— Centre of Excellence —
PRESCRIBED BURNING

Prescribed Burning Performance Measurement Framework

A PRODUCT OF THE NATIONAL BURNING PROJECT

APRIL 2018

An Australian Government Initiative

afac

Australian Institute for Disaster Resilience

FFMG

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Source: Office of Bushfire Risk Management, Western Australia

1. SUMMARY

A performance measurement framework for prescribed burning has been developed under the auspices of the National Burning Project in collaboration with AFAC and FFMG member agencies.

A high-level program logic model articulates how prescribed burning is expected to contribute to the strategic objectives and goals of the *National Bushfire Management Policy Statement for Forests and Rangelands* (FFMG 2014). The program logic is provided in Appendix E as a foldout chart. It provides a chain of reasoning that connects:

- Inputs – The resources used in prescribed burning;
- Activities – The strategic, program and operational planning, burn implementation and support activities;
- Outputs – The treatment of land with prescribed burning; and
- Outcomes – The resulting benefits for bushfire safety, environment and land management.

A suite of performance indicators are identified (refer to Table 1), drawn from measures currently in use by agencies or proposed in the literature. These are presented in relation to the program logic model, to show the aspects of prescribed burning being measured.

The indicators are designed to be:

- Logical – explicitly linked to the program logic;
- Balanced – measure inputs, activities, outputs, immediate outcomes, intermediate outcomes and final outcomes;
- SMART – specific, measurable, attributable, relevant and time-bound;
- Benchmarks – lend themselves to comparison between like settings;
- Responsive – likely to change in response to program delivery; and
- Scalable – measure performance at a variety of spatial scales.

The suite of indicators covers program finances (efficiency and cost-effectiveness), program planning activities, community understanding and support, operational planning activities, burn implementation, fuel management outcomes, risk reduction outcomes, ecological outcomes, greenhouse gas abatement outcomes and adverse impacts.

1. SUMMARY

Table 1 *Prescribed burning key performance indicators.*

Performance area	KPI
Financial	Expenditure ($) on prescribed burning
	Cost ($) per hectare treated with prescribed burning by zone/setting
	Cost ($) per % of risk reduction
Program planning activities	% of burnable agency managed land with current fire management plan
Community understanding and support	Activity indicator TBD - to be referred to AFAC community engagement subject matter experts for consideration
	% of community supporting prescribed burning
Operational planning activities	% of prescribed burns that demonstrate compliance with required agency procedures
	% of suitable days on which prescribed burning was undertaken
	% of prescribed burns at which level of community engagement meets agency standard
Burn implementation	% of planned prescribed burning program delivered
	Area (ha) treated with prescribed burning
	% of prescribed burns where burn objectives were met
	% of landscape treated with prescribed burning
	% of burns conducted in conjunction with Traditional owners and/or incorporating indigenous burning practices
Fuel management outcomes	% of managed land meeting prescribed fuel standards
Risk reduction outcomes	Residual risk (%)
	Area (ha) burnt by bushfire
	% of landscape burnt by bushfire
Ecological outcomes	% of vegetation communities with tolerable fire regime
Greenhouse gas abatement outcomes	Tonnes of CO_2 equivalent abated
Adverse impacts	% of prescribed burns that escape
	Number of days on which air quality threshold was exceeded due to prescribed burning

It is not envisaged that agencies would elect to measure and report all the indicators, rather they provide a toolbox from which an agency can pick those that reflect their burning program and meet the needs of their stakeholders.

A preliminary data dictionary is provided, showing how each indicator could be measured (refer to Chapter 7). It is recognised, however, that detailed specification requires knowledge of data availability in each jurisdiction and agreement of business rules that meet the needs of agencies and their stakeholders. It is common for KPIs to be refined through use, and the work presented in this report can be seen as a starting point.

2. INTRODUCTION

Prescribed burning is a well-established land management tool in Australia, used to mitigate the risk of damaging bushfires and to achieve a range of ecological and resource management goals (AFAC 2014; FFMG 2014). The National Burning Project sought to establish a national performance measurement framework for prescribed burning.

Public sector performance reporting is fundamental to public accountability (OAGBC 2010; Productivity Commission 2017a) and allows government and the community to see how well the reporting organisation is meeting its goals and delivering its services (OAGBC 2010).

Performance measurement also helps the reporting organisation make informed management decisions (OAGBC 2010) and enables it to benchmark performance against its peers (AFAC 2007; Hubbard 2004; OAGBC 2010) to improve the effectiveness and/or efficiency of its services (Productivity Commission 2017a).

Establishing and monitoring national key performance indicators (KPIs) for prescribed burning should assist agencies to:

- Establish baseline information, i.e. current state of performance;
- Set performance standards and targets to motivate continuous improvement;
- Measure and report improvements over time;
- Compare performance across geographic locations and/or management units;
- Benchmark performance against peers (comparable agencies or jurisdictions); and
- Allow stakeholders to independently judge performance.
  (adapted from Rozner 2013; OAGBC 2010).

Prescribed burning in Australia is undertaken in a wide range of operating environments (AFAC 2016c), by agencies with a range of legislated responsibilities, to achieve a range of strategic objectives. Typically, performance measures are developed as part of an agency's strategic planning process to show to what extent the agency is achieving its objectives (Hubbard 2004). The development of a performance measurement framework as part of the National Burning Project, however, is broader than a specific agency strategy. Rather, it uses the strategic objectives and goals of the *National Bushfire Management Policy Statement for Forests and Rangelands* (FFMG 2014) and the planning processes and risk frameworks established by the National Burning Project (AFAC 2014; 2015a; 2015b; 2015c; 2015d, 2016b; 2016c; 2017a) to develop a program logic for prescribed burning. This logic model is then used as a framework for the selection of a suite of potential performance indicators.

At the project outset, it was envisaged that the final product would be a small number (2-3) of indicators that could be used by all agencies across the nation. As the framework developed, however, it became apparent that a broader suite of indicators would be more useful. It is not envisaged that agencies would elect to measure and report all the short-listed indicators. Rather, they provide a toolbox from which an agency can pick those that reflect their burning program and meet the needs of their stakeholders.

3. BACKGROUND

3.1 National burning project

The National Burning Project has been jointly commissioned by the Australasian Fire and Emergency Service Authorities Council Ltd (AFAC) and the Forest Fire Management Group (FFMG), a sub-group of the Forestry and Forest Products Committee under the Agricultural Senior Officials Committee and Agriculture Ministers Forum.

The National Burning Project's objective is to develop a national approach to reducing bushfire risk to Australian and New Zealand communities by comprehensively managing prescribed burning at a landscape scale in a manner which balances operational, ecological and community health risks (AFAC 2016a).

The National Burning Project has produced several review and best practice documents to guide prescribed burning, which have informed this sub-project. These include:

- *Overview of prescribed burning in Australasia* (AFAC 2015a);
- *Review of best practice for prescribed burning* (AFAC 2014);
- *Risk management and review framework for prescribed burning risks associated with fuel hazards* (AFAC 2015b);
- *Risk management framework – smoke hazard and greenhouse gas emissions* (AFAC 2015c);
- *A risk framework for ecological risks associated with prescribed burning* (AFAC 2016b);
- *A risk framework for operational risks associated with prescribed burning* (AFAC 2016c);
- *National guidelines for prescribed burning operations* (AFAC 2016d); and
- *National guidelines for prescribed burning strategic and program planning* (AFAC 2017a).

3.2 Sub-Project No. 11 performance measurement

The National Burning Project is being delivered through a series of sub-projects that, together, will produce an enduring framework that can be progressively enhanced, updated or refreshed by future projects (AFAC 2016a).

Sub-project number 11 focuses on measuring prescribed burning performance. The objectives of the sub-project are to develop:

- Measures that support the monitoring of the performance of prescribed burning programs across agencies and jurisdictions;
- A framework of measures for the measurement of performance that can be used for benchmarking and target setting; and
- Supporting data standards and business rules to support agencies wishing to adopt the measures (AFAC 2016a).

This report provides a conceptual framework for prescribed burning performance measurement, as well as a suite of KPIs that may be useful to AFAC and FFMG member agencies.

4. METHODOLOGY

This section provides a brief description of the methodology used to develop the performance measurement framework.

4.1 Technical reference group

A Technical Reference Group (TRG) was established for the project comprised of representatives of AFAC and FFMG member agencies with a particular interest in prescribed burning. The agencies invited to participate in the TRG are listed in Table 2.

The TRG were consulted via two workshops, an online questionnaire, and follow up phone calls and emails. They provided guidance on the project scope, contributed agency doctrine on prescribed burning and performance measurement, and provided feedback on draft reports and short-listed KPIs.

Table 2 *Agencies invited to participate in TRG.*

Agency	Jurisdiction
AFAC	N/A
ACT Parks and Conservation Service	Australian Capital Territory
Bushfires NT	Northern Territory
Country Fire Authority	Victoria
Department of Environment, Land, Water and Planning	Victoria
Department of Environment, Water and Natural Resources	South Australia
Department of National Parks, Sport and Racing	Queensland
Department of Parks and Wildlife	Western Australia
Forestry Corporation of New South Wales	New South Wales
Office of Bushfire Risk Assessment[1]	Western Australia
NSW Rural Fire Service	New South Wales
Tasmania Fire Service	Tasmania

4.2 Data collection

Two strategies were used to gather information to inform the development of a high-level program logic for prescribed burning and identify potential performance measures:

1. Literature search; and
2. Online survey of agencies using a questionnaire.

1 Commented on draft report and participated in second TRG workshop.

4.2.1 Literature search

The objectives of the literature search were:

- To identify the objectives and planned/assumed outcomes/benefits of prescribed burning;
- To identify KPIs currently in use by agencies; and
- To identify KPIs suggested by independent reviewers of prescribed burning practice and/or effectiveness of KPIs.

Literature consulted was identified using the following search strategies:

- Contact with subject matter experts (TRG and via the online questionnaire);
- A search of literature currently held by Terramatrix;
- A conventional electronic search (using Google, Google Scholar); and
- Citation (literature) and site-ation (web-based) backward snow-balling (using the documents initially available to identify additional relevant publications) (Lecy and Beatty 2012).

Literature comprised agency doctrine, academic research, independent inquiries that considered prescribed burning, and literature of performance measurement theory. A total of 158 documents were consulted.

The literature helped to:

- Establish the rationale for prescribed burning, the outcomes being sought and the underpinning assumptions about how it works, to construct a high-level program logic model (WK Kellogg Foundation 2004);
- Identify performance measures currently in use; and
- Identify other areas of monitoring or evaluation recommended by previous reviews.

4.2.2 Agency questionnaire

AFAC member agencies involved in prescribed burning were asked to complete an online questionnaire using Survey Monkey (www.surveymonkey.com).

The objectives of the questionnaire were to:

- Identify current approaches to performance measurement of prescribed burning;
- Identify, in broad terms, what respondents believe a national framework should provide.

The questionnaire was distributed to the TRG with a request for their agency to fill it out and distribute it to others within their jurisdiction or broader network that may be interested or have information useful to the project. The email request was followed up with phone call reminders.

The brief questionnaire (Appendix A) contained a mix of 5 multiple choice and 5 open-ended questions. There were also opportunities for respondents to upload documents. The questionnaire themes were:

- Prescribed burning: policy, strategy and procedure documents;
- Performance measures in policy, strategy and procedures;
- Performance data collection and reporting;
- Performance measures and indicators; and
- Performance measures framework – best practice, value and potential risks.

Each respondent was also asked to provide their details (name, role, organisation and contact details).

4.3 Program logic

To support the development of a performance measurement framework, a high-level logic model has been developed as part of this project (see Appendix E). The model draws heavily on the program theory articulated in National Burning Project reports (AFAC 2014; 2015a; 2015b; 2015c; 2016b; 2016c; 2017a).

Program logic is the rationale behind a program (Commonwealth of Australia 2009); a model of what the program is trying to achieve and what it does to get results (Rozner 2013). It links outcomes (both short- and long-term) with program activities and the theoretical assumptions of the program (WK Kellogg Foundation 2004) to provide a chain of reasoning that makes explicit the connections between:

- Inputs – The resources that the program uses in the delivery of the service;
- Activities – The processes and actions undertaken to achieve the program's objectives;
- Outputs – The services the program delivers; and
- Outcomes – The resulting benefits for society (WK Kellogg Foundation 2004).

Logic models for complex programs can show a hierarchy of outcomes, where each outcome is a pre-requisite state to the achievement of a higher-level outcome. Typically, outcomes are described as shorter-term (immediate or intermediate) or longer-term (final) outcomes (AFAC 2007; OAGBC 2010; Productivity Commission 2017a).

Logic models are commonly used in program evaluation (e.g. Commonwealth of Australia 2009; DELWP 2015; WK Kellogg Foundation 2004; Owen 2006; Rozner 2013) and performance measurement (e.g. AFAC 2007; Productivity Commission 2017a).

Immediate and intermediate outcomes are more directly related to the delivery of outputs than are final outcomes, i.e. they are a more direct result of the service being delivered. Final outcomes are generally less directly attributable to program delivery, and more likely the result of multiple factors, including influences outside the program in question (AFAC 2007). Thus, program evaluation tends to focus on inputs-activities-outputs-intermediate outcomes where there is greater surety about the cause and effect relationships (AFAC 2007; Owen 2006).

Prescribed burning lends itself to the logic model approach as:

- There is broad consistency in program-level goals/objectives between like-agencies and jurisdictions;
- The rationale for the causal relationships between inputs-activities-outputs-outcomes has either been described or can be readily inferred (at a high level at least);
- There is a solid scientific basis for many assumptions in the program logic; and
- It has been the subject of monitoring, research and evaluation.

5. PERFORMANCE MEASUREMENT

This section describes an approach to performance measurement that uses program logic as a framework within which to develop potential indicators. This approach aligns with contemporary Australian fire management performance measurement (AFAC 2007; Productivity Commission 2017a; Productivity Commission 2017b). In addition, existing national and international performance reporting requirements relevant to prescribed burning are summarised, and indicators currently reported in agency annual reports are identified.

5.1 Approach to performance measurement

Performance indicators can be developed to measure performance at different stages of the program logic (see Figure 1), i.e. for:

- Inputs – to show that program resources are being used wisely;
- Outputs – to show that the program is being delivered well; and
- Outcomes – to show that the program is making a difference (adapted from AFAC 2007).

Each category of indicator tells you different things about a program (see Table 3).

Figure 1 *An approach to performance measurement using a program logic model (AFAC 2007).*

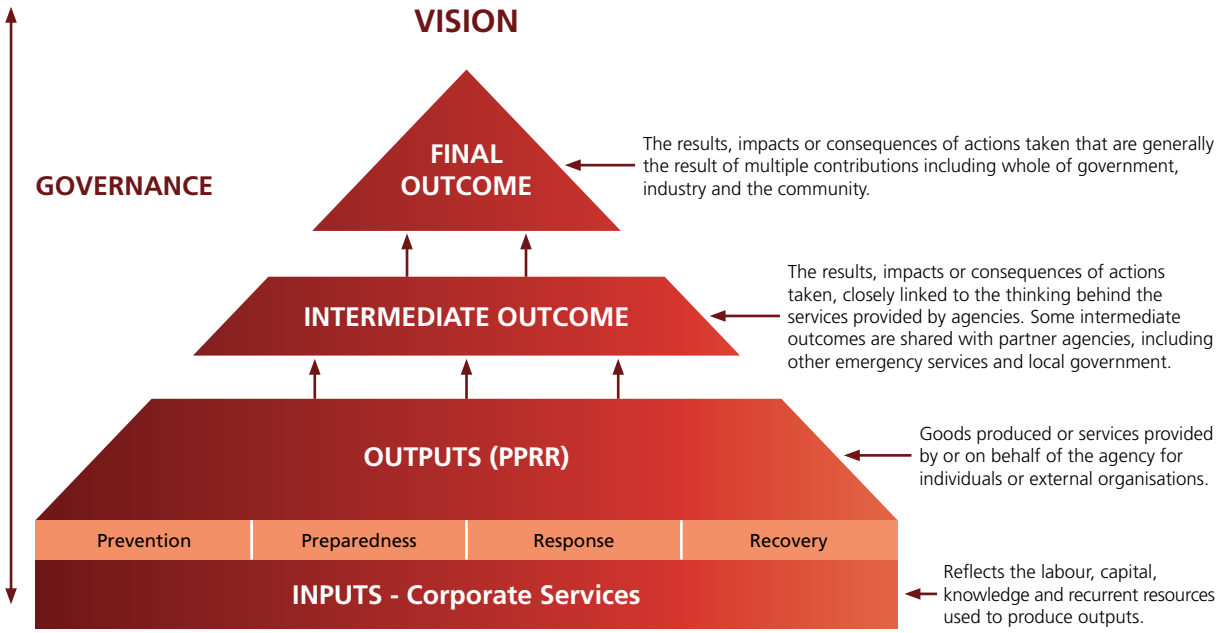

Table 3 *Different types of performance indicators (adapted from Rozner 2013).*

Category	Description	Strengths	Weaknesses
Input indicators	Describe the resources used	• Provide information on the size or scope of a program • Enable tracking of what public funds paid for • Tie most directly to budget process	• Provide no insights on effectiveness, efficiency or long-term impact • Not highly useful for strategic or policy analysis
Activity indicators	Describe the activities undertaken to produce a given output or level of service	• Provide information on the core, day-to-day activities being performed • Provide program managers with valuable information to drive decisions on resource use	• Provide no insights on effectiveness, efficiency or long-term impact • Not highly useful for strategic or policy analysis
Output indicators	Describe the products and services produced by an activity	• Useful for programs where a single service is relevant • Conducive to demonstrating the outputs of a publicly funded program	• Provide no insights on effectiveness, efficiency or long-term impact
Outcome indicators	Describe the extent to which a program's objectives were met	• Valuable for analysing programs and strategies at a high level	• Often require long-term monitoring or evaluation to show results • Data can be hard to obtain • Results hard to attribute
Efficiency or cost-effectiveness indicators	Describe the relationship between the program output or outcome and the resources required to produce it	• Expressed as a percentage, ratio or rate and, therefore, conducive to comparison and benchmarking • May be possible to increase (or decrease) efficiency by direct changes in resource levels	• Results may be hard to understand unless described in the context of benchmarks and targets

5.2 National and international reporting requirements for prescribed burning

Three existing performance reporting frameworks were identified with relevance to prescribed burning in Australia:

- Report on Government Services;
- State of the Forests Report; and
- Kyoto Protocol.

The relevant requirements are described below and, to the extent applicable, have been incorporated in the proposed suite of KPIs.

5.2.1 Productivity Commission Report on Government Services

The *Productivity Commission's Report on Government Services* publishes annual data on the 'equity, efficiency and cost effectiveness of government services' (Productivity Commission 2017b) across six sectors. 'Emergency management' is one of the reported sectors, with 'Emergency services for fire events' being a subset of this.

The objectives for emergency services for fire events are to:

- Build resilient communities that work together to understand and manage the risks that they confront; and
- Reduce the adverse effects of events on the community (including people, property, infrastructure, economy and environment).

A performance measures framework ensures that performance indicators are outcome-oriented, with information being supplemented by outputs data grouped under 'equity', 'efficiency' and 'effectiveness'. Data are collected on two outputs relating to urban fires, in addition to workforce statistics. Three outcomes are measured, being fire death rate, fire injury rate and the value of asset losses from fire events (Productivity Commission 2017b). Of these, only fire death rate has landscape fire (bushfire) losses expressed separately from all fire losses.

5.2.2 State of the Forests Report

Australia's State of the Forests Report is a five-yearly report that gathers information on the management, use and conservation of Australia's forests. The report was first released in 1998 following a commitment made in 1992 in the *National Forest Policy Statement*. The 2013 report, authored by the Montreal Process Implementation Group for Australia and the National Forest Inventory Steering Committee (with the Australian Bureau of Agriculture and Resource Economics and Sciences coordinating its preparation), is the fourth in the series (MPIGA and NFISC 2013).

There were seven criteria, each with a number of indicators, reported upon in the 2013 report. Criterion 3 is the 'maintenance of ecosystem health and vitality'. Indicator 3.1b reports the 'area of forest burnt by planned and unplanned fire'. This indicator aims to provide an understanding of the impact of fire on forests, with the rationale that fire can impact a forest's health and vitality positively or negatively. MODIS satellite imagery was used to map fire extent across northern Australia (parts of NT, QLD and WA), while state governments provided data for fire area in southern Australia (MPIGA and NFISC 2013).

5.2.3 Kyoto Protocol

Savanna fires contribute greatly to greenhouse-gas (GHG) emissions, with van der Werf *et al.* (2010) estimating that they accounted for 60% of total global fire emissions in the period 1997-2009. The significance of these emissions was recognised in the Kyoto Protocol which requires Tier 1 (developed economy) countries to account for GHG emission from 'prescribed burning of savannas' (United Nations 1998).

Anthropogenic ignition sources account for most Australian savanna burning (Russell-Smith *et al.* 2013; Whitehead *et al.* 2009). Therefore, in accordance with Article 6 of the Kyoto Protocol, which establishes the framework to address GHG emissions from anthropogenic sources, Australia established the Carbon Farming Initiative, a formal offsets mechanism that allows land managers to earn carbon credits by reducing GHG emissions or storing carbon (Russell-Smith *et al.* 2014). GHG accounting processes have been established to support the initiative.

5.3 Performance measurement within agencies

5.3.1 Response to questionnaire

A questionnaire was distributed to relevant agencies across Australia to understand performance measurement being undertaken and the potential for a set of agreed national KPIs. The questionnaire was distributed to representatives of 17 agencies. The total number of questionnaires received was 13 (representing 12 agencies), however two of these were incomplete. Documents provided as part of the survey were used to inform the project, including the development of the performance measures short list.

All respondents stated that their agency conduct a prescribed burn program, which was supported by policy, strategy or procedure documents. The majority of respondents stated that their agency currently collect and report on prescribed burning implementation and/or effectiveness.

In general respondents commented positively regarding this project and the potential for an agreed set of national performance measures, noting advantages such as:

- Consistency of reporting amongst (and between) agencies at both the state and national level;
- Expanding the understanding of monitoring and reporting metrics to continually improve prescribed burning planning and effectiveness;
- Developing a system that provides meaningful statistics, and can influence strategy and optimise effort into areas of most benefit;
- An agreed data dictionary for comparability of performance measures; and
- Development of a set of common (national) performance measurement as 'best practice'.

Respondents also noted the potential risks in implementing a national standard performance measures, including:

- The agency not being able to meet minimum performance targets when compared to other jurisdictions;
- A standard is developed that the agency is not well enough resourced to achieve;
- The measures are difficult or onerous to report on, or are beyond the resourcing capability of the agency;
- The measures are not meaningful and become a distraction from more meaningful work; and
- Standard measures and KPIs are applied to the wrong or unsuitable environments or agency structures.

An extended summary of the responses is provided in Appendix B.

5.3.2 Annual reports

Most agencies had annual reports available on the internet. Some of these included data on their performance in relation to prescribed burning. The measures or KPIs provided in the annual reports are shown in Table 4.

All agencies that reported on prescribed burning, reported on activity (e.g. number of burns) and/or outputs (e.g. area prescribed burnt or percentage of the agency's estate treated) either annually or as a multi-year average. Some also express these data as a percentage of the prescribed burning planned for the reporting period.

Some jurisdictions also reported on risk reduction, in terms of:

- Priority risk areas treated (e.g. Victoria and Western Australia);
- Number of assets protected by the area treated (e.g. New South Wales);
- Reduction in risk, assessed via fire behaviour and impact simulations (e.g. Tasmania and Victoria);
- Fuel age across the estate (e.g. Western Australia); and/or
- The relationship of the area affected by bushfire to the area of prescribed burning (e.g. Tasmania and Western Australia)

All Tasmanian agencies reported on the impact on air quality resulting from prescribed burning, expressed either as number of exceedances of regulatory standards or number of public complaints.

Community engagement activity regarding the prescribed burning program was reported for Tasmania and Victoria, and public response (positive and negative) was reported for Tasmania.

The cost of prescribed burning (expressed as dollars per hectare treated) was reported only for Western Australia.

No agencies included ecological outcomes from prescribed burning in their annual reports.

Table 4 *Prescribed burning performance measures provided in agency annual reports.*

Agency	Jurisdiction	Reporting period	Measures
Forestry Corporation	NSW	2015-2016	• Area burnt by prescribed fire (ha) • % area burnt vs annual target
Rural Fire Service	NSW	2015-2016	• Total annual hazard reduction area completed (ha) • Five-year average total area of hazard reduction work completed (ha) • Number of homes protected by hazard reduction works • Annual area burnt (ha) by land tenure
Office of Environment and Heritage	NSW	2016-2016	• Annual area treated (ha) • Five-year average area treated (ha) • % annual area target achieved
Department of National Parks, Sport and Racing	QLD	2015-2016	• Number of planned burns conducted • Area treated (ha) • % estate treated

5. PERFORMANCE MEASUREMENT

Source: Andrew Houley, Fire and Landscape Strategies

Agency	Jurisdiction	Reporting period	Measures
Department of Environment, Water and Natural Resources	SA	2014-2015	• Number of planned burns conducted • Area treated (ha)
Forestry SA	SA	2014-2015	• Number of planned burns conducted • Area treated (ha)
Department of Primary Industries, Parks, Water and Environment	TAS	2015-2016	• Number of fuel reduction burns • Area treated (ha) • Days exceeding 24-hour National Standards for $PM_{2.5}$ and PM_{10}
Forestry Tasmania	TAS	2015-2016	• Area treated (ha) • Area treated (ha) by burn purpose • Number of air quality complaints linked to prescribed burning • Cost of fuel reduction burning

5. PERFORMANCE MEASUREMENT

Agency	Jurisdiction	Reporting period	Measures
State Fire Commission	TAS	2015-2016	• Area treated (ha) • Number of planned burns • Area suitable for planned burning affected by bushfires (ha) • Number of bushfires in areas suitable for planned burning • Number of planned burns within a 5km radius of a human settlement area • Number of cross-tenure planned burns • Number of planned burns on private land • Number of operational burn plans prepared • Number of downloads of fuel reduction information and training materials from SFMC web pages • Number of general community forums • Number of community engagement activities with target audiences • Number of print, radio television and online stories on fuel reduction • Number of public smoke complaints associated with fuel reduction burning registered with the EPA • Number of public complaints on fuel reduction lodged through the Fuel Reduction Unit public enquiries email address and phone number • Number of positive fuel reduction related comments and enquiries/requests lodged with Fuel Reduction Unit

Agency	Jurisdiction	Reporting period	Measures
Department of Environment, Land, Water and Planning	VIC	2015-2016	• Area treated (ha) • Bushfire fuel management completed to protect key assets (ha) • Number of community engagement plans developed and implemented • Bushfire risk maintained at or below 70%
Parks Victoria	VIC	2015-2016	• Area treated (ha)
Department of Parks and Wildlife	WA	2015-2016	• Area treated (ha) • Average cost per hectare planned burnt ($) • Proportion of Priority 1 prescribed burns achieved (%) • Area of prescribed burning in three zones at defined distances (within 3.5km, 3.5-11km, beyond 11km) from the interface between populated areas and natural lands (ha) • % of target area prescribed burnt in three zones at defined distances (within 3.5km, 3.5-11km, beyond 11km) from the interface between populated areas and natural lands • Proportion of Department-managed lands in the south-west forest region that is less than six years since last burnt (%) • The ratio of area affected by bushfire to area of prescribed burning completed annually

6. PERFORMANCE MEASUREMENT FRAMEWORK FOR PRESCRIBED BURNING

Management by objectives is a key principle of the *National Bushfire Management Policy Statement for Forests and Rangelands* (FFMG 2014). The *National Guidelines for Prescribed Burning Strategic and Program Planning* state that (Principle 6, AFAC 2017a):

> *Strategic plans should contain clear objectives linked to performance indicators and metrics, so both delivery and performance can be evaluated.*

The Guidelines also advocate that performance measurement for prescribed burning considers long-term outcomes, intermediate outcomes, immediate outcomes and activity implementation (AFAC 2017a). A comprehensive approach to performance measurement was also recommended by a number of independent inquiries that considered prescribed burning (e.g. AGV 2003; Esplin *et al.* 2003; ENRC 2008; Teague *et al.* 2010).

In this section, a framework for prescribed burning performance measurement is described. It comprises a program logic model that articulates how prescribed burning is expected to contribute to the strategic objectives and goals of the *National Bushfire Management Policy Statement for Forests and Rangelands* (FFMG 2014). The logic model is used as a framework to show the aspects of prescribed burning measured by a compilation of performance indicators. The framework focuses on the planning, delivery and results of a prescribed burning program as a whole rather than on individual burns. The indicators are either currently in use by agencies, drawn from the literature or recommended by the project TRG.

6.1 Strategic objective and goals

For the purpose of developing the performance measurement framework, the strategic objective and goals of the *National Bushfire Management Policy Statement for Forests and Rangelands* (FFMG 2014) most relevant to prescribed burning were taken to represent the purposes of prescribed burning across the country.

These are:

Strategic objective A

Fire is used to manage Australia's forests and rangelands to achieve outcomes that involve reduced risk from severe bushfires, and enhance the resilience of ecosystems in the face of climate and other change.

Goals

1. *Maintain appropriate fire regimes in Australia's forests and rangelands;*
2. *Balance the environmental impacts of fire; and*
3. *Promote indigenous Australians' use of fire.*

The strategic objective identifies two high level outcomes being sought; reduction in risk from severe bushfires and enhanced resilience of ecosystems. These are used to frame the program logic for prescribed burning.

Goals 1 and 2 are considered to apply to all prescribed burning programs across Australia. The applicability of Goal 3 will vary considerably between jurisdictions, and may not be a primary consideration of the prescribed burning program in some locations.

6.2 Prescribed burning program logic

In this section, the prescribed burning program logic model is described. The logic model is provided in Appendix E as a foldout chart. The number in [ ] in the text below refers to the corresponding box on the logic model diagram.

The assumptions inherent in the program logic are canvassed in previous National Burning Project reports and are not repeated in any detail in this report. The reader is referred to the *National Guidelines for Prescribed Burning Strategic and Program Planning* and the risk frameworks for fuel hazard (AFAC 2015b), operational (AFAC 2016c), smoke and GHG (AFAC 2015c) and ecological (AFAC 2016b) risks for greater detail.

The strategic objective and goals of prescribed burning [boxes 1-4 of the logic model] are taken from the *National Bushfire Management Policy Statement for Forests and Rangelands* (FFMG 2014 pp11-12). These are, to effectively manage the land with fire [1] in order to maintain appropriate fire regimes in Australia's forests and rangelands [2]; to balance the environmental impacts of fire [3]; and to promote indigenous Australians' use of fire [4].

From these can be identified high level outcomes being sought through the fire management of Australian forests and rangelands; the reduction in the risk of severe fires [5] (FFMG 2014 p11) and enhanced resilience of ecosystems [6] (FFMG 2014 p11). A program of appropriate prescribed burning will contribute to achieving these, by strategically managing fuels in the landscape, minimising adverse effects of fire on water, vegetation, carbon and air shed [7] (FFMG 2014 p12) and maximising environmental benefits [8] (FFMG 2014 p12).

Promotion of indigenous Australians' use of fire [4] (FFMG 2014 p12) will integrate traditional burning practices and fire regimes with current practices and technologies [9] (FFMG 2014 p12).

The prescribed burning program requires the investment of time [10], funds [11] and plant and equipment [12] (*inputs*) to resource the necessary strategic planning, program planning, operational planning and burn implementation *activities* [14-22] (AFAC 2014 p20). The program is underpinned by knowledge [13] gained from many years of experience (including indigenous burning practices [15]), evaluation and research [20].

These activities result in delivery of a program of prescribed burns [22] (*activities*) that result in areas of land being burnt under prescribed conditions [23] (outputs) designed to achieve specific burn objectives (*immediate outcomes*) that contribute to realising the overall land management objectives (i.e. achieving the desired *intermediate* and *final outcomes* sought from the burning program as a whole).

The prescribed burning of an area results in the consumption of a proportion of vegetation and dead fuel [25]. This modifies the fuel hazard [26] for a period of time (duration dependent on vegetation type and fuel component being considered) and may also alter vegetation structure (e.g. understorey height) and composition [27] (AFAC 2016d p10). The reduction in fuel hazard (across surface, near-surface, elevated and bark fuels) should result in an immediate local decrease in fire behaviour (in terms of rate of spread, spotting, intensity, flame length etc.) [29] (Gill 2008).

Each prescribed burn also produces smoke [24] that, under unfavourable conditions, may have a negative impact on air quality [33] and flow on effects on some aspects of agriculture [36] and amenity etc. (AFAC 2015c p6). Prolonged or acute exposure to smoke from prescribed burning may have a negative impact on public health [40] (AFAC 2015c p6). Although, by reducing the extent [34] and severity [35] of bushfires, prescribed burning is expected to provide a net improvement in air quality [33], and hence public health [40], by reducing the occurrence of prolonged smoke logging of highly populated air sheds.

6. PERFORMANCE MEASUREMENT FRAMEWORK FOR PRESCRIBED BURNING

The cumulative effect of a prescribed burning program over time and space is a mosaic of fuel age classes across the landscape [28] (AFAC 2014 p44). This mosaic should moderate the fire behaviour (in terms of rate of spread, spotting, intensity, flame length etc.) [29] of a bushfire that burns into a fuel reduced area (AFAC 2016 p10). This can facilitate control of bushfires under moderate conditions, reducing the amount of fire in the landscape before extreme weather occurs (AFAC 2014 p25). In addition, if a bushfire burns into a fuel reduced area whilst still developing, its progress may be sufficiently curtailed to enable containment even under elevated FFDIs, thus also reducing the extent of bushfires [34]. If sufficient area, and in the right locations, has been burnt recently enough, this should influence even large fire behaviour up to Very High fire danger ratings, after which fuel reduction becomes less influential on fire behaviour (AFAC 2014 p25; Price and Bradstock 2012; 2013).

Intensive fuel management in the immediate vicinity of assets (AFAC 2014 p19) can reduce the level of bushfire attack upon them under even extreme conditions, enhancing the effectiveness of other bushfire risk mitigation such as building construction standards (Standards Australia 2009) and active defence, and reducing the risk to at risk values [38] (AFAC 2014 p20).

Moderating fire behaviour should, by itself, reduce the severity of bushfire [35] (AFAC 2014 p24) and, by improving the effectiveness and safety of fire suppression [30] (AFAC 2014 p24), reduce the extent of bushfires [34] (AFAC 2014 p24). This should reduce suppression costs over time [41] and lead to a reduction in firefighter injury or loss of life [37].

If bushfires are smaller [34] and/or less severe [35], the risk to vulnerable assets and values exposed to bushfire should be reduced [38]. This, over time, should result in reduced loss of human life [42], and reduced property and economic losses [43] (AFAC 2014 p20).

The mosaic of fuel ages across the landscape [28] should increase the proportion of vegetation that is within a fire regime (expressed primarily as fire frequency) desirable or tolerable for that vegetation type [31] and improve habitat values [32] for the majority of species (AFAC 2014 p47). A mosaic of age classes is believed to contribute to improved ecosystem resilience [39] (AFAC 2014 p47; AFAC 2016b p25), that in turn makes ecosystems less vulnerable to degradation from large, intense unplanned fires [45] that result in a homogenous fire landscape (AFAC 2014 p43).

Prescribed fire may be used to maintain healthy ecosystems or to reintroduce fire into fire-dependent vegetation from which fire has been excluded to the detriment of ecosystem health (AFAC 2017a).

In northern Australia, the replacement of late season, high intensity unplanned fires with lower intensity early season prescribed burning has been shown to reduce GHG emissions [44] (AFAC 2014 p65; AFAC 2015c p34; Price *et al.* 2012; Russell-Smith *et al.* 2013; Russell-Smith *et al.* 2014).

The increased ecosystem resilience [39], reduction in degradation of environmental values by fire [45] and reduction in GHG emissions [44] all contribute to the enhancement of environmental health and ecosystem functioning [46].

The reduction in losses from bushfire, across life [40 & 42], economy [43] and environment [44 & 45], will, in the long term, reduce the overall cost of unplanned fire in Australia [47].

Achievement of these final outcomes will deliver the vision for fire management of Australia's forests and rangelands of :

> *Fire regimes are effectively managed to maintain and enhance the protection of human life and property and the health, biodiversity, tourism, recreation and production benefits derived from Australia's forests and rangelands* [48] (FFMG 2014 p9).

6.3 Performance indicators

Performance indicators can be an important communication tool for both internal and external stakeholders, quantifying the activities being conducted and what is being achieved. It is desirable they be in a form readily understood by the community and other stakeholders.

A suite of performance indicators was developed through an iterative process, comprising:

- Identifying indicators currently in use or suggested for use in the literature (the 'complete' list);
- Consolidating indicators of similar intent and removing duplicates to provide a 'long list';
- Recommending to the TRG a 'shortlist' of indicators based on the criteria described below; and
- Finalising the list in a workshop with the TRG.

6.3.1 Selection process

Performance indicators identified were either in use by agencies or suggested in the literature by external stakeholders (e.g. inquiries into agency prescribed burning or academic research). The complete list of indicators is provided in Appendix C.

From the complete list, a long list was compiled (refer Appendix D). The long list consolidated a number of performance indicators, particularly those for activities and outputs, with similar intent that were common to multiple sources, albeit with different wording in some cases. Indicators identified that measure the same or similar aspects of the burning program via quite different metrics, were generally included separately. Those indicators included in the performance measurement framework are highlighted in Appendix D.

A sub-set of indicators was then shortlisted, for consideration by the TRG, based on the following considerations.

Logical – indicators that are explicitly linked to the prescribed burning program logic and measure performance at key points (as a proxy for reflecting specific program objectives of the various agencies).

Balanced – a suite of indicators spread across the 'length' of the program logic model (i.e. capturing inputs – activities – outputs – immediate outcomes – intermediate outcomes – final outcomes) and that measure efficiency, quality and effectiveness (KPI Institute online).

SMART (adapted from Rozner 2013, based on an original concept by Doran 1981) – indicators that are (or could be):

- Specific – clearly convey what they are measuring;
- Measurable (note: data availability is likely to vary between agencies);
- Attributable – measure something that the prescribed burning program is designed to achieve, or which is under the program's control;
- Relevant – measure important aspects/results of the program of use to internal or external stakeholders; and
- Time-bound – data are collected and reported regularly to allow performance to be tracked over time (note: this is likely to vary between agencies).

Benchmarks – indicators expressed as ratios or percentages, rather than absolute numbers, that lend themselves to benchmarking between like settings, agencies or jurisdictions.

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Responsive – indicators that measure elements of performance expected to change over time in response to program delivery.

Scalable – indicators that allow performance to be measured, and where appropriate compared, at management unit, agency and jurisdictional scales.

The relevancy (OAGBC 2010) of potential KPIs was considered in relation to questions that key internal and external stakeholders might have about the program (WK Kellogg Foundation 2004). Potential questions in relation to a program of prescribed burning are:

1. What prescribed burning is required to achieve agreed fire management goals? What area, what frequency, what locations?
2. How much is planned to be done? This season, and this multi-year planning cycle?
3. Are the community and other key stakeholders being effectively engaged in planning and consulted about implementation?
4. Are the community and other key stakeholders supportive of prescribed burning?
5. How much prescribed burning has been done? Where was it done and how does this relate to bushfire risk?
6. Are prescribed burns being done safely?
7. Are prescribed burns achieving their stated objectives?
8. What outcomes (risk reduction, ecological, commercial or GHG emission abatement etc.) are being delivered by the prescribed burning program as a whole?
9. Is the potential for unintended adverse impacts (e.g. smoke, escapes, environmental impact) being managed appropriately?
10. What is the program costing? Are resources being used efficiently? How does our program compare with those of comparable jurisdictions?

The first two questions are generally answered by strategic and burn program planning respectively. Questions 3 to 10 were used to test the relevance of performance indicators. It is recognised, however, that many agencies will have more detailed evaluation questions, specifically related to their burning program and agency mandate.

6.3.2 Performance area

The indicators in the long list were sorted into broad areas of performance measurement, relating to the goals of prescribed burning and the stages in the program logic model (see Appendix D). The performance areas identified were:

- Financial;
- Program planning activities;
- Community understanding and support;
- Operational planning activities;
- Burn implementation;
- Fuel management outcomes;
- Risk reduction outcomes, including bushfire occurrence and impact;
- Ecological outcomes;
- Greenhouse gas abatement outcomes; and
- Adverse impacts.

6.3.3 Proposed indicators

The TRG workshopped the shortlisted indicators and either:

- Agreed to the shortlisted indicator;
- Amended and agreed to the shortlisted indicator;
- Rejected the short-listed indicator as impracticable or already covered by an agreed indicator; or
- Proposed an alternative indicator they considered of value.

The TRG decreased the number of intermediate outcome indicators but increased the number of activity indicators, resulting in a slight decrease overall.

The indicators selected are listed in **Table 5** and described in more detail in Section 7. Their relationship to the prescribed burning logic model is shown in Appendix E.

6. PERFORMANCE MEASUREMENT FRAMEWORK FOR PRESCRIBED BURNING

Table 5 *Indicators selected by TRG.*

Performance area	KPI (alphanumeric refers to location in long list of indicators Appendix D)
A. Financial	A1. Expenditure ($) on prescribed burning
	A2. Cost ($) per hectare treated with prescribed burning by zone/setting
	A4. Cost ($) per % of risk reduction
B. Program planning activities	B1. % of burnable agency managed land with current fire management plan
C. Community understanding and support	C3. Activity indicator TBD - to be referred to AFAC community engagement subject matter experts for consideration.
	C4. % of community supporting prescribed burning
D. Operational planning activities	D2. % of prescribed burns that demonstrate compliance with required agency procedures
	D3. % of suitable days on which prescribed burning was undertaken
	D4. % of prescribed burns at which level of community engagement meets agency standard
E. Burn implementation	E2. % of planned prescribed burning program delivered
	E3. Area (ha) treated with prescribed burning
	E6. % of prescribed burns where burn objectives were met
	E9. % of landscape treated with prescribed burning
	E10. % of burns conducted in conjunction with Traditional owners and/or incorporating indigenous burning practices
F. Fuel management outcomes	F3. % of managed land meeting prescribed fuel standards
G. Risk reduction outcomes	G4. Residual risk (%)
	G7. Area (ha) burnt by bushfire
	G9. % of landscape burnt by bushfire
H. Ecological outcomes	H4. % of vegetation communities with tolerable fire regime
I. Greenhouse gas abatement outcomes	I1. Tonnes of CO_2 equivalent abated
J. Adverse impacts	J2. % of prescribed burns that escape
	J6. Number of days on which air quality threshold was exceeded due to prescribed burning

It is not envisaged that agencies would elect to measure and report all the indicators, rather they provide a toolbox from which an agency can pick those that reflect their burning program and meet the needs of their stakeholders. Hubbard (2004) recommends focussing attention on a few indicators that measure aspects of performance considered most important to the organisation.

7. DATA DICTIONARY

In this section, a preliminary data dictionary is provided that contains detail about the short-listed indicators and how they could be measured. This information is of a preliminary and illustrative nature only. The detailed specification of indicators requires knowledge of data availability in each jurisdiction and agreement of business rules that meet the needs of agencies. It is common for performance indicators to be refined through use (KPI Institute online) and the specifications provided below can be seen as a starting point.

Table 6 *Preliminary specification for short-listed Indicator A1.*

Name	A1. Expenditure ($) on prescribed burning.	
Description	The total cost of conducting an annual prescribed burning program (including maintenance of capability, strategic and operational planning, implementation, follow up works, monitoring and evaluation) and incorporating direct and indirect/shared costs (e.g. portion of staff salaries committed to prescribed burning). Excludes costs of suppression of escaped burns.	
Rationale	Reporting on how public funds are spent on fire management is fundamental to public accountability. Financial transparency enables government to make better resource allocation decisions.	
Success trend	N/A (but variation in expenditure should reflect variation in quality or quantity of burning, or inflation)	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Magnitude of inputs [10] + [11] + [12] + [13] on logic model
	Performance area	Financial
	Measure relationships	Input to: • A2. Cost ($) per hectare prescribed burnt by zone/setting • A4. Cost ($) per % of risk reduction
Calculation	**Formula**	= Direct and indirect expenditure on prescribed burning
	Frequency	• Annual • Previous 5 year rolling average Previous 5 year rolling average allows annual expenditure to be benchmarked against recent previous years to highlight any significant changes.
Data elements	**Definition**	TBD
	Sources	Agency human resource and finance systems
Benchmarking	Not suitable	
Monitoring	Monthly	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 7 *Preliminary specification for short-listed Indicator A2.*

Name	A2. Cost ($) per hectare treated with prescribed burning by zone or setting	
Description	The total cost of conducting an annual prescribed burning program expressed as cost per hectare treated	
Rationale	This is an indicator of the efficiency of the prescribed burning program. The indicator recognises that the cost of burning varies with the complexity of the burn and is expressed in terms of the FMZ in which burning is occurring or some other classification that is a proxy.	
Success trend	Decrease (unless offset by improved quality of implementation)	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Relationship of inputs to output (i.e. technical efficiency) [10] + [11] + [12] + [13] / [23] on logic model
	Performance area	Financial
	Measure relationships	Input from: • A1. Expenditure ($) on prescribed burning • E3. Area (ha) prescribed burnt
Calculation	**Formula**	= Direct and indirect expenditure on prescribed burning / hectares treated per FMZ or setting
	Frequency	• Annual • Previous 5 year rolling average Previous 5 year rolling average allows annual efficiency to be benchmarked against recent previous years to highlight any significant changes
Data elements	**Definition**	TBD
	Sources	Agency human resources and finance systems Agency burn program implementation reports
Benchmarking	Suitable for benchmarking between like settings	
Monitoring	Annually	
KPI reporting frequency	Annually	

Table 8 *Preliminary specification for short-listed Indicator A4.*

Name	A4. Cost ($) per % of risk reduction	
Description	The total cost of conducting an annual prescribed burning program expressed in terms of the % of risk reduction achieved. The % of risk reduction does not include reduction in residual risk due to fuel being burnt by unplanned fire or bushfire.	
Rationale	Reduction to community risk from bushfire is a primary objective of most prescribed burning programs. Modelling of bushfire risk reduction using fire simulation modelling is accepted as a proxy for improved fire safety outcomes. This is an indicator of cost-effectiveness of burning to reduce bushfire risk. Performance against this indicator can be improved by targeting burning to maximise risk reduction and/or increasing the efficiency of the burning program to reduce program expenditure or to enable additional burning to occur.	
Success trend	Decrease	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Relationship of an input to an intermediate outcome (i.e. cost effectiveness) [10] + [11] + [12] + [13] / [38] on logic model
	Performance area	Financial
	Measure relationships	Input from: • A1. Expenditure ($) on prescribed burning • % risk reduction (i.e. modelled % residual risk without burning program minus modelled % residual risk after burning program implemented)
Calculation	**Formula**	= Expenditure on prescribed burning / % risk reduction
	Frequency	• Annual • Previous 5 year rolling average Previous 5 year rolling average allows annual cost-effectiveness to be benchmarked against recent previous years to highlight any significant changes
Data elements	**Definition**	TBD
	Sources	Agency human resources and finance systems Burn program implementation reports Risk modelling
Benchmarking	Suitable for benchmarking between like settings	
Monitoring	Annually	
KPI reporting frequency	Annually	

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Table 9 *Preliminary specification for short-listed Indicator B1.*

Name	B1. % of treatable agency-managed land with current fire management plan	
Description	The coverage of the estate by current fire management plans. Plans are expected to consider both ecological and bushfire safety objectives as applicable.	
Rationale	Prescribed burning is conducted to achieve stated objectives. Strategic fire management planning sets fire management goals and objectives for areas of land and identifies the requirement for prescribed burning as a management tool to achieve the objectives.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Coverage of an activity
	Performance area	Program planning activity [14] on logic model
	Measure relationships	None
Calculation	**Formula**	Denominator = Area of treatable agency-managed land (ha) Numerator = Area of treatable agency-managed land (ha) covered by current fire management plan = Area of treatable agency-managed land (ha) covered by current fire management plan / Area of treatable agency-managed land (ha) * 100
	Frequency	Annual
Data elements	**Definition**	Treatable area – agency-managed land considered potentially suitable for prescribed burning
	Sources	Agency fire management planning process records
Benchmarking	Suitable for benchmarking at management unit, agency and jurisdiction scales	
Monitoring	Annually	
KPI reporting frequency	Annually	

Table 10 *Preliminary specification for short-listed Indicator C3.*

Name	C3. TBD – refer to AFAC community engagement SMEs	
Description	An indicator of the level of engagement with the broader community in relation to prescribed burning.	
Rationale	The support of the community and other stakeholders is important to the implementation of a burning program (especially if it involves private land) and helps mitigate outrage in the event of adverse outcomes.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Coverage of an activity [16] on logic model
	Performance area	Community understanding and support
	Measure relationships	Companion to: • C4. % of community supporting prescribed burning
Calculation	**Formula**	TBD
	Frequency	TBD
Data elements	**Definition**	TBD
	Sources	Agency community engagement records
Benchmarking	TBD	
Monitoring	Annually	
KPI reporting frequency	Annually	

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Table 11 *Preliminary specification for short-listed Indicator C4.*

Name	C4. % of community supporting prescribed burning	
Description	The percentage of the wider community that support the practice of prescribed burning. It is anticipated that community support will vary geographically (possibly in response to perceived bushfire risk) and temporally (possibly in response to fire events, e.g. major bushfire or high profile prescribed burn escape). This indicator would require long term monitoring via survey or other appropriate methodology with sampling sufficient to account for the anticipated spatial and temporal variability.	
Rationale	Stakeholder acceptance of prescribed burning facilitates the planning and conduct of burns. It also mitigates potential outrage at adverse events (e.g. burn escapes, smoke etc.).	
Success trend	Increase	
Reporting level	Jurisdiction	
Where it fits	**Program logic**	Quality of activities and/or outputs and/or recognition of value of outcomes being sought May relate to [16] and is likely influenced by perceptions of higher level intermediate and final outcomes i.e. [33] and above on logic model
	Performance area	Community understanding and support
	Measure relationships	Companion to: • C3 – TBD – refer to AFAC community engagement SMEs
Calculation	**Formula**	Denominator = Number of people sampled Numerator = Number of people sampled who support prescribed burning = Number of people sampled who support prescribed burning / Number of people sampled * 100
	Frequency	Bi-annual
Data elements	**Definition**	TBD
	Sources	Commissioned surveys
Benchmarking	Suitable for benchmarking at jurisdiction scale	
Monitoring	Bi-annually	
KPI reporting frequency	Bi-annually	

Table 12 *Preliminary specification for short-listed Indicator D2.*

Name	D2. % of prescribed burns that demonstrate compliance with required agency procedures	
Description	The percentage of prescribed burns that demonstrate compliance with all applicable agency procedures. Procedures may cover planning and implementation of burns.	
Rationale	Prescribed burning is inherently risky. These risks are minimised by thorough planning and quality assured approvals and implementation.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Quality of an activity Relates to [18], [21] and [22] on logic model
	Performance area	Operational planning
	Measure relationships	N/A
Calculation	**Formula**	Denominator = Total number of prescribed burns conducted Numerator = Number of prescribed burns demonstrating compliance with required agency procedures = Number of prescribed burns demonstrating compliance with required agency procedures / Total number of prescribed burns conducted * 100
	Frequency	• Annual • Previous 5 year rolling average Previous 5 year rolling average allows annual engagement to be benchmarked against recent previous years to highlight any significant changes
Data elements	**Definition**	TBD
	Sources	Agency burn program implementation reports Real-time performance monitoring
Benchmarking	Suitable for benchmarking at management unit, agency and jurisdiction scales	
Monitoring	Real time	
KPI reporting frequency	Annually	

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Table 13 *Preliminary specification for short-listed Indicator D3.*

Name	D3. % of suitable days on which prescribed burning was undertaken	
Description	The percentage of days, deemed suitable for prescribed burning, on which prescribed burning was undertaken. The measure does not consider the magnitude of burning (i.e. number of burns or area treated) but simply whether any prescribed burning occurred.	
Rationale	The days on which prescribed burning will be safe and effective are limited by fuel and weather conditions, both on the days that burning will be undertaken and in the immediate aftermath. Effective delivery of a planned program of prescribed burning requires advantage to be taken of suitable conditions.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Quality of an activity Relates to [21] and [22] on logic model
	Performance area	Operational planning
	Measure relationships	N/A
Calculation	**Formula**	Denominator = Total number of days suitable for prescribed burning Numerator = Number of suitable days on which prescribed burning was undertaken = Number of suitable days on which prescribed burning was undertaken / Total number of days suitable for prescribed burning * 100
	Frequency	• Annual • Previous 5 year rolling average Previous 5 year rolling average allows annual engagement to be benchmarked against recent previous years to highlight any significant changes
Data elements	**Definition**	Suitable day to be determined by agency prescriptions for burn implementation (note: should consider suitability of days following ignition on which burn may still be active)
	Sources	Agency burn program implementation reports Bureau of Meteorology weather records for relevant locations
Benchmarking	Suitable for benchmarking at management unit, agency and jurisdiction scales	
Monitoring	Monthly	
KPI reporting frequency	Annually	

Table 14 *Preliminary specification for short-listed Indicator D4.*

Name	D4. % of prescribed burns at which level of community engagement meets agency standards.	
Description	The percentage of prescribed burns for which people and groups who would be affected by a prescribed burn have been engaged in the strategic and/or operational planning of the burn to a level that meets agency standards. It would need to be determined how to define the affected community and stakeholders – possibly by proximity to burn location or connection to the land. It would also be necessary to define what constitutes engagement – one-way vs two-way, invitation to engage vs actual engagement etc.	
Rationale	Consultation with community and other stakeholders directly affected by prescribed burning is considered good practice.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Coverage of an activity Relates to [16] on logic model
	Performance area	Operational planning
	Measure relationships	N/A
Calculation	**Formula**	Denominator = Total number of prescribed burns Numerator = Number of prescribed burns at which level of community engagement met agency standards = Number of prescribed burns at which level of community engagement met agency standards / Total number of prescribed burns * 100
	Frequency	• Annual • Previous 5 year rolling average Previous 5 year rolling average allows annual engagement to be benchmarked against recent previous years to highlight any significant changes
Data elements	**Definition**	TBD
	Sources	Agency burn planning and implementation records
Benchmarking	Suitable for benchmarking at management unit, agency and jurisdiction scales	
Monitoring	Annually	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 15 *Preliminary specification for short-listed Indicator E2.*

Name	E2. % of planned prescribed burning program delivered	
Description	The percentage of the planned prescribed burning program delivered during the nominated time period. Measure could be expressed in terms of number of prescribed burns or by area treated.	
Rationale	Agencies are judged on the extent to which planned services are delivered. Measuring performance against this indicator can be mediated by including only 'core' rather than 'contingency' burns which are not realistically expected to be delivered during the nominated time period but are included in case of better than expected conditions. Performance could be heavily influenced by seasonal conditions beyond the control of the agency.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Relationship between planned and actual activity Relates to [22] on logic model
	Performance area	Burn implementation
	Measure relationships	Input from: • E3. Area (ha) treated with prescribed burning Companion to: • D3. % of suitable days on which prescribed burning was undertaken
Calculation	**Formula**	Denominator = Total number (or area) of prescribed burns planned Numerator = Number (or area) of prescribed burns conducted = Number (or area) of prescribed burns conducted / Total number or area of prescribed burns planned * 100
	Frequency	• Annual • Previous 5 year rolling average Five year rolling average accounts for variation between seasons conducive or not conducive to prescribed burning
Data elements	**Definition**	Planned program to be expressed as both number of prescribed burns and area to be treated Program delivered to be expressed as both number of prescribed burns and area treated
	Sources	Agency plans and schedule Agency burn program implementation reports
Benchmarking	Suitable for benchmarking at management unit and agency scales	
Monitoring	Monthly	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 16 *Preliminary specification for short-listed Indicator E3.*

Name	E3. Area (ha) treated with prescribed burning	
Description	The total area treated by prescribed burning in a year.	
Rationale	A basic measure of the amount of prescribed burning undertaken, likely to be required for reporting to government.	
Success trend	Increase (but limited by targets set in relation to area, budget or risk reduction)	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Magnitude of an output Relates to [23] on logic model
	Performance area	Burn implementation
	Measure relationships	Input to: • A2. Cost ($) per hectare prescribed burnt by zone/setting • E9. % of landscape treated with prescribed burning
Calculation	**Formula**	Count
	Frequency	Annual Five year rolling average Five year rolling average accounts for variation between seasons conducive or not conducive to prescribed burning
Data elements	**Definition**	Treated area – actual area over which fuel reduction objectives were met by prescribed burning Year – to be defined by jurisdiction to best reflect annual burning season
	Sources	Agency burn program implementation reports Agency post-burn assessments
Benchmarking	Not suitable	
Monitoring	Monthly during prescribed burning season	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 17 *Preliminary specification for short-listed Indicator E6.*

Name	E6. % of prescribed burns where burn objectives were met	
Description	The percentage of burns where post-burn assessment determines that the burn objectives have been achieved.	
Rationale	Each prescribed burn has documented objectives, in terms of % of area burnt, fuel hazard reduction, fire behaviour etc. Ensuring burn prescriptions are met is basic quality control of burn operational planning and implementation. Success in achieving immediate outcomes (i.e. burn objectives) is a pre-requisite to achieving longer term intermediate and final outcomes.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Quality of an output Relates to [26] and [27] on logic model
	Performance area	Burn implementation
	Measure relationships	Could be difficult to prove causal link between burn program implementation and outcomes.
Calculation	**Formula**	Denominator = Total number of prescribed burns Numerator = Number of prescribed burns where burn objectives met = Number of prescribed burns where burn objectives met / Total number of prescribed burns * 100
	Frequency	Annual Five year rolling average Five year rolling average accounts for variation between seasons conducive or not conducive to effective prescribed burning
Data elements	**Definition**	TBD
	Sources	Agency post-burn assessments
Benchmarking	Suitable for benchmarking at management unit and agency scales	
Monitoring	Monthly during prescribed burning season to identify any implementation issues	
KPI reporting frequency	Annually	

Table 18 *Preliminary specification for short-listed Indicator E9.*

Name	E9. % of landscape treated with prescribed fire	
Description	The percentage of burnable/treatable land that has been treated with prescribed fire in a year irrespective of land tenure.	
Rationale	Provides a holistic landscape view of the relative amount of prescribed burning in the treatable landscape. It encourages a tenure-blind assessment of the prescribed burning program.	
Success trend	Increase	
Reporting level	Scalable: management unit – jurisdiction	
Where it fits	**Program logic**	Coverage of an output Relates to [23] on logic model
	Performance area	Burn implementation
	Measure relationships	Input from: • E3. Area (ha) treated with prescribed burning Companion to: • G9. % of landscape burnt by bushfire
Calculation	**Formula**	Denominator = Area of treatable land (ha) Numerator = Area of treatable land (ha) treated with prescribed burning = Area of treatable land (ha) treated with prescribed burning / Area of treatable land (ha) * 100
	Frequency	Annual Five year rolling average Five year rolling average accounts for variation between seasons conducive or not conducive to prescribed burning
Data elements	**Definition**	Treatable area – land considered potentially suitable for prescribed burning regardless of land tenure Treated area – actual area over which fuel reduction objectives were met by prescribed burning Year – to be defined by jurisdiction to best reflect annual burning season
	Sources	Agency burn program implementation reports Agency post-burn assessments
Benchmarking	Suitable for benchmarking at management unit and jurisdiction scales	
Monitoring	Annually	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 19 *Preliminary specification for short-listed Indicator E10.*

Name	E10. Number of prescribed burns conducted in conjunction with Traditional Owners and/or incorporating indigenous burning practices	
Description	The number of prescribed burns conducted in conjunction with Traditional Owners and/or incorporating indigenous burning practices. Consideration needs to be given to what represents 'indigenous burning practices'.	
Rationale	Promoting indigenous Australian's use of fire is a goal of the National Bushfire Management Policy Statement for Forests and Rangelands (FFMG 2014). No measures relating to this goal were identified in the literature and this indicator is proposed as a starting point to be refined over time.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency - jurisdiction	
Where it fits	**Program logic**	Quality of an activity Relates to [15] and [22] on logic model
	Performance area	Burn implementation
	Measure relationships	None
Calculation	**Formula**	Count = Number of prescribed burns conducted in conjunction with Traditional Owners and/or incorporating indigenous burning practices
	Frequency	Annual Five year rolling average Previous 5 year rolling average allows annual engagement to be benchmarked against recent previous years to highlight any significant changes
Data elements	**Definition**	TBD
	Sources	Agency burn program implementation reports
Benchmarking	Suitable for benchmarking at management unit and agency scales	
Monitoring	Annually	
KPI reporting frequency	Annually	

Table 20 *Preliminary specification for short-listed Indicator F3.*

Name	F3. % of agency managed land meeting prescribed fuel standards	
Description	The percentage of the total area of land managed by an agency (i.e. their estate) that currently meets the fuel management standard nominated for land of that type (e.g. fire management zoning). Private land outside the control of agencies is not included in this measure. Fuel reduction by bushfire is counted in this measure. As burning (by prescribed fire or bushfire) modifies fuel hazard for a number of years, the duration of effect will need to be stipulated for each vegetation type, i.e. how recent the burning needs to be for fuel to be at or below the prescribed standard.	
Rationale	Fire management planning typically sorts public land into fire management zones, each with an associated desired fuel hazard rating or fire frequency. This measure assesses the degree to which fuel management outcomes of agency strategic fire management planning are being realised on the ground. Indicator links to FMZ fuel standards and would drive program planning.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Intermediate outcome Relates to [28] on logic model
	Performance area	Fuel management outcomes
	Measure relationships	Input from: • E3. Area (ha) treated with prescribed burning • G7. Area (ha) burnt by bushfire
Calculation	**Formula**	Denominator = Total area of agency managed land Numerator = Total area treated with prescribed fire within stipulated time frame + Area burnt by bushfire within stipulated time frame = Total area treated with prescribed fire within stipulated time frame + Area burnt by bushfire within stipulated time frame / Total area of agency managed land * 100
	Frequency	Annual Five year rolling average Five year rolling average accounts for variation between seasons conducive or not conducive to effective prescribed burning and occurrence and extent of unplanned fire or bushfire
Data elements	**Definition**	TBD
	Sources	Fire scar or perimeter mapping Agency post-burn assessments
Benchmarking	Suitable for benchmarking at management unit, agency and jurisdiction scales	
Monitoring	Annually	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 21 *Preliminary specification for short-listed Indicator G4.*

Name	G4. Residual risk (%)	
Description	The residual risk (expressed as a percentage of potential risk given no fuel management) after the fuel reduction effects of prescribed burning and bushfire have been accounted for. Risk is defined as impact on houses by bushfire with an intensity and ember density sufficient to destroy exposed buildings.	
Rationale	Bushfire losses are probabilistic and heavily skewed by occasional high consequence fires. Long term monitoring is required to establish meaningful trends. The hypothesis that sufficient (in terms of amount, location and currency) prescribed burning will reduce bushfire losses is well established. Fire behaviour and impact modelling that tests the effect of the prescribed burning program on bushfire risk provides a surrogate measure for actual bushfire loss.	
Success trend	Residual risk is at or slightly below target threshold (note: residual risk significantly below target is likely to be due to bushfire and hence may be undesirable)	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Condition and trend of an intermediate outcome Relates to [38] on logic model
	Performance area	Risk reduction outcomes (including bushfire occurrence and impact)
	Measure relationships	Input from: • E3. Area (ha) treated with prescribed burning • G7. Area (ha) burnt by bushfire
Calculation	**Formula**	TBD – require bushfire spread and impact simulation such as Phoenix
	Frequency	Annual Five year rolling average Five year rolling average accounts for variation between seasons conducive or not conducive to effective prescribed burning and occurrence and extent of unplanned fire or bushfire.
Data elements	**Definition**	TBD
	Sources	Agency risk modelling Fire scar or perimeter mapping
Benchmarking	Suitable for benchmarking at management unit and agency scales	
Monitoring	Annually	
KPI reporting frequency	Annually	

Table 22 *Preliminary specification for short-listed Indicator G7.*

Name	G7. Area (ha) burnt by bushfire	
Description	The total area burnt by bushfire or unplanned fire, regardless of intensity or damage caused.	
Rationale	Reduction in the extent of bushfire and unplanned fire is a key outcome sought from prescribed burning.	
Success trend	Decrease	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Condition and trend of an intermediate outcome Relates to [34] on logic model
	Performance area	Risk reduction outcomes (including bushfire occurrence and impact)
	Measure relationships	Input to: • F3. % of managed land meeting prescribed fuel standards • G4. Residual risk (%)
Calculation	**Formula**	= Area (ha) burnt by bushfire
	Frequency	Annual Five year rolling average Five year rolling average accounts for variation in occurrence and extent of unplanned fire or bushfire.
Data elements	**Definition**	As per AFAC landscape fire performance measures
	Sources	Fire scar or perimeter mapping Data for this indicator are likely to be captured through agency fire and incident reporting processes
Benchmarking	Not suitable	
Monitoring	Annually	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 23 *Preliminary specification for short-listed Indicator G9.*

Name	G9. % of landscape burnt by bushfire	
Description	The % of the total landscape burnt by bushfire or unplanned fire, regardless of intensity or damage caused. Includes both agency-managed and private land.	
Rationale	Reduction in the extent of bushfire and unplanned fire is a key outcome sought from prescribed burning.	
Success trend	Decrease	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Condition and trend of an intermediate outcome Relates to [34] on logic model
	Performance area	Risk reduction outcomes (including bushfire occurrence and impact)
	Measure relationships	Input to: • F3. % of managed land meeting prescribed fuel standards • G4. Residual risk (%)
Calculation	**Formula**	Denominator = Total area of jurisdiction Numerator = Area (ha) burnt by bushfire = Area (ha) burnt by bushfire / Total area of jurisdiction * 100
	Frequency	Annual Five year rolling average Five year rolling average accounts for variation in occurrence and extent of unplanned fire or bushfire.
Data elements	**Definition**	As per AFAC landscape fire performance measures
	Sources	Fire scar or perimeter mapping Data for this indicator are likely to be captured through agency fire and incident reporting processes
Benchmarking	Suitable for benchmarking at management unit scale	
Monitoring	Annually	
KPI reporting frequency	Annually	

Table 24 *Preliminary specification for short-listed Indicator H4.*

Name	H4. % of vegetation communities with tolerable fire regime	
Description	The percentage of area of defined vegetation communities that have a tolerable fire regime.	
Rationale	It is assumed that a tolerable fire regime will result in appropriate growth stage distribution that will promote the resilience of biodiversity. Improved biodiversity increases the resilience of ecosystems, which is an important objective of fire management.	
Success trend	Increase	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Intermediate outcome Relates to [31] on logic model
	Performance area	Ecological outcomes
	Measure relationships	Input from: Input from: • E3. Area (ha) treated with prescribed fire – mapped by vegetation type • G7. Area (ha) burnt by bushfire – mapped by vegetation type
Calculation	**Formula**	TBD
	Frequency	Annually
Data elements	**Definition**	Vegetation community classification schema needs to be determined for each jurisdiction Tolerable fire regime thresholds need to be established for each vegetation type – frequency, season, intensity etc.
	Sources	Fire scar or perimeter mapping Agency post-burn assessments
Benchmarking	Suitable for benchmarking at management unit, agency and jurisdiction scales	
Monitoring	Annually	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 25 *Preliminary specification for short-listed Indicator I1.*

Name	I1. Tonnes of CO_2 equivalent abated	
Description	The amount of GHG emissions abated through improved fire management practices expressed as tonnes of CO_2 equivalents abated.	
Rationale	In northern Australian savannas, fires late in the season tend to be more severe than those earlier in the season. More severe fires generate higher GHG emissions, thus an increase in early-season prescribed burning, and corresponding decrease in extent of more severe late-season bushfires, should result in reduced GHG emissions. Carbon accounting methodologies are established under GHG emission reduction schemes. Data for northern Australian savanna burning are captured and reported via these processes and could be utilised for prescribed burning performance measurement. GHG abatement benefit of prescribed burning is less clear in southern Australian forests, and this measure may currently be of less relevance. The TRG considered, however, that measuring and reporting of GHG impacts of prescribed burning in southern forests was likely to be required at some stage in the future.	
Success trend	Increase	
Reporting level	Jurisdiction	
Where it fits	**Program logic**	Condition and trend of an intermediate outcome Relates to [44] on logic model
	Performance area	GHG emission outcomes
	Measure relationships	N/A
Calculation	**Formula**	As per CFI accounting requirements
	Frequency	As per CFI accounting requirements
Data elements	**Definition**	As per CFI accounting requirements
	Sources	CFI reporting
Benchmarking	Suitable for benchmarking at management unit, agency or jurisdictional scales in comparable jurisdictions.	
Monitoring	TBD	
KPI reporting frequency	Annual	

Table 26 *Preliminary specification for short-listed Indicator J2.*

Name	J2. % of prescribed burns that escape	
Description	% of prescribed burns that escaped boundaries defined in the prescribed burn plan. Criteria for classification of an escape is >1ha burnt outside of planned perimeter and/ or additional resources required for control and/or damage is caused to life, property or environment.	
Rationale	Escaped burns can do significant damage to local communities and/or the environment. They can be high profile and bring into disrepute the agency(s) involved and the practice of prescribed burning. This measure enables agencies to identify failings in their burn planning or implementation.	
Success trend	Decrease	
Reporting level	Scalable: management unit – agency – jurisdiction	
Where it fits	**Program logic**	Quality of activity Relates to [34] on logic model
	Performance area	Adverse impacts
	Measure relationships	N/A
Calculation	**Formula**	Denominator = Total number of prescribed burns conducted Numerator = Number of prescribed burns that are classified as escapes = Number of prescribed burns that are classified as escapes / Total number of prescribed burns conducted * 100
	Frequency	Annually 5 year rolling average Previous 5 year rolling average allows annual engagement to be benchmarked against recent previous years to highlight any significant changes
Data elements	**Definition**	An escape is >1ha burnt outside of planned perimeter and/or additional resources required for control and/or damage is caused to life, property or environment.
	Sources	AIRS
Benchmarking	Suitable for benchmarking at management unit, agency or jurisdictional scales	
Monitoring	Real-time	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

Table 27 *Preliminary specification for short-listed Indicator J6.*

Name	J6. Number of days on which air quality threshold is exceeded due to prescribed burning.	
Description	The number of individual days the relevant air quality standard is exceeded each year. Exceedance may be due to cumulative effect of multiple prescribed burns over multiple days.	
Rationale	Prescribed burning can have a deleterious effect on air quality and contribute to adverse public health outcomes, even though by reducing the extent and severity of bushfires it should provide a net benefit in these matters. Smoke logging episodes are highly visible, can impact on many people and some horticultural activities, and are a ready focus for discontent with prescribed burning. Air quality is monitored and, in some cases regulated, by the relevant jurisdictional agency and data should be available for some locations.	
Success trend	Decrease	
Reporting level	Jurisdiction	
Where it fits	**Program logic**	Unwanted intermediate outcome Relates to [33] on logic model
	Performance area	Adverse impacts
	Measure relationships	N/A
Calculation	**Formula**	Count
	Frequency	Annually 5 year rolling average Previous 5 year rolling average allows annual engagement to be benchmarked against recent previous years to highlight any significant changes
Data elements	**Definition**	Number of days the relevant air quality standard is exceeded Standard may be PM_{10} concentration where monitored, visibility index or other measure as determined by the responsible authority
	Sources	Environment protection agency or equivalent
Benchmarking	Not suitable	
Monitoring	Real-time	
KPI reporting frequency	Annually	

7. DATA DICTIONARY

8. NEXT STEPS

The initial objective of the project was to find 2-3 KPIs suitable for implementation across all agencies. During the project, however, it became apparent that a broader balanced suite of indicators would be more useful. The relevancy and suitability of the KPIs themselves need to be monitored and reviewed over time.

Key elements needing further work include:

- Integrating the work on performance measurement with the *Objectives, Monitoring and Evaluation Framework for Prescribed Burning* (AFAC 2017b) developed concurrently by AFAC;
- Ensuring that selected indicators are relevant to the objectives of individual agencies;
- Further definition of the temporal and spatial boundaries of certain indicators;
- Further work on the KPI data dictionary to either match or identify gaps with data currently collected by agencies;
- Consideration of the resourcing requirements for implementing nationally;
- Development of an ongoing monitoring and review process to ensure KPIs in use retain relevancy, currency and achieve the intended outcomes;
- A process to improve or alter KPIs in response to emerging research; and
- A process to redefine KPIs in response to new information or changing government/community expectations.

Source: Department of National Parks, Sport and Racing, Queensland

9. CONCLUSION

Agency doctrine and relevant scientific literature were consulted to construct a high-level program logic for prescribed burning and identify current approaches to performance measurement, including the suite of indicators currently in use or that had been recommended for use.

Twenty-two indicators were selected by the TRG. They represent a balanced approach by measuring:

- Inputs;
- Activity;
- Outputs;
- Outcomes (particularly intermediate outcomes);
- Efficiency; and
- Cost-effectiveness.

The indicators have been grouped into the themes that relate to the program logic. The themes are:

- Financial;
- Program planning activities;
- Community understanding and support;
- Operational planning activities;
- Burn implementation;
- Fuel management outcomes;
- Risk reduction outcomes, including bushfire occurrence and impact;
- Ecological outcomes;
- Greenhouse gas abatement outcomes; and
- Adverse impacts.

It is not envisaged that agencies would elect to measure and report all indicators, rather they provide a toolbox from which an agency can pick indicators that reflect their burning program and meet the needs of their stakeholders.

An illustrative data dictionary is provided for the short-listed indicators, but it is recognised that detailed business rules require further input from agencies, and that the indicators are likely to be refined with use.

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Source: Adrian Pyrke, EcoLogical Australia

REFERENCES

AFAC (2007) A guide to performance measurement. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2010) Performance measurement for landscape fires: Project plan. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2012) Bushfire glossary. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2014) Review of best practice for prescribed burning: Report for National Burning Project: Sub-Project 4. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2015a) Overview of prescribed burning in Australasia: Report for National Burning Project: Sub-Project 1. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2015b) Risk management and review framework for prescribed burning risks associated with fuel hazards: Report for National Burning Project: Sub-Project 3. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2015c) Risk management framework - smoke hazard and greenhouse gas emissions. Report for National Burning Project: Sub-Project 3. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2015d) Landscape performance measures data dictionary. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2016a) National Burning Project request for quotation to undertake prescribed burning performance measures. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2016b) A risk framework for ecological risks associated with prescribed burning: Report for National Burning Project: Sub-Project 3. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2016c) A risk framework for operational risks associated with prescribed burning. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2016d) National guidelines for prescribed burning operations. Report for National Burning Project: Sub-Project 4. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2017a) National guidelines for prescribed burning strategic and program planning. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2017b) *Objectives, Monitoring and Evaluation Framework for Prescribed Burning*: Report for National Burning Project. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AGV (2003) Fire prevention and preparedness. Auditor General Victoria. (Melbourne, Victoria)

Attorney General's Department (2015) National emergency risk assessment guidelines. Australian emergency management handbook series 10. Attorney General's Department. (Canberra, ACT)

Barr S (2016) FFMG results map version 3 with draft measures. Draft performance measurement framework. Forest Fire Management Group. (Canberra, ACT)

REFERENCES

Bradstock RA, Cary GJ, Davies I, Lindenmayer DB, Price OF, Williams RJ (2012) Wildfires, fuel treatment and risk mitigation in Australian eucalypt forests: Insights from landscape-scale simulation. Journal *of Environmental Management* **105**, pp.66-75.

Cawson J, Muir A (2008) Flora monitoring protocols for planned burning: A users guide. Fire and Adaptive Management Report 74. Department of Sustainability and Environment. (Melbourne, Victoria)

Commonwealth of Australia (2009) NRM MERI framework: Australian Government natural resources management monitoring, evaluation, reporting and improvement framework. Department of Environment, Water, Heritage and the Arts and the Department of Agriculture, Fisheries and Forestry. (Canberra, ACT)

DELWP (2015) Monitoring, evaluation and reporting framework for bushfire management on public land. Department of Environment, Land, Water and Planning. (Melbourne, Victoria)

DELWP (2016) Department of Environment, Land, Water and Planning annual report 2016. Department of Environment, Land, Water and Planning. (Melbourne, Victoria)

DEWNR (2015) Department of Environment, Water and Natural Resources annual report 2014-15. Department of Environment, Water and Natural Resources. (Adelaide, South Australia)

DNPRSR (2012) Planned burn guidelines: Mitchell Grass Downs bioregion of Queensland. Department of National Parks, Recreation, Sport and Racing. (Brisbane, Queensland)

DNPRSR (2016) Department of National Parks, Sport and Racing Annual Report 2015-2016. Department of National Parks, Sport and Racing. (Brisbane, Queensland)

DNREA and Bushfires NT (no date) Landscape fire performance measures. Unpublished presentation. Department of Natural Resources, Environment and the Arts and Bushfires NT. (Darwin, NT)

Doran GT (1981) There's a S.M.A.R.T. way to write management's goals and objectives. *Management Review* **70** pp 35-36.

DPIPWE (2016) Department of Primary Industries, Parks, Water and Environment annual report 2016. Department of Primary Industries, Parks, Water and Environment. (Hobart, Tasmania)

DPW (2016) Department of Parks and Wildlife 2016-16 annual report. Department of Parks and Wildlife. (Perth, Western Australia)

DSE (2012) Planned burning regional key performance indicators: Draft. Department of Sustainability and Environment. (Melbourne, Victoria)

Ellis S, Kanowski P, Whelan R (2004) National inquiry on bushfire mitigation and management. Council of Australian Governments. (Canberra, ACT)

ENRC (2008) Inquiry into impact of public land fire management practices on bushfires in Victoria. Environment and Natural Resources Committee, Parliament of Victoria. (Melbourne, Victoria)

ESA (2014) The ACT strategic bushfire management plan 2014-2019. Emergency Services Agency. (Canberra, ACT)

Esplin B, Gill M, Enright N (2003) Report of the inquiry into the 2002-2003 Victorian bushfires. Department of Premier and Cabinet. (East Melbourne, Victoria)

REFERENCES

FCNSW (2016) Forestry Corporation of NSW annual report 2015-16. Forestry Corporation NSW. (Sydney, NSW)

FEWG (2004) Guidelines and procedures for ecological burning on public land in Victoria 2004. Fire Ecology Working Group, Department of Sustainability and Environment. (Melbourne, Victoria)

FFMG (2014) National bushfire management policy statement for forests and rangelands. Forest Fire Management Group for Council of Australian Governments. (Canberra, ACT)

Forestry Tasmania (2016) Forestry Tasmania annual report 2015/16. Forestry Tasmania. (Hobart, Tasmania)

Gibson F, Pannell D (2014) Integrated economic assessment of fire risk management strategies; Case studies in central Otago, New Zealand and Mount Lofty region, South Australia. Bushfire CRC. (East Melbourne, Victoria)

Gill M (2008) Underpinnings of fire management for biodiversity conservation in reserves. Fire and Adaptive Management Report 73. Department of Sustainability and Environment. (Melbourne, Victoria)

Gill AM, Christian KR, Moore PHR, Forrester RI (1987) Bushfire incidence, fuel hazard and fuel reduction burning. *Australian Journal of Ecology* **12** pp.299-306.

Government of South Australia (2009) Code of practice for fire management on public land in South Australia 2012-2016. Department of Environment, Water and Natural Resources, Country Fire Service, SA Water and Forestry SA. (Adelaide, South Australia)

Hubbard (2004) 'Strategic management: Thinking, analysis and action.' (Pearson Education Australia, Forest Hill, Victoria)

KPI Institute (online) Characteristics of good KPIs. Available at https://smartkpis.kpiinstitute.org/kpi-101/characteristics-of-good-kpis

Lecy JD, Beatty, KE (2012) Representative literature reviews using constrained snowball sampling and citation network analysis. Available at SSRN: https://ssrn.com/abstract=1992601 or http://dx.doi.org/10.2139/ssrn.1992601

Leeson P (2011) Possible fire management performance indicators for land management agencies: Defining the 5% challenge and are there better options? *AFAC and Bushfire CRC Conference 2011*. (Darling Harbour, NSW)

Marsden-Smedley JB, Sheriff LJ (2013) Planned burning manual: Guidelines to enable safe and effective planned burning on private land. NRM North. (Launceston, Tasmania)

McCarthy M (2012) Review of resilience concepts and their measurement for fire management. Fire and Adaptive Management Report 90. Department of Sustainability and Environment. (Melbourne, Victoria)

MPIGA and NFISC (2013) Australia's state of the forests report 2013. Montreal Process Implementation Group for Australia and the National Forest Inventory Steering Committee. (Canberra, ACT)

NSW NPWS, FCNSW and PCS (no date) Priority performance measures for NSW NPWS, FCNSW and ACT P&CS fire management activities (version 3). New South Wales National Parks and Wildlife Service, Forestry Corporation NSW and ACT Parks and Conservation Service. (Sydney, NSW)

OAGBC (2010) Guide for developing relevant key performance indicators for public sector reporting. Office of the Auditor General of British Columbia. (Victoria, British Columbia Canada)

OEH (2015) Fire management manual 2015-2016. Office of Environment and Heritage. (Sydney South, NSW)

OEH (2016) Office of Environment and Heritage annual report 2015-16. (Sydney, NSW)

REFERENCES

Owen J (2006) 'Program evaluation: Forms and approaches.' (Allen and Unwin, Crows Nest, NSW)

Price O, Bradstock R (2012) The efficacy of fuel treatments in mitigating property loss during wildfires. *Journal of Environmental Management* **113** pp.146-157.

Price O, Bradstock R (2013) Landscape scale influences of forest area and housing density on house loss in the 2009 Victorian bushfires. *PLOS One* **8(8)** pp. 1-6.

Productivity Commission (2017a) Report on government services – Volume A: Approach to performance reporting. Productivity Commission. (Canberra, ACT)

Productivity Commission (2017b) Report on government services – Volume D: Emergency management. Productivity Commission. (Canberra, ACT)

PV (2016) Parks Victoria annual report 2015-16. Parks Victoria. (Melbourne, Victoria)

RFS (2016) NSW RFS annual report 2015/16. NSW Rural Fire Service. (Lidcombe, NSW)

Rozner S (2013) Developing key performance indicators – a toolkit for health sector managers. United States Agency for International Development. (Bethesda, Maryland USA)

Russell-Smith J, Cook G, Cooke P, Edwards A, Lendrum M, Meyer, C, Whitehead P (2013) Managing fire regimes in north Australian savannas: applying Aboriginal approaches to contemporary global problems. *Frontiers in Ecology and the Environment* **11** pp.55-63.

Russell-Smith J, Yates C, Evans J, Desailly M (2014) Developing a savanna burning emissions abatement methodology for tussock grasslands in high rainfall regions of northern Australia. *Tropical Grasslands – Forrajes Tropicales* **2** pp.175-187.

SFC (2016) State Fire Commission annual report 2015-16. State Fire Commission. (Hobart, Tasmania)

Standards Australia (2009) Construction of buildings in bushfire-prone area, AS 3959:2009, Standards Australia

State of Victoria (2015) Safer together- a new approach to reducing the risk of bushfire in Victoria: The government response to the review of performance targets for bushfire fuel management on public land. Department of Environment, Land, Water and Planning. (Melbourne, Victoria)

Teague B, McLeod R, Pascoe S (2010) 2009 Victorian Bushfires Royal Commission final report volume II part two: Fire preparation, response and recovery. 2009 Victorian Bushfires Royal Commission. (Melbourne, Victoria)

United Nations (1998) Kyoto Protocol to the United Nations Framework Convention on Climate Change. United Nations. (New York, New York USA)

van der Werf G, Randerson J, Giglio L, Collatz, G, Mu M, Kasibhatla, P, Morton D, DeFries R, Jin Y, van Leeuwen T (2010) Global fire emissions and the contribution of deforestation, savanna, forest, agricultural and peat fires (1997-2009). *Atmospheric Chemistry and Physics* **10** pp. 11707-11735.

Whight (2016) Fuel Reduction Unit business plan 2016-2017. Tasmania Fire Service. (Hobart, Tasmania)

Whitehead P, Purdon P, Cooke P, Russell-Smith J, Sutton S (2009) The West Arnhem Land fire abatement (WALFA) project: The institutional environment and its implications. In 'Culture, ecology and economy of fire management in north Australian savanna: Rekindling the Wurrk tradition'. (Eds J Russell-Smith, P Whitehead and P Cook) pp287-312. (CSIRO Publishing, Collingwood, Victoria)

WK Kellogg Foundation (2004) Logic model development guide. WK Kellogg Foundation. (Battle Creek, Michigan USA)

Consulted in literature search but not cited

Ackland A, Blackett A, Norris J, Salkin O, Friend G, Fogarty L (2014) Development of the Victorian bushfire risk profiles and the concept of residual risk. *AFAC 14 After disaster strikes learning from adversity*. 2-5 September 2014. (Wellington, New Zealand)

AFAC (2010) Landscape fire performance measure business rules. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

AFAC (2013) Strategic directions for fire and emergency services in Australia and New Zealand. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

Bagdon B, Huang C (2016) Review of economic benefits from fuel reduction treatments in the fire prone forests of the southwestern United States. Southwest Fire Science Consortium. (Flagstaff, Arizona USA)

Beattie P, Annett S (2012) Department of Sustainability and Environment activity planning and output assessment standards: Draft scoping report. RMCG. (Bendigo, Victoria)

Bell T (2016) Optimisation of fuel reduction burning regimes for fuel reduction, carbon, water and vegetation outcomes: Annual project report 2015-2016. University of Sydney and Bushfire and Natural Hazards CRC. (Sydney, NSW)

Bennettton J, Cashin P, Jones D, Soligo J (1997) An economic evaluation of bushfire prevention and suppression in Victoria. Department of Natural Resources and Environment. (Melbourne, Victoria)

Boer M. Sadler R, Wittkuhn RS, McCaw L, Grierson P (2009) Long-term impacts of prescribed burning on regional extent and incidence of wildfires: Evidence from 50 years of active fire management in SW Australian forests. *Forest Ecology and Management* **259**, pp.132-142.

Bull H (2011) Fire ecology: Guide to environmentally sustainable bushfire management in rural Victoria. Country Fire Authority. (East Burwood, Victoria)

Cawson J, Muir A (2008) Flora monitoring protocols for planned burning: A rationale report. Fire and Adaptive Management Report 75. Department of Sustainability and Environment. (Melbourne, Victoria)

CFA (2014) SOP 9.39 Planning and conducting a planned burn or burn off (version 3). Country Fire Authority. (East Burwood, Victoria)

CFA (2016) CFA Annual report 2015-16. Country Fire Authority. (East Burwood, Victoria)

CFA (2017) Burn plan template (version 2.0). Country Fire Authority. (East Burwood, Victoria)

CFS (2015) SA Country Fire Service annual report 2015. Country Fire Service. (Adelaide, South Australia)

Cooper C (2016) Lancefield-Cobaw fire – October 2015: Report of community observations and response to independent investigation auxiliary report. Emergency Management Victoria. (Melbourne, Victoria)

DELWP (2015) Measuring bushfire risk in Victoria. Department of Environment, Land, Water and Planning. (Melbourne, Victoria)

DELWP (2015) Response to the recommendations of the independent investigation into the Lancefield-Cobaw fire. Department of Environment, Land, Water and Planning. (Melbourne, Victoria)

REFERENCES

DELWP (2016) East central bushfire risk landscape FOP statement: Fire operation plan (FOP) 2016/17-2018/19. Department of Environment, Land, Water and Planning. (Melbourne, Victoria)

DENR (2011) Fire policy and procedure manual 2011. Department of Environment and Natural Resources. (Adelaide, South Australia)

DENR (2011) Operational prescriptions field guide: Prescribed burning in South Australia. Department of Environment and Natural Resources. (Adelaide, South Australia)

DENR (2013) Ecological fire management guidelines for native vegetation in South Australia. Department of Environment, Water and Natural Resources. (Adelaide, South Australia)

DEPI (2013) Victorian bushfire risk profiles: A foundational framework for strategic bushfire risk assessment. Department of Environment and Primary Industries. (Melbourne, Victoria)

DEPI (2014) Overview of fuel management report 2013-14. Department of Environment and Primary Industries. (Melbourne, Victoria)

DEWNR (2013) Ecological fire management guidelines for native vegetation in South Australia. Department of Environment, Water and Natural Resources. (Adelaide, South Australia)

DFES (2016) Department of Fire and Emergency Services annual report 2015/16. Department of Fire and Emergency Services. (Perth, Western Australia)

DLRM (2016) Department of Land Resource Management 2015-16 annual report. Department of Land Resource Management. (Darwin, Northern Territory)

DNP (2016) Director of National Parks annual report 2016-16. Director of National Parks. (Canberra, ACT)

DNPSR (2015) Information sheet: Natural resource management: fire management mission statement. Department of National Parks, Sport and Racing. (Brisbane, Queensland)

DNPSR (2015) Operational policy: Natural resource management: QPWS fire management. Department of National Parks, Sport and Racing. (Brisbane, Queensland)

DSE (2012) Code of practice for bushfire management on public land. Department of Sustainability and Environment. (Melbourne, Victoria)

Dyer R, Jacklyn P, Partridge I, Russell-Smith J, Williams D (Eds) (2001) 'Savanna burning: Understanding and using fire in northern Australia' (Tropical Savannas CRC, Darwin, Northern Territory)

Edwards, J, Boura J, Esnouf G (2006) An approach to measuring CFA services. Country Fire Authority. (East Burwood, Victoria)

Edwards J, Ellis S (2016) Item for decision: Measures of achievement – strategic directions for fire and emergency services. Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

Emergency Services Commissioner (2005) Examination of prescribed burning practices. Office of the Emergency Services Commissioner. (Melbourne, Victoria)

EMV (2016) Emergency management performance standards. Emergency Management Victoria. (Melbourne, Victoria)

ESA (2009) Strategic bushfire management plan for the ACT: Factors contributing to bushfire risk. Emergency Services Agency. (Canberra, ACT)

REFERENCES

ESA (2014) ACT bushfire management standards. Emergency Services Agency. (Canberra, ACT)

Esnouf G (2004) Developing a broader suite of performance indicators for fire service response. Country Fire Authority. (East Burwood, Victoria)

FC NSW (2015) Forestry Corporation NSW fire management doctrine (draft). Forestry Corporation NSW. (Sydney, NSW)

FFMG (2013) Implementation plan (as at May 2013): National bushfire management policy statement for forests and rangelands. Forest Fire Management Group. (Canberra, ACT)

FFMG (2013) Item for decision: National KPI project. Forest Fire Management Group. (Canberra, ACT)

FFMG (no date) Fire reporting for Australia's state of the forests report 2018. Forest Fire Management Group. (Canberra, ACT)

FFMC (2016) Performance evaluation procedure. Forest Fire Management Victoria. (Melbourne, Victoria)

Fischer AP, Charnley S (2012) Risk and cooperation: Managing hazardous fuel in mixed ownership landscapes. *Environmental Management* **49** pp.1192-1207.

Forestry Tasmania (2005) Low intensity prescribed burning. Forestry Tasmania. (Hobart, Tasmania)

Forestry Tasmania (2014) Northern region tactical fire management plan. Forestry Tasmania. (Hobart, Tasmania)

Forestry Tasmania (2016) Forestry Tasmania strategic fire management plan. Forestry Tasmania. (Hobart, Tasmania)

Forestry Tasmania (2016) Fuel reduction burn forest operation plan. (Hobart, Tasmania)

Forestry Tasmania (2016) Regeneration burn forest operation plan. (Hobart, Tasmania)

Forestry Tasmania (2016) Regeneration burning manual. (Hobart, Tasmania)

FRNSW (2016) Fire & rescue NSW annual report 2015/16. Fire and Rescue NSW. (Sydney, New South Wales)

Gibson F, Pannell D (2014) Making strategic choices: What fire risk strategies provide the best value for money? *Fire Note* **124** Bushfire CRC. (East Melbourne, Victoria)

Government of South Australia (2009) Prescribed burning code of practice. Country Fire Service, Department of Environment and Heritage, Forestry SA and SA Water. (Adelaide, South Australia)

Government of South Australia (2017) Code of practice for fire management in South Australia 2017. Department of Environment, Water and Natural Resources, Country Fire Service, SA Water and Forestry SA. (Adelaide, South Australia)

Hockings M, Stolton S, Leverington F, Dudley N, Courrau J (2006) Evaluating effectiveness: A framework for assessing management effectiveness of protected areas. Best practice protected area guidelines series. The World Conservation Union. (Gland, Switzerland)

Holt L (2009) Understanding program logic. Unpublished presentation. Department of Human Services. (Melbourne, Victoria)

Hyde M (2013) 2013 Tasmanian bushfires inquiry volume one. 2013 Tasmanian Bushfires Inquiry. (Hobart, Tasmania)

IGEM (2015) Monitoring and assurance framework for emergency management. Inspector General for Emergency Management, Department of Justice and Regulation. (Melbourne, Victoria)

REFERENCES

ILCFIT (2015) Independent investigation of the Lancefield-Cobaw fire. Independent Lancefield-Cobaw Fire Investigation Team. (Melbourne, Victoria)

ILCFIT (2015) Lancefield-Cobaw fire investigation: Issues not within terms of reference. Independent Lancefield-Cobaw Fire Investigation Team. (Melbourne, Victoria)

JCSD (2016) Justice and Community Safety Directorate annual report 2015-16. Justice and Community Safety Directorate. (Canberra, ACT)

Kington W, Sparkes D (2017) National position on prescribed burning. *Fire Australia* **1**, pp38-40.

Kington W (2016) Fire management objectives and monitoring framework (version 0.3). Australasian Fire and Emergency Service Authorities Council. (East Melbourne, Victoria)

Kloot L (2009) Performance measurement and accountability in an Australian fire service. *International Journal of Public Sector Management* **22**, pp.128-145.

Lane P (2007) Literature review of wild and prescribed fire impact on water quality and yield- draft. School of Forest and Ecosystem Science, the University of Melbourne. (Melbourne, Victoria)

Marsden-Smedley JB (2009) Planned burning in Tasmania 2009: Operational guidelines and review of current knowledge. Fire Management Section, Parks and Wildlife Service, Department of Primary Industries, Parks, Water and the Environment. (Hobart, Tasmania)

Marsden-Smedley JB (2011) Planned burning in Tasmania: A review of current practice and supporting information. *Tasforests* **19**, pp.86-108.

Martinson EJ, Omi PN (2003) Performance of fuel treatments subjected to wildfires. *USDA Forest Service Proceedings* **RMRS-P-29**, pp.7-14.

Meredith C (1997) Best practice in performance reporting in natural resource management. Department of Natural Resources and Environment. (Melbourne, Victoria)

Miller SI, Carter W, Stephens RG (1984) Report of the Bushfire Review Committee on bushfire disaster preparedness and response in Victoria, Australia, following the Ash Wednesday fires 16 February 1983. Bushfire Review Committee. (Melbourne, Victoria)

Morley J (2015) Independent investigation into the conduct of the approvals and oversight process relating to the Lancefield-Cobaw planned burn. Wise Workplace Solutions. (Carlton, Victoria)

NTPFES (2016) Northern Territory Police, Fire and Emergency Services 2015-2016 annual report. Northern Territory Police, Fire and Emergency Services. (Darwin, Northern Territory)

NZFS (2016) New Zealand Fire Service annual report for the year ended 30 June 2016. New Zealand Fire Service. (Wellington, New Zealand)

Productivity Commission (no date) Proposed framework for reporting on 'what works' to improve service outcomes. Unpublished report. Productivity Commission. (Canberra, ACT)

PWS (2015) Planned burn policy and procedures. Parks and Wildlife Service, Department of Primary Industries, Parks, Water and the Environment. (Hobart, Tasmania)

PWS (2016) Fuel reduction program: Business plan (version 7a). Parks and Wildlife Service, Department of Primary Industries, Parks, Water and the Environment. (Hobart, Tasmania)

REFERENCES

RFS (2009) P-SOP#1 Prescribed burning activities – general (version 1.4). NSW Rural Fire Service. (Lidcombe, NSW)

SFMC (2012) State vegetation fire management policy. State Fire Management Council. (Hobart, Tasmania)

SFMC (2012) Burning in Tasmania: A new approach to reducing our statewide relative risk. State Fire Management Council. (Hobart, Tasmania)

Slijepcevic A (2013) Planned burning capability and capacity building – public land: Implementation plan. Country Fire Authority. (East Burwood, Victoria)

Smith (no date) Prescribed fire use, the legislative and policy conundrum. Unpublished presentation. Fire and Emergency Services Authority (Perth, Western Australia)

State of Victoria (2008) Victorian Government's response to the Environment and Natural Resources Committee's inquiry into the impact of public land management practices on bushfire in Victoria. Department of Premier and Cabinet. (Melbourne, Victoria)

Stephenson C (2010) The impacts, losses and benefits sustained from five severe bushfires in south-eastern Australia. Fire and Adaptive Management Report 88. Department of Sustainability and Environment. (Melbourne, Victoria)

TFS (2016) TFS fuel reduction burning policy. Tasmania Fire Service. (Hobart, Tasmania)

Tolhurst KG, Flinn DW, Loyn RH, Wilson AAG, Foletta I (1992) Ecological effects of fuel reduction burning in a dry sclerophyll forest: A summary of principal research findings and their management implications. Forest Research Centre, Department of Conservation and Environment. (East Melbourne, Victoria)

Toogood Z (2013) Increased planned burning participation of CFA personnel: A review of the issues and opportunities. Country Fire Authority (East Burwood, Victoria)

Whight S (2016) Trials, tribulations and triumph: Lessons learnt from tenure-blind fuel reduction in Tasmania in 'The 5th Fire Behaviour and Fuels Conference – Melbourne: Proceedings' (International Association of Wildland Fire and Bushfire and Natural Hazards CRC: Melbourne, Victoria)

GLOSSARY AND ACRONYMS

This appendix provides a glossary of terms and the authority for each definition. It also defines a list of acronyms used in the report.

Acronyms

AFAC Australasian Fire and Emergency Service Authorities Council Ltd
APZ Asset protection zone
CFI Carbon farming initiative
FDR Fire danger rating
FFDI Forest fire danger index
FFMG Forest fire danger index
GHG Green-house gas
KPI Key performance indicator
LMZ Land management zone
PM Particulate matter
RoGS Productivity Commission Report on Government Services

Glossary

[1] *Source: Productivity Commission (2017) Report on government services*

[2] *Source: AFAC (2007) A guide to performance measurement*

[3] *Source: AFAC (2012) Bushfire glossary*

[4] *Source: Attorney General's Department (2015) National emergency risk assessment guidelines*

[5] *Source: WK Kellogg Foundation (2004) Logic model development guide*

[6] *Source: FFMG (2014) National bushfire management policy statement for forests and rangelands*

[7] *Source: AFAC (2015d) Data dictionary landscape fire performance measures*

Access [1]
Measures how easily the community can obtain a delivered service (output).

Activities [5]
The processes, tools, events, technology and actions that are an intentional part of the program implementation.

Appropriateness [1 2]
Measures how well services meet client needs and also seeks to identify the extent of any underservicing and over servicing.

Assets [6]
Anything valued by people which includes houses, crops, forests and, in many cases, the environment.

Available fuel [3]
The portion of the total fuel that would actually burn under various environmental conditions.

Benchmark [7]
The ratio of a measure calculated by dividing the amount by a selected denominator that allows for meaningful comparisons between sets of data.

Bark fuel [3]
The flammable bark on tree trunks and upper branches.

Broad area hazard reduction [3]
Large scale removal of selected fuel before the onset of a bushfire danger period.

Burning program [3]
A program of prescribed burns scheduled for a designated area over a nominated time, normally looking ahead over one fire season (for the coming spring to the following autumn), but can also look ahead five years or more.

Burning unit [3]
A specified land area for which prescribed burning is planned.

Burn plan [3]
The plan which is approved for the conduct of prescribed burning. It contains a map identifying the area to be burnt and incorporates the specifications and conditions under which the operation is to be conducted.

Bushfire [3 6]
Unplanned vegetation fire. A generic term which includes grass fires, forest fires and scrub fires both with and without a suppression objective.

Bushfire management [3 6]
All those activities directed to prevention, detection, damage mitigation, and suppression of bushfires. Includes bushfire legislation, policy, administration, law enforcement, community education, training of firefighters, planning, communications systems, equipment, research, and the multitude of field operations undertaken by land managers and emergency services personnel relating to bushfire control.

Cost effectiveness [1]
Measures how well inputs are converted into outcomes for the community. Expressed as a ration of inputs to outcomes.

Ecological burning [3]
A form of prescribed burning. Treatment with fire of vegetation in nominated areas to achieve specified ecological objectives.

Ecosystem services [6]
The functioning of natural ecosystems provides services essential too human survival and well-being. Natural ecosystems maintain the atmosphere; provide clean water; control soil erosion, pollution and pests; pollinate plants; and provide many other essential processes. The language of ecosystem services has emerged in recent decades as a way of representing the significance of the benefits humans derive from natural systems.

Effectiveness [1]
Reflects how well the outputs of a service achieve the stated objectives of that service.

Efficiency [1]
Reflects how resources (inputs) are used to produce outputs and outcomes, expressed as a ratio of outputs to inputs (technical efficiency), or inputs to outcomes (cost effectiveness).

Equity of access [1]
Relates to all Australians having adequate access to services, where the term adequate may mean different rates of access for different groups in the community.

FDI (Fire Danger Index) [3]
A relative number denoting the potential rates of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed.

GLOSSARY AND ACRONYMS

FDR (Fire Danger Rating) [3]
A relative class denoting the potential rates of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed, indicating the relative evaluation of fire danger.

Final outcomes [2]
Are generally the result of multiple contributions including the whole of government, industry and the community.

Fire ecology [3]
The study of the relationships between fire, the physical environment and living organisms.

Fire frequency [3]
A general term referring to the recurrence of fire in a given area over time.

Fire hazard [3]
A fuel complex, defined by volume, type condition, arrangement, and location that determines the degree of ease of ignition and of resistance to control.

Fire management [3 6]
All activities associated with the management of fire prone land, including the use of fire to meet land management goals and objectives.

Fire regime [3 6]
The history of fire in a particular vegetation type or area including the frequency, intensity and season of burning. It may also include proposals for the use of fire in a given area.

Fire scar [3]
A mark left on a landscape by fire.

Fire simulator [3]
A device that imposes simulated fire and smoke on a projected landscape scene, for the purpose of informing fire suppression personnel of potential situations either for an actual or hypothetical fire(s).

Fire threat [3]
The impact a fire will have on the community.

Fuel [3]
Any material such as grass, leaf litter and live vegetation which can be ignited and sustains a fire. Fuel is usually measured in tonnes per hectare.

Fuel age [3]
The period of time lapsed since the fuel was last burnt.

Fuel arrangement [3]
A general term referring to the spatial distribution and orientation of fuel particles or pieces.

Fuel assessment [3]
The estimation or calculation of total and available fuel present in a given area.

Fuel load [3]
The oven dry weight of fuel per unit area. Commonly expressed as tonnes per hectare.

Fuel management [3]
Modification of fuels by prescribed burning, or other means.

Fuel reduction burning [3]
The planned application of fire to reduce hazardous fuel quantities; undertaken in prescribed environmental conditions within defined boundaries.

Goal [2]
A succinct statement of what is to be achieved.

Habitat [3]
The local environment in which an animal or plant lives.

Hazard [3 4 6]
A source of potential harm or a situation with a potential to cause loss. A potential or existing condition that may cause harm to people, damage to property or the environment. A source of risk.

Indicator [2 7]
A statistic used to assess relative position of a measure against a reference point.
A measurable variable that can be used to determine the degree of adherence to a standard or the level of quality achieved.

Intermediate outcomes [2]
Are those closely linked to the logic behind the risk treatments delivered by agencies. Some intermediate outcomes are shared with partner agencies including other fire and emergency services and local government.

Inputs [1]
The resources (including land, labour and capital) used by a service area in providing the service.

Measure [2 7]
The quantifiable amount of an item that has occurred or has been observed and recorded over a defined period.

Monitoring [4]
Continual checking, supervising, critically observing or determining the status to identify change from the performance level required or expected. Monitoring can be applied to a risk management framework, risk management process, risk or control.

Mosaic [6]
Used in reference to the spatial arrangement of burnt and unburnt fuels at either a local or a landscape scale.

Objective [2]
Specific, measurable, achievable, realistic and time-based milestones that need to be achieved to realise a Goal. There is a close relationship between objectives and outcomes.

Outcome [1 2]
The results, impacts or consequences of actions taken (products or services delivered) on the status of an individual or a group and on the success in achieving its objectives. Outcomes may be short term (intermediate) or longer term (final). A service provider can influence an outcome but external factors can also apply.

Output [1 2]
The service delivered by a service area, for example a completed episode of care is an output of a public hospital. Goods produced or services provided by or on behalf of an agency for individuals or external organisations.

Performance measure [7]
The collective term inclusive of the components that include measures, benchmarks and indicators.

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Prescribed burning [3 6]
The controlled application of fire under specified environmental conditions to a predetermined area and at a time, intensity and rate of spread required to attain planned resource management objectives.

Prescribed fire [3]
Any fire ignited by management actions to meet specific objectives. A written, approved burn plan must exist, and approving agency requirements (where applicable) must be met, prior to ignition.

Prescription [3]
A written statement defining the objectives to be attained during prescribed burning.

Process [1]
Refers to the way in which a service is produced or delivered (i.e. how inputs are transformed into outputs).

Program effectiveness [1]
Reflects how well the outcomes of a service achieve the stated objectives of that service.

Regeneration burn [3]
A burn lit under prescribed conditions for the purpose of achieving regeneration of a particular vegetation type.

Quality [1]
Reflects the extent to which a service is suited to its purpose and conforms to specifications.

Rate of spread [3]
The speed with which a head fire moves in a horizontal direction across the landscape.

Residual risk [4]
Risk remaining after risk treatment. Residual risk can contain unidentified risk.

Risk [4]
The effect of uncertainty on objectives. An effect is a deviation from the expected. Objectives can have different aspects and can apply at different levels. Risk is often characterised by reference to potential events and consequences, or a combination of these. Risk is often expressed in terms of a combination of the consequences of an event and the associated likelihood of occurrence

Risk assessment [4]
Overall process of risk identification, risk analysis and risk evaluation.

Smoke management [3]
Used by land managers and meteorologists planning a prescribed burn, to ensure that smoke does not cause problems downwind of the burn.

Spotting [3]
Behaviour of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.

Vulnerability [4]
The extent to which a community, structure, service or geographic area is likely to be damaged or disrupted by the impact of a particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster-prone area.

APPENDIX A: AGENCY QUESTIONNAIRE

1. **Does your agency conduct a prescribed burning program?**

   (yes/no)

2. **Does your agency have any of the following?**

   (please check all relevant options):

- A prescribed burning policy or similar that details goals or high level outcomes being sought from prescribed burning?
- A prescribed burning strategic plan or similar that details objectives, performance measures and targets for the burning program?
- A prescribed burning manual, SOP or similar that details data to be collected about the implementation and results of each prescribed burn?
- A document that clarifies what prescribed burning is intended to achieve and what it does to get results? This may take the form of program logic or theory that articulates what your agency is trying to achieve through prescribed burning.
- An evaluation of your prescribed burning program that could inform the development of performance measures?
- None of the above.
- Other (please specify).

   (if you answered yes to any of the above please upload all relevant documents)

3. **Does your agency collect and report data on prescribed burning implementation and/or effectiveness?**

   (yes/no)

4. **Does your agency measure and report prescribed burning performance for any of the following purposes?**

   (please check all relevant options):

- Planning your agency's burn program?
- Reporting to agency or jurisdictional oversight, e.g. Board, Minister or State/Territory government
- Report to Federal government, e.g. Productivity Commission Report on Government Services?
- Gauging agency performance and annual reporting?
- Testing objectives?
- Research?
- None of the above.
- Other (please specify).

   (please upload a copy of all relevant documents)

5. **Please outline performance measures and indicators you use (or upload an explanatory document). These may be measures of inputs, activity, outputs or outcomes. Please include in your answer:**

- The performance measure (what is being measures).
- The KPI (how the measure is expressed).
- The frequency of measurement.
- Anything else you think is relevant.

6. **Does your agency have a data dictionary or similar that details the business rules for calculating the KPIs?**

   (Yes/no/don't know)

   (If yes please upload a copy of the document)

7. **What does your agency (or the section of the agency you represent) hope to get out of a voluntary national performance measurement framework for prescribed burning?**

8. **How could a consistent national performance measurement framework assist the work of the agency you work for, and what benefits do you think may accrue at jurisdictional or national levels?**

9. **What risks could arise for your agency from a national performance measurement framework, and how could these be avoided or minimised?**

10. **Have we missed something? Is there any other information you think would help inform the development of a prescribed burn performance measurement framework?**

    (Please upload additional files)

APPENDIX B: AGENCY QUESTIONNAIRE RESULTS

The total number of surveys received was 13, however two of these were incomplete and are not included in the analysis below. Neither ACT nor NT provided a completed response.

All respondents stated their agency conduct a prescribed burn program, which was supported by policy, strategy or procedure documents. The number of respondents whose agency has these type of documents is shown in **Table 28.** Respondents were asked to attach all relevant documents to the survey. All documents received were reviewed for the project.

Table 28 *The number of respondents whose agency has policy, strategy or procedure documents to support the planned burn program.*

Question	No. of yes
A prescribed burning policy or similar that details goals or high level outcomes being sought from prescribed burning.	11
A prescribed burning strategic plan or similar that details objectives, performance measures and targets for the burning program.	9
A prescribed burning manual, SOP or similar that details data to be collected about the implementation and results of each prescribed burn?	9
A document that clarifies what prescribed burning is intended to achieve and what it does to get results? This may take the form of program logic or theory that articulates what your agency is trying to achieve through prescribed burning.	6
An evaluation of your prescribed burning program that could inform the development of performance measures.	6
None of the above.	0
Other (please specify): - Annual Operational Plans	2

APPENDIX B AGENCY QUESTIONNAIRE RESULTS

All but one of the respondents stated that their agency collects and reports on prescribed burning implementation and/or effectiveness. The ways in which this information is collected and reported is shown in **Table 29**.

Table 29 *Ways in which agencies measure and report on prescribed burning performance.*

Question	No. of yes
Planning your agency's burn program.	8
Reporting to agency or jurisdictional oversight, e.g. Board, Minister or State/Territory government.	10
Reporting to federal government, e.g. *Productivity Commission Report on Government Services.*	3
Gauging agency performance and annual reporting.	10
Testing objectives.	2
Research.	3
None of the above.	0
Other (please specify): Individual burns are assessed against measurable objectives and recorded as part of the burn report. No report but, information reviewed as data for scale and prioritising of burn activity (burn program), burn activity tracked as data and charts, and minimal key performance measures reported to Government as Service Delivery Standards including 2 fire measures - 5% burn coverage and % of protection burning activity achieved. Annual Report on Planned Burning. Ministerial correspondence whilst Parliament is sitting on planned burning progress. Inspector General of Emergency Management – reporting of planned burn escapes and investigating them. Research program.	2

Only two respondents stated that their agency had a data dictionary or similar that details the business rules for calculating KPIs. The others either said no, or that they were unsure.

APPENDIX B AGENCY QUESTIONNAIRE RESULTS

Respondents were asked what their agency (or section of their agency) hoped to get out of the voluntary national performance measurement framework for prescribed burning. The following responses were given:

- State based performance target;
- KPIs for Prescribed Burning for country area of Victoria;
- Realisation of capacity and resource requirements;
- Minimum capability level requirement;
- Demonstration that the agency will be working at the standard of a National best practice;
- Consistency of reporting amongst agencies at both the State and National level;
- A set of KPIs that are relevant and can be compared to similar agencies or jurisdictions across the country;
- Comparison of internally generated measures against other jurisdictions measures;
- Availability of alternative performance measure ideas and methodology to consider for adoption if suitable;
- Quality of areas treated rather that quantity of areas treated;.
- A system that provides meaningful statistics. Some measures might include quantifying risk reduced and or the percentage of opportunities utilized;
- A system that can be implemented by each jurisdiction without too much difficulty;
- Improved performance measures for us to use;
- Common performance measures across agencies nationally – national performance measures;
- A set of principles for measuring efficiency and effectiveness and impacts of prescribed burning. A small set of agreed performance measures;
- An agreed national approach (within reason) to both de-politicize the issue, but also demonstrate within jurisdictions that there is an accountable standard at the national level that is also relevant and cross-agency;
- Common standards, measures, and best practice, and
- Expand our understanding of monitoring and reporting metrics to continually improve prescribed burning planning and effectiveness.

When asked how a consistent national performance measurement framework could assist the work of agencies and whether there are benefits at either the national or jurisdictional level, the responses were:

- National code that can be subjected to scrutiny. Guiding principles to measure against and abide by;
- Consistent and relevant reviewing and monitoring of performance, establishing goals and targets additional to size of program or number of burns;
- Minor adjustments to align with nationally consistent standards are possible;
- Basic national activity collation is useful but difficult. While advanced measures are attractive for national collation, variability and different priorities would likely prevent consistent collation. Measures need to be of internal value, particularly at Regional level, to justify the effort;

- Influence strategy and optimise effort into areas of most benefit;
- Improved Agency performance measurement;
- Comparative assessment against similar agencies;
- Common (national) performance measurement as 'best practice';
- Common reporting framework;
- Agreed data dictionary for comparability of performance measures;
- Performance measures that actually tell us something about what we're doing and whether or not we're on the right track;
- Performance measures that help us to identify where we still need to improve;
- In many respects the value of the national approach will be intangible. When agencies are asked to account, or reviewed, if there is a national framework in place it can become the starting place and the benchmark for those analysis. At a jurisdictional level it helps to keep all agencies on track with each other. At a national level the framework may be useful for gap analysis to drive research agendas, as well as contributing to the ongoing discussions regarding funding;
- Making sure burns are prescribed and implemented to best practice environmental and silvicultural standards, and
- Expand our understanding of monitoring and reporting metrics to continually improve prescribed burning planning and effectiveness.

Respondents provided risks that may arise for their agency from a national performance measurement framework and suggested ways in which these may be avoided or minimised. The responses were:

- Risk of not being able to meet minimum performance targets when compared to other agencies. How to minimise: Increase in capacity and capability;
- A standard is developed that the agency is not well enough resourced to achieve. For example, if the agency needs to develop a new database, a new monitoring framework or use remotely sensed data then this cannot be achieved within the current budg*et all*ocation;
- Developing measures that are difficult or onerous to report on, or that require additional training of staff;
- Developing measures that are not meaningful and become a distraction from more meaningful work;
- Standard measures and KPIs applied to the wrong or unsuitable environments or agency structures;
- Other jurisdictions may have much greater resources financial and human and achieve much higher outputs;
- Risk that we (agencies) are forced into a hectare target instead of assessing performance via risk reduction. This approach could be avoided by developing a system whereby risk reduction is quantified;
- Performance measurement is not applicable or adopted nationally;
- Resources are allocated to support a national system or the system is designed to be able to be applied by agencies with existing resources;

- Comparison between agencies can be both good & bad. Larger (better funded) States will be seen to perform better, unless the performance measure incorporates some context (e.g. area managed, 'fire proneness', SDP (state domestic production), population exposed/at risk);
- Being required to report on performance measures that tell us nothing about our business and how we are travelling;
- Agreed performance measures signed off by each agency to ensure commitment;
- The standard will be higher than what is achievable;
- The KPIs whilst good on paper won't be measurable – or too susceptible to misinterpretation. I think a solution is to be clear about the role of the framework, when/where/how it might apply, though setting a clear minimum standard to demonstrate some national consistency. I also think the purpose for each different agency (response vs land management) needs to be articulated in the framework;
- Being more accountable for PB's, targets, and
- Prescriptions and conditions that we don't agree with.

The final question asked respondents to tell us anything else that may not have been covered. These were their comments:

- Legislative or policy barriers that may exist, restricting an agency's ability to progress;
- Prescribed burn performance measurement should not just include the reduction of fuel or risk. The framework should also include other measures such as introduction of other risks such as hazardous trees. In other words, do our burn programs increase the hazardous tree risk in reserves that have high visitation rates and do we therefore need to modify our work practices in regard to this (raking around trees, wetting them down, lighting around the back of them etc to prevent them catching alight and becoming a greater hazard). Work practices (see above) but also in regard to staff safety. Appropriate risk management using Burn Risk assessment tools. Administrative aspects of preparing and completing burn plans and associated maps and reports;
- A measure of non-financial cost (environmental/social impacts) of burning needs to be included, and
- What performance measures would be meaningful to each jurisdiction and why should be discussed.

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

This appendix contains performance measurement information relevant to prescribed burning drawn from the literature review. The literature presented information in various formats (from specific KPIs to broad areas where evaluation or research is required) depending upon the nature of the document. No attempt has been made to standardise this. Some documents are agency 'grey literature' or draft reports and their inclusion does not signify any formal status or agency commitment to their content, rather they are included to provide the broadest range of performance measures for consideration.

Table 30 *Complete list of prescribed burning performance indicators identified in the literature.*

N/A	AFAC	• % of managed lands within specified fire regime as per management plans • % of managed lands that are under a plan • % of target area that is treated to specified standard	AFAC (2010)	Project plan
	AFAC	• A1 Deaths from landscape fires per 1 million persons • A2 Landscape fire injuries per 100,000 persons • A3 Injury incident rate to firefighters from landscape fires per 100 firefighters • B1 percentage of area of high value/high risk zones burnt by bushfire • B2 Percentage of area of commercial plantations lost • B3 Number of stock killed • B4 Kilometres of fencing destroyed • C1 Primary dwellings destroyed by landscape fires per 100,000 dwellings • C2 Total number of hours by volunteers on bushfire suppression • D1 Number of cultural heritage sites damaged by bushfire • D2 Number of times the National Environmental Protection Measures standard for PM10 particulates resulting from bushfire and prescribed burns is exceeded each year in major population centres • D3 Proportion of harnessed water catchments impacted by high intensity bushfire • E1 Bushfires in a jurisdiction per 100,000 persons and per 100,000ha • E2 Number of deliberate ignitions • E3 Number of accidental ignitions	AFAC (2015d)	Data dictionary

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
		• F1 Percentage of community who understand the role of prescribed burning • F2 Percentage of community supporting prescribed burning as a necessary act in the protection of the community • H1 Percentage of fires contained to within determined standards in high value zones • H2 Percentage trend in median fire size in high risk/high value zones • H3 Percentage of specified fires not contained prior to 1000 the next day • I1 Percentage of target area that is treated to specified standard – % of target area burnt during prescribed burns		
	AFAC	• Hectare targets • Burn program completion targets • Cover of fire • Reduction in fuel load or hazard • Reduction in fuel distribution (horizontally or vertically) • Smoke pollution indicators • Smoke level indicators • Burn escapes • % of fire regimes on track, off track or significantly off track (TFIs goals) • Desirable targets as against metrics such as age class structure or geometric mean abundance • Monitoring of key ecological values (ecosystem health indicators and species populations) • Residual risk targets • Greenhouse surrogate performance measures such as hectares of prescribed fire as against wildfire • Accidents & property damage • Deaths & injuries	Kington (2016)	Draft performance measurement framework
	AFAC	• % of households living in a hazard area	AFAC (2016c)	Council meeting paper

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
	Council of Australian Governments	• Fuel hazard before and after prescribed burn • Total area subject to prescribed burning in each FMZ each year • Average proportion of that area successfully burnt	Ellis *et al.* (2004)	Inquiry
	Forest Fire Management Group	• % tenure blind risk mapped • % prescribed burn objectives met • % prescribed burns escaped • Area of escaped prescribed burns • % fire-excluded areas impacted by fire • % fires impacting fire-excluded areas • % vegetation communities within fire frequency threshold • % area with pest species increase	Barr (2016)	Draft performance measurement framework
	Forest Fire Management Group	• 2013 State of Forests Report- Area of forest burnt by planned and unplanned fire • % of land that has a plan that defines the acceptable risk of fire, how that level of risk will be achieved, and how each type of fire will be managed • % of area burnt by fires that fail land management objectives • % of fires that fail land management objectives • % of prescribed fires that have records showing that procedures described in the risk-based approach were followed	FFMG (no date)	Briefing note
	Montreal Process Implementation Group for Australia and National Forest Inventory Steering Committee	• Area of forest burnt by planned and unplanned fire	MPIGA and NFISC (2013	5 yearly report
	Productivity Commission	• Landscape fire death rate per million people	Productivity Commission (2017)	Annual report
Australian Capital Territory	Emergency Services Agency	• Area treated by fuel management by type (annual average of 5 years) • Fuel hazard assessment	ESA (2014)	Bushfire management plan

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
	Parks & Conservation Service	• % prescribed burn objectives met • % zones meeting prescribed fuel reduction management standards • % prescribed burns escaped • Area of escaped prescribed burns • Size of inappropriate fire contained • % vegetation within fire management prescription • Number of unplanned fires • % of fires contained within first shift • Fires in plantations kept to 1 hectares or less • % fires impacting fire-excluded areas	NSW NPWS *et al.* (no date)	Draft performance measurement framework
Northern Australia generic	Academic	• Area burnt early season vs late season • Tonnes CO_2 abated • % CO_2 abated relative to base line	Russell-Smith *et al.* (2013)	Journal article
New South Wales	Forestry Corporation NSW	• Area burnt by prescribed fire (ha) • % burnt vs annual target	FCNSW (2016)	Annual report
	Office of Environment & Heritage	• % of APZs treated to meet objectives • % of SFAZs treated to meet objectives • % of vegetation formations in LMZs within fire management prescription (expressed as % underburnt, % within biodiversity threshold, % overburnt)	OEH (2015)	Agency manual/ application guideline
	Office of Environment & Heritage	• Annual area treated (ha) • 5-year average area treated (ha) • % annual target achieved	OEH (2016)	Annual report
	National Parks & Wildlife Service and Forestry Corporation NSW	• % prescribed burn objectives met • % zones meeting prescribed fuel reduction management standards • % prescribed burns escaped • Area of escaped prescribed burns • Size of inappropriate fire contained • % vegetation within fire management prescription • Number of unplanned fires • % of fires contained within first shift • Fires in plantations kept to 1 hectares or less • % fires impacting fire-excluded areas	NSW NPWS *et al.* (no date)	Draft performance measurement framework

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
	Rural Fire Service	• Total annual hazard reduction area completed (ha) • 5-year average total area of hazard reduction work completed (ha) • Number of homes protected by hazard reduction works • Annual area burnt (ha) by land tenure	RFS (2016)	Annual report
Northern Territory	Department of Natural Resources, Environment & the Arts and Bushfires NT	• Frequency of fires and intervals between fires • Seasonal pattern of patchiness of the landscape (rather than patchiness of fires) • Number and area and/or proportion of fire sensitive vegetation/feature of concern affected by fire by date within fire season, and time since last fire or fire frequency, and ranked relative to identified threshold of concern (TPC) • Proportion of landscape by wildfire, planned burn, unburnt • Number of fires and area burnt during periods of each FDI class	DNREA and Bushfires NT (no date)	Unpublished presentation
Queensland	Department of Environment & Resource Management	• % of estate covered by a fire management plan • Number of planned burns by purpose • % of estate burnt by prescribed fire annually • Area burnt by prescribed fire annually • Total fire area (planned & unplanned) • Planned burn/wildfire ratio or % of total fire that is prescribed burning • Seasonal spread of fire • Time since last fire by vegetation type • Average fire interval • Time since treatment for APZs (as predictor of fuel hazard being in prescription) • Fire management expenditure (including unit costs per hectare for planned burns and wildfire)	Leeson (2011)	Conference paper
	Department of National Parks, Recreation, Sport & Racing	• Burn completeness • Burn severity • Specified ecological outcomes based on issues present • Area of planned burns vs area of wildfire • Residual fuel hazard • Residual fuel load	DNPRSR (2012)	Agency manual/ application guideline

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
	Department of National Parks, Recreation, Sport & Racing	• % of estate flammable, gross burnt area • planned burn area vs wildfire area • % gross burnt area vs flammable estate • gross burnt as % of reference area i.e. the midpoint burn area of recommended conservation regimes • seasonal spread of area burnt (early-middle-late)	DNPRSR (2014)	Internal performance report
	Department of National Parks, Sport & Racing	• Number of planned burns conducted • Area treated (ha) • % estate treated	DNPSR (2016)	Annual report
Southern Australia generic	Academic	• Annual probability of large unplanned fires (>1000ha) under specified fuel management regime • Mean annual probability of high intensity non-suppressible (>4,000kW/m) unplanned fire • Mean area burnt by unplanned fires per annum • Mean intensity of unplanned fires adjacent to wildland urban interface	Bradstock *et al.* (2012)	Journal article
	Academic	• Benefit: cost ratio • Cost vs task	Gibson and Pannell (2014)	Research report
	Academic	• Change in number of days per year fire would be unsuppressible at different fuel loads	Gill *et al.* (1987)	Journal article
South Australia	Multi-agency	• Annual expenditure • Indication of areas burned & not burned • Indication of areas burned & not burned • Degree of success in achieving objectives	Government of South Australia (2009)	Code of practice
	Department of Environment, Water & Natural Resources	• Number of planned burns conducted • Area treated (ha)	DEWNR (2015)	Annual report
	Forestry SA	• Number of planned burns conducted • Area treated (ha)	Forestry SA (2015)	Annual report
Tasmania	Department of Primary Industries, Parks, Water and Environment	• Number of fuel reduction burns • Area treated (ha) • Days exceeding 24-hour average National Standards for $PM_{2.5}$ and PM_{10}	DPIPWE (2016)	Annual report

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
	Forestry Tasmania	• Area treated (ha) • Area treated by burn purpose • Number of air quality complaints linked to prescribed burning • Cost of fuel reduction burning	Forestry Tasmania (2016)	Annual report
	Multi-agency	• How well did the burn meet its objectives? • % of block burnt • Intensity of planned burn	Marsden-Smedley and Sherriff (2013)	Agency manual/ application guideline
	State Fire Commission	• Number of operational burn plans prepared • Number of community engagement activities with target communities • Number of general community forums • Number of downloads of fuel reduction information and training materials from SFMC web pages • Number of print, radio, television and online stories on fuel reduction • Number of planned burns • Number of planned burns within a 5km radius of a human settlement area • Number of cross-tenure planned burns • Number of planned burns on private land • Area treated (ha) • Number of bushfires in areas suitable for planned burning • Number of public smoke complaints associated with fuel reduction burning registered with the EPA • Number of public complaints on fuel reduction lodged through the FRU public enquiries email address and phone number • Number of positive fuel reduction related comments and enquiries/requests lodged with FRU • Area suitable for planned burning affected by bushfires (ha)	SFC (2016)	Annual report

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
	Tasmania Fire Service	• Number of mitigation plans completed • Number of operational burn plans prepared • Number of engagement events • Number of burns completed • Area treated (ha) • Rolling yearly average of area treated (ha) and number of burns completed • Area & number of burns within a 5km radius of a human settlement area • Cost per burn per ha • Number of environmental incidents • Number of burn escapes • Number of smoke exceedances • Number of complaints • Total area and total number of areas where fuel has been reduced • Rolling yearly average of total area (ha) and number of areas where fuel reduced • Statewide relative risk • Change in statewide relative risk	Whight (2016)	Business plan
Victoria	Department of Environment, Land, Water & Planning	• Diversity of landscape age structure • Susceptibility to disturbance • Geometric mean abundance of species	McCarthy (2012)	Research report
	Department of Environment, Land, Water & Planning	• Tolerable fire interval • Vegetation growth stage structure • Geometric mean abundance of species	DELWP (2015)	Performance measurement framework
	Department of Environment, Land, Water & Planning	• Number of community engagement plans developed and implemented • Area treated (ha) • Bushfire fuel management completed to protect key assets (ha) • Bushfire risk maintained at or below 70%	DELWP (2016)	Annual report
	Department of Sustainability & Environment	• Frequency, cover and density of Key Fire Response Species	Cawson and Muir (2008b)	Research report

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
	Department of Sustainability & Environment	• Average size and % change in burn size by district and zone • % of burns on FOP (fire operations plan) that have natural and cultural values assessed prior to FOP finalisation • Proportion and area (ha) of burns planned from 3 Year FOP (by Region) • Proportion and area (ha) of burns prepared (plan & preparation complete) from 3 Year FOP (by Region) • % of burns at which fuel moisture content is regularly monitored • Number and % of identified days of opportunity when ignition occurred (by Region) • % of full year budget for prescirbed burning expended (by Region) against % of program achieved • Number and % of burns that breach containment lines and are classified as a bushfire • % and number of accredited staff participating in planned burning • Number and % of contributing 1-5 days, 6-20 days and greater than 20 days • Number of resource requests unable to be filled • Number and % of personnel days contributed by staff in Districts outside base District • Number and % shifts over 16 hours • Number and % of deployments over 7 days • Number and % of identified stakeholder groups met (by Region and per month) • Number and % of feedback forms that rate the engagement process at meetings/events as 'satisfactory' • Number and % of burns with burn mapping complete	DSE (2012b)	Draft performance measurement framework

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
	Environment and Natural Resources Committee	• Cost of prescribed burning • Total number of burns conducted within each FMZ for each region • Total area treated within each FMZ for each region • Extent to which planned ecological and fuel reduction outcomes were met within each FMZ for each region • Map intensity of burns	ENRC (2008)	Inquiry
	Fire Ecology Working Group	• Fire-age or structural profiles of vegetation within or across vegetation types	FEWG (2004)	Agency manual/ application guideline
	Multi-agency	• Cost and funding • Activities undertaken to achieve risk reduction target • Community engagement • Hectares treated • Smoke impacts • Impacts on plants and animals • Effect on the local environment's resilience • Performance against risk reduction target	State of Victoria (2015)	Policy/ strategy
	Office of the Emergency Services Commissioner	• The time in years during which a fuel threshold is exceeded using given intervals between prescribed fires • The time in years the fuel array is above a certain overall fuel hazard level • The time-integrated amount of fuel above a threshold, in tonne-years • Histograms of the proportions of blocks burned • The ratio of the estimated distance of spotting from the upwind side of the zone or block to its width (the smaller the number the better) • The proportion of the landscape with fuel quantity below a threshold for spread • The proportion of areas of given fuel ages burnt by unplanned fire	Esplin *et al.* (2003)	Inquiry

APPENDIX C: PERFORMANCE MEASURES FROM THE LITERATURE

Jurisdiction	Agency	Prescribed Burn Performance area/ Measures/Indicators	Reference	Source type
		• The estimated probability of a previous fuel reduction burn slowing a headfire • Comparing the severity of fires in the FMZs • The ratio of annual area burned to sum of 3pm FFDI cubed • The nature of the relationship between the logarithms of unplanned fire area and their log transformed frequencies • The number of fires exceeding 400ha (rather than the proportion of fires over 400ha) • Monitor the annual number of fires per unit of FFDI as a measure of reportage and/or effectiveness • Total area subject to prescribed burning • Average proportion of that area successfully burnt		
	Parks Victoria	• Area treated (ha)	PV (2016)	Annual report
Western Australia	Department of Parks & Wildlife	• Area treated (ha) • Proportion of planned Priority 1 prescribed burns achieved (%) • Area of prescribed burning in three zones at defined distances from the interface between populated areas and natural lands (ha) • % of prescribed burning in three zones at defined distances from the interface between populated areas and natural lands • Average cost per hectare planned burnt ($) • Proportion of Department-managed lands in the south-west forest regions that is less than six years since last burnt (%) • The ratio of area affected by bushfire to area of prescribed burning completed annually	DPW (2016)	Annual report

APPENDIX D: LONG LIST OF CONSOLIDATED PERFORMANCE MEASURES

Shading indicates inclusion in the performance measurement framework. Consult the 'Technical Reference Group feedback' column for any amendment to initial wording of the KPI.

Table 31 *Financial indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		**Financial**		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
A1. Expenditure ($) on prescribed burning	ENRC (2008) Forestry Tasmania (2016) Gibson & Panell (2014) Government of South Australia (2009) Leeson (2011) State of Victoria (2015)	Magnitude of an input Counta	**Shortlisted** A fundamental measure of public accountability. Business rules required to account for: • Shared costs (e.g. staff and plant with multiple uses) • Site rehabilitation and post-burn site management costs • Cost of escaped prescribed burns.	Retain as proposed indicator
A2. Cost ($) per hectare prescribed burnt by zone/setting	DPW (2016) TFS (2016)	Relationship of an input to an output i.e. technical efficiency Benchmark	**Shortlisted** Indicator recognises that relative cost varies with complexity and risk of burn. Setting or zone is suggested as a proxy for complexity (e.g. remote rural vs interface). Costing business rules to be determined as per Indicator A1. apply.	Retain as proposed indicator
A3. Ratio of % program delivered vs % of annual budget spent	DELWP (2012)	Relationship of an input to an output i.e. technical efficiency Benchmark	**Not shortlisted** There is unlikely to be a 1:1 relationship, i.e. program establishment and baseline capacity costs are independent of program delivery. Performance against this indicator would be particularly poor in years where conditions are unsuitable for burning but baseline capacity needs to be retained. 'Planned' program may be problematic as contingency burns may be listed in program plan, and thus the real intended maximum delivery is less than that indicated by the plan.	Not discussed

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Performance area		Financial		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
A4. Cost ($) per % of risk reduction		Relationship of inputs to outcomes i.e. cost effectiveness Benchmark	**Shortlisted** If modelling of risk reduction is accepted as providing a proxy for a benefit of prescribed burning, then measurement of cost effectiveness becomes viable. Requires jurisdiction to have quantified risk and to be able to model risk reduction based on program delivery. Not all jurisdictions may currently be in a position to measure this. Business rule required to account for impact of unplanned fire on fuel risk (may be as simple as excluding area of unplanned fire from calculation of this measure).	Retain as proposed indicator

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Table 32 *Program planning activity indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		Program planning activity		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
B1. % of estate with current risk-based (fire) management plan	AFAC (2010) FFMG (no date) Leeson (2011)	Coverage of an activity Benchmark	**Shortlisted** Prescribed burning is conducted to achieve stated objectives. This pre-supposes existence of documented management plans that have determined the need for, and nature of, a prescribed burning program. These plans are likely to be risk-based and aim to achieve both public safety and ecological objectives as relevant to the location. It is envisaged that the denominator would be estate area but could also be expressed by individual management units (parks, reserves, districts etc.). Could also be expressed in terms of jurisdiction as a whole (or bushfire prone area of the jurisdiction).	Reword as: '% of burnable agency-managed land with current fire management plan' Retain as proposed indicator It was advised that this indicator should focus on that portion of the agency estate suitable for prescribed burning.
B2. % of tenure-blind risk mapped	FFMG (2016)	Coverage of an activity Benchmark	**Not shortlisted** Risk-mapping (and ongoing monitoring/ modelling of risk) is a pre-requisite for measurement of some intermediate outcomes and cost effectiveness. Whilst risk mapping is an important foundational activity, change in relative risk is better measured as a modelled intermediate outcome. Consistent risk mapping not available in all jurisdictions.	Not discussed

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Table 33 *Community understanding and support indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		**Community understanding and support**		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
C1. Number of community engagement plans	DELWP (2016)	Magnitude of an activity Count	**Not shortlisted** Measure would need the nature of a community engagement plan to be clarified, i.e. is it a program planning activity or an operational planning activity or both? If a component of 'best practice' operational planning it could be included in a broader operational planning measure.	Not discussed
C2. Number of community engagement activities with target communities	DELWP (2012) State of Victoria (2015) SFC (2016) TFS (2016)	Magnitude of an activity Count	**Not shortlisted** Activity count unrelated to magnitude of need (i.e. size of prescribed burning program or size of community or number of stakeholders).	Refer to AFAC community engagement SMEs to advise on appropriate community engagement activity indicator. Propose replacement indicator TRG determined that additional specialist expertise was required to define this indicator.

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Performance area		Community understanding and support		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
C3. % of community and other stakeholders directly affected by a prescribed burn who have been engaged		Coverage of an output Benchmark	**Shortlisted** Consultation with community and other stakeholders directly affected by prescribed burning is considered good practice. It would need to be determined how to define the affected community and stakeholders (e.g. proximity to area being treated with prescribed fire, direct connection to land etc.) and what level of engagement would meet the intent of the indicator (e.g. one way vs two way, targeted vs broadcast etc.).	Refer to AFAC community engagement SMEs to advise on appropriate community engagement output indicator. Propose replacement indicator TRG considered the indicator impracticable and recommended that specialist community engagement expertise be sought to define this indicator.
C4. % of community supporting prescribed burning	AFAC (2015)	Stakeholder acceptance of the program, possibly an indicator of the quality of activities or outputs, or recognition of the value of outcomes being sought and/or achieved Benchmark	**Shortlisted** It is anticipated that community support will vary geographically (possibly in response to perceived bushfire risk) and temporally (possibly in response to fire events, e.g. major bushfire or high profile prescribed burn escape). Would require long term monitoring via survey or other appropriate method. Relevancy – is this is a key outcome of a prescribed burning program?	Retain as proposed indicator TRG advised that community support was critical to a prescribed burning program and should be monitored.

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Performance area		Community understanding and support		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
C5. % of feedback that is positive	SFC (2016)	Stakeholder acceptance of the program, possibly an indicator of the quality of activities or outputs, or recognition of the value of outcomes being sought and/or achieved Benchmark	**Not shortlisted** Feedback from self-selected respondents is likely to represent more extreme views (either positive or negative) on prescribed burning, or be in response to a particular event and not representative of community sentiment as a whole. This measure would require agencies to record and classify all feedback, which may be an unwarranted administrative cost.	Not discussed

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Table 34 *Operational planning activity indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		Operational planning activity		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
D1. % of prescribed burns conducted that have approved operational plan	SFC (2016)	Quality of an activity Benchmark	**Not shortlisted** Given the maturity of AFAC/FFMG agency prescribed burning programs, this is unlikely to be a responsive indicator as all burns are likely to have an approved operational plan.	Not discussed
D2. % of prescribed burns that have records showing that procedures described in the risk-based approach were followed	FFMG (no date)	Quality of an activity Benchmark	**Shortlisted** Requires the risk-based approach to be clearly defined (this would improve the specificity of the indicator). Indicator could define the desired quality of the output, i.e. compliance with a best practice guide for operational planning, governance, implementation, post-burn record keeping etc., and be used to drive performance.	Reword as: '% of prescribed burns that demonstrate compliance with required agency procedures' Retain as proposed indicator TRG advised simpler wording.
D3. % of suitable days on which prescribed burning was undertaken	Additional indicator proposed by TRG	Quality of an activity Benchmark	N/A A measure of the degree to which the limited opportunities for safe and effective burning are taken advantage of. The measure does not consider the magnitude of burning (i.e. number of burns or area treated) but simply whether any prescribed burning occurred.	Propose as indicator

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Performance area		Operational planning activity		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
D4. % of prescribed burns at which level of community engagement meet agency standard	Additional indicator proposed by TRG	Quality of an activity Benchmark	N/A The agency community engagement standard would need to determine how to define the affected community and stakeholders (e.g. proximity to area being treated with prescribed fire, direct connection to land etc.) and the level of engagement that would meet the intent of the indicator (e.g. one way vs two way, targeted vs broadcast, invitation to engage vs active engagement etc.).	Propose as indicator TRG advised this indicator as a replacement for Indicator C3. above. In effect replaces an indicator of community engagement output with an indicator of quality of the activity of community engagement.

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Table 35 *Burn implementation indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		**Burn implementation**		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
E1. Number of prescribed burns conducted	DEWNR (2015) DNPRSR (2016) DPIPWE (2016) ENRC (2008) Forestry SA (2015) Leeson (2011) SFC (2016) TFS (2016)	Magnitude of an activity Count	**Not shortlisted** Easily collected and reported, but provides data of limited usefulness. Expressing the count by burn purpose, FMZ, land tenure, priority or proximity to assets etc. would provide additional information.	Not discussed
E2. % of target number of prescribed burns achieved	DPW (2016) OEH (2016)	Relationship between planned and actual activity Benchmark	**Not shortlisted** Number of burns is not as useful a measure as area prescribed burnt or location of burns relative to risk. Difficulty in determining what is 'real' target when program plan is likely to contain contingency burns.	Reword as: '% of planned prescribed burning program delivered (by area burnt and number of burns)' Adopt as proposed indicator TRG advised that it was necessary to report 'actual vs planned' activity (number of prescribed burns) and output (area treated with prescribed burning).

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Performance area		Burn implementation		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
E3. Area (ha) prescribed burnt	DELWP (2016) DEWNR (2015) DNPRSR (2016) DPIPWE (2016) DPW (2016) Ellis *et al.* (2004) FCNSW (2016) ENRC (2008) ESA (2014) Esplin *et al.* (2003) Forestry SA (2015) Forestry Tasmania (2016) Leeson (2011) OEH (2016) PV (2016) RFS (2016) SFC (2016) State of Victoria (2015) TFS (2016)	Magnitude of an output Count	**Shortlisted** Area treated with prescribed fire is likely to be required for reporting to government and is currently reported as part of the international 'State of the Forests' report. Need to determine minimum burn coverage required for an area to be considered effectively treated. Could be expressed by burn purpose, FMZ, land tenure, priority or proximity to assets etc. Data on amount, location and age of treated area are required for risk modelling.	Reword as: 'Area (ha) treated with prescribed burning' Retain as proposed indicator TRG revised wording to focus the indicator on application of prescribed fire rather than the extent to which the treated area was burnt.
E4. % of target total area of prescribed burns achieved	DPW (2016) FCNSW (2016) OEH (2016)	Relationship between planned and actual output Benchmark	**Not shortlisted** Difficulty in determining what is 'real' target when program plan is likely to contain contingency burns. Jurisdictional targets may alter year-to-year and comparison between years may be of limited value, better considered over longer time frames.	Combine with Indicator E2. above Propose as indicator TRG advised that it was necessary to report 'actual vs planned' activity (number of prescribed burns) and output (area treated with prescribed burning).

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Performance area		Burn implementation		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
E5. % of prescribed burns where average % of burn area burnt is within desired range	AFAC (2010) AFAC (2015) DPNPRSR (2012) Ellis *et al.* (2004) Esplin *et al.* (2003) Government of South Australia (2009) Marsden-Smedley & Sherriff (2014)	Quality of an output Benchmark	**Shortlisted** Basic quality assurance metric. Data collection is a standard part of post-burn assessment. Mapping of burn severity from Aerial Photograph Interpretation etc. would be an enhanced alternative indicator.	Remove as proposed indicator TRG determined that the intent of this indicator was encompassed in the broader Indicator E6. below, with % of burn coverage being a specific burn objective.
E6. % of prescribed burns where burn objectives are met	ENRC (2008) FFMG (2016) Government of South Australia (2009) Marsden-Smedley & Sherriff (2014) NPWS, FCNSW & ACT P&CS (no date)	Quality of an output Benchmark	**Shortlisted** Objectives may include area to be burnt, completeness of burn, intensity, residual fuel hazard etc. Data are typically collected as standard post-burn assessment. Indicator may identify systemic problems with operational planning and/or burn implementation, e.g. techniques, prescriptions etc.	Retain as proposed indicator
E7. Number of prescribed burns within nominated distance of human settlement areas and key assets	SFC (2016) TFS (2016)	Magnitude of an activity Count	**Not shortlisted** Intent appears to be to indicate that risk to human settlement etc. is being addressed. Indicator, however, does not allow the adequacy of the burn program to be judged, i.e. how many burns close to assets are required? Indicators G4 and G6 are considered better indicators of impact of prescribed burning program on bushfire risk.	Not discussed

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Performance area		Burn implementation		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
E8. Area of prescribed burns within nominated distance of human settlement areas and key assets	DPW (2016) TFS (2016)	Magnitude of an output expressed relative to assets exposed to risk Count	**Not shortlisted** Intent appears to be to indicate that risk to human settlement etc. is being addressed. Indicator, however, does not allow the adequacy of the burn program to be judged, i.e. what area of prescribed burning close to assets is required? Indicators G4 and G6 are considered better indicators of impact of prescribed burning program on bushfire risk.	Not discussed
E9. % of treatable agency managed land treated each year	DNPRSR (2016)	Magnitude of an output Benchmark	**Not shortlisted** There has been considerable debate about the relance of area (%)-based targets as opposed to risk reduction-based targets. The strategy of many agencies is based on the latter, which decreases the ongoing relevance of this indicator.	Reword as: '% of landscape treated with prescribed burning' Adopt as proposed indicator TRG advised that it was necessary to report on percentage of landscape treated with prescribed burning.

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Table 36 *Fuel management outcomes indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		**Fuel management outcomes**		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
F1. Residual fuel hazard and fuel load	DPNPRSR (2012) Ellis *et al.* (2004) ESA (2014)	Immediate outcome (could also be considered an indicator of quality of an output) Benchmark	**Not shortlisted** These data should be collected as part of post-burn assessments to determine the extent to which fuel management objectives have been met. The initial fuel hazard and load, degree of fuel reduction aimed for, and hence acceptable residual fuel hazard will vary between sites based on fire history, vegetation type, location and FMZ etc. It is considered that Indicator E6 is a more useful indicator of the quality of individual prescribed burns and is easier to compile into a measure of prescribed burning program quality.	Not discussed
F2. Average fuel age or % of land where fuel age exceeds prescribed standard	DNREA & Bushfires NT (no date) Esplin *et al.* (2003) Leeson (2011)	Intermediate outcome Benchmark	**Not shortlisted** Use of this indicator would require desirable fuel ages to be defined for different vegetation types and FMZs. Averaging across vegetation types could confuse trends (e.g. a single burning of long unburnt wet forest may have a greater impact on the indicator than repeated burning of more fire prone dry forest). Performance in some time periods would be heavily influenced by wildfire.	Not discussed

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Performance area		Fuel management outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
F3. % of agency managed land meeting prescribed fuel reduction standards	DPW (2016) Leeson (2011) OEH (2015) NPWS, FCNSW & ACT P&CS (no date)	Intermediate outcome Benchmark	**Shortlisted** Indicator requires fuel hazard/load/age standards to be assigned to each parcel of managed land, and fuel accumulation to be monitored or modelled over time. Performance in some time periods would be heavily influenced by wildfire. Indicator links to FMZ fuel standards and would drive program planning.	Retain as proposed indicator
F4. % of APZs within prescribed time since fire/fuel age thresholds (within prescription, 1-1.5 * prescription, >1.5 * prescription)	Leeson (2011) OEH (2015) NPWS, FCNSW & ACT P&CS (no date)	Intermediate outcome Benchmark	**Shortlisted** Similar intent to Indicator F3, but focussing on intensively managed APZs that provide immediate protection to human settlement areas and other high value assets. Concept of quantifying the degree to which portions of the APZ are beyond prescription seems useful. Indicator could also be expressed in terms of fuel reduction standard as per Indicator F3.	Remove as proposed indicator TRG determined that the intent of this indicator was encompassed in the broader Indicator F3. above, with standard of APZs being a subset of the standard of all managed land.

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Table 37 *Risk reduction outcomes indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		Risk reduction outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
G1. Number of days a fire would not be suppressible	Gill *et al.* (1987)	Condition and trend of an intermediate outcome Benchmark	**Not shortlisted** Addresses the intermediate outcome of improved safety and effectiveness of suppression. Could only be applied to specific areas of particular fuel standard (e.g. areas of APZ maintained at Moderate overall fuel hazard) and relative to if that same area was unmanaged. Variability in frequency of fire weather could mask effect of fuel management.	Not discussed
G2. Annual probability of large unplanned fire (>1,000ha)	Bradstock *et al.* (2012)	Condition and trend of an intermediate outcome Benchmark	**Not shortlisted** Modelled likelihood of fires of nominated size could be reported as an adjunct to Indicator G4 but is considered less useful than modelled risk reduction. The relevance of fire size is dependent upon the fire's location and land management context. Modelling requires assumptions to be made about the probability and location of ignition that would heavily influence the result.	Not discussed
G3. Mean annual probability of high intensity non-suppressible fires	Bradstock *et al.* (2012)	Condition and trend of an intermediate outcome Benchmark	**Not shortlisted** Modelled likelihood of fires of nominated intensity could be reported as an adjunct to Indicator G4 but is considered less useful than modelled risk reduction. Modelling requires assumptions to be made about the probability of ignition that would heavily influence the result.	Not discussed

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Performance area		Risk reduction outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
G4. Statewide residual risk relative to target threshold	DELWP (2016) State of Victoria (2015) TFS (2016)	Condition and trend of an intermediate outcome Benchmark	**Shortlisted** Under the risk modelling approach, the prescribed burning program is designed to maintain the statewide residual risk at or below a target threshold. Has the advantage that the measure is tenure blind, but could be reported on relative to the risk and mitigation of each agency's estate. Major disadvantage is the investment required in some jurisdictions to enable the risk modelling capability (initial data collection, business rules for vegetation types, expertise etc.). If used as a national indicator it may be difficult to compare between jurisdictions if the assumptions in the modelling/ quality of the risk calculation is different.	Reword as: 'Residual risk (%)' Retain as proposed indicator TRG advised change of wording to allow the indicator to be spatially scalable.
G5. Change in statewide residual risk	DELWP (2016) State of Victoria (2015) TFS (2016)	Condition and trend of an intermediate outcome Benchmark	**Not shortlisted** Under the risk modelling approach, the prescribed burning program is designed to maintain the residual statewide risk at or below a target threshold. Thus, once fully implemented the level may not alter significantly over time due to prescribed burning (in fact major changes are more likely to be due to the impact of large bushfires on fuel hazard at a landscape scale).	Not discussed

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Performance area		Risk reduction outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
G6. % of key assets protected by prescribed burning	DELWP (2016) RFS (2016)	Condition and trend of an intermediate outcome Benchmark	**Not shortlisted** Definition of 'key assets' may be problematic, as would quantifying and collating across a broad range of asset classes – human settlement, infrastructure, agriculture, environmental etc. Agreement would also be required on how recent and how close prescribed burning needs to be to provide 'protection'.	Not discussed
G7. Area (ha) burnt by bushfire	Bradstock *et al.* (2012) Esplin *et al.* (2003) Leeson (2011) RFS (2016)	Condition and trend of an intermediate outcome Count	**Shortlisted** A contention of prescribed burning is that it will reduce the prevalence of bushfire. Data for this indicator are likely to be captured through agency fire and incident reporting processes. These data are a prerequisite for Indicator G9 and required for the 'State of the Forests' report. Measure could be expressed in terms of jurisdiction, agency estate, FMZ, proximity to high value assets etc.	Retain as proposed indicator
G8 Total area burnt (ha) by unplanned fire and prescribed burning	FFMG (no date) Leeson (2011) RFS (2016) TFS (2016)	Condition and trend of an intermediate outcome Count	**Not shortlisted** This is not recommended as a performance measure, but the data are required to enable Indicator G9. Business rule required to clarify how to account for areas that have been prescribed burnt and are re–burnt by unplanned fire in the same reporting period.	Not discussed

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Performance area		Risk reduction outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
G9. % of total area burnt that was prescribed burnt	DPNPRSR (2012) DPW (2016) DNREA & Bushfires NT (no date) Leeson (2011)	Condition and trend of an intermediate outcome Benchmark	**Shortlisted** Equivalent measure to the ratio of prescribed burn to wildfire but expressed in a way that provides clearer trend information. Measure could be expressed in terms of jurisdiction, agency estate, FMZ, proximity to high value assets etc. See also Indicators G10 and G11.	Replace with: '% of landscape burnt by bushfire' Retain as proposed indicator TRG suggested indicator be simplified by drawing out the two components (% burnt by prescribed fire and % burnt by bushfire) as separate indicators.
G10. % of area burnt by fires that fail land management objectives	DNREA & Bushfires NT (no date) FFMG (no date)	Condition and trend of an intermediate outcome Benchmark	**Shortlisted** A refinement of Indicator G9 to account for some unplanned fires may be in accord with land management objectives, i.e. not all unplanned fires have negative outcomes. Would require agencies to classify prescribed and unplanned fires regarding land management objectives for the areas burnt.	Remove as proposed indicator
G11. % of fires that fail land management objectives	FFMG (no date)	Condition and trend of an intermediate outcome	**Not shortlisted** Commentary as per G10. Number of fires considered less relevant than area burnt.	Not discussed

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Performance area		Risk reduction outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
G12. Mean intensity of wildfire in the wildland urban interface	Bradstock *et al.* (2012)	Condition and trend of an intermediate outcome Count	**Not shortlisted** May be suitable for a post-wildfire case study to review impact of prescribed burning. Insufficient area of interface is burnt to allow meaningful tracking of performance over time. Difficult to control for variations in FDI and topography. Modelled intensity could be reported as an adjunct to Indicator G4 but is considered less useful than modelled risk reduction.	Not discussed
G13. AFAC Landscape fire performance measures (Groups A-E)	AFAC (2015)	Condition and trend of high level intermediate and final outcomes Benchmark	**Not shortlisted** Whilst valid measures of society's overall performance in managing bushfire risk, they are not recommended as performance measures for prescribed burning, as the causal links between outputs and final outcomes area weak, i.e. many external factors, including other risk mitigation programs, influence the outcomes.	Not discussed

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Table 38 *Ecological outcomes indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		Ecological outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
H1. % area with pest species increase	FFMG (2016)	Intermediate outcome Benchmark	**Not shortlisted** Would require assessment of initial condition to enable comparison of pest species increase. Business rules required to quantify increase (e.g. frequency, cover etc.), determine at what time post-fire to measure and to weight importance of different pest species.	Not discussed
H2. % of burns achieving specific ecological outcomes based on issues present	DPNPRSR (2012) ENRC (2008)	Immediate outcome Benchmark	**Not shortlisted** It is considered that Indicator E6 is a more broadly useful indicator of the quality of individual prescribed burns.	Not discussed
H3. % of vegetation within fire management prescriptions	AFAC (2010) FFMG (2016) OEH (2015) NPWS, FCNSW & ACT P&CS (no date)	Intermediate outcome Benchmark	**Shortlisted** Need to define the parameters of 'fire management prescription' and the acceptable range for each vegetation type. Are these Tolerable Fire Intervals or similar? Does this relate to ecological outcomes only or do fuel management prescriptions take precedence? In which case, does prescription depend upon FMZ as well as vegetation type?	Remove as proposed indicator

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Performance area		Ecological outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
H4. % vegetation communities within fire frequency thresholds (% underburnt, within threshold, over burnt)	Leeson (2011)	Intermediate outcome Benchmark	**Shortlisted** It is assumed that fire frequency thresholds refer to Tolerable Fire Intervals or similar. Would the '% vegetation communities' indicator be expressed for each major vegetation community, or be calculated as mean % of area of all vegetation within tolerable fire frequency thresholds? Requires reasonably comprehensive fire history mapping. Measure seems useful to burn program planning as well as performance measurement.	Reword as: '% of vegetation communities with desirable fire regime' Retain as proposed indicator TRG advised that broader concept of fire regime (considering season, severity/ intensity etc. of burning as well as fire frequency) was a more broadly useful indicator.
H5. Diversity of landscape age structure	FEWG (2004) McCarthy (2012)	Intermediate outcome Benchmark	**Not shortlisted** It is considered that a mathematical measure of diversity of age classes may be hard to interpret and apply in a program planning context.	Not discussed
H6. % of fire excluded areas impacted by fire	FFMG (2016) NPWS, FCNSW & ACT P&CS (no date)	Intermediate outcome Benchmark	**Not shortlisted** Fire excluded areas requires definition. Is this all areas where we desire to exclude fire, or an ecological description? Many naturally fire excluded areas only burn under extreme conditions (elevated FFDI and/or drought). Under these conditions prescribed burning will have limited impact on preventing fire spread.	Not discussed
H7. Geometric mean abundance of species	McCarthy (2012)	Intermediate outcome Count	**Shortlisted** A measure of species diversity and abundance, considered to be a useful indicator of ecosystem health. Would require targeted monitoring program that may be beyond the resources of some agencies.	Remove as proposed indicator

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Table 39 *GHG emission abatement outcomes indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		Greenhouse gas emission abatement outcomes		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
I1. Tonnes of CO_2 equivalent abated	Russell-Smith *et al.* (2013)	Condition and trend of an intermediate outcome Count	**Shortlisted** Carbon accounting methodologies are established under GHG emission reduction schemes. Data for northern Australian savanna burning are captured and reported via these processes and could be utilised for prescribed burning performance measurement. GHG abatement benefit of prescribed burning is less clear in southern Australian forests, and this measure will be of less immediate relevance.	Retain as proposed indicator TRG noted that in the future all jurisdictions might be required to account for GHG emissions (generated by prescribed burning and/ or abated by prescribed burning displacing bushfire).
I2. % of CO_2 equivalent abatement vs. base line	Russell-Smith *et al.* (2013)	Condition and trend of an intermediate outcome Benchmark	**Not shortlisted** As per Indicator I1. Shows relative improvement that results from prescribed burning program.	Not discussed
I3. % of total area burnt that is burnt in early season	DNREA & Bushfires NT (no date) Leeson (2011) Russell-Smith *et al.* (2013)	Condition and trend of an intermediate outcome Benchmark	**Shortlisted** An increase in lower intensity early season prescribed burning relative to higher intensity late season burning results in reduced GHG emissions. This indicator is a variation on Indicator G9 that better reflects the logic of savanna burning for GHG abatement in northern Australia. Would require 'early' and 'late' season to be defined, this might vary geographically.	Remove as proposed indicator

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Table 40 *Adverse impacts indicators considered for inclusion in a prescribed burning performance framework.*

Performance area		Adverse impacts		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
J1. Number of prescribed burn escapes	DELWP (2012) TFS (2016)	Quality of activity Count	**Not shortlisted** Performance against this indicator is likely to decrease as the amount of prescribed burning increases (i.e. more prescribed burns conducted provide more opportunity for escapes). Thus, it may be counter to a strategic intention of increasing the amount of burning. Indicator J2 below is considered more appropriate. Need consistent criteria that define a reportable escaped prescribed burn.	Not discussed
J2. % of prescribed burns that escape	DELWP (2012) FFMG (2016) NPWS, FCNSW & ACT P&CS (no date)	Quality of activity Benchmark	**Shortlisted** This indicator is less dependent on the magnitude of the prescribed burn program, allowing benchmarking between like-agencies/jurisdictions and monitoring of temporal trends. Need consistent criteria that define a reportable escaped prescribed burn.	Retain as proposed indicator
J3. Total area (ha) of escaped prescribed burns	FFMG (2016) Government of South Australia (2009) NPWS, FCNSW & ACT P&CS (no date)	Unwanted immediate outcome Count	**Not shortlisted** Data for this indicator are likely to be captured through agency fire and incident reporting processes. This indicator has the potential for a large but low-consequence escaped burn in a remote area to mask other trends. Need criteria that define a reportable escaped prescribed burn. The term 'fire that fails land management objectives' may be more appropriate as it recognises that, under some circumstances, a prescribed burn larger than initially planned may not be negative. Could usefully be combined with an indicator of the consequence of the escape(s).	Not discussed

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Performance area		Adverse impacts		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
J4. Number of reportable environmental incidents	TFS (2016)	Quality of activity Magnitude of occurrence of unwanted immediate outcome Counts	**Not shortlisted** Quality assurance of agency prescribed burning programs should make this a rare occurrence. Reporting is likely to be required pursuant to environmental regulations and/ or land use planning controls. These regulations would also provide definition of 'reportable' incidents and are likely to vary between jurisdictions. Rate of reportable incident relative to number/area of prescribed burning may be more useful.	Not discussed
J5. Cost of managing adverse impacts		Magnitude of unplanned inputs Count	**Not shortlisted** Foreseeable costs should be included in program or other budget (e.g. post-burn site remediation, ongoing weed control, hazard trees). Rare exceptional costs are not considered a useful metric of program performance, but would be captured and reported on a case-by-case basis.	Not discussed

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Performance area		Adverse impacts		
Indicator	**Based on or adapted from**	**Type of measure**	**Shortlisting recommendation/ comments**	**Technical Reference Group feedback**
J6. Number of days PM_{10} standard is exceeded each year in major population centres	AFAC (2015) DPIPWE (2016) State of Victoria (2015) TFS (2016)	Unwanted intermediate outcome Count	**Shortlisted** Air quality standards (magnitude and duration of exposure) have been defined, and ongoing monitoring occurs in capital city air sheds. Capacity to monitor, e.g. with portable equipment, the impact of specific burns/ burn programs on regional centres is likely to increase over time. Measure needs to be linked to jurisdictional smoke management policies and standards.	Reword as: 'Number of days on which air quality threshold is exceeded due to prescribed burning' Retain as proposed indicator TRG advised indicator be reworded to enable a range of air quality measures to be applicable, and to ensure that smoke from prescribed burning was a contributory factor.
J7. Number of air quality complaints	Forestry Tasmania (2016) SFC (2016) TFS (2016)	Unwanted intermediate outcome Count	**Not shortlisted** This measure would require feedback to potentially multiple agencies (e.g. EPA, land manager, fire service, local government) to be captured and collated, which may be an unwarranted administrative cost.	Not discussed

APPENDIX E: PROGRAM LOGIC FOR PRESCRIBED BURNING

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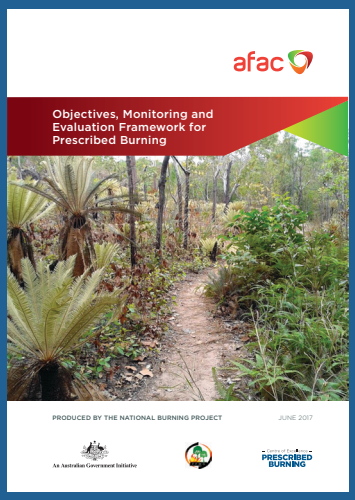

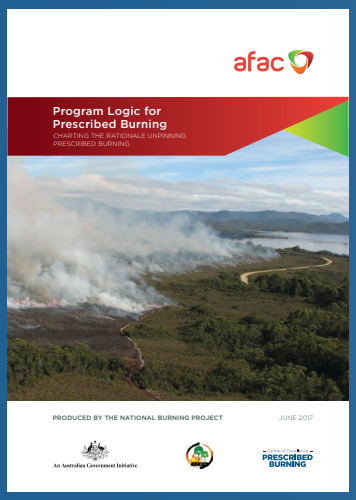

Measuring performance

Prescribed Burning Performance Measurement Framework

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The benefits of well-constructed performance measures should not be underestimated. Greater public accountability and more informed management decisions are the most obvious advantages. However, measuring performance also enables comparisons from year to year, from area to area, agency to agency and even from jurisdiction to jurisdiction. Well thought-out performance measures can galvanise an organisation's culture toward cooperating around certain goals, at all levels from directors, technicians and field staff; thereby encouraging continuous improvement.

This document proposes a consistent set of performance measures that can be adopted by agencies across Australia and New Zealand. They encompass prescribed burning inputs, activities, outputs and short to long term goals; and cover a wide range of topic areas such as financial, community support, burn implementation, risk reduction and ecological considerations.

The need to measure performance effectively is well recognised within prescribed burning organisations. It is recognised that there is more work to be done in this space, however this document will help give guidance and support to this growing area of work.

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