WANGETTI TRAIL

CONSTRUCTION METHODOLOGY

APRIL 2020

FINAL

CONTENTS

1 INTRODUCTION

This Construction Methodology has been prepared to guide construction activities associated with the Wangetti Trail project to minimise impacts to the environment and ensure compliance with all permits, approvals and legislative requirements. This document is intended to provide a high-level amount of information for contractors to inform the eventual Construction Environmental Management Plan. Note that information relating to the following is not covered in this document and will be required by WTMA of the successful contractor as part of the subsequent detailed Construction Environmental Management Plan:

- Weed and disease management;
- Flora management such as for fallen trees, old growth trees and vegetation clearing;
- Fauna management such as general and species-specific prescriptions.

The Department of Innovation and Tourism Industry Development Tourism Development Projects Division is proposing to establish the Wangetti Trail. The trail is proposed to be 94km dual use, stretching from Port Douglas in the north to Palm Cove in the south.

The Wangetti Trail will be an iconic overnight hiking/mountain biking trail, unique in Australia and the world. It traverses some of the most magnificent and picturesque scenery imaginable, with endless views out over the coast and the Great Barrier Reef. It passes through a myriad of different vegetation communities and aspects, including dense vine draped rainforests, more open rainforests with minimal understory, grassy open Eucalypt forests, fern and Cycad groves, mangroves and crystal-clear rainforest streams, providing a constantly changing backdrop and personality to the trail.

2 THE WANGETTI TRAIL

2.1 WHAT IS THE WANGETTI TRAIL?

The trail is proposed to be an approximately 94km dual-use trail used by hikers and mountain bikers, between Port Douglas and Palm Cove in northern Queensland.

The trail comprises two separable portions (SPs):

- SP1 Mowbray North – The northern section of the trail, from Port Douglas to the Mowbray River (northern bank);
- SP2 Wangetti Balance – The southern section of the trail, from the Mowbray River (southern bank) to Palm Cove, which will include campsites and supporting ancillary facilities.

This Construction Methodology is intended to address requirements for SP2.

The SP2 Wangetti Balance is a dual-use trail involving accommodation nodes and supporting ancillary facilities to support an expected 28,000 annual visitors. The length of the trail for SP2 is 82.15km, to a width of up to 1.5m, encompassing an area from the south of Mowbray River to Palm Cove.

Within the Wet Tropics World Heritage Area, the following components are proposed:

- Single dual use trail to accommodate both mountain bike users and hikers, consisting of natural ground and surface treatments;
- A number of low-level bridges and crossings including Hartley Creek bridge, boulder rock crossings and gully crossing style bridge from minor waterway crossings;
- Five public campsites;
- Four private campsites;
- Utilisation of existing access tracks;
- Mountain bike trail using existing access tracks associated with Twin Bridges Road (Black Mountain Road East) and Quaid Road.
- Landscaping treatments using natural materials available in-situ, including rock armouring, rock retaining walls, etc.;
- Landscaping treatments using imported materials such as pre-cast concrete steps, adjustable rock matting etc.;
- Upgrades, improvements or extensions to access roads as required for either construction or ongoing operational access purposes.

A fifth public and private campsite is located outside of the Wet Tropics Management Zone.

2.2 TRAIL ALIGNMENT

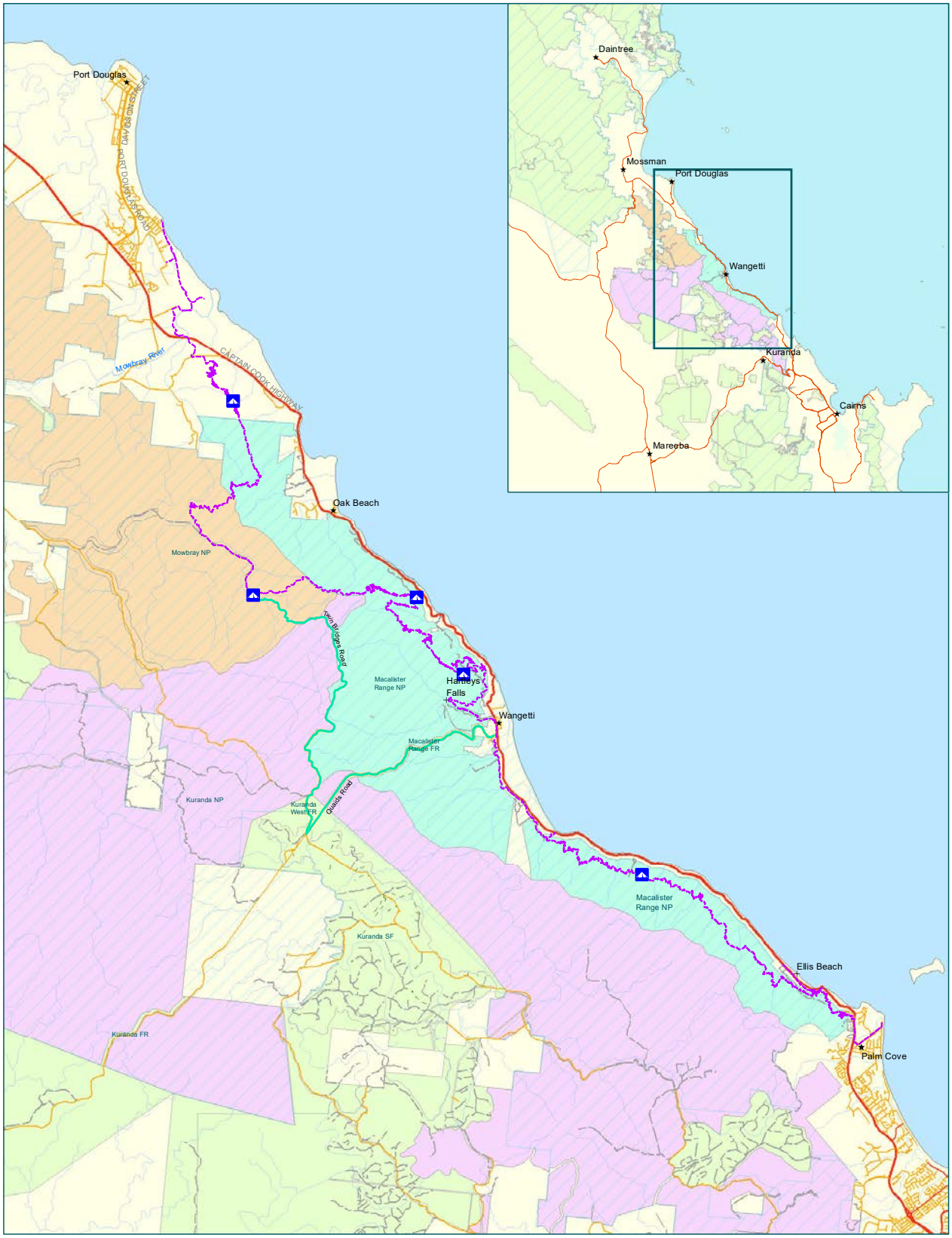
The Wangetti Trail is located between Port Douglas and Palm Cove, approximately 30km north of Cairns, in northern Queensland.

The trail alignment is constrained by the Pacific Ocean to the east and the Macalister Ranges to the west, and is mostly contained within the Mowbray and Macalister Range National Parks. The landscape is comprised of coastal floodplains, volcanic mountain ranges and estuarine mudflats, although the trail is generally aligned upon the elevated eastern slopes of the Macalister Ranges.

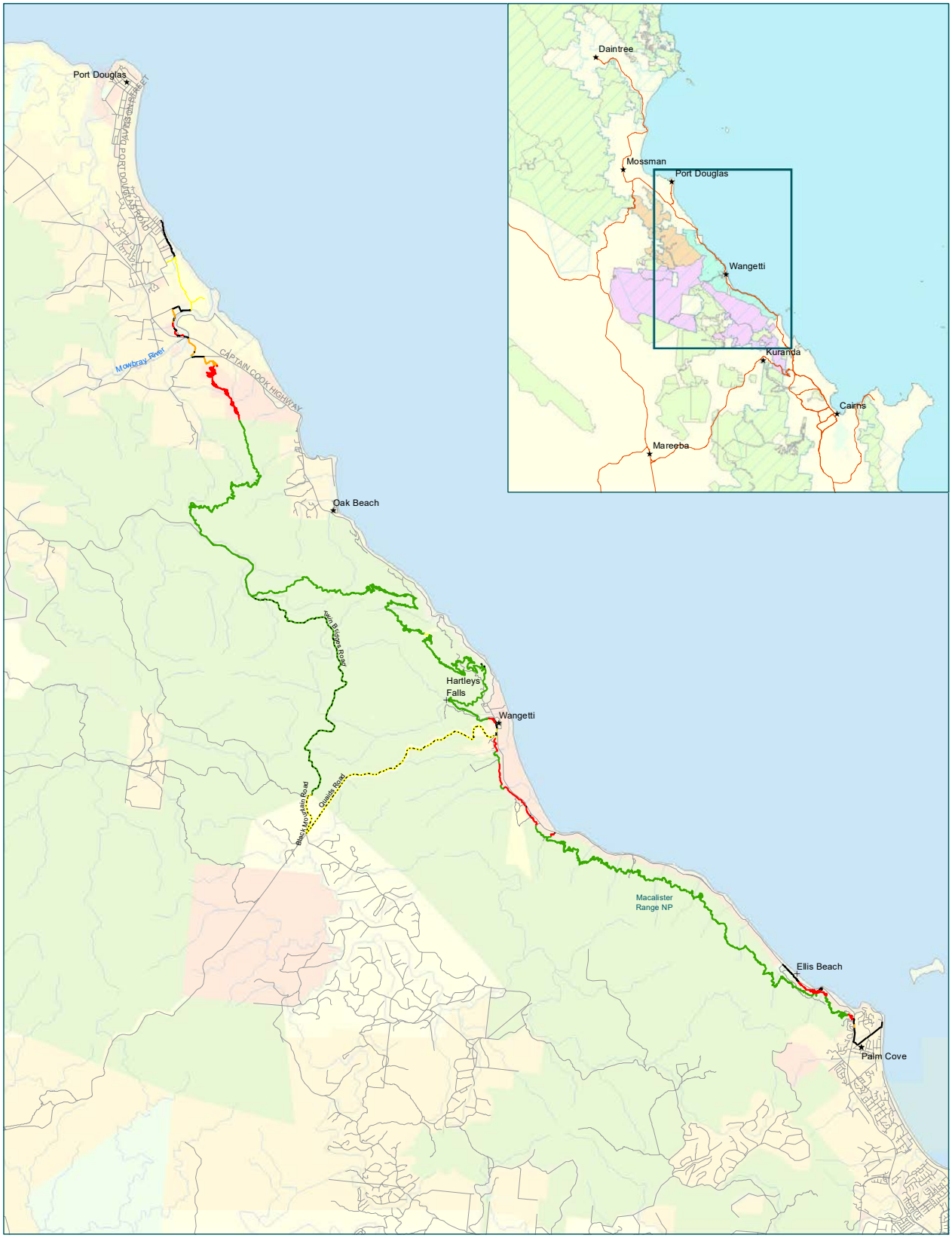
The proposed trail currently traverses undeveloped rural land, wet tropics conservation park, national park, unallocated state land, existing tracks, service roads and road reserve. It comprises of seven sections and one mountain bike only trail section that will traverse Twin Bridges Road (Black Mountain East Road) and Quaid Road.

Map 1 and Map 2, on the following pages show the proposed Wangetti Trail alignment.

Map 1 – Proposed Wangetti Trail Alignment



Map 2 – Proposed Wangetti Trail Alignment by Tenure



2.3 STYLE PHILOSOPHY

The Wangetti Trail experience will be uniquely Australian, emphasising the culture, history and way of life of the Traditional Owners, the Yirrganydji people. It will encourage a sense of exploration and a spirit of adventure. It will foster an appreciation of the natural environment and the diversity of flora and fauna within it.

For the Wangetti Trail to be a world-class trail, the construction must be of the highest quality, but the end result needs to look like it has been in place for thousands of years, blending into the landscape seamlessly and harmoniously.

The trail will be predominantly natural surface, constructed from the natural soil and rock found along the trail. Imported surfacing materials such as fine crushed rock may be used from time to time, but only in high traffic areas or where other requirements dictate its use. Imported materials can be visually unappealing and can introduce weeds and pathogens. Any surfacing materials that are used should be of local provenance and suitable for the intended purpose.

The Wangetti Trail has been designed to minimise built structures like bridges, boardwalks and viewing platforms. These built structures pose a number of challenges:

- They are normally constructed from imported materials and can be intrusive in the natural environment;
- They can burn during bushfires or prescribed burns;
- They can be difficult to construct in remote areas, due to the challenges of importing the materials;
- They increase the maintenance burden.

Where built structures are required, the design and finish will prioritise the use of local timbers and other materials that will age gracefully with time. Above all, the materials must be durable enough to withstand the harsh tropical climate and natural environment.

Any built structures must be designed and engineered to be fit-for-purpose, to have minimal impact to the surrounding environment, to have minimal maintenance requirements and will need to take a minimalistic approach to materials given the remote nature of the trail and difficulties getting materials into the locations where they are required.

The Wangetti Trail will utilise the natural rock and stone to maximum advantage, including rock slabs, rock outcrops and loose surface rock. Rock is the ultimate trail building material, especially when it is locally sourced. Loose surface rock provides the raw materials for rock walls, rock armouring and even the construction of trail-side furniture like bench seats.

The suite of different signs required along the Wangetti Trail must be complementary to each other, but also to the overall look and feel and aesthetic of the trail. The materials should be as natural as possible and durable within the outdoor environment; the colour palette should feature muted, earthy natural tones; styling should be elegant, timeless and understated.

The final position, character, style and finish of a trail is a combination of the design choices made by the construction team (particularly the machine operator), the terrain and environment, the intended user group and any permit conditions stipulated by the land manager and regulatory authorities. Constraints and no-go areas as marked and defined within plans and as part of the construction environmental management plan must also be considered.

2.4 TRAIL DIFFICULTY

As a dual-use trail for hikers and mountain bikers, the difficulty of the trail must match the expectations of the two main user groups.

To this end, the Wangetti Trail is proposed to have the following rating:

- Mountain Biking – Intermediate (blue square with blue outline) as defined in the Australian Mountain Bike Trail Guidelines Trail Difficulty Rating System (MTBA TDRS);
- Hiking – Grade 3 for hikers, as defined in the Australian Walking Track Grading System (AWTGS), which also equates to Class 3 in the Australian Standard for Walking Tracks, Part 1: Classification and Signage (AS 2156.1-2001).

In general, the Intermediate rating for mountain biking and Grade 3 rating for walking are fairly similar and complimentary and seem as the 'best fit' for the Wangetti Trail as described in this document, with the following comments/observations:

- The AWTGS specifies a distance of no more than 20km for a Grade 3 trail. As each section of the Wangetti Trail is proposed as a single stand-alone day walk, it will comply with this criterion;
- The MTBA TDRS states a width of 600mm plus or minus 300mm for an Intermediate trail, while the AWTGS simply states a width of less than 1200mm for a Grade 3 trail. Given the dual-use status and expected high usage of the Wangetti Trail, a width of 1000-1500mm is recommended, which is not deemed to contradict either of these ratings. Note that trail width in the MTBA TDRS is deemed one of the 'Guiding Criteria' and allows some deviation from the parameters provided;
- The AWTGS states that steps may be common. The MTBA TDRS doesn't discuss steps per se, but thy would be treated as 'unavoidable obstacles'. An Intermediate trail can have unavoidable obstacles up to 200mm high, hence single steps of less than 200mm would be acceptable. Flights of steps however, are not acceptable on a mountain bike trail, especially one that is dual directional. The trail has been designed to minimise any steps on the main trail – any steps that have been specified are located on alternative optional 'detour' sections.

Table 1. Summary of Trail Difficulty Ratings

Rating System	MTBA TDRS	AWTGS
Rating	Intermediate	Grade 3
Symbol		
General Description	Single trail with moderate gradients, variable surface and obstacles. Dual use or preferred use.	Short steep hills. Formed track, some obstacles. Sign posted. Some bushwalking experience recommended.
Distance	Not specified.	Total distance of track must not exceed 20km.
Signage	Not specified.	Track head signage and route markers at intersections and where track is indistinct.
Trail Width	600mm plus or minus 300mm.	Less than 1200mm.
Trail Surface	Possible sections of rocky or loose tread.	Formed earthen track, few obstacles. Generally, a modified surface, sections may be hardened. Mostly clear of intrusions and obstacles.
Average Trail Gradient	Mostly moderate gradients but may include steep sections. Ave. trail grade – 10% or less.	Generally, no steeper than 1:10 (10%).
Maximum Trail Gradient	Max. trail grade – 20%.	May exceed 1:10 (10%) for short sections.
Level of Trail Exposure	Exposure to either side of the trail corridor includes downward slopes of up to 20%.	Not specified.
Natural Obstacles and Technical Trail Features	Unavoidable obstacles to 200mm high, such as logs, roots and rocks. Avoidable, obstacles to 600mm may be present. Unavoidable bridges 600mm wide. Short sections may exceed these criteria.	Not specified.
Experience Required	Suitable for skilled mountain bikers with basic mountain bike skills. Suitable mountain bikes.	Users need no bushwalking experience and minimum level of specialised skills. Users may encounter natural hazards such as steep slopes, unstable surfaces and minor water crossings. They are responsible for their own safety.
Steps	Not specified	Steps may be common.

3 TRAIL DESIGN AND CONSTRUCTION PROCESS

3.1 TRAIL DESIGN PROCESS

The process used to design the Wangetti Trail included two broad stages – Conceptual Design and Detailed Design (also called ground-truthing).

The Conceptual Design stage involved the trail being planned and mapped out based on a sound understanding of the on-ground conditions, knowledge of access points into the trail and the aspirations of the project with regard to user experience, difficulty, trail sustainability etc.

The Detailed Design fieldwork was undertaken in 2018. The primary purpose of the work was to identify, flag and map the exact route in the field for the proposed Wangetti Trail. At completion of this work, the entire route was known and mapped, all construction treatments were allocated and quantified, a construction cost estimate was prepared and all proposed campsite locations were identified.

Over the course of three months in mid 2018, the entire route was walked twice by World Trail personnel, using an iterative 'two-pass process'. During the first pass, the objective was to determine the preferred alignment, mark it with coloured flagging tape and map it with GPS. In the second pass, the objective was to assess the alignment and determine appropriate construction treatments, measuring, photographing and recording them using GPS.

In relation to the flagging tape, the following protocols apply:

- The flagging tape indicates roughly the centreline of the proposed trail alignment;
- Generally, each strip of flagging tape should be visible from the next/previous one, but this can't always be relied on as they can be removed by weather/animals. In thick vegetation, flagging tape is placed more frequently. In sparse vegetation tape is used more sparingly;
- Where the trail performs a sharp turn or switchback, three pieces of tape tied around a single trunk or branch are generally used to indicate the apex of the turn (see **Error! Reference source not found.** on next page);
- Switchbacks are often used in close succession to each other to help a trail climb up or descend a steep slope. In these situations, there can be multiple 'legs' of the trail running roughly parallel to each other. Anyone attempting to follow the proposed trail alignment needs to be aware of where these switchbacks might be and ensure that they look forward along the contour to locate the next piece of flagging tape;
- Where the trail is proposed to follow an existing road flagging may be sporadic.

The alignment of the Wangetti Trail changed considerably during ground-truthing. The changes can be classified as:

- Minor changes, due to environmental factors identified in the field such as impassable barriers like cliffs etc. Minor changes were made at the discretion of field staff, in response to the environmental conditions present;
- Major changes, due to more strategic factors such as the overall length and cost of the trail, the identification of areas of cultural or environmental sensitivity, concerns about the user experience, safety or longevity of the trail and so on. Many such changes were driven by new discoveries in the field or by new information from other projects partners and approved by the client. Where major alignment changes were undertaken, these were also ground-truthed using the same two-pass methodology described above.

Further refinement of the ground-truthed alignment was undertaken by GHD in response to the following:

- Additional field investigations being undertaken of the alignment;
- Additional consultation with key stakeholders including adventure-based tourism operators;
- Additional consultation being undertaken with land owners impacted by the alignment;
- Consultation with WTMA regarding the location of the proposed infrastructure within the Wet Tropics Zone and whether they are considered appropriate for the intent of the zone.

This resulted in some minor amendments to the alignment, amendments to the location of the camps and the inclusion of the separate mountain bike trail (utilising the existing roads). This also resulted in the removal of one of the proposed camps on the basis of sensitive environmental areas being deemed too significant to accommodate a camp site at the proposed location.

Figure 1. Triple taping to indicate apex of switchback corner

3.2 STANDARD CONSTRUCTION PROCESS

The main construction activity to be undertaken in this project, covered by this Construction Methodology, is the construction of a dual-use hiking and mountain biking trail, including all associated landscaping, the campsites, bridges, boardwalks, viewing platforms and signage. The scope of works for this Construction Methodology is limited to the above. It does not include the construction of trail heads, car parks, roads or other supporting infrastructure associated with the broader Wangetti Trail project.

All trail construction activities should align with modern best practice for sustainable trail construction, as outlined below:

- Sustainable trails align with users' needs, provide social and economic benefits, minimise environmental impact and require less maintenance. To achieve sustainable trails, the land manager must develop the right trail, in the right area, the right way and for the right reasons.
- Trail development must be planned, designed and constructed with the highest environmental standards. Trails should be appropriate to the landscape, sense of place, and add value to the area.
- Trails should not destabilise soils or slopes. Vegetation should not be cleared or damaged beyond the required trail footprint. Trails should be used to manage recreation on wildlife and habitats in a positive way. Trails should be designed and constructed in a way that minimises the potential spread of pathogens, diseases and weeds.
- Trail development must be consistent with the sustainable provision of resources to manage the trail and associated infrastructure. Design and construction of trails should minimise maintenance requirements and ongoing costs.

A 40m corridor has been approved for the construction of the trail. This is referred to as the Ground-truthed Corridor. The purpose of the Ground-truthed Corridor is to allow flexibility for the placement of the trail and associated infrastructure, so as to avoid, where possible, impacting on Matters of State Environmental Significance (MSES) and Matters of National Environmental Significance (MNES).

The Ground-truthed Corridor is defined by the flagging tape placed during ground-truthing works, which represents the centreline of the Ground-truthing Corridor. The Ground-truthing Corridor extends 20m outward on both sides from the centreline (measured along the ground, perpendicular to the direction of the centreline). Note that if the flagging tape is no longer in place, the GPS alignment recorded during ground-truthing should be used as the indicative centreline. The successful contractor will be provided with the complete set of GPS coordinates of the final approved trail alignment and 20m corridor either side.

Broadly speaking, the process of constructing a standard mountain biking trail is as follows:

1. Prior to commencing work, each separate trail or section of trail as defined by the land manager, is to be re-walked and assessed as part of a Pre Start Trail Review (PSTR) – refer to Section 7.2 for more information about this process. At the completion of the PSTR the exact alignment of the trail will have been re-marked. There should be no ambiguity or uncertainty about the exact alignment of the trail. Although noting that during construction if something needs to be avoided, the trail can be moved around within the 40m corridor;

2. Clear the Construction Corridor of vegetation. The Construction Corridor is defined as the horizontal corridor from the top of the upslope batter to the toe of the downslope batter and the vertical corridor to about 2.5m high (sufficient to allow passage of the excavator). Clearing of the Construction Corridor is usually undertaken manually using motorized tools such as brush cutters, chainsaws and hedge trimmers and hand tools like loppers, hand saws and secateurs. Large trees do not need to be removed, as the trail can be routed to avoid them, however, it is

likely that small boughs and limbs may need to be removed. All vegetation that is removed is cut into small pieces and dispersed throughout the surrounding area – no large windrows or stockpiles should be present. At this stage, all vegetation is removed except for ground covers, herbs and grasses (which are left in place for later removal by the excavator). For larger trails such as the Wangetti Trail, the Construction Corridor is cleared in section lengths of approximately 100-150m at a time. This process allows a visible amount of vegetation to be cleared ahead of where the machine is operating, the trail construction to be undertaken by the machine operator and trail labourers working behind to clean up before moving ahead to the next section.

3. Cut the bench using cut and fill technique. The topsoil and mineral earth removed from the inner side of the bench are used to build up the outer edge of the bench. The excavator works forwards, cutting the bench ahead of it and then moving forward onto the bench. The bench must be wide enough and stable enough for the excavator to operate safely on. Using a small rubber-tracked mini-excavator (refer Figure 2) with a minimum track width of about 900mm, the bench is generally constructed at 1-1.5m width. Note that the cut material (i.e. the spoil) may be moved locally forward or backwards along the trail to areas where fill material is required. Overall, cut and fill is always balanced, with no fill material removed off-site. On steeper slopes, the outer edge of the bench may need to be retained. This is generally done using dry stone rock walls, built from rock sourced during the construction of the bench, with the excavator creating the foundations for the base course and moving the largest rocks into place;

4. Any additional trail embellishments, such as trail surfacing, steps, rock armouring etc., are generally constructed at this stage, prior to the finishing steps below;

5. Define the preferred riding/hiking line by placing rocks, logs and other obstacles as necessary. Large obstacles work best and should be manoeuvred into place by the excavator. The ideal riding/hiking line is generally on the inner side of the bench, at the toe of the upslope batter, where the soil is firm and compacted. Obstacles are manually and deliberately placed to control rider speed and position riders/hikers towards the inside of the bench;

6. Clean up the trail tread, removing loose rocks and roots, compacting the tread, back sloping the batter and managing drainage (for example, ensuring grade reversals flow correctly or that the trail is outsloped where practical). This step is undertaken manually by trail labourers working behind the excavator.

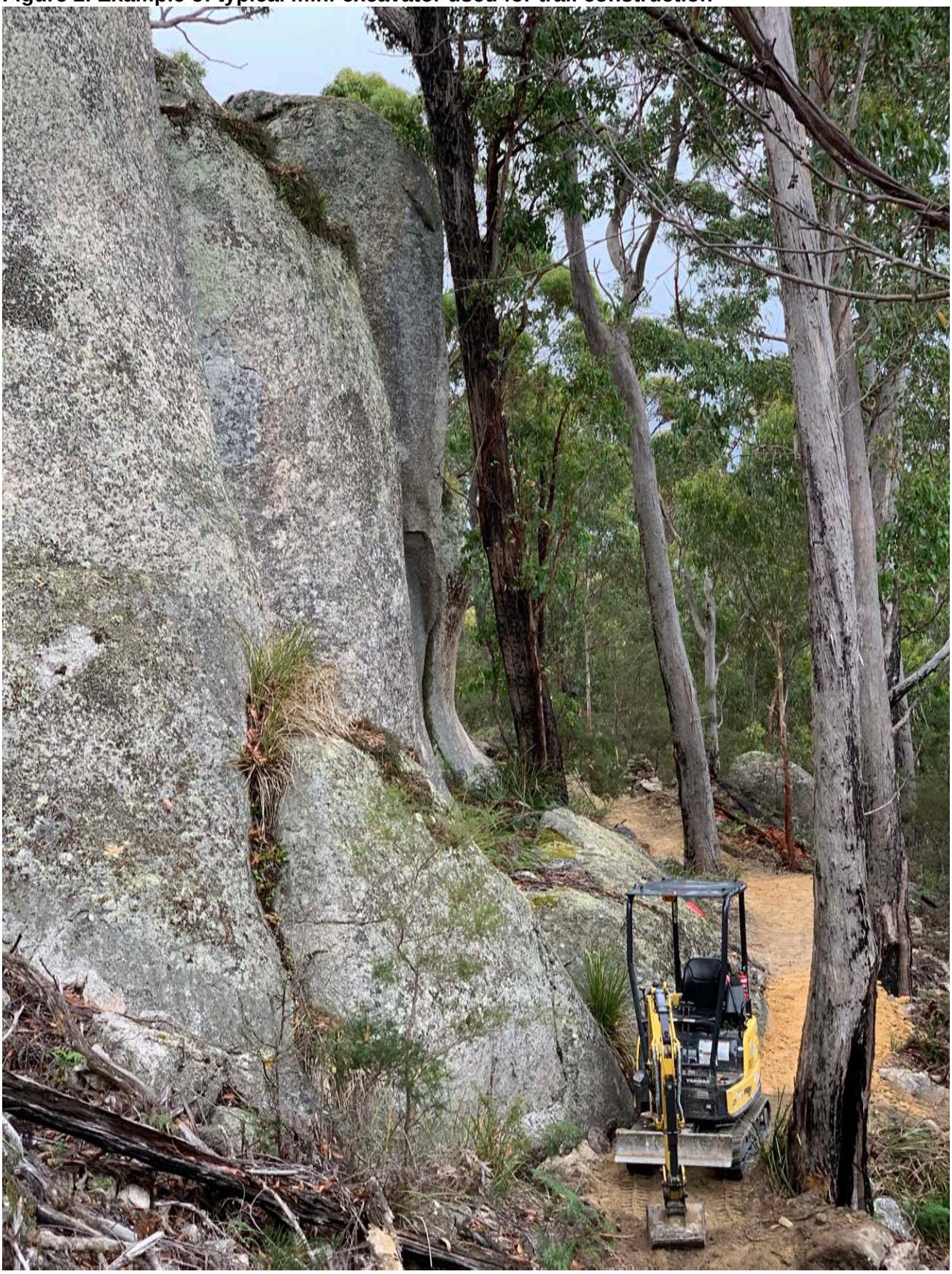
From time to time, step 3 may need to be undertaken by hand. Hand construction may be necessary in the following situations:

- It is not physically possible to get the mini-excavator to the location. For example, there is a steep-sided creek requiring the construction of a bridge, which will not be trafficable by a mini-excavator, or there are large boulders that prevent access of the machine;
- It is not safe to use a mini-excavator. For example, on extremely steep side slopes, or in locations with unstable ground, or on sloping rock slabs, it may not be deemed safe to operate a mini-excavator;
- Areas of high environmental or cultural heritage values, requiring minimal excavation;
- Close to large tree roots, especially buttress style roots running along ground surface;

The trail should be allowed to rest for a period before allowing riders/hikers to use it. This process is called ‘curing’ and allows the trail tread to settle and harden before being subjected to use.

This process above describes the typical methodology for 80-90% of trails.

Figure 2. Example of typical mini-excavator used for trail construction



3.3 RE-ALIGNMENT PROCESS

From time to time during trail construction, changes need to be made to the proposed trail alignment. These changes occur in response to issues that become apparent once construction commences (for example, unstable ground caused by a former industrial use), or in response to new opportunities that are identified to improve the trail experience.

If the proposed realignment is still within the approved 40m Ground-truthed Corridor, then the proposed realignment must be communicated to the TDPD Project Manager for their records.

If the proposed realignment passes outside the approved 40m Ground-truthed Corridor, then the proposed realignment must be referred to the TDPD Project Manager and will most likely require further investigations prior to approval.

4 CAMP SITE DESIGN AND CONSTRUCTION

The Wangetti Trail will include five high quality, sustainable camp sites, providing an interesting camping experience in a range of stunning tropical rainforest environments.

The Wangetti Trail will provide both public and private camp sites to cater for different user groups and experiences. The exact location and configuration of the proposed camp sites will be determined during further detailed planning to ensure the best sites are utilised to cater for a range of experiences.

Each camp site will be constructed to protect the environment by minimising the impact of people at each location. The use of elevated tent platforms and raised boardwalks has become the recognised means to provide a quality camping experience, while protecting the surrounding, sensitive environment.

All camp site locations along the Wangetti Trail must undergo thorough assessment to select an appropriate site based on the following design and construction considerations.

Table 2. Camp site Design and Construction Considerations

Consideration	Notes
Location	The five camp sites proposed as part of the Wangetti Trail include: • Camp site 1: Dark Jungle; • Camp site 2: Pinnacles; • Camp site 3: Vodaphone; • Camp site 4: Twin Bridges; • Camp site 5: Tresize (located outside of the WTWHA). ***Camp site 1: Dark Jungle*** An area of up to 0.25 ha will be permanently disturbed to allow for the construction of a public camp site, which will cater for a maximum of 20 people per night and be managed by QPWS. Properties impacted include lot 174 on NPW930. Located within Zone B of the WTWHA. ***Camp site 2: Pinnacles*** A conservative disturbance area of up to 3.6 ha has been allowed for the siting of the campsite infrastructure, including construction footprint and buffers for the public and private campsites. The design details of the campsite will be developed further during the detailed detail phase and would result in the permeant disturbance footprint of 0.5 ha. Properties impacted include lot 174 on NPW930. Located within Zone C of the WTWHA. ***Camp site 3: Vodaphone*** A conservative disturbance area of up to 3.3 ha has been allowed for the siting of the campsite infrastructure, construction footprint and buffers for the public and private campsites. The design details of the campsite will be developed further during the detailed detail phase and would result in the permeant disturbance footprint of 0.5 ha. Properties impacted include lot 174 on NPW930. Located within Zone C of the WTWHA. ***Camp site 4: Twin Bridges*** For campsite 4 a conservative disturbance area of up to 3.6 ha has been allowed for the siting of the campsite infrastructure, including construction footprint and buffers for the public and private campsites. The design details of the campsite will be developed further during the detailed detail phase and would result in the permeant disturbance footprint of 0.5 ha. Properties impacted include lot 174 on NPW930. Located within Zone C of the WTWHA.

Consideration	Notes
	Camp site 5: Tresize For campsite 5 a conservative disturbance area of up to 2.9 ha has been allowed for the siting of the campsite infrastructure, including construction footprint and buffers for the public and private campsites. The design details of the campsite will be developed further during the detailed detail phase and would result in the permeant disturbance footprint of 0.5 ha. This camp site is not located within the WTWHA and therefore does not require assessment as part of this permit. Properties impacted include lot 117 on SR898.
Visitor Experience	Take advantage of views but be well hidden and not obviously visible from the trail. Not detract from the primary experience of the ride/walk or diminish the remote experience.
Environmental Sustainability	Fit sensitively into the landscape with minimal ecological footprint, respectful of the carrying capacity of the site and avoiding damage to environmentally significant area. Be demountable to allow removal / relocation in the future if required. Be located on existing disturbed sites where possible. Avoid impacting areas of cultural significance.
Management and Operation	Be safe for all users and undergo a risk assessment (including tree fall, bushfire, falls from height, flood, drowning); Be in accordance with park management plans, overlays, zoning and legislation, including regard for the WTMA requirements. Be located to allow servicing by vehicle or quad bike where possible. All camp sites will require regular cleaning and maintenance of toilets and camp infrastructure. The frequency of servicing will depend on usage and time of year. Vehicle or side by side access will be important.
Scale	For all camp sites, the total impact footprint for the public and private camp site infrastructure will be 0.25 ha each, within the abovementioned buffer areas. Resulting in a total impact footprint of 0.5 ha at each campsite location, with the exception of Campsite 1 which will have a footprint of only 0.25 ha (as it will be a public only camp site). The buffer areas have been provided at each camp site to accommodate both private and public camp sites, with the exception of campsite 1 which will be a public only campsite. The actual location of the campsites within this buffer area will be determined by the nominated construction contractor. A minimum 100m buffer is allowed for between the public and private camp sites to provide a buffer between public and private users. Camp sites will accommodate a maximum of 20 people per night on 10 tent platforms. Each platform would be large enough to pitch a tent or lay a swag. It would ideally be elevated off the ground and connected by pathways at grade and elevated boardwalks to ensure minimal damage to the surrounding environment The campsite would be a clearly delineated, controlled zone which will reduce camp site ‘creep’, an important element in the World Heritage Area.

Consideration	Notes
Utility Connections	The camps will have no reliance on reticulated services and would be self-sufficient for power, using a combination of solar and gas with a small back-up generator for emergency power. Water would be sourced from roof capture. Domestic waste would be removed from the site by maintenance staff. Structures will be prefabricated, and assembled on site on screw piles that enable water flows to continue unaffected. Each camp site could provide unobtrusive, solar powered charge points for small electrical devices such as phones, GPS devices and digital cameras. To maintain a true camping experience, charge points will not run larger electrical devices or lights.
Public Camp Site Infrastructure	Each public camp site location shall contain the following infrastructure: • 10 x elevated timber camp desks/pads (4m diameter circular or 3mx3m square); • 1 x toilet block containing two toilets (note: Gough hybrid toilets are proposed to be used in accordance with the design in the QPWS Facilities Manual); • 1 x outdoor shower (optional); • 2 x rainwater storage tanks; • 1 x communal shelter facility (camping hub) for use as a gathering place and to provide protection from rain and extreme weather. This facility shall include bench seating and the allowance for 1 x bike rack facility incorporated into the camping hub (for up to 15 x bicycles); • Combination of pathways at grade and elevated boardwalks that interconnect the camp facilities (camping hub and toilet block) and camp decks (width approx. 1.2m); • Camp access tracks - from the camp site area to the main Wangetti Trail (as required). Figure 3 shows an example of public camp site infrastructure.
Private Camp Site Infrastructure	• 10 small basic huts; • 1 common building for dining, food preparation and bathrooms; • Interconnecting pathways, boardwalks and access tracks. Figure 4 shows an example of private camp site infrastructure.
Materials and Equipment Methodology	The construction of the camp sites will ultimately be determined by the nominated construction contractor; however the following objectives will be applied to the construction phase: • The camp sites must be sympathetic to the terrain and topography – they must blend into the landscape and create a sense of purpose and movement through the landscape; • The camp sites will connect to existing roads, vehicle tracks or walking tracks; • The camp sites will avoid areas of highest environmental significance where possible; • The camp sites will be built to modern best-practice standards for sustainable accommodation and amenities; • The structures at the camp sites will consist of modular, pre-fabricated and easy to assemble construction technologies to reduce construction related impacts; • The nominated contractor will be required to use locally sourced material that is lightweight yet durable; • Renewable, durable, non-toxic and environmentally sustainable materials to be considered during the construction phase of the camp sites; • Waste streams to be managed during construction through re-use of on-site materials that are within the development zone (e.g. soils, vegetation, fabricated materials);

Consideration	Notes
	• Water sensitive urban design practices such as rainwater tanks, onsite recycling of water/wastewater, swales and bio-retention basins for water treatment and water efficient appliances be considered during the construction phase.
Design Principles	• There needs to be a degree of physical and visual separation between the public and private campsites; • Ideally, no trees should need to be removed for the construction of the camp sites and associated facilities. Tent pads, walkways, communal shelters etc. to be sensitively located to avoid the need for tree removal; • Ideally, broad objective is to ensure the retention of as much vegetation as possible – only the area directly beneath each structure (i.e. tent pads, shelters, toilets etc.) and connecting walkways and pathways is to be cleared of vegetation. There should be no broad scale clearing of vegetation across the entire site. This requirement ensures protection of environmental values, but also helps to preserve the intended experience for the users – i.e. immersion in nature, solitude etc.; • The use of in-situ materials wherever possible (eg: rock for the access track, pathways, and stormwater deviations); • Minimal clearing and grubbing during construction; • Liaise with qualified ecological consultants to understand the implications at each camp site, and to adjust (micro-site) the position of each element to achieve the best possible environmental outcomes; • The intent of the camp sites is to enhance the trail experience; therefore, camp site arrangements need to sympathise with the environment, prioritise views where possible, allow privacy and space between campers and embrace the uniqueness that is at each location; • Where duplication can be achieved, this is encouraged as it may minimise costs, create ease of construction and simplify ongoing maintenance, user booking and actual use by trail hikers / bike riders; • Each camp site will be designed in a robust manner to minimise potential damage from vandalism or other anti-social behaviour.

Figure 3. Example of public camp site infrastructure. Bugiga Hiker Camp, Grampians Peaks Trail, Victoria

Figure 4. Example of private camp site infrastructure. Blue Derby Pods, Derby, Tasmania.

5 CONSTRUCTION TREATMENTS

5.1 LOCATION AND QUANTITIES OF CONSTRUCTION TREATMENTS

Section 5.2 of this document lists all of the Construction Treatments that have been specified for the construction of the Wangetti Trail. These Construction Treatments were specified by experienced trail designers working in the field during the Detailed Design stage of the project. Each specific occurrence of a Construction Treatment was measured on the ground and then recorded using high accuracy GPS enabled software. Each specific occurrence of a Construction Treatment consists of a number of pieces of information:

- The name of the Construction Treatment;
- The quantity (usually a length measurement);
- Photo/s;
- GPS coordinates;
- Other data specific to that treatment. For example, for rock armouring, the field worker is required to state whether rock is available on site or not.

Section 5.4 of this document provides specifications for the various Construction Treatments to be implemented.

The full suite of GPS data collected during ground-truthing will be provided to the Contractor, along with a series of maps that show the approximate placement of all of the Construction Treatments. However, it must be understood that the Construction Treatments and associated quantities as determined during ground-truthing and outlined in this document, should be used as a guide only. There are numerous reasons for this:

- GPS error margins – while ground-truthing was conducted using the best available technology, there remain inherent inaccuracies in the data, especially when working under heavy tree canopies. Accuracy of the field data collected is estimated to be generally under 10m;
- GPS recording process – the GPS data for the trail includes a linear trail alignment that should generally correspond to the flagged, ground-truthed alignment on the ground, and waypoints which correspond to the approximate centrepoint for a particular construction treatment. For example, a 20m section of rock armouring, is represented by a single waypoint, recorded at the approximate centre point for that specific treatment;
- Reliance on flagging tape – ground-truthing was undertaken in 2018. Flagging tape may or may not still be in place – it can degrade quickly in harsh environments and can be removed by animals, people, or strong wind.

During the construction phase, the Contractor will be required to use their experience and knowledge to determine the best Construction Treatment, understanding that the treatments and quantities specified are a guide only. This requires:

- GIS/GPS capabilities – The ability to interpret and follow the spatial data and flagging tape in the field, to navigate to and identify the locations of the various Construction Treatments;
- Trail design experience – The ability to read the landscape and choose the most appropriate treatment, understanding that the treatment specified and the quantity estimated will be influenced by the final position of the trail within the 40m Ground-truthed Corridor;
- Trail construction experience – The ability to implement the various Construction Treatments outlined in this document.

5.2 BILL OF QUANTITIES

Table 3. Bill of Quantities

Construction Treatment	Unit	Quantity	Drawing Reference	Drawing Title
Trail Benching Trail Benching (Hand Construction)	Metre Metre	82095 55	WTSTD-001-WG2	Typical Trail Benching
Vegetation Clearing	Metre	82150	WTSTD-033-WG2	Vegetation Clearing
Rock Walling (Up to 500mm)	Metre	1501	WTSTD-034-WG2	Rock Walling – Up To 500mm Placement and Dimensions
Retaining Wall (Up to 1000mm)	Metre	901	WTSTD-004-WG2	Rock Retaining Wall Up To 1000mm Placement and Dimensions
Ballast Surfacing	Metre	4595	WGST-045-WG2	Ballast Surfacing Placement and Dimensions
Pre-cast Concrete Steps	Step	1000	WTSTD-003-WG2 WTSTD-043-WG2 WTSTD-030-WG2	Precast Concrete Steps Placement and Dimensions Rock Pavement Treatment Trail Construction Precast Concrete Steps Trail Grading Guidelines
Natural Rock Seats	Stone Seats	20	WTSTD-005-WG2	Natural Rock Seat Placement and Dimensions
Rock Armouring	Metre	2315	WTSTD-007-WG2	Rock Armouring – Dual Use Placement and Dimensions
Boulder Water Crossings	Metre	1166	WTSTD-006-WG2	Boulder Rock Crossing Placement and Dimension
Minor Water Crossings	Metre	468	S030 & S031	Typical Gully Crossing – Sheet 1 & Sheet 2
Major Water Crossings	Metre	35	S010	Hartley's Creek Crossing

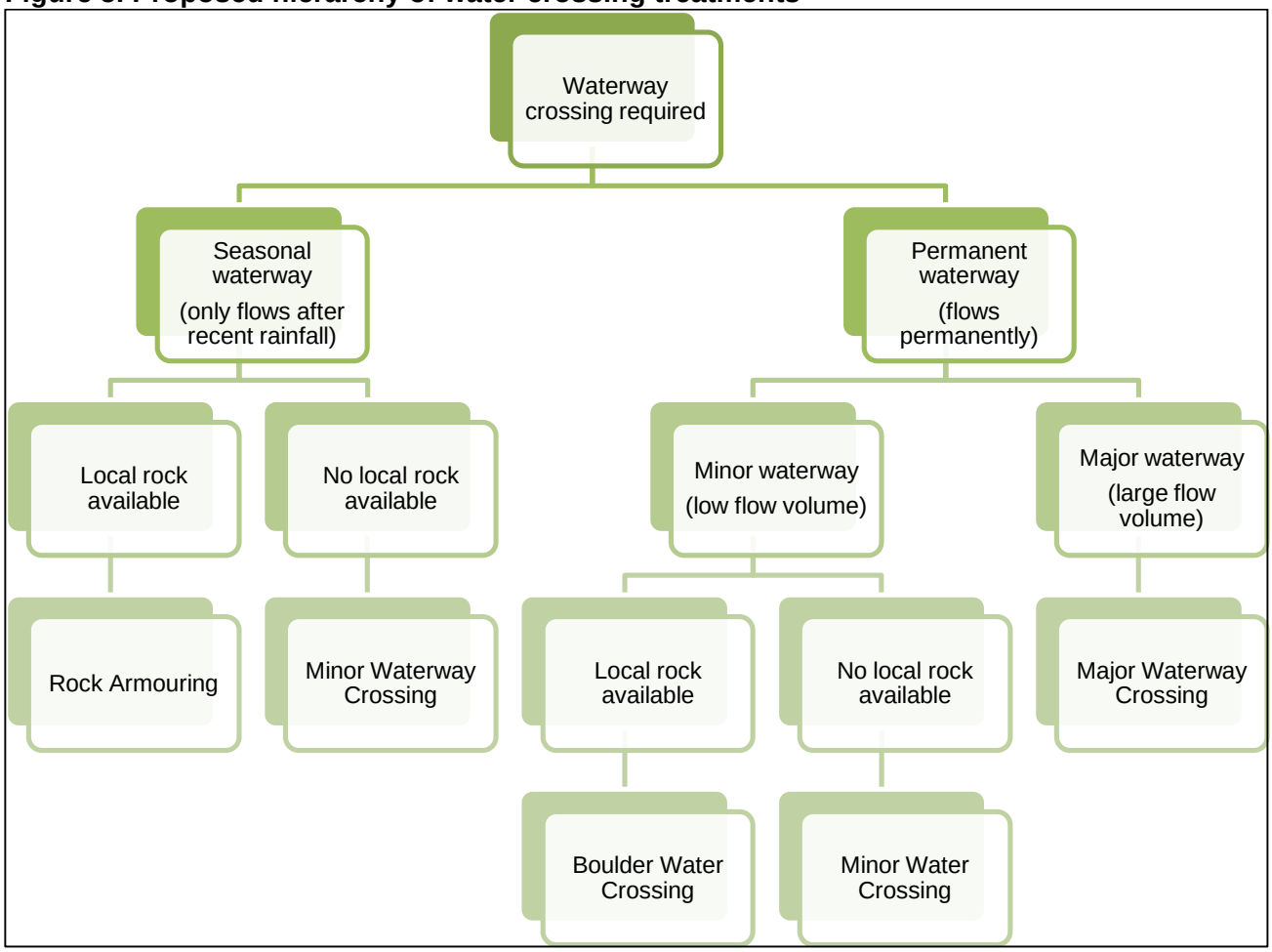
5.3 WATERWAY CROSSINGS

There are a number of different treatments proposed for the crossing of waterways:

- Rock Armouring;
- Boulder Rock Crossing;
- Minor Waterway Crossing;
- Major Waterway Crossing.

Figure 5 below shows the hierarchy for when/how the various treatments are to be applied.

Figure 5. Proposed hierarchy of water crossing treatments



5.4 CONSTRUCTION TREATMENTS – SPECIFIED

5.4.1 Trail Benching

What is it?

Trail Benching is the main construction technique to be used to construct the vast majority of the trail. It is the earthworks undertaken by a mini-excavator to construct the bench which becomes the tread of the trail. It is generally a balanced cut and fill process.

Trail Benching (Hand Construction) is a construction technique to be used to construct small sections of trail that can't be constructed with mini-excavator. It is otherwise the same as standard Trail benching, but all earthworks are undertaken by hand, using hand tools only.

When is it Used?

Trail Benching is used when creating new rolling contour trails in sideslope locations.

Why is it Used?

Trail Benching is the most appropriate, effective and least impact method of creating new rolling contour trail. Balanced cut and fill approach ensures that there is no surplus spoil to dispose of.

Trail Benching (Hand Construction) is used when it is not possible to use a mini-excavator. This may be due to safety concerns, physical space limitations that prevent the passage of an excavator, slope instability or the desire to create a narrower tread width than is possible with a mini-excavator.

Notes

The intended finished width of the Wangetti Trail is 1.5m. This means that the largest excavator that can be used to construct the trail is one with a track width of 1.5m, which would usually be less than 2.5T in weight.

While a larger excavator has more power, making it more efficient at moving soil and able to move larger rocks, this needs to be balanced against the larger footprint of the machine and the ability to have it airlifted by helicopter.

Materials

- In situ soil
- No imported materials

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.

Estimated Length of Treatment

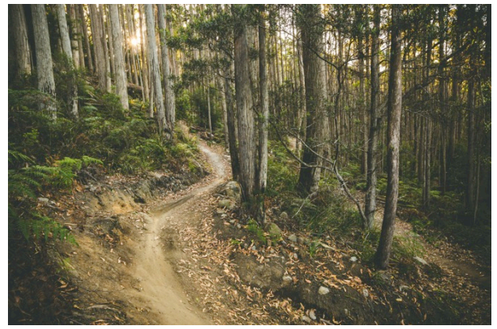
Trail Benching:
- 82,095 metres (of entire 82.15km length of trail)

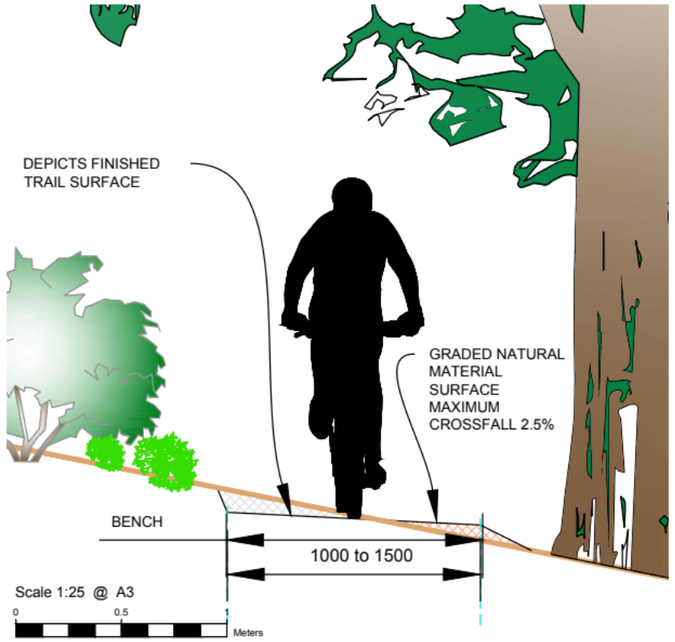
Trail Benching (Hand Construction):
- 55 metres (of entire 82.15km length of trail)

Drawing Reference

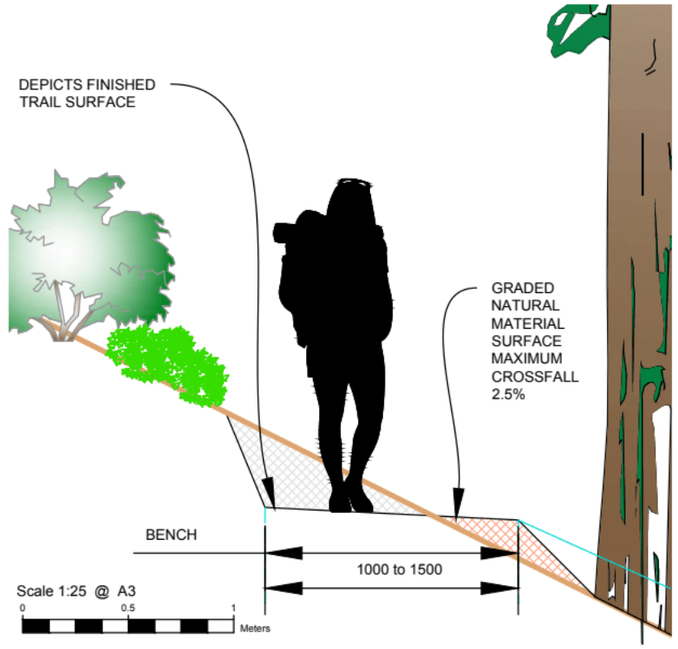
WTSTD-001-WG2
Typical Trail Benching

Examples





TYPICAL SECTION - 5:1 (20%) CROSS SLOPE
FILL BATTER SLOPE - 2:1



TYPICAL SECTION - 2:1 (50%) CROSS SLOPE
FILL BATTER SLOPE - 1:1

NOTES:

GENERAL:

- The trail will provide access along a slightly modified, natural environment alignment, with little provision of interpretive signage and few facilities.
- Users can expect occasional encounters with others.
- Locate and protect any underground or overhead services prior to commencement of works.
- Trail excavation is to be cut and fill.
- Naturally occurring rock is to be used to protect the uphill cut and the downhill toe where available and appropriate.
- Dimensions in millimetres unless otherwise notated.
- Trail excavation is to be cut and fill.
- Cut batters are at 67.5°. Fill batters are as defined.
- Rocks can be used in the toe of the fill batter to provide additional stabilisation at steeper slopes.
- Rocks and/or plants can be placed (or remain) in the bench area between the Ride & Hike Line and the Fill Batter to guide riders and hikers into the appropriate alignment.
- Cut material will need to be transported along the trail from steeper trail cross slope areas.
- All site clearing is is to be restricted to the trail alignment and nominal clearances for cut and fill works.
- Trail layout is to be undertaken using the "Sustainability Guidelines" as defined by the MTBA and as summarised below. More detailed information should be obtained through the MTBA.
- The trail is to be constructed to Class 3 Standard, as defined in AS 2156.1-2001.
- The trail is to be constructed in accordance with the "Blue Square" difficulty rating as defined in the *IMBA - Australia, Trail Difficulty Rating System, 2014, version 2.0.*

NOTES:

MTBA TRAIL SUSTAINABILITY GUIDELINES

THE HALF RULE

- A trail's grade shouldn't exceed half the grade of the hill slope or sideslope that the trail traverses.
- Grades exceeding the half rule may cause water to flow along the trail causing erosion.

THE TEN PERCENT AVERAGE GUIDELINE

- The overall grade of a trail should be 10% or less.
- Some sections may be steeper than 10% and some less steep.
- The ten percent average guideline may need to be adjusted to suit different soil types.

MAXIMUM SUSTAINABLE GRADE

- The maximum sustainable grade is typically 15% to 20% but is dependent on a wide range of factors.
- These factors include soil type, annual rainfall, vegetation and topography constraints and the level of difficulty for users.

GRADE REVERSALS - (see Standard Drawing WTSTD-046-WG2 for details)

- Grade reversals are points at which the trail gradient changes from down to up (or up to down), creating a low point where water is pushed off the trail.
- The more frequent the grade reversals, the smaller the amount of water that needs to cross at each point thereby reducing the potential erosion and the need for drainage infrastructure.

OUTSLOPE

- Outslope is the grading of the trail to a cross slope of 5% following the general slope direction of the local terrain.
- Outsloping enables stormwater to flow across the trail as a sheet rather than as concentrated flow.
- Outslopes will not be appropriate near berms or banked turns or in some loose soil types.

LEGEND:

AREA OF CUT

AREA OF FILL

NATURAL GROUND SURFACE

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
B	07/04/20	MAJOR LAYOUT & NOTES CHANGES			
A	24/03/20	ISSUED FOR INFORMATION	JR		

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 07/04/20	
Designed DS	Signed	Date 07/04/20	
Verified DS	Signed	Date 07/04/20	
Approved	Signed	Date	

Drawing Title: TYPICAL TRAIL BENCHING STANDARD DRAWING

Project No. WT20-Wangetti-001

Scale 1:25 | Sheet Size A3

Drawing No. WTSTD-001-WG2 | Rev. B

5.4.2 Vegetation Clearing

What is it?

Vegetation Clearing is the technique of clearing the intended pathway (i.e. the Trail Corridor) of vegetation ahead of the mini-excavator.

When is it Used?

Vegetation Clearing is used when creating new trails in vegetated locations. It generally occurs simultaneously with Trail Construction - Standard, but around 50-100m ahead of the excavator.

Why is it Used?

Vegetation Clearing is used to clear the pathway of vines, shrubs, bushes, ground covers and small trees, to allow clear access for the mini-excavator. It should also be cleared to sufficient height to allow for unimpeded access of trail users once complete.

Notes

Vegetation Clearing shouldn't proceed too far ahead of the excavator in case small realignments need to be made.

Care will be taken to ensure no windrows or stockpiles of cut vegetation are created. Cut vegetation must be scattered into the surrounding environment, without smothering existing vegetation

Materials

- No materials required.

Machinery / Equipment

- Mechanised tools including chainsaws, brushcutters and hedgetrimmers;
- Hand tools including loppers, snippers, hand saws, secatuers, shears etc.

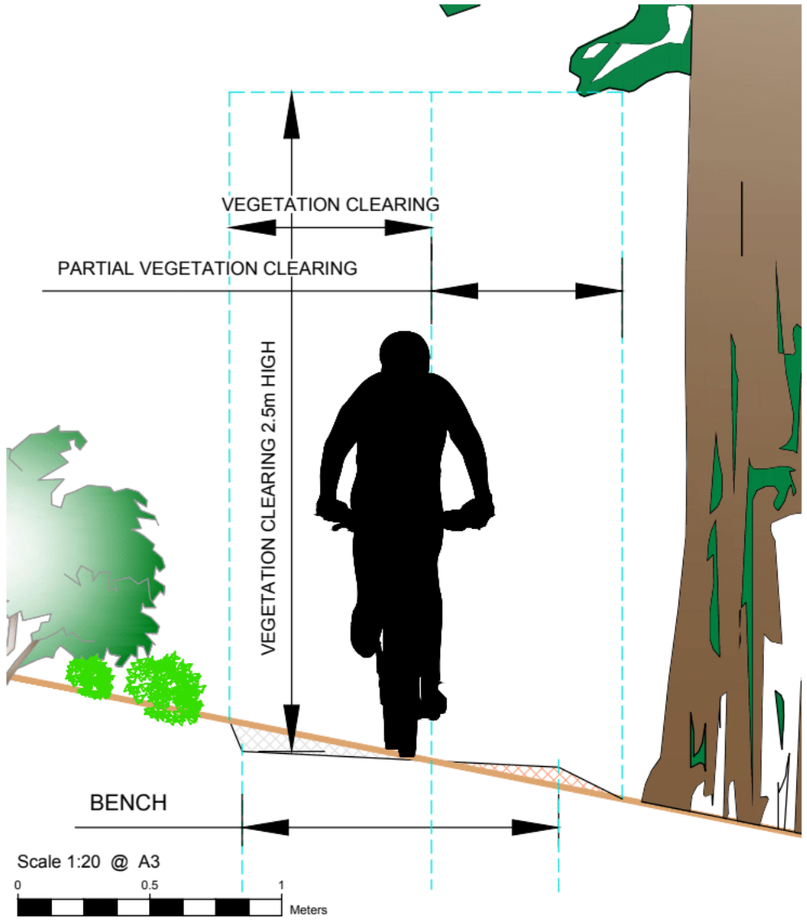
Estimated Length of Treatment

82,150 metres

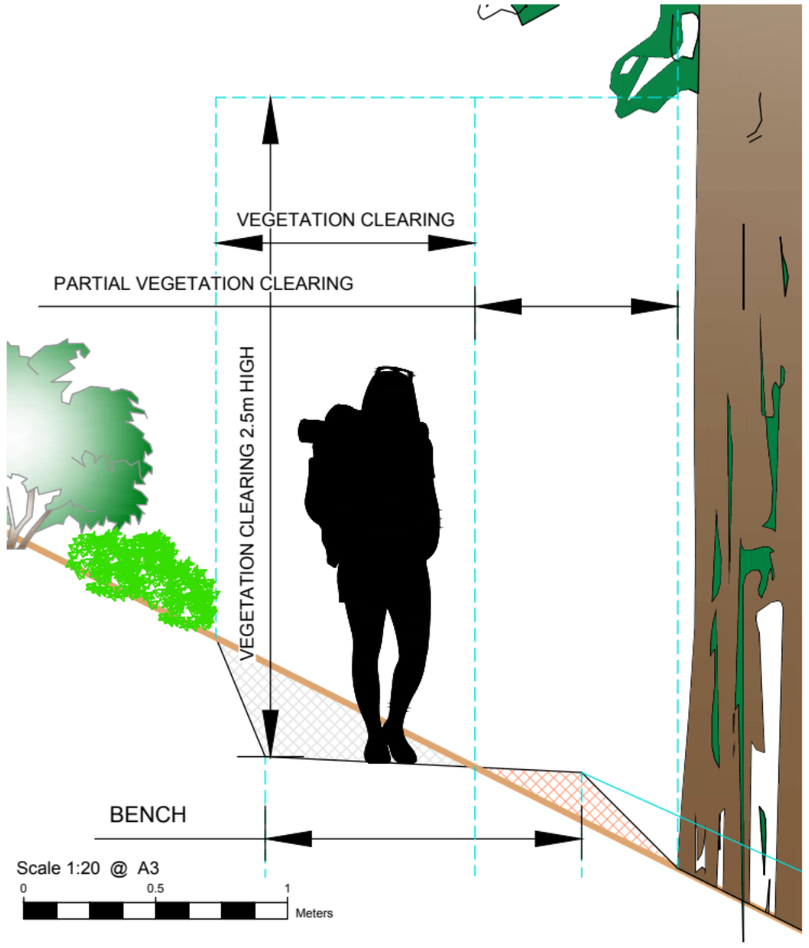
Drawing Reference

WTSTD-033-WG2
Vegetation Clearing

Examples



TYPICAL SECTION – 5:1 (20%) CROSS SLOPE
FILL BATTER SLOPE – 2:1



TYPICAL SECTION – 2:1 (50%) CROSS SLOPE
FILL BATTER SLOPE – 1:1

NOTES:

GENERAL:

- Vegetation Clearing should be kept to a minimum.
- Vegetation clearing should not be undertaken outside the Areas depicted on this plan unless approved by the Project Principle.
- Vegetation clearing should be undertaken as defined in AS 4970 - 2009 (Incorporating Amendment No. 1).
- No windrows or stockpiles should be created during vegetation clearing.
- Cut vegetation must be scattered into the surrounding environment, without smothering existing vegetation.

CONSTRUCTION ZONES VERSUS TERRAIN SIDE SLOPE				
TERRAIN CROSS SLOPE	BENCH WIDTH	VEG. CLEARING WIDTH	PARTIAL VEG. CLEARING WIDTH	TOTAL IMPACT WIDTH
5:1 (20%)	1-1.5 m	0.77 m	0.72 m	1.49 m
2:1 (50%)	1-1.5 m	0.98 m	0.77 m	1.75 m

LEGEND:

AREA OF CUT

AREA OF FILL

NATURAL GROUND SURFACE

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
B	07/04/20	CHANGES TO LAYOUT & NOTES	JR	DS	
A	25/03/20	ISSUED FOR INFORMATION	JR	DS	

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Project: WANGETTI TRAIL DETAILED DESIGN

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Verified DS	Signed	Date 07/04/20
Approved	Signed	Date

Drawing Title: VEGETATION CLEARING STANDARD DRAWING

Project No. WT20-Wangetti-001

Scale 1:20 | Sheet Size A3

Drawing No. WTSTD-033-WG2 | Rev. B

5.4.3 Grade Reversals

What is it?

Grade Reversals are points at which trail gradient changes from up to down (or down to up) as the trail moves across a side slope.

Grade Reversals push water off the trail at the low point of the grade reversal, preventing erosion. The undulations caused by the grade reversal give the trail a sense of playfulness.

When is it Used?

Grade Reversals should be used frequently, regardless of hand or machine construction, regardless of the intended user group and intended difficulty rating. They are a are critical (and often overlooked) element of sustainable trail design.

The size (height/amplitude) of the grade reversal is generally increased on steeper and more difficult trails.

Why is it Used?

Grade Reversals are the key element of sustainable trails. More frequent grade reversals push water off the trail incrementally, preventing it to build up volume or velocity, ensuring the long-term sustainability of the trail. With regular Grade Reversals, surface water can only be trapped on the trail for a short distance, flowing downwards along the trail until it reaches the first Grade Reversal. Grade Reversals effectively divide the trail into short, individual watersheds, so the drainage characteristics of one section of trail won't affect any other section.

Grade Reversals also make trails more enjoyable by giving them a sense of playfulness – a constantly rising and falling nature.

Notes

Grade Reversals are constructed during Trail Benching, integrated with the standard trail construction process.

As a general rule, the steeper the trail gradient, the more frequent the grade reversals should be, but this needs to be assessed on-site, with consideration of soils, rainfall, upslope catchment area, trail user types and speeds and so on. As a guide, the following spacing is suggested:

- Trail gradient of <5% - grade reversals to be spaced at approximately 20 - 40m intervals;
- Trail gradient of 5-10% - grade reversals to be spaced at approximately 16 - 19m intervals;
- Trail gradient of 10-15% - grade reversals to be spaced at approximately 12 - 15m intervals;
- Trail gradient of 15-20% - grade reversals to be spaced at approximately 8 - 11m intervals.

Materials

- In situ soil.
- No imported materials.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.

Estimated Length of Treatment

Not specified, but required across entire length of trail – 82,150 metres

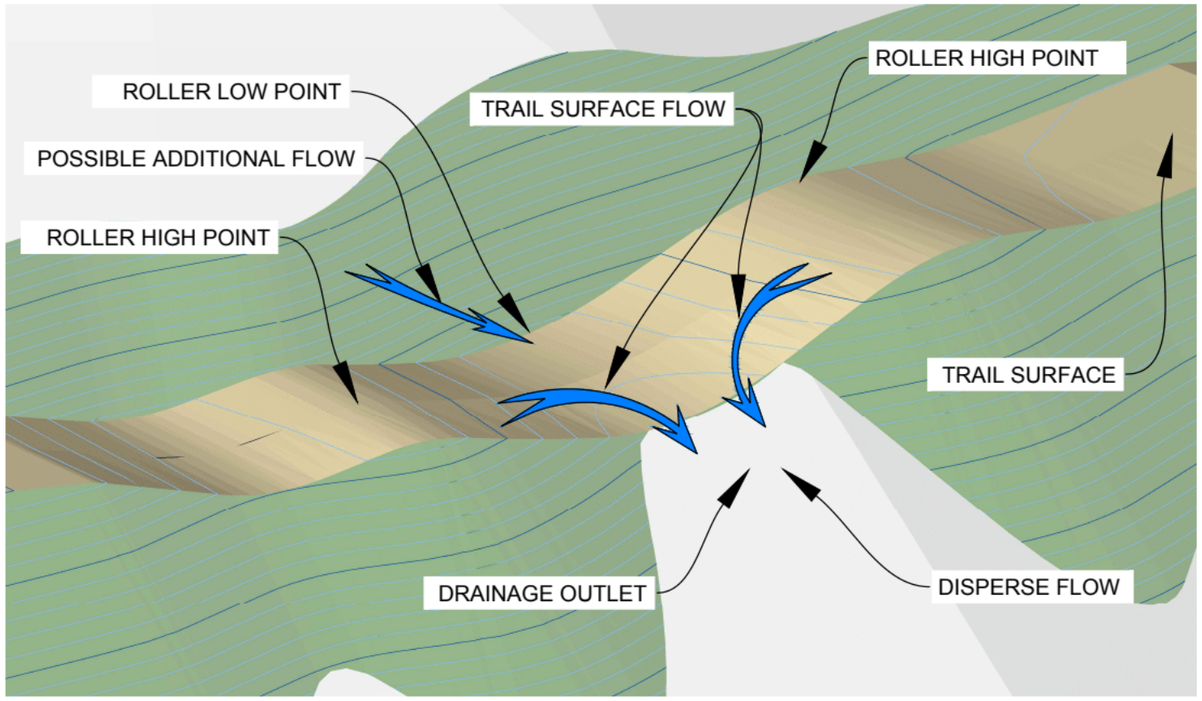
Drawing Reference

WTSTD-046-WG2
Trail Grade Reversals
Placement and Dimensions

Examples

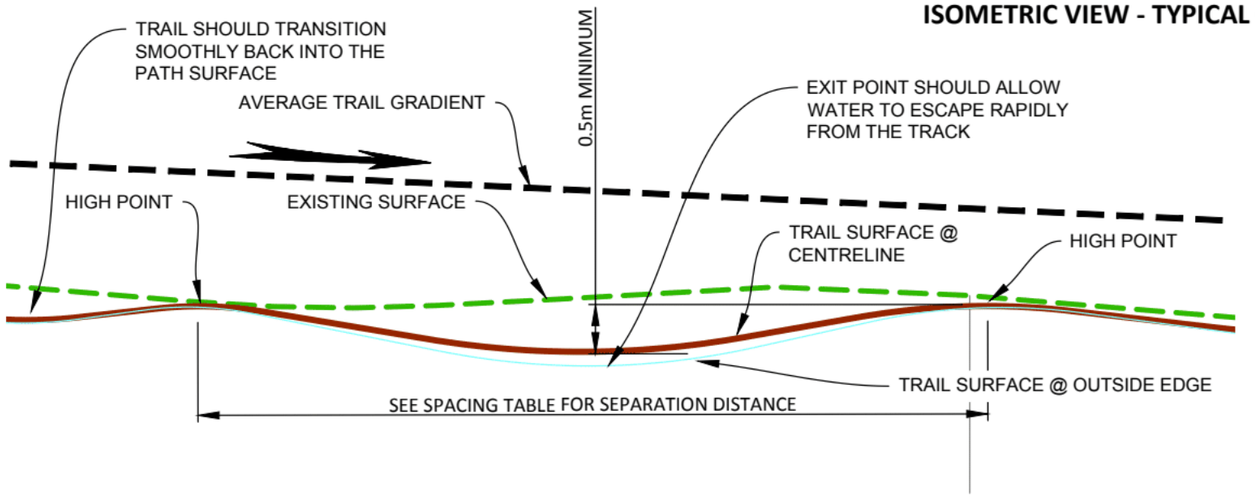
NOTES:

- Grade Reversals can be used on trails for walking, biking or dual use.
- Dimensions and setout of the swale may vary considerably from that depicted, depending on cross slopes, trail gradients and potential stormwater volumes.
- Water should exit the swale at the drainage outlet, ensuring rapid removal of flows from the trail.
- The drainage outlet should disperse water along the contour or across a broad discharge area to reduce velocities and allow for sediment dropout.
- Additional flows may occur from uphill of the grade reversal low point and should be considered in any sizing or erosion protection required.
- Erosion protection, generally using rock, may be required if the location constraints make it difficult to disperse flows.
- Grade reversals should not be confused with waterbars. A grade reversal is one of the most crucial parts in trail construction, both shedding water and also helping to shed speed.
- If a section of trail is on a low gradient with long arc to arcs then the grade reversal is longer and flatter.
- If a section of trail is on a steep gradient with shorter arc to arcs, then the grade reversal needs to be more aggressive, higher and deeper.
- Grade reversals need to be made sustainable and sized correctly to cope with factors like weather, time and riders wear.
- The recommended high point spacing table below provides guidance on these separations.
- Standard grade reversals should always be rollable by both novice and experienced riders.
- Experienced riders should be able to transfer across reverse grades if they are traveling at the necessary pace.
- Grade reversals should not be short, steep and kicky, as this can lead to abrasion, forced risk, injury and a substandard ride experience.
- The grade reversal shape should never force a less experienced rider into the air.
- Contours depicted are at 100mm intervals.



ISOMETRIC VIEW - TYPICAL GRADE REVERSAL @ 8m SPACING

0 1 2 Meters
Scale 1:40 @ A3



PLAN VIEW - TYPICAL REVERSE GRADE

0 1 2 Meters
Scale 1:50 @ A3

GENERAL ARRANGEMENT
SCALE: 1:50

RECOMMENDED REVERSE GRADE SPACING TABLE	
TRAIL GRADIENT (%)	HIGH POINT SPACING (m)
less than 5	20 - 40
5 - 10	16 - 19
10 - 15	12 - 15
15 - 20	8 - 11

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	07/04/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 07/04/20	
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Verified DS	Signed	Date 07/04/20	
Approved	Signed	Date	

Drawing Title: TRAIL GRADE REVERSALS PLACEMENT AND DIMENSIONS STANDARD DRAWING

FOR INFORMATION

Project No. WT20-Wangetti-001
Scale 1:50 | Sheet Size A3
Drawing No. WTSTD-046-WG2 | Rev. A

5.4.4 Switchbacks

What is it?

A Switchback is a 180^{o} turn on a hillside, engineered for drainage. The upper approach is usually insloped and the lower approach is usually outsloped. The Switchback turn reverses the direction of a trail, and is located on a relatively level, constructed landing.

When is it Used?

Switchbacks are used to ascend/descend steep slopes while avoiding unsustainably steep trail gradients. Ideally, the use of Switchbacks should be minimised as much as possible, and ideally, they should be staggered across a hillside rather than being stacked directly on top of each other.

Switchbacks are used when it is not possible for the trail to continue traversing across the hillside for some reason.

Why is it Used?

Switchbacks are used to provide a broad, flat platform on which a sharp turn can be placed. Grade Reversals should be incorporated into the trail at the entry and exit to the switchback corner, to prevent excess water flowing into the corner.

Notes

Switchbacks are constructed during Trail Benching, integrated with the standard trail construction process.

Materials

- In situ soil.
- In situ rocks for rock walls if required.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.

Estimated Length of Treatment

N/A

Drawing Reference

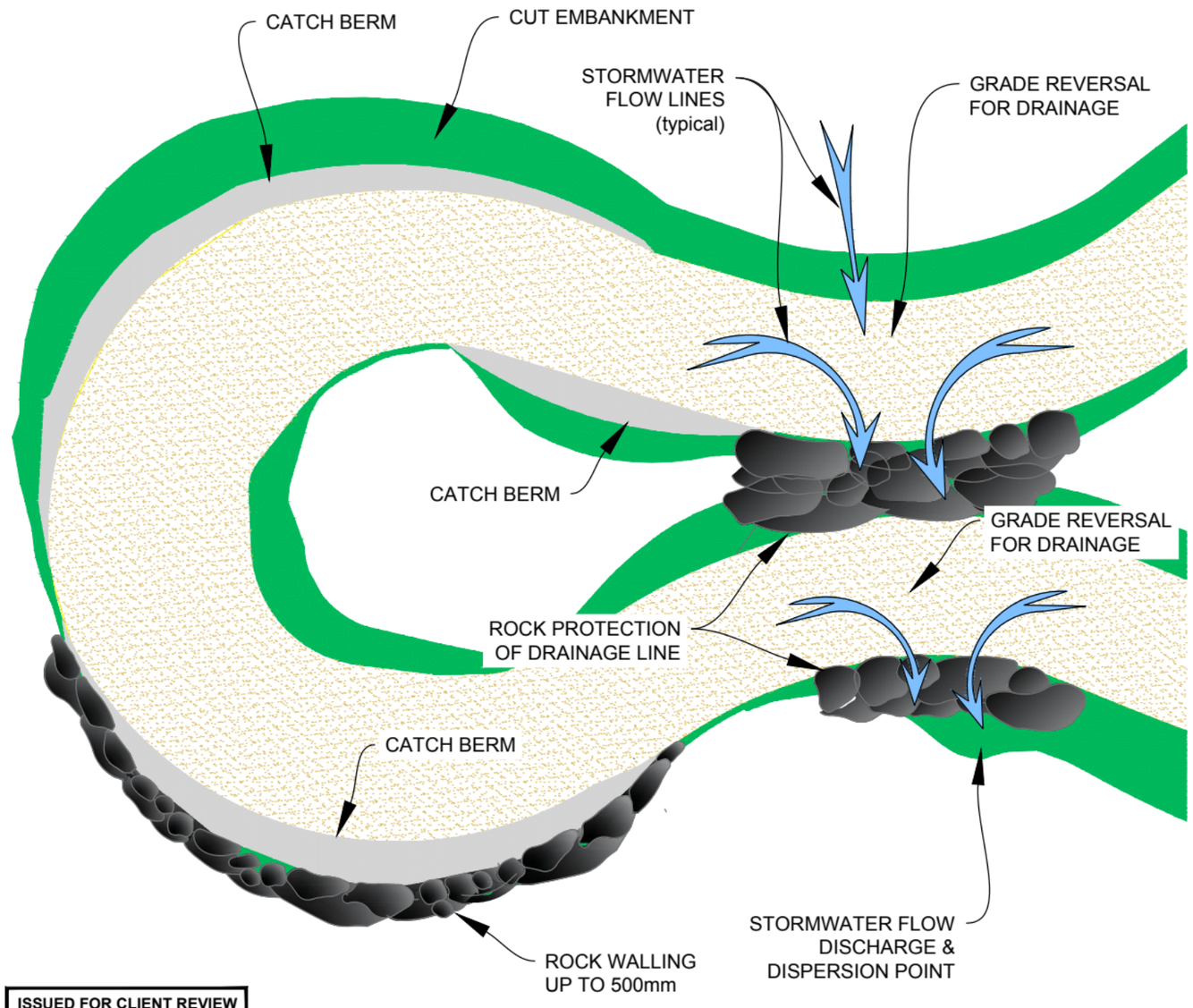
WTSTD-047-WG2
Rock Walled Switchback
Placement and Dimensions

Examples

NOTES:

GENERAL:

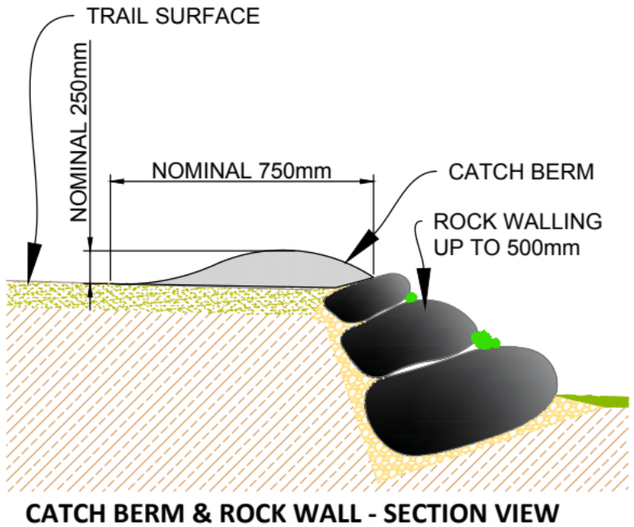
- The rock walled switchback is for steeper cross slopes where rock retaining is required to provide elevation to downhill trail edges.
- The switchback depicted is indicative only and large variations in shape and dimensions are expected due to the large variations in the topography and hydrology of switchback locations along a trail.
- This switchback is most suitable for cross slopes of 20% to 33%.
- Rock Walling will be 500mm or less in height. Refer to WTSTD-034-WG2 for details of rock wall installation.
- Embankment "Cut" sidewalls should not exceed 1.5m in height.
- Trail gradients through the switchback should comply with the general trail construction requirements.
- Trail widening will be required around the arc of the switchback with between 400mm & 700m wider than the standard trail width common.
- Radii of inside trail edge in the switchback may vary from 0.8m to 4m around the asymmetric arc.
- See details below for "Catch Berms" that are located at strategic locations to provide a riding edge to direct the ride line.
- The Catch Berms are constructed of well compacted trail wear surface material
- The drainage outlet should disperse water along the contour or across a broad discharge area to reduce velocities and allow for sediment dropout.
- Additional flows may occur from uphill of the switchback low point and should be considered in any sizing or erosion protection required.
- Erosion protection downstream of the outlet, generally using rock, may be required if the location constraints make it difficult to disperse flows.



ROCK WALL SWITCHBACK - PLAN VIEW

0 1 2 Meters

Scale 1:50 @ A3



CATCH BERM & ROCK WALL - SECTION VIEW

0 0.4 0.8 Meters

Scale 1:20 @ A3

ISSUED FOR CLIENT REVIEW	
APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐
SIGNED.....	DATE.....

GENERAL ARRANGEMENT
AS SHOWN

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	07/04/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

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Designed DS	Signed	Date 07/04/20	
Verified DS	Signed	Date 07/04/20	
Approved	Signed	Date	

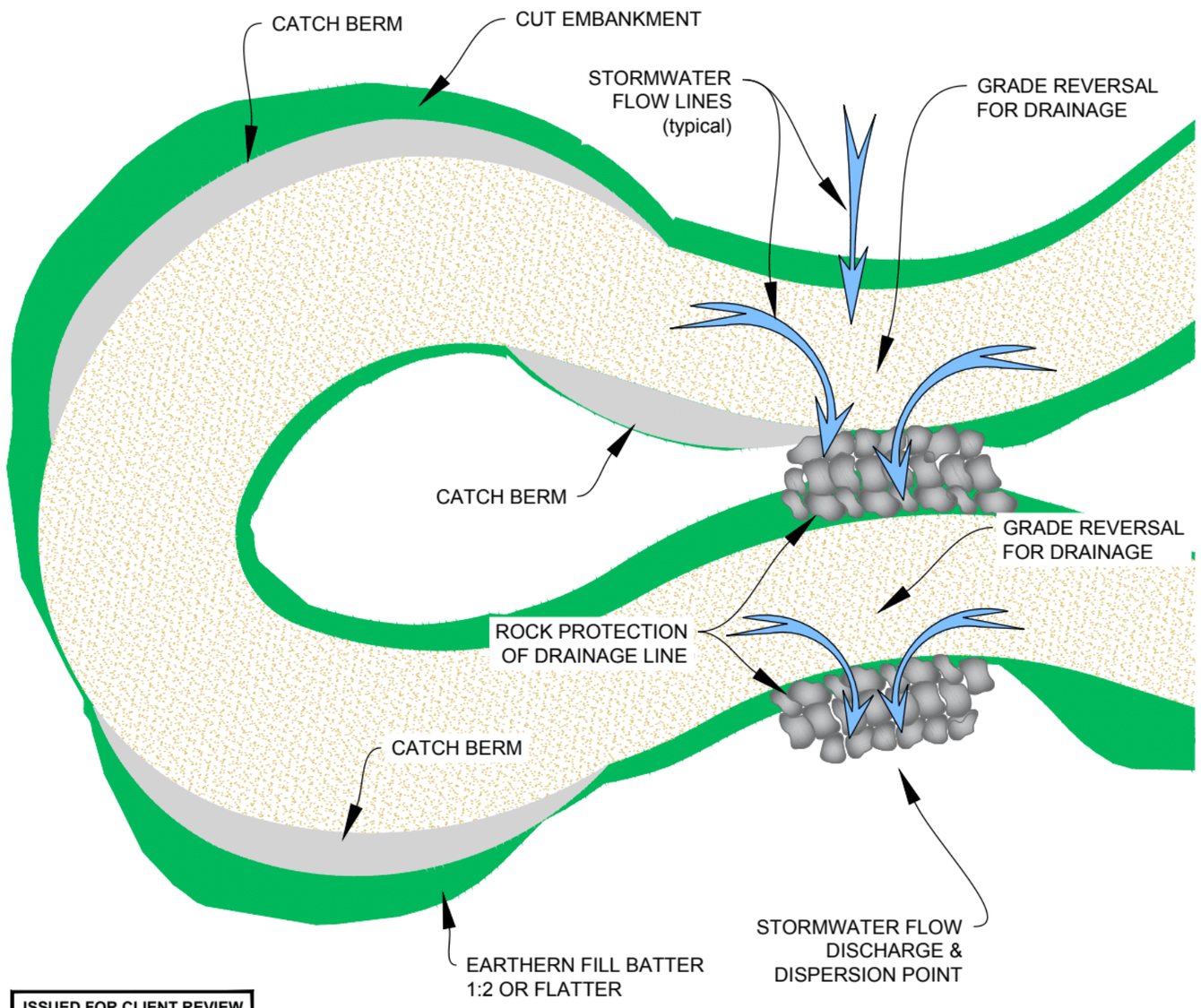
Drawing Title: ROCK WALLED SWITCHBACK PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001	
Scale AS SHOWN	Sheet Size A3
Drawing No. WTSTD-047-WG2	Rev. A

NOTES:

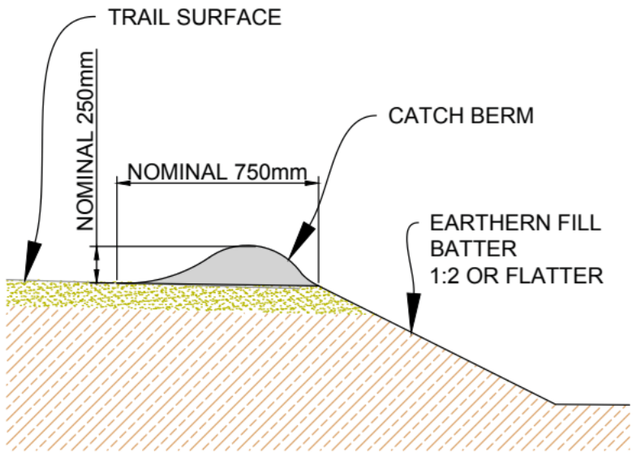
GENERAL:

- The standard switchback is for flatter cross slopes where earthen batters are sufficient to provide elevation to downhill trail edges.
- The switchback depicted is indicative only and large variations in shape and dimensions are expected due to the large variations in the topography and hydrology of switchback locations along a trail.
- This switchback is most suitable for cross slopes flatter than 25%.
- Embankment fill batters vary from 25% to 50%. Any fill batters steeper than 50% may require structural support and erosion protection depending on the fill material used.
- Embankment "Cut" sidewalls should not exceed 1.5m in height.
- Trail gradients through the switchback should comply with the general trail construction requirements.
- Trail widening will be required around the arc of the switchback with between 400mm & 700m wider than the standard trail width common.
- Radii of inside trail edge in the switchback may vary from 0.8m to 4m around the asymmetric arc.
- See details below for "Catch Berms" that are located at strategic locations to provide a riding edge to direct the ride line.
- The Catch Berms are constructed of well compacted trail wear surface material
- The drainage outlet should disperse water along the contour or across a broad discharge area to reduce velocities and allow for sediment dropout.
- Additional flows may occur from uphill of the switchback low point and should be considered in any sizing or erosion protection required.
- Erosion protection downstream of the outlet, generally using rock, may be required if the location constraints make it difficult to disperse flows.



STANDARD SWITCHBACK - PLAN VIEW

Scale 1:50 @ A3



CATCH BERM & FILL BATTER - SECTION VIEW

Scale 1:20 @ A3

ISSUED FOR CLIENT REVIEW	
APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐
SIGNED.....	DATE.....

GENERAL ARRANGEMENT
AS SHOWN

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	07/04/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 07/04/20	
Designed DS	Signed	Date 07/04/20	
Verified DS	Signed	Date 07/04/20	
Approved	Signed	Date	

Drawing Title: STANDARD SWITCHBACK PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale AS SHOWN
Sheet Size A3
Drawing No. WTSTD-048-WG2
Rev. A

5.4.5 Rock Walling (Up To 500mm)

What is it?

Rock Walling (up to 500mm) are smaller structures designed to restrain soil to a slope that it would not naturally keep to (typically a steep, near-vertical or vertical slope).

When is it Used?

Rock Walling is used to retain soils of height between 0 and 500mm. They may be used to retain the upslope or downslope batter.

Why is it Used?

On steep side slopes, cutting the trail to the desired width of 1500mm may create overly high, unsustainable and unstable betters, either the upslope or downslope batter. The use of Rock Walling provides a strong and durable structure that will prevent either batter from slumping.

Notes

Materials

- Rock (can be in situ or imported, subject to land manager requirements).

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.;
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.;
- Ropes, pulleys, winches, chains, straps and rock slings to assist in manipulating rocks into place.

Estimated Length of Treatment

1,501 metres (of entire 82.15km length of trail)

Drawing Reference

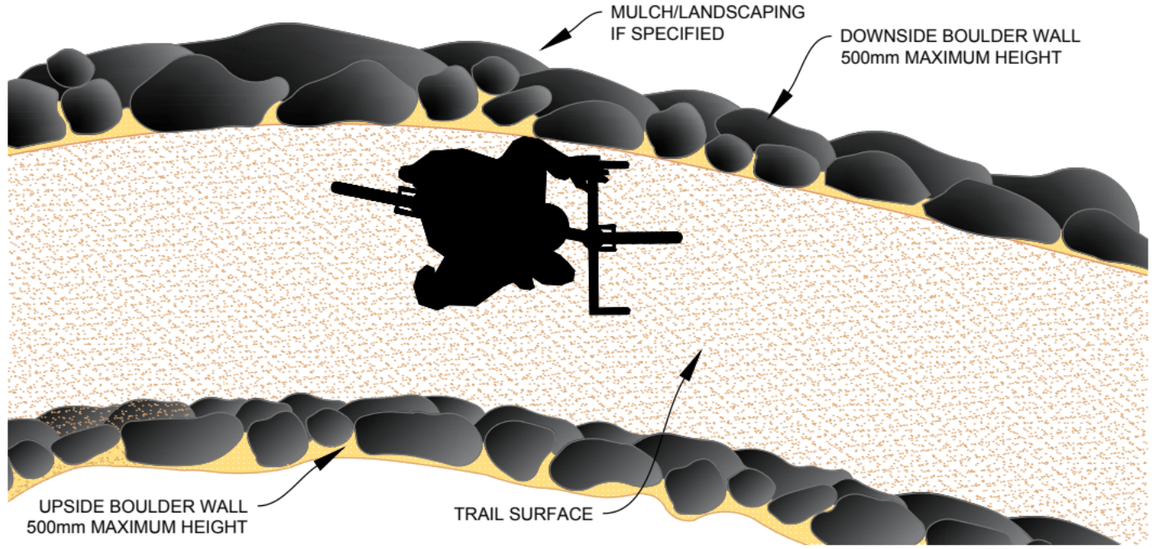
WTSTD-034-WG2
Rock Walling – Up To 500mm
Placement and Dimensions

Examples

NOTES:

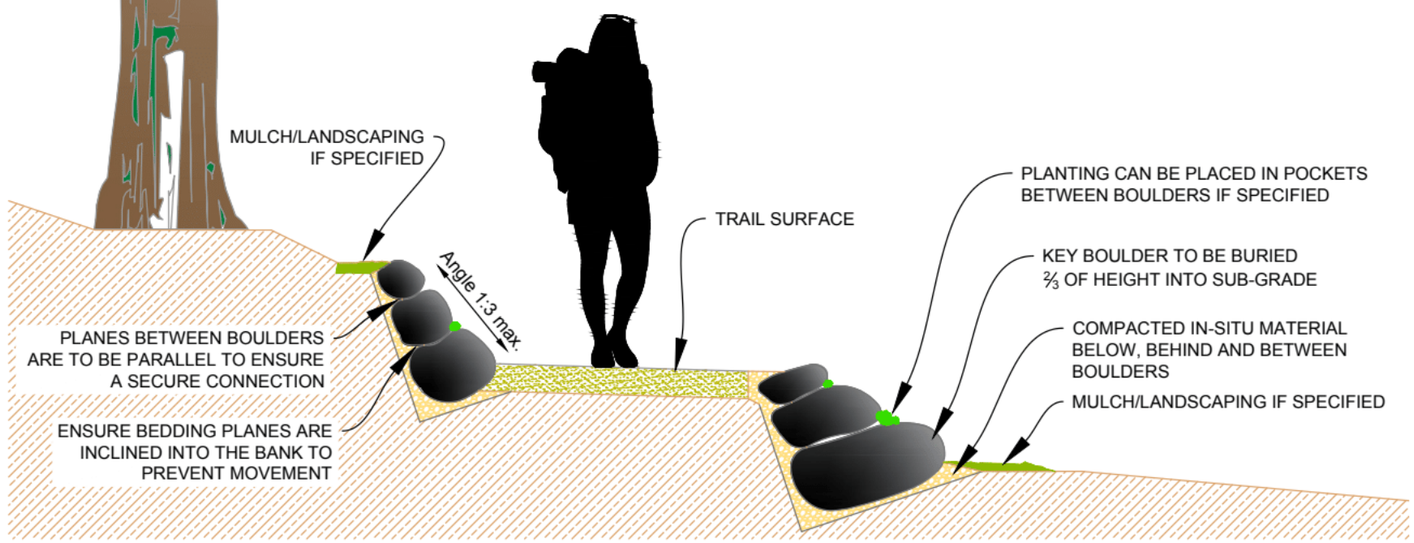
GENERAL:

- Boulders used for the retention wall to be a minimum size of 300mm * 300mm * 300mm.
- The approved boulder type used to form the wall shall be of one consistent type. Typically Granite, Sandstone, Volcanic Red Rock, Phorphyry or other Natural BushRock Boulders unless specified otherwise.
- Boulders as specified with the best and most natural surfaces exposed.
- Sharp / Angled edges are not acceptable.
- Boulder wall to be constructed by an experienced contractor and must not exceed 500mm in height.
- Refer to Standard Drawing WTSTD-004-WG2 for locations where the rock wall needs to be over 500mm.
- Fill used under, behind and between boulders to be in-situ material or equivalent approved material.
- In-situ material is to be compacted to 90% Modified Maximum Dry Density to AS1289.5.4.1.
- This plan depicts boulder walls on both the upside and downside of the track.In many locations only the upside or the downside walls will be required. This plan is meant to be used for the construction of one or the other or both types of retention depending on the local topography.



PLAN VIEW - 500mm BOULDER RETAINING WALL BOTH SIDES

Scale 1:25 @ A3



LEGEND:

- TRAIL SURFACE
- SELECT FILL
- NATURAL GROUND

0 0.5 1 Meters

Scale 1:25 @ A3

TYPICAL SECTION - 500mm BOULDER RETAINING WALL BOTH SIDES

GENERAL ARRANGEMENT
SCALE 1:25

ISSUED FOR CLIENT REVIEW

APPROVED ☐
APPROVED AS NOTED ☐
NOT APPROVED ☐

SIGNED..... DATE.....

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	07/04/20	ISSUED FOR INFORMATION	JR		

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn	JR	Signed	Date 07/04/20
Designed	DS	Signed	Date 07/04/20
Verified	DS	Signed	Date 07/04/20
Approved		Signed	Date

Drawing Title: ROCK WALLING - UP TO 500mm PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale 1:25 | Sheet Size A3
Drawing No. WTSTD-034-WG2 | Rev. A

5.4.6 Retaining Walls (Up To 1000mm)

What is it?

Retaining Walls are larger structures designed to restrain soil to a slope that it would not naturally keep to (typically a steep, near-vertical or vertical slope).

When is it Used?

Retaining Walls are used to retain soils of height up to 1000mm. They may be used to retain the upslope batter or the downslope batter.

Why is it Used?

On steep side slopes, cutting the trail to the desired width of 1500mm may create overly high, unsustainable and unstable betters, either the upslope or downslope batter. The use of a Retaining Wall provides a strong and durable structure that will prevent either batter from slumping.

Notes

Materials

- Rock (can be in situ or imported, subject to land manager requirements);
- Concrete;
- Mortar;
- Geofabric;
- Drainage materials as per drawing.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Concrete mixer;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.

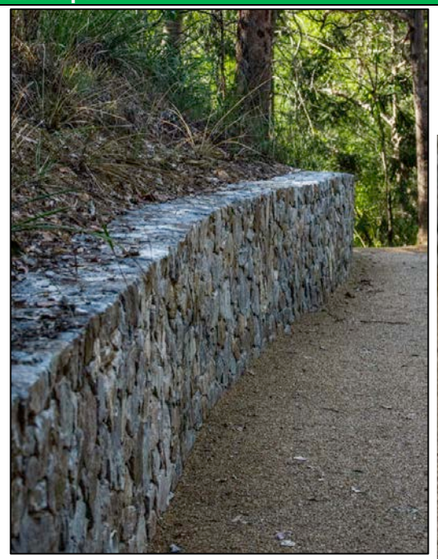
Estimated Length of Treatment

901 metres (of entire 82.15km length of trail)

Drawing Reference

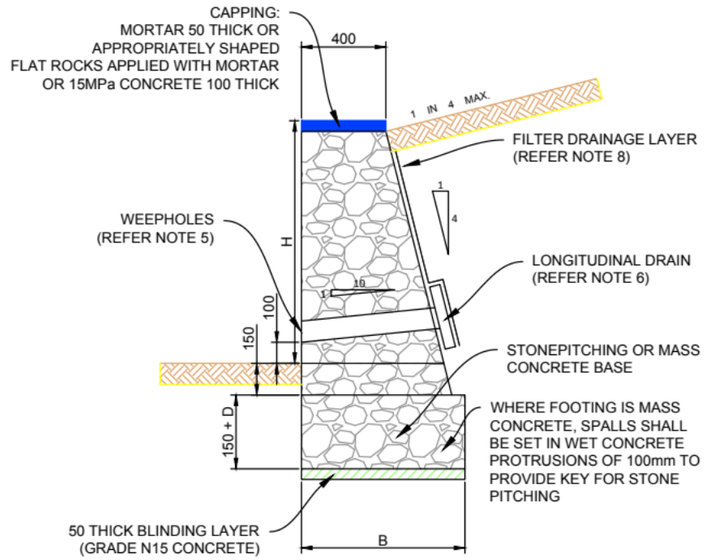
WTSTD-004-WG2
Rock Retaining Wall Up To 1000mm
Placement and Dimensions

Examples

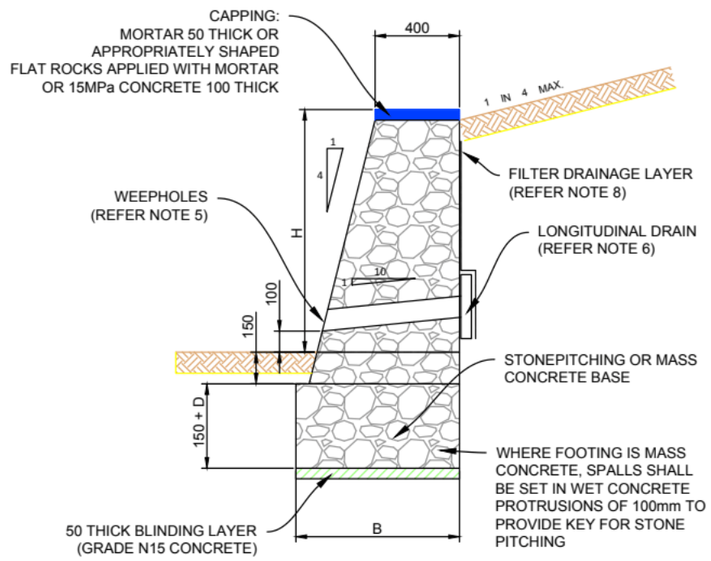


NOTES:

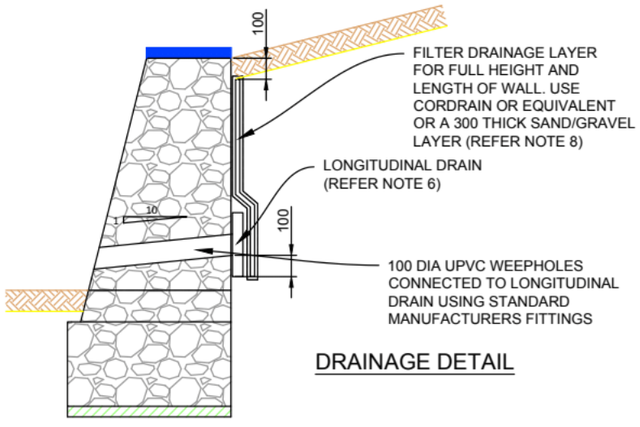
- The wall dimensions shown assume a minimum allowable bearing capacity of 100 KPa is available on site.
- Mortar to be 1 part cement to 3 parts sand (by volume). Face joints to be 25mm nominal width.
- Rocks to be selected spalls set in cement mortar beds in horizontal layers. Unless specified otherwise open faced stonepitching to be used where the concrete is recessed 50mm behind the stone facing. If closed face stonepitching is specified, concrete to be flush with stone facing. Select spalls to avoid sharp edges.
- The standard building regulation 1993 requires that a building application be lodged for earth retaining structures >1000mm high. A geotechnical assessment by a suitably qualified engineer is required for all walls founded in poor materials eg. bearing capacity <100 KPa.
- Install weepholes in addition to the longitudinal drain for maintenance and overflow purposes. Weepholes to be 100mm dia upvc at 1000mm max centres, positioned at approx 100mm constant height above ultimate ground level and connected to the longitudinal drain using standard manufacturers fittings.
- Longitudinal drain shall be 300mm * 50mm megaflow or 100mm dia corrugated perforated polyethylene pipe, encased with geofabric (BIDIM A29 or equivalent). The invert of the longitudinal drain and the weephole inlet shall be aligned to allow direct discharge via the weephole.
- All connection, including the joining of lengths of megaflow or corrugated perforated polyethylene pipe, shall be made using standard manufacturers fittings.
- Filter drainage layer for full height and length of wall to be Cordrain or equivalent with Geofabric (BIDIM A29 or equivalent) adhered to both sides. Alternately, a 300mm thick, free draining filter sand/gravel layer separated from insitu material by a type 2 geofabric layer.
- Backfill shall be freedraining, non plastic predominantly granular material with minimum friction angles of 38° and 27° where founding materials are sand or other materials respectively. Do not place backfill behind the wall until at least 10 days after wall construction.
- The 50mm blinding layer can be replaced with a 200 micron IR2 polyethylene sheet when the bottom off the footing excavation is in stable sound material.
- Drawings are not to scale.
- Dimensions in millimetres unless otherwise notated.



STONEPITCHED RETAINING WALL
VERTICAL FACE
UNSTABLE INSITU MATERIAL RETAINED



STONEPITCHED RETAINING WALL
4 IN 1 FACE SLOPE
UNSTABLE INSITU MATERIAL RETAINED



DRAINAGE DETAIL

WALL DIMENSIONS

SLOPING BACKFILL - 1 IN 4 (MAX) OR LEVEL WITH 5 kPa SURCHARGE		
H	B	D
0 - 400	600	0
401 - 750	660	0
751 - 1000	775	200

ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

GENERAL
ARRANGEMENT
SCALE 1:25

0 0.6 1.2 Meters
Scale 1:25 (typical) @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR	MB	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn	JR	Signed	Date 24/03/20
Designed	DS	Signed	Date 24/03/20
Verified	DS	Signed	Date 24/03/20
Approved		Signed	Date

Drawing Title: ROCK RETAINING WALL UP TO 1000mm PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale 1:25
Sheet Size A3
Drawing No. WTSTD-004-WG2
Rev. A

5.4.7 Ballast Surfacing

What is it?

Ballast Surfacing is a two-course surfacing treatment, used to raise and/or harden the surface of the trail.

When is it used?

Ballast Surfacing is used in high traffic areas, sunken or low-lying areas, wet or boggy areas, or areas requiring the passage of vehicles. Due to the high bulk material requirements, it is usually only used in areas where vehicle access is available nearby to import materials.

For the Wangetti Trail, this treatment is proposed to treat sections of existing, eroded, sunken four-wheel drive tracks in the flat terrain immediately south of Wangetti. In this area, the trail comes very close to the Captain Cook Highway to skirt around a military firing range. This proximity to the highway provides good access for trucks.

Why is it used?

Ballast Surfacing can be used for a variety of purposes - to harden the surface in high traffic areas, to provide a more uniform or level surface, to improve traction or for aesthetic purposes.

Notes

At the outset of the construction process, works should be undertaken to identify suitable surfacing materials that are locally available and that can be certified to weed/pathogen free status for land manager approval.

Materials

- Ballast rock for base course (as per drawing)
- Fine crushed rock for wearing course (as per drawing);
- Geofabric (as per drawing).

Machinery / Equipment

- Rubber tracked mini-excavator;
- Skid-steer excavator (i.e. Bobcat) for spreading;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.;
- Small dumper or mechanized wheelbarrow (i.e. power carriers) for moving the material along the trail from the stockpile location;
- Roller or vibrating plate compactor.

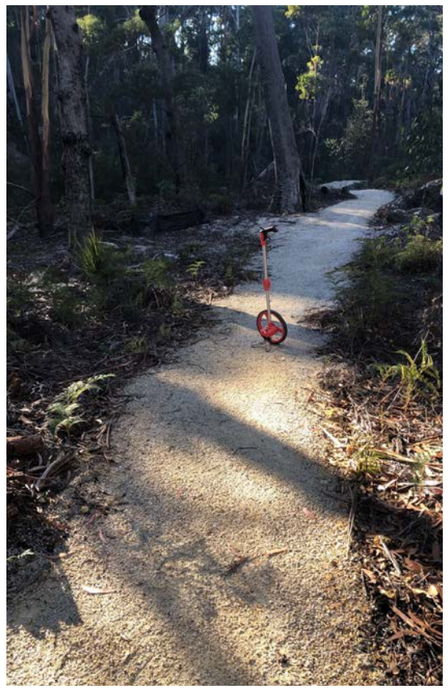
Estimated Length of Treatment

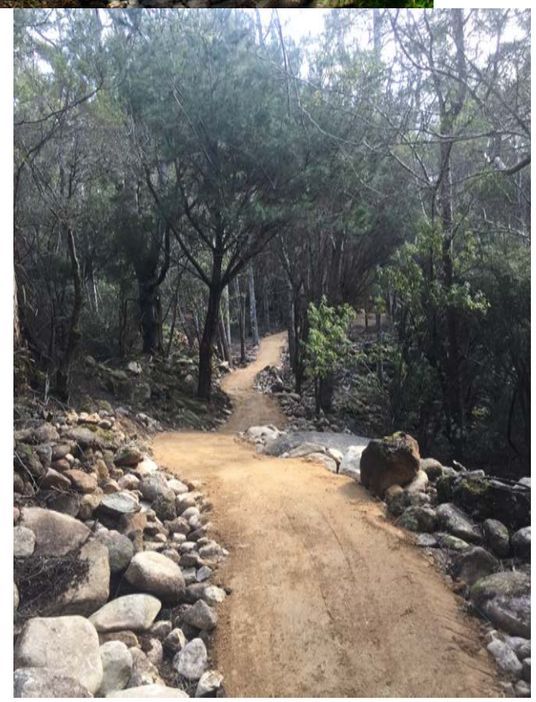
4,595 metres (of entire 82.15km length of trail)

Drawing Reference

WTSTD-045-WG2
Ballast Surfacing
Placement and Dimensions

Examples





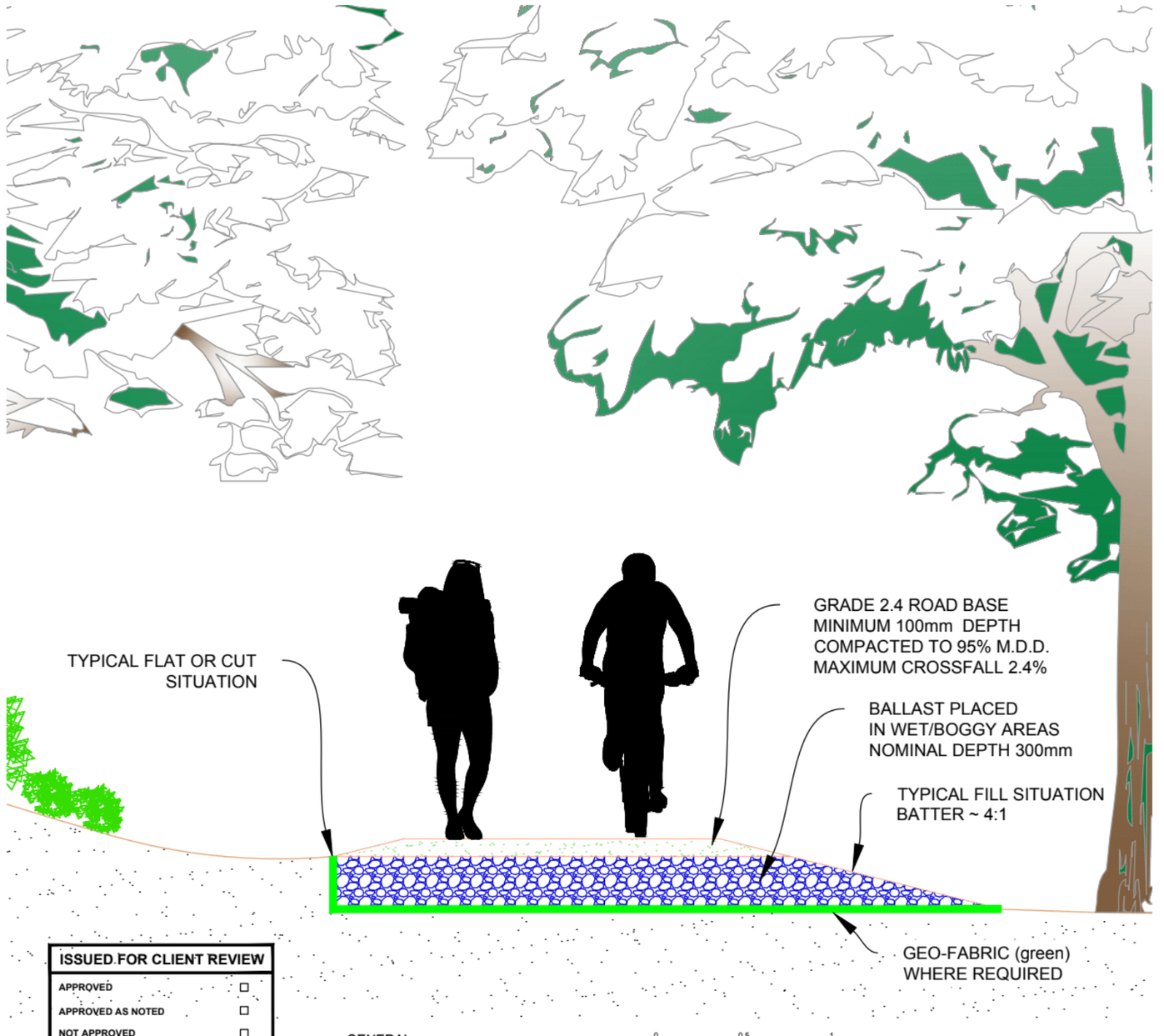
NOTES:

GENERAL:

- Dual direction (two way) trail.
- Dual use trail for walking and biking.
- The trail will provide access along a slightly modified, natural environment alignment, with little provision of interpretive signage and few facilities.
- Ballast surfacing is to be used in wet & boggy locations to provide a solid platform for the trail wearing course layer.
- Ballast is to be placed in such a way that it does not severely impede local stormwater flows.
- Locations where the placement of Ballast might impede the natural connectivity of fauna corridors should be identified and remediation infrastructure such as pipes or sections of boulder crossing implemented in a way that will mitigate the blockage.
- Dimensions in millimetres unless otherwise notated.

BALLAST PLACEMENT:

- Ballast shall be clean, durable crushed rock with a size distribution of 13mm to 63mm. The majority of particles shall be greater than 37.5mm in size.
- The Ballast rock shall be hard, non - flaky material with a Bulk Density greater than 1200 Kg/m³ and a Particle Density of greater than 2500 Kg/m³.
- The nominal depth of 300mm depicted may vary considerably, depending on the depth of unsuitable sub-grade material at each location.
- Trail width may increase from the general width in the sections with Ballast Surfacing. This is to allow additional shoulder width for trail users through these unsuitable locations.
- The width of the Ballast may extend up to 3m in particularly boggy areas to provide a stable platform for trail construction.
- Geofabric underlay of a suitable class may be required under the Ballast to minimise the intrusion of unsuitable material up into the Ballast embankment.
- Ballast should be compacted using wheel or track rolling, until the particles are firmly meshed and void spaces are minimised.
- In extreme locations and where low velocity water flows are possible, Geo-Fabric of a suitable class may also be required on top of the Ballast and under the Trail wearing course layer. In these locations the wearing course layer thickness may need to be increased to 150mm or 200mm.



ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

GENERAL ARRANGEMENT
SCALE 1:25

0 0.5 1 Meters

Scale 1:25 @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	07/04/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn	JR	Signed	Date 07/04/20
Designed	DS	Signed	Date 07/04/20
Verified	DS	Signed	Date 07/04/20
Approved		Signed	Date

Drawing Title: BALLAST SURFACING PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale 1:25
Sheet Size A3
Drawing No. WTSTD-045-WG2
Rev. A

5.4.8 Pre-Cast Concrete Steps

What is it?

Pre-Cast Concrete Steps are used to climb up/down steep sections of trail on hikers only sections.

When is it Used?

Pre-Cast Concrete Steps allow the trail to climb up/down steep slopes, while ensuring good traction and stability for hikers. They are not suitable generally for dual-use or mountain biking trails.

Why is it Used?

On steep slopes hikers may struggle to maintain traction, especially with a heavy pack, creating risks to safety and possible damage to the trail surface. The use of Pre-Cast Concrete Steps provides a safer and more sustainable outcome, while also hardening the surface and ensuring its long-term sustainability.

Notes

The Pre-Cast Concrete Steps detailed here result in a gradient of 28^{o} along a flight of these steps (approx. 31% gradient).

Materials

- Pre-cast concrete steps (available in different sizes);
- Concrete for foundation of base step;
- Road base for foundation of mid-flight steps;
- Mortar;
- Large rocks as corrals;
- Anchors to sides of flight of steps.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.;
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.;
- Concrete mixer;
- Vibrating plate compactor.

Estimated Length of Treatment

1,000 steps

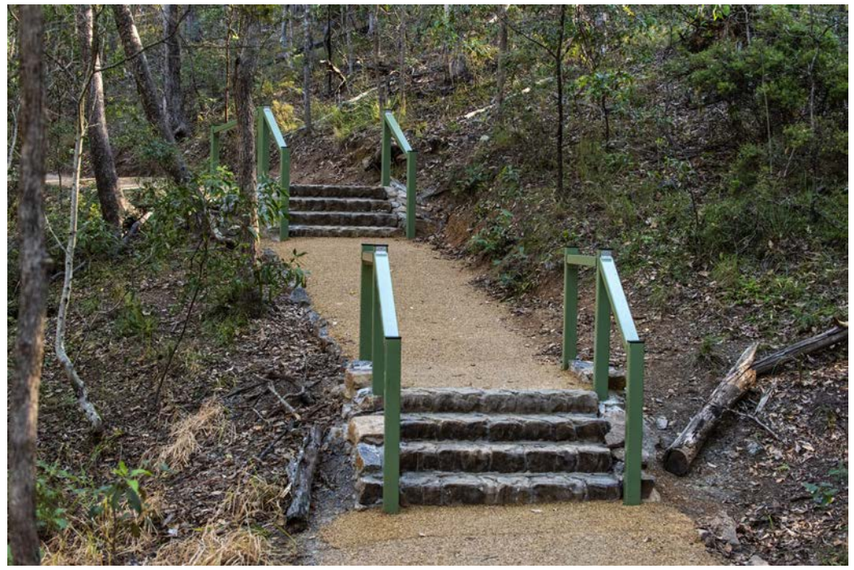
Drawing Reference

WTSTD-003-WG2
Precast Concrete Steps
Placement and Dimensions

WTSTD-043-WG2
Rock Pavement Treatment
Trail Construction

WTSTD-030-WG2
Precast Concrete Steps
Trail Grading Guidelines

Examples



NOTES:

STEP TREADS:

- Step treads are to be supplied by the Paving Group Pty Ltd trading as Stone Directions or equivalent treads as approved by the client or project principle.
- Step treads are precast from a 4:1 white Portland cement mix using screened crushed granite, high grade quartz/sandstone washed sand and fibre reinforcing.
- Steps meets around 55MPa material strength.
- Step treads are available in 4 widths: 1500mm, 1200mm, 900mm & 600mm.
- Other dimensions are as depicted on this plan and include a 50mm overlap between treads.
- In accordance with AS 2156.2 - 2001 Table 4, a Class 3 Walking Track can include up to 36 steps in a row before a landing is required.
- Landings will be a minimum of 900mm in length.
- The specifications of the precast concrete steps depicted in this drawing result in an overall slope/gradient of 28°.
- In some locations, ground conditions may not be conducive to this preset slope. Three options can be considered in these circumstances:
  1. Using hand tools, excavate the insitu ground to form the required slope.
  2. Import and compact suitable road base to form the ideal slope.
  3. Use landings (of varying lengths) to suit the existing slope of the work area.

HANDLING:

- Step treads should be handled using techniques appropriate to the item weight. See the adjacent table for approx. tread weights.
- Treads should be handled in a manner that minimizes the risk of cracking or fracture as treads must be undamaged or weakened before track use.

SITE FOUNDATION MATERIALS:

- The foundation materials on which the stairway is to be constructed must be carefully assessed for foundation rigidity.
- If foundation material conditions are not obvious or the site includes dangerous fall conditions a geotechnical analysisof the foundation materials should be undertaken.
- The foundation materials need to be assessed as to whether they are "Unstable or Sandy" or "Stable".
- Placement methodologies vary depending on this classification.

PLACEMENT:

UNSTABLE or SANDY FOUNDATION MATERIALS:

- The first step must be laid on a concrete slab footing of minimum 75mm depth.
- Concrete is to be minimum 15 MPa which allows the use of post mix or rapid set premix concrete.
- This slab footing must be a minimum of the length and breadth of the precast tread unit.
- The tread unit should be laid level apart from a slight fall to the front on the footing using 10 to 15mm of 4:1 mortar mix.
- Additional tread units should be laid with a 50mm overlap over the previous tread and with either another slab footing the size of the tread or at a minimum a strip footing along the sides and back of the tread.
- The strip footing should be a minimum of 100mm wide by 75 mm deep.
- The additional tread should again be laid on a 10 to 15mm mortar bed and levelled to provide a slight fall to the front of around 10mm.
- More additional treads can be added using a similar methodology.
- All slab and strip footings should be laid in an excavation or bounded with suitable rocks or local material to ensure concrete overflow does not impede backfill against the finished stairway using soils or rock protection.

STABLE FOUNDATION MATERIALS:

- Treads may be laid directly onto hard stable surfaces (eg shale or granite type materials) plumbed and leveled using a 4:1 mortar mix.
- Treads may be laid directly onto a well compacted 75mm layer of good quality road base again using a 4:1 mortar mix.
- The road base must be contained within an excavation or by appropriate retention rocks to facilitate compaction.
- Where this containment is not possible a concrete slab footing must be used particularly on the bottom tread.
- The contained road base or concrete footing must be at least the full size of the tread.
- Additional treads can be laid on well compacted road base using 10-15mm 4:1 mortar mix with a 50mm overlap over the previous tread.

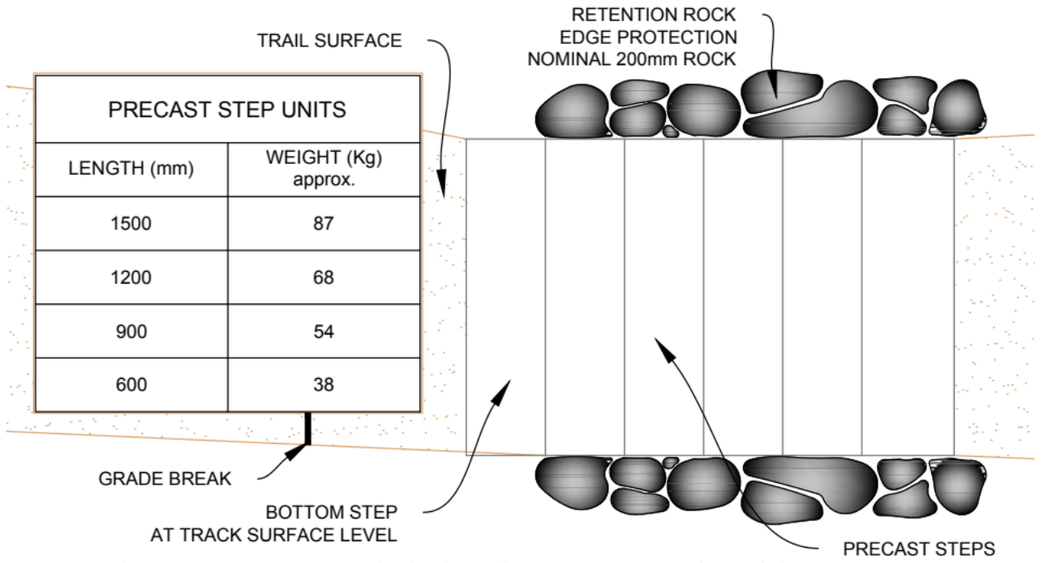
GENERAL PLACEMENT

- The mortar mix should be continuous around the bottom edge of the tread unit with some mortar will overflow up and into the hollow part of the tread unit to assist in holding the tread in place.
- The mortar mix must be placed on solid material with all flaky or loose material removed to ensure good bonding.
- The treads are designed to have a 300mm run and a 165mm rise. The mortar depth is critical in achieving this run/rise ratio.
- Additional side support to ensure the treads remain in place can be provided through backfill against the sides using soils or retention rock.
- Retention rock should be used in areas where water flows are likely to occur. Retention rock can be bound in place using a 4:1 mortar mix.
- Step treads are supplied with 3 pattern styles. Ensure styles are mixed and matched to avoid any obvious symmetry and maximize a "natural look".
- Dimensions in millimetres unless otherwise notated.

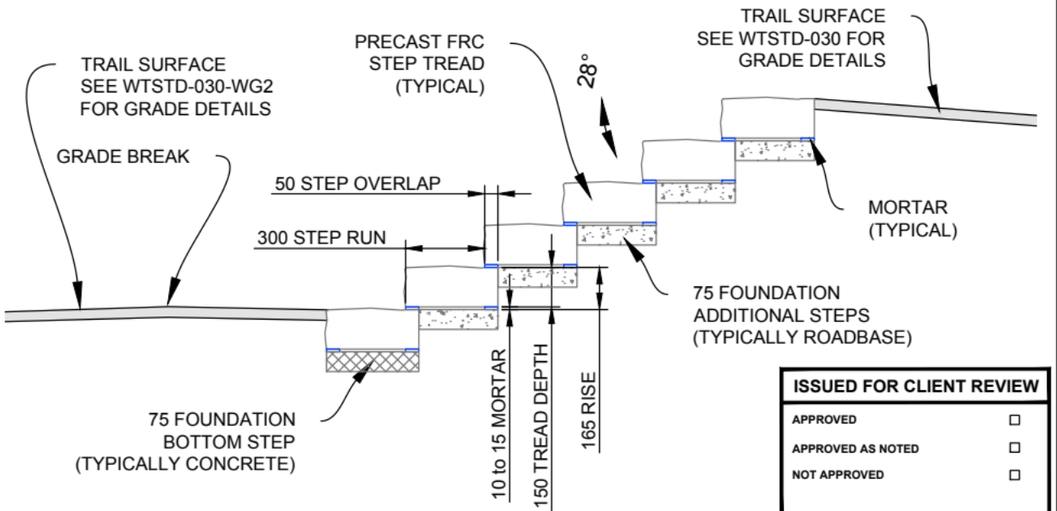
TRAIL ALIGNMENT

- See WTSTD-030-WG2 for details on trail grading requirements above, below & at landings between stair sections.

PRECAST STEP UNITS	
LENGTH (mm)	WEIGHT (Kg) approx.
1500	87
1200	68
900	54
600	38



TYPICAL PLAN VIEW - PRECAST STEPS WITH RETENTION ROCK



TYPICAL SECTION PRECAST STEPS - 5 STEP EXAMPLE

ISSUED FOR CLIENT REVIEW	
APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐
SIGNED..... DATE.....	

GENERAL ARRANGEMENT
SCALE 1:20

0 0.6 1.2 Meters

Scale 1:20 @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
E	07/04/20	TRAIL GRADE & BOTTOM STEP ALTERED	JR	DS	DS
D	14/08/19	ADDITIONAL NOTES ADDED	JR	DS	DS
C	07/08/19	RETENTION ROCK PLAN VIEW ADDED	JR	DS	DS
B	17/12/18	ADDITIONAL NOTES ADDED	JR	DS	DS
A	22/11/18	ISSUED FOR INFORMATION	JR	DS	DS

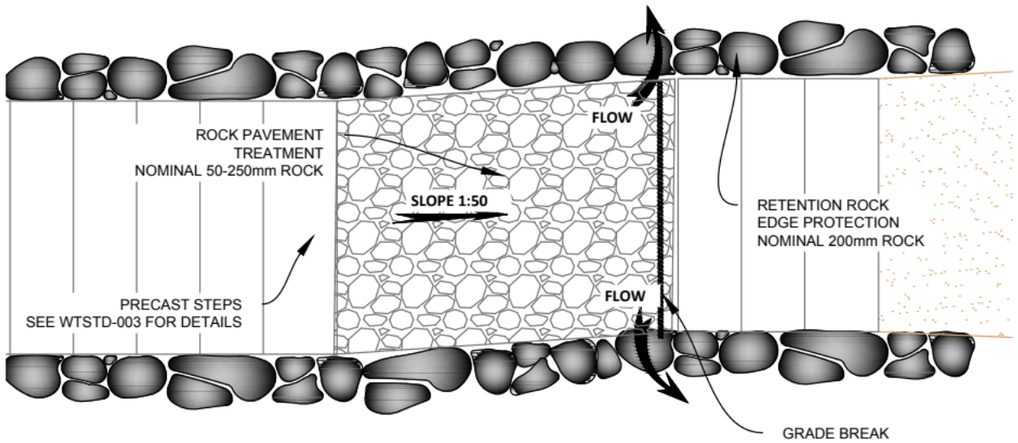
Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

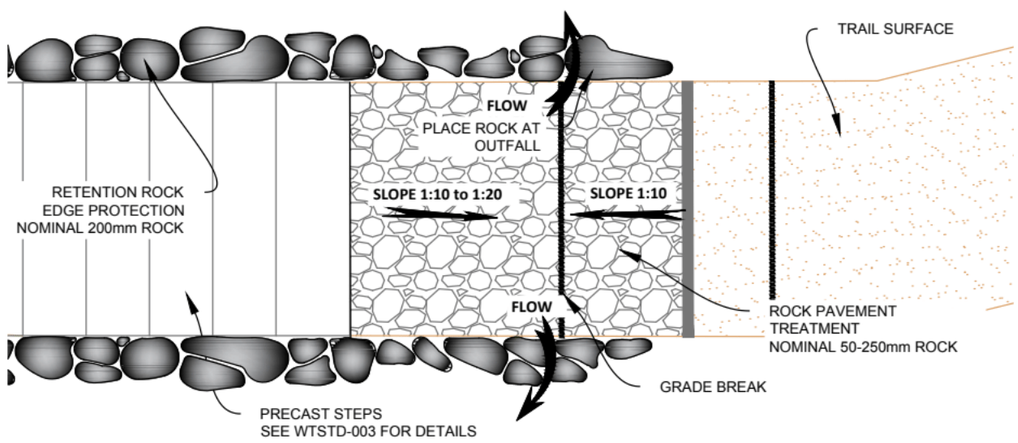
Drawn JR	Signed	Date 07/04/20	
Designed DS	Signed	Date 07/04/20	
Verified DS	Signed	Date 07/04/20	
Approved	Signed	Date	

Drawing Title: PRECAST CONCRETE STEPS PLACEMENT AND DIMENSIONS STANDARD DRAWING

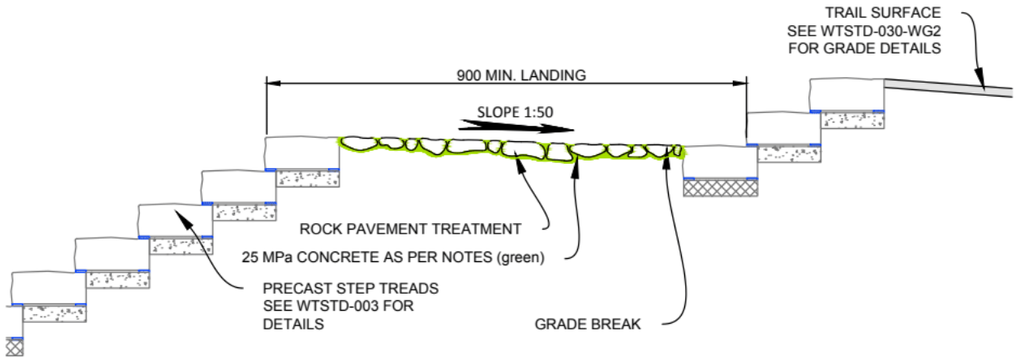
Project No. WT20-Wangetti-001	
Scale 1:20	Sheet Size A3
Drawing No. WTSTD-003-WG2	Rev. E



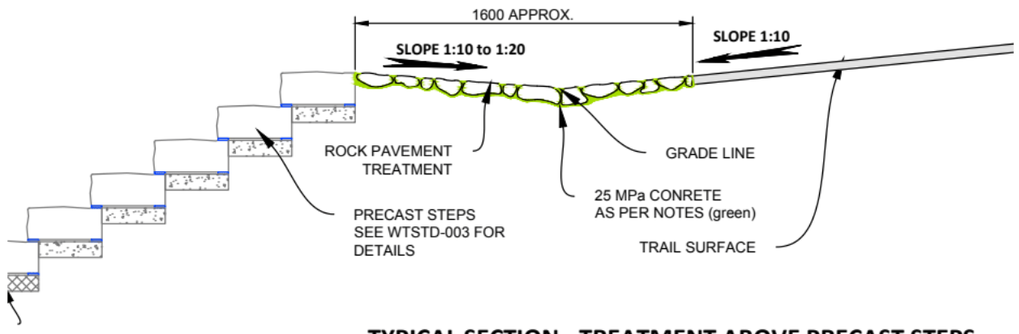
TYPICAL PLAN VIEW - ROCK PAVEMENT TREATMENT AT LANDING



TYPICAL PLAN VIEW - TREATMENT ABOVE PRECAST STEPS



TYPICAL SECTION - ROCK PAVEMENT TREATMENT AT LANDING



TYPICAL SECTION - TREATMENT ABOVE PRECAST STEPS

NOTES:

GENERAL:

- The main objective of the rock pavement treatment is to minimise linear stormwater flows cascading down steps and along the trail alignment.
- The main principle in avoiding this is to provide a protected surface near grade changes where water flows may concentrate.
- While this treatment is mainly to be used above or between precast steps, it may be appropriate to other grade change or susceptible sections of a trail.
- While rock armouring, see WTSTD-007-WG2, is similar, it is proposed for use in areas where water transversely crosses the trail. It would require larger rock due to the higher flow velocities expected at those locations.
- Rock Pavement Treatment is the use of smaller, preferably flat, rocks to provide a walkable, hardened trail surface that will not erode through smaller localised stormwater flows.
- The dimensions and slopes depicted in this drawing may need to be modified to suit the particular topography and natural water flows identified at the specific location of the treatment.
- Rock Pavement Treatment can be used in landings.
- The rock pavement treatment should interlink and mesh into the rock treatment along the edges of staircases as depicted in WTSTD-030-WG2.
- The rock treatment should follow the Grading Guidelines depicted in WTSTD-030-WG2.
- While not depicted in this drawing, the rock pavement treatment may be appropriate at the bottom of staircases where the ground is prone to softness and muddiness.
- Any major deviations from these layouts must be approved by the project principle or their relevant responsible officer.

PLACEMENT:

- Rock is to be nominally 100mm to 250mm in size with at least one reasonable flat face to enable a finished, walkable surface.
- Rocks are to be placed in such a way that they are interlocked and well bedded into a 25 MPa concrete bed poured onto the spoon drain foundation.
- 25 MPa Concrete to be poured into the gaps between the rocks and along the edges to form a neat transition to the trail surface.
- All exposed concrete should be finished to a rough texture to minimise slipping and provide further roughage to impede water flows.
- The tops of the rocks should be cleaned of concrete to provide a natural finish.
- Concrete should be tamped to ensure there is no air entrapment and that the concrete is placed firmly against the foundation material.

ISSUED FOR CLIENT REVIEW	
APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐
SIGNED.....	DATE.....

0 0.75 1.5 Meters

GENERAL ARRANGEMENT
SCALE 1:25

Scale 1:25 @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	07/04/20	ISSUED FOR INFORMATION	JR	DS	DS

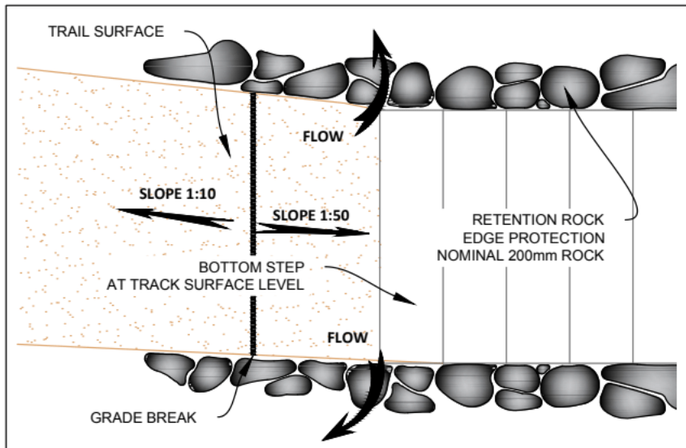
Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

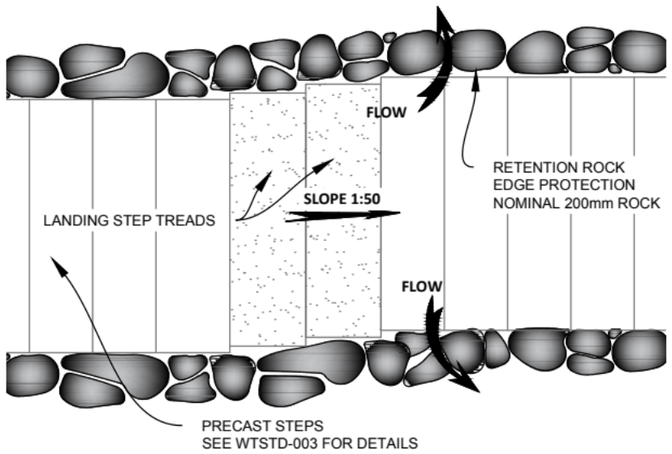
Drawn JR	Signed	Date 07/04/20	
Designed DS	Signed	Date 07/04/20	
Verified DS	Signed	Date 07/04/20	
Approved	Signed	Date	

Drawing Title: ROCK PAVEMENT TREATMENT TRAIL CONSTRUCTION STANDARD DRAWING

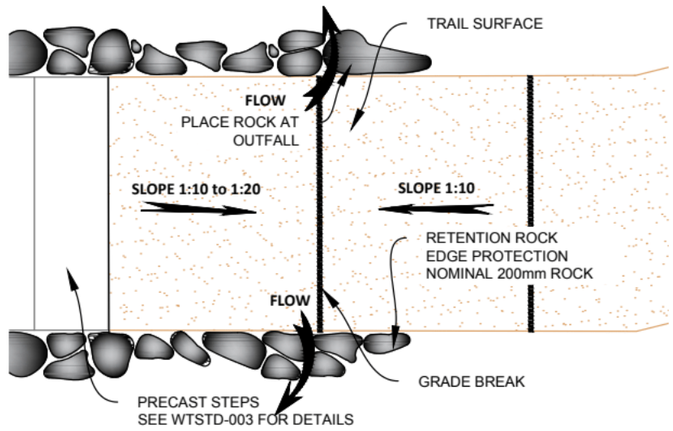
Project No. WT20-Wangetti-001	
Scale 1:25	Sheet Size A3
Drawing No. WTSTD-043- WG2	Rev. A



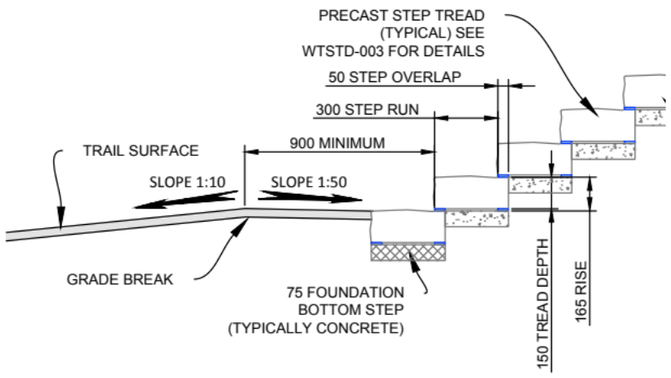
TYPICAL PLAN VIEW - TRAIL BELOW PRECAST STEPS



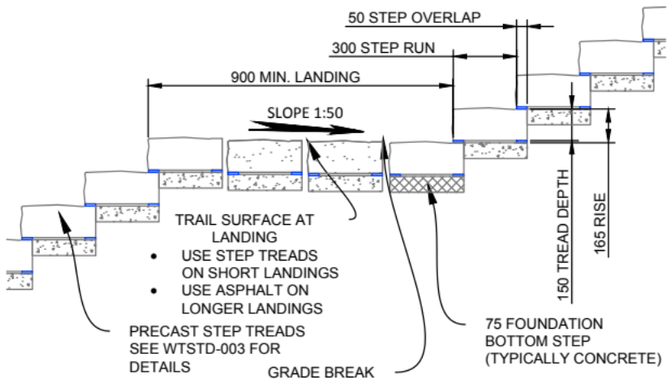
TYPICAL PLAN VIEW - PRECAST STEPS WITH LANDING



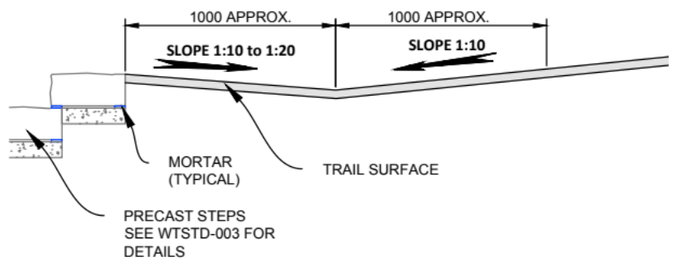
TYPICAL PLAN VIEW - TRAIL ABOVE PRECAST STEPS



TYPICAL SECTION - TRAIL BELOW PRECAST STEPS



TYPICAL SECTION - PRECAST STEPS WITH LANDING



TYPICAL SECTION - TRAIL ABOVE PRECAST STEPS

NOTES:

GENERAL:

- The main objective of the grading guidelines depicted is to provide solutions to minimise linear stormwater flows cascading down the steps and along the trail alignment.
- The main principle in avoiding this is to shed small amounts away from the trail alignment before they can concentrate into large volume flows.
- By shedding water above, between and below stairs, the flows down the stairways will be minimised.
- Details of placement of the precast step units depicted can be found in WTSTD-003-WG2.
- The dimensions and slopes depicted in this drawing may need to be modified to suit the particular topography and natural water flows identified at the specific location of the structure.
- On landings less than 1400mm long, step treads or concrete infill may be used instead of asphalt.
- Any major deviations from these layouts must be approved by the project principle or their relevant responsible officer.

EROSION PROTECTION

- The locations where water flows are shedded from the trail alignment need to be protected by rock and constructed in such a way as to disperse the discharging stormwater in a way that will not cause scouring in the receiving environment.
- Careful consideration needs to be given to assessing the type of material at the discharge location for its likelihood of scouring.
- Additional consideration must also be given to ensure the flow of water is not causing scouring, erosion or flooding further down the flowpath from the trail outfall point.
- Where the material in the discharge path has a high potential to scour, additional measures such as rock chutes, reinforcement or dispersion channels may be required.
- The need for additional protection may be identified and requested by the project principle or their relevant responsible officer.
- Any additional protection measures must be approved by the project principle or their relevant responsible officer.

ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

GENERAL ARRANGEMENT
SCALE 1:25

0 0.5 1 Meters

Scale 1:25 @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	07/04/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 07/04/20
Designed DS	Signed	Date 07/04/20
Verified DS	Signed	Date 07/04/20
Approved	Signed	Date

Drawing Title: PRECAST CONCRETE STEPS TRAIL GRADING GUIDELINES STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale 1:25 Sheet Size A3
Drawing No. WTSTD-030-WG2 Rev. A

5.4.9 Natural Rock Seats

What is it?

Natural Rock Seats are used at rest locations to provide seating.

When is it Used?

Natural Rock Seats are used when there is a good opportunity to provide a formalised rest spot – generally a location that has good views/ambience, or where it may be deemed necessary to create a rest (i.e. part way up a long climb).

Generally, this treatment is best suited to locations with lots of loose, suitable sized rock available, as importing rock for this treatment would be onerous and costly.

Why is it Used?

Stone is the most durable material for constructing trail furniture.

Notes

Materials

- Rock (can be in situ or imported, subject to land manager requirements);
- Concrete;
- Mortar;
- Geofabric;
- Drainage materials as per drawing.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Concrete mixer;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.;
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.

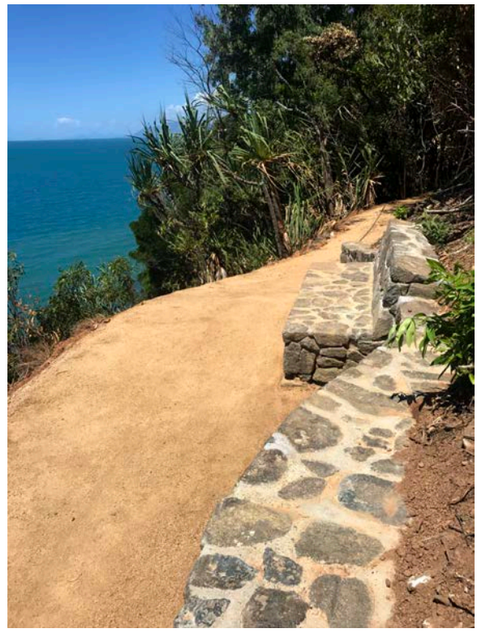
Estimated Length of Treatment

20 stone seats

Drawing Reference

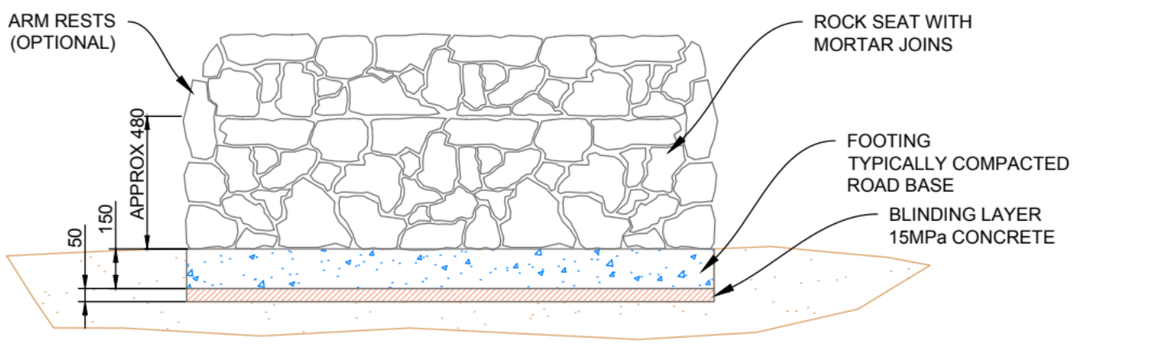
WTSTD-005-WG2
Natural Rock Seat
Placement and Dimensions

Examples



NOTES:

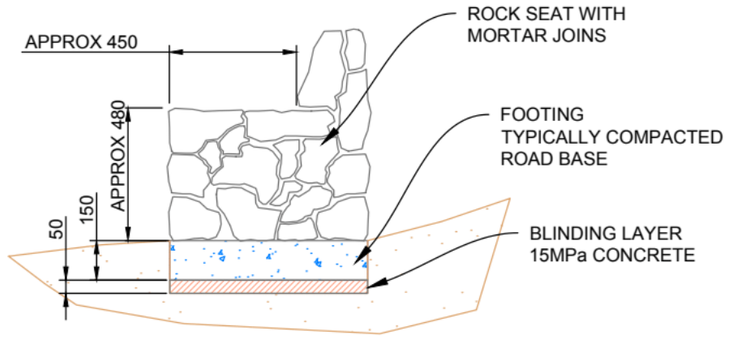
- The seat design depicted is a single seat layout that represents a whole range of possible configurations.
- Seats may in a line, curved, built into a retaining wall and can be anywhere from 1 to many metres in length.
- Seats may have a back rest as depicted or may be constructed as a bench with no backrest at all. When associated with a retaining wall, the wall can become the backrest.
- Rock used for seat construction must be of an appropriate shape, texture and colour to match the native rock and must provide a natural appreearance relative to its location .
- Mortar to be 1 part cement to 3 parts sand (by volume). Face joints to be 25mm nominal width.
- Rocks to be selected spalls set in cement mortar beds in horizontal layers. Unless specified otherwise open faced stone pitching to be used where the concrete is recessed 50mm behind the stone facing. If closed face stonepitching is specified, concrete to be flush with stone facing. Select spalls to avoid sharp edges.
- Where the seat is associated with a retaining wall it must not impede the drainage system constructed behind and through the wall.
- Weepholes from the retaining wall must continue through the seat through 100mm dia upvc at 1000mm max centres, positioned at a slope of 1 in 10.
- All connection, including the joining of lengths of megaflow or corrugated perforated polyethylene pipe, shall be made using standard manufacturers fittings.
- In stable foundation materials the 150mm seat footing can be constructed using well compacted road base. The outer edges must be scraped back to a clean hard surface so that the bottom layer of mortar will adhere to the surface.
- In unstable or high clay foundations the footing must be constructed using 15MPa concrete and the bottom row of rocks are to embedded around 100mm into the concrete.
- The core of the seat can be filled with well compacted good quality granular material with minimal clay content.
- The 50mm blinding layer can be replaced with a 200 micron IR2 polyethylene sheet when the bottom off the footing excavation is in stable sound material.
- Dimensions in millimetres unless otherwise notated.



TYPICAL NATURAL ROCK SEAT
FRONT VIEW

0 0.6 1.2 Meters

Scale 1:20 @ A3



TYPICAL NATURAL ROCK SEAT
SIDE VIEW

ISSUED FOR CLIENT REVIEW

APPROVED ☐
APPROVED AS NOTED ☐
NOT APPROVED ☐

SIGNED..... DATE.....

GENERAL
ARRANGEMENT
SCALE 1:20

0 0.6 1.2 Meters

Scale 1:20 @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR		

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 24/03/20	
Designed DS	Signed	Date 24/03/20	
Verified DS	Signed	Date 24/03/20	
Approved	Signed	Date	

Drawing Title: NATURAL ROCK SEAT PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale 1:20 | Sheet Size A3
Drawing No. WTSTD-005-WG2 | Rev. A

5.4.10 Rock Armouring

What is it?

Rock Armouring is a technique used to harden the trail surface, using rocks of 400-800mm in size, embedded into the ground to create a hard, rock paved surface.

When is it Used?

Rock Armouring is used in the following situations:
1. Sections of track that are often wet and boggy, where no alternate route is available – for example, where the trail crosses a drainage line;
2. On steep gradients, to reduce the potential for erosion and to provide traction for users;
3. In high traffic areas to prevent erosion or compaction.

Why is it Used?

Rock Armouring is used to prevent soil erosion and compaction, to provide traction for users, or to harden the trail surface in boggy areas. It is often used to cross small seasonal watercourses or drainage gullies. Rock Armouring is sometimes the only way to ensure the sustainability of a trail.

Notes

Rock Armouring will resist erosion and last for many years, if constructed correctly.

Materials

- Rock (can be in situ or imported, subject to land manager requirements).

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.;
- Ropes, pulleys, winches, chains, straps and rock slings to assist in manipulating rocks into place.

Estimated Length of Treatment

2,315 metres (of entire 82.15km length of trail)

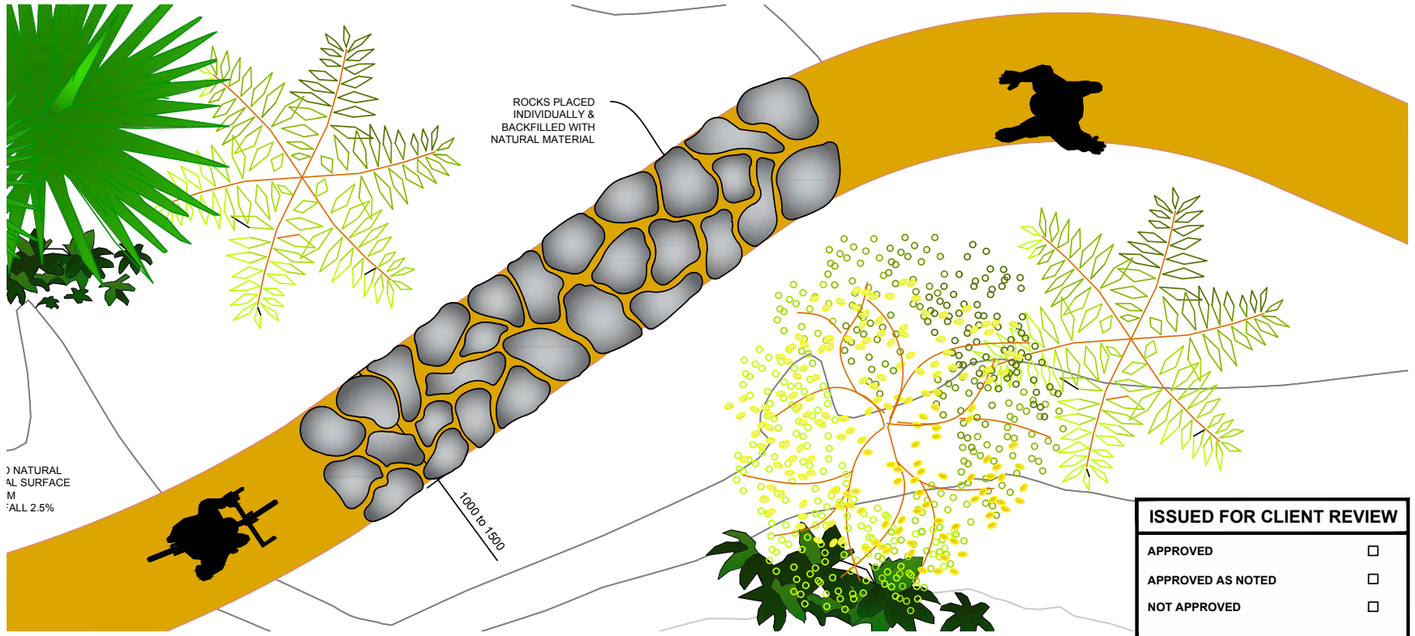
Drawing Reference

WTSTD-007-WG2
Rock Armouring – Dual Use
Placement and Dimensions

Examples

NOTES:

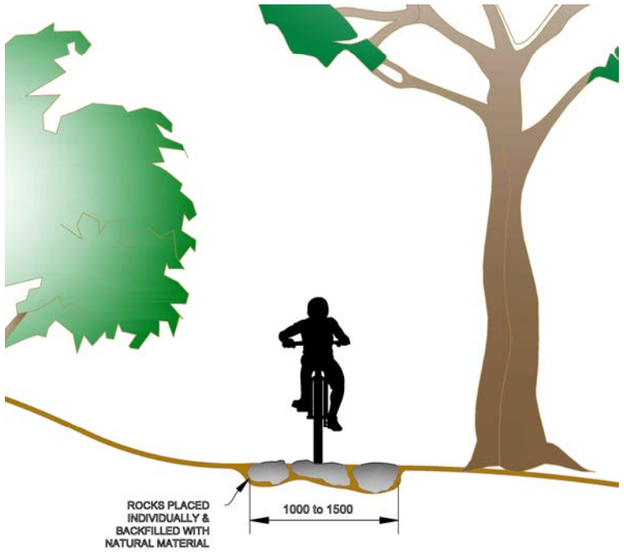
- Rock Armouring (RA) is to be used in trail sections that are often wet and boggy or to reduce erosion and increase traction on steeper trail sections.
- RA consists of natural or imported rock depending on availability with a minimum size of 400mm and up to 800mm.
- Typical dimensions for rock armoured areas would be 1200mm (minimum) wide and often 5000mm long
- RA sections may be straight or curved depending on the local topography and the track alignment at that location.
- Rocks are to be placed into the wet foundation material and backfilled with dry graded local material that is of a similar consistency to the general track surface.
- Each rock should be bedded into graded foundation material in such a way that it will remain stable with no rocking or misplacement.
- Rocks used for armouring should be of an appropriate shape, texture and colour to match the native rock and must provide a natural appearance relative to its location .
- Rocks should be placed so that the top surface provides reasonable traction for cycle and foot traffic. Distance between rocks will depend on the degree of "bogginess" and the ability of the foundation material to hold up the backfill material between the individual rocks.
- The texture of the top surface of the rocks should allow for reasonable traction for cycle and foot traffic with minimal slippage.
- Once the rocks have been placed, natural topsoil should be raked or swept into the gaps between the rocks and compacted to minimise future slumping or rock instability.

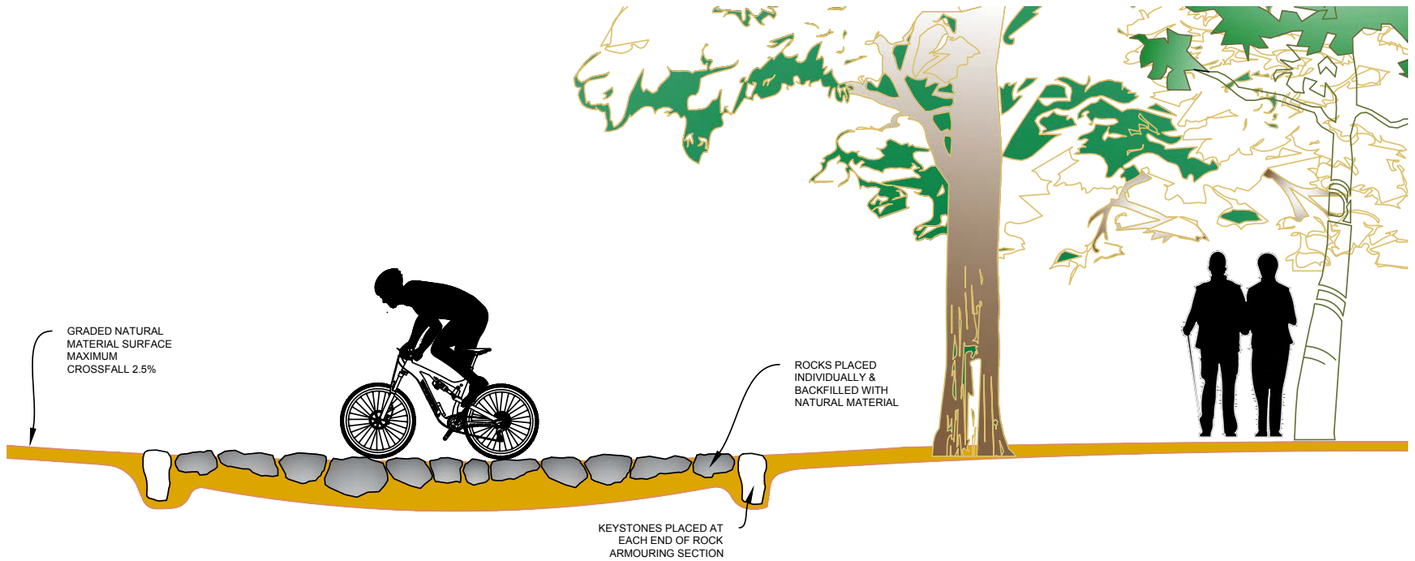


ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....





0 1.5 3 Meters Scale 1:50 @ A3

GENERAL ARRANGEMENT
SCALE 1:50

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn	JR	Signed	Date 24/03/20
Designed	DS	Signed	Date 24/03/20
Verified	DS	Signed	Date 24/03/20
Approved		Signed	Date

Drawing Title: ROCK ARMOURING - DUAL USE PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

Project No.	WT20-Wangetti-001
Scale	1:50
Sheet Size	A3
Drawing No.	WTSTD-007-WG2
Rev.	A

5.4.11 Boulder Water Crossings

What is it?

Boulder Water Crossings are structures made of rocks or boulders, used to allow passage of riders and hikers across a small watercourse, while minimising sedimentation.

When is it Used?

Boulder Water Crossings are used when the trail crosses a small permanent watercourse and there is suitable large rock or boulders available locally to construct a Boulder Water Crossing. Boulder Water Crossings should only be considered in watercourses with slow water velocities and a depth of less than 1m during high flows.

Why is it Used?

Boulder Water Crossings are used to facilitate safe crossing of small watercourses, keeping riders and hikers largely above the water. It is preferable to the construction of bridges or structures that require the importation of man-made materials. They are long lasting, relatively inexpensive, impervious to bushfire and maintain a natural appearance relative to their location and setting.

Notes

Boulder Water Crossings do not interfere with the movement of water, sediment or aquatic life when they are properly constructed.

Materials

- In situ rock / boulders, large enough to resist movement in high flow.
- No imported materials.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.;
- Ropes, pulleys, winches, chains, straps and rock slings to assist in manipulating rocks into place.

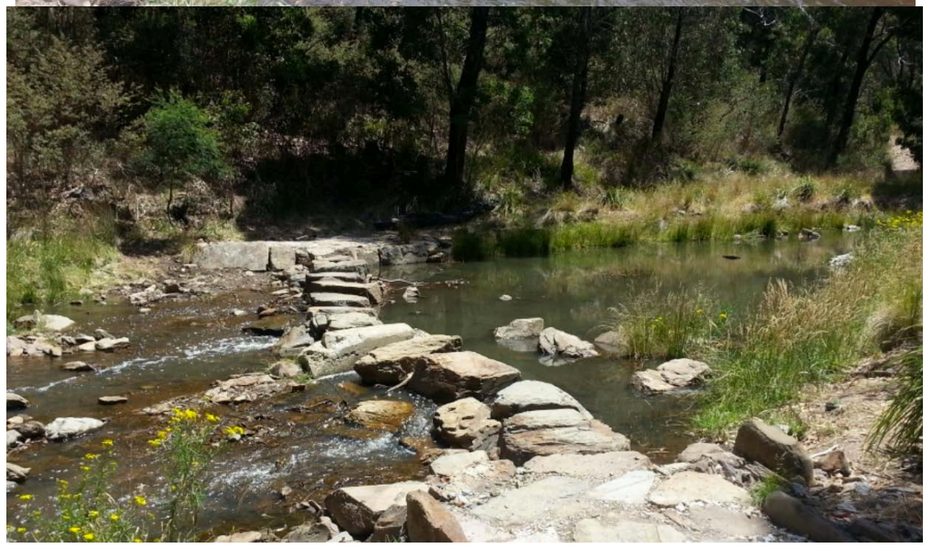
Estimated Length of Treatment

1,166 metres (of entire 82.15km length of trail)

Drawing Reference

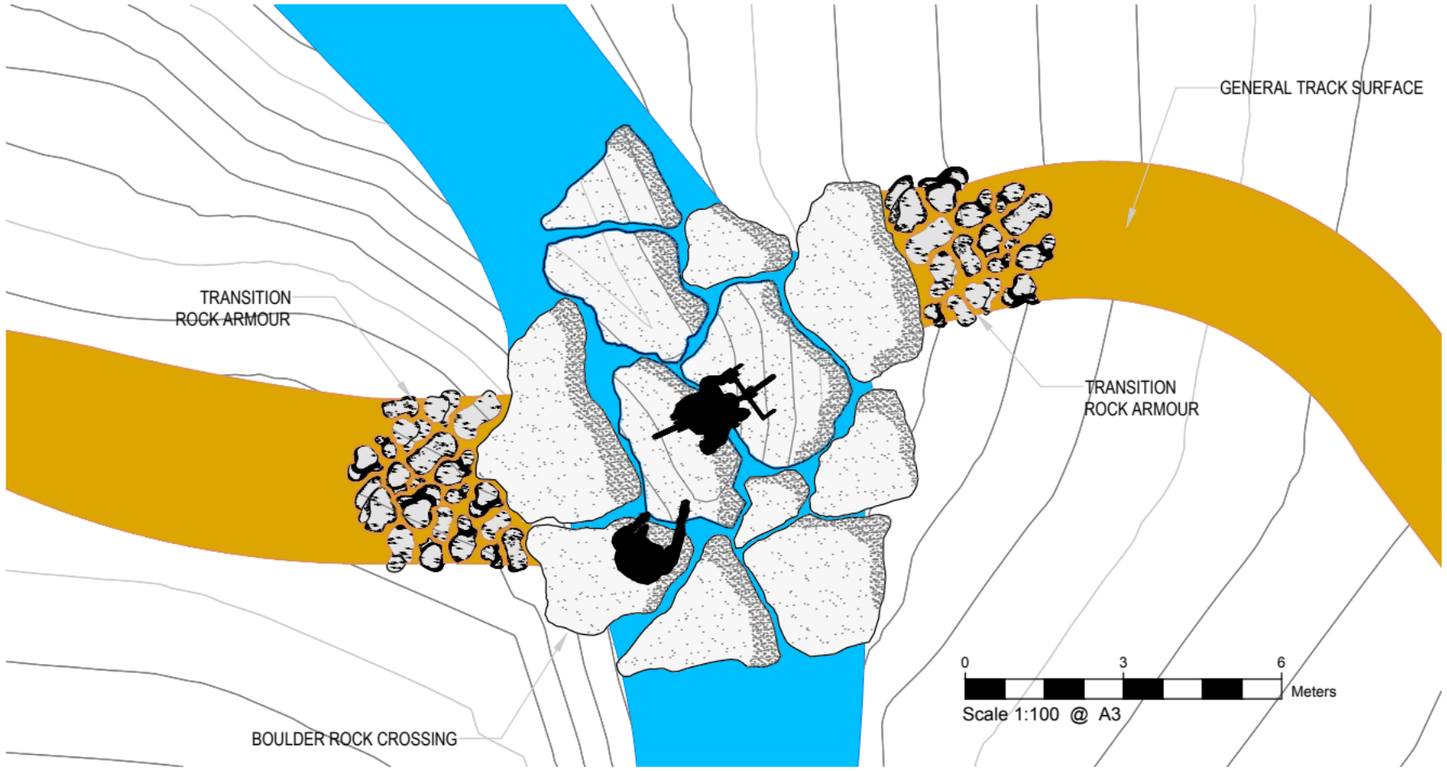
WTSTD-006-WG2
Boulder Rock Crossing
Placement and Dimension

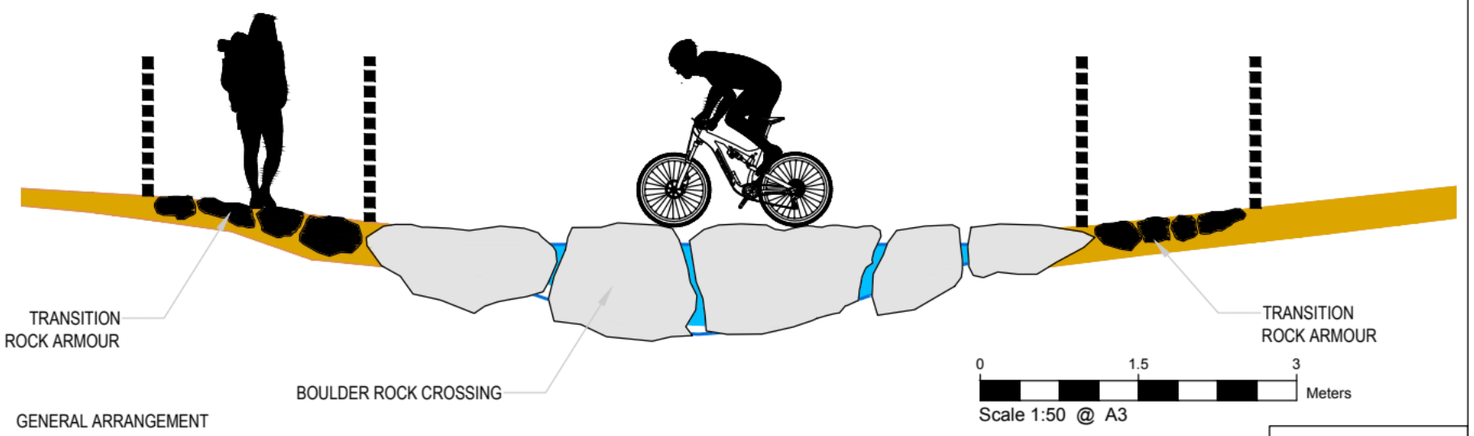
Examples



NOTES:

- The stone crossing design depicted is a single crossing layout that represents a whole range of possible alternate configurations.
- Crossings may be straight or curved depending on the local topography and the track alignment at that location.
- Crossings consist of rock transitions using rock armouring at each end and a large boulder crossing within the creek invert and between the transitions.
- See drawing WTSTD-007-WG2 for details on placement and design of rock armouring.
- Boulders in the creek invert should be large enough to resist being moved during high flow events. Minimum size around 1.5m.
- While gaps should be provided between the rocks to allow for water passage during normal flows, they should be narrow enough to allow for both hiking & bicycle passage.
- Boulders used for crossing construction must be of an appropriate shape, texture and colour to match the native rock and must provide a natural appearance relative to its location .
- Boulders should be placed so that the top surface provides a reasonable surface for foot placement and bicycle ride lines and the distances between stones should allow for reasonable bicycle passage and step lengths by an average person..
- The texture of the top surface of the boulders should allow for reasonable bicycle traction and hiker footage with minimal slippage.
- The transition connection of the track to the first boulders in the crossing should be well graded to allow safe access to the start of the crossing. This will provide an opportunity for riders and walkers to stop and assess the alignment required to navigate the crossing prior to proceeding.
- Smaller rocks can be used at the transitions to facilitate an even platform.





ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

GENERAL ARRANGEMENT
PLAN & PROFILE VIEW
SCALE varies

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

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Designed DS	Signed	Date 24/03/20	
Verified DS	Signed	Date 24/03/20	
Approved	Signed	Date	

Drawing Title: BOULDER ROCK CROSSING PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale varies
Sheet Size A3
Drawing No. WTSTD-006-WG2
Rev. A

5.4.12 Minor Waterway Crossings

What is it?

Minor Waterway Crossings are small bridges, spanning from 5m to 25m.

When is it Used?

Minor Water Crossings are used when the trail crosses a small permanent watercourse and suitable large rock or boulders are not available locally to construct a Rock Water Crossing.

Where required to cross multiple braids of the same waterway, separate Minor Water Crossings can be joined end to end (provided that span lengths are maintained as shown) to create a longer, boardwalk type structure or separated by earthen or rock landings.

Why is it Used?

Minor Water Crossings are used to facilitate safe crossing of small watercourses, keeping riders and hikers above the water, protecting water quality and minimising the potential for sedimentation of the waterway. It will also be used to span waterways that support the opal cling goby (*Stiphodon semoni)* habitat.

Notes

Typically, Minor Waterway Crossings should be less than 1m above the ground (measured from the top of the decking surface down to the ground) to avoid the requirement for handrails. Handrails can be a crush hazard to mountain bike riders' fingers. Sometimes the need for a handrail can be avoided by slightly adjusting the location of a bridge and thus reducing the height of the drop off.

Minor Waterway Crossings should be designed and placed so as to be as short, straight and level as possible. The trail entry and exit should ideally be straight and in-line with the bridge. The trail design should naturally slow riders on their approach to the bridge, ensuring that they don't enter at high speeds. Rock Armouring for 2-5m at the entry and exit of the bridge is generally recommended – it helps manage any abrasion that may result from heavy braking and can also help to shed mud/dirt off tyres before crossing the bridge.

A variety of different decking materials can be used. The most commonly used materials are timber, Fibre Reinforced Plastic (FRP) mesh or steel mesh. The use of mesh decking allows light and water to penetrate through the bridge, thus minimising the impact on the vegetation below.

Materials

- Subject to final design, but likely to include:
  - Decking materials – timber, steel mesh, FRP etc.;
  - Framing materials – timber, steel, FRP etc.;
  - Concrete for footings;
  - Fixings.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Concrete mixer;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.;
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.;
- Carpentry and general construction equipment.

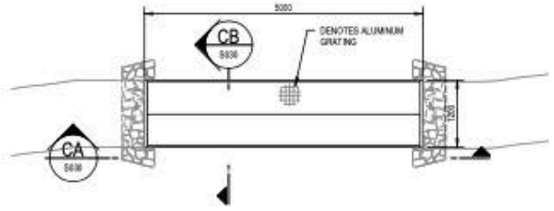
Estimated Length of Treatment

468 metres (of entire 82.15km length of trail)

Drawing Reference

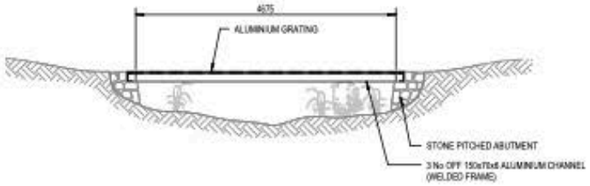
S030 – A
S031 – A

Examples

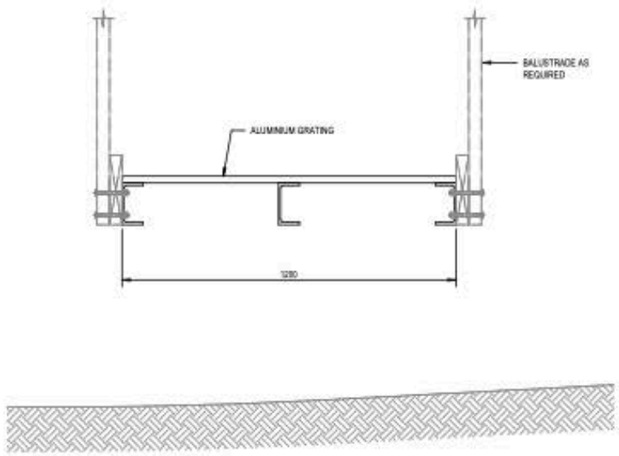


GULLY CROSSING - UP TO 5m SPAN

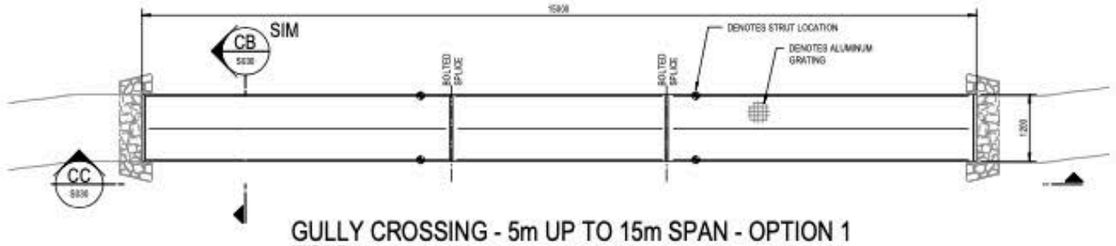
SCALE 1 : 50



SECTION CA
SCALE 1 : 50



SECTION CB
SCALE 1 : 10



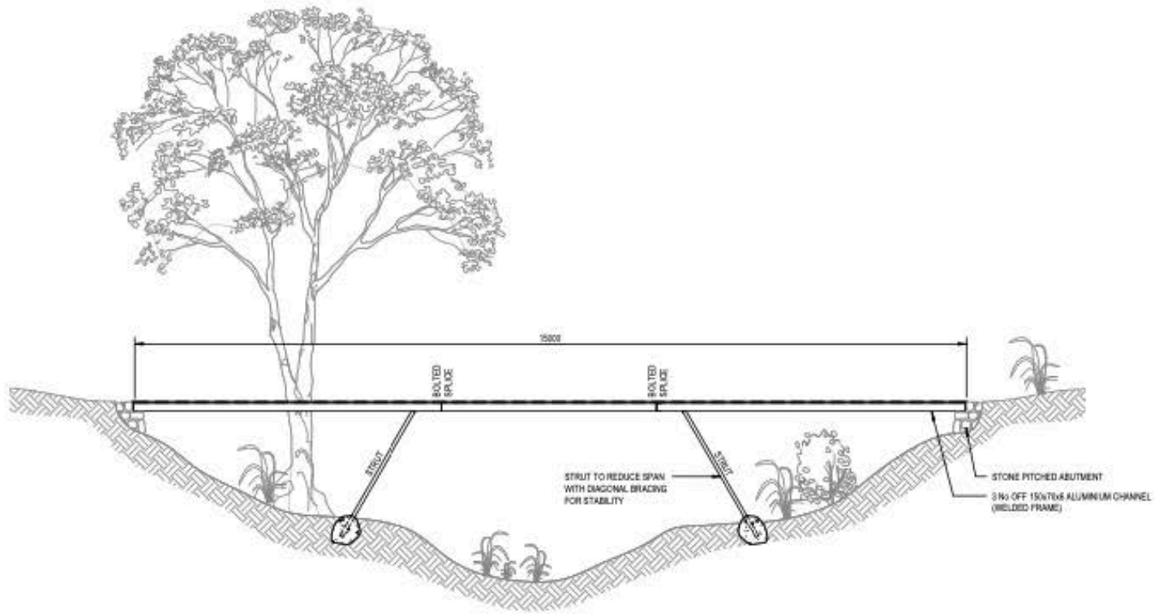
GULLY CROSSING - 5m UP TO 15m SPAN - OPTION 1

SCALE 1 : 50

OPTION 1:
SPANS 5m UP TO 15m MAX
- REQUIRES STRUTS WITH DIAGONAL BRACING FOR SUPPORT

OPTION 2: REFER DRG S031
SPANS 5m UP TO 15m MAX
- TRUSS BALUSTRADE REMOVES NEED FOR STRUTS WITH DIAGONAL BRACING

SPANS 15m UP TO 25m MAX
- TRUSS BALUSTRADE REQUIRES STRUTS WITH DIAGONAL BRACING FOR SUPPORT



SECTION CC
SCALE 1 : 50

NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DESIGN	DRAWN	CHECKED	APPROVED	RFEQ No.
A	03/09/2018	PRELIMINARY ISSUE	RB	MIC	RB		

BLIGH TANNER
LEVEL 9, 269 WICKHAM STREET, PO BOX 612
FORTITUDE VALLEY QLD 4006 AUSTRALIA
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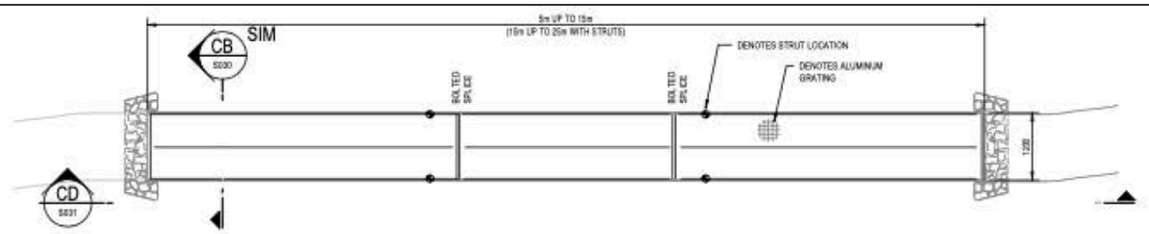
PROJECT	WANGETTI TRAIL
LOCATION	WANGETTI TRAIL, NORTH QLD
CLIENT	DITID
DRAWING TITLE	TYPICAL GULLY CROSSING DETAILS - SHEET 1
ARCHITECT	
ASSOCIATE CONSULTANT	WORLD TRAIL
SCALES	As indicated AT A1
JOB NO	2018.0336
DRAWING NUMBER	S030
REVISION	A



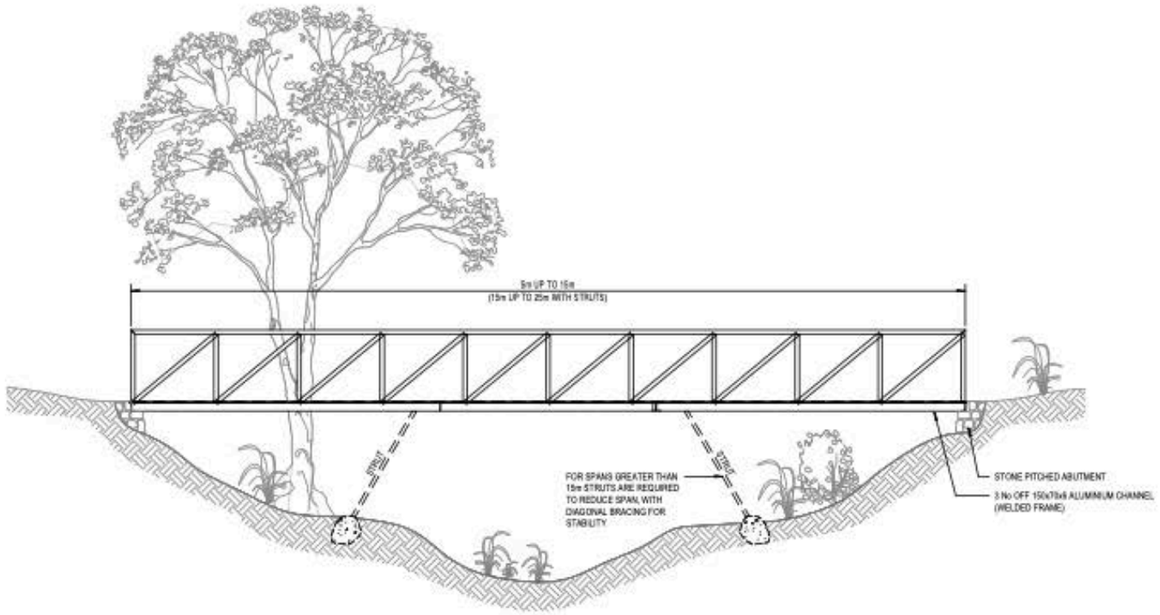
GULLY CROSSING - 15m UP TO 25m SPAN - OPTION 2

SCALE 1 : 50

OPTION 1: REFER DRG S030
SPANS 5m UP TO 15m MAX
- REQUIRES STRUTS WITH DIAGONAL BRACING FOR SUPPORT

OPTION 2:
SPANS 5m UP TO 15m MAX
- TRUSS BALUSTRADE REMOVES NEED FOR STRUTS WITH DIAGONAL BRACING

SPANS 15m UP TO 25m MAX
- TRUSS BALUSTRADE REQUIRES STRUTS WITH DIAGONAL BRACING FOR SUPPORT



SECTION CD
SCALE 1 : 50

NOT FOR CONSTRUCTION

BLIGH TANNER
LEVEL 9, 289 WICKHAM STREET, PO BOX 612
FORTITUDE VALLEY QLD 4006 AUSTRALIA
T 07 3251 8555 F 07 3251 8599

REV	DATE	DESCRIPTION	DESIGN	DRAWN	CHECKED	APPROVED	RFEQ No.
A	03/09/2018	PRELIMINARY ISSUE	RB	MIC	RB		

PROJECT: WANGETTI TRAIL	DRAWING TITLE: TYPICAL GULLY CROSSING DETAILS - SHEET 2	SCALES: 1 : 50 AT A1
LOCATION: WANGETTI TRAIL, NORTH QLD	ARCHITECT:	JOB NO: 2018.0336
CLIENT: DITID	ASSOCIATE CONSULTANT: WORLD TRAIL	DRAWING NUMBER: S031 REVISION: A

5.4.13 Major Waterway Crossing

What is it?

The Major Waterway Crossing is a cable suspension bridge proposed to be used to cross over Hartley's Creek near Wangetti township.

When is it Used?

It is proposed to be used on only one occasion – Hartley's Creek near Wangetti. It allows the trail to cross the waterway safely and sustainably, providing excellent views down in to the scenic and deeply incised granite gorge.

Why is it Used?

It is used to provide a safe and sustainable crossing of a major waterway and to elevate trail and bridge infrastructure above possible flood height levels.

Notes

The current QPWS access track starting at Hartley's Creek (adjacent to the Captain Cook Highway) would be used to transport equipment and materials required for the proposed suspension bridge. The type of construction equipment that can be used to build the bridge will be limited to the size of machinery and equipment that can be transported along this access track. Materials such as steel and concrete may be transported via helicopter to the bridge location where appropriate.

Materials

- Subject to final design, but likely to include:
  - Decking materials – timber, steel mesh, FRP etc.;
  - Framing materials – timber, steel, FRP etc.;
  - Concrete for footings;
  - Fixings.

Machinery / Equipment

- Rubber Tracked Excavator
- Crane
- Bobcat
- Carpentry and general construction equipment.
- Winches
- Helicopter

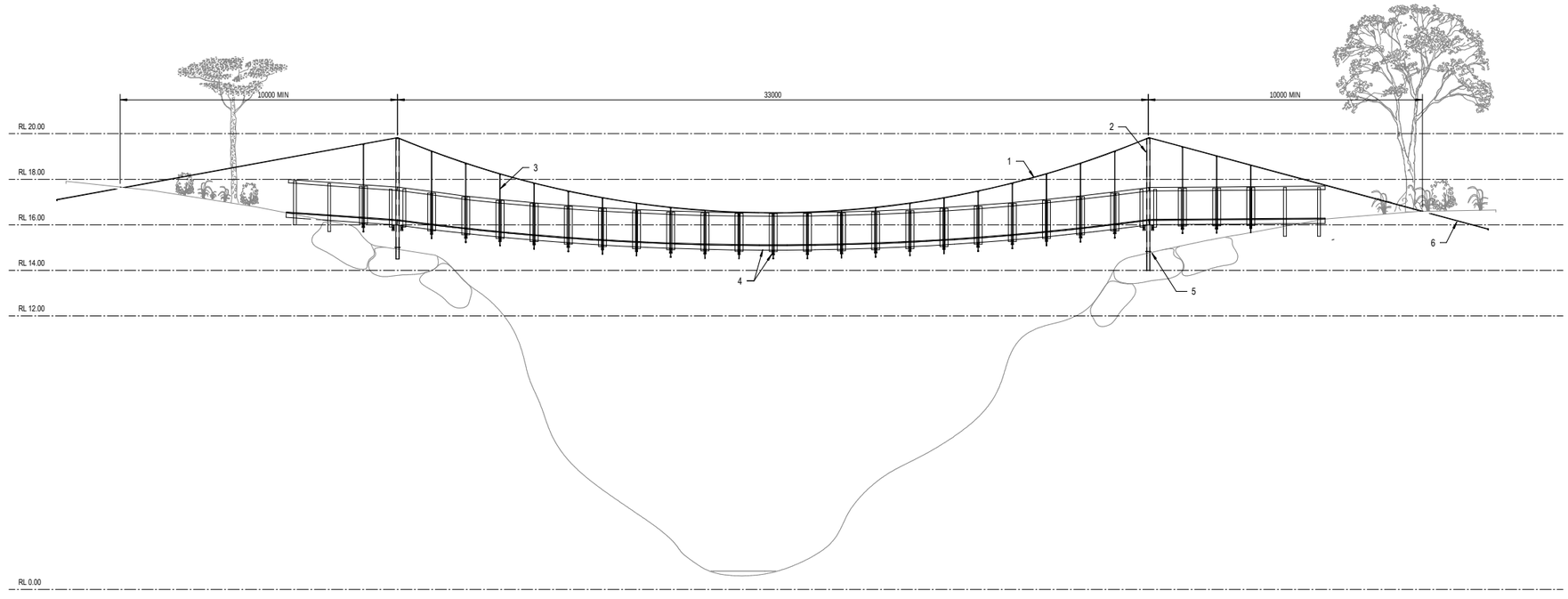
Estimated Length of Treatment

35 metres (of entire 82.15km length of trail)

Drawing Reference

S010 A

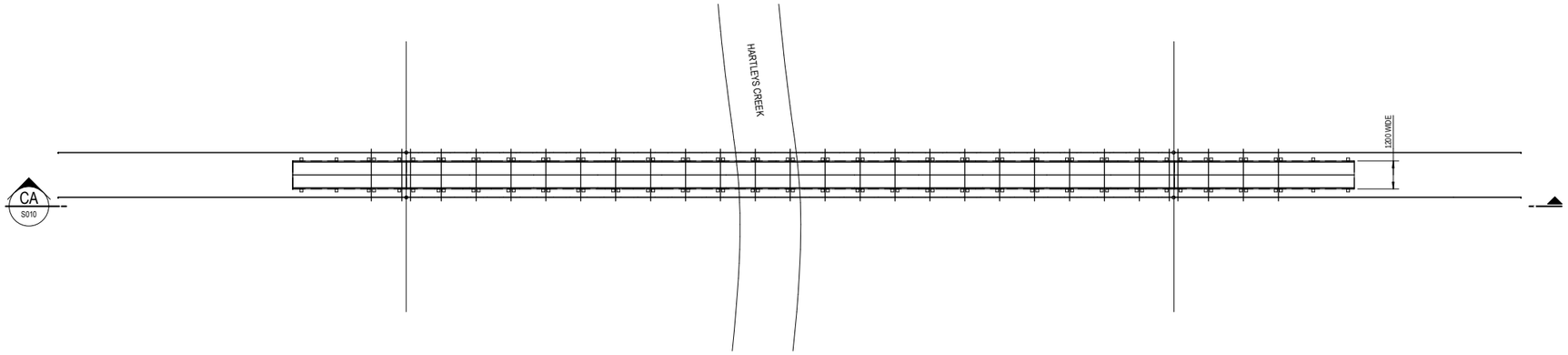
Examples



LEGEND:

1. 22mm DIAMETER GALVANISED STRAND CALBES.
2. 139 CHS STEEL PORTAL FRAMES
3. 12mm REID BAR HANGERS
4. HARDWOOD TIMBER DECKING FRAME.
5. STEEL PORTAL BOLTED TO STABILISED ROCK FOUNDATION.
6. STEEL ANCHOR BARS EPOXY GROUTED INTO THE ROCK BASE.

SECTION CA
SCALE 1 : 100 S010



BRIDGE PLAN
SCALE 1 : 100

NOT FOR CONSTRUCTION

1 : 100 1m 0 1000 2000 3000 4000

BLIGH TANNER
LEVEL 9, 269 WICKHAM STREET, PO BOX 612
FORTITUDE VALLEY QLD 4006 AUSTRALIA
T 07 3251 8555 F 07 3251 8599

REV	DATE	DESCRIPTION	DESIGN	DRAWN	CHECKED	APPROVED	RPEQ No.
A	03/09/2018	PRELIMINARY ISSUE	RB	MIC	RB		

PROJECT: WANGETTI TRAIL	DRAWING TITLE: HARTLEYS CREEK CROSSING	SCALES: 1 : 100 AT A1	
LOCATION: WANGETTI TRAIL, NORTH QLD	ARCHITECT:	JOB NO: 2018.0336	
CLIENT: DITID	ASSOCIATE CONSULTANT: WORLD TRAIL	DRAWING NUMBER: S010	REVISION: A

5.5 CONSTRUCTION TREATMENTS – NOT SPECIFIED

5.5.1 Adjustable Rock Matting

What is it?

Adjustable Rock Matting (ARM) is a proprietary product that approximates the look and feel of natural Rock Armouring.

When is it Used?

It is used when Rock Armouring is required, but suitable natural stone is not easily/readily available. It should not be placed in permanent waterways.

Why is it Used?

It provides a cost-effective means of hardening the trail surface when normal Rock Armouring is not possible or cost effective.

Notes

ARM is made from pre-cast concrete and held together using 4mm nylon mesh.

ARM comes in sheets of differing sizes, including 600mm and 1000mm widths, can be transported easily into most locations and approximates normal rock armouring in its installation, aesthetics and durability.

It is approximately 150mm high and is embedded into the ground to provide a continuous level tread surface with the adjacent tread of the trail.

Modules can be easily cut out to allow the sheets to curve around or mould into landscape features like large boulders.

Materials

- Adjustable Rock Matting sheets.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.

Estimated Length of Treatment

Not specified.

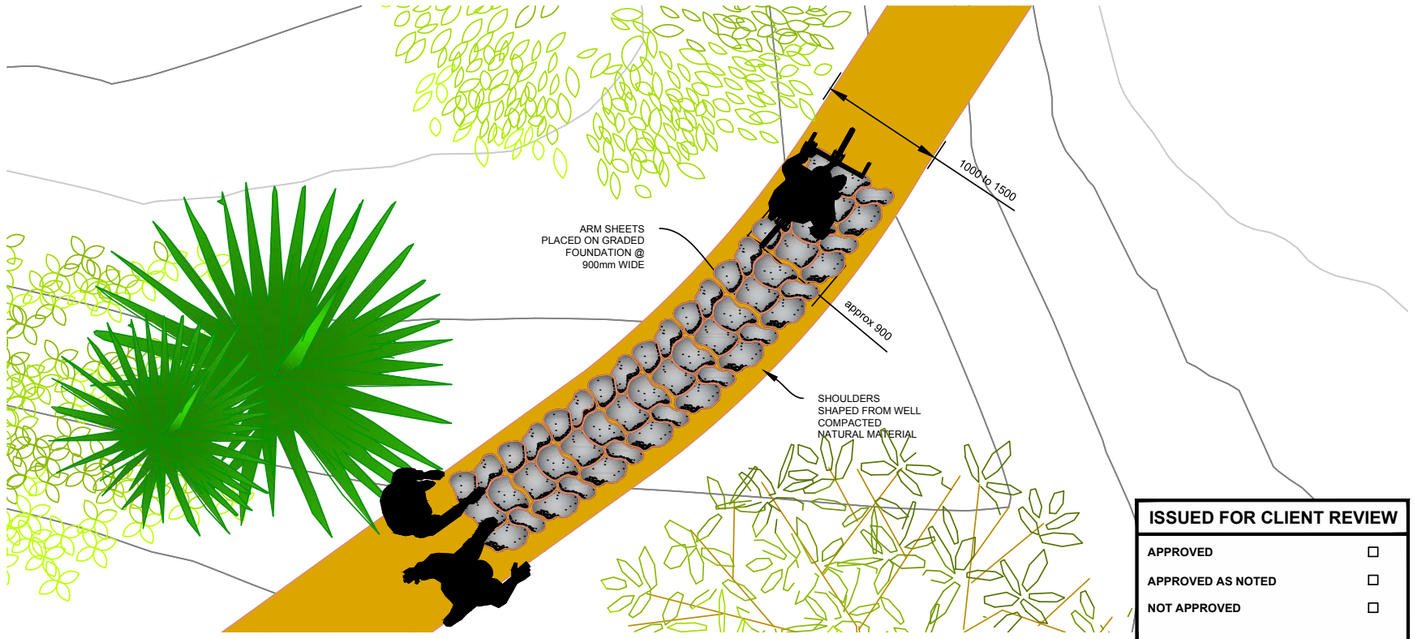
Drawing Reference

WTSTD-011-WG2
Adjustable Rock Matting 900mm
Placement and Dimensions

Examples

NOTES:

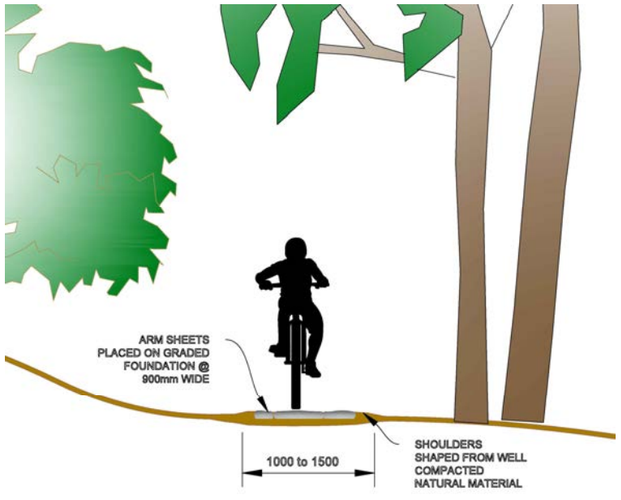
- Adjustable Rock Matting (ARM) is to be used in trail sections that are often wet and boggy or to provide a safe braking surface on unavoidable declines.
- ARM is manufactured in 600mm by 900mm sheets that have the capacity to be bent either vertically or horizontally to suit the required topography and trail alignment.
- The trail section providing a foundation for ARM should be leveled and treated to be free of protruding rocks or roots prior to installation.
- A base layer of imported material may be required to provide a suitable foundation for the ARM if the natural material is found to be unsuitable.
- Any excess loose material should be stockpiled nearby to be used as a coating surface after the ARM has been installed.
- ARM sheets should be installed from the lowest point and working uphill, checking the alignment as installation proceeds.
- Sheets can be cut to allow removal of sections to facilitate alignment around large unmovable objects or to allow tighter curves in difficult trail alignment sections.
- Each sheet should be checked to ensure it is sitting evenly and solidly on the ground without rocking or movement under pressure.
- The ARM sheets should be joined with cable ties and any excess matting trimmed.
- Secure the ARM sheets to the ground with pegs placed through the matting..
- Finish by raking or sweeping the stockpiled topsoil over the ARM sheets, filling and compacting soil into the gaps between the rocks.
- Ensure the ARM placement and soil topping provides a trafficable surface for both walking and biking.

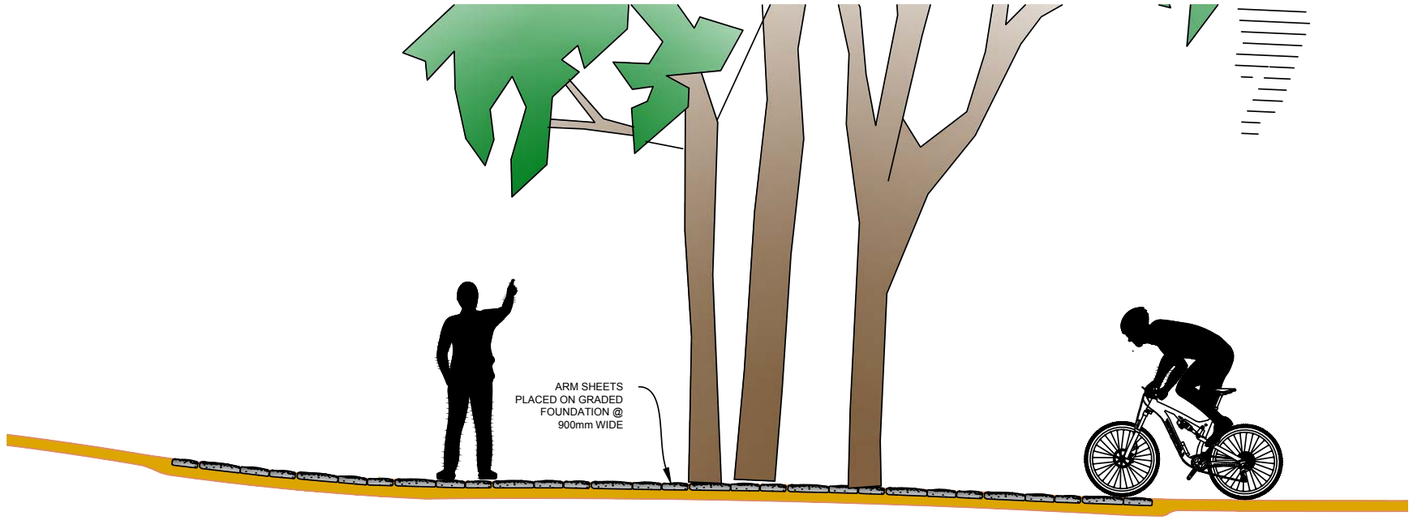


ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....





0 1.5 3 Meters Scale 1:50 @ A3

GENERAL ARRANGEMENT
SCALE 1:50

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 24/03/20	
Designed DS	Signed	Date 24/03/20	
Verified DS	Signed	Date 24/03/20	
Approved	Signed	Date	

Drawing Title: ADJUSTABLE ROCK MATTING 900mm PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

Project No. WT20-Wangetti-001

Scale 1:50 | Sheet Size A3

Drawing No. WTSTD-011-WG2 | Rev. A

5.5.2 Rock and Concrete Spoon Drain

What is it?

Rock and Concrete Spoon Drains are hardened sections of the trail, using concrete and rock, to manage water crossing the trail.

When is it Used?

Rock and Concrete Spoon Drains are used to convey surface runoff across the trail at a concentrated location. It could be used to manage the intersection of a small seasonal waterway and the trail, as per the description for Rock Armouring.

Why is it Used?

Rock and Concrete Spoon Drains can be used to cross small seasonal watercourses or drainage gullies, or to convey water from intercept drains across the trail.

Notes

Materials

- Rock (can be in situ or imported, subject to land manager requirements);
- Concrete;
- Mortar;
- Geofabric;
- Drainage materials as per drawing.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Concrete mixer;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.
- Rock work hand tools such as crow bars, rock bars, rock hammers, wedges etc.

Estimated Length of Treatment

Not specified

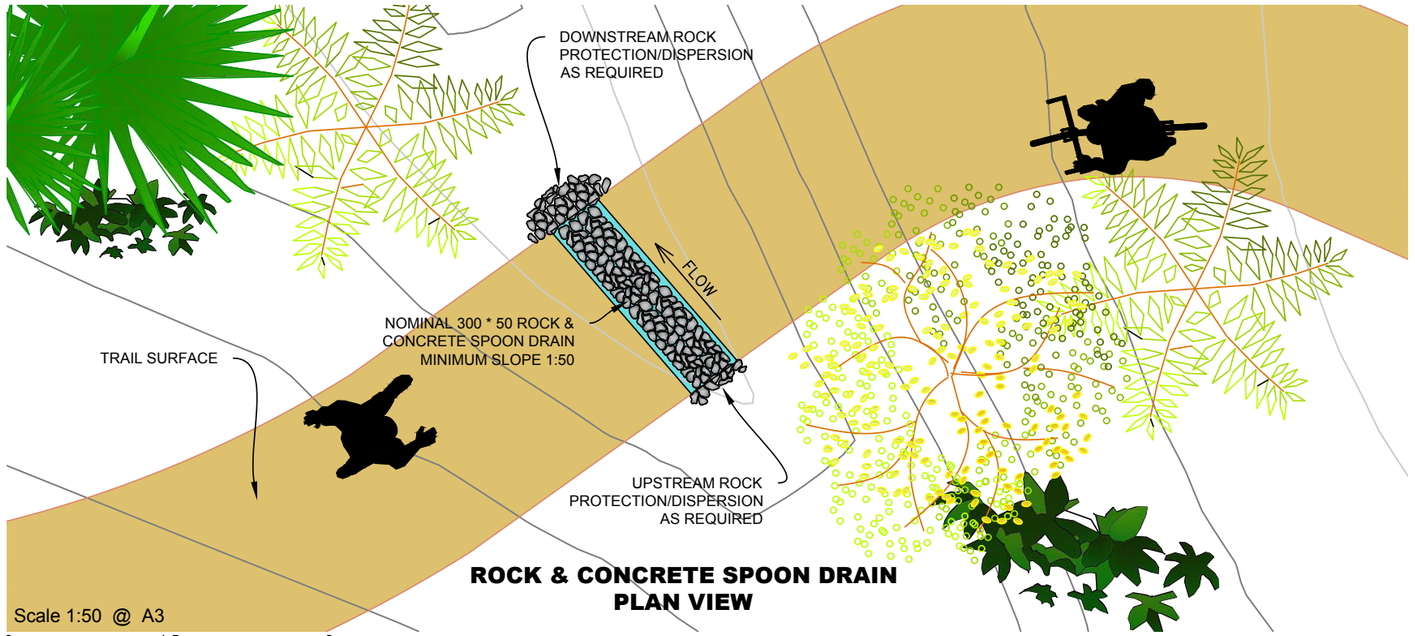
Drawing Reference

WTSTD-019-BF
Rock & Concrete Spoon Drains
Placement and Dimensions

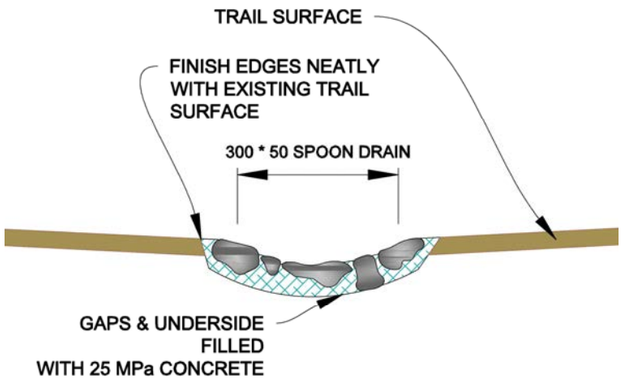
Examples

NOTES:

- Spoon Drains are to be used to convey surface runoff across the trail at a concentrated location without using below ground conduits while minimizing erosion.
- The spoon drain profile and alignment should be constructed in such a way that disturbances to trail walkability are minimized.
- Dimensions and layout depicted are nominal only and may vary to suit site topography and expected runoff surface flows.
- All dimensions are in millimeters unless advised otherwise.
- Rocks are to be placed in such a way that they are interlocked and well bedded into a 25 MPa concrete bed poured onto the spoon drain foundation.
- 25 MPa Concrete to be poured into the gaps between the rocks and along the edges to form a neat transition to the trail surface.
- All exposed concrete should be finished to a rough texture to minimise slipping and provide further roughage to impede water flows.
- The tops of the rocks should be cleaned of concrete to provide a natural finish.
- Concrete should be tamped to ensure there is no air entrapment and that the concrete is placed firmly against the foundation material.
- Rock protection should be placed at the discharge end to minimise erosion and to provide flow dispersion of the runoff.
- In some locations rock protection may be required at the upstream end to minimise erosion as the runoff flows enter the spoon drain.



ROCK & CONCRETE SPOON DRAIN PLAN VIEW



ROCK & CONCRETE SPOON DRAIN TYPICAL SECTION

Scale 1:10 @ A3

0 0.2 0.4 Meters

ISSUED FOR CLIENT REVIEW	
APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐
SIGNED..... DATE.....	

GENERAL ARRANGEMENT
SCALE varies

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	25/03/20	ISSUED FOR INFORMATION	JR		

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 25/03/20	
Designed DS	Signed	Date 25/03/20	
Verified DS	Signed	Date 25/03/20	
Approved	Signed	Date	

Drawing Title: ROCK & CONCRETE SPOON DRAINS PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale varies
Sheet Size A3
Drawing No. WTSTD-019-BF
Rev. A

5.5.3 Handrails

What is it?

Handrails are structures made with imported materials such as timber, steel and concrete, used to provide support for hikers on steep inclines (e.g. a flight of steps) or on areas with steep drop-offs beside the trail. This treatment is not proposed for use as a handrail on a Minor Water Crossing or Major Water Crossing.

When is it Used?

It is used to provide support to hikers on steep inclines (e.g. a flight of steps) or on areas with steep drop-offs beside the trail. It can be installed on a single side or both sides of the trail.

It is not generally used on mountain biking trails, as the handrails are located at a similar height to the rider's handlebars and can pose a hazard.

Why is it Used?

To provide support for hikers on steep inclines, to provide a barrier where there is a steep drop-off beside the trail, or to help define the trail and keep people from going off-track.

Notes

Materials

- Handrails and posts are constructed from a fibreglass/resin composite;
- Concrete for posts;
- Fixings as per drawing.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Concrete mixer;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.
- Carpentry and general construction equipment.

Estimated Length of Treatment

Not specified

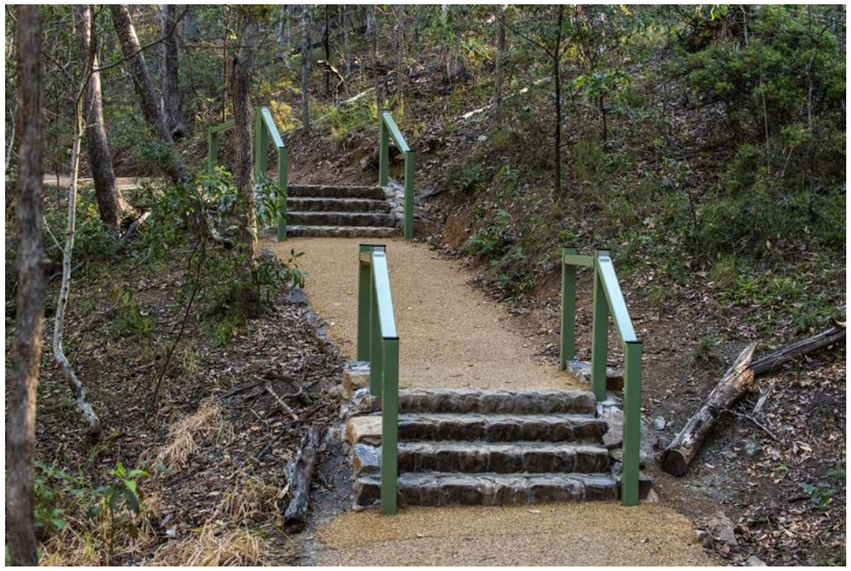
Drawing Reference

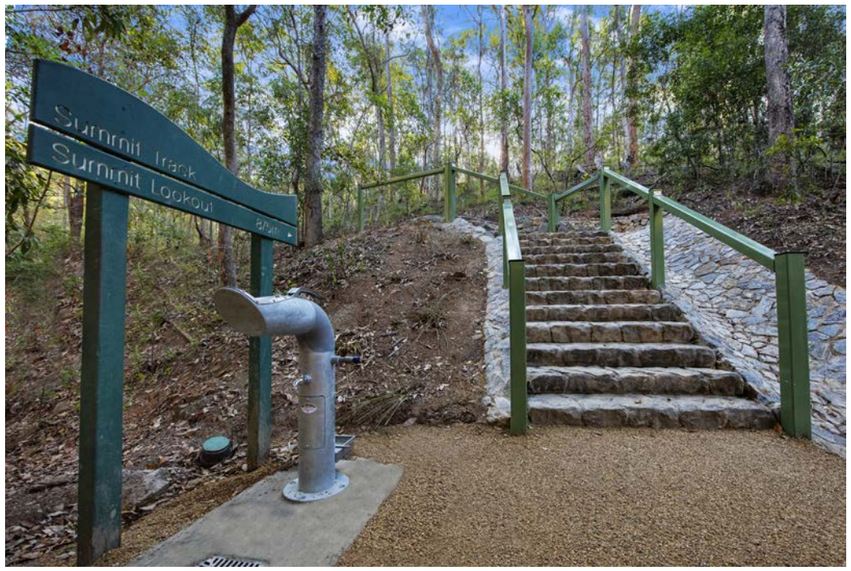
WTSTD-013-WG2
Trail Handrail – Multi Section
Placement and Dimensions

WTSTD-014-WG2
Trail Handrail – Single Section
Placement and Dimensions

WTSTD-015-WG2
Handrail – Post & Rail Installation
Placement and Dimensions

Examples





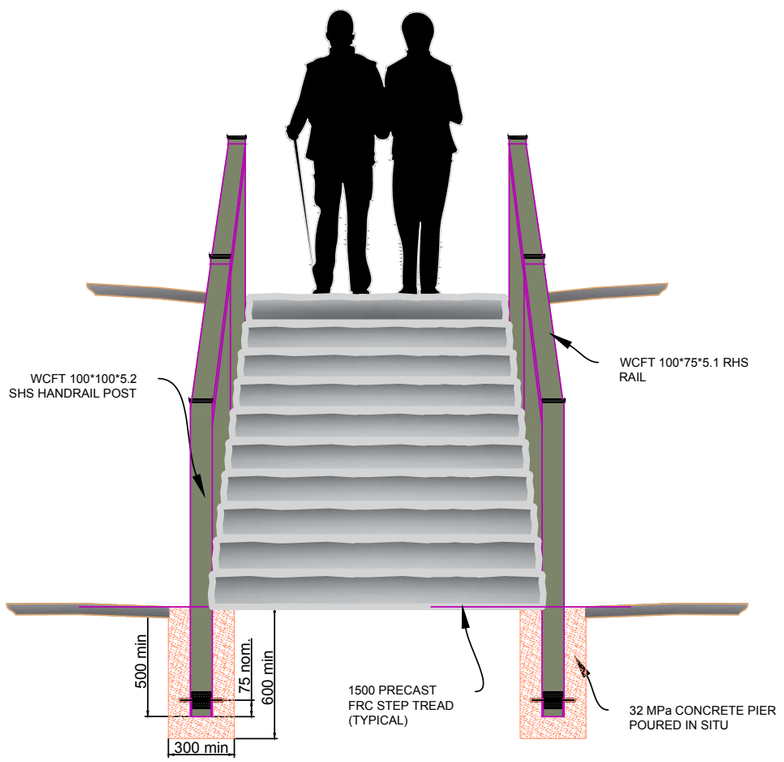
NOTES:

GENERAL:

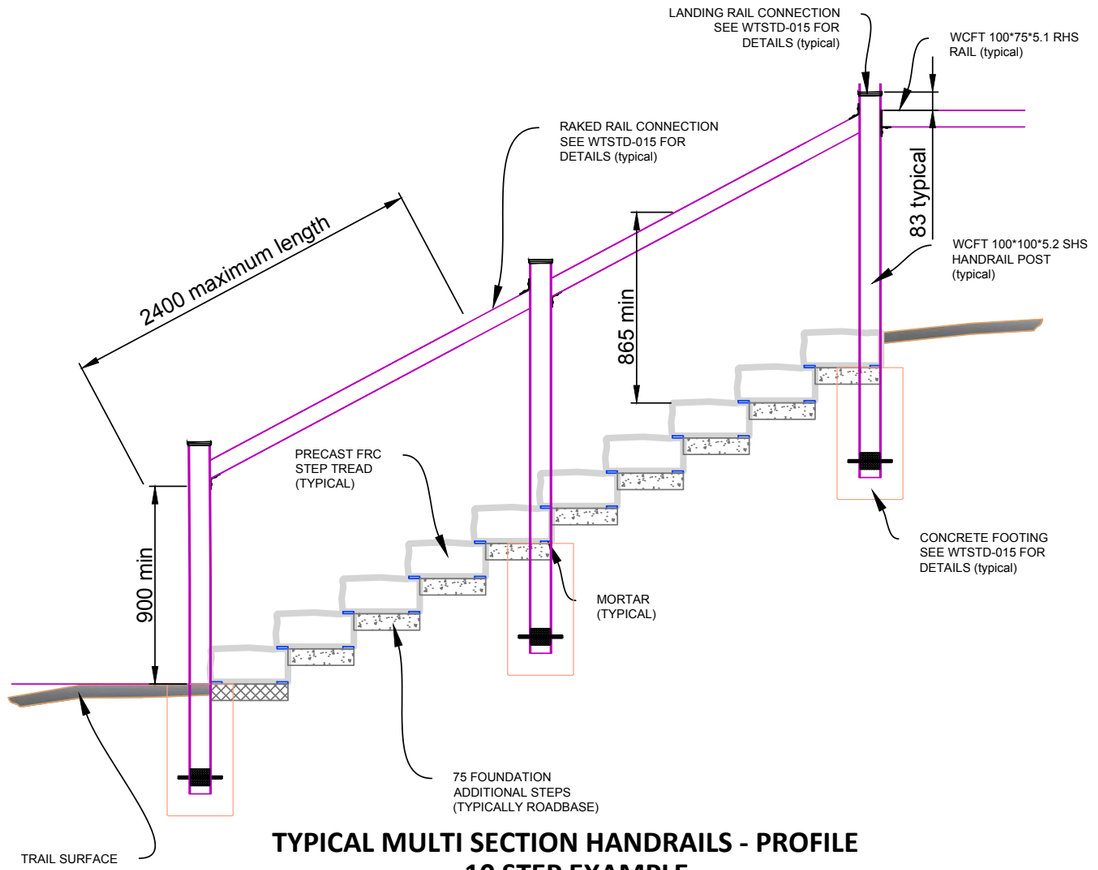
- The handrail layout depicted in this standard drawing is a typical layout for handrail sections with rails longer than 2400mm.
- Layouts in specific trail locations may vary considerably from that depicted however the design and construction requirements will still apply.
- The handrails depicted are to be placed in combination with the stair treads depicted in Standard drawing WTSTD-003-WG2 or along landings above, below or between these stair tread sections.
- The stairway example depicted in this standard drawing uses 1500mm wide precast treads. The design would also be appropriate for treads of other widths.
- This standard drawing must be used in conjunction with WTSTD-015-WG2 that defines the post placement and rail connection details.
- This standard drawing is suitable for stairs consisting of between 7 & 14 treads. See Standard drawing WTSTD-0014-WG2 for stairs consisting of 5 or less treads. Stairs of 15 or more treads would require an additional intermediate raking connection post to maintain a minimum rail length of 2400mm.
- Where the stair alignment has a corner at the top or the bottom of the stairway, double posts may be necessary to either protect entry/exit to the stairway or to connect neatly to horizontal railings.

HANDRAILS & POSTS:

- Handrails, posts and fixtures are supplied by Wagners CFT Manufacturing Pty Ltd, Toowoomba or equivalent as approved by the client or principle.
- Handrails and posts are constructed from a fibreglass/resin composite.
- All components must be installed as defined in this standard drawing and as described in Wagners Installation Guide, Rev. B - Sept 2010 or other installation documentation relevant to the supplier.



TYPICAL MULTI SECTION HANDRAILS - FRONT VIEW
10 STEP EXAMPLE



TYPICAL MULTI SECTION HANDRAILS - PROFILE
10 STEP EXAMPLE

NOTES CONTINUED:

HANDRAILS & POSTS:

Care should be taken to ensure posts do not touch or bind with the stair treads and they are aligned so that the rail is straight rather than being aligned to the edge of the stair treads.

CONCRETE FOOTINGS:

- Excavations for concrete footings must be cleaned out prior to pouring concrete so that they do not contain any loose material, tree roots or rocks or ponding water.
- Posts and concrete mix must be placed into the footing in such a way that the integrity of the excavation is maintained.
- Concrete should be tamped with a suitable rod after placement to ensure there is no air entrapment within the footing.
- Where footings are located adjacent to precast step treads, the post and concrete top surface should be placed and finished such that it does not impede the correct placement of the step tread.
- Standard Drawing - WTSTD-003-WG2 depicts the dimensions and installation requirements of the step treads.

ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

GENERAL ARRANGEMENT
SCALE 1:25

0 0.5 1 Meters
Scale 1:25 @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
C	25/03/20	ADDITIONAL NOTES ADDED	JR		
B	01/08/19	ISSUED FOR INFORMATION	JR		
A	15/06/19	ISSUED FOR INFORMATION	JR		

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 25/03/20
Designed DS	Signed	Date 25/03/20
Verified DS	Signed	Date 25/03/20
Approved	Signed	Date

Drawing Title: TRAIL HANDRAIL - MULTI SECTION PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale 1:25
Sheet Size A3
Drawing No. WTSTD-013-WG2
Rev. C

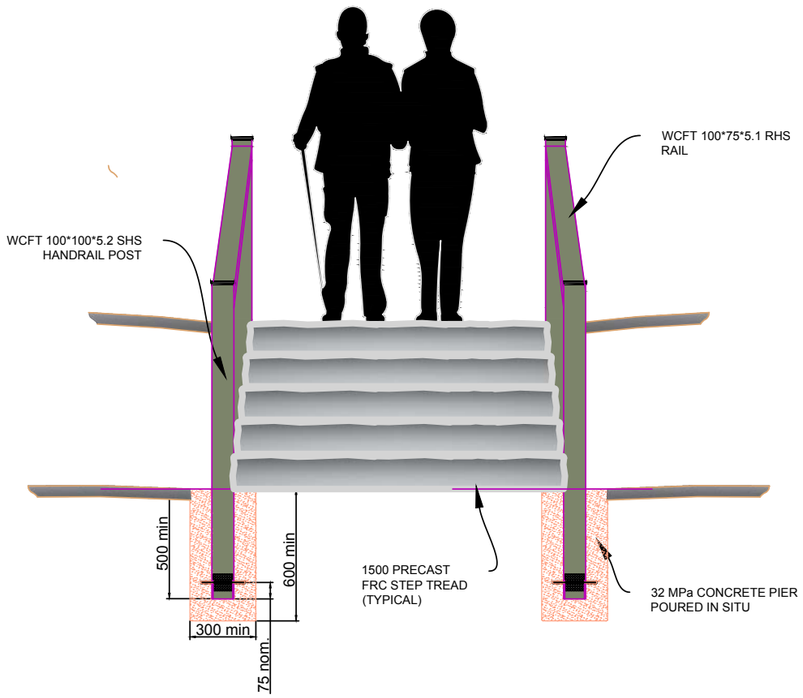
NOTES:

GENERAL:

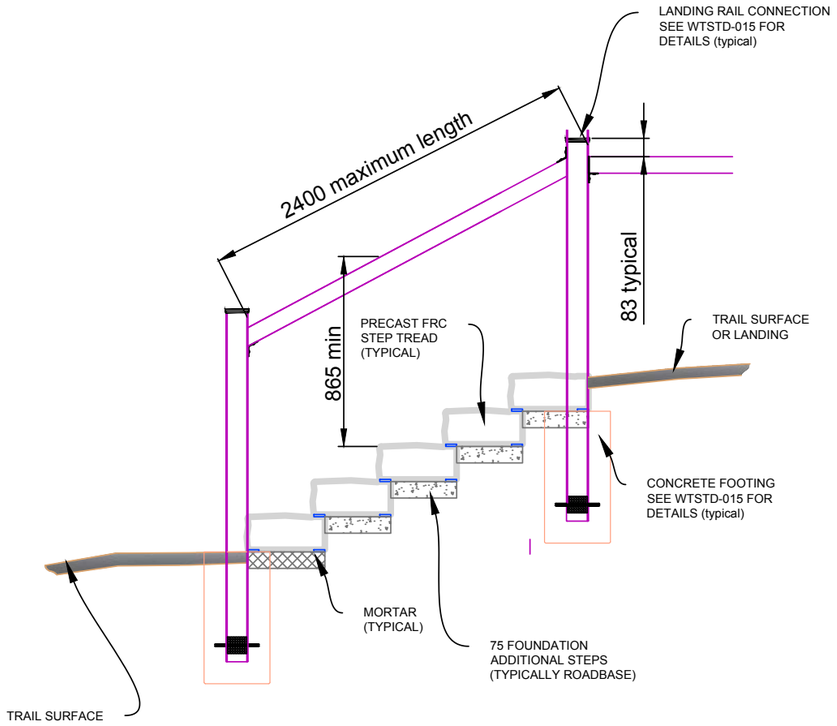
- The handrail layout depicted in this standard drawing is a typical layout for handrail sections with rails longer than 2400mm.
- Layouts in specific trail locations may vary considerably from that depicted however the design and construction requirements will still apply.
- The handrails depicted are to be placed in combination with the stair treads depicted in Standard drawing WTSTD-003-WG2 or along landings above, below or between these stair tread sections.
- The stairway example depicted in this standard drawing uses 1500mm wide precast treads. The design would also be appropriate for treads of other widths.
- This standard drawing must be used in conjunction with WTSTD-015-WG2 that defines the post placement and rail connection details.
- This standard drawing is suitable for stairs consisting of between 2 & 6 treads. See Standard drawing WTSTD-013-WG2 for stairs consisting of 7 or more treads.
- Where the stair alignment has a corner at the top or the bottom of the stairway, double posts may be necessary to either protect entry/exit to the stairway or to connect neatly to horizontal railings.

HANDRAILS & POSTS:

- Handrails, posts and fixtures are supplied by Wagners CFT Manufacturing Pty Ltd, Toowoomba or equivalent as approved by the client or principle.
- Handrails and posts are constructed from a fibreglass/resin composite.
- All components must be installed as defined in this standard drawing and as described in Wagners Installation Guide, Rev. B - Sept 2010 or other installation documentation relevant to the supplier.



TYPICAL MULTI SECTION HANDRAILS - FRONT VIEW
5 STEP EXAMPLE



TYPICAL MULTI SECTION HANDRAILS - PROFILE
5 STEP EXAMPLE

NOTES CONTINUED:

HANDRAILS & POSTS:

Care should be taken to ensure posts do not touch or bind with the stair treads and they are aligned so that the rail is straight rather than being aligned to the edge of the stair treads.

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CONCRETE FOOTINGS:

- Excavations for concrete footings must be cleaned out prior to pouring concrete so that they do not contain any loose material, tree roots or rocks or ponding water.
- Posts and concrete mix must be placed into the footing in such a way that the integrity of the excavation is maintained.
- Concrete should be tamped with a suitable rod after placement to ensure there is no air entrapment within the footing.
- Where footings are located adjacent to precast step treads, the post and concrete top surface should be placed and finished such that it does not impede the correct placement of the step tread.
- Standard Drawing - WTSTD-003-WG2 depicts the dimensions and installation requirements of the step treads.

ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

GENERAL ARRANGEMENT
SCALE 1:25

0 0.5 1 Meters
Scale 1:25 @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
C	25/03/20	ADDITIONAL NOTES ADDED	JR		
B	07/08/19	ISSUED FOR INFORMATION	JR		
A	15/06/19	ISSUED FOR INFORMATION	JR		

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 25/03/20	
Designed DS	Signed	Date 25/03/20	
Verified DS	Signed	Date 25/03/20	
Approved	Signed	Date	

Drawing Title: TRAIL HANDRAIL - SINGLE SECTION PLACEMENT AND DIMENSIONS STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale 1:25 | Sheet Size A3
Drawing No. WTSTD-014-WG2 | Rev. C

NOTES:

GENERAL:

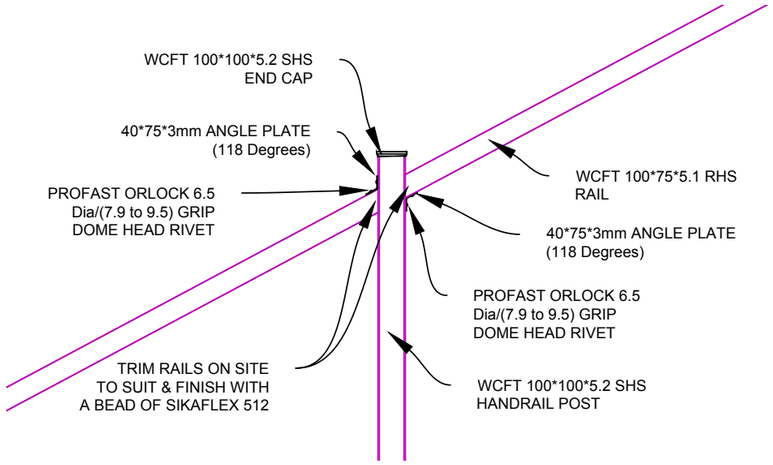
- The handrail layout depicted in this standard drawing is a typical layout for handrails built in conjunction with the precast step treads depicted in World Trail Standard Drawing - WTSTD-003-WG2.
- The post installation and handrail connections depicted in this plan are to be used in combination with World Trail Standard drawings WTSTD-013-WG2 or WTSTD-014-WG2.
- Other handrail layouts may require different angles, footing dimensions of connection fixtures than those defined in this drawing.
- Where the stair alignment has a corner at the top or the bottom of the stairway, double posts may be necessary to either protect entry/exit to the stairway or to connect neatly to horizontal railings.
- All materials and fixtures should be checked on site for damage or incorrect dimensions prior to assembly of the handrail.
- Specific components depicted on this plan may be replaced by equivalent products if the replacement is approved by the client or principle.
- All dimensions depicted on this plan are in millimeters unless otherwise noted.

HANDRAILS & POSTS:

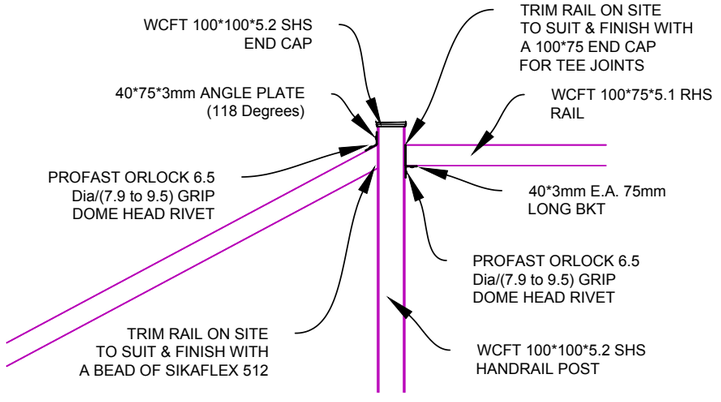
- Handrails, posts and fixtures are as supplied by Wagners CFT Manufacturing Pty Ltd, Toowoomba or equivalent product as approved by council.
- Handrails and posts are constructed from a fibreglass/resin composite.
- All components must be installed as defined in this standard drawing and as described in Wagners Installation Guide, Rev. B - Sept 2010 or equivalent installation guides applicable to selected equivalent products.
- Other dimensions are as depicted on this plan and include a 50mm overlap between treads.
- Angular rail to post joints may be finished with a modified 100*100 end cap for tee joints instead of a bead of silicon. This will require some cutting on site to provide neat fitment of the modified end cap.
- The top of rail must be kept at least 900mm above the walkable surface at all locations.
- Post end caps are to be installed as described in the Wagners Installation Guide which involves cutting a groove in the post using a specialist tool and using heat during placement or installed as defined in the inslallation guide of an approved equivalent product.

CONCRETE FOOTINGS:

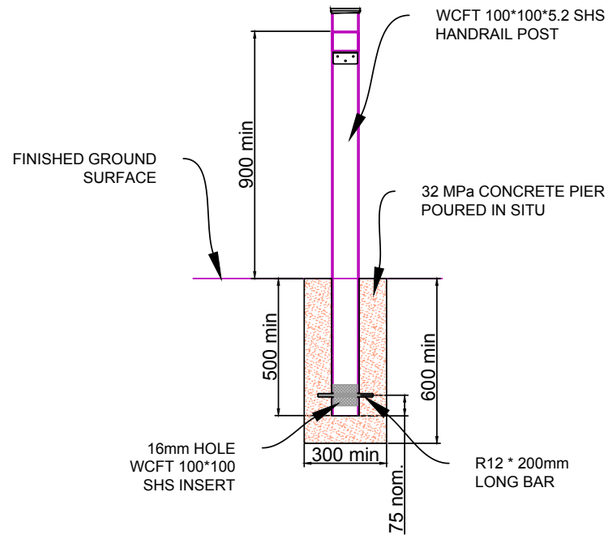
- Excavations for concrete footings must be cleaned out prior to pouring concrete so that they do not contain any loose material, tree roots or rocks or ponding water.
- Posts and concrete mix must be placed into the footing in such a way that the integrity of the excavation is maintained.
- Concrete should be tamped with a suitable rod after placement to ensure there is no air entrapment within the footing.
- Where footings are located adjacent to precast step treads, the post and concrete top surface should be placed and finished such that it does not impede the correct placement of the step tread.
- World Trail Standard Drawing - WTSTD-003-WG2 depicts the dimensions and installation requirements of the step treads.



TYPICAL RAKED HANDRAIL POST CONNECTION



TYPICAL LANDING HANDRAIL POST CONNECTION



TYPICAL HANDRAIL POST INSTALLATION

ISSUED FOR CLIENT REVIEW	
APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐
SIGNED..... DATE.....	

GENERAL ARRANGEMENT
SCALE 1:20

0 0.6 1.2 Meters
Scale 1:20 @ A3

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
B	25/03/20	ALTERATIONS MADE TO NOTES	JR		
A	07/08/19	ISSUED FOR INFORMATION	JR		

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn	JR	Signed	Date 25/03/20
Designed	DS	Signed	Date 25/03/20
Verified	DS	Signed	Date 25/03/20
Approved		Signed	Date

Drawing Title: HANDRAIL - POST & RAIL INSTALLATION PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

Project No.	WT20-Wangetti-001
Scale	1:20
Sheet Size	A3
Drawing No.	WTSTD-015-WG2
Rev.	B

5.5.4 Tree Root Protection

What is it?

Tree Root Protection is used to protect significant tree roots that lie close to the ground surface from the impacts of trail construction.

When is it Used?

Tree Root Protection is to be used in locations where the trail alignment cannot be redirected to avoid significant tree roots just beneath the surface.

Large, significant tree roots shouldn't be cut, as this could have detrimental impacts on the health of the tree. Furthermore, where significant tree roots are located within the top 100-200mm of soil, the construction of the trail over the top of the root can lead to compaction of the soil, which may impact on the health of the tree.

Why is it Used?

Tree Root Protection is used to prevent compaction of the soil around significant tree roots. The placement of the protective sleeve around the top of the root prevents the soil close to the root from becoming compacted.

Notes

Considerable efforts have been made during ground-truthing to ensure suitable offsets away from vegetation communities or species of high environmental significance. However, given the highly treed nature of areas of the study site, it is impossible to avoid constructing trails within the root zone of trees.

Materials

- PVC pipe with internal diameter large enough to provide a 25mm clearance from the tree root

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.

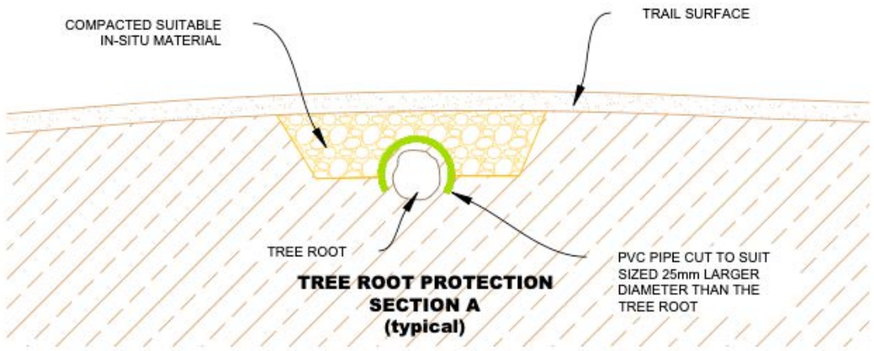
Estimated Length of Treatment

Not specified.

Drawing Reference

WTSTD-031-WG2
Trail – Tree Root Protection
Placement and Dimensions

Examples



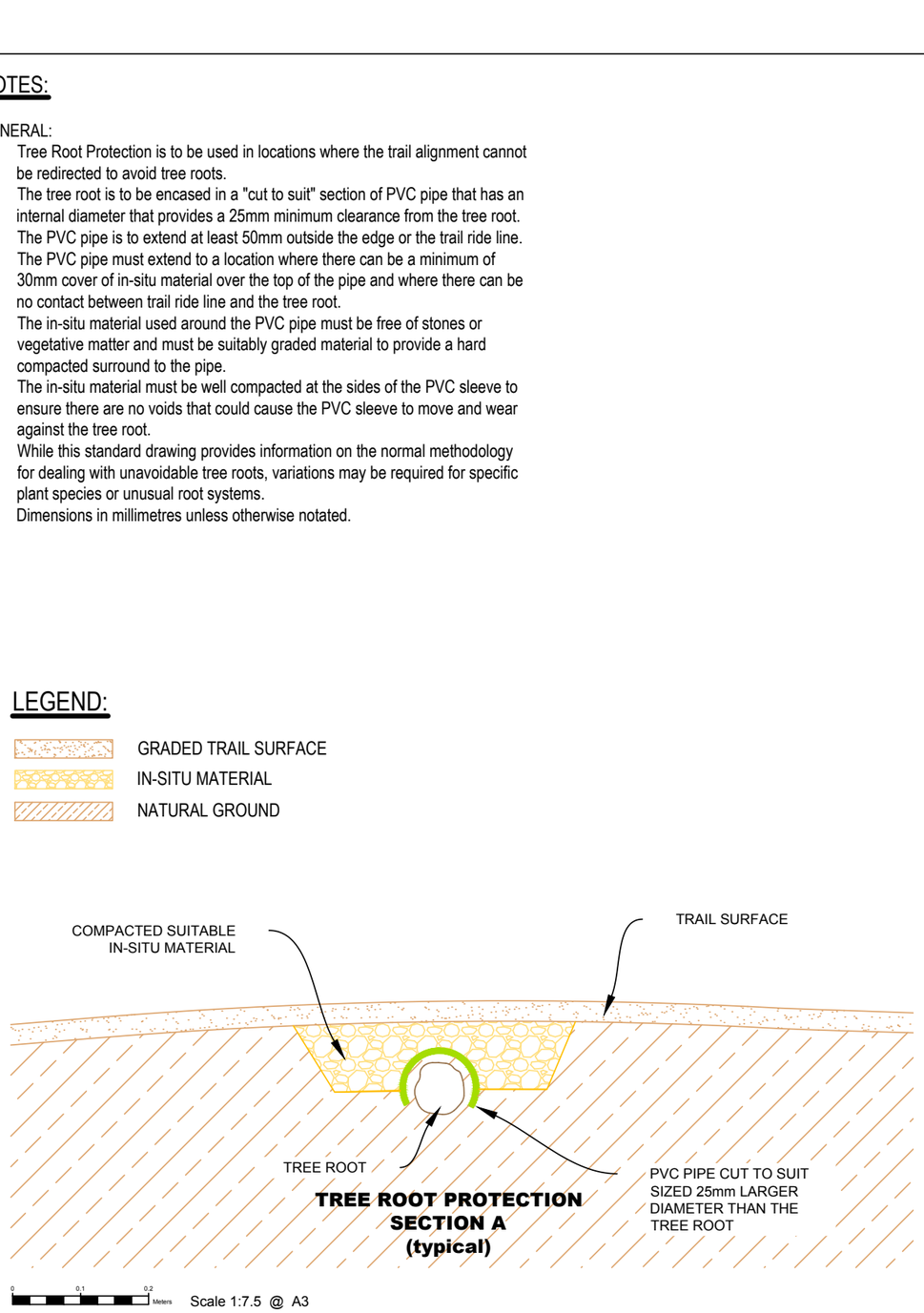
NOTES:

GENERAL:

- Tree Root Protection is to be used in locations where the trail alignment cannot be redirected to avoid tree roots.
- The tree root is to be encased in a "cut to suit" section of PVC pipe that has an internal diameter that provides a 25mm minimum clearance from the tree root.
- The PVC pipe is to extend at least 50mm outside the edge or the trail ride line.
- The PVC pipe must extend to a location where there can be a minimum of 30mm cover of in-situ material over the top of the pipe and where there can be no contact between trail ride line and the tree root.
- The in-situ material used around the PVC pipe must be free of stones or vegetative matter and must be suitably graded material to provide a hard compacted surround to the pipe.
- The in-situ material must be well compacted at the sides of the PVC sleeve to ensure there are no voids that could cause the PVC sleeve to move and wear against the tree root.
- While this standard drawing provides information on the normal methodology for dealing with unavoidable tree roots, variations may be required for specific plant species or unusual root systems.
- Dimensions in millimetres unless otherwise notated.

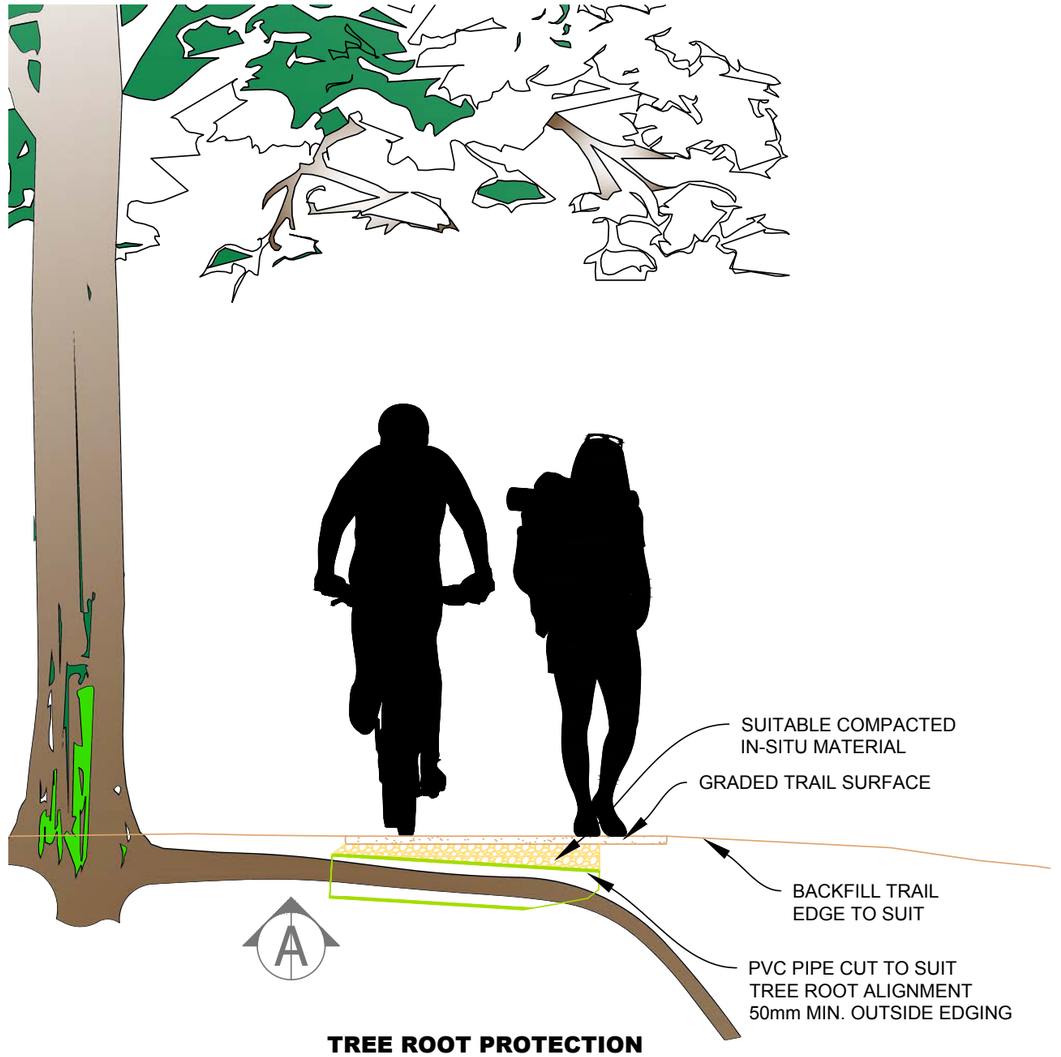
LEGEND:

GRADED TRAIL SURFACE
IN-SITU MATERIAL
NATURAL GROUND



TREE ROOT PROTECTION SECTION A (typical)

0 0.1 0.2 Meters
Scale 1:7.5 @ A3



TREE ROOT PROTECTION TRAIL ALIGNMENT (typical)

0 0.5 1 Meters
Scale 1:20 @ A3

GENERAL ARRANGEMENT
SCALE AS SHOWN

ISSUED FOR CLIENT REVIEW

APPROVED ☐
APPROVED AS NOTED ☐
NOT APPROVED ☐

SIGNED..... DATE.....

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn	JR	Signed	Date 24/03/20
Designed	DS	Signed	Date 24/03/20
Verified	DS	Signed	Date 24/03/20
Approved		Signed	Date

Drawing Title: TRAIL - TREE ROOT PROTECTION PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

Project No.	WT20-Wangetti-001
Scale	as shown
Sheet Size	A3
Drawing No.	WTSTD-031-WG2
Rev.	A

5.5.5 Raised Embankment

What is it?

Raised Embankments use extra 'fill' material to build the trail tread up higher. The fill material is usually sourced from another area where there is an excess of material and moved along the trail to where it is required.

When is it Used?

Raised Embankments may be necessary in trail sections that are often wet and boggy, or to improve rideability through changing the vertical alignment.

Raised Embankments are generally used where the ground surface is not suitable for typical cut and fill benching techniques. Examples include:

1. Areas with soft, boggy ground;
2. Areas that are very flat with no/little cross-slope to effect drainage;
3. Where additional fill/soil is used to 'ramp' up to a change in level – for example, where a trail is routed up and over a large rock slab.

Why is it Used?

It is used to ensure a smooth and consistent surface to the trail, using locally available surplus soil. Car needs to be taken to ensure that the Raised Embankment doesn't become a dam for surface flows.

Notes

Raised Embankments should be constructed so that they do not impede the flow of stormwater.

Rocks can be placed at the toe of the embankment to stabilise the batters and protect the bottom section of the embankment from erosion.

Borrow pits are not to be used to source material for Raised Embankments.

Materials

- In situ soil.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.

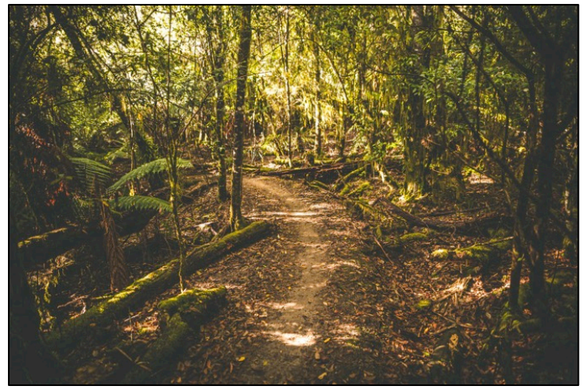
Estimated Length of Treatment

Not specified

Drawing Reference

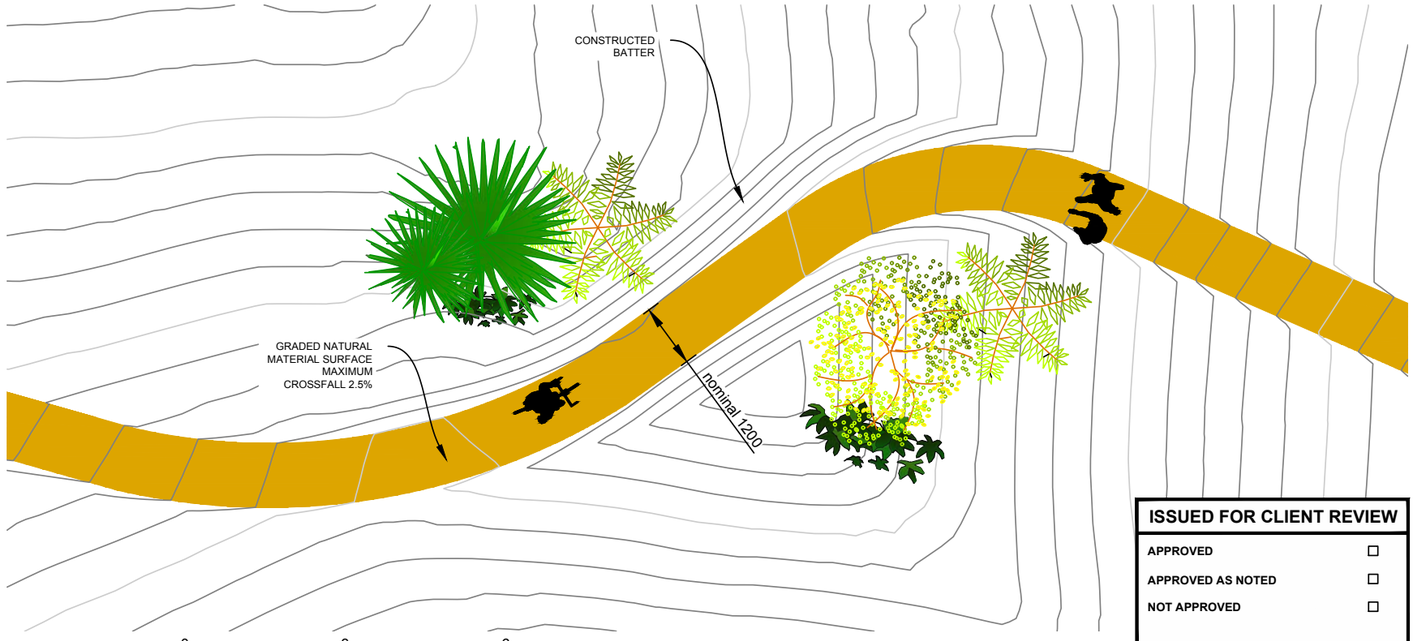
WTSTD-029-WG2
Raised Embankment – Dual Use
Placement and Dimensions

Examples

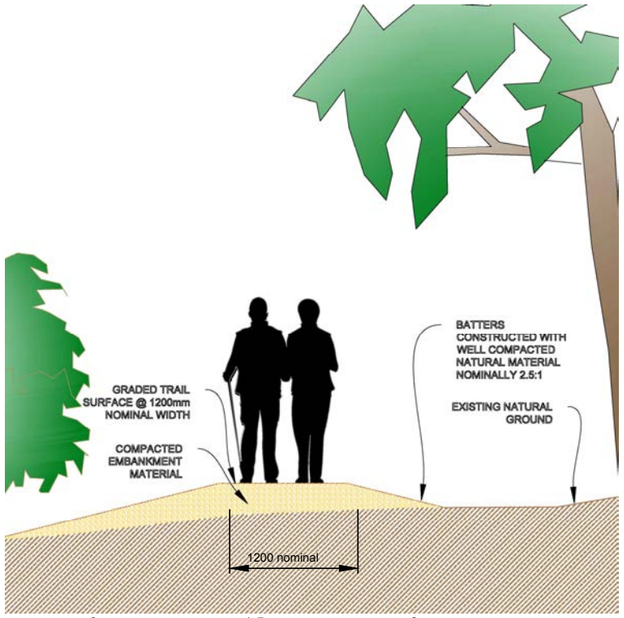


NOTES:

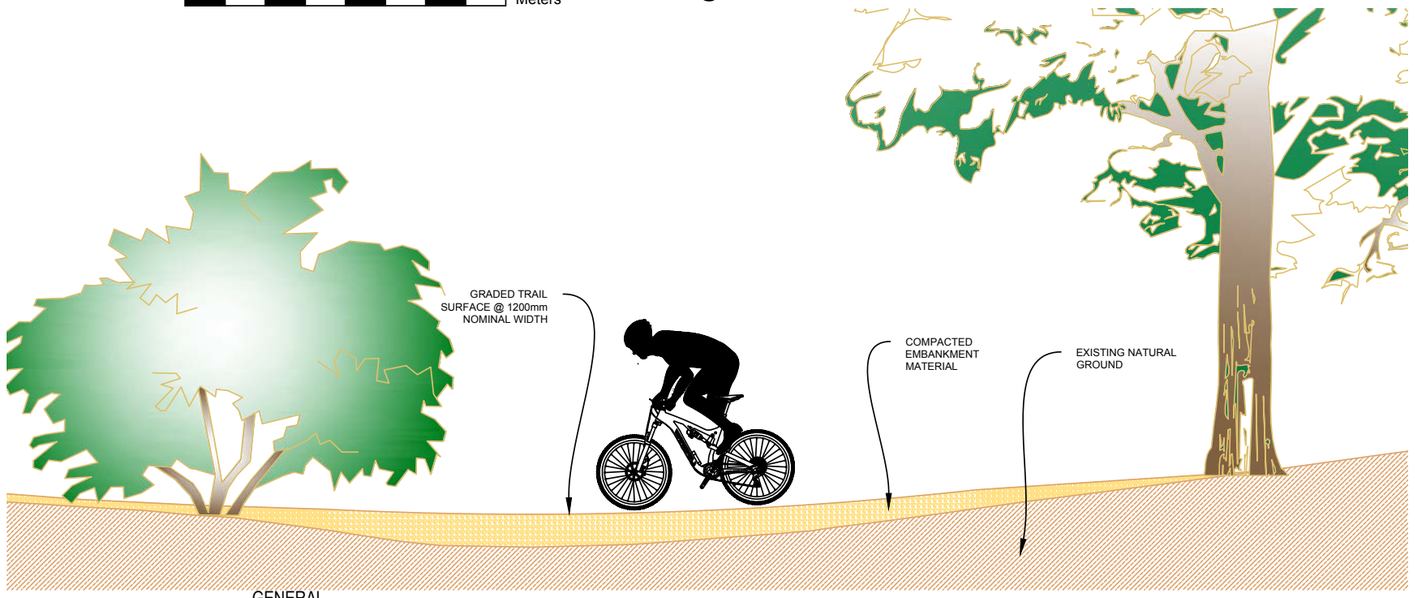
- Raised Embankments may be necessary in trail sections that are often wet and boggy or to improve rideability through changing the vertical alignment.
- Raised Embankments will only be appropriate in areas where spare embankment material is available and can be utilised economically.
- The height and length of the raised embankment will vary considerably depending on the location where it is required. It will vary from a slight elevation of a few hundred millimeters to around a meter as depicted on this plan.
- Embankment material should be free of large rocks and should not contain large amounts of vegetation matter.
- Embankments are to be compacted in layers of less than 200mm and to 90% of maximum dry density.
- Batter slopes should be nominally 2.5:1 but may vary considerably depending on the type and availability of fill material and the local topography of the trail location.
- Raised Embankments should be constructed so that they do not impede the flow of stormwater or they should have suitable drainage structures (eg pipes) placed at the bottom of the fill material.
- Rocks can be placed at the toe of the embankment to stabilise the batters and protect the bottom section of the embankment from erosion.
- Where there is sufficient room, rocks can also be placed at the top of the embankment to direct riders & hikers away from the embankment edges.



0 3 6 Meters Scale 1:100 @ A3



0 1.5 3 Meters Scale 1:50 @ A3



GENERAL ARRANGEMENT
VARIES

ISSUED FOR CLIENT REVIEW

APPROVED ☐
APPROVED AS NOTED ☐
NOT APPROVED ☐
SIGNED..... DATE.....

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 24/03/20	
Designed DS	Signed	Date 24/03/20	
Verified DS	Signed	Date 24/03/20	
Approved	Signed	Date	

Drawing Title: RAISED EMBANKMENT - DUAL USE PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale as shown
Sheet Size A3
Drawing No. WTSTD-029-WG2
Rev. A

5.5.6 Sediment Control

What is it?

Sediment Control is a construction treatment used to prevent the movement of sediment from the constructed trail into the surrounding environment.

When is it Used?

It is generally used in the following situations:
1. Below the outlet point of a grade reversal;
2. Below the lower edge of the trail on the approach (approx. 5-10m) to and exit from any permanent waterways.

Why is it Used?

Sediment Control is used to catch any sediment carried by water off the constructed trail, into the surrounding environment, thus preventing sediment from accumulating in waterways or smothering vegetation.

Sediment movement from trails that are constructed according to sustainable trail guidelines is minimal, and is usually greatest immediately at/after construction, decreasing with time as the trail settles and becomes stabilised.

Notes

Fibre Rolls and Silt Fencing both provide adequate sediment control and can be used interchangeably, or as directed by the Land Manager.

Sediment Controls should remain in place while the trail until the end of the Trail Curing Period, when the trail is deemed ready to be opened to the public.

Materials

- As per drawings.

Machinery / Equipment

- Rubber tracked mini-excavator;
- Trail building hand tools including rakes, mattocks, rake hoes, leaf rakes, shovels etc.
- Carpentry and general construction equipment.

Estimated Length of Treatment

Not specified

Drawing Reference

WTSTD-040-WG2
Sediment Control – Fibre Rolls
Placement and Dimensions

WTSTD-041-WG2
Sediment Control – Silt Fence
Placement and Dimensions

WTSTD-042-WG-2
Sediment Control – Silt Fence Notes
Placement and Dimensions

Examples

NOTES:

INSTALLATION:

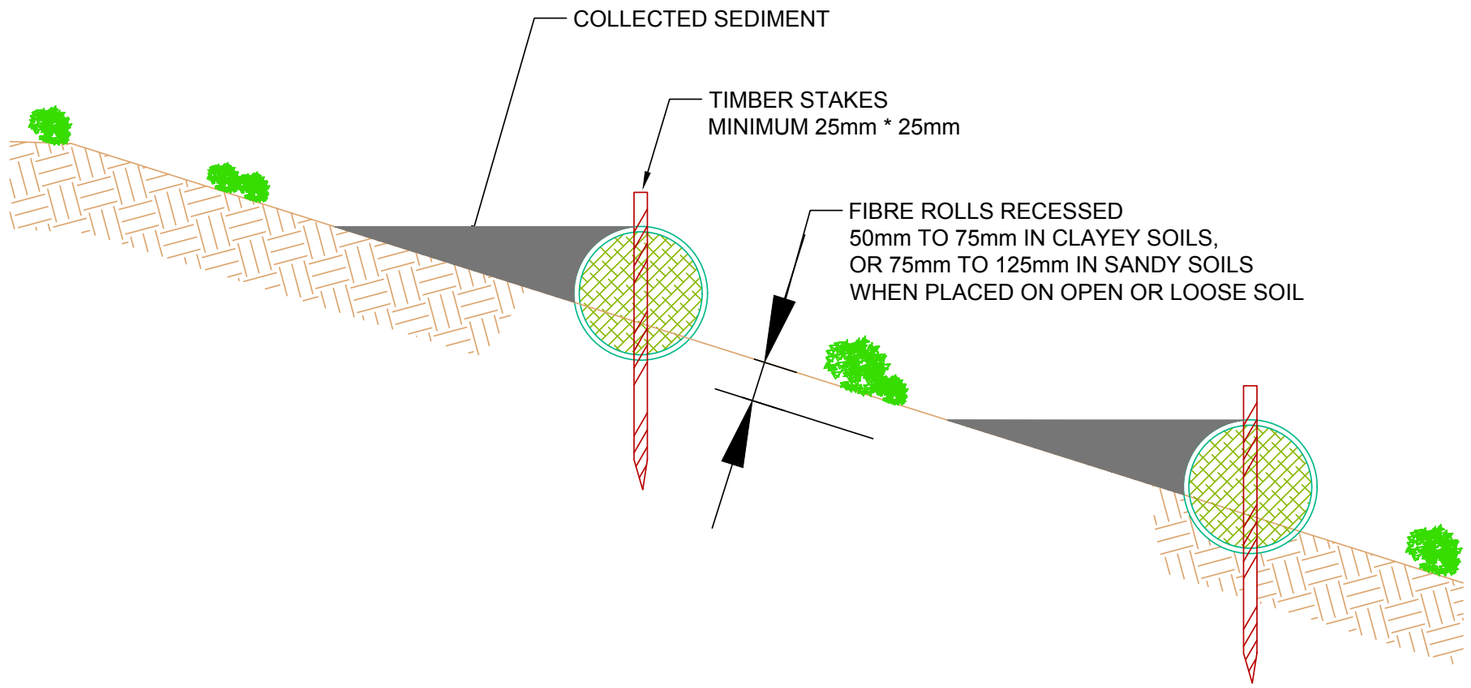
- Fibre Rolls are typically 200mm to 250mm Jute, Coir or Straw roll tied with synthetic biodegradable mesh.
- Fibre Rolls are to be installed as described in any project specific, approved plans. Any queries or alterations need to be provided by or approved by the clients engineer or on site representative.
- The rolls must be placed along the contour when placed across bare or newly seeded slopes.
- Ensure the outermost ends of a line of Fibre Rolls are turned up the slope to ensure ponding and minimise bypassing.
- When placed across the invert of minor drains ensure the rolls are spaced such that the crest of a downstream roll is level with or above the invert at the immediately upstream roll.
- When placed across the invert of minor drains ensure that each roll extends far enough up the banks on each side such that the crest of the roll in the center is lower than the ground height at the ends of the roll.
- Ensure the anchoring stakes are driven through the end of each roll and at a minimum spacing along the roll of the lesser of 1.2m spacings or 6 times the roll diameter.
- Stakes must be driven at a minimum spacing of 300mm when the rolls are being used to form a check dam.
- Adjoining rolls must be overlapped at least 450mm.

MAINTENANCE:

- All Fibre Rolls must be inspected at a minimum of once per week, always prior to a forecast rainfall event and at daily intervals during extended periods of rainfall.
- Any damaged or displaced Fibre Rolls must be replaced, relocated or repaired to ensure compliance with installation requirements.
- Collected sediment should be removed and disposed of in a suitable manner that will not cause erosion or detriment to water quality.

REMOVAL:

- Fibre Rolls are to be removed from site once they are no longer needed to provide their drainage or sediment control function.
- All excessive sediment must be removed from behind the rolls and disposed of as above, if it is likely to be washed away.
- Any biodegradable components of the Fibre Rolls may be suitable to remain on site as mulch.
- All materials that are not readily biodegradable must be removed from the site.



SECTION VIEW - TYPICAL INSTALLATION OF FIBRE ROLLS

0 0.2 0.4 Meters

Scale 1:10 @ A3

ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

NOTE: Sections of this plan have been derived from the Catchments and Creeks Standard Drawing - Plan FR-01

GENERAL ARRANGEMENT
SCALE 1:25

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR		

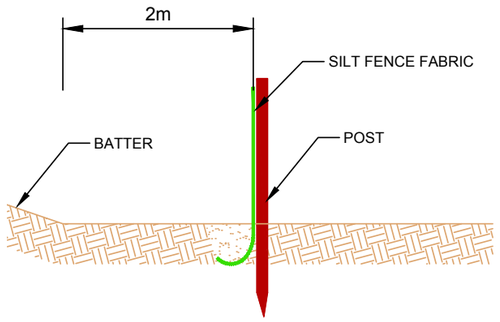
Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

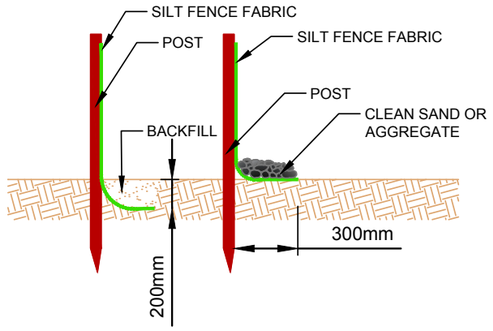
Drawn	JR	Signed	Date 24/03/20
Designed	DS	Signed	Date 24/03/20
Verified	DS	Signed	Date 24/03/20
Approved		Signed	Date

Drawing Title: SEDIMENT CONTROL - FIBRE ROLLS PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

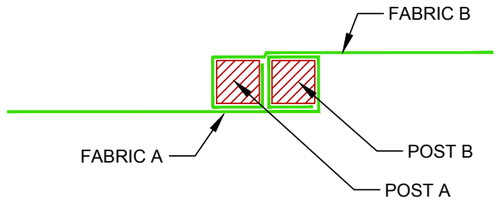
Project No. WT20-Wangetti-001
Scale 1:10 | Sheet Size A3
Drawing No. WTSTD-040-WG2 | Rev. A



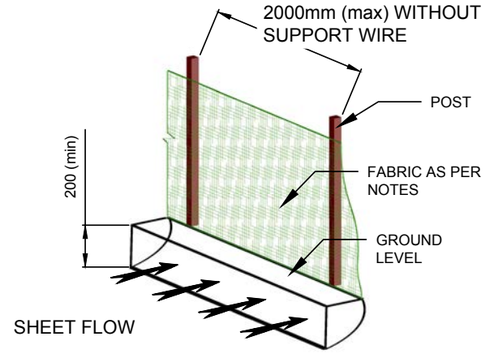
(a) LOCATION OF FENCE RELATIVE TO BASE OF SLOPE



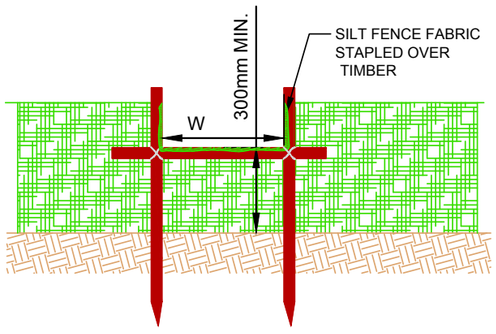
(b) SILT FENCE BASE ANCHORING



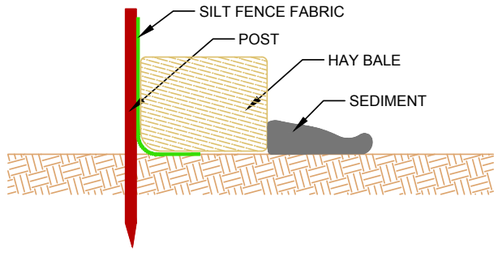
(c) JOINING FABRIC - METHOD 1



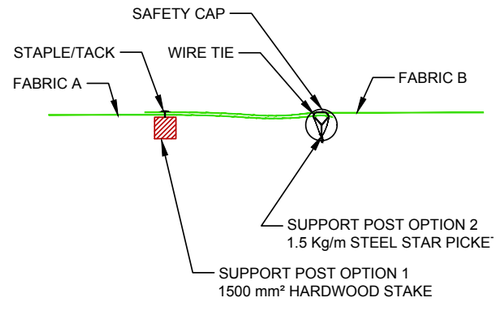
(d) INSTALLATION WITHOUT BACKING SUPPORT



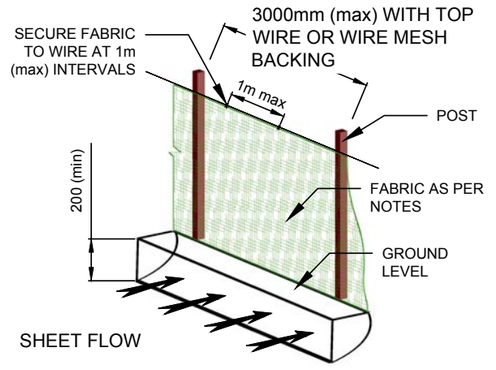
(e) SPILL-THROUGH WEIR



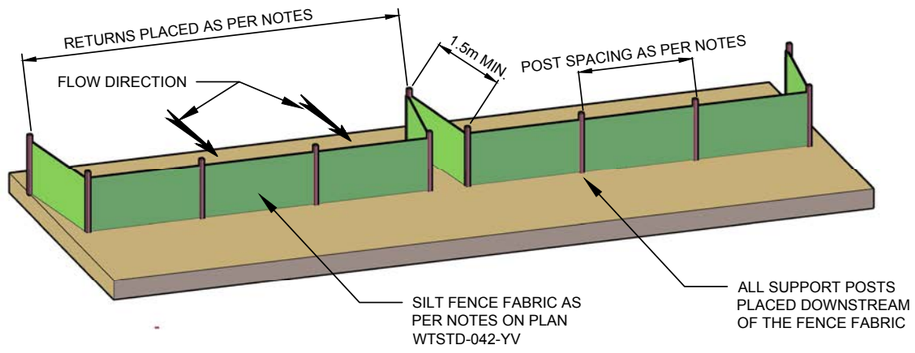
(f) PLACEMENT OF UP-SLOPE STRAW BALE



(g) JOINING FABRIC - METHOD 2



(h) INSTALLATION WITH TOP WIRE SUPPORT



(i) INSTALLATION OF SEDIMENT FENCE

NOTES:

- Sediment Fence to be installed along the contour where ever practical.
- Both ends of the Sediment Fence are to extend up the slope for at least 1m to avoid flow bypassing.
- Support posts to be placed at a minimum spacing of 2m or 3m if a top wire or mesh backing have been installed.
- Fence "returns" shall be installed at a maximum spacing of 20m when the fence is installed along the contour or 5m to 10m when installed on sloping ground.
- Silt Fence fabric is to be connected to the posts with a minimum of 4 staples or tie wires per post.
- This plan is to be read in conjunction with Plan WTSTD-042-YV and must not be interpreted by itself.

NOTE: Sections of this plan have been derived from the Catchments and Creeks Standard Drawing - Plan SF-01

ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR	DS	DS

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn JR	Signed	Date 24/03/20
Designed DS	Signed	Date 24/03/20
Verified DS	Signed	Date 24/03/20
Approved	Signed	Date

Drawing Title: SEDIMENT CONTROL - SILT FENCE PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

Project No. WT20-Wangetti-001

Scale NTS | Sheet Size A3

Drawing No. WTSTD-041-WG2 | Rev. A

NOTES:

MATERIALS:

FABRIC:

- Polypropylene. Polyamide, Nylon, Polyester or Polyethylene woven or non-woven fabric at least 700mm in width and 140 gsm.
- All fabrics to contain ultraviolet inhibitors and stabilisers to provide a minimum of 5 months of usable construction life (Ultraviolet Stability exceeding 70%)

FABRIC REINFORCEMENT:

- Wire or steel mesh minimum 14-gauge with a maximum mesh spacing of 200mm.

SUPPORT POSTS/STAKES:

- Hardwood Posts minimum 1500mm²,
- or Softwood Posts minimum 2500mm²,
- or Steel Star Pickets, minimum 1.5 Kg/m, suitable for attaching fabric.

INSTALLATION:

- Silt Fences are to be installed as described in any project specific, approved plans. Silt Fence Fabric should comply with any specifications provided. Any queries or alterations need to be provided by or approved by the clients engineer or on site representative.
- To the maximum degree practical, and where the plans allow, ensure the fence is located:
  (a) totally within the property boundaries
  (b) along a line of constant elevation wherever practical
  (c) at least 2m from the toe of any filling operations that may result in shifting soil/fill damaging the fence.
- Install returns within the fence at maximum 20m intervals if the fence is installed along the contour, or 5m to 10m maximum spacing (depending on slope) if the fence is installed at an angle to the contour. the 'returns' shall consist of either:
  (a) v-shaped section extending at least 1.5m up the slope; or
  (b) sandbag or rock/aggregate check dam a minimum 1/3 and maximum 1/2 fence height, and extending at least 1,5m up the slope.
- Ensure the extreme ends of the fence are turned up the slope at least 1.5m, or as necessary, to minimise water bypassing around the fence.
- Ensure the sediment fence is installed in a manner that avoids the concentration of flow along the fence, and the undesirable discharge of water around the ends of the fence.
- If the sediment fence is to be installed along the edge of existing trees, ensure care is taken to protect the trees and their root systems during installation of the fence. do not attach the fabric to the trees.
- Unless directed by the site supervisor or the approved plans, excavate a 200mm wide by 200mm deep trench along the proposed fence line, placing the excavated material on the up-slope side of the trench.
- Along the lower side of the trench, appropriately secure the stakes into the ground spaced no greater than 3m if supported by a top support wire or weir mesh backing, otherwise no greater than 2m.
- If specified, securely attach the support wire or mesh to the up-slope side of the stakes with the mesh extending at least 200mm into the excavated trench. ensure the mesh and fabric is attached to the up-slope side of the stakes even when directing a fence around a corner or sharp change of direction.
- Wherever possible, construct the sediment fence from a continuous roll of fabric. to join fabric either:
  (a) attach each end to two overlapping stakes with the fabric folding around the associated stake one turn, and with the two stakes tied together with wire; or
  (b) overlap the fabric to the next adjacent support post.
- Securely attach the fabric to the support posts using 25 x 12.5mm staples, or tie wire at maximum 150mm spacing.
- Securely attach the fabric to the support wire/mesh (if any) at a maximum spacing of 1m.
- Ensure the completed sediment fence is at least 450mm, but not more than 700mm high. if a spill-though weir is installed, ensure the crest of the weir is at least 300mm above ground level.
- Backfill the trench and tamp the fill to firmly anchor the bottom of the fabric and mesh to prevent water from flowing under the fence.

ADDITIONAL REQUIREMENTS FOR THE INSTALLATION OF A SPILL-THROUGH WEIR:

- Locate the spill-through weir such that the weir crest will be lower than the ground level at each end of the fence.
- Ensure the crest of the spill-through weir is at least 300mm above the ground elevation.
- Securely tie a horizontal cross member (weir) to the support posts/ stakes each side of the weir. Cut the fabric down the side of each post and fold the fabric over the cross member and appropriately secure the fabric.
- Install a suitable splash pad and/or chute immediately down-slope of the spill-through weir to control soil erosion and appropriately discharge the concentrated flow passing over the weir.

MAINTENANCE:

- Inspect the sediment fence at least weekly and after any significant rain. Make necessary repairs immediately.
- Repair any torn sections with a continuous piece of fabric from post to post.
- When making repairs, always restore the system to its original configuration unless an amended layout is required or specified.
- If the fence is sagging between stakes, install additional support posts.
- Remove accumulated sediment if the sediment deposit exceeds a depth of 1/3 the height of the fence.
- Dispose of sediment in a suitable manner that will not cause an erosion or pollution hazard.
- Replace the fabric if the service life of the existing fabric exceeds 6-months.

REMOVAL:

- When disturbed areas up-slope of the sediment fence are sufficiently stabilised to restrain erosion, the fence must be removed.
- Remove materials and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
- Rehabilitate/revegetate the disturbed ground as necessary to minimise the erosion hazard.

ISSUED FOR CLIENT REVIEW

APPROVED	☐
APPROVED AS NOTED	☐
NOT APPROVED	☐

SIGNED..... DATE.....

NOTE: Sections of this plan have been derived/copied from the Catchments and Creeks Standard Drawing - Plan SF-02

FOR INFORMATION

Rev.	Date	Revision Details	Drn.	Ver.	App.
A	24/03/20	ISSUED FOR INFORMATION	JR		

Client: Queensland Government

Project: WANGETTI TRAIL DETAILED DESIGN

Drawn	JR	Signed	Date 24/03/20
Designed	DS	Signed	Date 24/03/20
Verified	DS	Signed	Date 24/03/20
Approved		Signed	Date

Drawing Title: SEDIMENT CONTROL - SILT FENCE NOTES PLACEMENT AND DIMENSIONS WORLD TRAIL - STANDARD DRAWING

Project No. WT20-Wangetti-001
Scale na
Sheet Size A3
Drawing No. WTSTD-042-WG2
Rev. A

6 MATERIALS

The previous section detailed the various different Construction Treatments, and listed the materials required for that treatment. This section provides some further guidance and comments around the sourcing and use of those materials.

The main materials proposed to construct the majority of the Wangetti Trail are naturally occurring in situ materials – mainly, soil and rock (including large rocks [boulders]), small rocks and rock slabs). Priority is always given to sourcing material from within the trail alignment and surrounding area, ensuring minimal disturbance to the environment.

Soil

The proposed finished surface or wearing course for the majority of the Wangetti Trail is the natural soil – that is, the in situ mineral earth soil already in place beneath the vegetation, leaf litter and organic topsoil. This is true for both standard and hand-built trail construction. Where extra soil is required, for example, to build up over a low depression or to fill in between roots or to rake into the cracks between rock armouring, it can usually be sourced from the balanced cut and fill process used to create the bench which becomes the finished trail. While overall the cut and fill process is balanced, locally, soil may be moved up or down the trail, to manage local excesses or deficiencies.

If sufficient soil is not available in situ, it may be necessary to import soil, with agreement from the land manager. This scenario is seen as unlikely and difficult to achieve, given the large volume of materials that would be required and the remote setting of the trail.

Where imported soil is required, preference must be given to local, approved suppliers. Imported material must be free of weeds and pathogens. All material brought onto site must be accompanied by a certificate indicating that it is free of Phythophthora and weed species, unless the source has been agreed to by the TDPD Project Manager.

The use of ‘borrow pits’ to source extra soil is not permitted.

Aggregate/Fine Crushed Rock

In some instances, trails can be surfaced with imported materials like fine crushed rock. This is generally done in high traffic areas (e.g. campsites) or areas requiring additional materials for structural or drainage purposes.

While the application of imported materials as a wearing course is not proposed to be widespread on the Wangetti Trail, it is specified in at least one Construction Treatment (Ballast Surfacing).

Preference must be given to local, approved suppliers and agreement from the land manager will be required. The imported material must be free of weeds and pathogens. All material brought onto site must be accompanied by a certificate indicating that it is free of Phythophthora and weed species, unless the source has been agreed to by the TDPD Project Manager.

Rock

Rock, including small rock and large rock (boulders), will be used for the construction of rock water crossings, rock armouring, retaining walls, rock walling and to corral and anchor steps.

Priority must always be given to rock sourced from within the track alignment or from the surrounding area in the first instance, rather than importing rock from outside.

All rock material used for these construction treatments must be of an appropriate shape, texture and colour to match the native rock and must provide a natural appearance relative to its location.

The intention is for all constructed rockwork to 'disappear' within the surrounding natural landscape. Where possible, constructed rockwork will tie back into existing site features.

Harvesting of rock will be undertaken in a manner which minimises disturbance to the surrounding natural environment and does not present an obvious visual intrusion or disturbance to the landscape. Harvesting of rock will be only in the quantities required to fully complete the works. Over-harvesting will not be permitted. Rock will be harvested in a sequential manner to the construction works, thereby minimising stockpiles of material. Where rock awaiting use is stored, it must pose minimal disturbance to the environment. The ideal scenario is that all rock used for construction purposes is surplus rock removed during the construction of the bench.

Where local in situ rock is not available, it may be necessary to import rock for construction of features. This scenario is seen as very unlikely, and would be difficult to achieve given the large volume of materials that would be required. Imported rock must be free of weeds and pathogens. All material will be brought onto site accompanied by a certificate indicating that it is free of Phythophthora and weed species, unless the source has been agreed to by the TDPD Project Manager.

Constructed slope stabilisation such as rock gabions are not specified along the Wangetti Trail. Rock walling/retaining walls are proposed.

When used in the construction of rock water crossings, boulders must be large enough to resist movement in high water flow. No imported materials are to be used in the construction of rock water crossings.

If insufficient suitable sized rock is available, large boulders may be split.

Concrete

Concrete will be used for the construction of retaining walls, pre-cast concrete steps and foundations for built structures such as bridges and boardwalks.

Where concrete is required, it must be of a style and colour that is sympathetic to the local environment.

Materials for Built Structures

Built structures require numerous imported materials (such as concrete, timber, steel, aluminium, FRP etc.). These imported materials must complement the look and style of the Wangetti Trail, must be durable and functional for their purpose and should ideally come from a local source.

7 PROCEDURES

7.1 CONSTRUCTION INDUCTION

At the commencement of construction, all staff members will be required to attend a Construction Induction.

Key items to be covered in the Construction Induction include (but are not limited to):

- Project Location, including staging areas, access roads, stockpile locations, emergency evacuation points etc.;
- Project Scope of Works, including desired outcome of the project, construction program, key milestones, completion etc.;
- Construction Specifications – i.e. this document;
- Project Management protocols around reporting, procedures to follow if there are issues with construction works or the design, variations, etc.;
- Construction Environmental Management Plan;
- Work Health and Safety Management Plan;
- Visitor risk management protocols to minimise the risk of visitors using the trail while it is under construction;
- Hygiene protocols to ensure any machinery or tools are free from contaminated soil, weeds or seeds;
- Cultural heritage protection protocols including Aboriginal heritage site stop-work instructions;
- Proposed materials.

Ideally, representatives from TDPD, WTMA, QPWS, Traditional Owners, Douglas Shire Council, Cairns Regional Council and Mareeba Shire Council will be present at the induction and may choose to include organisation-specific induction material. Individual land managers or regulatory agencies may choose to provide their own Construction Induction, in line with their own internal requirements.

At the completion of the Construction Induction, all staff members will be required to sign an attendance form indicating their presence and understanding of the information discussed.

Any new staff members arriving throughout the duration of the project will be required to undertake a shortened Construction Induction with the Contractor's Project Manager.

7.2 PRE-START TRAIL REVIEW

At the commencement of the construction of the Wangetti Trail, the entire trail should be broken into Construction Segments. These Construction Segments may correspond to the sections shown in Map 1 and Map 2 (on pages 4 and 5) or may be determined based on the preferred staging approach undertaken by the TDPD Project Manager, or land tenures, or some other variable. The purpose of creating Construction Segments is to break the project into smaller components, for ease of inspections, reporting, invoicing, practical completion and staged opening.

Before starting the construction of a Construction Segment, a Pre-Start Trail Review (PSTR) must be undertaken.

The purpose of the PSTR is to review and inspect the proposed alignment of the trail with the TDPD Project Manager, prior to construction starting, to confirm the exact alignment within the ground-truthed corridor[1], identify any specific environmental values to be protected and to discuss and agree on specific construction treatments.

The following personnel will be required to attend the PSTR:

- TDPD Project Manager;
- Contractor's Project Manager;
- Contractor's Trail Designer/Builder for that Construction Segment.

A representative of the respective land manager(s) (QPWS, WTMA, Douglas Shire Council, Cairns Regional Council and Mareeba Shire Council and the Traditional Owners) should be invited to attend the PSTR.

Other personnel may also be required – for example, if the trail is in close proximity to areas of high environmental values, qualified environmental specialists should be present to provide assistance in miro-siting the trail to avoid impacts to these values. In areas of high cultural heritage values, qualified archaeologists and/or Traditional Owners should be present.

Where the Construction Segment is very long, shorter agreed sub-segments may be used, or the PSTR may be staged over multiple days.

Prior to commencing the PSTR, known information about the Construction Segment should be gathered and assessed – length, proposed difficulty rating, likely construction treatments, known water-crossings and any environmental issues that have been identified. During the field component of the PSTR, any changes to the alignment, treatment or other issues that are identified must be documented accordingly along with maps, GPS coordinates, photos and sketches as required. This process could also be sued to identify and document agreed likely variation items such as rock armouring.

[1] The ground-truthed corridor is defined as the flagged (where flagging tape is in place), GPS'd centre line, plus the agreed buffer of 20m to either side (i.e. a total corridor width of 40m). Where flagging tape is missing or sporadic, the GPS alignment can be used.

Where there is a known environmental issue (identified by WTMA or other reports) specific to the trail, the following protocol would apply:

- WTMA would be contacted prior to the field inspection for specific recommendations and invited to attend if required (for example, micro-siting to avoid threatened flora sites);
- During the field inspection, the scope of the environmental issue would be visually identified and then marked in the field as an exclusion zone (using different coloured flagging tape or bunting). The exact alignment of the trail to be constructed would be flagged in the field, ensuring an adequate buffer from the exclusion zone;
- Detailed documentation will be gathered, including photographs showing the pre-existing conditions on site before any works are undertaken. This allows for post-construction photos to be taken, which will enable before/after comparison.

On completion of the PSTR, the contractor will be required to record the outcomes. Specifically, they must document any proposed variations, any protection measures for areas of environmental or cultural heritage sensitivity, any changes to the alignment, or any other issues/decisions made during the PSTR. Documentation should include photos and specific GPS coordinates and should be signed by all attendees. A copy of the completed and signed PSTR report form must be provided to the TDPD Project Manager.

7.3 TEMPORARY CAMPSITES

Due to the remoteness of the trail, and the time taken to travel in and out to the work site, there may be occurrences when it is more cost and time effective for the trail builders to camp overnight. This would be at the discretion of the contractor, but may require some preparation ahead of time in order to obtain approvals.

If a contractor wishes to camp overnight, the following steps are to be taken to identify a temporary campsite location and obtain approval:

- Identify potential temporary campsite location. Look for locations with harder ground or sandier soils. Avoid low or poorly drained areas where soil or vegetation may be easily damaged. Consider whether mobile phone reception is available and/or necessary. Locations with nearby vehicle access and/or public amenities to be given priority;
- Notify/request approval from TDPD Project Manager and relevant land manager with following details:
    - Location of proposed temporary campsite;
    - Number of people/tents proposed to occupy temporary campsite;
    - Length of proposed duration of use of temporary campsite.

Once a temporary campsite is approved by the TDPD Project Manager and relevant land manager the following must be adhered to:

- Do not pitch tent underneath any loose, dead or overhanging tree limbs;
- Do not remove, or damage, any vegetation;
- No fires;
- Carry all rubbish out;
- Bury human waste at least 100m from streams and at least 15cm deep, or carry it out;
- Respect wildlife;
- No chainsaw use;
- Water:
    - Carry in enough water for the duration of the stay at the temporary campsite;
    - If unable to carry enough, collect water from streams and always boil for at least 5 minutes before drinking or use treatment tablets, a filter or UV treatment;
    - Wash at least 100m away from watercourses and scatter wash water.

On completion of use of temporary campsite, the following steps are to be taken:

- Take time to naturalise the site by covering scuffed areas with native materials (such as fallen leaves), brushing/raking out matted areas. This will help the site recover and also make it less obvious as a campsite;
- Compacted area is to be de-compacted to encourage regrowth;
- Scarification is to be perpendicular to the slope to reduce soil erosion. Logs, leaf litter and vegetation material are to be randomly spread over the site. On completion, the closed site must appear unusable to park visitors to discourage continued use.
- Carry out all rubbish;
- Any infrastructure/equipment brought in by the Contractor must be removed on completion;
- Advise TDPD Project Manager and relevant land manager the temporary campsite is no longer in use.

7.4 TRAIL COMPLETION PROCEDURE

Upon completion of a trail or Construction Segment, the following should occur:

- Remove all flagging tape that may still be visible;
- Removal any rubbish or construction debris;
- Remove all construction equipment and machinery;
- Leave in place any sediment control measures for a duration as agreed and determined by the TDPD Project Manager. As a minimum, sediment control measures should be retained until the Trail Curing Period has finished and the trail or Construction Segment is deemed ready to be opened to the public;
- Trim any tree branches that may protrude into the riding or walking corridor;
- Trim or remove any sharp tree stumps within the fall zone adjacent to the trail;
- Check that any imported surfacing materials or raised embankments have been compacted to a suitable level;
- Check that all rock work is stable and secure;
- Check that the trail is draining as intended – i.e. no puddling of water anywhere on the trail, all grade reversals have a clear outlet and are draining effectively with no blockages, that any outsloped sections of trail have the appropriate gradients and there are no blockages along the lower edge;
- If excavators and other plant/machinery are being relocated to another project or a different area, they are to be washed down at a commercial washdown facility or washdown facility at QPWS works depot.

Typically, at this stage, the contractor would arrange a walk-through inspection with the TDPD Project Manager, seeking Practical Completion for that trail or Construction Segment. Once Practical Completion has been achieved, the Trail Curing Period should commence.

Upon achieving practical completion, the trail or Construction Segment should remain closed for a period of 4-12 weeks (depending on weather, time of year and other variables) to allow for ‘curing’ of the trail surface. Signage and fencing should remain in place to restrict members of the public from accessing the trail during this time.

At the end of the Trail Curing Period, the trail will be ready for opening to the public. In the days just prior to opening the trail, a trail clean-up will be required. During the trail clean-up, the following activities are typically undertaken:

- Any large trees or branches that have fallen across the trail are removed;
- Leaves and other debris is removed – leaf blowers or grass rakes are ideal for this purpose;
- Removal of sediment control measures;
- Removal of any construction signage or fencing;
- Pruning of vegetation as required;
- Minor works to ensure the trail is draining as intended;
- Minor works to ensure no loose or uncompacted soil within the main trail tread.

Trail Completion Procedures may also have contractual implications. The procedure listed above relates to trail works, but DITID may put in place specific requirements around Practical Completion, a specified Defects Liability Period, the provision of ‘As Constructed’ drawings and the provision of specific reporting outputs against environmental or cultural heritage issues.

7.5 EMERGENCY PROCEDURES

Emergency procedures will vary depending on the nature of the incident.

The TDPD Project Manager will be verbally notified of any emergency incident within 2 hours of the Contractor's Project Manager becoming aware of the incident, and in writing within 24 hours. All notifications to the following authorities will be undertaken by TDPD:

- DITID;
- Department of Environment and Services / QPWS;
- State emergency services (Police / Fire / Ambulance / SES)
- Department of Transport and Main Roads (if necessary/proximal to Captain Cook. Highway).

The Contractor will be required to provide an Emergency Response Plan and for this plan to be thoroughly communicated to all staff members in the Construction Induction. The Emergency Response Plan should identify evacuation routes, mustering points, communication protocols and provide key contact details for local authorities and services. It should be compatible with the internal emergency response protocols of the various land managers.

Environmental incidents and emergencies will be identified within individual environmental risk management plans. However, pro-active environmental risk management measures should be undertaken wherever possible, if events such as extreme rainfall or flooding are forecast.

When reporting environmental incidents to TDPD, the following information is to be provided:

- The name and contact details of the reporting person;
- The date and time the environmental incident occurred;
- The activity that was being undertaken when the incident occurred;
- How the incident occurred;
- Any containment measures put in place to reduce or contain environmental harm;
- An assessment of the amount of environmental harm that occurred;
- If any other stakeholders are aware of the incident.

7.6 HELICOPTER PROTOCOLS

Frequent helicopter usage will be critical for the timely and efficient construction of the Wangetti Trail. The main applications for helicopters include:

- Delivery of materials – while much of the Wangetti Trail will be constructed without imported materials, some of the Construction Treatments require imported materials. For example, minor water crossings and pre-cast concrete steps. Given the remote and difficult nature of the terrain, the only way of transporting materials for these Construction Treatments is by vehicle to the closest possible access road, then by hand/power carrier along the trail, or by helicopter;
- Air lifting mini-excavators across impassable terrain – from time to time, the trail crosses sections of terrain that are not safe for the passage of a mini-excavator. These areas include steep-sided rocky gullies where bridges have been specified (note – bridges will not be engineered to allow passage of a mini-excavator [approx. 1.7T]), or large expanses of steep side-sloping rock slabs. In some instances, it may be possible to track the mini-excavator back out along the finished track, transport it by road to another access point further along the trail and commence working backwards until reaching the other side of the impassable terrain. In other instances, the mini-excavator may be able to track around the impassable terrain, with minimal impact or risk. However, it is envisaged that there will be frequent impassable sections where there is no alternative other than to airlift the mini-excavator.

In order to maximise the efficient operation of helicopters and minimise costs, helicopter operations should be carefully controlled, and clustered into half or full day blocks. Ideally, helicopter operations would be scheduled to occur on a recurring fortnightly/monthly basis (as required), with operations organised in advance. Works requiring a helicopter would then be identified in advance and allocated to the next upcoming helicopter operations day. Deliveries of materials to staging areas could be scheduled to minimise time in storage and double handling. This also allows for clear flight plans to be prepared, identifying materials and drop locations, along with GPS coordinates.

A permit will be required to fly a helicopter below 1000m in the World Heritage Area. Low flying has the potential to compromise certain World Heritage values, such as the wilderness qualities of certain areas. For this reason, flying an aircraft for commercial purposes in the World Heritage Area less than 1000 feet above the ground level is prohibited. However, the Authority may issue a Permit under the Wet Tropics Management Plan in special circumstances, such as these.

The Contractor will need to work with the TDPD Project Manager to coordinate the use of helicopters and ensure all permits and approvals are obtained prior to operations commencing.

Nine separate Helicopter Staging Locations have been identified - see

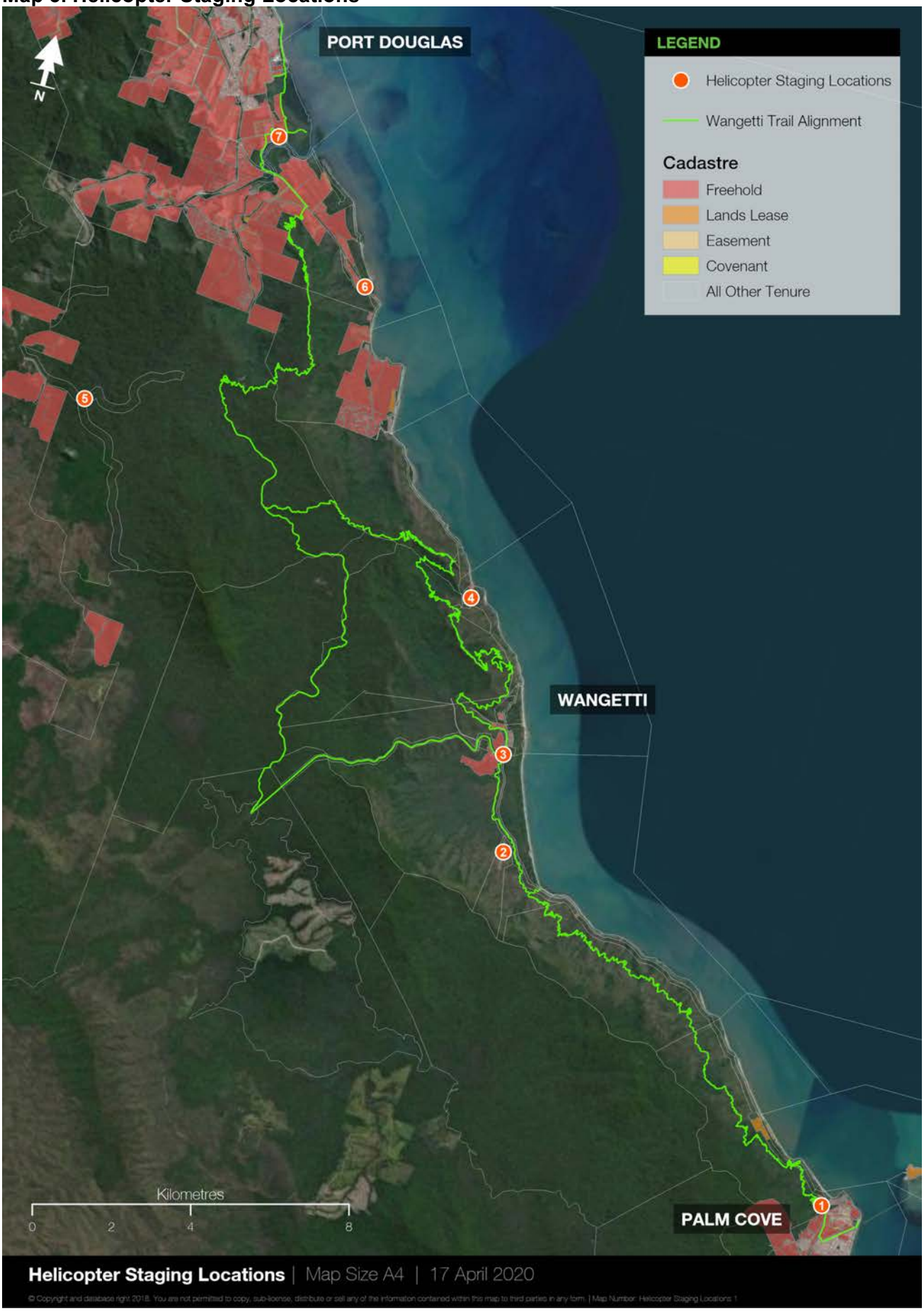
Table 4. Helicopter Staging Area Locations below.

Map 3 on the following page shows their locations.

Table 4. Helicopter Staging Area Locations

Name	Location	GPS Coordinates	Comments
Location 1	SES Depot - Off Captain Cook Highway	Lat: -16.73889453, Long: 145.66242376	Provides safe access for truck deliveries and has adequate room for helicopter staging activities.
Location 2	Rifle Range – Off Captain Cook Highway	Lat: -16.68258754, Long: 145.57192468	Provides safe access for truck deliveries and has adequate room for helicopter staging activities. Permission would need to be gained from relevant Australian Defence Force department as this location is still an active range for parts of the year.
Location 3	Off Captain Cook Highway	Lat: -16.66210901, Long: 145.56612575	A cleared parcel of land adjacent to the Captain Cook Highway provides safe access for truck deliveries and has adequate room for helicopter staging activities.
Location 4	Off Captain Cook Highway	Lat: -16.63104893, Long: 145.54990777	Located close to Turtle Cove, this location can be used as a helicopter staging location. Access to this location would be limited to 4x4 utility vehicles.
Location 5	Twin Bridges Road	Lat: -16.61092623, Long: 145.45351588	Located on Twin Bridges road this location provides safe access for truck deliveries and has adequate room for helicopter staging activities. The road would need to be closed to the public if helicopter activities were undertaken at this location.
Location 6	Off Captain Cook Highway	Lat: -16.57169983, Long: 145.50838583	Located close to Yule Point, this location can be used as a helicopter staging location. Access to this location would be limited to 4x4 utility vehicles.
Location 7	Andreassen Road – Off Captain Cook Highway	Lat: -16.54516221, Long:145.48039967	Located on the North side of the Mowbray River, this location provides safe access for truck deliveries and has adequate room for helicopter staging activities

Map 3. Helicopter Staging Locations



7.7 SITE ACCESS

Construction of the Wangetti Trail will most likely occur in multiple locations with multiple teams operating simultaneously. The Work Site for each team is generally defined as the location at which the rubber tracked mini-excavator is located, plus 50-100m ahead of the machine where vegetation clearing is being undertaken, plus 50-100m behind the machine where trail finishing works (rock armouring, drainage, trail clean-up etc.) are being undertaken. The Work Site is constantly moving, progressing forward in a linear fashion along the trail.

Day to day access to each work site for each particular team will be as follows:

- Construction vehicles will travel as close as possible to the work site using the approved access tracks. Construction vehicles to be parked in a suitable location along the access track, as close as possible to the intersection with the alignment of the Wangetti Trail. Vehicles must not be parked off-track but must also not be parked so as to obstruct the track;
- Construction personnel will walk along the completed section of trail to reach the work site. The use of mountain bikes (MTBs), electronic mountain bikes (eMTBs) or suitable motorbikes (e.g. farm or 'ag' bikes) to access the site is also acceptable, especially where the distance from the vehicles to the work site is large, or where construction personnel need to carry in fuel or water. The use of the completed trail for access to the work site provides a number of benefits:
    - Assists in compaction and 'curing' of the trail;
    - Prevents unnecessary impacts on vegetation caused by construction personnel travelling 'off-track' to and from their work site;
    - It is the safest way to access the work site;
    - Construction personnel are able to check the condition of the finished sections of the trail twice daily (start and end). If any issues or problems are identified, they can be easily rectified.

Points at which the Wangetti Trail crosses any vehicle tracks (whether they are open to the public or not) are the most likely potential ingress points for members of the public. Exclusion fencing (generally orange para-webbing, extending into the bush for 5-10m either side of the trail) and signage need to be erected at these points to discourage members of the public from accessing the trail prior to it being opened.

Map 4. Access Track Locations - South

Map 5. Access Track Locations - North

7.8 STOCKPILE LOCATIONS

The majority of the Wangetti Trail will be constructed using natural in-situ materials only – rock and soil predominantly. However, imported materials will be required from time to time and may need to be stockpiled temporarily.

Scheduling for any deliveries should be managed to minimise the length of time that stockpiles are required – i.e. deliver the materials as close as possible to the time at which it is required.

Table 5. Construction Materials Stockpile Summary

Construction Treatment	Materials Required	Location of Treatment	Importation Method	Stockpile Locations
Rock Armouring	• Rock (can be in situ or imported, subject to land manager requirements).	• Multiple locations across all segments of the trail; • Many in remote locations on steep hillsides and gullies.	• In situ rock to be sourced locally and moved to site along the constructed trail using power carrier.	• Stockpiled on the completed trail adjacent to the site of the Rock Armouring.
Rock Walling (Up To 500mm)	• Rock (can be in situ or imported, subject to land manager requirements).	• Multiple locations across all segments of the trail; • Many in remote locations on steep hillsides and gullies.	• In situ rock to be sourced locally and moved to site along the constructed trail using power carrier.	• Stockpiled on the completed trail adjacent to the site of the Rock Walling (Up To 500mm).
Retaining Walls (Up To 1000mm)	• Rock (can be in situ or imported, subject to land manager requirements); • Concrete; • Mortar; • Geofabric; • Drainage materials as per drawing.	• Multiple locations across all segments of the trail; • Many in remote locations on steep hillsides and gullies.	• In situ rock to be sourced locally and moved to site along the constructed trail using power carrier; • All other materials to be imported, either manually along the constructed trail, or by helicopter, depending on quantity and remoteness.	• Stockpiled on the completed trail adjacent to the site of the Retaining Wall (Up To 1000mm).
Ballast Surfacing	• Ballast rock for base course; • Fine crushed rock for wearing course; • Geofabric.	• Mainly in low-lying areas; • Main location to the immediate south of Wangetti township.	• Ballast rock for base course and fine crushed rock for wearing course to be imported using trucks and machinery.	• To be determined upon construction, but ideally materials will be dropped on the vehicle track exactly at the required locations and spread immediately.

Construction Treatment	Materials Required	Location of Treatment	Importation Method	Stockpile Locations
Pre Cast Concrete Steps	• Pre-cast concrete steps (available in different sizes); • Concrete for foundation of base step; • Road base for foundation of mid-flight steps; • Mortar; • Large rocks as corrals and anchors to sides of flight of steps.	• Generally in difficult, steep elevated terrain.	• All materials will likely need to be imported by helicopter, given remote and difficult setting.	• Stockpiled on the completed trail adjacent/ below the site of the Steps (Pre Cast Steps)
Natural Rock Seats	• Rock (can be in situ or imported, subject to land manager requirements); • Concrete; • Mortar; • Geofabric; • Drainage materials as per drawing.	• Multiple locations across all segments of the trail; • Generally in locations with good views.	• In situ rock to be sourced locally and moved to site along the constructed trail using power carrier; • All other materials to be imported, either manually along the constructed trail, or by helicopter, depending on quantity and remoteness.	• Stockpiled on the completed trail adjacent to the site of the Trail Furniture (Stone Seats).
Minor Water Crossing	• Subject to final design, but likely to include: • Decking materials – timber, steel mesh, FRP etc.; • Framing materials – timber, steel, FRP etc.; • Concrete for footings; • Fixings.	• Multiple locations across all segments of the trail; • Many in remote locations on steep hillsides and gullies.	• Manually carried in along the completed trail; • Lifted in by helicopter.	• Stockpiled on the completed trail adjacent to the site of the Minor Water Crossing.
Major Water Crossing	• Subject to final design	• Crossing of Hartley's Creek, upstream of Wangetti township.	• All materials to be imported using trucks and machinery, along nearby access route.	• To be determined.

There are a number of different stockpile types/scenarios to consider:

1. Major stockpiles at staging areas – given the size of the project, the Contractor will need to set up their own secure staging area/s. These staging areas will likely need fencing, containers for storage of equipment, a site office, toilet facilities, power and water, car parking and a clearly defined and designated stockpile area that is truck accessible. The staging area should also have a large cleared space, from which any helicopter lifting operations can take place. Given the large area covered by the Wangetti Trail it is recommended that staging areas be identified at three different locations – south/Palm Cove, mid/Wangetti and north/Mowbray. Depending on project scheduling, these different staging areas wouldn't all need to be operational at the same time. The Contractor will need to work with the TDPD Project Manager to identify suitable locations for these three staging areas;

2. Truck accessible stockpiles – truck accessible stockpiles can be placed at locations where the Wangetti Trail crosses over a vehicle access track that is suitable for 2WD truck access. Given the majority of the access roads throughout the area are probably not suitable for 2WD truck access, the number of these stockpile locations is very limited. These stockpile locations are likely to be located in areas where the trail comes down to lower altitude, for example, closer to the Captain Cook Highway;

3. 4WD accessible stockpiles – 4WD accessible stockpiles can be placed at locations where the Wangetti Trail crosses over a vehicle access track that is suitable for 4WD vehicle access. Given the majority of the access roads throughout the area are more suited to 4WD, the number of these stockpile locations is greater, but they are of limited value as standard 4WD vehicles have limited capabilities for delivery of bulky materials;

4. Helicopter drop-off locations – during ground-truthing fieldwork, clearings were identified as having potential as helicopter drop-off locations were recorded. These helicopter drop-off locations are generally located close to the trail, but should be reviewed by the Contractor for usefulness. While some may appear close to the trail, if they are located steeply downhill form the trail or with dense vegetation between, they may not have much value for material delivery. The ideal scenario is for any materials being delivered by helicopter to be dropped as close as possible to their required location, preferably on a section of completed trail.

Upon commencement, it is recommended that the Contractor review all access roads in the area to determine their suitability for vehicle access and delivery of materials.

As a general rule, no spoil will be required to be stockpiled. The construction of the trail is a balanced cut to fill methodology, requiring no spoil to be stockpiled or removed from site. Any stockpiling that occurs is temporary and very minor in nature and would be undertaken by stockpiling on the cut bench of the trail.

No waste will need to be stockpiled. Generally speaking, there is minimal waste produced during trail construction. Trail builders are responsible for removing all of their own personal waste daily. Construction of structures such as bridges or boardwalks can generate small amounts of waste that need to be removed, but this should ideally be limited through sound design and fabrication processes, so as to limit bringing in surplus or unnecessary materials in the first place.

Stockpiles should not be placed on native vegetation. Ideally, stockpiles are to be located in previously cleared areas, such as on road verges or cleared, completed sections of trail. If this is not possible, the placement of a plastic tarp may be necessary beneath the stockpile. Any stockpiles of soil or fine crushed rock or similar will require the use of sediment control measures to be put in place.

Camp sites – the construction and operation of the campsites will require vehicle access in most cases. While the clearing of vegetation for the campsites should be limited to the smallest possible footprint around the various pieces of infrastructure (i.e. walkways, tent pads, common area/shelter, toilets etc.), a small staging area will need to be cleared for construction purposes. This staging area would be the stockpiling location for all materials required for the construction of the campsites.

8 GLOSSARY OF TERMS

Term	Definition
Australian Standards (AS)	Voluntary documents that set out specifications, procedures and guidelines that aim to ensure products, services and systems are safe, consistent and reliable.
Australian Walking Track Grading Systems (AWTGS)	System used to grade walking trails on a difficulty scale from grades one to five, operating at two distinct tiers: 1. Technical grading determined by land manager using set of technical questions based on the AS 2156.1-2001 Walking Tracks – Classification and Signage; 2. Plain English language description to describe the walk to the public.
Bill of Quantities	Detailed statement of work, dimensions and other details for construction of a trail.
Cairns Shire Council	Local Government Authority for Cairns Shire and land manager for some sections of the Wangetti Trail.
Conceptual Design	Plan developed by specialist trail planners based on outcomes of site assessment and discussions, used to illustrate what the trail may look like, address key strategic priorities and provide high-level cost estimates for construction.
Construction Corridor	Total footprint of impact of construction of the trail. Extends from the top of the upslope batter to the toe of the downslope batter and generally has a height of 2 metre from the ground surface.
Construction Environmental Management Plan (CEMP)	Document prepared by the Contractor outlining how they will avoid, minimise or mitigate effects on the environment and surrounding area.
Construction Induction	Meeting held on or off-site with all project staff members (Contractor and others) prior to any construction work commencing. The meeting purpose is to share and discuss specific project information relating to trail construction.
Construction Methodology	Document prepared to provide high-level guidance to construction activities and information for the Contractor to inform the CEMP.
Construction Segment	A smaller component of the overall trail, allowing for ease of inspections, reporting, invoicing, practical completion and staged opening.
Construction Specifications	Document(s) providing relevant details for the work required to be completed in a trail construction project. This includes information such as materials, scope of work, construction process and quality of work.
Contractor	Person or company that undertakes contract to perform trail construction as set out in construction specifications and tender documents.
Department of Innovation and Tourism Industry Development Tourism Development Projects Division (TDPD)	Queensland state government department charged with a goal to build a thriving state economy and make new ideas and diversification a reality in the changing Queensland job market.
Detailed Design	Plan developed by specialist trail planners demonstrating definitive trail lines and construction specifications to enable construction work to be undertaken.
TDPD Project Manager	Responsible for planning, procurement and execution of the project.
Douglas Shire Council	Local Government Authority for Douglas Shire and land manager for some sections of the Wangetti Trail.

Term	Definition
Electric Mountain Bike (e-MTB)	Mountain bikes with a battery-powered “assist” that comes via pedalling.
Fibre Reinforced Plastic (FRP)	Composite material used in trail construction, often as a decking mesh or beam support structure.
Global Positioning System (GPS)	Navigation satellite system that provides geolocation and time information to a GPS receiver.
GHD	Consulting company contracted to prepare Environmental Assessment, Baseline Ecology Report for Wangetti Trail.
Ground-truthing	Process taken to identify, flag and map the exact route in the field for a proposed trail.
Ground-truthed Corridor	Area consisting of the flagged centre line, plus the agreed 20m buffer to either side (i.e. a total corridor width of 40m).
International Mountain Bicycling Association (IMBA)	An organisation for trail advocacy.
Mareeba Shire Council	Local Government Authority for Mareeba Shire and land manager for some sections of the Wangetti Trail.
Matters of National Environmental Significance (MNES)	Nine components of the environment in Australia that are protected under the *Environment Protection and Biodiversity Conservation Act 1999*.
Matters of State Environmental Significance (MSES)	Certain environmental values that are protected under Queensland legislation.
Mountain Bike (MTB)	A bicycle with a light sturdy frame, broad deep-treaded tyres, and multiple gears, designed for riding on mountainous terrain.
Mountain Bike Australia (MTBA)	The national governing body for mountain biking.
Pre-Start Trail Review (PSTR)	On-site review and inspection of the proposed alignment of the trail, undertaken prior to construction commencing with Contractor and TDPD Project Manager.
Project Location	Proposed Wangetti Trail, extending from Port Douglas to Palm Cove.
Project Scope of Works	Agreed work to be undertaken to successfully complete the project.
Queensland Parks and Wildlife Service (QPWS)	Queensland state government agency within the Department of Environment and Science, charged with managing the parks estate.
Sediment Control Measures	Processes and materials put in place to minimise site disturbance and the potential for erosion.
Tourism Development Projects Division (TDPD)	Division within DITID.
Traditional Owners	Aboriginal people who have ongoing traditional and cultural connections to Country. The Traditional Owners for the Country the proposed Wangetti Trail passes through are the Yirrganydji people.
Trail Difficulty Rating System	System used to grade trails with similar levels of technical difficulty. Trails are graded on width, grade (maximum and average), surface, natural obstacles and Technical Trail Features (TTFs). Other factors such as enclosure and exposure can also influence classification.
Wangetti Trail	Proposed trail of 94km, extending from Port Douglas to Palm Cove.

Term	Definition
Wet Tropics Management Authority	Joint Commonwealth and Queensland governments agency charged with managing the Wet Tropics World Heritage Area according to Australia's obligations under the World Heritage Convention.
Wet Tropics Management Plan	Developed in 1998, it provides the legal framework for management of the Wet Tropics of Queensland World Heritage Area.
Work Health and Safety Management Plan	Document prepared by the principal contractor to assist in managing their workplace health and safety obligations.
Wet Tropics World Heritage Area	An outstanding example of the world's natural or cultural heritage, as determined by the United Nations Educational, Scientific and Cultural Organisation (UNESCO). The Area covers almost 900,000 hectares and extends from Cooktown to Townville.

9 REFERENCES

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