NSW National Parks and Wildlife Service

NSW alpine resorts environmental performance report 2020–21

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Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

Artist and designer Nikita Ridgeway from Aboriginal design agency – Boss Lady Creative Designs, created the People and Community symbol.

Cover photo: Perisher snow groomer at sunrise.
Photo: Perisher Resort

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Foreword

Kosciuszko National Park is home to 4 major alpine resorts in New South Wales: Charlotte Pass Snow Resort, Perisher Ski Resort, Selwyn Snow Resort and Thredbo Alpine Resort. In total, these alpine resorts cover a combined leased or licensed area of just under 3,000 hectares. The alpine resorts contain internationally significant natural values, including restricted habitats of threatened species and threatened ecological communities, while also being recognised for their important recreational values.

The NSW National Parks and Wildlife Service (NPWS) (part of the NSW Department of Climate Change, Energy, the Environment and Water) is responsible for the implementation of the *Kosciuszko National Park plan of management 2006* (plan of management) (NPWS 2006). NPWS maintains oversight of environmental management within Kosciuszko National Park including the alpine resorts. NPWS is responsible for ensuring all operators within Kosciuszko National Park undertake environmental management, monitoring and annual reporting through an environmental management system in accordance with the plan of management and relevant tenure arrangements.

In addition, NPWS leads several environmental management and monitoring programs relevant to the alpine resorts and is responsible for delivering municipal services within the Perisher Range resorts, which includes Perisher Valley, Smiggin Holes, Blue Cow and Guthega.

This alpine resorts environmental performance report has been prepared by NPWS for the period between 1 March 2020 and 28 February 2021. It is based on information and environmental data provided by 3 of the 4 alpine resort operators: Charlotte Pass Snow Resort Pty Limited, Kosciuszko Thredbo Pty Limited and Perisher Blue Pty Limited. Selwyn Snow Resort was severely damaged during the January 2020 fires and as such did not submit data for this reporting period. The report also includes information and environmental data gathered from NPWS programs and operations, and club and commercial lodges within the Perisher Range resorts and Charlotte Pass Snow Resort.

This report demonstrates a commitment to the environment by the alpine resort operators, lodges and NPWS. Among other things, this commitment is shown through:

- continued implementation of energy-saving initiatives to help reduce total energy consumption
- ongoing weed control and rehabilitation
- upgrades and maintenance to sewage treatment plant infrastructure, helping to improve wastewater treatment and compliance
- continued resort collaboration on litter control through the Sustainable Snowies group.

NPWS would like to thank the alpine resort operators and lodges for their willingness to work collaboratively with us and each other to ensure the significant environmental values of Kosciuszko National Park are maintained. Together we can continue to improve our practices and preserve the park for future generations to enjoy.

Anthony Evans

A/Director, Park Operations Projects

NSW National Parks and Wildlife Service, Department of Climate Change, Energy, the Environment and Water

Summary

This *NSW alpine resorts environmental performance report 2020–21* covers the period between 1 March 2020 and 28 February 2021. The report combines information provided to the NSW National Parks and Wildlife Service (NPWS) by 3 alpine resort operators in their annual environmental performance reports, namely, Charlotte Pass Snow Resort, Perisher Ski Resort and Thredbo Alpine Resort. Selwyn Snow Resort was destroyed during the January 2020 fires and did not provide data for this report. Information has also been obtained from the NPWS Perisher Team, who operate municipal services within the Perisher Range resorts, the NPWS Resorts Environmental Services Team, and from the club and commercial lodges that operate in the Perisher Range resorts and Charlotte Pass Snow Resort.

The term 'Perisher Range resorts' refers to the resort areas of Perisher Valley, Smiggin Holes, Blue Cow and Guthega. Perisher Ski Resort (trading as Perisher Blue Pty Ltd), NPWS Perisher Team, and various club and commercial lodges operate in those resort areas.

In providing input for this report, the alpine resort operators and NPWS Perisher Team submitted their environmental performance data through the EarthCheck online portal for the first time. Alpine resort operators were required to calculate a 'person year' figure, which incorporates the staff population and guests, to calculate the full-time equivalent number of people in each resort for a full year. The person year figure is an additional indicator used to calculate the amount of water and energy consumed, and waste generated, per person per year. This reduces the effect of fluctuating visitor numbers on reporting requirements. This was a timely addition, as during the reporting period the NSW Government implemented COVID-19 restrictions which reduced visitation.

In accordance with management objective 12.1.1.8 of the *Kosciuszko National Park plan of management 2006* (plan of management) (NPWS 2006), this report includes the following key environmental reporting:

- water quality monitoring results
- measures applied to reduce air and noise pollution
- water conservation, energy conservation, waste minimisation, reduction in light spillage and scenic quality enhancement measures and results
- human waste volumes treated at each of the sewage treatment plants servicing the alpine resorts
- quantities of rubbish and recyclable material collected and its ultimate destination
- remediation progress at contaminated sites
- information relating to the nature of pollution incidents, how they have been managed, and the corrective action taken to prevent their recurrence.

The performance of the alpine resorts (Perisher Ski Resort, Thredbo Alpine Resort and Charlotte Pass Snow Resort) in relation to Chapter 12 of the plan of management is summarised in Table 1. Appendix A includes the EarthCheck-generated alpine resorts performance summary.

Table 2 shows a performance summary for the Perisher Range resort lodges and Charlotte Pass Snow Resort lodges against their targets.

The key to the performance trends in Table 1 and Table 2 are as follows:

Significant improvement: This can be due to a single event or a steady upward trend.

No significant change: This can mean the objective continues to be achieved or may mean continued impairment or poor performance during the reporting period.

Decline in performance: This can be due to a single event or a steady downward trend.

The key to the target status in Table 2 are as follows:

✕ Below the target

Exceeds the target

Table 1 Summary of NSW alpine resorts environmental performance in 2020–21 and trends since 2018, including Perisher Ski Resort, Thredbo Alpine Resort and Charlotte Pass Snow Resort

Annual report requirement	Section in this report	Environmental performance 2020–21	Trend 2018–19	Trend 2019–20	Trend 2020–21
Water quality monitoring results	Section 2	There were fluctuations in biological health and water quality within all sites (including control sites) during the reporting period. Total nitrogen in particular was outside guideline limits for most of the reporting period. Alpine resorts continue to work on improving water quality.	No significant change →	No significant change →	No significant change →
Measures applied to reduce air and noise pollution and to improve scenic quality	Section 6	Alpine resorts are continuing to implement a range of measures to maintain air quality, reduce noise pollution and improve scenic quality through weed management, rehabilitation and pest control.	Significant improvement ↑	No significant change →	No significant change →
Water conservation, waste minimisation, energy conservation, reduction in light spillage and scenic quality enhancement results	Sections 1, 2, 3, and 7	All alpine resorts and NPWS reduced their total energy consumption, particularly their electricity usage, during the reporting year. Alpine resorts continue to actively participate in and implement waste reduction programs. Water conservation by the resorts is ongoing.	No significant change →	Significant improvement ↑	No significant change →
Human waste volumes treated at each sewage treatment plant in the alpine resorts	Section 4	Human waste volumes treated at each of the sewage treatment plants is monitored by operators according to the relevant NSW Environment Protection Authority (EPA) environment protection licence. Overall, sewage treatment plant performance improved compared to the previous year. Charlotte Pass Snow Resort sewage treatment plant upgrade works resulted in a significant drop in the number of non-compliances, from 196 in 2019–20 to one non-compliance in 2020–21.	No significant change →	Decline in performance ↓	Significant improvement ↑
Quantities of rubbish and recyclable material collected and its ultimate destination	Section 3	Each alpine resort is responsible for the management of rubbish and recyclable material and its ultimate destination. During the reporting year, the percentage of recycling decreased, and the total waste generated also decreased compared to previous years. This correlates with a reduction in guest numbers due to COVID-19.	No significant change →	Significant improvement ↑	Significant improvement ↑

Annual report requirement	Section in this report	Environmental performance 2020–21	Trend 2018–19	Trend 2019–20	Trend 2020–21
Remediation progress at contaminated sites	Section 6	Potential for contaminated sites in the alpine resorts typically occurs around underground petroleum storage systems (UPSS). There was one (major) UPSS contamination event caused by the 2020 bushfires during the reporting period. During the decommissioning of the former Selwyn Snow Resort UPSS site, hydrocarbon-impacted soil was identified. Selwyn Snow Resort will prepare and implement an ongoing remediation action plan for the former UPSS site.	Significant improvement 	No significant change 	Decline in performance 
Information relating to the nature of pollution incidents, how they are managed, and the corrective action taken to prevent their recurrence	Section 5	Various pollution incidents have occurred in the alpine resorts throughout the reporting period, the majority relating to hydraulic fluid spills from vehicles and other machinery. All minor spills appear to have been managed in a timely and appropriate manner, and the total number of reported pollution incidents has reduced.	No significant change 	No significant change 	Significant improvement 

Table 2 Alpine lodges environmental management systems performance summary, including targets and performance for Perisher Range resort lodges and Charlotte Pass Snow Resort lodges

Environmental management systems target	2018–19 performance indicator	Target status	2019–20 performance indicator	Target status	2020–21 performance indicator	Target status
100% lodges have thermostat settings	Significant improvement ↑	Below the target ×	Decline in performance ↓	Below the target ×	Decline in performance ↓	Below the target ×
100% lodges have timer systems and/or sensor switches for lighting and heating	No significant change →	Below the target ×	Decline in performance ↓	Below the target ×	Decline in performance ↓	Below the target ×
100% lodges use off-peak hot water or instantaneous gas hot water	Significant improvement ↑	Below the target ×	Decline in performance ↓	Below the target ×	Significant improvement ↑	Below the target ×
25% of lodges purchase green power from their electricity provider	Significant improvement ↑	Below the target ×	Decline in performance ↓	Below the target ×	Significant improvement ↑	Below the target ×
100% lodges have more than 75% of light bulbs as fluorescent, LED, or high efficiency/long life bulbs	Significant improvement ↑	Below the target ×	Decline in performance ↓	Below the target ×	No significant change →	Below the target ×
100% lodges provide signs or other measures to encourage guests, visitors and staff to minimise energy use	No significant change →	Below the target ×	Decline in performance ↓	Below the target ×	No significant change →	Below the target ×
100% lodges separate out food waste and dispose of it through the composting waste stream	Significant improvement ↑	Below the target ×	Decline in performance ↓	Below the target ×	Decline in performance ↓	Below the target ×

Environmental management systems target	2018–19 performance indicator	Target status	2019–20 performance indicator	Target status	2020–21 performance indicator	Target status
Zero pollution incidents in the last 12 months	No significant change 	Meets the target ✓	No significant change 	Below the target ✕	No significant change 	Below the target ✕
60% of lodges undertaking weed control	No significant change 	Below the target ✕	Significant improvement 	Below the target ✕	Significant improvement 	Below the target ✕
Reduce amount of carbon dioxide equivalent emitted per visitor night	Decline in performance 	Below the target ✕	Decline in performance 	Below the target ✕	Significant improvement 	Exceeds the target 
Energy use per visitor night to be better than environmental management system lodge sector average	Decline in performance 	Below the target ✕	Decline in performance 	Below the target ✕	Significant improvement 	Exceeds the target 
More than 5% of total energy used to come from renewable sources	Decline in performance 	Below the target ✕	Decline in performance 	Below the target ✕	Significant improvement 	Below the target ✕
Less than 200 litres of water used per visitor night	Significant improvement 	Below the target ✕	Decline in performance 	Below the target ✕	Significant improvement 	Exceeds the target 

Introduction

This *NSW alpine resorts environmental performance report 2020–21* for the period 1 March 2020 to 28 February 2021 provides a summary of reporting against the environmental quality requirements outlined by section 11.6 and Chapter 12 of the *Kosciuszko National Park plan of management 2006* (plan of management) (NPWS 2006) across the alpine resorts in Kosciuszko National Park. The report combines the information provided to NPWS by 3 resort operators – Perisher Ski Resort, Charlotte Pass Snow Resort and Thredbo Alpine Resort – via their annual environmental reporting. Selwyn Snow Resort Pty Limited has not submitted data for this report. Since the January 2020 bushfires when the resort was severely damaged, the operator has been working with relevant agencies including NPWS to finalise plans and gain approval for rebuilding the resort to meet current standards and provide an enhanced guest experience.

This report also includes information from the NPWS Perisher Team and NPWS Resorts Environmental Services Team, along with reporting from independent lodge operators in Perisher Range resorts and Charlotte Pass Snow Resort. The term 'Perisher Range resorts' refers to the resort areas of Perisher Valley, Smiggin Holes, Blue Cow and Guthega.

To the best of our knowledge, the information provided for collation in this report has been provided in good faith and is true and correct.

This report aligns with the plan of management requirements for annual reporting, as outlined in Chapter 12, management objective 12.1.1.8. It is also consistent with the environmental quality objectives in section 11.6 of the plan of management. Environmental quality refers to the natural attributes and parameters that lead to the environmental character and sustainable use of Kosciuszko National Park. These have been identified in the plan of management as:

- water quality
- water consumption
- soil contamination
- waste generation
- energy consumption
- air pollution
- light pollution
- noise pollution
- scenic quality.

In addition to specific reporting for these objectives, the report includes details on the ongoing collaborative environmental management and regulatory work that the NPWS Resorts Environmental Services Team undertakes within the alpine resorts.

In providing input for this report, the alpine resort operators and NPWS Perisher Team submitted their environmental performance data through the EarthCheck online portal for the first time.

Lodges

The term ‘Perisher Range resort lodges’ refers to the approximately 123 ski club lodges, chalets and commercial lodges in the Perisher Range resorts leased directly from NPWS. The majority of Perisher Range resort lodges (120) have been reporting on their environmental performance since the early 2000s. Three accommodation providers have been added to the environmental management system reporting program for the 2020–21 period. These accommodation providers are Sponars Chalet, Ski Rider Hotel and Kosciuszko Tourist Park. Charlotte Pass Snow Resort has 13 lodges, who have been reporting on their environmental performance since 2018–19.

These lodges have collectively submitted information on their environmental performance, including a ‘visitor night’ figure for the 2020–21 reporting period. EarthCheck generates a ‘performance report’ for each lodge to show their individual performance compared to previous years. The data from all 136 lodges is included in this report.

Resorts

Energy consumption, water consumption and waste generation are all impacted by fluctuating visitor numbers. Therefore, a ‘person year’ (or per person per year) figure has been included in this report. Using the person year figure, energy consumption, water consumption and waste generation can be calculated into per person per year usage. This will show changes or continual improvement over time, even if visitor numbers at the alpine resorts fluctuate.

The person year figure incorporates the staff population and guests. The alpine resort operators have included overnight guests and staff numbers (to ascertain overnight population), along with commuting staff and guest ticket sales (to ascertain day visitation). The person year figure is calculated to be equivalent to 365 full person days, as detailed below:

- Each ‘guest night’ is counted as one person day (24 hours) and each ‘day guest’ is counted as one-third of a person day (8-hour day).
- Staff numbers are broken down into full-time, part-time and seasonal staff. Several staff also live onsite, which is accounted for in the same way as a guest night.
- Each guest figure and the seasonal staff figure is divided by 365 (for number of days in the year). Non-seasonal full-time staff figures are not divided by 365 as they are already present in the resort on a year-round basis.
- All figures are then added together to create the person year figure, equivalent to 365 full person days.
- The Perisher Range resorts person year figure includes NPWS staff, the Perisher Resort person year figure, the Perisher Range resort lodges total visitor night figure, and in some cases the Charlotte Pass Snow Resort person year figure (depending on the environmental metric for which the person year figure is required).

Alpine resort operators and NPWS Perisher Team total energy, water consumption and waste generation will continue to be documented and discussed in this report. The person year figure is an additional indicator being added to alpine resorts environmental reporting to enable easier benchmarking year-on-year.

Figure 1 NSW alpine resorts location map

1. Water

This section reports on environmental quality as per section 11.6 and Chapter 12 of the plan of management, which specifically requires the inclusion of water quality monitoring results and an outline of water conservation efforts.

The alpine streams in Kosciuszko National Park are located near the top of water catchments and provide water for lower catchment use including domestic, agriculture and hydro-electricity generation. These water catchment areas also support endemic and threatened vegetation communities, which include a rich diversity of freshwater and terrestrial biota. Alpine resort operations, where not managed appropriately, could impact on both the availability of water resources and the biodiversity which relies on it. NPWS and the alpine resort operators are required to monitor water quality and consumption in accordance with regulatory requirements.

1.1 Water quality monitoring

Biological, physical and chemical water quality monitoring is undertaken on:

- Spencers Creek around Charlotte Pass Snow Resort
- Rock Creek, Perisher Creek, Pipers Creek, Smiggin Tributary, Farm Creek and Blue Cow Creek around the Perisher Range resorts
- Diggers Creek around Sponars Chalet
- Sawpit Creek around the Kosciuszko Tourist Park
- Thredbo River around Thredbo Alpine Resort.

Monitoring reports provide a ‘stream health report card’ based on how the water quality measurements collected compare against the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZG 2018). Measurements include temperature, turbidity, total dissolved solids, electrical conductivity, pH, dissolved oxygen and nutrients.

Reports also provide details of biological health based on several macroinvertebrate indices, including:

- taxa richness
- EPT (Ephemeroptera, Plecoptera and Trichoptera) taxonomic order richness and ratio
- total and relative abundance of major taxonomic orders
- SIGNAL2 (stream invertebrate grade number average level) – family score (Chessman 2003)
- Australian River Assessment System (AUSRIVAS) models (eWater and Australian Government n.d.).

A summary of the results from the relevant reports is given in the following sections.

Perisher Range resorts and Charlotte Pass Snow Resort

Stream health around the Charlotte Pass Snow Resort and Perisher Range resorts is monitored by NPWS in conjunction with the Environment, Energy and Science Group in Department of Climate Change, Energy, the Environment and Water (the department), a summary of monitoring results is provided in Appendix B.

The information below is summarised from the annual Kosciuszko National Park resorts river quality and river health report cards for 2020 (DPE, unpublished). This information is the result of twice-yearly monitoring in autumn and spring at a total of 15 sites within the

Perisher Range resorts and 3 sites at Charlotte Pass Snow Resort. This is supplemented with additional fortnightly sampling during winter and monthly sampling over summer at 16 sites along Rock, Perisher, Pipers, Smiggin, Diggers and Sawpit creeks.

Charlotte Pass Snow Resort - Spencers Creek

Monitoring sites are shown in Figure 2. The results of 2020 monitoring include the following:

- Total nitrogen concentrations were outside guidelines levels at all 3 Charlotte Pass Snow Resort monitoring sites in autumn 2020 and at site 107 in spring 2020. Nitrogen oxide concentrations were outside guideline levels at site 107 in autumn. All other water quality indices, including ammonia, total phosphorus, electrical conductivity and turbidity, were within guideline levels during monitoring. There may be some natural nitrogen sources, however, both total nitrogen and nitrogen oxide were highest at site 107 downstream of Charlotte Pass Village and its sewage treatment plant. This suggests the treatment plant discharge contributes nitrogen to Spencers Creek and elevates the concentration above natural levels.
- Using the AUSRIVAS method, macroinvertebrates at sites 105 and 107 recorded band B (significant impairment) in autumn and improved to band A (similar to reference) in spring, whereas site 106 recorded band A in autumn and declined to band B in spring. EPT ratio at site 107, the furthest downstream site, was within the guideline while sites 105 and 106 were just outside the guideline for both the autumn and spring monitoring. EPT richness recorded ‘poor’ at site 106 closest to the Charlotte Pass Village, whereas sites 105 and 107 scored ‘moderate’ to ‘good’. Similarly, SIGNAL2 family grades were rated ‘moderate’ to ‘high moderate’ at sites 105 and 107 respectively, and ‘poor’ at site 106. Macroinvertebrate results suggest that the resort area around site 106 is degraded compared to sites 105 and 107.

Overall, the water quality variables measured by the department in autumn and spring 2020 were predominately ‘moderate’, with site 107 scoring ‘good’. The BioScore (biological response index) for site 107 improved from ‘moderate’ in 2019 to ‘good’ in 2020. The improvement could be, in part, due to the upgrades undertaken by Charlotte Pass Snow Resort to the sewage treatment plant. These upgrades were completed in December 2020.

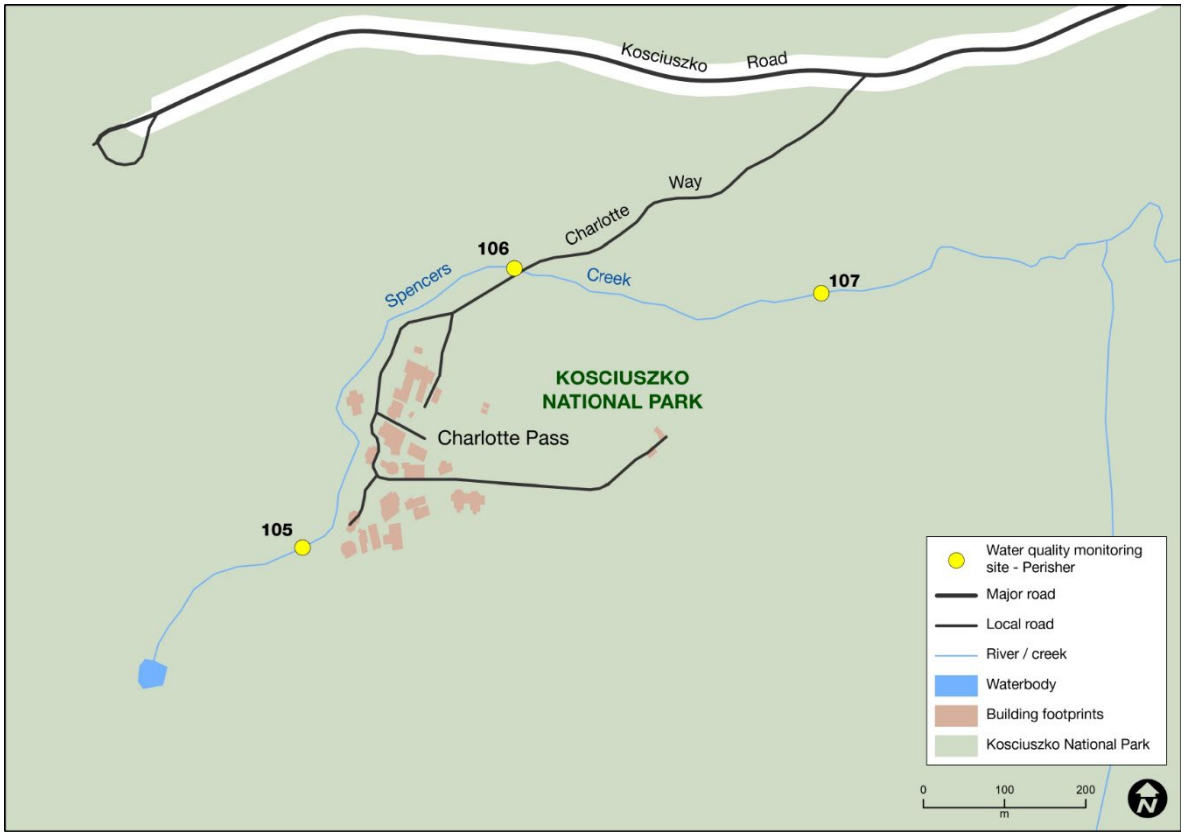

Figure 2 Water quality monitoring sites around Charlotte Pass Snow Resort

Perisher Valley – Rock Creek and Perisher Creek

Monitoring sites are shown in Figure 3. The results of 2020 monitoring include the following:

- Total nitrogen was consistently outside of guideline levels at all sites throughout the reporting period. Nitrogen oxide was also outside the guideline levels on all occasions at sites 123 and 124 (downstream of the resort car park and the sewage treatment plant) and significantly outside of the guideline on one occasion in spring at site 123, just below the treatment plant. Nitrogen oxide levels consistently outside the guideline are of concern, and continued monitoring will indicate if this is a one-off event or a trend that continues to increase.
- Site 123, below the sewage treatment plant, was the only site to record turbidity outside of guideline levels. Electrical conductivity and turbidity continue to be within guideline levels at all other sites, however they do show an upward trend in 2020. The downstream sites 122, 123 and 124 showed elevated salinity in spring, although still well within the guideline. This is most likely associated with road salting through winter, with the accumulated salt then mobilising in the spring snow melt and entering streams. The combined water quality indicator scores at all sites declined from upper ‘moderate’ and ‘good’ ratings in 2019 to upper and mid ‘moderate’ ratings in 2020.
- Biological indicators such as taxa richness were within the guideline at all sites with most upper (121) and lower sites (124) recording the highest taxa richness. This trend was similar to EPT richness, although there was a decline from autumn to spring, with EPT richness rated as ‘good’. Similarly, SIGNAL2 family grade at sites 120, 121 and 122 recorded decreases from autumn to a ‘moderate’ rating in spring. The furthest downstream sites increased in overall SIGNAL2 family grade from autumn to spring, with sites 123 and 124 rated as ‘good’ in spring. EPT ratio showed a similar trend to EPT richness with all sites increasing from 2019 to autumn 2020, then decreasing from autumn to spring, being rated as ‘moderate’ for sites 121 and 122, and ‘good’ for sites

120, 123 and 124. This trend does appear to have occurred in the past and is perhaps a seasonal response at the upstream sites. AUSRIVAS results at all sites were rated band A (similar to reference) for all monitoring events.

Overall, water quality monitoring showed elevated electrical conductivity and nitrogen oxide at the downstream sites (122, 123 and 124), and all sites showed elevated total nitrogen. Biological indicators including AUSRIVAS results showed ‘good’ macroinvertebrate communities and stream condition across all sampling sites and events; and BioScores followed a similar trend, with a slight increase from 2019 to 2020.The physiochemical data suggests the main car park and the sewage treatment plant are negatively impacting water quality. However, macroinvertebrate species have not shown the same decline, indicating that the impacts on water quality are acute rather than chronic.

Monthly monitoring of nutrients in Perisher Creek should provide a better understanding of the spatial and temporal extent of potential impacts that the main car park, Perisher Resort and treatment plant have on water quality and provide further information for the assessment of the macroinvertebrate community downstream.

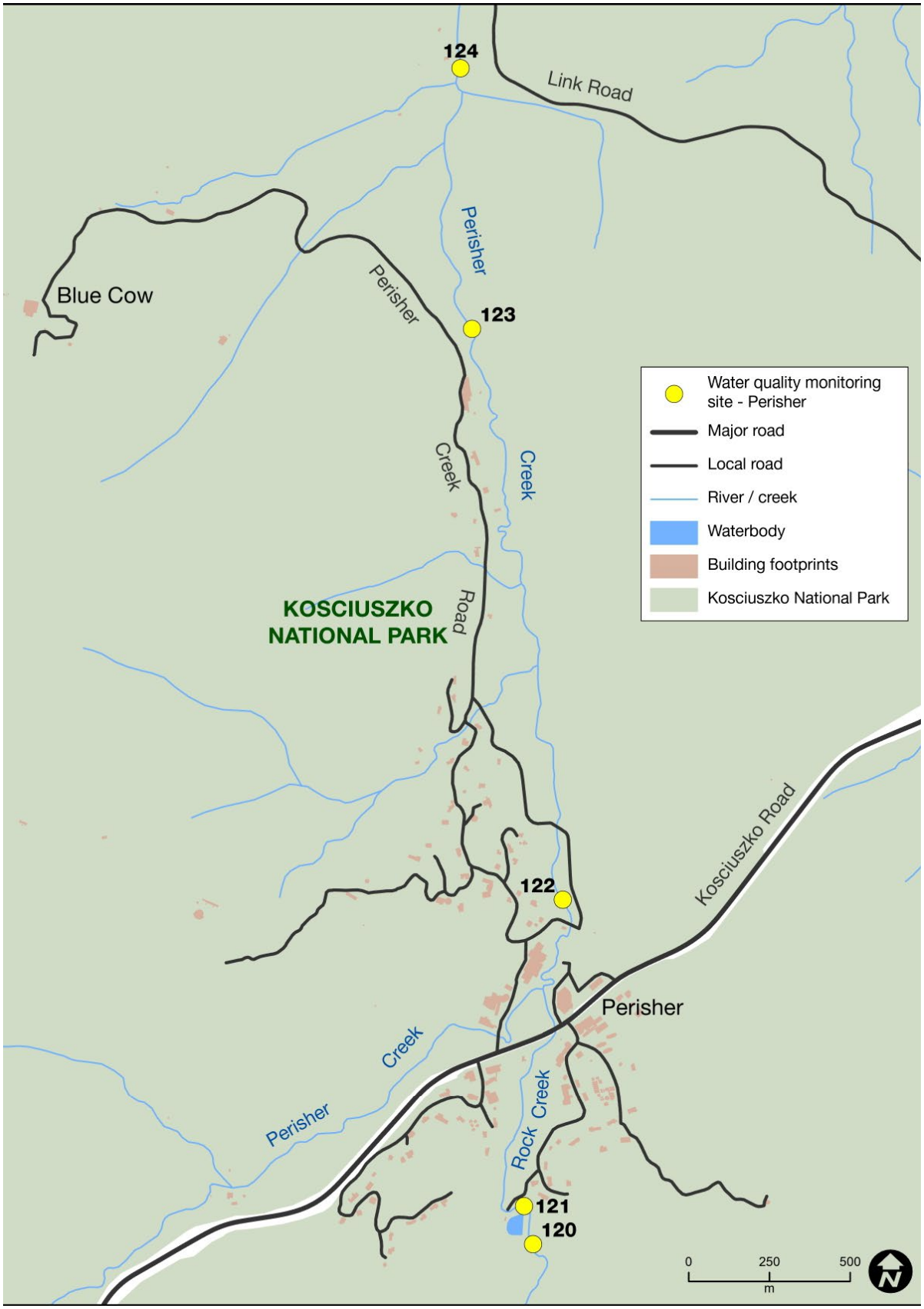

Figure 3 Water quality monitoring sites around Perisher Valley

Guthega and Blue Cow - Farm Creek and Blue Cow Creek

Monitoring sites are shown in Figure 4. Guthega has one monitoring site on Farm Creek (502) and one site on Blue Cow Creek (503). Site 501 on Farm Creek upstream of the weir was discontinued after 2019 because there has been negligible difference in water quality and macroinvertebrate condition since it was first sampled in 2004.

The results of 2020 monitoring include the following:

- Historically the water quality at Farm Creek has been excellent. All variables other than total nitrogen and total phosphorous were within the guideline levels in autumn and spring 2020. Total nitrogen was outside the guideline at both sites (502 and 503) in autumn but returned to guideline levels in spring 2020. Total phosphorus was within guideline levels for most of the reporting period except for site 503 in autumn, where concentrations were equal to the highest recorded since 2012 at the historical site (site 501).
- Ammonia has been consistently low at sites 502, 503 and the historical site 501 and remained low in autumn 2020. However, ammonia concentrations spiked in spring at site 503, the furthest downstream site, but remained within guideline levels. Future monitoring will indicate if this was a one-off event, or if ammonia concentrations are increasing. Electrical conductivity and turbidity both recorded some of the lowest results at sites 502 and 503 since 2012.
- Taxa richness was rated ‘very good’ on both sampling occasions and has consistently increased from 2019 to 2020. Site 503 recorded a decrease in EPT richness in spring and both sites recorded a decrease in EPT ratio from autumn to spring. However, EPT richness and ratio at both sites remained rated as ‘good’. AUSRIVAS results at site 503 were recorded as band A (similar to reference) on both sampling occasions, whereas site 502 was band A in autumn but fell to band B (significantly impaired) in spring.

Overall water quality at Farm Creek and Blue Cow Creek was rated as ‘good’ and macroinvertebrates score was rated ‘very good’ to ‘good’ for the reporting period.

Image 1 **The Snowy River, above Guthega Dam. Photo: E Stafford/DCCEEW**

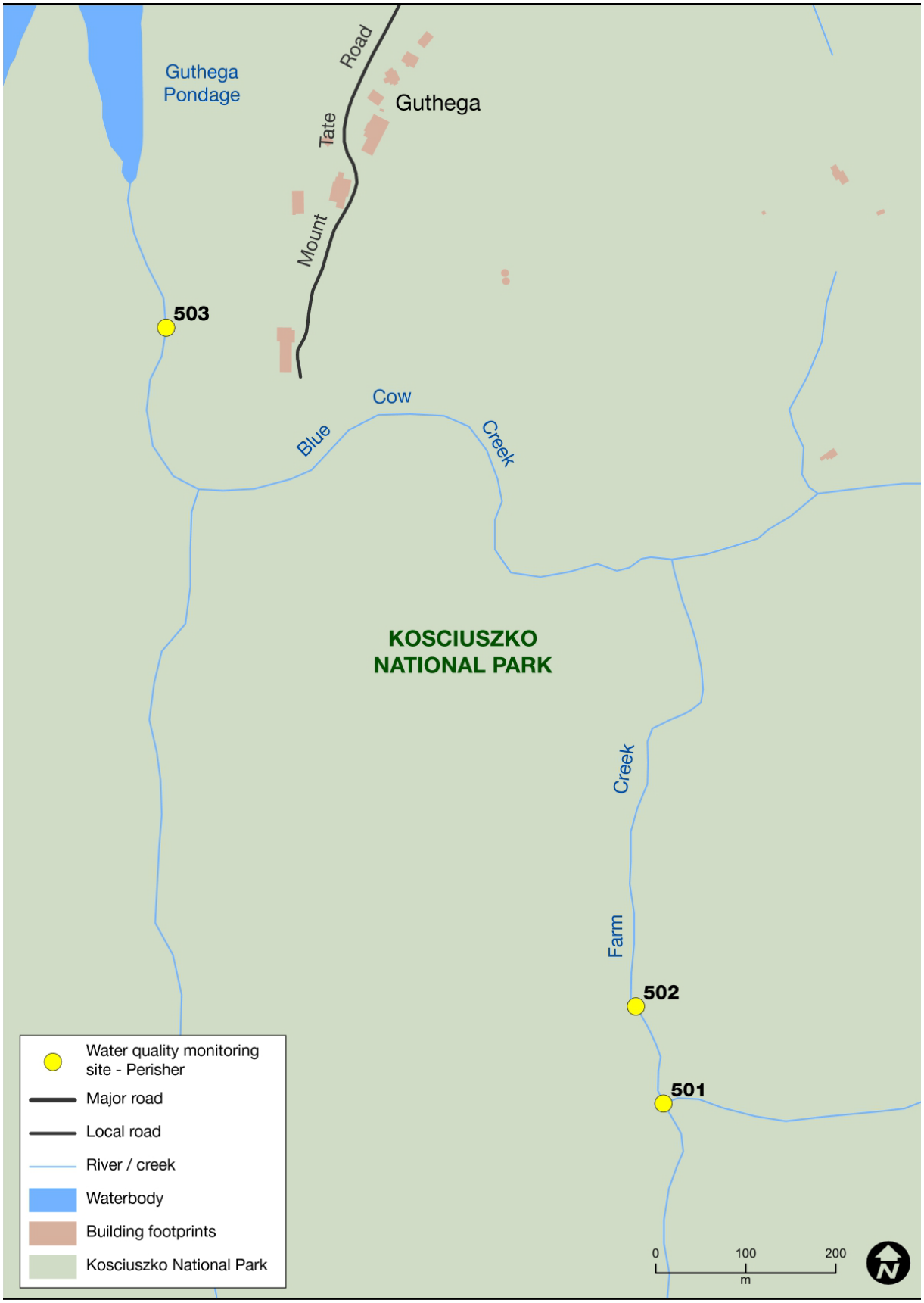

Figure 4 Water quality monitoring sites around Guthega resort area

Smiggin Holes - Pipers Creek and Smiggin Tributary

Monitoring sites are shown in Figure 5. The results of 2020 monitoring include the following:

- Total nitrogen and nitrogen oxide at Smiggin and Pipers creeks were consistently elevated. Total nitrogen was detected outside the guideline at all Pipers Creek sites (128, 128A and 129) in spring, and sites 128 and 129 in autumn. Nitrogen oxide concentrations were outside the guideline at site 129 in autumn but improved by spring. Sites 128 and 128A were within the guideline for nitrogen oxide, total phosphorus, electrical conductivity and turbidity.
- Electrical conductivity increased from autumn to spring at all sites except 128A. Sites 131, 130 and 129 recorded the highest salt concentrations, however, electrical conductivity was still within the guideline and below historic concentrations. Ammonia recorded a spike from autumn to spring at all sites except 128A which recorded a higher ammonia level in autumn. However, ammonia remained within the guideline levels across all sites.
- Site 131 recorded total phosphorus concentrations outside the guideline in autumn. These concentrations returned to within the guideline levels in spring 2020.
- Monthly water quality sampling performed by NPWS at Smiggins and Pipers creeks reveals a declining trend for total nitrogen, nitrogen oxide and turbidity for the majority of sites. This trend is much more prevalent at sites 129, 130 and 131 nearest the resort, from early winter to early spring. Total nitrogen and nitrogen oxide results show sites 130 and 131 to be outside guideline in early winter. From October onwards total nitrogen returned to within guideline levels for both sites and nitrogen oxide for site 131, whereas site 130 remained outside of guideline for nitrogen oxide. Sites 128 and 129 were above the guideline in early winter, returning to within or just above the guideline in September 2020. Electrical conductivity and ammonia show a reverse trend, with electrical conductivity increasing at sites 130 and 129 from July and September respectively. All sites other than site 129 recorded salinity within the guideline and site 129 exceeded the guideline from late July, with the concentrations returning to below the guideline in late spring 2020.
- Taxa richness was within the guideline at all sites other than site 130. Sites 128,128A and the furthest downstream site 129 recorded ‘very good’ taxa richness which increased from autumn to spring. Site 131 declined from autumn to spring but was still within guideline levels, whereas site 130 improved from autumn to spring, staying within the guideline but remaining the lowest taxa richness score. EPT richness at sites 128 and 128A scored ‘very good’, site 129 scored ‘good’, and sites 130 and 131 recorded ‘moderate’, with site 130 on the cusp of a ‘poor’ rating in spring. EPT ratio showed a similar trend with sites 128, 128A and 129 rated as ‘good’, whereas 130 and 131 were recorded as ‘poor’. Using AUSRIVAS in autumn 2020, site 128 was recorded as band X (more biologically diverse than reference). Site 128 in spring, and sites 128A and 129 in autumn were recorded as band A (similar to reference). Sites 130, 131 and 129 in spring were rated band B (significant impairment).
- Additional metal, oil and grease sampling takes place around the Smiggin Holes area of the alpine resort to investigate contamination from road and impervious surface runoff. Results indicated most toxicants were within guideline with the exception of aluminium. Aluminium was within the guideline at all sites, except site 130 in November 2020. While background levels of aluminium may be high, the concentration was highest at sites 130 and 131 in both May and November 2020. Although there are no guidelines for sodium, results indicated elevated levels at site 129 downstream of Smiggin Holes on Kosciuszko Road. Sites 130 and 131 also showed elevated sodium, though these concentrations were significantly lower than site 129.

The water quality score has fluctuated at all Smiggin Holes sites over time but sites upstream on Pipers Creek consistently scored better than the downstream sites. Electrical

conductivity and ammonia were found to be higher at sites 130, 131 and 129 within and below the resort area. Total nitrogen was consistently elevated, which could be caused by natural factors within the catchment, however, results were higher at sites 130 and 131 in the Smiggin Holes resort, suggesting some impact from the resort, car park runoff or snow clearing activities.

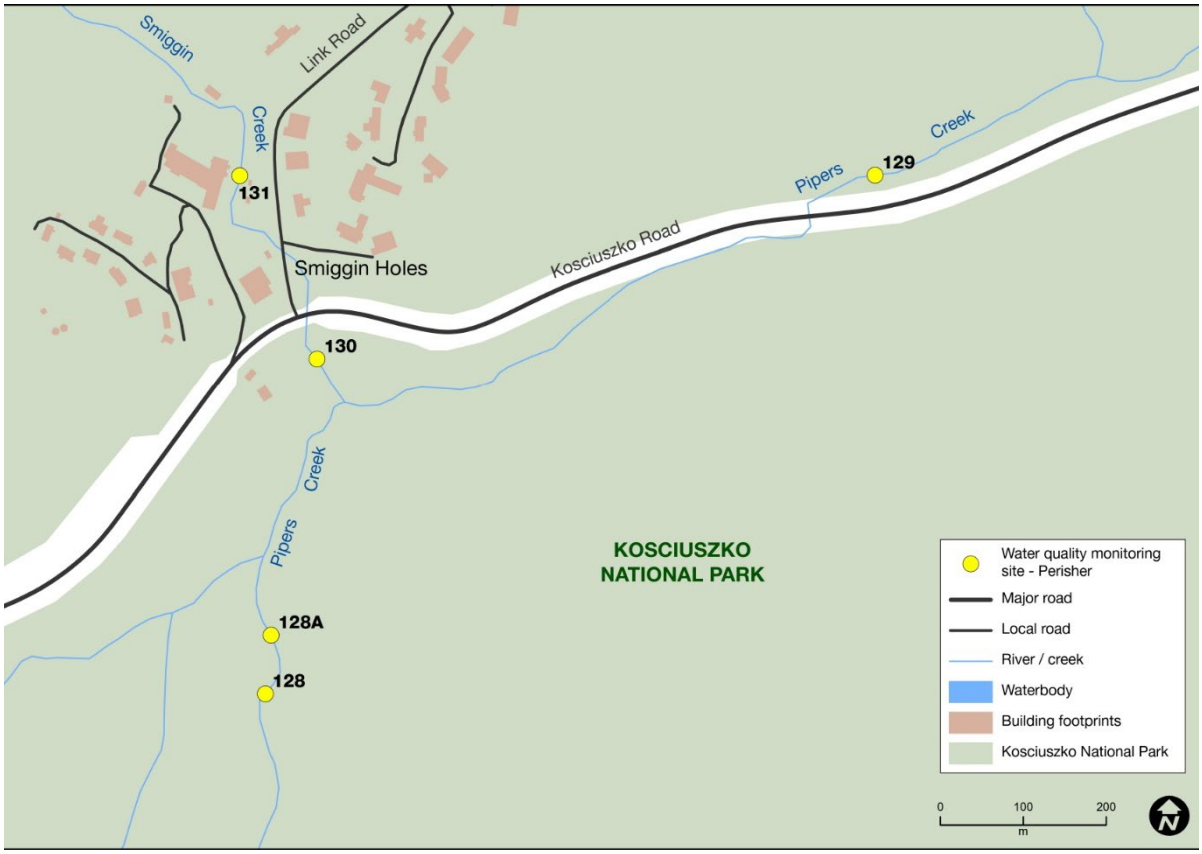

Figure 5 Water quality monitoring sites around Smiggin Holes resort area

Sponars Chalet - Diggers Creek

In 2020 NPWS began water quality monitoring year round, and added an additional site to Diggers Creek. The new Diggers Creek site 1 is above Sponars Chalet to complement Diggers Creek site 2 below Sponars Chalet. The 2 monitoring sites are shown in Figure 6. The results of 2020 monitoring include the following:

- Water quality monitoring found that pH was often outside guideline levels (more acidic). Only 5 monitoring events showed values within the guideline levels, including both sites in late July and December and site 2 in early June. Site 1 was not sampled at this time.
- Turbidity and electrical conductivity were within guideline levels throughout the year, however, site 2 was just within electrical conductivity guideline levels when monitoring took place in May 2020. Unfortunately, monitoring did not take place at site 1 until June 2020, therefore, comments cannot be made on whether higher electrical conductivity at site 2 was isolated to this area, impacted by the resort operations, or a natural catchment variation.

Overall, the Diggers Creek monitoring sites displayed ‘good’ water quality.

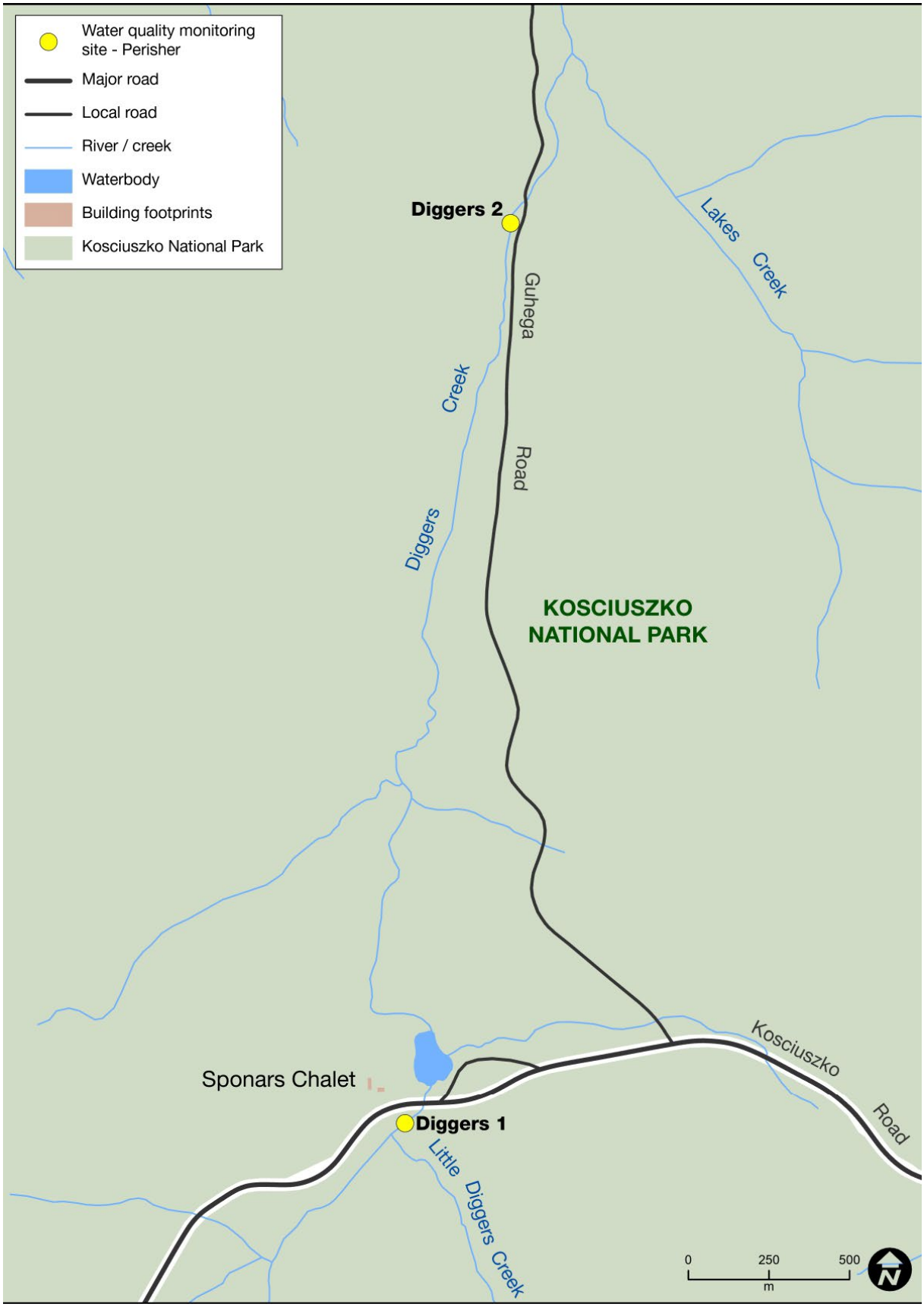

Figure 6 **Water quality monitoring sites around Sponars Chalet**

Ski Rider and Kosciuszko Tourist Park - Sawpit Creek

Monitoring sites are shown in Figure 7. The results of 2020 monitoring include the following:

- Total nitrogen recorded a large increase from 2019 to 2020. Sites 160 and 162 were outside the guideline levels in autumn and spring, with site 162 recording the highest total nitrogen concentrations equal to the highest recorded since 2012. Site 161 was outside guideline levels in autumn and improved to moderate, but still outside of guideline levels in spring. Total phosphorus increased from 2019 to 2020 at all sites. Total phosphorous was recorded just outside guideline levels at sites 160 and 161 in spring. Much like total nitrogen, total phosphorous recorded nearly equal to the highest concentrations since 2012 at site 162.
- Results for ammonia and nitrogen oxide were within the guidelines for all Sawpit Creek sites. Ammonia did record a spike in spring 2020 at site 162, and although this was still within the guideline it is a significant increase compared to historical data and should be monitored. Sawpit Creek has a history of high electrical conductivity however 2020 seems to be an exception, with results returning to just outside the guideline at all sites in autumn. This is an encouraging sign, though the electrical conductivity results do take a slight upward trend in spring 2020.
- Turbidity was within the guideline at all Sawpit Creek sites in autumn, then increased at all sites in spring. The increased turbidity at site 160 was just outside the guideline level while sites 161 and 162 were within the guideline. This trend is consistent with previous years. Site 160 is an upstream site close to the main road, and measures to decrease road runoff may aid a reduction in turbidity at this site specifically.
- Monthly water quality sampling performed by NPWS at Sawpit Creek shows similar results. Total nitrogen was consistently outside the guideline levels and at times (April and October 2020), with significantly higher than recommended guideline levels at the downstream site 162. Total phosphorus was within guideline levels until October 2020 when site 162 concentrations increased to outside of guideline levels. Nitrogen oxide was recorded well within the guideline, except on one occasion (July 2020) at site 162. This result may be due to above average rainfall, as neither total nitrogen nor total phosphorous recorded elevated concentrations during this time. Electrical conductivity increased to outside guideline levels at all sites from June to September, decreasing to within the guideline in October. This is likely to be associated with snow melt and road salting during winter, which is supported by the large increase in turbidity recorded from April to May (especially at site 160).
- Taxa richness indicated ‘very good’ community structure. Sites 161 and 162 have recorded continual increases since mid-2018, while site 160 has plateaued. EPT richness and EPT ratio show similar trends for sites 161 and 162, however site 160 has recorded continual decline in EPT richness and ratio since late 2018 and early 2019. Site 160 is the upstream site, but in close proximity to the major road where runoff causing increased turbidity could be impacting EPT richness and ratio. Although there were fluctuations within biotic indices of the macroinvertebrate community at all sites, AUSRIVAS bands on all but one occasion were rated band A (similar to reference), while site 160 in spring was rated band B (significantly impaired). This could be linked to above average rainfall in October before sampling.

Overall, high nitrogen and phosphorous are most likely associated with sewage treatment plant discharges as they are consistently recorded at their highest levels at the downstream site 162. Improvement to the treatment plant process will most likely lower the concentrations downstream. Continued monitoring of electrical conductivity will allow for a better understanding of the impact road salting has on the waterway and whether lower salinity concentrations seen in 2020 will be long term. Turbidity is of concern at site 160. Measures to decrease road runoff may aid a reduction in turbidity at this site specifically and benefit macroinvertebrate communities.

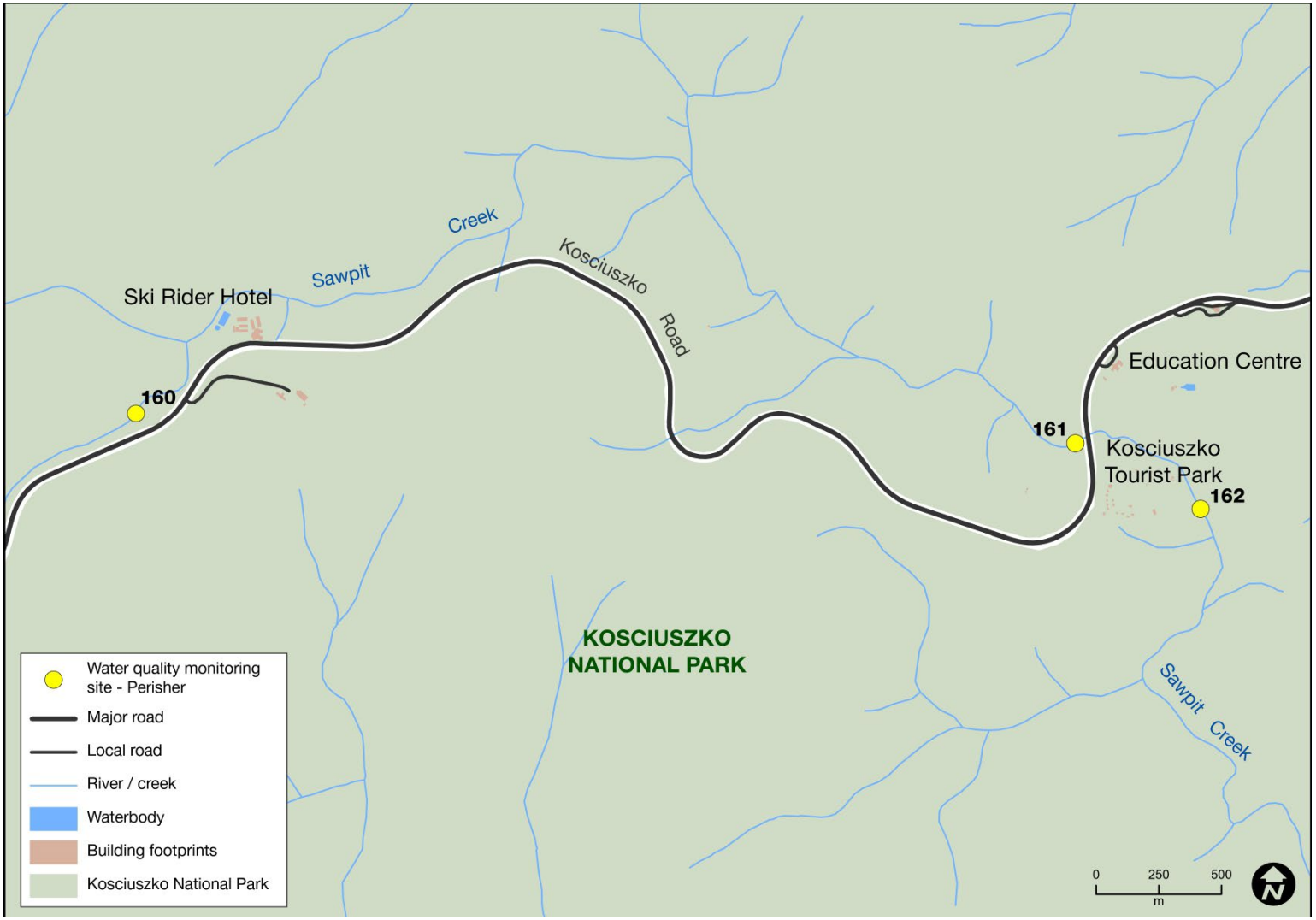

Figure 7 Water quality monitoring sites around Ski Rider Hotel and Kosciuszko Tourist Park

Thredbo Alpine Resort

Biological and physical assessments of the Thredbo River around the Thredbo Alpine Resort are undertaken 4 times per year at 4 sites (Figure 8) by the University of Canberra Institute for Applied Ecology (Lhendup et al. 2020a, b, c, d, 2021). Water quality is continually monitored to assess the effects of the Thredbo village and associated sewage treatment plant on the Thredbo River.

Findings from May, August and November 2020 and February 2021 include the following:

- Physical indicators measured as part of the program show fluctuations throughout the year along with seasonal temperature variations at all 4 monitoring sites. Site 11, the reference site, showed slightly elevated turbidity outside of guideline levels in May 2020 but had returned to within guideline levels by August 2020. The November monitoring showed turbidity levels were significantly higher than guidelines, with site 13 showing the highest turbidity at 13.6 nephelometric turbidity units (NTU). Turbidity was slightly outside guideline levels at all sites in February 2021.
- In November 2020 dissolved oxygen was measured outside of guideline levels at all sites. The pH measured at sampling sites varied throughout the testing timeframe, with site 12 in May, and sites 11, 12 and 14 in August, as well as all sites in November measuring outside the guideline levels (more acidic). This suggests that there is either some natural variation within the catchment having an influence on the readings further downstream, or the reference site is not appropriately located. Electrical conductivity was within the guideline and similar to the reference site in the reporting year. In November 2020, site 13 was higher than the reference and all other sites, but still well within guideline levels.
- Ammonia level was highest in May 2020 and February 2021 at site 11. Ammonia is known to be toxic to macroinvertebrates, however, there is currently no direct guideline limit for total ammonia. Total phosphorus was within guideline level and similar to the reference site, site 11, throughout the reporting period.
- Total nitrogen was outside of guideline levels at site 13 and 14 in August, and again at site 13 in November 2020. Nitrates were outside guideline levels at all sites in August. In May and November all sites except site 11 were outside of guideline levels, and in February 2021 site 12 was outside the guideline. This suggests there could be a source of nutrient enrichment coming from either Thredbo village or the wider catchment area that feeds the Thredbo River between sites 11 and 13. However, only 4 ‘point-in-time’ samples were taken in the reporting year, therefore these results may not be representative.
- Algal biomass (ash-free dry mass) shows seasonal variations during the reporting period. Site 13, located below both Thredbo village and the sewage treatment plant, had the highest ash-free dry mass and chlorophyll-*a* levels throughout the reporting year. In February 2021 site 11, the reference site, showed higher ash-free dry mass and chlorophyll-*a* levels than site 12 and 14.
- Using the AUSRIVAS Kosciuszko National Park – Thredbo riffle model, macroinvertebrate monitoring along Thredbo River shows site 11 consistently scored band A (similar to reference), and site 14 consistently scored band B (significant impairment). In August site 12 and 13 scored band A, and in November site 13 scored band A, which contrasts with August 2019 where all sites scored band B.

Overall, the addition of another reference site above site 11 would be beneficial to identify if the biological and physical variations are caused by natural catchment variations or are due to nutrient enrichment from Thredbo village and sewage treatment plant.

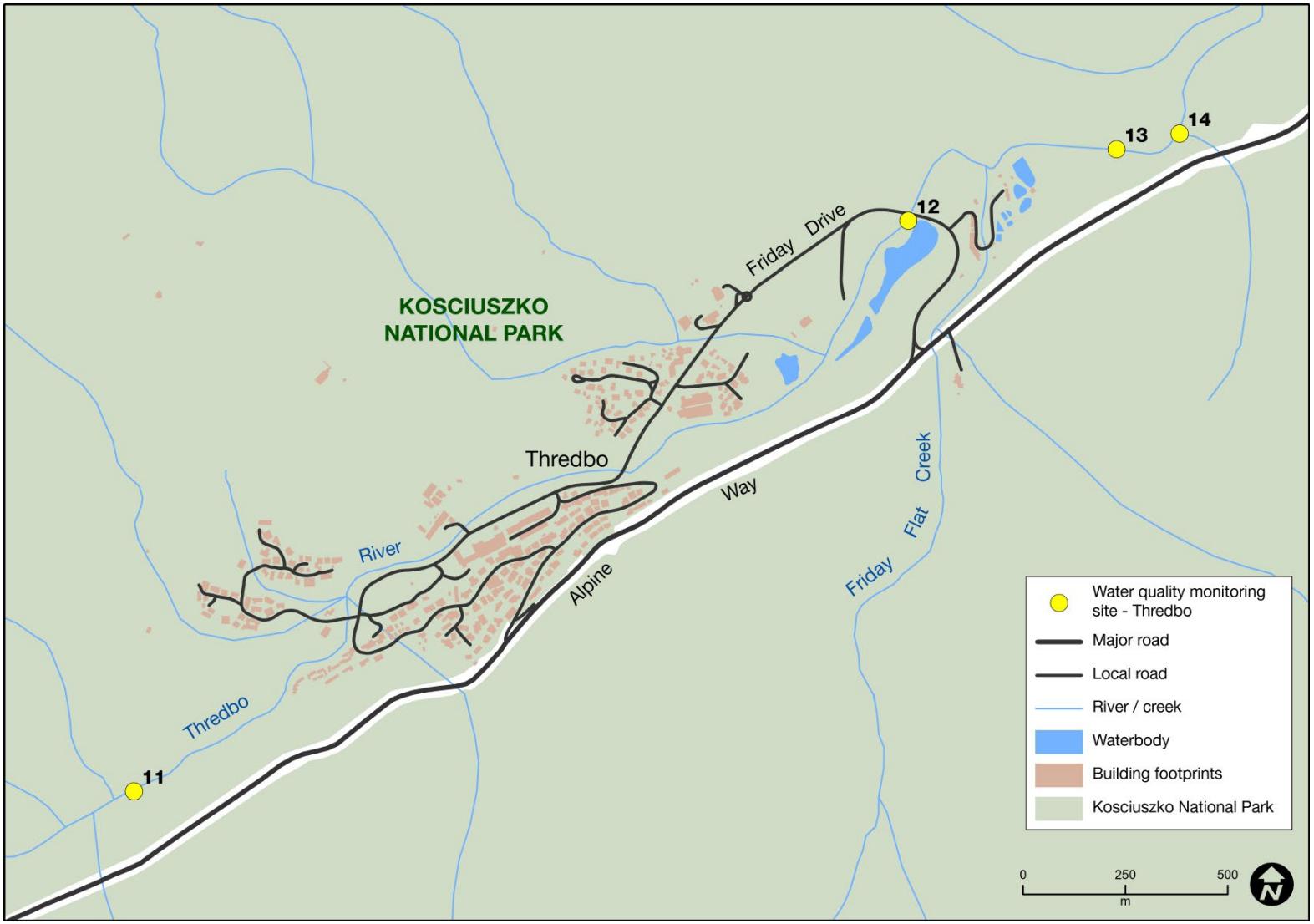

Figure 8 Water quality monitoring sites around Thredbo Alpine Resort

1.2 Water conservation measures

Water conservation in the alpine resorts, both within premises and on ski slopes, is dependent on a number of interrelated factors. These include visitor numbers and behaviour, infrastructure, maintenance and weather conditions. Table 3 shows potable water consumption by the resort operators, NPWS and Perisher Range resort lodges for the period from 1 March 2020 to 28 February 2021. NPWS and Thredbo Alpine Resort both reduced their water consumption between the 2019–20 and 2020–21 reporting periods.

Charlotte Pass Snow Resort

Charlotte Pass Snow Resort Pty Ltd holds 2 unmetered water extraction licences under the *Water Management Act 2000*. There is no official program to improve water conservation around the resort.

NPWS (Perisher Range and Sawpit Creek)

NPWS holds Water Management Act extraction licences for the Perisher Range and Sawpit Creek. There is no official program to improve water conservation in these locations.

Perisher Ski Resort

The Perisher Ski Resort operator has water extraction licences under the Water Management Act for snowmaking and potable water at some locations in the Perisher Range (such as Blue Cow). There is no official program to improve water conservation in resort operations.

Thredbo Alpine Resort

The Thredbo Alpine Resort operator has set a target to reduce water use by 25% from 2011–2012 levels (excluding snowmaking) by 2023. In the 2020–21 reporting year, Thredbo had reduced water use by 5.49% from 2011–12 levels, despite an increase in visitation. The reduction in water use has been achieved through the installation of low-flow showers, waterless urinals, dual-flush toilets, and water-efficient washing machines.

During the 2020–21 reporting period, 57% of toilets, shower heads and taps managed by Thredbo Alpine Resort were fitted with low-flow resistors or made dual-flush. The Thredbo Alpine Resort operator does not require their sublessees to fit low-flow products.

Lodges (Perisher Range and Charlotte Pass)

In the reporting period, 110 lodges in the Perisher Range resorts reported on their water consumption. Figure 9 shows that over the last 3 environmental management system reporting years lodges have been able to reduce their water usage from an average of 78.1 kilolitres per visitor night to 33.1 kilolitres per visitor night.

Lodges continue to reduce their water usage through a series of water conservation measures including:

- installing dual-flush toilets
- installing water-saving shower heads and taps
- checking taps periodically for leaks and fixing where required
- replacing old appliances with new appliances that have a higher water saving rating, when required

- providing signage and education for guests and club members.

Between March 2020 and February 2021, 54% of Perisher Range lodges implemented at least one of these water saving measures. Despite the lack of an available water metering system for Charlottes Pass lodges, water conservation measures are still implemented across the resort. It would be beneficial for Charlotte Pass lodges to install water meters to assess their water consumption on a premises-by-premises basis.

Table 3 Resort and lodge water consumption (kilolitres) between 1 March 2020 and 28 February 2021

Resort/Lodge	Potable water consumption (kL)
Charlotte Pass Snow Resort	0[a]
NPWS	90,290
Perisher Ski Resort	11,059[b]
Selwyn Snow Resort	0[c]
Thredbo Alpine Resort	319,218
Perisher Range lodges	31,964
Total	**452,531**

Table notes:

a. Charlotte Pass Snow Resort has 2 unmetered water extraction licences, one for potable water and the other for snowmaking. Due to the lack of metering, consumption is unknown.

b. Perisher Ski Resort was unable to provide complete water consumption data due to a technical difficulty with the recording system. This resulted in no water consumption data being available for May to August 2020.

c. Selwyn Snow Resort did not provide any data for the 2020–21 reporting period. Selwyn Snow Resort was severely damaged in the January 2020 fires, as such, zero water consumption.

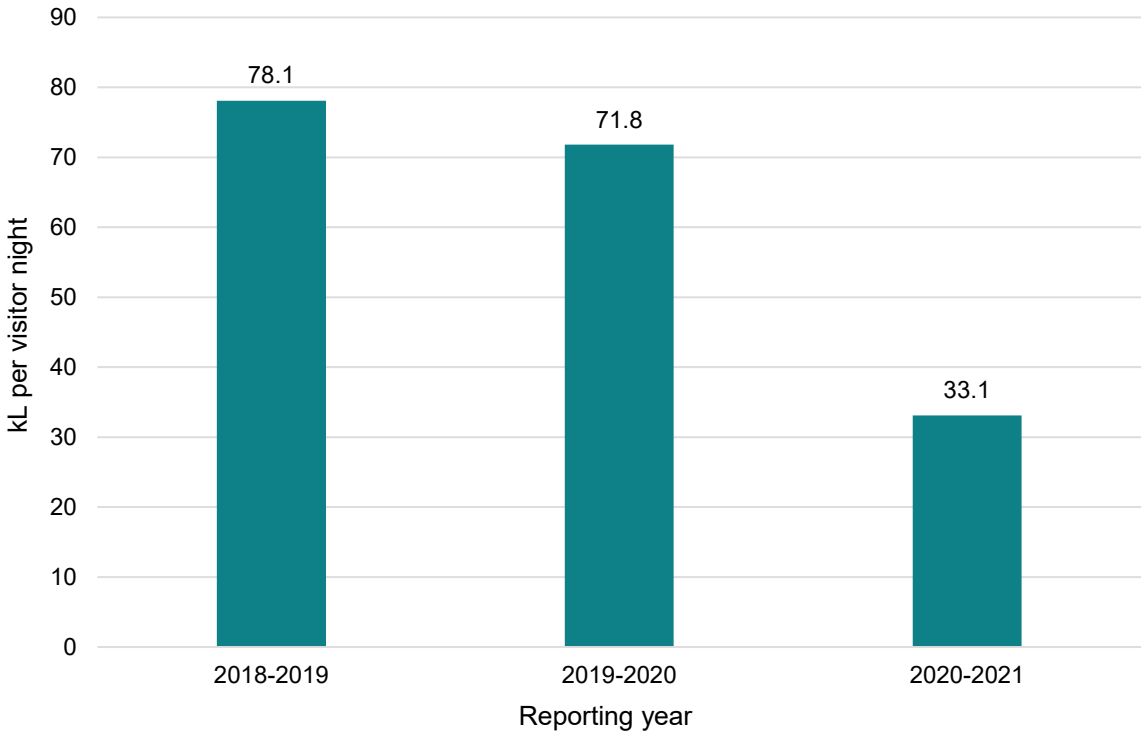

Figure 9 **Average water consumption (kilolitres) per visitor night for Perisher Range resort lodges**

1.3 Management response and review

Waterways in and surrounding the Kosciuszko National Park resorts are generally in a good condition. Some impacts from the sewage treatment plants, resort facilities and associated infrastructure are detected in both the macroinvertebrate and water quality monitoring results. The main stressors at some sites are elevated nutrients, most commonly nitrogen, and salinity. Many of the nutrient increases are seen during monitoring which follows rainfall events.

- NPWS, in consultation with Transport for NSW, should continue to investigate the use of salt on the main roads of Kosciuszko National Park (including Kosciuszko Road and Alpine Way) by Transport for NSW and its effect on water quality. This includes measures to reduce runoff from the road or alternative de-icing products to help mitigate the impact of salt and turbidity on macroinvertebrate species.
- There should be increased frequency and extent of monitoring of the Thredbo River and associated tributaries in the vicinity of the Thredbo Alpine Resort. An additional reference site further upstream would be beneficial to identify if the biological and physical variations observed are caused by natural catchment variations or due to nutrient enrichment from within the Thredbo Alpine Resort lease area and associated sewage treatment plant.
- Water extraction metering arrangements for Charlotte Pass Alpine Resort should be considered in order to provide meaningful data for future reporting.
- It would be beneficial for all resorts and lodges to record the number of water-saving taps, showers and dual-flush toilets that have been installed in their facilities.
- Thredbo Alpine Resort is the only resort to have set a water consumption reduction target.

Image 2 **Thredbo River. Photo: Thredbo Alpine Resort**

2. Energy

This section reports on environmental quality as per section 11.6 and Chapter 12 of the plan of management. Specifically, the section deals with energy consumption, conservation initiatives and results.

Many factors influence energy consumption in the alpine resorts, including variations in:

- temperature and humidity (for example, snowmaking relies on cold, dry air)
- maximum snow depth, snowfall and timing
- visitor numbers
- fuel conversions
- vehicle fleet adjustments.

2.1 Total energy consumption

Alpine resorts

The alpine resorts and NPWS rely on 3 main energy sources to run their operations: electricity, liquid petroleum gas (LP gas) and diesel. Heating oil and unleaded petrol are also used but in much smaller quantities. The use of onsite renewable energy is increasing, however, it is a small proportion of the total energy used by the resorts. A breakdown of this energy usage is shown in Table 4.

Table 4 Energy consumption in NSW alpine resorts and lodges in 2020–21

Resort/Lodge	Electricity (kWh)	Diesel (L)	Heating oil (L)	Petrol (L)	LP gas (L)	Onsite renewable energy generation (kWh)
Charlotte Pass Snow Resort [a]	1,341,872	80,300	14,200	4,000	8,035	0
NPWS	967,427	32,933	0	0	125,710	0
Perisher Ski Resort [b]	9,121,725	318,667	59,413	37,090	463,622	48,600
Selwyn Snow Resort [c]	0	0	0	0	0	0
Thredbo Alpine Resort	6,872,958	261,498	0	20,931	626,860	114,480
Lodges [d]	5,887,523	55,082.70	25,622	15,891	5,707,452	18,799
Total	**24,191,505**	**748,480**	**99,235**	**77,912**	**6,931,679**	**181,879**

Table notes: kWh = kilowatt hour; L = litre

a. Charlotte Pass Snow Resort energy figures include lodges owned and operated by Charlotte Pass Snow Resort Pty Ltd (Kosciuszko Chalet, Lucy Lodge and Stillwell Lodge).

b. The Perisher Ski Resort electricity figure includes electricity used by Perisher Resort, The Station Resort and Jindabyne properties.

c. Selwyn Snow Resort was severely damaged in the January 2020 fires, as such, zero energy consumption recorded.

d. Lodges include Perisher Range resort lodges and Charlotte Pass Snow Resort lodges (excluding the lodges owned and operated by Charlotte Pass Snow Resort Pty Limited).

During the 2020–21 reporting period all the alpine resorts and NPWS reduced their total energy consumption. Perisher Ski Resort and Thredbo Alpine Resort significantly reduced their electricity usage by 2,491,940 kilowatt hour and 2,336,440 kilowatt hour, respectively.

Petrol and diesel are used by the alpine resorts and NPWS for work vehicles and over-snow vehicles. Perisher Ski Resort reduced their use of both diesel and unleaded petrol in this reporting period. Thredbo Alpine Resort reduced their diesel usage, but had a slight increase in unleaded petrol usage. NPWS predominately uses diesel, and its usage stayed similar to the last reporting year. Charlotte Pass Snow Resort slightly increased its diesel usage and doubled its unleaded petrol usage in the 2020–21 reporting year. This is likely to be due to fuel delivery timing rather than a significant increase in actual use.

LP gas is used by the alpine resorts and NPWS for heating, cooking and hot water. Gas usage for all alpine resorts was less in the 2020–21 reporting period compared to the 2019–20 reporting period. However, NPWS slightly increased its use of gas in 2020–21.

Charlotte Pass Snow Resort uses heating oil combined with diesel in the operation of the sewage treatment plant, and Perisher Ski Resort uses heating oil to heat some of their buildings. Both resorts reduced their consumption of heating oil during 2020–21 when compared to the previous reporting year.

Image 3 **Snowmaking on Mt Perisher powered by electricity. Photo: Perisher Ski Resort**

Lodges (Perisher Range resorts and Charlotte Pass)

For the 2020–21 reporting year, 127 lodges from Charlotte Pass Snow Resort and the Perisher Range resort lodges submitted their energy consumption. Lodges submitted data on purchased electricity, renewable energy purchased or generated onsite, heating oil, diesel and unleaded petrol.

Table 4 and Figure 10 show that electricity and stationary fuel, which includes LP gas, heating oil and wood, are the primary energy sources used by lodges.

Figure 10 shows energy consumption in megajoules compared to visitor nights. In winter 2020, due to NSW Government COVID-19 restrictions of one person per 4 square metres, lodges were required to reduce their visitor capacity limits based on the size of their premises (NSW Government 2020). This therefore had an impact on energy consumption per person, as lodges were required to reduce capacity while heating the same building area.

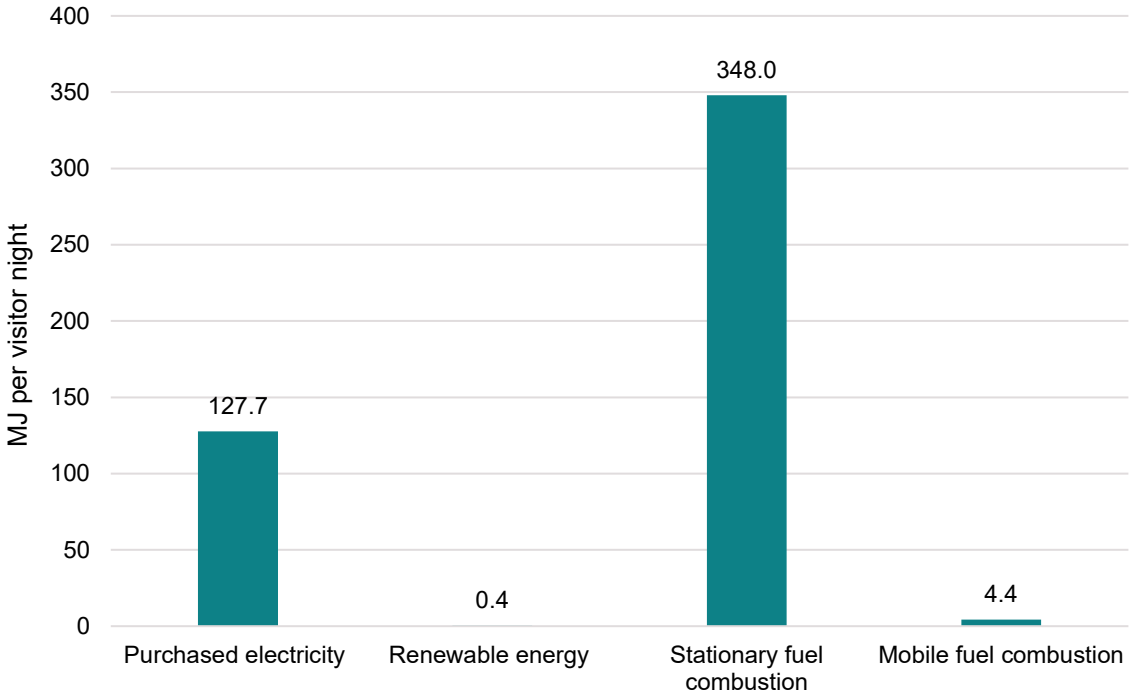

Figure 10 Average energy consumption (megajoules) for NSW alpine lodges (Perisher Range resorts and Charlotte Pass Snow Resort) in 2020–21

2.2 Renewable energy and energy efficiency

Overall, 17% of the energy used by the alpine resorts and NPWS was from renewable sources, as shown in Table 5. Thredbo Alpine Resort contributes the largest proportion of renewable energy usage to this figure.

Table 5 Total energy used (megajoules) and proportion of total energy from renewable sources for alpine resorts

Year	Total energy (MJ)	Proportion of energy from renewable sources (%)
2020–21	127,291,292	17.5

Charlotte Pass Snow Resort

During the reporting year, Charlotte Pass Snow Resort started to plan an electrical upgrade to the sewage treatment plant to improve energy efficiency. Charlotte Pass Snow Resort did not purchase renewable energy from their electricity supplier and had no onsite generation of renewable energy.

NPWS (Perisher Range and Sawpit Creek)

There is no formal program in place for improving energy efficiency and renewable energy use for NPWS infrastructure in the Perisher Range resorts and Sawpit Creek. However, energy efficiency is considered when upgrading or installing new equipment.

Perisher Ski Resort

The 27-kilowatt solar panel system on the Bullocks Flat Skitube Terminal building generated 48,600 kilowatt hours of electricity during the reporting period. During the 2020–21 reporting period, Perisher Ski Resort continued the expansion of energy-efficient lighting retrofits.

Thredbo Alpine Resort

The Thredbo Leisure Centre's 80-kilowatt solar panel system generated 114,480 kilowatt hours of electricity during the 2020–2021 reporting period. This is equivalent to 20.87% of the leisure centre's annual energy usage.

Thredbo Alpine Resort has an ongoing partnership with Red Energy to provide Thredbo's major resort operations with electricity from renewable sources, primarily Snowy Hydro. During the 2020–21 reporting period, 87.64% of the electricity used by Thredbo Alpine Resort was generated from renewable sources.

Lodges (Perisher Range resorts and Charlotte Pass Snow Resort)

Table 6 shows the total energy used and the proportion of energy from renewable sources. A total 21 lodges in the Perisher Range resorts purchased a proportion of renewable energy through their energy provider. No Charlotte Pass Snow Resort lodges purchased renewable energy in this reporting period.

Table 6 Total energy used (megajoules) and proportion of energy from renewable sources for lodges in the Perisher Range resorts and Charlotte Pass Snow Resort

Year	Total energy (MJ)	Proportion of energy from renewable sources (%)
2020–21	87,567,878.6	0.20

Lodges have continued efforts to reduce their energy consumption by pursuing energy efficient practices. This includes installing LED lighting and thermostat settings to control room temperatures. Many of the lodges provide signage or other measures to encourage their guests, visitors and staff to minimise energy use. Figure 11 shows the percentage of lodges which have installed various energy saving products.

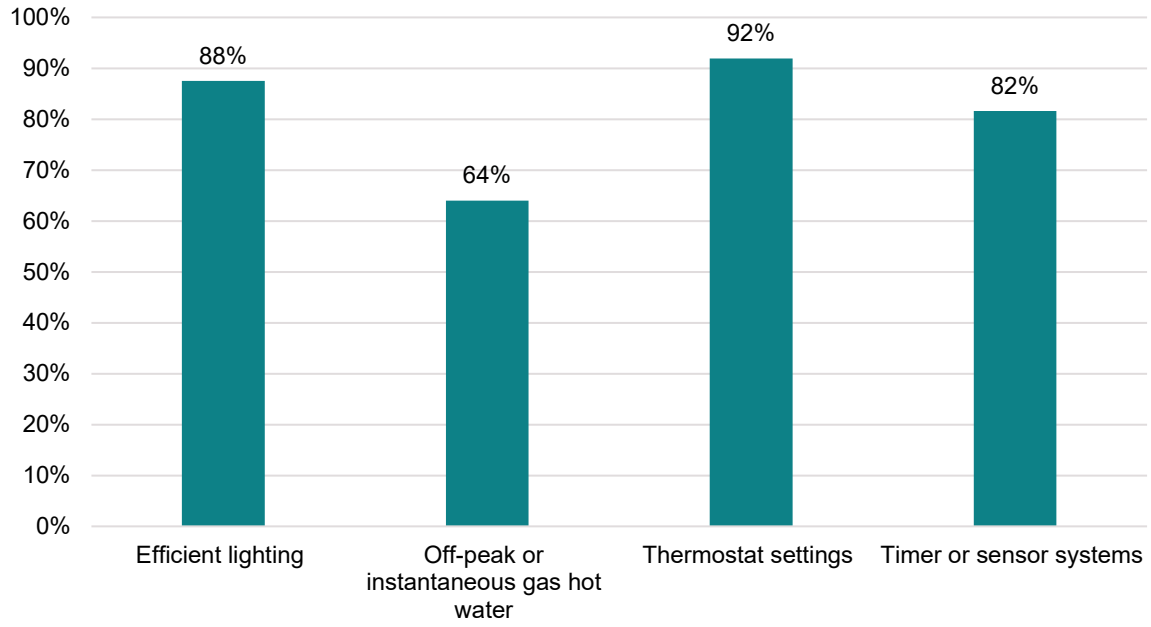

Figure 11 Percentage of lodges in Perisher Range resorts and Charlotte Pass Snow Resort using energy-efficient products in 2020–21

2.3 Carbon emissions and offset program

Charlotte Pass Snow Resort

Charlotte Pass Snow Resort has no formal commitment to reduce emissions and does not take part in an official offset program.

NPWS (Perisher Range and Sawpit Creek)

In March 2020, the NSW Government published the *Net Zero Plan Stage 1: 2020–2030* (DPIE 2020). The net zero plan is statewide and therefore not specific to NPWS, however, one commitment relates to expanding the NSW national parks estate from 2021 onwards to protect land that is currently a carbon sink and create opportunities for additional carbon sequestration activities.

Perisher Ski Resort

Vail Resorts (as operator of the Perisher Ski Resort) has committed to a goal of zero emissions by 2030. This will incorporate gains in efficiency, purchase of renewable energy and offsetting where required. While Perisher staff have been involved in tree planting initiatives and undertaken revegetation projects, these have not been for the purpose of sequestering the emissions generated by Perisher Ski Resort operations.

Thredbo Alpine Resort

Within the Thredbo Alpine Resort's *Environmental and social sustainability policy* (Kosciuszko Thredbo 2019), the Thredbo Alpine Resort operator has set a target to offset 100% of the greenhouse gas emissions caused by the generation of electricity used in the resort operations.

The operator continues to use GreenFleet to offset emissions generated by its resort vehicle fleet, which includes the over-snow vehicles and resort courtesy buses (Image 4). During the 2020–21 reporting period, the operator offset the 692.63 tonnes of carbon dioxide through the GreenFleet carbon offset program. Thredbo guests also made 3,408 contributions to GreenFleet, totalling 17.15 tonnes carbon dioxide equivalent to offset their journey to Thredbo Alpine Resort.

2.4 Management response and review

- All alpine resorts and NPWS reduced their energy consumption during the reporting period. It is difficult to determine the reasons for this because COVID-19 health orders applied both travel restrictions and capacity restrictions at times during the reporting period.
- Alpine resorts are focusing efforts on increasing renewable energy sources and ongoing installation of energy-efficient products. Offsetting carbon emissions is occurring in some cases and should be increased.

Image 4 **Thredbo courtesy bus transporting guests around Thredbo village. Photo: Thredbo Alpine Resort**

3. Waste

This section reports on environmental quality as per section 11.6 and Chapter 12 of the plan of management. Specifically, this section details the quantities of collected rubbish and recyclable material generated in the alpine resorts, the ultimate destination for that material, and efforts to manage litter.

Ongoing management of solid waste generated within the alpine resorts is linked to the levels and availability of recycling and the reuse of materials. NPWS and the alpine resort operators are working to increase levels of recycling within the alpine resorts and have implemented various waste minimisation improvements during the reporting period.

Each alpine resort operator monitors their waste production and the ultimate destination of the waste they produce. The main waste collection streams include general waste to landfill, and recycling of paper and cardboard, glass bottles, cans, plastic recycling, organics and cooking oil. Alpine resort operators report further waste information based on their specific waste management practices and methods of disposal. The total waste and recycling volumes for NPWS and the alpine resorts is shown in Figure 12 and a complete waste and recycling breakdown for the alpine resorts is shown in Table 7.

Waste volumes fluctuate depending on visitation numbers and the amount of construction activity in the alpine resort areas over a reporting period. Within the alpine resort areas, individual lodge construction projects are managed separately to alpine resort operations, with lodge construction contractors required to remove and dispose of any waste generated by their development. Information about such waste is not reported to the alpine resort operators or NPWS.

The decrease in the total waste volume between 2017 and 2021, shown in Figure 12, is largely due to Perisher (including Bullocks Flat) and NPWS. This is likely linked to the reduced capacity of overnight guests in Kosciuszko National Park due to COVID-19 restrictions, particularly in winter 2020. Figure 13 shows the overall change in the volume of landfill and recycling generated since 2017 and shows a trend towards reducing total waste generation.

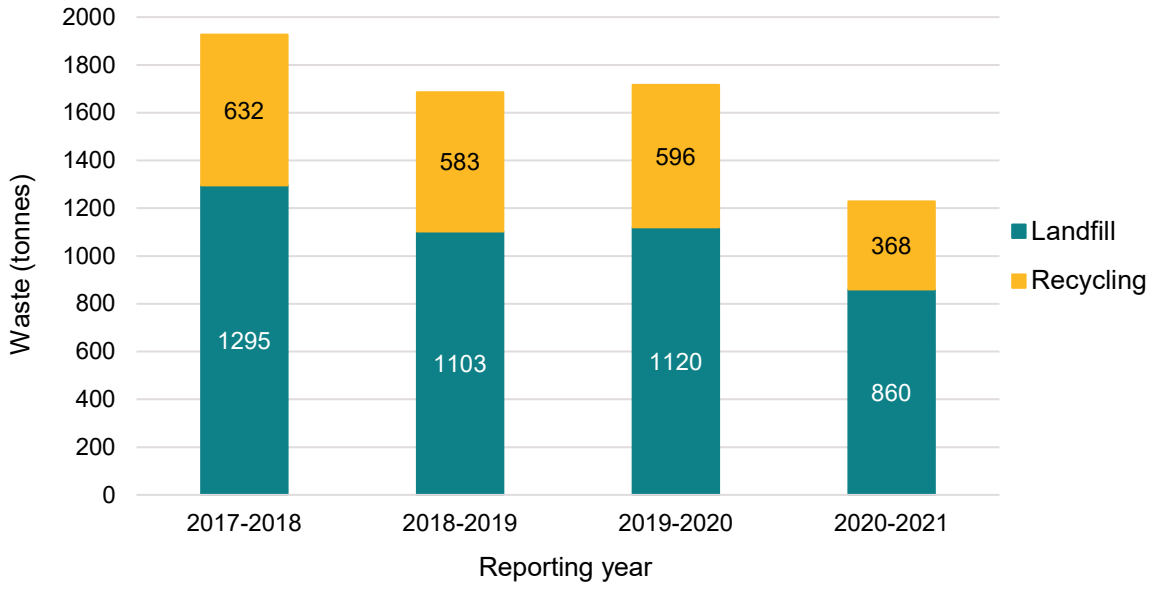

Figure 12 Total waste and recycling generated by alpine resorts for the reporting periods from 2017 to 2021

Table 7 shows the breakdown of waste and recycling at each waste transfer facility in the alpine resorts. Figure 13 shows total waste generated per person year by each alpine resort. This method of calculating a person year figure for waste generation is new to the environmental management system reporting and will help to show change over time even if visitation numbers fluctuate (refer to the Introduction for more information on person year figure calculation).

Table 7 Waste figures (tonnes) for NPWS, Perisher Ski Resort and Thredbo Alpine Resort waste transfer facilities in 2020–21

Waste type	NPWS-managed facility [a]	Perisher Bullocks Flat [b]	Thredbo Alpine Resort	Total
Landfill (including asbestos and building waste)	276.86	22.59	560.58	**860.03**
Co-mingled recycling (glass, cans and plastic)	83.48	3.73 [b]	123.45	**210.66**
Paper and cardboard recycling	39.58	0	61.65	**101.23**
Organics recycling	27.6	1.96	11.09	**40.65**
Cooking oil recycling [c]	4.61	0.52	7.00	**12.13**
Mattresses recycling	0	0	0.04	**0.04**
Rubber recycling (including tyres)	0	0	0.06	**0.06**
Fluoro light tubes recycling	0	0	0.10	**0.1**
E-waste recycling	0	0.01	2.97	**2.98**
Steel recycling	0	0.58	0	**0.58**
Battery recycling	0	0	0	**0**
Total waste	432.13	29.39	766.93	**1,228.46**
Waste sent to landfill	276.86	22.59	560.58	**860.03**
Total recycling	155.27	6.8	206.35	**368.42**
% of total waste recycled	36%	23%	27%	**30%**

Table notes:

a. NPWS-managed facility includes waste from Perisher Resort, Charlotte Pass Snow Resort, Charlotte Pass and Perisher Range resort lodges.

b. Perisher Bullocks Flat includes waste generated at Blue Cow. Co-mingled recycling data includes glass, cans, plastic, paper and cardboard.

c. For cooking oil, litres x 0.9/1,000 = tonnes

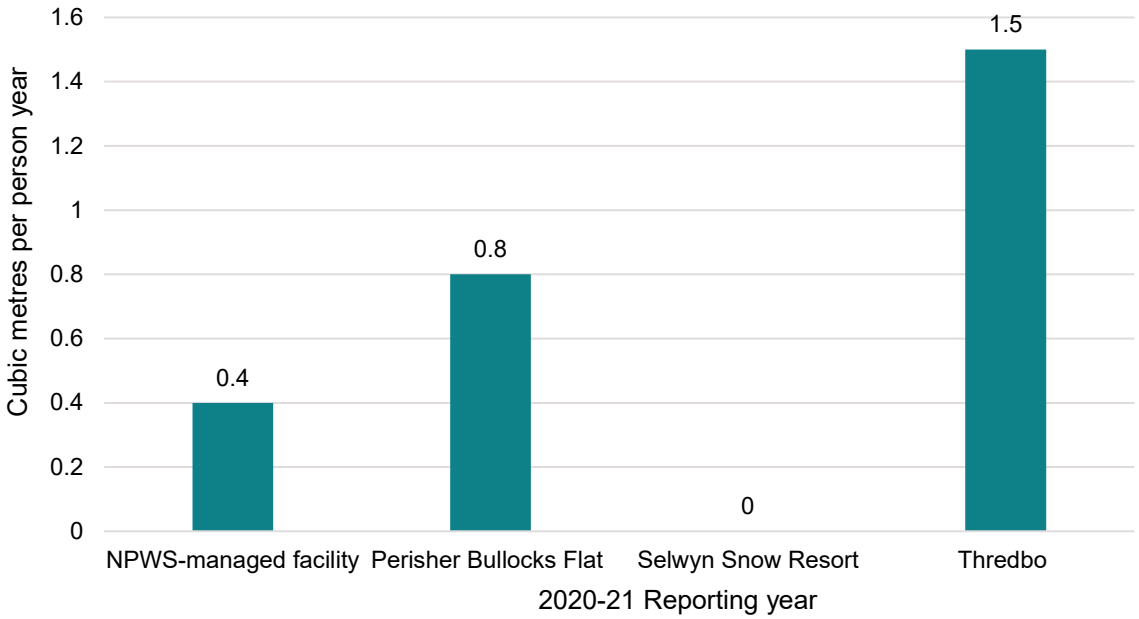

Figure 13 Total waste generation (cubic metres) per person year for the NSW alpine resorts

Note: Selwyn Snow Resort was not operating during this reporting period.

3.1 Total generation of waste

NPWS (Perisher Valley facility)

The waste generated by the Perisher Range resorts, Charlotte Pass Snow Resort and lodges within these resorts is primarily managed by NPWS Perisher Team through the waste transfer station at Perisher Valley. General waste is disposed of at Jindabyne Waste Management Facility, managed by Snowy Monaro Regional Council. Recycling is collected by a licensed waste contractor and transported to a materials recovery facility in Canberra, ACT. In specific areas of Perisher Valley, Smiggin Holes, Guthega and Charlotte Pass Snow Resort, an organic waste collection service operates during the winter season. This material is transported to the NPWS facility at Sawpit Creek for processing into compost. The compost produced is used for rehabilitation and plantings in Kosciuszko National Park.

The NPWS waste transfer station at Perisher Valley does not accept commercial bulk or hazardous waste. This is removed directly by the resort operator or individual lodges and their contractors.

In the 2020–21 reporting period at the NPWS waste transfer station, the recycling rate was 36%, which is less than the 2019–20 recycling rate of 43%. Waste sent to landfill reduced by a third, from 434.16 tonnes in 2019–20 to 276.86 tonnes in 2020–21, and the volume of recycling almost halved for all recycling streams. The reduced landfill volumes are likely due to the reduced overnight visitor numbers during winter 2020. Accommodation providers had to implement guest capacity limits based on the size of their premises (one person per 4 square metres rule), which was set by the NSW Government on 1 June 2020 in line with COVID-19 restrictions.

For the 2020–21 reporting year, the waste facility managed by NPWS in Perisher Valley processed 432 tonnes of waste, or 0.4 cubic meters of waste per person year (Figure 13).

Perisher Ski Resort

Waste from Bullocks Flat and Blue Cow is managed directly by Perisher Blue Pty Limited (Perisher Ski Resort) with the waste produced at Blue Cow transported via the Skitube to Bullocks Flat. Waste to landfill and recycling are transported to the Jindabyne Waste Management Facility, managed by Snowy Monaro Regional Council. The organics are transported to Cooma and processed at the Snowy Monaro Regional Council composting facility. Perisher Ski Resort also has systems in place to recycle waste generated by staff, including electronic waste, mobile phones and printer cartridges.

The recycling rate achieved by Perisher Blue Pty Limited decreased from 47% in 2019–20 to 23% in the 2020–21 reporting period. Both waste to landfill and recycling volumes decreased during the 2020–21 reporting year. There was a slight decrease in landfill volumes from 29.18 tonnes in 2019–20 to 22.59 tonnes in 2020–21. Co-mingled recycling along with paper and cardboard recycling decreased from 13.3 tonnes in 2019–20 to 3.73 tonnes in 2020–21 (Table 7). These lower figures reflect restricted resort operations during winter 2020 due to COVID-19.

Figure 13 shows that Perisher generated and processed 0.8 cubic meters of waste per person year in the 2020–21 reporting year.

Thredbo Alpine Resort

General waste from the Thredbo Alpine Resort is disposed of at Snowy Monaro Regional Council's Cooma landfill facility. Recycling materials are transported to a commercial recycler in Cooma and processed for further use. Scrap metal is collected and either reused onsite or is transported to Cooma for recycling. Food organics are composted onsite using a Closed Loop commercial composting machine, with the resulting compost used by local horticulturalists outside of Kosciuszko National Park.

Overall, Thredbo Alpine Resort reduced its waste to landfill from 572 tonnes in 2019–20 to 560.58 tonnes in 2020–21. Paper, cardboard and co-mingled recycling was also slightly decreased. By contrast, organics recycling doubled in volume, and e-waste recycling was introduced during the reporting period. The Thredbo Alpine Resort recycling rate remained at 27% for the 2020–21 reporting period.

Figure 13 shows total generation of waste per person year was 1.5 cubic metres at Thredbo Alpine Resort, which is higher than at the other resort areas.

3.2 Waste minimisation

Charlotte Pass Snow Resort

Charlotte Pass Snow Resort takes part in the recycling programs offered by NPWS through its Perisher Valley facility. This includes recycling paper and cardboard, glass, cans and plastic bottles, cooking oil and organics. Additionally, Charlotte Pass Snow Resort recycles building materials and scrap metals.

NPWS (Perisher Valley facility)

In 2019, NPWS purchased a soft plastics baler, shown Image 5, with funding from the EPA's Bin Trim Program. A soft plastic recycling program commenced in 2020 with the larger retail outlets within the Perisher Range resort areas participating. Retail outlets were chosen to start the recycling program as the waste stream is clean, resulting in a high-quality recycling product.

NPWS plans to progressively introduce soft plastic recycling to other areas including loading docks, accommodation and food and beverage providers. By running a progressive introduction, NPWS can identify possible contamination in each area and address non-conformances to reduce the levels and risk of contamination in the soft plastic waste stream.

The soft plastics will be baled and stored, before being transported to Albury. Once there, the plastics will be made into a variety of useful products by a local company, Plastic Forests.

Image 5 **Soft plastic baler in the NPWS Perisher Valley Waste Transfer Station. Photo: E Stafford/DCCEEW**

Perisher Ski Resort

Perisher Ski Resort has committed to a goal of zero waste to landfill by 2030 as part of the broader Vail Resorts 'EpicPromise Commitment to Zero'. To work towards this goal, several waste minimisation strategies have been implemented.

- Over winter 2020, the Perisher environment manager and environment officer undertook visual audits of waste streams at different Perisher Ski Resort premises to identify and improve waste separation practices. Figure 14 shows an example waste audit report card from a food and beverage venue with good waste management practices.
- Improved waste systems, such as organics recycling and soft plastic diversion, were made available for sublessees at waste collection areas.

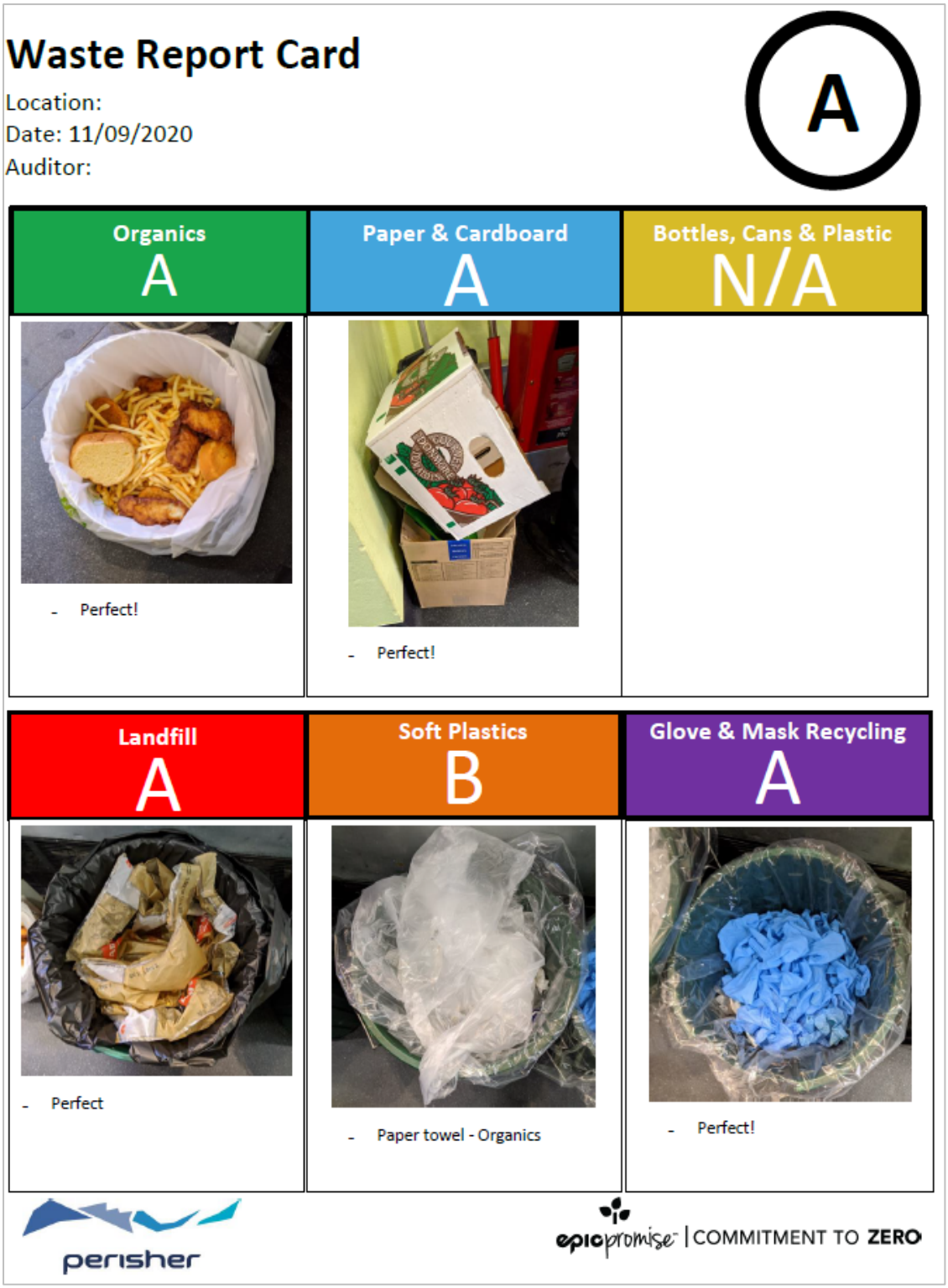

Figure 14 Example Perisher waste report card from waste audits during winter 2020. Image: Perisher Ski Resort

Thredbo Alpine Resort

In 2020, Thredbo Alpine Resort purchased a new Closed Loop organics recycling machine, which doubled Thredbo's capacity for food waste recycling. The machine heats and rotates food waste to encourage composting, which helps to reduce the volume of food waste by up to 90% in as little as 24 hours.

The procurement team at EVT, the parent company of the Thredbo Alpine Resort operator, introduced certified compostable food packaging. Thredbo Alpine Resort trialled the packaging in the Closed Loop machine and found that most of the certified food packaging composted well, except the bamboo cutlery. Additional signage was installed in the 'clean-away' area of the Thredbo Alpine Hotel Bistro to show staff how to separate items that could be recycled, composted and those that needed to go to landfill. The bistro was the only area asked to compost the packaging in 2020 as the Closed Loop machine needs higher ratios of 'wet' food waste to 'dry' packaging waste. It is anticipated that as food waste levels increase more packaging can be composted.

Lodges (Perisher Range resorts and Charlotte Pass)

A total 84 lodges in Perisher Range resorts and Charlotte Pass Snow Resort stated they had organics recycling in place during winter 2020. No new waste measures were implemented by lodges in the reporting period due to the impacts of COVID-19.

3.3 Litter management

In 2020, the Sustainable Snowies group signed a memorandum of understanding which provides a framework for collaborating partners regarding common issues and future cooperation to improve sustainability in the region. The signatory members are Canberra Region Joint Organisation, Thredbo Alpine Resort, NPWS, Nuggets Crossing, Perisher Ski Resort, and Snowy Monaro Regional Council.

Projects identified by Sustainable Snowies include initiatives to:

- reduce the use of single-use plastics, such as disposable coffee cups
- reduce littering within the Snowy Mountains
- promote messages to Snowy Mountains businesses, government and the community about a range of practical measures to improve sustainability.

Disposable coffee cups were highlighted by the group as a major issue as they are often littered and there is customer confusion around correct disposal. Therefore, the group focussed on providing an alternative to disposable coffee cups. In July 2020, Sustainable Snowies launched 'Green Caffeen', a program for distributing reusable swap-and-go coffee cups that are free for customers to use (Image 6). Sustainable Snowies members made financial contributions to the program, which allowed cafes within the Snowy Monaro region to join Green Caffeen for free. By October 2020, 20 cafes were signed up to the program, including cafes in Thredbo Alpine Resort, Perisher Range resorts, Jindabyne and Berridale.

Green Caffeen statistics show that between July and October 2020 around 25,000 Green Caffeen cups had been used in the Snowy Monaro region, which saved over 375 kilograms of disposable cups from either going into landfill or becoming litter.

Image 6 **A Green Caffeen cup being used at Thredbo Alpine Resort. Photo: Thredbo Alpine Resort**

3.4 Management response and review

- Overall, a total of 30% (or 368.42 tonnes) of all domestic waste was recycled by NPWS and the alpine resorts during the 2020–21 reporting year. This has resulted in the combined recycling rate decreasing by 5% compared to the previous reporting year.
- It is positive to see the resorts not only increasing the availability of recycling but also working to reduce the volume of waste sent to landfill.
- Ongoing education and clear signage are needed to increase the percentage of recyclables being captured and to reduce contamination in the recycling waste streams.

4. Sewage treatment plants

This section reports on environmental quality as per section 11.6 and Chapter 12 of the plan of management. It addresses the volume of human waste treated by each of the sewage treatment plants in the alpine resorts, as well as addressing sewage treatment plant incident management issues.

The management of human waste generated by visitors in Kosciuszko National Park poses both water safety and water quality issues. The EPA is the responsible regulatory authority for the sewage treatment plants within Kosciuszko National Park. There are 6 licensed sewage treatment plants within the alpine resorts, located at Sawpit Creek and Perisher Valley (both operated by NPWS), Thredbo village, Bullocks Flat (operated by Perisher Blue Pty Limited), Charlotte Pass Snow Resort, and Sponars Chalet. Additionally, Ski Rider Hotel has a sewerage system that is licensed and operated by South-East Waste Recovery Pty Limited.

Biosolids from Thredbo Alpine Resort and NPWS treatment plants continue to be diverted to a land rehabilitation project near Berridale and are used by local farmers for soil conditioning. In accordance with EPA guidelines, the biosolids are directly ploughed into the soil as a fertiliser for stock fodder crops. Bullocks Flat and Sponars Chalet biosolids are transferred to the Jindabyne sewage treatment plant, and Charlotte Pass Snow Resort biosolids are transferred to the Berridale or Cooma treatment plant for further processing. A summary of the biosolids produced from 2018 to 2021, including the reporting period, from each sewage treatment plant is provided in Table 8.

Image 7 **Perisher Creek, below Perisher Sewage Treatment plant. Photo: E Stafford/DCCEEW**

Table 8 Biosolids removed from sewage treatment plants between 2018 and 2021

Sewage treatment plant	Biosolids destination	2018–19	2019–20	2020–21
Charlotte Pass Village	Berridale or Cooma treatment plant for further processing	64 kL (wet)	91 kL (wet)	0
Perisher Valley	Land rehabilitation and soil conditioning in Berridale	28.3 dry tonnes	52.65 dry tonnes	1,542.25 kL (wet) (29.15 dry tonnes)
Sawpit Creek	Land rehabilitation and soil conditioning in Berridale	1.98 dry tonnes	1.6 dry tonnes	60 kL (wet) (1.2 dry tonnes)
Bullocks Flat Terminal	Jindabyne sewage treatment plant for further processing	65 kL (wet)	126 kL (wet)	26 kL (wet)
Selwyn Snow Resort [a]	–	17.70 tonnes	0	0
Ski Rider Hotel	NPWS treatment plant for further processing	–	–	0
Sponars Chalet	Jindabyne sewage treatment plant for further processing	–	–	8 kl (wet)
Thredbo village	Land rehabilitation and soil conditioning in Berridale	53.61 dry tonnes	55.38 dry tonnes	783 kL (wet) (69.6 dry tonnes)

Table notes: kL = kilolitre.

a. Figures from the Clivus Multrum composting toilet system previously installed at Selwyn Snow Resort are unavailable due to bushfire damage in January 2020 and demolition of associated infrastructure in preparation for rebuilding.

4.1 Sewage treatment plant incidents

Annual reports submitted to the EPA for Thredbo village, Bullocks Flat (Perisher Ski Resort), Charlottes Pass Snow Resort, Sponars Chalet, and Perisher Valley (NPWS) and Sawpit Creek (NPWS) treatment plants reveal various non-compliances with the environment protection licences issued under the *Protection of the Environment Operations Act 1997*. An outline of these non-compliances reported on the EPA Protection of the Environment Operations Public Register is provided in Table 9. Because licence periods differ from the environmental management system reporting period, NPWS reporting in the table is based on the licence, and the licence timeframe shown for each treatment plant has been chosen to include the 2020 winter season.

Table 9 Sewage treatment plant non-compliance summary 2020–21

Sewage treatment plant	Operator	Environmental protection licence (EPL)	Non-compliances
Charlotte Pass Village	Charlotte Pass Snow Resort Pty Ltd	EPL no. 1591 March 2020 to February 2021	One non-compliance between March 2020 and February 2021 for pH, which was recorded under the 6.5–8.5 limit at 6.42.
Perisher Valley	NPWS	EPL no. 1797 June 2020 to May 2021	The June 2020 to May 2021 period did not record any licence discharge limit non-compliances with the relevant EPL.
Sawpit Creek	NPWS	EPL no. 447 October 2019 to September 2020	The October 2019 to September 2020 period did not record any licence discharge limit non-compliances.
Bullocks Flat Terminal	Perisher Blue Pty Limited	EPL no. 2274 December 2019 to December 2020	The December 2019 to December 2020 period recorded one non-compliance for exceedance of the allowed ammonia level. Note this exceedance occurred in December 2019 and was reported in the 2019–20 alpine resorts environmental performance report (DPE 2022).
Ski Rider Hotel	License held by South-East Waste Recovery Pty Ltd	EPL no. 11603 Licence to transport category 1 and category 2 trackable waste	Wastewater from Ski Rider Hotel is pumped out and transported offsite by South-East Waste Recovery Pty Ltd. The wastewater is transported to either of the NPWS-managed sewage treatment plants at Perisher Valley or Sawpit Creek for further processing.
Sponars Chalet	Ski Sponars Pty Limited	EPL no. 3113 October 2019 to September 2020	The October 2019 to September 2020 period did not record any licence discharge limit non-compliances with the relevant EPL.
Thredbo village	Kosciuszko Thredbo Pty Ltd	EPL no. 1599 March 2020 to February 2021	During the 2020–21 reporting period, Kosciuszko Thredbo Pty Ltd had 2 non-compliances with the relevant EPL, both due to concentration limits for nitrogen (ammonia) being above the 90th percentile.

4.2 Management response and review

- In December 2020, the EPA removed the pollution reduction program licence condition for upgrade works to the Charlotte Pass Snow Resort sewage treatment plant as these works had been completed by the licensee. The upgrade works resulted in a significant drop in the number of non-compliances received by Charlotte Pass Snow Resort within the 2020–21 reporting period. Non-compliances reduced from 196 in 2019–20 to one non-compliance in 2020–21.
- All sewage treatment plants improved their standards of wastewater treatment and compliance with their environmental protection licence during the reporting period, compared to the previous year.

Image 8 **The Kosciuszko Chalet at Charlotte Pass Snow Resort. Photo: Charlotte Pass Snow Resort**

5. Pollution incidents

This section reports on environmental quality as per section 11.6 and Chapter 12 of the plan of management. It includes information about pollution incidents, the corrective action taken, and how incidents were managed with a view to preventing a recurrence. See section 4.1 for sewage treatment plant incidents and licensing non-compliances.

The alpine resort operators, and NPWS in its operations, have a responsibility to prevent leaks, spills and unlicensed discharges to the environment. Where incidents occur, this responsibility extends to managing and remediating in an environmentally sensitive manner. The main sources of potential pollution in the alpine resorts are:

- transportation, storage and use of hydrocarbons and chemicals
- operation and management of sewage treatment plants
- stormwater runoff from roads and car parks
- vehicles, including snow-grooming machines
- waste and litter.

Tables 10 and 11 outline the nature of pollution incidents across the reporting period for alpine resorts and lodges, respectively. Most incidents are of a minor nature and involve a small amount of clean-up, causing no material harm to the environment. A total 16 incidents were reported during the reporting period.

Image 9 **Gravel and asphalt removed from the Perisher Ski Resort car park surfaces during winter snow clearing, deposited into the surrounding creek and bog area. Photo: E Stafford/DCCEEW**

Table 10 Details of alpine resort pollution incidents in the 2020–21 reporting period

Nature of incident	Summary of incidents	Number and significance	Incident closed?	Management and corrective actions
Paint spill	Paint spill while line marking in Smiggin Holes car park. Cleaned up excess paint using absorbent material. Bollards used to prevent access and spread of paint.	1 minor	Yes	Spilled paint to be painted over with black to reduce visual impacts. No environmental damage.
Cooking oil spill	Intermediate bulk container (IBC) filled with used cooking oil leaked in a bunded area of the Thredbo Alpine Resort Waste Transfer Station, due to a hole in the IBC.	1 minor	Yes	Absorbent boom used to contain the spill. Absorbent material used to absorb oil before sweeping the area and bagging the material, which was disposed of via landfill. Check of 1,000-litre ICBs for holes or damage prior to loading with cooking oil.
Hydraulic fluid spill from snow groomer or over snow	Hydraulic hose breaks and diesel leaks mostly from minor breakdowns of snow-grooming machines resulted in the spilling of hydrocarbons on snow. All individual incidents were <10 litres.	4 minor	Yes	Spills occurred during winter months on snow. Standard Thredbo Alpine Resort and Charlotte Pass Snow Resort procedure is to collect contaminated snow and melt through the workshop filtration system. Implementation of 8,000-hour replacement scheme and replace hydraulic hoses on tiller every 3 years maximum by Thredbo Alpine Resort staff.
Hydraulic fluid spill from snow groomer or over snow	1 litre oil spilt from snow groomer on edge of Perisher car park, close to drain.	1 minor	Yes	Perisher mechanics shovelled up oil-soaked snow and transported to Smiggin Holes Workshop to melt out through interceptor. S200 Oil Gone applied to area. Machine repaired.
Vehicle or machinery leak	Slow oil leak from vehicle in a car park over approximately a 2-hour period.	1 minor	Yes	Absorbent boom placed around immediate area, and around drains as a precaution. Sokerol used to absorb oil spill.
Vehicle or machinery leak	Oil or fuel leak from unknown vehicle in car park, respondent arrived to find oil or fuel spilt but the vehicle had left the area. Spilt substance mobilised by rain.	1 minor	Yes	Hydrocarbon absorbent boom utilised down-flow of hydrocarbon spill to contain movement. Uneven surface hindered clean-up efforts. Area was monitored at 20-minute intervals to ensure no further spread of contaminant.

Nature of incident	Summary of incidents	Number and significance	Incident closed?	Management and corrective actions
Vehicle or machinery leak	Plum Pine Road 30 litres hydraulic fluid leak from snow-clearing vehicle (drips along road and on snow).	1 minor	Yes	Spill was cleaned up following morning. Vehicle repaired.
Oil drum spill	1 litre of oil leaked from an oil drum in the Village Eight storage area. Contaminated snow shovelled and area treated with s200 Oil Gone.	1 minor	Yes	The contaminated snow was bagged and disposed of at Smiggin Holes Workshop. Area manager to check all drums to ensure they are empty and capped.
Lift infrastructure	10 litres of diesel spill from Summit Chairlift diesel tank. Fuel tap for the diesel tank had unwound itself and diesel leaked over the station, bull wheel and some onto the load ramp and ground below. Tap was cable-tied to prevent it from coming out again and replaced in summer.	1 moderate	Yes	Lifts manager discussed incident at lift safety meeting.
Hydrocarbon spill from vehicle fire	Vehicle fire caused a hydrocarbon leak in car park outside of the Thredbo Alpine Apartments.	1 moderate	Yes	The fire was reported to NSW Fire and Rescue who extinguished the fire. Thredbo Alpine Resort Environmental Services staff placed absorbent booms around nearby stormwater drains to stop any leaking hydrocarbons from entering the storm water. Sokerol was used to absorb spilt fluids. This was subsequently bagged and disposed of by NSW Fire and Rescue. Bunding remained around drains for several days.
Cleaning chemical spill	Bleach spill in the Thredbo Alpine Hotel.	1 minor	Yes	Bleach was diluted with water and cleaned up with chemical absorbent pads from the hotel spill kit. Recommendation for improved chemical training for housekeeping staff.
Cleaning chemical spill	Chorine drum spill.	1 minor	Yes	Chemical spill pads and absorbent booms were used to absorb and contain the chlorine. No fluid reached drains. Relocation of chlorine containers discussed with staff.
Asphalt removed from car park surfaces	The asphalt removed from car park surfaces, an unintended consequence of snow clearing activities, remains an ongoing issue for the alpine resorts and NPWS due to potential impacts in the waterways and riparian areas.	Ongoing	No	The Perisher snow clearing manual has been reviewed, with additional snow stockpile areas identified to minimise potential impacts in the waterways and riparian areas. This will require NPWS to continue to monitor the stockpiled snow sites.
Total	–	**15 incidents**	–	–

Table 11 Details of lodge pollution incidents in 2020–21 reporting period

Nature of incident	Summary of incidents	Number and significance	Incident closed?	Management and corrective actions
Diesel spill in boiler room	Small diesel spill in the boiler room.	1 minor	Yes	Bunding was used to contain the spill, which was then cleaned up using absorbent pads from the onsite spill kit. NPWS was notified by phone and inspected the sewage treatment plant where no diesel was detected.
Total	–	**1 incident**	**–**	**–**

5.1 Management and review

- The overall number of reported pollution incidents reduced. The number of snow hydraulic fluid leaks over winter 2020 (5) remained similar to winter 2019 (7), indicating that alpine resort operations are continuing regular maintenance schedules for their over-snow vehicles.
- The impact from snow clearing activities on the surrounding waterways and riparian areas should continue to be monitored by NPWS and the alpine resorts. NPWS and alpine resort operators should investigate alternative clearing methods and undertake remediation at the end of each season to reduce the impact.

Image 10 Redwood Ski Lodge, North Perisher. Photo: T Scanlon/DCCEEW

6. Contamination

This section reports on environmental quality as per section 11.6 and Chapter 12 of the plan of management; specifically, remediation progress at contaminated sites within the alpine resorts. The potential presence of contaminated sites within the alpine resorts is mainly associated with past or ongoing storage of hydrocarbons and in-situ underground petroleum storage systems (UPSSs).

In January 2020, a former workshop and various other buildings at Selwyn Snow Resort were destroyed by a bushfire. The workshop was the site of 2 UPSS tanks, with 2 dispensers and a total capacity of 9,000 litres of diesel. During the 2020–21 reporting period the remains of the Selwyn Snow Resort workshop were demolished, and the former UPSS site was decommissioned. In conjunction with the decommissioning, a validation assessment was undertaken to comply with the NSW Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2019. The validation assessment conducted for the former Selwyn Snow Resort workshop UPSS identified hydrocarbon-impacted soil in both tank pits (Ground Doctor 2020). Some impacted soil was removed and disposed of offsite at the time of decommissioning. However, the fractured bedrock structure at the site made excavating further material unfeasible and likely an ineffective remediation measure.

In November 2020, a total of 9 monitoring wells around the former UPSS site were used to help identify the extent of contamination. The monitoring wells were gauged, purged and sampled. A plume of hydrocarbon-impacted groundwater was found to extend approximately 50 metres down gradient from the UPSS site. These impacts were reported by Selwyn Snow Resort Pty Ltd to the EPA in accordance with the *Contaminated Land Management Act 1997*.

As part of the resort rebuild, Selwyn Snow Resort is required to prepare and implement a remedial action plan for the former workshop and UPSS site. The remedial action plan will set objectives for a monitoring program at the former UPSS site, scope and frequency of monitoring events, and change thresholds that might lead to a revision of the remedial strategy.

6.1 Management response and review

- NPWS, with input from the EPA, will work with Selwyn Snow Resort Pty Limited to ensure the remedial action plan prepared for the former workshop UPSS site is appropriate, and associated monitoring and reporting activities are undertaken.
- NPWS will continue inspections of UPSSs, to make sure all UPSS sites meet the requirements of the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation.

7. Environmental quality

This section reports on environmental quality as per section 11.6 and Chapter 12 of the plan of management. This includes weed management, rehabilitation, development applications and controls, along with measures applied to preserve scenic quality, air quality protection, noise control and light pollution in the alpine resorts.

Maintaining and improving the environmental quality of alpine landscapes is a key objective of the plan of management and remains a high priority for NPWS and the alpine resort operators. The alpine resorts, with assistance from NPWS, aim to limit their impact on the natural environment, and improve environmental integrity where possible, via the responsible management of new developments, rehabilitation and weed control.

7.1 Development applications

Development consent under the *Environmental Planning and Assessment Act 1979* is required to be able to undertake most development within the alpine resorts. During the 2020–21 reporting period, specific considerations for that consent were set out in the *State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007* (Alpine SEPP). The Alpine Resorts Team within the Department of Planning, Housing and Infrastructure are the consent authority for development applications, with NPWS being a referral agency under the Alpine SEPP. NPWS assists the Alpine Resorts Team with assessment and formulating of conditions, and also works with proponents to provide advice and oversight which assists the carrying out of development in a responsible manner.

During the reporting period, NPWS received referrals and assisted the Alpine Resorts Team with the assessment of 43 development applications for projects valued at more than $17 million.

Proposed developments varied in complexity, with 27 associated with renovation and redevelopment of visitor accommodation, and 13 larger projects associated with upgrading both winter and summer infrastructure within the alpine resorts. In addition, there was one application submitted for a telecommunications facility, one for a new development on an unestablished site, and one for tree and rock removal (Planning NSW n.d.).

7.2 Air quality, noise control and light pollution

The alpine resorts and NPWS operations have an impact on air quality, noise and light pollution. The use of vehicles for resort and NPWS operations, snowmaking, construction, floodlights for night skiing as well as resort events all impact on the environment and local wildlife.

NPWS works with the Department of Planning, Housing and Infrastructure to identify potential adverse noise impacts from development and to avoid or mitigate those impacts. This primarily occurs through the development assessment and conditioning process under the Environmental Planning and Assessment Act and Alpine SEPP. For example:

- All outdoor events require a noise management statement as part of the planning process. This assesses the likely level of noise, the potential impact on residents and guests, and sets out a complaint response procedure.
- Construction hours are specified to reduce the impact of noise on nearby businesses, residents and guests.

Alpine resorts and NPWS are trying to minimise light pollution through design, including installing downward-facing streetlighting instead of bulb or upward-directed lighting when upgrading.

Further information on air quality is available in section 2.3 of this report, which relates to carbon emissions and offset programs.

Image 11 **Night skiing at Charlotte Pass Snow Resort. Photo: Charlotte Pass Snow Resort**

7.3 Weed management

The alpine resorts and NPWS spent a total of 1,010 hours on weed control during the 2020–21 reporting year, which is higher than the previous reporting year. Figure 15 shows the 2020–21 weed control hours undertaken by each alpine resort operator and NPWS compared to the previous reporting year.

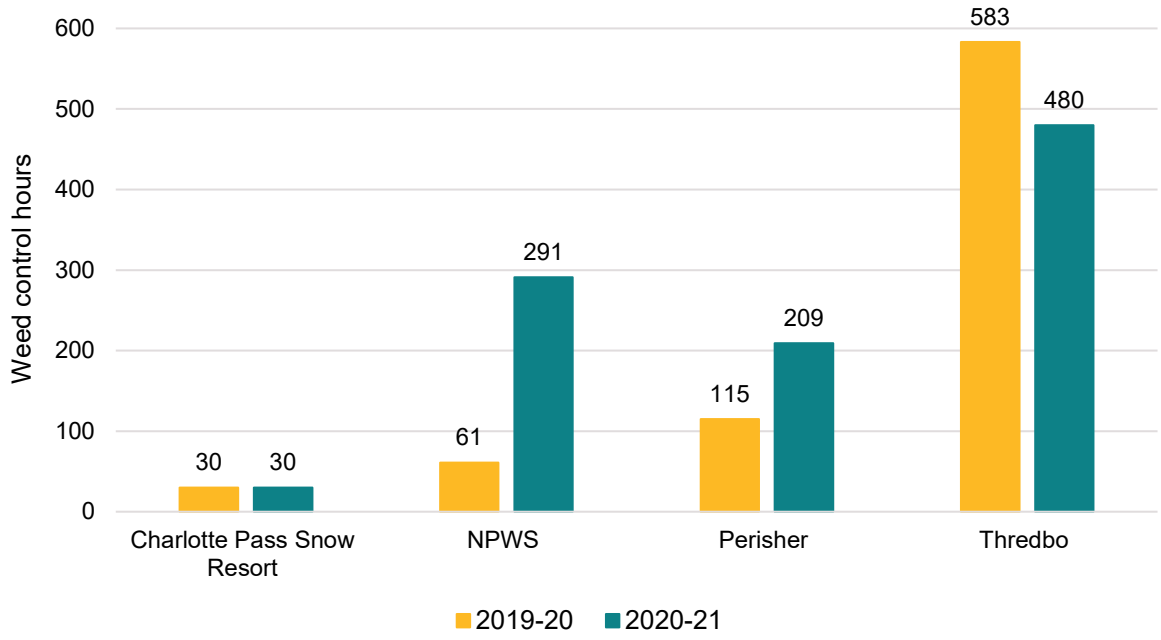

Figure 15 Staff and contractor hours spent on weed control in NSW alpine resorts

Charlotte Pass Snow Resort

Charlotte Pass Ski Resort undertook 30 hours of summer weed control, predominately along roadsides. The number of hours for weed control around Charlotte Pass Snow Resort is declining due to good outcomes from the weed management program. Species targeted include cocksfoot (*Dactylis glomerata*), timothy grass (*Phleum pratense*), milfoil (*Achillea millefolium*), wintercress (*Barbarea vulgaris*), vipers bugloss (*Echium vulgare*) and great mullein (*Verbascum thapsus*).

NPWS (Perisher Range resorts)

NPWS staff and contractors spent 291 hours on weed control. Focus areas were around NPWS infrastructure, Perisher Range resort lodges and along roadsides. Targeted species include vipers bugloss, milfoil, goat's beard (*Tragopogon dubius*), great mullein (*Verbascum thapsus*), St John's wort (*Hypericum perforatum*), wintercress, cocksfoot, dandelion and thistle species.

Perisher Ski Resort

Perisher Ski Resort staff and contractors spent 209 hours on weed control around the Perisher Range resort areas. This targeted soft rush (*Juncus effusus*), St John's wort, thistle species, russell lupin (*Lupinus polyphyllus*), milfoil and great mullein.

Thredbo Alpine Resort

Thredbo Alpine Resort spent a total of 480 hours on weed control, including staff and contactor weed spraying. Thredbo Alpine Resort staff focussed their weed control on vipers bugloss, St John's wort, great mullein, milfoil, thistle species and soft rush. Contactors used the cut-and-paint method to target blackberry (*Rubus fruticosus*) around Thredbo village, the Thredbo Golf Course and lower mountain.

Lodges (Perisher Range and Charlotte Pass)

Each lodge is responsible for maintaining their leasehold area, including weed control. In the 2020–21 reporting period, 58% of the lodges in the Perisher Range resorts (65/123) and Charlotte Pass Snow Resort (9/13) undertook weed control. Weed control is predominately undertaken by lodge staff or through club working bees and includes chemical spraying, whipper snipping, dead heading and hand pulling.

Image 12 **Milfoil (*Achillea millefolium*) is a weed present in all alpine resort areas and being targeted by alpine resort operators and NPWS in their weed control programs. Photo: E Stafford/DCCEEW**

7.4 Pest management

Pest animal control programs are run within and adjacent to the alpine resorts and target the control of foxes (*Vulpes vulpes*), cats (*Felis catus*) and rabbits (*Oryctolagus cuniculus*). These species have been identified as primary pests within the alpine resort areas. Table 12 shows the different pest control programs, and the numbers of individual animals caught and killed by each program.

Table 12 Pest management programs in 2020–21

Resort	Cat (cage/soft-jaw trapping)	Foxes (soft-jaw trapping)	Rabbits (ground shooting)
Charlotte Pass Snow Resort (NPWS-managed program)	1	0	0
Perisher Range (NPWS-managed program)	9	4	60
Thredbo Alpine Resort (operator-managed program)	16	n.a.	n.a.
Total	**26**	**4**	**60**

Foxes and cats

Perisher Ski Resort, Charlotte Pass Snow Resort, lodge staff and members of the public assist with cat trapping in resort areas as part of the 'See a cat catch a cat' program. Resort and lodge staff report pest animal sightings to the NPWS Perisher Team who respond to any sightings. Additionally, NPWS Perisher Team conducts a winter trapping program throughout Perisher Valley and surrounds. Thredbo Alpine Resort manages their own cat trapping program each year between the June and October long weekends.

A soft-jaw trapping program is conducted throughout the summer months with a focus on the endangered mountain pygmy-possum (*Burramys parvus*) habitat areas within the Perisher Range resorts and Charlotte Pass Snow Resort. This program targets both cats and foxes to minimise the impacts of predation on the core populations within the alpine resort areas.

Rabbits

From May to June 2020 Thredbo Alpine Resort, in consultation with NPWS, undertook a rabbit baiting program using pindone. An initial spotlighting program was run to assess rabbit population numbers and high-density areas, with 202 rabbits being counted. Spotlighting provides an indication of population size rather than actual population numbers.

Wire mesh covered bait stations were temporarily placed in the identified high-density areas of Thredbo Alpine Resort around the village and lower mountain. Initially free feed was used to encourage rabbits to feed. After one week of free feed, pindone-coated carrots were put under the bait stations and topped up every 2 to 3 days for a period of 2 weeks. Once the pindone program was complete the remaining pindone-coated carrots were collected and destroyed. NPWS and Thredbo staff carried out post-pindone spotlighting to reassess the rabbit population, with 98 rabbits counted, indicating a reduction in population size.

Wasps

During the reporting year a total of 5 bait stations containing fipronil baits were installed throughout Thredbo village to manage the European wasp (*Vespula germanica*) population.

NPWS supplied the baits and Hammond Pest Management was contracted by Thredbo Alpine Resort to treat active nests.

7.5 Rehabilitation programs

Charlotte Pass Snow Resort

No rehabilitation was undertaken by Charlotte Pass Snow Resort in this reporting year.

NPWS and Perisher Range resort lodges

In total, NPWS planted 5,540 native shrubs and snow gums, which includes the plants provided to lodges for rehabilitation projects. NPWS assists lodges to create a rehabilitation plan for their leasehold area, with the aim of removing weedy grasses, particularly timothy grass and cocksfoot, and rehabilitating appropriate areas. During the 2020–21 reporting period, 12 lodges (11.4%) took part in rehabilitation programs, planting a variety of native shrubs and snow gums (*Eucalyptus pauciflora* subsp. *niphophila*) including Beachcombers Lodge who ran a working bee to rehabilitate their leasehold area, shown in Image 13.

Image 13 **Left: NPWS team member delivering plants, compost and fertiliser tablets. Photo: Beachcombers Lodge. Right: Rehabilitation working bee at Beachcombers Lodge. Photos: Beachcombers Lodge**

Perisher Ski Resort

The Perisher Ski Resort summer rehabilitation program saw 4,170 eucalypts, grasses and mixed heath planted by Perisher staff and contractors during the reporting period. In 2020–21, rehabilitation focused on connecting areas of habitat by establishing native heath on ski runs and planting eucalyptus trees in areas of extensive dieback from wood-boring

longicorn beetles. Perisher also carries out rehabilitation as required by conditions of consent for development projects.

Thredbo Alpine Resort

Thredbo Alpine Resort planted 4,731 native trees, shrubs and grasses during the 2020–21 reporting period. This number includes the kids tree planting program, mountain bike trail maintenance, as well as rehabilitation projects linked to development consent conditions (for example around car park 2 and along the Merritts Gondola lift line).

7.6 Management, review and response

- NPWS to continue its work with the Alpine Resorts Team in ensuring thorough assessment of development applications on biodiversity, environmental quality and heritage grounds, and to assist in ensuring development within the alpine resorts occurs in an environmentally responsible manner.
- Weed management programs across all alpine resorts to continue, as well as increasing education around weed prevention for staff and visitors.
- Ongoing pest management by all alpine resorts and NPWS to continue to maintain and, where necessary, reduce pest animal population sizes.
- NPWS to continue Lodge Rehabilitation Plan program and associated advisory and planting materials supply work.

8. Mountain bike trail monitoring

The plan of management (objective 8.11.1 (11)) requires monitoring the impacts of mountain biking to enable the management of the activity within the bounds of threshold limits. The mountain biking season in Kosciuszko National Park occurs during the summer months, with the track monitoring program conducted at the season opening and season closing for the Thredbo Alpine Resort Mountain Bike Park.

The program consists of monitoring the Kosciuszko Flow and Thredbo Downhill trails and is conducted as a joint monitoring program with staff from Thredbo Alpine Resort and NPWS. Monitoring generally focuses on sustainable trail construction and erosion-related issues, but also identifies the presence and distribution of pest flora species.

Thredbo Alpine Resort Mountain Bike Park

The monitoring relevant to this reporting period was undertaken on 18 November 2020, at the opening of the 2020–21 summer season, by the NPWS environmental monitoring officer and Kosciuszko Thredbo environmental coordinator for both the Kosciuszko Flow and Thredbo Downhill trails.

The Flow Trail condition assessment found a total of 238 issues along the length of the trail, shown in Table 13. The majority of issues were sedimentation of adjacent vegetation (53), exposed batters (44) and exposed embankments (28). Sedimentation is primarily associated with sediment-laden runoff from the trail and is usually located adjacent to rollovers and water outlets from the trail. The 53 instances observed represent a large increase in occurrences over both the 2018 (68% increase) and 2019 (54% increase) monitoring events. Note that the higher number of issues recorded during December 2019 is because the monitoring was undertaken after the Cannonball Mountain Bike Festival rather than pre-season.

Table 13 Thredbo Alpine Resort Mountain Bike Park Flow Trail condition assessment data

Management issue	November 2018	December 2019	November 2020
Erosion and water management			
Water channelling	48	0	15
Water pooling	3	2	0
Under cut	21	44	6
Exposed rocks	6	29	25
Exposed roots	8	23	17
Braking bumps	1	121	0
Frost heave	0	0	0
Trail incision	5	22	25
Batters and embankments			
Exposed batter	58	50	44
Exposed embankment	17	26	28
Exposed soil	11	3	11
Vegetation			

Management issue	November 2018	December 2019	November 2020
Trail widening	9	37	4
Sedimentation of vegetation	17	24	53
Stop off area	7	16	6
Trail creep	0	1	0
Milfoil	3	6	0
Soft rush	4	1	3
Other			
Fauna impacts	0	1	0
Total	**218**	**406**	**238**

The Thredbo Downhill Trail condition assessment found a total of 288 issues along the length of the trail (Table 14). The most common issue observed was the occurrence of exposed roots (47), followed by water channelling (43) and sedimentation of adjacent vegetation (41).

Table 14 Thredbo Alpine Resort Mountain Bike Park Downhill Trail condition assessment data

Management issue	November 2018	December 2019	November 2020
Erosion and water management			
Water channelling	36	1	43
Water pooling	1	0	0
Under cut	14	30	32
Braking bumps	1	86	1
Exposed roots	25	38	47
Exposed rocks	3	36	25
Tree base (exposed)	9	19	12
Trail incision	5	47	30
Sheet erosion	0	0	0
Frost heave	0	0	0
Batters and embankments			
Exposed soil	14	1	6
Exposed batter	35	27	31
Exposed embankment	8	6	3
Vegetation			
Sedimentation of vegetation	14	11	41
Trail widening	5	17	11
Stop off area	1	6	4
Alternate trail	0	3	0
Milfoil	3	No data	2

Management issue	November 2018	December 2019	November 2020
Soft rush	1	2	0
Total	**175**	**330**	**288**

The recommendations for improvement from this report included:

- Address areas of vegetation affected by sediment-laden runoff from the trail through raking the sediment off vegetation and redesigning or installing additional or alternative trail drainage measures where possible.
- Implement batter and embankment stabilisation measures on all exposed batters.
- Continue maintenance of all plantings on batters including watering and replacement planting.

Overall, the trail network was presented in a reasonable condition for the November 2020 inspection, with evidence of extensive works undertaken during the bushfire and COVID-19 shutdown period in early 2020. These works have resulted in a significant improvement in condition to that observed in December 2019 and evidence of progress on some of the pre-existing issues, for example exposed and unstable batters and embankments.

Appendix A: Summary of environmental performance targets and indicators

Table 15 Performance summary including targets and performance for the alpine resorts 2018 to 2021, generated by EarthCheck

Environmental management system target	2018–19 performance indicator	Target status	2019–20 performance indicator	Target status	2020–21 performance indicator	Target status
Energy use per person year to be better than the resort average	Decline in performance	Exceeds the target	Decline in performance	Exceeds the target	Significant improvement	Exceeds the target
More than 5% of total energy used to come from renewable sources	Significant improvement	Below the target	Decline in performance	Exceeds the target	Decline in performance	Exceeds the target
Reduce amount of $C0^2$ equivalent emitted per person year	Decline in performance	Below the target	Significant improvement	Exceeds the target	Decline in performance	Below the target
100% resorts to have a carbon offset program in place	No significant change	✓ Meets the target	Decline in performance	Below the target	Decline in performance	Below the target
100% resorts monitor water quality	No significant change	Below the target	No significant change	Below the target	Significant improvement	Below the target

Environmental management system target	2018–19 performance indicator	Target status	2019–20 performance indicator	Target status	2020–21 performance indicator	Target status
100% resorts treat wastewater to a standard to mitigate environmental and health impacts	No significant change →	✓ Meets the target	Decline in performance ↓	Below the target ✗	Significant improvement ↑	Below the target ✗
Zero pollution incidents in the last 12 months	–	–	–	–	Significant improvement ↑	Below the target ✗
100% resorts review developments in wastewater treatment technology annually	No significant change →	Below the target ✗	No significant change →	Below the target ✗	Significant improvement ↑	Below the target ✗
Water use per person year to be better than the resort average	Significant improvement ↑	Below the target ✗	Significant improvement ↑	Below the target ✗	Significant improvement ↑	Below the target ✗
100% resorts complaint with relevant laws and regulations regarding soil contamination	No significant change →	Below the target ✗	No significant change →	Below the target ✗	Significant improvement ↑	Below the target ✗
Reduce amount of waste produced by 2.5%	Significant improvement ↑	Exceeds the target ★	Significant improvement ↑	Exceeds the target ★	Decline in performance ↓	Below the target ✗
100% resorts to have waste minimisation strategies in place	No significant change →	Meets the target ✓	Decline in performance ↓	Below the target ✗	Significant improvement ↑	Below the target ✗
Zero gaseous or particulate emissions affecting air quality	No significant change →	Below the target ✗	No significant change →	Below the target ✗	No significant change →	Below the target ✗

Environmental management system target	2018–19 performance indicator	Target status	2019–20 performance indicator	Target status	2020–21 performance indicator	Target status
Zero noise pollution affecting residents, communities, and wildlife	No significant change →	Below the target ✗	No significant change →	Below the target ✗	No significant change →	Below the target ✗
Zero light pollution affecting residents, communities, and wildlife	No significant change →	Below the target ✗	No significant change →	Below the target ✗	Significant improvement ↑	Below the target ✗
100% resorts undertaking weed management	No significant change →	Below the target ✗	No significant change →	Below the target ✗	Significant improvement ↑	Below the target ✗
100% resorts undertaking rehabilitation programs	No significant change →	Below the target ✗	No significant change →	Below the target ✗	Significant improvement ↑	Below the target ✗
No disturbance to intact vegetation	No significant change →	Meets the target ✓	No significant change →	Meets the target ✓	Significant improvement ↑	Below the target ✗
100% resorts undertaking litter projects and control measures	No significant change →	Below the target ✗	No significant change →	Below the target ✗	Significant improvement ↑	Below the target ✗
100% resorts undertaking pest management programs	No significant change →	Below the target ✗	No significant change →	Below the target ✗	Significant improvement ↑	Below the target ✗

Appendix B: Summary of water quality and macroinvertebrate monitoring results

Table 16 Summary of water quality and macroinvertebrate monitoring results for 2020, collected by Environment, Energy and Science, Department of Climate Change, Energy, the Environment and Water

Program Area	River	Site	Sample Date	Season	TN	NH_3	NO_X	TP	EC	Turb	AUS RIVAS		Taxa richness	EPT richness	EPT ratio	SIG-NAL 2	WQ	Bio score
Charlotte Pass	Spencers Creek	105	12/05/2020	Autumn	0.125	0.001	0.012	0.001	2.9	0.27	B	0.83	25	9	0.36	5.72	1.8	1.2
			24/11/2020	Spring	0.090	0.01	0.01	0.006	4.3	0.49	A	0.87	23	9	0.39	5.78	2.0	1.4
		106	12/05/2020	Autumn	0.108	0.001	0.010	0.002	3.5	0.2	A	0.97	24	8	0.33	5.55	1.8	1.2
			24/11/2020	Spring	0.090	0.01	0.01	0.003	5.5	0.41	B	0.73	24	8	0.33	5.55	2.0	1
		107	12/05/2020	Autumn	0.130	0.01	0.016	0.003	4.1	1.8	B	0.83	27	12	0.44	5.59	1.7	1.6
			24/11/2020	Spring	0.120	0.01	0.01	0.007	7.4	0.36	A	0.95	29	13	0.45	5.97	1.8	1.8
Perisher Resort	Rock Creek	120	12/05/2020	Autumn	0.125	0.001	0.007	0.001	3.6	0.07	A	0.97	30	15	0.5	5.83	1.8	1.8
			23/11/2020	Spring	0.180	0.01	0.01	0.01	6.8	1.08	A	0.95	30	14	0.47	5.57	1.8	1.8
		121	12/05/2020	Autumn	0.115	0.001	0.009	0.001	3.7	0.11	A	0.97	25	15	0.6	6.12	1.8	1.8
			23/11/2020	Spring	0.160	0.01	0.01	0.007	6.3	0.9	A	0.87	29	11	0.38	5.76	1.8	1.6
	Perisher Creek	122	12/05/2020	Autumn	0.155	0.001	0.012	0.001	9.2	0.26	A	1.1	25	12	0.48	6.12	1.8	1.8
			24/11/2020	Spring	0.120	0.01	0.01	0.004	13.1	0.52	A	0.95	27	10	0.37	5.63	1.8	1.6
		123	12/05/2020	Autumn	0.162	0.004	0.022	0.003	7.1	0.3	A	1.1	27	14	0.52	5.85	1.7	1.8
			24/11/2020	Spring	0.160	0.01	0.04	0.006	14.1	2.3	A	1.09	25	11	0.44	6.16	1.3	1.8
		124	12/05/2020	Autumn	0.147	0.001	0.021	0.002	7.2	0.3	A	1.11	28	14	0.5	5.93	1.7	1.8
			24/11/2020	Spring	0.150	0.01	0.03	0.006	13.6	0.62	A	1.17	31	14	0.45	6.29	1.7	2
Smiggin Holes	Pipers Creek	128	12/05/2020	Autumn	0.150	0.001	0.008	0.001	4.3	0.2	X	1.17	31	15	0.48	6.42	1.8	2
			24/11/2020	Spring	0.120	0.01	0.01	0.004	6.6	0.58	A	1.02	34	14	0.41	6.18	1.8	1.8
		128A	24/11/2020	Spring	0.080	0.01	0.01	0.004	7	0.51	A	1.09	34	14	0.41	5.82	2.0	1.6

Program Area	River	Site	Sample Date	Season	TN	NH_3	NO_X	TP	EC	Turb	AUS RIVAS		Taxa richness	EPT richness	EPT ratio	SIG-NAL 2	WQ	Bio score
			12/05/2020	Autumn	0.111	0.001	0.012	0.001	4.5	0.2	A	1.1	34	18	0.53	6.21	1.8	2
		129	11/05/2020	Autumn	0.188	0.001	0.018	0.003	14.9	1	A	1.1	25	10	0.4	6.12	1.7	1.6
			24/11/2020	Spring	0.120	0.01	0.01	0.005	28.7	0.61	B	0.66	27	10	0.37	5.81	1.8	1.4
	Smiggin Tributary	130	11/05/2020	Autumn	0.249	0.001	0.055	0.006	13.6	1.75	B	0.69	18	6	0.33	5.5	1.3	0.8
			24/11/2020	Spring	0.180	0.01	0.05	0.008	18.9	1.41	B	0.58	19	5	0.26	5	1.5	0.6
		131	11/05/2020	Autumn	0.323	0.001	0.038	0.014	9.8	1.1	B	0.76	25	9	0.36	5.4	1.2	1
			24/11/2020	Spring	0.160	0.01	0.03	0.007	14.4	1.1	B	0.8	23	6	0.26	5.26	1.7	0.8
Ski Rider & Kosciuszko Tourist Park Campground	Sawpit Creek	160	11/05/2020	Autumn	0.259	0.001	0.012	0.005	28.8	0.85	A	0.87	25	9	0.36	5.4	1.7	1.2
			23/11/2020	Spring	0.220	0.01	0.01	0.018	32	3.55	B	0.66	25	8	0.32	5.56	1.2	1
		161	11/05/2020	Autumn	0.214	0.001	0.011	0.008	31.8	1.26	A	0.9	32	15	0.47	5.28	1.5	1.6
			24/11/2020	Spring	0.180	0.01	0.01	0.013	32.4	1.8	A	1.17	36	17	0.47	5.75	1.5	1.8
		162	11/05/2020	Autumn	0.245	0.001	0.012	0.009	32.7	1.28	A	1.01	33	19	0.58	6.61	1.5	2
			24/11/2020	Spring	0.350	0.01	0.01	0.038	34.2	1.97	A	1.1	36	18	0.5	6.17	1.2	2
Guthega	Farm Creek	501	12/05/2020	Autumn	0.108	0.001	0.010	0.001	2.8	0.1	A	1.1	25	14	0.56	6.32	1.8	2
		502	24/11/2020	Spring	0.050	0.01	0.01	0.002	5.3	0.35	B	0.8	26	14	0.54	6.12	2.0	1.6
			12/05/2020	Autumn	0.150	0.001	0.015	0.021	3.4	0.22	A	1.07	26	17	0.66	6.42	1.5	2
	Blue Cow Creek	503	24/11/2020	Spring	0.060	0.01	0.01	0.002	5.6	0.52	A	1.17	30	14	0.47	6.3	2.0	2

Notes:

TN = total nitrogen; NH_3 = ammonia; NO_x = nitrogen oxide; TP = total phosphorus; EC = electrical conductivity; Turb = turbidity; AUSRIVAS = Australian River Assessment System; EPT = Ephemeroptera, Plecoptera and Trichoptera taxonomic groups; SIGNAL2 = average pollution sensitivity grades; WQ = combined water quality stressors indicator score, BioScore = combined biological response score.

Legend for colours used in the table:

Good	**Water quality measurement is within the ANZG 2018 guideline trigger level.**
Moderate	Water quality measurement is above the ANZG 2018 guideline trigger level but is less than 2 times the trigger level
Poor	Water quality measurement is more than twice the ANZG guideline trigger level

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