



ACT
Government

Fire Ecology Program Update 2016–19

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Acknowledgement of Country

We acknowledge the Ngunnawal people as Canberra's first inhabitants and Traditional Custodians. We recognise the special relationship and connection that Ngunnawal people have with this Country. Ngunnawal people are a thriving people whose life and culture is connected unequivocally to this land in a way that only they understand and know, and is core to their physical and spiritual well-being. The past disconnection of the Ngunnawal people from Culture and Country has had long-lasting, profound and ongoing health and well-being effects on their life, cultural practices, families and continuation of their law/lore. We acknowledge the historic dispossession of the Ngunnawal people of Canberra and their surrounding regions. We recognise the significant contribution the Ngunnawal people make in caring for Country as for time immemorial they have maintained and will continue to maintain a tangible and intangible cultural, social, environmental, spiritual and economic connection to these lands and waters.

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Front cover: An ecological burn in box-gum woodland at Hall Cemetery. Photo: Julian Seddon

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Executive Summary

This report summarises the key findings of the Fire Ecology Program of the Conservation Research Branch (CR) of the Environment, Heritage and Water Division of ACT Government's Environment, Planning and Sustainable Development Directorate (EPSDD) for the three years June 2016 - June 2019. This report, normally produced annually, has been delayed due to staff reassignments and the implications of the Orroral Valley fire for staff workloads.

The Fire Ecology Program of work consists of provision of evidence-based ecological advice at various stages of the statutory fire management framework in the ACT, ecological assessment of the impact of a selected sub-set of prescribed burns carried out each year, and additional research and monitoring carried out to build knowledge on the responses of ecological values to fire in the ACT. This report summarises findings of the research and monitoring carried out under this program, which is largely financed by the EPSDD Parks and Conservation Service's Fire, Forestry and Roads section (FFR) through the annual Bushfire Operations Plan (BOP) budget.

Ecological assessment of 11 prescribed burns in the 2017/18 and 2018/19 fiscal years was carried out against the EPSDD Ecological Guidelines for Fire and Fuel Management, a set of guidance developed by CR in collaboration with FFR. This assessment found that:

- 4/11 burns raised no ecological issues of concern;
- 5/11 burns met ecological advice/recommendations with respect to burn patchiness and severity, but caused some ecological impacts of concern, such as loss of hollow-bearing trees, vehicle or trampling damage in sensitive areas, or damage to fire-sensitive communities;
- 2/11 burns escaped containment lines, causing high-severity fire in high-value (long-unburnt) areas in one case and post-fire severe weed invasions in both.

Importantly, where prescribed burning led to documented ecological impacts, these impacts need to be viewed in the context of bushfire risk and weighed against the likelihood and magnitude of impacts caused by unmitigated bushfires.

Longer-term post-burn monitoring established for two prescribed burns that led to outbreaks (Potters Hill and Cotter River) was disrupted by the Orroral Valley fire, which burnt many monitoring sites. This work is being reconfigured into a different study design.

Two further projects on fire ecology were undertaken in this period. A study on the impacts of prescribed burning on the structure and function of dry eucalypt forests in Canberra Nature Park was carried out between 2013 and 2018. These sites have been resurveyed in 2022 and final results will be published in 2022/23. A second study (published in 2020) was carried out in partnership with citizen scientists and focused on the relationship of orchid species richness in CNP with fire history. Data from 76 sites found that overall, orchid species richness increased with increasing time since fire, with fire frequency exhibiting no independent effect. However, among rare species, five were associated with more frequently burnt areas, two with long unburnt areas, and three with areas with intermediate time since fire.

A set of key learnings and recommendations for fire management practices emerge from this work, related to timing of burns, use of Values Officers, use of working groups in fire planning, preventing

weed outbreaks, conserving high-value habitat trees, avoiding vehicle impacts, protection of riparian areas, assessing ecological values of potential burn outbreak areas, and rehabilitation planning.

1 Introduction

Scope of this report

This report provides information relating to the entire Fire Ecology Program of the Environment, Planning and Sustainable Development Directorate (EPSDD)'s Conservation Research (CR) Unit. The bulk of this program involves advice and monitoring related to the implementation of the ACT's Strategic Bushfire Management Plan (SBMP), the Regional Fire Management Plan (RFMP) that outlines EPSDD's planned bushfire mitigation works over a 5–10-year timeframe, and the annual Bushfire Operational Plan (BOP) that is delivered by the Parks and Conservation Service as part of implementing the RFMP. This policy and planning structure and the role of CR within it are described below.

In addition to this work, the Fire Ecology Program includes further ecological research to expand knowledge of the responses of the ACT's flora and fauna to fire and other fuel management treatments. This ecological knowledge is used to underpin evidence-based advice to feed into the planning of subsequent RFMPs and BOPs.

The research and monitoring work of the Fire Ecology Program over this period is summarised in Table 1, with further details of most projects presented in subsequent sections of this report. More detailed reports will be made available upon the completion of each project.

Table 1. Summary of ecological advice, review, monitoring, and research activities conducted during 2016-19 as part of CR's Fire Ecology Program.

Project	Status	Comment
Annual draft BOP review	Completed for 2016/17, 2017/18, and 2018/19 BOPs	CR ecological review and feedback on the draft BOPs proposed for following year. Advice provided to Conservator of Flora and Fauna.
Burn and works plan reviews	Completed for multiple BOP works	See section on annual qualitative review below.
Values Officer	CR staff involvement as environmental Values Officer on multiple prescribed burns including on-ground and IMT roles	Not detailed in this report.
Qualitative assessment of selected BOP prescribed burns	Complete for 2016 – 2019	See individual findings in this report.
Update of Ecological Guidelines	Completed	Version 1.4 published online**. Not discussed further in this report.
Canberra Nature Park prescribed burn study	Ongoing pre- and post-burn data collected over five years. Data analysis completed	Final report write-up planned for 2021-22. Brief summary of design in section 2.3 of this report.
Canberra Nature Map - orchids and fire	Complete; paper published in Australasian Plant Conservation 2019	Summary in section 2.4 of this report.
Cotter River burn (FB087) post burn monitoring*	Ongoing. Three seasons' data now collected	Sites affected by the Orroral Valley wildfire in 2020. Some sites may be incorporated into future work. Summary of the design and initial observations reported here.
Potters Hill burn (FB095) post burn monitoring*	Ongoing. Two seasons' data now collected	Not reported on in this update as data have not yet been analysed. Sites affected by the Orroral Valley wildfire in 2020. Some sites may be incorporated into future work.

*Additional post-burn monitoring of these burns was carried out because they involved significant escapes.

**These Ecological Guidelines available at:

https://www.environment.act.gov.au/_data/assets/pdf_file/0009/1483830/Ecological-Guidelines-2019-ver-1.3.pdf

Policy and planning context for fire management in the ACT

Much of CR's Fire Ecology Program relates to providing ecological input to the planning and implementation of statutory fire management in the ACT. Fire management for bushfire risk mitigation in the ACT is governed by the 5-yearly Strategic Bushfire Management Plans (SBMPs) (<https://esa.act.gov.au/about-esa/publications/strategic-bushfire-management-plan>). Within the broad policy framework of the SBMPs, the Environment, Planning and Sustainable Development Directorate (EPSDD) develops Regional Fire Management Plans (RFMPs) that provide a strategic, landscape scale approach to planning fire management activities on EPSDD managed lands including the extensive reserve network across the ACT. RFMPs have a 10-year lifespan with a 5-year review. RFMPs are a key planning tool that enable decisions to be made that balance all land management objectives and consider values in the landscape, including ecological values, in accordance with the requirements of the ACT wide SBMP. To ensure an acceptable level of risk reduction from uncontained and unplanned fire, trade-offs between many of these values and objectives may need to be made.

In accordance with the SBMP and associated ACT Bushfire Management Standards (<https://esa.act.gov.au/sites/default/files/2019-06/Fire-Managment-Standards-ACT-SBMPv31.pdf>), the RFMP provides that fuel management is of the highest priority near identified assets (Asset Protection Zones [APZs]) but also occurs in broader Strategic Firefighting Advantage Zones (SFAZs). APZs are designed to provide reduced fuels within the immediate vicinity of assets and necessarily require a greater intensity of management. SFAZs are designed to interrupt the likely paths of major fires approaching the urban area or catchment boundaries from the north-west where prevailing fire weather originates in the ACT region. The RFMPs also prescribe fuel treatment activities in the Landscape Fire Management Zone (LFMZ); however, in this zone activities are restricted to those that are compatible with agreed broader land management objectives including biodiversity conservation.

The annual EPSDD BOP is then developed by PCS from the agreed activities identified in the 10-year RFMP and must be approved by the Commissioner of the Emergency Services Agency. The BOP draws treatments from the approved and published RFMPs to provide strategic fire protection for the ACT within a broad zoning system. Each year the EPSDD BOP includes a comprehensive list of activities identified to reduce the risk of unplanned fire and/or enhance ecological condition.

The role of the Conservation Research Unit in relation to fire management

Conservation Research, through the Fire Ecology Program, provides ecological input at all levels of fire management planning and operations in the ACT. This includes: writing environmental sections of the SBMP; contributing to the development of RFMPs; annual review of proposed BOP activities on behalf of the ACT Conservator of Flora and Fauna; input to the development of burn plans and works plans deriving from the BOP; collaboration with fire management staff, rangers and community groups to identify and address risks to ecological values during implementation of planned burns and other bushfire mitigation works; monitoring the ecological outcomes of planned burning; and undertaking ecological research on the response of ACT flora and fauna to planned and unplanned fire to improve the scientific knowledge base to guide future fire management

activities. CR's work in this respect is supported by the PCS Fire, Forests and Roads Branch (FFR) through funding of the Fire Ecology Project Officer position in CR.

CR's role on behalf of the ACT Conservator of Flora and Fauna in relation to the development of the annual BOP is to carry out an ecological review of all works proposed for the following year's BOP, including all fuel management and access management activities. From this review CR makes recommendations as to the potential for adverse impact of planned fire management activities on ecological values, and collaborates with fire management staff to refine the proposed BOP so as to minimise ecological risks (see Table 2 for details).

The first step in this review process is a GIS desktop analysis highlighting any activities that could overlap with mapped high value and fire sensitive biodiversity assets. Maps produced through this process, along with annotated tables, are then reviewed by senior flora and fauna ecologists within CR. In cases where a negative environmental impact is considered possible, CR provides advice on mitigating actions that could be undertaken to modify or change treatments, whilst still meeting the agreed and accepted objective of fire risk reduction through fuel management and modification. Where potential negative impacts are small but unavoidable due to fire management objectives, advice is provided to minimise such impacts. Where significant negative impacts are likely, these are referred to the ACT Conservator of Flora and Fauna and the Executive Branch Manager for PCS for determine if the potential negative impacts upon ecological assets are justified to achieve fire management objectives. Meetings are held between CR, FFR, the EBM of PCS and the ACT Conservator of Flora and Fauna to establish an agreed outcome. A final agreed draft of each EPSDD BOP is then prepared by PCS for approval by the Emergency Services Agency (ESA).

Table 2. A total of 680 treatments were subjected to ecological review for the 2016-2017 BOP, 568 treatments for the 2017-2018 BOP and 571 treatments for the 2018-2019 BOP. Prescribed burn reviews included comment on selected burn and works plans developed by the PCS Fire, Forestry and Roads Branch.

Year	Prescribed Burns	Infrastructure	Grazing	Access	Slashing	Chemical	Physical Removal	Total Treatments
16/17	79	23	72	146	243	48	69	680
17/18	52	15	73	115	246	33	34	568
18/19	43	14	73	128	241	38	34	571

Thus, each treatment in the approved EPSDD BOP is subject to three levels of ecological review: at the level of the SBMP, at the level of the RFMP, and at the level of the draft EPSDD BOP. The PCS FFR section has a legislated obligation to ensure that all the identified tasks within the approved EPSDD BOP are delivered and that the identified areas meet the relevant SBMP fuel standards. Hence, once activities are endorsed through this hierarchical planning and approval framework, PCS is obligated to implement the EPSDD BOP to the extent that resources and conditions allow.

CR further carries out annual post-hoc qualitative assessments of selected BOP prescribed burns and other works, to assess their outcomes and feedback learnings for future EPSDD BOPs. CR

carries out monitoring of activities in the BOP related to two areas, in order to support adaptive management:

- 1. Fuel management:** Reduction of fuel in certain areas using a range of methods, including prescribed burning, grazing, slashing, chemical treatment, and physical removal of vegetation. Each of these activities impacts on the local environment, and the major objective of monitoring is to measure the impact of these activities and identify adverse environmental impacts to underpin evidence-based recommendations to minimise such impacts in future operations.
- 2. Ecological burning:** Prescribed burns which are identified and implemented with the main objective of improving ecological health and/or stimulating responses from target species. Ecological burns may also aim to reduce fuels to mitigate bushfire risk, but this is not the primary driver. Monitoring of ecological burning seeks to measure the impact of these activities and their conservation outcomes, particularly for threatened species and communities.

By agreement between CR and FFR, 10 percent of prescribed burns conducted in each EPSDD BOP year are assessed for ecological outcomes against recommendations made in the CR EPSDD BOP review and against burn plans. A total of 11 burn treatments were completed in 2016/17, 22 in 2017/18 and 25 in the 2018/19 fiscal years, and of these, 5 were assessed in 2017/18 and 6 in 2018/19 (see Table 3). For substantial periods in 2016 and 2017 the Fire Ecology Project Officer position in CR was reassigned to fire management officer duties with FFR, so burns conducted during the 2016/17 season were not assessed and are not reported here.

The selection of treatments for outcome assessment and follow up monitoring was not random. Rather, there was a focus on burns considered more likely to cause negative ecological impacts, with the rationale that these would provide the greatest opportunities for learning and improvement.

Report timing

This report is normally published annually. However, due to reassignment of the officer occupying the Fire Ecology Project Officer position to the FFR in 2017 (international firefighting deployments) and 2018 (development of the 2019-29 RFMP) and consequent lack of capacity within the CR fire ecology team, a separate report was not prepared for the 2016-2017 period. Work on this report began in 2019. However, staff turnover in both CR and the FFR, combined with the CR fire ecology team's work commitments assessing the impacts of the 2020 Orroral fire on Namadgi National Park and monitoring the park's subsequent recovery, have delayed its completion.

2 Summary of research and monitoring outcomes

Qualitative assessment of selected BOP prescribed burns

Qualitative assessment of planned burns is based on comparing the ecological outcomes against advice, prescriptions and recommendations made by Conservation Research and others in the BOP review, in burn plans, and during burn implementation. In particular, outcomes are assessed against the relevant 'Ecological Guidelines for Fire, Fuel and Access Management Operations' ([Ecological Guidelines](#)) as stipulated in the burn plan for each burn. Some guidelines are generic and apply to most prescribed burns. For example, Ecological Guideline 1.2 states:

1.2 For ecological reasons it is recommended that burns generally be low intensity and patchy across the burn area, aiming to achieve 30% unburnt (in patches), 70% burnt and less than 10% crown scorch.

Other Ecological Guidelines may only be stipulated when relevant based on the context and/or timing of the prescribed burn such as where the burn has potential to impact a threatened species. For example, for burns adjacent to rivers occupied by the EPBC- and ACT-listed Endangered Macquarie Perch (*Macquaria australasica*), Ecological Guideline 39 applies:

39.1 Avoid treatments that could cause siltation in waterways where this species breeds. This is particularly important in spring.

Burns selected for assessment are inspected post-burn either on-ground and/or aerially by helicopter. Field observations are combined with any available remote data such as satellite derived burn severity mapping or aerial imagery and the degree to which stipulated ecological advice and prescriptions have been met is determined. Where appropriate, suggestions are made for future burn planning and implementation, both verbally post operation and through these Fire Ecology Program update reports.

A summary of the main ecological impacts of the 11 assessed burns for 2017/18 and 2018/19 is presented in Table 3. Overall, 4/11 burns raised no ecological issues of concern. 5/11 burns met ecological advice/recommendations with respect to burn patchiness and severity, but caused other ecological impacts of concern, such as loss of hollow-bearing trees, vehicle or trampling impacts in sensitive areas, or damage to fire-sensitive communities. Finally, 2/11 burns escaped primary containment lines, causing high-severity fire in high-value (long-unburnt) areas in one case, and post-fire severe weed invasions in both. Importantly, where prescribed burning led to documented ecological impacts, these impacts need to be viewed in the context of bushfire risk and, taking into account reduction of risk caused by the burn, weighed against the likelihood and magnitude of impacts caused by unmitigated bushfires.

A number of burns were conducted well below identified minimum ecological thresholds or minimum Tolerable Fire Interval (TFI) for the specific vegetation community. The SBMP recognises that in the context of bushfire risk mitigation TFIs are used as a guide to ecological risk and not as a prescription to exclude planned fire. Even so, repeated burning below min-TFI increases the likelihood of ecological impacts and hence is minimised through strategic scheduling of burns

(RFMP) and through detailed burn planning around ignition patterns, and timing with respect to weather and fuel moisture levels.

Outcomes of the assessment for each of the 11 selected burns are discussed in turn below.

Table 3. Summary of planned burn performance against ecological criteria. ✓ = accorded with ecological advice/prescriptions; ✗ = did not accord with ecological advice/prescriptions; * indicates a nuanced outcome: consult text for details.

Year	Burn	Seasonal timing	Patchiness	Severity	Burn escape?	Other ecological issues (see text for details)
2017-2018	FB014 Barry Drive	*	✓	✓ *	No	No
	FB016 Black Mountain Tower	NA	✓	✓	No	No
	FB043 Cooleman Ridge	*	✓	✓	No	No
	FB095 Potters Hill	NA	✗ Good except in escape area	✗ Good except in escape area	Yes	Yes – high severity fire in long-unburnt vegetation and significant grassland; post-fire weed invasion
	FB115 Piccadilly	NA	✓	✗ *	Yes	Yes – post-fire weed invasion
2018-2019	FB018 Aranda	✓	See text	✗ See text	No	Yes – loss of hollow-bearing trees
	FB072 Smokers	NA	✓	✓	No	Yes – on ground Values Officer re-tasked during burn; some trampling of bog. Some areas burnt in both 2003 and 2013 were re-burnt against ecological advice
	FB132 Umbagong	✓	✓	✓	No	Yes – no Values Officer; incomplete riparian buffer; vehicles damage to grassland
	FB449 Black Mountain Summit	✓	✓	✓	No	Yes – loss of hollow-bearing trees
	FB628 Tango Spur	NA	✓	✓	No	No
	FB679 South Brandy	✓	✓	✓	No	Yes – some damage to fire-sensitive grassland and bog

2017-18 Prescribed Burns

FB014 Barry Drive, Black Mountain Nature Reserve

The Barry Drive burn was identified as suitable for winter/early spring burning due to the presence of several rare orchid species. Identification and flagging of vulnerable orchid communities was conducted by Park Care Volunteers and PCS rangers prior to burning. The Barry Drive burn was conducted on 24/04/2018.

Pre-burn advice provided

The formal advice provided by CR in the 2017/18 BOP prior to this burn was:

This burn area contains important populations of at least four orchid species rare in the ACT, all with an estimated ACT population of less than 250 plants. These are Copper Beard Orchid (Calochilus montanus), Rufous Midge Orchid (Corunastylis clivicola), Horned Midge Orchid (Corunastylis cornuta) and Pink Caps (Stegosyla congesta). It is possible that the first three species warrant listing as nationally threatened, and that Black Mountain is the national stronghold for these species. The Beard and Pink Cap orchid flower in spring while the midge orchids flower from January to May. This burn should not go ahead until the data from the Citizen Science project is analysed and a burn program responsive to conservation of significant orchids developed for the Black Mountain Sandstone area. A burn between June and early September would be best.

Post-burn comments

The orchid sites identified in the pre-burn advice were flagged off and protected. The burn was conducted outside the recommended June-September period after consultation with CR. This means the burn may have impacted orchids that were not able to be identified prior to the burn.

The southern section of the burn exhibited small patches of high intensity fire behaviour, particularly along the powerlines (**Figure 1**). This occurred mainly in previously cleared shrub and eucalypt regeneration adjacent to the powerline easement. The remaining burn area was patchy overall and met the recommended ecological guidelines. Coarse woody debris was left intact as prescribed.



Figure 1: Small area of scorch in juvenile eucalypts along the Barry Drive power line easement. Patchy, low intensity burning is evident in the interior of the burn.

FB016 Black Mountain Tower

The Black Mountain Tower burn was conducted for asset protection of Black Mountain Tower with an objective of reducing the overall fuel hazard from 'Very High' to 'Low' to meet the required SBMP fuel standard. The Black Mountain Tower Burn was conducted on 2/05/2018.

Pre-burn advice provided

The formal advice provided by CR in the 2017/18 BOP prior to this burn was:

*Last burnt 7 years ago so would be below minimum ecological threshold (Min-TFI) if burnt now. Conditional on fuel loads. If not accumulated recommend postponing for several years. Some non-local weedy species including WA Bluebell Creeper (*Sollya heterophylla*) and Lunate-leaved Acacia (*Acacia lunata*) have spread from plantings in the vicinity of the tower into the surrounding reserve. Burning may help these species to spread further. Follow-up weed control recommended.*

Post-burn comments

This burn took place below the recommended minimum ecological threshold. This burn met the specified objectives and ecological guidelines. Minimal crown scorch and consumption of coarse woody debris was evident and burn patchiness was maintained.



Figure 2: View looking south from Black Mountain Tower. Burn patchiness and minimal consumption of coarse woody debris is evident and consistent with ecological guidelines.

FB043 Cooleman Ridge

The objective of the Cooleman Ridge burn was to reduce the overall fuel hazard from high to low to meet the standards required under the SBMP and to provide asset protection to the suburb of Chapman. The Cooleman Ridge Burn was conducted on 9/03/2018.

Pre-burn Advice

The formal advice provided by CR in the 2017/18 BOP prior to this burn was:

Last burnt 5 years ago - well below minimum ecological threshold for woodland components. Burn should be postponed for several years or if this is not possible should be low intensity and patchy and largely restricted to grasses non-woody areas. PTWL prescriptions apply. Hollow bearing trees should be protected, through being raked hoed around. It is likely that Cooleman Ridge Parkcare Group would assist with this task.

Post-burn comments

The burn took place well below minimum ecological threshold for this woodland. The burn was low intensity and patchy, targeting mostly grassland fuels. The large habitat trees and rare ferns identified by the ParkCare group were flagged off and remained unburnt.

As advised, this area was identified as Pink-tailed Worm Lizard (PTWL) habitat. The 2017 version of the ecological guidelines advised that burning in PTWL habitat should occur between July and October to ensure minimal impact on the species. The burn was conducted on 9 March 2018. While this was outside the recommended window for PTWL, CR staff were consulted and advised that burning outside this window under the prevailing conditions was unlikely to have had adverse impacts.



Figure 3: The Cooleman Ridge burn conducted to reduce grassland fuels was patchy and low intensity with minimal crown scorch, consistent with ecological advice provided.

FB095 Potters Hill

The Potters Hill burn was one of four large rural prescribed burns conducted in PCS estate during the 2017/18 season. The objective of the burn was to reduce the fuel hazard rating to less than 'High' and by doing so create a strategic area to assist in preventing the spread of wildfire within NNP and adjacent NSW land. The planned maximum burn extent was 679 ha. However, the final burn area totalled 877 ha. The burn was conducted over nine days, commencing on Friday 10 March 2018.

Unpredicted, deteriorating weather conditions saw an increase in fire behaviour on Sunday 18 March 2018 resulting in the burn breaking containment on the south-eastern corner of the Long Flat Fire Trail. A 3.5 km bulldozer fire break was constructed around the escape to prevent the fire from spreading north towards Long Flat Fire Trail. Within 24 hours, the escape had been contained.

Pre-burn advice provided

The formal advice provided by CR in the 2017/18 BOP prior to this burn was:

Burn planning and implementation should take great care to avoid escape to surrounding long unburnt habitat.

The burn plan for FB095 Potters Hill prescribed burn identified the *Poa* tussock grasslands along Grassy Creek as a significant ecological asset and noted existence of significant weeds in the proposed burn area including seeding Nodding Thistle and Sweet Vernal Grass.

Post-burn comments

The burn characteristics for the original planned burn area met stipulated ecological guidelines and exhibited low to moderate burn severity with patchy consumption of ground and elevated fuels.

Approximately 200 ha of additional land was impacted by the escaped prescribed burn. The escape impacted previously long unburnt sub-alpine woodland and dry sclerophyll forest, and also a significant area of *Poa* wet tussock grasslands.

Areas of previously long unburnt vegetation located to the south-east of the original burn area were burn at high severity, resulting in extensive crown scorch and crown consumption, complete consumption of ground cover and significant loss of soil organic material (Figure 4). This area of long unburnt woodland and forest in NNP is recognised as a significant ecological asset in the SBMP and RFMP and was identified as such during the BOP development process and in the planning for the Potters Hill burn.



Figure 4: High severity fire impact on long-unburnt forest resulting from escaped of the Potters Hill prescribed burn. Long Corner Fire Trail, three months after fire escape.

The *Poa* wet tussock grasslands along Grassy Creek adjacent to Long Flat Fire Trail were burnt as part of backburning operations in an attempt to strengthen containment lines ahead of unexpected weather change. This backburning operation impacted the *Poa* grasslands though very high burn severity, subsequent off-road vehicle access, and significant ash and sediment run-off into Grassy Creek causing prolonged elevated turbidity (Figure 5). These grasslands are rated as a Category 1 Conservation Significance site in the 2017 ACT Native Grassland Conservation Strategy and were identified in the burn plan and Incident Action Plans (IAPs) as a significant ecological asset to be left unburnt. The ACT Ecological Threshold for this community is categorised as “no planned burning”.



Figure 5: Burnt River Tussock *Poa* grassland and elevated turbidity along Grassy Creek. This area was impacted by backburning operations that were implemented in an attempt to prevent escape of the Potter Hill prescribed burn ahead of an unexpected weather change.

Rehabilitation

Rehabilitation of the bulldozer containment line to the north of Long Corner Fire Trail was completed within four weeks of the burn. The trail was rehabilitated in accordance with PCS Track Rehabilitation Guidelines. The removal of the thatch layer along Grassy Creek by the backburning operation resulted in the post fire germination of a high density of Nodding Thistle (*Carduus nutans* subsp. *nutans*) from the soil seed bank. Spraying was conducted in January but was of limited effectiveness, because much of the thistle had already reached reproductive maturity and set seed by December.

Follow up spraying was conducted in mid/late November 2019 to re-treat the remaining population prior to seed set. The recovery of *Poa* tussocks was initially very slow, as a result of the severity of the backburn and the occurrence of drought conditions over much of 2018 and 2019. The slow return of *Poa* grass cover has exacerbated the propagating of Nodding Thistle in the burnt area and this species will likely require ongoing monitoring and chemical treatment. Any future fire in this area is likely to lead to further outbreaks of Nodding Thistle and it is recommended early intervention be implemented.

CR recommends ongoing monitoring for weed incursions be established following all burns, especially where rehabilitation works are required and/or implemented.

In conjunction with FFR, CR established a monitoring program in spring/summer 2018 at Potters Hill to monitor the impacts of high intensity fire on vegetation structural dynamics and fauna habitat condition in

forest and sub-alpine woodland communities. This project, which used the same methodology as the Cotter Hut prescribed burn monitoring project discussed later in this report, is currently being reconfigured following the 2020 Orroral Valley wildfire, which impacted many of the sites. A major focus of the project was to measure the post-fire response of previously long-unburnt Subalpine Woodlands and Dry Sclerophyll Forest communities in southern NNP. Data from the monitoring project will inform the discussion around strategic fire planning by quantifying fuel dynamics within previously long unburnt areas of NNP and provide insights to how such areas will respond to both planned burning and bushfires.

FB115 Piccadilly

The objective of the Piccadilly prescribed burn was to prevent the spread of wildfire in NNP and the Cotter Catchment by reducing the overall fuel hazard level in the defined burn area from 'Very High' to 'Low'. The burn plan specified a low intensity and patchy burn, with 80% of near surface and elevated fuels consumed. After discussion between CR and the FFR unit, it was decided that the preferred option ecologically was a smaller planned burn area, even though the choice of a soft containment line (the dry bed of Condor Creek) increased the risk of an escape. The planned burn area was reduced to 319 ha, with a maximum burn area of 888 ha, representing the area bounded by hard containment lines. The final burn area was 348 ha. Burning commenced on 8 March 2018 and was completed by the 18 March 2018.

Pre-burn advice

The formal advice provided by CR in the 2017/18 BOP prior to this burn was:

Last burnt in 2003 - 14 years ago so well below minimum threshold. If burnt should be patchy and low intensity with minimal impact on overstory canopy.

The CR aquatic team had also raised concerns about potential sedimentation and requested the installation of sediment fencing and completion of water quality assessments. However, this request was submitted late in the planning process (5 March 2018) and therefore was not acted on.

Post burn comment

Overall, the planned burn area was patchy, burnt at a moderate intensity with minimal crown scorch, and met the ecological guidelines (Figure 6).

High fire severity was recorded in a limited area along Two Sticks Road where the fire broke the northern containment line and ran uphill from Condor Creek (Figure 7). High fire severity was also recorded along the roadside edges of the south-east containment line (Brindabella Road).



Figure 6. Aerial view of burn area of FB115 Piccadilly prescribed burn. Some crown scorch indicating higher intensity fire is evident on the slope beneath Two Sticks Road (rear of photo), but across most of the area the burn was patchy and low intensity in accordance with stipulated ecological guidelines.



Figure 7: Small, localised area of high severity fire along Two Sticks Road.

Rehabilitation

At the request of the FFR Unit, CR completed a post-burn environmental risk assessment on 13 March and prepared a prioritised rehabilitation plan.

The bulldozer trails located along Two Sticks and Camages Roads were rehabilitated approximately four weeks post-burn in accordance with PCS Track Rehabilitation Guidelines. These tracks were accessed by recreational four-wheel drives prior to being rehabilitated, highlighting the need to act as quickly as possible to close tracks after an incident is complete, as identified in the CR's risk assessment and rehabilitation plan and by PCS district staff.

A significant infestation of Yarrow (*Achillea millefolium*) was recorded along Two Sticks Road post-burn – likely as a result of fire vehicles operating around a dam that was a known infestation site. The Yarrow infestation was treated and mapped following the completion of the prescribed burn. There is also a possibility that heavy equipment operating at this burn may not have been decontaminated prior to attending the Potters Hill burn escape. Post-burn weed monitoring and control is ongoing for both the Potters Hill and Piccadilly burns.

The source of the Yarrow infestation is located at Pete's Camp Dam on Two Sticks Road. The dam was only utilised as a water point for fire appliances after the fire crossed over the south-eastern section of Condor Creek and Two Sticks Road on the morning of 12 March and was not included in any ecological review prior to the burn. Moving forward, CR is looking to develop a process of assessing the associated ecological risks of areas adjacent to defined burn blocks at the burn plan review stage.

2018-19 Prescribed Burns

FB018 Aranda

The objective of the Aranda bushland burn was to reduce the risk of fire spread into the suburb of Aranda. The Overall Fuel hazard was 'High', and the intent of the burn was to reduce this to 'Moderate'/'Low' as per the standards required under the SBMP. The burn was conducted on 11/04/2019.

Pre-Burn Advice Provided

The formal advice provided by CR in its review of the 2018/19 BOP was as follows:

A spring burn should be avoided in this area as it contains rare spring flowering orchids. Where possible, planned burns should be undertaken during non-vegetative stages of orchid growth. Where this is not possible, populations should be protected from fire impact. Burns must be low intensity and patchy to minimise the risk of erosion as this area is already heavily grazed by macropods. The friends of Aranda Bushland ParkCare group should be notified of this burn.

Post burn comments

Timing of this burn was in line with recommendations. Fuels at this site were dry, meaning that maintaining a low intensity, patchy burn across the burn was challenging for ground crews, leading to 100% coverage of fire occurring. On the day, the Values Officer and Divisional Commander identified an internal gully (Figure 8) as an area to remain unburnt to introduce greater patchiness to the burn coverage. Ground crews successfully prevented fire from entering the drainage gully, as well as marking areas of vulnerable orchids, scar trees and habitat trees for fire exclusion.

Some mature trees were impacted by fire and eight trees were subsequently felled. It would be useful to monitor tree loss in urban reserves more formally to quantify the extent of tree loss from repeated prescribed burning and thereby provide data that can be modelled to predict future outcomes in these reserves over the longer-term.



Figure 8. Internal gully successfully excluded from the burn area of FB018 Aranda by ground crews.

FB072 Smokers

The objective of the Smokers prescribed burn was to reduce fire hazard in the burn area from an Overall Fuel Hazard of 'Very High' to a rating of less than 'High', thereby creating a strategic area to assist in limiting the spread of fire within Namadgi National Park. The burn plan specified a low to moderate intensity burn, with canopy scorch limited to less than 10%. Lighting commenced on the 10/04/2019 and was completed by 17/04/2019. The planned burn area was 3,012 ha with a maximum area of 5,577 ha representing the area bounded by hard containment lines.

A large proportion of the planned burn area had been burnt in a 2013 fuel reduction burn, only 6 years previously. Furthermore, the entire proposed burn area had also burnt in the 2003 bushfire, meaning many areas in the planned burn extent of FB072 had already burnt twice in less than 17 years.

Pre-burn Advice Provided

The formal advice provided by CR in its review of the 2018/19 BOP was as follows:

This burn should only be implemented where fuel moisture differentials will allow for 'ridge top' unbounded burn containment on aspect and slope. The general burn block includes stands of young Alpine Ash regeneration (post-2003) that is currently well below minimum ecological threshold (25 years). Fire should be excluded from these areas. Some bogs and Broad-toothed Rat habitat on north of burn need protection from fire.

Populations of listed Blackfish and Macquarie Perch in the Cotter River adjacent. Previous monitoring of burns in the area has found a noticeable impact on fish and water chemistry after the first rain post burn. Consider pre-burn preparation and post-burn placement of erosion control fencing immediately post fire to mitigate against potential erosion impact from high rainfall events. Maintain a minimum (more is better) 30m riparian zone buffer from the river to burn perimeter. Keep burn out of significant drainage creeks. Avoid burning during fish breeding time (Spring). Preferred burn season is Autumn.

Follow EHN disinfection protocols. If burn is likely to occur notify CR aquatic research team and ICON Water of timing so that pre and post burn monitoring can take place.

Eucalyptus perriniana and Eucalyptus glaucescens, which are both restricted to about 10 locations in the ACT, occur on the ridge tops within the proposed burn area and both are still recovering post 2003. E. perriniana requires fire for recruitment from seed held in the canopy, however Tas. DPIPW recommend avoiding frequent burning. As this is a less frequent and sporadically occurring species in the ACT, care needs to be taken to avoid burning stands with recent burn history.

E. debeuzevillei also occurs throughout the proposed burn areas. Snow gums can regenerate after a few close interval wildfires, but trees will die if a frequent regime is maintained. Structural and understorey diversity can also be impacted for many years. Care needs to be taken to limit the intensity and coverage of fire in these stands.

This burn must have a dedicated on-ground values officer assigned.

When FB072 Smoker's was first proposed to be re-burnt in the 2016/17 BOP, Conservation Research expressed concern about the potential impacts to both ecological values and the possibility of increasing elevated fuel levels through fire germinated shrubs. Conditional endorsement was given by the Conservator on advice from CR that among other conditions, areas burnt in 2013 would not be re-burnt, and that fuel monitoring take place to determine how this vegetation type responds to repeated short-interval prescribed fires.

Post burn comments

Fuel consumption across the burn area was patchy and burn intensity was generally low to moderate. A reduction in Overall Fuel Hazard was achieved. Burning was largely confined to ridge tops as prescribed.

Although less than 10% of the burn area experienced high severity fire, this included some patches that were also burnt in the 2013 prescribed burn 6 years previously, and in the 2003 bushfires.

No on-ground Values Officer was assigned to this burn. CR staff were notified of the burn going ahead and made themselves available to the Incident Management Team (IMT) but were not contacted during implementation. The use of Values Officers has since become more widespread for PCS prescribed burns in the ACT and a formwork for standardising this practice is currently being developed collaboratively by CR and FFR.

Hand crews were effective at preventing fire from backing into an area of fire sensitive alpine Sphagnum bog. However, this area was subsequently trampled by crews. It is recommended that, where possible, ecological values such as sensitive ecosystems should be included on fire ground maps. Further development of the Values Officer role has identified collaboration in preparation of fireground maps as a key element of the role.



Figure 9. Areas of higher severity fire on western slopes of ridges. These areas were limited in extent, comprising less than 10% of the burn area.

FB132 Umbagog Grassland Burn

The Umbagog Grassland Burn was conducted to prevent the spread of fire into the suburb of Latham. The objective was to reduce the Overall Fuel Hazard from 'High' to 'Low' to meet the standards required under the SBMP. This burn was conducted on 21/09/2018.

Pre-burn Advice provided

The formal advice provided by CR in its review of the 2018/19 BOP was as follows:

This burn should be restricted to grasslands only and should not include the surrounding woodland communities. A low intensity spring burn (ideally between September-October) is preferred to ensure PTWL can safely leave the area and Golden Sun Moths are not yet flying (October onwards).

Ginninderra Catchment Group must be notified of this burn as they have significant interest in using fire to help restore and enhance the grasslands along Ginninderra Creek.

Ecological Guidelines for Pink Tailed Worm Lizard, Golden Sun Moth and Native Temperate Grasslands apply.

A values officer should be assigned to this burn.

Post burn comments

Consistent with CR's advice the Umbagog burn was conducted during the recommended period for Pink Tailed Worm Lizard and Golden Sun Moth (late September).

The burn was of low-moderate intensity with little crown scorch. Regenerating wattle was successfully prevented from burning and post burn re-sprouting was avoided.

Vehicles drove through the recently burnt grassland in several locations; in future, more care should be taken to minimise vehicle impacts on sensitive post-fire environments. At the time of assessment in 2019, the Wallaby Grass was regenerating well, despite minimal rain post burn.

No values officer was assigned.

A 50+ metre buffer was maintained between the burn and Ginninderra Creek over most of the area; however, there was no buffer established along a 200-metre section of the stream bank. This highlights the need for burn plans to identify buffers along all perennial waterways to minimise the risk of erosion and sedimentation.



Figure 10. Vehicle tracks through Golden Sun Moth habitat at the southern end of Umbagog Park.

FB449 Black Mountain Summit

The Black Mountain Summit burn was implemented to reduce the fire risk to Black Mountain Tower and adjacent infrastructure. The intent was to reduce the Overall Fuel Hazard of the site from 'High' to less than 'Moderate' to meet the standards required under the SBMP. The burn was conducted on 17/05/2019.

Pre-burn Advice Provided

The formal advice provided by CR in its review of the 2018/19 BOP was as follows:

All of the burn except the western edge is long unburnt. Care should be taken to avoid burning into the adjacent long unburnt community. This area is known habitat of rare, predominantly spring flowering orchids so a spring burn should be avoided, and an autumn burn is preferred. A district staff member should be assigned as the values officer for this burn.

Extensive consultation was conducted between the Fire Unit, CR, PCS and Friends of Black Mountain ParkCare group in the lead up to implementation. Sensitive plant species were identified and flagged on the ground by ParkCare, and CR and PCS staff reconnoitred the site prior to implementation to discuss mitigation options.

Post burn comments

Although the burn was patchy, some areas of dense vegetation and litter were burnt intensely. Particularly on the NW slopes, surface and near surface fuels were 100% consumed and there were some areas of canopy scorch.

Several high-quality habitat trees were lost, despite pre-burn works including manual removal of fuels around the base of large trees.

The *Pomaderris intermedia* was well protected from fire impact. A mineral earth line was established around this site and several other areas.

Overall, the burn met fuel reduction targets and significant effort was put into protecting the ecological assets identified by CR and ParkCare. However, this burn highlights that the significance of large, mature habitat trees should be highlighted to ground crews and emphasis placed on minimising the risk to these assets from fire. Handlines could also be rehabilitated in order to minimise lasting impact to the burn area.



Figure 11. Successful protection of *Pomaderris intermedia* population via handline on the northern slope of the burn



Figure 12. A felled fire affected habitat tree located along the northern containment line of the burn.

FB628 Tango Spur

The purpose of the Tango Spur Burn was to provide asset protection for the Tidbinbilla Nature Reserve Depot and reduce the fuel hazard to create a strategic area to assist in limiting the spread of fire in Tidbinbilla Nature Reserve. Additionally, two debris piles were to be burnt down. The objective of the hazard reduction burn was to reduce the fuel hazard to less than High. The burn was conducted from 10/04/2019 until 12/04/2019.

Pre-burn advice provided

The formal advice provided by CR in its review of the 2018/2019 BOP was as follows:

This area is 9 years below the recommended minimum tolerable fire interval.

Nationally listed Greater Gliders have been recorded in this area. Particular care should be taken to protect hollow bearing trees and associated habitat.

The Robertson's Peppermint/ Red Stringy Bark vegetation communities located in the north-west area of this burn should be protected. Minimal fire should be introduced to the older, wet forests on the southern slopes of this burn. Fuel moisture differentials should be used to avoid fire spread into old, wet forests and cool, moist gullies.

There is one record of Galium gaudichaudi subsp. parviflorum: Rough Bedstraw in the ACT. It is a 1969 record from the then "first trail branching from Lyrebird track Tidbinbilla". Care should be taken not to physically disturb vegetation in the vicinity of the recorded location.

A district staff member should be assigned as a values officer for this burn.

Post burn comments

The burn was of low/moderate intensity as prescribed. A patchy consumption of fuels across the burn block was successfully achieved and the spread of fire into sections of wet sclerophyll forest and wet gullies was minimal. The native slash piles to the north of the Tidbinbilla depot which were burnt in conjunction with the main burn were successfully consumed and the surrounding native vegetation was minimally impacted.

The length of time between completion of pre-burns work by crews and the implementation of the burn (over 12 months) reduced effectiveness of pre burns work. Large habitat trees along the edge of Camelback Road were impacted, suffering canopy scorch and structural damage at the base. During pre-burn works these trees had been protected, but litter build up over the following year rendered these works mostly ineffective. This highlights the value in future of review of current effectiveness of all pre-burn works before ignition is undertaken.



Figure 13. Looking east down Spur 1 Fire Trail, the low/moderate intensity of the fire behaviour is evident.

FB679 South Brandy

The purpose of the South Brandy burn was to reduce fuels to create a strategic area to assist in limiting the spread of fire within NNP and east into NSW. Overall Fuel Hazard was to be reduced to less than 'High'. The burn was implemented over 9 days from 16/05/2019 to 24/05/2019.

Pre-Burn Advice provided

The formal advice provided by CR in their review of the 2018/19 BOP was as follows:

Close to 50% of this burn is 20 years below minimum threshold.

Poa grasslands and Eucalyptus stellulata communities along Naas Ck should not be burnt and should be excluded from the burn area.

Recent 2015 Corunastylis arrecta recorded location next to Boboyan Road, just outside of burn area should be protected from any physical disturbance. Given previous records of this orchid in the vicinity burn should avoid late spring-early summer flowering time.

Given that this area is likely to breeding habitat of Rosenberg's Monitor care should be taken to burn in such a way that termite mounds will not be destroyed, and the burn is patchy and low intensity.

NTG Ecological Guidelines apply where these communities occur.

A district staff member should be assigned as an on-ground values officer for this burn.

In addition to these BOP review comments CR, FFR, and PCS district staff formed a working group to oversee detailed operational planning of FB679 and to assist in identifying values that could be impacted and appropriate mitigations. CR highlighted the importance of keeping fire out of the bog and grassland habitat on the northern containment. It was agreed that the burn should be implemented at the cooler and moister end of prescription and that RAFT crews and/or helicopter resources should be on hand to mitigate impacts on the bog.

Post burn comments

The South Brandy burn was successful in achieving a patchy and generally low severity burn; FFR reported an effective reduction in the Overall Fuel Hazard.

The timing of this burn was an important element in achieving the desired patchiness and consumption. Timing the burn during cooler conditions with high overnight humidity was important due to the dryness of the local fuels.

The ecological outcomes of the South Brandy burn were broadly achieved; however, due to a falling tree that crossed the containment line at night, the burn did impact a small section (<0.5 ha) of fire sensitive Temperate Montane Grasslands and montane bog habitat that had been identified as locations where fire should be excluded.

Formation of a working group was successful in providing stakeholder input and gaining support and this highlights the value of this approach, particularly for large rural burns where significant ecological risks have been identified. Care needs to be taken that all parties are fully aware of the final strategy prior to ignition to remove any uncertainty about key ecological risks and how they are to be mitigated.

Favourable weather conditions and sufficient allocation of resources for this burn was a significant factor in meeting the ecological outcomes. Crews were placed on standby ready to mobilise where required and the aircraft assigned to this burn was prepared to switch to bucketing operations if the need arose. These preparations allowed for a rapid response and helped mitigate the risks to ecological values.



Figure 14. Extent of burn impact on fire sensitive grasslands and bog areas on the northern containment of the South Brandy burn. Crews were quickly deployed to the area and this edge was successfully contained, preventing further impact.

Cotter River burn (FB087) post burn monitoring.

In 2015 a post-burn ecological monitoring study was established in subalpine woodland, tall wet forest, and montane dry forest in and around the planned burn footprint of the Cotter River prescribed burn and associated escape which occurred in autumn 2015.

During 2016-19 two further rounds of fauna camera trapping and vegetation monitoring were conducted across fire severity gradients associated with the Cotter River burn (Table 11).

Table 4. Number of plots initially allocated to each fire severity/vegetation class for the Cotter River burn monitoring study in Namadgi National Park

Vegetation ID	High severity	Low-mod severity	Unburnt
Sub alpine woodland	3	3	3
Tall wet forest	3	3	3
Montane dry forest	3	3	3

Formal data analysis has not yet been conducted for this study, but field observations indicated that shrub recruitment appeared to be high in high severity areas although tree mortality was reasonably low. Data will contribute to an understanding of the vegetation structural (and fuel) dynamics in montane forests and woodlands and help inform future habitat and fuel management planning in NNP. This project is currently being reconfigured following the 2020 Orroral Valley bushfire, which impacted the project area.

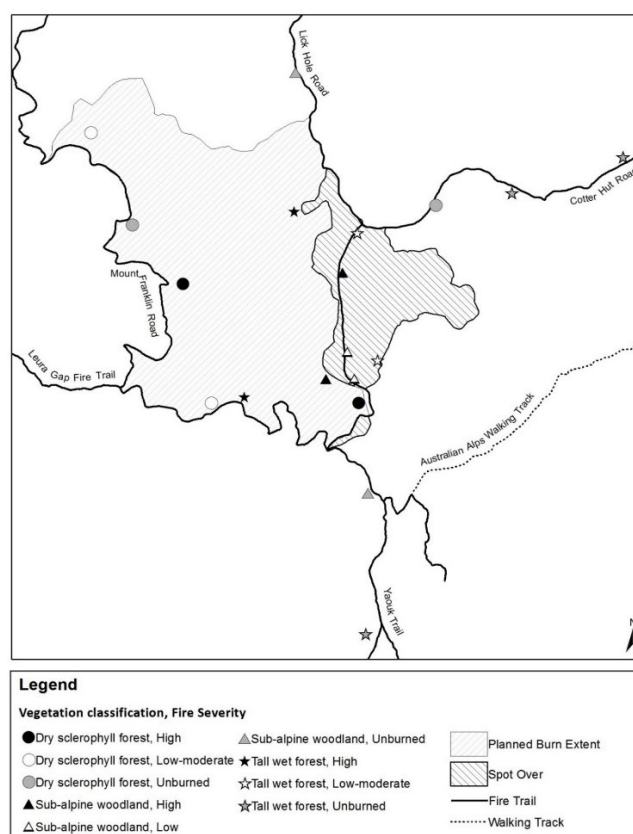


Figure 15: Cotter River burn (FB087) post burn monitoring sites

Canberra Nature Park Prescribed Burn Study

In 2013 an experiment was established by Conservation Research to study the effects of prescribed burning on the structure and composition of dry eucalypt forest in Canberra Nature Park (CNP; Mulvaney et al. 2014). The study was established according to a replicated Before-After-Control-Impact (BACI) design and included 22 'treatment' and 22 'control' plots spread over five separate proposed prescribed burns. All sites were surveyed pre-burn in spring and summer 2013. 'Treatment' plots were then burnt in autumn 2014 as part of the PCS BOP fuel management program. All 'treatment' and 'control' sites were resurveyed in spring 2014, 2015, 2016 and 2018. No survey was completed in 2017 due to staff secondments and international deployments.

In spring 2018 data were collected from all 44 prescribed burn monitoring plots in Black Mountain and surrounding Nature Reserves. This was the final monitoring round of these plots which have been recovering for five years post burn.

Preliminary analysis of monitoring data from the CNP prescribed burn study was performed on the first three years of data (2013-15) and presented in the 2015/16 Fire Ecology Program Update. A comprehensive analysis was performed on the complete dataset in early 2019 and will be written up as scientific journal article in 2021-22.

Canberra Nature Map – Orchids and Fire

This project was carried out as a unique partnership between CR and citizen scientists using the Canberra Nature Map platform. CR provided a robust survey design for the program and data analysis, while community members enthusiastically contributed expertise and survey effort across orchid sites in CNP.

Data from 76 sites in CNP were analysed, revealing that overall, orchid species richness increased with increasing time since fire, but did not exhibit any clear relationship with fire frequency independent of time since last fire. Of the nine nationally or regionally rare species included in the analysis, five were associated with more frequently burnt areas, two with long unburnt areas, and three with areas that were neither recently burnt nor long unburnt. This study was published in the journal *Australasian Plant Conservation* in 2020¹.

These findings indicate that maintaining orchid diversity in CNP will require maintaining a patchwork of different fire histories, including long unburnt areas. Improved knowledge of the fire response of individual orchid species resulting from this project will be available for future prescribed burn planning and operations to enhance ecological outcomes in the Black Mountain area.

¹ Mulvaney et al. (2020). Orchid diversity and occurrence in relation to past fire in Canberra Nature Park. *Australasian Plant Conservation: Journal of the Australian Network for Plant Conservation*, 28(3), 20–22.
<https://search.informit.org/doi/10.3316/informit.093705231083940>

3 Key recommendations for future practice

Assessment of ecological outcomes of the prescribed burn operations presented in this report provides an array of insights to inform future practice. To reduce or eliminate adverse ecological impacts associated with prescribed burning, the CR Unit makes the following suggestions:

Note: Delays in publication of this report have afforded the opportunity to document actions that have been or are being adopted since 2019 in response to the recommendations. These actions are noted in italics after corresponding recommendations.

Values Officers

1. Values Officer training is developed and rolled out by the Fire Unit and CR.
 - *The role of Values Officers (VO) in planned burns and in bushfire suppression is being formally defined and documented in a collaborative project between CR and FMU with support from Federal bushfire recovery funding. The project has developed an environmental data platform to support VOs. In 2022-23 the project will develop a VO training package and conduct VO role awareness workshops with ACT ESA/RFS.*
2. Values Officers provide input to burn maps to identify ecological values and threats such as mapped weed infestations.
 - *The Values Officer role development project (see 1. above) articulates appropriate points of input for VOs during burn planning and implementation including contributing spatial information concerning ecological sensitivities. Inclusion of fire sensitive ecological values and environmental weeds on burn maps has been adopted as best practice for several recent burns and the routine use of VOs will ensure this in future.*

Burn timing (short and long-term)

3. High severity fire in vegetation communities that are below their minimum Tolerable Fire Intervals (TFIs) is avoided wherever possible. While the primary avenue for considering TFIs and Growth Stage Diversity (GSD) in fire management planning is in development of the RFMPs, this should also be considered at the burn planning and implementation stage.
 - *It should be noted that implementation of fuel reduction burns planned primarily for reducing bushfire risk will still be required where some ecological risks exist. In cases where planned burns include vegetation communities significantly below minimum tolerable fire interval (minTFI), burn implementation has and will wherever possible endeavour to minimise the risk of high severity fire within these areas.*
4. Wherever possible, prescribed burns are conducted within the period recommended in the formal BOP advice, Ecological Guidelines and burn plan comments provided by CR.
 - *Where this is not feasible due to weather or other operational constraints FMU has in the past and will continue in future to consult with CR and identified Values Officers to discuss ecological risks and possible further mitigation actions.*

Use of Working Groups

5. Working groups are established to oversee implementation of all large rural burns where significant ecological risks have been identified, to gain stakeholder input and to ensure that all parties are fully aware of the final strategy prior to ignition, removing any uncertainty about key ecological risks and how they are to be mitigated.
 - *Working groups have been successfully established for several ecologically sensitive burn since 2019, most notably the 2021 Pipeline Burn. Currently under consideration is a proposal*

that implementation working groups be formed to ensure all burn objectives are addressed in the finalisation of burn plans where CR has provided conditional support in the annual ecological review of the draft BOP.

Protection of riparian areas

6. Burning in close proximity to perennial waterways is minimised, to reduce the risk of erosion and sedimentation.
 - *In recent years FMU has collaborated with the University of Melbourne to develop soil erosivity maps which have been used in burn implementation, including planning ignition patterns, to minimise risk of erosion and sedimentation impacts of aquatic habitat.*

Weed spread

7. Vehicle access is avoided in known weed infestation sites to minimise the spread of weeds around the fire ground.
 - *The routine use of Values Officers in burn planning including contributing to burn maps will address this recommendation.*
8. Ongoing monitoring and control of weed incursions following all burns is established, particularly where rehabilitation works are required and/or implemented.
 - *The routine use of Values Officers in burn planning including contributing to burn maps will partly address this recommendation.*
9. Standard decontamination procedures are implemented for all vehicles, especially where they are moving between incidents.
 - *This is usually normal practice however there have been some incidents where it is acknowledged that under urgent circumstances decontamination may have been missed. The routine use of Values Officers in burn implementation will help address this recommendation.*

Vehicle impacts

10. Off-road vehicle access is limited to the existing trail network. This is particularly important in sensitive areas such as native wet tussock grasslands, upland bogs and fens and any areas recently burnt (Ecological Guideline 1.3).
 - *The routine use of Values Officers in burn implementation including at crew briefings will address this recommendation*
11. Where rehabilitation of new or re-opened dozer trails is required, this occurs as soon as possible after prescribed burning is completed to prevent public access and potential erosion.
 - *Noted.*

Protection of high-value habitat trees

12. The significance of large, mature habitat trees is highlighted to ground crews and emphasis placed on minimising the risk to these assets.
 - *The routine use of Values Officers in burn implementation including at crew briefings will address this recommendation*
13. If significant time has elapsed since pre-burn preparation to protect habitat trees was undertaken, the effectiveness of these works is assessed before ignition.
 - *The routine use of Values Officers in burn implementation will address this recommendation*

Assessing ecological values of potential burn outbreak areas

14. Contingency areas for containing potential prescribed burn outbreaks are identified during the planning process, and these areas are assessed for their ecological values in consultation with CR ahead of implementation.

- *Noted.*

Rehabilitation planning

15. Rehabilitation plans are sent to CR for comment.

- *Noted.*

16. In the planning phase, consideration is given to areas where potential erosion and/or sedimentation is identified, and sufficient resources/materials are identified and available for possible rehabilitation works.

- *Noted. Such pre-burn rehab planning has since been implemented for several burns including on the recommendation of the burn implementation working group for the 2021 Pipeline Burn.*

17. Consideration is given to rehabilitating handlines, to minimise lasting impact to the burn area.

- *Noted. IMT staff directed ground-crews to rehabilitate handlines during the 2021 Pipeline on the recommendations of the on-ground Values Officers.*