shared understanding of the vision, objectives and desired outcomes for the project
- to use the outcomes of the Central Highlands SDS as a framework to identify potential IWM opportunities (including risks and potential barriers) across each township.

Figure 5. *Open discussion at the stakeholder workshop (4th May 2021)*

With groups focussing on one township at a time, each group rotated from 'town to town' to introduce ideas or opportunities as well as building on or challenging those that had already been identified. This process was important in building our collective knowledge about each town as well as building the project's 'long list' of IWM opportunities.

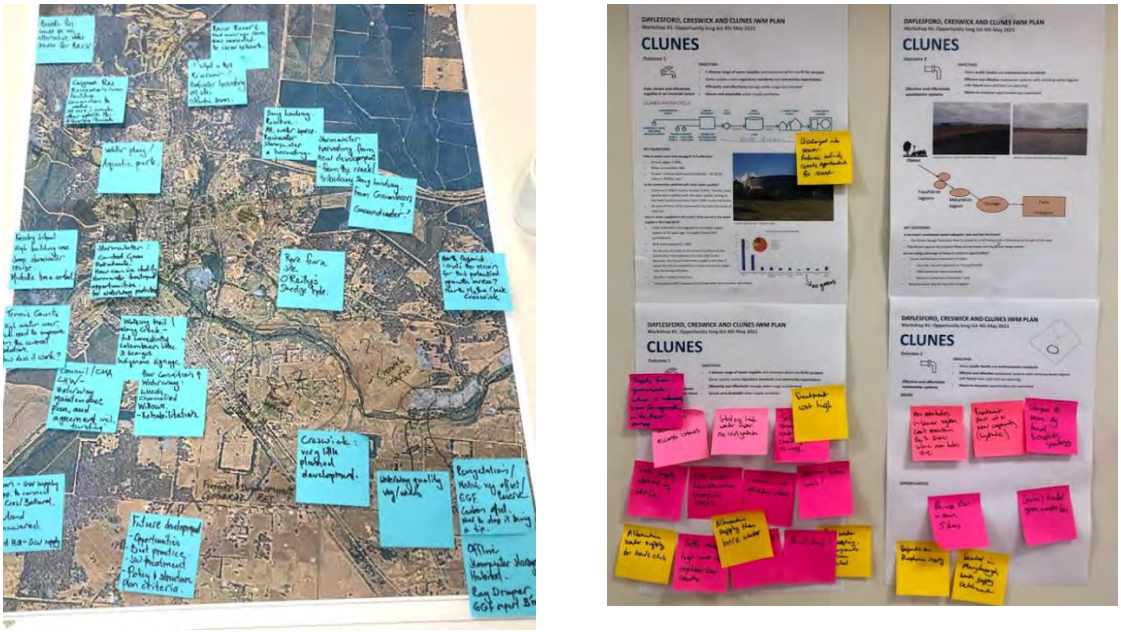


Figure 6. *Examples of feedback collected from the stakeholder workshop (4th May 2021)*

Community consultation

Daylesford & Hepburn, Creswick and Clunes have vibrant, engaged and active communities. Capturing that energy was a priority at the outset of this plan. On reviewing the Hepburn Shire Council Plan 2021 – 2025 (Hepburn Shire Council, 2021) it is clear that the community values its connection to place, nature and the natural assets such as street trees, parks and open spaces, lakes and waterways, botanic gardens and national parks.

Over the period of the COVID-19 pandemic planned face-to-face community engagement including 'open' town hall meetings were not possible. To adapt to this challenge, community engagement was taken online primarily through the Shire's *Participate Hepburn* platform.

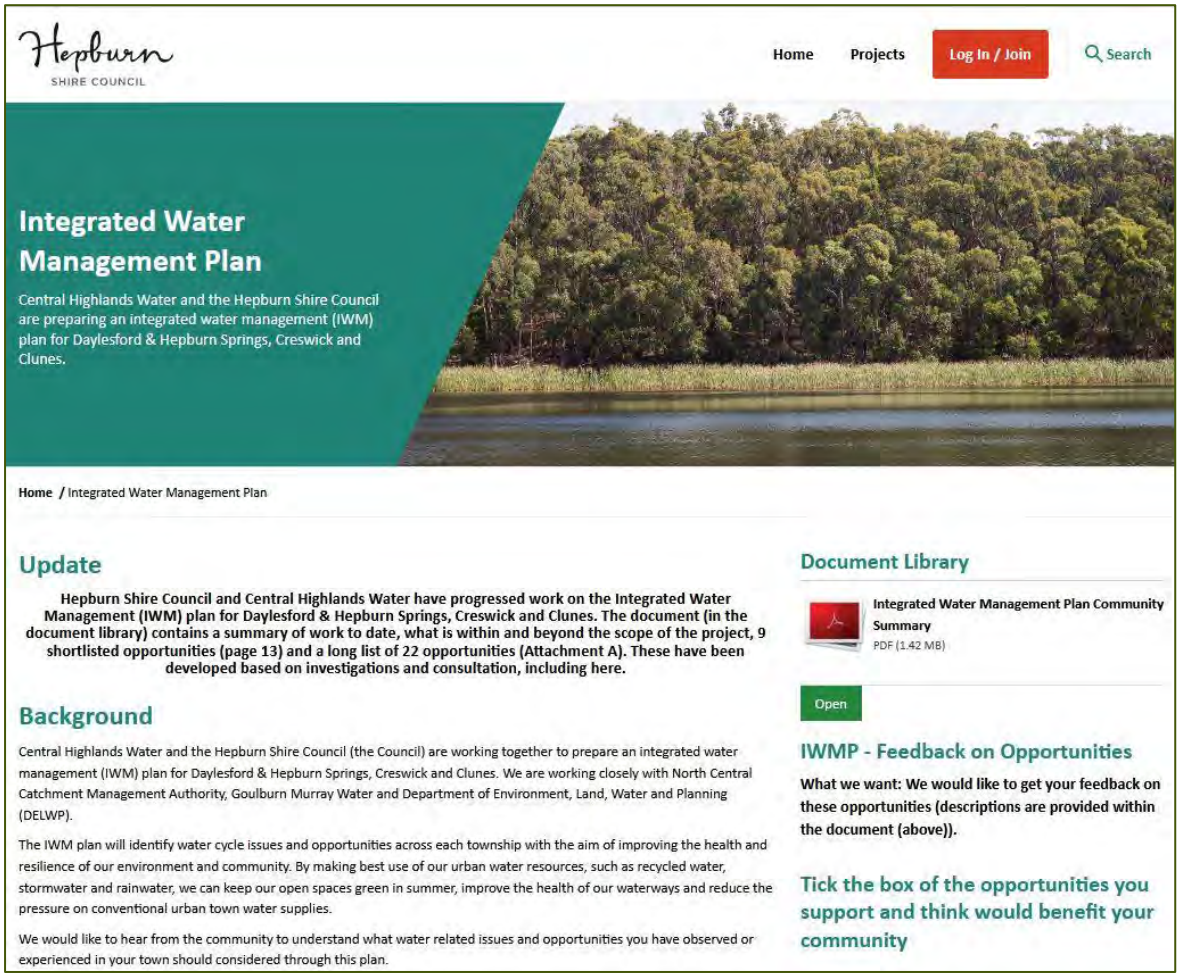


Figure 7. *IWM Plan Community Summary feedback request on Participate Hepburn webpage*

The first round of online engagement was undertaken from July to August in 2021. Based on a short questionnaire, we sought to understand the value of water to the community and any opportunities, issues and desired changes around water management. Outcomes were combined with the findings from literature review, data analysis and agency workshop.

Following this stage, interviews with Hepburn Shire Councillors, as representatives of the broader community, were undertaken. The aim was to verify what we had heard through Participate Hepburn, and to seek the views of the Councillors themselves.

A second round of community engagement was undertaken in November to December 2021 where the community was asked to comment on a number of IWM opportunities that had been identified to address the issues raised to date. Figure 8 below summarises the key issues raised with specific quotes from respondents.

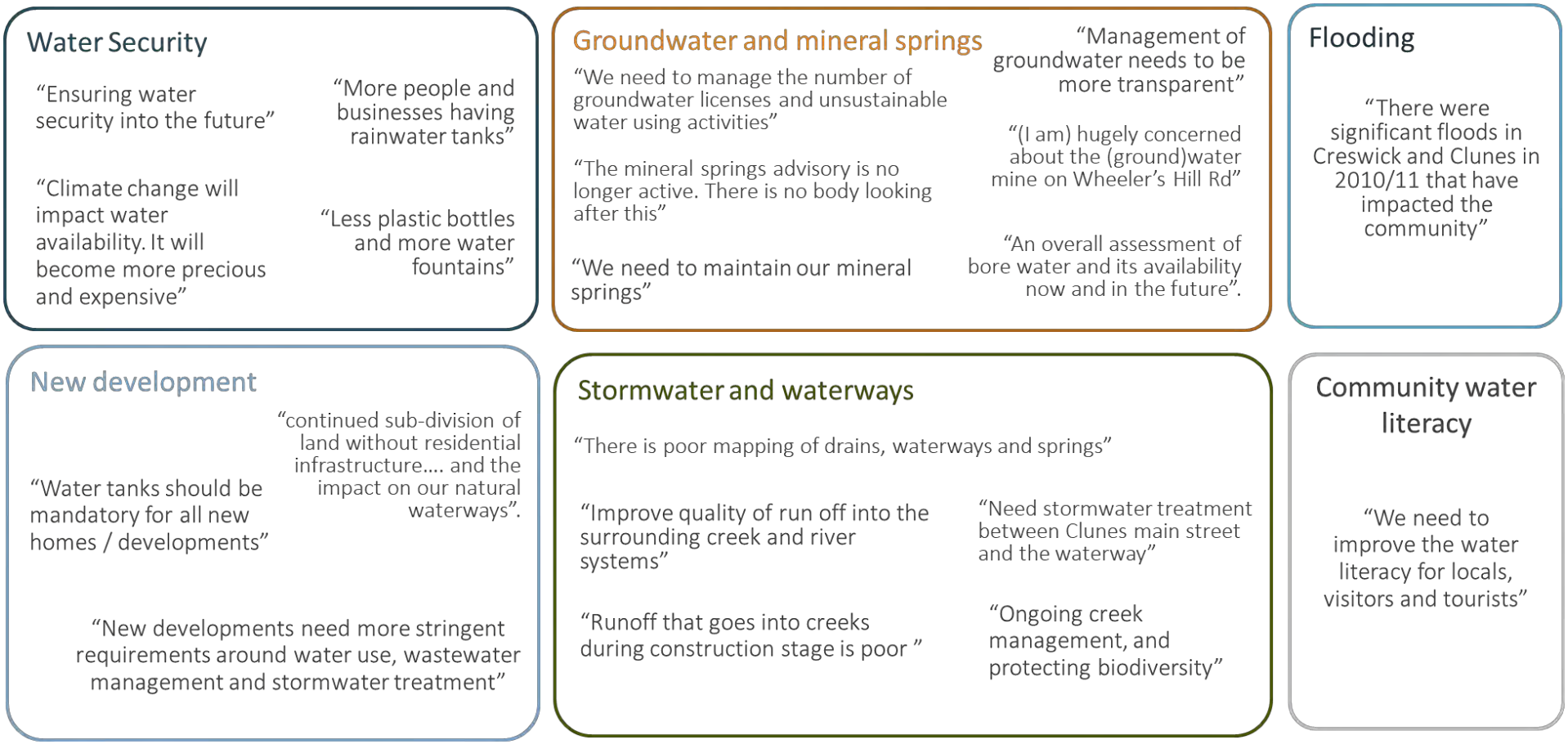


Figure 8. *Summary of community feedback from the Participate Hepburn website*

2. Strategic context

2.1. Central Highlands IWM Forum Strategic Directions Statement (2018)

The Central Highlands IWM Forum is one of nine regional IWM Forums established across Victoria. It is important to note that this IWM Plan aligns with the Central Highlands SDS 2022 Draft as the final 2022 SDS document will be publicly released mid-2022.

Each Forum has produced a Strategic Directions Statement (SDS) that is tailored to the local region. The vision for the Central Highlands SDS stated as:

Working together to leverage opportunities across the water cycle to deliver a healthy, resilient and prosperous future for the region and its communities.

Key to each SDS was the development of seven desired outcomes for each region. These outcomes were unique to each region and have been used as a framework to guide the development of this IWM plan and the opportunities identified within it. The 'outcomes' published in the SDS are reproduced in Figure 9. It should be noted that the township of Trentham lies within the Coliban SDS and is therefore not addressed within the scope of this plan.

Each outcome includes up to four more specific objectives that provide the next level of detail as to what IWM Forum participants are seeking to achieve in the region.

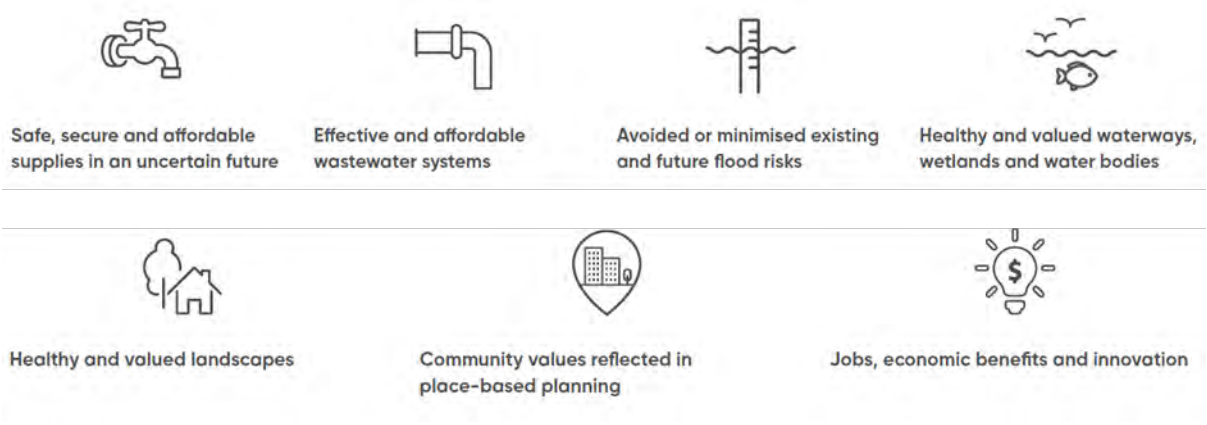


Figure 9. *Central Highlands SDS outcomes*

Action CH5

Action CH5 in the SDS is the "Daylesford IWM Plan" that would "articulate a community vision…identify IWM opportunities…and outline priority projects for implementation". Through consultation it was agreed that the geographical scope of the project would be extended to include Creswick and Clunes. As such, the "community vision" to be articulated was reflected as more of a regional vision. As such the vision expressed within the SDS, and reproduced above, was adopted as the vision for this IWM Plan.

Since early 2022, Central Highlands Water and Coliban Water have collaborated to engage a dedicated resource to the implementation of IWM across the Coliban and CHW business areas, including the recommendations within this plan.

2.2. Hepburn Shire Council

Community Vision 2021 – 2031 / Council Plan 2021 – 2025

The Community Vision and Council Plan including the Municipal Public Health and Wellbeing Plan (Hepburn Shire Council, 2021) was developed through the Hepburn Together project. A key "Focus Area" identified within this document is for "*A resilient, sustainable and protected environment*". Priority Statement 1.5 under that focus area is to "*Protect and regenerate the natural resources of the Shire including soils, water and ecological systems, for both current and future threats*".

Strategy 1.5.3 specifically notes that Council will "*Support the implementation of priorities of the Integrated Water Management Plans*".

Council Planning requirements

The Hepburn Planning Scheme (2021), Section 19.03-3S, defines the objective of IWM as being to: '*sustainably manage water supply, water resources, wastewater, drainage and stormwater through an integrated water management approach*'.

There are seven requirements under the IWM provisions:

1. Take into account the catchment context.
2. Protect downstream environments waterways and bays
3. Manage and use potable water efficiently
4. Reduce pressure on Victoria's drinking water supplies
5. Minimise drainage, water or wastewater infrastructure and operational costs'
6. Minimise flood risks
7. Provide urban environments that are more resilient to the effects of climate change.

2.3. Dja Dja Wurrung Country Plan

Goal 5 of Dhelkunya Dja - Dja Dja Wurrung Country Plan (2014 – 2034), sets out four objectives in relation to Rivers and Waterways:

- Ensure all of our waterways are healthy, with the right water in the right place at the right time to meet the needs of the environment, Djaara People and the broader community
- Have a recognised and legitimate role in water governance, with genuine consultation in policy development to take part in decision-making about our waterways
- Secure adequate and equitable water rights that meet our social, cultural, spiritual, economic and environmental needs
- Share our creation stories to teach people how water works in the landscape

The plan also identifies actions going forward, including to "*Ensure that Dja Dja Wurrung People have a meaningful role in the development of the water policy framework in Victoria and Murry Darling Basin independently and as members of peak Traditional Owner bodies*".

While there has been engagement with the Dja Dja Wurrung in the development of this plan, more work, time and effort is required to meaningfully respond to the objectives set out above. It is the beginning of a longer journey that will change and enrich how we manage water across these three townships, the Shire and Victoria.

2.4. State Government

Victoria Planning Provisions

These requirements build on the Victoria Planning Provisions and under the Particular Provisions in Clause 56.07 that sets out the IWM requirements to be met for residential subdivision proposals in an urban area including:

- reduce the use of potable water (56.07-1)
- encourage the use of non-potable water resources like rainwater (56.07-2)
- minimise wastewater and manage disposal (56.07-3), and
- manage the quality and flow of stormwater run-off (56.07-4).

These legislative requirements drive the implementation of many IWM initiatives in Metropolitan Melbourne in particular.

From an urban development perspective, Clause 56.07-4 requires new development to meet stormwater quality requirements that are defined under the Urban Stormwater – Best Practice Environmental Management Guidelines (Victorian Stormwater Committee 1999). Specifically this requires the following stormwater quality improvement targets to be met in new residential, commercial and industrial developments:

- 80% reduction in the typical urban load of total suspended solids
- 45% reduction in the typical urban load of total phosphorous
- 45% reduction in the typical urban load of total nitrogen
- 70% retention of typical urban load of litter.

Climate change adaptation

Climate change adaptation is a central driver behind an IWM approach to planning. The Victorian Government's "Building Victoria's Climate Resilience" (DELWP, 2022) specifically addresses impacts on the water cycle. The plans identifies the following key priorities:

- Investigate ways to diversify and augment water supplies, including by enabling greater use of stormwater and recycled water.
- Examine co-investment opportunities to deliver water infrastructure with the community, private investors and government partners.
- Enhance climate-related hazard and risk assessment capabilities to support water infrastructure planning, design and investment decisions.
- Identify opportunities to strengthen the water sector's emergency capability, systems and processes for resource sharing.
- Prioritise greater Traditional Owner participation in water cycle adaptation.
- Explore new water efficiency standards for homes and review existing building and plumbing requirements for rainwater tanks and water efficiency.
- Promote innovation to reduce Victoria's water-related emissions across households and businesses, build climate resilience and transition to a circular economy, including by trialling measures to reduce water-related energy use.

All organisations associated with this IWM Plan are acutely aware of these changes and the need to plan for a drier and less predictable future.

3. System understanding

A foundational activity in developing the IWM Plan was an investigation into the water cycle for each town that is summarised within the Water Cycle Performance Summary document (see Attachment A) that addressed questions like: How does each system work? Where does water come from and go to? Where is it treated? Are there 'system' vulnerabilities? This relied on data, information, background literature and a guided tour of critical water cycle assets from reservoirs to treatment plants.

Figure 10. *Cosgrave Reservoir, at Creswick*

Figure 11. *Two Mile Hill water supply tank at Clunes*

The Water Cycle Performance Summary document provides an understanding of each element of the water cycle within each town. It is also the first phase of identifying IWM issues and opportunities that this plan can respond to. A brief summary of key points is provided below and in Section 3.1 and 3.2:

- Hepburn Shire is within the Loddon River catchment.
- Each town has distinct geography, topography and climate that influences their water cycle. For example, Daylesford is relatively elevated in the catchment while Clunes is relatively low lying (see Figure 2).
- Each town has distinct water supply characteristics:
    - Daylesford & Hepburn's water supply is reliant on winter rainfall to local reservoirs with some susceptibility to periods of prolonged drought.
    - Creswick is connected to the Ballarat water supply system that is supported by external sources such as the Goldfields Superpipe.
    - Clunes relies predominantly on treated groundwater.
- In terms of sewerage:
    - Both Clunes and Daylesford & Hepburn have local wastewater treatment plants (WWTP). Daylesford's Shepherds Flat WWTP is located approximately 8.5 km north of Daylesford.
    - Creswick's wastewater is pumped to the Ballarat system for treatment.
    - Both the Shepherd Flat and Clunes WWTPs produce excess volumes of recycled water that are currently used for local farm irrigation.
- Creswick Creek flows through Clunes and Creswick and is susceptible to flooding. Major floods in 2010/11 and 2022 inflicted damage to the urban areas of Creswick and Clunes and impacted the community's relationship to the waterway.
- Daylesford has a close connection to its lakes that are of significant recreational and aesthetic value.
- The stormwater network across the region is not completely mapped making detailed planning challenging. There is some information on drainage pits and pipes.
- As noted above, Hepburn Shire contains over 80% of Victoria's mineral springs contributing greatly to the region's commercial industries, including tourism. This concentration of springs is unique to Australia.

3.1. System summary

A summary of important points by town and aspect of the water cycle is provided in Table 2 below. This provides context for the identification of IWM issues and identification of opportunities. Groundwater and minerals springs is addressed separately below this table.

Table 2. Water cycle summary for Daylesford & Hepburn, Creswick and Clunes

	 Safe, secure and affordable supplies in an uncertain future	 Effective and affordable wastewater systems	 Healthy and valued waterway wetlands and water bodies	 Avoided or minimised existing and future flood risks
Town	**Water supply**	**Wastewater**	**Waterways, lakes and stormwater**	**Flooding**
Daylesford & Hepburn Springs	Daylesford & Hepburn Springs relies on winter rainfall to replenish Wombat, Bullarto and Hepburn Reservoirs. These storages are not large (relatively speaking) and as such water supply is potentially vulnerable to periods of extended drought / climate change.	Wastewater from Daylesford & Hepburn Springs is pumped to the Shepherds Flat wastewater treatment plant (WWTP) about 8.5 kms north of Daylesford. It produces Class B and C recycled water that is used to irrigate 25 hectares of nearby farmland.	Hepburn Shire is located high in the Loddon River catchment. Daylesford is notable for its lakes such as Lake Daylesford and Lake Jubilee that are highly valued community assets. Creswick is home to St Georges Lake and Lake Calembeen that are also valuable recreational assets. Creswick Creek runs through Creswick and Clunes with varying degrees of waterway condition including the presence of invasive vegetation species that are clogging the waterway at some locations. Urbanisation has and continues to impact waterways, generating stormwater with associated pollutants (particularly during construction) The local stormwater networks of each town are not well mapped making stormwater planning challenging.	The townships of Creswick and Clunes are particularly susceptible to flooding with major flood event in 2010/11 and the most recent flood event on 6 January 2022 that caused damages to about 150 homes. The 2010/2011 flood events had significant impact on the community with a flood study and flood mitigation works subsequently undertaken in Clunes. Flood risk in Daylesford is relatively low by comparison given its elevation in the catchment. Sections of the drainage network within each town are also susceptible to nuisance or localised flooding
Creswick	Creswick is connected to the broader Ballarat water supply system. Water is supplied from White Swan Reservoir and water treatment plant. Cosgrave and Newlyn Reservoirs also feed raw water to White Swan Reservoir.	Wastewater from Creswick is piped to Ballarat North WWTP for treatment, approximately 10 km away.		
Clunes	Clunes is supplied by groundwater bores that are approximately 6km south of Clunes. Water is treated at the Clunes Water Treatment Plant (WTP) and pumped to the Two Mile Hill storage where it is gravity fed to town.	The Clunes WWTP produces Class B and C recycled water for local farm irrigation. Treated water is also lost via evaporation. Winter storages on site are often at capacity and there is typically an elevated level of salinity in the recycled water		

3.2. Groundwater and mineral springs

Groundwater is an important and unique aspect of water management in this region that is managed by Goulburn-Murray Water. Daylesford is within the Loddon Zone of the Central Victorian Mineral Springs Groundwater Management Area (GMA) that is characterised by five main aquifers. Creswick and Clunes are within the Ullina and Ascot Zones respectively, within the Loddon Highlands Water Supply Protection Area (WSPA), characterised by two main aquifers.

The GMA and WSPA are divided into management zones based on catchments, hydrogeological characteristics, groundwater flow paths and license entitlement locations to facilitate appropriate management and groundwater use. As well as supporting potable water supplies as discussed above, groundwater from stock and domestic bores is used in agriculture and is therefore critical for the local agricultural economy.

Table 3 summarises the number of groundwater licenses, volume of entitlements and proportion of the entitlement that is typically used in each region. It shows that typically less than 50% of entitlement volumes around Daylesford, and 30-40% of entitlements in Clunes and Creswick are extracted.

Table 3. Summary table of management zones and groundwater licenses for each town in the IWM plan*

	Management zone	Relevant town	Number of licences	Licence volume (GL/ year)	Proportion of licence entitlement used (%)
Central Victorian Mineral Springs GMA	Loddon	Daylesford	71	2.7	< 50%
Loddon Highlands WSPA	Ascot	Clunes	68	7.0	30 – 40%
	Ullina	Creswick	19	2.4	

*Source: Goulburn Murray Water (2013) Central Victorian Mineral Springs Groundwater Management Area – Local Management Plan

Mineral Springs

Hepburn Shire contains over 80% of Victoria's mineral springs. The springs that discharge from the Ordovician sedimentary bedrock aquifer around Daylesford & Hepburn is unique to Australia. Impacts from groundwater pumping on mineral springs that rely on regional and intermediate scale groundwater systems will be managed by capping groundwater licence entitlement. Impacts to mineral springs with high environmental values that rely on local scale groundwater systems will be considered when assessing groundwater licence applications in accordance with Section 40 of the Victorian *Water Act 1989*.

Figure 12. *Wombat Reservoir that supplies Daylesford*

Figure 13. *Shepherds Flat Wastewater Treatment Plant (north of Daylesford)*

Figure 14. *Clear water ponds at the Clunes WWTP*

4. IWM Issues

Identifying potential IWM issues in each town has been based on a combination of sources, including:

- A review of Hepburn Shire Council, Central Highlands Water and other stakeholders documentation, data, plans and strategies
- A site system tour
- Regular feedback from the Project Working Group
- Community plans and social research
- Interviews with Hepburn Shire Councillors
- Feedback gathered from the community via the Participate Hepburn website
- A visit to identified opportunity site with Dja Dja Wurrung representatives.

The IWM issues identified through that process are summarised in Table 4 below and categorised according to desired IWM outcomes as defined within the Central Highlands SDS.

Table 4. Water cycle issues for Daylesford & Hepburn, Creswick and Clunes

Town	 Safe, secure and affordable supplies in an uncertain future Water supply	 Effective and affordable wastewater systems Wastewater	 Healthy and valued waterway wetlands and water bodies Waterways, lakes and stormwater	 Avoided or minimised existing and future flood risks Flooding	 Safe, secure and affordable supplies in an uncertain future Groundwater
Daylesford	Water supply vulnerability due to reliance on seasonal rainfall and local storages Hepburn Shire is the highest water user in Daylesford (due to aquatic facilities, open space irrigation etc.)	The potential for a higher value use of recycled water in Daylesford. The distance of the treatment plant from town is a potential barrier to brining recycled water back into town On site septic tanks impacting waterway health and neighbourhood amenity particularly in new developments	Stormwater quality and volume is an issue impacting waterway health Impacts of infill and greenfield land development due to stormwater volume and quality, additional potable water demand and wastewater generated. This is a key community issue Creek management, protection of biodiversity: Exotic waterway vegetation including along Creswick Creek impacting conveyance efficiency and aesthetic appeal Some communities and townships don't have access to their local lakes and waterways. Connection could be improved There is limited detail on Council's stormwater assets (e.g. location, alignment and size, age and condition) making planning stormwater treatment and reuse opportunities challenging	Riverine flooding does not represent a high risk in Daylesford	There is community concern regarding: • the sustainable use of groundwater • the use of groundwater for bottling • understanding how sustainable groundwater yields are determined. • the impact of land development on the quality and uses of groundwater (and the mineral springs)
Creswick	Creswick and Clunes have a relatively high level of water security through connection to Ballarat and secure groundwater supply respectively The long-term sustainability and groundwater use is of interest and concern for the community	Wastewater is conveyed to Ballarat. There is limited scope for recycled water use in Creswick (with the exception of the possibility of sewer mining that would require a large and consistent demand)		Significant flood risk in Clunes in comparison to Creswick. Recent, serious flood events have impacted the community's relationship with waterways. Waterway maintenance (e.g. weed removal) is required to ensure appropriate flow conveyance during large flow events	
Clunes		There is a local recycled water resource in Clunes with potential for higher value uses Salinity is (anecdotally) a potential barrier to reuse			

5. IWM opportunities

In response to the issues identified above, a long list of IWM opportunities was developed through a process of PWG engagement, agency workshop and taking on community feedback. The following chapter sets out the process of going from the long list, through an assessment phase to a short list of 9 opportunities.

A summary of that process is provided in Figure 15.

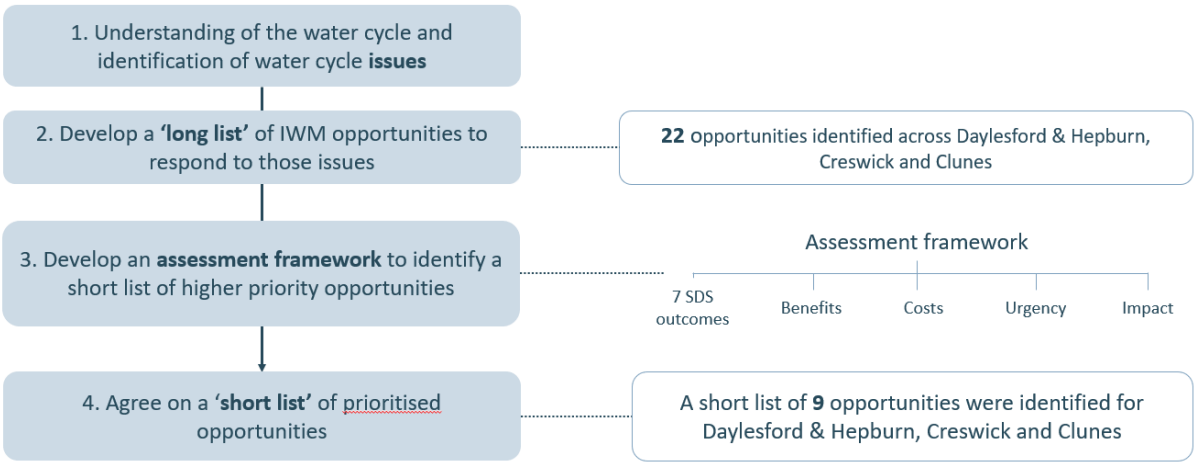


Figure 15. *Opportunity identification and shortlisting*

Feedback from the Dja Dja Wurrung on specific opportunities is included in Table 5, Table 6 and Table 7 below. All lead agencies that take carriage of IWM opportunities identified as part of this plan, commit to ongoing engagement with Dja Dja Wurrung as the plan is progressed.

5.1. Long list

IWM opportunities are actions designed to move each town towards the IWM outcomes set out within this plan and the Central Highlands SDS. The long list of opportunities was developed with stakeholders with the aim of identifying opportunities that respond to identified issues. Ideally, an IWM opportunity will address multiple issues, deliver multiple benefits and require collaboration across stakeholder agencies to deliver. Opportunities were not considered if they did not meet this requirement for collaboration. For example, a conventional drain upgrade, even if urgent, was not seen as requiring collaboration.

Opportunities can take a range of forms including small to large infrastructure projects that are applicable at a range of spatial scales, planning, capacity building and education initiatives and cultural initiatives etc.

The aim of the plan was to identify a mix of opportunities: from ambitious to more affordable that will allow the plan to progress even if funding is variable. Opportunities have been identified at the township scale, to respond to the unique needs of each town, while also considering opportunities at a multi town, or Shire wide scale. The long list of opportunities for each town are presented in the tables below. The first stage of evaluation was against the seven SDS outcomes that were introduced in Section 2.1. A more detailed explanation of each opportunity is provided in Attachment B: - Complete long list of opportunities.

The Dja Dja Wurrung have also identified where their involvement and guidance could be valuable where opportunities are progressed. This has been highlighted in green within the descriptions of the opportunities below.

Daylesford

The following table summarises the IWM opportunities identified with stakeholders for Daylesford and if they align with the seven SDS outcomes.

Table 5. Daylesford IWM opportunity llong list and preliminary assessment against SDS outcomes

Daylesford IWM Opportunities	Dja Dja Wurrung feedback	SDS outcomes						
		Water supply	Wastewater	Flooding	Healthy waterways	Healthy landscapes	Community values	Economic benefit
Alternative water sources for open space irrigation: *a general investigation into the potential for non-potable water sources being used for irrigation within Daylesford and Hepburn Springs*	For irrigation opportunities, there is a preference to prioritise recycled water and stormwater over raw water. Irrigation projects should also consider water efficiency improvements to minimise extraction from the natural environment. There is an opportunity to explore reallocation of water for cultural and environmental flows where water savings are realised.	✓			✓	✓	✓	
Shepherds Flat recycled water use strategy: *identify higher-value local demand or business enterprises that represent more productive use of that recycled water*	There is an opportunity to utilise treatment plant land and recycled water to grow traditional food and fibre plants. Also to explore treatment processes that utilise natural plants and processes to cleanse recycled water. This may in turn create opportunities to use recycled water as cultural flows.	✓	✓		✓	✓	✓	✓
Wombat Hill mini hydro*: assess the feasibility of a mini- hydro scheme at Wombat Hill*							✓	✓
Daylesford Lake water quality: *an investigation into the causes of algal blooms with recommendations for mitigating strategies*					✓	✓	✓	✓
Urban forestry and street tree canopy cover strategy: *identify streetscapes that would benefit from greater canopy cover supported by passive street tree irrigation*	For low lying & natural ephemeral water courses, recommend planting out riparian revegetation prioritising food, fibre and medicine plants. Also introduce wetlands and other WSUD assets to keep water in landscape				✓	✓	✓	✓
General township IWM opportunities: *a town-wide scan to identify small scale IWM and WSUD opportunities*		✓			✓	✓	✓	✓

Creswick

The following table summarises IWM opportunities identified with stakeholders for Creswick. and if they align with the seven SDS outcomes.

Table 6. Creswick IWM opportunity llong list and preliminary assessment against SDS outcomes

Creswick IWM Opportunities	Dja Dja Wurrung feedback	SDS outcomes						
		Water supply	Wastewater	Flooding	Healthy waterways	Healthy landscapes	Community values	Economic benefit
Doug Lindsay Reserve alternative water supply: *identify alternative water sources to meet irrigation and other non-potable demand*	For irrigation projects, there is a preference to prioritise recycled water and stormwater over raw water. Irrigation projects should also consider water efficiency improvements to minimise extraction from the natural environment.	✓			✓	✓	✓	✓
Park Lake Gardens tennis courts alternative water supply: *identify a non-potable water supply options for the tennis courts*	As per Doug Lindsay above	✓		✓	✓	✓	✓	
Creswick Creek stormwater condition improvements: *better understand the source of stormwater reaching Creswick Creek, and the opportunities to treat or reuse that water*	For stormwater treatment opportunities, use natural processes and native plants (prioritising food, fibre and medicine plants) to treat stormwater and also add ecological and habitat functions while holding water within the landscape. There is an opportunity to undertake Aboriginal Waterway Assessments (AWA) on stretches of waterways not previously assessed to enable more informed cultural flows advice to be provided in future.				✓	✓	✓	
Alternative water supply from Russells Reservoir: *to investigate the potential to supply raw water from Russells Reservoir for non-potable uses.*		✓				✓	✓	✓
O'Reilly's dredge hole connection and ecological investigation: *to understand the values at this site and respond with a plan for rehabilitation / revegetation / protection*	All projects requiring ecological values assessment should include a cultural values assessment				✓	✓	✓	

Creswick IWM Opportunities	Dja Dja Wurrung feedback	SDS outcomes						
		Water supply	Wastewater	Flooding	Healthy waterways	Healthy landscapes	Community values	Economic benefit
The old wastewater treatment plant (WWTP) land: *to investigate the potential ecological and social value that a large landholding like this could present for Creswick.*	As per Shepherds Flat, there is an opportunity at the old Creswick wastewater treatment plant site to utilise land for the growing of traditional food and fibre plants				✓	✓	✓	✓
Known areas of nuisance flooding: *Investigate options for flood mitigation work*				✓				✓
General IWM opportunities*: a town-wide scan to identify small scale IWM and WSUD opportunities*		✓			✓	✓	✓	✓

Clunes

The following table summarises IWM opportunities identified with stakeholders for Clunes and if they align with the seven SDS outcomes.

Table 7. Clunes IWM opportunity llong list and preliminary assessment against SDS outcomes

Clunes IWM Opportunities	Dja Dja Wurrung feedback	SDS outcomes						
		Water supply	Wastewater	Flooding	Healthy waterways	Healthy landscapes	Community values	Economic benefit
Reducing potable water usage in Clunes: *investigate alternative water supply opportunities for large water using activities*	As for irrigation opportunities identified above, prioritise recycled water and stormwater over raw water. Also consider water use efficiency improvements to minimise extraction of water from the natural environment.	✓	✓		✓	✓	✓	✓
Clunes historical water supply network: *investigate opportunities to repurpose the network as a linear trail linking to existing trails or the Goldfields trail*	For interpretation projects, there is an opportunity to introduce Djaara story telling through signage and art.					✓	✓	
Two Mile Tank beautification: *a mural or artwork on the water storage tank (similar to Silo Art Trail throughout Western Vic).*					✓	✓	✓	✓
Clunes urban forest strategy*: Develop an urban forest strategy to explore opportunities to establish 'green boulevards' throughout Clunes*	For low lying & natural ephemeral water courses the planting out of riparian revegetation should prioritise food, fibre and medicine plants. Where possible, wetlands and other WSUD assets should be introduced to retain water within the landscape.					✓	✓	✓
Lothair Reserve wetland: *enhance the wetland values as part of a development adjacent (west) to the Clunes train station.*	As part of wetland rehabilitation, there is an opportunity to utilise suitably treated (and quality) stormwater to fill swamps and wetlands			✓	✓	✓	✓	
General IWM opportunities: A *town-wide scan to identify small scale IWM and WSUD opportunities*		✓			✓	✓	✓	✓

All towns / Shire

The following table summarises IWM opportunities that have been identified with stakeholders that are applicable to more than one town, or to the Shire as a whole.

Table 8. All towns IWM opportunity llong list and preliminary assessment against SDS outcomes

All towns / Shire	Dja Dja Wurrung feedback	SDS outcomes						
		Water supply	Wastewater	Flooding	Healthy waterways	Healthy landscapes	Community values	Economic benefit
Community water education, communication and indigenous engagement program: *Develop an education and communication program for community and business to focus on sustainability, particularly around water use.*		✓	✓		✓	✓	✓	✓
Planning conditions for infill and greenfield developments: *Develop or promote existing planning conditions for new developments to guide implementation of IWM and WSUD principles*		✓		✓	✓	✓	✓	
Connecting natural spaces for recreation: *Develop a Masterplan that promotes the connection of community to natural assets.*					✓	✓	✓	✓
Creswick Creek urban waterway management strategy: *An urban waterway management strategy that sets out a long-term plan for the health and function of Creswick Creek, that connects Creswick and Clunes, and could include other Creeks in the area such as Kilkenny and Birches Creek.*	Undertake an Aboriginal Waterway Assessment (AWA) on stretches of waterways not previously assessed to enable more informed cultural flows advice to be provided in future.			✓	✓	✓	✓	

5.2. Opportunities assessment

Opportunities were assessed against a Preliminary Assessment Method (PAM) that was developed in accordance with the Preliminary Assessment Method (PAM) for Integrated Water Management Strategies (DELWP, Western Water and Hume City Council, 2015). This was a qualitative assessment framework that used a relatively simple low (L), medium (M) and high (H) rating to enable a comparative evaluation of opportunities. The 'Benefits' criteria of the assessment required an understanding of the number of SDS outcomes that each opportunity addressed. The process of assessing each opportunity involved the design team undertaking a preliminary assessment that was subsequently review and then updated in a workshop setting. A final assessment was approved by the PWG to produce an IWM opportunity short list (see Section 5.3).

Table 9. Preliminary Assessment Method (PAM) Criteria

Criteria	Description	Guidance
Benefits	The opportunity is assessed according to the number of IWM Strategic Directions Statement outcomes that the opportunity responds to	H: > 4 SDS outcomes
		M: 3 or 4 SDS outcomes
		L: 1 or 2 SDS outcome/s
Risks	The opportunity is reviewed against the following risk categories: • **Social:** the risk that there is community resistance or objection to the opportunity. Is it a potentially controversial project with known, anticipated or expected opposition? • **Environmental**: risk that the opportunity will have a negative impact on the environment. Are their environmental unknowns? Will the project have a significant carbon footprint for example? • **Technical**: risk that the project is complex / not technically feasible to deliver. Are there accepted approaches and known suppliers or is this all together new? Risk is assessed in terms of consequence and likelihood.	H: High consequence / medium to high likelihood of risks across any risk category (e.g. high complexity, expensive with few comparable examples)
		M: Medium consequence / medium likelihood (e.g. potentially challenging with internal capacity building required, but there are existing industry examples)
		L: Low consequence / Low to medium likelihood (e.g. industry standard with examples from the delivery organisation)
Cost	This is based on an opinion of likely cost (can consider both capital and operating cost) and is based on the scale of infrastructure and complexity of the opportunity.	H: Larger catchment scale assets (wetland, stormwater harvesting scheme, recycled water distribution scheme: > $500k of capital works
		M: Medium precinct scale assets (e.g. WSUD assets, street-scale biofilter, a passive irrigation program, large rainwater harvesting schemes) or non-infrastructure work that requires external support (e.g. requiring design or planning work): $100 - 500K
		L: Smaller, street scale assets (passive tree irrigation, smaller rainwater tanks) and non-infrastructure work that can be completed is largely internal (e.g. policy development / community engagement): up to $100k (e.g. of internal resources and in-kind time)
Urgency	This refers to the need to commence the project and whether delay may result in a lost opportunity. Therefore, the opportunity will need to be actioned within a given period of months / years.	H: < 2 years
		M: 2 - 5 years
		L: > 5 years / timing isn't relevant
Impact	This speaks to the impact of the opportunity, in terms of community acceptance or desire for the project and the aesthetic impact the opportunity will / could have on the town.	H: Town wide aesthetic impact / (likely) high community interest and support
		M: Precinct wide impact / moderate community interest and support
		L: Lot or street-scale impact / low or limited community interest and support

The results of the PAM Preliminary Assessment Method (PAM) are summarised in the tables below. They are presented by town and Shire (All towns). The final score was used as the basis of discussion within the PWG to shortlist options. It was not necessarily the deciding factor however those that performed well under the PAM were likely to be discussed at greater length to further investigate their merits and applicability to this plan. Any discussions within the PWG that influenced the development of a short list of opportunities is also summarised after each table

Daylesford

The Daylesford assessment looked at six opportunities, noting that under some opportunity headings, there are potentially a number of smaller opportunities. In this assessment the identification of alternative water sources was rated highly as was understanding if there were higher value end uses for Shepherds Flat recycled water.

The idea of identifying a number of smaller scale or 'general' IWM opportunities aligned well with the aim of finding smaller cost, financially feasible projects, as well as more ambitious opportunities, however it was agreed that this was challenging to scope in detail given the large number of smaller opportunities that it implies.

Table 10. Daylesford Preliminary Assessment

IWM Opportunity Name	Type of investigation	Preliminary Assessment Method (PAM) criteria					
		Benefits	Risks	Cost	Urgency	Impact	Score
Alternative water sources for open space irrigation	Town wide investigation	M	L	M	M	H	**12**
Shepherds Flat recycled water use strategy	Investigation	H	M	M	M	H	**12**
Wombat Hill mini hydro	Investigation	L	M	M	L	L	7
Daylesford Lake water quality investigation	Investigation	M	H	M	M	H	10
Urban forestry and street tree canopy cover	Strategy / pilot project / program	M	M	M	M	H	11
General IWM opportunities	Investigation	H	L	M	M	H	**13**

Creswick

The Creswick assessment looked at eight opportunities. Doug Lindsay Recreation Reserve was of interest as the central open space and sporting precinct in the town, that had undergone recent upgrade. Similarly, Park Lake Gardens Reserve tennis courts are a highly valued recreational asset in Creswick. There was also cross-organisation interest in improving the condition of Creswick Creek (including through stormwater management). This was described as a Masterplanning type exercise that could identify large and small scale stormwater treatment opportunities. Like Daylesford, the prospect of identifying a number of smaller scale or 'general' IWM opportunities, performed well under the criteria.

Table 11. Creswick Preliminary Assessment

IWM Opportunity Name	Type of investigation	Preliminary Assessment Method (PAM) criteria					
		Benefits	Risks	Cost	Urgency	Impact	Score
Doug Lindsay Recreation Reserve alternative water supply	Alternative water source investigation	H	M	H	M	H	**11**
Park Lake Gardens - tennis courts alternative water supply	Alternative water source investigation	M	L	M	M	M	**11**
Creswick Creek stormwater condition improvements	Masterplan	M	L	M	M	M	**11**
Russells Reservoir alternative water supply	Investigation	M	M	H	M	H	10
O'Reilly's dredge hole connection and ecological investigation	Ecological survey / assessment	M	M	M	L	M	9
The old wastewater treatment plant (WWTP) land	Site assessment to understand ecological and social value	M	L	M	L	L	9
Known areas of nuisance flooding	Flood mitigation Investigation at various locations	L	M	M	M	M	9
General IWM opportunities	Investigation	H	L	M	M	H	**13**

Clunes

The Clunes assessment looked at six opportunities. Again, there was a focus on reducing potable water demand by identifying large water users where the demand could be met by non-potable water supplies. The idea of artwork or a mural on the prominent Two Mile Tank was a unique opportunity that rated well. The 'general' IWM opportunities performed well again, albeit with potential issues around scoping.

Table 12. Clunes Preliminary Assessment

IWM Opportunity Name	Type of investigation	Preliminary Assessment Method (PAM) criteria					
		Benefits	Risks	Cost	Urgency	Impact	Score
Reducing potable water usage in Clunes	Town wide investigation	H	L	M	M	H	**13**
Clunes historical water supply network	Masterplan	L	L	M	L	M	9
Two Mile Tank beautification	Community artwork	M	L	M	L	H	11
Clunes urban forest strategy	Strategic plan	L	L	L	L	M	10
Lothair Reserve wetland	Ecological investigation and wetland certification	M	M	M	M	M	10
General IWM opportunities	Investigation	H	L	M	M	M	**12**

All towns / Shire wide

Finally, four opportunities were identified that could be applied Shire wide. Making sure that relevant IWM planning conditions were understood and met by large and small land developers within the Shire was seen as highly important and reflected quite clear community feedback. This partnered well with increasing community understanding of the unique characteristics and challenges of the water cycle in Hepburn, including how to educate tourists as to the need to conserve water.

The opportunity to prepare Masterplans focussing on connecting people to and along natural assets like waterways and lakes, and improving that experience, performed well, as did improving the condition of Creswick Creek, that flows through Creswick and Clunes. This aligns well with the opportunity identified under the Creswick options.

Table 13. All towns / Shire wide Preliminary Assessment

IWM Opportunity Name	Type of investigation	Preliminary Assessment Method (PAM) criteria					
		Benefits	Risks	Cost	Urgency	Impact	Score
Community water education, communication and indigenous engagement program	Education and communication	H	L	M	M	H	**13**
Planning conditions for infill and greenfield developments	Planning conditions Development IWM plan / IWM planning clauses	H	L	M	M	H	**13**
Connecting natural spaces for recreation	Engagement / Master planning exercise	M	M	M	M	H	11
Creswick Creek urban waterway management strategy	Management strategy	M	L	M	M	H	12

5.3. Short list

Based on the assessment set out above, nine opportunities were short listed. Four of these were identified as being suitable for progression to 'Concept design'. A 'concept' is simply a more detailed investigation into the opportunity to improve stakeholder and community understanding of the opportunity including its potential scope, feasibility, potential barriers, benefits and items for further work.

Those opportunities that were not shortlisted are not to be forgotten or 'deleted'. The shortlisting does however provide a focus for future work by identifying projects worthy of further investigation under this IWM Plan or as separately scoped pieces of work.

An important consideration in identifying candidates for Concept Design was to understand which opportunities could be progressed within the context of the scope of the IWM Plan design consultancy. For example, while the Creswick Creek Urban Waterway Management Strategy opportunity was very well supported, it was seen by the PWG as being a reasonably significant piece of work. It was therefore agreed that if stakeholders wished to progress it, that can be done as a separately scoped piece of work. On the other hand, undertaking a scoping for the provision of non-potable water to Doug Lindsay Reserve was able to be progressed to a reasonable concept level within the scope of this project.

The nine shortlisted opportunities are summarised in Table 14 below with the four concept design opportunities highlighted.

5.4. Concept designs

Referring to Table 14 below, four 'concept designs' were identified and completed as part of this plan and are included as attachments:

- Concept 1 – Doug Lindsay Recreation Reserve, Creswick, alternative water supplies (Attachment C)
- Concept 2 – Reducing potable water use in Daylesford (Attachment D)
- Concept 3 – Reducing potable water use in Clunes (Attachment E)
- Concept 4 – Implementing IWM in new developments (Attachment F).

Figure 16. *Lake Calembeen, Creswick*

Table 14. Short List (9) and Concept design (4) opportunities

Daylesford	IWM Opportunity Description	Included as concept design?
Alternative water sources for open space irrigation	Investigation into the potential for non-potable water sources to reduce potable water demand. Includes consideration of using recycled water use from Shepherds Flat WWTP.	**Yes**
Shepherds Flat recycled water use strategy	Development of a Shepherds Flat recycled water use strategy to identify higher value uses for Daylesford's recycled water.	No – recycled water included within the above concept design
Creswick	**IWM Opportunity Description**	**Included as concept design?**
Doug Lindsay Recreation Reserve alternative water supply	Alternative water / rainwater harvesting concepts for the irrigation of open space and to meet toilet and local garden demands	**Yes**
Creswick Creek stormwater improvements	A stormwater / waterway management plan focusing on improved waterway health through stormwater and vegetation stormwater management.	No –retain for future scoping
Clunes	**IWM Opportunity Description**	**Included as concept design?**
Reduce potable water use	Identification of alternative water supply opportunities to reduce potable water demands for large water users including open spaces and sporting clubs. This will rely predominantly on Clunes recycled water from the WWTP	Yes
All towns / Shire wide	**IWM Opportunity Description**	**Included as concept design?**
IWM planning conditions for infill and greenfield developments	Promote existing IWM planning conditions for new developments and how they can be met.	**Yes**
Street and building scale IWM opportunity investigations	This was favourably assessed within each town and should be the subject of a more detailed town scale scan in future. Some small scale rainwater harvesting is identified in the Creswick and Clunes potable water reduction concepts	No
Community water education and awareness campaign	An education and communication program for community and business to focus on sustainability, particularly around water use. The IWM planning information is seen as a first and more urgent step.	No
Connecting natural spaces for recreation	Develop a Masterplan that promotes the connection of community to natural assets. This is seen as worthy of its own project and requires planning to ensure meaningful scoping with, and involvement from, the Dja Dja Wurrung.	No

6. Discussion and next steps

The main body of this document sets out the strategic drivers for this IWM Plan and the characteristics of each town's water cycle. Through a process of engagement and investigation, issues and opportunities were identified that were evaluated against out project objectives. Nine opportunities were shortlisted with four identified for concept design.

First, the **Doug Lindsay Recreation Reserve** alternative water supply investigation considers each of raw water, stormwater and recycled wastewater to substitute for one of the highest potable water demands in Creswick. Raw water was the preferred approach based on a review of reliability, feasibility and costs. There is also an very good opportunity for rainwater harvesting to meet toilet flushing and garden bed irrigation demands. Dja Dja Wurrung have expressed a preference for recycled water and/or stormwater to take precedence over raw water to reduce the volumes for water extracted from the environment. The recommended approach can be reviewed in this context, however both stormwater and recycled water (via a sewer mine) were not assessed as being technically viable. This will require further discussion with Dja Dja Wurrung as well as investigating any potential irrigation efficiency measures at Doug Lindsay Reserve.

The second concept investigates a range of options to '**Reduc(ing) potable water use in Daylesford**'. This involved a high level review of non-potable demands (particularly irrigation demands) and identification of suitable supply options across raw water, stormwater and recycled water. This responded to a specific question raised during consultation regarding the feasibility of bringing recycled water back into Daylesford & Hepburn from Shepherds Flat to use that resource for irrigation. A range of irrigation options are investigated in that concept, including recycled and raw water. Stormwater harvesting was not preferred given the rural nature of the catchments and the location of open spaces within those catchments. The cost of bringing recycled water approximately 8.5 km from Shepherds Flat to Daylesford remains a significant cost barrier.

Another opportunity is for the Dja Dja Wurrung to use treatment plant land and recycled water for commercial purposes, including the growing of food and fibre plants. This opportunity should be the subject of ongoing discussion.

The third concept undertook a similar process to examine options for '**Reducing potable water use in Clunes**'. With less options available than Daylesford, the use of wastewater from the Clunes wastewater treatment plant was of interest given the reliability of supply and that there are few competing end uses. There is also an opportunity here for the use of surrounding land and recycled water for the growing of food and fibre crops, much like Shepherds Flat.

The fourth concept - **Implementing IWM in new developments** - focussed on an aspect of IWM that was clearly raised by Hepburn Shire and the community, namely the impact of land development on potable water resources, wastewater volumes and stormwater quality. With infill developments in each town ongoing, and larger developments planned, clarifying and promoting what is in Council's IWM Planning Provisions (Hepburn Planning Scheme) was seen as a priority. The aim of this concept is to provide information to Council and developers on how they can meet Council's IWM guidelines and in doing so meet the intent of this plan.

In reviewing the IWM Plan, it is evident that there is a strong emphasis on reducing potable water demand. This may be a worthy IWM response as the options encompass greening of those spaces, improving potable water supply security, resilience to climate change as well as using a resource that might otherwise be unused or released to the environment.

There are however other opportunities that were not selected for Concept Design that did not focus on potable water use reduction. These performed well under the evaluation assessment and were well supported by the PWG. They also provide opportunities for more meaningful engagement with the Dja Dja Wurrung around waterways, landscape and cultural values. Some of these are listed below.

- Creswick Creek stormwater improvements: this opportunity proposes taking a closer look at the impact of stormwater on the water quality and condition within Creswick Creek. While the focus in recent years has been on mitigating the impact of flood, there is significant interest in undertaking water sensitive urban design planning that can reduce sediments and pollutants reaching the creek.
  This should be scoped with Dja Dja Wurrung to
  - consider natural processes and native plants (including food, fibre and medicine plants) to improve stormwater quality
  - add ecological and habitat functions while holding water within the landscape.
  - undertake Aboriginal Waterway Assessments (AWA) on stretches of waterways not previously assessed to enable more informed cultural flows advice to be provided in future.
- Connecting natural spaces for recreation: related to the above is a broader opportunity to prepare a Masterplan or similar that promotes the connection of the community to the range of natural assets within and surrounding these townships for recreation. This may be through walking and cycling tracks and the provisions of facilities to encourage its use (e.g. lookouts, tables, BBQ's etc.).
  This is seen as an important project with a potentially significant scope that should be developed with stakeholders as part of future works. This would also benefit from the involvement of the Dja Dja Wurrung to ensure cultural story telling is incorporated into the cultural interpretation of landscape and water.
- Community water education, communication and cultural flows: This opportunity could include an education and communication program for community and business to focus on sustainability, particularly around water use in tourism destinations and accommodation. For example: Ecotourism - this could involve rebranding tourism in the context of caring for natural resources and requiring water conservations standards in tourist operations that better reflect community values and concerns.
  As part of this there was also strong support for an indigenous water assessment. This could be a part of a formal plan for engagement with the Dja Dja Wurrung on water related issues to reflect their culture and values.
  A cultural flows assessment could be a meaningful way to both engage local traditional owners but also educate Daylesford's local population around the cultural values of water.

This plan provides IWM stakeholders within the Central Highlands region with opportunities at a range of scales that can be pursued in each town. It is recommended that the concepts be reviewed and presented to stakeholder organisations, including DELWP, to highlight their alignment with the outcomes of the SDS document and to ultimately seek funding to progress them further.

7. References

Central Highlands Water (2017) Urban Water Strategy

DELWP, Western Water and Hume City Council (2015), Preliminary Assessment Method (PAM) for Integrated Water Management Strategies

DELWP (2018) Integrated Water Management Framework for Victoria

DEWLP (2020) Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria

DELWP (2022) Building Victoria's Climate Resilience

Dja Dja Wurrung (2014), Dhelkunya Dja - Dja Dja Wurrung Country Plan (2014 – 2034)

Goulburn Murray Water (2013) Central Victorian Mineral Springs Groundwater Management Area Local Management Plan

Hepburn Shire Council (2021) Hepburn Shire Council Plan (2021-2025) including Municipal Public Health and Wellbeing Plan

Hepburn Shire Council (2014) Domestic Wastewater Management Plan

IWM Forum (2018), Central Highlands Strategic Directions Statement

North Central Catchment Management Authority (2012) Creswick Flood Mitigation and Urban Drainage Plan

Attachment A. Water cycle performance summary report

CENTRAL HIGHLANDS WATER

Hepburn SHIRE COUNCIL

alluvium

WATER CYCLE PERFORMANCE SUMMARY REPORT:

Daylesford, Creswick and Clunes Integrated Water Management Plan

April 2022

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Alluvium acknowledges the Traditional Owners and custodians of the lands on which we work.

This project was undertaken in Hepburn Shire, on the lands of the Dja Dja Wurrung. We pay our respects to their elders, and the elders of all Aboriginal and Torres Strait Islander Peoples, past, present, and into the future.

We would like to acknowledge and thank all those who attended consultation and workshop activities that were critical in developing this plan.

Contents

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Abbreviations

Alluvium	Alluvium Consulting Australia Pty Ltd
CBD	Central Business District
CHW	Central Highlands Water
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
ha	Hectare
HSC	Hepburn Shire Council
IWM	Integrated Water Management
LGA	Local Government Area
ML	Megalitre
NCCMA	North Central Catchment Management Authority
VPA	Victorian Planning Authority
WTP	Water treatment plant
WWTP	Wastewater treatment plant

1 Introduction

This water cycle performance summary report sets the foundation of our understanding of all elements of the Daylesford, Creswick and Clunes water cycle system to inform their IWM plan. This report has been developed through a review of the existing literature, analysis of data and information provided by Central Highlands Water (CHW), Hepburn Shire Council (HSC) and the North Central Catchment Management Authority (NCCMA), as well as discussion and workshops with the aforementioned agencies.

The aim of this report is to understand, at a high-level, the overall water balance of each town, where water comes from, how it is used and any notable risks or issues that may impact the system into the future.

1.1 Location

The IWM plan focuses on the townships of Daylesford, Creswick and Clunes, located within the Hepburn Shire, approximately 100km north west of Melbourne on the land of the Dja Dja Wurrung. The Shire lies within the Central Highlands region at the edge of the Great Dividing Range and at the upper catchment of the Loddon River (Figure 1).

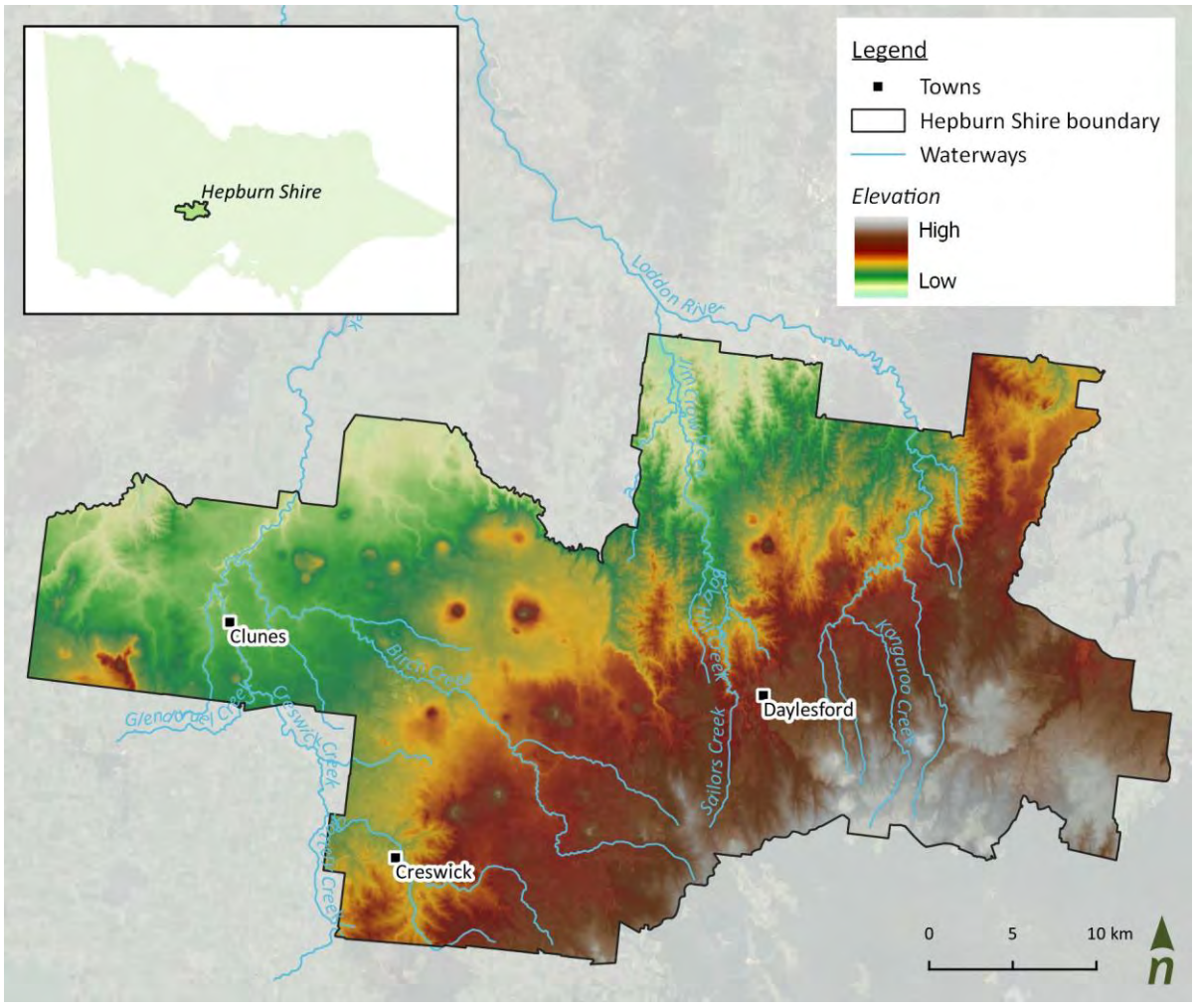


Figure 1. *Location of Hepburn Shire, Daylesford, Creswick and Clunes, elevation and major waterways*

Key takeaways

Due to their respective locations in the Central Highlands and Loddon River catchment, each town has a distinct geography, influencing their climate and interaction with water and waterways.

1.2 Population

Population in Daylesford, Creswick and Clunes steadily rising at an average annual rate of 0.6 to 1.1%. In 2021, the total population of the three towns combined was 8,351, constituting about 50% of the Shire's total.

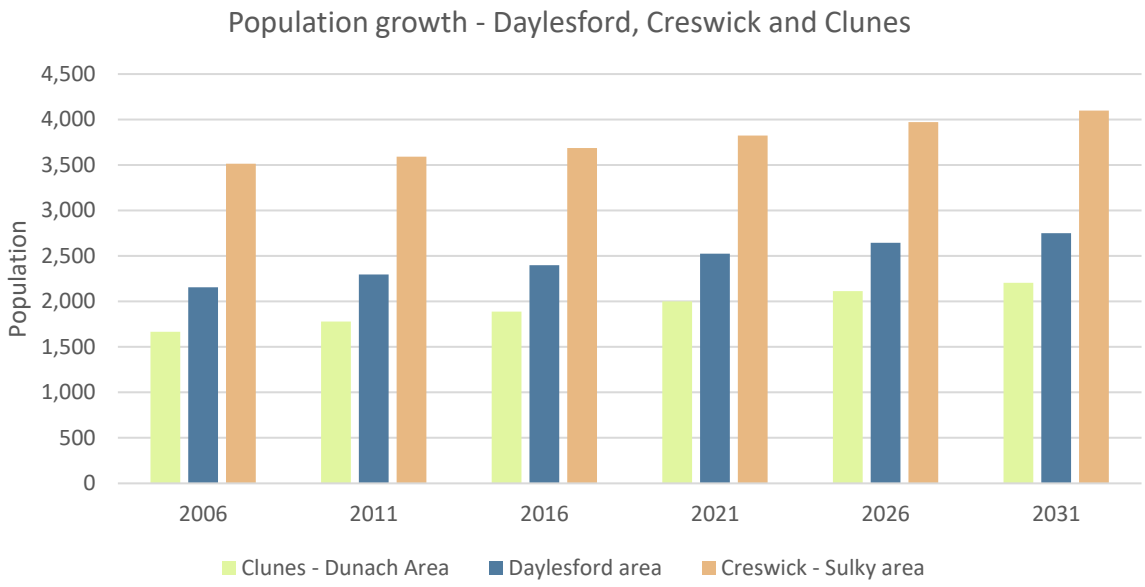


Figure 2. *Population in Daylesford, Creswick and Clunes (Data: Hepburn Shire Council – Council Plan 2013 - 2017)*

Key takeaways

Population is growing steadily in in all three towns, with Clunes expected to have the fastest growth rate. While this will increase demand for water, it is not expected that the increasing population will put undue strain on potable water supplies into the near future.

1.3 Climate

Daylesford, Creswick and Clunes are located in the Central Highlands Region at the edge of the Great Dividing Range, situated at elevations of 616m, 430m and 310m respectively. Despite their proximity to each other, each town has distinct rainfall and temperature patterns.

Between the three towns, as elevation increases, rainfall tends to increase, while average minimum and maximum temperatures tend to decrease. 3, Figure 4 and 5 show the mean monthly rainfall and temperature between 1900 and 2021 in Daylesford, Creswick and Clunes respectively. Figure 6, Figure 7 and Figure 8 shows the mean annual rainfall between 1900 and 2020 at Daylesford, Creswick and Clunes respectively. Data is collated from the SILO Australian Climate database.

Mean monthly rainfall and temperature

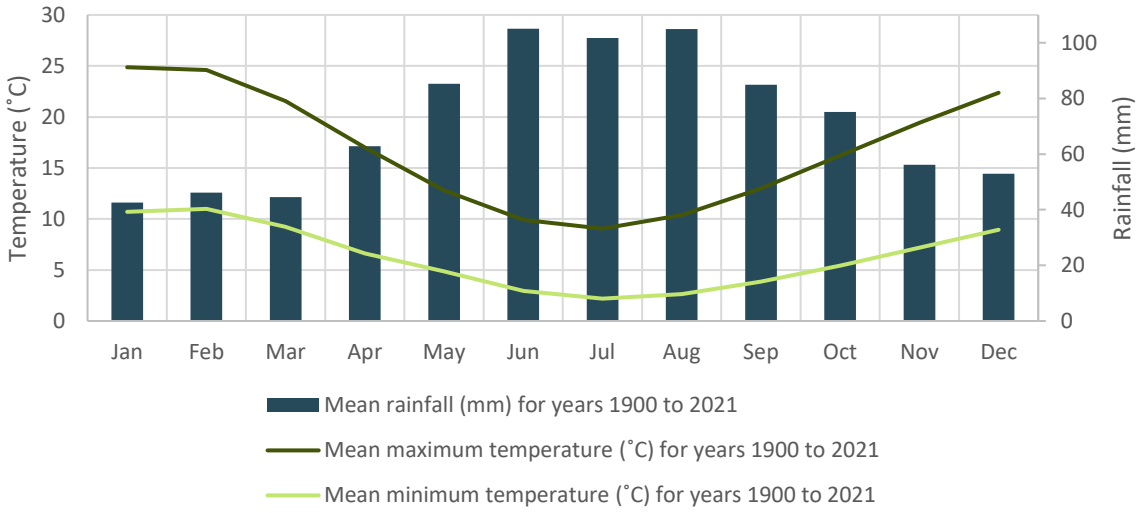


Figure 3. *Monthly average rainfall and temperature (1900 to 2021) at Daylesford (Data: SILO Gauge Data: Daylesford [Station 88020])*

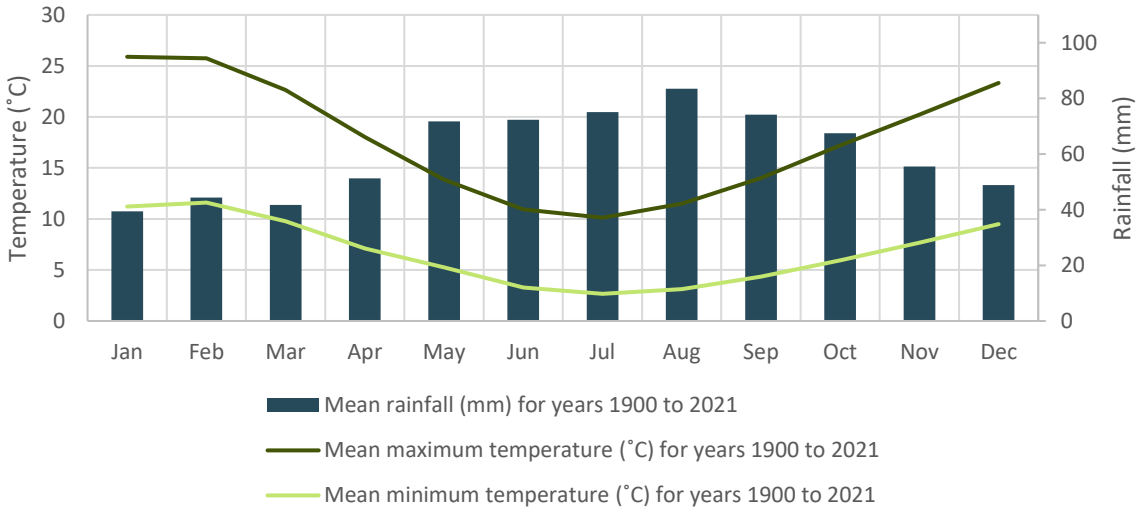


Figure 4. *Monthly average rainfall and temperature (1900 to 2021) at Creswick (Data: SILO Gauge Data: Creswick [Station 88018])*

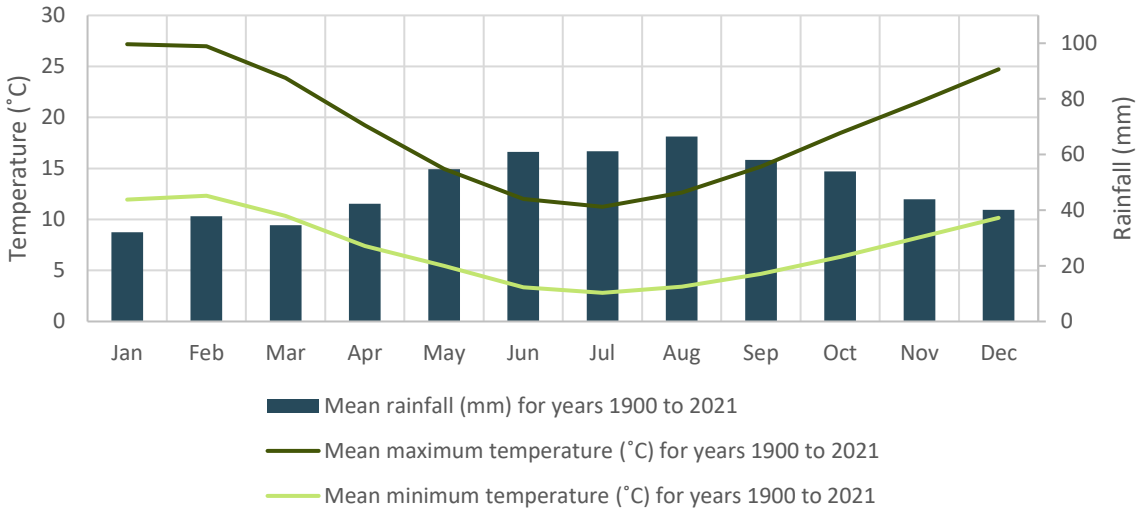


Figure 5. *Monthly average rainfall and temperature (1900 to 2021) at Clunes (Data: SILO Gauge Data: Clunes [Station 88015])*

Mean annual rainfall

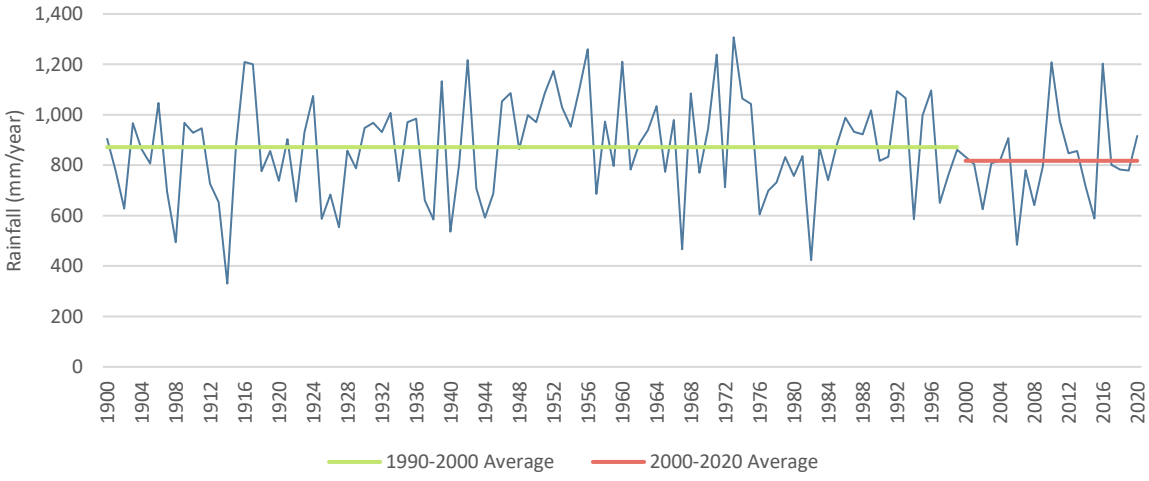


Figure 6. *Mean annual rainfall and temperature (1900 to 2021) at Daylesford (Data: SILO)*

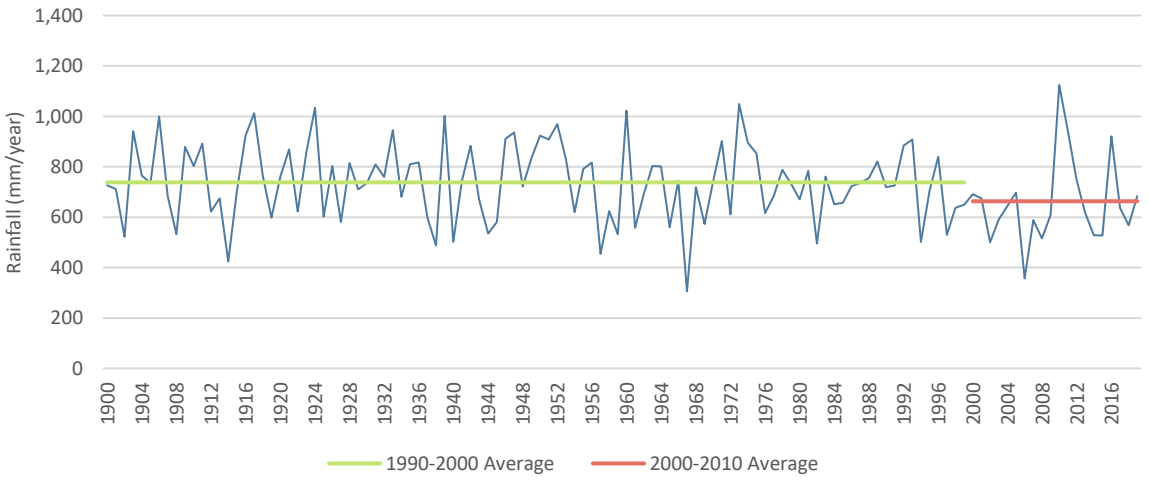


Figure 7. *Mean annual rainfall and temperature (1900 to 2021) at Creswick (Data: SILO)*

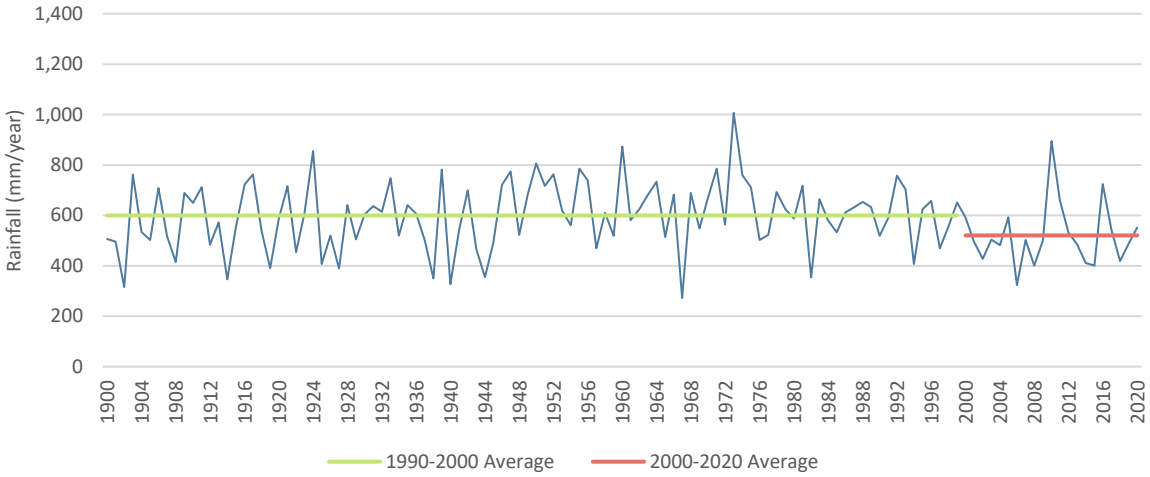


Figure 8. *Mean annual rainfall and temperature (1900 to 2021) at Clunes (Data: SILO)*

These figures show:

- relatively consistent and reliable rainfall across the year, with a considerable increase during the winter months in Daylesford
- the average rainfall for the most recent period of 2000 – 2020 is lower compared to the long-term average (1900 – 1999) for all three towns, but more notably in Creswick and Clunes.
- Peak wet years appear to be less frequent and lower in rainfall from 1975 onwards for all three towns.

Climate change

Climate change is a significant driver behind the preparation the Daylesford, Creswick and Clunes IWM plan. This is due to the impact of climate change on rainfall and temperature and therefore on the reliability of traditional surface water supplies. Reduced ground and surface water flows also impact the health of natural assets like waterways and wetlands. Further, landscape amenity within the town is impacted if open spaces cannot remain green and high temperatures exacerbate the urban heat island effect in central business district (CBD) areas.

DELWP's *Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria (2016)* sets out anticipated changes in temperature, rainfall and runoff in 2040 and 2065 from metropolitan and rural catchments, including the Loddon River Basin.

The potentially significant reduction in rainfall and runoff over time will impact those factors listed above with a direct bearing on water security and the ecological health and social values associated with waterways, wetlands and lakes.

Table 1. Estimated changes relative to current climate baseline (1975-2014) in the Loddon River Basin (Source: DELWP, 2016)

	Change relative to baseline	
Criteria	**2040**	**2065**
Temperature change (˚C)	1.3	2.4
Potential evapotranspiration (%)	4.6	7.7
Average annual rainfall (1975 – 2014): 459 mm / year		
10th percentile (low) (%)	2.5	3.2
50th percentile (medium) (%)	-2.8	-5.6
90th percentile (high) (%)	-14.3	-22.9
Average annual runoff (1975 – 2014): 24 mm/ year		
10th percentile (low) (%)	12.4	6.9
50th percentile (medium) (%)	-7.4	-17.6
90th percentile (high) (%)	-36.6	-57.6

* Please note that the figures above are for the whole Loddon River Basin and are not specific to Hepburn Shire.

Key takeaways

Daylesford's water supply system is reliant on local climate conditions, specifically good winter rainfall to ensure reservoirs are replenished in time to meet summer demands. Clunes and Creswick's water supply systems are less impacted by local climate variations due to their reliance on groundwater (Clunes) and external sources such as the Goldfields Superpipe (Creswick). However, climate change still has an impact on the security of these supplies. Additionally, increasing temperatures and reduced rainfall still has the potential to increase demand for water, namely for irrigation.

1.4 Land use and development

Figure 9, Figure 10 and Figure 11 shows the land uses in around Daylesford, Creswick and Clunes respectively. Land use zones are sourced from the Victorian Planning Authority (VPA).

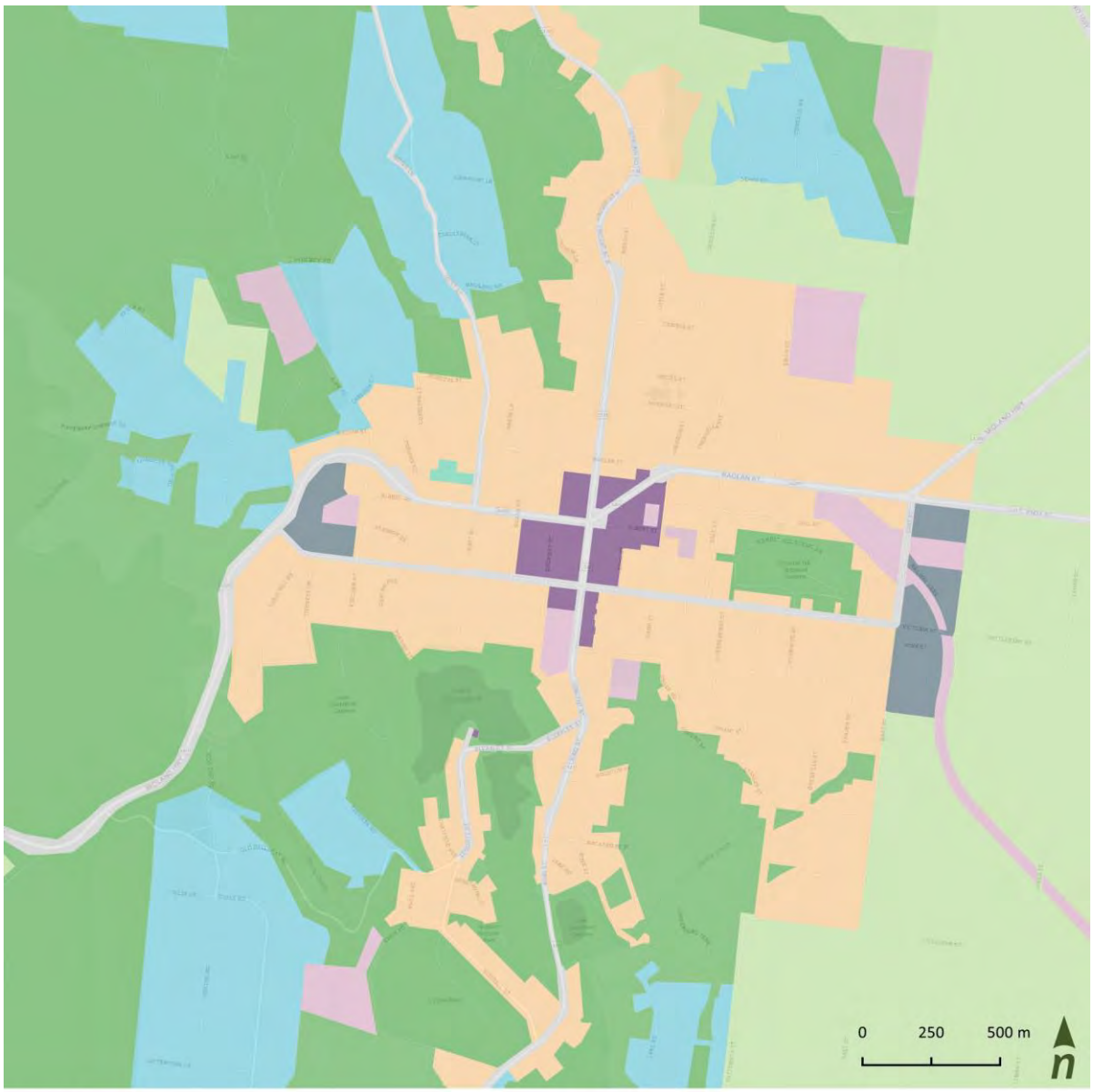


Figure 9. *Land use in and around Daylesford (Data: Victorian Planning Authority)*

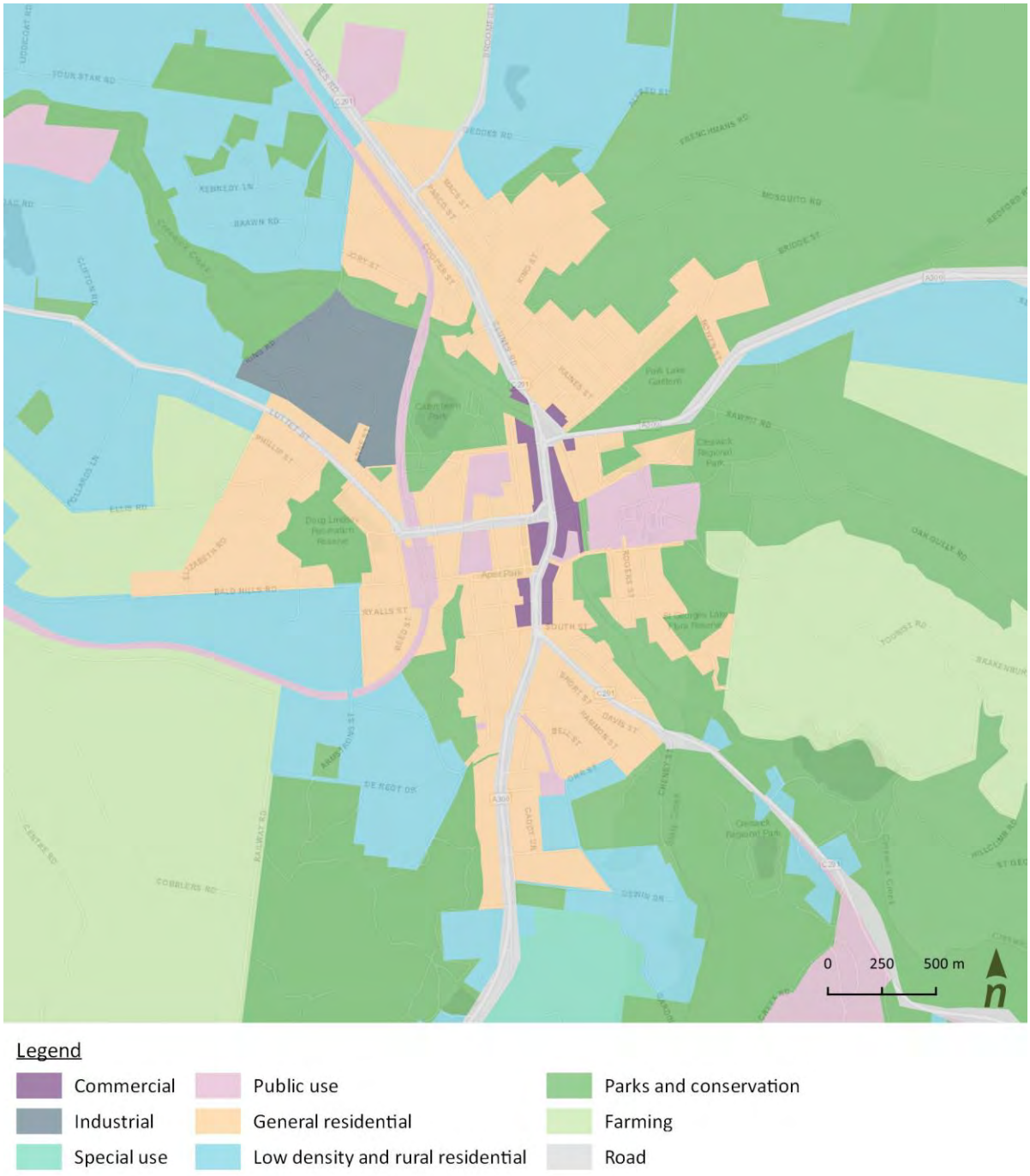


Figure 10. *Land use in and around Creswick (Data: Victorian Planning Authority)*

Figure 11. *Land use in and around Clunes (Data: Victorian Planning Authority)*

Key takeaways

Each town is characterised by mix of general residential and township zones within the urban centres, surrounded by low density and rural residential areas, and farming zones beyond that. Significant areas of parks and conservation areas traverse and surround each town.

Increasing development (both infill and greenfield) leads to an increase in impervious areas, thereby increasing the volume and intensity stormwater runoff from those areas. Development also brings an increase in population and the demand for potable water that is associated.

- Development in Daylesford is largely constrained due to its topography and surrounding forest, however, there are some notable infill developments within the town.
- Clunes is expected to have the highest rate of growth out of the three towns, with low density and rural residential areas surrounding the township earmarked for subdivision and development.
- Like Clunes, some areas of low-density development are proposed for Creswick notably around the town's cemetery.
- Spatial data on proposed development areas is required to determine the scale of land use change and impact on the water cycle.

1.5 Waterways, lakes, wetlands and groundwater

Hepburn Shire is located high in the Loddon River catchment. Creswick Creek runs through Creswick and Clunes and is a significant natural feature for these towns. For Creswick and Daylesford in particular, lakes such as Lake Daylesford, Lake Jubilee, St Georges Lake and Lake Calembeen are highly valued ecological, recreational and amenity assets.

The Hepburn Shire is also home to 80% of Australia's mineral spring reserves, which are a major drawcard for the Shire's tourism industry.

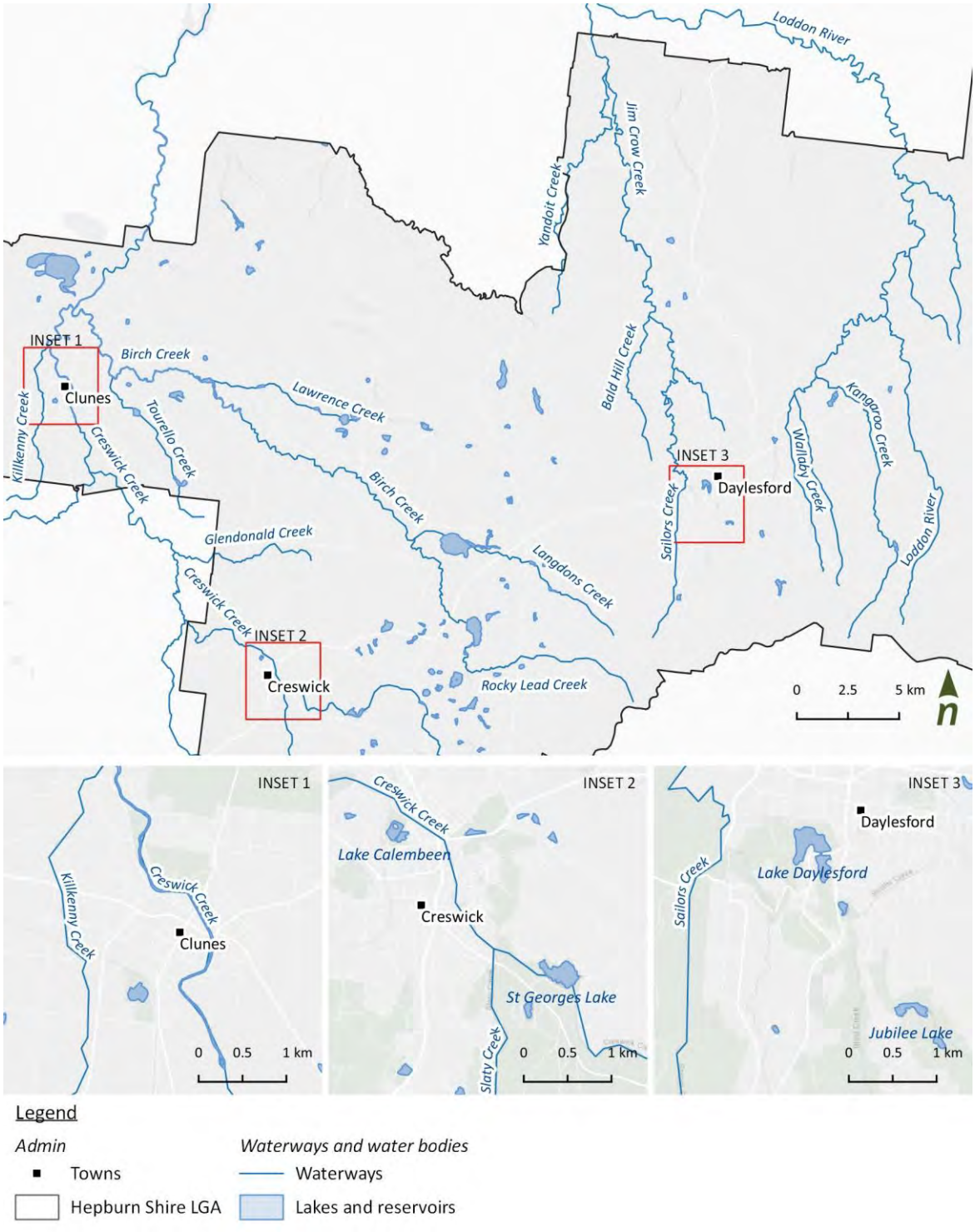


Figure 12 *Hepburn Shire waterways, lakes, wetlands and groundwater*

Key takeaways

- Creswick Creek is a major waterway that passes through the towns of Creswick and Clunes. Kilkenny Creek is also a valued waterway for Clunes.
- Lakes in and around Daylesford and Creswick are highly valued community assets.
- Mineral springs are of high economic and community value, particularly to Daylesford.

1.6 Flooding

Creswick Creek runs through the urban centres of both Creswick and Clunes. The creek is susceptible to flooding, notably during a major flood event in 2010/11.

Minor waterways around Creswick include Slaty Creek, Sawpit Gully (otherwise known as Spring Gully) and Nuggetty Gully. These all flow into the Creswick Creek and contribute to flash flooding in Creswick. There are two water storages located upstream of Creswick: St Georges Lake and Cosgrave Reservoir. When empty, they provide limited, informal detention that contributes to flood mitigation in Creswick.

The build-up of exotic vegetation within the creek channel over the years has reduced the capacity of Creswick Creek and exacerbated the risk of flood damage to adjacent properties during large events. However, the trees along the riparian zone are highly valued by the community for their aesthetics and amenity. Some vegetation removal works have been undertaken, however, ongoing management is required.

Flood risk in Daylesford is low. Some areas adjacent to Lake Daylesford and Blind Creek are vulnerable.

Figure 13. *Creswick Draft LSIO and FO Map for existing conditions (Courtesy North Central CMA and Water Technology, 2013)*

Figure 14. *Clunes: Draft LSIO and FO Map for existing conditions (Courtesy North Central CMA and Water Technology, 2013)*

Key takeaways

- Creswick Creek is susceptible to flooding, impacting the urban areas of Creswick and Clunes.
- Flooding is exacerbated by the build-up of exotic vegetation within the Creek channel. However, the trees along the riparian zone are highly valued by the community. Tree removal is labour intensive and ongoing management is required.

2 Water supply

2.1 Daylesford

Water supply system
Daylesford's water supply system is supplied from the Wombat, Bullarto and Hepburn Reservoirs and the Coomoora groundwater bore. A diversion at Wallaby Creek provides an alternate water supply that is utilised during extended dry periods. Raw water is treated at the Daylesford Water Treatment Plant and pumped to storage basins on Wombat Hill where it is then gravity fed into the town network. The Daylesford Water Treatment Plant was constructed in 2000 and has a capacity to treat 8 ML/ day.

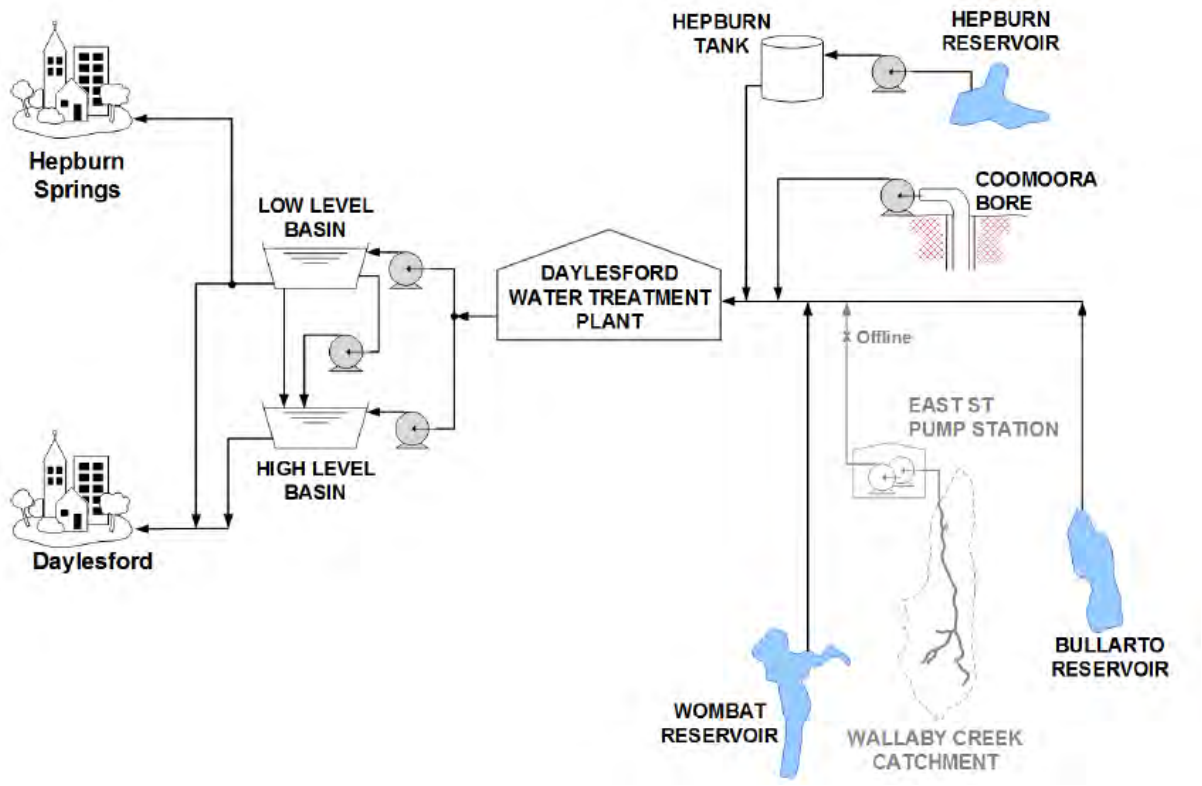


Figure 15. *Daylesford potable water system schematic (Source: Central Highlands Water)*

System vulnerability
CHW have a bulk water entitlement to extract up to 916 ML/ year of surface water for the Daylesford system. The Daylesford system has a total storage capacity of 819 ML/year, which is equivalent to about 18 months of supply. It relies on sufficient inflows during winter and spring to keep the reservoirs filled. This makes the system vulnerable to dry spells as was experienced in 2002/03 and 2006/07 where severe water restrictions were required to maintain reserves.

The planned Daylesford Goldfields Superpipe connection will add additional reliability to the system, securing water supply into the future.

Major water users

Annual water usage from the Daylesford system is approximately 520 ML/ year (CHW 2019). Figure 16 shows the top ten water users in Daylesford in 2019/20 and the breakdown of the highest user, HSC. Amongst HSC assets, water is mostly used for recreational aquatic facilities and irrigation of open spaces.

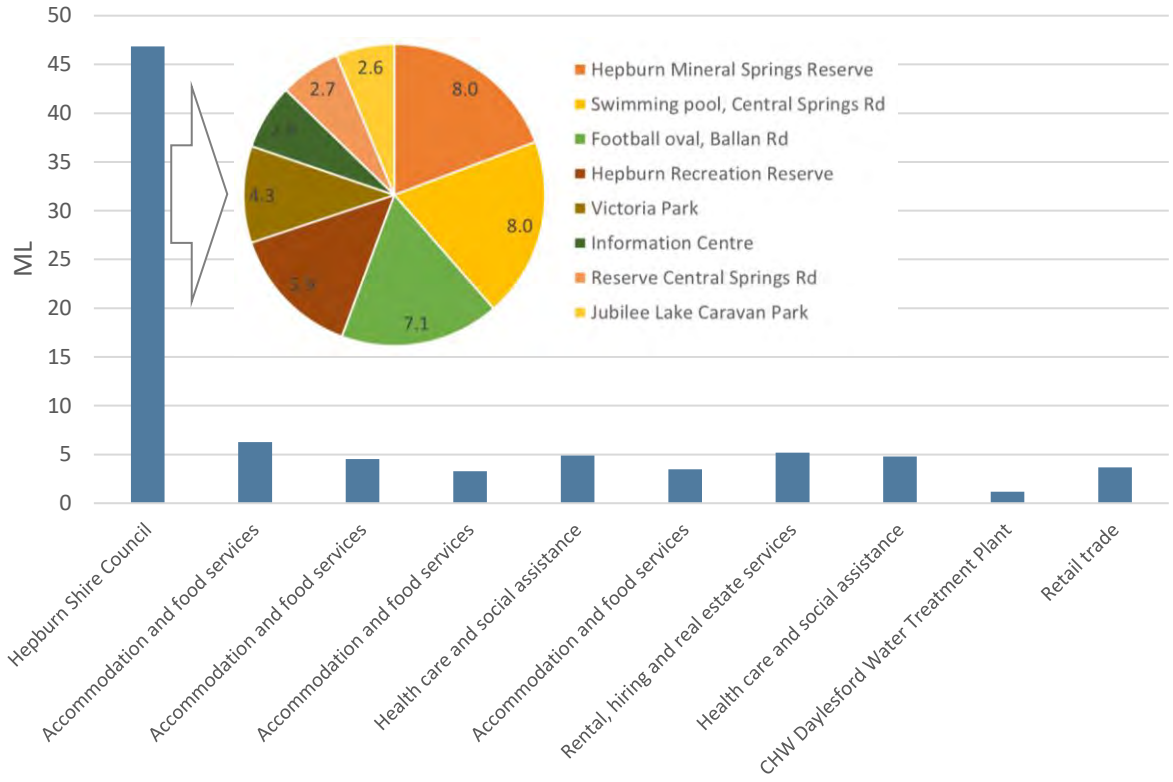


Figure 16. *Daylesford top 10 water users 2019/20 (Data: Central Highlands Water)*

Key takeaways

- The Daylesford water supply system is reliant on local climate conditions being good winter and spring rainfall. Limited storage capacity means that the system is vulnerable to dry spells.
- Hepburn Shire Council (HSC) is the highest water user, with the majority of water being used to service recreational aquatic facilities and open space irrigation.

2.2 Creswick

Creswick's water supply system is supplied by the White Swan Reservoir and the Goldfields Superpipe, which forms part of the Ballarat Water supply system. Creswick was historically supplied by Cosgrave, Dean and Russells Reservoir via the Lincoln Basin, however, this system was decommissioned and Creswick was connected to the Ballarat in the early 2000s to improve the reliability and security of supply.

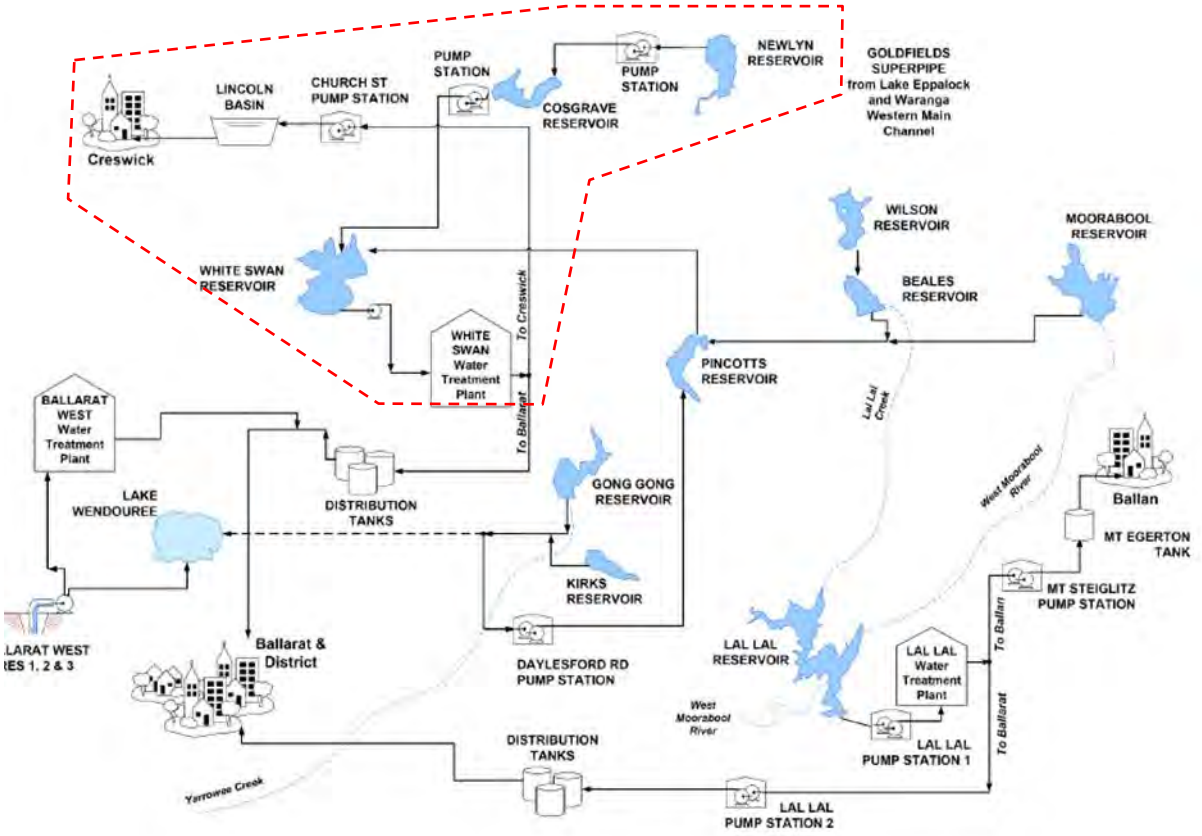


Figure 17 *Ballarat potable water system schematic – Creswick system outlined in red-dashed border (Source: Central Highlands Water)*

Water supply system

Figure 18 shows the top ten water users in Creswick in 2019/20 and the breakdown of HSC's water use. The Royal Automobile Club of Victoria (RACV) Goldfields Resort is the highest water user in Creswick, using more than twice that of HSC. Amongst HSC assets, water is mostly used for irrigation of open spaces.

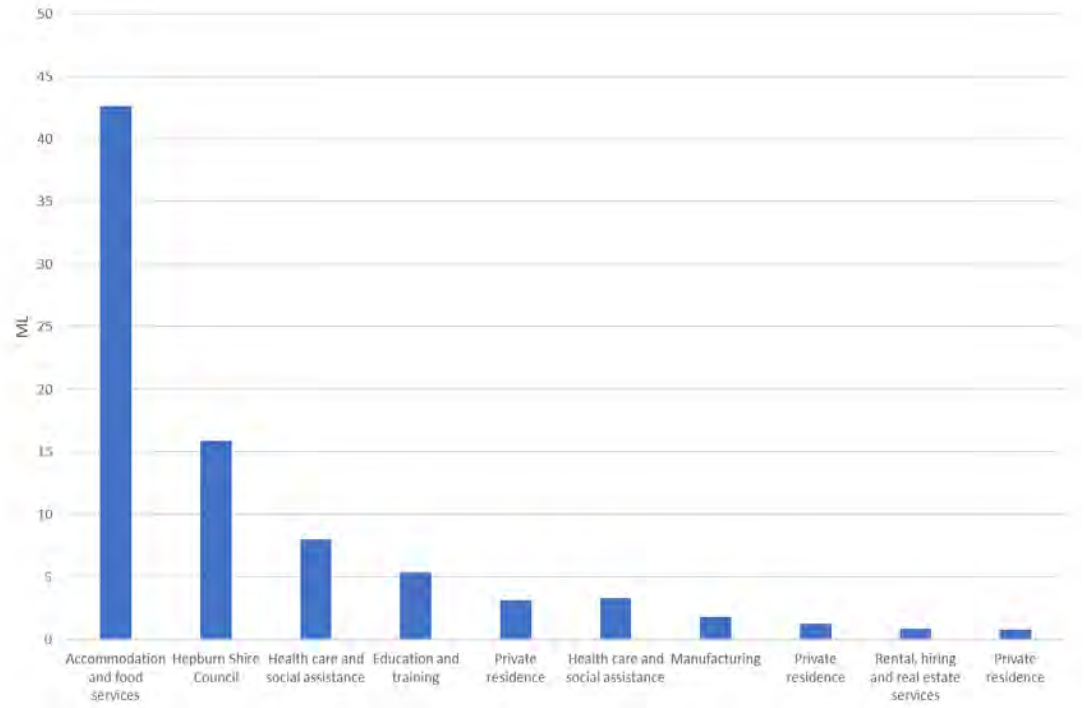


Figure 18 *Creswick high water users (2019/2020)*

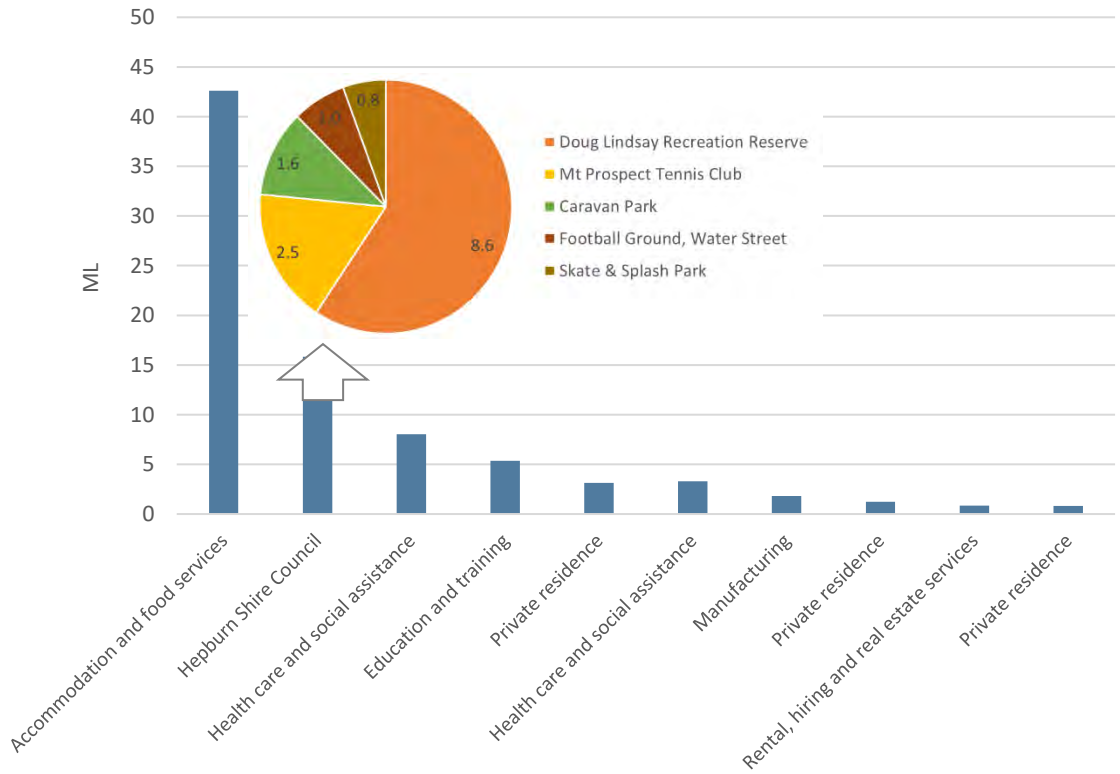


Figure 19. *Creswick top 10 water users 2019/20 (Data: Central Highlands Water)*

System vulnerability

The White Swan Reservoir is connected to the Goldfields Superpipe which provides additional supply from the Goulburn system adding security to the entire Ballarat system. However, this supply is still susceptible to the impacts of climate change.

Key takeaways

- The Creswick water supply system is connected to the Ballarat system, including the Goldfields Superpipe. This provides greater security of water supply, however, may also be susceptible to impacts of climate change and competing demands.
- An 'Accommodation and food services' venue is the highest water user, with more than double the water use of the second highest user HSC.

2.3 Clunes

Water supply system

The Clunes water supply system is supplied from groundwater bores, located approximately 6km south of Clunes. Water is treated at the Clunes Water Treatment Plant and pumped to a 2.5ML storage tank at Two Mile Hill, where it is then gravity fed into the town network.

The water supply system including the Water Treatment Plant was constructed in 2005, replacing the previous surface water supply system to become the sole water supply system for Clunes.

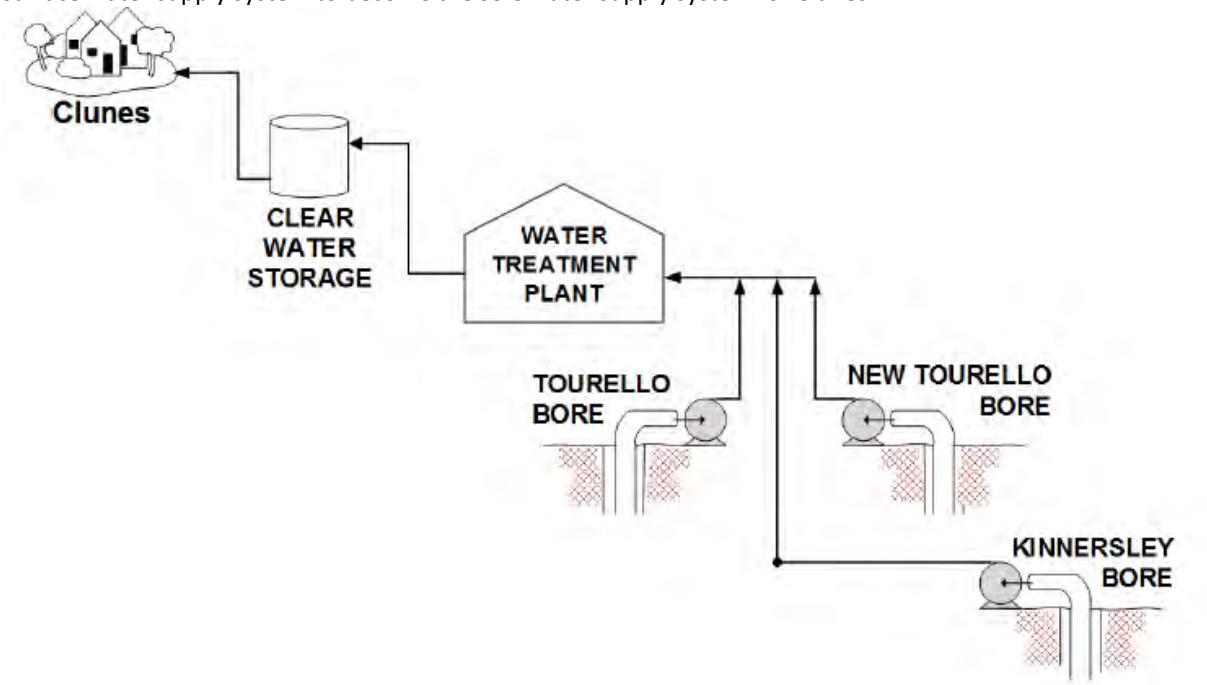


Figure 20. *Clunes potable water system schematic (Source: Central Highlands Water)*

Figure 21. *Two Mile Hill water supply tank at Clunes*

Major water users

Annual water usage from the Clunes system is approximately 176 ML / year with per capita water consumption estimated at 295L / day (CHW 2019). Figure 22 shows the top ten water users in Clunes and breaks down HSC's water usage. Notable high-water users in Clunes include an 'Education and training' facility and the recreation reserve.

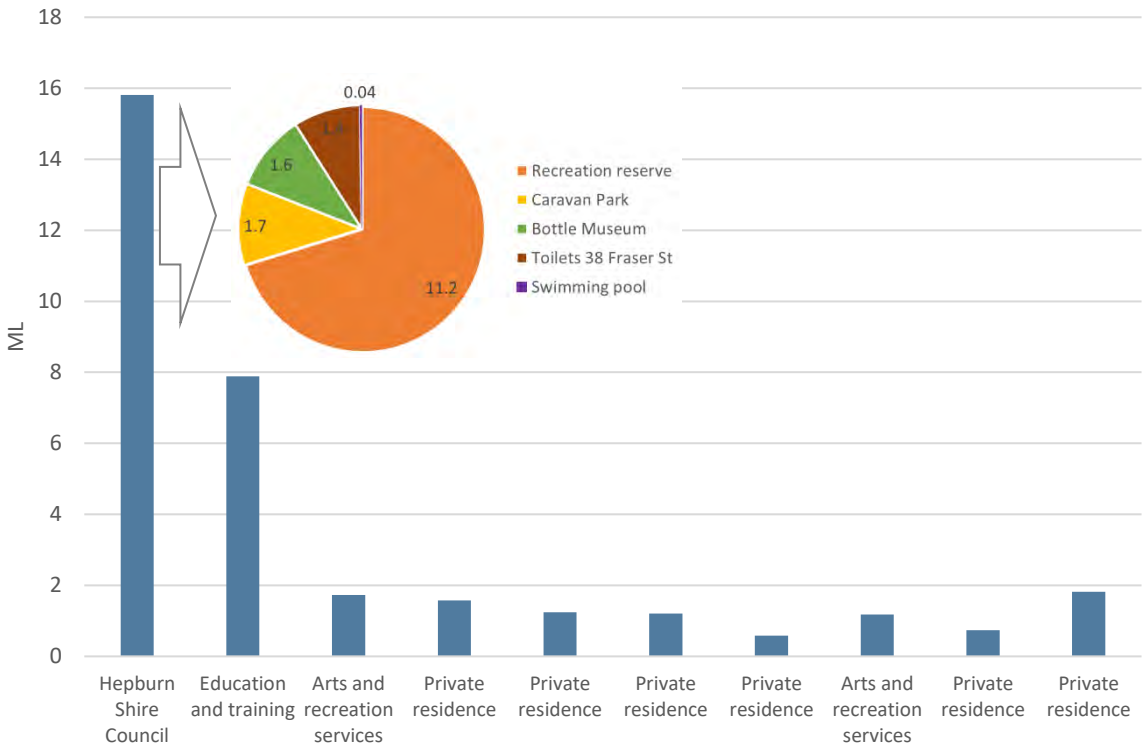


Figure 22. *Clunes top 10 water users 2019/20 (Data: Central Highlands Water)*

System vulnerability

The groundwater supply is considered to be relatively stable and secure, however, there are some risks to security of supply. These include:

- A lack of security in the event of a failure in the distribution main between the Two Mile Hill storage tank and Clunes.
- Focus on groundwater in the Ascot area.
- There is a high cost associated with treating groundwater from the Clunes system to a potable standard. The treatment process also creates a saline waste stream that is diverted directly to the WWTP. The salinity in the wastewater limits reuse opportunities for recycled water generated from the wastewater stream.
- While population growth has been steady, there is a potential that population, and thus demand for water could grow in coming years, putting further pressure on the water supply system.

Key takeaways

- The Clunes water supply system is sourced from reliable and stable groundwater bores, so is less susceptible to the impacts of climate change in the short term.
- The cost of the potable water treatment process is high and creates a saline waste stream that impacts the usability of recycled water from the WWTP.
- HSC is the highest water user, with the majority of water being used for open space irrigation.

3 Wastewater and recycled water use

3.1 Daylesford

Wastewater from Daylesford and Hepburn Springs is treated at Shepherds Flat WWTP, located approximately 8.5 kms north of Daylesford. Shepherds Flat WWTP produces Class B and C recycled water that is currently being used to irrigate 25 ha of local farmland. The WWTP has observed a rise in load since 2020, and there is an excess supply of recycled water produced by the WWTP. The distance to transfer recycled water from the Shepherds Flat WWTP back to the Daylesford town centre is a limiting factor in expanding the recycled water reuse in Daylesford.

Figure 23. *Shepherds Flat Wastewater Treatment Plant*

3.2 Creswick

Wastewater from Creswick is piped and treated at the Ballarat North WWTP approximately 10 km away. The Ballarat North WWTP produces Class A recycled water, which is supplied to Lake Wendouree to help maintain water levels in the lake and to local schools for the irrigation of their sports fields. It also produces Class B recycled water. Due to the relative distance of the WWTP to Creswick compared to Ballarat, there are limited opportunities for recycled water from the Ballarat North WWTP to be transferred back to and utilised in Creswick.

Figure 24. *Ballarat North Class A Recycled Water Facility (Source: Central Highlands Water)*

3.3 Clunes

Wastewater from Clunes is treated at the Clunes WWTP. The Clunes WWTP produces recycled water that is currently used for local farm irrigation. Winter storages at the plant are often at hydraulic capacity.

The treatment process for Clune's potable water supply creates a saline waste stream that is diverted directly to the WWTP, increasing the saline concentration of recycled water produced. This is exacerbated by the evaporation that occurs in the WWTP's lagoons. Should reuse options be investigated, anecdotal suggestions of elevated salinity in the recycled water should be investigated. produced, limits the suitability and reuse potential of this water.

Figure 25. *Clunes Biosolids drying facility (left) and Clunes Wastewater Treatment Plant storage pond (right)*

Key takeaways

- Recycled water is produced at the WWTPs servicing Daylesford and Clunes.
- Both the Clunes and Daylesford WWTPs produce excess volumes of recycled water that is currently used for local farm irrigation.
- Opportunities for recycled water reuse for to supplement urban demands are limited, in Daylesford, by the distance between WWTP and town, and in Clunes, by elevated salinity levels in the recycled water due to the potable water treatment process, and in Creswick as wastewater is not treated locally.

4 Stormwater and pollutants

Stormwater is generated when rainfall comes into contact with hard, paved surfaces like footpaths, roads and carparks, carrying associated pollutants (including nutrients, grease, oils, heavy metals and litter) to receiving environments. Managing stormwater volume and quality is an important aspect of any IWM Plan as it offers opportunities to reuse those volumes of water for things like irrigation, while reducing the risk of stormwater pollution to lakes, rivers and creeks.

By understanding where the stormwater is generated now and into the future, particularly due to urban development, opportunities for stormwater treatment and harvesting can be pinpointed.

Figure 26, Figure 28 and Figure 27 show the stormwater drainage network across Daylesford, Creswick and Clunes respectively.

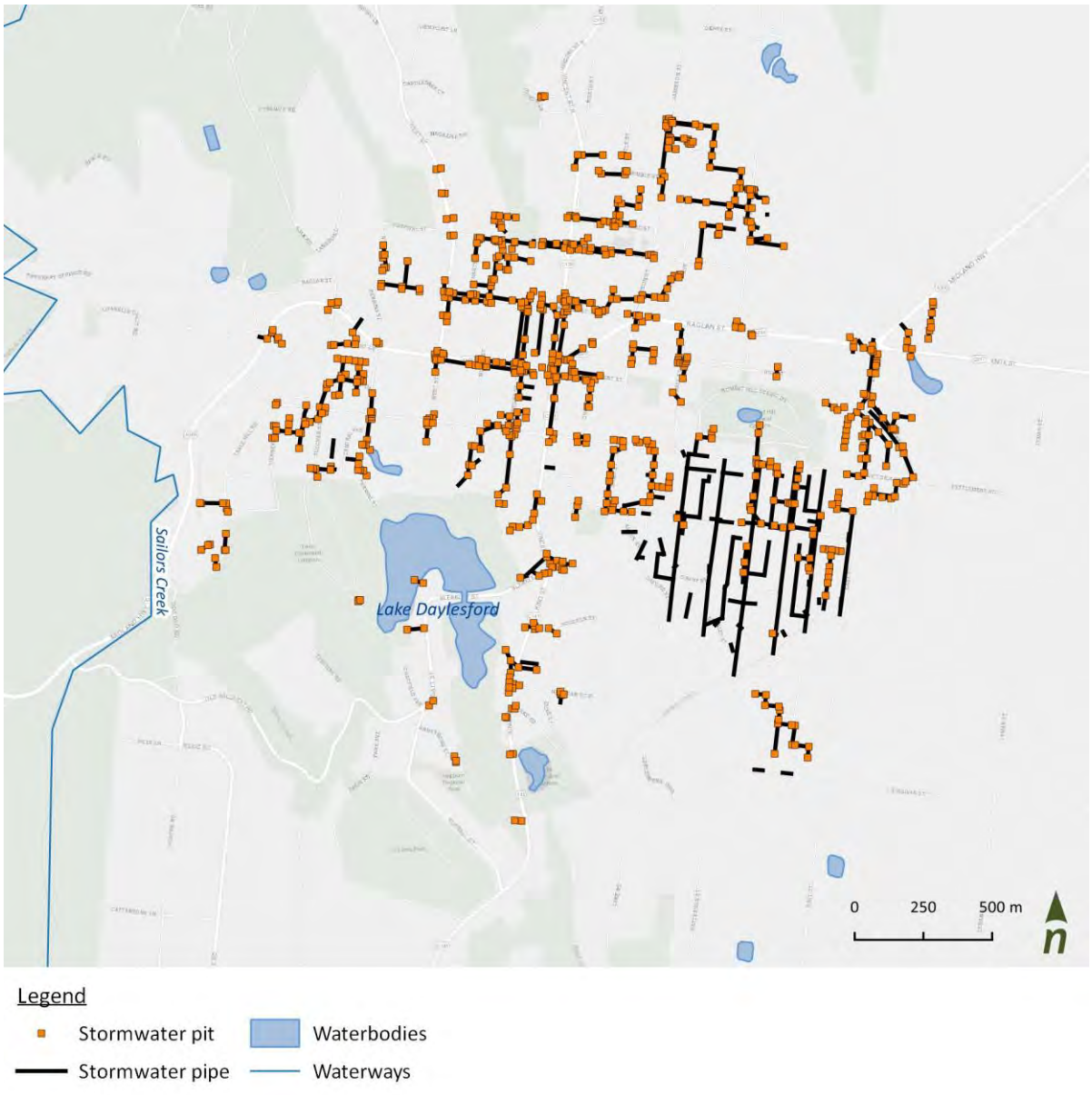


Figure 26. *Stormwater drainage network in Daylesford (Data: Hepburn Shire Council)*

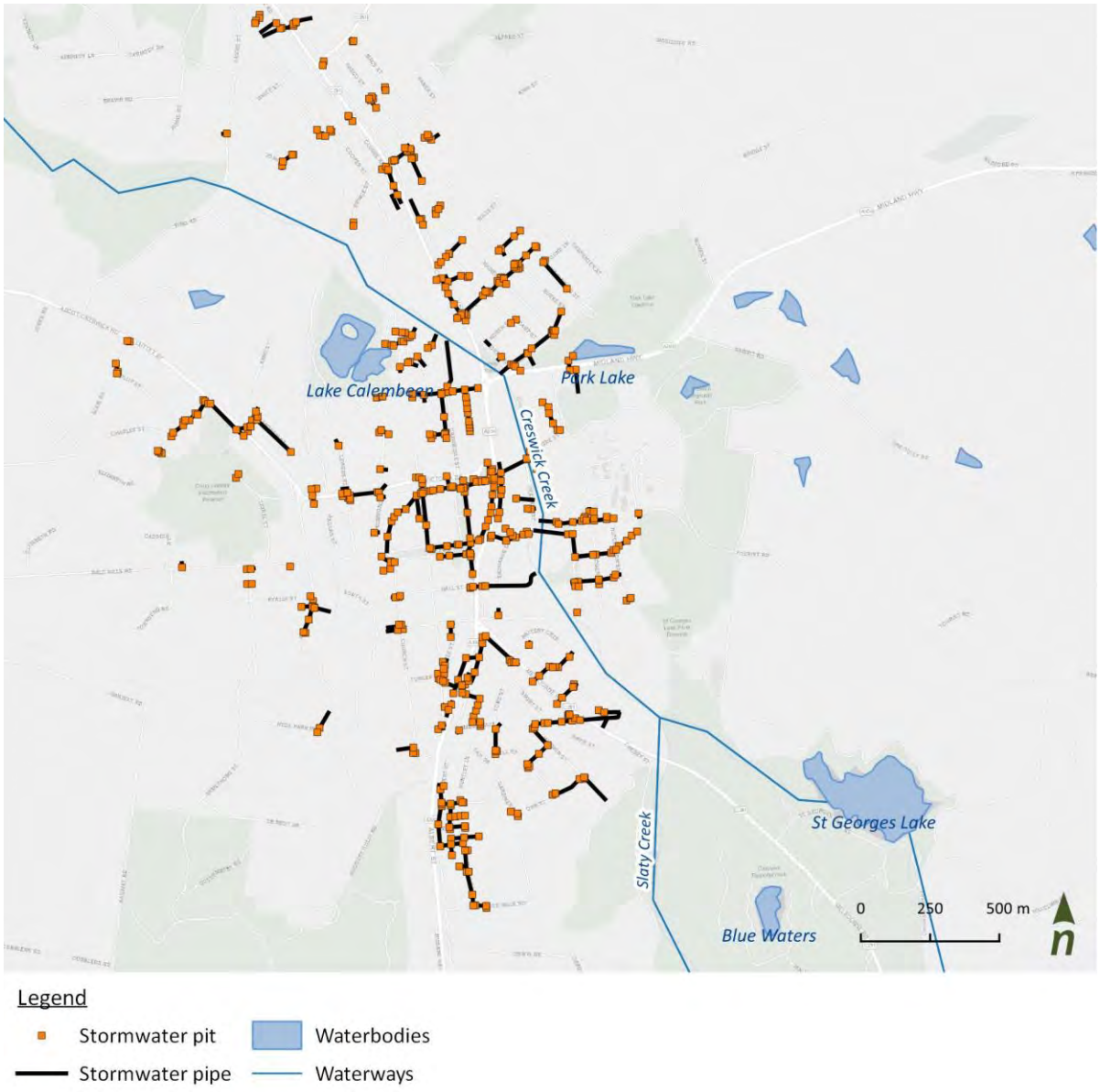


Figure 27. *Stormwater drainage network in Creswick (Data: Hepburn Shire Council)*

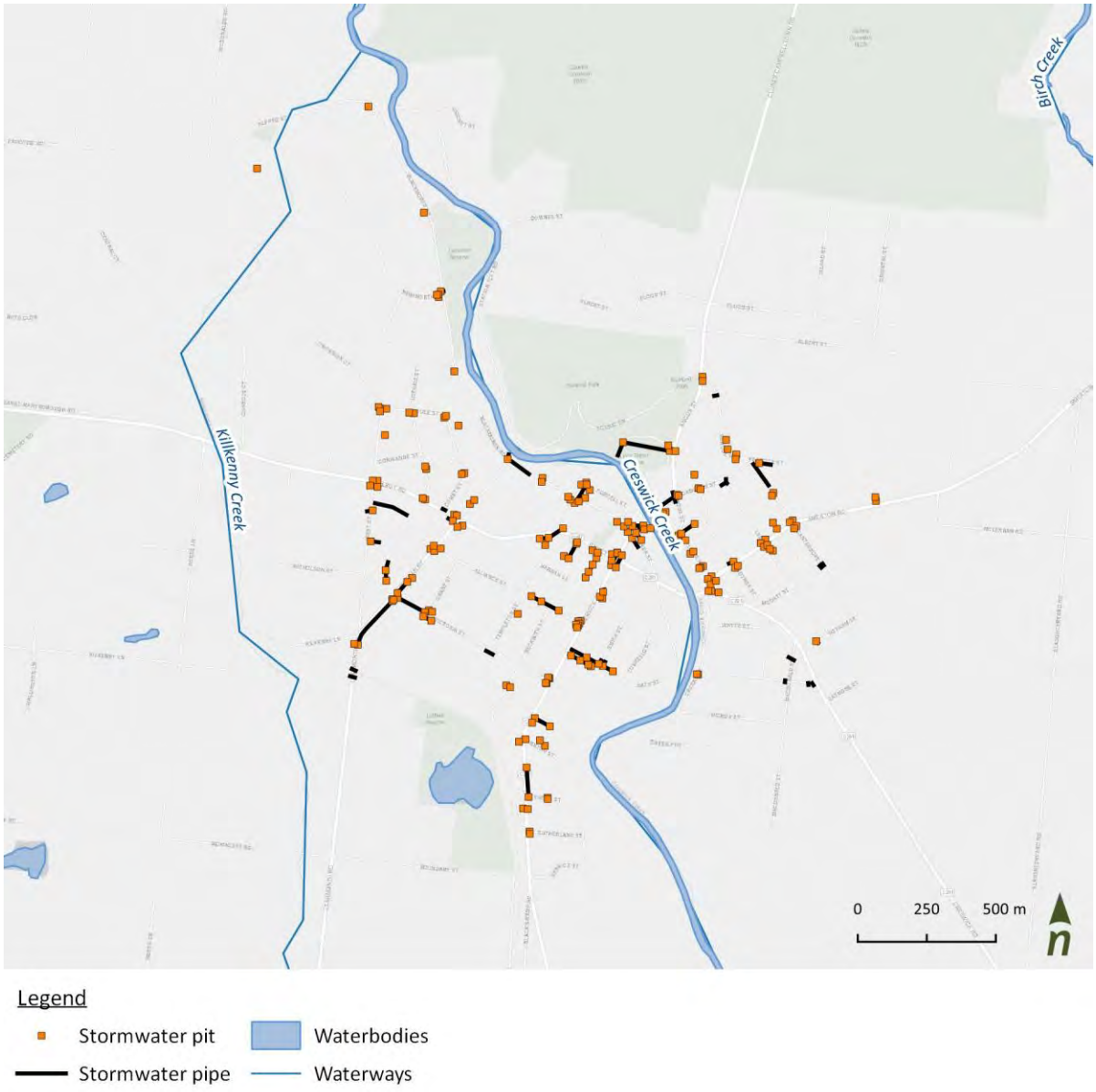


Figure 28. *Stormwater drainage network in Clunes (Data: Hepburn Shire Council)*

Key takeaways

- It is understood that there are sections of the drainage network susceptible to nuisance flooding due to an increase in runoff beyond the capacity of the existing system, related to industrial areas or urban development, and aging or deteriorating infrastructure.
- There is limited data on stormwater assets, including location, alignment and size, age and condition. In some areas, such as Clunes, data is lacking altogether. This limits the understanding of the stormwater system, where major constraints and risks are as well as opportunities for improvement.
- Further proposed greenfield and infill development is expected to put additional pressure on existing stormwater networks.

5 Groundwater

5.1 Zones and aquifers

Daylesford lies within the Loddon Zone of the Central Victorian Mineral Springs Groundwater Management Area (GMA) (Figure 29), while Creswick and Clunes are within Ullina and Ascot Zones respectively, within the Loddon Highlands Water Supply Protection Area (WSPA) (Figure 30).

Groundwater in the Central Victorian Mineral Springs GMA is characterised by five main aquifers. These are summarised in Table 2 below.

Table 2. Central Victorian Mineral Springs GMA aquifers

Aquifer	Characteristics
Ordovician sedimentary bedrock	Typically low yields Deeper systems host carbonated mineral water Salinity low in the south, higher in the north
Granite	Low yields Variable salinity Useful for domestic and stock supply
Deep leads	High yields Low salinity Narrow and difficult to locate with little extraction to date
Basalt	Moderate yields (1ML/ day) Lower yields are common Generally very good quality Most licensed extraction is from this aquifer Used for domestic and stock, small-scale irrigation
Shallow alluvial	Well connected to waterways Few bores Aquifer relatively thin and limited extent

Groundwater in the Loddon Highlands Water Supply Protection Area (WSPA) is characterised by two main aquifers. These are summarised in Table 3 below.

Table 3. Loddon Highlands WSPA aquifers

Aquifer	Characteristics
Newer Volcanic Fractured Basalt	Variable yields up to 2 ML/ day Groundwater quality generally good
Deep Lead sand and gravel deposits	Found underlying the basalt and contained within narrow trenches Higher yields up to 5 ML/ day Groundwater quality generally good

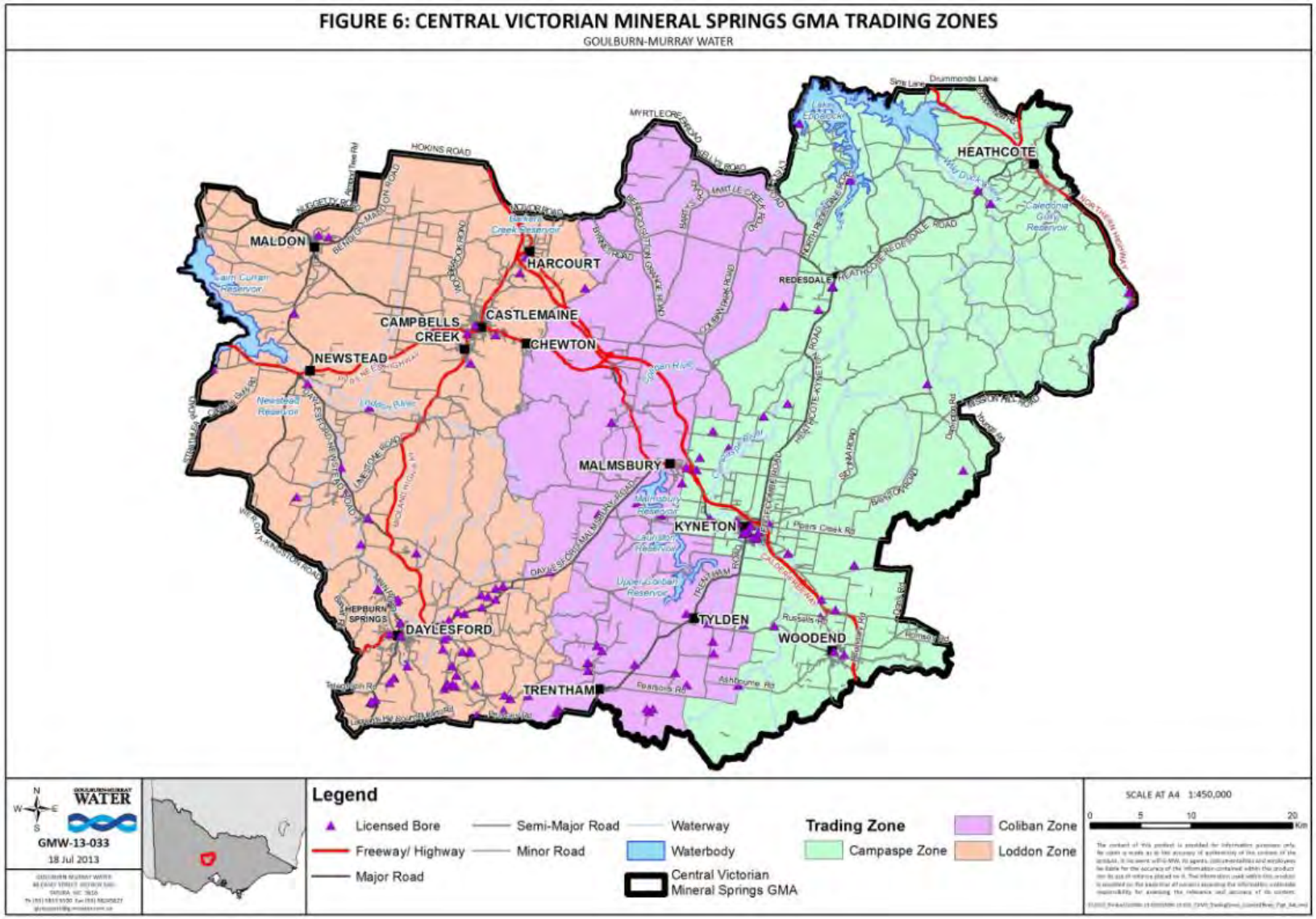


Figure 29. *Central Victorian Mineral Springs Groundwater Management Area and management zones (Source: Goulburn Murray Water)*

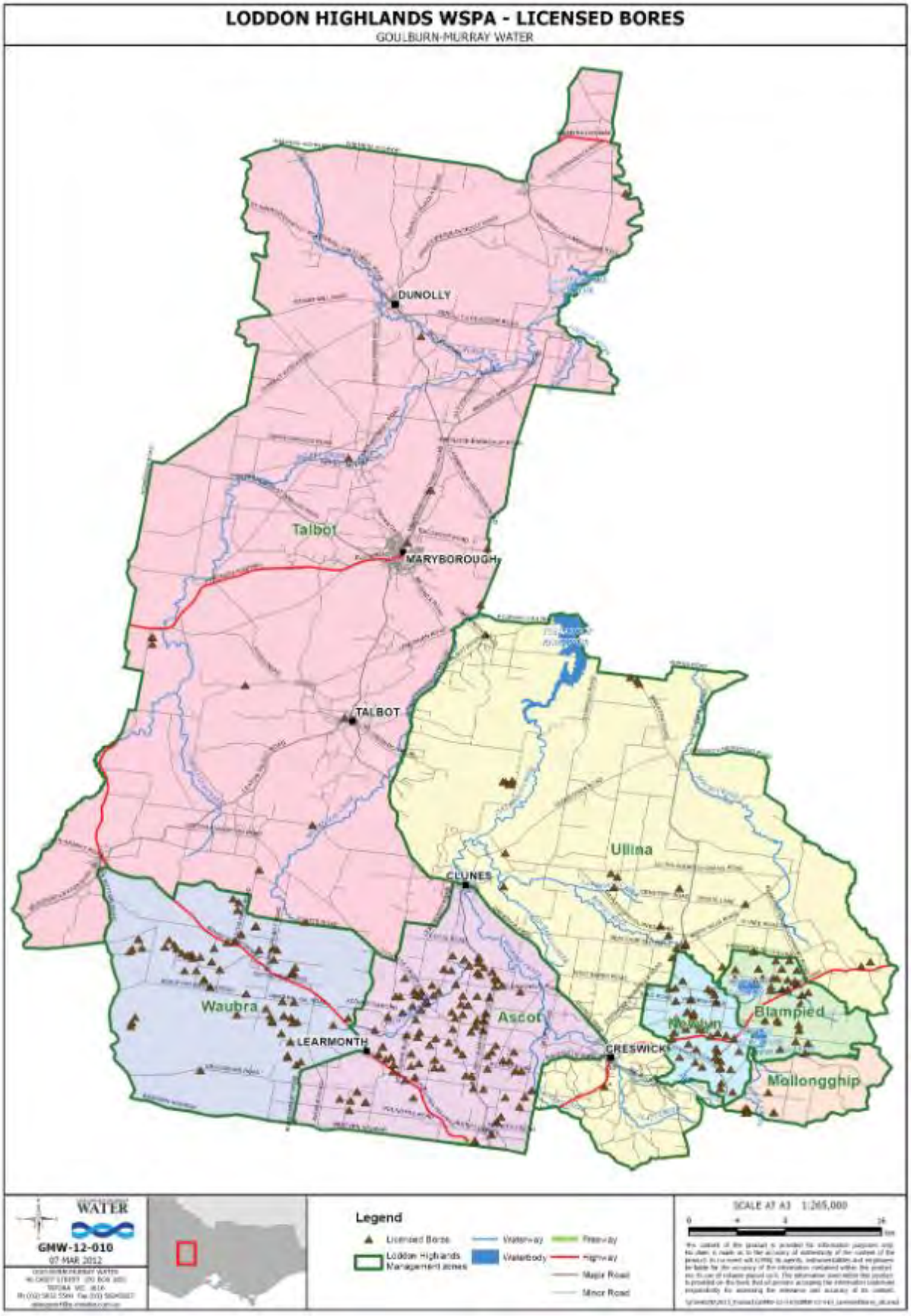


Figure 30. *Loddon Highlands Water Supply Protection Area (Source: Department of Sustainability and Environment)*

5.2 Management, licenses and extraction

The GMA and WSPA are divided into management zones based on catchments, hydrogeological characteristics, groundwater flow paths and licence entitlement locations to facilitate appropriate management and groundwater use.

The Loddon Zone, which comprises Daylesford holds 71 extraction licences with a volume of 2.73 GL/year, over half the license volume of the GMA. Monitoring is limited and only recently introduced, however, metered usage from upland areas indicates that usage is generally no more than 50% of the licence entitlement, even during dry periods. Even though the groundwater system has remained relatively stable since monitoring commenced in 1984, caps on licence entitlements have been set that provide secure access to existing users and mitigate the impacts of extraction.

In the Loddon Highlands WSPA, more than one third of the licences are held in the Ascot Zone, which includes Clunes, accounts for 68 licences and has a license volume of 7.0 GL/ year, while the Ullina Zone, which includes Creswick, accounts for 19 licenses and has a license volume of 2.4 GL/ year. Based on available data, usage ranges between 30 – 40% of the licence entitlement. Table 4 summarises management zones and groundwater licenses for each town in the IWM Plan.

Table 4. Summary table of management zones and groundwater licenses for each town in the IWM plan (Source: Goulburn Murray Water and Department of Sustainability and Environment)

GMA/ WSPA	Management zone	Relevant town	Number of licences	Licence volume (GL/ year)	Usage (%)
Central Victorian Mineral Springs GMA	Loddon	Daylesford	71	2.7	< 50
Loddon Highlands WSPA	Ascot	Clunes	68	7.0	30 – 40
	Ullina	Creswick	19	2.4	

5.3 Mineral springs

Hepburn Shire contains over 80% of Victoria's mineral springs contributing greatly to the region's commercial industries, namely tourism. The concentration of mineral springs that discharge from the Ordovician sedimentary bedrock aquifer around the Daylesford and Hepburn area is unique to Australia.

Impacts from groundwater pumping on mineral springs that rely on regional and intermediate scale groundwater systems will be managed by capping groundwater licence entitlement. Impacts to mineral springs with high environmental values that rely on local scale groundwater systems will be considered when assessing groundwater licence applications in accordance with Section 40 of the Victorian *Water Act 1989*.

The Victorian Mineral Water Committee[1] (VMWC) was established to advise on the management of mineral spring reserves, ensuring that policies and plans are in place to protect and enhance mineral spring reserves in Victoria and ensure the sustainable management and development of this resource.

Key takeaways

- Groundwater in each of the three towns is supplied by a diverse range of aquifers and their yields, quality and end use vary greatly.
- Groundwater management zones are established to manage and facilitate sustainable groundwater extraction and mitigate impacts to the environment, including the use of caps on license entitlements.
- Extraction rates in the GMA and WSPA range between 30% and 50%, even during dry periods, however monitoring is limited and only recently implemented.
- Hepburn Shire contains a nationally significant reserve of mineral springs that contribute greatly to the local economy. Impacts to the mineral springs from groundwater extraction are managed mitigated by rules set out in the Central Victorian Mineral Springs GMA Local Management Plan.

[1] https://www.hepburn.vic.gov.au/wp-content/uploads/2015/05/Draft-Report-270415.pdf

6 Water cycle summary: key takeaways

The summary below highlights some of the important water cycle issues and opportunities for Daylesford, Creswick and Clunes.

Location
Due to their respective locations in the Central Highlands and Loddon River catchment, each town has a distinct geography, influencing their climate and interaction with water and waterways.

Population
Population is growing steadily in in all three towns, with Clunes expected to have the fastest growth rate. While this will increase demand for water, it is not expected that the increasing population will put undue strain on potable water supplies into the near future.

Climate
Daylesford's water supply system is reliant on local climate conditions, namely, good winter rainfall to ensure reservoirs are replenished and can meet the summer demands. Creswick and Clunes' water supply systems are less impacted to local climate variations due to their reliance on groundwater and external sources such as the Goldfields Superpipe. However, climate change still has an impact on the security of these supplies. Additionally, increasing temperatures and reduced rainfall still has the potential to increase demand for water, namely for irrigation.

Development

- Development in Daylesford is largely constrained. However, there are some notable infill developments within the town.
- While projected growth in Clunes is low, there are low density and rural residential areas surrounding the township of Clunes that are earmarked for subdivision and development.
- Like Clunes, some areas of low-density development are proposed for Creswick notably around the town's cemetery.
- Spatial data on proposed development areas is required to determine the scale of land use change and impact on the water cycle.

Waterways, lakes, wetlands and groundwater

- Creswick Creek is a major waterway that passes through the towns of Creswick and Clunes. Kilkenny Creek is also a valued waterway for Clunes.
- Lakes in and around Daylesford and Creswick are highly valued community assets.
- Mineral springs are of high economic and community value, particularly to Daylesford.

Flooding

- Creswick Creek is susceptible to flooding, impacting the urban areas of Creswick and Clunes.
- Flooding is exacerbated by the build-up of exotic vegetation within the Creek channel. However, the trees along the riparian zone are highly valued by the community. Tree removal is labour intensive and ongoing management is required.

Water supply

Daylesford

- The Daylesford water supply system is reliant on local climate conditions, namely, good winter and spring rainfall. Limited storage capacity means that the system is vulnerable to dry spells.
- HSC is the highest water user, with the majority of water being used to service recreational aquatic facilities and open space irrigation.

Creswick

- The Creswick water supply system is connected to the Ballarat system, including the Goldfields Superpipe. This provides greater security of water supply, but may also be susceptible to impacts of climate change and competing demands.
- An 'Accommodation/food services' venue is the highest water user, with more than double the water use of the second highest user, being HSC.

Clunes

- The Clunes water supply system is sourced from reliable and stable groundwater bores, so is less susceptible to the impacts of climate change in the short term.
- The cost of the potable water treatment process is high and creates a saline waste stream that impacts the usability of recycled water from the WWTP.
- HSC is the highest water user, with the majority of water being used for open space irrigation.

Wastewater and recycled water

- Recycled water is produced at the WWTPs servicing Daylesford and Clunes
- Both the Daylesford and Clunes WWTPs produce excess volumes of recycled water that is currently used for local farm irrigation.
- Opportunities for recycled water reuse for to meet urban demands are limited, in Daylesford, by the distance between WWTP and town, and in Clunes, by elevated salinity levels in the recycled water due to the potable water treatment process.

Stormwater and pollutants

- It is understood that there are sections of the drainage network susceptible to nuisance flooding due to an increase in runoff beyond the capacity of the existing system, related to industrial areas or urban development, and aging or deteriorating infrastructure.
- There is limited data on stormwater assets, namely sizes, age and condition. In some areas, such as Clunes, lack data all together. This limits the understanding of the stormwater system, where major constraints and risks are as well as opportunities for improvement.
- Further proposed greenfield and infill development is expected to put additional pressure on existing stormwater networks.

Groundwater

- Groundwater in each of the three towns is supplied by a diverse range of aquifers and their yields, quality and end use vary greatly.
- Groundwater management zones are established to manage and facilitate sustainable groundwater extraction and mitigate impacts to the environment, including the use of caps on license entitlements.
- Extraction rates in the GMA and WSPA range between 30% and 50%, even during dry periods, however monitoring is limited and only recently implemented.
- Hepburn Shire contains a nationally significant reserve of mineral springs that contribute greatly to the local economy. Impacts to the mineral springs from groundwater extraction are managed mitigated by rules set out in the Central Victorian Mineral Springs GMA Local Management Plan.

Attachment B. Complete long list of IWM opportunities

Complete Long List of IWM Opportunities

Daylesford		
Opportunity	**Type**	**IWM Opportunity Description**
Alternative water sources for open space irrigation	Town wide investigation	**Opportunity:** a general investigation into the potential for non-potable water sources being used for irrigation within Daylesford. This could include options such as • Sourcing water from Jubilee and Daylesford Lakes • Wallaby Creek Weir: infrastructure is in place to divert raw water • Examine pipe alignment at East Street and investigate potential to pump water to Wombat Hill • Stormwater harvesting opportunities throughout the town that could be identified. • Groundwater bores including Wombat Hill, Victoria Park and along Wallaby Creek pipeline • High level assessment of cost of return recycled water pipeline from the WWTP to recreation sites in Daylesford. Taken generally, this would be a high-level identification of non-potable water opportunities in Daylesford and a scan of their potential yields.
Shepherds Flat recycled water use strategy	Investigation	Shepherds Flat wastewater treatment plant produces recycled water that is irrigated to land surrounding the plant and may sometimes spill to the waterway (Jim Crow Creek). The challenge is that the plant is remote from town so, are there enterprises nearer to the plant, or could the water be intercepted closer to town. **Opportunity:** identify local demand or business enterprise to identify better and more productive uses for that recycled water e.g.: • Support a social or farming enterprise e.g. near Cricket Willow, Yulong lavender (e.g. YVW trade school) • Identify suitable locations for irrigation or other uses. • Potentially align with a DELWP initiative of using treated wastewater as an environmental flow in waterways.
Wombat Hill mini hydro	Investigation	**Opportunity:** to assess the feasibility of a mini - hydro scheme that could generate, or recover energy from the Wombat Hill supply scheme (i.e. generate electricity when water is released from the high-level storage)

Opportunity	Type	IWM Opportunity Description
Daylesford Lake water quality investigation	Investigation	Lake Daylesford and Jubilee Lake have historically had blue-green algae issues. **Opportunity:** to undertake an investigation into the causes of those blooms, and based on the outcomes of that work, implement strategies to reduce their likelihood. As part of this IWM plan that could be addressed is the causes were seen to be related to high nutrient runoff entering those lakes. This could lead to recommendations around water sensitive urban design (WSUD)options to reduce nutrient loads.
Urban forestry and street tree canopy cover	Strategy / pilot project / program	Feedback received is that community wants and values trees in the main street. **Opportunity:** to identify key streetscapes that would benefit from greater canopy cover (from a liveability / urban cooling perspective) and support tree growth using IWM / WSUD methods including passive street tree irrigation. This could begin as a pilot and grow to a program over time. The autumn leaves are synonymous with Daylesford and highly valued by community, however they are a maintenance burden for council (e.g. blocking drains and impacting waterways). Could an education element change the type of trees to a less labour intensive, more resilient to climate change species?
General IWM opportunities	Investigation	Undertake a town-wide scan to identify opportunities for: • Rainwater tanks • Stormwater harvesting • WSUD • Education and information (e.g. re: Creswick Creek and Creswick's location in the context the Loddon and Murray Darling Basin) • Other

Creswick		
Opportunity	**Type**	**IWM Opportunity Description**
Doug Lindsay Reserve alternative water supply	Alternative water source investigation	The central active open space in Creswick with surrounding parks and gardens with demand of approximately 8.6 ML/year of potable water. **Opportunity:** To identify rainwater and stormwater sources that could meet some / all of that demand. There has been some land development to the west / northwest that will create additional stormwater to the tributary along the western boundary. Is there an opportunity to collect and reuse that stormwater? Opportunity: Investigation of the existing or potential rainwater harvesting opportunities from the DL pavilion for internal, non-potable uses (e.g. toilet, with overflow irrigating surrounding landscaping.
Park Lake Gardens - tennis courts alternative water supply	Alternative water source investigation	Park Lake Gardens are a high quality, highly valued community facility that requires significant irrigation to maintain those values. Currently the courts use potable water with a scheme \that brings water from a nearby lake / waterbody, set up during the Millennium Drought in relative haste. **Opportunity:** to identify at potential non-potable water supply options for the courts. It is proposed that as a regionally significant recreation asset, there is an economic value for Creswick in maintaining the quality of these courts.
Creswick Creek stormwater condition improvements	Town wide strategic investigation	**Opportunity:** to better understand the source of stormwater reaching Creswick Creek, and the opportunities to treat or reuse that water to improve the overall condition of the creek. An investigation could include: • mapping key stormwater assets and identifying where they discharge to the creek • identifying opportunities within catchments for harvesting, diversion and treatment • overlaying litter hotspots to identify potential locations for gross pollutant traps (GPT) This could be combined with options 2a / 2b to be a part of a broader masterplan or waterway quality plan for Creswick. Combine with 2b to understand if there are localised erosion or other issues that this project may assist in rectifying
RACV resort alternative water supply from Russells Reservoir	Investigation	The RACV resort is a large potable water user. **Opportunity:** to investigate the potential for this and other sites to be supplied raw water for irrigation and other demands from Russells Reservoir. This would involve an investigation into total and seasonal demand, how that water is used (i.e. water quality requirements), and the potential to convey water from Russells Reservoir both in terms of source (including catchment area and available storage) and transfer infrastructure (pipes and pumps), including the legal framework on accessing the water e.g. bulk entitlement etc. There is a question as to whether this represents broader community values, but it is still valid as a potable water saving investigation.

Opportunity	Type	IWM Opportunity Description
O'Reilly's dredge hole connection and ecological investigation	Ecological survey / assessment	O'Reilly's dredge hole is a waterbody located north Luttet St, near the Creswick landfill. It appears to be an online waterbody, on a tributary to Creswick Creek. It has been noted to be habitat for Growling Grass Frog (GGF) **Opportunity:** to understand the values at this site and respond with a plan for rehabilitation / revegetation / protection to enhance its habitat values (*Co-ordinates: -37.416221, 143.883478)*
The old wastewater treatment plant (WWTP) land	Site assessment to understand ecological and social value	Central Highlands Water own a large area of land on Creswick Creek that was once the site of the Creswick wastewater treatment plant. **Opportunity:** to investigate the potential ecological and social value that a large landholding like this could present for Creswick. This could include: • Investigating connectivity with other sites along the creek (see opportunity 2) • House biodiversity and habitat offsets • Improve the site, connecting to others along creek • Plantings to realise carbon offsets • Habitat improvement (there is a known population of GGF in this location).
Known areas of nuisance flooding	Flood mitigation Investigation at various locations	The main trunk at Victoria Street is an old brick-lined pipe that is deteriorating. The debris creates blockages in the pipe, constraining the ability of the pipe to drain. St Augustine's Primary School on Napier Street has large impermeable areas and buildings. The drainage infrastructure at the Turner Street intersection is often overwhelmed and susceptible to flooding. Current drainage network and 128 Clunes Road passes underneath an existing house and train line. Culverts are susceptible to blockage and flooding. **Opportunity:** Investigate options for flood mitigation works such as rehabilitating or maintaining existing assets, diversions, flood detention with retarding basins or rainwater tanks (and possible integration of alternative water supply).
General IWM opportunities	Investigation	Undertake a townwide scan to identify opportunities for: • Water efficiency measures • Rainwater tanks • Stormwater harvesting • WSUD • Education and information (e.g. re: Creswick Creek and Creswick's location in the context the Loddon and Murray Darling Basin) Notable high users include the Melbourne University Forestry School (5.4 ML used in 2019-20) and the John Curtin Aged Care centre (8.0 ML used in 2019-20)

Clunes		
Opportunity	**Type**	**IWM Opportunity Description**
Reducing potable water usage in Clunes	Town wide investigation	The Clunes water supply system sources water from the Tourello and Kinnersley groundwater bores for treatment at Clunes Water Treatment Plant and storage at Two Mile Hill. The groundwater supply is relatively stable and secure, with some risks to security of supply including: • One distribution main between the storage tank and Clunes. • Concerns around groundwater allocations and access. • Competing uses for groundwater including agriculture into the Ascot area. • Climate change impacts. • Other issues include cost of treating water to a potable standard, waste stream from water treatment process that goes to wastewater and potential population growth. Clunes wastewater treatment plant (WTP) produces volumes of recycled water that is currently used for local farm irrigation and is nearing its hydraulic capacity. The waste stream from potable water treatment increases the saline concentration of wastewater effluent (reducing potential uses / increasing treatment costs). This is exacerbated by the evaporation that occurs in the WWTP's lagoons. **Opportunity:** To investigate alternative water supply opportunities (including rainwater and stormwater harvesting) and water efficiency initiatives to reduce potable water demands in Clunes, particularly for large water using activities including: • Recreation reserve (11.2 ML/ year) • Wesley College Campus (7.9 ML/year) • Clunes Bowling Club (1.73 ML/ year) • Clunes Bottle Museum (1.6 ML/ year) • Clunes Golf Club (1.18 ML/year) • Clunes Neighbourhood House (unknown) Assess stormwater harvesting opportunities by identifying stormwater catchments and collection points and if stormwater can be captured, treated, stored and reused. Investigation of rainwater harvesting opportunities including identifying large roof areas and their proximity to high water users. Investigate opportunities to broaden the re-use of wastewater from Clunes reducing pressure on the WTP while reducing potable water demand by providing an alternate source of water to Clunes. This would involve: • Assessment of water discharge volumes and water quality (including salinity concentration) • Identify suitable end uses • Identify options for removing or reducing the saline concentration (shandy, reverse osmosis) • Investigate feasibility of transferring recycled water back into town (5km) to meet demands there.

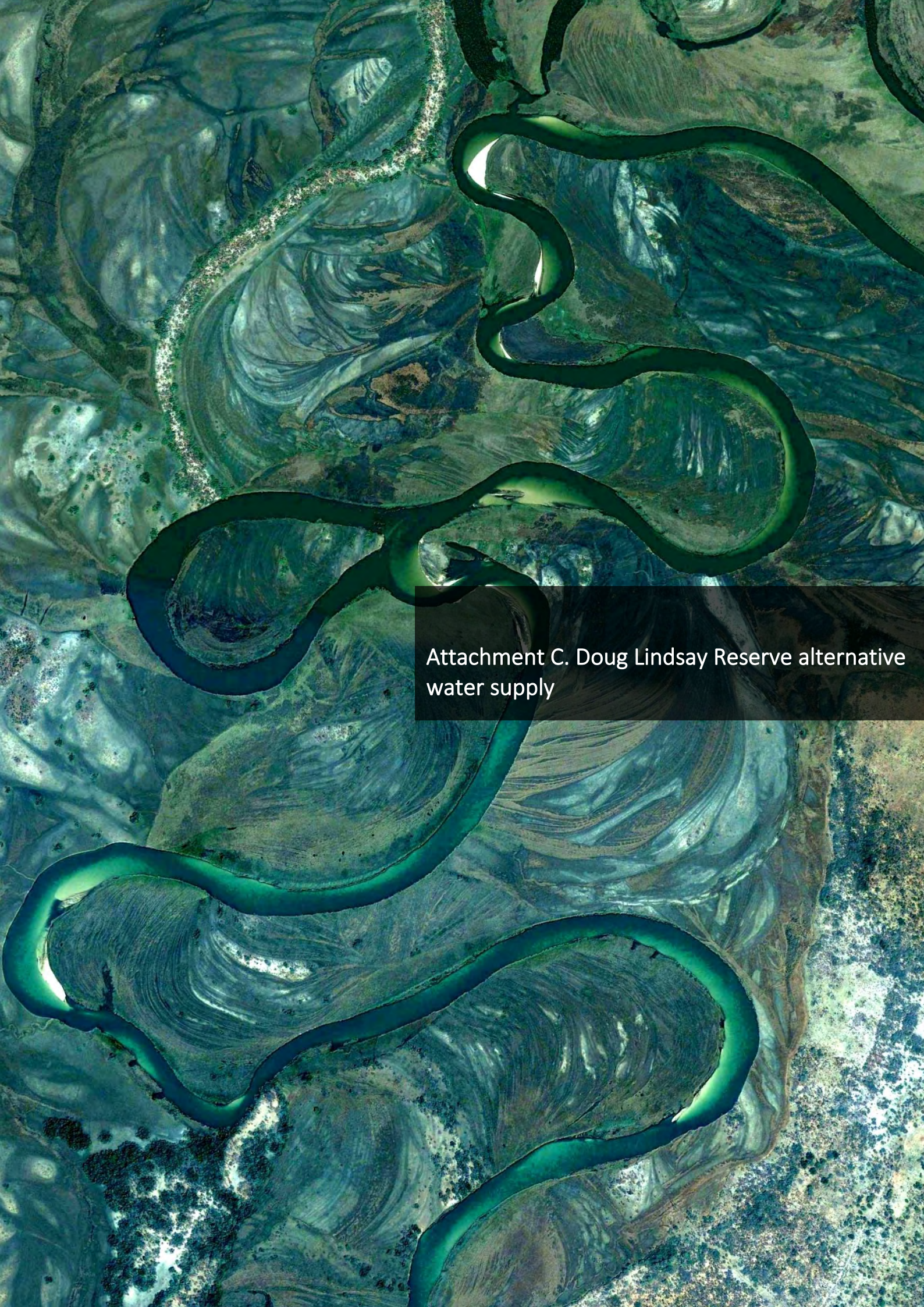
Opportunity	Type	IWM Opportunity Description
Clunes historical water supply network	Masterplan	Following the upgrade of the Clunes water supply system in 2005, the historical water supply network in Clunes was decommissioned. This infrastructure is no longer suitable for transferring potable water but may be suitable for other uses. **Opportunity:** To investigate opportunities to repurpose this asset e.g. as a linear trail linking to existing trails or the Goldfields trail. This may take the form of a landscape masterplan and high-level concept designs for public consultation and engagement (see example - Greening the Pipeline in Melbourne's West, Williams Landing).
Two Mile Tank beautification	Community artwork	The storage tank on Two Mile Hill is the primary balancing storage for the Clunes Water supply system. **Opportunity:** To Commission a mural or artwork on the water storage tank at Two Mile Hill similar to the Silo Art Trail throughout Western Victoria. This could involve the local community to establish a vision for the asset and concept designs.
Clunes urban forest strategy	Strategic plan	Trees and the natural environment and highly valued by the Clunes community. However, it is reported that reactive soils make it difficult for street trees to establish themselves in some parts of town. As a result limited canopy contributes to the urban heat island effect reducing shade and streetscape greening. **Opportunity:** Develop an urban forest strategy to explore opportunities to establish 'green boulevards' throughout Clunes to improve canopy cover and links to existing active transport networks and open spaces. Establish street trees to help offset the removal of any trees from the creek corridor, enhance amenity and mitigate urban heat impact. Focus on improving amenity in areas of lower socio-economic status. • Identify species that are suitable for the soil condition and local context within Clunes. • Investigate potential for of passive irrigation street trees.
Lothair Reserve wetland	Ecological investigation and wetland certification	A new development is proposed adjacent (west) of the Clunes train station. There is an existing wetland in this development area that has potential ecological value and there is an opportunity to enhance the wetland values as part of that development. **Opportunity:** There is an opportunity to: • Undertake an ecological assessment to identify wetland values • Assess post-development stormwater impacts on the wetland and mitigation strategies • Incorporate these findings into Council land development requirements.

Opportunity	Type	IWM Opportunity Description
General IWM opportunities	Investigation	Undertake a town-wide scan to identify opportunities for: • Rainwater tanks • Stormwater harvesting • WSUD • Education and information (e.g. re: Creswick creek and Creswick's location in the context the Loddon and Murray Darling basin The Clunes Community Plan (2015) was developed by Clunes residents and presented to Council. A central community garden was proposed in the Clunes Community Plan (2015). Revisit this proposal and find a location and land to establish a community garden (noting that the neighbourhood House is the primary space for community activity).

All towns / Shire wide		
Opportunity	**Type**	**IWM Opportunity Description**
Community water education, communication and indigenous engagement program	Education and communication	Communities of Daylesford, Creswick and Clunes are active, informed and engaged, who are passionate about sustainability and their environment. Climate change has been identified as the #1 issue in the Daylesford community survey. However, perceptions of environmental issues can sometimes be misaligned with the realities of the situation. Tourism is also a major industry across the towns and the positioning as a luxury destination can be counter-productive with efforts to improve sustainability practices. Spas and hot springs in Daylesford, as well as the RACV club in Creswick are major users of potable water. Tourists make up a large proportion of visitors to these towns. When they arrive there may be a perception that the perception of a luxury holiday is coupled with excess or waste. Daylesford, Creswick and Clunes have rich Aboriginal and European cultural heritage. Communities in these towns have expressed a strong interest in enhancing the representation of Aboriginal and European cultural heritage values in the landscape. **Opportunity:** Develop an education and communication program for community and business to focus on sustainability, particularly around water use. Harness the intellect and energy of the local community through meaningful citizens science programs that gather data to answer questions that can support and benefit the implementation of opportunities identified in this plan. • Rebrand tourism in the context of looking after natural resources, including water. This may be an education campaign designed to reduce water consumption of visitors and to perhaps require water conservations standards in tourist operations that better reflect community values. • Undertake indigenous water assessment and establish a formal engagement plan to engage First Nations groups in IWM. Incorporate and celebrate Aboriginal cultural heritage values through signage and naming of local waterways and landscapes. Implement the UIWM plan with meaningful engagement with Traditional Owners and to reflect their cultural history and values. There are a number of examples as to how this can be achieved and the plan would need to be specific: • A cultural flows assessment could be a meaningful way to both engage local traditional owners but also educate Daylesford's local population around the cultural values of water (Tullaroop cultural water assessment is a local example of this) o Identifying suitable local plants for inclusion in WSUD assets within the streetscape and providing signage and information o Changing the name of Jim Crow Creek if this is a sensitive issue o Indigenous educational signage on nature walks etc

Opportunity	Type	IWM Opportunity Description
Planning conditions for infill and greenfield developments	Planning conditions Development IWM plan / IWM planning clauses	Populations in each of the three towns are steadily increasing putting pressure on water supply, drainage systems and waterways. New developments provide opportunities to integrate IWM principles where retrofitting existing built-up areas may be constrained. In Daylesford, Implementation of WSUD has traditionally been limited as much of the developments are infill. The issue is that infill developments at lot scale may not have appropriate WSUD and there is no auditing or ongoing maintenance. It is a requirement of title to maintain these assets. General residential development is planned for the North of Creswick, in an area near the Creswick cemetery reserve, east of the Clunes – Creswick Road. **Opportunity:** • Develop or promote existing planning conditions for new developments to guide implementation and WSUD and integration of IWM principles such as promotion of amenity, urban greening/ cooling and mitigate any potential stormwater impacts to waterways. • Draft planning clauses that specify IWM / stormwater management requirements. The Victorian Planning Provisions will need to be met, so the question is what can we propose in addition to this? It may include lot scale rainwater tanks, street scale passive irrigation etc. This opportunity can be developed in collaboration with Council's planning department • Revisit WSUD requirements for infill to meet water quality, drainage network constraint and / or potable water reduction objectives.
Connecting natural spaces for recreation	Engagement Masterplanning exercise	Daylesford, Creswick and Clunes are surrounded by natural spaces and assets that are highly valued by communities for a range of recreational activities. A number of reservoirs exist that are no longer utilised for water supply, however, have the potential for enhanced community engagement through improved access and facilities. **Opportunity:** Develop a Masterplan that promotes the connection of community to natural assets. This would encourage people to use these for recreation rather than high water demand open spaces or sports fields. This may include: • Investigate options to provide improved facilities (e.g. toilet blocks, picnics, BBQs) at areas such as Cosgrave and Russells Reservoir. • Identifying, developing and promoting locations and landscapes that fit the definition of suitable, natural, recreational space. • Identifying and planning for one such space that stakeholders agree fills a community need and an identified gap. e.g. an ecotherapy garden like the one being planned in Romsey?

Opportunity	Type	IWM Opportunity Description
		Creswick Creek runs through the Clunes and Creswick and is a significant feature of both towns. Flooding has been an issue with major floods in September 2010 and January 2011 causing damage to private and public property. A contributing factor to the severity of flooding is the concentration of exotic trees and weeds within the creek channel reducing its capacity. The trees (particularly elms) are highly valued by the community for their amenity and there is resistance to their removal. Kilkenny Creek is also a significant waterway that requires management and maintenance. Water quality in both these creeks is impacted by agricultural runoff in the upstream catchment with urban stormwater also of concern. We could extend this to Birches creek and understand the greater Loddon basins issues, the Murray darling Basin, catchment of Tullaroop reservoir which is a primary supply for Maryborough.
Creswick Creek urban waterway management strategy	Strategic plan	**Opportunity:** An urban waterway management strategy that sets out a long-term plan for the health and function of Creswick Creek and other Creeks in the area such as Kilkenny and Birches Creek covering: • Exotic tree removal and revegetation plan: apply a gradual approach to removal of exotic species with replacement with more suitable species to maintain the amenity and function of the creek. • Investigation into pollutant sources with mitigation options. • Review of flood mitigation options (building on Watertech's flood mitigation and urban drainage plan for Clunes 2013). • Establishing / extending walking tracks along Creswick Creek connecting the outer town with walking, horse and bike paths (as per Clunes Community Plan, 2015). • Develop an agreed program of works to rehabilitate Creswick Creek. This would be focussed on improving the quality of waterway vegetation through the removal of weed species while also improving flood conveyance and reducing flood risk. • It is proposed that previous vegetation clearing works have shifted a 'choke' downstream (e.g. south of Ring Road), so further flood mitigation work may be required. A key part of this will be clearly defining waterway management responsibilities between Council and the CMA. This may take the form of an MOU or other document that clarifies responsibilities and identified opportunities to work together.



Attachment C. Doug Lindsay Reserve alternative water supply

1 Doug Lindsay Recreation Reserve alternative water supply

The Doug Lindsay Recreation Reserve is the central active open space in Creswick that consumes approximately 8.6 ML/year (2019-20) of potable water. It is the Hepburn Shire Council's largest individual water user in Creswick. This concept investigates opportunities to provide an alternative (non-potable) water supply to the Reserve on a fit for purpose basis to reduce the town's potable water use overall.

1.1 Scope

A number of alternative water sources were considered for the irrigation of open space including:

1. A raw water supply from nearby reservoirs and lakes
2. Stormwater harvesting, and
3. Recycled wastewater (sewer mining).

Analysis was also undertaken to understand the potential benefit of harvesting rainwater off the main pavilion roof for internal toilet use and irrigation of surrounding gardens.

The concept compares the relative feasibility of these options to identify a preferred non-potable source and establish the basis of further investigations.

1.2 Tasks

The investigation includes:

- Estimation of the potential yield from each source (including assumptions)
- Estimation of infrastructure requirements
- Location and alignment of infrastructure
- Considerations for extraction licences and bulk entitlements where relevant
- Assessment of potential volumes of potable water saved and reliability of each source
- Indication of capital costs of proposed works
- Cost-benefit summary of each option and recommended approach.

1.3 Location

Doug Lindsay Recreation Reserve is located to the west of the Creswick CBD on Lindsay Park Drive (Figure 1). The broader reserve precinct includes a cricket/ football field, two soccer pitches, netball courts and the Creswick Bowling Club.

There is also a larger pavillion with change rooms, toilets and a bar / function area (Figure 2). There is a smaller change room building between the soccer pitch and netball courts.

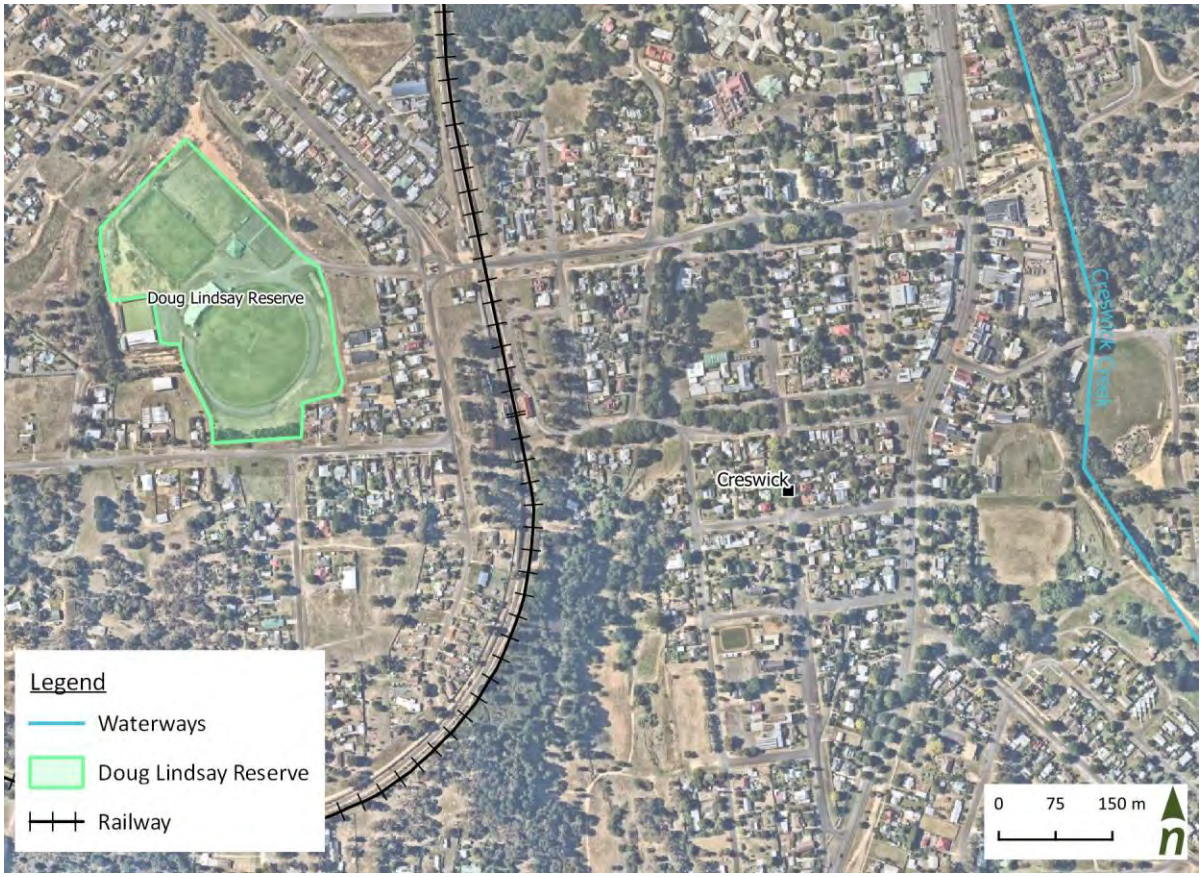


Figure 1. *Doug Lindsay Reserve location map*

Figure 2. *Doug Lindsay Reserve Facilities*

1.4 Analysis

Water demand

The Doug Lindsay Recreation Reserve is the Hepburn Shire Council's largest potable water user in Creswick consuming 8.6 ML in 2019-20 (Figure 3). A breakdown of end users within the precinct is unavailable, however uses include irrigation, toilet, hand basins, showers, kitchen and bar facilities.

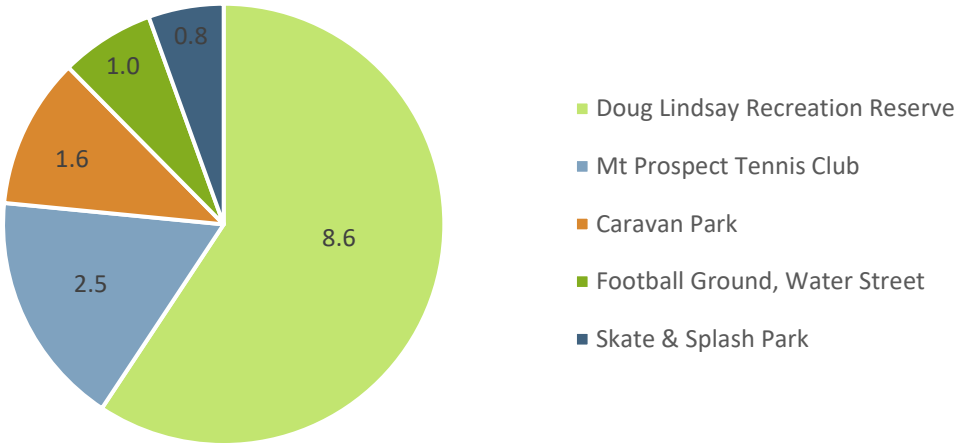


Figure 3. *Top 5 Hepburn Shire Council Potable water users in Creswick showing Doug Lindsay Reserve as the highest water user (in ML/year)*

Seasonal irrigation demand

While some water will be used internally e.g. for toilet use, showers, catering etc, it is assumed that most water is used for irrigation of sports fields. Irrigation demand changes with the seasons, with the greatest proportion used in summer. The assumptions regarding the percentage of total demand irrigated each month is set out in Figure 4. This assumption has been based on irrigation projects in drier areas, in the west of Metropolitan Melbourne.

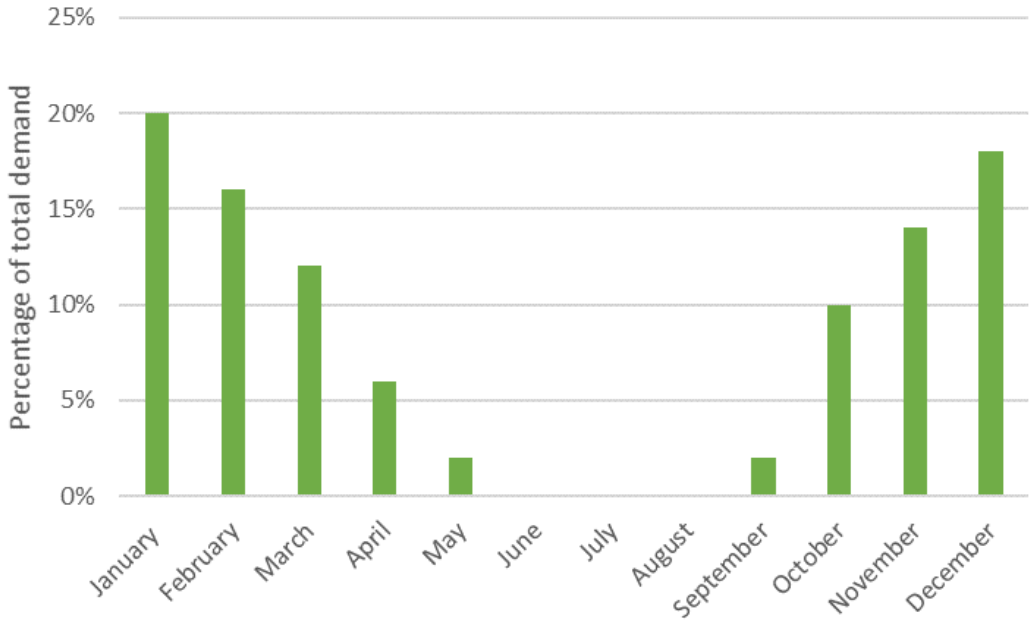


Figure 4. *Seasonal irrigation demand distribution by month (assumed)*

Based on this, the following has been assumed in terms of seasonal demand and irrigation practice:

- The estimated irrigation volume in January is 20% of total irrigation demand or 1.7 ML
- If we assume that the oval is irrigated every 3 days in January, there are 10.3 (assumed 10) irrigation 'events' in January
- Therefore each irrigation cycle uses approximately 170 kL of water (that is, 1.7 ML divided by 10 irrigation cycles).

Non-potable pavilion demands: toilet use

There is also an opportunity to reduce potable water use associated with toilet flushing within the main pavilion. During the site visit the number of toilets and urinals were counted to estimate what volume of potable water could be saved. Rainwater is assumed to be the most appropriate source given:

- Proximity of roof and downpipes to bathrooms meaning this is a relatively straight forward retrofit, and
- Rainwater not requiring additional treatment prior to use, unlike stormwater, recycled water or raw water.

It is difficult to estimate how much water is used in the toilets each year. There is no separate metering, therefore some sensitivity analysis has been undertaken. For the purposes of establishing a 'base case', the following is assumed:

- The pavilion is used year-round (i.e. for cricket in summer and AFL and football in winter)
- There is one larger gathering a week (e.g. on game day / Saturday). It is assumed
    - 50 people attend
    - 50% use a urinal (25 urinal flushed) and 50% use the toilet (25 toilet flushes)
- There are two training nights a week that includes 20 players. 75% use the urinal and 25% use the toilet. Therefore each week there are
    - 15 uses of the urinal x 2 nights a week = 30 per week
    - 5 uses of the toilet x 2 nights a week = 10 per week.

These assumptions are summarised in the table below and equate to roughly 15kL of demand annually.

Table 1. Pavilion – estimated toilet use demand

End use	Main Pavilion	Volume per use	Use assumption (per week)	Total volume (per week)
Toilet	6	6	35	210
Urinal	4	1.5	55	82.5
			Sub total	292.5
			Annual (52 weeks)	**15,210 L**
				15.2 kL

In considering other uses for rainwater, local garden irrigation should also be considered if / when garden beds are to be established within the precinct (i.e. surrounding the pavilion and within the car park). At the time of writing these beds were yet to be established.

While an estimate for this has not been provided for irrigation demand, sensitivity analysis assumes there are demands in addition to toilets. One approach may be to install leaky tanks that overflow to garden beds while also meeting toilet demands.

1.5 Option 1: Raw water from Lake Calembeen

This option was identified through consultation with Central Highlands Water (CHW) staff. It involves using a relatively small portion of CHW's bulk entitlement for the Creswick water supply system for irrigation at Doug Lindsay Recreation Reserve. The benefit of this is that water used to irrigate Doug Lindsay Reserve is currently sourced from this system via the White Swan Reservoir and Water Treatment Plant, this option would effectively bypass that treatment process and deliver raw water directly to the reserve.

CHW has access to up to 500 ML / year from the system that supplies Creswick that includes three reservoirs. Cosgrave Reservoir is currently the only active or 'in service' reservoir. Daily flow allowance from each (under the relevant bulk entitlement) is shown below (Bulk Entitlement Conversion Order, 2004):

- Dean Reservoir - not exceeding 4.3 ML/day
- Cosgrave Reservoir - not exceeding 7.0 ML/day
- Russell Reservoir - not exceeding 4.3 ML/day.

There are two possible operational arrangements that could deliver water to the reserve.

1. Extract raw water directly from Lake Calembeen (~1km from the Reserve) and reduce the volume extracted from Cosgrave Reservoir accordingly
2. Release water from Cosgrave Reservoir and 'shepherd' the water along Creswick Creek to Lake Calembeen. In this arrangement, the water will spill from St Georges Lake to be received at Lake Calembeen.

There may also be potential to adopt a combination of these two approaches, however any operational issues with this would need to be confirmed with stakeholders. From Lake Calembeen water can then be pumped via an ~1 km rising main to a proposed storage within the Doug Lindsay Recreation Reserve precinct (Figure 5).

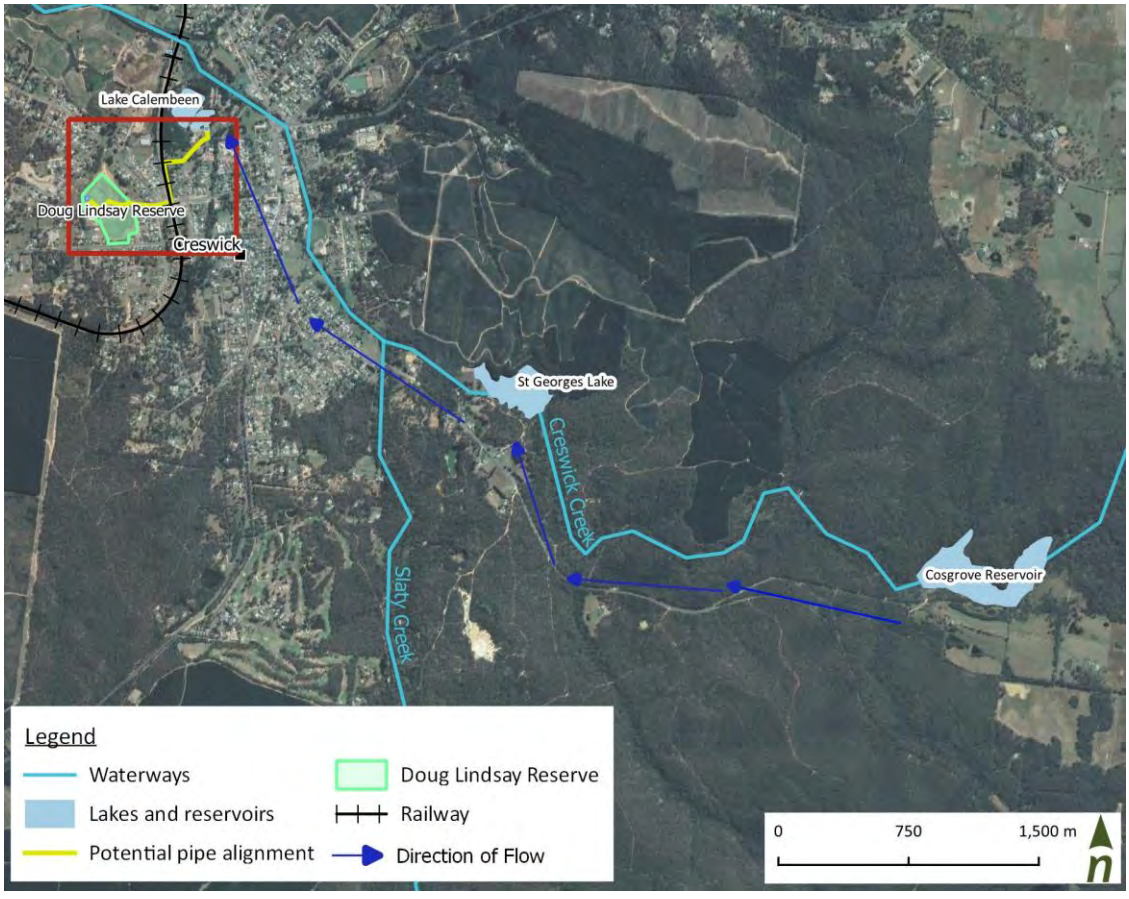


Figure 5. *Raw water from Lake Calembeen arrangement overview (inset in* Figure 6 *below)*

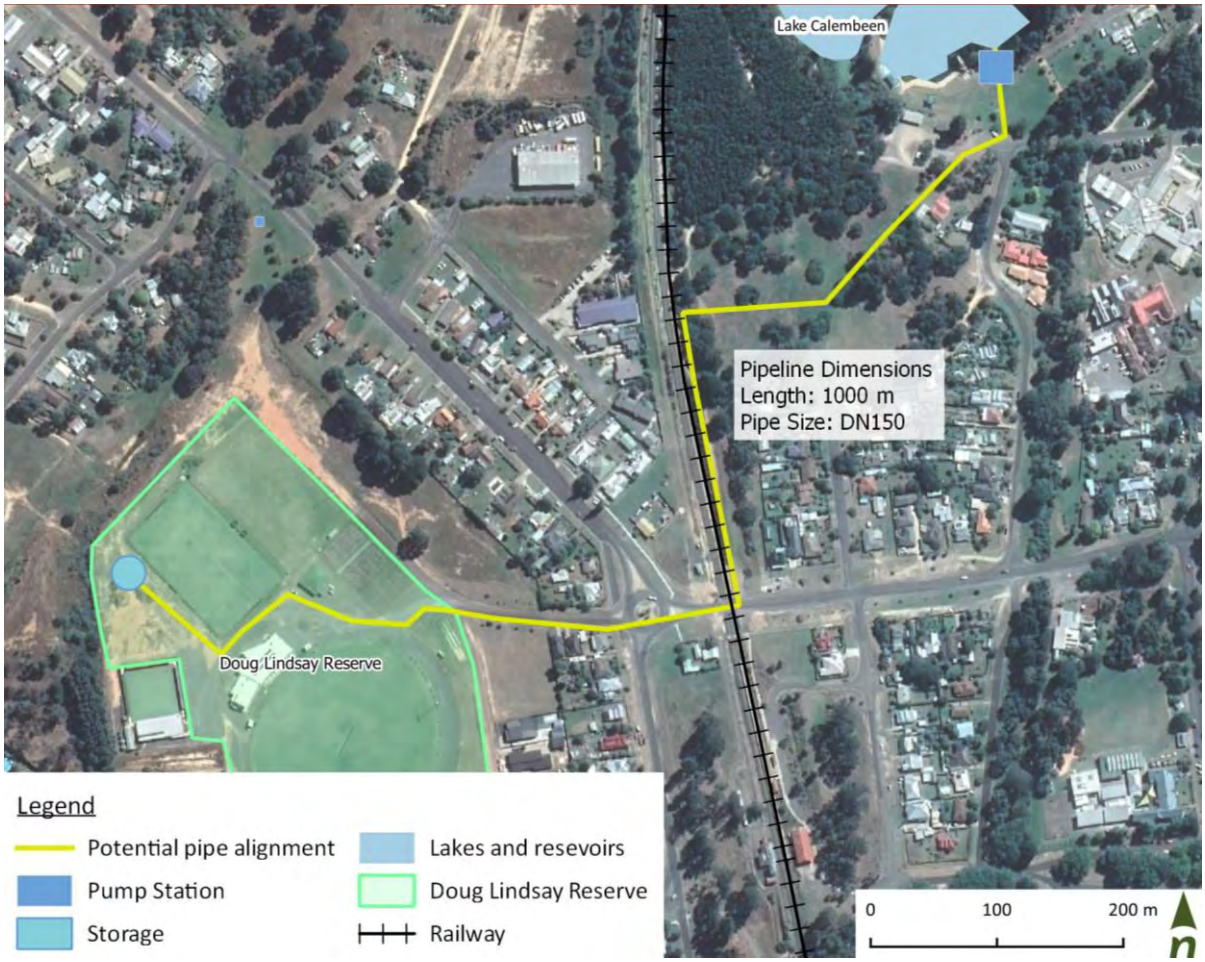


Figure 6. *Raw water from Lake Calembeen infrastructure requirements*

Infrastructure requirements

Based on seasonal irrigation estimates, each irrigation cycle requires approximately 170 kL. This is a relatively small volume in the context of the bulk entitlement and well within the capacity of Cosgrave Reservoir to supply. Initial consultation with Goulburn Murray Water and Central Highlands Water raised no specific objections in terms of accessing this volume. This concept therefore proposes:

- A solar water pump station located at Lake Calembeen to transfer 170 kL over an 8 hour period (i.e. overnight or off peak). This equates to a pump rate of approximately 6 L/s requiring a DN 150 rising main.
- The estimated static head, based on available contour information, is approximately 25m. If we allow for friction head loss of 5m / km for a DN150 (as per the Water Supply code of Australia Section 3.2.5.2) then a total head of approximately 30m should be allowed for over the 1 km distance from Lake Calembeen to Doug Lindsay Recreation Reserve.
- A 170 kL storage to hold one irrigation cycle . If reliability from the Cosgrave system decreases over summer then this could be reviewed. It is assumed that this is situated above ground to reduce cost.
- The storage may be located between the bowls club and soccer pitch. The Doug Lindsay Recreation Reserve (Creswick) Redevelopment Masterplan (Hepburn Shire Council, 2018) suggests a second bowling green is planned for this location. It is proposed that changes be considered if possible to accommodate the tank's footprint that is estimated to be 95-100 m^2.
- Treatment: it is likely that the raw water will require some filtration and UV disinfection before entering the existing irrigation network.

The infrastructure requirements are summarised in Table 2.

Table 2. Infrastructure summary

Infrastructure	Description
Pump station	6 L/s, 1.7 kW Consideration should be given to a solar pump
Rising main	1,000m of DN150 Approximately ¾ through open ground and ¼ through established roadway
Storage	170kL (assumed to be steel, 2.2m high with a footprint of approx. 95-100 m^2)
Filtration and UV disinfection	To achieve disinfection and protect downstream irrigation network

Costs and benefits

The following table summarises some of the costs and benefits associated with the scheme.

Table 3. Cost and benefit summary

Cost	Benefits
Transfer, storage and treatment infrastructure (see below)	High reliability of supply (assumed to be 100%) given the relative difference between demand and daily BE allowance
Potential change to existing masterplan (including engagement with lawn bowls club)	8.6 ML/year of raw water avoids being treated to potable standard
	Council likely to pay a reduced tariff for raw water (~ $0.84/ kL) compared to potable water (~ $2.38 / kL), a saving of approximately $13k / year.
	Green playing surface over summer, with a softer sub-soil resulting in a better playing experience and potentially less injuries

Design considerations

This option would have implications that would require further investigation including:

- Consultation with Goulburn Murray Water (who manage both Lake Calembeen and Creswick Creek), suggests that the physical transfer of water is allowable under the current bulk entitlement without amendment (i.e. if CHW want to transfer to themselves). Therefore this is the preferred operational approach.
- It may require additional compliance monitoring to demonstrate that releases over summer are within the terms of the Bulk Entitlement
- Community consultation may be required to address the potential social implications of extracting water from Lake Calembeen to ensure it doesn't compromise lake aesthetics and utility.
- The rising main from Calembeen Creek to Doug Lindsay Recreation Reserve would cross the Mildura train line. Initial consultations have been made with VicTrack that indicate this should not be a significant barrier or have significant cost implications.
- Stakeholders will need to clarify relevant management, compliance reporting and communications roles with the community in the event that there is perceived inequity in the distribution and use of that water e.g. can Council still irrigate if other irrigators are under restrictions?
- Confirm if a relevant works licence is needed to be established or amended with regard to works at the lake.

Capital and maintenance cost estimate

The following cost estimate has been prepared that accounts an offtake from Lake Calembeen, pump well, rising main, storage and treatment. It is assumed that there is an existing irrigation network that this treated raw water will feed into. The cost rates are based on previous project experience. An estimated cost of **$891k** includes a 30% contingency has been included to reflect the high-level nature of the concept.

Doug Lindsay Reserve_Raw Water Shceme				
Description	**Unit**	**Quantity**	**Rate**	**Amount**
Preliminaries				
General (site establishment)	Item	1	$5,000	$5,000
Site clearing	Item	1	$5,000	$5,000
Traffic management / Rail Crossing approval	Item	1	$5,000	$5,000
Pump station				
Install pump station offtake	m	10	$200	$2,000
Pump station wet well pit and screen	No.	1	$20,000	$20,000
Pump set (solar)	No.	2	$15,000	$30,000
Power supply	No.	1	$5,000	$5,000
Control panel	No.	1	$20,000	$20,000
Pump control	No.	1	$2,500	$2,500
Level sensors	No.	1	$2,500	$2,500
Rising main				
Rising main (open ground)	m	750	$200	$150,000
Rising main (within roadway)	m	750	$350	$262,500
Storage				
Enclosed steel 170 kL tank	No.	1	$25,000	$25,000
Site preparation	No.	1	$5,000	$5,000
Storage drainage connections	No.	1	$5,000	$5,000
Treatment				
UV treatment	Item	1	$45,000	$45,000
Filtration	Item	1	$5,000	$5,000
Sub – total				**$594,500**
Design (10%)				$59,450
Site investigations e.g. geotech, survey, service detection etc (10%)				$59,450
Contingency (30%)				$178,350
Total				**$891,750**

Some high-level estimates of annual maintenance cost were made based on a percentage of capital cost for each asset class. This estimates a maintenance cost of approximately $12k per annum. This only includes maintenance of identified assets and not an allowance for energy or the cost of the raw water.

Maintenance cost estimate					
Asset	Pipeline	Pump stations	Storage	Treatment	**Total**
Maintenance rate (as a % of capital cost)	1%	5%	5%	5%	
Sub-total	$ 4,125	$ 1,500	$ 1,250	$ 2,500	**$ 9,375**
30% contingency					$ 2,813
					$ 12,188

1.6 Option 2: Stormwater harvesting

Option 2 looked at supplying the Doug Lindsay Recreation Reserve with harvested and treated stormwater from local catchments. Analysis of site topography and drainage networks identified three stormwater catchments (Figure 7).

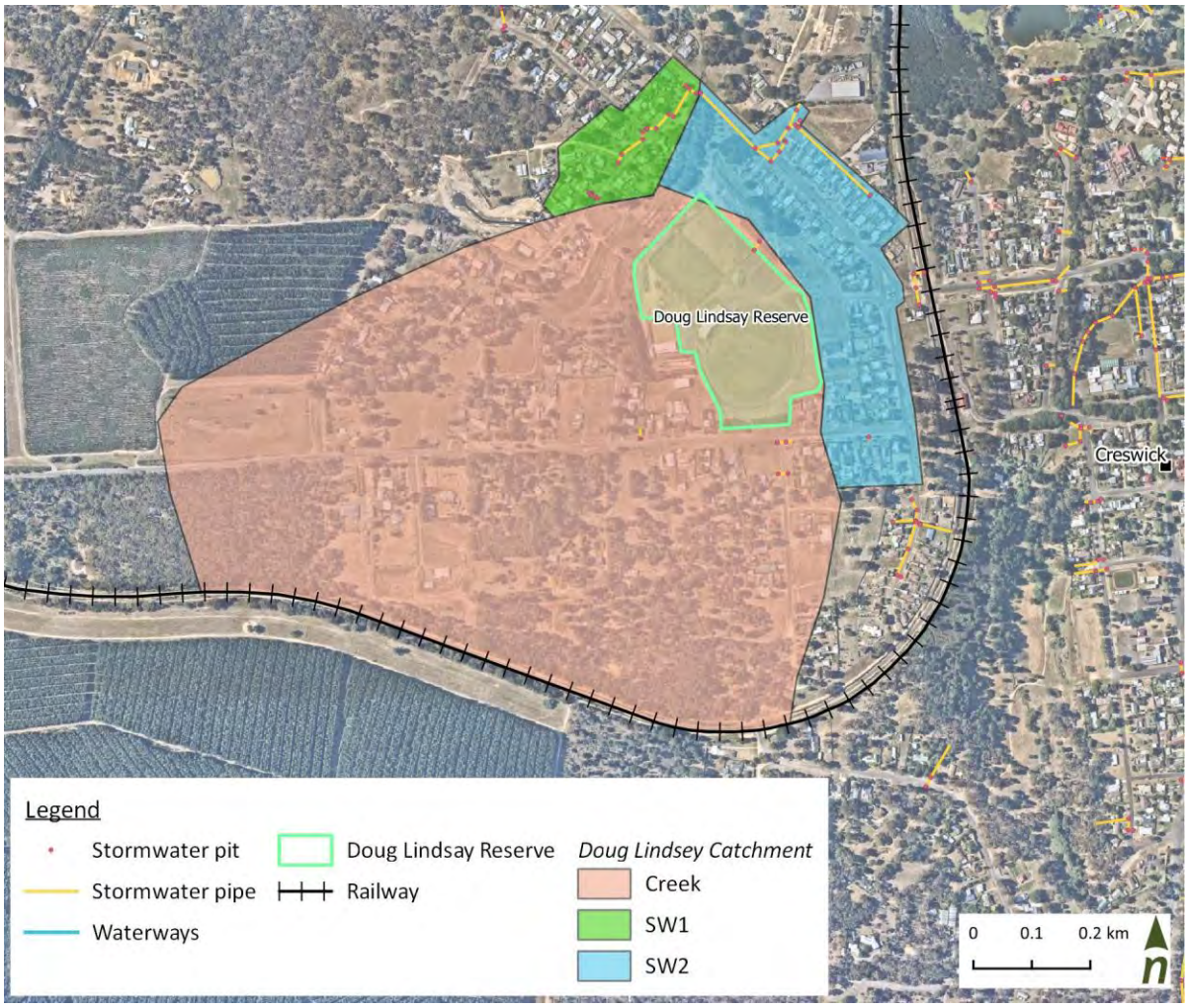


Figure 7 *Doug Lindsay Recreation Reserve stormwater harvesting catchment areas*

Land uses across each catchment include low density residential, public parks, recreation and forested areas that have relatively low impervious fractions. The fraction impervious (FI) indicates the proportion of the catchment that consists of hard surfaces (e.g. roads, roofs etc, car parks) that then indicates the proportion of the catchment that is likely to generate stormwater.

FI was estimated for each catchment using a combination of Melbourne Water's Model for Urban Stormwater Improvement Conceptualisation (MUSIC) guidelines (Melbourne Water, 2018) and by viewing satellite imagery (Table 4).

Table 4. Doug Lindsay Recreation Reserve catchment areas and fraction impervious

ID	Catchment	Area (ha)	Fraction Impervious
1	Creek	75.71	0.1
2	SW1	3.69	0.3
3	SW2	12.77	0.3
Total		**92.17**	

It can also be seen that there is formal drainage in only some parts of catchments SW 1 & 2 (Figure 7). Additionally, a site visit showed that:

- The creek to the west of Doug Lindsay Recreation Reserve is a conveyance point. There is potential for flows to infiltrate or evaporate prior to reaching a harvesting point.
- The surrounding streetscapes were observed to lack, in some locations, formal kerb and channel infrastructure that would typically and efficiently, convey flows to a central point for harvesting. This may create additional system 'losses'.

These factors are not incorporated into the modelling, and it may therefore overstate what volume is harvestable in practice.

Model set up and system layout

A MUSIC model was developed using rainfall data from Ballarat Aerodrome rainfall station (089002) between 1966 and 1974 at a 6-minute time-step. Ballarat Aerodrome rainfall station (~12.6 km away) is the closest station to Creswick that has a sufficiently complete rainfall record at the required frequency for the MUSIC model. While the Creswick rainfall station is closer (1.1 km away), the available data was not at a frequency or duration suitable for modelling requirements.

For this analysis, the three catchment areas drain to a central point near the intersection of Elizabeth Road and Luttet Street (Figure 8). This seems a reasonable assumption based on a site visit. From there, a stormwater pit & pump station would convey diverted flows to a storage within the Doug Lindsay precinct e.g. the open space adjacent to the creek, between the existing bowling green and soccer pitch (see Figure 9). A rough layout drawing is provided in Figure 10.

Figure 8 *The intersection of Elizabeth Road and Luttet Street*

Figure 9 *Potential storage location next to the bowling club*

Figure 10 *Stormwater harvesting arrangement showing diversion and transfer to storage site within Doug Lindsay Recreation Reserve precinct*

Modelling results and system yield

The factors that were modelled to determine scheme feasibility include:

- Catchment areas and fraction impervious
- Seasonal irrigation demand
- Storage requirement.

In modelling the scheme, and identifying a suitable storage volume, sensitivity analysis was undertaken to ensure the system could meet 80% volumetric reliability over the year i.e. 80% of demand is met by the stormwater harvesting scheme.

Figure 11 shows the MUSIC modelling outputs and the relationship between supply reliability (in % of total demand) and storage volume assuming that all three catchments are diverted to a collection pump station at Luttet Street. For the purposes of sensitivity two pump rate diversions were tested: 50 L/s and 100 L/s. While there was not a great deal of difference between the two pump rates, the results indicate that a storage volume of approximately 550 kL would be required to meet 80% reliability.

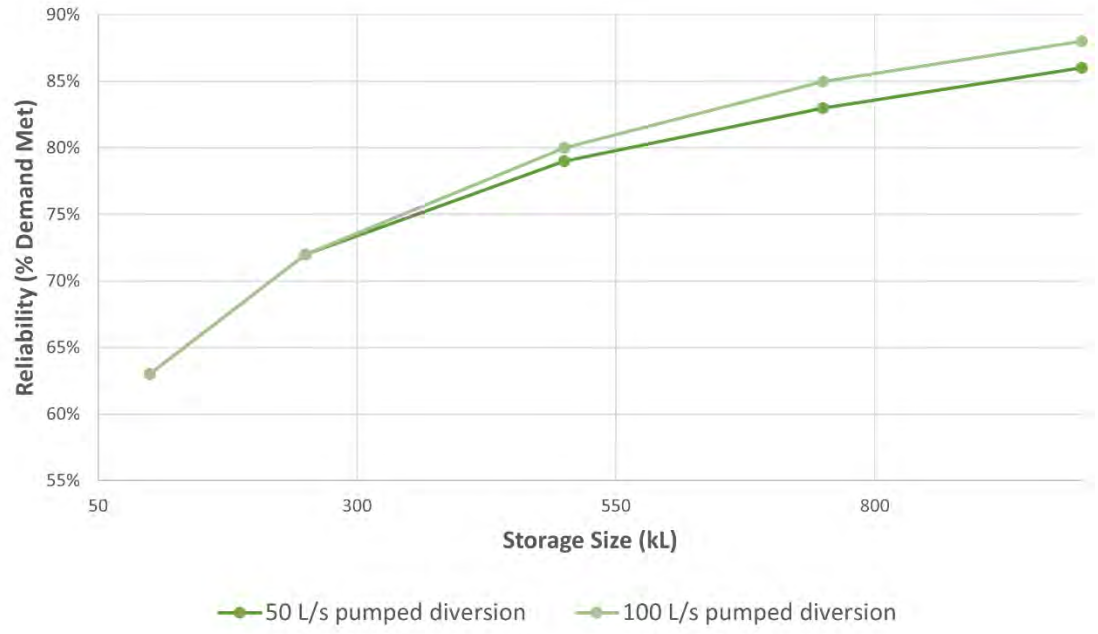


Figure 11 *Stormwater harvesting reliability for Doug Lindsay Recreation Reserve*

In summary

- Approximately 80% of demand (or 6.7 ML/year) of stormwater could be used annually assuming a storage of approximately 550 kL and a diversion rate (i.e. pump rate) from the creek at Luttet Street of 50 L/s
- A smaller 'clear water' storage is also likely to be required to hold treated stormwater that is irrigation ready (assumed to be 170 kL as per a January irrigation event).
- Given the rural nature of the catchment this is expected to be an optimistic assessment given the absence in some streetscapes of kerb and channel and the expectation that some flows will be lost in the creek through infiltration and evaporation.

Infrastructure requirements

Based on the above description, required infrastructure is summarised in Table 5.

Table 5. Infrastructure summary

Infrastructure	Description
Stormwater diversion and pump station	50 L/s (this flowrate will need to be defined if this option is progressed
Rising main	400m of DN225 rising main All assumed to be through open ground
Storage	550kL storage to meet 80% annual irrigation reliability
Filtration and UV disinfection	To achieve disinfection and protect downstream irrigation network

Costs and benefits

The following table summarises some of the costs and benefits associated with a stormwater harvesting scheme.

Table 6. Cost and benefit summary

Cost	Benefits
Modelled 80% reliability, however catchment characteristics suggest this estimate may not be met	A maximum of 6.7 ML/year of saved potable water (likely to be less than this modelled figure)
Transfer, storage and treatment infrastructure Larger pump transfer rate and storage required compared to Option 1 (Raw water) Separate raw and clear water storage likely to be required.	Waterway benefit by removing excess stormwater and nutrients from the waterway. However this has less impact in a rural environment
Potential change to existing masterplan to accommodate proposed storage	Council avoids ~ $2.38 / kL of cost or approximately $16k / year.
Higher flowrate means solar pumps are unlikely to be viable	Green playing surface over summer, with a softer sub-soil resulting in a better playing experience and potentially less injuries
Flows are less reliable during summer when compared to Option 1	

Optional Design Requirements

This option would have implications that would require further investigation including:

- More detailed catchment analysis to better understand if the estimates of catchment runoff are reasonable given local conditions and infrastructure. Based on a site visit there is some reservation that the scheme would perform as modelled.

Capital and maintenance costs

The following cost estimate has been prepared to estimate diversion, pump well, rising main, storage and treatment. The cost rates are based on previous project experience. An estimated cost of **$783k** includes a 30% contingency has been included to reflect the high-level nature of the concept.

Doug Lindsay Reserve_Stormwater harvesting				
Description	**Unit**	**Quantity**	**Rate**	**Amount**
Preliminaries				
General (site establishment)	Item	1	$10,000	$10,000
Site clearing	Item	1	$10,000	$10,000
Traffic management / Rail Crossing approval	Item	1	$10,000	$10,000
Pump station				
Gross pollutant trap	No.	1	$50,000	$50,000
Install pump station offtake	m	10	$200	$2,000
Pump station wet well pit and screen	No.	1	$20,000	$20,000
Pump set	No.	2	$60,000	$120,000
Power supply	No.	1	$5,000	$5,000
Control panel	No.	1	$20,000	$20,000
Pump control	No.	1	$2,500	$2,500
Level sensors	No.	1	$2,500	$2,500
Rising main				
DN225 Rising main (open ground)	m	400	$250	$100,000
Storage				
Enclosed steel 275 kL tank	No.	2	$30,000	$60,000
Clear storage tank	No.	1	$25,000	$25,000
Site preparation	No.	1	$5,000	$5,000
Storage drainage connections	No.	1	$5,000	$5,000
Treatment				
UV treatment	Item	1	$45,000	$45,000
Self cleaning 80 micron filter	Item	1	$10,000	$10,000
Dual media pressure filter	Item	1	$20,000	$20,000
Sub – total				**$522,000**
Design (10%)				$52,200
Site investigations e.g. geotech, survey, service detection etc (10%)				$52,200
Contingency (30%)				$156,600
Total				**$783,000**

Some high-level estimates of annual maintenance cost were made based on a percentage of capital cost for each asset class. This estimates a maintenance cost of approximately $24k per annum. This only includes maintenance of identified assets and not an allowance for energy or the cost of the raw water.

Maintenance					
Asset	Pipeline	Pump stations	Storage	Treatment	
Maintenance rate (as a % of capital cost)	1%	5%	5%	5%	**Total**
Sub-total	$ 1,000	$ 6,000	$ 4,250	$ 7,250	**$ 18,500**
30% contingency					$ 5,550
Total					**$ 24,050**

1.7 Option 3: Sewer Mining

Sewer mining was raised as an option to provide non-potable water. With a recent experience providing recycled wastewater to Beaufort, it was also discussed for Doug Lindsay Recreation Reserve. The concept would include tapping into the existing DN 450 vitrified lay sewer rising main, that conveys Creswick's sewage to Ballarat for treatment.

Infrastructure requirements
In theory, the following would be required:

- a treatment plant would be constructed near the main, notionally at the existing waste transfer station
- the treatment plant would need to produce Class B water that is suitable for irrigation (including filtration and two stages of disinfection including possible chlorine and UV
- a 1 km rising main to a storage within the Doug Lindsay precinct and storage, assumed to be 170 kL (similar to Option 1 – Raw Water) reflecting the relatively high reliability of the source.

Issues and design considerations
The main issues raised in discussions with CHW were

- The scale of the scheme: discussions suggested that a treatment plant of at least 1 ML/day, and preferably 2 ML/day may make a sewer mine or sewage treatment plant potentially viable. Given we are talking about volumes of about 170 kL per day in summer, this is far less than is considered worth pursuing.
- The seasonality of its use: The water will not be required for approximately 4 months of the year, meaning that the plant would need to be mothballed for those periods. This is a costly exercise and implies a high maintenance and operational cost.

For these reasons, and in consideration of the relatively positive Raw Water transfer option available, a sewer mine has not been investigated further.

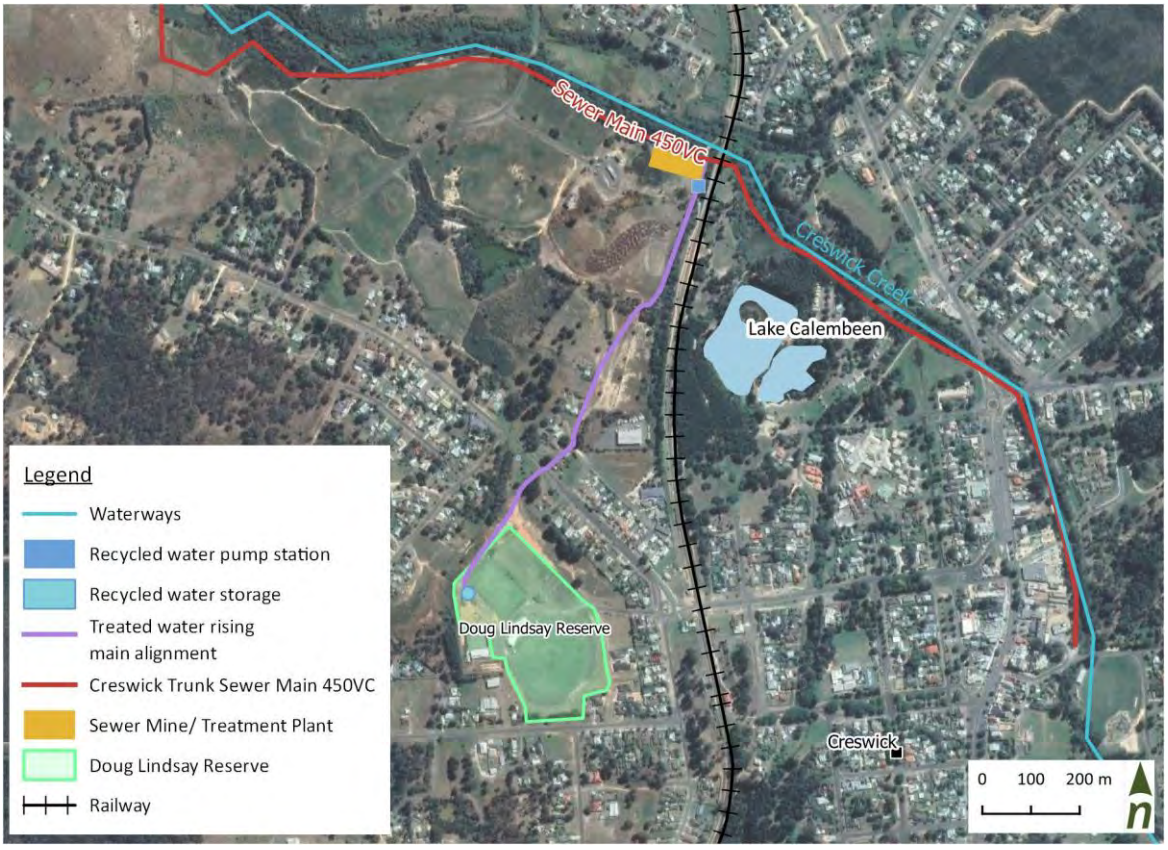


Figure 12. *Proposed sewer mining arrangement*

1.8 Rainwater harvesting

In addition to the larger volumetric sources to meet irrigation demand, rainwater harvesting can reduce potable water use within the main pavilion in particular. As noted in Section 1.4 above, an audit of toilets and urinals was undertaken with a high-level estimate of water demand prepared.

The site visit also highlighted the large roof area of the pavilion and the proximity of downpipes (draining to the back of the building) to bathrooms and toilets. Figure 13 shows two photos of a number of downpipes draining to the back of the pavilion (away from the oval). This space is relatively open and unused and seems suitable for siting tanks.

Figure 13 *Pavilion downpipes and potential location for rainwater tanks*

Model set up

The rainfall and climate characteristics used for Option 2 – Stormwater harvesting, was also used for this opportunity. The Pavilion roof area is assumed to be ~1,200 m^2 based on aerial photography. This catchment is assumed to have an impervious fraction of 0.95, meaning most of the rainfall that falls on the roof will reach the rainwater tanks.

The baseline demand of 15 kL per year was adopted (as per Section 1.4). Demand is assumed to be evenly distributed over the year (i.e. 8.3% per month).

Given the uncertainty around this demand assumption, sensitivity analysis was undertaken to:

- Understand what the potential of supply was if the 15 kL per year assumption was proved to be not entirely accurate (e.g. by subsequent metering), and
- To understand what additional volumes may be available for irrigation of gardens.

Sensitivity analysis results

Figure 14 shows the results for a range of storage volumes (along the x-axis) and annual demand volumes from the assumed 15 kL up to 50 kL per year.

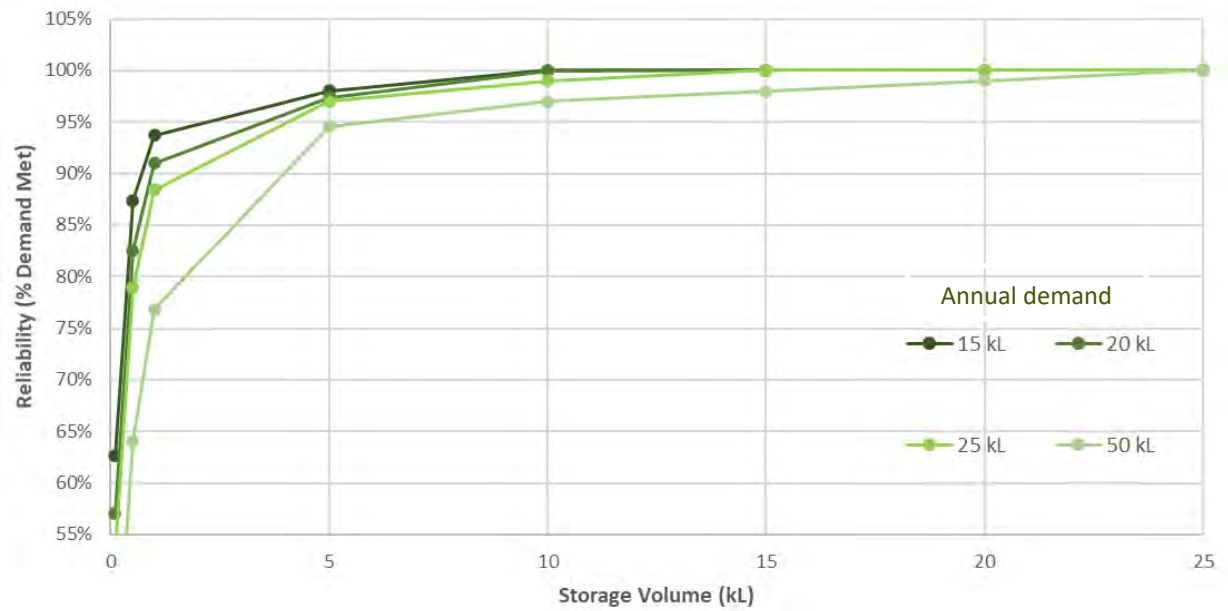


Figure 14 *Rainwater Harvesting Reliability for Doug Lindsay Recreation Reserve*

In summary

- Approximately 10kL of storage can meet the assumed 15 kL of demand each year
- Up to 50kL of rainwater can be harvested if 25 kL of storage is installed. This may be reasonable, given the space available.

For the purposes of costing we have assumed that 15 kL of rainwater storage is installed at the rear of the pavilion and plumbed to toilets. This has the potential to supply up to 25 kL/year of rainwater for toilets and garden.

Design considerations

In summary, some verification of the toilet demand in the pavilion would be beneficial.

If this is not possible, then installing the rainwater tanks could be staged. For example, instal 10kL of storage, connect this to the bathroom and observe its performance. If the tank is regularly emptied, install an additional 5 to 10kL that is connected to the original 10kL storage.

Continue to observe until a suitable storage volume is reached.

Further, take into account the potential to irrigate local garden beds through direct irrigation or via overflows from a 'leaky tank' i.e. where the outlet is below the top of the tank to ensure that there is always some airspace in the tank.

Capital and maintenance costs

The following cost estimate accounts for downpipe diversions to three tanks. The system will be pressurised, delivering flows on demand. It is assumed that the three tanks prime one pump that delivers flow to the building.

Doug Lindsay Reserve_Rainwater harvesting				
Description	**Unit**	**Quantity**	**Rate**	**Amount**
Preliminaries				
General (site establishment)	Item	1	$2,000	$2,000
Pump station				
Pump set	No.	1	$3,000	$3,000
Power supply	No.	1	$2,500	$2,500
Level sensors	No.	3	$500	$1,500
Plumbing				
Downpipe connection	No.	10	$200	$2,000
Plumbing and fittings	No.	3	$500	$1,500
Rainwater storage				
Site clearing and tank pad	Item	3	$1,000	$3,000
5kL rainwater tanks	No.	3	$3,000	$9,000
Sub – total				**$24,500**
Design (0%)				
Site investigations e.g. geotech, survey, service detection etc (10%)				
Contingency (10%)				$2,450
Total				**$26,950**

Some marginal costs have been assumed for maintenance, specifically cleaning and clearing, gutter maintenance and pump checks (Commonwealth Scientific and Industrial Research Organisation [CSIRO], 2012). It is assumed that these costs apply to each of the three rainwater tanks.

Maintenance tasks	**Frequency**	**Average cost per tank**	**Average annual cost per tank**
Sediment checking cleaning	Three years	$ 160	$ 53
Gutter maintenance etc	Annual	$ 80	$ 80
Check pumps, filters, water quality	Annual	$ 50	$ 50
		Sub-total	**$ 183**
		No. of tanks	3
		Total	**$ 550**

1.9 Discussion and recommendation

From the opportunities examined it is recommended that the 'Raw water from Lake Calembeen' be progressed to more detailed stages of design. This option provides:

- a high level of reliability
- can function within existing operational constraints (i.e. an update of the bulk entitlement is not necessarily required)
- the associated infrastructure is relatively straight forward, being a 1 km rising main from lake to reserve.

Design tasks will include:

- Commence engagement on this proposal
- Undertake service identification and feature survey
- Confirm system locations and alignments (including the pump station at Lake Calembeen, rising main alignment and storage location)

It is noted that the advice from Dja Dja Wurrung is to prioritise stormwater harvesting and recycled water when seeking a non-potable water supply. These options have been investigated. Stormwater harvesting is seen as too unreliable given the rural nature of a) the catchment and b) the drainage infrastructure upstream of Doug Lindsay. A relatively large storage is also required that will require space and also have a greater visual impact than the storage associated with the raw water option. This would also be a scheme that neither Council nor CHW have experience operating. This is not an in surmountable barrier, but may present challenges.

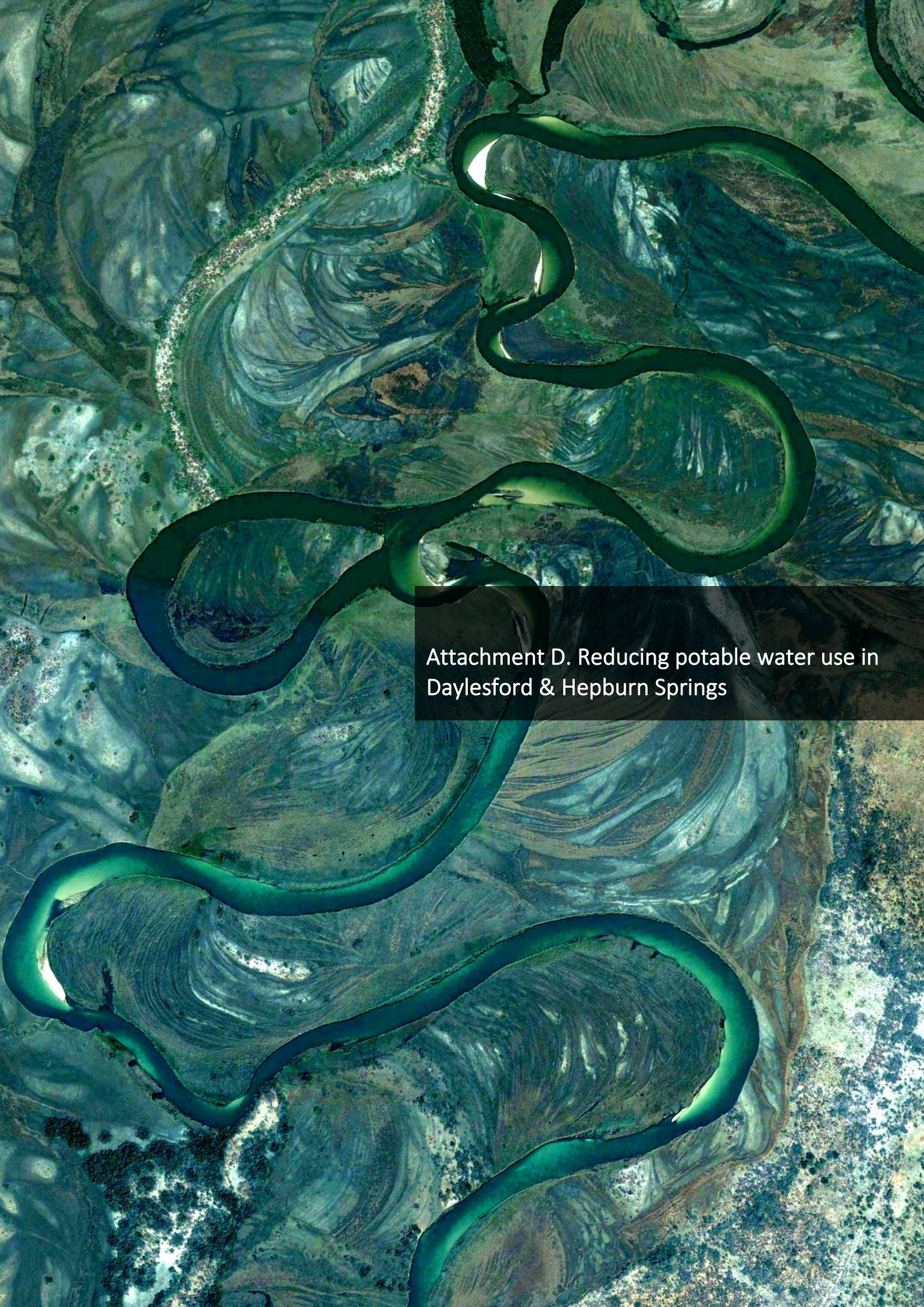
Sewer mining is not considered viable at this scale and for this end use.

Outstanding issues will include:

- **Irrigation efficiency**: as part of any alternative water supply scheme, the existing efficiency of the irrigation system at Doug Lindsay should be audited and updated as required.
- **Community consultation**: based on further analysis to confirm that this opportunity will not impact community enjoyment of Lake Calembeen.
- **Storage and other infrastructure location**: there is an existing Masterplan for the Doug Lindsay Recreation Reserve and it is recommended that this Masterplan be updated to accommodate water storage in the future.

It is also recommended that rainwater to toilets be progressively installed in the pavilion. This will reduce potable water and be a very visible and educational example of CHW IWM approach.

- Undertake a review of pavilion plumbing to confirm where in the treatment process the rainwater enters.



Attachment D. Reducing potable water use in Daylesford & Hepburn Springs

1 Reducing potable water use in Daylesford & Hepburn Springs

1.1 Introduction

This concept report investigates opportunities to provide an alternative water source to meet potable water demands within Daylesford & Hepburn Springs. This work has been identified as part of the Daylesford & Hepburn Springs, Creswick and Clunes IWM Plan and is focussed on reducing potable water consumption in the system, and specifically at Council owner assets.

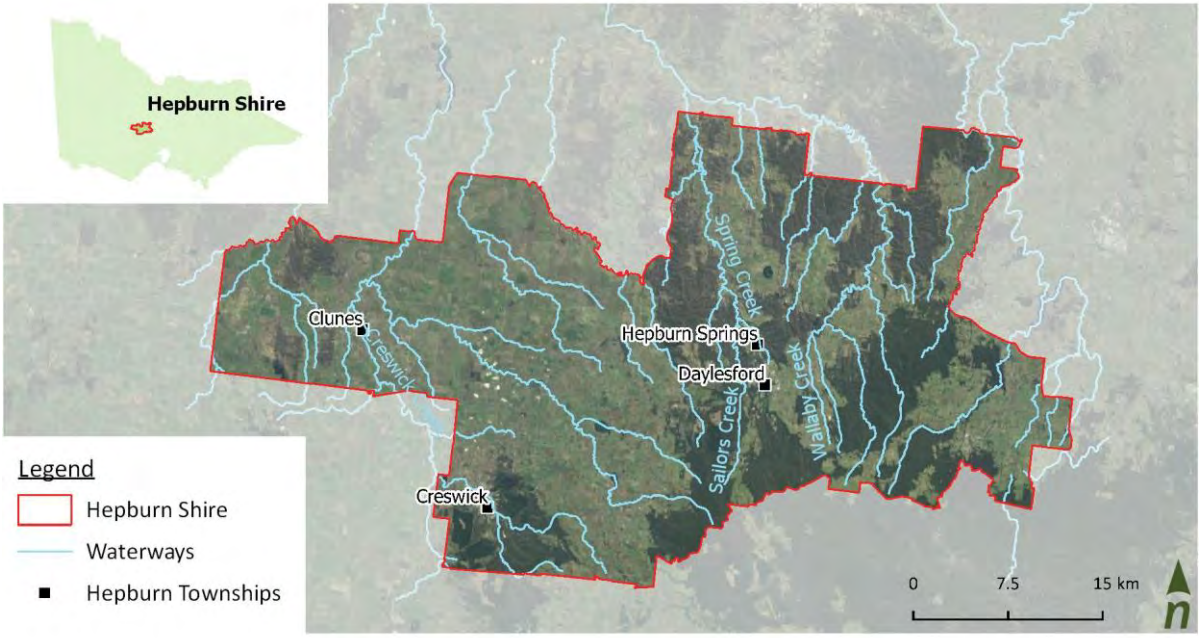


Figure 1. *Location map showing Daylesford and Hepburn Springs within the Shire of Hepburn*

1.2 Scope

The scope reviews a range of potential water sources potentially available in Daylesford & Hepburn Springs. Predominantly, these are to replace irrigation demands for Council open spaces and gardens, that represent the highest demands across the area. The following steps were undertaken.

Identify demands

High water users within Daylesford and Hepburn Springs have been identified to understand where the greatest potential water savings may occur.

Identify alternative water sources

The water sources considered include:

- Stormwater harvesting
- Rainwater harvesting
- Recycled wastewater
- Raw water (from lakes or waterways), and
- Groundwater extraction.

Feasibility review
For each water source and demand location, the feasibility of each alternative water is reviewed according to the following approach:

- Identification of high-water users within Daylesford & Hepburn Springs and what that water is used for (sometimes assumed given lack of detailed metering data)
- Review the end use and location of each demand point and assess the suitability, or compatibility, of each water source to meet that demand
- For those combinations of demand and supply that are compatible, provide
    - a map of the concept
    - likely infrastructure requirements
    - design considerations
    - indication of capital and operating costs (based on high level assumptions)
    - a summary of the benefits associated with the feasible opportunities.
- Consideration of bulk entitlement and extraction licences conditions as appropriate.

1.3 Daylesford and Hepburn Springs high water users

Central Highlands Water (CHW) has provided water use data in Daylesford & Hepburn Springs 2019/20 (see Figure 2). Hepburn Shire Council is the largest water user in Daylesford & Hepburn Springs with water used across a range of sporting and recreational reserves.

Highest among these is the Hepburn Mineral Springs Reserve (at 8 ML/year) and the Ballan Road football oval (at 7.1 ML/year). The Daylesford pool on Central Springs Road is also a significant water user at 8 ML/year.

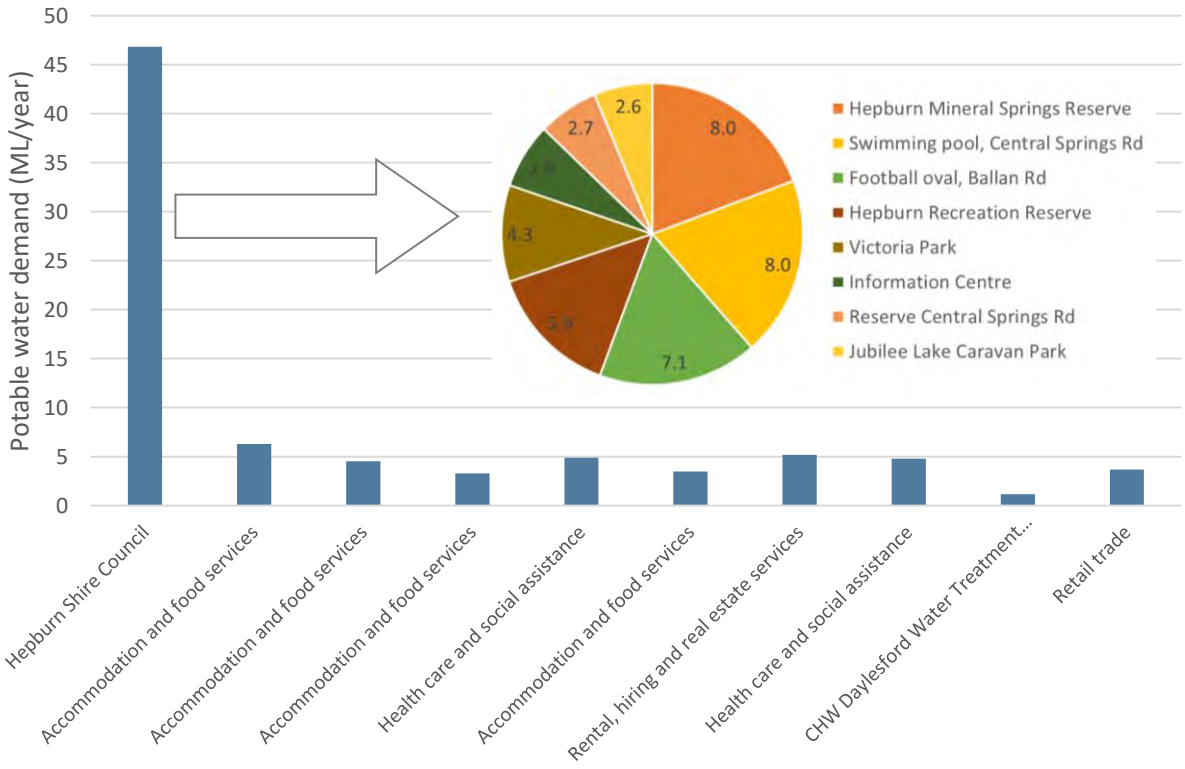


Figure 2. *Top 10 water users 2019/20 (Data: Central Highlands Water) and top Hepburn Shire Council potable water users in Daylesford and Hepburn Springs*

Based on this data, a number of high water use sites have been identified for further investigation including:

- Hepburn Mineral Springs Reserve
- Daylesford Olympic Swimming Pool
- Football oval (Ballan-Daylesford Road) and Victoria Park, Daylesford
- Hepburn Recreation Reserve
- Central Lake Reserve Daylesford
- Jubilee Lake Reserve Daylesford

Figure 3. *Map of high water users in Daylesford*

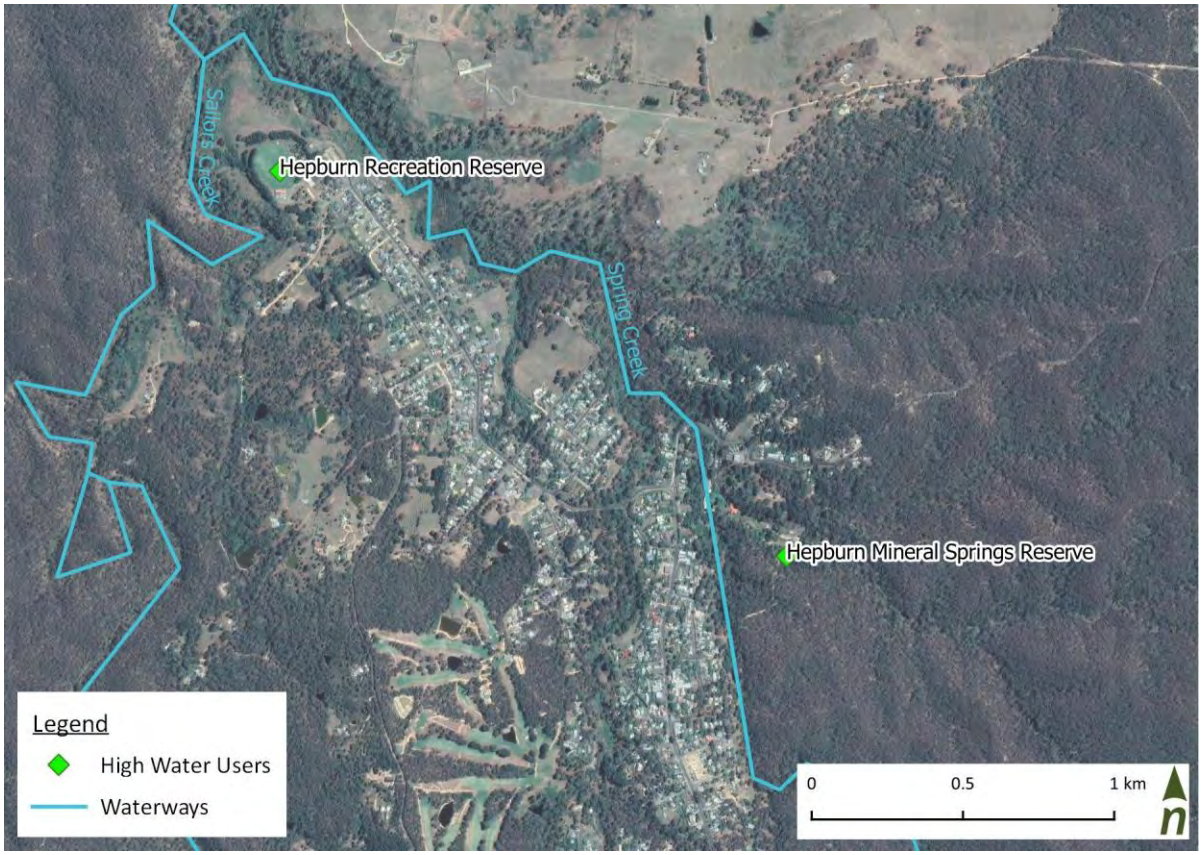


Figure 4. *Map of high water users in Hepburn Springs*

1.4 Alternative water supply options

Possible non-potable water supply opportunities within Daylesford and Hepburn are described below.

Stormwater harvesting

Stormwater is rainfall that has come into contact with ground level, hard surfaces such as roads, pavements and car parks. The more impervious the catchment, the more stormwater is generated. Stormwater can be harvested when it is:

- Collected – by diverting stormwater from the drainage network (via gravity or by a pumped diversion). Treated stormwater can also be diverted from the outlet of a constructed, stormwater treatment wetland
- Treated – to remove sediment, pollutants and bacteria and viruses using mechanical filtration units and disinfection (e.g. UV light) and / or by using water sensitive urban design (WSUD) assets biofilters and
- Storing stormwater prior to use, typically for the irrigation of open space.

Stormwater harvesting is typically suitable where a large, highly impervious catchment drains to a central point for convenient collection, ideally through a constructed drainage network. It is economically more feasible when used to meet larger scale irrigation demands (e.g. football ovals).

Much of Daylesford's landscape is characterised by undulating forested or rural terrain with limited formalised drainage infrastructure. The resulting stormwater catchments are fragmented and highly pervious, with few discrete collection points to divert stormwater from or tap into. Collectively this presents a significant limitation on the potential for stormwater harvesting.

Using topography, satellite imagery and drainage networks an assessment of potential stormwater harvesting catchments was undertaken. No significant potential stormwater harvesting opportunities were identified in proximity of sites that have been identified as having high irrigation demands.

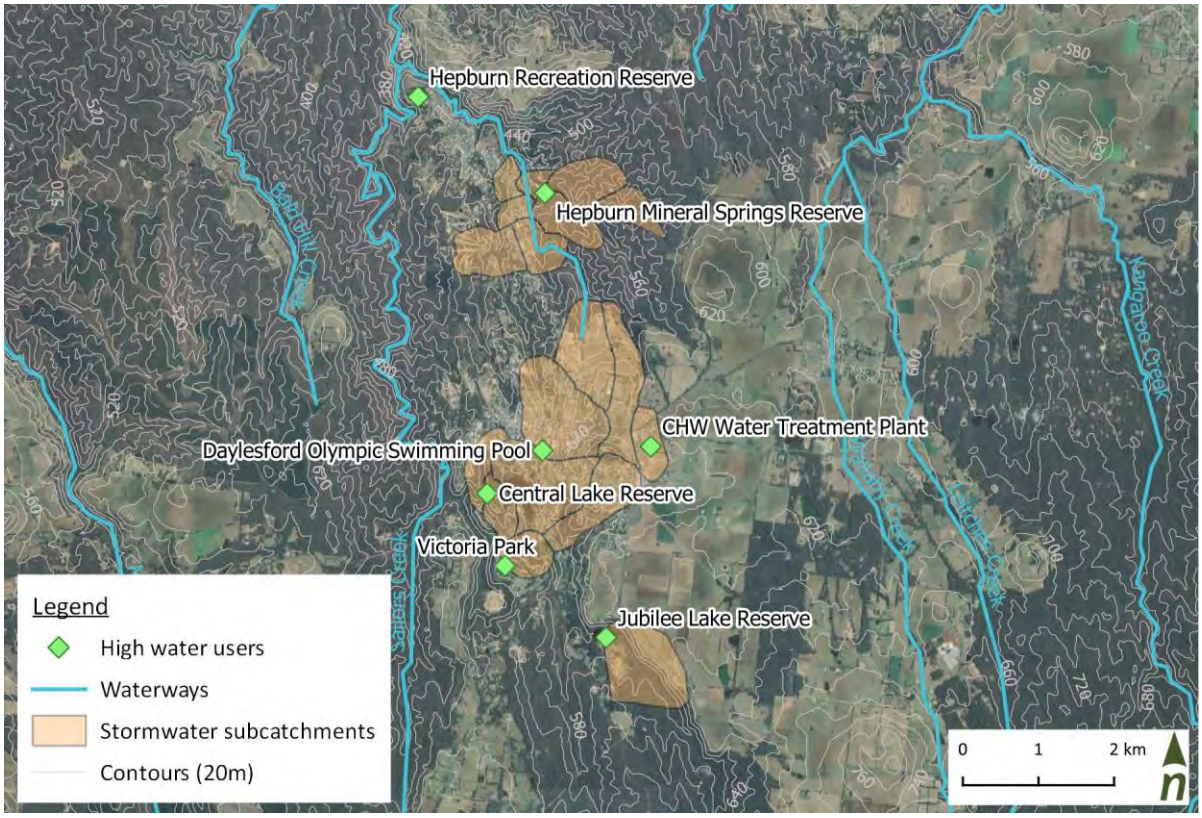


Figure 5. *Stormwater subcatchments in relation to high water users in Daylesford and Hepburn Springs*

Rainwater harvesting
This is where rainwater is collected directly from the building or house roof into a rainwater tank. Rainwater is a better quality of water than stormwater and does not require treatment to be used for things like garden irrigation, toilet use and laundry use.

There are also examples of rainwater being directed to hot water services. Rainwater harvesting is suitable for smaller demands, proximate to medium to large roofs where high water quality (i.e. including internal uses) is required. Some options may exist in Daylesford.

Raw water extraction
Raw water is untreated water that is typically held in water supply reservoirs, within local lakes or flowing within a creek or waterway. Raw water needs to be conveyed to a water treatment plant to be suitable for human consumption. Alternatively, it can be diverted to meet non-potable uses including irrigation.

Under Section 51 of the Water Act, "a person may apply to the Minister for the issue of a licence to take and use water from a waterway" or a bulk entitlement. Some potential locations for extraction of raw water in Daylesford include Lake Daylesford and Jubilee Lake.

There is also existing infrastructure to divert raw water from Wallaby Creek to Daylesford. This diversion is currently utilised in emergency during extended dry periods.

Recycled water
Recycled water involves treating wastewater to required quality standards to ensure it is suitable for non-potable end uses. Typically 'Class B' recycled water can be used for irrigation or agricultural use. Further treatment is required to reach a 'Class A' standard that is then suitable for use within households (e.g. for toilet flushing, laundry and garden irrigation).

Wastewater from Daylesford and Hepburn Springs is treated at the Shepherds Flat wastewater treatment plant (WWTP) that is located approximately 8 kms north of Daylesford. 'Shepherds Flat' produces Class B and C recycled water that is currently used to irrigate 25 ha of local farmland. The WWTP has observed a rise in inflow since 2020 and there has consequently been an excess in supply of recycled water.

The distance of Shepherds Flat from Daylesford town centre has been a limiting factor in expanding recycled water reuse in Daylesford.

Groundwater
Daylesford lies within the Loddon Zone of the Central Victorian Mineral Springs Groundwater Management Area (GMA). There are 71 extraction licences within the Loddon Zone totalling a volume of about 2.7 GL/year. Metered usage (implemented relatively recently) from upland areas indicates that usage is generally no more than 50% of the licence entitlement, even during dry periods

Extraction is regulated and available to be traded on a take and use basis under Section 51 of the Water Act. Consultation with Goulburn Murray Water suggests groundwater can typically be purchased at a rate of between $2,000 – 2,500 / ML.

1.5 Opportunity summary

Table 1 below outlines the opportunities and constraints for alternative water supply options at the highest water using Hepburn Shire Council sites across Daylesford and Hepburn Springs. Note that deep green cells indicate potentially feasible options. Lighter green cells are less obvious but may call for further investigation. Each is discussed further below.

Table 1. Alternative water supply option opportunities and constraints (Green cells indicate the preferred options that have been investigated further below)

No	Site	Water use ML (2019/20)	Water use type	Alternative water source				
				Stormwater harvesting	Rainwater harvesting	Raw water extraction	Recycled water	Groundwater
1	Hepburn Mineral Springs Reserve	8.00	Bath house, mineral springs	Not suitable for bath house use	No significant roof areas within proximity	Not suitable for bath house use	Not suitable for bath house use	Not suitable for bath house use
2	Daylesford Olympic Swimming Pool	8.00	Swimming pool Toilet and shower facilities	Not suitable for swimming pool use	There may be potential for a large-scale rainwater harvesting scheme to feed to pool e.g. from nearby large roofs (e.g. Coles).	Not suitable for swimming pool use	Not suitable for swimming pool use	Possible option: Groundwater quality may be suitable for pool use
3	Football oval (Ballan – Daylesford Road) and Victoria Park, Daylesford	7.10 + 4.30 = Total of 11.4	Open space irrigation	No significant stormwater offtake opportunities within proximity. Highly forested catchments, low catchment runoff & stormwater yield.	Potential to harvest rainwater from pavilion roof for internal toilet use	Opportunity to receive flows from the Wallaby Creek diversion	Assumed to be an unlikely option given the distance from the oval to the WWTP (12-15 km)	Possible option. There is an existing domestic and stock bore @ Victoria Park (104245) TBC
4	Hepburn Recreation Reserve, Hepburn	5.90	Open space irrigation	No significant stormwater offtake opportunities within proximity. Highly forested catchments, low catchment runoff & stormwater yield.	Potential to harvest rainwater from pavilion roof for internal toilet use	No suitable open water bodies within vicinity	Suitable location to potentially receive recycled water ~4km from the WWTP	Possible option. There is an existing domestic and stock bore 114930
5	Central Lake Reserve, Daylesford	2.70	Open space irrigation	Highly forested catchments, low catchment runoff & stormwater yield.	No significant roof areas within proximity	Extract water from lake for irrigation	Assumed to be an unlikely option given the distance from the oval to the WWTP	Possible option. There is an existing SOBN bore 104069
6	Jubilee Lake Reserve, Daylesford	2.60	Open space irrigation	No significant stormwater offtake opportunities within proximity.	No significant roof areas within proximity	Extract water from lake for irrigation	Assumed to be an unlikely option given the distance from the oval to the WWTP	Possible option. Proximate to licensed bore WRK012225

Based on the high-level assessment an assessment of the options presented in Table 1 above, the following options have been investigated further.

1.6 Hepburn Recreation Reserve recycled water scheme

This option investigates the supply of recycled water from the Shepherds Flat WWTP to meet the 5.9 ML/year irrigation demand at Hepburn Recreation Reserve. The reserve is located to the north of Hepburn Springs and as such it is the closest open space (within this project area) to the Shepherds Flat WWTP. This could also serve as the first phase of a larger recycled water scheme.

This option would require the installation of transfer infrastructure (i.e. pipes and pumps) to convey recycled water approximately 4.5 km to the Reserve. For the purposes of this concept, the alignment of that transfer pipeline is assumed to be parallel to the existing wastewater pipeline alignment that currently transfers sewage to the WWTP.

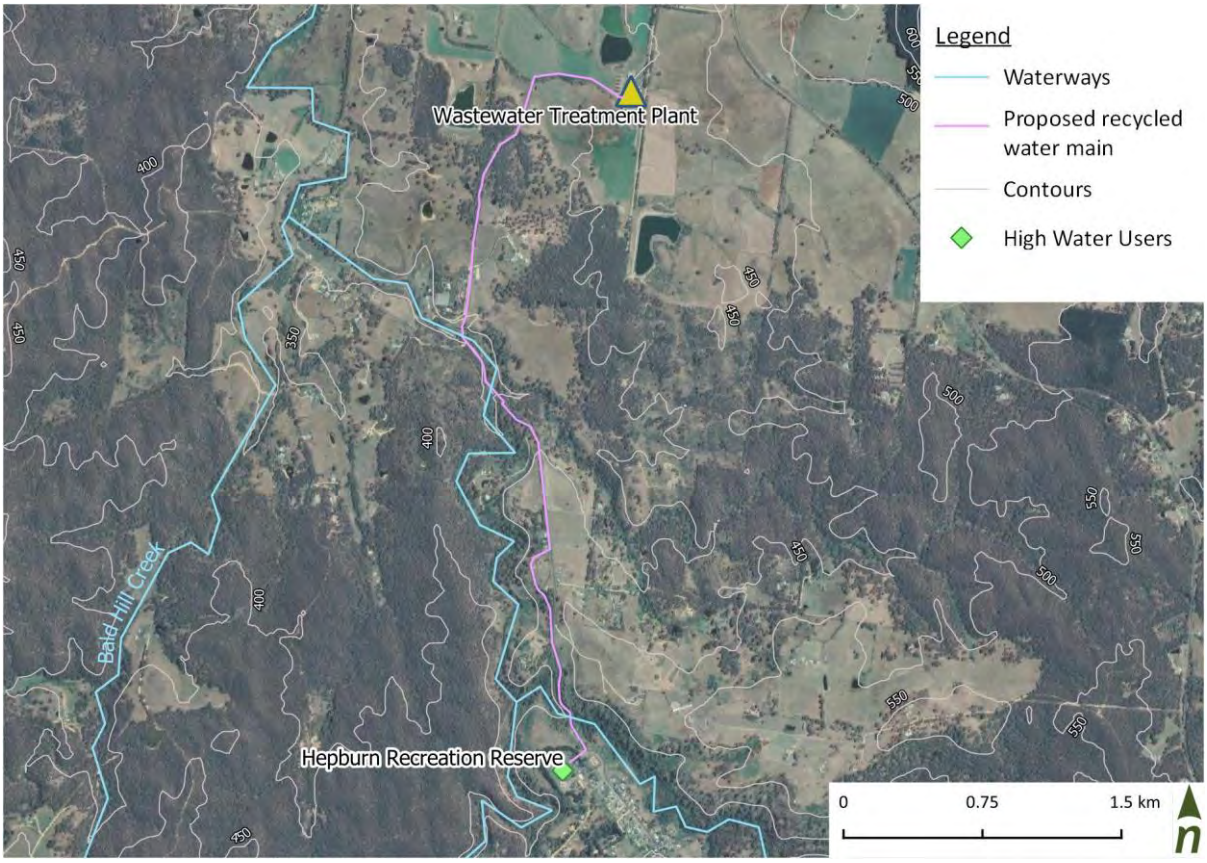


Figure 6. *Proposed arrangement of transfer network from Shepherds Flat WWTP to Hepburn Recreation Reserve*

A long section of the elevation profile (Figure 7) illustrates that the WWTP sits at an elevation of approximately 400m RL. As such a gravity main may be suitable to the 2,000 – 2,500m mark, with one or more booster pump stations being required to lift the water the 80m static head over the 2,000m length of the main.

Figure 7. *Elevation profile of pipeline alignment from the Shepherds Flat WWTP (at distance zero) to the Hepburn Reserve*

Irrigation demand and infrastructure requirements

While some water will be used within the Reserve's pavilion (e.g. for toilet use, showers, catering etc), it is assumed that the greater proportion of water demand is for the irrigation of the reserve. Irrigation demand changes with the seasons, with the greatest proportion irrigated in summer. The assumptions regarding the percentage of total demand irrigated each month is set out in Figure 8. This assumption has been based on irrigation projects in drier areas, in the west of Metropolitan Melbourne.

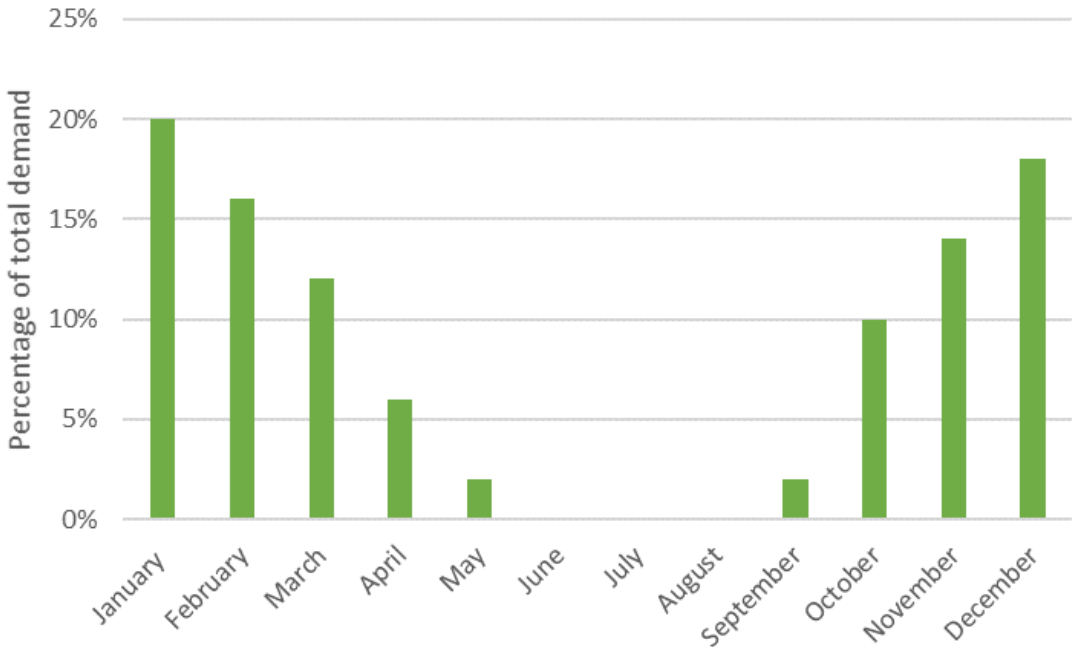


Figure 8 ***Seasonal irrigation demand by month (assumed)***

In summary:

- The estimated irrigation volume in January equates to 20% of total irrigation demand, that is 1.18 ML
- If we assume that in the peak irrigation month of January, the oval is irrigated every 3 days, there are 10. 3 (assume 10) irrigation 'events' in January
- Therefore each irrigation cycle uses approximately 118 kL of water.

Given the relatively high reliability of the water source, it is proposed that a 118 kL storage (to accommodate one irrigation cycle) is sufficient at the Reserve to accommodate one irrigation cycle. To fill that storage over an (assumed) 8 hour period requires a flow rate of 4.1 L/s. As noted above, the Shepherds Flat WWTP at approximately 400m RL and delivering water to approximately 435m RL. For the purposes of this investigation, one booster pump is assumed. Based on the above description, required infrastructure is summarised in **Error! Reference source not found.**.

Table 2. Infrastructure summary

Infrastructure	Description
Recycled water gravity main	~2.5 km of DN150 gravity main (allowing for potential additional capacity in future) ~2 km of DN150 rising main Alignment as per Figure 6 along the Hepburn – Newstead Road before going along Mullers Lane
Storage	118 kL above ground storage located within the reserve precinct 2.2m high x 8.7 m in diameter
Treatment	Assumed that the standard of recycled water (Class B) is sufficient for use on the Reserve
Pump station	Allowance for one booster station to lift 4.1 L/s with static head of approximately 80m approximately 2.5 km

Costs and benefits

The following table summarises some of the costs and benefits associated with the scheme.

Table 3. Cost and benefit summary

Cost	Benefits
Transfer and storage infrastructure. It is assumed treatment is managed at the WWTP	High reliability of supply (assumed to be 100%) given the relative difference between demand and current yield from the WWTP
Community engagement, information and education likely to be required surrounding use of recycled water on sports fields	5.9 ML/year of saved potable water
Identifying suitable location for recycled water storage tank (above ground has been assumed to reduce cost)	Council likely to pay a reduced tariff for recycled water (TBD) compared to potable water (~ $2.38 / kL)
Site management plans to monitor soil condition required	Green playing surface over summer, with a softer sub-soil resulting in a better playing experience and potentially less injuries

Further design considerations
The following would need to be undertaken to progress this design:

- Consultation with the users of the Reserve to introduce the idea and hear their feedback.
- Consultation within CHW and with Council to discuss the concept and agree, in principle, roles and responsibilities. It is assumed that CHW would design and manage this scheme, selling water to the Shire.
- Agreement on a recycled water main alignment that considers factors like existing infrastructure, geotechnical conditions, cultural heritage and ecological values.
- Confirming that Shepherds Flat WWTP produces suitable quality wastewater for irrigation, particularly considering the nature of soils at the Reserve.
- Understanding if there would be a desire to extend the scheme from Hepburn Springs and sizing transfer infrastructure accordingly to retain system flexibility.
- Compare this opportunity to the costs and benefits of supplying groundwater to the Reserve. A review of proximate bores shows two bores north of the Hepburn Recreational Reserve and one to the south near "The Hive". Their depths are estimated at between 20 and 50m. The bore reference 131349 is ~94m in depth with an estimated yield of 0.25 L/s. There is no other monitoring data available. To compare groundwater to recycled water some additional yield and quality information is required. Potential constraints to groundwater may therefore include depth to water table and available groundwater yield (in L/s)

Capital and maintenance costs estimate

The following cost estimate has been prepared that includes an offtake for recycled water at the treatment plant, a gravity main, booster pump station, rising main and storage. It is assumed that this scheme will connect to an existing irrigation network at the Reserve. The cost rates are based on previous project experience.

An estimated cost of **$2.15 M** includes a 30% contingency and an allowance for design and site investigations. It is estimated that the scheme will have a maintenance cost in the order of $19k / year. This only includes maintenance of identified assets and not an allowance for energy or the cost of the raw water.

Hepburn Recreational Reserve_Recycled water				
Description	**Unit**	**Quantity**	**Rate**	**Amount**
Preliminaries				
General (site establishment)	Item	1	$10,000	$10,000
Site clearing	Item	1	$10,000	$10,000
Traffic management	Item	1	$20,000	$20,000
Recycled water diversion				
Install offtake	m	50	$200	$10,000
Diversion pit and screen	No.	1	$10,000	$10,000
Valving	No.	2	$2,500	$5,000
Transfer pipeline				
Gravity main (within roadway)	m	2500	$250	$625,000
Rising main (within roadway)	m	2500	$250	$625,000
Pump station wet well pit and screen	No.	1	$20,000	$20,000
Pumpset	m	2	$20,000	$40,000
Power supply	No.	1	$5,000	$5,000
Control panel	No.	1	$20,000	$20,000
Level sensors	No.	1	$2,500	$2,500
Storage				
Enclosed steel 118 kL tank	No.	1	$25,000	$25,000
Site preparation	No.	1	$5,000	$5,000
Connections	No.	1	$5,000	$5,000
Sub – total				**$1,437,500**
Design (10%)				$143,750
Site investigations e.g. geotech, survey, service detection etc (10%)				$143,750
Contingency (30%)				$431,250
Total				**$2,156,250**

Maintenance					
Asset	Pipeline	Pump stations	Storage	Treatment	
Maintenance rate (as a % of capital cost)	1%	5%	5%	5%	
Sub-total	$ 12,600	$ 1,000	$ 1,250	$ -	**$ 14,850**
30% contingency					$ 4,455
Total					**$ 19,305**

1.7 Victoria Park irrigation from the Wallaby Creek Diversion

The Wallaby Creek diversion is a raw water supply that is only utilised within Daylesford during dry periods. It meets the Daylesford township near the corner of East St and Stanbridge St. This option would extend the Wallaby Creek diversion to the football oval at Ballan – Daylesford Road (7.1 ML/year) and Victoria Park (4.3 ML/year) to meet the total irrigation demand at the site of 11.4 ML/year.

As part of Bulk Entitlement (Daylesford – Hepburn Springs) Conversion Order 2004, Central Highlands Water can take up to 0.4 ML/day from the Wallaby Creek Weir. There are corresponding passing flow requirements meaning that at least 0.2 ML/day passes the weir.

It is also noted that the quality of this water means it is "not preferred for Daylesford supply" (Central Highlands Water, 2017) and may therefore be better utilised for non-potable uses. The same document notes that the "Wallaby pit main is in a very deteriorated condition" and therefore require replacement as part of this scheme.

If we assume this pipeline I functional, then an additional 2,800 m of pipeline is required to extend the raw water network to the vicinity of Victoria Park.

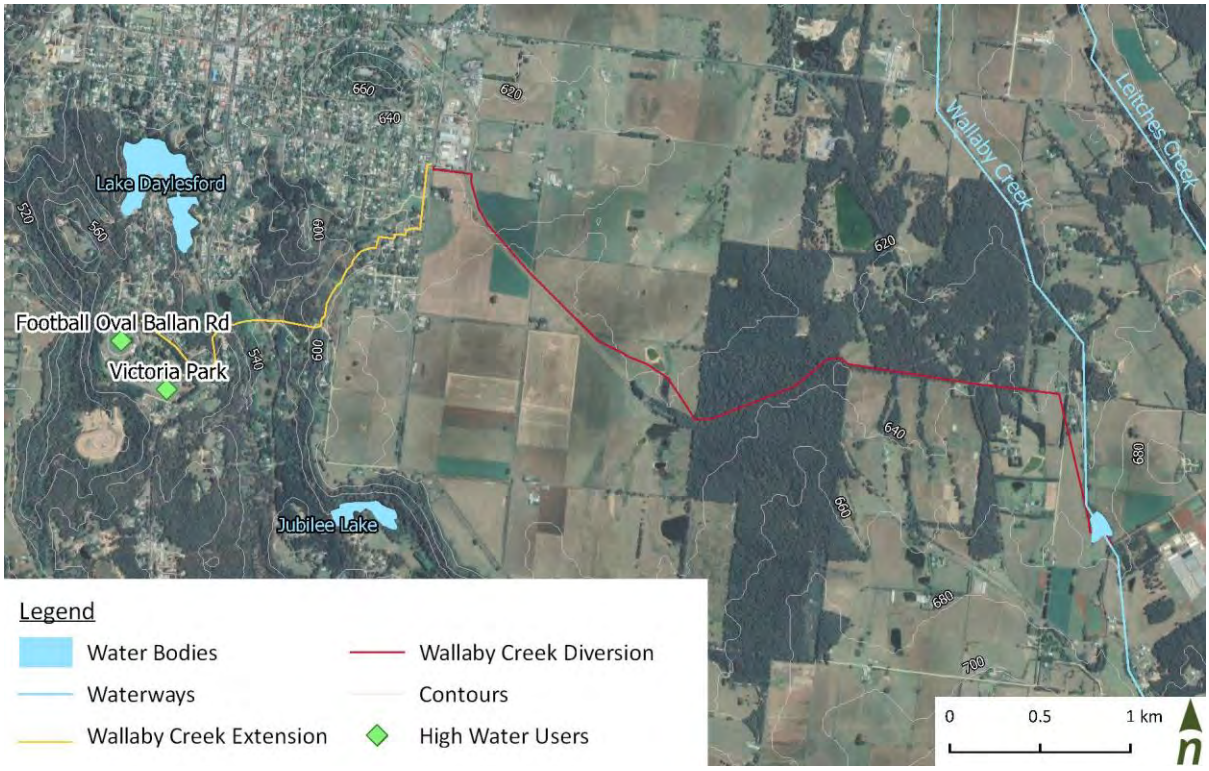


Figure 9. *Proposed arrangement of transfer network from Wallaby Creek Diversion to Victoria Park*

A long section of the elevation profile (Figure 7) illustrates that the Wallaby Creek diversion junction sits at an elevation of approximately 620 m RL. Further hydraulic analysis may be required once the alignment of the main has been agreed to understand if a gravity main can negotiate the 2.8 km length main to the 580m RL elevation at Victoria Park. If not, a small booster pump may be required at or near Smiths Creek at about 1,750m from the diversion.

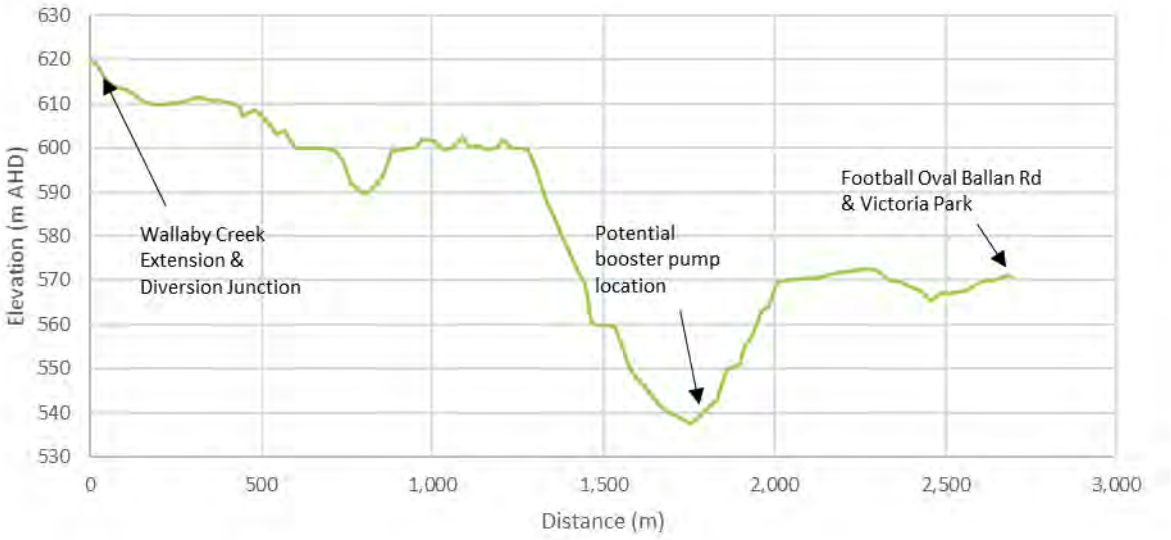


Figure 10. *Elevation profile of pipeline alignment*

Irrigation demand and infrastructure requirements

The same irrigation pattern is assumed for Victoria Park as was set out in Figure 8 above. The results based on that seasonal demand include the following:

- It is assumed that there are two open spaces within the precinct
    - Victoria Park (4.3 ML/year) and
    - Ballan – Daylesford Road reserve (7.1 ML/year)
- The estimated irrigation volume in January equates to 20% of total irrigation demand, that is:
    - 0.86 ML at Victoria Park, and
    - 1.42 ML at Ballan – Daylesford Road
- If we assume that in the peak irrigation month of January, the oval is irrigated every 3 days, there are 10. 3 (assume 10) irrigation 'events' in January
- Therefore each irrigation cycle uses approximately:
    - 86 kL at Victoria Park, and
    - 142 kL at Ballan – Daylesford Road

There may be lower reliability associated with the Wallaby Creek diversion in summer, therefore it may be advisable to include storages that can hold two irrigation cycles i.e.:

- 172 kL at Victoria Park (two times 86 kL) and
- 284 kL at Ballan – Daylesford Road.

To fill those storage over an (assumed) 8 hour period requires a flow rate of 6.0 L/s at Victoria Park (two times 86 kL) and 9.9 L/s at Ballan – Daylesford Road. This equates to a total transfer rate of 15.8 L/s. This maximum or summer flowrate equates to approximately 0.46 ML/day.

Therefore, the extraction will need to be limited to 0.4 ML/day as per the bulk entitlement (and assuming adequate passing flows of 0.2 ML/day are maintained with that extraction).

Table 4. Bulk entitlement rules for Wallaby Creek

Total flow (ML/day)	Diversion to Central Highlands Water (ML/day)	Flow down Wallaby Creek (ML/day)
Greater than 2.4	1.2	Total flow (1.2 ML/d)
Between 0.4 ML/d and 2.4 ML/d	50% of total flow	50% total flow
Between 0.2 ML/d and 0.4 ML/d	Total flow - 0.2 ML/d	0.2 ML/d
Less than 0.2 ML/d	0	100% flow

Some flow rate monitoring data was available for Wallaby Creek (at Dairy Flat Road culvert, Musk). The data covers four years: 1998 - 2002. So while not an extensive record, it does provide an indication as to the seasonal flows at that location. While there is a relatively consistent flow, the flowrate can dip below 1 ML/day over summers months.

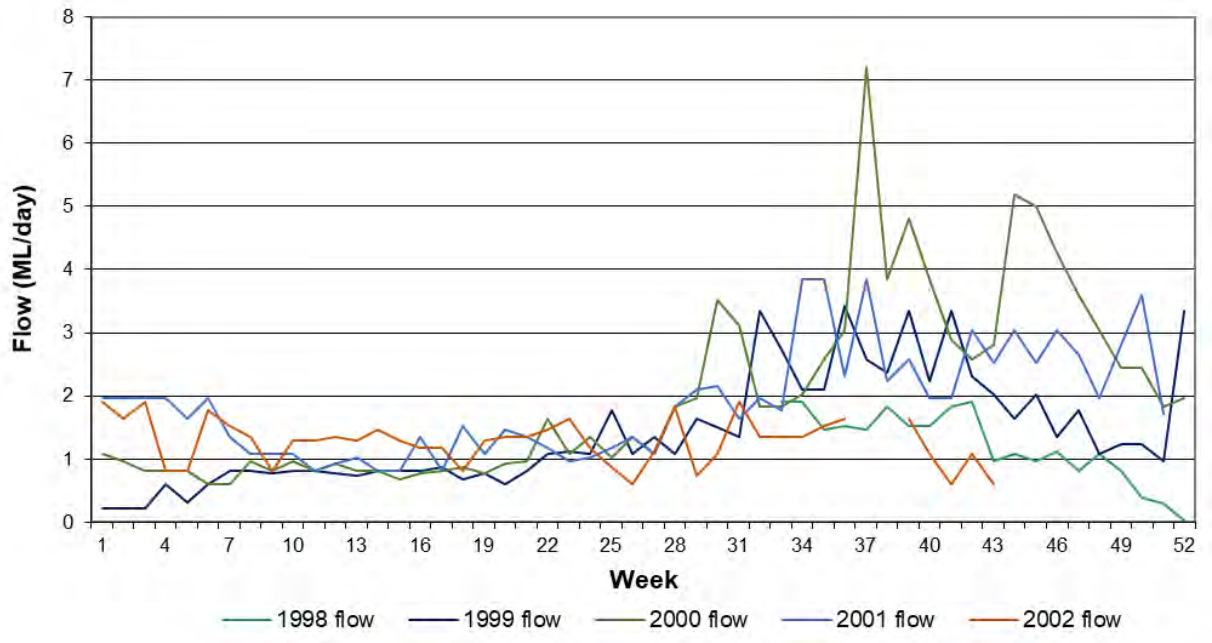


Figure 11. *Flowrate data from Wallaby Creek at Dairy Flat Road culvert, Musk 1998 - 2002*

Based on the above description, required infrastructure is summarised in Table 5. Given the condition of the Wallaby Creek Diversion, this may also require replacement.

Table 5. Infrastructure summary

Infrastructure	Description
Wallaby Creek extension*	2,800m of DN150 to DN 225 gravity main / rising main All assumed to be through open ground
Storages	172 kL at Victoria Park
	284 kL at Victoria Park
Treatment	Filtration and UV prior to storage or prior to irrigation
Pump station	15.8 L/s To be determined based on alignment

Costs and benefits

The following table summarises some of the costs and benefits associated with the scheme.

Table 6. Cost and benefit summary

Cost	Benefits
Transfer, storage and treatment infrastructure	Medium supply reliability
Flows are less reliable during summer	Up to 11.4 ML/year of saved potable water
Negotiation with residents if construction of pipeline alignment approaches properties or Smiths Creek	Council likely to pay a reduced tariff for raw water (~$0.84/ kL) compared to potable water (~ $2.38 / kL), a saving of approximately $17.5k / year.
	Green playing surface over summer, with a softer sub-soil resulting in a better playing experience and potentially less injuries

Further design considerations

The following would need to be undertaken to progress this design:

- Further investigation is required to understand the reliability of the Wallaby Creek system to provide flows over summer months while meeting the terms of the bulk entitlement for that location.
- It is assumed that given CHW manage the bulk entitlement for the diversion, no changes to that entitlement need to be made.
- Flow monitoring of Wallaby Creek and condition assessment of Wallaby Creek Diversion infrastructure (including the is required to understand if this needs replacing.
- Consultation within CHW and with Council to discuss the concept and agree, in principle, roles and responsibilities.
- Agreement on a diversion alignment that considers factors like existing infrastructure, private property, Smiths Creek, geotechnical conditions, cultural heritage and ecological values.
- Confirm treatment requirements. It is assumed that filtration and disinfection will be sufficient.

Capital and maintenance costs estimate

The following cost estimate has been prepared that includes a gravity extension of the Wallaby Creek Diversion, storage and treatment. It is assumed that the scheme can operate via gravity and no pump stations have been costed. It is assumed also that this scheme will connect to an existing irrigation network and therefore, irrigation is not costed. The cost rates are based on previous project experience.

An estimated cost of **$1.37 M** includes a 30% contingency and an allowance for design and site investigations. It is estimated that the scheme will have a maintenance cost in the order of $20k / year. This only includes maintenance of identified assets and not an allowance for energy or the cost of the raw water.

Table 7. Capital cost estimate

Victoria Park_Wallaby Creek Diversion				
Description	**Unit**	**Quantity**	**Rate**	**Amount**
Preliminaries				
General (site establishment)	Item	1	$10,000	$10,000
Site clearing	Item	1	$20,000	$20,000
Traffic management	Item	1	$10,000	$10,000
Raw water diversion				
Install offtake	m	50	$200	$10,000
Diversion pit and screen	No.	1	$5,000	$5,000
Valving	No.	2	$2,500	$5,000
DN150 to 225 Gravity main (out of)	m	2800	$250	$700,000
Pump station wet well pit and screen	No.	0	$20,000	$0
Pumpset	m	0	$10,000	$0
Power supply	No.	0	$5,000	$0
Control panel	No.	1	$10,000	$10,000
Level sensors	No.	1	$2,500	$2,500
Storage				
Enclosed steel 172 kL tank	No.	1	$30,000	$30,000
Enclosed steel 284 kL tank	No.	1	$35,000	$35,000
Site preparation	No.	2	$5,000	$10,000
Connections	No.	2	$5,000	$10,000
Treatment				
UV treatment	Item	1	$45,000	$45,000
Filtration	Item	1	$10,000	$10,000
Sub – total				**$912,500**
Design (10%)				$91,250
Site investigations e.g. geotech, survey, service detection etc (10%)				$91,250
Contingency (30%)				$273,750
Total				**$1,368,750**

Table 8. Operating and maintenance cost estimate

Maintenance					
Asset	Pipeline	Pump stations	Storage	Treatment	**Total**
Maintenance rate (as a % of capital cost)	1%	5%	5%	5%	
Sub-total	$ 7,200	$ -	$ 3,250	$ 2,750	**$ 13,200**
30% contingency					$ 3,960
Total					**$ 17,160**

1.8 Raw water extraction from Lake Jubilee or Lake Daylesford to irrigate Jubilee Lake Reserve and Central Lake Reserve (respectively)

This option aims to extract water from Lake Jubilee and Lake Daylesford to provide raw water to their adjacent parklands for irrigation. As the reserves are in close proximity to the lakes, these options would require only a modest investment in transfer infrastructure.

Figure 12. *Lake Jubilee and Jubilee Lake Reserve, Lake Daylesford and Central Lake Reserve*

Jubilee Lake Reserve has an annual potable water demand of 2.6 ML, while Central Lake Reserve has an annual potable water demand of 2.7 ML. The assumed seasonal irrigation demand distribution is consistent with other irrigation examples discussed in this report. In those examples, it is assumed that:

- The estimated irrigation volume in January equates to 20% of total irrigation demand
- If we assume that in the peak irrigation month of January, the oval is irrigated every 3 days, there are 10. 3 (or 10 – 11) irrigation 'events' in January

One of the key concerns with this option is the community's response and potential aesthetic impact. Therefore, noting the surface area of Lake Jubilee and Lake Daylesford, the theoretical impact on lake depth of each irrigation cycle has also been estimated, and found to be minimal. Table 9 below summarises these findings.

Table 9. Annual irrigation demand distribution

	Lake Jubilee	Lake Daylesford
Annual demand (ML/ year)	2.60	2.70
Peak (January) irrigation month volume (ML)	0.52	0.54
Volume per irrigation cycle (kL)	52	54
Volume per month (in kL - 3 cycles)	156	162
Surface area (m^2)	25,800	94,100
Estimated change in water level per month (cm)	**0.6**	**0.2**

Infrastructure requirements
Based on the discussion above regarding seasonal irrigation demand, it is estimated for both schemes, each irrigation cycle requires around 55 kL. The concept for therefore proposes for both schemes:

- A transfer pump station located at each lake that is able to transfer:
    - Lake Jubilee: 52 kL over an 8 hour period (i.e. overnight or off peak). This equates to a pump rate of approximately 1.8 L/s.
    - Lake Daylesford: 54 kL over an 8 hour period (i.e. overnight or off peak). This equates to a pump rate of approximately 1.9 L/s.
- A small diameter transfer main (e.g. DN 80) from each.
- Local small storages of ~50 kL in each Reserve. These are assumed to be surface storages but could be sub-surface to minimise the aesthetic impact of each storage.
- Treatment: it is assumed that some filtration and UV disinfection will be required before entering the irrigation network.

The infrastructure requirements are summarised in Table 10 .

Table 10. Infrastructure summary

Infrastructure	Description	
	Lake Jubilee	**Lake Daylesford**
(Solar) pump station	1.8 L/s	1.9 L/s
Rising main (to connect to irrigation network)	~50m of DN80	~50m of DN80
Storage	50 kL	50 kL
Filtration and UV disinfection	To achieve disinfection and protect downstream irrigation network	

Costs and benefits
The following table summarises some of the costs and benefits associated with the scheme.

Table 11. Cost and benefit summary

Cost	Benefits
Transfer, storage and treatment infrastructure (see below)	Moderate reliability of supply noting that irrigation is likely to be second priority behind aesthetic and other uses like swimming.
Potential impacts to amenity of the Lakes, particularly during summer months	5.3 ML/year of saved potable water
Comprehensive community engagement / Community perception of extracting water from the lakes	Green and cooler surface over summer
Confirmation that extraction is within the terms of any existing license or bulk entitlement	

Design considerations

More detailed analysis would be required including a water balance model of the lake that takes into account catchment inflows, outflows, losses to evaporation, infiltration and groundwater recharge as well as a bathymetric survey to establish a more accurate picture of the dynamics of water in the lake system and the potential impacts of raw water extraction on the lake's water level and amenity.

From the estimations presented above, the amount of extraction required to meet the irrigation demands of the Lake reserves would have little impact on the lakes' water levels. Licensing or a bulk entitlement for raw water extraction would also need to be considered and any changes may require ministerial approval.

Lake Daylesford and Lake Jubilee are highly valued community assets. Comprehensive and effective engagement with stakeholders and community is essential to ensure that there is buy-in and acceptance of any proposed scheme that could impact the amenity and function of these lakes.

Conditions, such as maximum extraction rates, volumes and scheduling would need to be established and negotiated to ensure that it would not significantly impact other uses and outcomes the lakes provide.

Capital and maintenance costs estimate

The following cost estimate has been prepared that includes an offtake for recycled water at the treatment plant, a gravity main, booster pump station, rising main and storage. It is assumed that this scheme will connect to an existing irrigation network at the Reserve.

An estimated cost of **$264k** includes a 30% contingency and an allowance for design and site investigations. The cost rates are based on previous project experience. It is estimated that the scheme will have a maintenance cost in the order of $19k / year. This only includes maintenance of identified assets and not an allowance for energy or the cost of the raw water.

Table 12. Capital cost estimate

Lake Jubilee and Lake Daylesford				
Description	**Unit**	**Quantity**	**Rate**	**Amount**
Preliminaries				
General (site establishment)	Item	2	$10,000	$20,000
Site clearing	Item	2	$5,000	$10,000
Traffic management	Item	2	$5,000	$10,000
Raw water diversion and pump station				
Install offtake	m	100	$100	$10,000
Valving	No.	2	$2,500	$5,000
Submersible pump (2 l/s) and pit with sensors and filter	m	2	$10,000	$20,000
Power supply	No.	2	$5,000	$10,000
Storage				
Enclosed 50kL storage	No.	2	$10,000	$20,000
Distribution pump / irrigation pump / sensor	No.	2	$8,000	$16,000
Site preparation	No.	2	$5,000	$10,000
Connections	No.	2	$5,000	$10,000
Treatment				
UV treatment	Item	2	$5,000	$10,000
Filtration	Item	5	$5,000	$25,000
Sub – total				**$176,000**
Design (10%)				$17,600
Site investigations e.g. geotech, survey, service detection etc (10%)				$17,600
Contingency (30%)				$52,800
Total				**$264,000**

Table 13. Maintenance cost estimate

Maintenance					
Asset	Pipeline	Pump stations	Storage	Treatment	
Maintenance rate (as a % of capital cost)	1%	5%	5%	5%	**Total**
Sub-total	$ 250	$ 1,800	$ 1,000	$ 1,750	**$ 4,800**
30% contingency					$ 1,440
Total					**$ 6,240**

1.9 Discussion and next steps

A number of non-potable supplies were considered for Daylesford. A key driver behind this is to green open spaces and reduce potable water demand. There was also a willingness to investigate the potential for recycled water to brough back into Daylesford and Hepburn Springs to see if a higher value use of that water can be identified. A key barrier to this is the distance from Shepherds Flat to the open spaces examined in this report.

While the analysis of these options was being undertaken, meeting with Dja Dja Wurrung at the Shepherds Flat site raised the opportunity for a local reuse scheme, where recycled water could be used on treatment plant land to cultivate food and fibre crops. This would be a higher value use of that water and would align well with the "Jobs, economic benefits and innovation" outcome in the Strategic Directions Statement. Therefore, this option should be investigated in collaboration with the Dja Dja Wurrung to understand the feasibility of that enterprise.

In reviewing the options examine within the report, the following will be required to progress those options.

Hepburn Recreation Reserve recycled water scheme

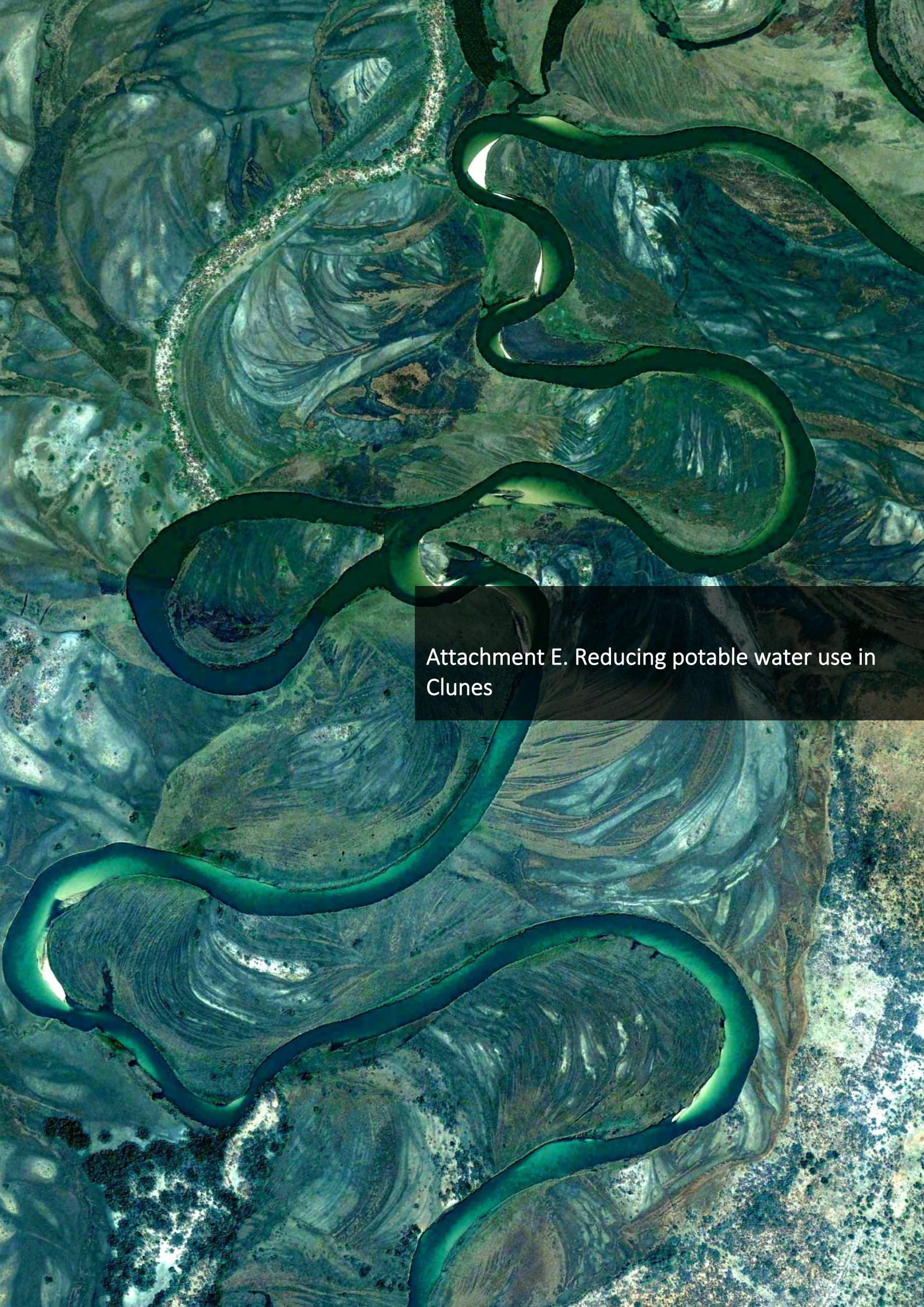
- Engagement with relevant sporting and community groups to understand if the opportunities identified have support and/or what additional information might be required.
- Investigation of the recycled water quality from Shepherds Flat to understand if it is fit for purpose for use at the Hepburn Recreation Reserve
- Undertake a preliminary design of a recycled water scheme including asset locations and alignment to get a better sense of costs.

Victoria Park irrigation from the Wallaby Creek Diversion

- Engagement with relevant sporting and community groups to discuss providing an alternative water supply and how that may impact each space (e.g. the inclusion of a surface storage).
- Confirm the Wallaby Creek system's capacity to support irrigation demands and the likely reliability of that system, including during dry periods.
- Investigate the potential for rainwater harvesting at the pavilion itself, to reduce potable water demand within buildings
- Undertake a preliminary design of a raw water diversion scheme including asset locations and alignments to get a better sense of costs.

Raw water extraction from Lake Jubilee or Lake Daylesford

- Consultation with Council and the Community to understand if this is something the community wants and is acceptable in principle.
- Review and confirm the potential impact of extraction on surface levels and lake aesthetic. It is assumed that if the aesthetic impact is negative then the project is a non-starter.
- Investigate if suitable locations for extraction points and above ground infrastructure are available and likely to be aesthetically acceptable.



Attachment E. Reducing potable water use in Clunes

1 Reducing potable water use in Clunes

1.1 Introduction

This concept report investigates opportunities to for alternative (or non-potable) water supply to meet non-potable water demands within Clunes. This work has been identified as part of the Daylesford & Hepburn Springs, Creswick and Clunes IWM Plan and is primarily aimed at reducing potable water consumption at Council held assets. The aim is that this process will be replicable in other towns across the Shire.

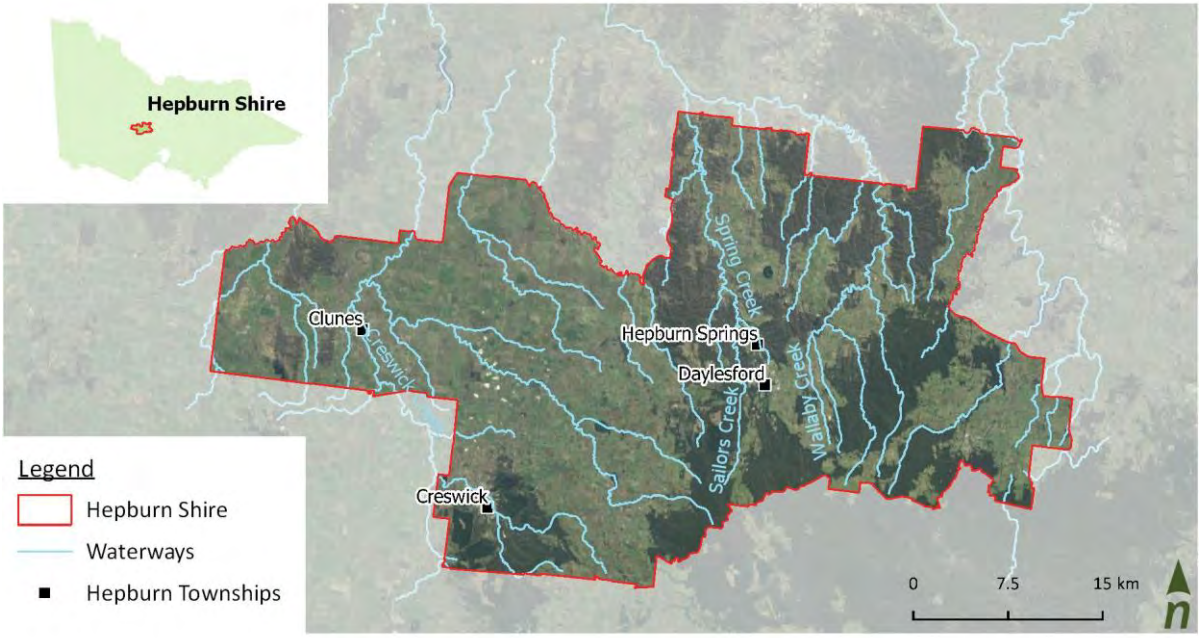


Figure 1. *Location map of Clunes on Creswick Creek in the Shire of Hepburn*

1.2 Scope

The scope reviews a range of potential water sources potentially available in Clunes. Predominantly, these are to replace irrigation demands for Council open spaces and gardens, that represent the highest individual demands within Clunes. The following steps were undertaken:

Identify demands
High water users within Clunes have been identified to understand where the greatest potential water savings may occur.

Identify alternative water sources
The water sources considered include:

- Stormwater harvesting
- Rainwater harvesting
- Recycled wastewater
- Raw water (from lakes or waterways), and
- Groundwater extraction.

Feasibility review
For each water source and demand location, the feasibility of each alternative water is reviewed according to the following approach:

- Identification of high water users within Clunes and what that water is used for (sometimes assumed given lack of detailed metering data)
- Review the end use and location of each demand point and assess the suitability, or compatibility, of each water source to meet that demand
- For those combinations of demand and supply that are compatible, provide
    - a map of the concept
    - likely infrastructure requirements
    - design considerations
    - indication of capital and operating costs (based on high level assumptions)
    - a summary of the benefits associated with the feasible opportunities.
- Consideration of bulk entitlement and extraction licences conditions as appropriate.

1.3 Clunes high water users

Central Highlands Water (CHW) has provided water use data in Clunes for 2019/20 (see Figure 2). Hepburn Shire Council is the largest water user in Clunes, with 11.2 of the total 16 ML (approx.) used for the irrigation of the Ligar Street Reserve.

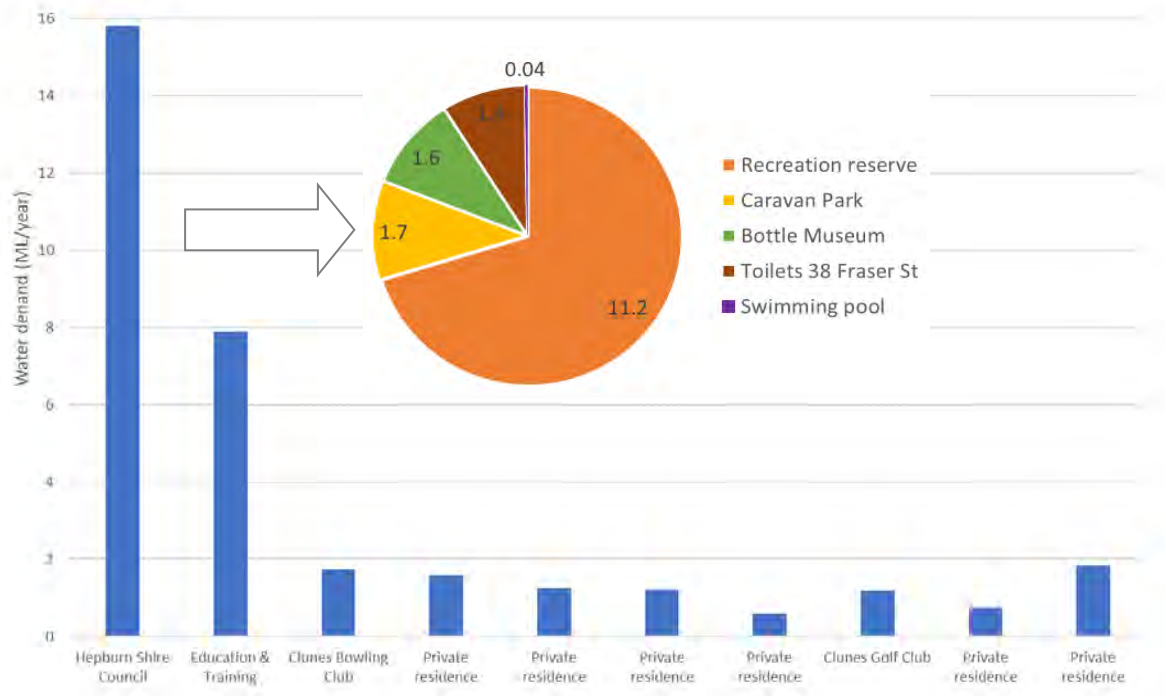


Figure 2. *Top 10 water users 2019/20 (Courtesy Central Highlands Water) and top Hepburn Shire Council potable water users in Clunes*

Based on this data, the following high water users have been identified for further investigation:

- Recreation Reserve (Ligar Street) - assumed to be largely irrigation for the football/cricket oval
- Caravan Park – partially associated with irrigation and toilet with potable sues like showers and kitchen
- Fraser St toilets – assumed to be toilet flushing, but a high volume so more investigation required. Aerial photography suggests that there is an existing rainwater tank
- Clunes Bowling Club - assumed to be largely irrigation of bowling greens.

The following demands have not been investigated

- Education & Training facility – this site hasn't been investigated as the proportion of potable and non-potable water use is unclear. Given the overall use however, this could be considered if and as the opportunities presented within this concept are progressed.
- Bottle Museum – it is assumed that water consumption is associated with potable end uses. There may be an opportunity for rainwater harvesting to meet some of those demands (including toilet).
- Swimming Pool – rainwater is permissible for use within community pools, however, other than the pavilion, there is not a significant roof in the vicinity. This has therefore not been looked at in more detail.
- Clunes Golf Club. - assumed to be largely irrigation however this is relatively remote from the rest of the town and irrigation demands. Again, there may be an opportunity for rainwater harvesting for toilet use.

The location of the high water users in Clunes is provided Figure 3.

Figure 3. *Map of high water users in Clunes*

1.4 Non-potable water supply options

Possible non-potable water supply opportunities within Clunes are described below.

Stormwater harvesting

Stormwater is rainfall that has come into contact with ground level, hard surfaces such as roads, pavements and car parks. The more impervious surfaces within the catchment, the more stormwater is generated. Stormwater typically flows to a drainage network and onto a waterway. Stormwater can be harvested when it is:

- Collected – by diverting stormwater from the drainage network (via gravity or by a pumped diversion). Treated stormwater can also be diverted from the outlet of a constructed, stormwater treatment wetland.
- Treated – to remove sediment, pollutants and bacteria and viruses using mechanical filtration units and disinfection (e.g. UV light) and / or by using water sensitive urban design (WSUD) assets biofilters and
- Storing stormwater prior to use, typically for the irrigation of open space.

Stormwater harvesting is typically suitable where a large, highly impervious catchment drains to a common point for convenient diversion and collection. It is economically more feasible when used to meet larger scale irrigation demands (e.g. irrigation of larger spaces like football ovals).

Rainwater harvesting

This is where rainwater is collected directly from a building or house roof into a rainwater tank. Rainwater is a better quality of water than stormwater and does not require treatment to be used for, garden irrigation, toilet and laundry use.

There are also examples of rainwater being directed to hot water services. Rainwater harvesting is a good option for smaller demands where they a proximate to medium to large roofs.

Raw water extraction

Raw water is untreated water that is typically held in water supply reservoirs, within local lakes or flowing within a creek or waterway. Raw water needs to be conveyed to a water treatment plant to be suitable for human consumption. Alternatively, it can be diverted to meet non-potable uses including irrigation.

Under Section 51 of the Water Act, “a person may apply to the Minister for the issue of a licence to take and use water from a waterway”. Waterways within Clunes, including Creswick Creek and Kilkenny Creek, may be suitable. However following consultation with Goulburn Murray Water significant barriers to this approach were noted, including:

- competing uses for stock and domestic irrigation
- relatively low flows particularly over summer months (when irrigation water would be required), and
- a diversion scheme may encounter community opposition.

Based on this, extraction of raw water from these creeks has not been considered further.

Recycled water
Recycled water is sewage that has been treated to a suitable and required standard for intended end uses. Typically 'Class B' recycled water can be used for irrigation or agricultural uses. Wastewater from Clunes is pumped to the Clunes Wastewater Treatment Plant (WWTP) for treatment. Clunes WWTP produces Class B and C recycled water that is currently used to irrigate local farmland. The WWTP is situated in an elevated position approximately 5 kms north of Clunes.

There is sufficient volume to supply irrigation needs in Clunes, however the distance to transfer recycled water back to town (~5km under gravity) and the potential need for some further treatment present potential barriers.

Groundwater
Groundwater is the source of Clunes' potable water supply and is sourced from the groundwater bores located approximately 6km south of Clunes. While there is a relatively high cost associated with treating groundwater to a potable standard, there may be an opportunity to use untreated groundwater for irrigation of open spaces.

Clunes is within the Loddon Highlands water supply protection area (WSPA). The allocations in this WSPA are available, and groundwater is available for trade with a current groundwater user. Consultation with Goulburn Murray Water suggests groundwater can typically be purchased at a rate of between $2,000 – 2,500 / ML.

This would require the sinking of a new bore proximate to the proposed demand and meeting associated regulatory requirements

1.5 Opportunity summary

Table 1 below outlines the opportunities and constraints associated with supplying large water users with non-potable or alternative water supply options. Darker green cells indicate opportunities that are worthy of further investigation. In summary, given the rural nature of the catchment and absence of detailed drainage information, stormwater harvesting has not been prioritised. Other opportunities within the IWM plan highlight the need for stormwater treatment within Clunes and Creswick to protect Creswick Creek. Rainwater harvesting is seen as an effective small-scale intervention that responds to community feedback and increases the visibility of IWM across the township. Groundwater is also an available option with a relatively well understood price point.

Table 1. Alternative water supply option opportunities and constraints)

				Alternative water source				
No	**Site**	**Water use (2019/20)**	**End use**	**Stormwater harvesting**	**Rainwater harvesting**	**Raw water extraction**	**Recycled water**	**Groundwater**
1	Clunes Recreation Reserve	11.2	Open space irrigation	No significant stormwater catchment / resource upstream	Large roof area to support rainwater harvesting for toilet use within the pavilion	No suitable waterway / open water body within vicinity for extraction	Potentially suitable location to receive recycled water from the WWTP	Groundwater can be used as a comparison to recycled wastewater opportunities for irrigation
2	Clunes Bowling Club	1.7	Open space irrigation	No significant stormwater offtake opportunities within proximity	Moderate roof area to support rainwater harvesting for internal toilet uses	No suitable open water bodies within vicinity	Possible option if recycled water network is extended to Ligar St Reserve. ~ 400m to the bowling club. Existing storage onsite	
3	Clunes Caravan Park	1.7	Open space irrigation	No significant stormwater offtake opportunities within proximity	Moderate roof area to support rainwater harvesting for use at the camp's toilet block	No suitable open water bodies within vicinity	Possible option if recycled water network is extended to Ligar St Reserve. ~ 350m to the caravan park	
4	38 Fraser St toilets	1.4	Toilet flushing	Unsuitable	Small roof area and existing tank. Very high demand for small toilet block. Need to understand more about nature of demand and if this all associated with toilet block	Not suitable	Potentially suitable but likely to require construction of a main down Clunes' main St	Considered too small a site to warrant sinking a bore.
5	Clunes Golf Club	1.2	Open space irrigation	No significant stormwater catchment / resource upstream	Small roof area but potential to install a rainwater tank to supply the clubhouse toilet	No suitable open water bodies within vicinity	Possible option: the additional distance to the Golf Course (~3km) is seen as a potential barrier. An additional storage and irrigation infrastructure is likely to be required, making this a potentially expensive extension to the scheme	Potential option for golf course irrigation
6	Clunes Pool	0.04	Swimming pool Toilet and shower facilities	Not suitable for swimming pool use	Rainwater is suitable for use in community swimming pools. Adjacent clubhouse has ~1,000 m2 catchment area. Unlikely to be large enough. May be worth further analysis.	Not suitable for swimming pool use	Not suitable for swimming pool use	Not suitable for swimming pool use

2 Further investigation

2.1 Clunes recreation reserve

This option aims to supply recycled water from Clunes WWTP to meet (approximately) 11.2 ML/year of irrigation demand of the Recreation Reserve. This would require the installation of approximately 5 km of recycled water main from the WWTP to a suitable storage at or near the Recreation Reserve and potentially additional treatment.

For the purposes of this concept, it is assumed that a new recycled water pipeline would run parallel to the wastewater rising main that currently transfers sewage to the WWTP. Based on a desktop review the proposed alignment along Angus St / Clunes – Cambelltown Road has relatively few obvious constraints, other than negotiating Birch Creek.

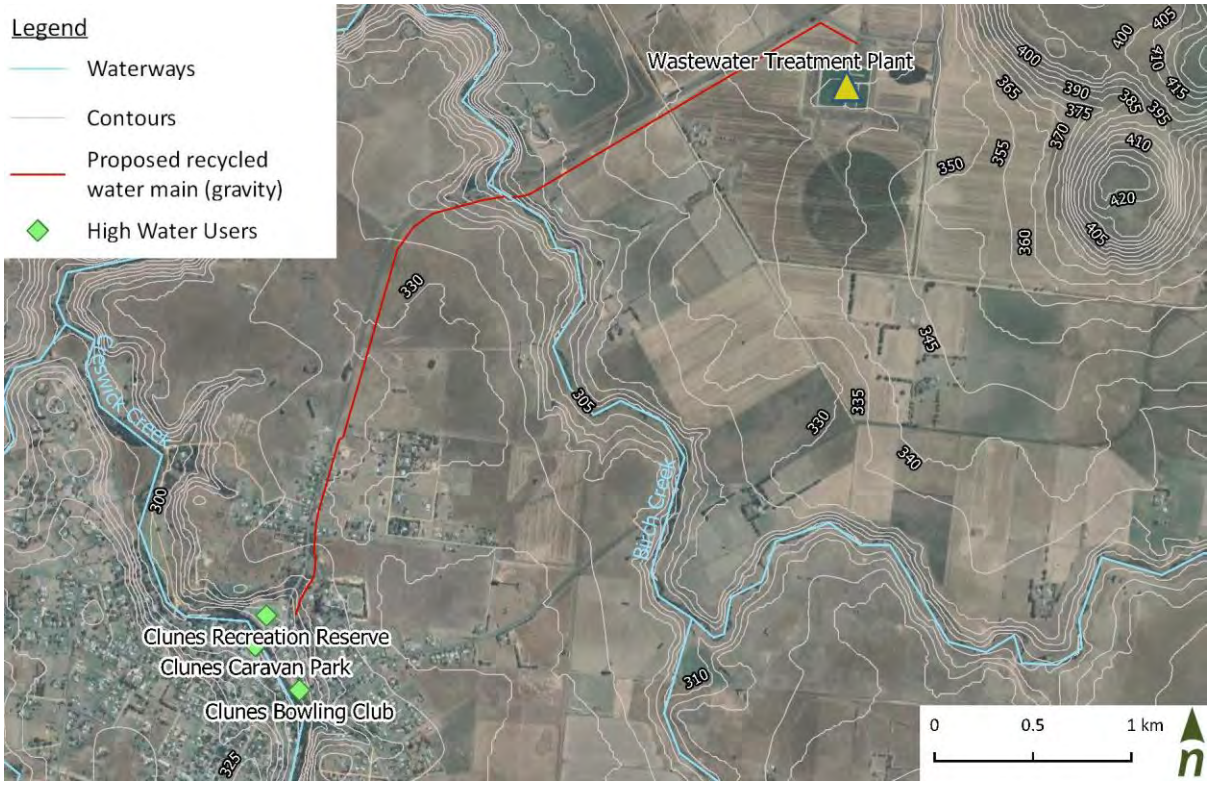


Figure 4. *Proposed arrangement of transfer network from Clunes WWTP to Clunes Recreation Reserve*

A long section of the elevation profile (Figure 5) illustrates that the WWTP sits at an elevation of approximately 340m RL. Further hydraulic analysis may be required to understand if a gravity main can negotiate the 330m RL elevation west of Birch Creek. If not a small booster pump may be required. However in theory it is proposed that water be gravitated to the recreation reserve.

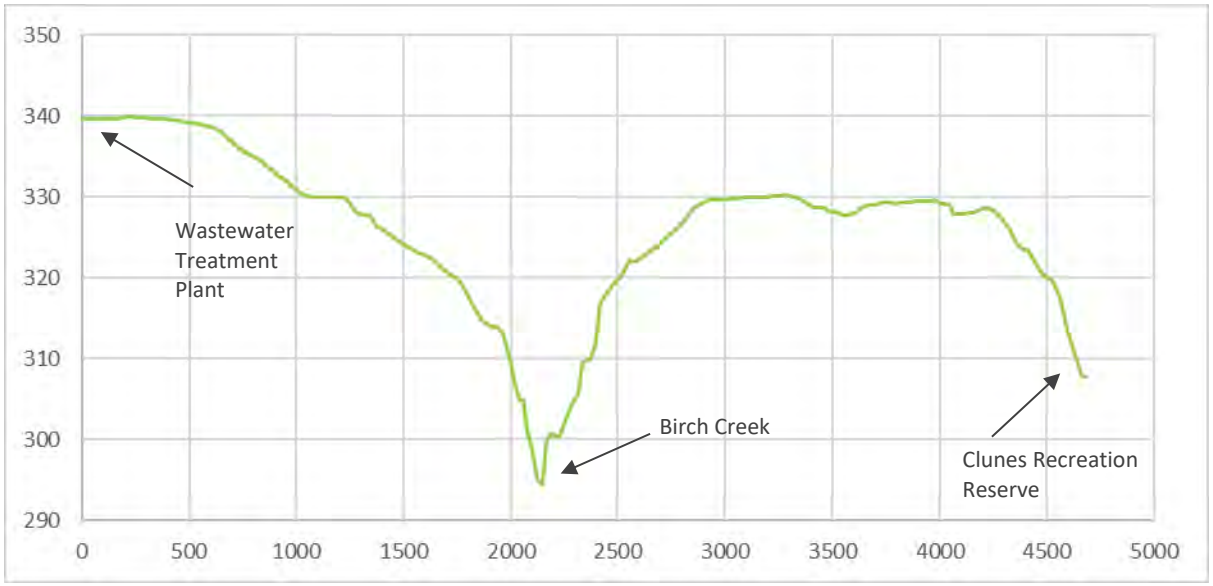


Figure 5. *Elevation profile of pipeline alignment*

Irrigation demand and infrastructure requirements

While some water will be used internally e.g. for toilet use, showers, catering etc, it is assumed that most water is used for irrigation of sports fields. Irrigation demand changes with the seasons, with the greatest proportion used in summer. The assumptions regarding the percentage of total demand irrigated each month is set out in Figure 6. This assumption has been based on irrigation projects in drier areas, in the west of Metropolitan Melbourne.

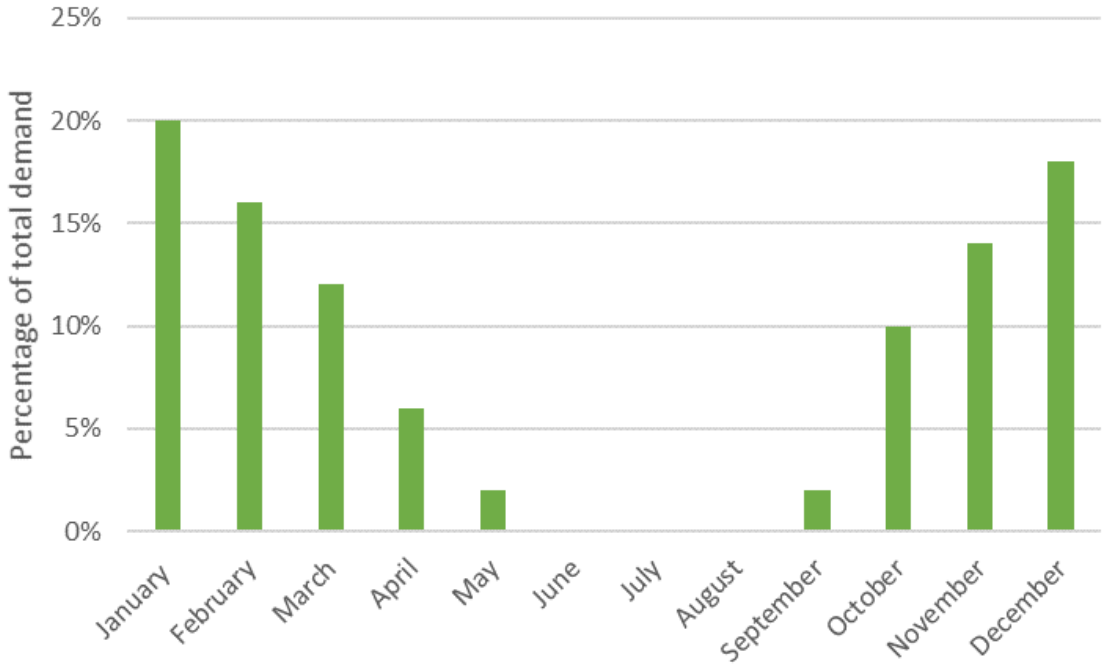


Figure 6. *Seasonal irrigation demand pattern by month (Assumed)*

In summary:

- The estimated irrigation volume in January equates to 20% of total irrigation demand, that is 2.24 ML
- If we assume that in the peak irrigation month of January, the oval is irrigated every 3 days, there are 10. 3 (assume 10) irrigation 'events' in January
- Therefore each irrigation cycle uses approximately 224 kL of water.

Given the relatively high reliability of the water source, it is proposed that a 224 kL storage (to accommodate one irrigation cycle) is likely to be sufficient. To fill that storage over an (assumed) 8 hour period requires a flow rate of 7.8 L/s. Based on the above description, required infrastructure is summarised in Table 2.

Table 2. Infrastructure summary

Infrastructure	Description
Recycled water gravity main	5 km of DN150 gravity main Alignment along Angus St / Clunes – Cambelltown Road with one bridge crossing
Storage	224 kL of above ground storage located within the reserve precinct 2.2m high x 11.6m in diameter
Treatment	It is likely that some additional filtration and UV disinfection will be required prior to storage or use This small treatment shed and control panel would be located at the WWTP so that delivered water is fit for purpose

Figure 7 *Ligar St Recreational Reserve, Clunes*

Costs and benefits

The following table summarises some of the costs and benefits associated with the proposed scheme.

Table 3. Cost and benefit summary

Cost	Benefits
Transfer, storage and treatment infrastructure	High reliability of non-potable water supply (assumed to be 100%) given the relative difference between demand and wastewater volumes being treated
Additional treatment assets to maintain	Council may likely to pay a reduced tariff for recycled water compared to potable water (~ $2.38 / kL)
Identifying suitable location for recycled water storage tank (above ground has been assumed to reduce cost)	Green playing surface over summer, with a softer sub-soil resulting in a better playing experience and potentially less injuries
Community engagement, information and education likely to be required surrounding use of recycled water on sports fields	Potential to extend this scheme, if successful, to other water users in Clunes including the bowling club and caravan park
Site management plans to monitor soil condition and potential impact of salinity in recycled water	

Further design considerations

During consultation with Dja Dja Wurrung, there was some interest in the potential for the cultivation of food and fibre crops using the land surrounding the Clunes WWTP and the recycled water produced there. Before progressing the irrigation of public open spaces, the feasibility of the Dja Dja Wurrung proposal should be looked at, so that additional demands that may be allocated to irrigation, do not render the food and fibre option unfeasible.

To progress the irrigation option, the following would need to be undertaken:

- Consultation with the users of the Reserve to introduce the idea and hear their feedback.
- Consultation within CHW and with Council to discuss the concept and agree, in principle, roles and responsibilities.
- Agreement on a recycled water main alignment that considers factors like existing infrastructure, waterway crossing, geotechnical conditions, cultural heritage and ecological values.
- Confirm treatment requirements noting that recycled water produced by the WWTP has been reported to contain high levels of salinity. Treatment or ‘shandying’ with potable water may be required to ensure water is suitable for irrigation of the recreation reserve
- Determination of locations for proposed infrastructure, including an above ground storage tank.

Capital and operating costs estimate

The following cost estimate has been prepared that includes an offtake for recycled water at the treatment plant, a gravity main, storage and treatment. It is assumed that no pumping is required and that the scheme will connect to an existing irrigation network (therefore, irrigation is not costed). The cost rates are based on previous project experience.

An estimated cost of **$2.1 M** includes a 30% contingency and an allowance for design and site investigations (Table 4). Some high-level estimates of annual maintenance cost were made based on a percentage of capital cost for each asset class. This estimates a maintenance cost of approximately $23k per annum (Table 5). This only includes maintenance of identified assets and not an allowance for energy or the cost of the raw water.

Table 4. Capital cost estimate

Clunes Recreational Reserve_Recycled water				
Description	**Unit**	**Quantity**	**Rate**	**Amount**
Preliminaries				
General (site establishment)	Item	1	$5,000	$5,000
Site clearing	Item	1	$5,000	$5,000
Traffic management	Item	1	$10,000	$10,000
Recycled water diversion				
Install offtake	m	10	$200	$2,000
Diversion pit and screen	No.	1	$10,000	$10,000
Power supply	No.	1	$5,000	$5,000
Control panel	No.	1	$20,000	$20,000
Level sensors	No.	1	$2,500	$2,500
Shut off valve	No.	1	$2,500	$2,500
Gravity main				
Gravity main (within roadway)	m	5000	$250	$1,250,000
Storage				
Enclosed steel 225 kL tank	No.	1	$30,000	$30,000
Site preparation	No.	1	$5,000	$5,000
Connections	No.	1	$5,000	$5,000
Treatment				
UV treatment	Item	1	$45,000	$45,000
Filtration	Item	1	$10,000	$10,000
Sub – total				**$1,407,000**
Design (10%)				$140,700
Site investigations e.g. geotech, survey, service detection etc (10%)				$140,700
Contingency (30%)				$422,100
Total				**$2,110,500**

Table 5. Maintenance cost estimate

Maintenance					
Asset	Pipeline	Pump stations	Storage	Treatment	
Maintenance rate (as a % of capital cost)	1%	5%	5%	5%	
Sub-total	$ 1,000	$ 625	$ -	$ -	**$ 1,625**
30% contingency					$ 488
Total					**$ 2,113**

2.2 Other opportunities

Clunes bowling club
If the above scheme was progressed, it could be extended approximately 400m from the Recreational Reserve to the Clunes Bowling Club. It is estimated that the bowls club uses 1.7 ML of water each year. In estimating a cost of providing recycled water to the bowling club it is assumed:

- The 1.7 ML/year is used for irrigation
- Treatment (filtration and UV) takes place at the WWTP, so that all gravity fed water is fit for purpose
- The water is gravity fed to the bowling club
- That the water tanks at the bowling club can receive recycled water and that these tanks are connected to the bowling club's irrigation network.

It is recognised that the turf at the bowls club will be sensitive to water quality, and therefore the suitability of recycled water for that use would need to be investigated further.

A high-level capital cost based on these assumptions is provided in Table 6 below that estimates a capital cost of approximately $240k (including a 30% contingency) to extend that network.

Table 6. Bowling Club extension – Estimated capital cost

Clunes Bowling Club_Recycled water				
Description	**Unit**	**Quantity**	**Rate**	**Amount**
Preliminaries				
General (site establishment)	Item	1	$5,000	$5,000
Site clearing	Item	1	$5,000	$5,000
Traffic management	Item	1	$10,000	$10,000
Recycled water diversion				
Diversion pit and screen	No.	1	$10,000	$10,000
Power supply	No.	1	$5,000	$5,000
Control panel	No.	1	$10,000	$10,000
Level sensors	No.	1	$2,500	$2,500
Shut off valve	No.	1	$2,500	$2,500
Gravity main				
Gravity main (within roadway)	m	400	$250	$100,000
Storage				
Site preparation	No.	1	$5,000	$5,000
Connections	No.	1	$5,000	$5,000
Sub – total				**$160,000**
Design (10%)				$16,000
Site investigations e.g. geotech, survey, service detection etc (10%)				$16,000
Contingency (30%)				$48,000
Total				**$240,000**

Clunes caravan park
A third phase of this scheme could be the extension of a recycled water main to the caravan park that consumes 1.7 ML/year. It is assumed that much of this would be for showers and food preparation etc. If however there was a need for irrigation water at the park then a recycled water main could be extended 300m to it. This extension adopts the assumptions of the bowling club extension above, except that a storage would be required at the Caravan Park and is estimated to cost approximately **$230k**.

2.3 Priority rainwater harvesting opportunities

A number of rainwater harvesting opportunities were identified in Section 1.5.

It is suggested that as part of the roll out of any IWM Plan that rainwater harvesting be encouraged where possible and appropriate. In parallel with the recycled water investigation, it is proposed that individual rainwater harvesting concepts and costs be developed for the following sites as a priority:

- Clunes Recreation Reserve
- Clunes Bowling Club, and
- 38 Fraser St public toilets

Of particular interest is 38 Fraser St that is purported to use 1.4 ML/year. This would appear to be a high priority for rainwater harvesting however aerial photography suggests a rainwater tank exists at this site.

3 Next steps

Progressing potable water use reduction initiatives in Clunes will require:

- Engage with relevant sporting and community groups to understand if this opportunity is generally supported, and/or what additional information might be required.
- Investigation of the recycled water quality, particularly regarding salinity, to understand if 'shandying' or treatment is required to making this water fit for purpose.
- Undertake a preliminary design of a recycled water scheme to get a better understanding of asset locations, alignment and costs.
- If positive and approved, undertake further design and consultation with end users to make an assessment as to the value of extending the scheme to other end users like the bowling club or the caravan park. This could also be extended to the golf club if the scheme is successfully extended into the town centre.
- Undertake standalone rainwater harvesting audits for each high water using site.

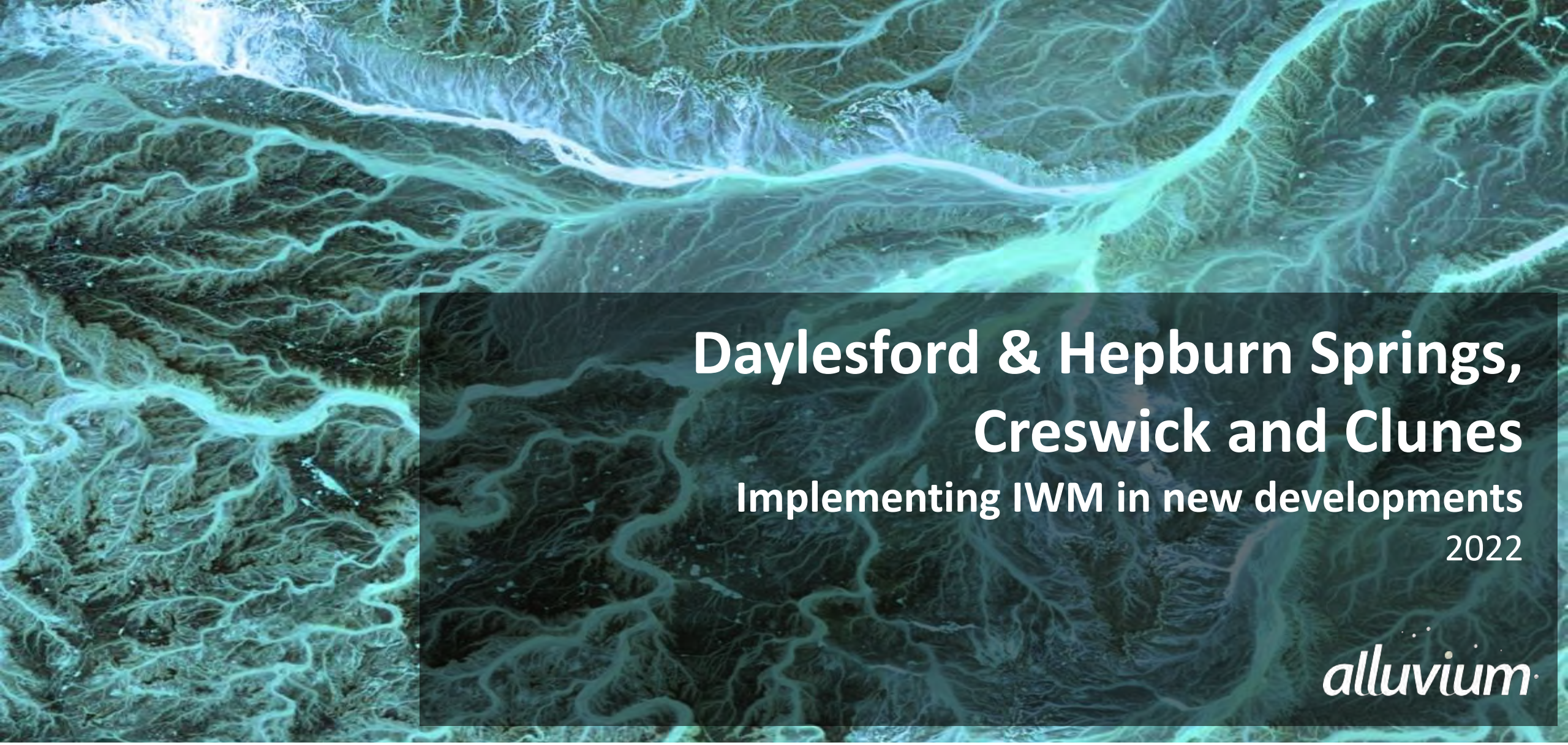
3.1 Creswick Creek

Other steps include reviewing the main body of the Daylesford & Hepburn, Creswick and Clunes IWM Plan to identify other relevant IWM opportunities for Clunes, specifically:

Creswick Creek urban waterway management strategy*: An urban waterway management strategy that sets out a long-term plan for the health and function of Creswick Creek and other Creeks in the area such as Kilkenny and Birches Creek.*

It is recommenced that this opportunity be progressed as an important opportunity for improvement in waterway health and collaboration with IWM stakeholders including Hepburn Shire, North Central CMA, GMW and Dja Dja Wurrung.

Attachment F. Implementing IWM in new developments



Daylesford & Hepburn Springs, Creswick and Clunes

Implementing IWM in new developments

2022

alluvium

CENTRAL HIGHLANDS WATER

Hepburn SHIRE COUNCIL

This document

Urban development impacts the water cycle in a number of ways. From additional demand for potable water to generating excess volumes of stormwater (with associated sediment and pollutants) and wastewater.

The Victorian Planning Provisions and Hepburn Shire Council's planning provisions specifically require developers to adopt an IWM approach to infill and greenfield residential developments.

Integrated Water Management (IWM) requires developers to consider all aspects of the water cycle and minimise the impact of urbanisation on the environment and community.

This document:

- Clarifies the content, intent and requirements of
  - The Hepburn Shire Council's Integrated Water Management Provisions and
  - The Victorian State Governments Planning Provisions as they relate to IWM.
- Provides developers with practical approaches and options for meeting these requirements.

Why adopt an IWM approach?

An IWM approach to urban development calls for developers to:

- Minimise impact on receiving waterways, lakes and bays
- Reduce potable (drinking) water demand
- Reduce the volume of stormwater reaching waterways (including by recharging local groundwater through stormwater infiltration)
- Creating greener and cooler urban environments with a high level of visual amenity that reduces the urban heat island effect.

Community advocacy for IWM in Daylesford

Victoria Planning Provisions

Clause 56.07 sets out the IWM requirements to be met for residential subdivision proposals in an urban area:

- Reduce the use of potable water (56.07-1)
- Encourage use non-potable water resources like rainwater (56.07-2)
- Minimise wastewater and manage disposal (56.07-3)
- Manage the quality of stormwater run-off (56.07-4)

Stormwater quality (What is BPEM?)

The required quality of stormwater run-off is defined under the *Urban Stormwater – Best Practice Environmental Management Guidelines (Victorian Stormwater Committee 1999)…or BPEM.* It requires the following reductions in pollutions levels:

- 80% reduction in the typical urban load of total suspended solids
- 45% reduction in the typical urban load of total phosphorous
- 45% reduction in the typical urban load of total nitrogen
- 70% retention of typical urban load of litter.

Initially, these requirements were applicable to residential settings. **Clause 53.18 – Stormwater management in urban development** has now extended that requirement to non-residential land use settings.

Hepburn Shire Council IWM provisions

- **What?** The Shire's planning provisions (Section 19.03-3S) define the objective of IWM as: 'sustainably manage water supply, water resources, wastewater, drainage and stormwater through an integrated water management approach'. The provisions include 7 requirements (see table below).
- The table includes an explanation as to **Why?** each is important.
- The following pages set out **How?** developers can respond to each

What?		Why?	Equivalent VPP Clause
1	Take into account the catchment context	To understand where flows are coming from and going to. And therefore, what you need to protect downstream as well as understanding what flows, pollutants etc are being generated upstream.	56.07-3 56.07-4
2	Protect downstream environments (waterways and bays).	The waterways, lakes and springs of the Hepburn Region are critical to its character. All urban development should be designed to protect those community and environmental assets.	56.07-3 56.07-4
3	Manage and use potable water efficiently	Reducing demand for drinking water to improve the resilience of local water supplies and delay the need for local, water supply system augmentations.	56.07-1 56.07-2
4	Reduce pressure on Victoria's drinking water supplies	To delay or avoid the need for water supply system augmentations at the State network scale (e.g. connections to other catchments or water supply schemes.	56.07-1 56.07-2
5	Minimise drainage, water or wastewater infrastructure and operational costs	Minimising community cost is always important. Council and developers need to think creatively about how to achieve IWM objectives affordably while creating an ongoing benefit for the community (e.g., through reduced water bills and cleaner waterways).	
6	Minimise flood risks	Urban development increases the volume of stormwater runoff and heightens the peak flowrate. Development must avoid creating additional floods risk for people and property downstream.	56.07-4
7	Provide urban environments that are more resilient to the effects of climate change	To reduce the urban heat effect that is created when paved and dark surfaces retain heat during hot weather. This can be achieved by increasing shade in streetscapes and open spaces.	

1 . Take into account the catchment context &
2. Protect downstream environments - Stormwater

In a residential sub-division, the volume of stormwater runoff needs to be reduced and treated to meet *Best Practice Environmental Management Guidelines (Victorian Stormwater Committee 1999).* The approach will depend on the scale of the development. The most commonly applied approaches include wetlands, biofilters, swales and raingardens.

Sub-divisions of greater than 10 Ha

Wetlands

Wetlands capture urban runoff within a defined drainage reserve at or near the bottom of the development's catchment before being released downstream.

Suitable for	Urban catchments of greater than 10 Ha (Melbourne Water's MUSIC Guidelines)
Design & function	The wetland is sized to meet the BPEM pollutions reduction targets using MUSIC modelling software. Stormwater meanders through wetlands for about 72 hours. The wetland retains sediment (through a sediment basin) and removes nutrients via sedimentation, vegetation uptake and denitrification (the conversion of nitrogen to gas)
Other benefits	Habitat Community asset (e.g., for walking, birdwatching, etc.) Contributes to reduced urban heat

Sub-divisions of less than 10 Ha

Precinct scale

Biofilters

Biofilters also capture surface run off and treat stormwater through both vegetation and filter media

Suitable for	Urban catchments smaller than 10 Ha (Melbourne Water's MUSIC Guidelines)
Design & function	Like wetlands, biofilters are sized to meet the BPEM pollutions reduction targets using MUSIC modelling software Stormwater is drain to the surface of the biofilter where it is evenly distributed. It soaks into the media where water is taken up by vegetation or drains to a sub-surface outlet.
Other benefits	Urban greening Improved street level aesthetic Contributes to reducing urban heat

Street scale

Swales and raingardens

At a street scale, swales and raingardens take road runoff, slowing and treating it before discharging to the conventional drainage network

Suitable for	Street scale stormwater capture and treatment
Design & function	Raingardens function in a similar way to biofilters – receiving surface runoff and removing pollutants via vegetation and filtration Swales are a simpler asset, using a grassed channel to slow and infiltrate stormwater. These may be suitable down the centre of a development's main 'boulevard', capturing road runoff.
Other benefits	Urban greening Improved street level aesthetic Contributes to reducing urban heat

1 . Take into account the catchment context &
2. Protect downstream environments - Stormwater

In a residential sub-division, the volume of stormwater runoff needs to be reduced and treated to meet *Best Practice Environmental Management Guidelines (Victorian Stormwater Committee 1999).* The approach will depend on the scale of the development. The most common and practical approaches are wetlands, biofilters, swales and raingardens.

Sub-divisions of greater than 10 Ha

→ Wetlands

Sub-divisions of less than 10 Ha

Precinct scale

→ Biofilters

Street scale

→ Swales and raingardens

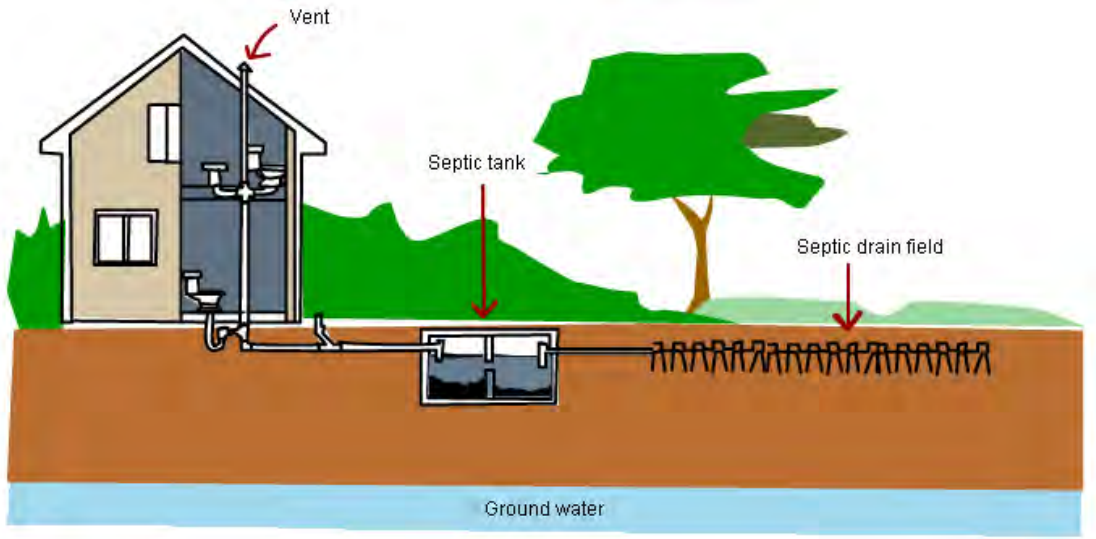
2. Protect downstream environments (Sewage)

The State Environment Protection Policy (SEPP) aims to ensure that all residential subdivisions are provided with reticulated sewer access at the time of subdivision. Where this is not possible, each lot must be capable of treating and retaining domestic wastewater within the allotment boundary.

In these cases, wastewater must be managed in accordance with the Shire's Domestic Wastewater Management Plan (DWMP) to minimise and downstream impacts.

Wastewater management aims to reduce the environmental, health and economic risks, to the council and the community, posed by domestic wastewater (DWMP, 2014).

Applies to	Domestic wastewater generated in new and existing developments and sub-divisions
Design & function	The Shire's DWMP (with the EPA's Septic Tank Code of Practice) is designed to: • comply with current on-site domestic wastewater legislation • minimise the impacts of domestic wastewater on human health and the environment • direct the management of current Onsite Wastewater Treatment Systems (OWTS). The key is to ensure septic tanks are installed where they are suitable and they comply with the DWMP, including undertaking a land capability assessment (LCA) that determines the site's ability to retain wastewater onsite.
Other benefits	Neighbourhood amenity (smell) Public health (wastewater in drains, lake bodies and waterways) Potential impact on groundwater



3. Manage and use potable water efficiently &
4. Reduce pressure on Victoria's drinking water supplies

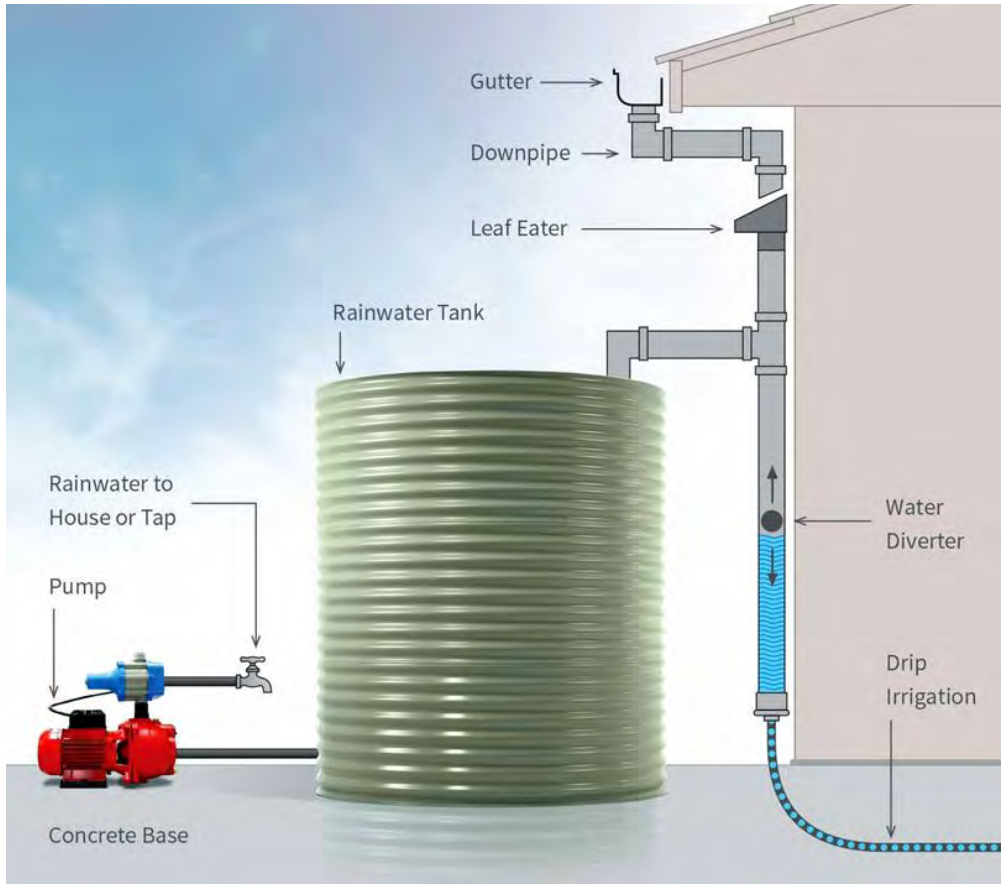
In a residential sub-division, the most space and cost-effective way for houses to reduce their water consumption through efficient water using fixtures and rainwater tanks. Efficiency is recognised as the cheapest way to save water, while rainwater provides a safe source of water that has catchment and waterway benefits as well as the resident (by reducing their water bills).

Water efficient fixtures - the following are recommended requirements for appliances in new residential sub-divisions using Water Efficiency Labelling and Standards (WELS)

Item	Recommended rating	Consumption or Flowrate (approx.)
Showerheads	4 star	6 litres per minute
Low flow taps	6 star	4 litres per minute (or less)
Toilets	4 star	3.5 litres per flush (average)
Dishwashers	6 star	9.5 litres per wash

Rainwater tanks capture roof runoff from household downpipes. The water quality is generally good, meaning rainwater can be used for toilet flushing, laundry and garden without further treatment.

Suitable for	All residential houses and larger roofs e.g., commercial and industrial areas.
Design & function	Rainwater tanks should be plumbed to internal fixtures (incl. toilet and laundry) to get the greatest water savings. The appropriate volume of a rainwater tank is based on local climate, desired end uses (likely demand) and available space. An appropriate volume can be modelled using MUSIC Typically, between 2 kL (min) and 5 kL is appropriate to supply toilet, laundry and garden.
Other benefits	Reduced overall water demand Reduced water bill If there is regular use, there will be storage space within the tank that can reduce downstream runoff volumes



5. Minimise drainage, water or wastewater infrastructure and operational costs

Council and developers need to think creatively about how to achieve IWM objectives affordably while ensuring an ongoing benefit for the community. Retrofitting IWM infrastructure can be prohibitively expensive. Therefore, it is critical that IWM principles be applied early in the planning process. Including IWM approaches at the master planning stage will ensure opportunities that can achieve multiple objectives are possible, and that sufficient development footprint can be set aside.

Early integration of IWM principles into infrastructure investment	
Suitable for	Greenfield and infill urban development, capital works programs, infrastructure renewal
Design & function	Urban developments should incorporate IWM requirements that can then promote liveability, amenity and sustainability outcomes such as reduced water bills (through rainwater tanks), green & cool streets and waterway protection as a value proposition. Large infrastructure projects such as road renewal or drainage renewal offer an opportunity to investigate stormwater treatment or harvesting works. Costs are more affordable if undertaken during construction or with other works.
Other benefits	Capacity building across Council departments (e.g., wetland construction requires collaboration across engineering, biodiversity and open space). Achieving multiple outcomes from infrastructure projects and gaining community support for positive environmental initiatives Potential of opening up IWM funding streams (e.g., with water authority or State Government).

Cosgrave Reservoir

6. Minimise flood risks

Urbanisation increases stormwater volume and peak flowrates. During larger events this can increase the risk of flooding downstream. Under the Victorian Planning Provisions, Council can require that the post development flowrate is equivalent to predevelopment. Interventions can also be required is the downstream drainage system does not have the capacity to accept higher peak flowrates.

Retarding or Detention basin (large developments)	
Suitable for	Larger residential developments that are upstream of flood prone or high-risk areas.
Design & function	Retarding basins are essentially airspace that receive and contain flows during large rainfall events They are typically designed to ensure that pre and post development flows are equivalent for the 1% Average Exceedance Probability rainfall event. They can require a significant footprint.
Other benefits	Retarding basins can be used to house stormwater treatment assets like wetlands There can also be opportunities to house community open space, understanding that any fixtures will be inundate during a flood event.

Stony Hill Creek retarding basin, Courtesy of Melbourne Water

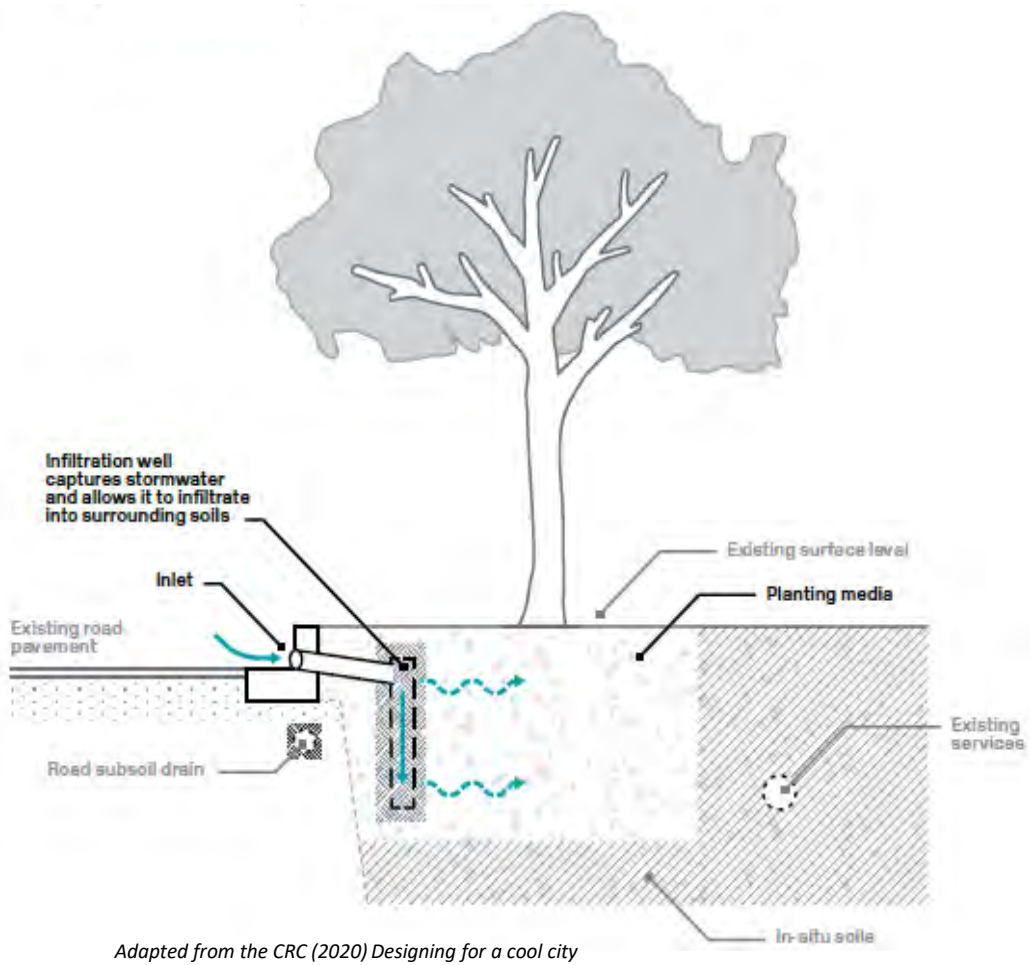
On-site stormwater detention (small developments)	
Suitable for	Smaller multi-lot and infill development where the existing drainage system cannot accommodate an increase in stormwater flowrate.
Design & function	On-site Stormwater Detention (OSD) is on-site storage with sufficient capacity to hold an agreed volume of runoff e.g., up to the 1 % AEP event. This needs to be confirmed by Council. They can be above ground (if levels allow), or below ground (as per the image) The storage will have a flow control device that limits discharge to the agreed flowrate The storage delays release of flows effectively delaying the peak.
Other benefits	OSD can be incorporated into rainwater tanks by providing a ‘leaky’ outlet, that maintains a consistent volume of airspace to receive additional flows.

Sub-surface storage example

7. Provide urban environments that are more resilient to the effects of climate change

Increased imperviousness associated with urbanisation (i.e., roads, roofs and paths) can contribute to warmer microclimates during summer as well as retention of that heat overnight. New developments can respond with shade, evapotranspiration and soil moisture to mitigate these impacts. Stormwater in particular, can be diverted to passively irrigate street trees.

Passive irrigation of street trees	
Suitable for	Residential streetscapes and community open spaces (including grassed and paved areas)
Design & function	There are several different design approaches to passively irrigate street trees The CRC for water sensitive cities has produced “Designing for a cool City: Guidelines for passively irrigated landscapes” provides examples and illustrations. An approach utilising infiltration trench and pit is illustrated on the right Council can review and approve a number of approaches to enable flexibility for developers to respond to local conditions.
Other benefits	Increased soil moisture Great rate of tree growth, and therefore quicker to reach desirable tree canopy cover (shade) Enhances local biodiversity Reduces stormwater runoff and increases infiltration



Adapted from the CRC (2020) Designing for a cool city

Further information & links

Best-Practice Environmental Management Guidelines (CSIRO, 1999)
https://www.publish.csiro.au/book/2190/

Urban stormwater management guidance (publication 1739), (EPA, 2021)
https://www.epa.vic.gov.au/about-epa/publications/1739-1

Victoria Planning Provisions (VPP) Clause 56
https://www.planning.vic.gov.au/permits-and-applications/specific-permit-topics/residential-development/accordion-pages/residential-subdivision-provisions

Clause 56.07 - Integrated water management practice note
https://www.planning.vic.gov.au/__data/assets/pdf_file/0030/97176/PPN39-Using-the-Integrated-Water-Management-Provisions-of-Clause-56-Residential-Subdivision.pdf

Example of Guidelines for Onsite stormwater detention (Melton City Council, 2009)
https://www.melton.vic.gov.au/files/assets/public/services/building-planning-amp-transport/engineering/infrastructure-planning/on-site_stormwater_detention_guidelines.pdf

Guidelines for passively irrigated landscapes (CRC for Water Sensitive Cities, 2020)
https://watersensitivecities.org.au/content/designing-for-a-cool-city-guidelines-for-passively-irrigated-landscapes/

Hepburn Shire Domestic Wastewater Management Plan
https://www.hepburn.vic.gov.au/wp-content/uploads/2015/05/Hepburn-Shire-DWMP-December-2014.pdf