New Zealand Mountain Bike
Trail Design Guidelines

Recreation Aotearoa
Te Whai Oranga

Department of Conservation
Te Papa Atawhai

He Kaupare. He Manaaki. He Whakaora.
prevention. care. recovery.

SPORT NEW ZEALAND
IHI AOTEAROA

New Zealand Mountain Bike
Trail Design Guidelines

ISBN 978-1-7386253-4-5

Artwork by Jeff Carter and Paul Kennett

Front cover photo by Digby Shaw. Back cover photo by Jemma Wells.
All other photos by Jonathan Kennett unless stated otherwise.

Recreation Aotearoa Disclaimer:
The information contained in this document is intended as a resource only and should not be interpreted as a standard, specification, or regulation.

These guidelines have been produced by Recreation Aotearoa with funding support from ACC and Sport New Zealand.

Material has been drawn from the following four trail design guides: IMBA Trail Solutions, New Zealand Cycle Trail Design Guide, DOC Cycle Service Standards and Recreation Aotearoa New Zealand Mountain Bike Trail Design & Construction Guidelines.

Special thanks to all the land managers, trail designers and track builders around the country who provided their expertise via workshops, surveys and reviews of the various drafts.

In particular, we would like to thank:

Jeff Carter from Southstar Trails

Chris Mildon from Tasman Trails Ltd

Nick Sutcliffe and Bruce Webster from the Department of Conservation

Tim Harkness, David Halliday and Mark Kent from Wellington City Council

Simon Alefosio-Tuck from Rotorua Lakes District Council

Steven Peters from Queenstown Lakes District Council

Simon Noble from EnvisageNZ

Mark Smith and Maddi Keurntjes from Christchurch Adventure Park

Chris Foggin, John Humphrey and the other good folk at Trail Fund NZ

Pete Masters from Ngā Haerenga New Zealand Cycle Trails

Mark Mandeno, Adventure Works NZ

The Kennett Bros

Contents

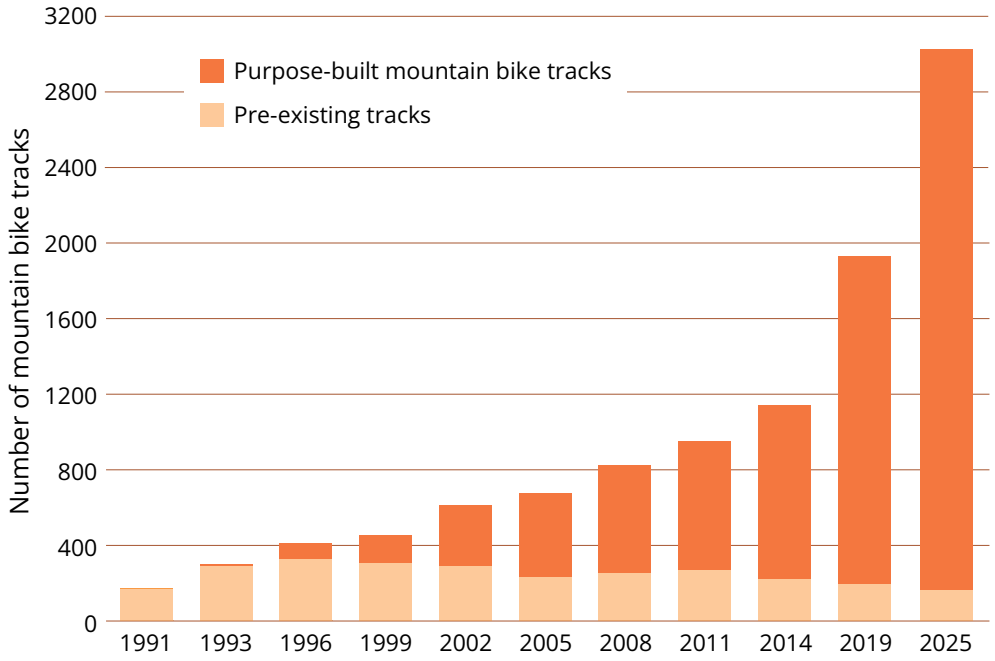
Preface

This is the third edition of the **New Zealand Mountain Bike Trail Design Guidelines** published by Recreation Aotearoa. It has been revised in partnership with the Department of Conservation and replaces the DOC Cycle Track Service Standards.

These guidelines also draw heavily from IMBA's trail building guidelines and closely align with the Ngā Haerenga New Zealand Cycle Trail Design Guidelines. For information on accessible trails, see **Chapter 8 Adaptive Biking Trails** and refer to the Outdoor Accessibility Design Guidelines published by Recreation Aotearoa in 2025.

Mountain biking is one of the most popular recreational activities in New Zealand. The first purpose-built mountain bike tracks appeared in the North Island in the early 1990s, with the most significant development starting at Whakarewarewa in the summer of 1992-93.

By the end of the 1990s, the popularity of track building and dedicated mountain bike parks had taken off, with some people spending more time building tracks than riding them. In 2002, the number of purpose built tracks reached 300, and by 2020, it exceeded 1000.



The growth of purpose-built mountain bike tracks in New Zealand

Source: Kennett Bros

Hogs back work party. Credit: John O'Malley

The boom in mountain bike tracks has been accompanied by a boom in the number of people riding them. Recent surveys estimated that 25% of New Zealanders own a mountain bike and 11% went mountain biking at least once in the last 12 months. Of those that haven't been mountain biking, 14% are interested in giving it a go. The single biggest determinant of the number of people who will take up mountain biking in future is the access to high quality trails.

These guidelines provide the information needed to provide consistent, sustainable, high-quality trails that will fuel the uptake of mountain biking long into the future.

01 The big picture

Successful trails are fun, sustainable and affordable to build. That's not an easy combination to achieve. People have different preferences, different bikes, and different levels of skill and fitness across all ages. You need to create a variety of trail types to satisfy a broad range of riders. User groups change over time, although some types of trails have more long-term appeal than others.

What is mountain biking?

At its core, mountain biking simply involves riding a mountain bike off sealed roads, through mountains and forests. It can be recreational or competitive; cruisy or hardcore; fast or slow. Mountain biking means a lot of different things to different people.

Credits: Mead Norton , B Wall
S Kennett, Ben Karalus

Type	Description	Grade	Potential market
Leisure	This group includes all ages and abilities. These riders may not bike very often and usually have limited skills. They are not members of riding groups. They mostly ride close to home, or when they are on holiday. May be on a hired or borrowed bike. Will be attracted to easier New Zealand Cycle Trails.	Seeking Grade 1 and 2 trails. May extend to a Grade 3.	Largest
Recreation	Enthusiasts with good bikes and reasonable fitness and skills. Unlikely to enter races. Looking for well-built and signposted trails, be they technical, flow, jumps or just old-school tracks.	Seeking Grade 3 and 4 trails. Will ride Grade 2 to get to harder trails. Considers Grade 5 occasionally.	Large and enthusiastic
Sport	Likely to be members of a club or regular riding group. Will purchase high-quality bikes and spend considerable time training for events: downhill, cross-country, enduro, etc. Elite racers are less likely to ride e-bikes.	Seeking Grades 3, 4 and 5. May extend to 6.	Small but prominent
Adventurer	Experienced outdoors people who choose mountain biking as one way of keeping fit and travelling far and wide. They will go far to seek out new trails, more based on location than trail type. Likely to enjoy bikepacking.	Will ride anything that takes them where they want to go.	Small
Gravity assist	Bold, highly skilled, thrill seekers who ride the same trails multiple times, going faster/higher each time. Will be attracted to chairlifts, shuttles and e-bikes. More interested in downhills than up hills, and thrills more than fitness. Often focused on flow and jumps.	Seeking Grade 4, 5 and 6	Depends on uplift facilities
Adaptive MTB	Seeking a range of experiences while on three and four-wheeled bikes. Mostly on e-bikes now. Often limited by infrastructure barriers.	Seeking Grade 1, 2 and 3 mostly.	Tiny but growing

Notes: These are broad generalisations. Mountain biking is dynamic and inventive. New types of mountain biking and bikes will surprise us in future.

What is not mountain biking?

The bike is a giveaway. If it's not happening on a mountain bike, it's probably not mountain biking. BMX, massive dirt jumps, gravel riding, cyclo-cross and bike packing are close cousins of mountain biking. They are complimentary, but they aren't mountain biking.

The trail surface is another giveaway. Cycling on a sealed path or road is not mountain biking, and a mountain bike isn't needed. A natural surface (dirt, gravel, or rock) is essential for mountain biking.

Of course, there are always exceptions to the rule, for example, the fringe activity of 'under biking' where skilled riders spice it up by a bike not ideally suited to the conditions (i.e., a gravel bike, unicycle or cyclocross bike).

Shared-use or single-use trails?

In New Zealand, many mountain bike park trails are open to bikes only, whereas most trails outside mountain bike parks are shared use. For example, most DOC tracks open to bikes are also open to walkers, and every NZ Cycle Trail is shared use. On the famous Old Ghost Road (NZ's longest single track) 48% of the users were trampers in 2024. In Wellington, the council has a default position of sharing most trails, except downhill trails which are 'Bike Priority'.

It's quite rare, however, to share a trail with horses, motorbikes or 4WDs as they damage purpose-built mountain bike trail very quickly and conflict can be difficult to manage.

If user numbers are moderate-low, and expectations are managed, sharing a trail with walkers can be a good use of resources.

Walkers: are relatively slow and can be unaware of other users. Can be startled easily and are not always happy to share the trails.

Runners: are often fast and fit. They can often travel at a similar pace to bikers and are generally happy to share.

Trampers: likely to be on rougher trails with a low number of bikers. They are hardy people, often with mountain bike experiences of their own.

While it's not safe to share high-speed downhill trails, many trails have much lower use and lower speeds. In those cases, land managers recognise several benefits of shared use trails, including:

- accommodating the needs of the largest number of users
- fostering a wider sense of community and tolerance
- cost effective for land managers
- increasing the economic returns and making remote trails, in particular, financially viable.

However, in busy locations, single-use trails have advantages:

- In urban locations where trails will be used by thousands of riders a month, it can be beneficial to separate walking and biking trails to improve the experience for both user types and to avoid conflict.
- If trails are high speed, then it's safer to make them one-way and single use.
- If a trail is mainly focused on nature, and people are likely to be wandering along and stopping to look at plants or birds, it may be better to make the trail a walking only trail, or design it to be low speed.

Land managers generally want to cater for as many users, and user groups, as possible by building a full range of trail types across all grades. An added bonus is using the trails to help restoration efforts, for example, providing a route for weed removal, native tree planting and/or predator control.

4WD tracks

Most mountain bike parks include 4WD tracks and pylon roads which are a valued part of the trail network.

These tracks and roads are generally not open to the public. They are used by park managers, service vehicles and farmers. They're also used by emergency vehicles, and sometimes shuttle vehicles.

Enhancing the mountain biking experience

Mountain bikers, like everyone else, prefer natural environments with biodiversity. Major tree planting efforts have been led by trail groups around the country, including Whakarewarewa (it's not all pine trees), Motupipi Hill in Golden Bay, Motu Trail in the Bay of Plenty, Matairangi Trail Builders and the Brooklyn Trail Builders in Wellington, the Waikato River Trail (over 100,000 trees planted), and many others.

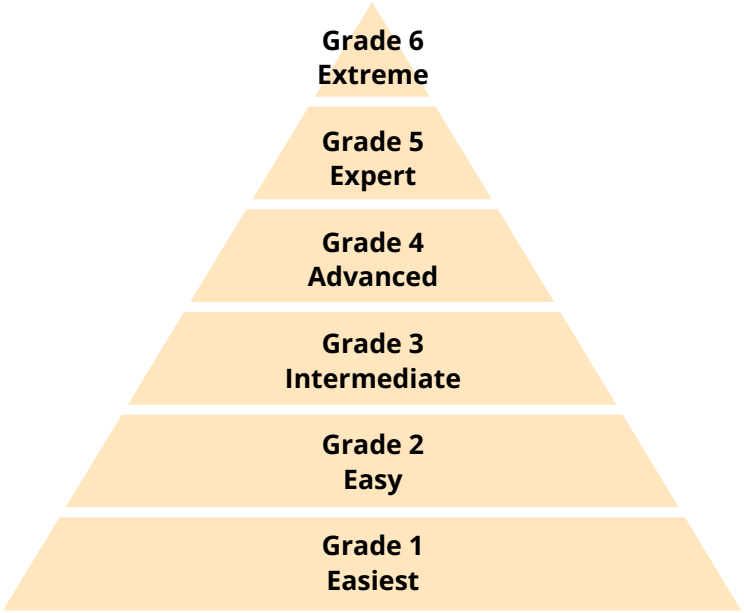
At Makara Peak Mountain Bike Park in Wellington an early goal was set of planting one tree for every metre of track built. This was to offset the impact of clearing vegetation to build tracks and improve the environment in the park. Since the Park was first formed in 1998, more than 50,000 metres of track have been built, and 60,000 trees planted.

The Makara Peak Supporters also set up pest control in the park, including 40 traps to catch stoats, weasels and rats. As a result, growing numbers of endangered native birds have been observed in the park, including korimako (bellbird), kākā and, since 2024, kiwi!

Another benefit of this work has been to improve the reputation of Makara Peak, increasing its support base especially among politicians and environmental groups that may otherwise not support a mountain bike park

Trail Grades

Trails cater for people with a range of skills and aspirations.



Everyone starts biking at Grade 1 or 2. If beginner riders have good experiences, they may continue riding and work their way up through the grades. Some will be more ambitious than others. Most people are happy at Grade 3 or 4. Some move up to Grade 5, and just a few reach Grade 6.

Everyone will pass their peak at some stage and start seeking easier grades of trail. This may be due to a serious crash or illness, or simply because they're getting older and slower.

Most trail building leaders are highly capable Grade 4, 5 and 6 riders. They love mountain biking and contribute by building trails. Naturally, they most want to build Grade 4, 5 and 6 trails, because these are so much more fun for them. The feelings of flow and fear, risk and relief, challenge and accomplishment make them feel alive!

Over a million New Zealanders own mountain bikes, but most of those owners only have Grade 1, 2 and 3 riding skills. They cannot ride higher grade trails.

In most cities in New Zealand, there is a gap between a Grade 1 trail (i.e., a rail trail or gravel track around a school park) and the 'easy' trails in their local mountain bike park. Whakarewarewa in Rotorua sought to fill that gap by building short and long Grade 2 trails. Their experience proved that those easy trails can be hugely popular, but they are also costly to build.

In fact, a trail managers' dilemma is that the hard tracks are the easiest (and least expensive) to build, and the easy tracks are the hardest (and most expensive) to build. To cater for everyone, a wide range of trails are required.

Arapuke, Palmerston North Credit: J Kennett

The Beginners View

The following is based on an email that was sent to the manager of a large mountain bike park in New Zealand. In the email, the rider explains what it is like to take up mountain biking. The main takeaway is that we were all learners at some stage, so don't forget to factor in the new riders' viewpoint and lack of experience to your trail design and network.

"I know there is a wealth of mountain biking experience in the park, and I do wonder if the beginner experience is so far in the past for most that they have forgotten what it's like to learn to mountain bike.

As a beginner our experience can be:

1. We go slow
2. We are getting the hang of the bends and berms
3. We don't know what line to choose
4. We are not experienced in rolling over "rough" terrain (rocks and ruts)
5. We get tired and sit on our seat
6. We don't have all the gear
7. We cling on tightly to the handlebars
8. Obstacles seem magnified
9. We can be braking continuously.

How to enhance the beginner experience:

- Improve the trail by removing some of the stones and rocks. Even having a couple of sections smoothed out, especially near the top, would help.
- Add designated rest stops:
  - Name them as such
  - Have at least 2 stops
  - Enables the beginner to rest and see themselves progressing
- Add more signs to coach and encourage beginner riders."

To build or not to build?

Before starting on a new trail, make sure you discuss with all stakeholders why a new trail is needed, and what the costs and benefits might be.

Below is a framework that may help with initial meetings and discussions.

Trail Decisions

WHY

- Do we need a new trail?
- Who is the trail for?
- What style and grade will it be?
- How does it complement the surrounding trail network?
- How many people will ride it (based on similar tracks in the area)?
- Is the existing trail network performing to its full potential?
- Could an old trail be rebuilt to meet new or emerging needs?

ENVIRONMENTAL IMPACTS

- How important is the proposed area ecologically?
- What effect will this track have on conservation and the natural environment?
- How can the negative impact of building another trail be mitigated or offset?

SUSTAINABILITY

- Can this trail be kept in grade long term?
- How will the track surface hold up?
- How much annual resource will be allocated to maintenance (10% or 20% of the total build cost)?
- Will it stretch volunteers' capacity?

COST

- What is the capital build cost?
- What is the short- and long-term management cost?
- Will resources (time and/or money) be allocated for maintenance?
- Will building a new trail add further strain to already limited resources?

Before deciding what type of trail, or experience, you are trying to create, do some research into the existing and potential market. Learn how popular the existing trails are by installing trail counters and looking at Strava's Global Heatmap. Keep in mind that Strava is used by a subset of mountain bike enthusiasts and will be missing the majority of riders who don't use it. Nonetheless, it can still indicate patterns of use.

Once a trail partnership has been formed and the key stakeholders have worked through these questions, you are ready to build trails. That is exactly what these guidelines focus on.

Grooming a sweet trail with Weapons of Mass Creation (WMC). Credit: Lisa Ng

Ten ways to attract riders to your trails

Here are some top tips from IMBA, adapted for Aotearoa:

1. **Provide and promote trails for all abilities**

   Beginners enjoy quiet roads and wide dirt paths. Intermediate and advanced riders seek more remote and challenging experiences through forest and up and down hills. Provide and promote an abundance of all these experiences.

2. **Spread the love**

   Advertise all the trails in your area to spread the load.

3. **Showcase and enhance the land's natural beauty**

   Recommend rides that visit beautiful places, as well as places that are being restored. Tell the stories, past, present and future.

4. **Getting lost can be the worst experience for visiting and first-time riders**

   Ensure your trails are well signposted, and provide maps online and at trail heads and hubs. Don't rely solely on Trailforks, as in mid-2025, they started requiring users to have accounts. Many visitors will not have accounts.

5. **Photograph your trails professionally**

   Develop a library of outstanding images of both trails and the surrounding area.

6. **Partner with bike shops and bike hire businesses**

   Bike shops are essential to a healthy riding area. Visitors and school groups may want to hire bikes, and bikes need constant repair. Bike shops are also a great place for people to learn more about a local riding area.

7. **Advertise other activities and locations**

   To attract a wide range of people, don't forget to mention other popular activities nearby, including places to eat near the trails.

8. **Be active online**

   Whatever social media platforms you choose, stay active. Appoint someone to ensure there are new posts every few days, or weeks at the most. A platform that hasn't been active for months is a sign of a trail area in decline.

WORD on top of Rangituhi, Porirua. Credit: Ashley Peters

9. **Get your community involved**

   Whether you are developing signs, promoting events, or organising work parties, make sure your local community knows all about it. See if locals are willing to get involved and always look for opportunities to tell your story.

10. **Celebrate success**

    Ensure continued support at all levels by quantifying and celebrating your successes. Appeal to people's hearts with photos of happy people, and appeal to their heads with data that demonstrates the success of your projects. Declare the number of trails, trees, visitors and volunteers. It's a story worth celebrating!

02 Landowners

Every trail crosses land owned by someone. Much of it is owned by the Department of Conservation, Māori groups, or councils. There are also great trails on private land.

Most of these trails involve a partnership of some sort between a mountain bike group and one or more of the following stakeholders:

- Central or local government agencies
- Iwi or hapu groups
- Funding providers/sponsors
- Farmers
- Other interested groups (local residents, Federated Mountain Clubs, etc)

Mountain bike groups are encouraged to become a club and/or incorporated society or trust. Formal groups such as these have a structure and reliability that makes them more reputable and accountable. They are able to open bank accounts, raise and spend funds, and sign agreements that are long lasting.

For partnerships to work well, it is worth considering a few key principles. These principles were first developed by the International Mountain Bike Association (IMBA), and subsequently modified for New Zealand:

1. Write an agreement

Before trails are built, all partners must be on the same page. Start with a simple Memorandum of Understanding (MOU) that lays out the goals and roles of all parties. This helps develop clear rules and responsibilities, which sets you up for a healthy ongoing partnership. Try to be specific, and acknowledge that the MOU can be updated in future if needed.

2. Start simple

Begin with simple steps, where both parties share a clear goal, and the stakes are low. A small shared project like a work party to tidy up a track, or plant trees is ideal. The goal is to start building relationships.

3. Have patience

Land management decisions and processes usually take time. Try to understand the priorities and constraints facing land owners and managers. Volunteers can become frustrated if they don't understand the processes in advance. Partnerships require staying power, and a commitment to work things through. More complicated agreements take longer. If possible, write up timelines with milestones to help monitor progress. Set realistic expectations.

4. Respect

Just as different mountain bikers want different types of trails, different land managers have different goals. They are usually required to balance the needs/desires of the public and their managers/trustees/councillors. This is not an easy task. Partners will succeed if they learn to respect and appreciate each other's position.

5. Keep communicating

Partnerships usually require a great deal of meeting and negotiation to develop agreements. It is important that partners find the right people for the job: people with the skills to develop the relationship and ensure consistency with the MOU.

6. Adapt to change

MOU's may need to change over time to reflect changes in mountain biking, changes in land use priority, or changes in health and safety regulations. For example, e-mountain bikes are leading to a desire for more technical uphills. Biodiversity challenges and archaeological awareness are changing the protocols for trail building. Also, coroners reports lead to recommendations for safer, more consistent trails.

7. Upgrade knowledge and skills

Land management professionals have high standards and expect high quality trails. Track builders, both volunteers and contractors, have fuelled the growth of mountain biking and must now raise their standards to meet land managers' expectations. All parties should find ways to constantly upgrade their knowledge and skills.

8. Keep your eyes on the prize

While navigating through the inevitable challenges that any partnership involves, it is important to focus on the vision and not get bogged down by past differences and frustrations. Sometimes, it pays to let go of the baggage, so you can stride forward and get to work.

9. Celebrate success

At every milestone, take time to look back at what you've achieved. Give praise to those who deserve it. And if it is a major milestone, such as a track opening, communicate the achievement widely. Clubs should make sure that the landowners at the highest level (politicians or trustees, etc) know what is being celebrated and that the land use (i.e., mountain biking) is being appreciated. Positive feedback is usually passed back down the ranks.

03 Trail grades

Grade 1 Easiest

Fairly flat, wide and smooth track. Includes rail trails and gentle gravel roads. These trails are ideal for family groups and non-cyclists, as well as gravel bike riders. There are no jumps or technical trail features. Refer to page 13.

Grade 2 Easy

Mostly flat with gentle climbs on smooth tracks with easily avoidable obstacles, such as the occasional rock, tree root or pothole. Grade 2 trails are suitable for most ages and fitness levels, but not all. There may be some technical trail features, but they will all be easily rollable. Refer to page 14.

Grade 3 Intermediate

Steeper, narrower tracks, with loose surfaces in places and possibly some tricky technical trail features and jumps, but they should all be rollable with care at a slow 'pre-ride' speed. There may be exposure at the outside edge of the track. Users need the skills to ride on narrow trails around tight corners. Refer to page 15.

Grade 4 Advanced

A mixture of steep climbs/descents, loose track surfaces, and obstacles that are tricky to avoid or roll over. Often exposed at the edge of the track. In MTB parks, there may be jumps that are only rollable at slow 'pre-ride' speeds. Switchbacks are tight. Backcountry trails may include walking sections. Refer to page 16.

Grade 5 Expert

Prolonged steep climbs and/or fast steep descents. Generally exposed at the outside edge of the track. Expect many technical trail features, sharp corners and possibly jumps. Not all features will be rollable. Riders must have high levels of skill and experience. Refer to page 17.

Credit: Matthew Wood

Grade 6 Extreme

Downhill or free-ride specific tracks. Extremely steep sections with large drop-offs and other unavoidable obstacles. May include huge structures and jumps catering for exceptionally skilled riders. Can also include very steep and technical uphills. Refer to page 18.

Credit: Jan Fearnley

Grade 1 Easiest

Flat, wide and smooth trail without obstacles or technical challenges. An easy ride for beginners, families and almost all types of bikes.

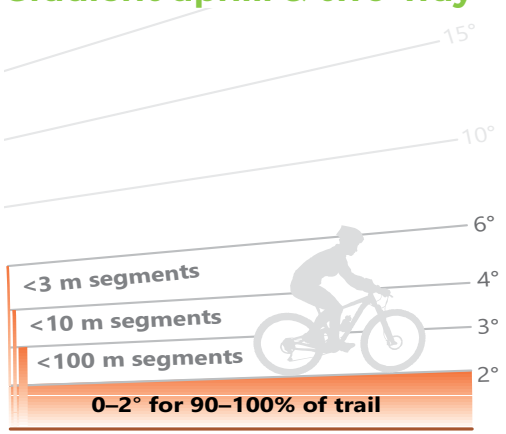
Key trail features	
Track width	
Absolute minimum (m)	1.2 m one-way and 2.2 m two-way
Preferred minimum (m)	1.5 m one-way and 2.5 m two-way
Track surface	Well formed with compacted aggregate (AP20 or finer). No mud. No loose gravel on corners.
Obstacles	Up to 30 mm high, perpendicular to track
Berms	Up to 10° for fast corners

Technical trail features	
Jumps	None
Downhill drops	Maximum 50 mm with gentle transition
Uphill steps	None
Concurrent features	None

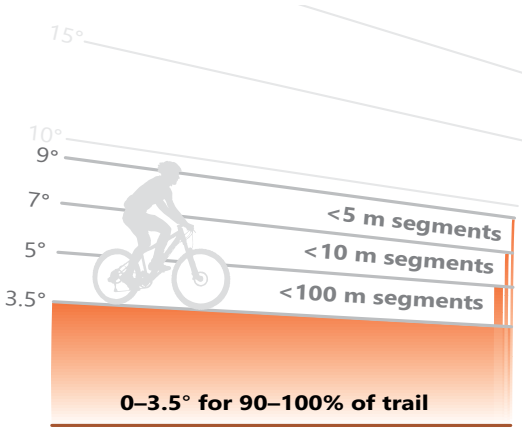
Vegetation
Assess and protect valuable native trees.
Limbs/stumps must be cut flush to the main branch or ground.
Move cut vegetation out of sight, or use it to stabilise spill material.
On two-way trails, ensure vegetation clearance allows for good visibility.

Tracks on steeper terrain should have extra width, or a bund, or a barrier to fall or have the fall zone planted with shrubs (see page 42).

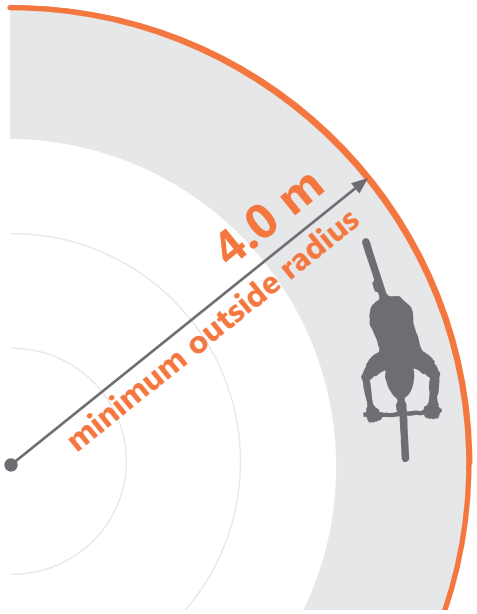
Gradient uphill & two-way



Gradient downhill



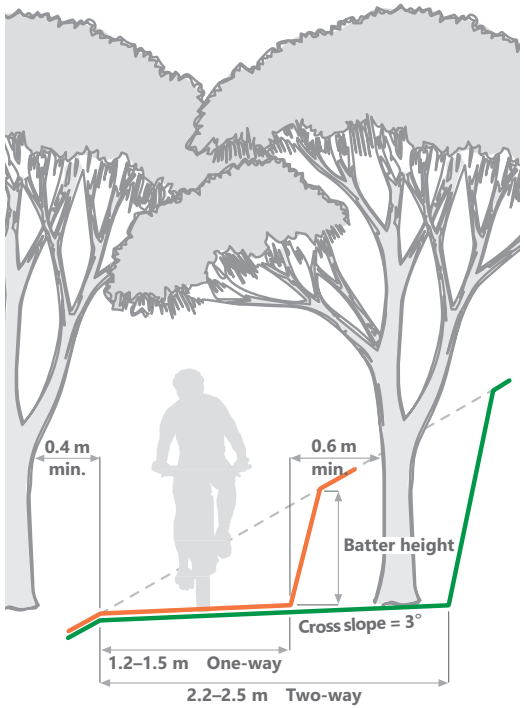
Radius at outside edge



More vegetation clearance is needed around the inside of corners.

You can allow half the clearance passing individual trees, rocks or handrails.

Width



Grade 2 Easy

Relatively smooth and wide track with some gentle climbs. Any obstacles are easy to avoid. An easy ride for most beginners and families on any mountain bike.

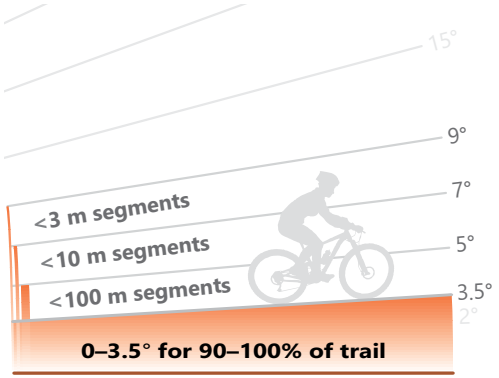
Key trail features	
Track width	
Absolute minimum (m)	1.0 m one-way and 2.0 m two-way
Preferred minimum (m)	1.2 m one-way and 2.2 m two-way
Track surface	Well formed with compacted aggregate (AP40 or finer) No loose gravel on corners. Minimal mud.
Obstacles	Up to 50 mm high, perpendicular to track
Berms	Up to 20° for fast corners

Technical trail features All features will be rollable	
Jumps	Elongated rollers with 5°–20° linear ramps
Downhill drops	Maximum 100 mm with gentle transition
Uphill steps	Maximum 50 mm with gentle transition
Concurrent features	1 feature at a time

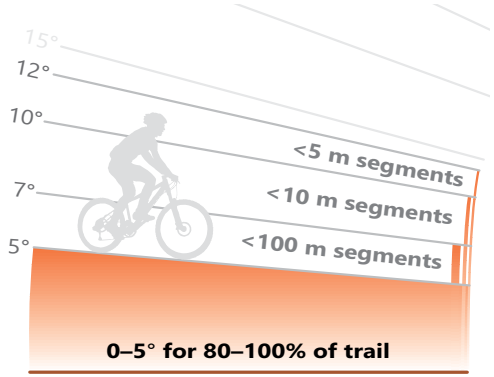
Vegetation
Assess and protect valuable native trees.
Limbs/stumps must be cut flush to the main branch or ground.
Move cut vegetation out of sight, or use it to stabilise spill material.
On two-way trails, ensure vegetation clearance allows for good visibility.

Tracks on steeper terrain should have extra width, or a bund, or a barrier to fall or have the fall zone planted with shrubs (see page 42).

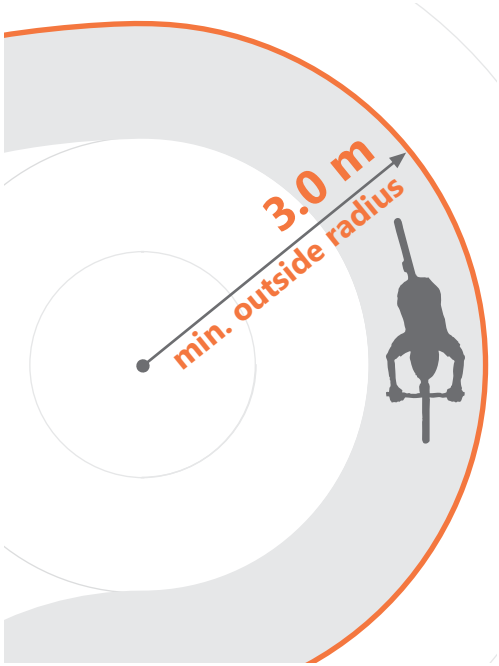
Gradient uphill & two-way



Gradient downhill



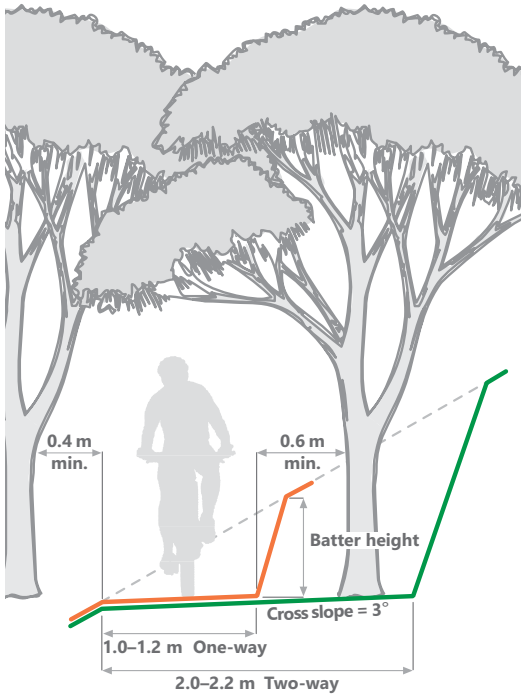
Radius at outside edge



More vegetation clearance is needed around the inside of corners.

You can have half the clearance passing individual trees, rocks or handrails.

Width



Grade 3 Intermediate

Steeper climbs and descents, looser surfaces, narrower track with some exposure at edge. Riders need to have fitness and skill to avoid obstacles and loose sections on a narrow track. Jumps and obstacles can be rolled at slow 'pre-ride' speed.

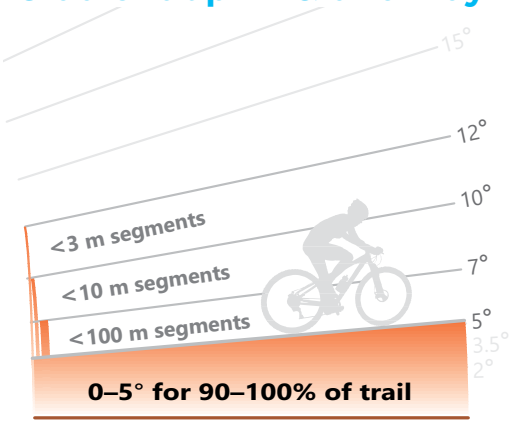
Key trail features	
Track width	
Absolute minimum (m)	0.8 m one-way and 1.0 m two-way
Preferred minimum (m)	1.0 m one-way and 2.0 m two-way
Track surface	Generally well formed. May be some rocks and roots. Loose surface in places
Obstacles	Up to 100 mm high
Berms	Up to 30° for fast corners

Technical trail features All features will be rollable	
Jumps	1–4.5 m long, with 10°–25° linear ramps
Downhill drops	Maximum 300 mm with gentle transition
Uphill steps	Maximum 100 mm with gentle transition
Concurrent features	1–2 features at a time

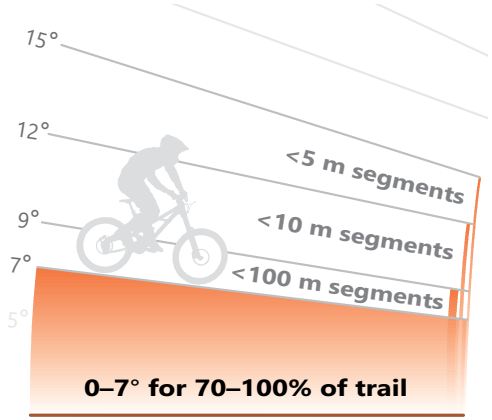
Vegetation
Assess and protect valuable native trees.
Limbs/stumps must be cut flush to the main branch or ground.
Move cut vegetation out of sight, or use it to stabilise spill material.
On two-way trails, ensure vegetation clearance allows for good visibility.

Tracks on steeper terrain should have extra width, or a bund, or a barrier to fall or have the fall zone planted with shrubs (see page 42).

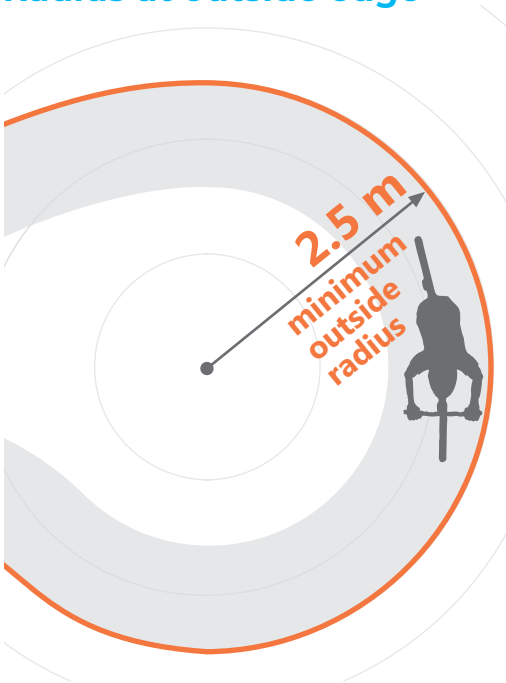
Gradient uphill & two-way



Gradient downhill



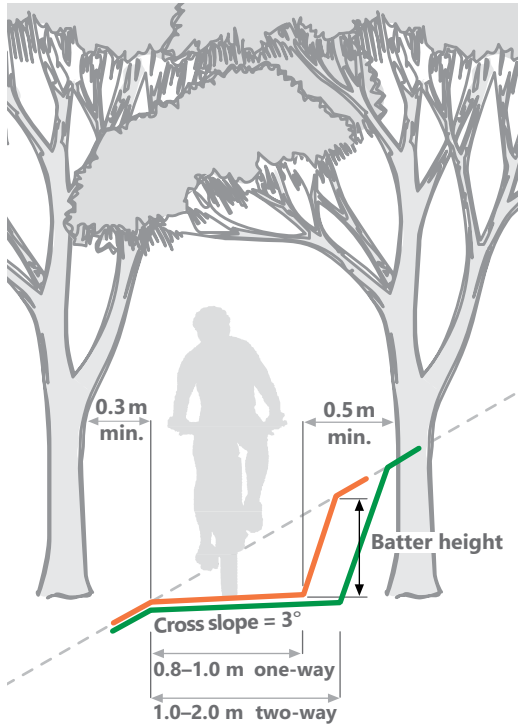
Radius at outside edge



More vegetation clearance is needed around the inside of corners.

You can have half the clearance passing individual trees, rocks or handrails.

Width



Grade 4 Advanced

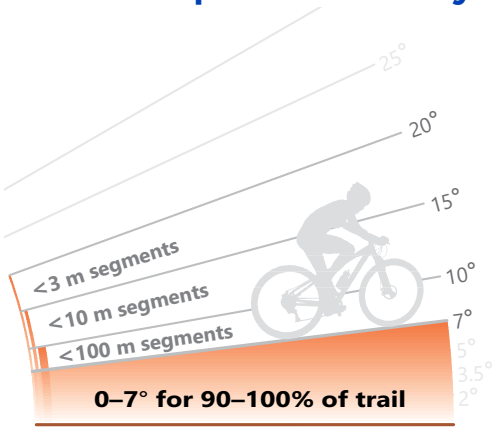
A track that may be narrow, have steep climbs/descents, loose surfaces, big obstacles and jumps. Only suitable for riders with excellent skills, years of experience and a quality mountain bike.

Key trail features	
Track width	
Absolute minimum (m)	0.6 m one-way and 1.0 m two-way
Preferred minimum (m)	0.8 m one-way and 1.8 m two-way
Track surface	Mostly stable, some variability Loose rocks possible in places
Obstacles	Up to 200 mm high
Berms	Up to 40° for fast corners
Technical trail features All features will be rollable	
Jumps	1–7 m long with 10°–30° linear ramps
Downhill drops	Maximum 400 mm (rollable)
Uphill steps	Maximum 200 mm
Concurrent features	1–3 features at a time

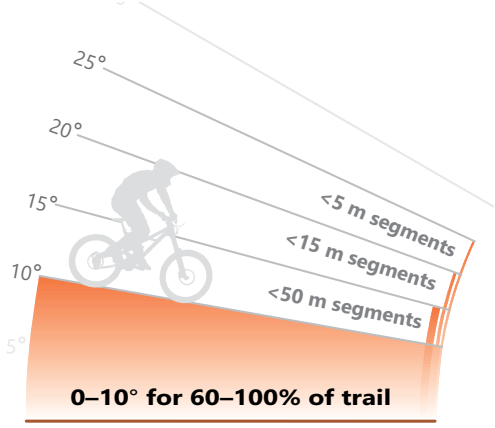
Vegetation
Assess and protect valuable native trees.
Limbs/stumps must be cut flush to the main branch or ground.
Move cut vegetation out of sight, or use it to stabilise spill material.
On two-way trails, ensure vegetation clearance allows for good visibility.

Tracks on steeper terrain should have extra width, or a bund, or a barrier to fall (see page 42). Steep gradients will need frequent grade reversals and rock armouring to be sustainable. Some sections of trail may not be formed and the actual width may not be discernible in rooty or rocky areas.

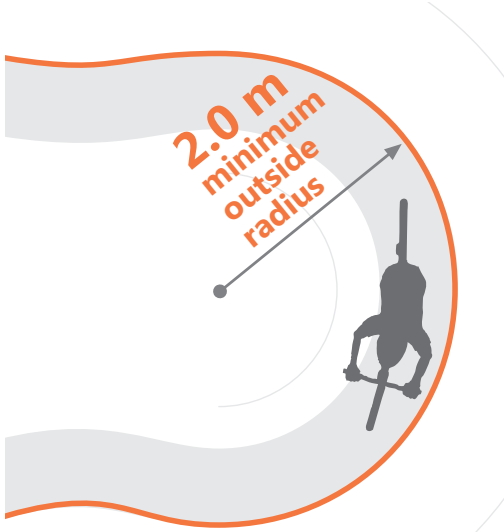
Gradient uphill & two-way



Gradient downhill



Radius at outside edge

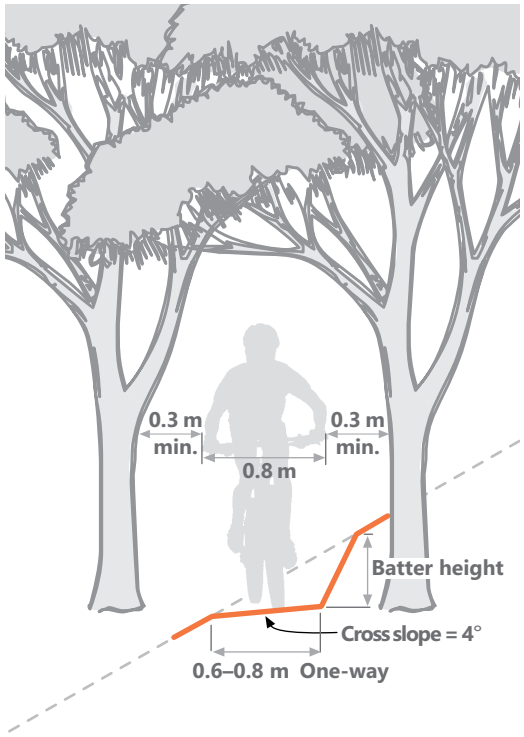


More vegetation clearance is needed around the inside of corners.

You can have half the clearance passing individual trees, rocks or handrails.

Always provide reset sections and grade reversals after steep features.

Width



Grade 5 Expert

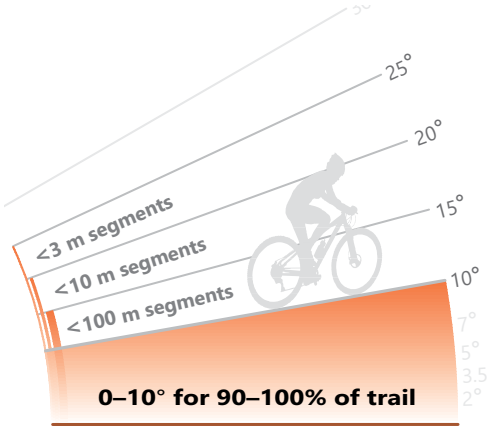
A track with a mix of monster climbs/descents, narrow sections, exposed edges, technical obstacles and possibly large jumps. Expect dangerous drops and poor traction in places. Only suitable for fit, experienced and coordinated riders on quality mountain bikes.

Key trail features	
Track width	
Absolute minimum (m)	0.4 m one-way
Preferred minimum (m)	0.8 m one-way
Track surface	Widely variable (roots, rocks, ruts)
Obstacles	Up to 500 mm high
Berms	Up to 50° for fast corners
Technical trail features Rollable or have a b-line	
Jumps	1–12 m with 15°–35° linear or curved ramps
Downhill drops	Maximum 1,000 mm
Uphill steps	500 mm high
Concurrent features	1–4 features at a time

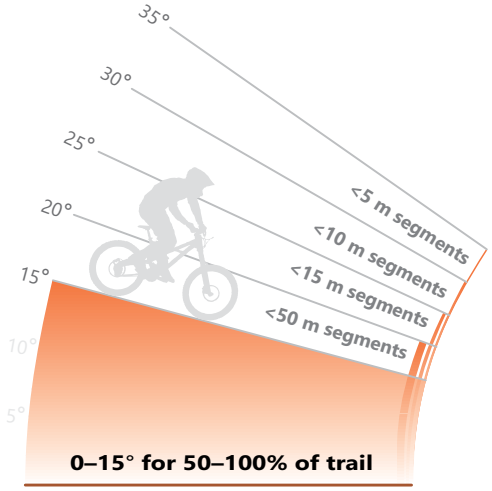
Vegetation
Assess and protect valuable native trees.
Limbs/stumps must be cut flush to the main branch or ground.
Move cut vegetation out of sight, or use it to stabilise spill material.
Ensure vegetation clearance allows for good visibility.

Tracks on steeper terrain should have extra width, or a bund, or a barrier to fall (see page 42). Steep gradients will need frequent grade reversals and rock armouring to be sustainable. Some sections of trail may not be formed and the actual width may not be discernible in rooty or rocky areas.

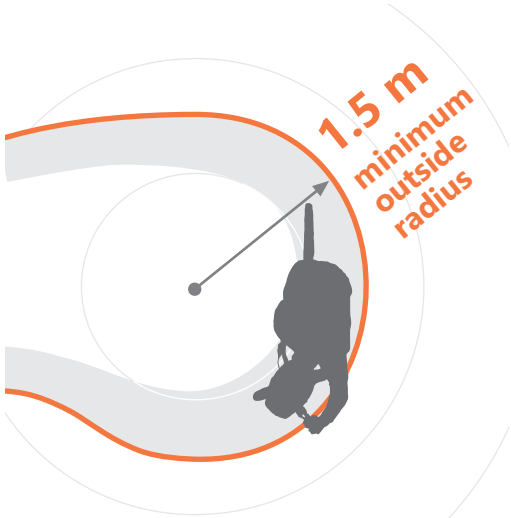
Gradient uphill



Gradient downhill



Radius at outside edge

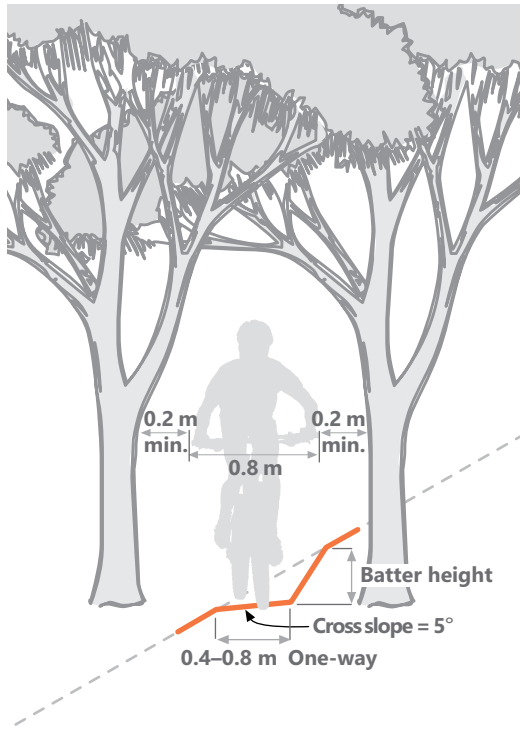


More vegetation clearance is needed around the inside of corners.

You can have half the clearance passing individual trees, rocks or handrails.

Always provide reset sections and grade reversals after steep features.

Width



Grade 6 Extreme

Downhill or free-ride specific tracks with extremely steep sections and dangerous drop-offs. Extremely skilled riders who are willing to accept high levels of risk for a thrill. Requires years of experience.

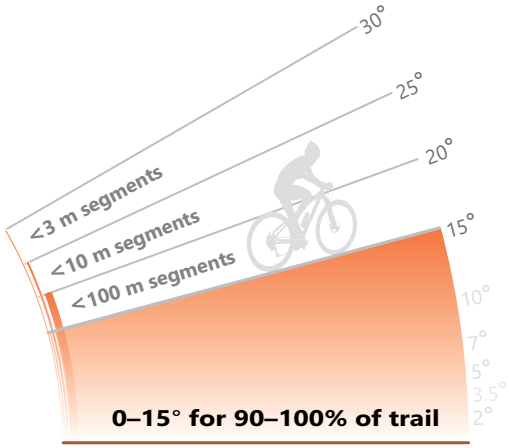
Key trail features	
Track width	
Absolute minimum (m)	0.2 m one-way
Track surface	Rough as guts. Big rocks, ruts, jumps, drops and wooden obstacles.
Obstacles	No limit
Berms	No limit
Technical trail features Unrollable features with no b-line	
Jumps	No limit
Downhill drops	No limit
Uphill steps	No limit
Concurrent features	4 or more features at a time

Vegetation
Assess and protect valuable native trees.
Limbs/stumps must be cut flush to the main branch or ground.
Move cut vegetation out of sight, or use it to stabilise spill material.
Ensure vegetation clearance allows for good visibility.

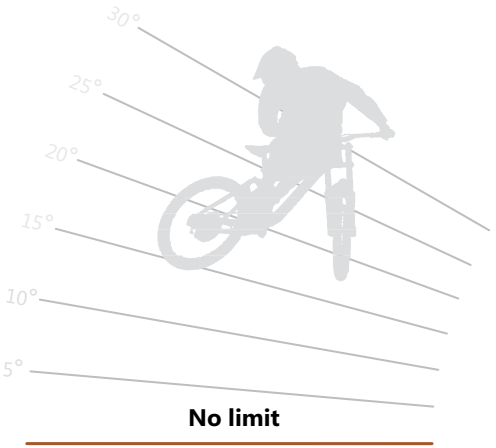
Steep gradients will need frequent grade reversals and rock armouring to be sustainable.

Some sections of trail may not be formed and the actual width may not be discernible in rooty or rocky areas.

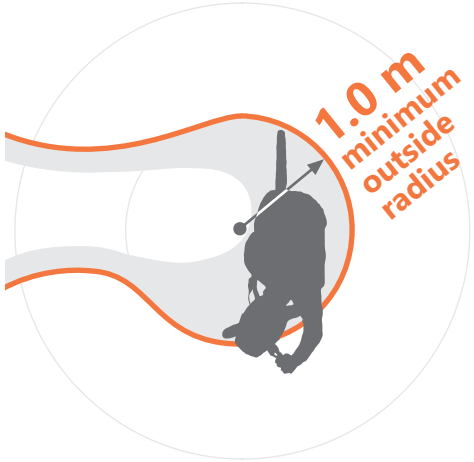
Gradient uphill



Gradient downhill



Radius at outside edge

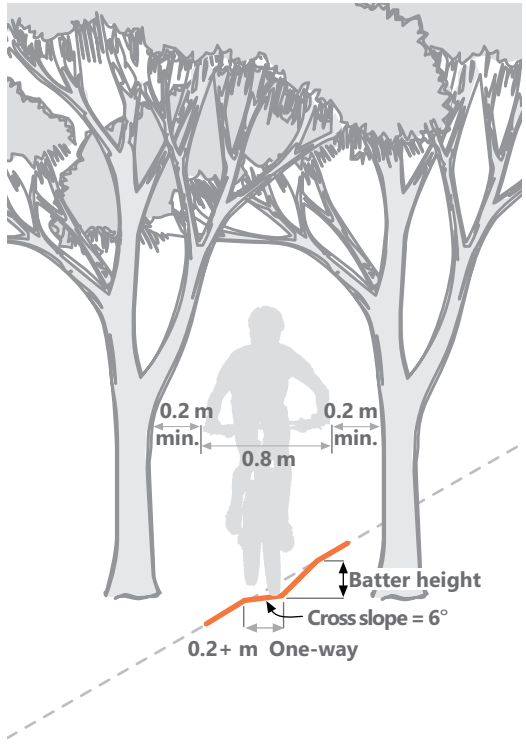


More vegetation clearance is needed around the inside of corners.

You can have half the clearance passing individual trees, rocks or handrails.

Always provide reset sections and grade reversals after steep features.

Width

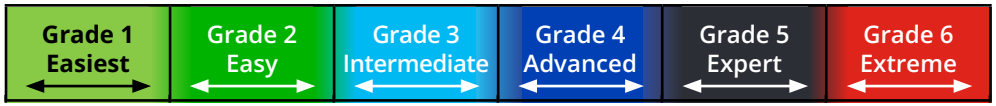


Mountain bike grades compared

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Notes
Gradient: Uphill and two-way	**0–2°** for over 90% of the trail	**0–3.5°** for over 90% of the trail	**0–5°** for over 90% of the trail	**0–7°** for over 90% of the trail	**0–10°** for over 90% of the trail	**0–15°** for over 90% of the trail	Do not built at a constant gradient. Add lots of grade reversals. Always provide gradient relief at the top and bottom of steep sections.
Steeper sections **Up to 100 m** **Up to 10 m** **Up to 3 m**	2–3° 3–4° 4–6°	3.5–5° 5–7° 7–9°	5–7° 7–10° 10–12°	7–9° 9–12° 12–15°	10–15° 15–20° 20–25°	15–20° for up to 100 m 20–25° for up to 10 m 25–30° for up to 3 m	
Gradient: Downhill	0–3.5° for over 90% of the trail	0–5° for over 80% of the trail	0–7° for over 70% of the trail	0–10° for over 60% of the trail	0–15° for over 50% of the trail	No limit	Steeper gradients are generally unsustainable. They are likely to require rock armouring. Soil strength varies from region to region.
Steeper sections	3.5–5° for up to 100 m 5–7° up to 10 m 7–9° up to 5 m	5–7° for up to 100 m 7–10° up to 10 m 10–12° up to 5 m	7–9° for up to 100 m 9–12° up to 10 m 12–15° up to 5 m	10–15° for up to 50 m 15–20° up to 15 m 20–25° up to 5 m	15–20° for up to 50 m 20–25° up to 15 m 25–30° up to 10 m 30–35° up to 5 m		
Width	1.2 m absolute minimum (1.5 m standard) 2.2 m absolute minimum for two-way tracks	1.0 m absolute minimum (1.2 m standard) 2.0 m absolute minimum for two-way tracks	0.8 m absolute minimum (1.0 m standard) 1.0 m absolute minimum for two-way tracks	0.6 m minimum Grade 4 tracks in MTB parks should be one-way only, or built to be slow speed with good sight-lines	0.4 m minimum Grade 5 tracks in MTB parks should be one-way only	0.2 m minimum Grade 6 tracks in MTB parks should be one-way only	Resource consent may be required to build tracks over 1.5m wide. Jumps landing area must be wider.
Radius at outside edge	4.0 m minimum	3.0 m minimum	2.5 m minimum	2.0 m minimum	1.5 m minimum	1.0 m minimum	Uphill switchbacks may be tighter if they have a berm or a handrail to prevent a fall.
Berms	Slow speed 5° Fast speed 10°	Slow speed 5° Fast speed 20°	Slow speed 5° Fast speed 30°	Slow speed 5° Fast speed 40°	Slow speed 5° Fast speed 60°	No limit	
Tread obstacles (roots, rocks, ruts)	30 mm maximum	50 mm maximum	100 mm maximum	200 mm maximum	500 mm maximum	No limit	On uphills, unavoidable tread obstacles should be half the height
Steps/drops (up and down)	Uphill: none Downhill: 50 mm	Uphill: 50 mm Downhill: 100 mm	Uphill: 100 mm Downhill: 300 mm	Uphill: 200 mm Downhill: 400 mm	Uphill: 500 mm Downhill: 1,000 mm	No limit	All technical trail features on Grade 1–4 trails must be rollable.

Trail design notes

- If a short section of trail is steeper than recommended for the trail grade, this may be compensated for by making the trail wider, easing the turns, improving the surface, or other compensatory measures. Other criteria can be similarly compensated for to allow the trail to meet the needs of the target market.
- Any sections of trail that are harder should only be one grade harder, and only in short sections of no more than 100 metres.
- Maximum downhill gradients are applicable only if the trail is promoted to be ridden in one direction.
- The trail widths given are minimum widths. If the terrain beside a track is rideable for the target market (i.e., mown grass beside a gravelled path for Grade 1), then the minimum width can be reduced if need be. In some cases, however, you may want to provide wider paths (i.e., because of very high use, or because there is a steep drop off beside the trail).
- An acceptable alternative to barriers or handrails at bluffs, steep drop-offs or water bodies is adequate horizontal clearance, or planting out the fall zone. See Fall hazard guidance on page 43.
- Any steep section of trail should be preceded by and followed by a grade reversal, or flat section (on uphills it gives people rest, and it stops water flowing down the track, scouring it out).
- Maximum gradients of 5 degrees are most sustainable. Trail gradients that are steeper than this for long sections are physically unsustainable, will erode over time, and require higher levels of maintenance, or sealing/rock armouring.
- Local environmental factors (i.e., weak soils, or trails exposed to wind and rain) may mean you need to work to even lower maximum gradients than stated in this guide.
- As the side slope on the downhill side of the track increases, the consequence of fall increases, and therefore extra track width may be required.
- Out-slope of 3 degrees is generally recommended, so that water runs straight across the track, rather than along the track, scouring it out. A common exception is for bermed corners, where an in-slope will make it easier to ride.
- Grade reversals are recommended at intervals relative to the gradient and soil type of the trail. Spacing between grade reversals should decrease as gradient increases. Also, a grade reversal should occur at every unbridged water crossing (even if the water crossing is dry at the time of construction).



Trail criteria are not targets

There are two ways people think about the criteria in track guidelines: as a range or a target.

It is easy to mistake the criteria as targets and build a track to the maximum gradient, minimum width and minimum radius of turn. There are two reasons this happens.

1. It takes less resource (money/time) to make a track steeper, narrower and tighter. A contractor will save money; volunteers will get the track built quicker.
2. The people building the track are often better riders than their target audience and naturally would prefer to be building harder tracks, **or** they have, over years of riding, lost sight of what it means to be a rider of lower ability.

A better long-term way to think of the criteria is that they are a range, from one grade to the next. For example, the gradient of a Grade 3 track will **range** from 0 degrees up to 5 degrees (with some short exceptions allowed where necessary. The width will **range** from 0.8m to 1.5m. The radius of a switchback will be from 2.5m up to 3.0m or more.

If too much is built at the upper limit of the Grade 3 criteria, then within a season or two the track is bound to become Grade 4. Instead, you might consider building in the middle of the range for the desired grade; then there is a buffer for when the track deteriorates between maintenance cycles.

For example, a good Grade 3 track would be built at 0-4 degrees gradient, 1.0m wide and with 2.7m radius corners. The technical features could also be pulled back from the limits.

This means that, as your new Grade 3 track deteriorates between maintenance cycles, it will remain within Grade 3 criteria. The natural deterioration will include the track narrowing, the surface becoming uneven, rocks and roots appearing, and ruts forming. This is normal. Plan for it in your design and you will reduce your maintenance burden.

04 Safety in design

As with all outdoor sports, mountain biking involves challenge and risk. Riders can manage that risk to some extent by choosing a trail that matches their level of skill. Inconsistent trail grading, trails that include out-of-grade obstacles and poorly designed or constructed features, can lead to, or contribute to, crashes.

Some injuries can have life-altering consequences, while even minor incidents can shake a rider's confidence and turn them away from the sport. In 2020, ACC spent $18 million on helping people recover from mountain bike injuries.

Mountain bike fatalities have led to the following coroner's recommendations.

1. Introduce a consistent method of warning riders of hazards, especially 'out of grade' sections of track.
2. Introduce a single national signage standard for safety signs.
3. Adopt consistent trail grading standards wherever the public has access (both public and private land).

These guidelines seek to address the coroner's recommendations, and include new signage and auditing guidelines.

While this chapter focuses on safe trail design, there are other significant factors at play in supporting rider safety on a bike trail.

- Crashes can be greatly reduced if riders take coaching lessons. We encourage mountain bike parks to promote lessons.
- The impact of a crash can be reduced by wearing safety gear.
- Large mountain bike parks like Whakarewarewa and Christchurch Adventure Park fund dedicated first response units, which provide onsite medical assessments.

Mountain bike crash statistics show that:

- 10–19 years is by far the largest age group for mountain biking accidents.
- However, people in their 20s, 30s and 40s also make up a high number of accidents requiring treatment.
- Most accidents happen on the first downhill run of the day.

Peak Safety first responders training in Rotorua. Credit: Peak Safety

- 90% of those that crash are male riders.
- The largest number of crashes are on Grade 4 trails, followed by Grade 3 and then by Grade 5.
- Relatively few crashes happen on Grades 1, 2 or 6 trails.

If first response teams are the ambulance at the bottom of the cliff, the prevention at the top of cliff is coaching. Professional mountain bike coaches can train people in safe riding habits that significantly reduces the likelihood of crashes, even on challenging tracks. One of the best things that park managers can do is promote coaching.

Trail design factors that reduce safety and contribute to injuries

Inconsistent trail grading

Discrepancies in trail difficulty ratings can lead riders onto trails that are beyond their skill level, increasing the risk of accidents.

Out of grade features

Features like logs, rocks and steep drops, while part of the challenge, can be problematic if not designed or maintained properly, especially if the feature is too hard for the trail grade.

Steep side slopes

Trails with excessive camber can cause riders to lose control and slip, especially on turns or when navigating uneven terrain.

Poor drainage

Poor drainage leads to trail deterioration, resulting in unexpected changes to the trail surface, the development of hazards, muddy or slippery conditions, and a potential increase in trail difficulty/grade.

Insufficient trail width

Trails that are too narrow for the grade of riding can force riders into precarious situations, especially when encountering obstacles or other riders.

Unclear signage and trail markings

Inadequate trail markings can result in riders unintentionally straying from the intended route, becoming lost, or encountering technical features they are not prepared for.

Recommendations for safer trails

Accurate trail grading

Make sure you apply and stick to consistent trail gradings to ensure your trails are appropriate for the intended skill level and riders can be confident they are riding to grade. This should involve updating a trail grade if needed (i.e., due to a lack of maintenance).

Remove out of grade features

Mitigate or remove high risk features that are harder than the trail grade. In particular jumps or drops that are on the main trail line.

Clear signage and trail markings

Provide clear signage and trail markings to guide riders and prevent them from unintentionally going into areas beyond their skill level.

Appropriate trail design

Consider the terrain, intended skill level and potential hazards when designing trails.

Regular trail maintenance

Regularly inspect and maintain your trails to ensure all features are safe, drainage is effective and obstacles are manageable.

Education

Educate riders about trail safety, proper riding techniques and the importance of riding within their skill level. On feature packed trails give particular emphasis to the “Pre-ride, Re-ride, Free-ride” message.

Trail features associated with injuries

Common Causes of Injury	Solution
A branch or stump that has not been cut flush, resulting in puncture wounds when riders fall on it. Injuries result in stitches, hospitalisations, loss of an eye in one case, death.	Always cut stumps/branches flush. Before opening a track, check for any stumps/stakes.
Exposed waratahs lacerating or impaling riders. Hospitalisation and stitches required.	Avoid using waratahs where possible Otherwise, cover the top of waratahs with plastic caps or a timber board.
Sticks or tree fern fronds on tracks leading to front wheels sliding out. A variety of injuries depending on how the rider falls.	Regularly clear tracks. Some trails have volunteers sweep through tracks after storms to assess the damage and remove minor wind fall.
Loose gravel accumulating on the side of a trail, especially on corners. Bike slides out under the rider. Injuries are commonly gravel rash or sprained/broken wrist or broken collar bones from reaching out to break the fall.	Remove the loose gravel if it is accumulating in a way that's likely to cause crashes. Sometimes loose gravel increases over summer and goes away over winter
Drops, which become more difficult over time as the soil at the bottom is eroded away through use. Crashes have led to dislocations, broken bones and at least one known spinal injury.	Rock armour or soil cement the bottom of a drop to stop the drop growing with erosion. Alternatively, lower the top of the drop.
High speed track leading into a tight corner resulting in loss of control of the bike. There are likely to be braking bumps leading into the corner. Crashes range from abrasions to broken bones and concussion	Redesign the trail so the natural approach speed and the speed of the corner are matched. Realign the approach to be less steep and include a grade reversal to scrub speed and/or increase radius of the corner.
Table-top or gap jump length too short (or long) and not matched with trail speed. Riders fly past the land ramp and land on the flat. Injuries include fractures, breaks, concussion and sometimes spinal injuries.	Use the jumps table on page ??? to redesign the approach to the jump and reduce speed or redesign the jump itself to match to the common trail speed. Designers should use one of a number of methods for determining actual trail speed, including speed guns, GPS, bike speedometers and manual timing.

Note: these hazards can be signposted, however, that should only be a temporary measure because safety signs are not as effective as changing the design of the trail itself.

Non-physical attributes associated with injuries

Issue	Solution
An out-of-grade feature on a trail. Sometimes expert riders will promote such features as being good for progression. However, there is plenty of room for progression within each trail grade.	Modify the feature so it fits the grade of trail that it is on. A common solution, which is less preferable, is to build a bypass line.
Under-graded trails resulting in riders' skills being mismatched with the trail difficulty.	Seek target market feedback when grading a trail (i.e., listen to an intermediate level rider for feedback on a Grade 3 trail). Are lots of riders finding the trail too hard? Does the grade, and/or promotional material accurately represent the trail? Consider changing the grade, and/or promotional material (especially images). For example, when the Tongariro Crossing changed its name to the Tongariro Alpine Crossing, the number of incidents reduced immediately.
A popular event, such as Crankworx, promotes massive jumps and, following the event, younger riders attempt the jumps (while being filmed) and have massive crashes.	There are a range of options, from signposting the dangers involved with the massive jumps to closing the trail (at least until the event fervour has died away). Or in extreme cases, close the jumps to the general public and only open them for events.
Too many clothoid-shaped (curved) jump ramps being used inappropriately on trails. For less experienced riders, clothoid-shaped jump ramps often cause bucking or kicking, leading to front wheel landings and over the bars accidents.	Clothoid (curved) ramps are best suited for more experienced riders (Grades 5–6) and need to be carefully considered for every situation. Grades 3 and 4 trails should only have linear ramps, and grade 2 trails should only have elongated rollers or low step-drop jumps.
A track simply has so many difficult features that it has a high accident rate.	Temporary closure until the features can be assessed and addressed. The frequency of significant features should be carefully planned. They need to be far enough apart that riders can reset between features.

Intersections

Every track fork offers a choice. Riders must be clearly informed, especially if one of the choices leads to features that are out of grade. Install signs to explain those choices.

- At split lines, where tracks fork, it is important to provide information about the options ahead. This issue is covered in detail in the Signs chapter (see page 61).
  - If the tracks ahead are one grade different from each other, then the harder line should have a yellow 'Splits' warning sign with supplementary sign/s that show what the two different grades are.
  - If the harder option is two grades higher than the main track, or it leads to a known hazard with a history of serious crashes, you must use a 'Danger' sign. This can be a red triangle sign or a plastic marker blade as shown in the sign chapter.

- Where split-lines lead to harder features, consider closing the harder line, or modifying the harder features so that they are true to the trail grade.
- Also consider modifying the intersection so that the easier option is more prominent than the harder line.
- Alternative lines with features that are more than one grade harder should not be built on any new trail.
- Install a 'No Entry' sign where a one-way track joins another track, to stop collisions. It can be helpful to add the name of the track below the 'No Entry' text.
- At trail hubs, consider adding a map board that clearly shows the grades of the trails leaving the hub.

Where popular trails cross service roads safety signs are recommended. Credit: J Kennett

Trail intersection warning sign. Credit: J Kennett

05 Designing trails

- Trail Gradient
- Switchbacks and berms
- Trail width
- Cut bench profile
- Cross slope
- Grade reversals
- Trail surface
- Technical Trail features
- Rollovers and chutes
- Jumps
- Fall Hazards and Mitigation
- Horizontal clearances
- Environmental considerations

Trail gradient

Gradient is the most important design element to get right, and the hardest thing to change after a track has been built. It is easy to widen a track or increase the radius of a corner, but changing the gradient involves building new sections of track. Therefore, it is important to get the gradient right during the design phase to ensure it is sustainable.

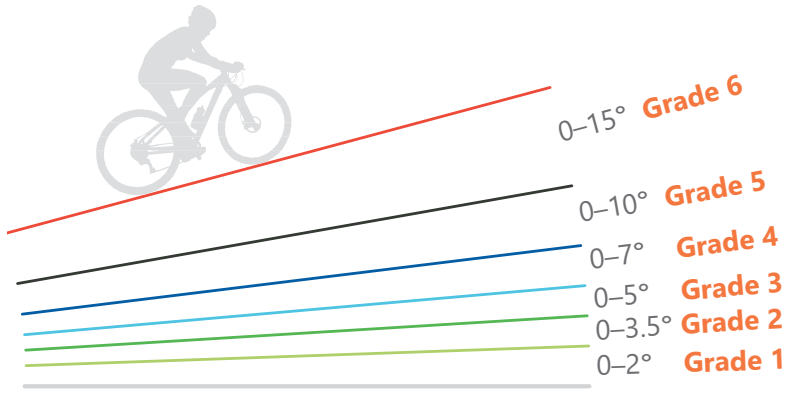
Note: There is a gradient conversion table at the back of this book (page 86) for those who prefer to work in percent or ratio.

Gradient for 90–100% of a two-way trail: Indicates to the designer (and the rider) that, for at least 90% of the trail length, the gradient will be within a certain band (e.g., Grade 3 two-way tracks will be 0°–5°).

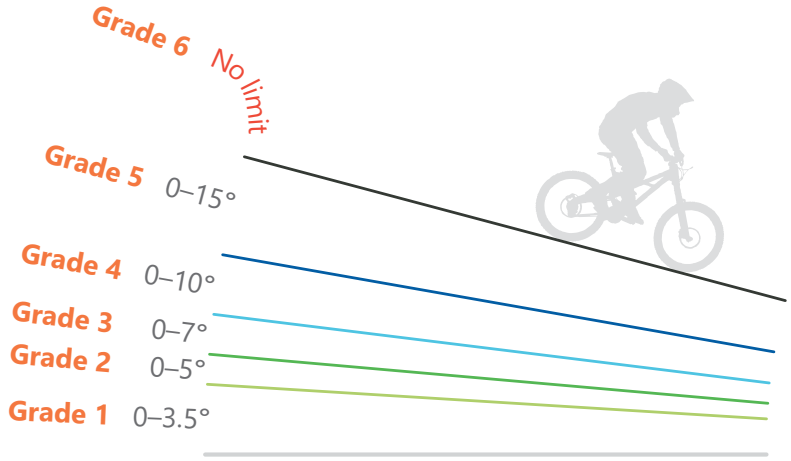
Maximum gradients: A specified percentage of the trail length (depending on the trail grade) can be made up of steeper segments. Only resort to these steeper segments if you have to (i.e., because you need to get around a tree or massive boulder, etc), and always provide 'reset' sections afterwards.

The gradient limits are not targets to aim for. It is safer and more sustainable to design at the middle of the gradient range, rather than at the top end. Add fun with rollovers, grade reversals, berms, drops and jumps rather than long steep gradients.

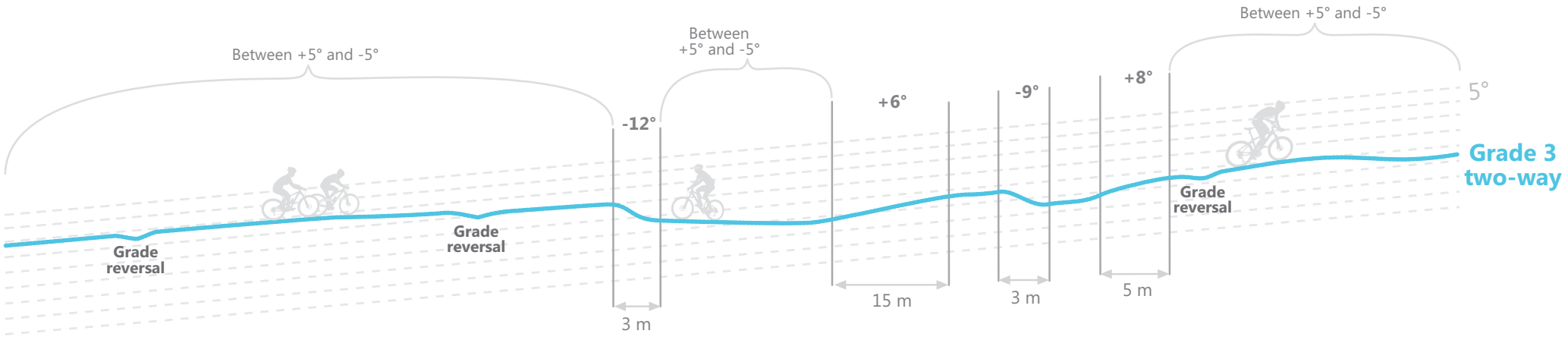
Long steep gradients are not sustainable. Through the processes of compaction and displacement, all tracks become a little dished. Then water runs down the track and if there are no track features to get water off the track, the water will build up and scour out the track.



Typical gradient for different grades of uphill and two-way tracks



Typical gradient for different grades of downhill only tracks



Guidance: it is important to note that a mountain bike trail should have variation in gradient throughout its length, but that variation should have a purpose.

Examples of variation that feel natural and fun are:

- Climbing above or below a tree
- Dipping in an out of a dry stream bed
- A grade reversal to scrub some speed before a corner
- Rolling over a spur or big boulder
- Jumps and rollers.

All of these examples will make a trail more interesting, especially when riding downhill. A constant gradient is like a straight line – boring.

For example, a Grade 3 two-way trail can include segments that are:

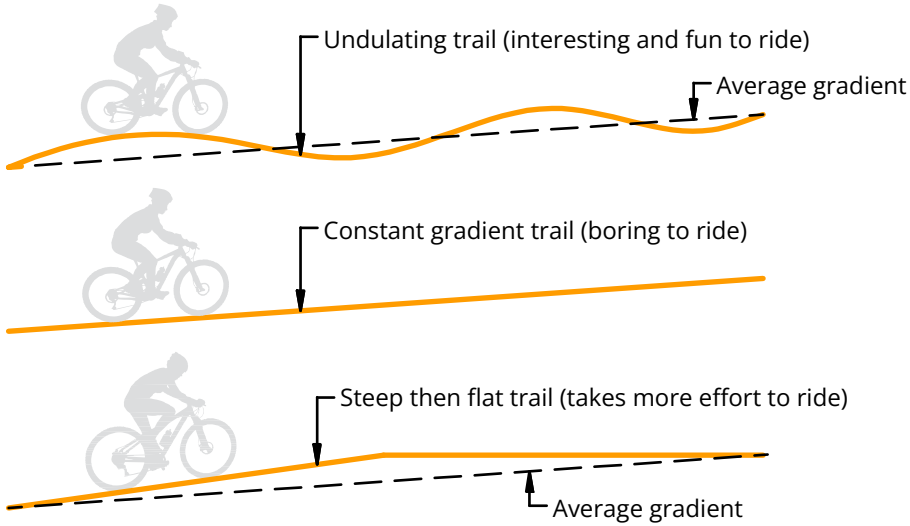
A. 5–7° for up to 100 metres at a time

B. 7–10° for up to 10 metres at a time

C. 10–12° for up to 3 metres at a time.

All the segments of A + B + C added together must be less than 10% of your trail length.

Mitigate steep segments with a flat stretch or big grade reversal at both ends, to give riders time to prepare for, or recover from, the steep section.



Examples of gradient options

Soil strength = trail strength

The maximum gradient guidelines in this book will not work in all regions due the highly variable soil types across the country. Some soils are strong and some are not.

If the soil type is prone to erosion, then the gradients will have to be reduced, and the number of grade reversals increased. Refer to the grade reversals frequency table on page 33.

Factors influencing maximum sustainable trail gradient

The half rule Longitudinal gradient should not exceed half the gradient of the cross-section side slope. If it does, it is considered a fall-line track and will be prone to water erosion.

Surface type Natural surfaces that include rocks or roots (i.e., Wellington and Nelson) can often sustain steeper gradients. Whereas natural surfaces that are made up of wind blown dirt (i.e., Canterbury and Southern Lakes) will have to be less steep.

Grade reversals Frequent use of grade reversals will be needed on steeper gradients and/or weaker soil types.

Number of users High use trails may also need gentler gradients, more robust surfacing and more frequent maintenance.

Level of difficulty Grade 4–5 trails, with steeper gradients, will require more grade reversals and tread armouring in steeper places.

Annual rainfall Very high, and very low rainfall areas may need to be designed with gentler gradients.

Climate change Earth Sciences NZ (aka NIWA) states that wet regions are becoming wetter and dry regions are becoming dryer, and sea level is rising. Plan appropriately for climate change in your region.

How to make stronger trails

- Reduce the average trail gradient and increase the flow. Try to make a trail that people will ride with minimal rear wheel braking.
- Keep steep sections short and rock armour them.
- Surface trails with a compacted aggregate such as lime stabilised base course, or clay overburden. The best aggregate will be known by local trail professionals.

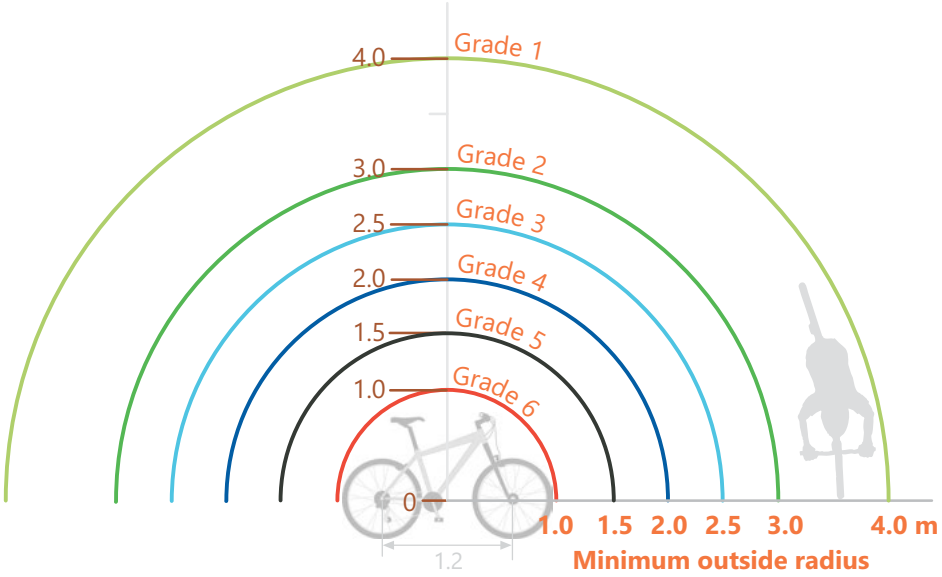
Region/park	Common soils	Trail building issues
Woodhill	Sandy soil	Sensitive to disturbance and will be easily pushed around by bike tyres. Woodhill has responded by importing aggregate with a high clay content and surfacing their more popular trails.
Taupo & Rotorua	Volcanic/pumice soils	Derived from volcanic eruptions, these soil types are ideal for trail building and generally do not need surfacing, unless the trail is very high use.
Taranaki	Papa (mudstone) and sandstone	Generally stable when dry, then a bit slippery when wet, and then terribly sticky when soaked. Trails need to be surfaced if ridden in all weather conditions.
Wellington	Yellow-brown earth over greywacke rock	Can be variable, but steep terrain will have less than a metre of soil on top of irregular rock. Will erode on extended slopes over 10 degrees and will erode rapidly on slopes over 20 degrees.
Nelson/Tasman	Variable soil types	On steep terrain it is likely to be very rocky and will produce resilient trails. Soils on top of the rock can erode quickly on steep trails. Generally well draining with high substrate variability due to the influence of earthquake faultlines.
Port Hills	Wind blown loess (dust) on volcanic rock.	The loess soil has very little strength and once broken up is easily washed away by rain. Once eroded down to volcanic rock the usual remediation is to resurface with aggregate from a quarry.
Southern Lakes	Clayey/Sandy silt over schist bedrock	Will not sustain steep trails for long. Erosion can be mitigated by reducing gradients and designing trail flow that reduces braking.

Top tip! It is important to have reset sections (incorporating grade reversals) after every steep section. This is where riders recover and settle their bikes and water is diverted off the track.

Switchbacks

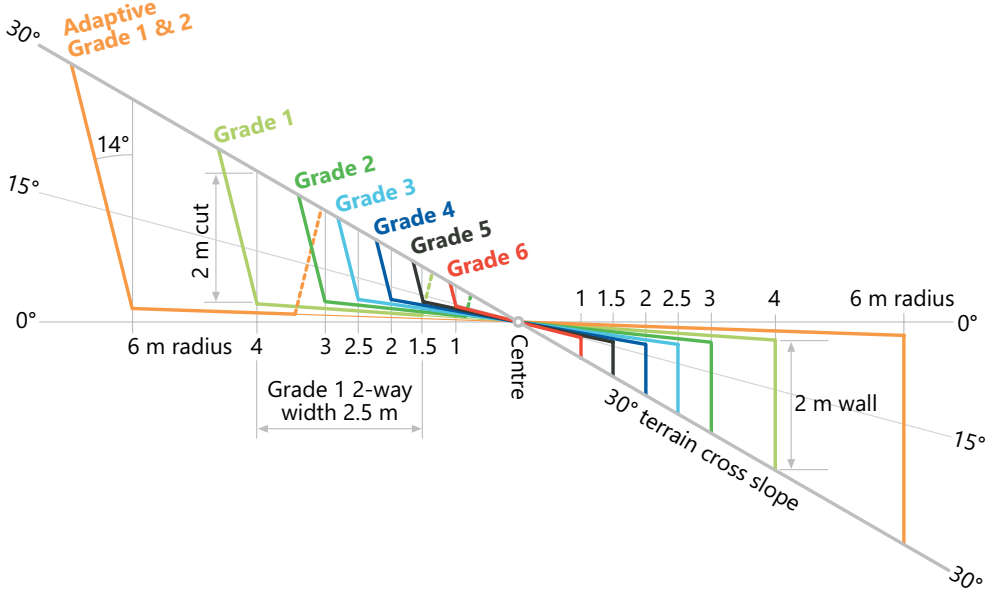
Switchbacks are measured from the centre of the turn to the outside of the track.

Mark the outside of the switchback all the way around, using survey tape, bamboo stakes or pig tails. Once you've done that, you can calculate the height of your uphill cut and downhill fill, and you'll know if you need a retaining wall, and, how high it will need to be.



Top tip: don't dig out the centre of your switchback. It will look better, ride better, and take less effort to build if you don't dig out the centre.

A designer will need to consider the placement of switchbacks early in the design process. This is because the amount of work it takes to build a switchback depends on topography.



The illustration above shows the significant difference that cross slope makes in the effort required to build a switchback. It shows examples of a 30 degree cross slope and a 15 degree cross slope. This reveals the huge amount of earth to be moved to build to Grade 2 and 3, and the massive amount required to build to Grade 1.

If you can find a location with less cross slope the earthworks will be less and you may not have to build retaining walls. Good design saves a lot of money and has less impact on the environment.

Always avoid steep terrain for your switchbacks.

Test riding your switchbacks is recommended. This one, on steep terrain, required three rock breaking sessions to meet Grade 3 radius (2.5 m). Credit: J Kennett

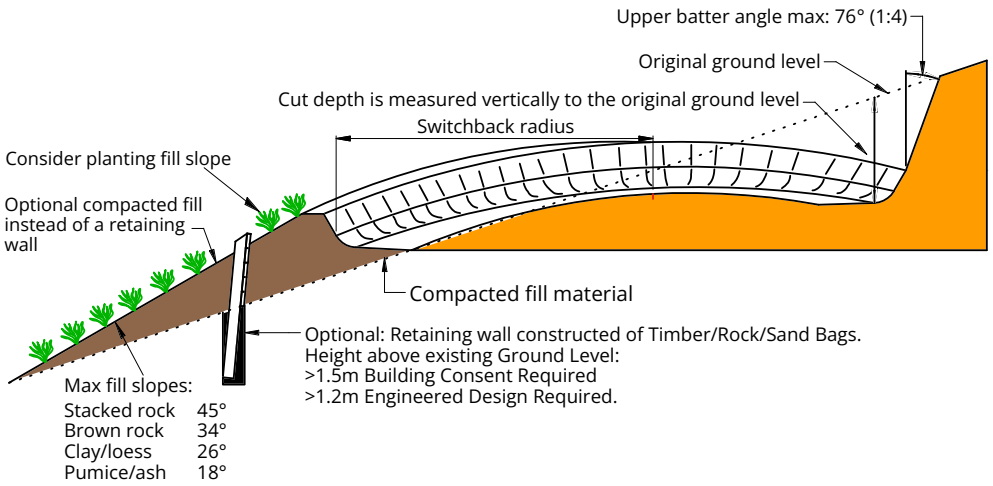


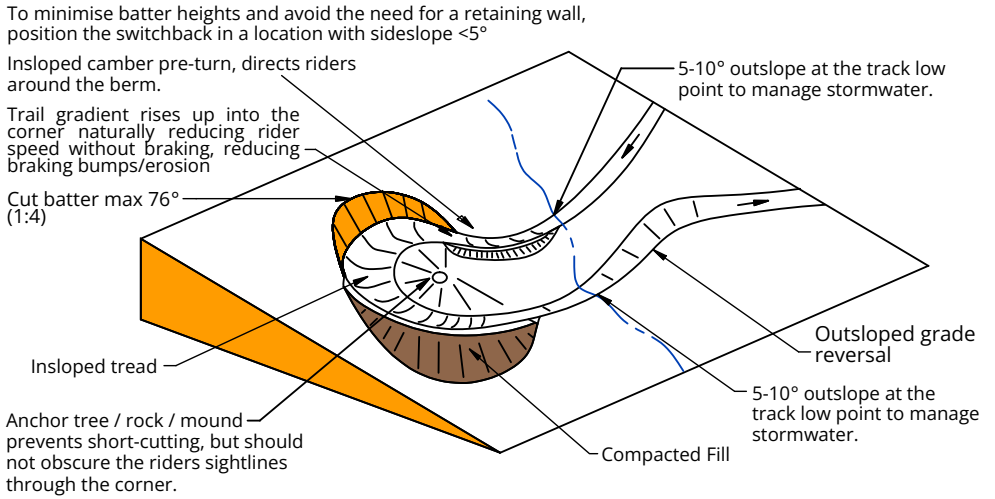
Illustration showing typical cross section of a bermed switchback. Credit: Jeff Carter

Vertical drop for switchbacks

The table below shows the vertical drop for switchbacks of different sizes and gradients. This table can be useful to work out if you can get around a big boulder or a tree without exceeding the maximum gradient.

Vertical Trail Drop for Corners – entry to exit for a 180-degree turn						
Gradient x outside radius	3.5 degs	5 degs	7 degs	10 degs	15 degs	20 degs
1.5m radius	0.28m	0.42m	0.56m	0.85m	1.23m	1.65m
2m radius	0.38m	0.56m	0.74m	1.1m	1.67m	2.2m
2.5m radius	0.47m	0.71m	0.94m	1.4m	2.12m	2.75m
3m radius	0.56m	0.85m	1.13m	1.69m	2.54m	3.29m
4m radius	0.76m	1.13m	1.51m	2.27m	3.40m	4.41m
5m radius	0.94m	1.41m	1.99m	2.83m	4.24m	5.5m

Note: remember that best practice is to add a grade reversal before and after your switchback. See the drawings below.



Bermed switchback Credit: Jeff Carter

Berms

Berms around the outside of corners are what make switchbacks fun, and, if done right, safe.

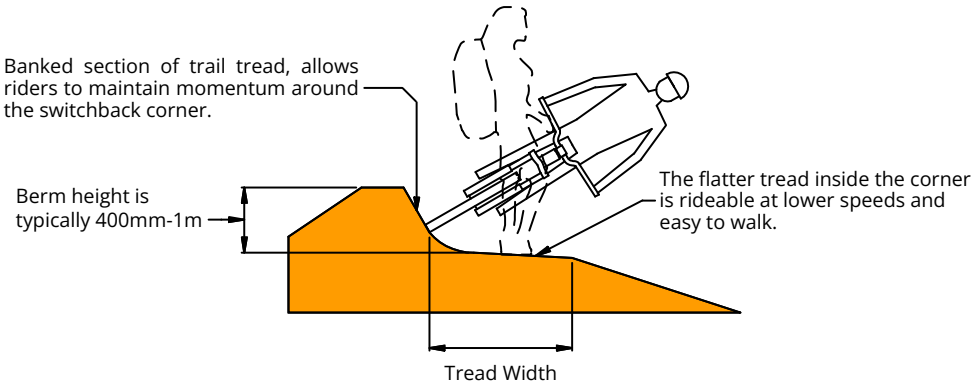
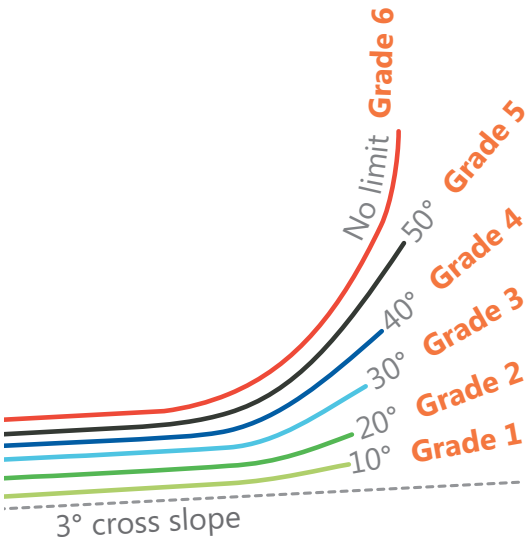


Illustration showing a berm. Credit: Jeff Carter



The maximum berm slope for each trail grade.

There are different maximum angles for different grades. However, a steeper berm can be built outside the minimum radius for each grade of switchback, and the benefit of doing this is that higher grade riders will enjoy the corner more. The downside is that you have to shift a lot of dirt to make a big berm, but if you can, it is a good idea.

Note: Less confident riders and adaptive MTBers cannot ride steep berms. They need a flatter track inside the berm.

Trail Width

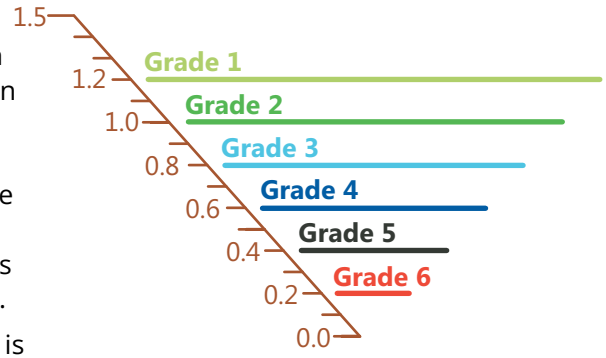
One-way track width: These guidelines give absolute minimum widths for each trail grade. You can build wider if you want to, and if you're on a digger, you probably will. But most landowners will have maximum allowable widths (e.g., in Wellington a resource consent is needed to build wider than 1.5 m).

A common width for jumps tracks is 1.5 m. The landing should be wider than the take-off.

Adaptive MTBs need 1.0–1.5 m width, depending on the grade. Refer to the Adaptive guidelines on page 58.

New Zealand Cycle Trail Great Rides are generally 1.5–2.5 m wide. The majority of Grade 1 and 2 trails are built wide enough to be able to ride side by side, which requires 2.2 m width as a comfortable minimum.

Two-way track width: It all depends on location and rider numbers. In a mountain bike park, or on a popular cycle trail, two-way tracks need to be twice as wide as single tracks to allow safe passing and comfortable riding side by side. A remote trail with low numbers of users does not need any additional width, however, adequate sightlines are important to reduce the risk of head-on collisions and passing bays should be considered.



Additional width guidance:

To mitigate the risk of steeper side slopes, you can add extra width outside of the trail, build bunds, or plant out the fall zone below the trail with shrubs, or, as a last resort, install barriers.

All Grade 5 and 6 trails in mountain bike parks should be one-way only, regardless of width.

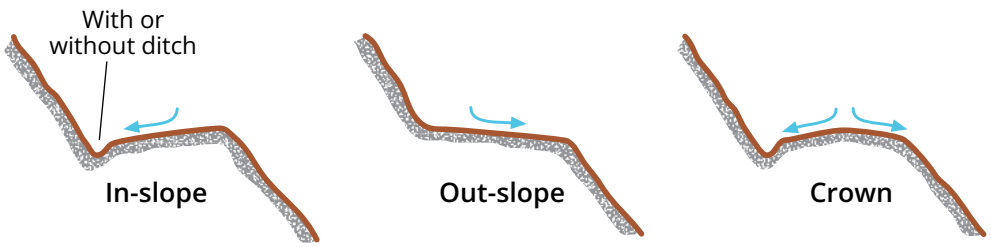
To assist with two-way trail flow, provide regular passing bays, and/or wider sections of trail.

Some sections of trails at Grade 4 and above may not actually be formed and the width may not be discernible in rooty or rocky area. In those cases, refer to the natural cross slope table on page 32.

Bench profiles

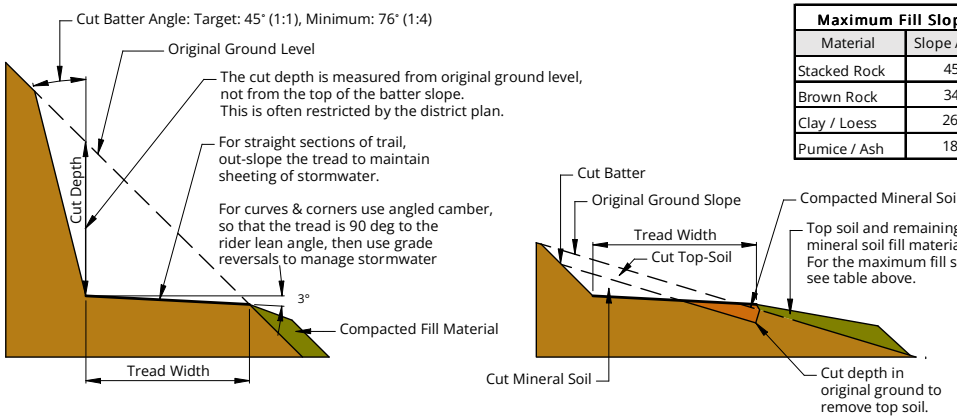
The life expectancy of a trail is largely determined by gradient, cross slope and grade reversals.

There are three standard track profiles, and the longest lasting is the out-sloped bench.



In-slope is used for corners with berms. A crowned profile is used on roads and some cycle trails, but generally not mountain bike tracks. The best profile is an out-slope bench built to the specifications shown below.

Note: higher grades can have steeper cross-slopes



Maximum Fill Slopes	
Material	Slope Angle
Stacked Rock	45°
Brown Rock	34°
Clay / Loess	26°
Pumice / Ash	18°

Details for out-sloped bench formation.

Credit: Jeff Carter

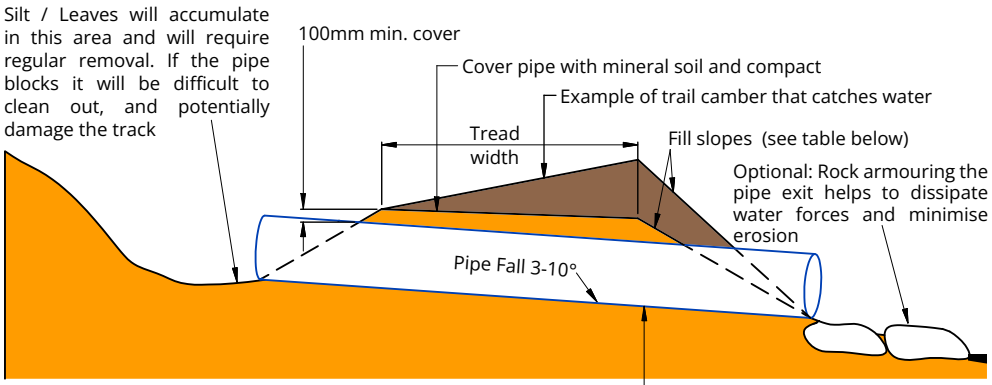
Out-sloped track helps water shed across a track, rather than along the trail where it will build volume and momentum and scour out the surface.

However, over time, the centre of the trail will become worn and dished. That is inevitable, which is why grade reversals are so important (see below).

Top test: if you roll a cricket ball down your trail it should roll off within a few metres.

On the inside of berms and in very wet regions, it is common to have an in-sloped tread surface. In that situation you will need to pipe the water under the track (see below).

Culvert installation



Reasons to install a culvert pipe:

1. Where there is typically medium - high flowing water (creek).
2. Upstream wet/boggy area drained under a raised trail formation.
3. Where the trail formation / camber has trapped water.
4. Use trail rock armouring instead of a culvert pipe where there is no or minimal flowing water and approach angles are suitable.

Maximum fill slopes	
Material	Slope angle
Stacked rock	45°
Brown rock	34°
Clay/loess	26°
Pumice/ash	18°

Credit: Jeff Carter

Cross slopes on off-camber natural ground

On unformed sections of grade 3, 4 or 5 trail, the cross slope can be three times the recommended cross slope of a built trail. If traction is good enough (i.e., on high friction rocky surfaces) or the trail is passing a short section (i.e., up to 10 metres) of natural slope, then six times the recommended built cross slope is allowed.

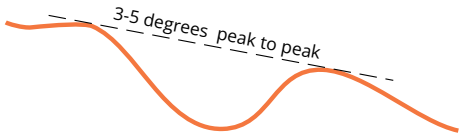
	Built trail cross slope	Natural cross slope (roots, dirt, loose rocks)	Grippy rock cross slope (granite, etc)
Grades 1 & 2	3 degs	n/a	n/a
Grade 3	3 degs	9 degs	18 degs
Grade 4	4 degs	12 degs	24 degs
Grade 5	5 degs	15 degs	30 degs

Trail cross slopes depending on surface type.

Note: Higher grade tracks can have steeper cross slopes because the riders are more skilled. Cross slopes may vary by 1 or 2 degrees in places (the margin of error).

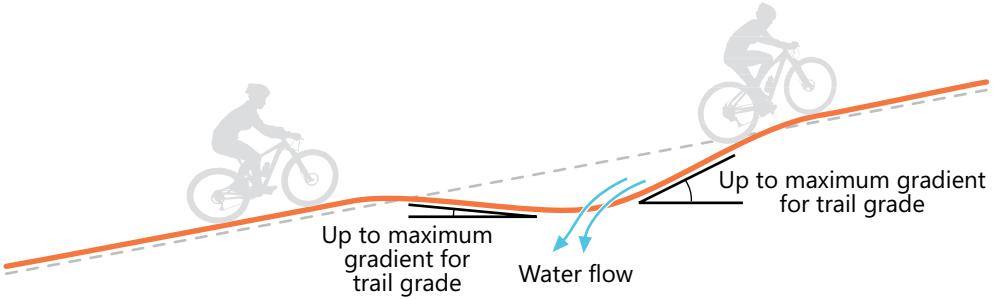
Dippers

Jumps, rollers and dippers also act as effective grade reversals. Gradient between the peaks of a dipper should be 3–5°.

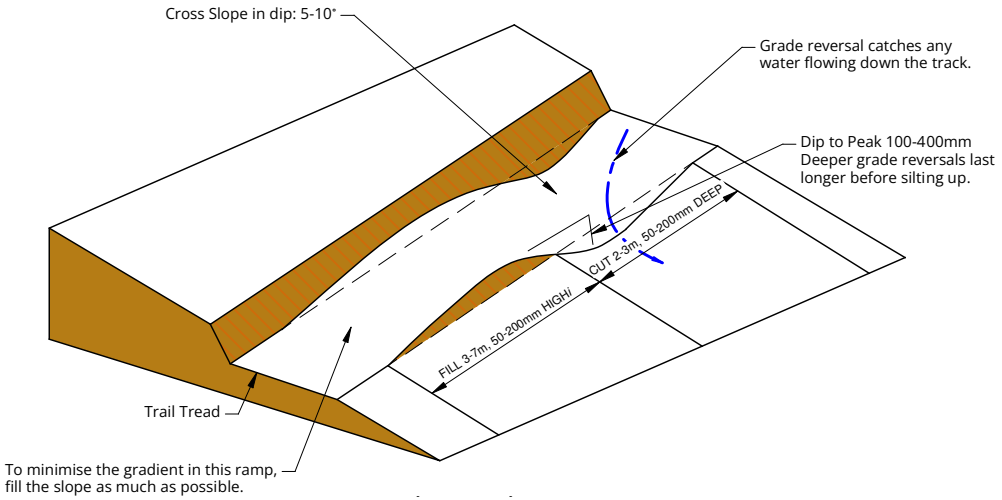


Grade Reversals

Grade reversals are gold! They combat water scour by diverting water off a trail before it builds up. Build lots of grade reversals anywhere that water will flow on to and along the track. Make them fun little rollers or big dippers.



Grade reversals can be retrofitted, but it is better to plan them before you begin building the trail. That way you can make them fit the landscape better. Anywhere that water will flow across/along the track when it's raining should have a grade reversal.



Specifications for fun retrofitted grade reversals. Credit: Jeff Carter

Grade reversals can be big enough to become a feature. Credit: Kennett Bros

Jumps also act as effective grade reversals.

The frequency of grade reversals should vary depending on soil strength and gradient.

The steeper the track, the more grade reversals are needed. The weaker the soil, the more grade reversals are needed.

For example, a Grade 3 trail at Taupo will be built at 2-5 degrees gradient, with a grade reversal every 10 metres. Some of these grade reversals are dippers built across dry stream beds, and may be rock armoured.

Grade reversal frequency

	Trail gradient								
	1 deg	2.3 deg	3.5 deg	4.5 deg	6 deg	7 deg	8 deg	9 deg	10 deg
Gravelly clay	40m	29m	21m	15m	10m	7m	4m	2.5m	
Clay and sand mix	27m	17m	11m	7m	4m	2m	1m		
Crushed aggregate	24m	15m	9m	5m	3m	1m			
Organic soil	20m	12m	7m	4m	2m				

Source: Natural Surface Trails by Design, Troy Scott Parker, published by Natureshape, 2004 and available on Amazon.

Notes:

- No trail tread should be flat. Water pools on flat ground.
- Grade reversals should be placed at all unbridged water crossings, and at all places where water will flow in heavy rain.
- Grade reversals are also a useful way to slow riders down before switchbacks and trail junctions.

Top tip: Retrofitting grade reversals is ten times harder than designing and building them in the first place.

On higher grade tracks the surface may be natural ground. Credit: Ted Webb

Trail surface

Grade 1	Grade 2	Grade 3	Grade 4	Grade 5 & 6
Surface to be well-formed, smooth and even, and surfaced with durable material such as compacted AP20mm aggregate or volcanic soil.	Surface to be well-formed, smooth and surfaced with durable material such as compacted AP20–40mm aggregate or volcanic soil.	Surface to be mostly well-formed and generally firm. May have some loose sections where there are protruding roots or rocks.	Surface to be mostly firm but if it is a technical trail is likely to have some loose sections where there are protruding roots or rocks.	Trail surface will be highly variable, natural surface, including some mud, water, roots, rocks, etc. Major obstacles may be removed, but minor obstacles should not be removed.
Wet areas should be drained, or have a boardwalk over them.	Wet areas should be drained, or have a boardwalk over them.	Should be rideable in all weather conditions without getting too muddy.	Should be reasonably rideable in all weather conditions.	Despite all the obstacles, the trail should still provide reasonably good riding in most weather conditions.
In dry weather riders should not get wet or muddy.	In dry weather riders should not get wet or muddy.	Up to 2% wet and muddy sections. No more than 50mm deep.	Up to 2% wet and muddy sections. No more than 50mm deep	Wet and muddy sections up to 300mm deep where riders may need to walk.
No tread obstacles	Tread obstacles up to 50mm, but the trail should still be easy to ride.	Tread obstacles up to 100mm, but the trail should still be rideable.	Tread obstacles up to 200mm, but the trail should still be rideable.	Tread obstacles up to 500mm, but the trail should still be rideable.

Trail aggregate guidance

Except for volcanic soils, all grade 1 and 2 trails should be surfaced, and most grade 3 and 4 trails should be surfaced.

Trails should be surfaced with crushed aggregate made up of a range of particle sizes that will bind together when compacted.

Stones should have at least three flat sides. Uncrushed river stones will never bind and should not be used.

The aggregate should be placed at a depth 2.5 times the size of the largest stones. For example, AP20 should be laid down at least 50mm thick.

All aggregate should be plate compacted (when not too dry or too wet).

Track armouring

On steeper gradients it is common to armour the surface with rocks gathered from around the track. Start from the bottom with an anchor rock and build up a rock layer. This may take a lot of building time, but will virtually eliminate maintenance time in future.

Note: tree cover will protect your trail surface from wind and rain (and reduce maintenance spraying of weeds such as gorse and rank grass).

Technical trail features (TTFs)

Technical trail features add challenge and fun to mountain biking.

They include jumps, drops, berms, rock gardens, and other obstacles. They are usually found on more advanced trails but to help progression, small features can be added to Grade 1 and 2 trails also. However, all technical trail features on Grade 1, 2, 3 and 4 trails must be rollable. On Grade 4 trails they are likely to only be rollable at a slow, pre-ride speed, and at normal speed riders will become airborne.

Grade 5 features should be rollable or have an obvious and signposted alternative line. Grade 6 features may not be rollable and may not have an alternative.

Technical Trail Features, including jumps, must be true to the trail grade unless they are an optional and well marked split line.

If the trail manager allows an out of grade feature, it should not be on the main riding line, and should be no more than one grade harder than the trail grade.

Split lines and out of grade features should be sign posted as described in the Sign guidelines chapter (see page 61).

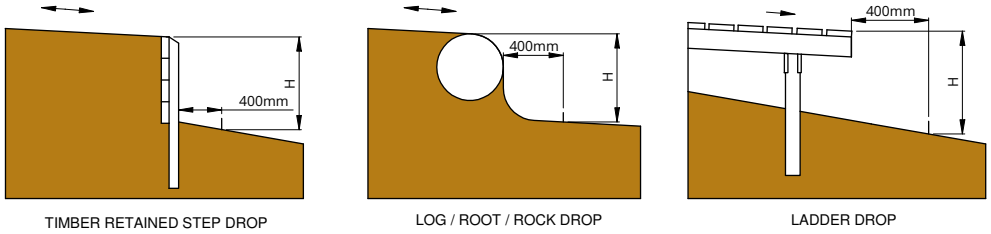
It must be clear to riders that they are approaching a feature that is out of grade, and the rider must have enough time to choose to avoid the feature. This is particularly important in popular mountain bike parks, where expectations of consistency and safety are higher than on remote, backcountry trails.

Steps table

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
Uphill step	None	50 mm	100 mm	200 mm	500 mm	No limit
Downhill drop	50 mm	100 mm	300 mm	400 mm	1000 mm	No limit
Concurrent features	None	1 feature at a time	1-2 features at a time	1-3 features at a time	1-4 features at a time	4 or more features

Guidance notes:

- Concurrent features are multiple features happening all at once or in very quick succession. A Grade 2 trail only has one feature at a time. Higher grades have increasingly more concurrent features (i.e., Grade 5 may have a stepped drop, on a corner, landing in a rock garden).
- The spacing between drops and other features should be 3m or more to allow riders to get both wheels on the ground before the next feature.
- Downhill step drops higher than 400mm are not generally rollable and require the rider to have the skill to lift the front wheel.
- Provide angled landing transition (not flat).
- Downhill drops require rollable bypasses.



Various types of steps.

Credit: Jeff Carter

Rollovers and chutes

Short steep sections such as **rollovers** and **chutes** are prevalent on Grade 3, 4, 5 and 6 tracks. They fill the gap between the steepest allowable gradients and vertical downhill drops.

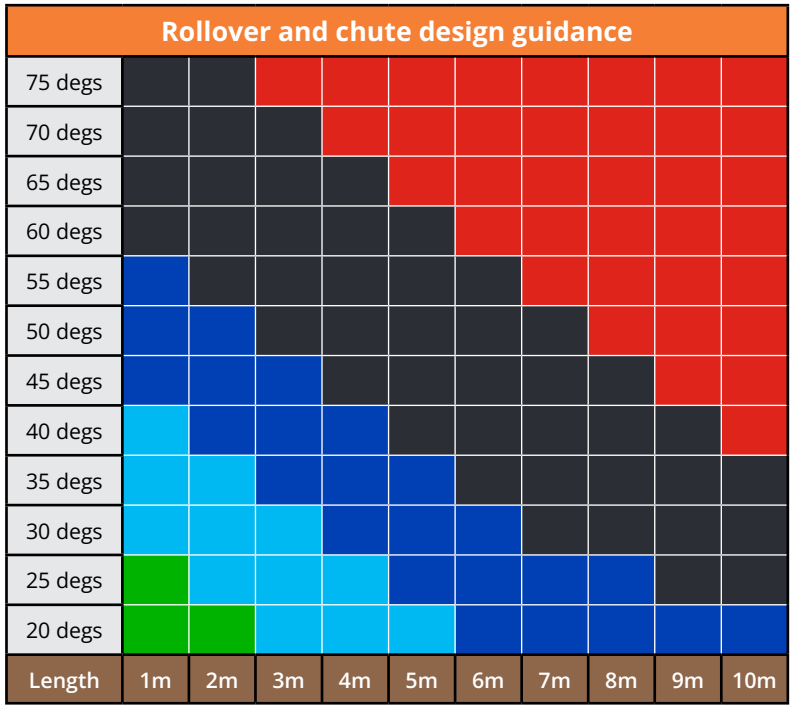
Any slope greater than 75 degrees is considered a vertical downhill drop.

Preparation and Reset sections are required where riders can settle both wheels on the ground and be easily in control. These easy sections before/after must have gentle gradient that is within the 90% allowable (i.e., Grade 4 reset section would be less than 10 degrees and a Grade 5 reset section would be less than 15 degrees) ideally for at least 5m at the top and 10m at the bottom. Longer is better, and the same principal goes for jumps and technical trail features.

Design criteria for rollovers is on the next page.

Kissing Rock, Arapuke

Credit: Ashley Peters

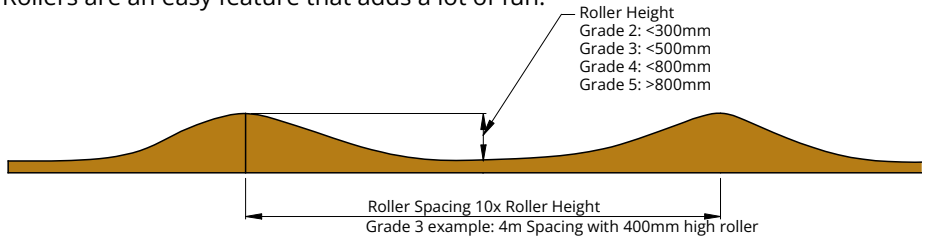


Key: Grade 2 | Grade 3 | Grade 4 | Grade 5 | Grade 6

Notes: Must have a good roll in and roll out. If it has a technical roll out, add one grade. Rollovers are often rock armoured to eliminate erosion.

Rollers

Rollers are an easy feature that adds a lot of fun.



Notes:
Rollers are used by riders to pump and generate speed on flat sections of trail.

Jumps

There are a wide range of jumps to consider, starting at Grade 2 with rollers that aren't even jumps at slow speed and working up to massive Grade 6 jumps where emergency vehicle access should be carefully considered.

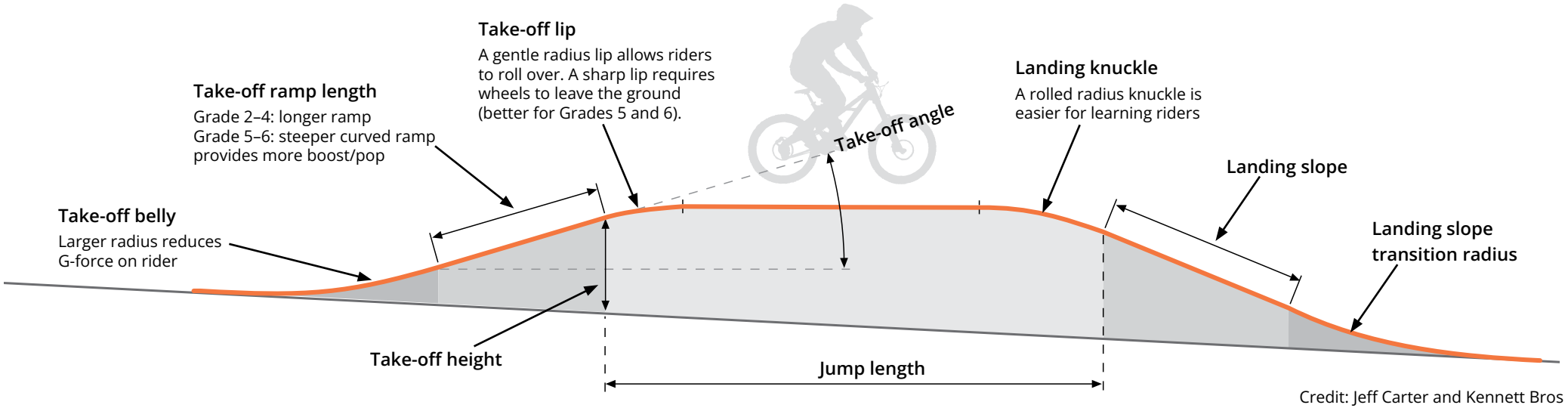
For grades 3, 4 and 5, tabletop jumps are very common, and detailed guidance is provided below.

The style of jumps needs to be considered for each trail. Jump design should be consistent on a trail to provide continuity for users. Jump design requires careful consideration as several important variables will ultimately and directly influence rider safety. Many highly technical resources are available to help with this, Trailism Jump Design being a fine example (go to www.trailism.com/jump-design/).

Rider expectations for jumps

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
Horizontal tabletop jump length lip to lip	None	None	1–4.5 m	1–7 m	1–12 m	Unlimited
Jump ramp angles	None	5°–20°	10°–25°	10°–30°	15°–35°	Unlimited
Take-off height belly to lip	None	None	Up to 1.5 m	Up to 2 m	Up to 4 m	Unlimited
Minimum linear take-off ramp length	None	None	2.5 x height	2x height	Can be curved all the way to the lip, i.e., no linear ramp	Can be curved all the way to the lip, i.e., no linear ramp
Types of features	Rollers	Rollers	Rollers, tabletop, rollable double	Rollers, tabletop, rollable double	Rollers, table-top, rollable double	Rollers, table-top, rollable double
Gap jumps	None	None	None	None	Optional gap up to 8 m, with bypass line	Gaps of un-limited size, no bypass line required

Anatomy of a jump



Credit: Jeff Carter and Kennett Bros

Guidance notes

- The aim of a good progressive jumps trail is to have a range of jump sizes to suit the speed of the trail. Not all jumps should be at the maximum length. For example, a Grade 3 jumps trail, could have 80% of the jumps at 1–3 m long, with the remaining 20% of jumps at 3–4.5 m long.
- To measure the take off angle on a curved take off, position a bike with the front wheel on the ground contact point at the jump lip and measure the angle between the wheel centres.
- The ideal curved take-off ramp shape should follow a 'clothoid' form, meaning a curve of a gradually increasing radius from the belly to the lip.
- For a double to be rollable (Grade 2, 3 and 4) with tyres staying on the ground at trail pace, the height drop between the roller peaks must not exceed 200mm.
- There are two main types of jump ramps – flat/linear and curved/arched ramps.
- Flat/linear ramps are safer and more predictable. Flat ramp jumps are less 'kicky' and create less variance in jump distance, so are best suited to grade 3 and 4 trails. The transition between the trail and the ramp should be a large, gentle curve, and the ramp from the end of the transition to the ramp lip should be flat/linear. The flat part of the ramp should be at least as long as the wheelbase of a mountain bike (approx. 1.4m).
- Curved/arched ramps provide a lot more opportunity for riders to pump or boost, but tend to be 'kicky', so are best suited to experienced riders on grade 4, 5 and 6 trails.
- Step-up style jumps will often require steeper jump ramps to be viable. Up to 5 degrees steeper than the angles indicated in the chart above will usually be sufficient.
- Step-down (or drop down) style jumps need to be treated with caution and will generally require much flatter jump ramps (even at a downhill angle) to be viable. Careful consideration needs to be given to trail speed and jumping distance relative to landing ramps when designing a step-down jump.

Launching off a jump on the Taniwha, Whakarewarewa. Credit: Mead Norton

Test before opening new or changed jumps

As there is significant potential for riders to become injured on jumps, it is important that all new jumps are test ridden before opening to the public.

Testing should include riders from the target grade. In other words, get some Grade 3 riders to test Grade 3 jumps, not Grade 6 riders.

Take this opportunity to assess the grade of the jumps, so that if caution/ warning signs are required they are installed before the track opens.

Calculated jump lengths (metres)									
Speed at take off	Take off ramp angle								
	5°	10°	15°	20°	25°	30°	35°	40°	45°
10 km/h		0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.8
15 km/h		0.6	0.9	1.1	1.4	1.5	1.7	1.7	1.8
20 km/h	0.5	1.1	1.6	2	2.4	2.7	3	3.1	3.1
25 km/h	0.9	1.7	2.5	3.2	3.8	4.3	4.6	4.8	4.9
30 km/h	1.2	2.4	3.5	4.6	5.4	6.1	6.7	7	7.1
35 km/h	1.7	3.3	4.8	6.2	7.4	8.3	9.1	9.5	9.6
40 km/h	2.2	4.3	6.3	8.1	9.6	10.9	11.8	12.4	12.6
45 km/h	2.8	5.4	8	10.2	12.2	13.8	15	15.7	15.9
50 km/h	3.4	6.7	9.8	12.6	15.1	17	18.5	19.4	19.7
55 km/h	4.1	8.1	11.9	15.3	18.2	20.6	22.4	23.4	23.8
60 km/h	4.9	9.7	14.2	18.2	21.7	24.5	26.6	27.9	28.3
65 km/h	5.8	11.4	16.6	21.4	25.5	28.8	31.2	32.7	33.2
70 km/h	6.7	13.2	19.3	24.8	29.5	33.4	36.2	38	38.5

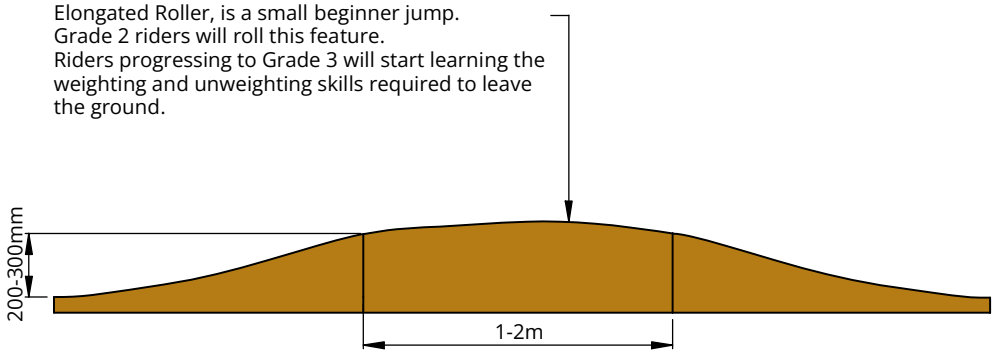
Assumes lip and landing at same elevation.

Key: Grade 3 Grade 4 Grade 5 Grade 6

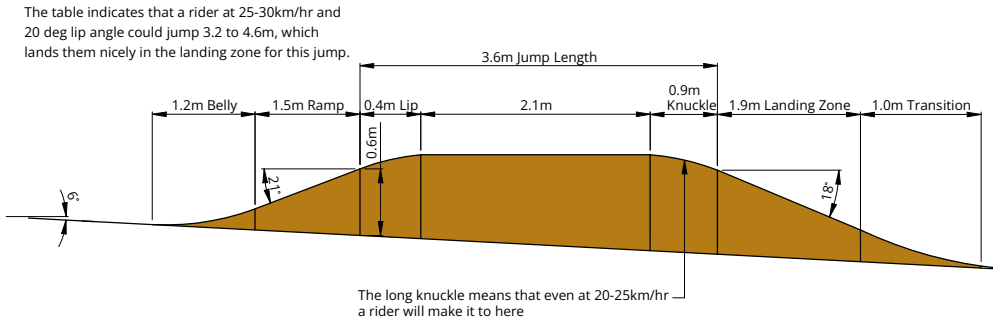
Guidance notes

- At higher speeds, aerodynamic drag (including wind resistance) becomes the dominant force slowing down the bike and rider, significantly impacting jump distance. A head or tail wind will also influence jump distance. The information in this table aims to get the trail builder in the ball-park for initial construction. The next step is to carefully test ride the jump and adjust the lip angle or jump distance as required to match the rider speed.
- Jumps often change over time as the trail hardens, gets faster and storm water and rider traffic change the jump geometry. Tracks with a lot of jumps are often refreshed over time. Each refresh has the potential to refine and improve the rider experience.

Specific examples of recommended jumps are shown below. These jumps have been well tested and are well loved. They are a sound starting point for anyone building jumps.



Grade 2 elongated roller design

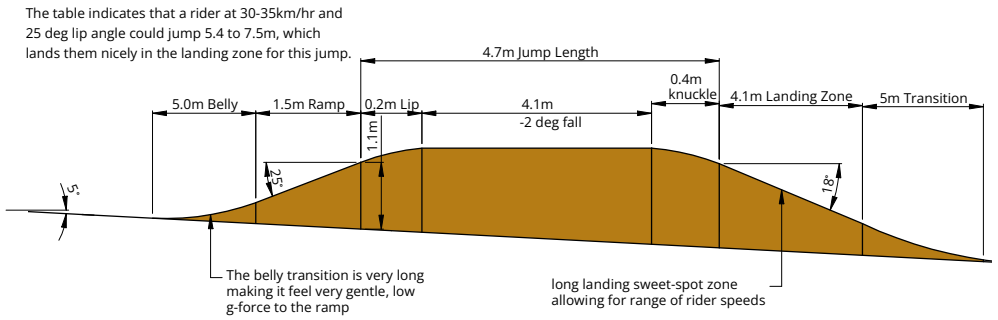


Grade 3 table top design

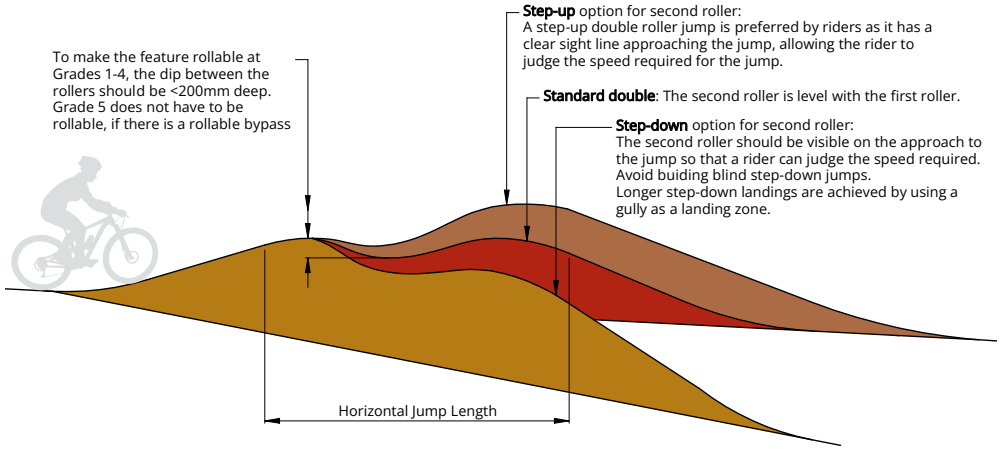
The dimensions in the drawing above are from a popular Grade 3 jump on Mt Victoria in Wellington. This is a proven table top jump.

Example of a Grade 4 table top jump as shown in drawing below. Credit: J Kennett

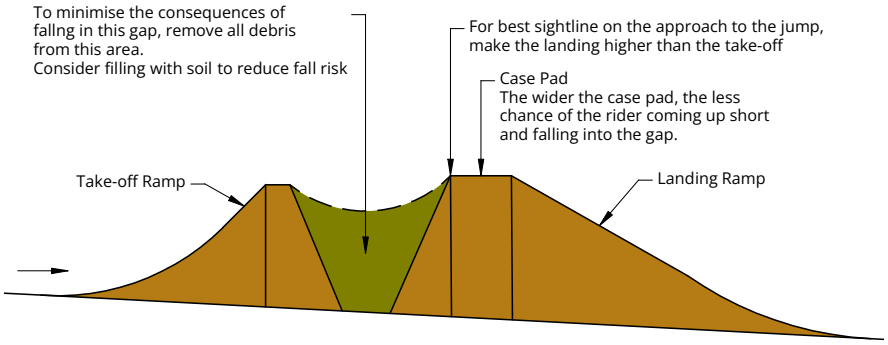
The jump in the photo above is both popular and meets Grade 4 criteria. The exact dimensions of it are shown in the technical drawing below.



Grade 4 table top design



Double roller jump examples



Grade 1-4: No Gap Jumps
Grade 5: Gap Jump must have rollable bypass
Grade 6: Gap Jump does not require bypass

Gap jump example drawing

Sending it on Rude Rock, Queenstown. Credit: Karl Boomsma

Assessing fall hazards and mitigation

Step One: Fall hazard consequence	
Key questions	**Answer**
Is the height and/or length of the fall likely to result in serious injury or death?	**Yes / No?**
Are there secondary consequences present that are likely to lead to serious injury or death? For example, being swept away in a river, landing on rocks, or falling in boiling mud. See **Fall zone surface assessment** table on next page. Answer **No** for **benign** or **favourable**. Answer **Yes** for **unfavourable** or **hazardous**.	**Yes / No?**

If **Yes** to either of the above, continue with **Likelihood Assessment**

Step Two: Likelihood assessment score				
Key questions	**Likely = 3**	**Possible = 2**	**Unlikely = 1**	**Very unlikely = 0**
How wide is the track?	<0.6 m	0.6–1.5 m	1.5–2.4 m	>2.5
How technically difficult is the track surface?	Unstable, rough, out-sloping and/or slippery	Stable, loose and rough	Stable, firm and relatively smooth	Sealed or wood with netting
Is there vegetation on the fall zone?	None	Some – may stop/slow a person's fall	Abundant, sturdy, likely to stop a persons fall.	Thick and will stop a person
What is the alignment of the track and the visibility of the hazard?	Blind corner leading into drop-off	Curvy trail but sight line is more than stopping distance	Curving trail with ample line of sight	Straight, ample line of sight
Expected level of rider?	Grade 1, 2	Grade 3	Grade 4, 5	Grade 6

Total likelihood score (level of risk):

Step Three: Recommended mitigations			
Level of risk	**Low (score 5–7)**	**Moderate (8–10)**	**High (score 11–15)**
Suggested treatment	Generic advisory and communication (i.e., signs at car park or trail head, and trail website, social media, email list).	Physical treatment using any, or all, of the following: • Outer bunds • Natural barriers (i.e., rocks, shrubs, trees) • Physical impediments (i.e., gate system).	Engineered safety fence as per design code (see note below)* Add 1 metre shy space between the track and the fall hazard.

*Note: This is generally the best practice, however it might not be feasible due to a lack of anchors or being on an active slip zone. In cases where it is not feasible, other options such as walk-only zones can be considered. Regardless of the chosen treatment, it is crucial to identify how the treatment will be maintained and who will do it.

Definitions

Unstable: a section of track that may collapse (i.e., especially the edge).

Rough: a surface that exceeds the height of trail obstacle for the given grade (see pages 13–18).

Serious injury: a fracture, concussion, severe cuts or other injury that requires, or would usually require, a person to be admitted to hospital for immediate treatment.

Examples of risk treatment

- Grade 2 track with 35 degree fall slope that was densely planted with shrubs.
- Sections of Grade 4 track with vertical fall to riverbed had a barrier to fall installed.
- Many tracks have had specific warning signs installed, but please note that signs are often not as effective as other physical treatments.
- Add 'shy space'. As the side slope below the track becomes steeper and scarier, add some "shy space" (extra width). For example, on a 45° side slope add 1.0 m for Grade 1 trails and 0.6 m for Grade 2 and 3 trails.

Fall zone surface assessment		
Fall surface category	**Description of surface**	**Examples of surfaces within category**
Benign	A surface with features that will tend to reduce the effect of impact.	(a) Deep moss (b) soft vegetation (c) shallow still water deep enough to cushion a fall (d) swamp.
Favourable	A surface with features that neither reduce nor amplify the effect of impact.	(a) Gravel (b) sand (c) deep water with reasonable means of exit (d) grass.
Unfavour-able	A surface with features that will tend to amplify the effect of impact.	(a) Jagged stones (b) concrete pavement (c) deep water without reasonable mean of exit (d) sharp cut off branches.
Hazardous	A surface with features that will result in serious harm regardless of the effect of fall to the initial impact point.	(a) Swiftly flowing water without means of exit (b) boiling mud or water (c) extended falls arising from rolling or sliding, following initial impact on terrain whose slope exceeds 35°.

Horizontal clearances

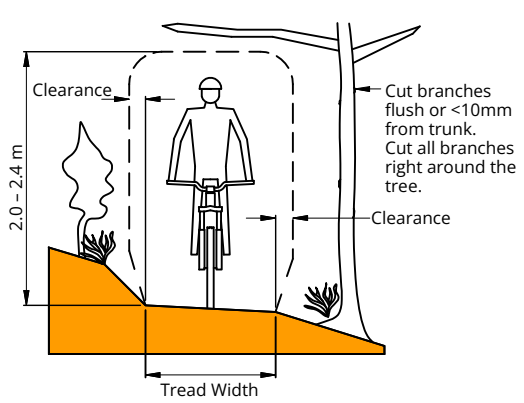
Clearances vary depending on the grade of the trail. Apart from providing space to easily ride, clearances should also provide adequate sightlines of the trail ahead. On two-way tracks and shared tracks this is particularly important. The sightline distance needs to be greater on high speed tracks, and less on slow speed tracks.

Clearance from individual obstacles, such as trees and boulders, should be a minimum of 0.15–0.3m from the outer edge of the trail and to a height of 2.0–2.4m. Additional clearance of up to 800mm is necessary on bends where riders will lean into corners.

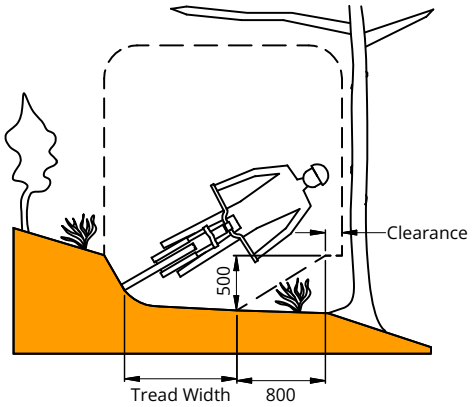
Clearance from continuous obstacles, such as wall and hedges, should be a minimum of 500mm and a up to 1.0m.

Leaving trees on the downhill side of the track will improve the safety of the track, and reduce the likelihood of edge erosion.

General vegetation clearances



Corner vegetation clearances



Notes:

Minimum clearance to **single obstacles** (e.g., tree, large rock, bridge abutment, sign post, drain, or handrail <400mm) is 150 mm.

Minimum clearance to **continuous solid obstacle** (e.g., fence, wall, rock face, or retaining wall >400 mm) is 500 mm for Grade 1–2 trails, 300 mm for Grade 3–4 trails, and 200 mm for Grade 5–6.

Cut/cleared vegetation options

Trees and shrubs should be assessed for their ecological value, and where possible, exotic species removed rather than native species. Trail alignment should be adjusted to avoid removing rare and/or large native trees, which are valuable to the landscape and ecological values of the trail.

- All limbs should be cut flush (or to within 10mm) of the trunk or main branch or ground.
- All cut tree stumps should be rounded off to remove the sharp edges.
- **DOC and Council reserves:** Cut woody vegetation should be removed from the track surface and, if practicable, out of view of the track.
- **Forestry Plantations:** Cut woody vegetation should be removed from the track surface and can be placed beside the track to biodegrade, however, sharp sticks/branches should not be left in the fall zone.
- **National Parks and scenic reserves:** Cut woody vegetation shall be removed from the track surface and vegetation <100mm chipped, vegetation >100mm moved out of site of the track.

Note: over time rules for vegetation clearance may change from region to region.

Top Trail Tips

1. Cut all branches and stumps flush with the tree or ground.
2. Dig a full bench and never bury topsoil, roots, or branches under your track. They have no long-term strength.
3. Build lots of long grade reversals. They are fun to ride and stop water scouring out your track.
4. Riders prefer native forest. If working in mixed scrub, clear the trail corridor through gorse and barberry plants, etc and leave the native trees.

Accidental discovery

Aotearoa New Zealand has been settled for hundreds of years, and valuable signs of ancient settlement can be found almost anywhere.

For this reason, most organisations involved with any sort of construction will have protocols for 'accidental discovery'.

If when you are digging you encounter bones, charcoal with shells, carved wood or any human made artefacts that could be over a hundred years old, you must stop digging at that site and notify the landowners. This gives them the opportunity to get the discovery inspected by an archaeologist, who will advise on further steps (i.e., moving the discovery, or moving the trail).

Health and safety

All landowners and contractors will have Health and Safety protocols designed to mitigate or eliminate the risks of building trails. Make yourself aware of Health and Safety responsibilities and be always ready to identify and mitigate/remove onsite hazards.

A formal safety audit should be completed just as the trail is being completed, including an assessment of the safety of potential fall zones. This may be part of a general trail audit, which also recommends a trail grade.

Environmental considerations

- Before design and construction, check local council rules, building consent requirements, local planning restrictions/ constraints and Resource Management Act requirements.
- Earthworks machinery, hand tools and PPE should be cleaned before being bought on to site to avoid importing weeds and other contaminants.
- In native forests, and close to waterways, extra care needs to be taken to avoid soil erosion and sediment entering streams. Close to waterways, sustainable trail construction involves compacting dug soil on the side of the track so that it doesn't wash to streams. Berms and trail gradients should be gentler, to avoid soil erosion.
- Plant grass or native vegetation alongside the edge of the track as soon as possible after construction, to stabilise the edges and reduce visual impact. This may involve replanting plants that have been dug from the trail alignment during construction.
- Imported gravel, soil and armouring materials must be from a weed-free source.
- Survey tags, left over construction materials/signs, spray painted marks and general rubbish should be removed at trail completion.

Credit: Lisa Ng

Trail building tools

Good trail building tools make the job so much easier, faster and more enjoyable.

An assortment of trail building tools

Credit: Revolution Bikes

Trail building tools can be bought at local hardware stores, or from specialist businesses, such as Revolution Bikes and WMC Tools. The specialist tools are usually more effective than tools that are bought at hardware stores.

McLeod Trail Tool is a US designed fire rake. It combines a heavy-duty rake with a sharpened blade for chopping roots. The head is also an effective compactor.

Hilty Hoe is a wide grubber, perfect for digging, cutting roots and compacting.

Weapon of Mass Creation is a very strong rake/grubber/compactor. It is indestructible, but a bit heavy for some people.

These specialist tools are available at:

- www.revolutionbikes.co.nz/products/mtb-trail-tools
- www.wmctrailtools.co.nz

Other essential tools for track building available at hardware stores are:

Mattock with a grubber head on one side and a chopper or pick on the other. These are very good on rooty and rocky ground. Most are around 2.2 kg weight. Cyclone makes a 1.6kg mattock which is good for workers who prefer something lighter. Avoid really lightweight garden grubbers (thistle grubbers) which are too light to be effective and break easily.

Garden Spade with a sharp edge is useful for cutting the batter as well as shifting dirt.

Garden rakes and **leaf rakes** are useful for clearing debris and grooming the trail surface before compacting. When raking aggregate, you should flip the rake to avoid the tines 'sorting' the aggregate into larger and smaller stones.

Pruning saws like the high-quality Bahco 360mm, 6 TPI are worth the investment. Bahco also make folding saws, which fit neatly in a small backpack and are ideal for maintenance patrols.

Silky saws are also top quality and come in folding models and holster models. Avoid cheap saws as they wear out quickly and become frustrating.

Metal files are needed to keep your tool edges sharp. Five minutes a day sharpening tools makes them so much more efficient to use.

Departures process

If designers/builders cannot meet the guidelines for whatever reason, they must contact the landowner / trail manager and explain what the issue is before work continues.

The issue may need to be investigated and alternative options explored before departing from the guidelines. This is formally known as 'seeking a departure from the guidelines'.

If the departure is significant, all parties need to understand the impacts of alternative options, including the following:

Issue	Impact
Budget: cost over-runs?	E.g., additional $6000 needed
Time: delayed construction?	E.g., an extra 10 days
Trail grade: change of grade?	E.g., change from grade 3 to 4
Landscape or Environmental impact: trees to be removed?	E.g., overall reduced vegetation removal
Any other unintended impacts	E.g., none

Ensure a clear agreement is reached and written down before proceeding with construction.

Examples of approved departures:

1. In 2024, Grade 4 switchbacks were built on the Grade 3 Shotover Gorge Trail. The terrain did not allow Grade 3 switchbacks to be built, and a departure was agreed. However, a handrail was added to the out-of-grade switchbacks to make them safer and less scary.
2. In 2015, a set of 280 steps was approved on The Old Ghost Road. The trail trust had almost run out of budget and steps were all that could be afforded in such difficult terrain. These steps were temporary, and in 2025, the steps were replaced with new section of trail.
3. In 1999, a steep section of trail (6 degrees for 47 metres) was built on Koru, the Grade 2 entry trail at Makara Peak Mountain Bike Park. This was approved by council to avoid an area where rare birds were nesting.

The Old Ghost Road steps, 2015–2025. Credit: J Kennett

06 Structures

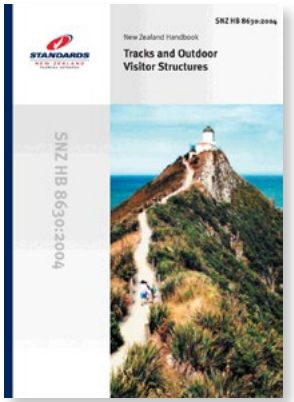
This chapter covers:

- bridges
- handrails
- boardwalks
- culverts
- retaining walls
- entry barriers
- seats, shelters and other facilities
- steps and stiles
- bike racks.

The main source of information for structures on off-road tracks and trails in New Zealand is the **New Zealand Handbook: Tracks and Outdoor Visitor Structures – SNZ HB 8630:2004 (HB 8630)**.

You can purchase HB 8630 (cost in 2025: $242), or you can print a free single downloadable copy from this webpage: www.standards.govt.nz/shop/snz-hb-86302004

Handbook HB 8630 is written primarily for walking user groups but is equally relevant to mountain bike tracks.



The table on the right shows the relationship between mountain bike track grades and the HB 8630 track classes and visitor groups. This is important for helping determine which structures are needed on which grade of track.

MTB Grade	Equivalent HB 8630 Track Classification	Equivalent HB 8630 Visitor Group	Comments
EASIEST	2. Short walk	SST (Short Stop Traveller)	All watercourses bridged. Trails can be longer than the distances suggested in HB 8630.
EASY	3. Walking track	Day Visitor (DV)	Similar experience level.
INTERMEDIATE	4. Great walk/easy tramping track	Back Country Comfort Seeker (BCC)	Similar experience level. Moderate fitness required.
ADVANCED	5. Tramping track	Back Country Adventurer (BCA)	Similar experience level. Considerable fitness required.
EXPERT	5. Tramping track	Back Country Adventurer (BCA)	Considerable fitness required. HB 8630 says some tracks may be unformed.
EXTREME	6. Route	Remoteness Seekers (RS)	HB 8630 specifies that routes are unformed. This will only be the case for some Grade 6 tracks

Bridges

Bridges and boardwalks are fun, attractive and practical features on any mountain bike trail. They are also expensive assets that needs to be planned and built carefully.

Bridges under 15-20 metres long are generally single-span structures, with wood or steel bearers. If they are under 1.5m high and don't require a building consent, you can follow the standard type of design shown in the technical drawings to follow.

The widths specified in HB 8630 can be too narrow for bike tracks. Refer instead to the widths specified in the table below.

Specification	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
Recommended bridge width	1.5-2.5 m	1.5-2.0 m	1.2-1.5 m	0.8-1.0 m	0.6-1.0 m	0.4-0.8 m
Minimum bridge width	1.2 m	1.0 m	0.8 m	0.6 m	0.4 m	0.2 m

Notes:

- These widths are at deck height.
- More width is needed at handlebar height (see below).
- Minor watercourses can be culverted instead (see page 50).

Boardwalks are the same width. Measurements should not include kickboards.

Narrow bridges are a major obstacle for three/four-wheel bikes and wherever possible widths should accommodate these users (see page 58).

Suspension bridge at Makara Peak, Wellington.

Credit: J Kennett

Handrails

You will generally need handrails wherever a fall is possible that could result in death or a serious injury. To determine if handrails are required or not, refer to the fall hazards assessment method on page 43.

Ideally, handrails should slope outwards by 10 degrees (+/- 5 degrees) to provide comfortable handlebar clearance. Sloping the handrails this way increases the effective width of the structure at minimal cost and improves the aesthetics of the bridge.

Handrail height should be 1.2m.

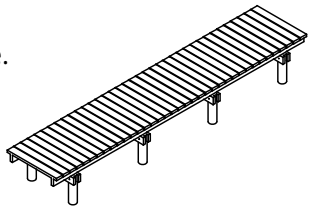
The exception to this rule is for structures that have a handrail built for some other reason than safety, for example, a cycling cattle stop. Such cases usually have 0.8m high barriers on the side to stop sheep and cattle getting through. This is an ideal height for mountain bikers, as handlebars are higher than 0.8m and will clear the top of the barrier.

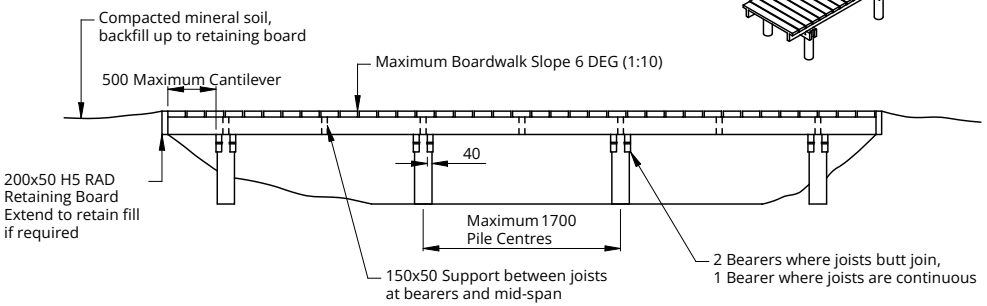
Boardwalks

Boardwalks are a good way of taking a trail across small, shallow or temporary watercourses, wetlands and boggy ground. They don't generally have handrails because they are not high off the ground, although some do have kickboards.

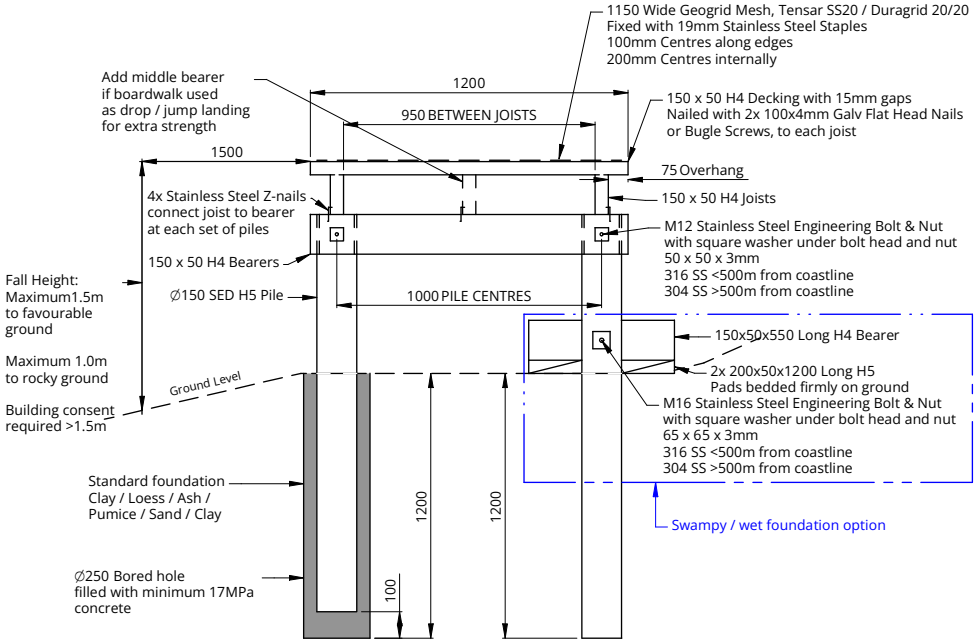
Heaphy boardwalk Credit: Kennett Bros

See the pictures and technical drawings below for guidance.





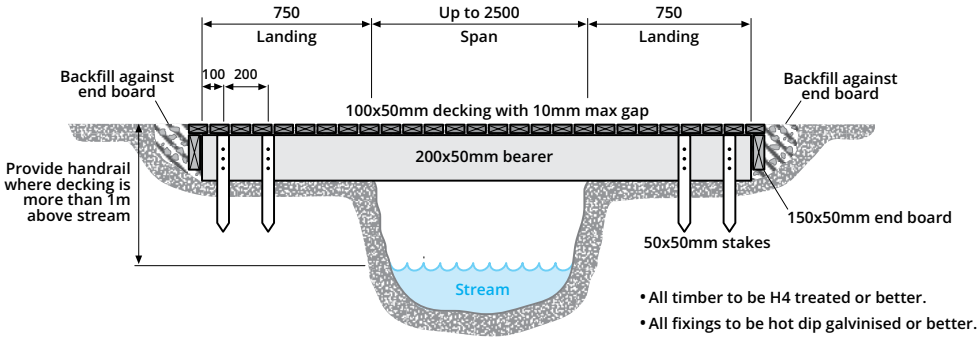
EXAMPLE OF ENGINEERED BOARDWALK - ELEVATION

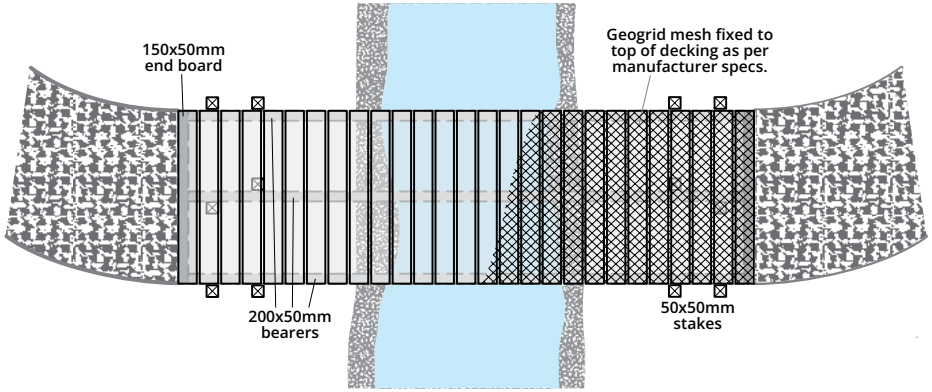


EXAMPLE OF ENGINEERED BOARDWALK - SECTION

Guidance:
Narrower boardwalks can be built to match narrower tread widths
It is typically lower cost to rock armour gullies or damp areas if rock is available nearby the trail, than to build a boardwalk.
When building boardwalks around bends, angle decking planks so they touch in the inside and have a maximum of 40mm gap at the outside.
It is recommended that all foundation holes are photographed with a tape measure to record depth and width of holes.

Credit: Jeff Carter





Example of short boardwalk.

Credit: Kennett Bros

Skid resistance

Wooden decking can be slippery when wet. To increase skid resistance, you can staple a UV stable polymer mesh to the deck. It can be difficult to source strong polymer mesh in small quantities, which is the main reason some organisations use wire netting instead. Wire netting can wear out more quickly, especially if riders are likely to skid along it because the bridge is on an angle or leading into a corner.

Culverts

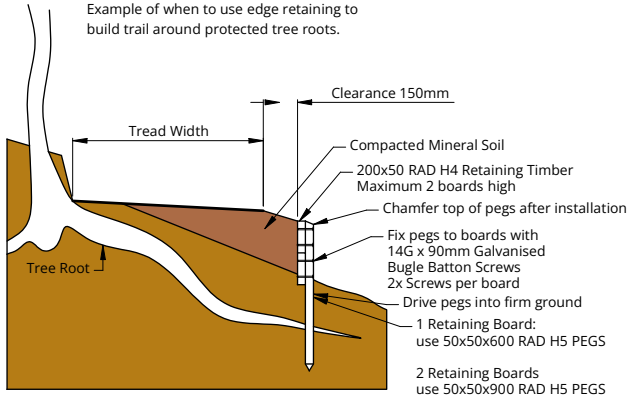
You can use culverts instead of short boardwalks or bridges for small or generally dry streams. However, the culvert must be large enough to take storm water (consider using two culvert pipes if you can't access a large single pipe). It's common for culverts to blow out during extreme storms – and wash away sections of track in the process. They are then usually replaced with two culvert pipes, or a larger pipe, to increase the capacity for storm water.

See page 31 for installation notes.

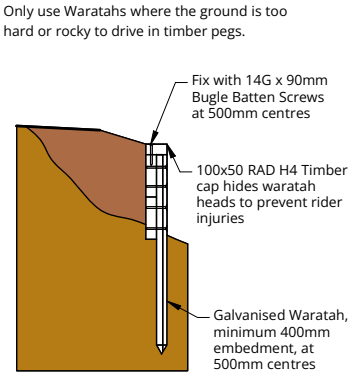
Volunteers putting the final touches on a berm. Credit: Lisa Ng

Retaining walls

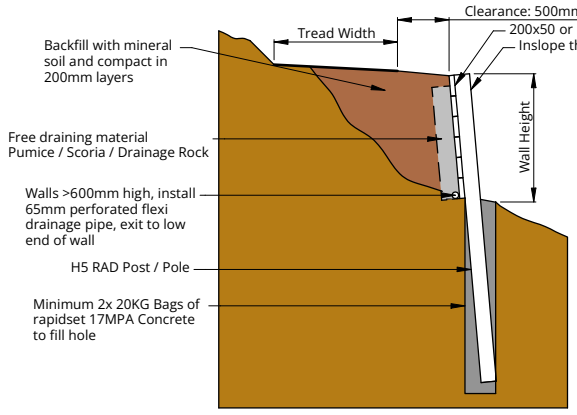
In some cases, you may need to construct a retaining wall to achieve the full trail width required. For retaining walls over 1.5m high, you will need to get engineers' designs and a building consent. For lower retaining walls, refer to the technical drawings below.



EDGE RETAINING WITH TIMBER <400mm HIGH
(Preferred Method)



EDGE RETAINING WITH WARATAHS

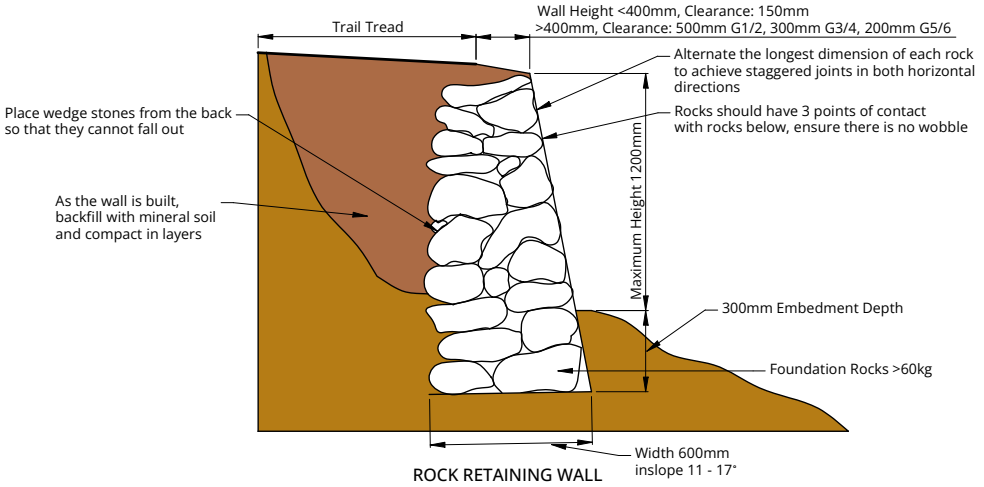


TIMBER RETAINING WALL 400-1200mm HIGH

TIMBER RETAINING WALL DETAILS				
MAX WALL HEIGHT	POST DIAMETER	HOLE DIAMETER	POST CENTRES	EMBEDMENT DEPTH
400	125	275	1800	900
600			1200	1000
800			900	1200
1000	150	300	1200	1500
1200			900	1800

Credit: Jeff Carter

Note: You may not always need to in-slope the retaining wall, however, doing so even slightly will significantly counter the loading on the wall. If you have any doubt about the strength of the wall, consider in-sloping, as this means that when the timber finally rots, in 30 to 40 years' time, the trail is less likely to fail catastrophically.

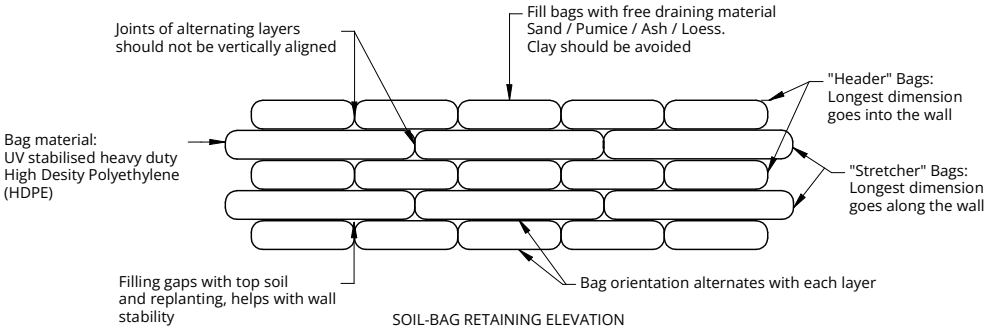


ROCK RETAINING WALL

Credit: Jeff Carter

Guidance notes:

- Where rocks are available, consider using them for your retaining over timber retaining as the structure will last longer. It's also a more environmentally friendly option and looks great.
- Rocks should be rectangular with four flat sides.
- The worst rocks to use are round river rocks.

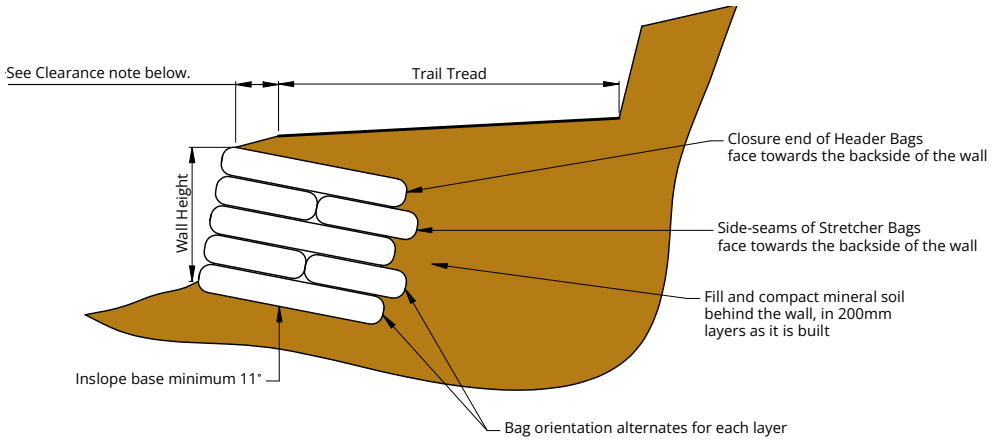


SOIL-BAG RETAINING ELEVATION

Credit: Jeff Carter

Guidance notes:

- HDPE Sandbags have a life expectancy of 12-18 months and so should only be used as a temporary solution.
- Longer life (20+ years) proprietary sandbag and connecting plate systems such as the FLEX MSE Vegetated Wall are available in New Zealand.

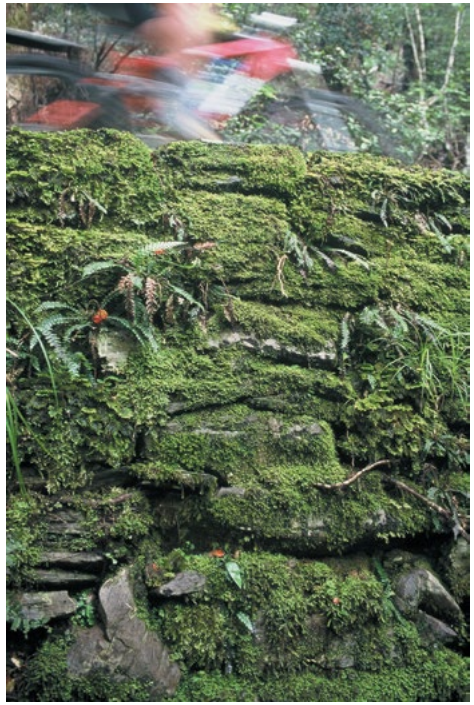


SOIL-BAG RETAINING CROSS SECTION

Credit: Jeff Carter

Guidance notes:

- If the wall height is less than 400mm, the clearance from trail to edge is 150mm.
- If the wall height is more than 400mm, then the clearance varies depending on the grade of trail. Provide 500mm clearance for Grade 1 and 2, 300mm clearance for Grade 3 and 4, and 200mm of clearance for grade 5 and 6.
- Wall Height >1.2m requires Engineered Design
- Wall Height >1.5m requires Building Consent



Rock wall built in 1864, Coppermine Trail.

Credit: J Kennett

Trailhead barriers

Look to remove all barriers, such as gates, from your trail unless there is a clear health and safety concern that requires their use. Barriers can impede legitimate access to the trail, by stopping those with modified cycles or other adaptive equipment, as well as cycles with child trailers and prams. They also create hazards for people who are blind or vision impaired. However, you should balance this against the need to deter motorcycles and other prohibited vehicles from accessing and damaging your trail.

Bollards centred in the middle of a track are not ideal, because that it the riding line, so a rider who is not paying attention could easily hit a central bollard. If you need to use bollards, it's better to use two, both off centre.

Large rocks at the entry to Pikikuranga Trail, Takaka Hill. Credit: J Kennett

Another common option is to place large rocks at the entry point. Try to place these 1.2 m apart for a slow-speed entry and 1.5 m apart for a faster trail Adaptive bikes will be able to enter the trail at 1.2 m spacing.

Kissing gates are a type of barrier, which stop motorbikes and stock from getting onto a trail. However, kissing gates cannot be ridden by any type of bicycle, and are disliked by cyclists. A better option to stop stock is a narrow cattle stop, as shown on page 55.

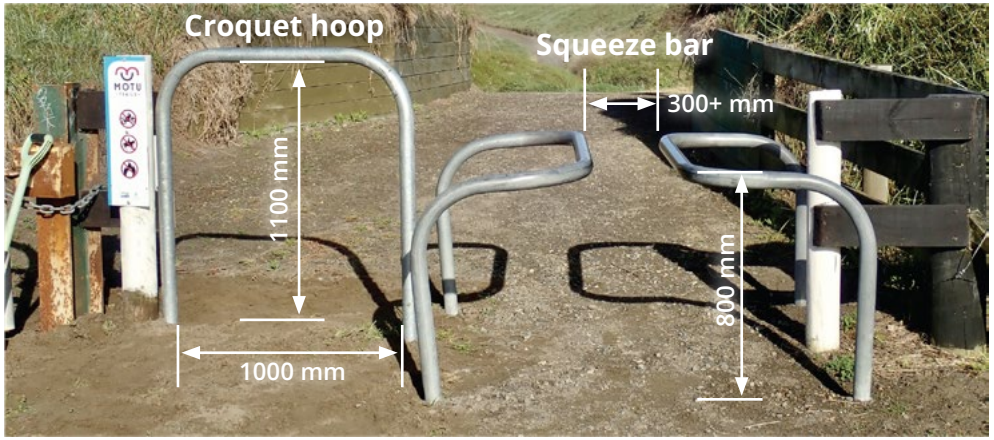
Squeeze barriers were developed by Bike Taupo and soon spread around New Zealand. They are disliked by cycle tourers, cargo bikes and adaptive bikes. Mountain bikers on two wheels can generally ride through without a problem.

These barriers are only needed in places where motorbikes are a problem.

Other barrier options are wooden and steel bar chicanes. These are easy to install and, as long as they aren't too tight, they won't bother many riders. They are ideal for slowing cyclists down before meeting traffic.

Another option is the boulder squeeze. This requires placing two or three large boulders at the trail entrance (see left).

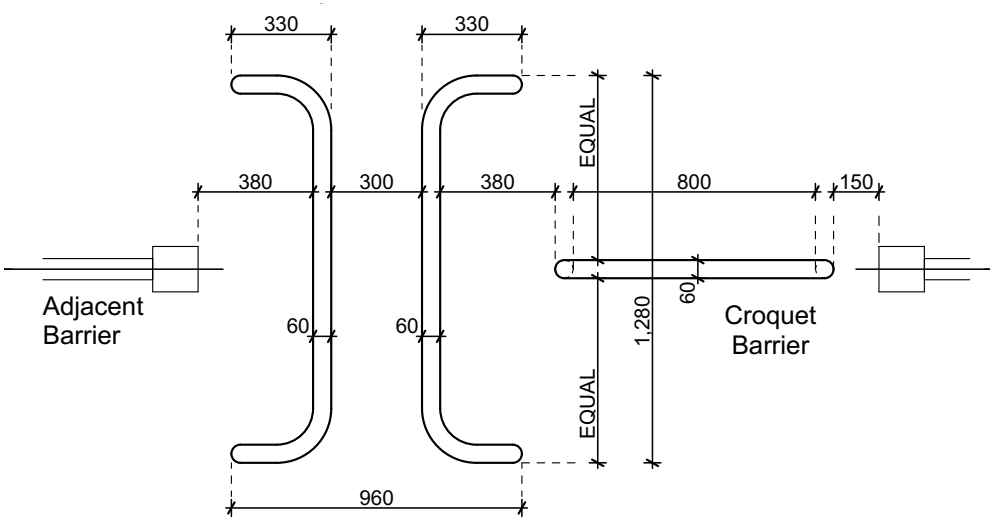
As with all barriers, consider if they are really needed and how narrow they need to be. Ideally, there will be a 1.2 m gap for three- and four-wheeled bikes to be able to get onto the track.

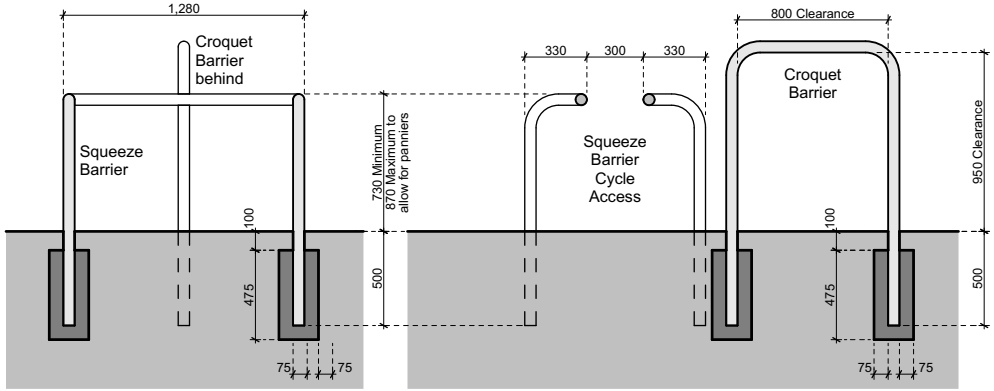


Squeeze barriers on the Motu Trails. Credit: Jim Robinson

Although these specifications are more accessible than the traditional squeeze gate and croquet hoop design, they are not 100% accessible for all types of mobility devices or adaptive equipment, and you will need to bear this in mind in assessing the suitability of your barrier options.

Squeeze barrier plan





Notes:

- The two squeeze bars require a solid jig to hold them in place while the concrete feet are setting. Otherwise, they naturally want to fall inwards.
- The height of squeeze bars is very important, as it enables handlebars to go over the top of them. If the path under the bars erodes or compacts, and gets lower, this effectively makes the bars higher. Because of this problem, some people concrete the middle strip of trail under the bars.

Seats, shelters and other facilities

Martin's Lookout, Rameka Track, Golden Bay. Credit: J Kennett

At places where riders congregate, seats and shelters are welcome additions to a trail network. Carparks, lookouts and the top of long hill climbs are logical places, where people appreciate the opportunity to rest. It's a good idea to install seats and picnic tables early in a project so your track builders can use them too.

Seats and tables can be purely practical, and cost very little. Or they can be an opportunity for a skilled volunteer to express a little creativity.

Larger mountain bike parks are able to fund toilets, drinking water and bike wash stations at their trailheads. Think about making these facilities accessible to adaptive mountain bikers. Guidance on accessible facilities can be found in the Outdoors Accessibility Design Guidelines.

The emergency shelter at the top of Makara Peak is fitted with a Park Tool Trailhead workstation. Credit: J Kennett

Steps and stiles

There should be no steps on a mountain bike trail, except for single downhill steps, which are designed for jumping off, or as a trail end treatment to stop people riding up a downhill trail. Stiles and steps are mostly unrideable barriers for any type of bike, and for those on adaptive mountain bikes, they are a completely unpassable.

If, for some reason, you have to include steps, make sure all stakeholders (the trail builder/designer, the land manager and funders) understand the need for them and accept their use before you start constructing them.

Many riders find stiles difficult to lift their bikes over – especially if they are riding an e-bike. Better alternatives are a cyclists' cattle stop or even a small gate.

Bike racks

There are two common types of bike rack. The old 'wheel benders' where you slot your front bike wheel into a stand and the more modern type that you lean your bike against. Bikers always prefer to lean their bike against something as it's more stable. The old wheel benders only work for certain wheel sizes, can damage wheels and make it easy for a bike to be stolen.

The most common type of bike stand is the Sheffield stand, but there are many variations on this stand.

The common Sheffield stand, and variations on this option, provide stable parking with plenty of locking locations.

Cheap and nasty wheel bender racks. They can bend rotors and rims. You can only lock your front wheel to this rack, making the bike easy to steal.

Log stands like this can be seen around the country.

Cattlestops

Mountain bike cattlestops were developed by the Christchurch City Council for use on cycle trails and tracks on the Port Hills and Banks Peninsula. They have been installed all over the country.

They need to be carefully located so that stock can't get a run up and try jumping through them.

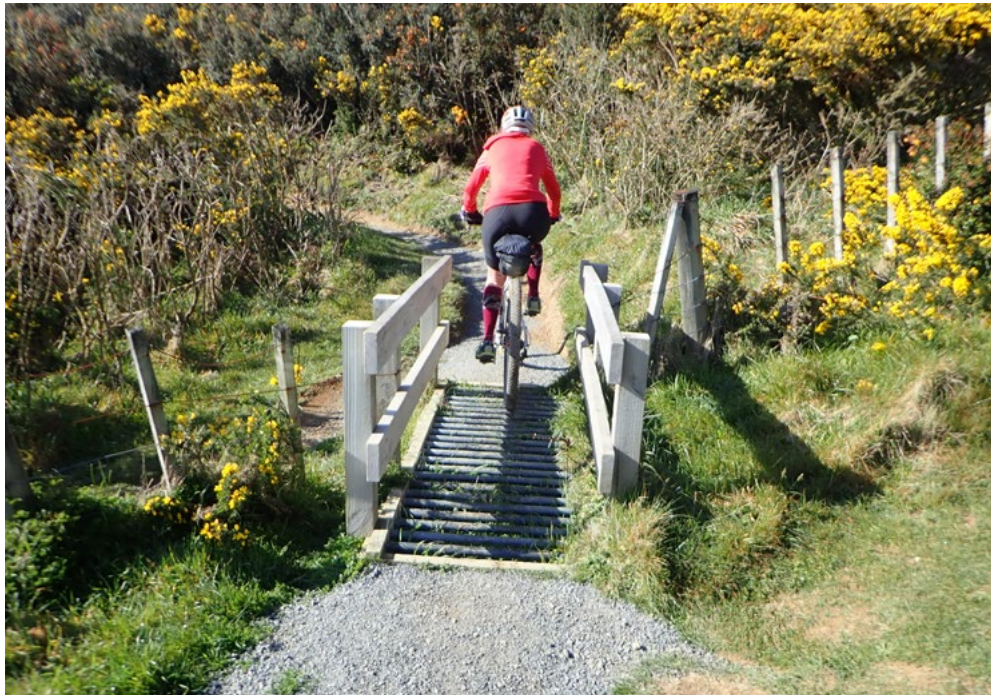
When they are first installed it is best to have tape, or an electric fence, across them while inquisitive stock investigate them.

If farmers are particularly worried about stock getting stuck in them, then add a minor chicane before the entry.

There should be a pit at least 400mm deep below the bars, and this needs to be kept clear of weeds.

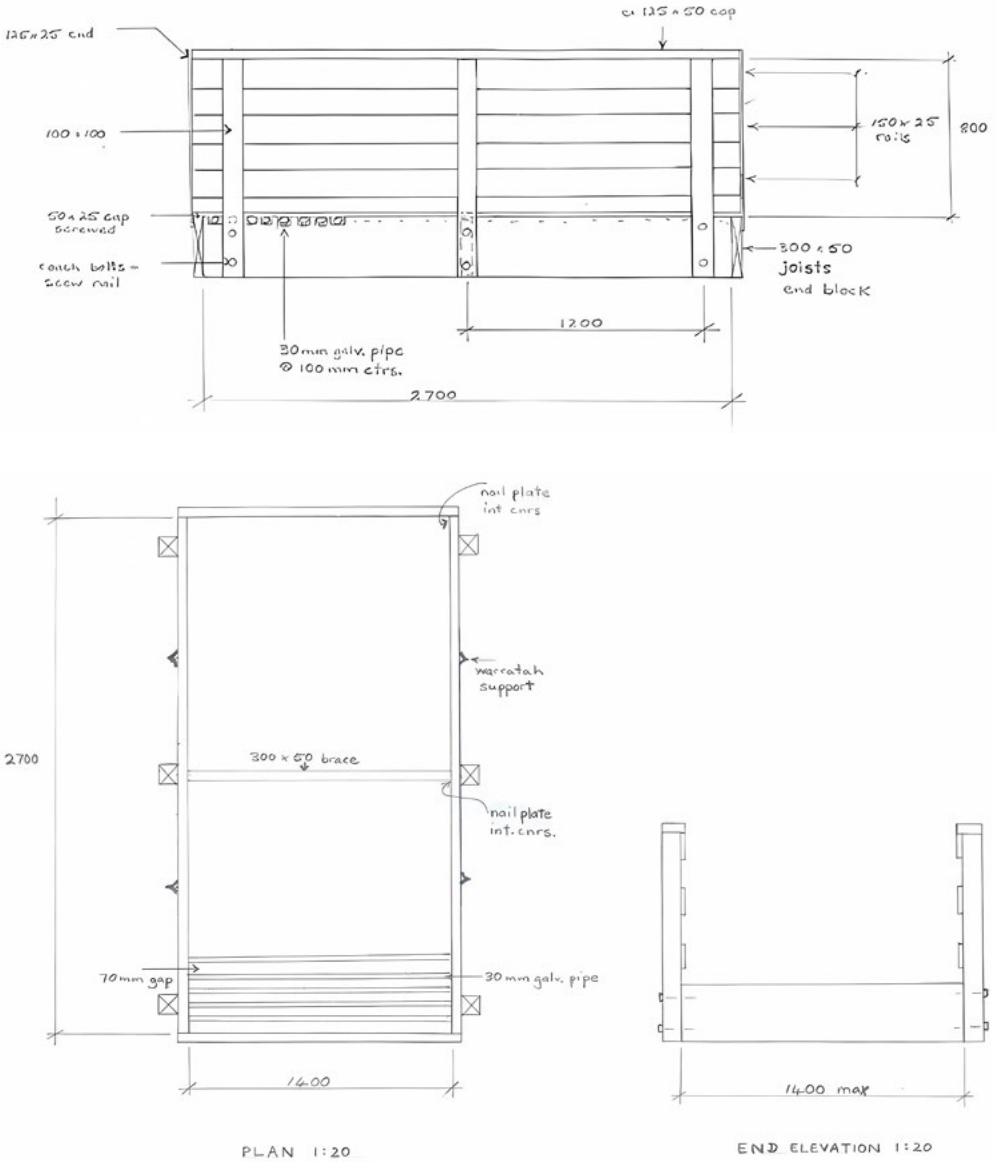
Ensure it is easy to remove the bars, so the pit can be cleared out, as they do fill up with mud and gravel over time.

The rails are specifically 800mm high so that handlebars will pass above them.



Cattlestop on Wellington's Skyline Track. Credit: J Kennett

Cattlestop plan



Note: Cattlestops are generally 900 mm or 1100 mm wide, although Christchurch's Little River Rail Trail cattlestops are 1400 mm wide, which is better for adaptive bikes.

07 Trail enhancers

Trails motivate people to ride for a wide range of reasons. Some people seek adrenalin, others seek endorphins, many just want to get some healthy exercise in the outdoors. Whatever the reason, most people will enjoy a trail even more if it is enhanced somehow.

Trail enhancers are things you can add to almost any trail. Exactly what you add will depend on the target market.

Some enhancers, such as jumps and structures, are purely to add challenge.

On longer trails, there may be opportunities to add interpretation signs, which are great for visitors.

Almost any trail, can have creativity added, through a sculpture, or by painting a boardwalk or mural for example.

Everyone appreciates native trees being planted beside trails.

The list of trail enhancers is huge, and will never stop evolving. The examples below are just a sample of what is possible.

Global context


Impressive concept art/sculptures

Creative waymarkers


Historical artefacts


Furniture made from local resources


Flow

Ben Karalus


Trig or viewing platform at highpoint

Impressive gateways

Dave Mitchell


Tunnels

Clever track name/signage combos


Trail alongside a stream or tailrace

Swimming (or other non-cycling activity)

Artworks

Funky boardwalk treatments

Cairns

Bird life

Mary-Rose Blackley

Rock with a view

Archways (rock or trees)

Murray Drake

Caves and tunnels

Big suspension bridges

Dave Mitchell

Pou (cultural context)

Mary-Rose Blakeley

Amusing signage

Big swing bridges

Options

Cafe and a bike shop!

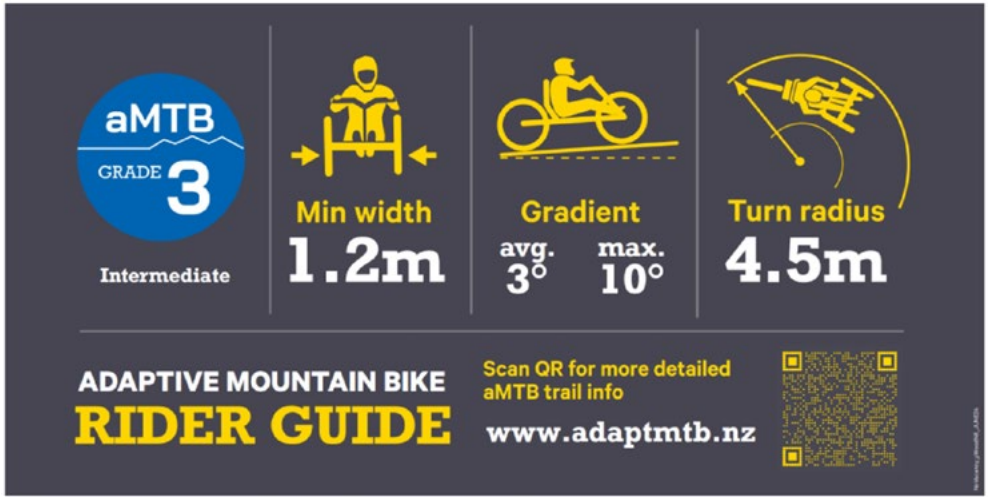
08 Adaptive biking trails

Outdoors Accessibility Design Guidelines is the definitive source of information about inclusive trails and outdoors accessibility. It was published by Recreation Aotearoa in 2025 (www.nzrecreation.org.nz/outdoors-accessibility-design-guidelines).

Most trails currently ridden by adaptive mountain bikes were not originally designed with inclusion in mind. There are now many types of three- and four-wheeled mountain bikes and rapid advances in electric-assist technology. However, these bikes are often limited by trail width and tight corners. The **Outdoors Accessibility Design Guidelines** set out best practice for truly inclusive trail design, with specific criteria for adaptive mountain bike (aMTB) trails, which are different from standard mountain bike trails.

Importantly, trails built to aMTB standards aren't just for adaptive riders. Trails that can be ridden by three-wheeled bikes are also great for families, less confident riders and anyone looking for a more accessible riding experience. Trails built to this standard offer the best experience for adaptive mountain bikers.

For example, an aMTB grade-3 trail looks like:



The ***Adapt MTB*** website (www.adaptmtb.nz) has more information about other aMTB grades.

Top features of adaptive biking trails

The top six factors people with impairments consider when choosing a trail, in order of importance, are:

1. structures (steps, barriers, gates, bridges, etc)
2. surface
3. gradient
4. width
5. camber
6. length.

Whakarewarewa Credit: AdaptMTB

Show stoppers

Pinch points that are narrower than a bike can completely stop people in their tracks. They often occur at bridges or squeezes between boulders or trees. Also, road-end barriers which are designed to deter motorbikes, need to be specially designed to allow three- and four-wheeled bikes through – or simply not used at all.

For more information see:

- **Outdoors Accessibility Design Guidelines**: Decision-making matrix for existing barriers on-trail on page 205 (www.nzrecreation.org.nz/outdoors-accessibility-design-guidelines)
- **Trail Barrier Remediation: Least restrictive access** (Recreation Aotearoa) (www.nzrecreation.org.nz/sites/default/files/content-files/Trail_Barrier_Remediation_Least_Restrictive_Access.pdf)

Facilities

Facilities are also an important consideration for adaptive mountain bikers. The top five facilities considered when choosing where to ride are:

1. signs (information panels, maps, trail markers, etc)
2. accessible toilets
3. accessible car parks (wide, hard surface, flat/level)
4. drinking water supply
5. shelters.

The Outdoors Accessibility Design Guidelines (www.nzrecreation.org.nz/outdoors-accessibility-design-guidelines) provides detail on how to make these facilities more accessible.

Accessible trails around New Zealand

New Zealand adaptive mountain bike riders have compiled a useful collection of ride reports at www.adaptmtb.nz/destinations.

Eagle vs Shark, Whakarewarewa, Rotorua

Credit: Bryce Wilson

"One significant shift we would like to see in people's perception is that building inclusive trails is not an all-or-nothing proposition. Most of the trails we are currently riding on with three-wheel bikes aren't built to be "inclusive," but they are perfectly adequate and provide plenty of fun given the equipment available now. Three-wheel bikes and their riders, like two-wheel bikes and their riders, have a huge range of abilities.

The key factors that can make or break experiences are barriers at the start and end of the trail, as well as the trail width. Trails that aren't wide enough or have pinch points, and barriers that are not accessible, are showstoppers.

We encourage asset owners and trail builders to do what they can with what they have. If a trail is wide enough and has no barriers at the end, we can usually use it, even if, for example, the turn radius is too tight and we need to do a three-point turn."

Mark Mandeno, champion of adaptive biking

Adaptive bike trail specs

Adaptive bikes are two-, three- or four-wheeled cycles. Most adaptive bikes have electric motors and are 800–950mm wide, though some can be up to 1.1m wide. They have large turning circles, and some three-wheeled trikes can be unstable on off-camber sections. There is a wide range of designs, with narrower and lower equipment often used on higher-grade trails.

Adaptive mountain bikes create opportunities for a range of users with broad physical, intellectual, neurological and sensory abilities. Inclusive trails built to the adaptive mountain biking specifications create quality experiences for all trail users.

Accessibility to and from the trail car park needs to be carefully considered and allowed for, including any transition to trails, amenities and facilities (i.e., toilets).

These grades each have their own symbol, which can be used on trailhead signs.

	Grade A1	Grade A2	Grade A3	Grade A4	Grade A5	Notes
Gradient (at least 90% of length of trail)	0–2° for over 90% of the trail	0–4 ° for over 90% of the trail	0–5° for over 90% of the trail	0–5° for over 90% of the trail	0–7° for over 90% of the trail	Do not built at a constant gradient. Add lots of gentle grade reversals to make the track fun and sustainable.
Gradient (max)	2–5° for up to 10 m section	4–7° for up to 10 m sections	5–10° for up to 10 m sections	5–15° for up to 10 m sections	7–20° for up to 10 m sections	
Width	1.5 m minimum	1.5 m minimum	1.2 m minimum	1.0 m minimum	1.0 m minimum	No pinch-points less than 1.0 m wide. Keep track cross slope camber to less than 3°, to avoid the risk of trikes rolling.
Cross slope	Level, 1–2°	Max 3°	Max 3-5°	Max 5°	Max 5°	
Radius at outside edge	6.0 m plus	6.0 m minimum	6.0 m flat, and 4.5m bermed	4.0 m flat, and 4.0m bermed	3.5 m flat, and 3.5m bermed	Trikes will tip over on off-camber corners. It is always better to have corners slightly bermed or flat.
Berms	Level	10° maximum	10- 20° maximum	20- 30° maximum	No camber restrictions	
Surface	AP20 compacted. Loose material less than 5 mm	Firm and stable	Mostly stable, some variability	Mostly stable, some variability	Widely variable	
Tread obstacles	None	50 mm maximum	100 mm maximum	200 mm maximum	250 mm maximum	
Technical trail features (i.e., jumps and drops)	All features rollable. No drops or jumps. If shared use, handrails are recommended where the gradient is steeper than 4°.	All features rollable. Drops maximum height of 100 mm with gentle downhill transitions. No jumps. 1 feature at a time.	All features rollable. Drops maximum height of 200 mm with gentle downhill transitions. Jumps with ramp angle maximum of 20°. 2 features at a time.	All features rollable. Technical features such as gap jumps must have clearly identified alternative line. Drops 200 mm maximum height. Jumps with ramp angle maximum of 25°. 3–4 features at a time.	All features rollable. Technical features, such as gap jumps, must have clearly identified alternative line. Drops 200 mm maximum height. Jumps with ramp angle maximum of 30°. 4 or more features at a time.	All technical trail features must be rollable.

09 Sign guidelines

Signs are an integral part of a successful trail network. Trail signs perform several purposes for trail managers, visiting riders and first responders. To work well, signs must be clear and consistent.

The main purposes of signs are to communicate:

- orientation and directional information for trail users
- the grade of each trail
- safety messages, including hazards
- emergency pick-up locations
- trail updates.

Signs can also cover:

- the mountain bikers' code
- cultural, heritage and environmental information
- riding skills required for the trail
- the 'pre-ride, re-ride, free-ride' advice for safer trail riding.

Signs are most important for new riders. They should be obvious without being obtrusive or a hazard to bikers. If bikers are likely to hit them, think about moving them aside, or using flexible plastic sign blades (the same as road shoulder markers).

Planning

Sign planning is a skill that requires both local and outside knowledge. Riders familiar with an area don't usually realise that visitors won't instinctively know where to go. Visiting riders need to know:

- how to get from the carpark to the trail head (it won't be obvious without signs)
- how to get from the trail head to specific trails
- which way to go at every intersection.

Land managers and trail owners usually have established sign systems, including wayfinding signs, interpretation signs and management signs. They will include a unique brand and provide consistency across a riding area.

These guidelines include:

1. a wayfinding sign system that is being used at a growing number of places around the country
2. national safety sign guidance
3. sign examples from around the motu (country) to provide ideas and inspiration.

Trailhead signs

Trailhead signs (usually next to a carpark) provide users with a detailed introduction to a mountain bike park or trail. They will include the following.

- A large, clear map of the trails, including a colourful "You are here ➔" arrow pointing to the location of the map board, a scale and a legend
- A summary of the 1 to 6 trail grading system (see example on page 64)
- A list of the trails, ranked by grade and using the specific grade-classification colours
- A summary of trail etiquette, including any local rules that visitors may be unaware of
- Useful riding tips specific to an area, such as 'avoid papa mud tracks when wet' or 'watch out for kiwi after dark'
- Land manager branding and contact details
- Local MTB club/group logos and contact details
- Sponsors' logos (if appropriate)
- Emergency contact details
- Special updates/notices of new trails, fire bans, trail closures, etc.

Trail managers, landowners and iwi should be in the loop when developing new signs.

Wayfinding signs

Provide wayfinding direction signs at the start of every trail and at all intersections to help visitors and emergency responders find their way. Visitors do not have a navigation sixth sense. They need guidance from the start. If they don't have a line of sight to the trail entrance, they will need to rely on signs to get them there.

Elements of trail wayfinding signs

An arrow is the largest and most important element in a wayfinding sign. Other elements are listed below:

- Trail name (essential)
- Trail grade (essential)
- Type of trail subtitle (recommended): Tech, Flow, Jumps, Drops. If a trail has no features, leave this blank.
- Distance (optional)
- Destination (optional)
- One-way or two-way (recommended)
- Background colour to match the trail grade (recommended)
- Shared use (recommended and often provided with symbols of user type)
- Location grid reference to help first responders (optional)
- Branding (council, club, government organisation, sponsors, etc).

Intersections

Every track fork/intersection/hub offers a choice. Install signs to explain the choices.

- If it is a hub, consider adding a map board.
- If it is an intersection where riders cannot easily stop / slow down, consider locating signs before and again just after the intersection. The location of these signs depends on the average approach speed. If it is a high-speed track, the sign should be 20–30 metres before the intersection and repeated 1–4 metres after the intersection.
- A 'No Entry' sign is needed where a one-way track joins another track, to stop collisions. It can be helpful to add the name of the track below the 'No Entry' text.
- At **split lines**, where tracks fork, it is important to provide information for safety.
  - 'Easy'/'Hard' signs are commonly used where the split lines are the same grade.
  - If the tracks are different grades, it is important to show this. If they are one grade apart, then the harder line should have a yellow warning sign with supplementary sign/s that show what the two different grades are.
  - If the harder option is two grades harder than the main track, or leads to a known hazard with a history of serious crashes, a 'Danger' sign should be used. This can be a plastic marker blade as shown below.
  - If one of the split-line options leads to a feature that is more than one grade harder than the main trail, consider closing the harder line or modifying the feature so it is only one grade harder than the main line.
  - Don't build new alternative lines with features that are more than one grade harder on any trail.

Flexible plastic signs can be used before a trail feature. They are easy to install and will bend if a rider crashes into them. This sign explains what the feature is, and what grade it is.

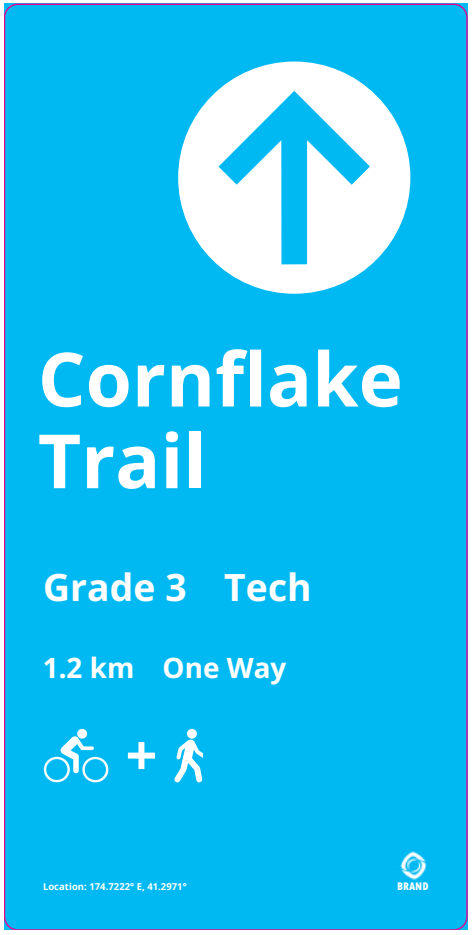
Wayfinding sign templates

These signs have been modified from the Makara Peak sign templates, which were developed for Wellington City Council in 2016, and are now used in several riding locations. They provide a clear design hierarchy of the elements required for wayfinding signs.

The design elements shown in this example:

- Arrow: up
- Trail name: Cornflake Trail
- Trail grade: Grade 3 on a sign that is the same colour as the trail grade (e.g., light blue)
- Type of trail subtitle: Tech
- Distance: 1.2 km
- Direction: one way
- Users: cycle + walking symbol
- Location: Long, Lat
- Branding: Council and/or company

Note: signs may also indicate if a user group is banned (i.e., dogs or motorbikes).



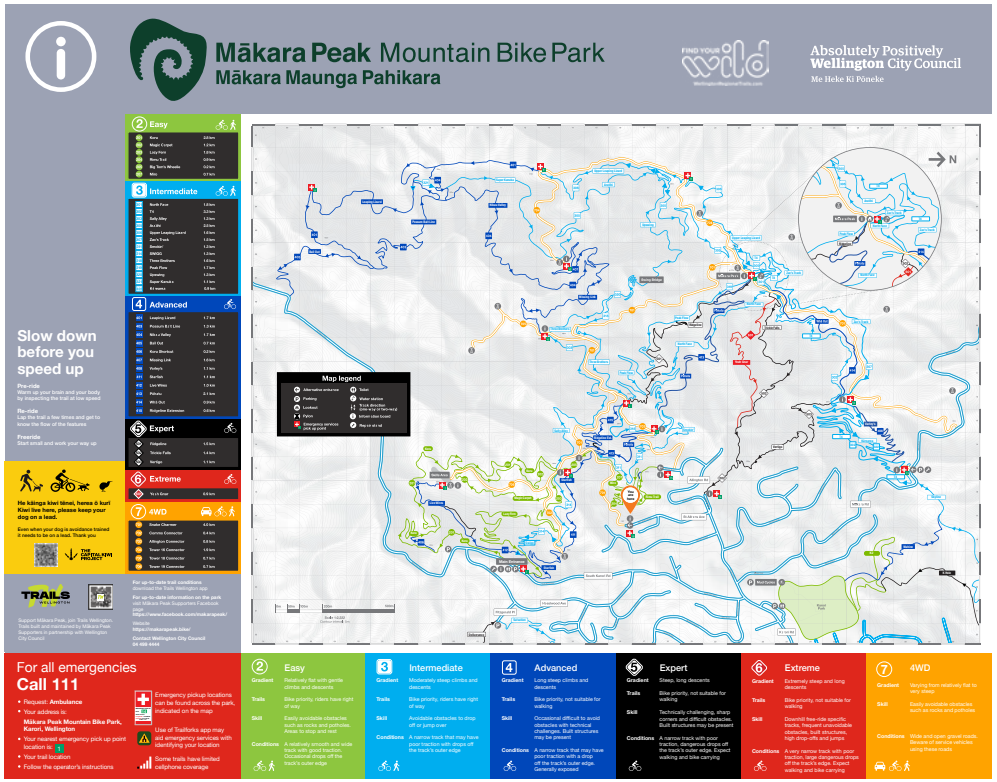
Trail identification sign
(240 x 480 mm)

Fingerboard direction sign: “standard” length (480 x 80 mm) or custom length (depending on trail name length)

Rectangle direction sign (480 x 80 mm)

Rectangle direction sign
(240 x 80 mm)

The background colour of wayfinding signs should match the trail grade colour.



A map board example, including a list of the trails from easy to hard, with definitions for each grade, and a close-up of a more complex area of trails at a distant trail hub.

Example of Makara Peak wayfinding and warning signs shown at a split line. Notice that there are three separate physical signs assembled on one post to make a coherent sign.

Credit: J Kennett

Locations and destinations

These signs point people to key hubs or destinations such as a carpark, café or even the next town.

- It is helpful to add the distance to the destination.

Recommended route signs

If a network of trails looks like a can of spaghetti you've thrown on the kitchen floor, then it will be helpful to recommend and signpost a few good loops for visitors.

Keep loops a consistent trail grade and be accurate about the grades (experience shows it is best to involve 'easy riders' to develop easy loops, 'intermediate riders' to develop intermediate loops and 'expert riders' to develop expert loops).

Consider additional opportunities to add directional signs at key intersections along the way, and if the intersection is a trail hub, then another map board could be useful (perhaps smaller but still showing your location).

Direction signs

These signs are needed if a track is one-way only. Reinforce direction signs with a 'No Entry' sign at the end of one-way tracks.

It is also important to let people know that a track is two-way, especially if most other tracks in the area are one-way.

Kilometre marker posts

On longer trails, it can be useful to add kilometre marker posts (like, milestones). These help riders know where they are and can be useful if they need to contact trail managers about track damage or help emergency services find an injured rider.

Note: Branding should not interfere with wayfinding or safety messages.

Information signs

Although not so common on mountain bike trails, providing information about the area will enrich the riding experience, especially for visitors. You can include details about unique historical features or wildlife, or a story specific to how the trail was built.

Be factual and connect with iwi when researching pre-colonial stories.

Information signs can also be used to teach mountain biking techniques – especially on trails that are designed to progress riders' skills.

Keep the signs short and simple (100–200 words per panel, accompanied by a few photos/ illustrations).

Interpretation panels at the top of Makara Peak Mountain Bike Park, Wellington.

Credit: J Kennett

Bilingual signs

Nothing says you are in Aotearoa New Zealand better than a bilingual sign. Te reo is becoming more common, and adding Māori to your signage kete (kit) can be a fun part of the journey for you and your manuhiri (visitors).

If an interpretation sign is telling iwi stories, then consider providing the full text in both te reo Māori and English.

Kataore, Whakarewarewa, by Tāwhanga Rika.

Font type and size

Font type

Recommended open-source fonts:

- **Open Sans** (Bold, semibold and regular, never use italics on a sign)
- **Overpass** (Bold, semibold and regular, never use italics).

These are both clean, simple and highly readable fonts. Open Sans is more readable than the default fonts in Word and Overpass is a free variant of the font used on highway signs. Both fonts are free to download from many font websites, including Google Fonts.

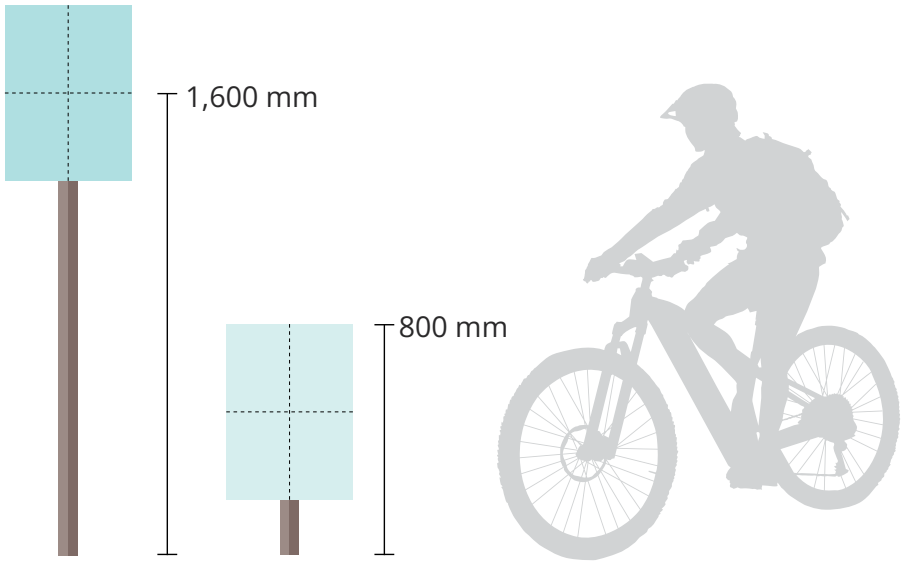
Font size

For signs to be readable when riders are travelling at different speeds, the font size needs to vary to match the reader's expected speed.

Speed	**Minimum** font size
Not moving	15 mm
5–15 kph	25 mm
20–30 kph	50 mm
30–40 kph	75 mm
40–60 kph	100 mm
65+ kph	125 mm

Sign placement

The height of a sign depends on when it is being read. Signs at hubs and carparks are usually read while people are standing up and should be 1,600mm high. Signs that are read while people are riding should be 300mm to 800mm high because riders are generally looking down at a track, and handlebars are over 800mm high and won't be clipped by signs under 800mm high.



Credit: New Zealand Land Safety Forum

Sign materials

Conditions in New Zealand can be very harsh, especially for signs that are out in the open, and facing north.

In the past, wooden routered or painted signs have been common. These are inexpensive, have a low carbon footprint, and will last for approximately 10–20 years. However, a routered sign cannot contain more than a few words.

For temporary signs, corflute or laminated paper can be used. These are often attached to plywood to add strength. Depending on which way they are facing, and how wet they get, they can last from 6 months to 10 years. If laminated signs are not placed under cover, do not staple through the lamination. Glue to plywood instead.

For more permanent signs, the preferred choice is

- Aluminium Composite Material (ACM) for signs in a milder environment.
- Painted marine plywood with vinyl lettering, which will last for over ten years in an exposed environment such as the top of Makara Peak.
- Aluminium for signs that need to last a long time in harsh environments, such as alpine areas.

Number of signs per site

Try to limit the number of signs to one or two per feature/hazard.

Placing four or more signs in one place is 'sign clutter' and dilutes the important messages.

Be as concise as possible, without being difficult to understand.

More signs lead to higher construction and maintenance costs. They can also lead to sign pollution and reader complacency. Plan carefully and be concise.

Safety signs guidance

In 2024, two coroners' reports recommended the development of nationally consistent safety signs. To help land managers and clubs produce nationally consistent safety signs a suite of standard templates have been developed in conjunction with the Outdoor Safety Signs team at Land Safety Forum.

The **mountain bike sign template files** are available to download at:

https://www.nzrecreation.org.nz/new-zealand-mountain-bike-trail-design-guidelines

The national safety signs shown here are based on the **Land Safety Forum Outdoor Safety Signs** guide (2025).

You can read the full guidelines on the Department of Conservation website at: www.doc.govt.nz/globalassets/documents/about-doc/role/land-safety-forum/lsf-good-practice-guide-outdoor-safety-signs.pdf

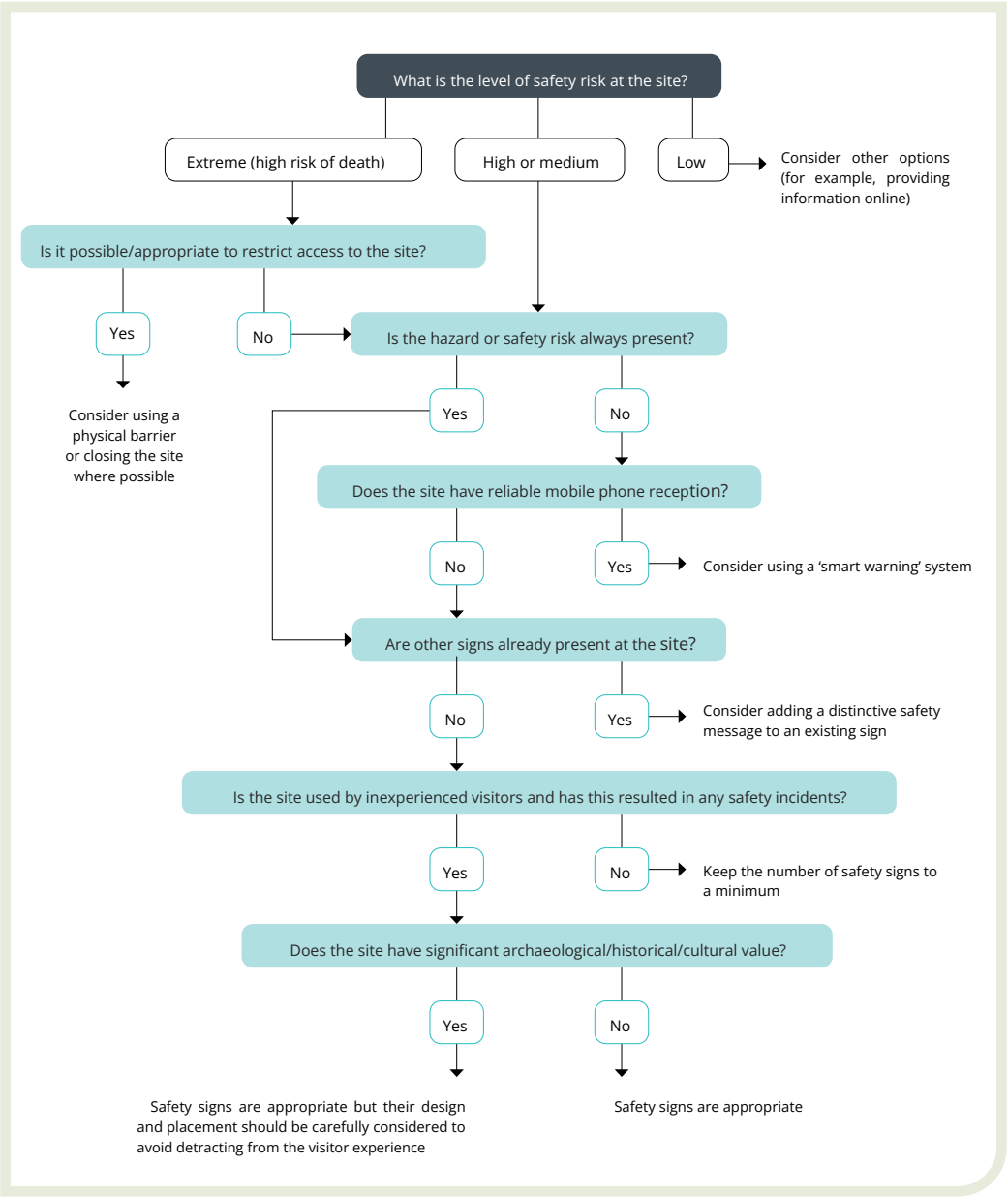
Landowners/managers usually have specifications and styles for trail signs and boards. Check before you go too far.

Most mountain bikers understand that the difficulty of a trail depends on its grade. They then choose a grade that suits their skills. Once they have started riding a trail, it is important that their experience is within the expected grade. Any out-of-grade sections, or unexpected hazards, may require safety signs (or you may need to remove or mitigate the hazard).

While signs may be appropriate in popular, highly accessible mountain bike parks, they may be out of place in remote settings. The flow chart below can help you determine if a sign is the best option at the feature/hazard you are considering.

Safety signs should convey important messages with minimal words.

- Don't use a safety sign unless you need to. Consider if it could be better to remove or mitigate a hazard or out-of-grade feature. If there are multiple out-of-grade features on a track, consider the work required to bring the trail into one consistent grade. If it is not possible to remove/mitigate the hazards/features, then consider re-grading the track (last resort).
- When safety signs are over-used, or used where they are not needed, they lose effect.



Flow chart from Outdoor Safety Signs published 2025 by Land Safety Forum

Safety signs consist of the following components.

- Colour of red for danger (or grade 6) and orange/yellow for warning signs
- Shapes are triangles or diamonds with exclamation marks or symbols
- Up to seven words combined with the colours, shapes/symbols on a rectangular board.

See below for design guidance, templates and examples.

Colours

There are two internationally recognised colours and shapes used for safety signs.

How these are used depends on the level of hazard or out-of-gradeness of a feature.

- The colour red in a triangle indicates the highest level of risk. Red triangles are used for DANGER signs.
- The colours yellow or orange in a diamond indicate lower levels of risk. Yellow diamonds are used for WARNING signs.
- These individual signs can be placed on their own where the hazard/feature is obvious and no further explanation is needed.
- The red exclamation sign replaces the traditional **XXX** and ↓↓↓ signs as it is used and understood around the globe.

These rectangular DANGER and WARNING signs can include common feature/hazard details, such as 'DROP', 'GAP', 'ROCKFALL', 'JUMP', 'CLIFF', etc.

If the feature is out of grade, the grade can also be added, for example, 'GRADE 4', 'GRADE 5', or 'GRADE 6'.

Choosing the right symbol

Yellow diamond and black symbol warning signs are used worldwide. The symbols can also be placed on a rectangular sign with words (see right).

Where a sign relates to a specific hazard, aim to use a symbol that shows the nature of the hazard so that visitors can quickly understand the risk, while riding past the sign.

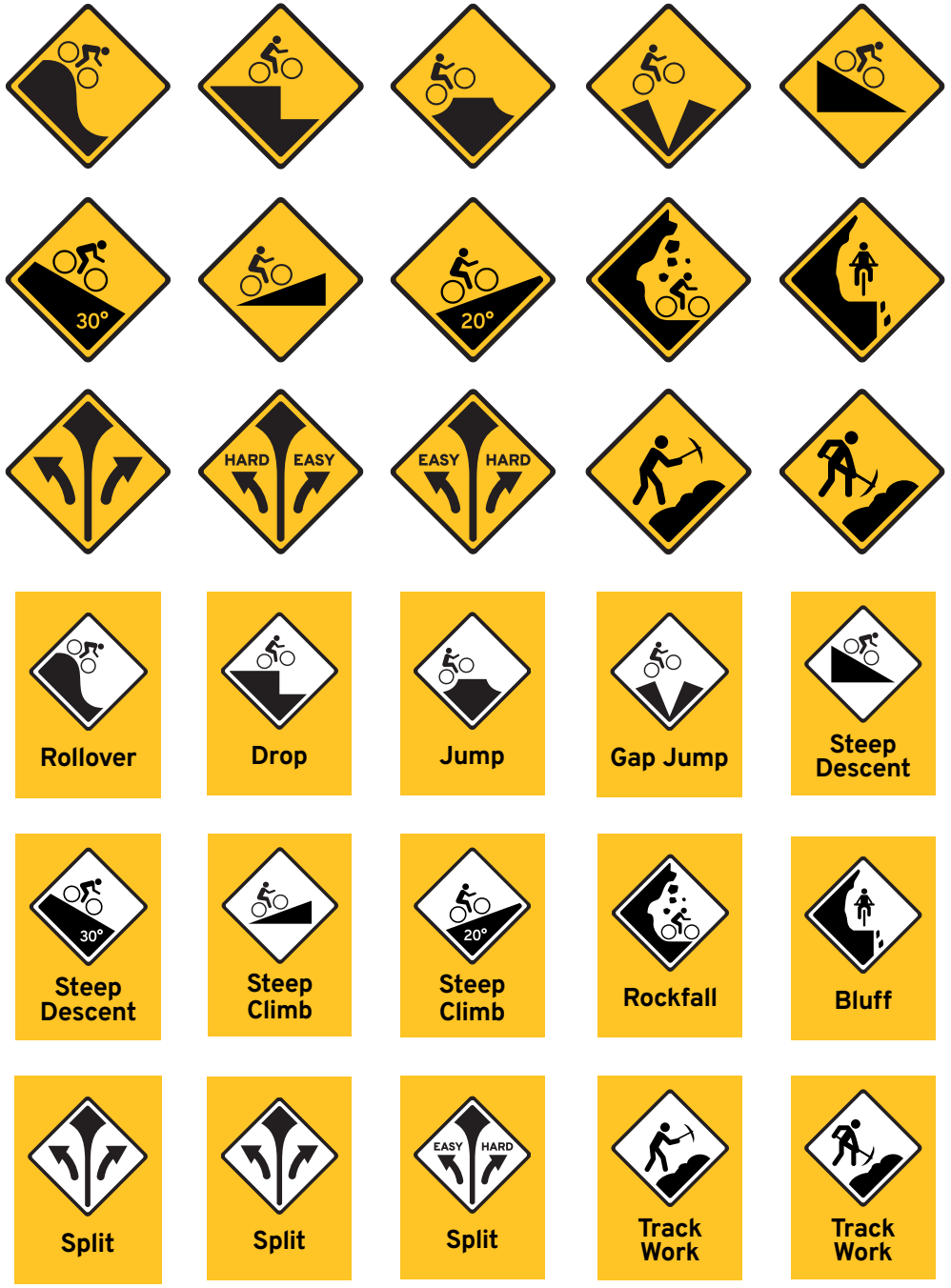
Where a sign is alerting visitors to a more general risk, or to multiple hazards, use a large exclamation mark symbol to attract attention. Smaller, more specific symbols or text can then be used to further describe the hazard/s.

General hazards should also be part of trailhead signs, as that is where visitors will take more time to read safety messages.

A rectangular supplementary sign can be added, like this:

Rockfall sign before cliffs on the Timber Trail. Credit: J Kennett

Diamond warning signs



Split lines

Split lines are common locations for serious accidents. They require people who are riding at speed to make a split-second decision that may, or may not, lead them to an out-of-grade feature. The rider may not necessarily have the skills to safely ride the out-of-grade feature.

To give people more time to make a good decision, the split-line must be signposted before the track forks.

The sign placed before the split should be confirmed with two coloured arrow signs immediately after the intersection. Double-signing like this consolidates the understanding of which line is easier or harder.

The main track line should be the easier option, and if the hard option is out of grade, it should have a DANGER or WARNING sign on it immediately after the split.

In summary, a rider will pass the split-line sign on the approach and both lines will be confirmed with coloured arrow signs immediately after the split. The trail formation should help direct riders onto the easier line, and if they choose the harder option, they will see a red or yellow sign warning them of the out-of-grade feature ahead (yellow for one grade harder and red for two grades harder).

Note: The easier line can still have a feature on it – the feature just needs to be within grade.

Note: A sign is not needed at a split line if both options are the same grade and they rejoin within sight of the split (e.g., the two riding lines are on open terrain).

Example of HARD / EASY fingerboard signs colour coded to indicate a left Grade 4 (Advanced) alternative line on a right Grade 2 (Easy) trail.

Example of an EASY / HARD fingerboard signs colour coded to indicate a right Grade 5 alternative line on a Grade 2 trail.

Example of HARD / EASY fingerboard signs colour coded to indicate a left Grade 6 alternative line on a Grade 4 trail.

Example of Easy / Hard signs used in Rotorua. Note that branding can sometimes compete with the safety message.

Grade symbols

Mountain bike grade symbols (draft design - new logos coming late 2025).

Adaptive mountain bike trail grade symbols from the AdaptMTB Rider Guide.

Emergency pick-up location signs

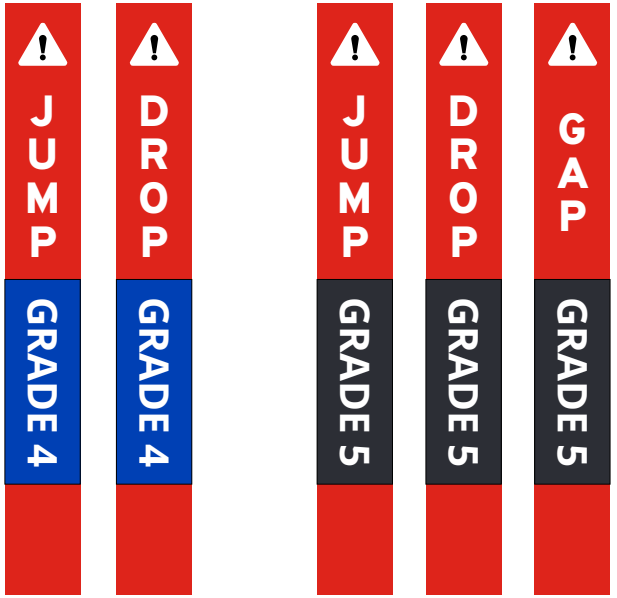
Emergency pick-up locations are places where first responders (usually an ambulance or rescue helicopter) know it is practical to meet injured riders. Emergency pick-up locations are common in mountain bike parks.

The latitude and longitude coordinates can be given to the national call centre so that it is clear to first responders where they should go. This removes a potentially life-threatening misunderstanding.

The number of pick-up locations will vary by location.

In 2016, Whakarewarewa Forest installed 185 mapped marker signs at pick-up locations. Makara Peak, which is much smaller, has 16 signposted emergency pick-up locations.

Warning/Danger flexible marker blades



Flexible road-side edge markers can be seen on every highway in New Zealand. Trails began using them around 2015, primarily as kilometre marker posts.

More recently, they have been used as warning signs in mountain bike parks because, if someone crashes into them, they just bend.

Some edge markers have their top edges rounded to reduce the chance of cuts.

Old Ghost Road, kilometre marker post. These help riders, trail managers and first responders identify specific locations along a trail. Note that the '14km' text should be larger to meet recommended font size.

Credit: J Kennett

10 Maintenance & repairs

Trails are dynamic and will deteriorate over time unless maintained regularly.

They are primarily impacted by:

- Vegetation growth (especially introduced weeds like gorse)
- Direct exposure to wind and rain (especially where there is no tree cover)
- Compaction and displacement from trail users (especially popular trails)
- Water scour.

Once a track is built (that was the fun part) maintenance is required to keep it within grade for as long as the trail remains open. Budget needs to be allocated for trail maintenance.

In Queenstown, the council MTB trails expert advises that 20% of the resources required to build a trail should be allocated annually for trail maintenance. This might be for paid trail builders or volunteer hours (or a mix).

The amount of budget required for trail maintenance will depend on:

The density of **tree cover** that protects the track from direct weather. Exposed tracks will deteriorate faster than tracks under forest cover.

The **construction of the trail**. Full bench trails, built on inorganic material and well surfaced (or armoured) will last longer.

Water control. Trails with plentiful grade reversals and drainage points will minimise water scour.

Trail design. Sustainable gradients and good trail flow reduces damage from skidding.

User numbers. Naturally, a hundred thousand tyres will have more impact than a few hundred tyres.

A steep, popular, exposed trail, will result in a high maintenance burden, whereas a gentle, popular trail under tree cover will require much less maintenance. An unpopular trail will require minimal maintenance.

Approaches to maintenance

There are two common approaches to maintenance:

- Soft maintenance
- Hard maintenance.

Soft maintenance

'Soft maintenance' refers to controlling the vegetation but not doing any work on the tread surface (the vegetation is soft, and the tread surface is hard).

Over time, bike wheels (and feet) will compact the centre of the trail, and it will become dished. Water will then run down the trail, taking lighter surface material with it, until it meets a drain or a grade reversal. Drains usually block up over time, and once they do it's down to the grade reversals to save your trail from significant water scour.

Soft maintenance on its own is a common approach, and it leads to chronic deterioration of the trail (see lifestyle illustration above).

This deterioration is referred to as the trail's 'life cycle'. It generally varies from 3 to 10 years. Eventually,

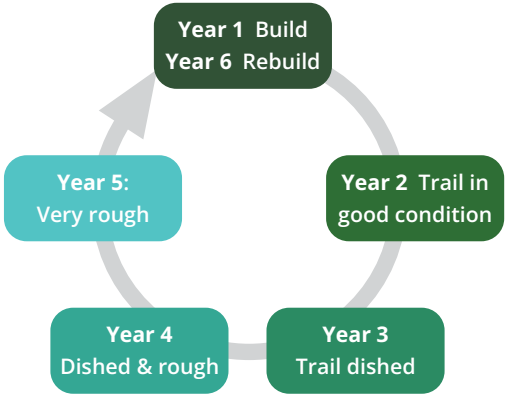


Illustration of 6-year life cycle

a trail manager will have to decide to either rebuild (aka renew/refresh) the trail or accept a lower level of service and change the promoted trail grade. In the worst-case scenario, a trail may be retired, although closing a trail is seldom easy – there are likely to be some stubborn volunteers who want to keep it open.

Note that rebuilding a trail can be an opportunity to improve it, making it more appealing to a wider range of people.

Hard maintenance

Ideally, a trail manager will schedule regular maintenance that not only controls the trackside vegetation and drainage issues but also reshapes and resurfaces worn out sections of trail. Frequent maintenance keeps the trail within grade and the trail users happy and safe.

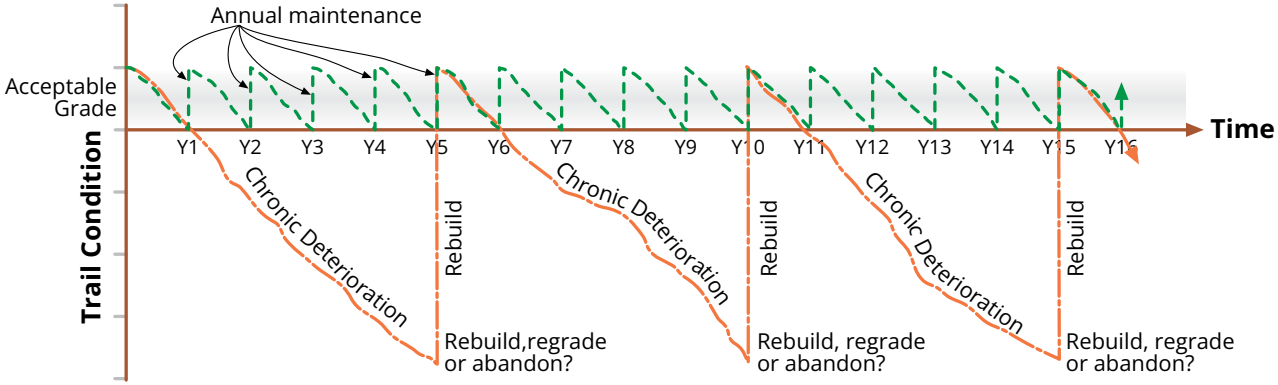
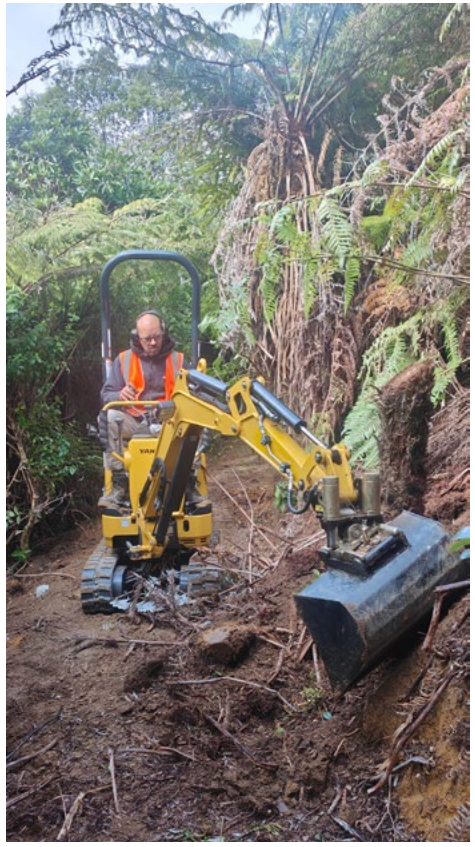


Illustration showing soft and hard maintenance trajectories.

Usually, a maintenance regime sits somewhere between soft and hard maintenance, and the trail life is extended. Vegetation maintenance is programmed annually or biannually but work on the trail surface happens where and when resources become available. Over time, sections of the trail require reactive repairs, and eventually the trail is reshaped and resurfaced (i.e., rebuilt), or it is regraded (see Ridgeline example on page 76).



This narrow 0.8 tonne digger with a tilt bucket is perfect for trail maintenance as it won't damage the track surface. This is on the Jungle Jim climbing trail in Wainuiomata.

Credit: Jeff Carter

Adopt a track

In some parts of New Zealand, local volunteers 'adopt a track'. The result, depending on the volunteers, ranges from soft maintenance right up to hard maintenance. For example, on a popular flow trail in Wellington (Ikigai, 2.4km, Grade 4), one person does 2 hours maintenance a week and keeps the track in mint condition.

Trail managers can support volunteers to adopt a track by providing tools and training.

Volunteers digging out the berm on the low side and the built-up material on the high side of the Rameka Track.

Recommended annual maintenance

Below is a list of maintenance priorities to consider when scheduling annual maintenance.

Vegetation

Keeping the trail corridor clear of vegetation helps people ride the trail safely. In New Zealand, most trails require two rounds of vegetation control a year – during growth flushes in spring and autumn.

Volunteers can run a productive work party with pruning saws and loppers, cutting back encroaching vegetation and moving branches and fern fronds off the track. Usually, any spraying work or tree felling is left in the hands of qualified contractors.

Top tip: Always cut branches flush with the nearest branch/ trunk. Do not leave cut 'stakes' for people to fall onto.

Drains and water control

Drainage work is required to prevent deterioration of the track surface. Water scour will occur wherever water is allowed to flow down the trail. There are four reasons this may happen.

1. The trail is too steep. Steep trails are a maintenance nightmare! Water naturally wants to flow down them and retrofitting grade reversals is difficult. You can install large, but gentle 'knicks' (aka swales) with 5–10 degrees cross slope to direct water to the outside of the trail. These will require regular clearing and reshaping
2. The drains have filled up. Over time, drains fill up and need clearing. They can fill up slowly, or if there is a big storm, they can fill overnight!
3. The trail lacks out-slope. Over time, every trail will suffer from compaction and displacement. This means the centre of the trail will be lower, and material will build up on the outside edges of the trail, which are rarely ridden on. Once the riding line has become dished, water can't escape. The solution is to 'deberm' the trail by removing the material built up on the outside edge (sometimes called 'silt sausages' or 'dirt dams').
4. There aren't enough grade reversals. Although it is far easier to design and build grade reversals when first building your trail, it is never too late to add some more. As always, make them big. The bigger they are, the longer they will last.

Top tip: To understand how water is damaging your trail, go and walk it on a rainy day. Take some ice cream sticks or little flags and put them in the ground beside the trail wherever water is flowing onto the riding line.

Rocks, roots and loose gravel

Wear and tear usually result in rocks and roots coming to the surface, and 'growing' over time. While this can be great fun for advanced riders on full suspension bikes, it can also become a hazard over time for beginner and intermediate riders. Check the trail grade and associated criteria before deciding how many rocks and roots to remove.

Loose gravel on exits to corners is a common cause of crashes. Rake off excessive loose rocks and gravel before they claim a victim.

Note: an early study at Rotorua's Whakarewarewa found that the most common cause of crashes was loose gravel on corners.

Rock armouring

As a trail ages, the need for rock armouring may become obvious – where excessive wear and tear is leading to too much trail damage and/or maintenance. Common places for rock armouring are:

Rock armouring at the top of Starfish, Makara Peak, Wellington.

- Minor stream crossings, including 'dry streams', where water flows after heavy rain.
- Places where riders skid a lot: a steep section or tight corner or a T-intersection.
- The bottom of a steep drop, where tyres are landing hard scrubbing out soil. This can become particularly dangerous, as a drop can slowly become larger, until it is beyond grade and dangerous for the intended rider group.
- In the low point of grade reversals, to reduce wear from tyres/shoes, which in turn may impact water run-off.

Note that experienced trail builders will often rock armour steep slopes before the trail is opened.

Climate change resilience

Earth Science NZ (aka NIWA) predicts that the wet areas of New Zealand will become wetter and the dry areas drier.

Given the growing number of severe weather events (Nelson/Tasman is a good example), consider digging wider and deeper drainage sumps and using larger diameter pipe to disperse increased water volume on the trails.

Also allow for more extreme floods by building higher and longer bridges, and rock armouring areas that may be damaged by storms.

Prioritising maintenance and repairs

Maintenance work can be prioritised according to cost/impact of the work required, and the benefits of that work.

Vegetation and drainage work are core maintenance tasks required to protect your trail assets. They are high priority.

Health and safety issues are also high priority. This includes any structure repairs and issues that are two or more grades above the promoted (i.e., sign posted) trail grade.

	Out by two or more grades	Out by one grade	Within grade but marginal	Within grade
Small easy fix	Definitely fix	Definitely fix	Maybe fix	No works needed
Moderate fix	Definitely fix	Maybe fix	Maybe fix	No works needed
Hard fix	Maybe fix	Maybe fix	Don't fix	No works needed

Table: Matrix to help prioritise work. Note that anything that is out by more than two grades must be signposted.

Rerouting or regrading – the last resort

An unsustainable trail will require high levels of resource (time and money) to maintain to the target grade originally intended. At some point, those in charge of allocating resources may decide that the cost-benefit for maintaining a particular track is no longer worth it. At this point, there are a few options to consider:

1. Reduce maintenance resources and change the trail grade to match the rougher trail condition (more roots, rocks, ruts and drops). This will lead to fewer users.
2. Reroute the unsustainable sections of track.
3. Completely rock armour or pave the unsustainable surface, at great expense.
4. Not only reduce maintenance resources and change the trail grade to match new trail conditions, but also build a completely new track to provide for the existing market (see Ridgeline Track retrospect, page 76).
5. Close the track. This should involve reinstating the natural water courses and planting it out.

Plan ahead

Trails will deteriorate over time. How much they deteriorate depends not only on the factors described in this chapter but also on how trail managers plan for the work required to keep a trail network in top condition. Plan ahead by completing a trail assessment (see Auditing and grading guidelines on page 77) and prioritising the work required.

Ridgeline Track retrospective

By Jonathan Kennett

In September 1998, half a dozen volunteers climbed onto the skyline ridge of Makara Peak, Wellington, for the first official work party – the first of over a thousand. It was a windy, damp day, but everyone was eager to start building.

The Ridgeline Track was based partly on a goat track and partly on a design by the Kennett Brothers. IMBA's **Trail Solutions** guide hadn't yet been written to offer any advice, such as the 10% rule. When we finished the track, just a few months later, it was smooth and relatively easy – close to grade 3 – despite several steep sections. Even with no suspension, almost anyone could ride it, and everyone loved it. But that didn't last long.

By the end of that summer, ruts were becoming a problem on the two steepest sections, so we laid down playground matting to help hold the soil in place. But the matting was slippery when wet, so people would ride beside it. After each rut formed, riders would move over and form another rut. When we had several parallel ruts down the steep slopes, we decided to build long reroutes to avoid those sections. We didn't need to close the old steep sections: riders just didn't like them, so the lines grew over naturally.

We learnt fast, built better tracks and the park became popular.

Despite significant efforts to maintain the Ridgeline Track, the ruts and rocks grew larger along almost half the trail. We tried more reroutes, but in the long run, we realised that anything over 6 degrees, both uphill and downhill, was being eroded by tyres and rain faster than we could fix it.

We regraded the track as a grade 4 and tried to maintain it at that level. But even that was too hard.

Eventually, after 10 years, the Ridgeline Track was abandoned to expert riders, and work began on an alternative (North Face).

North Face runs roughly parallel to the Ridgeline Track but has an average gradient of 4 degrees and a maximum sustained gradient of 6 degrees. It is easier to ride, more sustainable and far more popular than the Ridgeline Track, which is now grade 5.

The soil just won't stick to a track this steep (15–20 degrees).

Conclusion

Abandoning the Ridgeline Track to expert riders was the right decision, even though it's now only used by a few hundred riders each year. The new sidle track, North Face, is a great replacement, and it is enjoyed by thousands annually.

With the benefit of hindsight, we should have built the Ridgeline Track under 6 degrees all the way from top to bottom. Trying to maintain it to grade 4 standard took a huge amount of effort: and that just wasn't sustainable.

Soil has built up at low points wherever the trail flattens out. The rear wheel in the photo above is sitting at the original track level. The handlebars are resting on the current track.

Postnote

Most of the erosion on the Ridgeline Track was caused by skidding tyres and direct rainfall (due to lack of tree over). There wasn't much water scour, because of the large number of grade reversals.

Wherever the track was under 5 degrees, it was fine. Wherever it was over 10 degrees, all the soil, right down to bedrock, has disappeared.

11 Auditing and grading

New Zealand Mountain Bike Trail Auditing Process

This chapter is for land managers, trail managers and trail auditors. It has three sections.

1. Auditing mountain bike trails
2. Grading mountain bike trails
3. Out-of-grade allowances.

New or existing trails should be graded by measuring them against the criteria in these trail design guidelines.

Auditing may be undertaken by different professionals, for different purposes.

This chapter focuses on trail condition and trail grade audits. As they complement each other, it is common for them to be undertaken by the same auditor.

Tools for measuring trails

You will need the following tools to accurately assess trail specifications.

- Tape measure
- Clinometer and/or electronic level, or a phone clinometer app
- Camera
- GPS
- cycle computer (or use a GPS)
- Waterproof notebook and pen/pencil.
- A copy of these guidelines, or the **New Zealand Mountain Bike Trail Builders Handbook**.

Purpose	Outputs	
Trail condition audit	**Trail condition assessment**	For use in planning repairs, renewals and maintenance. Will usually cover the trail and other assets, such as signs, shelters and carparks.
Trail grade audit	**Trail grade recommendation**	To identify what does and does not meet the trail grade. Helps managers provide consistent grades and plan work to pull trails into grade. To assess general rider experience feedback.
Health & safety audit	**H&S compliance report**	To identify what does not comply with H&S regulations. Involves reviewing trail management documents and processes. Good preparation for WorkSafe NZ investigations.
Significant structures audit	**Structures report**	For structures requiring a building consent. Undertaken by experienced builder/track inspector every 1–2 years, and by structural engineer every 4–6 years, depending on consent conditions.

If you have a large network of trails, and having them all audited is beyond your budget. Consider getting 20 percent of them audited by someone from outside your area and then use the comparison method to grade the rest.

Ask local riders of different abilities to rank all your trails against those that have been independently audited. Then recalibrate your trail grades.

Aim to repeat this exercise every five years, or more often if budget allows.

Standard auditing tools

The **tape measure** needs to be 5–8 metres long. It is for measuring track width, switchback radius and rollover length.

The **clinometer** is needed for track gradient measurement (especially over more than 3 metres). Note: Electronic inclinometers are now available that are cheaper than an optical clinometer. Phone app clinometers can be problematic due to the difficulty of sighting accurately with such a short device.

The **electronic level** is for measuring track cross-slope, batter angles, berm angles and any other slope measurements (under a couple of metres).

If you measure the gradient of a bumpy track with an electronic level (or a phone app), you can end up over estimating the slope by measuring all the steep bits and taking an average of those measurements. Likewise, you could measure the less steep bit and underestimate the slope. Take a balanced approach to measuring uneven ground.

The **camera** should be waterproof as you're bound to end up working in the rain at some stage. Take multiple photos of anything you want to report on.

The **GPS** allows you to easily create a map at back at the office and take waypoints if needed. You can buy all these tools through Trig Instruments at https://triginstruments.co.nz

These guidelines or the **Trail Builders Handbook**, will be useful for helping confirm on site if you need to gather information about a particular feature or not.

A person who audits and/or grades a trail should:

- be independent of the trail build
- have extensive knowledge of the trail design guidelines
- be able to ride the trail or go with an experienced rider who can.

If they also have extensive track building experience, they will be able to add value to the final report.

Criteria to be measured

You don't need to measure the whole trail – that would be too much information to be useful for the trail managers.

Step 1 Ride the whole trail from start to finish. Gain a feel for issues that require measuring, but remain flexible in your thoughts. This is not the time for conclusions.

Step 2 Start by taking several measurements in the first few hundred metres to confirm that your 'feel' is accurate. Err on the side of caution and take more measurements than you think you'll need.

Step 3 Ride/walk the trail, only stopping when you come across something that could be over the grading criteria or requires repair or maintenance.

If you measure something and it is in grade and in good condition, then move on.

Step 4 If there is an issue, take photos and record measurements. If you plan to grade the trail, then you'll need the measurements to prove it's out of grade (steep gradient x length, narrow width x length, downhill drop x height, etc).

Note the location and take a waypoint if needed. Write it all down to make sure nothing is forgotten.

You will need this data to populate an audit template, such as the one on shown page 81 (and downloadable from https://www.nzrecreation.org.nz/nz-mountain-bike-trail-design-and-construction-guidelines.

In the interests of efficiency, gather all the data you need onsite. You don't want to waste time going back to remeasure something.

Audit techniques

This section explains how to fill out each section of the trail audit template and how to measure the various criteria.

Location

The location entry can either be a distance from the start of the trail, as measured on your cycle computer, or GPS coordinates.

Locations should always be listed in a consecutive order, from one end of the trail to the other.

Photos

Take an excess of photos and select the ones you need for the report back at the office.

Take a quick shot of every asset, including signposts.

If you have identified an issue, then take time to compose a good photo, which will clearly show what the issue is. Provide some visual context so the trail manager knows where the photo was taken.

To remember where the photo was taken you can take a GPS waypoint and note it down, or take a photo of your cycle computer at the location.

Gradients

Use a clinometer for taking gradient measurements and do not count small (less than 1 m height) bumps or grade reversals. Do count significant gradient changes over lengths of more than a few metres.

Using your clinometer, take a measurement to either a piece of survey tape you've tied to a tree at eye level or to another person. Before using a person, you need to allow for height differences. Work out where you should aim your clinometer by first standing beside your workmate on level ground and measuring what part of them is exactly the same height as your eyes.

Sometimes, you may not believe the reading on your instrument. To double check your measurement:

- **Electronic level:** Turn the electronic level around 180 degrees to check it is giving exactly the same measurement. If it doesn't, it needs recalibrating (check the manual, or YouTube the process).
- **Clinometer:** If you've been measuring uphill, then walk up and measure the same slope downhill. You should get the same measurement. Note that if you are in bush, and it is too dark to read your optical clinometer, you can shine a torch into the side of the clinometer to light up the scale.

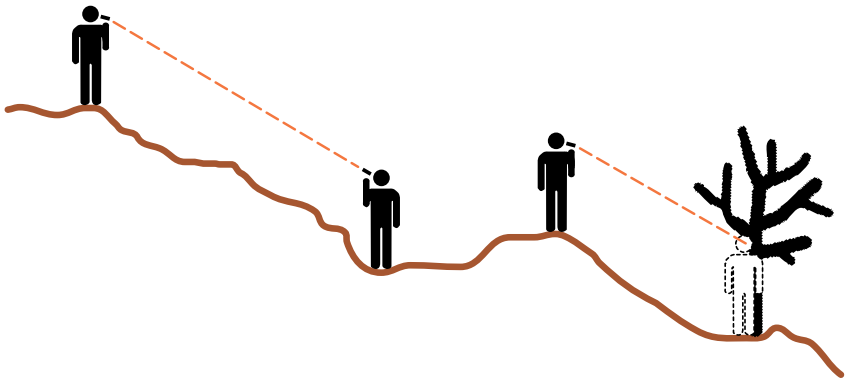


Illustration showing how to measure steep sections from a person or tree and for distances over 3m long.

Switchbacks

Place a stick or pole at the centre of the switchback to measure out from. You'll have to move the pole around a few times to find the exact centre. Take at least five measurements around the corner.

Assuming the switchback is bermed, if it is a steep berm, you'll need to check if all of it is within grade – use your electronic level or phone app. If the outside edge is too steep, then measure the radius at the point it becomes too steep (i.e., for grade 3, measure up to the point it exceeds 30 degrees).

Trail width

Measure the rideable width of the trail surface, not just the worn riding line. If the trail surface can be ridden on, even if wear patterns show that it isn't, then it needs to be included in the width measurement. Consider the skills of the target market. On grade 1 trails, the surface must be smooth and consolidated, but on a grade 5 trail it can be full of ruts, rocks and roots.

Berms and cross slope

Use an electronic level or phone to measure berms and cross slopes. To check the level (if you don't trust it), turn the electronic level around 180 degrees: it should give exactly the same measurement. If it doesn't, it needs recalibrating (check the manual, or YouTube the process). You should do this regularly with any electronic level.

Structures

Measure width as per the guidelines, both on the deck, and at handlebar height. Assess the entry and exit (radius, width and gradient). Structures can be assessed by people with experience building/designing structures, however, structures that required a building consent will also need to be checked periodically by a structural engineer.

Vegetation

Measure at handlebar height and consider the lean angle of riders going around corners.

Fall hazards

Measure and assess fall hazards using the method shown on pages 26–27 of the **Trail Builders Handbook**. Complete your assessment on site.

Downhill drops and stepped drops

Measure the height 400mm out from the top of the drop.

Rollovers/chutes

These need to be measured with an electronic level. Take measurements every 1m or so (only use a clinometer for consistent slopes over 3m long). Also measure the length from the top (where people roll over) to the bottom (where the slope becomes gentle enough to be considered the reset zone. Make a sketch of the feature. A technical rollover may have steep and gentle parts to it. Select contiguous steep measurements and refer back to the rollovers table to assess the most difficult part of the feature.

Jumps

Refer to the components of a jump on pages 22–23 of the **Trail Builders Handbook**. You will need to measure angle, length and optimum approach speed.

For clothoid ramps, the angle of the ramp needs to be determined from the angle of the wheelbase of a bike (i.e., 1,200 mm) when the front wheel is leaving the lip.

To measure approach speed, either hire/buy a speed gun or, if you have the skills to jump safely, you can measure the maximum speed on a cycle computer (just reset the 'max speed' before each jump).

Miscellaneous

You may record things that have no criteria but are useful for the land manager to know, for example, maintenance issues such as blocked drains, bent signs or graffiti.

You may also wish to note something exceptionally good about the trail, such as a new type of fun feature or a surprising sculpture.

Trail audit template example

Take lots of notes and photos on the trail to populate this template in the office. Add rows as required. Download templates from https://www.nzrecreation.org.nz/nz-mountain-bike-trail-design-and-construction-guidelines.

Back in the office

Back at the office, select photos and drop them into your audit report template.

Complete all text boxes as required.

If the audit is solely for a **track assessment (or prescription)**, then the comments should focus on practical recommendations. Your audit comments may be used to develop a contract that lists the work required to upgrade the track.

If, on the other hand, your audit will primarily be used to support a **trail grading recommendation**, then the comments need to reflect that, and the Grade column will be most important. Read the next section to see how to supplement your audit report with a grading report.

All audits should be supported by a summary that includes a map and the basic statistics about the trail (see over page). The map and elevation chart, printed from Google Earth using the GPS data collected during the audit, shows the trail manager where the audit occurred and what the overall terrain is like.

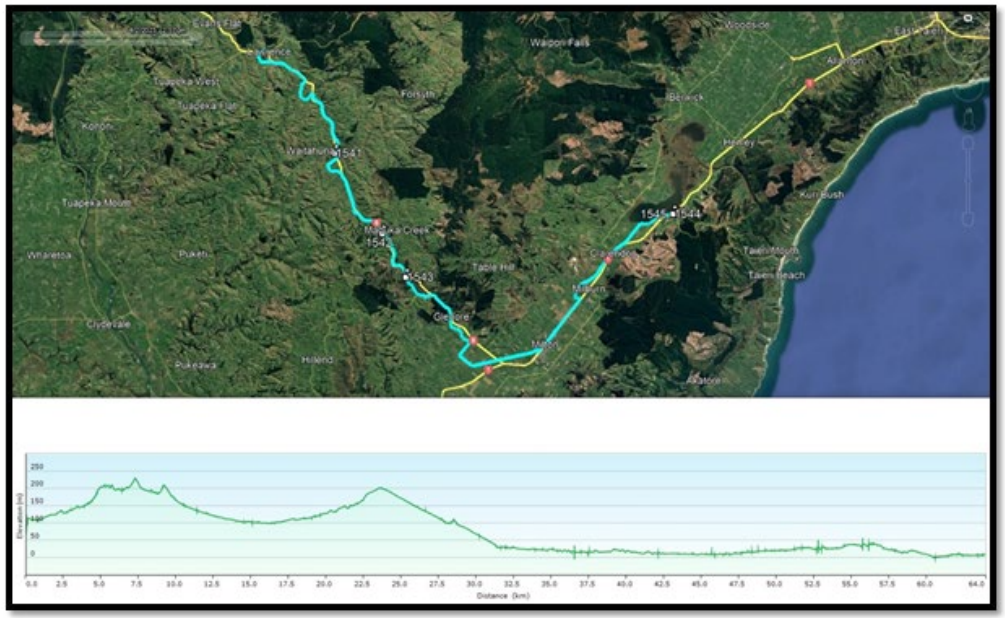
Auditing in a network

Although trails are usually audited one at a time, it is worth considering how the trail fits into the surrounding network. Use the following data to compare nearby trails, especially if they connect to the trail you are auditing.

- **Signposted grade** Compare the grade of connecting trails.
- **Strava Heatmap** Popularity is one sign of success.
- **Trail counter** Onsite counters provide the most accurate source of data.
- **Trail Forks star rating and comments** The rating is an average from rider reviewers. If a ride is not popular, perhaps it needs a refresh? There may be useful comments, including suggestions for improvements.

With the above data, you should be able to draw some useful conclusions about the user experience and how it could be improved.

Trail/park location: **Project MTB**		Audit date: **1 Jan 2035**			
Trail name: **Rough Guts** Grade: **3 Intermediate**		Assessor(s): **A D Visor**			
Location	**Photos**	**Issue and measurements**	**Comments / recommendation**	**Priority (L/M/H)**	**Grade?**
0.44 km 72 948235 N 47 349648 E		Switchback is 1.8m radius. Gradient is 7 degrees on the lower side and 3 degrees on the top side. There is an intimidating drop below the switchback.	Radius minimum for G3 is 2.5m. Increase switchback radius (will require a rock breaker). Build barrier to fall for 7 metres on DH side.	Med	Grade 5 radius
2.8 km 72 948235 N 47 349648 E		Bridge handrails are substandard and the ramp at the start is 30 degrees (too steep).	The structure is unsafe. The handrails will not stop a falling person. Demolish the existing bridge and replace with a bridge that meets the Outdoor Structures standard.	High	Grade 4
2.9 km 72 948235 N 47 349648 E		16 degrees for 9 metres. Max for G3 over 9 metres is 7 degrees.	Re-align the track here to reduce gradient to 3–5 degrees.	Low	Grade 4
3.2 km 72 948241 N 47 349649 E		Cracks are appearing in the track where it is slumping.	Fill and compact. Then monitor after heavy rainfall.	Low	Grade 2
	Continue adding rows as needed				



Example of a Google map and elevation chart produced for a trail audit.

Note: A typical GPS unit reaches maximum accuracy after 12 minutes from turning it on.

4WD tracks

People often mountain bike on 4WD tracks (through farms and forestry blocks). For example, part of the Bridge to Nowhere Track and parts of the Rangituhi Reserve trail network are on old farm tracks. 4WD tracks should be assessed using the same criteria as purpose-built tracks. The factors that are most likely to push the grade of a 4WD track up/down are gradient and surface obstacles (ruts and rocks).

Grading guidelines

The aim of the grading exercise is to help riders choose a trail that matches their riding skills and expectations. Grading trails correctly helps deliver safer and more enjoyable riding experiences.

When grading trails in the same region, it is worth creating a comparison table, ranking the local trails from easiest to hardest. This may have been done already by the land manager. Also refer to Trailforks.com.

Trail name	Nominal grade	Trailforks grade
Koru	Grade 2	Grade 2
Lazy Fern	Grade 2	Grade 2
Sally Alley	Grade 3	Grade 2
Upswing	Grade 3	Grade 3
Pōhatu	Grade 4	Grade 4
Missing Link	Grade 4 (hard)	Grade 4 (hard)
Ridgeline	Grade 5	Grade 5
Tricklefalls	Grade 5 (hard)	Grade 5 (hard)

Note: the numbers above are examples only. They are not based on real audits.

A comparison table is a useful cross-check. It helps identify trails that may have been incorrectly graded.

When cross-checking with Trailforks, keep in mind that Trailforks content is user-generated. Different riders have contributed to the content, and so the grades will not be consistent across the country, or sometimes even within a single mountain bike park.

Once you have completed your trail audit, start filling out a grading assessment table as shown below, in the following order:

1. Write the criteria for the target grade in the left column.
2. Clearly state with yes/no answers if the criteria were met.
3. Complete the assessment column carefully. This will require referring back to the whole of the audit report and totalling the out-of-grade sections for each criteria.
4. Complete a high-level summary to support your grading recommendation.

Grading assessment [example]		
Trail name: Rough Guts		**Target grade: 3**
Criteria	Criteria met Y/N?	Assessment
1. **Gradient:** 0–5 degrees for 90% of the trail	Yes	99% of the trail was 0–5 degrees.
2. **Gradient:** A. 5–7 degrees for up to 100m, B. 7–10 degrees for up to 10m, C. 10–12 degrees for up to 3m D. Rollovers/chutes	No	There was an 8m section that was 35 degrees, with an unrideable rut (Grade 5). This could easily be fixed by reshaping the trail surface and using suitable material to build up the trail and reduce the gradient.
3. **Track width:** 0.8m min for one-way trails and 1.0m min for two-way	Yes	All of the trail is 0.8m to 1.2m wide.
4. **Track surface:** generally well formed. Some rocks and roots.	Yes	The trail has been recently surfaced with lime stabilised AP25.
5. **Obstacles:** up to 100mm high	Yes	The trail has been graveled and there are no obstacles over 100m high.
6. **Structure width:** minimum 0.8m, recommended 1.2–1.5m	Yes	All bridges are 1.2m wide with flared handrails.
7. **Corners:** minimum radius 2.5m to the outside of the track	No	8 of the 10 switchbacks are less than 2.5m. 6 are 2–2.4m radius (grade 4). 2 are 1.8 m radius (grade 5).
8. **Berms:** up to 30 degrees	Yes	All berms are 15–25 degrees.
9. **Jumps:** 1–4.5m long with 10–25 degree linear ramps	Yes	There are no jumps.
10. **Downhill drops:** up to 300mm	Yes	None
11. **Uphill steps:** up to 100mm	Yes	None
12. **Vegetation:** 0.4m clearance from track edge	No	300m of track is overgrown and requires clearing. At the 1.8 km mark, there is a dead overhanging pine tree.

Grading assessment [example]		
Trail name: Rough Guts		**Target grade: 3**
Criteria	Criteria met Y/N?	Assessment
13. **Sightlines:** two-way trails only	No	As above, the vegetation in the middle 300m needs clearing to provide adequate sightlines.
14. **Fall hazards** (see assessment in handbook)	No	One switchback requires a handrail on the downhill side due to a 10m fall at 60 degrees.
15. **Signs:** particularly wayfinding and safety	No	There is a split-line at 2.9km that requires signposting. There is a 30m long grade 4 line on the left-hand side going downhill. The bridge limit sign (2 persons) at the bottom bridge is broken and needs replacing.
16. **Stage of maintenance cycle:** when was trail last maintained, and when is it next to be worked on.	n/a	Minor maintenance done over last three year. Plan to do maintenance following this report.
17. **Miscellaneous:** sign issues, structures, car park, gates, rubbish, etc.	No	The gate at the 4 km mark opens out towards a steep drop. Reverse the opening direction so people don't have to wheel their bikes close to the track edge.

Grading Summary [example]
Trail out of grade: • 400m (7%) of this 5000m trail is out of grade. • 6% is Grade 4 and 1% is Grade 5. **Trail Grade:** Therefore, the trail is currently Grade 4 (Advanced).
Recommendations To pull the trail back to Grade 3 requires moderate work, starting with the Grade 5 sections (two switchbacks and 8 metres of steep, rutted track) and progressing to the Grade 4 sections.
Conclusion: When this work is complete, the track will meet Grade 3 criteria.

Out of grade allowances

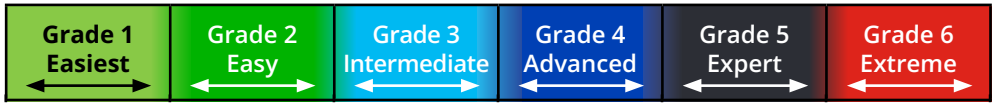
The distinctions between each grade are made up of multiple criteria and are not always completely black and white. Auditors should use their discretion and experience when making recommendations.

Short sections of trail, totalling up to 5% of the track length may be marginally out of grade for gradient, width and uphill radius of turn, so long as it does not present a significant danger to the target audience. These allow for minor errors in construction and measuring.

Guidance for allowable out of grade sections	
Gradient	Up to 2 degrees steeper for sections up to 100 metres long
Width	200mm narrower for sections up to 100 metres long
Radius	300mm tighter on climbing switchbacks
1. Add up the length of all out of grade sections. 2. The total should be less than 5% of total track length	

Having more than 5% of the trail length out-of-grade will push the audited grade up.

This is because, if a Grade 3 trail had a short section of Grade 4 and was then promoted as a Grade 4 trail, instead of Grade 3, people who rode that trail would then think they had the skills to ride Grade 4 trails when they do not.



It is important to promote a trail accurately, and for its difficulty to be comparative to other trails of the same grade.

Trail promotion should make it clear if there are significantly out of grade sections so that visiting riders are not taken unaware.

For long trails, a grading pie chart could be provided, (similar to NZCT trail info). This could look something like:

Example of a trail grading wheel, which shows the trail is 8% Grade 2, 60% Grade 3, 20% Grade 4 and 12% Grade 5. (For more information, refer to www.nzcycletrail.com)

Note that the best approach is to build a trail that provides a consistent experience, rather than jumping around four different grades as per the example above.

12 Glossary

AP20, AP25, AP40: crushed aggregate provided from a quarry that is produced by shaking it through a sieve with 20mm/25mm/40mm gaps. AP20 has particles that are from 0 to 20mm in size. The AP20 and AP25 is sometimes called **topcourse**. The AP40 is often called **basecourse**.

Batter: the angled slope of a bank or rock wall on the inside of a trail. The batter creates extra width for handlebars. A sloped batter also means water can run onto a trail less 'aggressively' compared with a vertical bank or wall.

Bench: the section of trail tread created by digging into the hillside, forming a flat, in-sloped or out-sloped surface for people to ride on.

Berm: (aka **super elevation**): a sloping bank built on the outside of corners to help people ride around the corner faster. See page 30.

Clearance: the distance between a trail and an obstruction, such as a tree, cliff or bridge handrails. This is often divided into either short, **discrete clearances** (called **C1**) required when passing a single obstacle, such as a tree, or **continuous clearances** (called **C2**), which are required when passing a long obstacle, such as a hedge or cliff face.

Climbing turn: a curve in a trail that is climbing. If the curve goes around 180 degrees, then it's called a switchback (uphill or downhill).

Concurrent features: multiple features happening at once or in very quick succession. Higher grade tracks have increasingly more concurrent features.

Double track: US term for a **4WD track** where people can ride side by side.

Downhill drop: a sudden drop in the trail that riders can roll or launch off. The face of it may be a wooden retaining wall or a natural rock drop.

Flow trails: smooth trails with berms and rollers designed for a fast/flowing ride. The best ones require no braking.

Gateway/waharoa: a feature used to provide an attractive threshold at the start of a trail. For example, the two posts holding up a routed Old Ghost Road sign, or the giant chainring entrance to Kaiteriteri Mountain Bike Park.

Grade reversal: a short section of trail where the grade changes from a climb to descent or a descent to a climb. The purpose is to help get water off the track. They can be built as rollers, dippers or even jumps.

IMBA: International Mountain Bike Association.

In-slope: a section of trail that slopes in towards the hillside (as opposed to 'out-slope'). Can result in water/mud puddles if not drained well.

Jumps trail: a trail with multiple jumps where riders get airborne. These jumps can vary in type, such as table tops, gaps, shark fins, ski ramps, etc. See page 37.

Out-slope: a section of trail that slopes down toward the outer side of the track.

Pinch point: a short section of trail where the track is narrower or steeper than normal.

Power climb: technically challenging climb with features to make it fun, especially on an e-bike.

Roller: rounded bump/hump in the trail, designed to be ridden smoothly, and often enhanced by riders pumping the track.

Rollover/chute: a steep downhill section, usually 2–10 metres long, where riders may let go of the brakes and roll over the top.

Shared path/trail: In New Zealand this means a trail that is shared between walker/trampers/runners and mountain bikers/cyclists.

Single track: a narrow track designed for people to ride single file. These are usually one-way trails.

Swale: shallow, broad channels on the outside of a trail to help with drainage / water runoff.

Switchback: a 180 degree bend in a section of trail that is climbing or descending. Usually made more fun with a berm around the outside.

Technical trail features (TTF): specific elements or obstacles that are intentionally added to the trail to provide variety and challenge. This can include elements such as jumps, drops, berms, rollovers, rocks, tree roots and narrow boardwalks.

Technical trails: rough, natural trails that have roots, rocks, ruts and irregular challenges that require a high level of skill.

Tread: the trail surface.

Tread obstacles: roots, rocks and ruts are common features on technical trails, especially on grades 4, 5 and 6.

13 Gradient conversion table

Degrees	Percent (%)	Ratio (rise:run)	Relevance
1°	1.7%	1:57	
2°	3.5%	1:29	Max climb Grade 1
3°	5.2%	1:19	
3.5°	6.1%	1:16	Max climb Grade 2
4°	7.0%	1:14	
5°	8.8%	1:11	Max climb Grade 3
6°	10.5%	1:9.5	
7°	12.3%	1:8	Max climb Grade 4
8°	14.1%	1:7	
9°	15.9%	1:6	
10°	17.5%	1:5.7	Max climb Grade 5
11°	19.4%	1:5.2	
12°	21.3%	1:4.7	
13°	23.1%	1:4.3	
14°	24.9%	1:4	
15°	27.0%	1:3.7	Max climb Grade 6
20°	36.0%	1:2.7	
25°	46.6%	1:2.2	
30°	58.5%	1:1.7	
35°	70.0%	1:1.4	
40°	83.9%	1:1.2	
45°	100.0%	1:1	

14 References

1. New Zealand Handbook – SNZ HB 8630:2004 – Tracks and Outdoor Visitor Structures.
2. Trail Solutions: IMBA's Guide to Building Sweet Singletrack. 2004. Published by International Mountain Bike Association (IMBA).
3. Managing Mountain Biking: IMBA's Guide to Providing Great Riding. 2007. Published by International Mountain Bike Association (IMBA).
4. Cycle track service standards. 2019. Department of Conservation **Te Papa Atawhai.**
5. Ngā Haerenga New Zealand Cycle Trails Design Guide. Sixth Edition – July 2024. Ministry of Business Innovation and Employment.
6. Outdoor safety signs: A good practice for land-based recreation areas in Aotearoa New Zealand. 2025. Land Safety Forum **Te Ope Tautiaki Whenua.**
7. Trailism: Trail building, science, art, journeys, and gear. 2008. Published at www.trailism.com

15 Appendix: Sign examples

The signs below are good examples to provide guidance.

Te Miro Mountain Bike Park, map board

Kaiteriteri Mountain Bike Park, map board using different colours for different grades.

Nelson, wayfinding signs

Eskdale, Hawke's Bay, wayfinding signs

Te Miro Mountain Bike Park, wayfinding sign

Arapuke, Palmerston North, a modular approach to wayfinding

Mt Victoria, Wellington, no entry sign on step (doubly effective).

Waitangi Forest, no entry sign

Waitangi Forest, track ends sign

Whakarewarewa Forest, no entry sign

Makara Peak, track ends sign

Queenstown, reduce speed safety sign

Queenstown Skyline Tracks, slow safety sign at an intersection

Ohakune, advisory sign

Wooden routed fingerboard signs that have lasted for over 30 years at 1400m elevation.

Volunteer made signs

Low-tech, volunteer-made signs sometimes hit the mark perfectly. The following examples have been appreciated over many years.

Safety sign at Craters of the Moon, Taupo, made by Bike Taupo.

Wooden routed sign for the Rameka Track.

A wooden routed sign at one of the stunning lookouts on The Old Ghost Road.

Makara Peak, information signs (painted plywood with vinyl text; installed 1999).

Naseby Forest, wayfinding signs

Split line sign

Queenstown map bollard

Pre-ride, Re-ride, Freeride sign

New Zealand Mountain Bike
Trail Design Guidelines

The essential resource for trail builders wanting to build awesome trails from Grade 1 (easiest) to Grade 6 (extreme).

These guidelines provide all you'll need to build fun, consistent and sustainable trails. They also include signage and auditing guidelines.

This guide is supported by the smaller handy sized New Zealand Mountain Bike Trail Builders Handbook.