



NSW National Parks and Wildlife Service

Landslides and rockfalls procedures

**Practical guidance for implementing the
landslides and rockfalls policy**



Acknowledgement of Country

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

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

This resource may contain images or names of deceased persons in photographs or historical content.

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Contents

Quick user guide	v
Preamble	1
Objectives	2
What risks do these procedures address?	3
Types of landslides and rockfalls	4
Procedures	5
1. Overview	5
2. Responding to incidents	6
3. Identifying landslide and rockfall hazards	7
4. Risk assessment by NPWS staff	13
5. Risk assessments by geotechnical consultants	13
6. How to decide whether a quantitative risk is tolerable	15
7. Developing a risk treatment plan	20
8. Treating rockfall hazards	23
9. Recordkeeping requirements	25
10. Monitoring the treatment of a hazard	28
11. Adding the hazard to the Branch Risk Register (if required)	29
About the procedures	30
Scope and application	30
Definitions	30
Accountabilities	33
References	36
More information	37
Appendix A – Department’s risk matrix	38
Appendix B – Guidance for preparing geotechnical assessment reports	39
Executive summary	39
Appendix C – Risk treatment plan template	41

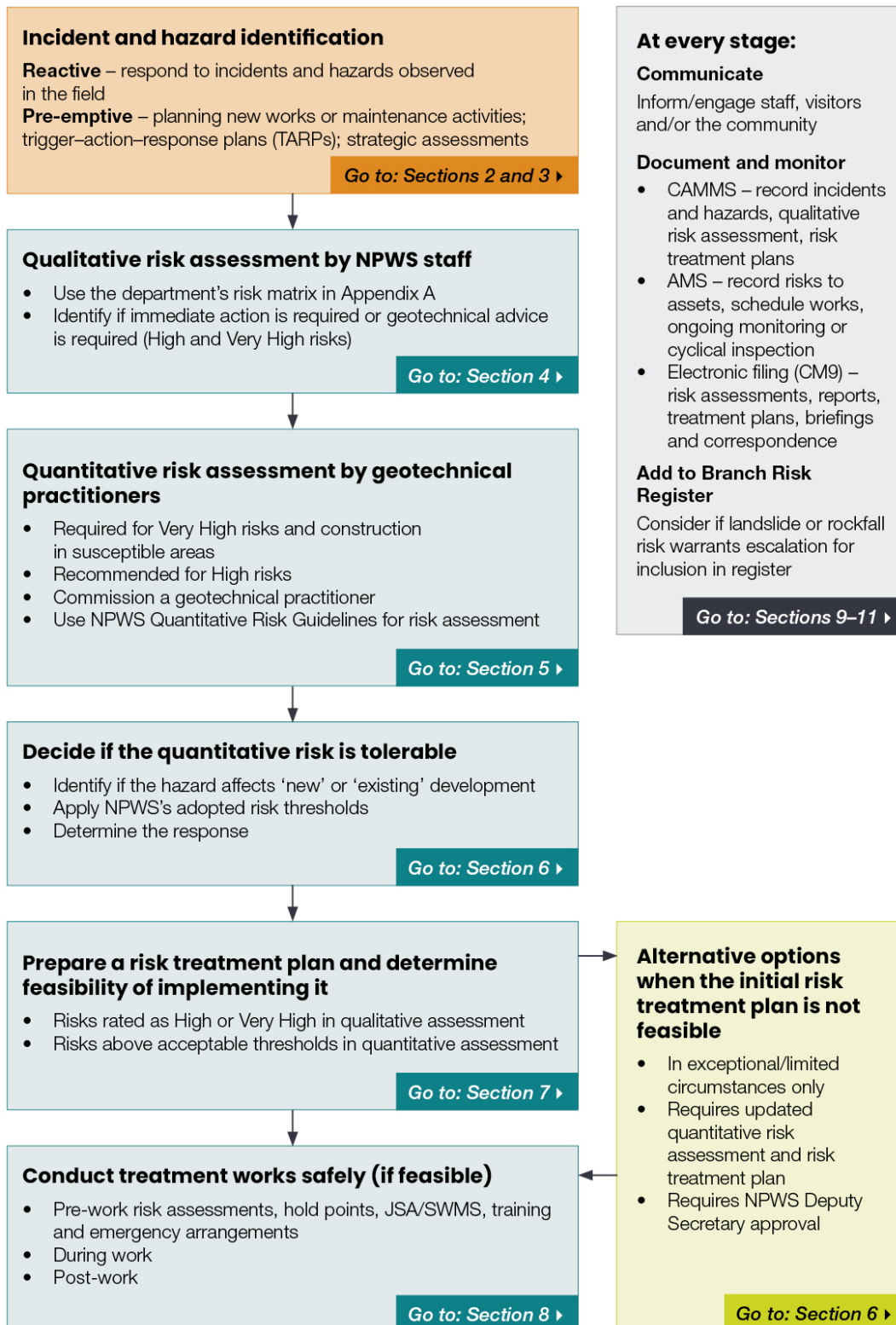
List of tables

Table 2	Next steps after a qualitative risk assessment	13
Table 3	Examples of existing and new developments in parks	15
Table 4	NPWS responses to unacceptable, tolerable and acceptable risks	17

List of figures

Figure 1	Landslide types	4
Figure 2	Thresholds for evaluating risks to the individual	16
Figure 3	Thresholds for evaluating societal risk	18

Quick user guide



Preamble

Landslides and rockfalls can pose risks to the safety of visitors and workers in national parks. Sometimes, landslides and rockfalls in parks may also create risks to park assets such as visitor facilities and neighbouring properties.

The NSW National Parks and Wildlife Service (NPWS) provides a wide range of visitor facilities and assets that support park management. These assets are in many different park contexts – from highly developed visitor precincts to remote areas – reflecting the diversity of experiences sought by park visitors. As set out in the *Landslides and rockfalls policy* (see 'More information'), NPWS focuses on protecting people (including visitors, workers and neighbours) from landslides and rockfalls. High visitation locations are particular priorities when assessing and managing risks from landslides and rockfalls.

Consistent implementation of the *Landslides and rockfalls policy* and the procedures will support NPWS in meeting its duty of care and the legislative requirements for the exclusion of personal liability. The *National Parks and Wildlife Act 1974* (NPW Act; section 156C) excludes NPWS staff from personal liability for anything done or omitted to be done in good faith for the purpose of exercising functions under national parks legislation.

Objectives

These procedures provide practical support for implementing the *Landslides and rockfalls policy*. They aim to provide a consistent process for NPWS's management of landslides and rockfalls in parks, and specifically address:

- identifying potential landslide and rockfall hazards
- assessing risks to life and property
- seeking expert advice from a geotechnical practitioner
- deciding whether a quantified risk is tolerable
- developing a risk treatment plan and deciding whether treatment is feasible
- planning and carrying out treatment works
- monitoring hazards
- documenting landslide and rockfall management.

Expert advice and industry guidelines have informed the preparation of these procedures, including guidelines issued by the Australian Geomechanics Society (AGS) and the Australian National Committee on Large Dams (ANCOLD).

What risks do these procedures address?

These procedures address the risks of landslides and rockfalls to:

- park visitors
- NPWS workers, contractors and volunteers working in parks
- assets and visitor facilities in parks
- properties and lands adjoining parks.

Types of landslides and rockfalls

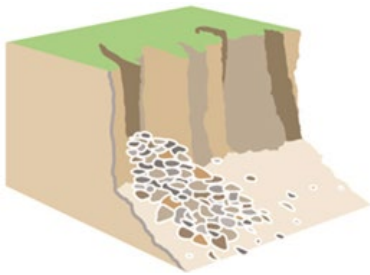
Geotechnical practitioners often use the term 'landslide' to mean any kind of movement of material down a slope (see 'Definitions' below).

As illustrated in Figure 1, different combinations of **movement** and **material** create different landslide types. The 4 main types of movement are:

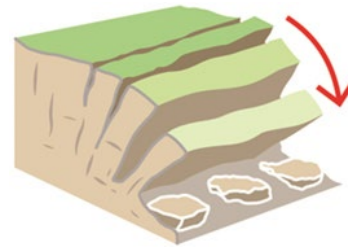
- falls
- topples
- slides (rotational and translational)
- flows.

Landslides are classified as one of these movements or, more commonly, as a mixture of several types. Geologists also refer to the type of material involved, e.g., rock, debris, or earth.

The prevalence of these types of landslides varies between parks and locations within parks.



Fall



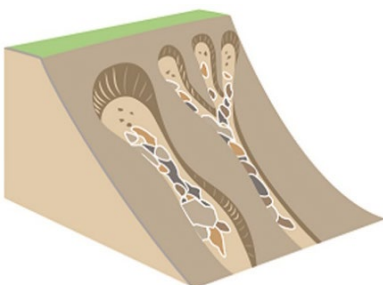
Topple



Rotational slide



Translational slide



Flow



Talus slope at base of fall or topple

Figure 1 Landslide types

Source: British Geological Survey, *How to classify a landslide*

Procedures

1. Overview

Landslides and rockfalls are recorded and their risk assessed

NPWS uses CAMMS (Camms.Risk), the hazard and incident reporting system of the Department of Climate Change, Energy, the Environment and Water (the department), to:

- record landslide and rockfall incidents
- record and manage identified landslide and rockfall hazards
- qualitatively rate landslide or rockfall risks as Low, Medium, High or Very High by applying the department's risk matrix in CAMMS (see Appendix A).

Highest risk hazards are managed first

NPWS assesses as a priority landslide and rockfall hazards that pose a risk to:

- park visitors (particularly in high visitation locations)
- NPWS workers and contractors working in parks
- land and properties adjoining parks.

Assessment of landslide and rockfall hazards is incorporated into planned works in parks.

Managing landslides and rockfalls is supported with systems and expert advice

NPWS supports its management of landslide and rockfall hazards by:

- obtaining geotechnical advice on managing landslides and rockfalls when required
- scheduling required treatment works for at-risk assets in the NPWS Asset Management System (AMS)
- maintaining spatial data systems for recording information on landslides and rockfalls
- recognising significant or systemic landslide and rockfall risks in Branch Risk Registers where appropriate
- working towards applying a strategic approach to identifying and managing landslides and rockfalls at a landscape scale (multiple locations in a park, whole-of-park or multi-park).

NPWS follows recognised procedures for managing rockfall and landslide risks

The NPWS approach to managing rockfall and landslide risks is informed by expert advice and accepted industry guidelines prepared by the AGS (AGS 2007) and ANCOLD (ANCOLD 2022).

Risk analysis

Risk analysis involves hazard analysis, frequency (or likelihood) analysis, consequence analysis, and risk evaluation.

NPWS initially evaluates the risk of a rockfall or landslide hazard via the department's risk matrix in CAMMS (see Appendix A).

Risk assessment

Risk assessment involves estimating or calculating a risk via a **quantitative** or **qualitative** approach (or a combination of both) and evaluating the risk against a tolerability threshold.

Risk treatment

Risk treatment (or risk management) involves selecting one or more risk mitigation options from:

- accepting the risk – and monitoring the hazard on an ongoing basis
- avoiding the risk
- reducing the **likelihood** of the risk
- reducing the **consequences** of the risk
- transferring the risk.

2. Responding to incidents

NPWS places a high priority on minimising the potential harm from landslides and rockfalls, but cannot fully eliminate the risk of an incident involving people in parks.

NPWS must document all rockfall and landslide incidents that impact people or property.

Responding to incidents – observe and make the incident site safe

Protect life

When a landslide or rockfall-related incident occurs, the **immediate priority** is to protect life.

Staff should follow any existing incident or emergency management plans. Line managers should also be notified as soon as possible to help facilitate a timely and effective response.

When something goes wrong the key steps are:

Landslides and rockfalls procedures

CEASE	<p>Cease operations.</p> <p>Stop work underway in the area and any public activities.</p>
RESPOND	<p>Provide assistance including first aid.</p> <p>Address any injuries or risks to life, including providing first aid and contacting emergency services if required.</p> <p>Managers should assess the risk to workers participating in rescue operations or immediate stabilisation works.</p>
SECURE	<p>Secure the scene including any plant.</p> <p>Prevent public access and secure any plant or equipment.</p> <p>Close or restrict access to surrounding areas if required. It may be necessary to quarantine the area until a geotechnical expert can assess the site.</p>
NOTIFY	<p>Notify supervisor immediately via phone.</p> <p>Advise supervisors and appropriate people within the Branch that the incident has occurred.</p> <p>If people are injured in the incident, staff should also notify the NPWS Safety, Risk and Compliance Team.</p> <p>Record the incident in CAMMS and AMS.</p>

All landslide and rockfall incidents must be recorded

As soon as possible after a landslide or rockfall incident occurs, NPWS must do all of the following tasks:

What must be done?	Who is responsible for ensuring it is done?
Record the incident in CAMMS	All staff
Notify the supervisor/manager and relevant Branch staff	All staff
Notify the Safety, Risk and Compliance Team (if a person is injured)	Area manager
Record the incident against the asset record in AMS	Work supervisor

3. Identifying landslide and rockfall hazards

Hazards observed in the field

If a rockfall or landslide hazard is identified in the field, NPWS staff must:

- document the hazard (see Section 9)
- complete a qualitative risk assessment (see Section 4).

NPWS does not expect staff to become experts in geotechnical assessment.

NPWS will look to develop training programs and provide information to help staff identify common landslide and rockfall hazards. These programs will support early detection and intervention by providing staff with a baseline understanding of landslides and rockfalls.

Visitors or other people in parks may also observe potential landslide or rockfall hazards and report them to NPWS. Staff should treat reported hazards similarly to hazards observed by workers in the field (i.e. document and complete a qualitative risk assessment).

Identifying hazards when planning works

Landslides and rockfalls may impact proposed construction or maintenance activities.

Environmental impact assessment

Potential landslide and rockfall hazards are considered as part of the environmental impact assessment of activities. These hazards are documented during preparation of a:

- review of environmental factors (REF) – must be prepared for activities that are not exempt development
- conservation risk assessment (CRA) – prepared for minor work that is exempt development
- streamlined assessment checklist – if the works do not require an REF or CRA.

Staff should refer to the guidelines and templates for undertaking an REF or CRA on the *Environmental impact assessment guidelines* intranet page.

Expert geotechnical advice may be required to inform preparation of the environmental impact assessment.

Construction assessment

Construction and maintenance works with significant exposure to landslides and rockfalls require appropriate engineering assessment and certification before, during and after construction works.

The NPWS *Construction Assessment Procedures* provide information on certification requirements. The *Park Facilities Manual* also provides guidance for specific types of infrastructure, such as viewing platforms.

Staff may also wish to refer to the guidelines for safe hillside construction practice in the *AGS GeoGuide LR8 (Construction Practice)* (see 'More information').

Doing works

All works where landslide and rockfall risks are identified must be planned and completed to minimise the potential risks to workers and contractors.

Safe work requirements are set out in Section 8 below.

Pre-emptive actions to manage hazards

Trigger–action–response plans

NPWS may prepare and implement trigger–action–response plans (TARPs) as a way of mitigating the impacts of landslides and rockfalls that are caused or could be caused by heavy rainfall. Other triggers that may require the preparation of a TARP include observed changes in the landscape (e.g. increased rockfall frequency, formation of a tension crack, or ground movement).

Landslides and rockfalls procedures

A common example of a TARP is one that states how NPWS will respond to rainfall thresholds (e.g. amount of rain forecast to occur, or actually recorded over 24 hours) and details actions that NPWS will take in response to each threshold. Those actions may include:

- physically closing access to visitor facilities or access to a park
- erecting signs about closure of access to facilities or access to a park
- posting closure information on the National Parks Visitor website
- sending SMS alerts to NPWS park managers and senior executives
- sending SMS alerts to other parties, e.g. licensees or lessees, commercial recreation providers, contractors and local Police, RFS and SES
- scheduling post-rainfall inspections of facilities or areas in parks before reopening to visitors
- scheduling geotechnical inspections or assessments for hazards assessed as a High or Very High risk
- other monitoring measures, e.g. rolling cumulative rainfall records and forecast rainfall levels.

The following case study outlines the TARP approach for rainfall events in the Blue Mountains.

Case study – TARP* for heavy rainfall events in Blue Mountains National Park

NPWS has developed a TARP for Blue Mountains National Park (BMNP) to inform closure of visitor facilities in the upper mountains (Katoomba, Leura, Wentworth Falls and Blackheath precincts) during heavy rainfall events. The TARP has 5 trigger levels based on forecast or cumulative rainfall with corresponding actions, e.g. closure of walking tracks and other facilities and monitoring requirements (Table 1).

Table 1 Trigger–action–response plan for La Niña Southern Oscillation Index periods

Trigger level	Trigger	Expected annual closure frequency	Response/Action	Responsible person	Monitoring ^{1,2}
1	<40 mm rainfall in 24-hr period	N/A	Watch and monitor	Area manager or authorised delegate	Daily rainfall records and predictions
2	≥40 mm forecast rainfall in 24-hr period	6	Closure of BMNP track network for 24 hrs	Area manager or authorised delegate	Daily rainfall records and forecast predictions
3	≥80 mm cumulative rainfall in 72-hr period	4	Closure of BMNP track network for 72 hrs	Area manager or authorised delegate	Rolling cumulative rainfall records and forecast predictions
4	≥160 mm cumulative rainfall in 7-day period	2	Closure of BMNP track network for 5 days	Area manager or authorised delegate	Rolling cumulative rainfall records and forecast predictions
5	≥300 mm cumulative rainfall in 14-day period	0.5	Closure of BMNP track network for 10 days	Area manager or authorised delegate	Rolling cumulative rainfall records and forecast predictions

¹ BoM rainfall data for Katoomba

² BoM forecast rainfall for Katoomba

Trigger level 1

Recorded rainfall of less than 40 mm in 24 hours – no action required; monitor rainfall predictions.

Trigger level 2

Forecast rainfall of ≥ 40 mm in 24 hours – close walking tracks for 24 hours.

Trigger levels 3, 4 and 5

- **Recorded rainfall of ≥ 80 mm in 72 hours** – close all walking tracks for 72 hours
- Recorded rainfall of ≥ 160 mm in 7-day period – close all walking tracks for 5 days
- Recorded rainfall of ≥ 300 mm in 14-day period – close all walking tracks for 10 days.

Blue Mountains Branch first applied the TARP in July 2022. Responding to the forecast on 1 July for heavy rain over several days, the Branch closed some tracks in the upper mountains. The total recorded rainfall at Katoomba over 6 days (2–7 July) was 509 mm, with 207 mm recorded on 3 July. Consequently the Branch closed all walking tracks for up to 10 days to reduce risks to visitors and to allow safety inspections before reopening the tracks.

Standard Operating Procedures for implementing the TARP

Blue Mountains Branch has developed Standard Operating Procedures (SOPs) for implementing the TARP for heavy rainfall events. The SOPs address:

- facilities identified for closure, e.g. high-risk walking tracks; fire trails susceptible to damage; campgrounds
- Grade 5 walking tracks and wilderness areas – no action required
- low and medium-risk areas – required actions:
 - SMS alerts to local park managers and NPWS senior executives
 - SMS alerts to licensees or lessees, commercial recreation providers, contractors and local Police, RFS and SES groups
 - information about park and facility closures for posting on the National Parks Visitor website.

*Note: TARPs are tailored for particular locations and relevant circumstances; there is no one-size-fits-all approach. Also note that the BMNP TARP will be adjusted from time to time to take account of new information and experiences in application.

Strategic identification of rockfall and landslide hazards

NPWS aspires to understand and manage landslide and rockfall hazards at the strategic scale, e.g. across a visitor precinct; across a park; or across multiple parks in an Area or Branch.

Strategic assessment aims to:

- identify upfront the rockfall and landslide hazards across the landscape (i.e. beyond individual sites)
- improve understanding of overall risks from rockfalls and landslides (including their significance relative to other hazards)
- inform park management decisions about the location of planned works, visitor experiences, and resource allocation.

Strategic assessment of rockfall and landslide hazards is an emerging area that requires additional resourcing, time and expert guidance to facilitate. NPWS aims to implement this approach progressively.

A strategic assessment brings together information about:

- areas that are susceptible to rockfalls and landslides
- areas where people are most exposed to rockfalls and landslides
- local triggers for rockfalls or landslides.

Good recordkeeping is an important first step in developing a strategic assessment process. A GIS-based record of known incidents can help NPWS and geotechnical practitioners to identify areas susceptible to landslides and rockfalls (see Section 9).

Case study – strategic assessment in Blue Mountains National Park



Blue Mountains Branch manages some of the most popular and historically significant walking tracks in New South Wales. Many of these tracks are located in areas of steep terrain and are susceptible to landslides and rockfalls. Rockfalls are a major concern for the Branch, particularly on the cliffs and escarpments in BMNP.

In 2019, the Branch commissioned a geotechnical investigation of 12 sites in BMNP. The geotechnical report identified multiple hazards at each site and assessed the quantitative risk to life for each hazard and an overall risk for each site. The Branch uses those assessments to make decisions about the highest priority sites for management action, including allocation of resources.

The Branch is also developing a centralised record of historical rockfalls, drawing on local staff knowledge and available documentation.

When and where will NPWS do strategic assessments of landslide and rockfall risks?

NPWS will consider doing strategic assessments of landslide and rockfall risks in parks or in parts of parks that have major visitor precincts and significant or numerous landslide and rockfall hazards.

Situations where NPWS will consider assessing landslide and rockfall risks strategically include:

- locations that have multiple hazards and present a risk to park visitors or to adjoining lands, e.g. assessment of known high-risk sites in a park (see BMNP case study above)
- **visitor precincts in landscapes that are prone to landslides or rockfalls**, e.g. NPWS commissioned a 'slope stability assessment' in 2021 of the Jenolan Caves Visitor Use and Services Zone (an area of about 50 hectares comprised of unstable karst geology), which guides NPWS's management of landslide and rockfall hazards
- **broader landscapes that have numerous landslide and rockfall hazards and major visitor facilities**, e.g. NPWS commissioned an assessment in 2022 of the upper Grose and Jamison valleys in BMNP (an area of about 35,000 hectares), which produced

landslide susceptibility mapping and a slope stability risk assessment of walking tracks and other visitor facilities.

4. Risk assessment by NPWS staff

Once a hazard has been identified, NPWS must complete a **qualitative** risk assessment (for assessing risk to life) using the department’s risk matrix (see Appendix A). This will result in a **qualitative** risk rating of Low, Medium, High or Very High.

The purpose of this qualitative assessment is to identify whether:

- immediate action is required (e.g. track closure)
- the hazard warrants closer inspection by a geotechnical expert (including a detailed quantitative risk assessment [QRA]).

After completing the qualitative assessment, staff should determine the next steps using Table 2.

Table 2 Next steps after a qualitative risk assessment

Qualitative risk rating (from the department’s risk matrix)	Inspection and/or quantitative risk assessment by geotechnical expert	Risk treatment plan	Response timeframe
Very High	Required	Required*	Stop any at-risk activity immediately and make the site safe
High	Optional but recommended	Required*	Seek urgent approval to implement controls within 1 week or sooner
Medium	Optional	Optional	Actions must be completed within 3 months of approval
Low	Optional	Optional	Risk may be tolerated based on cost and practicality, otherwise complete actions within 6 months of approval

*Note: the CAMMS system will prompt the hazard owner (e.g. area manager) to prepare a risk treatment plan for a safety hazard with a High or Very High risk rating.

5. Risk assessments by geotechnical consultants

When is a quantitative risk assessment required?

Consistent with the *Landslides and rockfalls policy* and Table 2 above, a QRA is required when:

- a qualitative risk assessment of a hazard has identified a Very High risk
- construction activities are planned in areas susceptible to landslides or rockfalls.

A QRA is also highly recommended in circumstances when a qualitative risk assessment results in a High risk.

Note that in some situations it may be determined to go straight to a QRA, without completing a qualitative risk assessment. That is a decision for park operations branches taking account of known hazards and existing information.

Commissioning a geotechnical consultant

NPWS follows existing NSW Government and agency procurement processes to engage consultants. This includes the option of sourcing consultants that have been approved under prequalification schemes (see 'More information').

Where expert geotechnical advice is required, NPWS will aim to engage consultants with experience and qualifications that are appropriate to the particular situation.

The project brief and contract must require the consultant to use the NPWS Quantitative Risk Guidelines. The report of the QRA (sometimes called a 'landslide risk assessment') must generally be prepared consistent with the headings and contents in Appendix B of these procedures.

NPWS Guidelines for Quantitative Risk to Life Calculations for Landslides

QRAs prepared for NPWS by geotechnical consultants must use the NPWS Quantitative Risk Guidelines. The guidelines have worked examples specific to NSW parks, and require an assessment of individual risk and of societal risk (summarised here):

Risk measure	When it's used	What it measures
Individual risk	Where fewer than 10 people are exposed to the hazard annually (e.g. at a small work depot or on a remote management trail used infrequently by staff)	The likelihood that a particular person will be killed by the hazard in a given year
Societal risk	Where 10 or more people are exposed to the hazard annually (e.g. on a walking track)	The likelihood of at least one death occurring in a year, or the likelihood that the hazard will cause multiple deaths at once

Note: In some situations, a geotechnical consultant may propose a different method (e.g. based on available data or specific circumstances of the hazard). The geotechnical consultant must clearly explain and justify their reasons for deviating from the NPWS Quantitative Risk Guidelines. Appendix B sets out the required contents of an assessment report.

NPWS will need to provide geotechnical consultants with information to help complete the QRA. Where available, this information includes:

- historical rockfalls or landslides in the area
- numbers of visitors and/or workers accessing the area (current or anticipated)
- patterns of use (e.g. seasonal variation in visitation, locations where people linger)
- previous geotechnical reports.

Visitor numbers should be based on the best available evidence.

Maintaining easily accessible records of rockfalls or landslides will make this process easier and ultimately improve the QRA's accuracy (see Section 9).

6. How to decide whether a quantitative risk is tolerable

Consistent with the AGS guidelines, NPWS has adopted quantitative thresholds to decide whether a risk is *acceptable*, *tolerable* or *unacceptable*. The thresholds vary depending on:

- whether the hazard affects a 'new development' or an 'existing development'
- the risk assessment method used (i.e. risk to the individual or societal risk).

Tolerable risks are managed consistent with the ALARP principle (as low as reasonably practicable), which states:

Risks, lower than the limit of tolerability, are tolerable only if risk reduction is impracticable or if its cost is grossly disproportionate (depending on level of risk) to the improvement gained.
(ANCOLD 2022)

New and existing developments

Consistent with the AGS guidelines, a higher level of risk is tolerated for existing developments than for new developments (Table 3).

This recognises that many of the assets managed by NPWS have inherent risks because of where they are located or how they were originally constructed. The age of assets, patterns of existing use and changing environmental conditions all impact the available management options.

In contrast, when considering a new development, there is greater opportunity to take steps to reduce or avoid risks upfront, including by using new construction techniques, designs or technical standards.

Table 3 **Examples of existing and new developments in parks**

Type of development	Examples
Existing developments	<ul style="list-style-type: none"> • Any existing assets or facilities such as picnic areas, lookouts, walking tracks, camping areas, car parks, built accommodation • Minor upgrades to existing assets or facilities
New developments	<ul style="list-style-type: none"> • New assets or visitor facilities • Major redevelopment of existing assets or facilities (e.g. major walking track upgrades or realignments)

NPWS must identify whether the hazard impacts an existing development or a new development before applying the risk thresholds below.

Tolerable risk thresholds – risk to the individual

‘Individual risk’ measures the likelihood that a particular person will be killed by the hazard in a year. Assessment of individual risk is appropriate where one person is exposed to a hazard for a long period of time, e.g. a person staying overnight in a cabin that is exposed to a rockfall hazard.

The results of a quantitative assessment of risk to the individual must be compared against the criteria in Figure 2. These thresholds for acceptable and tolerable individual risk are consistent with recommendations in the AGS guidelines.

The required NPWS response is then determined by reference to Table 4.

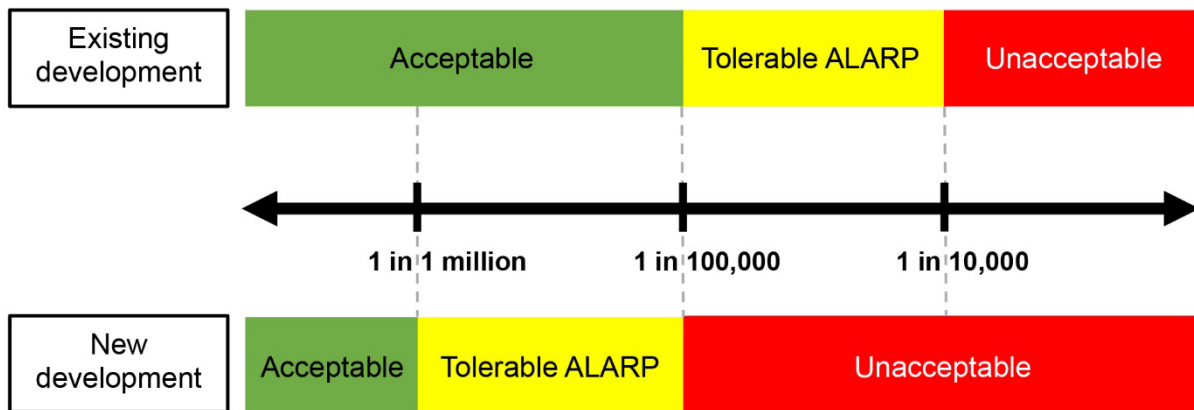


Figure 2 Thresholds for evaluating risks to the individual

Note: NPWS uses the tolerable and acceptable risk thresholds for existing and new developments recommended in AGS (2007).

Tolerable risk thresholds – societal risk

‘Societal risk’ measures the likelihood that a hazard will cause one or more fatalities in a year. It can also be calculated as the likelihood that the hazard will cause multiple fatalities at once. Societal risk is a more appropriate measure for use in national parks, as in most situations there are many persons exposed to a hazard, e.g. the number of visitors using a walking track over a year.

The results of a societal risk analysis are often shown on an ‘F–N curve’ (Figure 3). An F–N curve shows the likelihood (F) that a hazard will cause a particular number of fatalities (N).

The F–N curves in Figure 3 show the adopted thresholds of acceptable and tolerable risk. A hazard with the potential to cause more than 100 deaths, whilst uncommon in parks, must be treated on a case-by-case basis.

Note that the risk thresholds for **existing** developments are an order of magnitude (i.e. 10 times) lower than for **new** developments. For example, the acceptable and tolerable thresholds for **existing** developments are respectively 1 in 100,000 and 1 in 1,000; the thresholds for **new** developments are respectively 1 in 1 million and 1 in 10,000.

The results of a quantitative assessment of societal risk must be compared against the criteria in Table 4, which sets out the required NPWS response.

Peer review

NPWS has the option of requesting a peer review of landslide and rockfall risk assessments at any time. A peer review may be appropriate if the initial QRA:

- finds an extremely High risk (particularly if assessing the risks to workers)
- if there are significant costs associated with mitigating a risk
- if there are concerns or uncertainties about the outcome of the QRA for other reasons (e.g. if a risk is assessed to be 'acceptable' but remains a concern for staff).

A peer review is also required when NPWS is considering alternative options for managing an unacceptable risk (see above).

Peer reviews should be done by independent third parties.

Determining the NPWS response

Table 4 sets out the required NPWS response once the QRA has been completed.

Table 4 NPWS responses to unacceptable, tolerable and acceptable risks

Risk zone (from QRA)	Description of risk	NPWS response
Unacceptable	Risks in this zone are Very High NPWS cannot tolerate an unacceptable risk , except in exceptional and limited circumstances	NPWS must prepare a risk treatment plan to identify options to reduce risk to a tolerable level (see chapter 7 of these procedures) NPWS will determine the feasibility of implementing the risk treatment plan after considering the factors in chapter 7 of these procedures
Tolerable – ALARP	Risks in this zone may still be quite High, but NPWS may be willing to tolerate them to provide other benefits (e.g. to keep a walking track open) Risks in this zone should be managed to be <i>as low as reasonably practicable</i> (ALARP principle) NPWS will reduce these risks further if possible	NPWS must prepare a risk treatment plan to identify options to manage risk consistent with the ALARP principle (see chapter 7 of these procedures) NPWS will determine the feasibility of implementing the risk treatment plan after considering the factors in chapter 7 of these procedures
Acceptable	Risks in this zone are Low and considered acceptable to society Additional work to further reduce the risk is not mandatory (see definition of 'acceptable risk')	Action to reduce the risk is generally not required Preparation and implementation of a risk treatment plan is discretionary, to be determined based on the circumstances of the risk

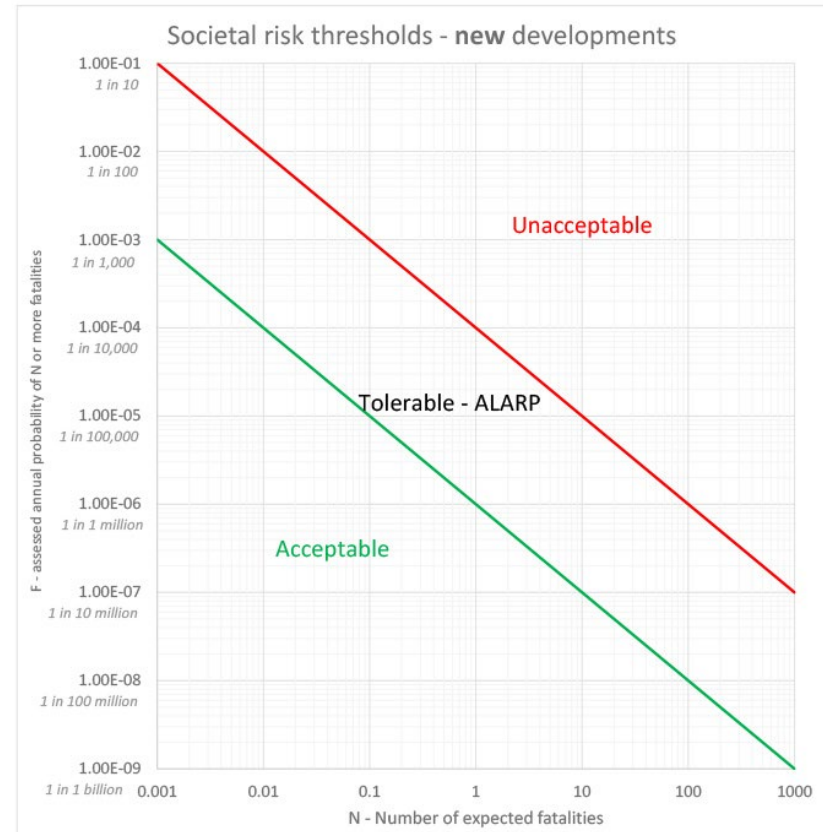
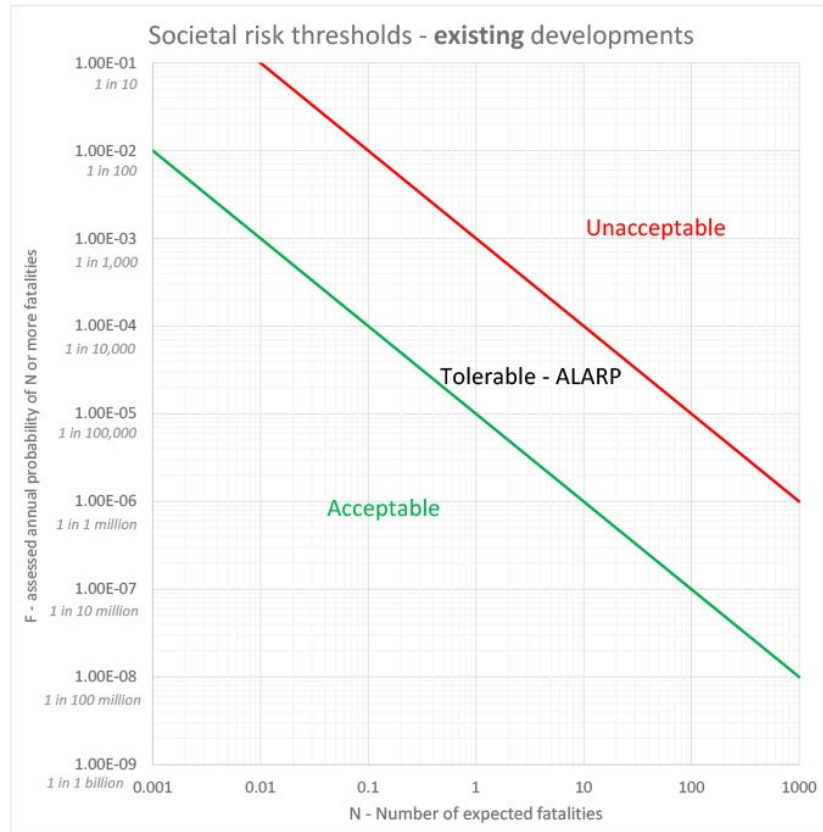


Figure 3 Thresholds for evaluating societal risk

Note: NPWS has adapted these thresholds from the ANCOLD (2022) societal risk criteria. Hazards with the potential to cause more than 100 fatalities must be assessed on a case-by-case basis. ALARP principle – ‘Risks, lower than the limit of tolerability, are tolerable only if risk reduction is impracticable or if its cost is grossly disproportionate (depending on level of risk) to the improvement gained’ (ANCOLD 2022).

How does NPWS manage risks assessed as 'unacceptable'?

NPWS manages landslide and rockfall risks in parks consistent with duty of care requirements under relevant NSW civil liability law.

When a landslide or rockfall hazard in an area is assessed as unacceptable then 2 main options are available to NPWS:

- exclude visitor access (and staff, if warranted) to the area
- implement actions identified in a risk treatment plan (see Appendix C) that would reduce the risk to a tolerable or acceptable level.

If it is not feasible – due to cost or practicality – to reduce an unacceptable risk to a tolerable or acceptable level, NPWS will consider whether there are alternatives to managing the risk (see steps below).

What if it is not feasible to reduce unacceptable risks?

In some cases, the cost or practicality of reducing the risk to a tolerable level may not be feasible, taking account of environmental, safety, resourcing and other factors.

In these circumstances, NPWS **may** consider whether the risk can be adequately managed through alternative options to enable continued use of the area. This should occur **only in limited and exceptional situations**, such as high visitation locations where the ability to completely close the area to public access is likely to be impracticable.

Key messages

- At all times the default and overriding objective when managing areas of identified unacceptable risk is to ensure public and staff safety.
- If there is reasonable doubt about the capacity for alternative options to deliver this safety objective, then NPWS must take a precautionary approach and must close access by the public and/or staff to the relevant area of park (either temporarily or permanently).

NPWS will follow these steps to determine whether alternative options may be applied to manage unacceptable risks

1. **Obtain a peer review of the initial assessment** (including any qualitative or quantitative risk assessment and risk treatment plan [see Appendix C]) by one or more geotechnical experts.
2. If the outcome of the peer review **is uncertain, inconclusive or does not support the initial assessment findings**, prepare an updated risk treatment plan (Step 4 below) or consider obtaining a fresh geotechnical assessment by a different expert.
3. If the outcome of the peer review **supports the findings of the initial assessment** – either prepare an updated risk treatment plan (Step 4 below) or exclude access to the area on an ongoing basis or until it is feasible to implement the initial risk treatment plan.
4. **Prepare an updated risk treatment plan** (see Appendix C) aimed at reducing risks to a level consistent with the ALARP principle. The updated risk treatment plan may include (but is not limited to):

Landslides and rockfalls procedures

- a. providing additional information for visitors on signs and on the National Parks Visitor website¹
 - b. undertaking regular geotechnical assessments and/or ongoing monitoring (e.g. real time monitoring linked to alert or warning systems)
 - c. improving physical infrastructure to reduce exposure of visitors to the hazard
 - d. measures to reduce visitation levels (and hence visitor exposure), such as booking systems to access high-risk areas, and seasonal closures
 - e. developing and implementing trigger–action–response plans (TARPs), which could include (for example) monitoring of rainfall and rainfall forecasts and implementing track closure when designated thresholds are exceeded.
5. **Prepare an updated QRA** that considers the resulting risk levels if the updated risk treatment plan were implemented.
 6. **Obtain legal advice (if necessary)** to assess whether NPWS is meeting its duty of care if it implements the updated risk treatment plan and reopens the facility or area to the public.
 7. **Obtain the approval of the NPWS Deputy Secretary for the updated risk treatment plan** – in determining whether to grant approval, the Deputy Secretary will consider:
 - a. the initial QRA and risk treatment plan and the reasons for determining that implementation was not feasible
 - b. whether the updated risk treatment plan has identified appropriate and feasible actions to reduce risk consistent with the ALARP principle
 - c. **if the risks remain unacceptable** (based on the revised QRA accompanying the updated risk treatment plan), whether it is appropriate in the circumstances, and considering the primary objective of visitor and staff safety, for the area to be publicly accessible.
 8. **If approved by the NPWS Deputy Secretary, implement the recommended mitigation actions in the updated risk treatment plan.**
 9. **Obtain the approval of the NPWS Deputy Secretary to reopen the facility or area to the public after the completion of all identified actions in the risk treatment plan.**

7. Developing a risk treatment plan

A risk treatment plan (see Appendix C) is required for any hazard where:

- the risk is rated High or Very High in a qualitative assessment
- a QRA produces a risk number above the ‘acceptable’ threshold (i.e. the risk is rated ‘unacceptable’ or ‘tolerable – ALARP’).

Five possible responses to a risk

There are 5 broad options for responding to an identified risk:

¹ Note that as part of meeting its duty of care, NPWS has a responsibility under the *Civil Liability Act 2002* to warn visitors engaging in recreational activities of risks (e.g. via erection of warning signs). However, where a risk has been assessed as unacceptable (e.g. on a walking track susceptible to rockfalls), NPWS **should not** rely solely on erecting a risk warning sign to meet its duty of care to the general public.

- **accept the risk** – do not treat the hazard but monitor regularly (e.g. by scheduling cyclic inspections in AMS)
- **avoid the risk** – move vulnerable assets to a safer location, or restrict access
- **reduce the likelihood of the risk** – treat the hazard (e.g. by rock descaling or other engineering works) to reduce the risk of an incident occurring
- **reduce the consequences of the risk** – warn visitors with signs about the hazard and the need to limit their exposure to it, or limit access to an asset and post alerts (e.g. if weather is a causative factor)
- **transfer the risk** – move responsibility for managing an asset or part of a park to another entity (e.g. by revoking a public road from a park and transferring it to Transport for NSW or the local council).

Not all options are appropriate for every hazard. The risk treatment plan (see Appendix C) for a hazard should identify NPWS's preferred option (or options).

What must NPWS consider when determining the feasibility of implementing a risk treatment plan?

Consistent with the *Landslides and rockfalls policy*, NPWS staff must consider these factors alongside the assessed risk level (qualitative or quantitative) when deciding how to address the risk:

- **environmental impacts of alternative management responses**, particularly impacts on biodiversity and cultural heritage
- **available resources**, including funds and trained staff and management capacity to manage all risks (e.g. will it divert resources from another risk management activity?)
- **impact of response on park management**, e.g. will the response require the removal of a significant number of camping sites?
- **cumulative impact of responses** that may occur over time and across visitor areas, parks and branches
- relevant plans or standards
- **community views and expectations**, including views on the extent of modifications to a location.

Actions to reduce the risk

Subject to the factors above, NPWS may adopt the recommended actions in a geotechnical report as a treatment plan. Actions typically recommended in geotechnical reports include:

- removal of boulders
- rock descaling (removal of loose surficial blocks or rock layers)
- removal of trees to prevent root jacking (tree roots weakening or forcing apart fractured rocks)
- erection of rockfall hazard warning signs
- drone survey of hazardous slopes and cliff faces
- rock bolting and cabling
- regular monitoring of landslide or rockfall locations, including after major weather events such as heavy rainfall

- removal of vegetation around hazards to assess the condition of potential detachment surfaces
- closure of visitor facilities (e.g. walking track, picnic area, lookout) to avoid the landslide or rockfall risk
- track repairs to maintain a safe walking surface
- installation of barriers to prevent access to an unstable slope or cliff
- recording rockfalls (via regular inspections) at a treated site and noting potential causes (e.g. heavy rain, bushfire, ground disturbance by animals, root jacking)
- installation of rock catch-fences or nets
- relocation of visitor facilities (e.g. accommodation buildings) to safer or less exposed locations.

Other risk management actions

Implementation of a treatment plan may also require:

- environmental impact assessment (REF or CRA)
- works certification under the NPWS *Construction Assessment Procedures*
- additional or ongoing geotechnical advice
- operational risk management including safe work measures.

How does NPWS manage the risk resulting from accumulated hazards?

Some areas in national parks are exposed to a succession of landslide or rockfall hazards, e.g. there may be a series of rockfall hazards along a walking track, each of which may be the subject of a specific QRA. For assessing the rockfall risk along the full length of the walking track, those successive hazards can be grouped into **accumulated hazards**.

Steps for managing risk from accumulated hazards along a walking track

Suitably qualified and experienced geotechnical practitioners should be engaged to advise on the most appropriate approach for specific locations. Options for identifying and managing accumulated risks include:

1. **Assess each hazard along a walking track** – rate each hazard as unacceptable, tolerable or acceptable.
2. Take actions to mitigate unacceptable risks first, followed by actions (if required) to mitigate tolerable risks – the objective is to mitigate enough hazards to reduce the cumulative risk to a tolerable level.
3. Create a risk map following implementation of mitigation actions, showing estimated risk along the track.

Mitigating highest risk hazards on walking tracks

Actions for mitigating the highest risk hazards on walking tracks include:

- erecting rock netting over the cliff face, or erecting stair structures to move the track away from the rockfall zone
- realigning part of the track to avoid a rockfall zone

- planting shrubs or trees to seal off areas where people commonly leave the formal track (e.g. to get better views) and consequently enter potential rockfall areas
- placing barriers upslope of sections of the track with risk of boulders rolling down slope
- removing an existing lookout and constructing a new lookout in an area less vulnerable to rockfalls.

Documentation is essential

Documentation in accordance with established corporate recordkeeping systems is critical. This ensures NPWS is able to both take appropriate steps to address significant risks and demonstrate that it has done so.

It is essential for NPWS staff to prepare and document every treatment plan in CAMMS, implement and record the necessary actions in AMS and close the plan once complete (Section 9).

8. Treating rockfall hazards

Treating a rockfall hazard (e.g. by descaling rocks or removing boulders) often involves exposing NPWS workers or contractors to the hazard for long periods. NPWS must carefully plan treatment works to assess and manage the risk.

Planning phase

Complete a risk assessment

NPWS must complete a risk assessment prior to the commencement of descaling works to determine all risks to NPWS workers, contractors and visitors, regardless of whether the works involve working at height.

The risk assessment must be documented and must include control measures based on the hierarchy of control appropriate to the type of hazard and the level of risk.

The risk assessment should include geotechnical engineering advice to assist managers and site supervisors to identify rockfall risks. That advice will form the basis of detailed planning of works.

The risk assessment must identify ways to manage the risks to be as low as practicable.

If there are significant or unacceptable risks to workers, the risk assessment should include professional advice on alternative management strategies that avoid the risk (e.g. closures).

The risk assessment must consider adverse weather, geological events or other issues that could potentially alter the geological integrity of the site during works.

The risk assessment must determine the need for adequate communication devices and systems, particular where lone workers are involved.

Determine hold points

A hold point is a stage in the approval process that requires either:

- a geotechnical expert to approve the next stage of the works, or to advise that access by visitors to a treated rockfall site can be approved

- a director to approve the next stage of the treatment works, or to approve visitor access to the site.

The purpose of determining and observing hold points is to allow a period to pass (to be determined on advice from a geotechnical expert) before resuming works or allowing visitor access.

A hold point must include assessing stability above or below the work site.

Prepare a job safety analysis or safe work method statement

All work must have a detailed job safety analysis (JSA) or safe work method statement (SWMS) that has been drafted specifically for the proposed works.

Like the risk assessment, the JSA/SWMS must be prepared in consultation with workers and geotechnical experts, and must be peer-reviewed and endorsed by the area manager or branch director.

The JSA/SWMS must be routinely reviewed and updated throughout the life of the work activity and at the end of works.

Consider lone worker arrangements, if applicable

NPWS may require workers to do work (e.g. repair or construct walking tracks) in locations with landslide or rockfall risks where a worker or workers could be isolated from vehicle access and may not have reliable mobile phone coverage.

In those situations, NPWS follows the Isolated and Remote Work Policy.

Consider arrangements for working at height

NPWS follows the Working at Height Policy's requirements for working on cliff faces, batters and other places requiring vertical rope access.

Under the policy, NPWS workers and contractors must follow and comply with:

- Australian Standard AS/NZS 4488.2.1 1997 Industrial rope access systems, Part 2: Selection, use and maintenance
- the Industrial Rope Access Association Industry Code.

Ensure all workers are adequately trained

Workers are to be trained to meet the requirements of the work task. If required to work on rope, workers must be trained in industrial rope techniques or equivalent.

Training qualifications of contractors must be assessed and recorded and must meet the above standard as a minimum.

Consider emergency management arrangements

Emergency management arrangements must be planned in consultation with workers and others.

Emergency management arrangements must consider:

- lone worker arrangements
- communication arrangements
- the provision of equipment and resources including first aid/medical supplies

- availability of trained first aiders
- a system to adequately summon assistance quickly
- adequate emergency response times and site access by emergency responders
- regular testing arrangements.

Review proposed works and seek approval

A senior manager must peer review the proposed works.

NPWS should seek input from geotechnical professionals and/or specialist service providers.

The branch director is responsible for approving all high-risk descaling work and other mitigation works.

When works commence

- Complete a site or work induction.
- A daily job safety brief (JSB) must be delivered and recorded prior to the commencement of work. Changes to risks and their controls identified during the briefing must be reflected in the updated JSA/SWMS and prior to the next work activity day, and not wait until the end of works.
- A take 5 (a pre-work hazard identification process) must be completed and recorded and must take into consideration any changes in worksite or work environment. This should occur at points of notable change throughout the day.
- If works require workers to work at height, or if there is a risk of workers falling from height, the Fall Prevention Procedure is to be applied and risks are to be managed.
- Site-specific signage (including temporary signs) for the closure of work areas or visitor areas must comply with the NPWS *Park Signage Manual*. Work sites are to be sign-posted accordingly, and visitors are not permitted to enter the site without authorisation.
- Observe agreed hold points.

After works are complete

- Observe agreed hold points.
- At the completion of the works, the geotechnical engineer must assess the works to ensure they are completed to specifications and provide the agency with a report stating such.
- All project/work activity documentation must be recorded in a project-referenced CM10 file.
- Record cost and effort against the relevant Work Order in AMS.
- Review the project to assess compliance, outcomes and lessons learned.
- Monitor the hazard.

9. Recordkeeping requirements

Good recordkeeping is an essential component of rockfall and landslide risk management. Maintaining up-to-date, easily accessible written records allows NPWS to:

- make the history of a rockfall or landslide site available to park staff and geotechnical practitioners (now and in the future)

Landslides and rockfalls procedures

- demonstrate the agency has acted on its duty of care responsibilities
- keep track of ongoing management actions
- observe patterns in where, when and how rockfalls and landslides occur.

NPWS currently uses 3 main systems for recording information about rockfalls and landslides:

- CAMMS – the department’s hazard and incident reporting system
- Asset Management System (AMS)
- HPE Content Manager 10 (CM10) – the department’s electronic filing system.

CAMMS

All landslide and rockfall incidents must be recorded in CAMMS where there is a direct link to safety to enable capture of data:

- Add New Safety Event – select Hazard, Injury/Illness or Near Miss (see the box below).
- **Description** – use the most relevant term (e.g. ‘rockfall’ or ‘landslide’) to show the incident relates to a rockfall or a landslide (this assists with trend analysis).

All hazards recorded in CAMMS require a qualitative risk assessment – use the department’s standard risk matrix (Appendix A).

If a risk treatment plan is required, the plan must be uploaded to CAMMS.

Recording landslide and rockfall incidents on CAMMS

Only events that directly relate to the health and safety of an individual should be reported on CAMMS. AMS is used to capture geotechnical activity that does not have a link to the health and safety of individuals.

Safety event category	When it’s used	Examples
Hazard	An incident or situation where there is potential for injury or illness but this has not occurred, i.e. stored energy	Geotech provides advice on a feature that has the potential to fail and lead to injury or death of an individual An identified hazard will impact on an NPWS asset, e.g. cracked rock over a NPWS park bench
Near miss	An incident or situation where there was potential for injury or illness but this did not occur, i.e. released energy but didn’t result in an injury or illness	An individual was near a landslide or rockfall but was unharmed
Injury/illness	An incident that causes an injury or illness (including fatalities)	An individual was struck by a rockfall or buried by a landslide

The department must notify SafeWork NSW if an incident results in:

- fatality
- serious injury or illness

- imminent threat to cause a serious injury or illness.

CAMMS – NPWS staff responsibilities

NPWS staff share responsibility for recording hazards, rating risks, and preparing and approving risk treatment plans in CAMMS:

- **All staff** – all NPWS employees are responsible for reporting safety events in CAMMS. Once an event is recorded in CAMMS, it is allocated a responsible officer (i.e. usually the supervisor of the person who recorded the hazard or a person with suitable delegation, e.g. area manager).
- **Responsible officer** – a ‘responsible officer’ is responsible for evaluating the risk, and for rating the risk under the Health and Safety Risk Matrix, i.e. Low, Medium, High or Very High. If the hazard is a public safety risk (i.e. that could pose a risk to the safety of members of the public and park visitors), and the risk is High or Very High, the hazard owner must prepare a risk treatment plan.
- **NPWS Area managers** – are responsible for public safety hazards reported in their Areas, and are therefore hazard owners. They are responsible for ensuring adequate documentation of risk assessments and management decisions.
- **Branch directors** – are responsible for overseeing the maintenance of safety information in CAMMS at a Branch level. They are responsible for approving risk treatment plans and certifying the adequacy of their implementation.

Asset Management System

NPWS staff must use AMS to:

- capture landslide and rockfall hazards as **Equipment Records** (parented to the impacted asset), ensuring all characteristics are entered correctly including Geo Hazard Type*, and TRIM ID (CM10 record)
- ensure spatial data is captured in the Assets Geodatabase Hazard Feature Class, and linked to AMS via the AMS Equipment Number
- capture **cost and effort** associated with treatment works or incidents through **Work Orders** raised against the Hazard Equipment Record
- request the creation of any **Cyclic Maintenance Plans** (i.e. Cyclic Inspection Work Orders) required to monitor the hazard
- **confirm and complete** Work Orders created by Cyclic Maintenance Plans.

*Note: The ‘Geo Hazard Type’ characteristic of the AMS Equipment Record should be entered as a ‘Rockfall’ or ‘Landslide’ to ensure it contributes to inventories of incidents, hazards, completed or scheduled landslide/rockfall work orders.

To view the spatial location of captured hazards, use ParkMap Viewer or ArcMap.

Asset Management System – recording hazards

Landslide and rockfall incidents or hazards may affect multiple assets, such as different sections of a walking track.

The best way to record a landslide or rockfall incident or hazard in AMS that affects multiple assets, will require consideration. NPWS staff should seek advice from their branch asset officers or asset and infrastructure branch as required.

CM10

Landslide or rockfall incidents, hazards, risk assessments, reports, treatment plans and relevant correspondence should be stored in an appropriate location in CM10, with cross-references to the CAMMS and AMS records.

GIS records

Branches should ensure all hazards recorded in AMS are also added to the Assets Geodatabase by their spatial data officers. Additional off-park hazards may be loaded directly into the Assets Geodatabase to contribute to a broader hazard inventory. By mapping the locations of rockfalls and landslides, NPWS can begin to identify geographical patterns in rockfall and landslide occurrence.

Ultimately, GIS-based records can be a starting point for designating areas that are susceptible to rockfalls and landslides. Over time, NPWS may work with geotechnical experts to map these areas as part of a strategic approach to hazard identification (see 'Strategic identification of rockfall and landslide hazards' above).

10. Monitoring the treatment of a hazard

NPWS must track and monitor all management responses to ensure they are implemented fully. This monitoring may include physical site inspections and assessments at appropriate intervals. Staff should use AMS to schedule cyclic inspections and ensure all inspections are documented.

In some cases, monitoring landslides and rockfalls may be the primary management response (e.g. following a moderately-sized rockfall on a low-volume walking track).

In other cases, the response might involve active management of landslides and rockfalls (e.g. through physical works or signage). It is important for staff to monitor whether the adopted management approach is effective and to consider other risk treatment options if required.

11. Adding the hazard to the Branch Risk Register (if required)

Staff should consider adding landslide and rockfall hazards to the relevant Branch Risk Register if they are systemic, of significant scale or concern and warrant ongoing attention and resourcing. The Branch Risk Register escalates hazards for priority attention in the regular cycle of Branch decision-making on resource allocation.

To decide whether the landslide or rockfall risk is significant enough to include in the Branch Risk Register, NPWS should consider the following questions:

- Is the landslide or rockfall isolated to a specific location or event, or is it a broader issue affecting multiple locations?
- Is the landslide or rockfall that caused the incident a result of persistent environmental factors?
- Is the same (or a similar) incident likely to reoccur?
- Is the landslide or rockfall in an area frequented by people (either visitors or workers)?
- Are neighbouring properties at risk from the landslide or rockfall?
- Does the landslide or rockfall have flow-on implications for park management or local communities (e.g. impacts to visitor movements and activities across a park, impacts to local businesses reliant on park visitors)?

The NPWS Safety, Risk and Compliance Team can provide advice about the inclusion of a landslide or rockfall in the Branch Risk Register.

Adding a landslide or rockfall to the Branch Risk Register will not, on its own, be a sufficient management response. Implementing the treatment plan remains critically important.

About the procedures

Procedures adopted **30 November 2019**

Procedures updated **30 December 2023**

Scope and application

These procedures apply to all lands acquired or reserved under the *National Parks and Wildlife Act 1974* except for lands reserved under Part 4A of the Act (unless the Board of Management for those lands has adopted the procedures). However, NPWS staff can use these procedures as guidance in their dealings with Boards of Management.

These procedures apply to landslides and rockfalls occurring on the surface of karst areas in parks, and to rockfalls inside caves. The NPWS Caves Access Policy addresses visitation to caves.

These procedures apply to landslides and rockfalls in parks caused by mining subsidence. Hazards associated with mining subsidence may also be addressed through separate whole-of-government processes, consistent with the *Enterprise risk management policy* and procedures and the NPWS *Visitor safety policy*.

These procedures do not apply to development proposals in alpine resort areas in Kosciuszko National Park, which are covered by State Environmental Planning Policy (Kosciuszko National Park – Alpine Resorts) 2007 (Alpine SEPP). The Alpine SEPP requires geotechnical and land stability issues associated with construction in steep alpine environments to be rigorously assessed under the Geotechnical Policy – Kosciuszko Alpine Resorts (2003).

These procedures must be read and applied in the context of the *Landslides and rockfalls policy*.

Definitions

acceptable risk means a risk that society is prepared to accept – additional work to further reduce the risk is generally not justifiable (AGS 2007).

AGS Guidelines means the Landslide Risk Management Framework published by the Australian Geomechanics Society in 2007 (AGS 2007). The framework addresses landslide susceptibility, hazard and risk zoning for land-use planning, and outlines a step-by-step process for doing risk analysis, risk assessment and risk management of landslide and rockfall hazards.

ALARP means *as low as reasonably practicable* – the ALARP principle states that ‘risks, lower than the limit of tolerability, are tolerable only if risk reduction is impracticable or if its cost is grossly disproportionate (depending on level of risk) to the improvement gained’ (ANCOLD 2022).

alpine resort areas means the Thredbo, Perisher Range, Mount Selwyn and Charlotte Pass ski resorts; the Kosciuszko Mountain Retreat, Ski Rider and Sponar’s Chalet accommodation areas; and the Bullocks Flat Skitube terminal.

ANCOLD Guidelines means the Guidelines on Risk Assessment published by the Australian National Committee on Large Dams in 2022 (ANCOLD 2022). Those guidelines are an accepted industry standard for the practical application of risk assessment, including guidance on addressing societal risk.

Landslides and rockfalls procedures

Asset Management System (AMS) means the Plant Maintenance module of SAP that supports NPWS's management of assets in parks. AMS includes a corporate master list of all assets owned and/or maintained by NPWS.

CAMMS (or **Camms.Risk**) means the Department of Climate Change, Energy, the Environment and Water's web-based Work Health and Safety system, which allows the capture and management of incidents, hazards, audits and safety interactions (CAMMS is named after the software company's founders – **Collins, Anderson, Murfitt Management Solutions**).

consequence means the outcome or impact of an event and may be expressed qualitatively or quantitatively – there can be more than one consequence from one event (AS/NZS 31000:2009 Risk Management).

conservation risk assessment (CRA) means a rapid assessment of the environmental impacts of a minor activity or small-scale work that qualifies as exempt development under State Environmental Planning Policy (Infrastructure) 2007.

geotechnical engineer (or **engineering geologist**) means a specialist geotechnical engineer or engineering geologist who is degree-qualified, is a member of a professional institute and who has achieved chartered professional status as a CPEng, CPGeo or RPGeo with 'Landslide Risk Management' as a core competence (adapted from DIPNR (2003)).

geotechnical report means a report prepared by and/or technically verified by a geotechnical engineer or engineering geologist of an assessment of the risk posed to people or property by all reasonably identifiable hazards at a site (adapted from DIPNR (2003)).

hazard means a potential or existing condition that may cause harm to people or damage to property or the environment (Emergency Management Australia 1998 – Australian Emergency Management Glossary). In these procedures, a *hazard* is a physical event or condition in the landscape that causes or may cause harm or damage, e.g. a landslide or a rockfall.

hazard owner means the person responsible for evaluating a risk, and for rating the risk under the department's risk matrix; for landslides and rockfalls in parks, the hazard owner is generally an area manager.

hold point means a stage in the approval process that requires either:

- a geotechnical expert to approve the next stage of the works, or to advise that access by visitors to a treated rockfall site can be approved
- a director to approve the next stage of the treatment works, or to approve visitor access to the site.

individual risk (or **individual most at risk**) means the likelihood that a specific individual will be killed in an incident – it is expressed as a ratio of *an event* (e.g. a death) to *number of years* (e.g. 1 event every 1,000 years, 3 events every 10,000 years) (adapted from AGS [2007] and Saw et al. [2009]).

job safety analysis (JSA) means a process of identifying potential hazards associated with a job, assessing their risk and recording how to eliminate, or minimise, the risk to worker safety (controls) (Department of Planning and Environment 2017 – Hazard Identification and Risk Control Procedure).

job safety brief (JSB) means the process of formally communicating to staff the hazard controls developed for their job, allowing consultation about the hazard controls, and documenting that this process has taken place (Department of Planning and Environment 2017 – Hazard Identification and Risk Control Procedure).

Landslides and rockfalls procedures

karst means an area or environment formed from the erosion of soluble rocks such as limestone to create underground caves and streams, fissures and sinkholes.

landslide (or **landslip**) means the movement of a mass of rock, debris, or earth (soil) down a slope (AGS 2007).

landslide risk assessment – alternative term for quantitative risk assessment.

likelihood means a general description of probability or frequency – it can be expressed qualitatively or quantitatively (AS/NZS 31000:2009 Risk Management).

mining subsidence means changes in the landscape resulting from previous or continuing sub-surface mining in parks, which may cause the collapse of cliffs, changes to the ground surface and to drainage, and other risks to park visitors and workers.

NPWS Construction Assessment Procedures means the processes for ensuring that building and infrastructure works in parks meet the requirements of the Building Code of Australia (BCA), the Disability (Access to Premises – Buildings) Standards 2010, and Australian Standards (NPWS *Construction Assessment Procedures* 2011).

NPWS Quantitative Risk Guidelines means the *NPWS Guidelines for Quantitative Risk to Life Calculations for Landslides* prepared by Golder Associates in 2023 (Golder Associates 2023). NPWS requires geotechnical consultants to use these guidelines when doing QRAs of rockfall and landslide hazards in parks.

park means a reserve gazetted under the *National Parks and Wildlife Act 1974*, including a national park, nature reserve, historic site, Aboriginal area, state conservation area, karst conservation reserve, regional park or any land acquired by the Minister under Part 11 of the NPW Act.

qualitative risk assessment means an analysis that uses a descriptive (e.g. Low, High or Very High) or a numeric rating scale to describe the magnitude of potential consequences and the likelihood that those consequences will occur (AGS 2007).

quantitative risk assessment (QRA) means an analysis based on numerical values of the probability, vulnerability and consequences (of the risk), and resulting in a numerical value of the risk (AGS 2007). It is often expressed as a ratio, e.g. 1:10,000.

relevant NSW civil liability law means the *Civil Liability Act 2002*, which provides the principles for determining whether a public or other authority has a duty of care or has breached a duty of care, and may also include any civil liability common law principles.

review of environmental factors (REF) means an environmental assessment undertaken to assist in meeting the requirements of Part 5 of the *Environmental Planning and Assessment Act 1979*. It is completed before NPWS undertakes an activity, or grants approval allowing an external party to undertake an activity. An REF examines the significance of likely environmental impacts of a proposal and measures required to mitigate adverse impacts to the environment.

risk means a measure of the probability and severity of an adverse effect to health, property or the environment (AGS 2007).

risk threshold means a numerical description (e.g. 1 in 1 million or 1 in 100,000) of the upper limit of a risk category, i.e. there is a threshold (upper limit) for an acceptable risk, and a threshold (upper limit) for a tolerable risk.

risk treatment means the process of decision-making for managing risk and the implementation or enforcement of risk mitigation measures and the re-evaluation of [their] effectiveness from time to time, using the results of risk assessment as one input (AGS 2007).

Landslides and rockfalls procedures

risk treatment plan means a written plan that is prepared (under either a qualitative or quantitative risk assessment) for implementing risk mitigation measures and the re-evaluation of their effectiveness from time to time. A risk treatment plan can be prepared as a stand-alone document or can form part of or be appended to a QRA or geotechnical report prepared by a qualified geotechnical engineer.

rockfall means the action of boulders, rocks or slabs of rock falling or toppling.

rock descaling (or **scaling**) means the removal of loose surficial blocks or rock layers.

root jacking means the process of roots penetrating joints and defects in rock and movement of rock masses due to pressure generated by growing roots (Transport for NSW 2015).

societal risk (or **population risk**) means the likelihood of one or more persons being killed in a year – it is generally expressed as a graph (called an F–N curve) showing the *frequency* (F, i.e. likelihood) of one or more persons being killed by a hazard against the *number* (N) of deaths (e.g. 3 in 1,000, 10 in 10,000, 50 in 100,000, 400 in 1 million) (adapted from AGS (2007) and expert advice).

safe work method statement (SWMS) means a written document that sets out the high-risk construction work activities to be carried out at a workplace, the hazards and risks arising from these activities and the measures to be put in place to control the risks (WorkCover NSW 2014 – Construction work code of practice).

take 5 (or **take 5 pre-start checklist**) means a hazard identification process to be completed by an individual or work team on site before commencing work (Department of Planning and Environment 2017 – Hazard Identification and Risk Control Procedure).

tolerable risk means a risk within a range that society can live with to secure certain net benefits – the risk is non-negligible and should be kept under review and reduced further if possible (AGS 2007).

Accountabilities

Task	Position accountable
Responding to landslide and rockfall incidents	
Record incident in CAMMS as a Near Miss or Injury	All NPWS staff
Notify supervisor/manager and relevant Branch staff	All NPWS staff
Notify Safety, Risk and Compliance Team (if incident is deemed a notifiable incident)	Area manager
Record incident against the asset record in AMS	Works supervisor*
Recording landslide and rockfall hazards	
Record a hazard in CAMMS	All NPWS staff
Capture Hazard Equipment records and Work Orders in AMS	Hazard owner (e.g. area manager)
Add the hazard to the Branch Risk Register (if required)	Branch director
Managing landslide and rockfall hazards	
Approve risk treatment option (i.e. accept, avoid, reduce or transfer) and determine whether a treatment plan is required	Branch director

Landslides and rockfalls procedures

Task	Position accountable
Tolerate (accept) the risk (without preparing a treatment plan)	Branch director
Prepare a risk treatment plan	Area manager
Approve a risk treatment plan	Branch director
Approve a risk treatment plan for an area subject to an unacceptable risk	Deputy Secretary, NPWS
Approve reopening of an area subject to an unacceptable risk following mitigation works	Deputy Secretary, NPWS
Implement a risk treatment plan	Area manager
Monitor the hazard and update treatment approach	Area manager
Report on satisfactory completion of treatment works (assessed by geotechnical engineer)	Senior asset officer Area manager
Monitor the hazard on an ongoing basis	Senior asset officer Area manager
Identifying hazards in construction works	
Identify landslide or rockfall hazards during preparation of REF	Area manager
Obtain geotechnical advice on significant hazards for inclusion in REF	Area manager
Obtain engineering certification of construction and maintenance works with significant exposure to landslides and rockfalls	Senior asset officer Area manager
Treating rockfall hazards	
Prepare a risk assessment of proposed descaling or other works	Area manager
Obtain geotechnical advice on risk of proposed works and advice on treatment	Senior asset officer Area Manager
Approve risk assessment of proposed works in consultation with geotechnical engineer	Branch director
Verify approved hold points for each stage of works	Branch director
Prepare JSA or SWMS for proposed works with geotechnical engineer and verify appropriate work licences	Senior asset officer Area manager Works supervisor*
Verify an approved JSA or SWMS has been developed for proposed works	Branch director
Site induction/site handover for contractors	Works supervisor*
Prepare daily JSB for proposed works or verify contractor has performed brief	Works supervisor*
Prepare take 5 (onsite hazard identification by work team)	Works supervisor*
Approve proposed works	Branch director
Strategic identification of rockfall and landslide hazards	
Maintain inventory of incidents and hazards at Branch level	Senior asset officer Area manager Branch programs manager

Landslides and rockfalls procedures

Task	Position accountable
Commission an assessment of rockfall and landslide hazards at a multi-site or multi-park level	Branch programs manager Branch director

* **Works supervisor** means an employee responsible for overseeing and coordinating works or overseeing contractors doing works, and who has been delegated by an area manager or branch director to manage a project. A works supervisor may be (but not exclusively) a senior field supervisor, field supervisor, team leader rangers or ranger.

References

- ANCOLD (Australian National Committee on Large Dams) (2022) *Guidelines on Risk Assessment*, Australian National Committee on Large Dams Inc., Melbourne.
- AGS (Australian Geomechanics Society) (2007) 'Landslide Risk Management', *Journal and News of the Australian Geomechanics Society*, 24(1), <https://australiangeomechanics.org/downloads/>, accessed 29 August 2019.
- British Geological Survey (n.d.) [How to classify a landslide](#), British Geological Survey website, accessed 29 August 2019.
- DIPNR (Department of Infrastructure, Planning and Natural Resources) (2003) *Geotechnical Policy – Kosciuszko Alpine Resorts*, NSW Department of Infrastructure, Planning and Natural Resources.
- Golder Associates (2023) *NSW National Parks and Wildlife Service: Guidelines for Quantitative Risk to Life Calculations for Landslides*, report commissioned by NPWS, (referred to in these Procedures as 'NPWS Quantitative Risk Guidelines').
- NSW Department of Planning, Industry and Environment (2019) *National Parks and Wildlife Service Mandatory Incident Reporting – Instruction Sheet*, NSW Department of Planning, Industry and Environment, Sydney.
- Saw JL, Wardman M, Wilday J, McGillivray A, Balmforth H, McManus H, Reston S and Rushton A (2009) *Societal Risk: Initial Briefing to the Societal Risk Technical Advisory Group* (HSE RR703), prepared jointly by the Health and Safety Laboratory and the Health and Safety Executive.
- Transport for NSW (2015) *Vegetation Hazard Management in the Rail Corridor*, Transport for NSW.

More information

- [AGS GeoGuide LR8 \(Construction Practice\)](#) [PDF 1.4MB]
- [AS/NZS 4488.2.1 1997 Industrial rope access systems Part 2: Selection, use and maintenance](#)
- [Asset Management System](#) [accessible by NPWS staff only]
- [Camms.Risk](#)
- [Caves Access Policy](#)
- [Construction Assessment Procedures](#)
- [Consultant prequalification schemes](#)
- [Environmental impact assessment and planning support](#)
- [Geotechnical Policy – Kosciuszko Alpine Resorts \(2003\)](#) [PDF 433KB]
- [How to classify a landslide – British Geological Survey](#)
- [Landslides and Rockfalls Policy](#)
- [National Parks and Wildlife Act 1974](#)
- [National Parks Visitor website](#)
- [NPWS Guidelines for Quantitative Risk to Life Calculations for Landslides](#)
- [Park Facilities Manual](#) [accessible by NPWS staff only]
- [ParkMap Viewer](#) [accessible by NPWS staff only]
- [Remote and Isolated Work Policy](#) [accessible by NPWS staff only]
- [Remote and Isolated Work Procedure](#) [accessible by NPWS staff only]
- [Visitor Safety Policy](#)

Appendix A – Department’s risk matrix

Use this risk matrix to assess the qualitative **risk to life** for a landslide or rockfall.

Risk matrix	Consequence				
Likelihood	Insignificant	Minor	Moderate	Major	Extreme
Almost certain	Medium 11	High 17	High 20	Very high 23	Very high 25
Likely	Low 7	Medium 12	High 18	High 21	Very high 24
Possible	Low 4	Medium 9	Medium 13	High 19	High 22
Unlikely	Low 2	Low 5	Medium 10	Medium 14	High 16
Rare	Low 1	Low 3	Low 6	Medium 8	High 15

Source: NSW Department of Planning and Environment WHS Risk Management Procedure, June 2022

Appendix B – Guidance for preparing geotechnical assessment reports

The NPWS *Landslides and rockfalls procedures* explain the requirements for carrying out landslide risk assessments in NSW national parks. A report setting out the results of a Landslide Risk Assessment is required for all landslide risk assessments and **must contain all of the following**.

Executive summary

- A description of the site and its location.
- A description of the landslide and rockfall hazards to which the site is subject.
- The outcomes of a risk assessment undertaken consistent with the NPWS *Landslides and rockfalls procedures*, including whether the assessed risks are **acceptable**, **tolerable** or **unacceptable**.
- A summary of recommended risk mitigation measures (i.e. from the risk treatment plan for risks assessed as tolerable and unacceptable).

Details of the geotechnical practitioner and their qualifications and experience

- Provide full details of the geotechnical practitioner's qualifications and experience – including but not limited to experience in the management of slope instability problems and landslide risk management.

Detailed site description

- The detailed site description must include plans, cross-sections and photographs of the subject site.
- Plans and cross-sections are to be based on field measurements, with measured ground slopes shown and drawn to scale and dimensioned.

Description of landslides or rockfalls that have previously occurred on or near the site

- The description of previous landslides and rockfalls on or near the site must include, if available, the frequency with which those landslides or rockfalls have occurred.

Details of all site investigations and any other information used in preparation of the geotechnical report

- Full details of all site investigations must be provided.
- All sources of information must be fully referenced.

Description of landslide and rockfall hazards identified

- All landslide and rockfall hazards must be fully described and mapped.

Landslide Risk Assessment prepared consistent with the NPWS Quantitative Risk Guidelines



- A Landslide Risk Assessment prepared consistent with the NPWS Quantitative Risk Guidelines must be prepared for all reasonably identified landslide and rockfall hazards that could impact the subject site.
- The Landslide Risk Assessment must include a full quantitative assessment of the risk posed to life, and an F–N plot showing where the assessed risk plots relative to the risk assessment criteria.
- This section of the report should also include a plain English description of the assessed risk, specifically whether it is acceptable, tolerable or unacceptable based on the relevant criteria.

Recommendations for landslide risk mitigation (risk treatment plan*)

- The Landslide Risk Assessment must include recommendations for landslide risk mitigation as appropriate.
- The recommended risk mitigation measures will comprise the risk treatment plan for NPWS to implement.

*Note: NPWS may determine, on a case-by-case basis, whether the risk treatment plan is prepared as part of the geotechnical assessment or the QRA, or as a stand-alone document (see Appendix C for a risk treatment plan template).

Appendix C – Risk treatment plan template

 		NPWS Risk Treatment Plan	
Date:		Ref:	
Branch and Area:			
Risk description			
Current controls Record here any current controls or measures (e.g. policies and procedures) that are in place to manage the risk.			
Consequence:	Likelihood:	Risk level:	
Treatment options			
Environmental and other considerations			
Proposed actions			
Resource requirements			
Timing			
Performance measures			
Reporting and monitoring required			
Residual risk evaluation on completion of risk treatment plan Are you lessening the <u>likelihood</u> or the <u>consequence</u> (or <u>both</u>) and what is the overall reduction in the risk rating?			
Consequence:	Likelihood:	Residual risk level:	
Prepared by:		Date:	
Endorsed, Area manager:		Date:	
Approved, Branch director:		Date:	
To be implemented by:			