SC6.2 Bushfire management plans

SC6.2.1 Application

1. This planning scheme policy applies to development where an applicable code identifies Planning Scheme Policy 2 Bushfire management plans as supporting an outcome of that Bushfire hazard overlay code.
2. The bushfire overlay map used in the planning scheme is a state-wide detailed analysis of bushfire hazard areas. For more information about bushfire map methodologies — see SC6.2.5 Technical standards, below.

SC6.2.2 Relationship to the Planning Scheme

1. This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Planning Scheme and applies when development is proposed in an area identified on OM4 Bushfire hazard overlay. This Policy specifically relates to the assessment of Section 8.4 Bushfire hazard overlay code and ensuring development is consistent with the overall outcomes and performance outcomes specified in the code.

SC6.2.3 Purpose

1. The purpose of this planning scheme policy is to:
   a. identify the qualifications required to be held by the author of a bushfire hazard risk assessment and management plan;
   b. identify requirements for site assessments and management plans;
   c. provide supporting technical information, where relevant;
   d. provide supporting information on who should be consulted regarding adjoining landowners;
   e. identify other relevant guidelines, standards, and information sources, where relevant.
2. The planning scheme policy is arranged into the following sections:
   a. Qualifications;
   b. Technical standards;
   c. Definitions;
   d. Minimum requirements for management plans;
   e. Technical information for different types of bushfire hazard risk assessment;
   f. Consultation of relevant stakeholders.
3. An information request will be requested where the information required by this policy is not supplied when a development application is made.

SC6.2.4 Qualifications

1. The Bushfire management plan should be prepared and certified by a qualified and experienced bushfire management consultant, who has a minimum five years' experience in the assessment of bushfire hazard and risks and has one of the following qualifications:
   a. degree (AQF level 8) qualifications in environmental science, environmental management (or equivalent discipline); or
   b. BPAD Bushfire Planning and Design Accredited Practitioner Level 3;
   c. demonstrated experience in botanical survey and spatial analysis methods, including use of geographic information systems (GIS) software;
   d. demonstrated experience in the assessment of bushfire hazard and risks or technical qualifications in environmental science, environmental management (or an equivalent discipline).

SC6.2.5 Technical standards

1. The following guidelines and standards are relevant when preparing a Bushfire hazard risk assessment and management plan.
2. A reference in the policy to a specific resource, guideline, standard or document means the latest version of the resource, guideline, standard or document.

SC6.2.5.1 Guidelines

1. The following guidelines are relevant when preparing a Bushfire management plan:
   a. Leonard et al, (2014) A new methodology for State-wide mapping of bushfire prone areas in Queensland, CSIRO

b. Queensland Fire and Emergency Services (2017) Queensland Emergency Risk Management Framework: Risk Assessment Process Handbook, State of Queensland, Brisbane
c. Queensland Fire and Emergency Services (2019) Bushfire Resilient Communities: Technical Reference Guide for the State Planning Policy State Interest 'Natural Hazards, Risk and Resilience - Bushfire', State of Queensland, Brisbane
d. Queensland Government (2017) State Planning Policy Guidance Material
e. Queensland Reconstruction Authority (2020) Bushfire Resilient Building Guidance for Queensland Homes, The State of Queensland, Brisbane

SC6.2.5.2 Standards

1. The following standards are relevant when preparing a Bushfire management plan:
   a. Building Code of Australia (Australian Building Codes Board, as amended)
   b. Performance Standards for Private Bushfire Shelters (Australian Building Codes Board, 2010)
   c. Standards Australia (2010), A*ustralian Standard 3745-2010 Planning for emergencies in facilities*, SAI Global Limited, Sydney.
   d. Standards Australia (2012)*, Australian Standard 1851-2012 Routine service of fire protection systems and equipment*, SAI Global Limited, Sydney.
   e. Standards Australia (2018), *AS/NZS ISO 31000-2018 Risk management— Principles and* guidelines, SAI Global Limited, Sydney.
   f. Standards Australia (2018), *Australian Standard 3959-2018 Construction of Buildings in Bushfire-Prone Areas*, SAI Global Limited, Sydney.

SC6.2.6 Consultation

2. Council may seek third party advice or comment about an application where:
   1. development may conflict with a code; or
   2. technical advice is required to assess the development.
3. Where technical advice is outsourced to an independent consultant an additional fee will apply

SC6.2.7 Definitions

Bushfire Management Plan - A living document that sets out short, medium, and long-term bushfire risk management measures for the life of the development.

Bushfire Hazard risk assessment - A broad three tier categorisation of vegetation into hazard levels based on fuel characteristics.

BAL Contour Map - A scale map of the subdivision illustrating a bushfires potential flame length and radiant heat flux for the development site or proposed lot.

SC6.2.8 Minimum requirements for management plans

1. The Bushfire hazard risk assessment and management plan should provide the minimum in Table below:

Table SC6.2-1: Standard requirements for Bushfire hazard risk assessments and management plans

SECTION	DETAILS
Section 1: Introduction	This section should state the purpose, aims and objectives of the Bushfire hazard risk assessment and management plan.
Section 2: Development details	This section should include: a. site details, real property description and street address b. description of the proposed development and resulting land use/s; c. details of any relevant previous approvals; d. the date on which the assessment and any plans were prepared, including any amendments; e. name and relevant professional qualifications of the person/s preparing the assessment and management plan; f. plans that show as a minimum: north point, scale, location of property boundaries, roads, street names, vegetation location.
Section 3:	This section should include:

Environmental considerations	a. Bushfire risk management measures must be considered alongside environmental, biodiversity and conservation values. b. The BMP should identify whether onsite clearing or modification of native vegetation will be required; and whether areas are proposed to be revegetated as part of the planning proposal. c. The BMP should provide evidence that the vegetation clearing can be achieved. If vegetation clearing is not possible this needs to be acknowledged in the BMP. d. Where revegetation or restoration is proposed, the following should also be included: i. a landscape plan demonstrating that how the restoration work will be undertaken ii. what legislative instruments will be used to protect the restored area into the future; iii. who will be responsible for the ongoing bushfire management of the restored area.
Section 4: Bushfire hazard risk assessment and results	This section should include: a. Assessment inputs; i. the nature of activities to be conducted on the site, intended future population size and characteristics, usage patterns on the site, estimated traffic generation etc.; ii. direction of bushfire attack and risks posed from adjoining or nearby sites; iii. proposed storage or handling of hazardous chemicals; iv. access to the site for emergency services or disaster response purposes, location of evacuation routes and safety zones, warning, or evacuation requirements; v. environmental values and the total extent of any clearing, revegetation and landscaping proposed for the site as indicated on a site plan. vi. maps that show: 1. vegetation hazard class (VHC) survey locations within the site assessment area; 2. the extent and configuration of VHCs within the site assessment area before and after development, including any vegetation to be retained, revegetation areas and/or environmental offsets. b. Assessment outputs; i. results of any reliability assessment; ii. Bushfire Attack Level (BAL) contour map showing potential flame length and radiant heat flux; iii. potential fire line intensity and potential rate of spread. c. Summary of the results of the bushfire hazard risk assessment.
Section 5: Bushfire protection measures	This section should provide clear recommendations regarding: a. separation measures and location; b. siting, including development envelope area; c. access and evacuation routes; d. water supply; e. ongoing landscape and vegetation management practices and location.
Section 6: Assessment against the Bushfire Hazard overlay code	This section should provide: a. an assessment demonstrating consistency with the acceptable solutions and/or performance outcomes and/or overall code outcomes. b. justification for any variation from the measures outlined in the Bushfire hazard overlay code.
Section 7: Implementation responsibilities for bushfire hazard management	This section should: a. identify the parties responsible for any initial implementation and ongoing maintenance identified in the Bushfire hazard management plan to mitigate ongoing risk (e.g. landowners or occupiers of land, the developer, Council or others). b. Prepare Evacuation Plans or Procedures for landowners or occupiers of land to follow: i. how to monitor for bushfires; ii. an interpretation of the triggers to shelter or evacuate; iii. shelter on-site plan and procedures; iv. evacuation plan and procedures; v. bushfire season preparation ('get ready') plan (e.g. how to reduce fuel loads, maintain fire trails, evacuation drills etc.); c. details of consultation with any other agencies (e.g. Queensland Rural Fire Services) if applicable. d. Vegetation Management Plans, consistent with Planning Scheme Policy SC6.1 Biodiversity and Section 8.4 *Bushfire Resilient Communities: Technical Reference Guide for the State Planning Policy State Interest 'Natural Hazards, Risk and Resilience - Bushfire'* e. Landscape Management Plans, consistent with Planning Scheme Policy SC6.7 Landscaping and Section 8.5 Bushfire Resilient Communities: Technical *Reference Guide for the State Planning Policy State Interest 'Natural Hazards, Risk and Resilience - Bushfire'*
References	List of documents referred to in the study
Appendices	For example, maps, plans and diagrams showing detailed assessment or supporting material

SC6.2.9 Technical information for different types of bushfire hazard risk assessment

1. Bushfire hazard risk assessment (BHRA) determines the potential intensity of a bushfire in an area where the mapped area. The BHRA assessment is a pre-development decision-making tool used to inform the suitability of land for subdivision and development. After a site specific bushfire hazard risk assessment has been completed in accordance with *Bushfire Resilient Communities: Technical Reference Guide for the State Planning Policy State Interest 'Natural Hazards, Risk and Resilience - Bushfire'* further changes to the development may be necessary to demonstrate compliance with the overlay code.

SC6.2.9.1 Bushfire hazard risk assessment

1. A BHRA should be undertaken for any area identified for intensification of land use in the Bushfire hazard overlay areas.
2. A BHRA assessment should be prepared in accordance with AS.3959 and this policy.
3. The assessment methodology categorises the bushfire hazard level as low, moderate, high, or very high.
4. Provide photographic evidence in addition to aerial imagery and/or vegetation map data to verify low or moderate BHRA areas. Where evidence of the vegetation height is required (i.e. shrubland), a height stick, or other appropriate indicator of height should be included in the images.
5. Further evidence may be required if the decisionmaker is not satisfied with the photographic evidence provided.
6. All slopes within the BHRA assessment area need to be defined with land contour information.
7. Information to be included should include:
   a. An aerial image of the BHRA assessment area should form the base map and be overlayed with the following information:
      i. areas of classified vegetation and excluded vegetation (if any) in the form of plots;
      ii. land contours for slope calculation;
      iii. areas where vegetation is proposed to be cleared or revegetated (if applicable);
      iv. photo points to indicate where images of vegetation have been taken;
      v. any other features of the subject site and assessment area that are relevant bushfire considerations;
      vi. canopy crown density information should be provided for vegetation classifications that do not apply the worst case scenario.
   b. The Vegetation Classification Map should be presented separately from the BAL Contour Map to ensure the information is legible.

SC6.2.9.2 Bushfire attack level (BAL) contour map

1. The BAL contours will assist by identifying:
   a. land suitable for development; and
   b. bushfire risk management measures to reduce the potential bushfire impact to an acceptable level, such as BAL—29 or below.
2. The BAL Contour Map should be revised for each stage of a subdivision; and where a structure plan is modified.
3. A BAL Contour Map should be prepared in accordance with the principles of AS.3959 and based upon the bushfire hazard risk assessment.
4. Information on the BAL Contour Map should include:
   a. North point
   b. At a scale where individual lots can be clearly identified.
   c. An aerial image of the subject site and surrounding area should form the base map and be overlayed with the following information:
      i. boundaries of the subject site, the surrounding 150m vegetation assessment area and 100m BAL Contour assessment area.
      ii. the proposed lot layout, including proposed lot numbers, development envelope area.
      iii. BAL contours and proposed BAL ratings.
      iv. Show BAL contour in the colours shown **in the Table below:**

HAZARD LEVEL	COLOUR
BAL-40 and greater	Red
BAL-29	Orange
BAL-19	Yellow
BAL-12.5 and lesser	Blue

SC6.2.9.2.1 Compliance certification

1. Compliance certification should be undertaken by the Bushfire Planning Practitioner who prepared the original BAL Contour Map
2. Certification that the indicative BAL ratings are still accurate should be provided after the subdivision has been completed and ready to be placed on maintenance.
3. Certification will ensure prospective purchasers are aware of the identified BAL rating for each lot.

SC6.2.10 Consultation of relevant stakeholders

1. The following bodies should be consulted during the preparation of a bushfire management plan:
   a. Queensland Fire and Emergency Services (QFES) in relation to any elements of their proposal that do not conform to the acceptable solutions in the bushfire protection criteria or where a performance based assessment is proposed
   b. State Assessment Regulation Authority in relation to any clearing permit requirements ahead of lodging a planning application.
   c. Department of Environment and Scenic in relation to areas with significant environmental conservation values.
   d. Council in relation to locally significant native vegetation and other planning requirements;
   e. Seqwater for proposals abutting waterways.
   f. Department of Natural Resources and Water for proposals involving taking of water or have water resource implications.
   g. Local Rural Brigade to be provided with a final copy of the approved Bushfire management plan, where in a Rural or Rural Residential area, after the development has been completed.

SC6.2.11 Design requirements for fire trails

1. Fire trails are primarily used for fire management by QFES 4WD Medium and 4WD Light Response vehicles. Design criteria to ensure a fire trail can be safely traversed by 'heavy response vehicles' (i.e. 15 tonnes weight capacity) have not been included.
2. These trails that are dedicated provide access for both wildfire suppression and hazard reduction burn operations. The provision of a trail must demonstrate provide a secondary purpose for nature based recreation opportunities. Council will not accept fire trails that cannot be demonstrate a dual purpose.
3. When designing fire trails for 'heavy response vehicles' the design criteria for fire trails should be considered guidance.

Table SC6.2-2: Fire trail and working area design requirements

ELEMENT	DESIGN REQUIREMENT
Width	Contains a width of at least 20m including: 1. A *trafficable surface* (cleared and formed): a. with a minimum width of 4m that can accommodate a rural firefighting vehicle; b. with no less than 4.8m vertical clearance from canopy vegetation; c. with no adjacent inhibiting embankments or retaining walls. d. not on slopes that exceed 15%. 2. *A working area each side of the trafficable surface:* a. with a minimum width of 3m each side; b. cleared of all flammable vegetation more than 10cm in height. 3. The *balance* (i.e. 10m width (5m each side)) managed vegetation area: a. sited to separate the trafficable area from adjacent mapped medium, high or very high potential bushfire intensity areas managed vegetation. b. comprising managed vegetation that reduces the fuel load and is clear of major surface hazards (e.g. fallen branches).
Access Easements	Access easements are granted for Council and Queensland Fire and *Emergency Services* for firefighting purposes. *Note—An access easement that is provided for Council and QFES is to be maintained by the landowner.*
Egress	Contains trafficable vehicle routes in the low hazard areas, every 200m.

SC6.2.12 Fire trail construction guide

SC6.2.12.1 Introduction

1. The following provides a guide to the construction of functional and sustainable fire trails within land to be dedicated to Council.

2. The following section will:
   a. provide a framework for the construction of fire trails;
   b. fire trail construction practices to ensure safe access for bushfire suppression and hazard reduction burn operations;
   c. provide the framework for construction techniques that ensure a sustainable outcome;
   d. guide the construction of fire trails that can be safely traversed by medium and light response vehicles, only.

Table SC6.2-3: Definitions

TERM	DEFINITION
Asset protection zone (APZ)	A fuel reduced area surrounding or dividing built assets from potential bush fire risk. Vegetation within this planned zone is managed to minimise the transfer of fire to assets either from the ground level or through the tree canopy. The width of the APZ will vary with slope, aspect, vegetation and type oFigf building construction.
Bank retention	A constructed wall to retain banks and the cut left after a trail bench is formed. This retaining wall maybe rock filled wire baskets or suitably placed large rock.
Batter	Where the high side of the trail has been cut leaving a vertical wall, the wall is battered or cut back at an angle to minimise collapse and subsequent erosion. The minimum angle will be 45º in stable soils (see Figure SC6.2-1: Typical trail bench utilising outfall).
Bench or benching	Achieving a basic trail profile and shaping the trail surface to create an outfall (5%-8%). This outfall is to ensure overland flow is shed across and off the trail. In falling trails are not to be constructed (see Figure SC6.2-1: Typical trail bench utilising outfall).
Box drain	An excavated trench or area of the trail that is filled with aggregate to catch and/or direct water across the fire trail and provide a firm trafficable surface (see Figure SC6.2-8: Typical box drain and Figure SC6.2-9: Typical box drain & table drain combination).
Cultural heritage	Historical or anecdotal evidence of Indigenous and European artefacts, infrastructure, cultural and spiritual sites.
Drain mouth or outlet	A drain mouth is the exit point for water being shed from the fire trail. The drain mouth should be at least 35% wider than the entrance point of the drain to ensure free flow and self-cleaning (see Figure SC6.2-5: Typical example of watershed in plan view).
Fall line	A line that runs downhill at right angles to the contour lines, the path of least resistance for water to flow or the area over the topography most susceptible to erosion once disturbed (see Figure SC6.2-15: Fire trails must not be constructed along the fall line).
Fire trails	For this guideline, fire trails are dedicated access trails, suitable for 4WD Medium & 4WD Light Response vehicles utilised by QFES. These trails are to provide access for wildfire suppression, hazard reduction burn and reserve management operations.
Grade reversal	Alignment of the trail is to rise and fall over the topography, to create a rolling contour that sheds overland flow from the trail at the lower points. Design will always include outfall (see Figure SC6.2-16: Example of grade reversal).
Interface zone (iZone)	The iZone is the area of land where the bushland meets the infrastructure of the built environment. This is not a defined line but encompasses both the bushland and infrastructure development and defines an area of bushfire risk.
Outfall or crossfall	The trail bench is shaped to slope down to the outside of the trail and will be a minimum of 5% (see Figure SC6.2-1: Typical trail bench utilising outfall).
Silt trap	A small dam or wall of spoil at the end of water bars and drains. The silt trap function is to catch silt and slow the water flow at the drain mouth or outlet. Simply formed by leaving fill at the end of the drain mouth to catch water and allow it to soak or evaporate. The high point or wall of the silt trap must be low enough to ensure trapped water does not back up onto the trail bench.
Table drain	A table drain assists in lowering the water table in the trail and keeps the surface dry and firm where the boggy conditions are encountered. A constructed drain or trench is filled with aggregate that runs parallel to the trail where it intercepts and carries both surface and sub-surface water to a point where the water crosses the trail and exits with aid of a box drain at a water bar or relief culvert (see Figure SC6.2-6: Typical example of table drain in cut bench and Figure SC6.2-7: Typical example of table drains along level terrain).
Vegetation encroachment management	Defines the extent of vegetation clearing required along the fire trail corridor necessary to allow uninterrupted vehicle movement.

(VEM)	
Water bars (Whoa Boys)	A combination of a raised and lowered area of the fire trail surface that directs water across and off the trail. It is constructed by shaping the existing surface material to form a water diversion bar across the trail at a given angle (Figure SC6.2-4: Water bar orientation). The surface material used may need to be mixed with a high clay content road base, 25-40mm aggregate or 'geo-binder' to bind and harden the water bar against wear and movement if soil types are not suitable (see Figure SC6.2-2: Correct formation of water bar and Figure SC6.2-3: Incorrect formation of water bar).
Watersheds — Grade dips or spoon drains	A lowered section of the fire trail surface used to direct water across and off the trail. They are usually used on a curve, corner or at a natural change of grade (see Figure SC6.2-5: Typical example of watershed in plan view).

SC6.2.12.2 Environmental and legislative obligations

1. Ensure all Cultural Heritage Assessments have been completed over the proposed footprint prior to undertaking work consistent with the requirements of the *Aboriginal Cultural Heritage Act*.
2. Dial Before You Dig. The Contractor must ensure Services such as Electricity, Telephone Water and Sewage are not affected by construction and all necessary service checks are undertaken prior to the beginning of construction.
3. Ensure detailed flora and fauna assessments have been completed over the proposed fire trail alignment prior to undertaking work and consistent with the requirements of the *Nature Conservation Act* and the *Vegetation Management Act*.
4. Minimise all damage to vegetation adjacent to the fire trail footprint.
5. All surplus introduced material must be removed from site.
6. Ensure all relevant Local, State and Federal Environmental Legislative requirements are met and necessary approvals granted.

SC6.2.12.3 Design criteria for fire trails

SC6.2.12.3.1 Re-establishment of dormant fire trails

1. At times, it may be possible to use existing or renew disused trails. In some cases, these may have been established on a desirable contour and remain well grassed, well-shaped and adequately drained with negligible erosion impacts. In these cases, nothing further may need to be done to the trail surface. However, the trail may be covered by regrowth vegetation that will require removal. Some older, well established trails may even contain larger trees within the Vegetation management Zone (VMZ) that should not be removed when they can be isolated from elevated fuels and design criteria for vehicle clearance can be achieved. However, all regrowth is to be removed consistent with the VMZ Guideline (see Figure SC6.2-17: Vegetation encroachment management on fire trails).
2. If an existing trail shows signs of any major erosion, then all works must be undertaken in accordance with SC6.2.3.2: Building new fire trails.

SC6.2.12.3.2 Building new fire trails

1. New fire trails in most cases, will be constructed across and or on steep slopes. It is critical the cut batter height is minimised to maintain stability on both the up slope and down slope batters. Where a fire trail is to be constructed in conjunction with an Asset Protection Zone (APZ), the trail must have a minimum cleared width of 5.8m and minimum formed width of 3m. Where terrain contains steep grades exceeding 15%, deep natural drainage lines and side slopes exceeding 25%, it is preferable to realign the trail on more suitable grades to achieve a sustainable alignment.
2. Due to the steep grades passing or turning bays must be available every 200m along the trail. These passing or turning bays do not need to be constructed if the topography and side slope does not exceed 8%, and the vegetation density allows safe passing or turning.
3. Links to other fire trails, public roads and water supply infrastructure are to be provided for in the planning stage. These links are to be designed on safe and sustainable alignments.

SC6.2.12.4 Drainage

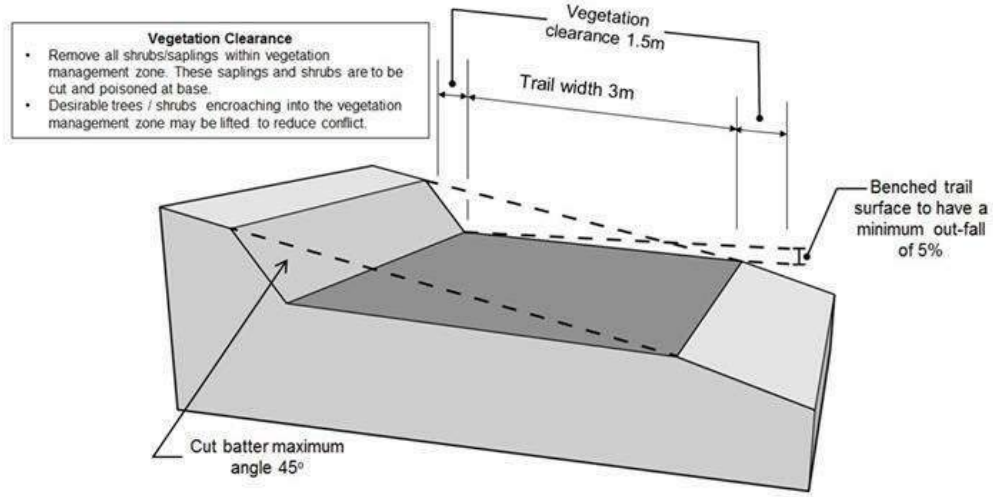
1. Drainage is the key factor in constructing sustainable low maintenance fire trails. Drains of various types, as explained in this guideline, when constructed correctly on existing soil types will save both construction and maintenance costs. Key elements for sustainable trail drainage and design, include:
   a. avoiding the Fall Line;
   b. utilising Grade Reversal;
   c. ensuring Outfall; and

   d. utilising Watersheds - Grade Dips or Spoon Drains.
2. Road drainage structures must be located, constructed and maintained in such a way that they will have enough capacity to convey the peak flow from a 1:5 year storm event.
3. Water bars are required on trails where sections of straight trail exceed 50m with trail gradients between 5% and 20%. When exceeding 8% on straight sections of trail use the detail in Table SC6.2-3: Trail gradient based on soil class with nominal water bar spacing as a reference.
4. Water's erosive capacity is influenced by the catchment directed onto the trail and the gradient on which the trail is constructed. The primary means used to decrease erosion is to locate trails on shallower slopes while ensuring effective drainage is installed to cope with both the velocity and volume of water movement on the trail.
5. Consideration of the catchment and overland flow above the trail is essential to plan the placement of drainage elements along the trail. In some cases, drainage may only direct water to the trail below. This can be acceptable as at least the flow has been removed off the trail above. Where water is directed to the trail below suitable drainage at this new point must be inserted into the trail.
6. A small outfall of 5% is recommended to be maintained along the trail surface with water bars installed at intervals and angles consistent with Table SC6.2-3: Trail gradient based on soil class with nominal water bar spacing. Soil type is a major consideration when constructing trails. Section SC6.2.8 Soil classes classifies the soil types likely to be encountered.
7. Other elements of drainage construction will be mentioned throughout the guideline. These elements of drainage will be used to improve drainage issues in specific locations where water bars would not be appropriate, effective or necessary.

SC6.2.12.4.1 Trail bench and outfall

1. The bench is the basic shape of the running surface of the trail and is constructed with 5-8% outfall (see Figure SC6.2-1: Typical trail bench utilising outfall). The bench will be a maximum of 3m wide with a vegetation clearance zone of 1.5m either side of the bench and vertical clearance consistent with Figure SC6.2-17: Vegetation encroachment management on fire trails. Grasses and ground cover are to remain to stabilise down slope edges.
2. The outfall is a critical component of the basic trail profile providing the primary element of drainage. The outfall is to ensure water is leaving the trail regularly, not running for any great distance along the trail and not relying entirely on other drainage elements to remove overland water flow.
3. A 5% outfall should be maintained along the nominal trail surface and gradually achieving a maximum of 8% to the drain mouth of the water bar, spoon drain or grade dip. When benching is complete, no spoil or vegetation is to remain along the outside edge of the trail. Water must be able to move freely off the trail. For vegetation clearances refer to Figure SC6.2-17: Vegetation encroachment management on fire trails.

Figure SC6.2-1: Typical trail bench utilising outfall



SC6.2.12.5 Water bar construction

1. Where water bars are necessary to remove overland flow across and off the trail at regular intervals, the following information must be adhered to:
   a. The recommended orientation angles and intervals for the construction of water bars are governed by the grade of the trail surface and the topography that the trail has been constructed through. It is generally accepted that the steeper the trail, the more water bars that must be constructed into the trail utilising a shallower angle of orientation (see Table SC6.2-3: Trail gradient based on soil class with nominal water bar spacing).

b. Where a water bar exits onto steep side slopes, silt traps must be constructed across the drain mouth or outlet. The length and grade of the outlet must be minimised to prevent water moving at speed over long steep distance before dispersing slowly into vegetation. It is imperative that soil types are determined as part of the design.
c. The trough of a water bar is not to be excavated as a trench across the trail and the crest of a water bar rising out of the trough is not to be constructed as a hump trail (see Figure SC6.2-3: Incorrect formation of water bar).
d. Water bars must be constructed so the crest of the water bar is a gradual slope downhill into the trough of the next water bar and should follow a simple saw tooth pattern trail (see Figure SC6.2-2: Correct formation of water bar).
e. The trough of the water bar must have an outfall of at least 5% with a wide mouth to minimise blockage and facilitate self-cleaning. The trough should fan out towards the mouth or outlet and maintain a good outfall ensuring no water pools within the trough.
f. The crest must be constructed to withstand wheel ruts that will channel water over the water bar. The water bars compacted finished height will be governed by the grade of the trail. The height must be high enough to direct all water off the trail without topping over the crest and without impeding vehicle travel. In some soil types, the water bar crest will need to be hardened with a stabiliser or 25-40mm aggregate compacted into existing bulk material.

SC6.2.12.6 Water bars

1. Water bars must not be constructed primarily with road base or Cement Treated Base (CTB) materials.
2. Figure SC6.2-2: Correct formation of water bar shows the correct shape of water bars and how they should be incorporated into the trail surface. As a rule of thumb, the excess material taken from the trough should be used to construct the crest and trail surface leading down to the following trough. Any material used to form the crest or trail surface must be keyed into the existing surface and compacted to ensure no separation of the layers can occur. All organic matter must be removed from between the layers.

Figure SC6.2-2: Correct formation of water bar

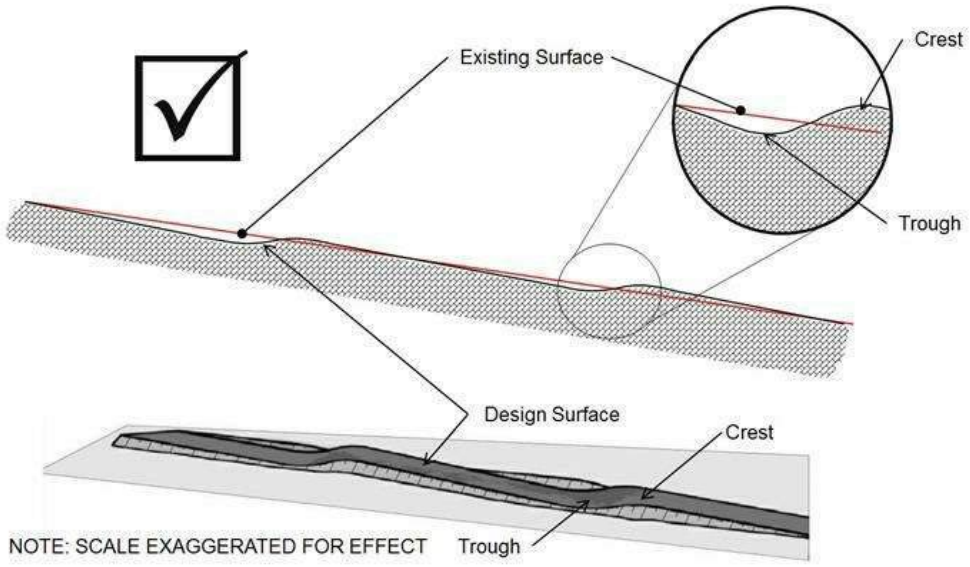
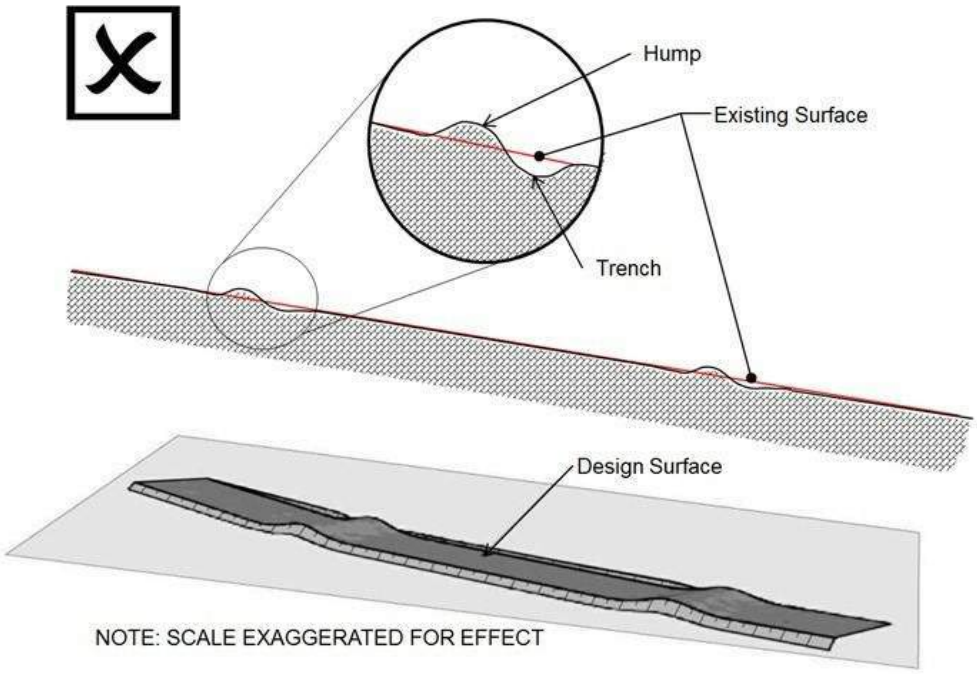


Figure SC6.2-3: Incorrect formation of water bar



SC6.2.12.7 Soil classes

1. Class A — Low susceptibility of soil erosion - Brown, red and yellow soils derived from finer sediments, metasediments including clays.
2. Class B — High susceptibility of soil erosion - Red soils on fine granites and basalts, fine sandstone and basalt.
3. Class C — Very high susceptibility of soil erosion - Grey and yellow soils derived from granites, sediments and metasediments. Especially coarse grained soil types.
4. The table below provides a guide for most situations likely to be encountered in the Gold Coast.

Table SC6.2-4: Trail gradient based on soil class with nominal water bar spacing

TRAIL GRADE	WATER BAR ORIENTATION	SOIL CLASS A WATER BAR SPACING	SOIL CLASS B WATER BAR SPACING	SOIL CLASS C WATER BAR SPACING	WATER BAR HEIGHT
Up to 10%	35°	15-20m	10-12m	7 10m	0.3-0.4m
11%-15%	25°	8-12m	7-10m	Undesirable	0.4-0.6m
15%-20%	15°	5-8m	Concrete	Concrete	Concrete & outfall
21%-25%	Concrete	Concrete	Concrete	Concrete	Concrete & outfall
26%-30%	Concrete	Concrete	Concrete	Concrete	Concrete & outfall
Above 30%	Relocate trail alignment	Relocate trail alignment	Relocate trail alignment	Relocate trail alignment	Relocate trail alignment

Note—Relaxation of the trail surface gradients is possible when other on ground factors are taken into consideration, such as but not limited to the following:

a. utilisation of existing farm or logging trail;
b. size of upstream catchment and expected overland flow velocity and volume; and
c. short linear length of trail (<50m).

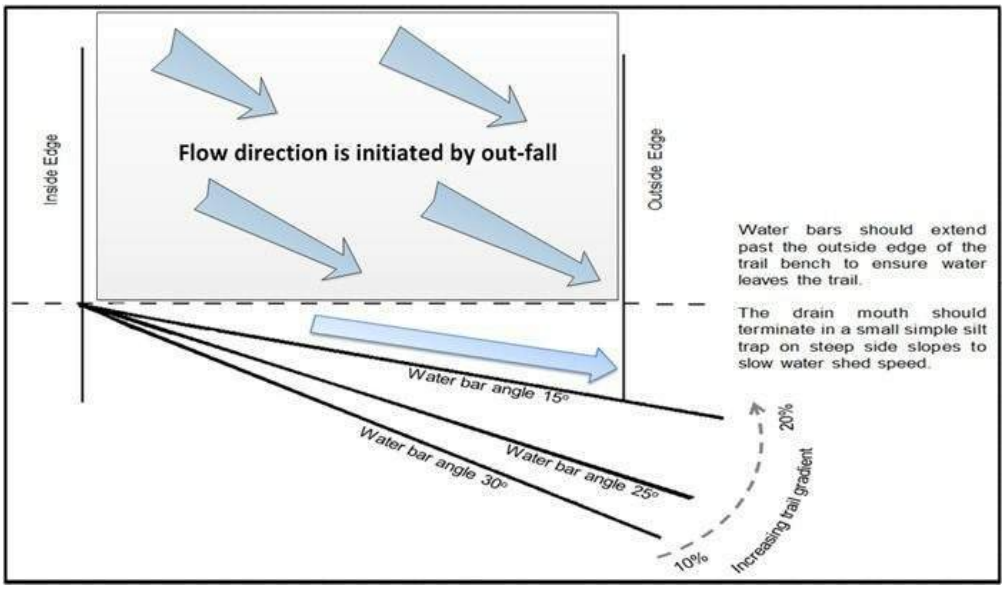
SC6.2.12.8 Water bar orientation on the trail

1. The angle of orientation of a water bar is crucial. This angle will govern the self-cleaning ability of the water bar and the speed in which the water moves across the trail surface to the outside edge of the trail.
2. The outfall along the trail should increase (at least, 5-6m out) as it approaches the Water Bar to ensure the water is shed

from the trail prior to being concentrated at the Water Bar.

3. The outside or down slope edge of the trail is most vulnerable to erosion. This erosion can be minimised by decreasing the spacing between water bars and decreasing the orientation angle across the trail (see Figure SC6.2-4: Water bar orientation and Figure SC6.2-15: Fire trails must not be constructed along the fall line). The addition of silt traps at the outlet and minimising the outlet grade will also assist in erosion control.

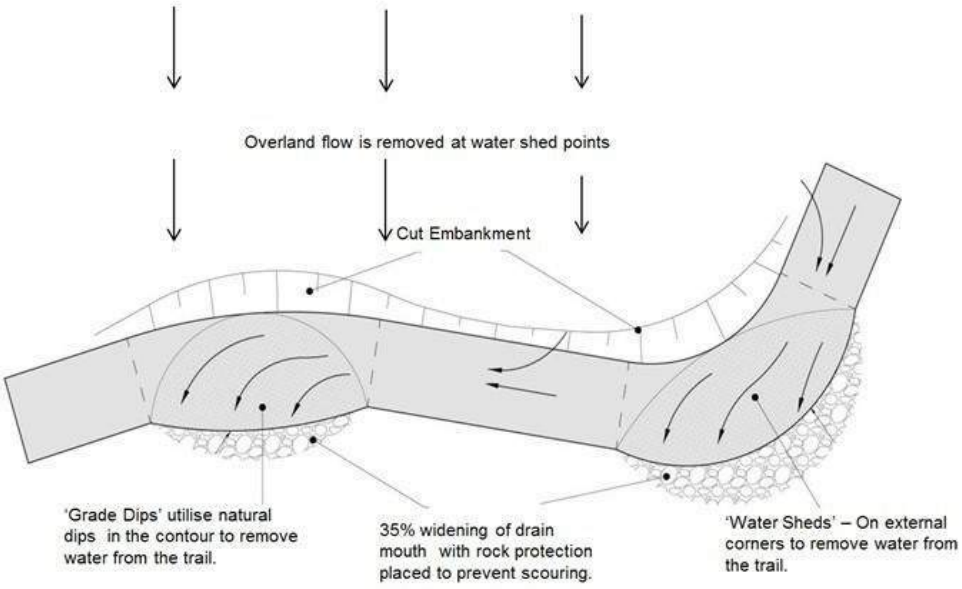
Figure SC6.2-4: Water bar orientation



SC6.2.12.8.1 Watersheds - grade dips and spoon drains

1. Watersheds are generally located on corners and are created by lowering the outside edge of the trail and gradually increasing from a minimum of 5% to an 8% outfall. This will ensure water travelling along the trail is quickly diverted at the corner and off the trail (see Figure SC6.2-5: Typical example of watershed in plan view).
2. Grade dips are utilising natural dips in the trail surface or very shallow drainage lines to remove water from the trail replacing the need to construct a water bar. The drain mouth should be made at least 35% wider than where the dip enters on to the higher side of the trail. Create a minimum outfall of 5% across the trail gradually increasing to approximately 8% at the mouth. This will ensure good flow and self-cleaning ability (see Figure SC6.2-5: Typical example of watershed in plan view).

Figure SC6.2-5: Typical example of watershed in plan view



SC6.2.12.9 Table drains

1. The primary purpose of a table drain is to lower the water table within the trail body and keep the surface firm. Table drains must be constructed where sections of a trail remain wet due to long term or permanent soaks (see Figure SC6.2-6: Typical example of table drain in cut bench and Figure SC6.2-7: Typical example of table drains along level terrain). The preferred outcome would be to design the trail on a different alignment. However, when this is unavoidable, the inside of the trail below the batter is boxed out to a width and depth of 600mm. It is then filled with 75-150mm aggregate wrapped with suitable geotextile material. This will allow water to flow over and through the aggregate within the drain to the next down slope box drain or water bar and then off the trail. An outfall of a minimum 5% must be maintained along the trail.

   Note—If water bars are used to move permanent water across the trail and the trail remains soft then the trough of these water bars are to be constructed as box drains while the simple saw tooth pattern described in Figure SC6.2-2: Correct formation of water bar is maintained (see Figure SC6.2-9: Typical box drain).

Figure SC6.2-6: Typical example of table drain in cut bench

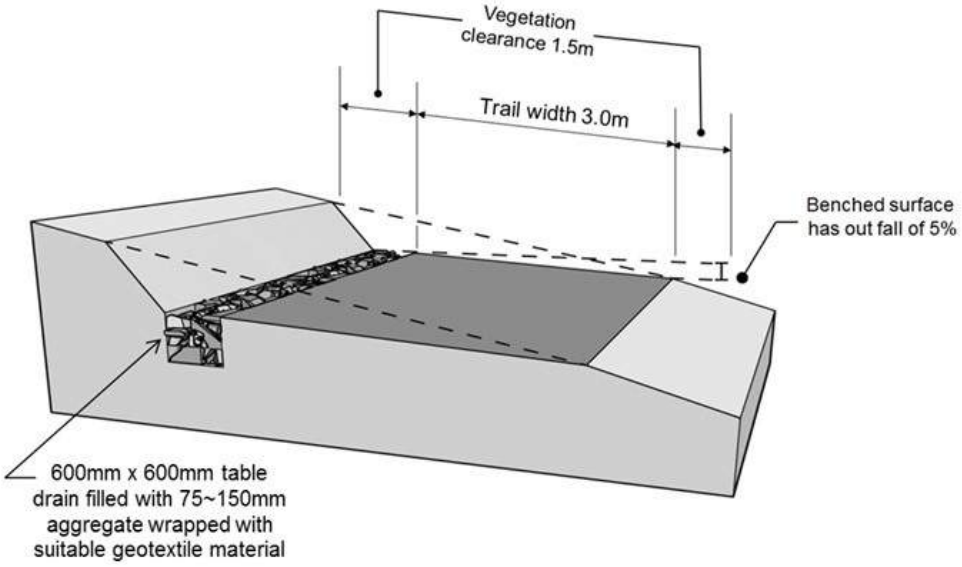
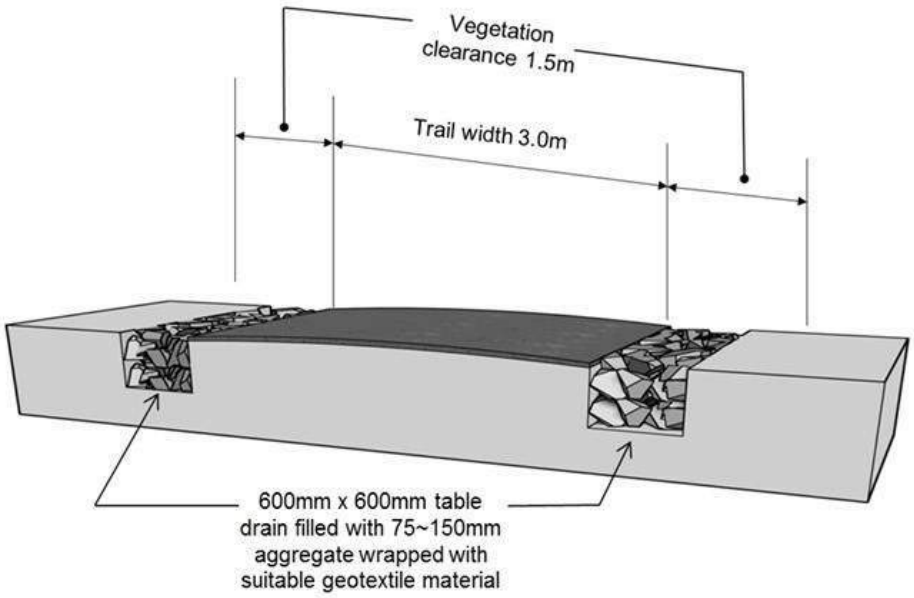


Figure SC6.2-7: Typical example of table drains along level terrain



SC6.2.12.10 Box drain

1. These types of drains will be placed on trails where a section of the trail continually experiences 'boggy' conditions. A box drain is constructed at a lowered section of the trail that is excavated and filled with 75—150mm aggregate and shaped to ensure water flow is maintained on and through the aggregate and directed across and off the trail. These drains must be designed to allow movement of fire fighting vehicles.
2. A box drain width may vary to suit different locations and vary from a depth and width of 600mm x 600mm crossing the trail at appropriate intervals. Outfall locations will require the installation of rock mattresses (installed as per manufacturer's specifications) extending along the full length and width of the wet section of trail (see Figure SC6.2-8: Typical box drain and Figure SC6.2-9: Typical box drain & table drain combination). On some occasions, the preferred outcome may be to design the trail on a different alignment. In locations where the trail is level and can only be located through an area with consistent sub surface soil moisture, an approved drainage cell system can be installed according to manufacturer's specifications.

Figure SC6.2-8: Typical box drain

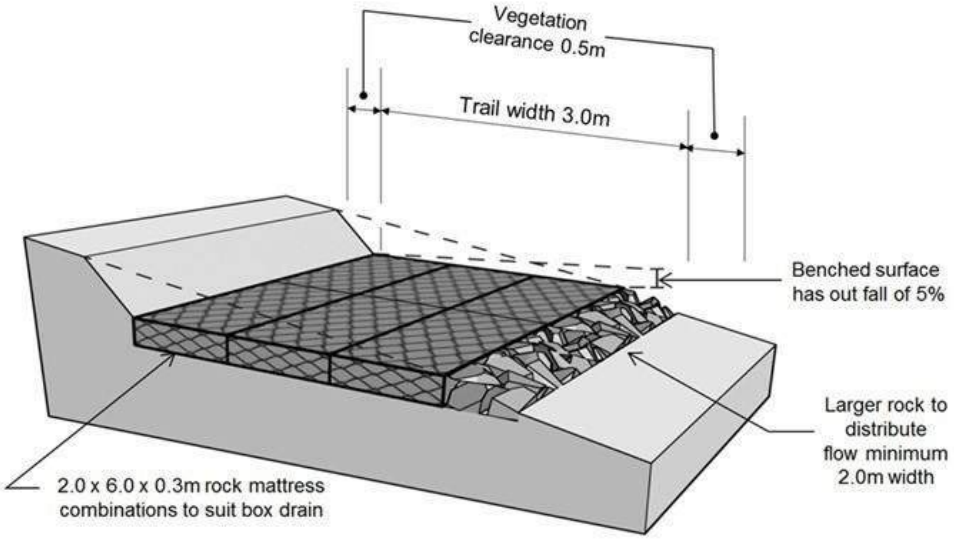
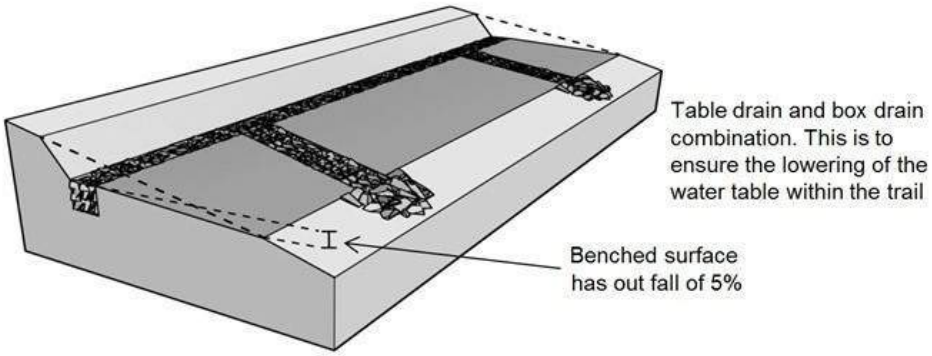


Figure SC6.2-9: Typical box drain & table drain combination



SC6.2.12.11 Trails on steep slopes greater than 20%

1. On occasions, it may be unavoidable to construct trails on slopes greater than 20%. It would always be preferable to alter the trail alignment to reduce the trail gradient. When trails exceed 20% gradient, concrete is an accepted surface material (see Figure SC6.2-10: Example of a concrete trail to be used on slopes >20%). Other erosion prone materials such as CTB must not be utilised as a substitute.

Figure SC6.2-10: Example of a concrete trail to be used on slopes >20%

SC6.2.12.12 Creek crossings

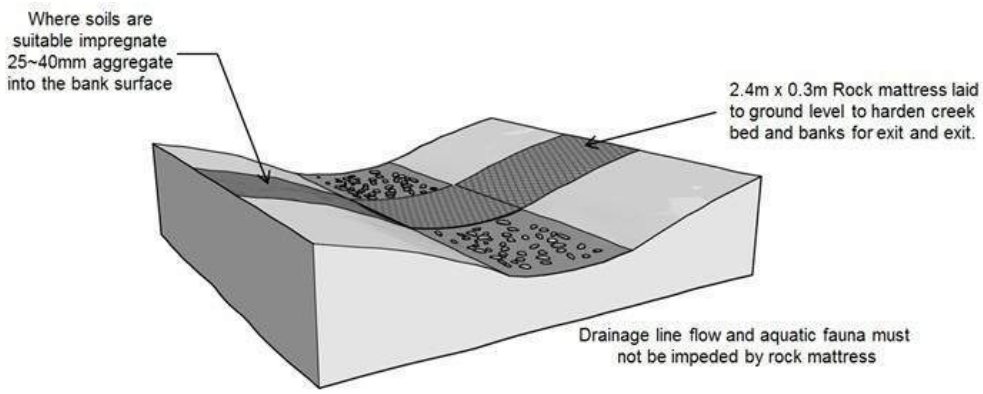
1. Where possible, creek and water crossings should always be avoided. Where this cannot be achieved, appropriate and approved vehicle crossing points may be installed through creeks and drainage lines. A sustainable outcome may typically require one or a combination of acceptable outcomes.
2. In addition, the design and construction must be undertaken in such a way as to minimise water quality and environmental impact. The original bank line and direction of a creek or drainage line should not be altered without consulting relevant

authorities for approval.
3. Vehicle crossings will not be constructed where a bend exists in a creek or drainage line unless it is already in place and is functioning in a sustainable manner. Where creek or drainage lines are shallow, alteration to the bed and banks must be minimised. State and Federal approvals may be required to construct the creek crossing.

SC6.2.12.13 Soft bedded creek or drainage line

1. When the bed of the creek or drainage line combines soft soil and/or mobile surface material the crossing must be hardened to accept vehicular traffic. Concrete fords, rock filled mattress, large rock or approved drainage cell systems should be used (Figure SC6.2-11: Example of a crossing in soft bedded creek). The construction methodology is determined by the volume and velocity of water flow which will determine the extent of engineering design required and material to be used. The flow of water must not be impeded upstream or diverted around the built structure or create turbulence that will affect water quality of downstream aquatic habitat. The outcome is to maintain water flow at the original levels, minimise erosion during and after construction and limit impacts to water quality and in stream environmental values.
2. If the adjoining embankments are slippery, soft or steep it may also be necessary to extend the material used up the bank to maintain vehicle traction, limit vehicular access, and egress impact.
3. Where the soil type is stable 25-40mm aggregate may be scarified into the embank surface and compacted to ensure traction up and down shallow banks. Aggregate should not remain loosely spread on the finished trail surface.

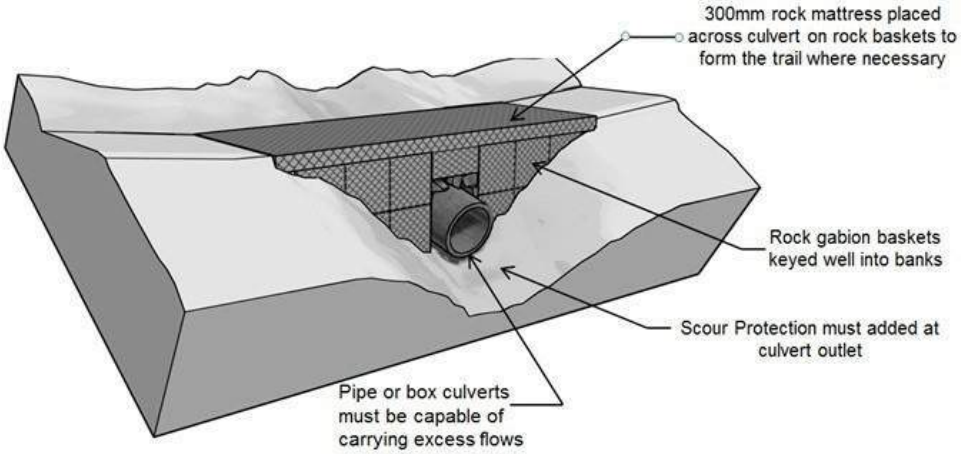
Figure SC6.2-11: Example of a crossing in soft bedded creek



SC6.2.12.14 Constructed culvert crossings and headwalls

1. Culvert crossings must be avoided where possible to minimise the cost of both trail construction and maintenance. The preferred outcome is to redesign the alignment of the trail to a more stable crossing location.
2. In a situation where a very steep banked drainage lines is not able to be avoided, it is critical the size of the culvert pipe and associated rock protection is designed and installed to effectively cope with the volume and velocity of water from the upstream catchment (Figure SC6.2-12: Typical constructed culvert creek crossing).
3. Concrete formed headwalls are to be avoided in these locations and rock mattress combined with larger rock gabion baskets should be fitted around the pipe structure and keyed effectively into the drainage line banks. Rock filled gabion baskets are preferred as they act as the finished trail surface, provide effective bank retention and allow the percolation of water during rainfall events.

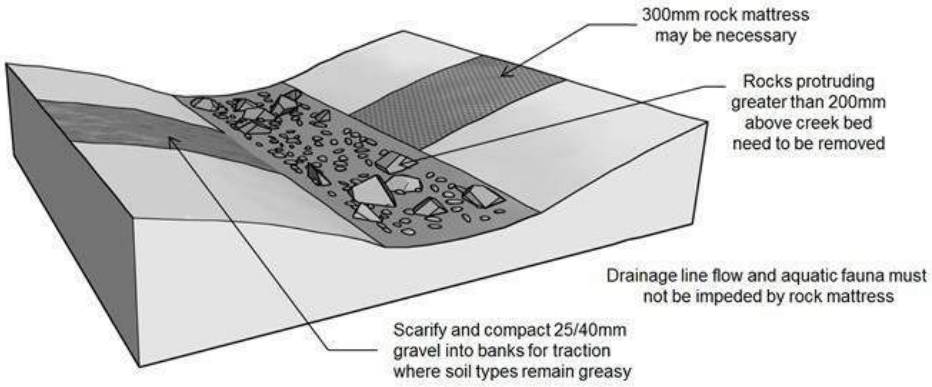
Figure SC6.2-12: Typical constructed culvert creek crossing



SC6.2.12.15 Stone or bedrock based creek and drainage lines

1. Where stony or bedrock crossings exist, the bed must be left unaltered. Some larger rocks may need to be manipulated to allow vehicular movement across the creek to ensure safety and avoid any possible vehicle damage. These rocks should only be moved if they are above the surface by 200mm (Figure SC6.2-13: Use of a stone or bedrock based creek).
2. Bank entrances and exits should be hardened with rock mattress or (the preferred option) impregnated and compacted with 25-40mm aggregate to allow improved traction for vehicles whilst exiting the creek. Aggregate should remain loosely spread on the finished trail surface. Shaping of entrance and exit ramps must be minimised but need to be designed to cater for the approach and departure angles of the fire fighting vehicles.

Figure SC6.2-13: Use of a stone or bedrock based creek

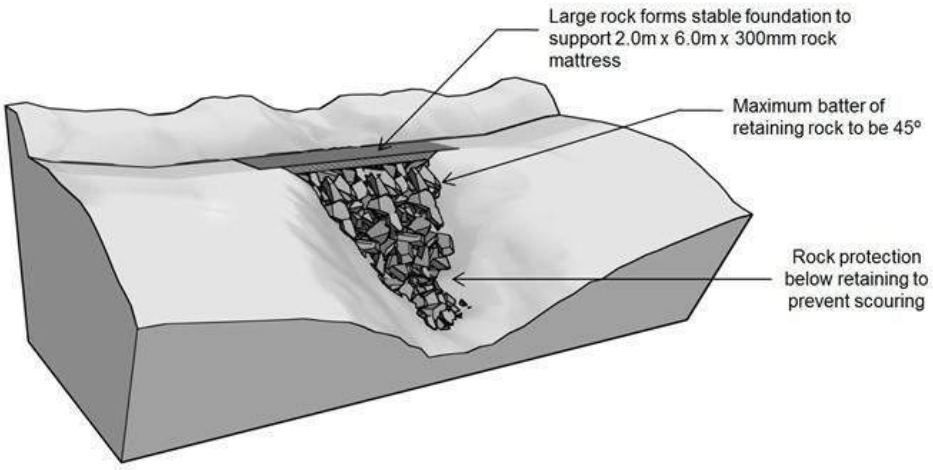


SC6.2.12.16 Steep drainage lines that cross narrow contours

1. Steep drainage line crossings should be avoided where possible to minimise cost of both construction and maintenance. At times, these drainage lines carry large volumes of fast flowing water. The preferred outcome is to redesign the route of the trail to a more suitable crossing location.
2. Where trails unavoidably run across steep contours and meet steep drainage lines, it will be necessary to minimise the width of the crossing to minimise the height of cut batters.
3. A 2.4m wide trail across the drainage line will be enough incorporating 1.5m of vegetation pruning each side of the trail to give good vehicular clearance. The crossing is constructed and retained with large rock of minimum 800mm diameter and filled with 75-150mm aggregate to provide a bed to place rock mattresses. The rock mattresses will form the trail surface. The outside edge of the trail is to be battered at maximum of 45 degrees to retain the lower side of the crossing. All rock must be well placed and stabilised to form and retain the lower side of the crossing (see Figure SC6.2-14: Typical solution for a steep and narrow crossing).
4. Rock baskets may also be used to form the crossings in place of large rock. The area below the remaining batter must be

rock protected to prevent scouring during extreme rainfall events.

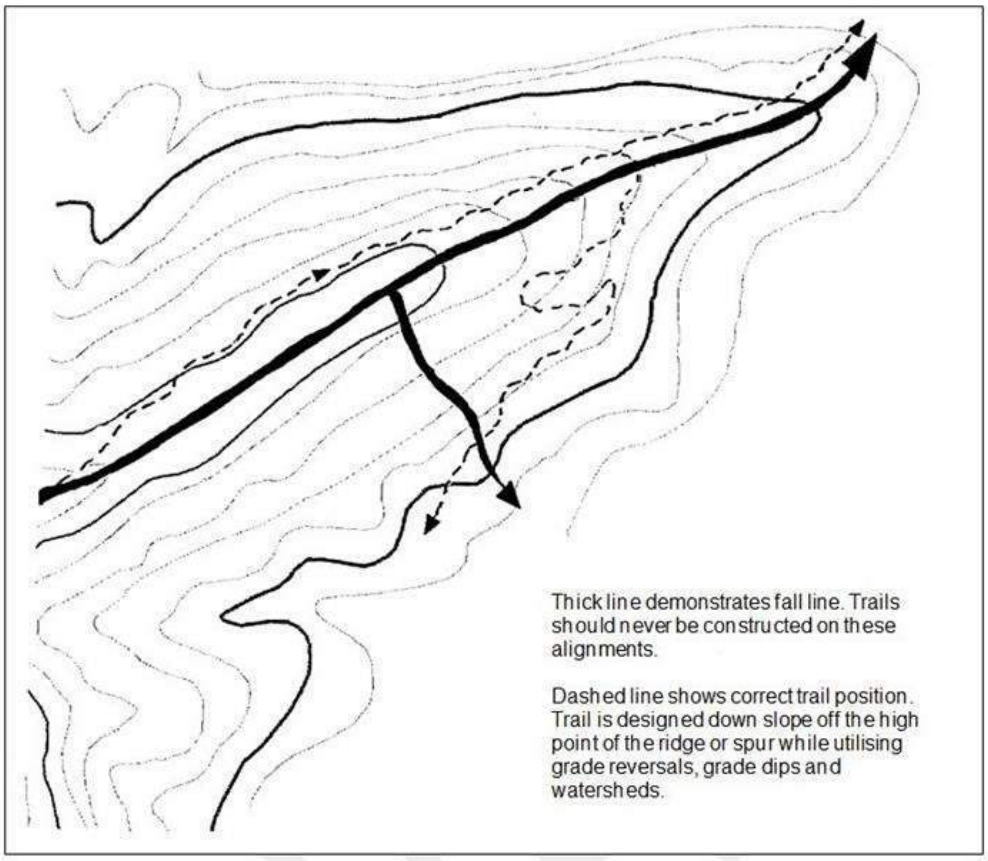
Figure SC6.2-14: Typical solution for a steep and narrow crossing



SC6.2.12.17 Fall line

1. Construction of fire trails along the fall line is not sustainable and must be avoided. The fall line is the line of least resistance for water movement down a slope, or the line directly at right angles to the contours. Trails constructed on the fall line are expected to suffer from high levels of erosion (see Figure SC6.2-15: Fire trails must not be constructed along the fall line).
2. Fire trails must not be constructed along a ridgeline or spur. The trail should always be constructed down slope and off to the side of the ridge or spur line far enough to enable the installation of the nominal outfall of 5% to ensure that water is shed. The trail may cross the ridge lines incorporating techniques such as grade reversals, watersheds and grade dips. Long straight sections of trail should be avoided, where this cannot be achieved, water bars must be used.
3. Contours should be used to design trails across slopes to minimise trail grades on steep country, utilising switchbacks to decrease in elevation. Trails must never be constructed in straight lines down steep slopes for long distances (typically should not exceed 20m). Where this becomes unavoidable, water bars will need to be constructed using Table SC6.2-3: Trail gradient based on soil class with nominal water bar spacing and Figure SC6.2-2: Correct formation of water bar of this construction guide.

Figure SC6.2-15: Fire trails must not be constructed along the fall line



SC6.2.12.18 Grade reversal

1. Grade reversal is the technique of using the rise and fall of the trail across the contours as it decreases in elevation.
2. If this technique is adopted, then grade reversals are constructed into the trail at the same intervals as prescribed in Table SC6.2-3: Trail gradient based on soil class with nominal water bar spacing. The trail can be constructed far more economically and sustainably utilising grade reversals rather than relying on the construction of water bars (see Figure SC6.2-16: Example of grade reversal).

Figure SC6.2-16: Example of grade reversal

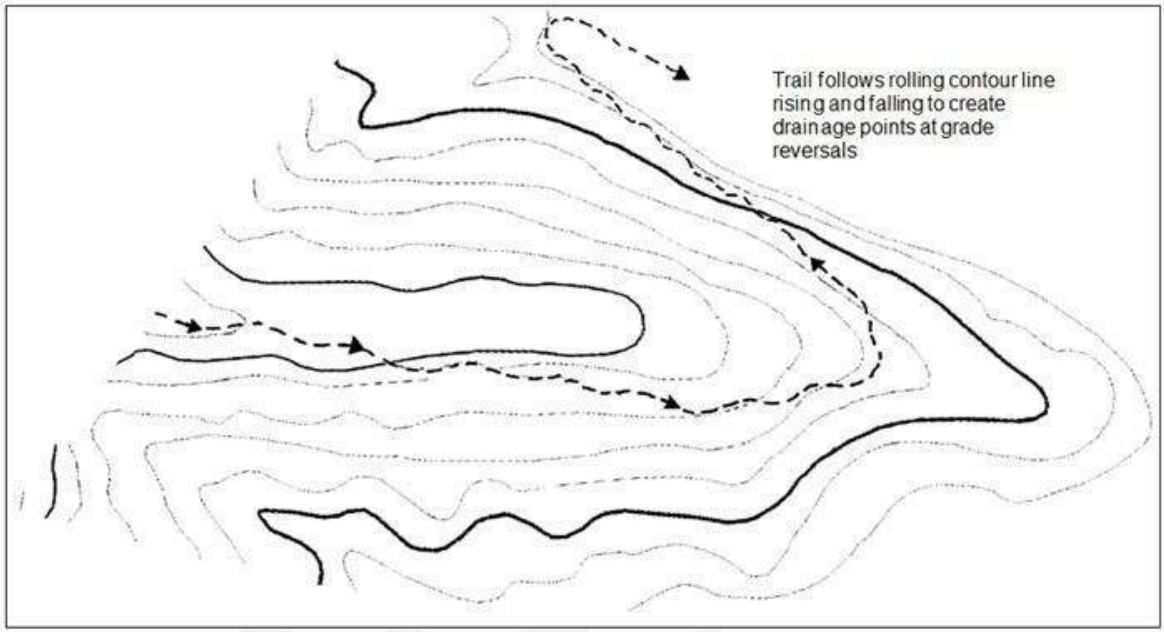
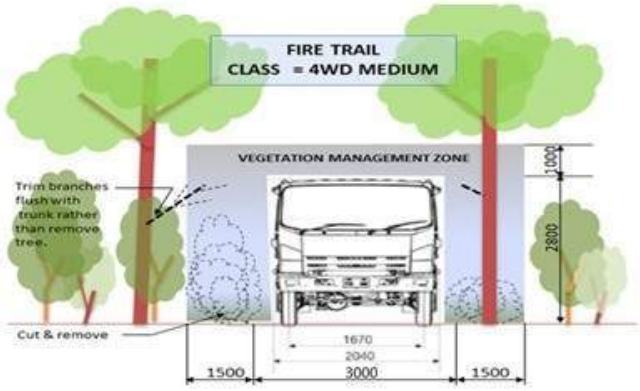


Figure SC6.2-17: Vegetation encroachment management on fire trails



Notes:

- Remove all shrubs/saplings within vegetation management zone. These saplings are to be cut and poisoned at based.
- All cut debris is to be evenly dispersed >20m from the edge of the fire trail or mulched and used in onsite restoration or removed from site.