



*Falls Creek Alpine Resort:
Integrated Water Management Plan (Final)*

June 2025



Three
Seeds



Traditional Owners

We acknowledge Dhudhuroa, Waywurru, and Jaithmathang as First Peoples with connection to Country that includes Falls Creek Alpine Resort. First Peoples language, knowledge and concepts referenced in this document remain the cultural and intellectual property of those First Peoples.

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Falls Creek Resort. Source: Visit Victoria (<https://www.visitvictoria.com/see-and-do/outdoor-and-adventure/snow-and-skiing/falls-creek>)

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Executive Summary

This Integrated Water Management (IWM) Plan establishes a framework for managing water and water systems at Falls Creek Alpine Resort over the next 20 years. It has been prepared to support the economic viability and ecological and cultural values of the resort in a changing climate.

The plan addresses water supply (including snow making), stormwater management, wastewater treatment, and environmental water. It has been developed in consultation with resort stakeholders and informed by ARV's ongoing engagement with Traditional Owners.

Resort Context

Falls Creek Alpine Resort is located in the Bogong High Plains within the Victorian Alps, at the top of the Upper Kiewa river catchment which ultimately flows to the Murray River. The Bogong High Plains area is significant to the Traditional Owners, including Dhudhuroa, Waywurru and Jaithmathang, with ongoing negotiations for formal recognition under State and Federal legislation.

The resort covers 1,550 hectares at elevations ranging from 1,210 to 1,850 metres, surrounded by Alpine National Park. It is Victoria's only ski-in ski-out village with the largest land area above the snow line of all Victorian alpine resorts.

Falls Creek attracts 435,492 winter visitor days with daily peaks of up to several thousand on weekends, and 89,838 summer visitors. The resort features 450 hectares of skiable terrain with 14 lifts and snowmaking infrastructure covering 120 hectares. There are extensive areas for cross-country skiing and green season mountain biking trail networks.

The local environment includes critical alpine peatlands and wetlands that purify and regulate water flow, store carbon and provide habitat for rare and

threatened species including spot-tailed quoll, mountain pygmy possum, bogong moth, skinks and stoneflies.

Water Context

Falls Creek Alpine Resort is unique among Victorian alpine resorts in having access to Rocky Valley Dam, a 28 GL storage built in 1959 for the Kiewa Hydroelectric Scheme and operated by AGL. The resort holds a licence to extract up to 1,500 ML per year from the dam with no seasonal or daily restrictions. However, water quality and temperature issues can result in this supply being unsuitable for potable water and snowmaking.

Three groundwater bores (two vertical and one horizontal with a combined allocation of 200 ML / year) are the primary source of potable water, with Rocky Valley Dam providing a supplementary potable supply during the peak winter demand. The resort typically uses approximately 290 ML per year (150 ML potable water, 140 ML snowmaking) – a small fraction of its annual licenced capacity.

Extensive snowmaking infrastructure, including over 200 snow guns covering key ski runs and resort areas, is operated to supplement natural snow using water from Rocky Valley Dam. There is considerable ongoing investment in snowmaking infrastructure and equipment to improve efficiency, respond to climate change impacts and continue providing visitors with a ski-in ski-out experience.

Wastewater is treated using biological nutrient removal aerobic processes and UV disinfection before being discharged to Rocky Valley Creek catchment under an EPA waste discharge licence.

Climate Context

Victoria's alpine resorts all face significant challenges from climate change, which is altering key environmental and economic conditions.

Key changes for Falls Creek include:

- declining snowfall and natural snow depth
- decreasing annual precipitation
- rising temperatures
- reduced hours suitable for snowmaking with snow guns
- increased risks of bushfire and extreme weather events.

Despite having access to substantial water allocations, the effectiveness of snowmaking depends on suitable weather conditions, water quality, and energy costs. Climate change is reducing the weather windows suitable for snowmaking with snow guns, increasing reliance on more weather-independent snow factories.

Cultural Context

Multiple Traditional Owner groups represent First Peoples with connection to the Falls Creek area. This includes Dhudhuroa Waywurru Nations, Dhuduroa Dhargal, Jaithmathang TABOO and Jaithmatang TO.

Documented Traditional Owner knowledge reflects a holistic approach to cultural rights and responsibilities, emphasizing the interconnectedness of land, water and people. This IWM plan draws on Traditional Owner principles and perspectives and support future partnerships linked to implementation of this IWM Plan and aligned ARV's Traditional Owner Engagement and Self-Determination Strategy.

Water Management Options

The IWM plan evaluated 18 options with stakeholder input and analysis refining these to 11 priority recommendations for implementation or further investigation across three categories.

Good Water Management

1. Building cultural understanding and two-way knowledge sharing with Traditional Owner groups
2. Water metering and leak detection
3. Water efficiency (buildings and snowmaking)
4. Maintenance (all core water infrastructure)
5. IWM reporting covering all aspects of resort water management

Stormwater and Environment

6. Stormwater filtering (car park trial)
7. Stormwater harvesting (feasibility)
8. Rainwater harvesting (pilot project)

Future Water Resilience

9. Snowmaking capacity upgrade (feasibility)
10. Additional treatment of Rocky Valley Dam water (feasibility)
11. Alterations to Rocky Valley Dam offtake arrangements (feasibility).

Additional groundwater bores, wastewater recycling were not pursued as other options were perceived to deliver greater benefits across multiple IWM outcomes. Pumped hydro-electricity may be considered in partnership with AGL.

Strategic Alignment

The recommended options align with ARV's strategic objectives (investment, environment, visitors, reform, progress, and people) and the Victorian Government's IWM outcomes. The options seek to:

- enhance water security through improved access to Rocky Valley Dam and diversified supply options
- protect downstream ecosystems and alpine peatlands through better stormwater management
- recognise Traditional Owner values and support cultural land management initiatives
- improved visitor experience through reliable water services and consistent snow coverage
- build resilience to climate change impacts through adaptive snowmaking infrastructure and alternative water sources
- support more sustainable and efficient water use across all resort operations.

Implementation is contingent on ARV priorities, available resources (including grant funding), regulatory requirements, and stakeholder support.

Action Plan

Suggested actions based on priority recommendations are summarised below.

Immediate / Current

- Continue developing relationships with Traditional Owner groups to build cultural understanding and knowledge sharing opportunities

Short-term (1-3 years)

- Implement comprehensive water metering, leak detection and water efficiency improvements; continue water network maintenance
- Investigate stormwater management and filtering options at car
- Consider feasibility of stormwater harvesting and rainwater harvesting
- Investigate options to improve the quality and temperature of water extracted from Rocky Valley Dam

Medium-term (4-10 years)

- Investigate options to increase snowmaking capacity through pump upgrades

Long-term (10+ years)

- Reassess the potential of additional groundwater bores and wastewater recycling as alternative water supplies
- Review the appropriateness/resilience of Rocky Valley Dam as a water supply source in the context of hydroelectric operations.

1 Introduction

1.1 Purpose of this plan

The purpose of this plan is to provide a comprehensive framework for managing water resources at Falls Creek Alpine Resort (referred to in this report as Falls Creek) in a way that balances environmental sustainability, social needs, and economic considerations. By integrating diverse aspects of water use—supply, wastewater, stormwater, and environmental flows—the plan seeks to optimize the overall performance of water systems while addressing challenges like climate change, visitation growth, and resource scarcity. It promotes collaboration among stakeholders to align goals and actions. Ultimately, this plan aims to ensure the long-term availability and quality of water, protect ecosystems, enhance resilience, and support resort function in a coordinated and efficient manner over the next 20 years.



1.2 Overview of Falls Creek Alpine Resort

Falls Creek is located in the Bogong High Plains within the Victorian Alps, 375 kilometres (5 hours) from Melbourne. This area is significant to Traditional Owners, including Dhudhuroa, Waywurru and Jaithmathang. Information on First Peoples water-related connections to this area is documented in *Integrated Water Management in North East Victoria’s Alpine Region*.¹

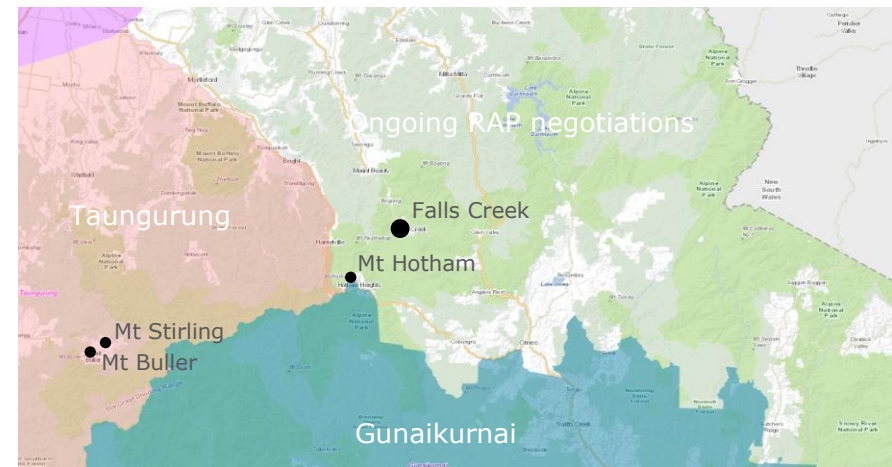


Figure 1. Alpine Resorts in North East Victoria and Registered Aboriginal Party (RAP) areas (Source: Victorian Aboriginal Heritage Register and Information System, annotated with Victorian Alpine Resorts)

The resort is situated on Crown Land, surrounded by the Alpine National Park and supports alpine and sub-alpine ecosystems connected to the broader area. This includes alpine peatlands that purify and regulate water flow, store carbon and provide habitat for rare and threatened species. The area is home to a range of threatened and endangered fauna including the spot-tailed quoll, mountain pygmy possum, bogong moth, skinks and stoneflies.²

¹ Three Seeds (2025). *Integrated Water Management in North East Victoria’s Alpine Region*.

² Falls Creek Alpine Resort Management Board (2022). *Environmental Management Plan*.

The land, water and skies are of great significance to First Peoples of North East Victoria's alpine region. Everything here has been created by ancestral beings, the signs of which are deeply intertwined with all aspects of existence. For countless generations, to coincide with the annual bogong moth migration, Nations from around Victoria would travel to the alpine peaks to take part in ceremonies, feast on the nutritious moth, trade, settle disputes and perform marriages.

Alpine Shire: Bright and Surrounds - First Peoples²

Falls Creek covers an area of 1,550 hectares with an altitude ranging from 1,210 to 1,850 metres. The resort area extends to Mt McKay, the highest peak on the Plateau. It has the largest land area above the snow line of all of Victorian alpine resorts and is Victoria's only ski-in ski-out village.⁴

The resort has a high number of ski runs suitable for intermediate skiers during the white season, as well as a large toboggan slope and snowplay zone. There is a well-developed cross-country trail system and backcountry skiing options at Mt McKay. Snowshoeing, skidoo rides and fat biking are also offered.⁵



Figure 2. Falls Creek Ski and Snowboard Trails Map (Source: Falls Creek Alpine Resort)

³ Alpine Shire: Bright and Surrounds - First Peoples (visitbright.com.au/things-to-do/arts-and-culture/museums-and-history, accessed January 2025)

⁴ Urban Enterprise (2021). *Victorian Alpine Resorts Visitor Economy Development Plan*.

⁵ Ibid.



Figure 3. Falls Creek Cross Country Trails Map (Source: Falls Creek Alpine Resort)

In the green season, Falls Creek provides a base for activities including hiking (via a wide variety of walking trails), mountain biking and road cycling.

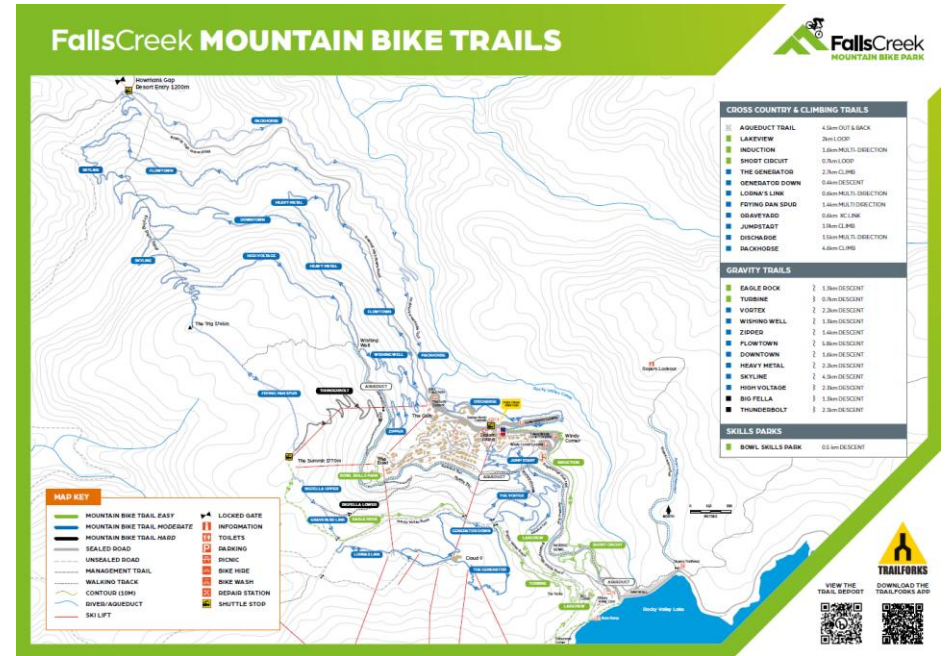


Figure 4. Falls Creek Mountain Bike Trails Map (Source: Falls Creek Alpine Resort)



Figure 5. Falls Creek Hiking Trails Map (Source: Falls Creek Alpine Resort)

Table 1. Falls Creek Profile

Statistics	Values
Winter Visitation (2024)	435,492 visitor days
Summer Visitation (2021/22)	89,838 visitors
Resort Size	1,550 ha
Resort Altitude (Village)	1,600 metres
Distance from Melbourne	375 km
Food establishments	35
Accommodation (beds)	5,100
Cross-country skiing	65 km
Snowmaking terrain	120 ha
Skiable terrain	450 ha
Lifts	14
Road cycling*	30 km
Mountain biking*	45 km
Walking*	45 km

* including sections of road / trail beyond the resort

Source: Urban Enterprise (2021)⁶, ARV (2025)⁷

⁶ Urban Enterprise (2021). *Victorian Alpine Resorts Visitor Economy Development Plan*.

⁷ ARV (2025). *Visitation statistics*.

Water plays a critical role at Falls Creek, particularly in supporting the resort's operations and environmental sustainability. The resort relies on water for snowmaking to maintain the resort's ski terrain and provide a consistent ski experience throughout the winter season. Water is also vital for various operational and recreational purposes, including water supply for guests, food preparation, and cleaning.

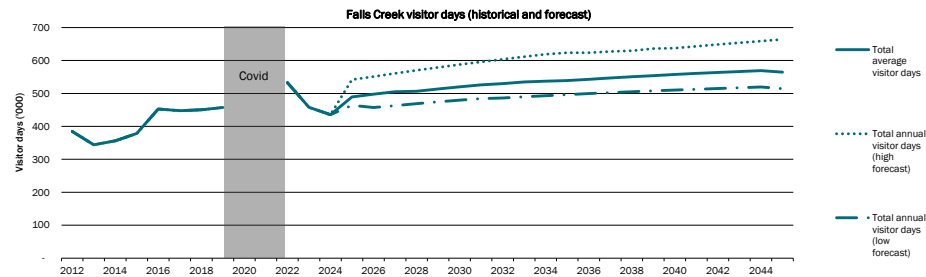


Figure 6. Historic and Projected Total Number of Visitor Days under different snow scenarios (data provided by Centre for International Economics, 2024 and ARV, 2025).⁸

The economic viability of the alpine resorts are under pressure as a result of climate change and increasing climate variability. Without adaptation, shorter snow seasons and reduced winter visitation will impact winter season activities, making diversification and year-round operations increasingly important. Figure 6 shows historic and projected visitor days for Falls Creek under different scenarios (average year, low snow year, and high snow year), assuming an adaptation scenario where half of the natural snow reduction from climate change is alleviated through snowmaking.⁹

With snowmaking, visitor days are projected to increase or remain similar to historic visitor days. Visitation projections do not incorporate alternate snowmaking scenarios to reflect advances in snowmaking technology.

“Upgrades are necessary to ensure the resilience and reliability of the snowmaking operations. However, there comes a threshold in how much you invest in infrastructure in the context of declining [natural] snow.”

Workshop 2 participant

⁸ ARV, 2025. 2024 Winter Visitation Statistics.

⁹ Centre for International Economics. (2024). *Carrying Capacity of Victorian Alpine Resorts: Preliminary Draft Report*.

1.3 History of snow depth at the resort

Daily snow depth data has been recorded at the resort since 1993, providing an excellent basis for understanding changes in climate and the impact on water management. The chart below shows snow depth for each season since 1988 together with the long-term snow depth trend. It is rare for the snow depth to exceed to get more than 2 metres. Snow depth constantly varies in response to snow-producing cold fronts, snowmaking, rain, wind and warm weather.

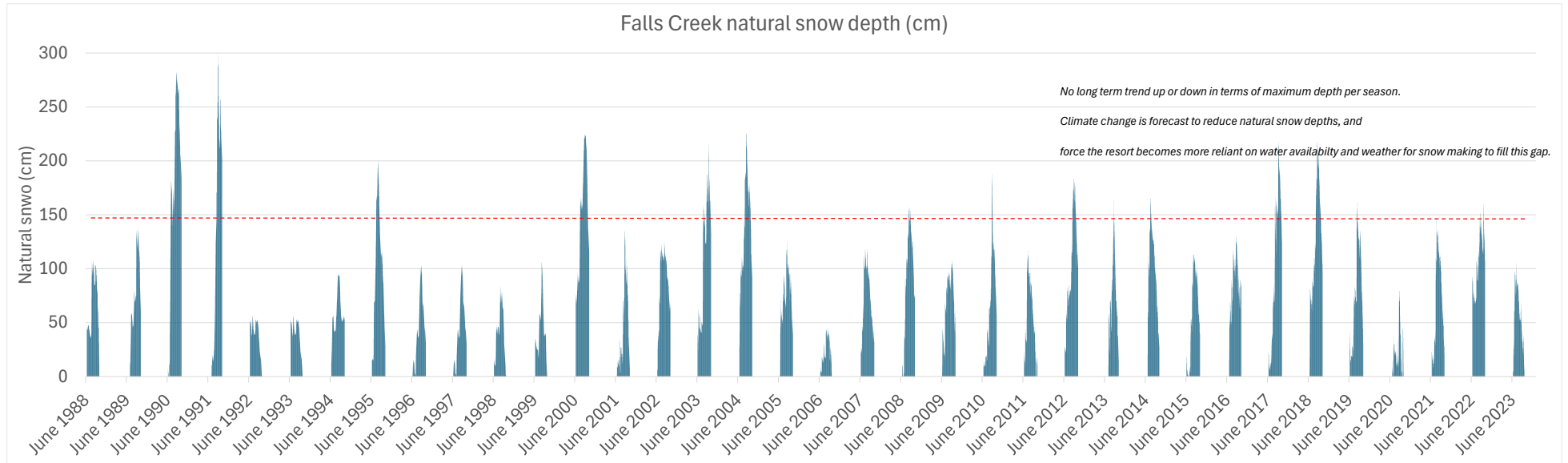


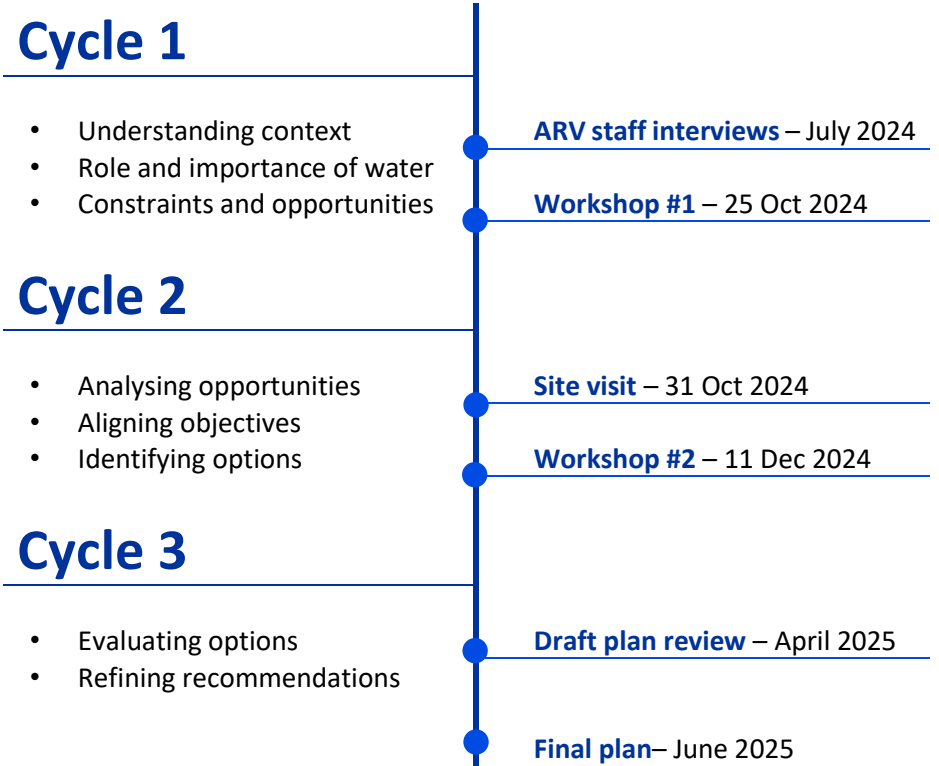
Figure 7. Snow depth at Falls Creek Alpine Resort (1988-2023).

1.4 Water planning approach

An iterative process was used to understand the resort’s water and environmental context, identify potential opportunities, and evaluate options (see figure to the right). Wave Consulting visited the resort with ARV staff to assess existing infrastructure and ground-truth potential opportunities.

Wave Consulting worked with ARV and Falls Creek stakeholders to understand and explore the resort’s water-related context, aspirations and challenges through a series of informal interviews, online workshops and feedback on the draft plan. An initial workshop focused on understanding the role of water, and constraints and opportunities associated with water management at the resort. A second workshop identified and critiqued potential options that form the basis of options presented in this plan . Workshop outcomes are presented in the Appendix.

Stakeholders engaged in the development of this plan include DEECA, Goulburn Murray Water, North East Water, Vail Resorts, and North East Catchment Management Authority. Traditional Owners were not directly involved in water planning for Falls Creek; however, cultural considerations and associated water-related opportunities were identified with reference to relevant Traditional Owners Country Plans, strategies and other information. ¹⁰ ARV are also engaging with Traditional Owners of North East Victoria to develop a Traditional Owner Engagement and Self-Determination Strategy.



¹⁰ Three Seeds (2025). *Integrated Water Management in North East Victoria’s Alpine Region*.

2 Water context

2.1 Waterway Catchments

Falls Creek is situated at the top of the Upper Kiewa river catchment which ultimately flows to the Murray River. The location of the resort within its surrounding catchments and in relation to the Great Dividing Range is shown in Figure 8.

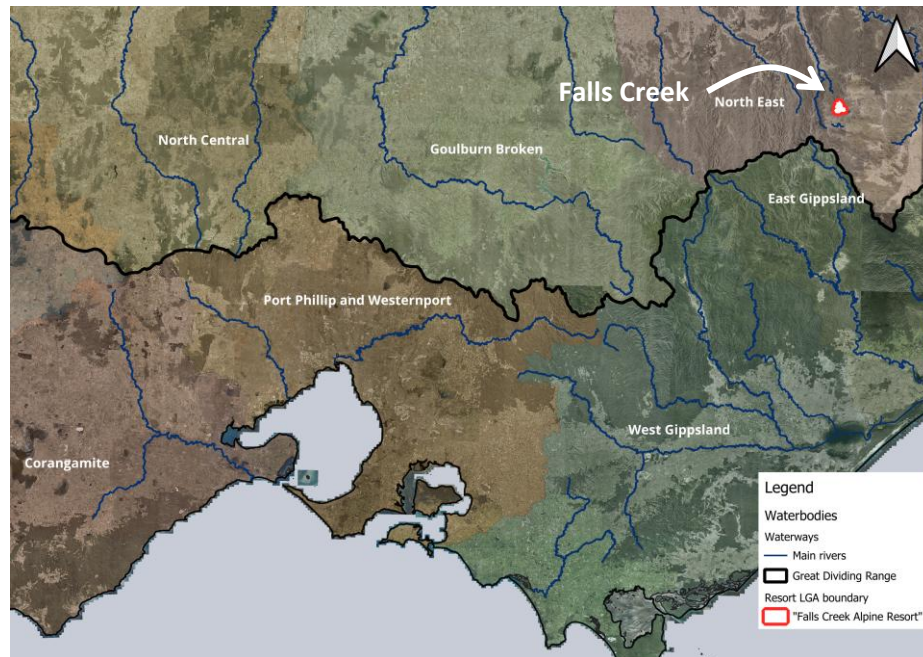


Figure 8. Falls Creek Alpine Resort and surrounding catchments.

The resort is situated within a unique and ecologically significant ecosystem and is surrounded by the Alpine National Park. The combination of porous soils, ground water systems, vegetation that can hold water, and the formation of snow and ice, mean the Alps have an important role in holding water and regulating its release throughout the year. Alpine peatlands and wetlands (distributed throughout the Resort, including along Frying Pan Spur, in the Sun Valley area and within the village) play an important role in water quality and regulating the release of water to the downstream catchment.¹¹

The Falls Creek Environmental Management Plan guides best practice environment management and continuous improvement in environmental outcomes. It outlines legislation and strategies relevant to environmental protection and management, and environmental aims related to:

- protecting and enhancing biodiversity and threatened species
- minimising environmental impacts associated with waste and resource consumption
- effective water and catchment management supporting healthy waterways and associated ecosystems
- managing land use, development and recreational activities in a manner compatible with Falls Creek's unique environment
- being a leader in emissions reductions, energy efficiency and renewable energy use.¹²

¹¹ Falls Creek Alpine Resort Management Board (2022), *Environmental Management Plan*.

¹² Ibid.

From a water planning perspective, relevant provisions under the Planning and Environment Act 1987 and underlying planning schemes relate to:

- biodiversity conservation (no net loss)
- protection and conservation of environmentally sensitive areas
- habitat preservation and enhancement for threatened species
- native vegetation management
- sustainable development / development compatible with environmental values.¹³



Figure 9. Falls Creek downstream of the resort.

¹³ DEECA (2025). Pers. comms. via email (feedback on draft IWM Plan), 23 May 2025.

2.2 Water Infrastructure

2.2.1 Water Supply

The water supply system at Falls Creek consists of multiple elements designed to provide a reliable and safe water source for the resort. Water from Rocky Valley Dam and three separate groundwater sources (two vertical production bores and one horizontal bore) supply water to an accumulation tank which transfers water through a calcite filtration system to manage pH levels before entering a header tank. The system also includes two 1.5 ML water storage tanks located above the village and two Wedeco Spektron 250e UV disinfection units. Approximately 4 km of ductile iron concrete-lined (DACL) pipes distribute the treated water.

During the peak winter demand, water is drawn from an intake at Rocky Valley Dam and pumped to two settling tanks that help remove suspended solids, before being directed via a pipeline or gravity main to the 1.5 ML tanks. This surface water supply is typically inactive between September and May, the main summer period.¹⁴ However, water from Rocky Valley reservoir provides a water source for firefighting.¹⁵

¹⁴ Alpine Resorts Victoria (2022). *Drinking Water Quality Annual Report, 2022 – 2023*.

¹⁵ Falls Creek Alpine Resort Management Board (2022), *Environmental Management Plan*.

2.2.2 Rocky Valley Dam

Falls Creek Alpine Resort is the only alpine resort in Victoria storage with access to a large water storage for potable water use and snowmaking.

Rocky Valley Dam was built in 1959 for the Kiewa Hydroelectric Scheme¹⁶, and is now operated by AGL as part of their hydroelectric operations. This storage supplies water to four power stations and is part of the largest hydroelectric scheme in Victoria, with an average annual output of 404 GWh¹⁷.

The dam has a storage capacity of 28 GL, and Falls Creek has a licence to extract 1,500 ML per year, with no seasonal or daily restrictions.¹⁸ While the resort has access to a significant volume of water from Rocky Valley Dam it is not always able to use it due to:

- Water temperature issues, and
- Water quality issues.

Falls Creek typically uses approximately 290 ML per year from Rocky Valley Dam for potable water uses and snowmaking. Despite the large water allocation (relative to use), the temperature and quality issues meant the resort needed to secure other water supplies and has installed groundwater bore to supplement potable supplies.

IWM initiatives are critical to providing a diversity of supply options, secure water supplies, and improve the social, environment and economic values through wastewater, groundwater and stormwater / rainwater related projects.

¹⁶Victorian Collections, 2025. Photograph Rocky Valley Dam Excavations, Rocky Valley Dam Wall Excavation, c1947-48.

¹⁷AGL, 2025. Hydroelectric Power Stations.

¹⁸ Alpine Resorts Victoria (2022). *Drinking Water Quality Annual Report, 2022 – 2023*.



Figure 10. Rocky Valley Dam (Source: Wave Consulting Australia)

2.2.3 Wastewater

The wastewater treatment plant at Falls Creek operates year-round using a biological nutrient removal aerobic process, effectively removing nitrogen and phosphorus to high standards. Treated effluent is discharged into the Rocky Valley Creek catchment, while activated sludge is removed from the resort during the summer months. Final disinfection is achieved through high-intensity UV treatment. The plant operates under an Environment Protection Authority (EPA) waste discharge licence, which sets limits for key parameters that are tested monthly.¹⁹

2.2.4 Snowmaking

Falls Creek has developed extensive snowmaking infrastructure, included over 200 snow guns, to ensure consistent snow coverage and enhance the guest experience throughout the snow season. In 2021, the resort invested \$1.88 million in snowmaking and grooming equipment; this upgrade included the installation of automated TechnoAlpin snow guns along Wombats Ramble, Main Street, and at the base of Drovers Dream.²⁰ Additionally, a significant upgrade is underway on the Drovers Dream run, a popular area for beginner and intermediate skiers. This project involves the installation of 12 new Techno Alpin automated snow guns, replacing older equipment to maximize snow production.²¹

There is an ongoing movement in the industry, including at Falls Creek, to adapt and transition snow making infrastructure in response to climate change. The use of more efficient snow guns, more sensors to calibrate and target snow production, and the installation of snow factories will continue to in response to changing climate impacts and to support the resort's objectives of a ski in and ski out resort experience.

¹⁹ Falls Creek Alpine Resort Management Board (2022). *Annual Report 2022*.

²⁰ Falls Creek Ski Lift Pty Ltd (2021). "Falls Creek Invests \$1.88 Million in NEW Snowmaking Upgrades!"

²¹ Falls Creek Ski Lift Pty Ltd (2025). "Major Snowmaking Upgrade on Drovers Dream!"

Falls Creek sources water for snowmaking from the Rocky Valley Dam.



Figure 11. Snow guns on the resort runs



Figure 12. Snow guns on the resort runs

2.3 Water Demand

Water demand data and patterns are a function of the seasonal nature of visitation, weather patterns, and water use by facilities and accommodation across the resort. Metering is critical to accurately assess water demands at a

macro scale, and submetering and individual meters is required to understand water use in different locations and for different purposes. Water demand correlates with the wastewater treatment plant inflows.

Resort visitation data, local rainfall records, nearby weather (temperature, humidity, wet bulb, and wind direction and speed at an hourly interval) was used to create a demand profile for the two main uses of water:

- Potable water for all accommodation, toilets, buildings, administration and workshop
- Snowmaking production

Indicative monthly water use is shown in the figure below, noting that annual water use patterns fluctuate based on weather, visitation rates, water leaks, and other climate variables.

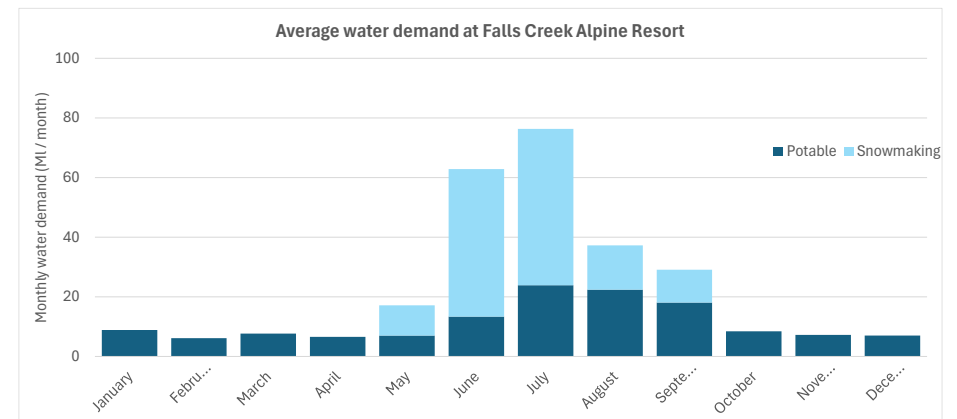


Figure 13. Monthly water demand pattern

2.4 Water Balance

A water balance represents the average flow of water through a geographic area, and highlights the complexity of the different water uses, diversions, runoff relationships, and end uses of all sources and discharges of water. The Falls Creek water balance was calculated using a variety of models and data

sets to create the best estimate of how much water is associated with different resort areas and activities (refer Figure 14).

Most of the water falling on the resort (as rain and snow) is intercepted by vegetation and returns to the atmosphere via evapotranspiration. Access to Rocky Valley Dam (with a combined diversion licence of up to 1,500 ML / year) is an important part of the Falls Creek water balance. Impervious runoff from the buildings and several car parks and natural snow melt are relatively large discharges from the resort, compared to wastewater treatment and discharge to Rocky Creek.

Resort operations are not constrained by access to raw water and storage (due to the scale Rocky Valley Dam and associated allocations). However, water quality of various sources and the temperature of water extracted from Rocky Valley Dam are constraints.

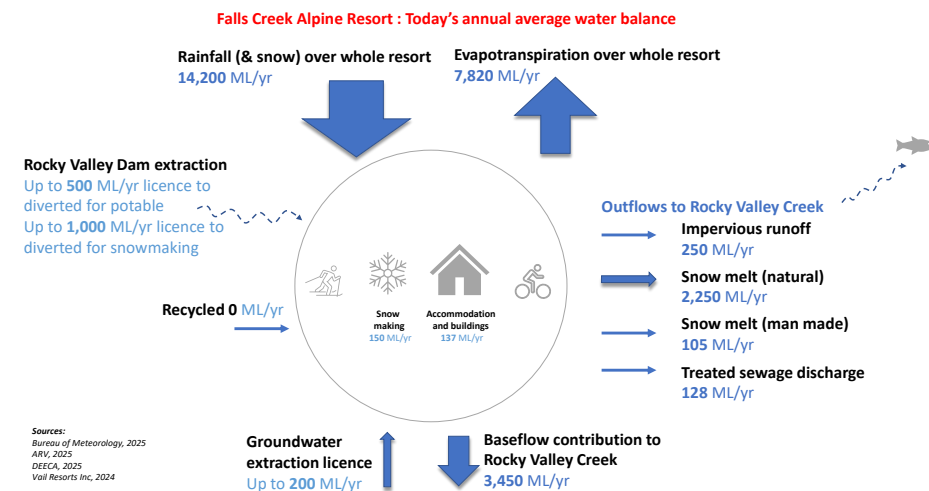


Figure 14. Falls Creek water balance

²² Nation Partners (2024). *Summary of Climate Change Science and Impacts*. Prepared for Alpine Resorts Victoria. Version 3.0, 11 July 2024. Melbourne, VIC.

2.5 Climate Context

Victoria’s alpine resorts, including Falls Creek, face significant challenges from climate change, which is altering key environmental and economic conditions. Over the past 70 years, snowfall has decreased, with the snow season now starting later and ending earlier. By 2070-2099 relative to 1961-1990, under a high emissions scenario (RCP8.5), snowfall decline at Falls Creek is projected to be around 79%.²²

“Conventional water management makes the resort vulnerable in a changing climate.”
Workshop 1 participant

Snowmaking technology will be critical for sustaining winter tourism, but its effectiveness depends on future water availability and energy costs. An overall decline in Spring rainfall by 22% in 2040-2059 under high emissions scenarios in the Ovens-Murray region may limit water supply for snowmaking. Earlier snowmelt could also reduce water storage capacity, affecting both ski operations and environmental water flows. Whilst average rainfall may decline, projected changes in heavy rainfall events are mixed with large uncertainties; projections suggest a decline in daily rainfall intensity of up to 9% for events with a 20-year recurrence interval for a high emissions scenario but an increase of 3% for a medium emissions scenario.²³

While average annual rainfall is expected to decrease in the ARV alpine regions, there is also indication that drought durations may see an increase at Falls Creek. At the same time, average daily maximum temperatures for both summer and winter are projected to increase on the historic average. Minimum winter temperatures are modelled to increase at Falls Creek by 1.6°C by 2050 under a high emissions scenario and summer average daily

²³ Ibid.

maximum temperatures are expected to increase by 2.5°C.²⁴ This warming accelerates snowmelt, shortens the snow season, reduces snowmaking efficiency, and increases bushfire risk.

Figure 15 (following page) illustrates how the climate is forecast to change, with a focus on minimum and maximum temperatures, often with more change in the alpine area than other areas of the state. A temperature increase of 5 or 6 degrees would significantly alter the snow coverage, depth and overall visitor experience.²⁵

This appreciation of climate change and the associated impacts on all alpine resorts that is described above, is consistent with the Victorian Climate Change Strategy that the Victorian Government published in early 2025²⁶. In Chapter 5 of this strategy (“A climate resilient Victoria”) the following themes are central to the adaption strategy.

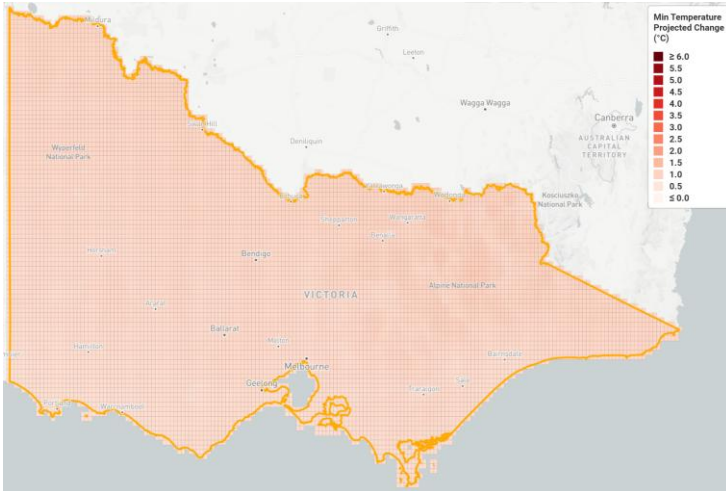
- Emergency management and disaster preparedness
- Built environment and infrastructure
- Industries and livelihoods
- Communities and regions
- Biodiversity, ecosystems and natural resources

Smarter water management that enables and supports the activities and economy in the alpine environment will draw on all these themes and it will be prudent to work closely with any Victorian Government programs, initiatives and supporting grants in this adaptation process.

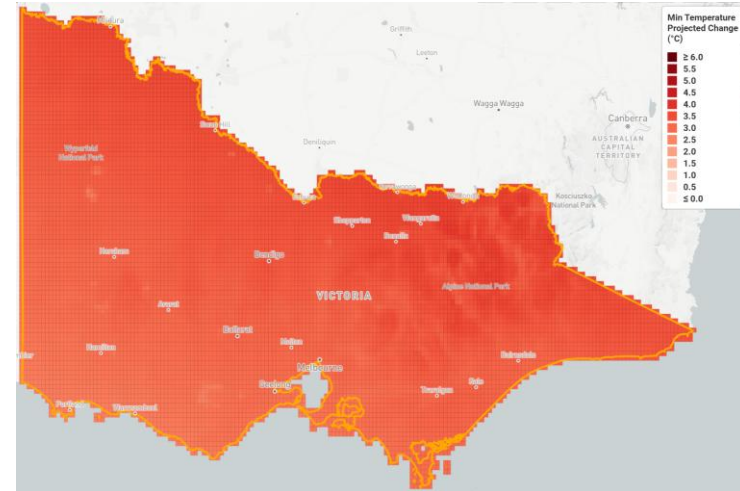
²⁴ Ibid.

²⁵ Clarke JM, Grose M, Thatcher M, Hernaman V, Heady C, Round V, Rafter T, Trenham C & Wilson L., 2019. *Victorian Climate Projections 2019 Technical Report*. CSIRO, Melbourne Australia.

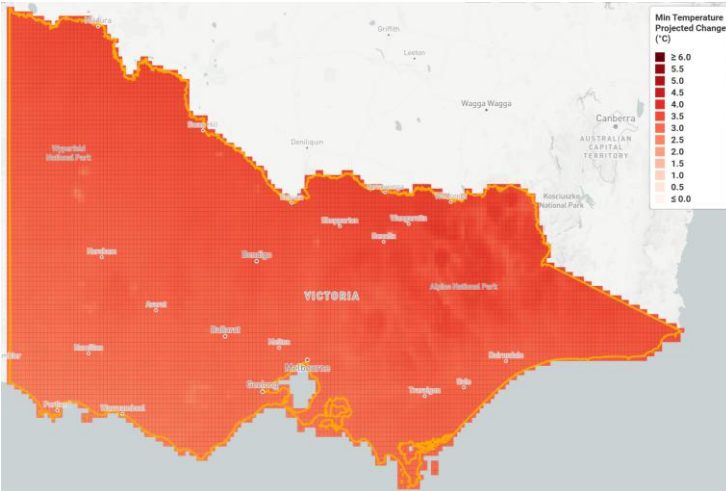
²⁶ Victorian Government, 2025. *Victorian Climate Change Strategy*



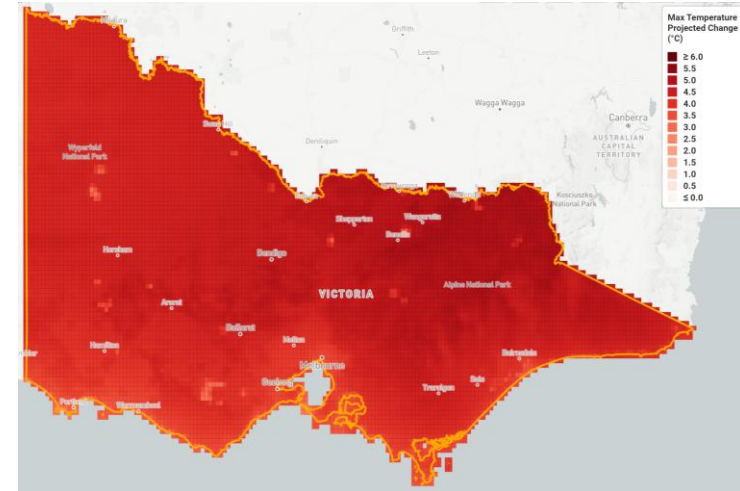
Climate change impact on minimum temperatures for 2020-2039



Climate change impact on maximum temperatures for 2020-2039



Climate change impact on minimum temperatures for 2080-2099



Climate change impact on maximum temperatures for 2080-2099

Figure 15. Climate change forecasts by DEECA / Victoria Climate Future Tool.

2.6 Managing Country

Traditional Owners groups who identify connection to the Falls Creek area include Dhudhuroa Waywurru Nations, Dhuduroa Dhargal, Jaithmathang TABOO and Jaithmatang TO. Efforts to establish formal recognition under the Victorian Aboriginal Heritage Act (2006), Victorian Traditional Owner Settlement Act (2010), and Commonwealth Native Title Act (1993) are ongoing.

Traditional Owner groups have expressed cultural rights and aspirations in individual Nation Statements collated in *Water is Life: Traditional Owner Access to Water Roadmap (Section B)*.²⁷ Brief extracts relevant to managing land and water in alpine resorts are included below, together with information on recent collaborations with government organisations.

2.6.1 Dhudhuroa Waywurru

*Our collective obligations and duty is to our sacred waterways, the land, the animals and plants, and all parts of the ecosystem and landscape.*²⁸

Dhudhuroa Waywurru Nations Aboriginal Corporation (DWNAC) have been involved in various projects/partnerships with DEECA, Parks Victoria, North East Catchment Management Authority (NECMA) and North East Water.²⁹

Dhudhuroa, Waywurru and Ngurai Iillum have an active Native Title Application with the Australian Federal Court (lodged in 2023) which includes parts of Falls Creek Alpine Resort.

²⁷ DEECA (2022). *Traditional Owner Nation Statements – Water is Life (Section B)*.

²⁸ DWNAC (2022). *Dhudhuroa Waywurru Nation Statement – Water is Life (Section B)*.

²⁹ DELWP (2019). *Traditional Owner objectives and outcomes: Compilation of contributions to Victoria's water resource plans*.

2.6.2 Dhuduroa Dhargal

*Our vision [is for] future generations to enjoy healthy waterways which are thriving and rich in resources, with cultural heritage protected. Being the sovereign water holder and authority to manage water so that country and its people can thrive.*³⁰

Dhuduroa Dhargal Aboriginal Corporation (DDAC) worked with Victorian Government departments and agencies on water and land management initiatives in 2022-23.³¹

2.6.3 Jaithmathang TABOO

*Jaithmathang have a cultural responsibility and duty to care for our water courses and waterways. To us, Myremyal (water) is life for everything, it is part of our Dreaming, and it is a fundamental part of our connection to Mother. Our waterways link us to our past and are [an] essential part of our future.*³²

Jaithmathang's approach includes working with government agencies to build partnerships in managing country and water, while acknowledging the conflict between conservation and tourism/ development as a constraint to protecting and healing alpine country.

Jaithmathang TABOO and GLaWAC collaborated with North East Catchment Management Authority (NECMA) on a five-year Mountain Pygmy Possum recovery project (2019-2023) through the National Landcare Program. Jaithmathang TABOO also has connections with the Nallawilli Group of

³⁰ DDAC (2022). *Dhuduroa Dhargal Nation Statement – Water is Life (Section B)*.

³¹ Vic Catchments (2025). [Vic Catchments North East Case Study](#)

³² JTABOO (2022). *Jaithmathang TABOO Nation Statement – Water is Life (Section B)*.

companies, including asset intelligence, land management, and workplace supplies businesses.

2.6.4 Jaithmatang TO

Jaithmatang Traditional Owners identify the inter-relationship between water, people and culture, expressed as:

maintaining our waterways and connections to water will determine the future of Jaithmatang culture

how Jaithmatang knowledge and culture influences modern water management will determine the future of our waterways.³³

Jaithmatang Traditional Owners identify that capacity building for the Jaithmatang Nation, including supporting and empowering more Jaithmatang people to move into land and water management roles on County is essential.

2.7 Partnering with Traditional Owners and Building Cultural Competency

ARV has obligations and aspirations to:

- build organisational cultural competence to engage with Traditional Owner groups with rights and interests in alpine resorts (Registered Aboriginal Parties and Traditional Owner groups without formal recognition)
- support Aboriginal self-determination and partner with Traditional Owners in the planning and management of alpine resorts.

Integrated Water Management in North East Victoria³⁴ informs this IWM plan and contributes to building ARV's water-related cultural knowledge and competence. ARV's *draft Traditional Owner Engagement and Self-Determination Strategy* identifies a series of actions 'to champion Aboriginal self-determination through genuine partnerships with Traditional Owners, ensuring their rights and interests in Alpine Country are understood, supported and upheld'. These actions relate to three key focus areas: governance and accountability, culture and Country, and economic opportunities.³⁵

³³ JTO (2022). *Jaithmatang TO Nation Statement – Water is Life (Section B)*.

³⁴ Three Seeds (2025). *Integrated Water Management in North East Victoria's Alpine Region*.

³⁵ ARV (2025). *DRAFT Traditional Owner Engagement and Self-Determination Strategy*.

3 Integrated Water Management Planning in an Alpine Environment

Integrated Water Management (IWM) is a collaborative approach to managing water resources that considers the interconnectedness of water systems, including supply, demand, wastewater, stormwater, and environmental flows. In alpine environments, IWM is particularly important due to the region's unique ecological, hydrological, and climatic characteristics. These areas are critical sources of freshwater for downstream communities and ecosystems, yet they face increasing pressures from climate change, seasonal variability, tourism, and development.

Effective IWM in alpine environments ensures sustainable water use, protects fragile ecosystems, and enhances the resilience of water systems against extreme weather events like droughts, fires, and floods. By integrating perspectives across stakeholders, IWM helps balance the needs of people, industry, and nature while preserving the alpine environment for future generations.

As discussed previously, the options for IWM management considered in this plan were sourced from conversations with ARV staff and stakeholders during the two workshops, as well as interviews and the site visit. The ideas and opportunities generated from this engagement were then analysed using available data and also were evaluated based on their alignment with ARV strategic objectives and IWM outcomes. This alignment is important as it addresses how each option supports ARV's organisational goals, as well as the broader outcomes IWM seeks to support.



Figure 16. IWM framework for alpine resorts

3.2 ARV Strategic Objectives, 2024 – 2027

Alpine Resorts Victoria (ARV) has six strategic objectives to guide activities between 2024 – 2027. These objectives were created to ensure ARV has clear direction to support sound decision-making. The alignment of these objectives with each individual IWM option will be discussed further in the next chapters. The table below shows the connection between the ARV objectives and IWM planning.

ARV Strategic Objective	Relevance to IWM planning
Investment: Enable investment that drives sustainable businesses	Supports IWM through financing water infrastructure improvements and ensuring water-related services are resilient and sustainable
Environment: Protect and enhance the alpine environment and adapt to climate change	Reducing water use and improving water security mitigates environmental impacts on alpine ecosystems
Visitors: Enhance the visitor experience	Ensures water services meet visitor demand, maintaining quality and accessibility
Reform: Implement practical policy and regulatory reform	Facilitates the adoption of updated water management practices and regulations
Progress: Enhance organisational excellence and sustainability	Effective IWM planning depends on robust governance, resource allocation, and continuous improvements.
People: Build constructive culture and leadership capabilities	Developing expertise in IWM among ARV staff ensures long-term sustainability and informed decision-making.

3.3 IWM outcomes and relevance to Falls Creek

There are generally eight strategic outcomes of an IWM approach; each outcome addresses a different aspect of the water system. However, it is important to recognise that most IWM plans (and outcomes) are focused on urban environments and communities that are quite different from a resort or alpine environment. The following table displays the IWM strategic outcomes and their relevance to Falls Creek Alpine Resort.

System Aspect	Outcome	Relevance to Falls Creek
Water sources	1. Safe, secure and affordable supplies in an uncertain future	Increase the amount of water conserved or alternative water volume supplied to meet demand.
Wastewater	2. Effective and affordable wastewater systems	Ensure environmental and public health standards are met while maximising resource recovery.
Drainage, stormwater, and flooding risks	3. Effective stormwater management to manage flood risks	Minimise environmental impacts of stormwater; ensure resilience to existing and future flood risks.
Waterways	4. Healthy and valued waterways and waterbodies	Improve ecological health of alpine bogs and riparian areas; improve hydrology and water quality.
Water in urban landscapes	5. Healthy and valued landscapes	Maximise the connectivity, accessibility, aesthetic, and recreational values of landscapes.
Traditional owners	6. Traditional Owner values, opportunities, and inclusion	Ensure that Traditional Owner values and priorities are acknowledged, respected, and enhanced.

System Aspect	Outcome	Relevance to Falls Creek
Community value of water	7. Community values reflected in place-based planning	Ensure that different communities are considered and included in planning and design. Consider how to increase water systems literacy of resort visitors.
Economic values	8. Jobs, economic opportunity and innovation	Recognition that water management is an integral part of sustainable business

3.4 Traditional Owner Considerations

As an interim step toward understanding and respecting Traditional Owner values of alpine water systems in North East Victoria, cultural considerations are identified below. These are based on documented cultural knowledge, aspirations and land management principles of Traditional Owners groups that identify connection with Falls Creek Alpine Resort. Engagement with Traditional Owners through the development of ARV’s Traditional Owner Engagement and Self-Determination Strategy and/or implementation of this IWM Plan may provide opportunities to review and refine these cultural considerations and associated IWM options.



Figure 17. Cultural considerations for alpine resort water planning.

- 1. Respect First Peoples connection to Country**
Alpine areas are culturally significant to First Peoples

IWM Consideration: Recognise and respect First Peoples connection to Country. Understand that formal recognition of First Peoples rights is ongoing.
- 2. Manage water as part of cultural landscape**
Water is part of a cultural landscape; everything is connected

IWM Considerations: Understand and address potential adverse impacts of water management decisions on the cultural landscape within and beyond alpine resorts.
- 3. Support cultural land management initiatives**
Work together to care for Country

IWM Consideration: Identify opportunities to support Traditional Owner cultural land management goals and aspirations through alpine water planning and management.

4 Water Management Options

The options presented in this plan have been grouped into four categories.

- **Good water management.** These set of options relate to good asset management and sound management of water as a precious resource, that also should be pursued irrespective of the long-term strategic plan for the resort. They include partnerships and understanding with the traditional owners, and there is better reporting on water consumption, savings, end uses and discharges, for an overall increased water efficiency resort.
- **Stormwater and environment.** These set of options relate to the impact of surface water systems on the downstream and surrounding environment. Options specific to reducing the impact of stormwater from the impervious surfaces (in particular the car parks in and around the resort) are critical to these options. The options relate to reducing diffuse source pollution, and erosion, and in some instance wastewater discharges on the environment.
- **Energy and water.** Energy and water are both significant issues in running the alpine resorts, and options that relate to increasing the opportunities for renewable energy production through the smart use of water storages and water discharges are noted in these set of options.
- **Future water resilience.** These options relate to augmentation of the water supply, storage and infrastructure system that support moves to creating a more resilient water system that can cope with climate change and forecast visitation at the resort.

The options under these themes are shown in Figure 18.

4.1 Refining options based on stakeholder feedback

Figure 18 has 18 unique options across a wide range of IWM issues and strategies. A useful IWM plan is one that is clear and prioritises action and investment in a few key areas that will support IWM and the resort's vision, rather than a long list of options.

To refine the 18 options and leverage stakeholder expertise, the project conducted multiple iterations to stress test the feasibility and level of support. Two workshops, attended largely by the same representatives, played a key role in this process. In particular, the second workshop provided an opportunity for ARV staff and stakeholders to critique and refine options (see Appendix B). Through this process, some options were deemed infeasible, while others were refined or improved based on stakeholder insights.

This resulted in a priority set of 15 options deemed worthy of additional review and modelling. Of the 15, one of the options (increased water storage for snowmaking) did not pass the technical feasibility task and is not included in the action plan. Also, of the 15 options, eight of these are in the category of 'good water management', which were agreed to be sound pieces of work to do at the resort, irrespective of other larger water related options.

To further expand on some of the reasoning and issues that were discussed in the workshops, Figure 19 briefly notes how far each option got in terms of meeting various criteria that was raised and discussed in the workshops.

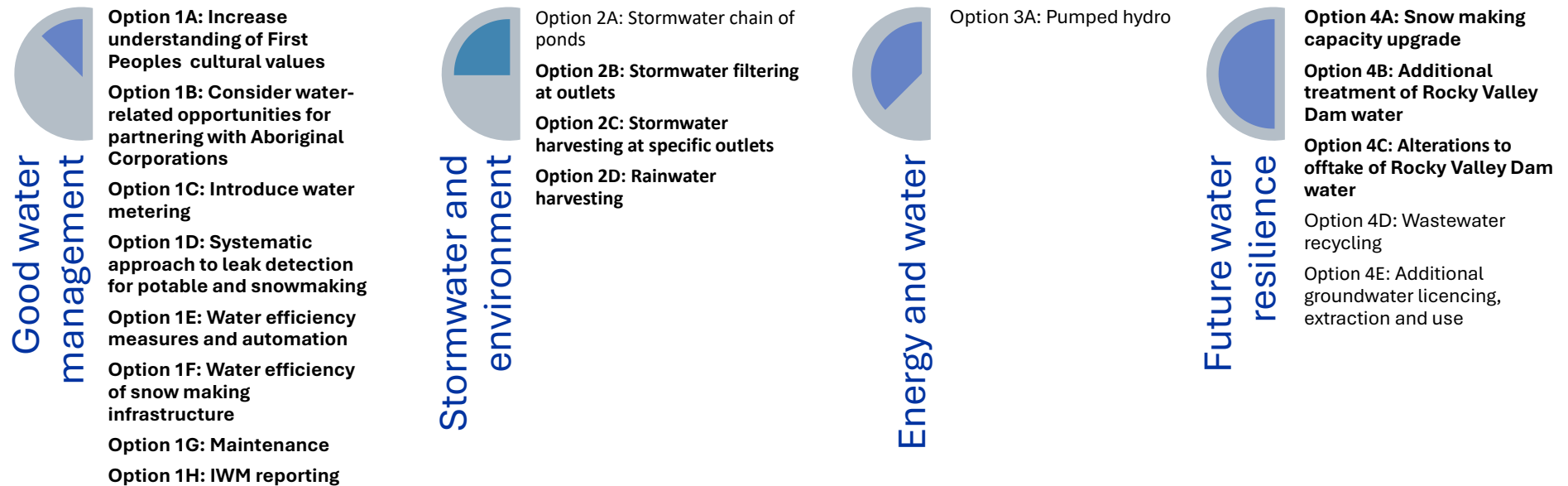


Figure 18. List of all IWM options

Options in **bold** in were presented to stakeholders involved in the second workshop and broadly supported and where necessary were subject to additional review and analysis.

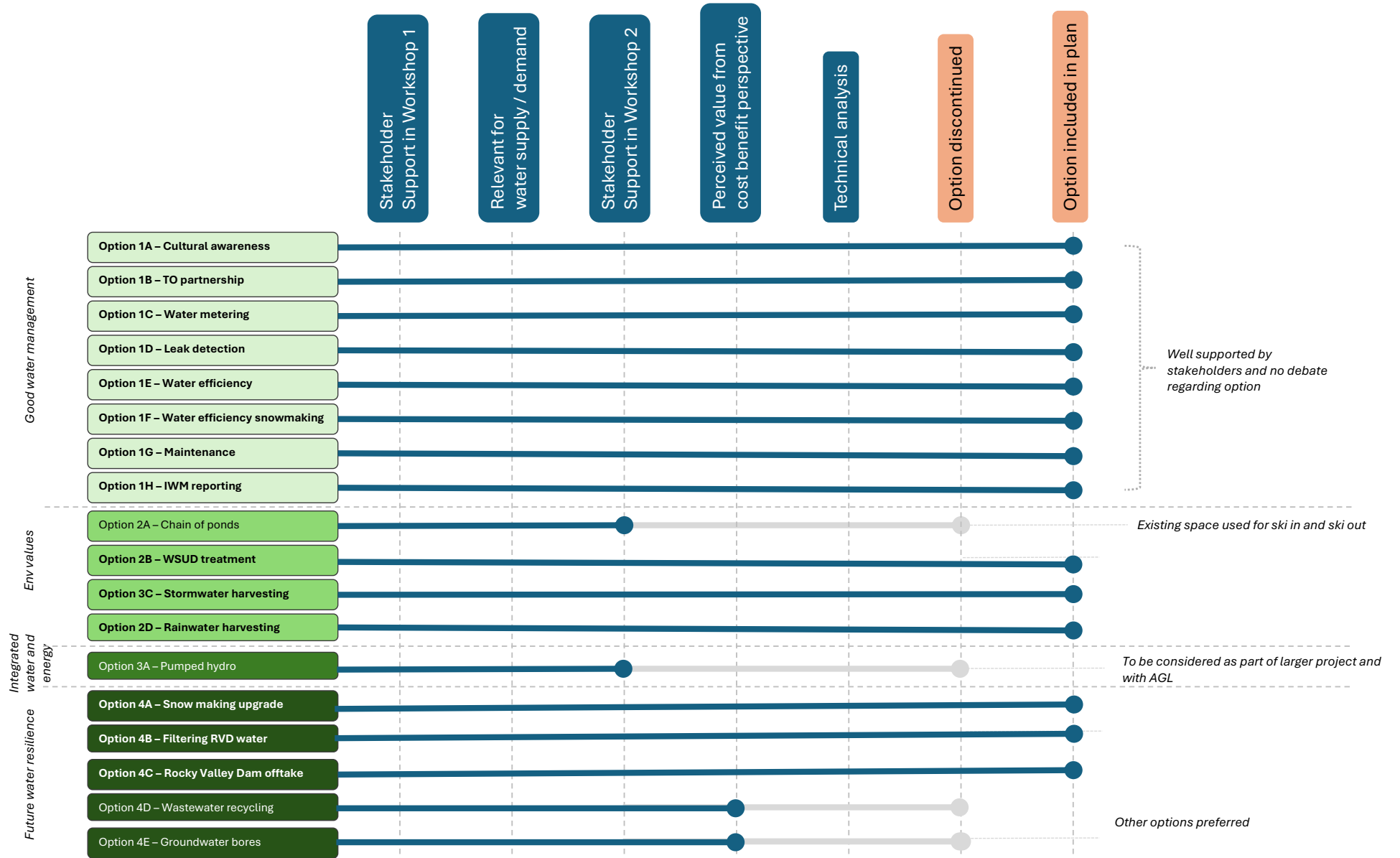


Figure 19. Summary of support for options

Water management options supported by ARV and resort stakeholders, perceived to represent value (from a cost-benefit perspective), and considered technically viable are presented in Section 5.3. Options that were initially considered but not pursued are listed below (Table 2).

Table 2. Options not pursued

Option Name	Description	Reason not pursued
Wastewater recycling	Option to filter and reuse treated wastewater for snowmaking.	There are adequate supplies for snowmaking, and other options are preferable to find additional water for snowmaking over this one, that would require significant capital expenditure and ongoing maintenance.
Additional groundwater bores	Identify another bore, in addition to the two bores in operation	Option to improve water quality from Rocky Valley Dam was considered a higher priority. This option remains an option in the long term.

5 Options analysis

5.1 Description of options

The subsequent pages present the modelled options for Falls Creek, as well as identify beneficiaries, costs, uncertainties, and risks. There are also several options recommended for Falls Creek (discussed in Section 4) that were unable to be modelled due to lack of available data.

5.2 Modelling method

A custom model was built to model, at an hourly time step, over 10 years, every demand for water, the fluctuations in storages and diversions, and the water demand of snowmaking and melting. Weather, rainfall, visitation, GIS data, and snowmaking data was used to calibrate the model. Options could be then tested against the base case operations.

To assess water options, the following assumptions were made:

- The resort uses in total 290 ML / year of water (150 ML / year of potable water for the buildings and operations, and 140ML / year of non-potable water for the snowmaking).
- The resort uses snowmaking across the resort at multiple runs, and in total this covers 120 hectares.
- Snowmaking requires 500 L / cubic metre of snow.
- Water is extracted from Rocky Valley Dam and ultimately stored in three storage tanks (total capacity of 4.5 ML), noting from a volume perspective there is virtually no 'water stress' in terms of access to water.

- Modelling of rainwater patterns was based on the hourly data at Falls Creek, and pluviometer data at Dartmouth Reservoir (as the nearest station) for a 3 decade period from 1975 to 2010 .
- Mean annual rainfall for the period used in the modelling is based on Falls Creek, which has a 1368 mm / year.
- Hourly temperature, humidity, wind and wet bulb data for Falls Creek was used to model snowmaking conditions, as the closest station with hourly data, and provides a good basis to identify appropriate weather conditions for snowmaking, and melting.
- Snowmaking was modelled to occur every time the wet bulb temperature is less than '-2 degrees'.
- It is assumed that up to 125 cm of snow would be made if the weather were conducive, there was available water, and the volume of water did not exceed the pump capacity, in the peak of winter.
- Snow melt was modelled using a 'degree days' function, which varies with temperature (i.e. a higher Degree Days Factor for a higher temperature). The following function was used to determine the melting factor (and applied every time step): $y = 0.2415 e^{-.1004x}$ (where y = cm of snow melt, and x = temperature).³⁶

³⁶ Muhammad Fraz Ismail, H.-u.-R. W. (2015). *Degree day factor models for forecasting the snowmelt runoff for Naran watershed*.

The figures below highlights the subtle downward trend in available weather windows that are suitable for snowmaking, with snow guns, based on the hourly observations of wet bulb.

It should be noted that there are a variety of factors that influence the optimum time and period to run the snow guns, which are not all represented in the figure below. The second figure is indicative of how a warming climate (which considers a 2 degree warming) changes the number of hours where the temperature, humidity, wind speed and wet bulb is changing and there is less opportunity for snowmaking.

This changing climate has implications for the need to use more water in a shorter period of time, which is explored in the options below.

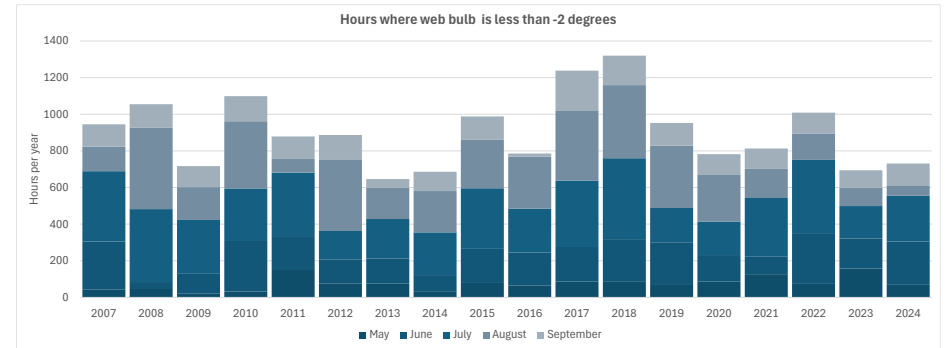


Figure 20. Bureau of Meteorology’s Falls Creek weather station history from 2007 to 2024.

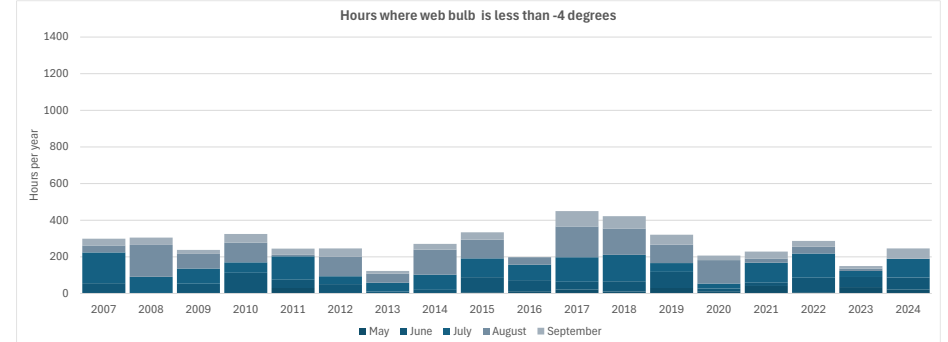


Figure 21. Bureau of Meteorology’s Falls Creek weather station history from 2007 to 2024.

5.3 Options detail

5.3.1 Option 1A: Building cultural understanding

This option supports broader and deeper understanding of Traditional Owner cultural values of water in alpine landscapes, including connections to Country beyond the resort via headwater streams of the Kiewa River.

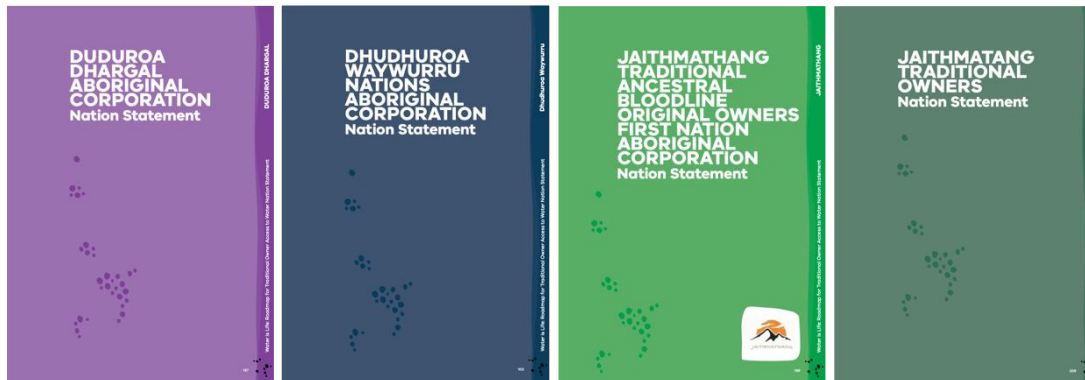
Initiatives should:

- focus on building the cultural awareness and competence of resort staff, stakeholders and visitors,
- align with ARV's Traditional Owner Self-Determination and Engagement Strategy (in-development), and
- where possible, be developed and delivered in partnership with Traditional Owner groups that identify connection with Falls Creek Alpine Resort based on their self-determined priorities and capacity.

Category: Good Water Management

Who benefits: ARV and resort stakeholders, Traditional Owners, Resort visitors.

Costs: To be determined (dependent on the scope of specific initiatives and level of involvement)



Alignment with IWM Outcomes and ARV Objectives:



Risks and uncertainties:

- Traditional Owner involvement will be self-determined, informed by their priorities and capacity.

Summary:

Greater awareness of cultural values of water in alpine landscapes supports ARV obligations and aspirations to work in partnership with Traditional Owners.

5.3.2 Option 1B: Two-way knowledge sharing

This option is focused on identifying potential water-related opportunities for resort stakeholders and Traditional Owner groups to partner on social, cultural and/or economic activities that support two-way knowledge sharing.

Specific initiatives should:

- build on existing relationships between Traditional Owner groups and other government agencies
- align with existing resort-based initiatives (e.g. Falls Creek Arts and Culture Strategy 2022 – 2027)
- align with ARV's Traditional Owner Self-Determination and Engagement Strategy (in-development).

Specific opportunities could include, for example, resort-based events, ecological monitoring, environmental/biodiversity management, and cultural celebrations.



Risks and uncertainties:

- Traditional Owner involvement will be self-determined, informed by their priorities and capacity which may vary over the life of this plan.
- Identification of specific initiatives was not possible at the time this plan was prepared.

Summary:

Working with Traditional Owner groups on two-way knowledge sharing initiatives supports ARV obligations and aspirations to work in partnership with Traditional Custodians, will strengthen landscape resilience and biodiversity initiatives.

Category: Good Water Management

Who benefits: ARV, Traditional Owners, resort stakeholders and visitors.

Costs: To be determined (dependent on specific initiatives).

Alignment with IWM Outcomes and ARV Objectives:



5.3.3 Option 1C to 1H: Water metering; leak detection; water efficiency, maintenance and reporting

Various ‘good water management’ options are presented as a group of actions that capture current and future work that forms part of a business-as-usual approach to water management.

This includes water metering, water efficiency at all buildings (noting that in Perisher 98% of all showerheads have been replaced³⁷), maintenance to reduce leaks and pipe cracking in the potable network, daily monitoring to identify when flows significantly exceed usual demands, and mapping all pipes and connections across the resort (to be added into the ARV asset management database). Leaks may be identified with a peak in sewage treatment (if a toilet leaks for example); a cracked pipe may be located through wet patches or springs in the landscape.

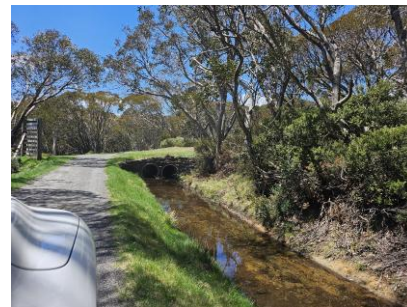
Category: Good Water Management

Who benefits: Resort management and all users through a more resilient water infrastructure system

Costs: Not estimated (ongoing).



Maintenance of pits, pipes and outlets is important.



Management and integrity of the aqueduct is an important part of reuse of snow melt, and preventing excess runoff to downstream waterways, that also reduces erosion risks.



Monitoring of pumps and consumption, and protection of existing infrastructure is critical.

Risks and uncertainties:

- The location and condition of all existing pipes and network connections is not currently mapped (identified actions seek to address this uncertainty over time).
- Maintenance / upgrades may impact ecological and cultural values (e.g. vegetation removal, landscape disturbance, soil erosion). Early engagement with relevant authorities / custodians should be undertaken to minimise risks.

Summary:

System losses tend to account for 3 to 15% of overall water consumption (based on urban water authority data)³⁸ when not proactively monitored and managed. Ongoing maintenance and repairs to existing infrastructure is a critical part of resort management, and supports efficient use of existing water supplies.

Alignment with IWM Outcomes and ARV Objectives:



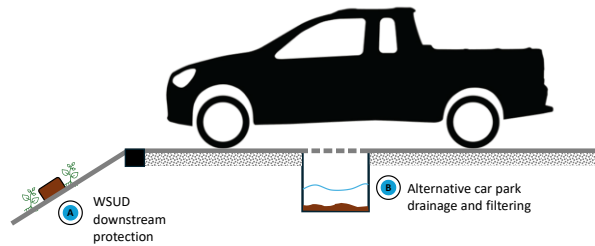
³⁷ Perisher, 2025. Monitoring results.

³⁸ Bureau of Meteorology, 2024. Urban national performance report 2023-2024 raw dataset for small and medium sized utilities.

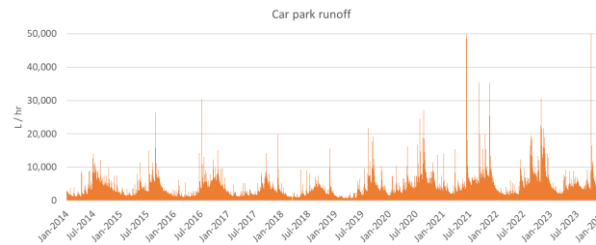
5.3.4 Option 2B: Stormwater management (filtering)

Stormwater runoff from car parks impact downstream environments through stormwater pollution and erosion. These impacts could be mitigated through the re-design/upgrade of car park edges, for example, by:

- (1) introducing diversions and berms to manage runoff on slopes below the car park, and/or
- (2) installing a strip trench and grate system set two meters back from the edge (to allowing snow clearing) while capturing and filtering stormwater pollutants through a sump pit and sand filter.



Car park alongside Bogong High Plains Road



Car parks (0.5-2 ha) generate significant stormwater runoff and associated pollutants, and can cause erosion and asset damage. In alpine environments snow, salt, and snow-clearing machinery introduce challenges for managing stormwater.

Summary:

Managing stormwater runoff from car parks supports environmental protection through reduced stormwater pollution and erosion risks. Re-design/upgrade of car parks, and changes to snow clearing processes may be required, and environmental benefits will need to consider potential construction phase impacts. This option could potentially be integrated with the stormwater harvesting option (Option 2C).

Category: Environmental values

Who benefits: Environment, ARV (via asset protection)

Costs: Not estimated (design dependant)

Alignment with IWM Outcomes and ARV Objectives:

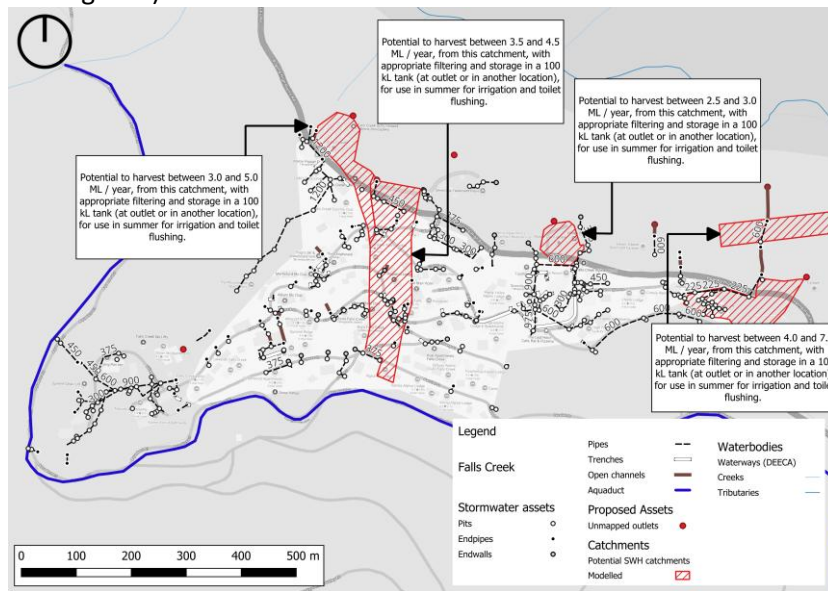


Risks and uncertainties:

- Potential construction-phase impacts on significant ecological values / vegetation adjacent to car park (liaise with DEECA Natural Environment Program as part of further investigation/design)
- Potential operation-phase impacts on current snow clearing processes (consider as part of further investigation/design).
- Appropriate maintenance process and frequency (consider as part of further investigation/design).

5.3.5 Option 2C: Stormwater harvesting

Collecting, filtering, storing that currently discharges from the piped stormwater network could support environmental protection (by reducing runoff and associated pollutants, and reduce erosion) while providing an alternate water source for non-potable uses (e.g. toilet flushing and summer irrigation) through a new distribution network. Four potential locations for stormwater harvesting were identified (see below), with modelling indicating that each location could supply 2.5 - 7.5 ML / year for toilet flushing and summer irrigation with a 100 kL storage tank. Further investigation is required to confirm feasibility and identify and assess any potential ecological impacts from construction and operation (e.g. location of storage tanks, maintenance access, changed downstream flow regimes).



Category: Environmental values

Who benefits: Environment, ARV (longer asset life)

Costs: \$50k to 100k for business case / concept design

Alignment with IWM Outcomes and ARV Objectives:



Risks and uncertainties:

- Feasibility and cost effectiveness (further investigation required, including seasonality and maintenance)
- Potential impacts of new infrastructure, particularly storage tanks, on biodiversity and habitat (liaise with DEECA Natural Environment Program as part of further investigation/design)

Summary:

This option has the potential to deliver environmental and water supply benefits. However, feasibility (including storage locations and system maintenance) and cost-effectiveness need further consideration.

5.3.6 Option 2D: Rainwater harvesting

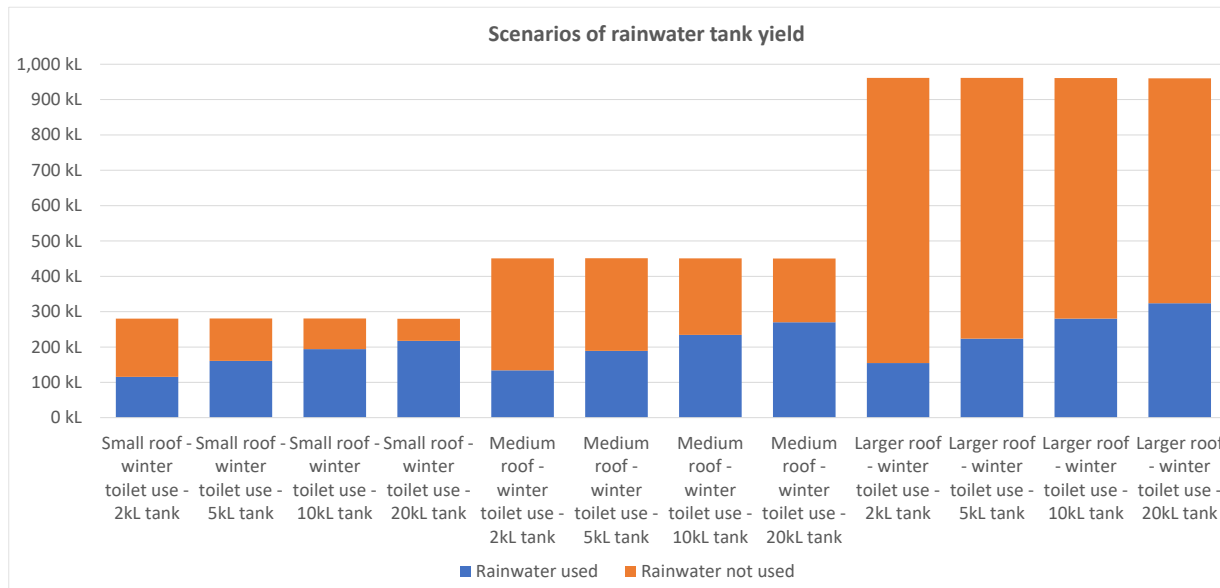
Rainwater harvesting from one or more buildings to supply toilet flushing reduces impervious surface runoff (and associated environmental impacts) and provides an alternate water source. There are multiple possible configurations for this option. Buildings would need to be retrofitted with gutters suitable for rainwater and snowpack, with individual filtering and storage units set-up at one or more building to supply toilet flushing. Roof areas tested in this option ranged from 250 m² to 850 m² in size. Initial investigations demonstrate that rainwater harvesting could supply between 30% to 80% of the demand (300 kL a year assumed for toilet flushing at high visitation sites) depending on tank size (storages of 2-20 kL investigated).

Category: Stormwater and environment

Who benefits: Environment, ARV (longer asset life)

Costs: Variable

Alignment with IWM Outcomes and ARV Objectives:



Risks and uncertainties:

- Confirming roof design and gutters appropriate for alpine context (see Mt Stirling example).
- Location of storage tanks and associated infrastructure should avoid impacting native vegetation and the natural environment.
- Plumbing would need to be insulated to prevent water in pipes from freezing.

Summary:

Rainwater harvesting as the potential to reduce runoff and associated pollutants and erosion. Individual rainwater tanks would only save 0.1 to 0.2 ML / year, but if scaled-up across multiple buildings there could be significant reduction in potable water demand over the longer term, reducing pressure on current potable supply system (with associated water quality and water temperature considerations).



5.3.7 Option 4A: Snowmaking capacity upgrade

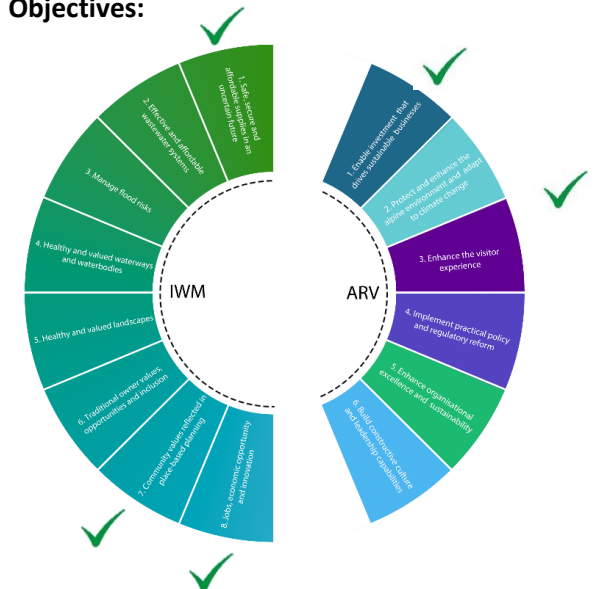
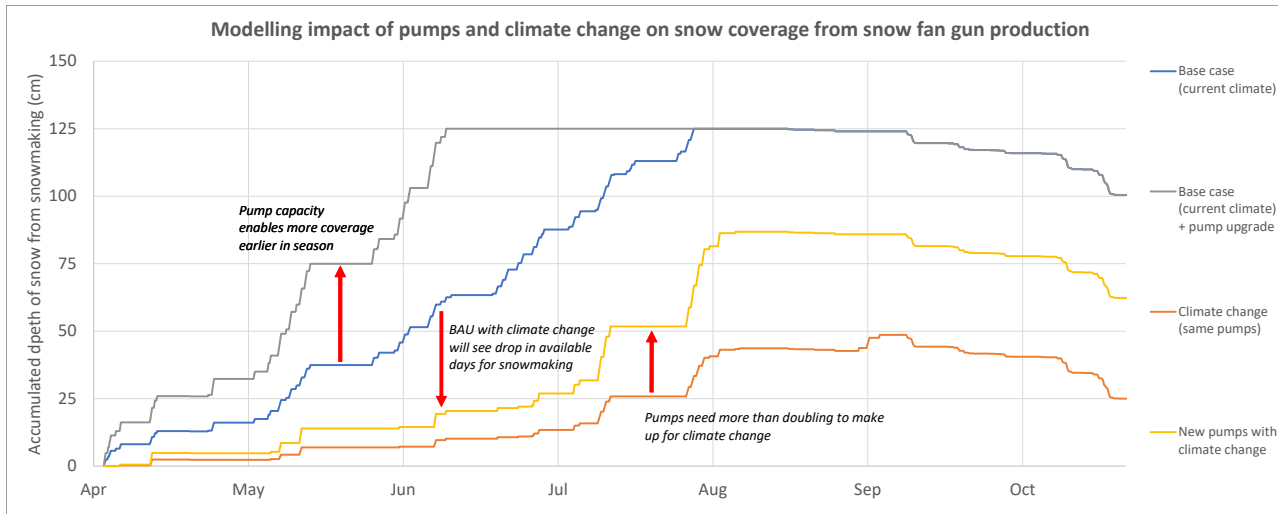
This option considers infrastructure upgrades (including doubling pump capacity) allowing greater snowmaking capacity to partially offset shorter favourable weather windows for snowmaking associated with climate change. Snow factories, which are less weather dependent, are not included in the initial assessment of this option. The resort has 450 hectares of skiable terrain, with snowmaking infrastructure currently covering 120 hectares. Initial modelling indicates that increasing pump capacity can support increase snow production as favourable weather windows for snowmaking decline. However, doubling pump capacity is not sufficient to fully offset the increasing effects of climate change on snow cover (see figure below). Further investigation is required to consider energy demands, snow gun efficiency, temperature of the water extracted from Rocky Valley Dam, and localised issues that impact the ability to create snow pack.

Category: Future Water Resilience

Who benefits: Visitors, Vail Resorts, ARV

Costs: Not determined (further investigation required).

Alignment with IWM Outcomes and ARV Objectives:



Risks and uncertainties:

- Additional considerations beyond pump capacity need to be investigated (e.g. energy supply/capacity, snowmaking efficiency, water quality and temperature).
- Potential impacts of upgrade works (e.g. pumps, distribution networks) have the potential to impact biodiversity and habitat (liaise with DEECA Natural Environment Program as part of further investigation/design).

Summary:

Initial modelling indicates that upgrades to snowmaking infrastructure can support long-term snowmaking and snow coverage as climate change impacts increase. However, further investigation and analysis is required to better understand the potential feasibility, benefits and costs of this option (including consideration of the role of snow factories).

5.3.8 Option 4B and 4C: Additional treatment of Rocky Valley Dam water

The quality and temperature of water extracted from a storage reservoir is influenced by the level (depth) of the extraction point. ARV and Vail Resorts have separate offtake points for the potable water system and snowmaking, respectively. There are times when water from Rocky Valley Dam is unsuitable for snowmaking (due to elevated water temperature and elevated levels of iron and magnesium³⁹ and snowmaking has relied on groundwater extractions.

Water quality issues could be addressed by upgrading the treatment process and/or the changing the offtake level. Options to improve water quality include chemical, physical or mechanical solutions (promoting pollutant flocculation), adding more settling tanks, and additional treatment prior to distribution.

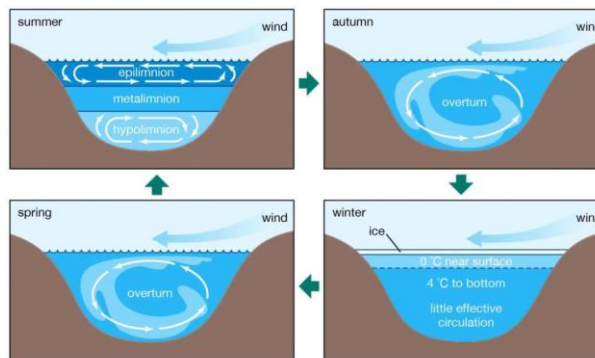
Water temperature could be addressed by creating a new multi-level offtake or investigating shared use of ARV and Vail Resorts offtakes to meet individual and collective needs. Constructing an above ground storage is also a potential option for addressing water temperature issues. However, this option is unlikely to be viable.



40

Risks and uncertainties:

- Feasibility of new treatment and/or offtake options (further investigation required)
- Potential ecological impacts of any new infrastructure (liaise with DEECA Natural Environment Program as part of further investigation/design .



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Summary:

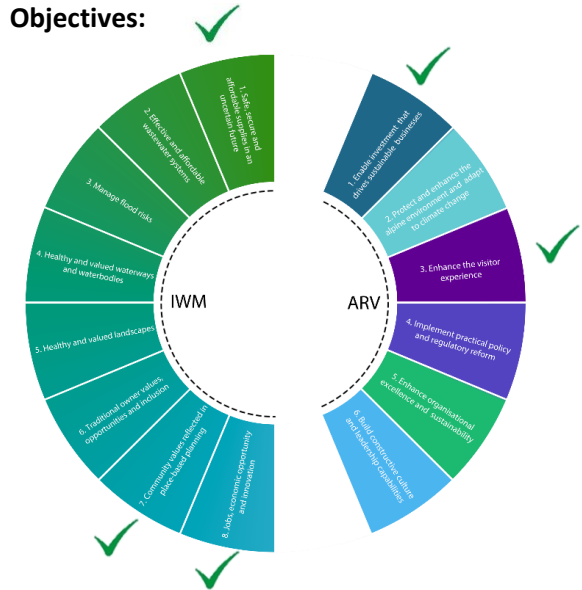
This option has the potential to address surface water quality and temperature issues that impact water supply for potable water and snowmaking. Further investigation and analysis of current water quality and temperature issues, and assessment of feasibility of potential options is required.

Category: Future water resilience

Who benefits: ARV and all visitors with increased quality and reliability of water.

Costs: TBD

Alignment with IWM Outcomes and ARV Objectives:



³⁹ ARV, 2020. Falls Creek Alpine Resort – Water Quality Annual Report 2019-20

⁴⁰ Encyclopædia Britannica Inc, 1998. <https://www.lakehomes.com/info/lifestyles/the-science-behind-lake-stratification>

6 Recommendations

A suite of water management options for Falls Creek have been identified and developed through engagement and analysis. Recommendations for progressing these options, including additional analysis / assessment to ensure there is a sound business case for investment, are included below. Options that were identified as not being viable are also listed.

6.1 Recommended

These options collectively contribute to ARV objectives and IWM outcomes. Options are grouped by IWM category.

Good Water Management

- **#1. Building cultural understanding and two-way knowledge sharing** [Options 1A and 1B]
Continue developing relationships with Traditional Owners focused on building understanding of cultural values of water at Falls Creek and identifying longer term opportunities for knowledge sharing / working together.
- **#2. Water Metering and Leak Detection** [Option 1C and 1D]
Progressively introduce water metering and leak detection across the whole resort to support long-term management of all water resources and to reduce/delay future supply augmentation. This includes metering potable water consumption in all accommodation, meal / bistro, and administration and workshop buildings, and systemic leak detection and reporting to identify and address leaks in potable water and snowmaking systems.

- **#3. Water Efficiency** [Option 1E and 1F]
Introduce water efficiency and automation measures to reduce water use in buildings and for snowmaking. This includes upgrading all showers and toilets to/near maximum WELS rating, installing timers on all taps, and ongoing automating snowmaking infrastructure. This supports other options (e.g. rainwater harvesting) by reducing water demands.
- **#4. Maintenance** [Option 1G]
Continued regular maintenance of all core infrastructure, including inspection and maintenance of all tanks, pipes, drainage lines for potential blockages, algal build up, etc.
- **#5. IWM Reporting** [Option 1H]
Prepare a brief (2-4 page) annual report, commencing in 2026, on the annual resort water balance. This should include data on visitor water consumption (total and per visitor days), snowmaking water consumption, wastewater discharge, annual rainfall, rainwater captured, stormwater (modelled volumes and pollutants), and water-related environmental impacts including erosion.

Stormwater and environment

- **#6. Stormwater filtering** [Option 2B]
Design and build a car park stormwater retention/filtering trial (whole area or ~1,000 m²) to reduce the stormwater volume and associated pollutants entering Rocky Valley Creek. This trial should be monitored and assessed to inform future stormwater-related environmental initiatives and could support two-way knowledge sharing partnerships with Traditional Owners.

- **#7. Stormwater harvesting** [Option 2C]
Undertake a stormwater harvesting feasibility study at one of the four sub-catchments (below Gully Car Park, below the Slalom Car Park, below lower Slalom Car Park, and downstream of Windy Corner). The feasibility study is required to develop and assess options for filtering, storing and distributing treated stormwater to provide an alternate water supply for potable use and/or snowmaking, with a target harvesting yield of between 6 and 60 megalitres a year (variable due to catchment and storage size). Catchment areas range from 3,000 and 100,000 m².
- **#8. Rainwater harvesting** [Option 2D]
Undertake a retrofit rainwater harvesting project at one toilet block or admin building (with at least 500 m² roof area), with the intention that this harvested rainwater be plumbed into internal toilet flushing and any irrigation lines. Monitor and evaluate the system to determine the indicative potable water reduction that this results in, and any other additional benefits, to better understand the potential of expanding rainwater harvesting to other buildings.
- **#11. Alterations to offtake of Rocky Valley Dam water** [Option 4C]
Assess the feasibility of options to alter the offtake point for water extracted from Rocky Valley Dam to avoid water quality and temperature issues for both potable and snowmaking supply. This is recommended to be completed in the short term.

6.2 Not recommended

Additional groundwater bores and wastewater recycling were discussed in the stakeholder workshops, but not supported for investigation as part of this IWM plan as other options were perceived to deliver greater benefits across multiple IWM outcomes. Pumped hydroelectric power was not investigated but may be considered as part of a larger project with AGL.

Future Water Resilience

- **#9. Snowmaking capacity upgrade** [Option 4A]
Assess the feasibility of further upgrades to snow making infrastructure (including distribution infrastructure) with consideration of different climate and weather scenarios. This is recommended to be completed in the short term.
- **#10. Additional treatment of Rocky Valley Dam water** [Option 4B]
Undertake a feasibility study to identify and assess options for reducing turbidity and mineral (e.g. iron) concentrations of water extracted from Rocky Valley Dam. This is recommended to be completed in the short term to increase the resilience of the potable supply system.

7 Action plan

The delivery of this plan is contingent on available resources and grant funding to support ARV to upgrade the resort and create an integrated water management demonstration site.

The following table lays out the broad set of tasks and staging of projects that is recommended to meet the IWM and ARV objectives of the site.

Table 3. Action plan and staging of projects

Timing	Name / Option	Task(s)	Link to objectives	Theme	Indicative cost	Lead	Water savings (ML / year)
Immediate	Option 1A & 1B – Traditional Owners	<ul style="list-style-type: none"> Continue developing relationships with Traditional Owners and build understanding of cultural values of water at Falls Creek Identify longer-term opportunities for knowledge sharing / working together. 	Cultural and community values	Good water management	TBC	ARV	NA
Short term (1 to 3 years)	Option 1C to 1H – metering, leaks, water efficiency and reporting	<ul style="list-style-type: none"> Continue adoption of smart meters and associated monitoring systems Ongoing maintenance work to ensure integrity of the system, stop leaks, and map the existing water network and end uses. Systematically review every single tap, toilet, hose and water outlet to ensure all units are very water efficient (as per WELS rating) and water efficient flow restrictors in place, over a 3-year period. 	Water efficiency and sustainable asset management	Good water management	Ongoing Opex	ARV, EPA	> 0.5 ML / year

Timing	Name / Option	Task(s)	Link to objectives	Theme	Indicative cost	Lead	Water savings (ML / year)
Short term (1 to 3 years)	Option 2B – stormwater management	<ul style="list-style-type: none"> Identify specific areas where WSUD filters (or simple solutions such as the placement of old logs or coir logs) would be useful to retain sediment and leaf litter, and reduce erosion risk, around car park 1 and 2. Locations must be below the edge of the asphalt, to ensure graders are not affected when clearing snow from the car park. Monitor effectiveness of these stormwater interventions. 	Environmental management and sustainable asset management	Water and environment	\$10,000	ARV, NE CMA, Alpine Shire	NA
Short term (1 to 3 years)	Option 2C – stormwater harvesting	<ul style="list-style-type: none"> Pending investigation into Rocky Valley Dam water quality, consider feasibility and benefit of stormwater harvesting, at one or multiple locations, for potable use. 	Cultural and community values, Environmental Management, and Safe, secure, affordable water supplies	Water and environment and Future water resilience	\$50k to \$100k for feasibility	ARV	7.5 ML / year
Short term (1 to 3 years)	Option 2D – rainwater harvesting	<ul style="list-style-type: none"> At specific locations, to reduce potable water use for toilet flushing and increase irrigation options, investigate feasibility of rainwater harvesting options at one or multiple locations. 	Environmental management	Water and environment and Future water resilience	\$25k to \$50k for feasibility	ARV	0.2 ML / year
Short term (1 to 3 years)	Option 4B / 4C – Rocky Valley Dam quality	<ul style="list-style-type: none"> Investigate two options (flocculation and offtake level) to improve the quality and temperature of water extracted from Rocky Valley Dam. 	Safe, secure, affordable water supplies	Future water resilience	\$50k to \$100k for feasibility	ARV, Vail Resorts	NA

Timing	Name / Option	Task(s)	Link to objectives	Theme	Indicative cost	Lead	Water savings (ML / year)
Medium term (4 to 10 years)	Option 4A – pump upgrades for snowmaking	<ul style="list-style-type: none"> Investigate the option to increase pump capacity and the impact this has on snow production, on the basis it can add more snow to the resort, in a reduced weather window, and recognises that the existing storages will provide enough water for upgrade. 	Safe, secure, affordable water supplies	Future water resilience	\$50k to \$100k for feasibility	Vail Resorts	NA
Long term (10+ years)	-	<ul style="list-style-type: none"> Revisit the option for additional groundwater bores, wastewater recycling, to support ongoing diversification of alternative supplies for potable and snowmaking demands. 	Safe, secure, affordable water supplies	Future water resilience	NA	NA	NA
Long term (10+ years)	-	<ul style="list-style-type: none"> Ongoing review of the resilience of Rocky Valley Dam, in light of other priorities for hydroelectric power and pumped hydro. 	Safe, secure, affordable water supplies	Future water resilience	NA	NA	NA

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Appendix A. Workshop 1 summary report

Appendix B. Workshop 2 summary report

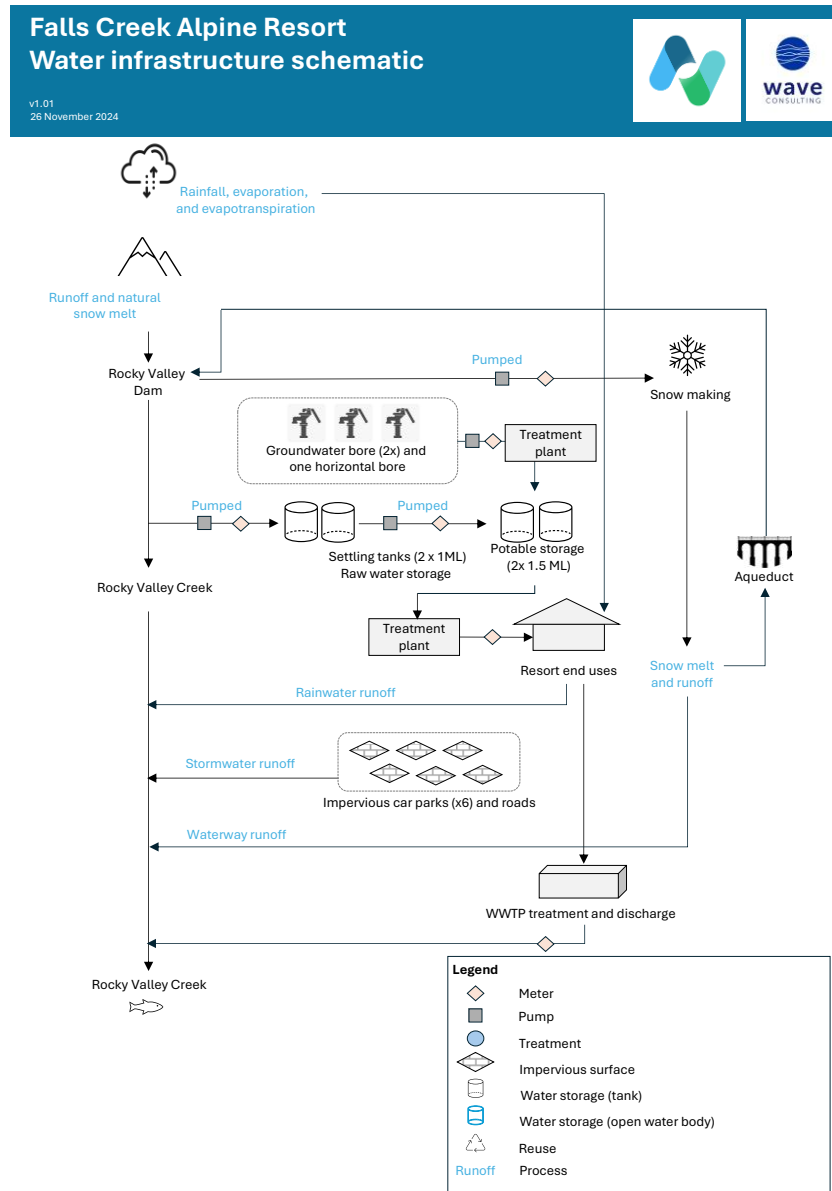
Appendix C. Available data

Data for this project came from a variety of sources. These are listed below, with reference to the time period that the data covers.

Table 4. Data sources and records

Variable	Source	Start	End
Snow (natural)	FCAR Snowdepth 2023.xls	1998	2023
Snow (making)	ARCC_DailySnowDepthRecordsFalls Creek_from_1993.sv	2006	2017
Potable consumption	Water 2018-19.xls and files up to 2024	2018	2024
Recycled water	NA	-	-
WWTP discharge	Water 2018-19.xls and files up to 2024	2018	2024
Rainfall	BOM - Falls Creek station 83084	1998	2024
Temperature (min and max)	BOM – Falls Creek station 083074	1991	2024
Temperature (hourly)	BOM – Falls Creek station 083074	1991	2024
Humidity (hourly)	BOM – Falls Creek station 083074	1991	2024
Wet bulb (hourly)	BOM – Falls Creek station 083074	1991	2024
Wind (hourly)	BOM – Falls Creek station 083074	1991	2024
Visitor days - winter	ARCC_Annual_Winter_VisitorDays_Historical_Records_from_1985.csv	1985	2024
Visitor days - summer	ARCC-Summer-18.19-vis-nos-and-vehicle-countB.csv	2007	2024
Assets - tanks etc	ARV geospatial data	-	-
Assets - stormwater	ARV geospatial data	-	-
Assets - impervious	ARV geospatial data	-	-

Appendix D. Water schematic



Appendix E. Traditional owner's summary

Appendix F. Stormwater modelling

8.1 Review of assets and subcatchments

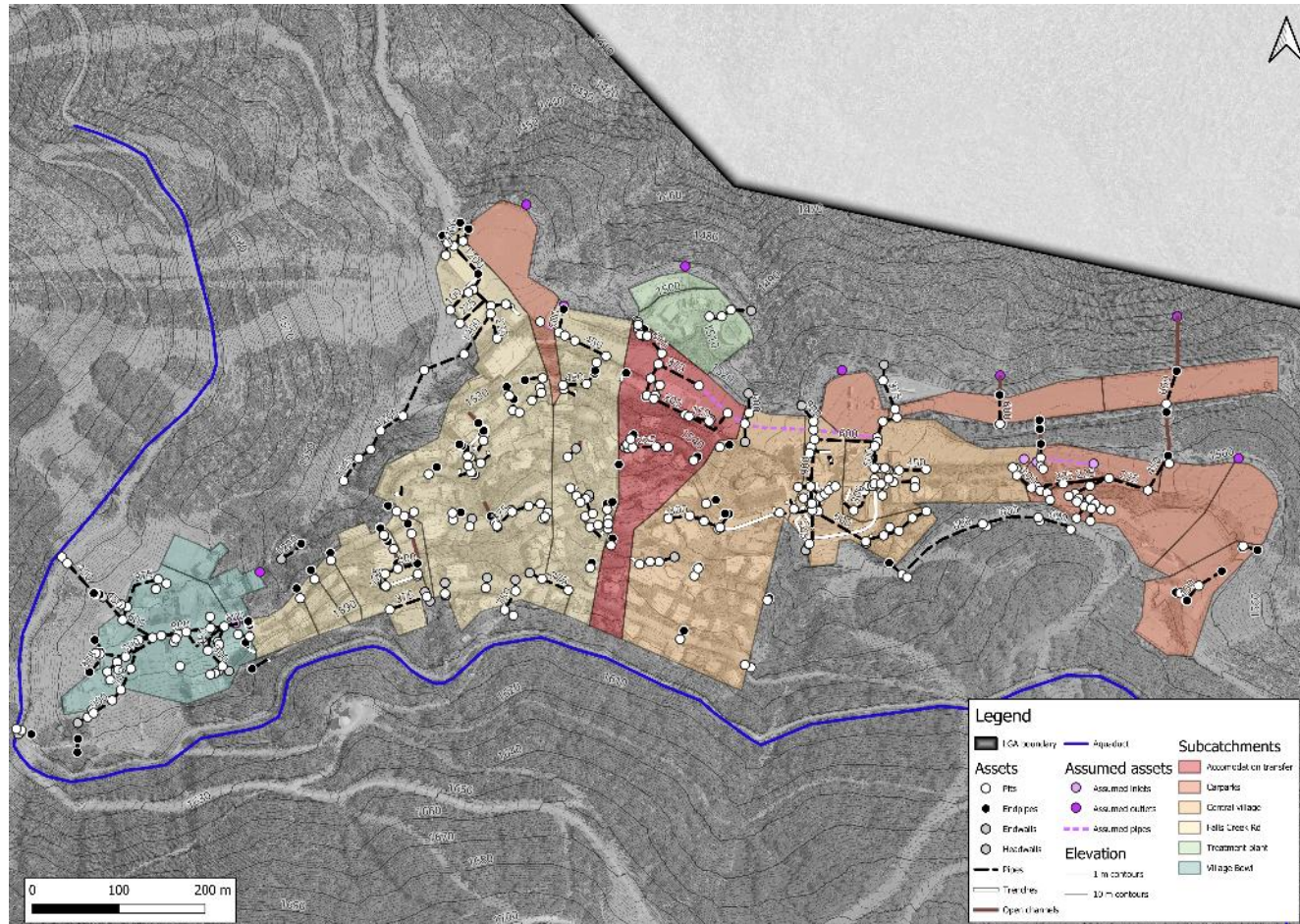


Figure 22. maps the impervious areas of the stormwater network, and groups them into six different regions or subcatchments zones across the resort. The Village Bowl and Falls Creek Road both eventually drain into the 1200 mm outfall in the northwest of the village. Car parks make a significant area of impervious across the resort. There is stormwater infrastructure across the whole resort, but it is often not connected from one pit and pipe, to another downhill. The network usually finishes with a 600 mm pipe and endwall, on the lower side of the Bogong High Plains Road. There is one significantly larger outfall that takes a larger catchment and ends with a 1200 mm outlet pipe.

Figure 22. Falls Creek stormwater assets.

8.2 Review of stormwater capacity and pipe network

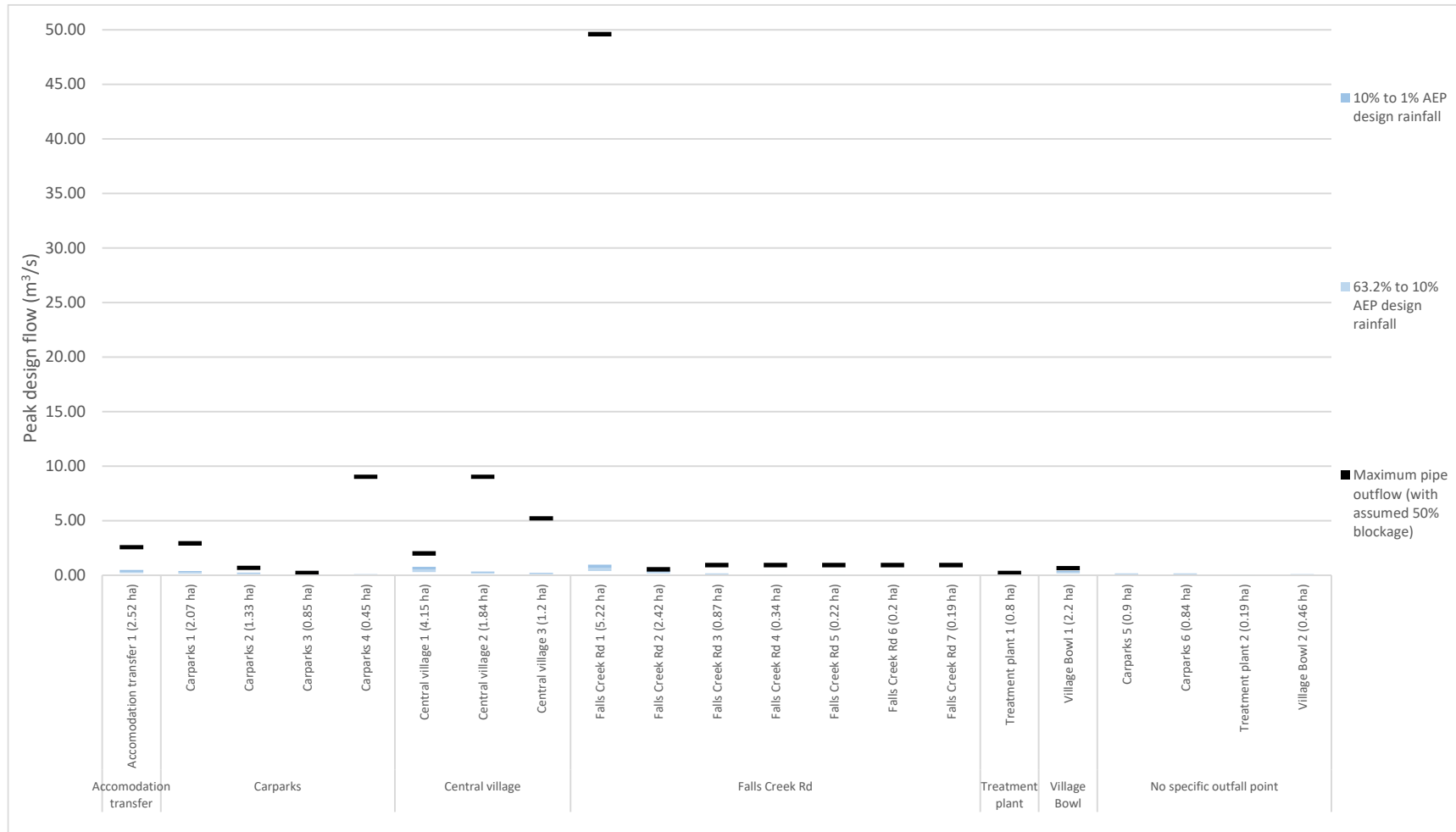


Figure 23. Stormwater capacity issues highlighted across Falls Creek resort.

Traditionally stormwater and urban catchments only need to be sized to cater for approximately 0.2 m³ / sec to 0.5 m³ / sec peak flows at most, depending on the size of the catchment, pipe size and slope. At Falls Creek, with larger catchments, pipes and slopes, there are several examples of peak flows for the 10% design rainfall events that exceed 1 m³ / sec in the Falls Creek resort, which is unusual for a stormwater network.

Figure 23 above illustrates that the assumed max flow rate that the assets can cater for, is above the 10% AEP design rainfall, therefore there are no catchments or outfalls where the stormwater network needs upgrading to cater for minor storm events and associated runoff.

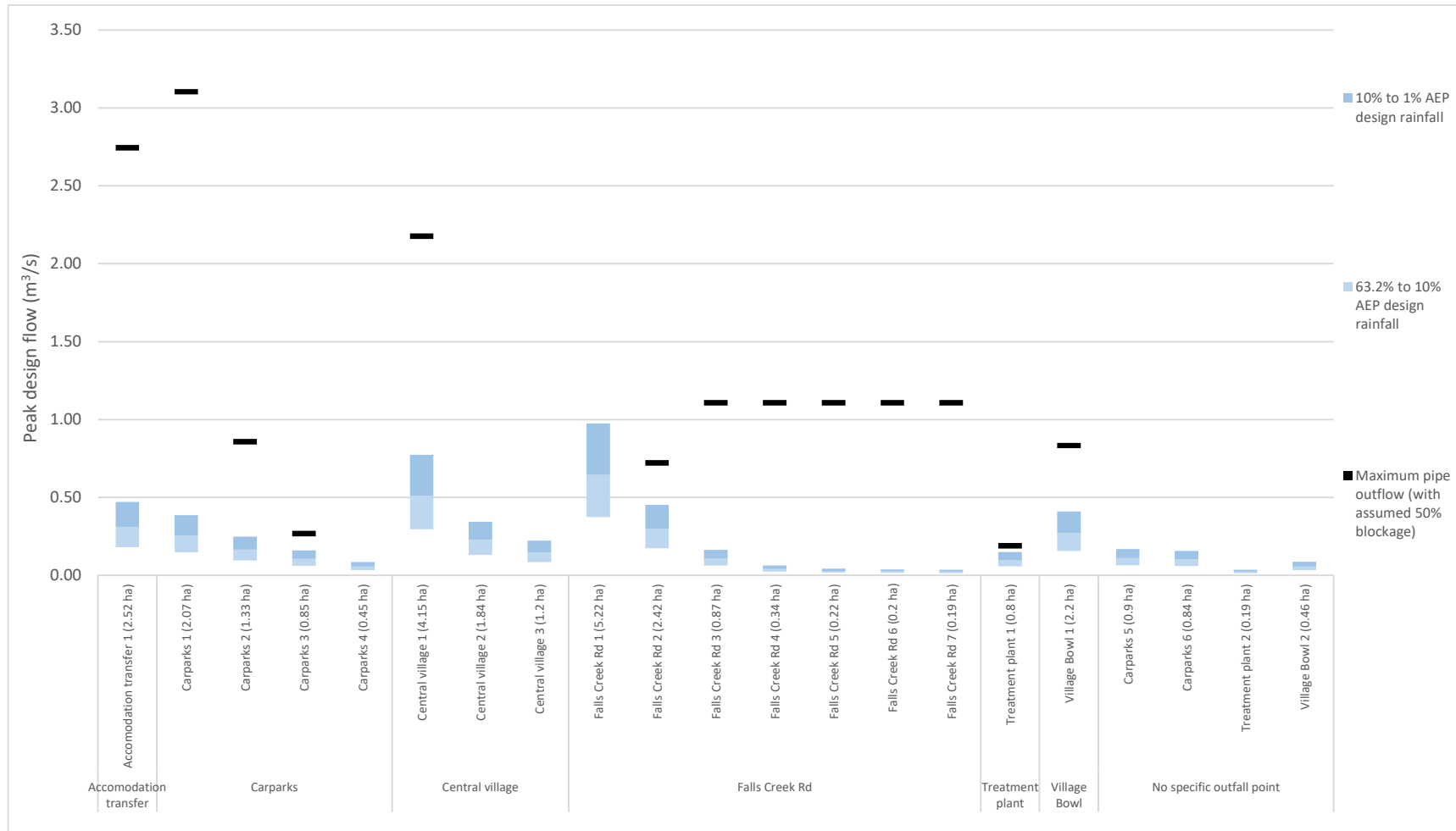


Figure 24. Stormwater capacity issues highlighted across Falls Creek resort with axis adjusted.

Figure 24 is the same figure as before but with an adjusted axis to illustrate data for peak flows that are below 3.5 m³ / second.

8.3 Review of stormwater capacity and pipe network with climate change

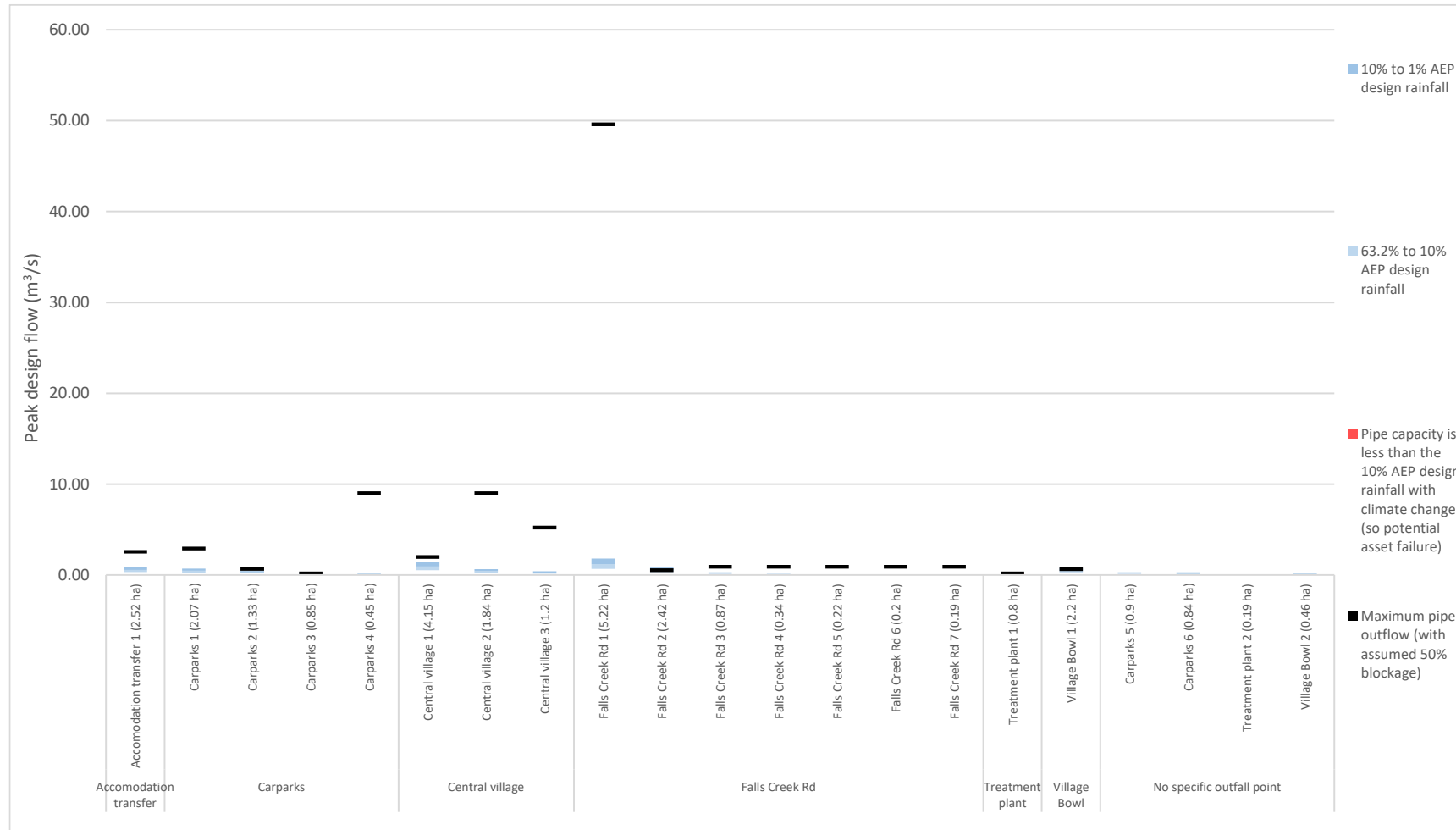


Figure 25. Stormwater capacity issues highlighted across Falls Creek resort with projected effect of climate change on rainfall.

Climate change is forecast to create more intense storms, and therefore the potential to see more assets failure or not be able to cope with the 10% design rainfall storm. When all the catchments were modelled with a more intense storm, the existing pipes were still designed to handle peak flows that are above this climate change type of storm.

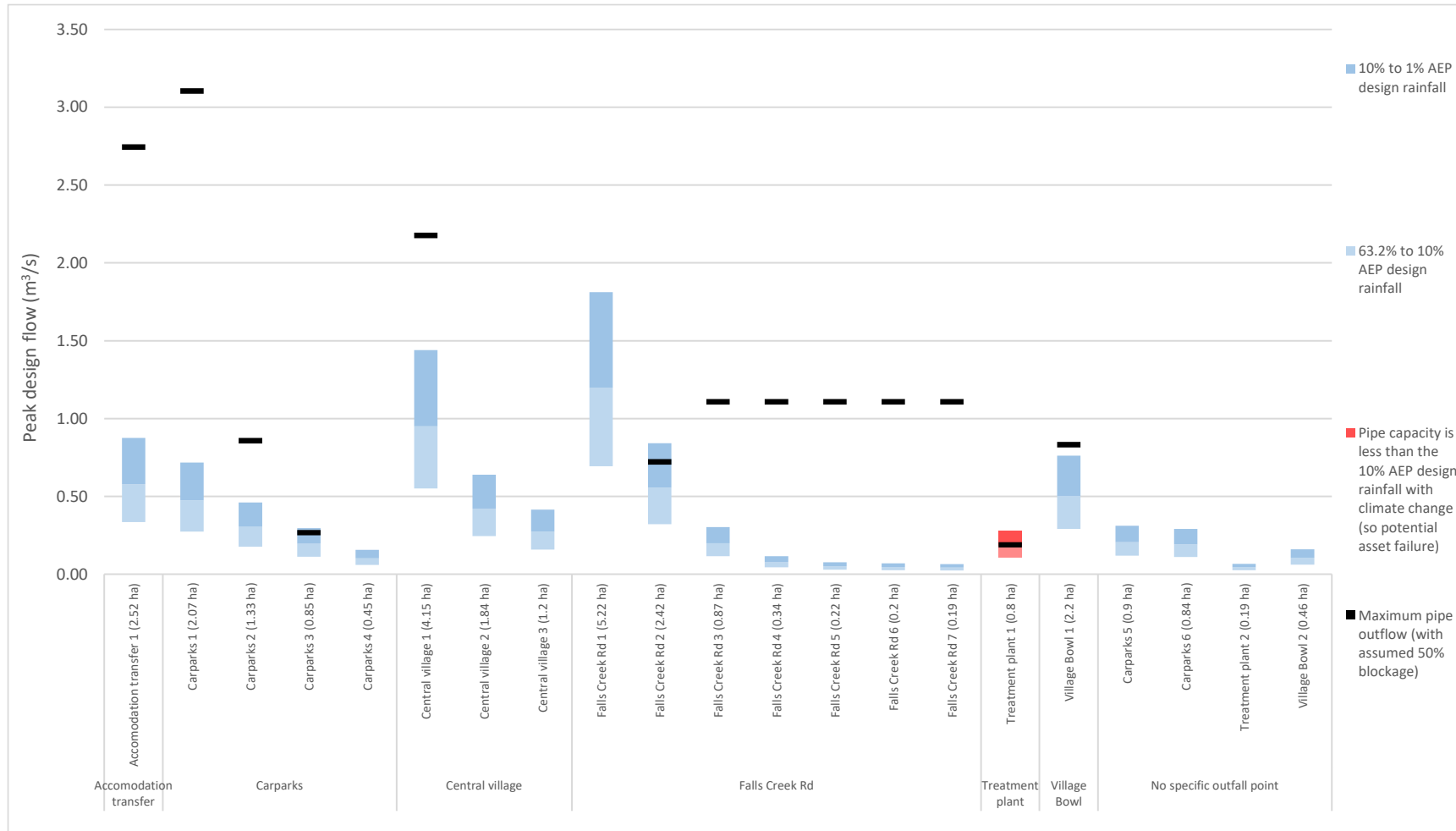


Figure 26. Stormwater capacity issues highlighted across Falls Creek resort with projected effect of climate change on rainfall with axis adjusted.

Figure 26 shows that the stormwater network near the Treatment Plant at Falls Creek, may have issues coping with intense rainfall under climate change, but this area is the only one in the whole resort.

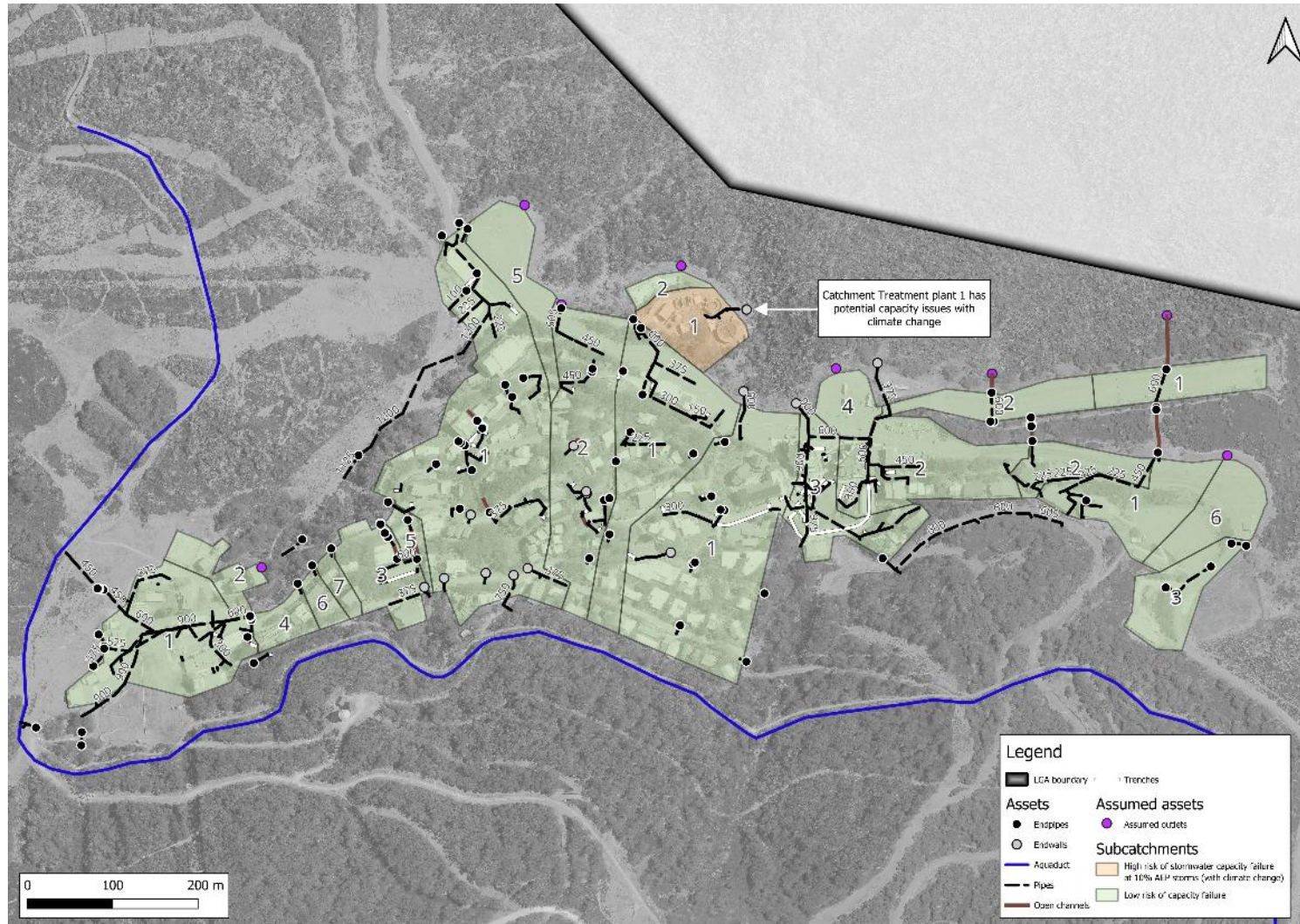
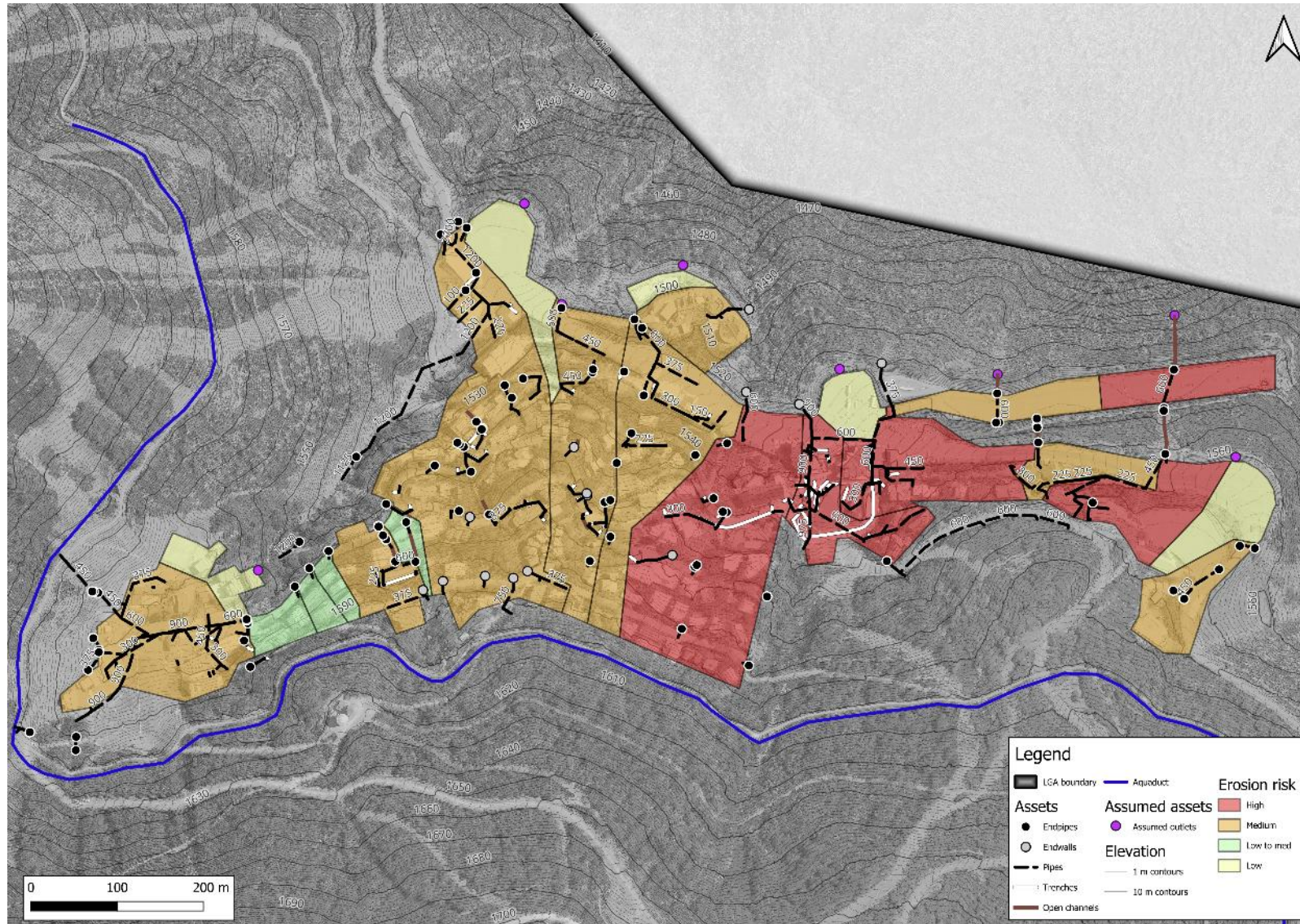


Figure 27 highlights graphically the modelling work that identifies any areas that should be considered for future investment to cope with intense rainfall and climate change.

Figure 27. Modelled outfalls and pipes that require upgrades to meet design specifications

8.4 Identifying erosion risks at outlets



The figure above shows that due to the nature of the size of catchments, and slope, there are only a few areas that have a high risk of erosion where the stormwater enters the downstream alpine environment, mostly in the middle of the village. Based on the semi-quantitative analysis in Figure 28, it may be worth considering a more detailed assessment of the local environment and risk of erosion, and how to mitigate this risk (thinking of actions within the catchment and at the outlet).

Figure 28. Erosion risk across all catchments in Falls Creek Resort