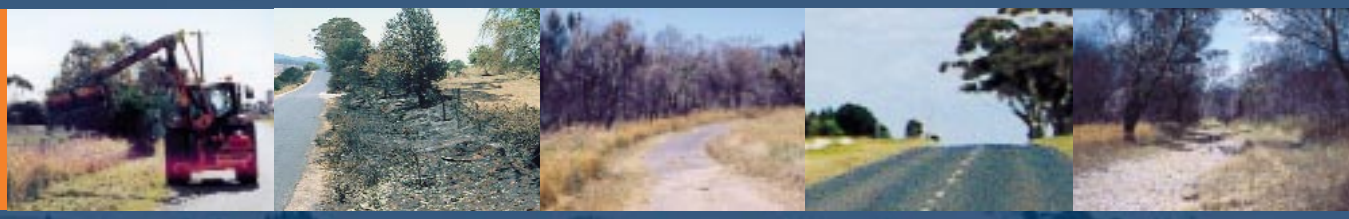
Roadside Fire Management Guidelines



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ACKNOWLEDGEMENTS

These guidelines have been developed by the Country Fire Authority Victoria (CFA), after consultation with the Rural and Urban Fire Brigades Associations, Department of Natural Resources and Environment (DNRE), VicRoads and the Municipal Association of Victoria (MAV).

part a
INTRODUCTION

Traditionally, roadsides have been used extensively for the implementation of fire prevention programs. With changes in land and resource management and a shift to risk based emergency management, there is a need to review fire prevention on roadsides to keep pace with community expectations and ensure a consistent approach to fire management.

LEGISLATION

The management of roadsides for fire prevention purposes is specifically referred to in the CFA Act 1958 in Section 43(1), which states that:

It shall be the duty of every municipal council and every public authority to take all practicable steps to prevent the occurrence of fires on and to minimise the danger of the spread of fires on or from:

- any land vested in it or under its control or management, and
- any highway, road, street, lane or thoroughfare the maintenance of which is charged upon it.

Section 55A of the CFA Act states that:

- each municipal council must prepare and maintain a Municipal Fire Prevention Plan (MFPP) in accordance with the advice and recommendation of the Municipal Fire Prevention Committee (MFPC).
- the Plan must identify areas which are at particular risk;
- specify how these are to be treated; and
- specify who is responsible for treating those risks.

The MFPPs will be audited by CFA under S55B of the CFA Act.

Roadsides serve many important objectives. In many areas, roadsides have high conservation values. A range of legislation at the Commonwealth, State and local level supports conservation objectives. These objectives need to be considered in addition to fire management objectives.

Conservation values of national significance are protected under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999. Under this legislation actions which significantly impact upon matters of national significance (such as species or communities of national significance) must have prior approval from the Commonwealth Environment Minister.

The Flora and Fauna Guarantee (FFG) Act 1988 includes the following objectives:

- that Victoria's flora and fauna can survive, flourish and retain their potential for evolutionary development in the wild;
- to conserve Victoria's communities of flora and fauna; and
- to manage potentially threatening processes.

Under the FFG Act, all public authorities including CFA and MFPCs should be administered so as to have regard for these objectives (S4). Works on public roadsides which may affect "protected flora" (S3) may require an FFG protected flora permit from the Department of Natural Resources and Environment (NRE) (S48). Given the extent of protected vegetation throughout Victoria, consultation with NRE during the planning phase is advisable.

Under the Planning and Environment Act 1987, Native Vegetation Clearance Controls are included in all planning schemes to restrict the removal of native vegetation except by Council permit. Currently, there are exemptions from gaining a permit under this legislation if the proposed clearance relates to firefighting measures, periodic fuel reduction, or other specified fire prevention works. Exemptions also apply to works carried out in accordance with the Code of Practice for Electrical Line Clearance prepared under S65 of the Electricity Safety Act 1988.

It is the responsibility of agencies or individuals proposing works on roadsides to ensure that they meet all relevant legal obligations.

Information on the location and management requirements for sites of conservation significance in Victoria can be obtained from Flora and Fauna Officers in NRE regions. Further information on matters of national significance can be obtained from Environment Australia.

ROADSIDE MANAGEMENT PLANNING

Roadside management is a responsibility shared by municipalities and VicRoads within the Country Area of Victoria. DNRE is responsible for those roads that cover the Fire Protected Area (ie. State Forests, National Parks, State Parks and other protected public land). Road managers are assisted in their task by advice and training programs provided by the Roadside Conservation Advisory Committee (RCAC). Municipal Fire Prevention Committees are provided with opportunities to include requirements considered necessary for fire prevention. These requirements must be based on fire management objectives identified through the Municipal Fire Prevention Planning Process. For comprehensive information about how fire prevention planners can become involved in the Roadside Management Planning Process, refer to Roadside Management Guidelines for Fire Prevention Planners (CFA, 1994). More information about the roadside management planning process is available from DNRE or the Municipalities. Guidelines for Roadside Management have been published by RCAC (1995).

MUNICIPAL FIRE PREVENTION PLANNING

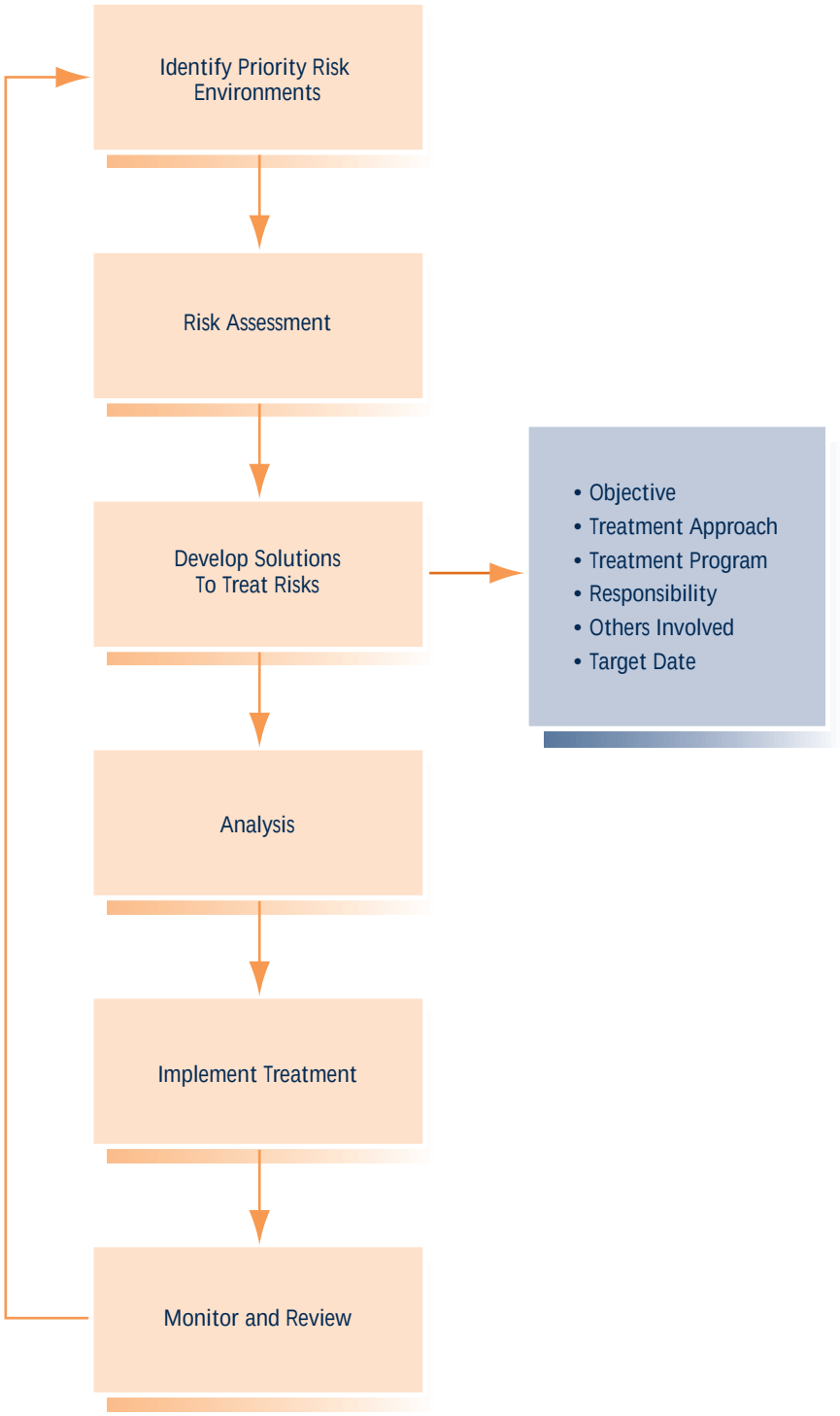
The Municipal Fire Prevention Guidelines (CFA, 1997) provide guidance to Municipalities in developing their Fire Prevention Plans. They provide a process for the identification of fire risks and development of treatment programs. However, they do not provide treatments or guidance on their application.

Community consultation during the Municipal Fire Prevention Planning process and the Roadside Management Planning process will ensure community acceptance and ownership of the plans.

The Municipal Fire Prevention Planning Guidelines are based on the application of the Risk Management Standard (Standards Australia/Standards New Zealand 1995). Risks to the community are identified and suitable treatments developed and implemented to prevent fires from occurring or to minimise their impact on the community (see Figure 1).

When considering the risk of wildfire and potential impacts on the community, management of roadsides may assist in mitigating this risk.

Figure 1. Steps Of The Municipal Fire Prevention Planning Process



part b
ROADSIDE FIRE MANAGEMENT

These Guidelines will assist with:
1. Identification of management objectives;
2. Identification and assessment of treatment options; and
3. Development of roadside management programs.

For most municipalities, risk treatments for wildfire risks may involve specific roads or roadsides. These Guidelines are intended for use by people involved in the management of roadsides to prevent or mitigate the impact of wildfires. The Guidelines will assist with the assessment of proposed treatments and selection of most appropriate solutions.

The Guidelines are organised according to five management objectives. For each objective, the information guides the user to the most suitable treatment. A range of treatment options is presented, with technical information (where available) to indicate the likely success of treatments in various situations.

OBJECTIVES OF ROADSIDE FIRE MANAGEMENT

Effective risk management requires clear objectives. Although road user safety is always a priority, there are a number of objectives of roadside fire management:

1. Prevent Fires on Roadsides

   The causes of ignitions may be natural, accidental or deliberate. Programs which target the behaviour of those responsible for such fires are likely to be most effective.

2. Contain Roadside Fires

   To prevent roadside fires becoming large and uncontrollable, we need to manage the factors that affect fire spread. Few treatments will be successful unless fire suppression is also undertaken. Changing the nature, quantity and arrangement of the fuel are treatments that may reduce the rate of fire spread and/or ensure the earliest possible suppression.

3. Manage Safety of Road Users

   Research suggests that roads are unsafe during the passage of a fire front. People can tolerate only low levels of radiant heat without some protection. While cars offer some protection from low intensity fires, they will not protect people in moderate to intense grass fires or in any location where scrub or forest abut the road. Strategies should aim to reduce the likelihood of people being on roads during the passage of a fire front.

4. Provide Control Lines

   Roads, combined with fuel modification, may provide an opportunity to limit the spread of large fires. They provide good access for suppression activities and an existing fuel-modified, continuous break.

Direct frontal attack on moderate to intense wildfires is unlikely to be safe or effective unless there is considerable modification in the fire intensity as it approaches the control line. Spotting may limit the success of a control line while elevated fuels may enable flames to cross roads and firebreaks. Treatments should provide or utilise large fuel-modified areas abutting roads.

5. Recovery From Roadside Fires

   Restoring normal community function following a major wildfire will help to reduce the impact of the fire on the community. The road infrastructure is an important asset to the community and its service ability following a major fire will be critical to the community's recovery.

RISK TREATMENTS

Risk treatments should offer solutions to address the identified roadside management objectives. Each treatment option must be evaluated to ensure that the most effective treatments are implemented.

CONSIDERATION SHOULD BE GIVEN TO:

- factors limiting success;
- financial costs;
- other impacts including environmental and social;
- other benefits; and
- alternative treatments.

IMPLEMENTING TREATMENT PROGRAMS

Implementation programs should include:

- identifying the agencies or individuals responsible for implementing and supporting the programs;
- establishing appropriate time frames;
- developing the necessary budgets; and
- monitoring of performance and establishing review procedures to ensure that the strategies are effective and appropriate.

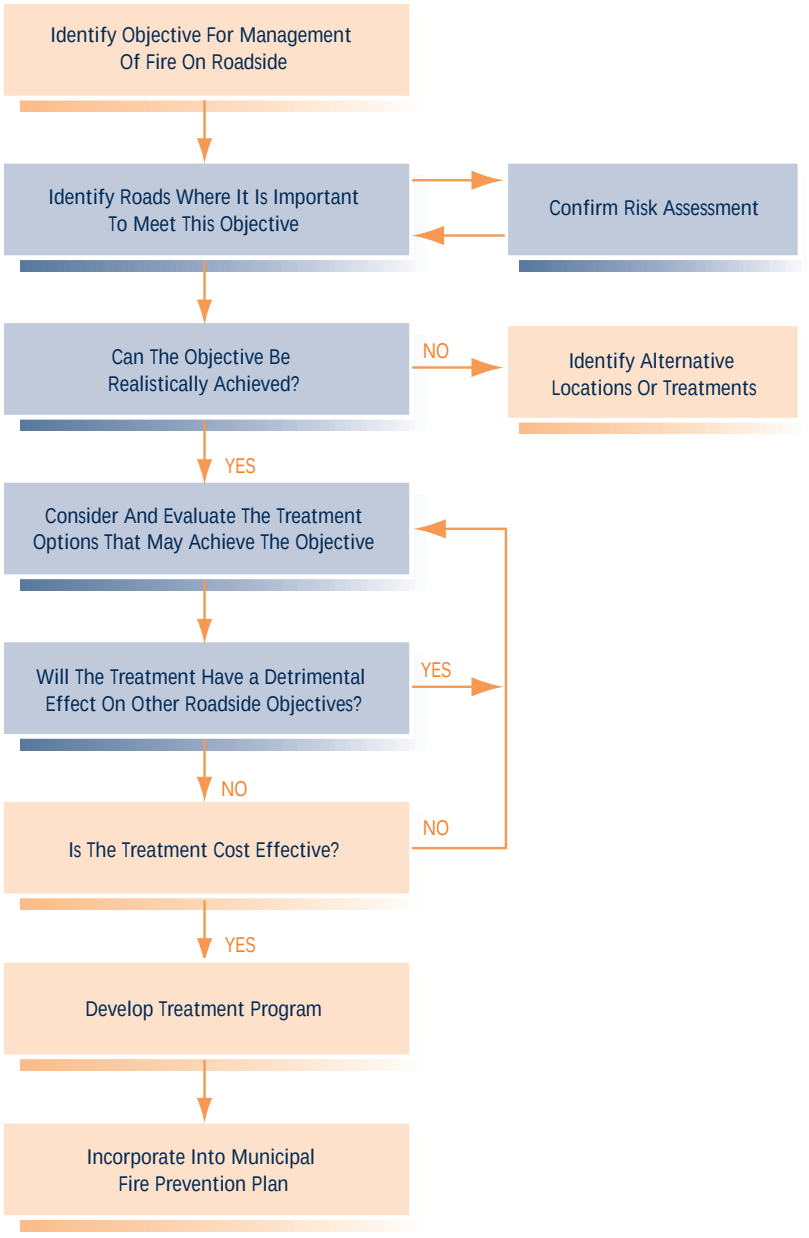
OUTCOMES

If the process (summarised in Figure 2) is followed, and the information is incorporated into the Municipal Fire Prevention Plan, planners will have a document which:

- identifies priority risk environments;
- identifies the objectives of roadside fire risk management;
- identifies locations where these objectives will be met;
- identifies treatments which will achieve the objectives;
- provides information to include in the Municipal Fire Prevention Plan;
- can be used in developing a roadside management plan; and
- can be used to manage implementation of treatment programs.

Figure 2. This chart outlines the steps to be taken once the wildfire risk has been identified, and an objective has been identified that can be met by managing the roadside.

Roadside Risk Assessment Process



Objective 1: Prevent Fires on Roadsides

RISK ASSESSMENT

1. What are the causes of ignitions?
2. Which are most common or likely?
3. Where did they occur?
4. What are likely to be the consequences if ignitions occur?

Preventing Fires on Roadsides

1. By eliminating the sources of ignition.
2. By promoting fuel conditions adjacent to the roadside that will not support combustion.

The key causes of roadside fires are:

- deliberate; especially where there are abundant weeds or debris adjacent to the road, where these may be targetted for unauthorised/deliberate fires.
- vehicles; faulty exhausts, brakes, wheel bearings, particularly where vehicles may be slowing or under load.
- machinery/equipment; mowing or slashing causes sparks where metal may contact rocks or other metal
- discarded cigarettes; where fuels are exceptionally dry and fine, and only if fully cured.

Where fire causes are unknown, particular efforts should be made to find out these facts through proper fire investigation.

TREATMENTS THAT MAY PREVENT FIRES ON ROADSIDES

1. Education

Fire safety messages specific to ignition sources can be included in education campaigns. The messages should address major causes of ignitions.

For vehicle related causes, education messages can be delivered through licencing and registration agencies and by people involved with driver training, vehicle maintenance and repair.

For deliberate ignitions, fire agencies, police and municipalities should consider joint approaches and community programs. For juveniles, the Juvenile Fire Awareness Intervention Program (JFAIP) can be utilized (Refer to CFA Regional Office for information).

2. Regulation of Ignition Sources

Regulation and enforcement are inextricably linked to community education programs. There are many legislative requirements in place to restrict ignition sources:

- CFA Act S38, S40 — Permits to burn, Total Fire Bans
- Electricity Safety Act S65 — Power line clearances
- CFA Act S50 — Motor vehicles / machinery / equipment

In protected public lands, sections 61-72 of the Forests Act are relevant.

3. Provision of Fuel free Areas

For those ignitions that relate to the use of the road by vehicles, including the discarding of smokers' materials from vehicles, the separation of the ignition source from any flammable material will prevent the ignition of a wildfire. This may require a fuel free area where the ignition source (the vehicle and the activities of the occupants) may be located.

For ignitions emanating from hot parts of the vehicle (e.g. brakes, exhausts), there should be no opportunity to contact combustible material should the vehicle pull off the road for any reason.

One strategy is to provide a pull-over lane of adequate width (3m) to offer driver safety as well as separation from combustible fuel. Ploughed ground immediately adjacent to the road may be hazardous for vehicles leaving the road. However, a graded strip of 3m will provide the desired fuel free area. In some cases a fuel free shoulder will be sufficient. In others a slashed verge adjacent to the road shoulder may be preferred if the road shoulder width is inadequate. The slashed verge should be maintained at 10 cm height during the fire danger period. For specially constructed pull-over areas such as picnic, toilet and rest areas, the trafficable sections should be clear of combustible materials, as these are areas where vehicle occupants may discard materials which may initiate fires.

Material ejected from a moving or stationary vehicle may result in a fire if the material makes contact with combustible fuel such as sparse grass in a ploughed area and grass in a slashed area.

Well maintained road reserves may reduce the incentive for deliberate ignitions where this may be a problem.

EVALUATION OF TREATMENTS THAT MAY PREVENT FIRES ON ROADSIDES

Table 1 provides a summary of the limitations and the benefits of the various treatments.

Table 1. Treatments That Can Reduce the Occurrence of Roadside Fires

TREATMENT	FACTORS LIMITING SUCCESS	OTHER IMPACTS	OTHER BENEFITS
Education	• Changing behaviour is a long term process • Adequate identification of fire causes		• May enhance general wildfire knowledge • Supports regulators' approach
Regulation of ignition sources	• Enforcement • Considerable time period for development • Adequate identification of fire causes		
Adequate horizontal separation from fuel adjacent to road (fuel free shoulder)	• Will not cater for material ejected from moving vehicles • Must be maintained during the Fire Danger Period • Addresses ignitions caused by hot vehicle parts and materials discarded by occupants of stationary vehicles	• May damage road edges • Erosion • Ground disturbance may encourage weed invasion • Visual impact • Environmental and OH&S concerns about herbicide use	• May improve road safety sight lines
Vertical separation between fuel and vehicle (10 cm height one vehicle width [3m] adjacent to road shoulder or on trafficable road verges)	• Must be maintained during the Fire Danger Period • Addresses ignitions caused by hot vehicle parts	• Alteration of grassland ecosystem	• Provides some protection for road users during wildfire

SELECTING TREATMENTS

- What are the reasons you have selected this treatment?
- What do you expect this treatment to achieve?

RECOMMENDATION

The level of treatment is based on the level of risk. The level of risk is defined by the type of road as classified by VicRoads on the basis of volume of traffic and the strategic importance of the road.

SOME RISKS SHOULD BE ADDRESSED ON A CASE BY CASE BASIS:

- Areas with a documented high level of ignitions
- Roadsides to the north and west of adjacent high wildfire risk areas, such as subdivisions nestled in forest, where it can be shown that risk treatments on the roadside are critical to the overall risk management.

Table 2. Recommended Treatments to Reduce Roadside Fires

	LOW RISK	MODERATE RISK	HIGH RISK
	Municipal Roads	Class B and C roads	Class M and A roads
Recommended Treatments	• Regulation • Education	• Regulation • Education	• Regulation • Education • Fuel free shoulder maintained during fire danger period

Objective 2: Contain Roadside Fires

RISK ASSESSMENT

1. What is the history of roadside ignitions in this area?
2. What will the fire behaviour be if it leaves the road reserve?
3. What is the extent of fire prevention works on adjoining land?
4. What is the response time of suppression forces to this location?
5. What is the consequence if the fire is not controlled on the roadside?

The spread of fires on roadsides may be minimised by:

- rapid suppression; and
- mitigation of spread through fuel management.

For suppression to be effective in containing the fire to the road reserve, the fire must be burning under low fire danger. At fire danger levels of moderate or above, it is likely that the fire will have left the reserve before suppression resources arrive as shown in Table 3.

Table 3. Estimated time taken for a fire that starts on the side of the road to spread off the reserve, if grass is slashed or standing

GRASSLAND FIRE DANGER	POTENTIAL RATE OF FORWARD SPREAD (m/min)	TIME TAKEN TO REACH EDGE OF RESERVE IF DISTANCE FROM ROAD IS:*	
		10 m	20 m
Low	2-3	3-6 min.	6-12 min.
Moderate	8	1 min.	2 min.
High	20-30	20-30 sec.	1 min.
Very High	83	7 sec.	20 sec.

Assumptions: Flat ground, grassland 100% cured, rate of spread assumed to be related to fire danger. Calculations are based on Cheney and Sullivan 1997.

** Time taken to reach edge of road reserve may be longer depending on how long it takes for the fire to build. Until fires reach a width of about 100 m, their rate of spread is less than their potential rate of spread.*

Mitigation of fire spread through fuel management may include the use of fire breaks and/or fuel modification. Bare earth fire breaks have limited success if there is any spotting activity.

The effectiveness of bare earth fire breaks has been shown to be related to the width of the break, the fire intensity and the presence or absence of trees within 20 m. The likely intensity of fires that start on roadsides may be estimated by their likely rate of spread and the fuel load using the following rule of thumb:

$$I = 500 \times w \times R,$$

where I is the fire intensity (kW/m),
w is the fuel load (less than 6mm diameter) in tonnes per hectare (t/ha),
and R is the rate of spread of the fire front in km/h

Table 4: Fire Intensities (kW/m) for Various Combinations of Fuel Load and Rate of Spread

GRASSLAND FIRE DANGER (MCARTHUR MARK IV)	RATE OF SPREAD (km /h)	FUEL LOAD (t/ha)					
		1	2	3	4	5	6
low	0.1	50	100	150	200	250	300
low	0.2	100	200	300	400	500	600
moderate	0.5	250	500	750	1000	1250	1500
high	1.0	500	1000	1500	2000	2500	3000
high	2.0	1000	2000	3000	4000	5000	6000
very high	5.0	2500	5000	7500	10000	12500	15000

Direct attack likely to succeed

The fuel load is a measure of the amount of fine fuel (grass, leaf litter) per hectare and can be measured by fuel sampling techniques. (See CFA Manager Community Safety or DNRE Fire Management Officer for more information). However, for planning purposes the estimates given in Table 5 should be adequate.

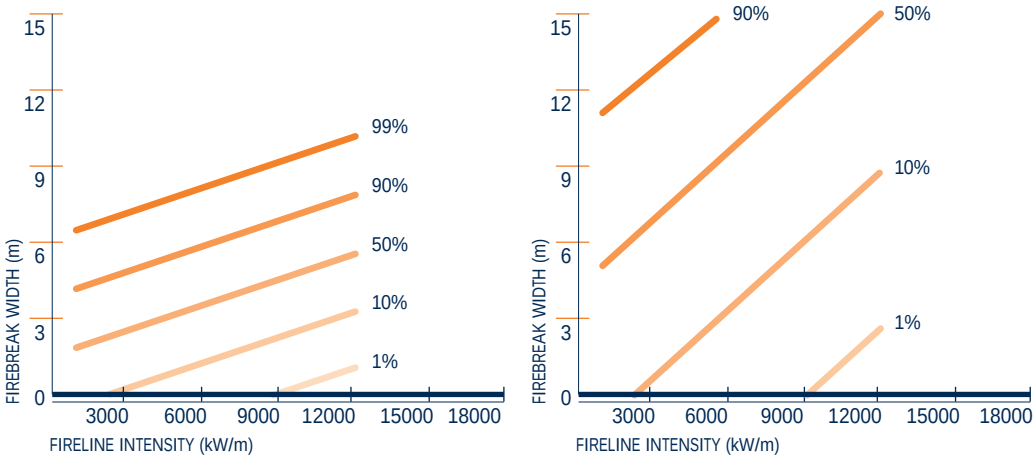
Table 5. Fuel Loads of Pastures

PASTURE CONDITION	FUEL LOAD (t/ha)
Very sparse	1
Sparse	2
Light	3
Good	4
Good - heavy	5
Heavy	6

This information can then be used to estimate the effectiveness of a firebreak in stopping a fire leaving the road reserve.

The graphs in Figure 3 indicate the likelihood of a fire break holding a fire in relation to the fire intensity and the width of the fire break . The information refers to fires approaching 'head on'. Flanking fires will be less intense and the fire break will be more likely to succeed.

Figure 3: Probability of a bare-earth fire break holding a head fire in grasslands with no elevated fuel.



Source: Cheney and Sullivan 1997, P70

TREATMENTS TO CONTAIN ROADSIDE FIRES

1. Suppression

Rapid suppression response is critical to contain fires in roadsides. When fire danger is high, regardless of fuel management, a fire is likely to leave the reserve in a matter of minutes (see Table 3).

2. Education

Education may include a pre-season campaign to encourage motorists to report ignitions as soon as they occur. Information about obligations to report fires may be included in licence testing. Consideration should be given to appropriate reporting for specific causes (i.e. need to minimise reporting of authorised burning), as well as an awareness of causes of roadside fires.

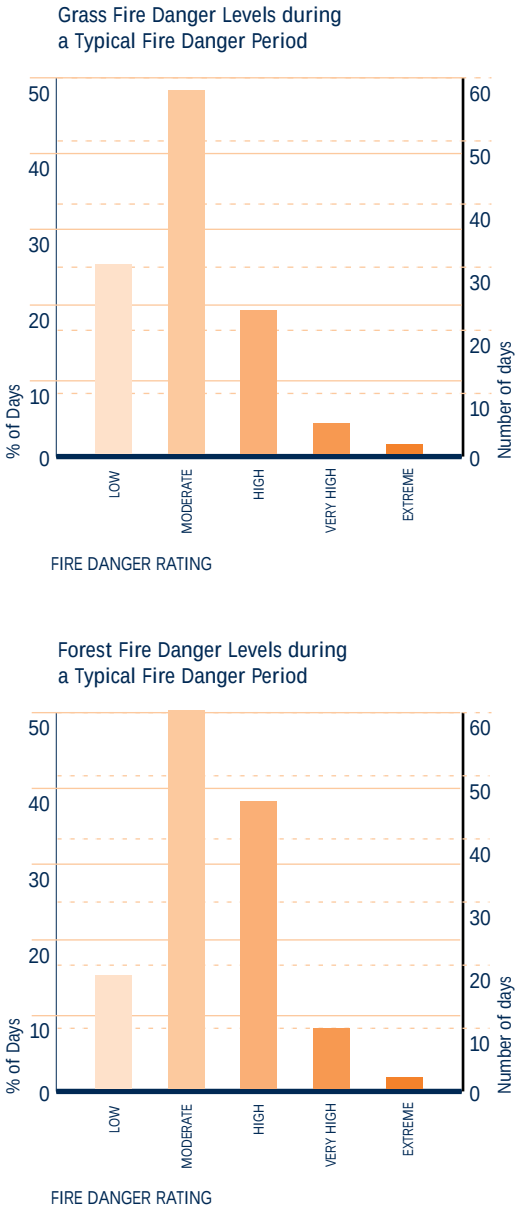
3. Slashing of Grass

The rate of spread of a fire in slashed grass is about the same as that in standing grass (Cheney and Sullivan 1997), but the flame height will be approximately halved.

3.1 Slashing of Grass From Road to Fence Line

Because of the reduced flame heights, suppression is more likely to succeed, but only if suppression forces arrive quickly. If the road reserve is mostly grassed and the grass is 100% cured slashed grass, and the fire danger is moderate, fire will cross a 10m reserve in about a minute (see Table 3). Slashing the full width of a road reserve is unlikely to achieve the objective of keeping fires contained to the road reserve unless fires are burning under low fire danger. To illustrate, Figure 4 provides information on the historical fire danger during an average season at Bendigo.

Figure 4. Fire Danger Levels for an average season at Bendigo



This information was derived from the weather records at Bendigo over a period of 11 years. The graphs are indicative only. These graphs can be used in conjunction with Tables 3 and 4 and Figure 3 to estimate the number of days that various fuel treatments may be effective, or ineffective.

When fire danger is high, regardless of fuel management, a fire is likely to leave the reserve in a matter of minutes.

3.2 Slashing of Grass Along Fence Line

If there are no trees present, the reduced flame height may be beneficial to preventing a fire from breaching an adjacent clear earth break through direct flame contact. If trees are present, the fire break is likely to be breached by spotting activity.

4. Ploughed Or Graded Fire Break

Ploughed or graded fire breaks are generally clear of fuel but may contain some combustible material in which case their effectiveness will be more like a slashed area and they should NOT be considered equivalent to bare earth breaks. Bare earth breaks should be close to the road, as the further a fire has spread, the more severe its behaviour and the more likely it is to breach a break.

4.1 Ploughed Or Graded Fire Break Along Fence Line

The effectiveness of bare earth fire breaks depends on the width of the break, the fire intensity and the presence or absence of trees and shrubs within 20m. For road reserves with heavy grass fuel loads, if there are trees present on the road reserve, the success of a 3 m bare earth fire break is limited to about 20% on fire danger days above moderate.
If there are no trees, this break would be

The effectiveness of bare earth fire breaks depends on the width of the break, the fire intensity and the presence or absence of trees within 20 m.

effective on about 50% of occasions. For a 6m bare earth break, the success rates are about 40% and 95 % with and without trees respectively. The likely intensity of fires that start on roadsides may be estimated by their likely rate of spread and the fuel load (see Tables 3, 4 and 5).

The predominant wind direction will affect the likely success of the fire break. The presence of trees within 20m up wind of the break greatly reduces the effectiveness of the break.

If the vegetation on the road reserve is environmentally significant and the adjacent land is cleared, it may be preferable to situate the break on the adjacent land. However, consultation with land holders is essential.

4.2 Ploughed Or Graded Fire Break Through Road Reserve

Ploughed or graded breaks which meander through treed areas are of minimal benefit in halting fire spread and can only be expected to be effective under low fire danger conditions.

5. Fire Break on property adjacent to Road Reserve

Fire breaks could be located away from the road reserve. The success of the breaks may be estimated by the graphs in Figure 3. Roadside managers should seek to cooperate with land holders.

6. Fuel Reduction Burning

Fuel reduction burning on the road reserve may reduce surface fuels to a minimum and deprive an ignition source of fuel. In areas where there is a history of successful fuel reduction burning and where there is no dispute over the application of this treatment, it is suggested that the practice continue where it clearly addresses this objective.

Fuel reduction burning should be carried out along ecological principles. In very general terms, burning vegetation in patches, or mosaics, roughly every five years is suitable.

Fuel reduction burning may follow the application of herbicides to prematurely kill exotic grasses prior to the Fire Danger Period and permit safe burning. Herbicides must not be used on native vegetation, including grasses, prior to burning. The use of herbicides should follow all safety and environmental standards. (Refer to The Agricultural and Veterinary Chemicals Control and Use Act 1992 and Regulations 1996).

Fuel reduction burning should be carried out along ecological principles. In very general terms, burning vegetation in patches, or mosaics, roughly every five years is suitable. If the impacts of the burn on the local flora and fauna are not understood, then advice should be sought from the local DNRE office. Some burns may result in prolific weed species, such as phalaris, producing an annual management problem.

In the case where burning is suggested as a new treatment, a number of factors must first be considered.

- Can the burn be safely conducted?
- Is the area populated? If so, are there plans to notify all affected people? Will there be a risk to road users or the community?
- Are there people available who are skilled in the use of fire for prescribed burning?
- Are there resources available to assist with the suppression requirements of the burn? Burns must be patrolled to prevent escapes.

If the burn is planned during the Fire Danger Period, a permit must be issued by the Municipality. Existing roadside management plans (Municipal or VicRoads) should be taken into account. Liaison with DNRE to plan burning activities may provide for better use of resources and sharing of skills. A burn plan should also be developed as it can act as a checklist to ensure all relevant factors have been addressed.

7. Regulation of Fuel Management

Municipalities can require land holders to remove combustible materials to reduce the fire hazard. This approach has been widely used in the past around homes or on vacant lots, but not on roadsides. An integrated approach which combines roadside fuel management with directions given to landholders may enhance the effectiveness of works.

8. Fuse Breaks

In the situation where fires may spread along the roadside through uninterrupted stretches of fuel, fuse breaks across the roadside reserve may assist with containing the spread of fire. Driveways or other roads may effectively act as fuse breaks. The guidance for the width of the break is as for the width of fire breaks which run parallel to the road. Fuse breaks may also be used to provide fire vehicle access.

EVALUATION OF TREATMENTS THAT MAY CONTAIN ROADSIDE FIRES

Table 6 provides a summary of the limitations and the benefits of selecting various treatments.

Table 6. Treatments That Can Assist to Contain Roadside Fires

TREATMENT	FACTORS LIMITING SUCCESS	OTHER IMPACTS	OTHER BENEFITS
Suppression	• Time delays	• Work load on crews	
Education	• Changing behaviour is a long term process		• May enhance general wildfire knowledge
Slashing - all methods and locations	• Weather limited • Minimal slowing of fire • Relies on prompt suppression • Proximity of trees spotting • Regrowth	• Changes ecosystem • Weed invasion if done when native vegetation is flowering or setting seed • Prevents regeneration • Loss of biodiversity	• May increase sight lines • May provide some fodder • May assist with Objectives 3 and 4
Ploughed or graded fire break - all locations	• Weather limited • Proximity of trees spotting • Access • Topography • Width of break • Maintenance cost	• Weed invasion, possibly to a more hazardous vegetation • Changes ecosystem • Potential for erosion • May spread weeds and diseases	• May provide access • May protect fences
Fire break distant from road reserve	• Ability to manage • Area burnt will be greater	• Reduction in agricultural productivity	• Likely to have little environmental impact
Fuel reduction burning	• Opportunities to burn • Burn intensity and frequency too low or too high	• Environmental and safety issues (if herbicide used) • Changes ecosystems • Visual • Road traffic management • Smoke - health and safety • Potential for escapes	• Brigade training opportunity • Opportunity to manage ecosystem • Possibility to reduce bark hazard
Regulation	• Weather • Co-ordination	• Land owner onus • Difficult to maintain 'standards'	• Promotes fire awareness • Community pressure to be 'good neighbour'

SELECTING TREATMENTS

- What are the reasons you have selected this treatment?
- What do you expect this treatment to achieve?

RECOMMENDATION

The level of treatment should be based on the level of risk.

SOME RISKS SHOULD BE ADDRESSED ON A CASE BY CASE BASIS:

- Areas with a documented history of ignitions
- Roadsides to the north and west of adjacent high wildfire risk areas, such as subdivisions nestled in forest, where it can be shown that risk treatments on the roadside are critical to the overall risk management the adjacent area.

Objective 3: Manage Safety of Road Users

RISK ASSESSMENT

1. What is the likely fire behaviour along this road?
2. What is the traffic volume of this road?
3. How important is this road in providing access and egress?
4. Are there optional routes?

Research suggests that roads are unsafe for the travelling public during the passage of a fire front. Vehicles offer some protection from low intensity fires, if they stay on a cleared area and people remain inside their vehicle. In any location where scrub or forest abut the road, fire intensity is likely to be life threatening inside the vehicle. Solutions which reduce the likelihood of people being on roads during the passage of a fire front will be most effective.

Another option is to provide 'safe areas', such as a heavily grazed paddock. Such areas will require adequate maintenance, access and signposting to ensure their viability. Some roadside rest areas may be suitable. This option relies on people remaining in their vehicles.

However it is unwise to assume that fuel management techniques alone can protect road users.

The risks of driving on roads during fire events are not restricted to exposure to the fire itself. Reduced visibility under stressful circumstances, can result in road accidents.

TREATMENTS TO MANAGE SAFETY OF ROAD USERS

1. Planning

Planning should identify roads that will be critical during a wildfire including those that are essential to access or egress for local populations or temporary populations such as holiday makers. Planning may also include the preparation of safety areas on high risk roads. Well known high risk roads which fire fighting agencies have expressed concern about using, are probably also those roads which the public should not be using. Planning should also consider early road closures which may be specified in the Emergency Management Plan.

2. Education

Information about safety on roads during wildfire could be included in driving licence testing and pre-season signage and campaigns could provide information on safety use of roads during fires. There are also opportunities to link to other educational programs which advise residents about their safety strategies. Information about the causes of roadside ignitions could be provided.

3. Fuel Management

While there have been many instances of people surviving the passage of a fire in vehicles, there is also considerable evidence that being caught on the road is dangerous (Wilson 1985, Krusel and Petris 1992).

People can only tolerate low levels of radiant heat. Vehicles may provide some protection from low intensity fires with flame heights of only a couple of metres. They will not protect people in moderate or intense grass or forest fires.

Estimates of flame heights of fires of varying rates of spread in grassland fuels are provided in Table 7, and for forest fuels in Table 8.

Table 7. Flame Heights in Pastures

RATE OF SPREAD (km/h)	FLAME HEIGHT (m)		
	NATURAL PASTURE	GRAZED OR MOWN PASTURE	EATEN-OUT PASTURE
1	1.8	0.9	0.3
6	3.1	1.3	0.5
10	3.6	1.5	0.7
20	4.4	1.9	-

Source: CSIRO Grassland Fire Spread Meter 1997

Table 7 shows that flame height can be reduced significantly by modifying the fuel.

If there are trees and elevated fuels present, flame heights may be significantly greater than in grassland. The Overall Fuel Hazard Guide (McCarthy et al 1999) should be referred to for specific information on the contribution of bark and elevated fuels to fire behaviour. In general, the surface fuel, bark and elevated fuels all contribute to the fire behaviour.

If there are trees adjacent to the road reserve, their contribution to fire behaviour should be taken into account.

At elevated fuel levels above moderate to high, they become the dominant fuel in terms of fire behaviour. It is likely that for crown fires in forest fuels, the height of the flames will be considerably over the height of the trees. If there are trees adjacent to the road reserve, their contribution to fire behaviour should be taken into account.

Table 8. Estimated Flame Heights in Forests

FUEL LOAD (t/ha)	FLAME HEIGHT (m)				
	FIRE DANGER:				
	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5	0.3	0.6	1.5	3.0	6.0
10	1.0	2.0	4.0	7.0	14.0
15	2.0 3.5	7.0 12.0	crown		
20	2.5 5.0	9.0 crown	crown		
25	3.0 7.0	12.0 crown	crown		

Source: McArthur Mark V Forest Fire Danger Meter (1973)

The Overall Fuel Hazard Guide (McCarthy et al 1999) (Available from DNRE) can be used to estimate fuel loads from fuel hazard levels (see Table 9).

Table 9. Fuel Loads (t/ha) Estimated from Fuel Hazard Levels

FUEL	HAZARD:				
	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
Bark	0	0	2	5	7
Surface fine	2	5	10	16	20
Elevated	0	0	2	6	10

4. Traffic Management

Traffic management measures can protect road users by limiting the opportunity for road users to be threatened by fire. Traffic management plans should be incorporated into the Municipal Emergency Management Plans.

EVALUATION OF TREATMENTS THAT MANAGE THE SAFETY OF ROAD USERS

Table 10 provides a summary of the limitations and the benefits of selecting various treatments.

Table 10. Treatment Options to Manage the Safety of Road Users

TREATMENT	FACTORS LIMITING SUCCESS	OTHER IMPACTS	OTHER BENEFITS
Planning	• Requires cooperation with other planners (Municipal Emergency Management, CFA Operational Plans)		• Maximises the value of individual plans
Education	• Changing behaviour is a long term process		• May enhance general wildfire knowledge
Fuel Management	• In forest areas, road safety cannot be realistically achieved • Road accidents are not prevented • Extent of fuel reduction may be impractical • Relies on appropriate behaviour	• Reduction of environmental value • Reduction of road user amenity • Smoke management	• General road safety • May assist with objective 4 • Fuel reduction burning could enhance ecological values
Traffic Management	• Needs support of an education program otherwise creates problems for local residents • Requires good planning and implementation	• May hinder residents returning to their properties or may separate families	• Provides easier access for emergency vehicles • May be cost effective and practical compared to fuel management

SELECTING TREATMENTS
- What are the reasons you have selected this treatment?
- What do you expect this treatment to achieve?

RECOMMENDATION

The level of treatment is based on the level of risk. The level of risk is defined by the type of road as classified by VicRoads on the basis of volume of traffic and the strategic importance of the road.

Table 11. Recommended Treatments to Manage the Safety of Road Users

	LOW RISK	MODERATE	HIGH
	Municipal Roads	Class B, and C roads	Class A and M roads
Recommended Treatments	• Planning • Education • Traffic management	• Planning • Education • Traffic management	• Planning • Education • Fuel management • Traffic management

SOME RISKS SHOULD BE ADDRESSED ON A CASE BY CASE BASIS:

- Areas with a documented level of high ignitions
- Roads providing the only access or egress for vulnerable populations

Objective 4: Provide Control Lines

RISK ASSESSMENT

1. Are large fires likely in this area (is there a history of them)?
2. Are there adequate or better control lines than the road?
3. What are the consequences if the fire is not controlled at this point?
4. What are the chances of controlling a fire at this road ?

A control line is a natural or constructed low-fuel area or a fire edge used to control a fire (AFAC 1995). Roads may be useful as control lines if they are located in low fuel areas. Recent experience by CFA shows that control lines are most effective when they are adjacent to a substantial area of relatively non combustible fuel. This is usually where there is a major change in land use, for example, to a different agricultural use, a low lying swamp area or a river flat.

In a landscape which is predominantly grassland or cropping, the road reserve may be one of the more heavily treed parts of the countryside. In such cases, the road reserve is likely to be the least suitable place to plan a control line as the fire behaviour there will be more intense than in surrounding areas and fire fighter safety may be compromised.

If used for back burning, roadsides may provide safe anchor points from which to burn and they should be prepared so that there is minimal opportunity for spotting. In the case of treed roadsides, pre-season preparation by control burning should aim to reduce the ground, elevated and bark fuels. If the adjoining landscape is also treed, it should receive similar treatment. For this treatment to be included in fire prevention or roadside management plans, the intention to use a roadside for this purpose should be clearly stated in operational management and preparedness plans.

To be effective as control lines, roads need to be 'in the right place at the right time' with respect to the fire. This limits the effectiveness of planned control lines and they may not be practical unless they are specifically located to aid asset protection during wildfire.

TREATMENTS THAT MAY PROVIDE CONTROL LINES

1. Planning

The effectiveness of roads as control lines in fires is often limited by the speed of fire spread in rural Victoria. Planned control lines are more likely to be used and therefore more likely to achieve their objective. For this reason it is imperative that roads that may be used as control lines be identified in brigade and regional operational plans.

2. Education

Training of fire suppression and fire management personnel in fire behaviour and fire suppression should always be a high priority. Successful planning and use of control lines requires effective planning by the fire prevention managers, and effective application by the fire suppression people. As such, both groups need to understand the fire behaviour, suppression and safety aspects of control lines.

In a landscape which is predominantly grassland or cropping, the road reserve may be one of the more heavily treed parts of the countryside. In such cases, the road reserve is likely to be the least suitable place to plan a control line.

3. Fuel Management on Reserve (and Abutting Land)

Preparatory fuel management works on control lines will only be effective if the control lines are incorporated into Brigade plans and Regional Operational Management Plans, as fuel breaks will only be effective as control lines if supported by suppression activity.

When planning for control lines, firefighter safety is of paramount concern. Direct attack of fires can only occur safely on low intensity fires, therefore fuel management must substantially reduce the flame height for it to be effective. If located in or adjacent to fuels with spotting potential, road reserve treatment should be accompanied by treatment of the adjacent fuels to minimise the overall fuel hazard.

For control lines that may be used for back burning in rapid grass fires or in scrub and forest fires above moderate fire danger where indirect attack is necessary, the control lines must be located in low fuel areas. Fuel preparation requires minimising spotting potential by either pre-season control burning, or by preparation during the fire (e.g. raking, bull dozing).

EVALUATION OF TREATMENTS THAT MAY PROVIDE CONTROL LINES

Table 12 provides a summary of the limitations and the benefits of selecting various treatments to provide control lines.

Table 12. Treatments for Control Lines

TREATMENT	FACTORS LIMITING SUCCESS	OTHER IMPACTS	OTHER BENEFITS
Planning	• Requires cooperation with operational planners		• Adds strategic value to individual plans
Education	• Changing behaviour is a long term process		• More safe and effective suppression operations
Fuel Management	• Weather • Adjacent land use may render suppression unsafe • Trees or elevated fuels may render suppression unsafe • Cooperation of adjacent land owners may be hard to manage • Extent of fuel reduction may be impractical • Relies on effective on site suppression • Relies on effective planning with operational managers • Location is difficult to plan unless aimed at asset protection	• Reduction of environmental value • Reduction of road user amenity	• May assist with objective 3

SELECTING TREATMENTS

- What are the reasons you have selected this treatment?
- What do you expect this treatment to achieve?

SUMMARY

Treatments that utilise large low-fuel areas abutting roads will provide the most safe and effective control lines.

Treed roadsides may not provide good control lines as spotting activity may cause breach of the control line, and also be because firefighter safety may not be adequate. This may be especially so if there are no accessible low fuel areas to which firefighters and vehicles can retreat.

In general, direct head fire attack (even with the support of control lines) should not be attempted during high fire danger in grass fuels or when fire danger is moderate or higher in forest fuels unless there is a significantly modified fuel zone to reduce the fire intensity and the flame height.

If roads are to be used as control lines for indirect attack in back burning operations, adequate preparation must be done to minimise spotting. Pre-season burning or raking and bulldozing during the fire are needed.

Objective 5: Recovery From Roadside Fires

RISK ASSESSMENT

1. Is there any road infrastructure vulnerable to wildfire?
2. How disabling would the loss of these assets be to the community?

Restoring normal function to a community following a major wildfire will help mitigate the effects of the fire on the community.

The road infrastructure is an important asset to the community and its serviceability following a major fire will be critical to the community's recovery.

TREATMENTS TO ASSIST RECOVERY FROM ROADSIDE FIRES

1. Planning

Municipal Emergency Management Plans should identify and develop plans for reinstatement of infrastructure that is vulnerable to wildfire. Planned infrastructure works in high fire risk areas should be as resistant to fire as practical. Existing assets which are vulnerable should be identified (e.g. wooden bridges) and treatment plans developed.

Recovery of the road reserve itself after a fire should also be considered. An environmental recovery plan for significant roadside areas or roads with high conservation value should be considered.

Roadside management plans should be considered in any mop up operations. Heavy earth moving machinery may destroy high conservation areas, may facilitate erosion and poor management practices may spread weeds and pathogens.

Road users should be aware of the dangers associated with using the road both during and after a fire.

2. Education

The community should understand the demands placed on roads during bushfires. Road users should be aware of the dangers associated with using the road both during and after a fire, and should be kept informed about road status.

EVALUATION OF TREATMENTS TO ASSIST RECOVERY FROM ROADSIDE FIRES

Table 13 provides a summary of the limitations and the benefits of selecting various treatments.

Table 13. Treatments to Facilitate Recovery From Roadside Fires

TREATMENT	FACTORS LIMITING SUCCESS	OTHER BENEFITS
Planning	• Requires cooperation with other planners (Municipal Emergency Management, CFA Operational Plans) • Focus on short term recovery works may jeopardise long term roadside management plans or road maintenance activities	• Maximises the value of individual plans
Education	• Changing behaviour is a long term process	• May enhance general wildfire knowledge

SELECTING TREATMENTS

- What are the reasons you have selected this treatment?
- What do you expect this treatment to achieve?

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ROADSIDE RISK ASSESSMENT PROCESS

THE RISK ASSESSMENT PROCESS

The assessment of wildfire related risk of roadside reserves will support Municipal Fire Prevention Planning and facilitate Roadside Management Planning.

A systematic risk assessment of categories of roadside reserves and specific sites should enable high risks or high priorities to be identified and addressed.

This section provides a summary of the risk assessment process and outlines treatments or management options that can address risks.

In some situations, many kilometres of roads will be assessed as one risk type or category. In other cases, small stretches of road, such as rest areas, will need to be considered separately.

Worksheets and checklists are also provided to assist with field assessment and recording of information.

SUMMARY OF RISK ASSESSMENT PROCESS

Stage 1 : Research

Identify risk environments and specific sites to be assessed and consider the likely impacts on the community.

Stage 2: Assessment

The Roadside Risk Assessment Worksheets (1 & 2) provided with these guidelines should be used to record information about risk environments and proposed treatments.

As indicated on Worksheet 1, it is important to consider nearby assets including, residential, industrial and other populated areas, before selecting the objectives to be addressed using Worksheet 2.
For each risk environment or site, consider the five management objectives:

1. Prevent fires on roadsides
2. Contain roadside fires
3. Manage safety of road users
4. Provide control lines
5. Recovery from roadside fires

- Select objective(s) to be addressed
- Select treatments to help achieve the objective(s)

Stage 3: Recommendations

A. Identify high priorities for the community
B. Incorporate recommendations into Municipal Fire Prevention Plans
C. Develop implementation programs

SELECTING TREATMENT OPTIONS

The chart below is a summary of the treatment options available to achieve roadside risk management objectives. Choice of treatment for a given risk environment or site will depend on the characteristics of the site(s) and the likely impact on the community.

Selecting treatment options:

POSSIBLE TREATMENTS	LIMITATIONS
Objective 1: Prevent Fires Starting on Roadsides	
• Enforcement • Adequate identification of causes • Changing behaviour is a long term process • Regulation • Education • Fuel-free shoulder maintained during fire danger period • Vertical separation between fuel and vehicle (10 cm height one vehicle width [3m] adjacent to road shoulder or on trafficable road verges)	• Will not cater for material ejected from moving vehicles • Only addresses ignitions caused by hot vehicle parts and materials discarded by occupants of stationary vehicles • Must be maintained during the Fire Danger Period
Objective 2: Contain Roadside Ignitions	
• Bare earth fire break limitations- success rate for a 3m bare earth break: - in sparse grass - 70% High FDI; 55% V.High FDI; 35% Extreme FDI - in good grass - 60% High FDI, 0 at V.High or Extreme FDI - in heavy grass - 50% at High FDI, 0 at V.High or Extreme FDI	• Topography - fire breaks less likely to succeed on up slope fires
• Fuel reduction burning	• Opportunities to burn • Burn intensity too low or too high • Environmental considerations
Objective 3: Manage the Safety of Road Users	
• Planning (Municipal Emergency Management, CFA Operational Plans) • Education • Changing behaviour is a long term process • Fuel management to reduce the flame height and fire intensity • Traffic management	• Needs support of an education program otherwise creates problems for local residents (e.g. road closures)
Objective 4: Provide Safe and Effective Control Lines	
• Planning -road must be identified for this objective on operational plans • Fuel management to reduce intensity to 2-3000 kW/m and to minimise spotting	• Adjacent trees or elevated fuels • Weather • Recommended where supported by a change to a less hazardous land use (e.g. intensive agriculture)
• Education	• Needs to be linked to operational training
Objective 5: Recover From Fires Which Affect Roadsides	
• Planning (Municipal Emergency Management, CFA Operational Plans) • Education	

Roadside Reserve Categories

Clearly, the characteristics of the road reserve and of the adjacent land must be considered together. The aspect, slope and adjacent land vegetation or fuels of the road reserve and adjacent land will influence fire behaviour.

It is very important to describe and record the characteristics of the risk environment as part of the risk assessment.

The fuel categories suggested here can be used in combinations as appropriate to describe the vegetation of roadsides and surrounding areas.

To record this information on the Worksheets, just tick the appropriate box(es).

Bare Earth
(eg graded shoulder)

Grass

Scrub

Trees

ASSESSMENT NO:

worksheet 1

ROADSIDE RISK ASSESSMENT

Municipality _____ Grid Ref. _____

Brigade _____ Date _____

Site or Area Details _____ Facing (circle direction) _____

INSTRUCTIONS

Step 1. Indicate approximate slopes on sketch.

Step 2. Tick circle or circles below to describe vegetation.

Step 3. Indicate land use on adjacent land.

Step 4. Indicate width of road and roadside reserves.

Step 5. Indicate Fuel Load of adjacent land and reserves.

Step 1

	ADJACENT LAND	FENCELINE	RESERVE	ROAD	RESERVE	FENCELINE	ADJACENT LAND
Step 2				N/A			
Step 3 Land Use			N/A	N/A	N/A		
Step 4 Width (m)	N/A						N/A
Step 5 Fuel load (t/ha) or Fuel Hazard				N/A			

Estimate the Fuel Load by referring to Table 5 Use McCarthy et.al. 1999 to estimate Fuel Hazard

Length of road and reserve in this assessment (km): _____

Road Category (VicRoads) or municipal road: _____

Describe the surrounding residential, industrial and other populated areas: _____

Indicate, on a sketch, locations of likely assets and likely approach of wildfire:

Objective(s) to be Addressed: _____

Suggested Treatments:

1. _____

2. _____

3. _____

Assessment Completed By: _____

worksheet 2

SELECTING APPROPRIATE TREATMENTS

Objective 1: Prevent Fires Starting on Roadsides

Need to address this objective? Yes / No

What are the most likely causes of ignitions here?

What are likely to be the consequences if these ignitions occur?

Which treatments are realistic and worthwhile?

Objective 2: Contain Roadside Fires

Need to address this objective? Yes / No

What is the history of roadside ignitions in this area?

What will the fire behaviour be if it leaves the road reserve?

What is the extent of fire prevention works on adjoining land?

What is the response time of suppression forces to this location?

What is the consequence if the fire is not controlled on the roadside?

Which treatments are realistic and worthwhile?

Objective 3: Manage the Safety of Road Users in Large Fires

Need to address this objective? Yes / No

What is the likely fire behaviour along this road?

What is the traffic volume of this road?

How important is this road in providing access and egress?

Are there alternative routes?

Which treatments are realistic and worthwhile?

Objective 4: Provide Control Lines

Need to address this objective? Yes / No

Are large fires likely in this area (is there a history of them)?

Are there adequate or better control lines than the road?

What are the consequences if the fire is not controlled at this point?

What are the chances of controlling a fire at this road ?

Which treatments are realistic and worthwhile?

Objective 5: Recovery from Roadside Fires

Need to address this objective? Yes / No

Is there any road infrastructure vulnerable to wildfire?

How disabling would the loss of these assets be to the community?

Which treatments are realistic and worthwhile?

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APPENDICES

APPENDIX 1: CFA REGIONS

REGION 2	45 Chapel Street, Bendigo, 3550	(03) 5443 7444
Consists of:	Greater City of Bendigo (Part), Northern Grampians (Part), Mt Alexander (Part), Central Goldfields (Part), Loddon (Part) Buloke (Part) and Campaspe (Part)	
REGION 4	38 Henty Street, Casterton, 3311	(03) 5581 1114
Consists of:	Glenelg, Southern Grampians (Part) and West Wimmera (Part)	
REGION 5	P O Box 389, Hamilton, 3300	(03) 5572 3122
Consists of:	City of Warrnambool, Southern Grampians (Part), Moyne (Part) and Corangamite (Part)	
REGION 6	115B Bromfield Street, Colac, 3250	(03) 5232 1923
Consists of:	Corangamite (Part) and Colac/Otway (Part)	
REGION 7	61 Separation Street, North Geelong, 3215	(03) 5277 1499
Consists of:	Borough of Queenscliffe, City of Greater Geelong, Surf Coast, Golden Plains and Colac/Otway (Part)	
REGION 8	120-122 Princes Highway, Dandenong, 3175	(03) 9793 4088
Consists of:	Bass Coast, Casey, Frankston, Cardinia, Mornington Peninsula, French Island, Greater Dandenong and Kingston (MFB)	
REGION 9	24 Normanby Street, Warragul, 3820	(03) 5623 1180
Consists of:	La Trobe, Baw Baw and South Gippsland	
REGION 10	81 Macarthur Street, Sale, 3850	(03) 5144 2933
Consists of:	Wellington and La Trobe (Part)	
REGION 11	130 MacLeod St, Bairnsdale, 3875	(03) 5152 3048
Consists of:	East Gippland	
REGION 12	52 Tallarook St, Seymour, 3660	(03) 5799 1517
Consists of:	Greater Bendigo (Part), Murrindindi and Mitchell	
REGION 13	18-22 Lakeview Drive, Lilydale, 3140	(03) 9735 0511
Consists of:	Banyule (Part & MFB), Manningham (MFB), Knox, Maroondah (MFB), Nillumbik (Part & MFB) and Yarra Ranges	
REGION 14	14-15 Melton Valley Drive, Melton, 3337	(03) 9747 6014
Consists of:	Nillumbik (Part & MFB), Wyndham (MFB), Melton, Moorabool (Part), Hume (MFB) Banyule (Part & MFB), Hobson's Bay (MFB), Macedon Ranges (Part) and Whittlesea (MFB)	
REGION 15	1120 Sturt Street, Ballarat, 3350	(03) 5331 7966
Consists of:	City of Ballarat, Macedon Ranges (Part) Mt Alexander (Part), Hepburn, Central Goldfields, (Part) Moorabool (Part), and Golden Plains (Part)	
REGION 16	390 Barkly Street, Ararat, 3377	(03) 5352 5516
Consists of:	Rural City of Ararat, Northern Grampians (Part), Pyrenees, Moyne (Part) and Southern Grampians (Part)	
REGION 17	119 Firebrace Street, Horsham, 3400	(03) 5382 6672
Consists of:	Horsham Rural, Hindmarsh, West Wimmera, Northern Grampians (Part) and Yarriambiack (Part)	
REGION 18	Curlewis Street, Swan Hill, 3585	(03) 5033 1884
Consists of:	Rural Cities of Mildura and Swan Hill, Buloke (Part) and Yarriambiack (Part)	
REGION 20	173 Boundary Street, Kerang, 3579	(03) 5450 3406
Consists of:	Campaspe (Part), Loddon (Part), Buloke (Part) and Gannawarra	
REGION 22	270 Maude Street, Shepparton, 3630	(03) 5831 4075
Consists of:	Greater Shepparton, Campaspe (Part), Moira (Part) and Strathbogie	
REGION 23	22 Rowan Street, Wangaratta, 3677	(03) 5721 4122
Consists of:	Delatite, Indigo (Part), Wangaratta Rural and Moira (Part)	
REGION 24	Cnr Smythe & Stanley Streets, Wodonga, 3690	(02) 6056 3022
Consists of:	Wodonga Rural City Council, Indigo Shire Council (Part), Alpine Shire Council and Towong Shire Council	

APPENDIX 2: GLOSSARY OF TERMS

Sources: AFAC Rural Fire Terminology, McCarthy *et al*. 1999, Standards Australia / Standards New Zealand 1995, VicRoads Road Design Guidelines 1997.

Available fuel	The portion of the total fuel that would actually burn under various specified conditions.
Back burning	A fire started intentionally along the inner edge of a fire control line to consume the fuel in the path of a wildfire.
Bark fuel hazard	The type of bark fuel expressed in terms of one of five categories related to the general suppression difficulty of a fire.
Burn plan	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.
Direct attack	A method of fire attack where wet or dry firefighting techniques are used. It involves suppression action right on the fire edge which then becomes the fire control line.
Elevated fuel	Elevated fuel comprises shrub, heath and suspended material.
Elevated fuel hazard	The amount and structure of elevated fuel expressed in terms of one of five categories related to the general suppression difficulty of a fire.
Fire break (or fuel break)	Any natural or constructed discontinuity in a fuel bed used to segregate, stop, and control the spread of a wildfire, or to provide a fire line from which to suppress a fire.
Fire control line	A natural or constructed barrier, or treated fire edge, used in fire suppression and prescribed burning to limit the spread of fire.
Fire Danger Index (FDI)	(or Fire Danger Rating) A relative number denoting an evaluation of spread, or suppression difficulty for specific combinations of fuel, fuel moisture and wind speed.
Fire Danger Period	Refers to the Country Area of Victoria and means the period declared under the CFA Act to be the fire danger period. Declaration is by publication in the Government Gazette, and is by the Chairman of CFA after consultation with the Secretary of the Department of Natural Resources and Environment.
Fire hazard	Any fuel which if ignited, may be difficult to extinguish.
Fire prevention	All activities associated with minimising the incidence of wildfires, particularly those of human origin.
Fire protection	All activities designed to protect an area (including life, property, assets and values) from damage by fire.
Fire risk	The probability of fire starting.
Flank attack	Obtaining control of a fire by attacking its side/s (flank/s).

Fuel load	(or fuel quantity or fuel weight) The oven dry weight of fuel per unit area. Commonly expressed as tonnes per hectare.
Indirect attack	The use of back burning as a method of suppression to confine the fire within a defined area bounded by existing or prepared control lines. Control lines may be a considerable distance ahead of the fire.
Overall fuel hazard	The sum of the influences of the bark hazard, the elevated fuel hazard and the surface fine fuel hazard.
Near surface fuels	e.g. grass tussocks, dead bracken, low shrubs or wire grass. Interact with surface litter to increase fire behaviour and are added to produce the surface fine fuel hazard.
Prescribed burning	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.
Risk	The chance of something happening that will have an impact on objectives; measured in terms of likelihood and consequences.
Risk assessment	The process used to determine risk management priorities by evaluating and comparing against target risk levels.
Road shoulder	The section of the road adjacent to the lane, usually of a slightly lower surface standard than the lane, but readily trafficable (see diagram).
Road verge	Verges are adjacent to the road shoulder. They provide a trafficable transition between the shoulder and the batter slope (see diagram).

Scrub	Refers to vegetation such as heath, wire grass and shrub which grows either as an understorey or by itself in the absence of a tree canopy.
Spotting	The ignition of spot fires from sparks or embers.
Spot fires	Isolated fires started ahead of the main fire by sparks, embers or other ignited material, sometimes to a distance of several kilometres.
Surface fine fuel hazard	The litter bed depth and near surface fuels expressed as one of five hazard classes related to the fire behaviour and the equivalent litter fuel load.
Wildfire	An unplanned fire. A generic term which includes grass fires, forest fires and scrub fires.

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