Construction Water Management Plan

July 2018

Mt Messenger Alliance

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NZ TRANSPORT AGENCY WAKA KOTAHI | Mt Messenger Bypass

New Zealand Government

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Contents

Glossary of Terms and Abbreviations

Acronym /Term	Definition
AEE	Assessment of Environmental Effects
BPO	Best Practicable Option
CEMP	Construction Environmental Management Plan
CIS	Container Impoundment System
CWAR	Construction Water Assessment Report
CWD	Clean Water Drain
CWMP	Construction Water Management Plan
DEB	Decanting Earth Bund
DMP	Dust Management Plan
DWD	Dirty Water Diversion
E&SC	Erosion and Sediment Control
ELMP	Ecology and Landscape Management Plan
NPDC	New Plymouth District Council
PAC	Poly aluminium chloride
RMA	Resource Management Act 1991
SCWMP	Specific Construction Water Management Plan
SH3	State Highway 3
SRP	Sediment Retention Pond
SSF	Super Silt Fence
TRC	Taranaki Regional Council

1 Introduction

The Construction Water Management Plan (CWMP) has been developed to provide the overall approach and guidance for construction water management during construction of the NZ Transport Agency's Mt Messenger Bypass (the Project), and support the assessment detailed in the Construction Water Assessment Report (CWAR). The objectives of the CWMP are summarised in Figure 1.1.

Construction Water Management Plan (CWMP)

- Developed pre-works and Project wide.
- Supports the CWAR and the resource consent application.
- Confirms the overall approach and guidance for construction water management during construction of the Project with a specific focus on principles, practices and a comprehensive management approach.
- Forms the guidance for all Specific Construction Water Management Plans prepared for the Project.
- Is a 'live document' that will be reviewed annually and updated as necessary, during the course of the Project to reflect significant changes associated with construction techniques, communication, mitigation or the natural environment.

Specific Construction Water Management Plans (SCWMPs)

- In accordance with the conditions of consent, SCWMPs will be prepared and finalised prior to construction works to which they apply.
- Confirms practices and principles that will apply to specific Project areas or activities in accordance with the guidance provided in the CWMP.
- Sets out design detail and documents monitoring outcomes and learnings (where relevant).

Figure 1.1 - CWMP framework

1.1 Purpose and scope of the CWMP

The CWMP primarily sets out the approach to erosion and sediment control site management practices during construction of the Project, so that works are undertaken in a manner that potential or actual discharges of sediment from the site are minimised to the greatest extent possible. The CWMP also addresses the management of other contaminants, such as concrete and fuel use which may also directly or indirectly discharge into receiving environments from construction works.

The main construction activities, along with key considerations to manage construction water effects, are summarised in Sections 5 and 6 of the CWMP. Construction methods and specific design details shall be set out in the relevant SCWMPs.

The CWMP sets out:

- The procedures for determining staging and sequencing of earthworks (Section 4);
- Identification of a suite of appropriate structural and non-structural erosion and sediment control measures to be installed prior to and during works (Section 5 – 6);
- Design specifications for erosion and sediment controls to be implemented (Section 5);
- Procedures for decommissioning the erosion and sediment control measures (Section 5.5);
- A procedure to establish and define minor on the ground changes to erosion and sediment control, in accordance with the intent of the CWMP (Section 11); and
- Methods for amending and updating the CWMP as required (Section 1.4 and 11).

While the erosion and sediment control measures and practices discussed within this CWMP are conceptual in nature, they are based on widely used practices that are well understood and known to effectively mitigate environmental effects.

The CWMP references the key construction stages developed for the Project (refer to the Construction Environmental Management Plan (CEMP) and the Assessment of Environmental Effects (AEE) prepared for the Project), which are based on a four year construction period.

1.2 Approach

The approach for construction water management during construction of the Project is to:

- Develop an overall framework to assist with medium to long term construction decision making (the CWMP);
- Develop detailed plans for area and activity based planning and short term decision making (the SCWMPs);
- Implement a monitoring programme to assess site performance and assist with all construction decision making (Construction Water Discharges Monitoring Programme (CWDMP)); and
- Have an experienced and involved team to ensure that all relevant aspects of the Project are taken into consideration as part of planning and decision making.

This approach will ensure that adequate Project team resources, commitment and expertise are available for construction water management. It will also ensure that all key stakeholders, such as Taranaki Regional Council (TRC) as the consent authority responsible for ensuring compliance with the consent conditions, are involved and communicated with as necessary during the construction phase.

This approach applies to the implementation of erosion and sediment control measures from start to finish of the Project i.e. design and construction planning through to disestablishment of controls and reinstatement of the site.

1.3 Associated management plans and reports

Related management plans and technical reports prepared for the Project and referenced in the CWMP include:

- Construction Environmental Management Plan (CEMP);
- Ecology and Landscape Management Plan (ELMP);
- Construction Dust Management Plan (CDMP);
- Construction Water Assessment Report (CWAR, Technical Report 13); and
- Assessment of Ecological Effects – Freshwater Ecology (Technical Report 7b).

1.4 Updates to the CWMP

The CWMP will be updated to reflect conditions of resource consent prior to construction.

The CWMP will be supported by a suite of detailed SCWMPs prepared for the management of construction water effects at specific work locations or for construction activities.

SCWMPs will be prepared, reviewed or finalised at the construction stage prior to commencement of works in the location or for a specific activity. SCWMPs will confirm the construction method(s), risk profile, management measures and water control devices to be implemented. Further detail on preparing the SCWMPs is provided in Section 4 of this CWMP.

During the course of the Project, and in accordance with the conditions of consent, this CWMP will be reviewed and updated to reflect significant changes associated with construction techniques, communication, mitigation or the natural environments. The review process for this CWMP is set out in Section 12.

Amendments to the CWMP and SCWMPs will be made subject to the requirements set out in Section 12.

2 Project Background and Description

2.1 Existing environment

As described in the CWAR, the Project is located within the Mount Messenger Parininihi area, situated in the North Taranaki Ecological District.

The Project site experiences a mean annual rainfall of about 2000 mm[1].

The Project includes works within both the Mangapepeke and Mimi catchments. The topography comprises steep slopes (typically greater than 20%) over most of the Project area. The Project alignment within the lower slopes of the valley has slopes typically less than 10%.

[1] Measured at a private rainfall gauge monitored by a local landowner.

The Project area includes both degraded habitats from farming activities, and high quality habitat for indigenous terrestrial and aquatic flora and fauna. The geology is dominated by papa mudstone (primarily silt based), and has a considerable influence on stream substrate where the gravels are soft and a relatively high amount of fine sediment is present at the stream bed.

Sediment laden discharges and deposits are observed to be naturally occurring in these catchments, in particular following heavy rainfall. This is reflected in the baseline monitoring carried out to date (refer Appendix C).

2.1.1 Mangapepeke catchment overview

The northern Project area comprises the alignment between Chainage 0 – 3635, located within the Tongaporutu catchment (Construction Zones 1-5). The Tongaporutu catchment within the northern Project area discharges to the Mangapepeke Stream and tributaries of the Mangapepeke Stream. The stream continues past the Project site via an existing culvert under SH3. The existing environment within the northern construction zones comprises vegetated steep slopes, gullies and incised streams leading down to an indigenous forest valley floor. The forest valley becomes pasture and grazed wetland to the north, where the ground is poorly drained.

2.1.2 Mimi catchment overview

The southern Project area comprises the alignment between Chainage 3635 – 5955, located within the Mimi catchment (Construction Zones 6-10). The Mimi catchment discharges to tributaries of Mimi Stream, which becomes Mimi River further south of the Project. The Mimi River flows south-west to enter the coast between Waiiti and Urenui. The catchment is predominantly covered in indigenous forest, however the valley through which the main stream meanders is predominated by pasture and grazed wetland. A kahikatea, pukatea swamp forest is present downstream of the Project, which has high ecological value. A raupo /sedgeland wetland is located directly upstream of the swamp forest and observed to provide some natural sediment retention.

2.2 Construction water assessment

The CWAR that supports the application identifies that potential construction water related effects from the Project will arise from the exposure of bare land from earthworks to rainfall (particularly within steep topography), and works within or adjacent to watercourses. The assessment indicates that both erosion and sediment controls are required to capture and minimise sediment laden runoff that may enter the receiving environments as a result of the Project.

The assessment also recognises the ecological values associated with areas of the immediate receiving environment, and that some increase of naturally occurring sediment laden discharges to these environments are likely during construction of the Project, which will need to be appropriately managed (refer Section 5.3 of the CWAR).

The CWMP provides the framework and approach to manage the potential increase of sediment discharges from the Project area, to avoid or minimise adverse effects from the Project.

An important consideration to this approach is that construction water management methods and measures may need to vary across the Project site to reflect the nature of work in specific localities and environmental sensitivities. This shall be documented through the SCWMP process, set out in Section 4 of the CWMP.

2.3 Construction method overview

An overview of the construction method for the Project, along with construction staging and sequencing, is outlined in the CEMP and AEE. In summary:

- The Project is anticipated to take four years to construct, commencing in late 2018 with completion proposed by the end of 2022.
- Project works will be carried out in two construction regions; North Region (including the proposed Mt Messenger Tunnel) and South Region. These regions are further split into ten construction zones.
- Construction of the Project will be undertaken on a number of fronts or work faces, such that different construction operations will, at times, be simultaneously progressed across all construction zones. Construction regions and zone are shown on Drawings MMA-DES-CON-E1-DRG-1051-1054 appended to the CEMP.

The key construction stages comprise:

- **Preparatory works within each region** (referred to as Preparatory works). This will comprise initial works to enable Establishment Works and Construction Works such as:
    - site surveys
    - investigations (including geotechnical investigations)
    - monitoring
    - land disturbance activities to establish site access, access tracks, construction yards, laydown areas and spoil disposal sites and associated erosion and sediment control
- **Establishment works within each region and zone** (referred to as Establishment works). This will comprise earthworks to progressively open up and establish the construction site. This will initially include constructing and/or widening roads/tracks to access construction areas and install sediment control measures (e.g. sediment control ponds), followed by:
    - Wider vegetation clearance;
    - Forming the construction yards;
    - Establishing full width access tracks/haul roads;
    - Installing remaining erosion and sediment controls; and

    - Establishing stream diversions at key locations (e.g. embankment fills at the north and south tunnel portals).
- **Main construction works within each zone** (referred to as Construction works). This will comprise all construction works, including:
    - Wick drains and ground improvement works;
    - Temporary and permanent drainage installation;
    - Bulk earthworks (cut and fill activities);
    - Bridge and tunnel construction;
    - Pavements and surfacing; and
    - Reinstatement of site following the completion of construction including; landscaping, installation of permanent road furniture and ancillary works.

3 Overview of Construction Water Management

3.1 Objectives and principles

Key objectives and principles for construction water management during construction of the Project are defined in the CWAR. The CWMP is prepared to meet the overall objective of the CWAR by applying these key principles. These principles are not repeated below and can be referenced within Section 7.3 of the CWAR.

3.2 Erosion and sediment control

Erosion control is based on the practical prevention of sediment generation in the first instance. Sediment control refers to management of the sediment after it has been generated. It is inevitable that some sediment will be generated through land disturbance activities even with best practice erosion control measures in place. Sediment control measures are designed to capture this sediment to minimise any resultant sediment-laden discharges to waterways.

If erosion control measures and practices are effective, then sediment generation will be minimised and the reliance on sediment control measures shall be reduced.

Erosion and sediment control for the Project recognises the need to minimise the potential for erosion, rather than primarily relying on sediment control measures. In addition to erosion and sediment control structural practices, which include physical measures such as sediment retention ponds, the Project will use a series of non-structural practices that will focus on various site management practices.

Examples of structural and non-structural measures include:

Structural

- Erosion and sediment control specific device installation;
- Baffles within SRPs and higher risk DEBs;
- SRP decant pulleys; and
- Chemical treatment devices.

Non-Structural

- Training and staff education;
- Construction methodologies and sequencing;
- Monitoring including pre, during and post rain inspections;
- Implementing a monitoring programme which allows continuous improvement in response to monitoring outcomes when required; and
- Selection of all discharge locations (and the timing) to the receiving environment to minimise potential effects on sensitive environments (where practical).

4 Specific Construction Water Management Plans

SCWMPs are detailed erosion and sediment control plans that will be prepared for specific work areas or activities within the site. Any SCWMP that was not provided at the hearing shall be submitted to TRC for certification. The SWCMP will provide the detailed design, specific erosion and sediment control measure location, staging and sequencing of works for that location / activity.

The SCWMPs are considered field documents, and will need to be developed in consultation with construction supervisors and engineers. They shall be suitable to guide works at the construction stage.

The SCWMPs shall take into account environmental and ecological values and risks to determine the most effective and appropriate form of erosion and sediment control practices to manage construction water on a location and/or activity basis.

4.1 Documentation

The SCWMPs shall confirm on a location or project wide activity basis the:

- Soil types to be encountered;
- Area and volume of earthworks and stream works at specific locations, and identification of the downstream receiving environment;
- Locations of all earthworks and stream works;
- Duration of the earthworks and stream works;
- Time of the year that the stream works are to be undertaken, and where applicable, the measures to be implemented to respond to any heightened weather risks at that time;
- Methods for managing construction water effects;
- Stabilisation methods and timing to reduce the open area at key locations and assist with a reduction in sediment generation;
- Chemical treatment (flocculation) for all SRPs, and DEBs with greater than 500m^2 of contributing catchment area;
- Process for decommissioning of structural erosion and sediment control measures;
- Any specific monitoring details that relate to the SCWMP and the overarching CWDMP including any procedures for adapting the controls to appropriately respond to the monitoring findings; and
- Associated exposure risk for the activity. Exposure risk is determined by assessing nature of works, timing of works and rainfall probabilities or weather forecast (where available). This is discussed further in Section 7 of this CWMP.

A SCWMP template has been developed which address the above requirements and is attached in Appendix B. This template may be updated over time based on feedback from

TRC compliance staff and/or in response to lessons learned as works proceed and/or as part of the CWMP review process.

SCWMPs will be prepared as follows:

<u>On a location basis (defined by a chainage extent):</u>

- Establishing the construction site, in particular construction yards, access roads and temporary stream diversions for access;
- Bulk earthworks within the construction zones, including associated ground improvement works (e.g. wick drains) and establishing temporary stockpile/lay down areas where required;
- Staged works for fill embankment 12 at the northern tunnel portal, including establishing access and stream diversions;
- Staged works for fill embankment 13 at the southern tunnel portal, including establishing access and stream diversions; and
- Bulk earthworks for site improvement works at the southern extent.

<u>On a Project wide activity basis:</u>

- Bulk earthworks at tie-in locations of the new alignment to the existing SH3;
- Works to install grout anchors in the upper few meters of cut embankments where required;
- Works to construct the tunnel, including establishing access and yard areas;
- Works to construct the bridge, including establishing access and yard areas;
- Spoil disposal sites, where required; and
- Establishing water takes, where required.

Prior to the commencement of earthworks to which a SWCMP applies, as-built audits of the erosion and sediment control measures shall be prepared and reviewed by the Project team to confirm that the control measures for that location / activity have been constructed in accordance with the SCWMP. These "as-built" audits will be provided to TRC prior to earthworks commencing.

4.2 Project specific design

The Transport Agency Erosion and Sediment Control Guidelines for State Highway Infrastructure – Construction Stormwater Management (2014) are specific to State highway projects, and as set out in the CWAR, are adopted as the principal guidance document for the CWMP.

In some circumstances, there will be specific practical reasons for not implementing controls in direct accordance with the Transport Agency Guideline. In particular, with the higher slope categories on the Project, there are some practical constraints with respect to installing devices to guideline design standards and volume criteria. As such, Project specific design will be proposed in some circumstances and outlined within the SCWMPs, This will be based on determining the best practicable option for that location.

5 Construction Water Management Approach and Implementation

5.1 Erosion and sediment control tool box

A tool-box approach to erosion and sediment control will support the SCWMP process described above. Table 5.1 sets out erosion and sediment control measures considered suitable for the Project, in accordance with the principles of the CWAR.

For design and construction planning purposes, site appropriate measures and typical details are indicatively shown on drawings MMA-DES-ESC-C0-DRG-1001-1010 in Appendix A of this CWMP.

Key considerations for specific stages of work are summarised in Sections 5.2 - 5.5 below. Further considerations for specific Project activities are detailed in Section 6 below.

The methods implemented for any given part of the works may be modified and improved in response to detailed design and site conditions as works proceed, and will be reflected in updates to SCWMPs prepared for locations and specific activities.

Further guidance on erosion and sediment controls measures are set out in Sections 6 and 7 of the CWAR.

Maintenance requirements for erosion and sediment control measures are summarised in Section 7 of the CWMP.

Table 5.1: Erosion & sediment control tool-box

Measure	**Purpose**	**Typical Project application** Note: Design details to be confirmed in relevant SCWMPs
Water treatment		
Sediment retention ponds (SRPs)	Detain runoff flows so that deposition of transported sediment can occur through settlement within the SRP	Primary device to treat run-off from areas of bulk earthworks where the catchment is between 0.3- 5 ha. A typical detail is shown in Drawing MMA-DES-ESC-C0-DRG-4001 and 4007.
Silt fence/ Super silt fence	Detain runoff flows so that deposition of transported sediment can occur through settlement	Used to treat un-concentrated run-off (or "sheet-flows") from batter slopes or roads, where it is not practical to direct the flow to an SRP or DEB. May also be used on the downslope side of work near waterbodies.

Measure	Purpose	Typical Project application Note: Design details to be confirmed in relevant SCWMPs
		Installation details are set out in the Transport Agency Guidelines. A typical detail is shown in Drawing MMA-DES-ESC-C0-DRG-4002.
Decanting earth bunds (DEBs)	Detain runoff flows so that deposition of transported sediment can occur through settlement	Primary device to treat run-off from areas of earthwork, where the maximum catchment is 0.3 ha DEB volumes will be based on the design criteria within the Transport Agency Guidelines. A typical detail is shown in Drawing MMA-DES-ESC-C0-DRG-4003.
Container impoundment systems (CIS)	Detain runoff flows so that deposition of transported sediment can occur through settlement. Will be utilised where there is limited ability develop SRPs or DEBs. Can also be used to aid in treating runoff for pH.	In locations where SRPs or DEBs cannot be located due to slope, space constraints or stability issues and for activities where pH treatment is required. A typical detail is shown in Drawing MMA-DES-ESC-C0-DRG-4008.
Sump/ sediment pit	Intercept runoff flows from earthwork surfaces within dirtywater diversion channels to allow heavier sediment particles to drop out and retain the maximum sediment onsite. Note these are not a primary sediment control device.	Sumps/sediment pits ($2m^3$) will be positioned along the dirty water channels at 50m intervals.
Chemical treatment	Flocculation will be used to improve the sediment removal efficiency of SRPs, DEBs and CIS's.	Preliminary testing has been carried out on surficial soil samples collected from the Project site. Results indicate a noted improvement of water clarity achieved with the addition of chemical flocculant. A framework for chemical treatment is provided in Section 5.5. A typical detail for a rainfall activated flocculation unit is shown in Drawing MMA-DES-ESC-C0-DRG-4001.
Water diversion		

Measure	Purpose	Typical Project application Note: Design details to be confirmed in relevant SCWMPs
Dirty water diversions(DWDs)	Temporary drains which intercept and convey run-off from earthwork surfaces to sediment treatment measures.	A typical cross section for a dirty water drain is shown in Drawing MMA-DES-ESC-C0-DRG-4006. This detail will typically apply to dirty water drains outside or on the perimeter of the earthworks footprint and are likely to have a duration of more than 1 month. These drains may be stabilised dependent upon soil type and slope for the specific area of works.
Clean water diversions (CWDs)	Intercept and convey runoff from upslope (non earth worked) catchments to stabilised ground	All clean water diversions to discharge to stabilised ground or a constructed stabilised outlet. These drains may be stabilised dependent upon soil type and slope for the specific area of works. Three concepts for clean water diversions have been developed and are shown in Drawing MMA-DES-ESC-C0-DRG-4006.
Contour drains/bunds	To intercept and slow down runoff over bare soil or erodible ground with a primary purpose to reduce overall slope lengths.	Contour diversion will be used to intercept and slow down flows from disturbed slopes. Contour diversions shall discharge to DWD (if dirty). Contour diversions used for directing clean water shall be constructed of non-erodible material (e.g. pinned filter socks) and may discharge to stabilised ground (if clean). Contour Drains will be based on the design criteria within the Transport Agency Guidelines where practicable.
Permanent or temporary Pipe drop/ flume structures (clean or dirty water)	Convey a concentrated flow of clean or dirty surface runoff down a slope without causing erosion	May be used to convey run-off down incomplete cut and fill batter slopes, either to keep separate clean and dirty water, or to convey flows to treatment devices without scouring of the batter face. Where practical, permanent flume structures will be used to convey clean water down the cut embankments, and discharge to a clean water channel or vegetated ground.

Measure	Purpose	Typical Project application Note: Design details to be confirmed in relevant SCWMPs
Rock check dams	To reduce the velocity of flow within the channel and prevent scour of the channel surface. Check dams also allow for some settlement of suspended solids within the channel	Rock Check Dams will be based on the design criteria within the Transport Agency Guidelines where practicable.
Temporary stream diversions	Temporary practices used to convey stream water from above a construction activity to downstream of that activity	Refer Section 6.6 of this CWMP
Other controls (as required)		
Stabilisation	The application of a "cover" over the exposed soil surface to achieve a stabilised surface and as a result minimise erosion from that surface.	Stabilisation is defined as resistant to erosion such as rock, or rendered resistant by the application of aggregate, geotextile, vegetation or mulch. Stabilisation can be in many forms including geotextiles, mulching and the placement of clean aggregate. Where vegetation is to be used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once an 80% vegetation cover has been established. The design criteria for the various techniques will be as within the Transport Agency Guidelines where practicable.
Slash/mulch bunds	Provide a bund of mulch or slash during vegetation removal activities to assist with reduction of water runoff velocities (sheet flow) and to assist with the capture of any sediment. Note these are not a primary sediment control device.	Mulch and slash bunds may be used to temporarily reduce water velocities and to filter runoff from disturbed areas where sheet flows are expected.

Measure	Purpose	Typical Project application Note: Design details to be confirmed in relevant SCWMPs
Filter sock/ polymer filled socks	To temporarily impound sediment-laden runoff, slowing down the flow rate and allowing sediment to settle out of the water.	May be used on short batter slopes (pinned to ground) and around watercourses and vegetated or protected areas. Can provide secondary containment and treatment where it is not possible to direct flows to a sediment treatment pond. Filter Socks will be based on the design criteria within the Transport Agency Guidelines where practicable.
Stabilised entrance ways	Stabilised pads at site entry and exit points to minimise sediment generation from these areas and also help to reduce dust generation and tracking of sediment to public roads.	For construction yards, and where site access points are identified. A typical detail is shown in Drawing MMA-DES-ESC-C0-DRG-4004.

5.2 Establishment works

Establishment works comprise the early stages of construction works to establish construction yards, clear and access the earthwork areas and establish areas to store/stockpile equipment to the site for construction. Establishment works will include:

- Constructing access tracks;
- Temporary stream works to provide access across streams;
- Temporary stream works to access through the base of steeply sided gullies; and
- Localised earthworks to create a base or pad for long-term sediment retention ponds.

Establishment works will be set out in the relevant SCWMPs. Key considerations for this stage include:

- Weather forecast monitoring for planning works;
- Working (to the extent possible) only in a dry weather period;
- Maintaining a buffer between the area of works and watercourses (where practicable);
- Avoid, where practicable, plant tracking through watercourses, unless a stream diversion is in place. Where this is not possible, the SCWMP for the works shall confirm:

    - How access will be minimised as far as practicable with respect to crossing extent, duration and frequency; and
    - Timing of works to coincide with stream flow conditions.
- Minimising works areas (i.e. minimising access widths);
- Installing "interim" erosion and sediment controls (e.g. sediment "traps", silt fence and super silt fences, treatment by CIS); and
- Utilising a "construct and cover" methodology when practical to establish access roads.

The indicative sequences of establishment works for Fills 12 and 13 (the two largest fill embankments for the Project) are shown on Drawings MMA-DES-CON-C0-DRG-1201, MMA-DES-CON-C0-DRG-1205 and MMA-DES-CON-C0-DRG-1301, in Appendix A and will be confirmed (in stages) prior to construction through the SCWMP process.

5.3 Construction works

5.3.1 Northern Construction Zone

The Project works will include removal of vegetation from steep slopes within the Mangapepeke catchment and localised areas of the valley floor to allow access roads to be established and cut and fill earthworks to be carried out. Other activities within the northern construction zones include:

- Permanent diversion of the Mangapepeke Stream headwaters;
- Permanent culverting of tributaries to the Mangapepeke Stream; and
- Constructing permanent stormwater treatment wetlands.

The proposed measures for the northern construction zones will be confirmed in relevant SCWMPs and shall consider:

- DEBs and silt fences for all access tracks as the specific erosion and sediment control. Progressive cover methodologies will also be utilised for access tracks with the final control measures specified within the SCWMPs,
- Silt fence and super silt fence for linear fill earthworks between CH 0 – 350. Cut and cover methodologies shall be utilised for these works.
- Where practical, clean water diversion channels, bunds and checks to separate clean water from sediment laden water, progressively installed as works proceed. Clean water diversions shall discharge into Mangapepeke Stream via permanent or temporary culverts or flumes.
- Chemically treated SRPs utilised for treatment of cut and fill earthworks between CH 350 – 3400. SRPs will treat discrete Project catchments varying from 2-5 ha, and will be progressively installed as works proceed. Where possible, discharge of the SRP directly into Mangapepeke stream will be avoided and a vegetation "polishing" buffer of at least 5m shall be maintained between the stream and pond's discharge point. SRP discharge point to land shall be stabilised with rock and/or geotextile to prevent subsequent erosion and scour.

Some SRPs are located within the 20 year flood extents and will require additional consideration for resilience against flooding for this event.

5.3.2 Southern Construction Zone

The Project works will include removal of vegetation from steep slopes within the catchment to allow access tracks to be established and cut and fill earthworks to be carried out. Other activities include:

- Bridge construction between CH 4150-4270;
- Permanent diversion of headwaters, which discharge into the kahikatea swamp forest;
- Permanent culverting of tributaries to the Mimi River; and
- Construction of a permanent stormwater treatment wetland.

The proposed measures for earthwork activities in the southern construction zones will be confirmed in relevant SCWMPs and shall consider:

- DEBs and silt fences for all access tracks as the specific erosion and sediment control. Progressive cover methodologies will also be utilised for access tracks with the final control measures specified within the SCWMPs., .
- Silt fence and super silt fence for linear fill earthworks between CH 4800 – 5955. Cut and cover methodologies shall be utilised for majority of these works.
- A DEB utilised for cut earthworks between CH 5450 – 5700, which discharges to the Mimi River via permanent or temporary culverts.
- Where practical, clean water diversion channels, bunds and checks to separate clean water from sediment laden water, progressively installed as works proceed. Clean water diversions shall discharge to either tributaries of the kahikatea swamp forest or Mimi River via permanent or temporary culverts.
- Chemically treated SRPs utilised for treatment of cut and fill earthworks between CH 3635 – 4800. SRPs will treat discrete project catchments which vary from 0.5- 3ha, and shall be installed progressively as works proceed. Where possible, discharge of the SRP directly into a tributary stream will be avoided and a vegetation “polishing” buffer of at least 5m shall be maintained between the stream and pond’s discharge point. SRP discharge point to land shall be stabilised with rock and/or geotextile to prevent subsequent erosion and scour.

5.4 Construction staging and progressive stabilisation

The extent of exposed soil and length of time that an area is exposed has a direct influence on the sediment discharged from the area. Earthworks and construction activities will be staged and sequenced as part of the normal construction programme. These earthworks areas shall be progressively stabilised to reduce the potential for erosion to occur.

Where Project areas are not actively worked for more than 14 days (or a period otherwise agreed in relevant SCWMPs) the area will be stabilised. This will encourage and enforce the need to ensure that potentially erodible areas are not left exposed for long periods of time

and reduce the potential for sediment generation (and subsequent discharges). The 14 day stabilisation period is further defined as below:

- Stabilised Area (as per Section 5.5 below) is defined as an area inherently resistant to erosion such as rock, or rendered resistant by the application of aggregate, geotextile, vegetation or mulch, or as identified in the Construction Water Management Plan. Where vegetation is to be used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once an 80% vegetation cover has been established.
- The method of stabilisation is dependent upon site conditions and may include use of mulch and/or other woody organic matter, geotextile, the use of hard fill material and exposing rock.
- Actively worked means actively subject to earthworks production with cut and fill, stockpiling or topsoil removal.
- Areas of earthworks will be monitored on a weekly basis with ongoing field checks and understanding of production locations. The Environmental Manager will have a responsibility for ensuring identification of areas not worked and ensuring these are stabilised within the 14 day period (or otherwise agreed). A register of areas subject to earthworks, including timing, will assist in this process.
- The 14 day period (or otherwise agreed) will apply to all earthworks and will include parts of larger earthwork footprint locations. The overall intent is that if the Project is not working an area (or part of an area) then the stabilisation period provision applies.

Where mulch is used, it may include hay/straw and wood bark (generated where possible onsite through the removal and mulching of existing vegetation) as appropriate. Stabilisation will also apply at stockpile areas and batter establishment to reduce both erosion and dust generation.

Mulch will typically be applied to slopes of less than 15 degrees where erodible soils are exposed. However, greater slope angles can be subject to mulching if combined with an approved tackifier. Hydromulch can also be utilised in some circumstances. At these higher slope angles, alternatives may need to be considered and could include the use of pinned geotextile, coir matting and/or spray polymer products. Spray polymer products shall only be specified where the product is demonstrated to achieve a stabilised surface based on site trials.

The development of SCWMPs will outline the specific stabilisation requirements and timing.

Stabilisation will be undertaken to achieve the following:

- To achieve progressive stabilisation in accordance with the consent conditions for the Project;
- To reduce the open area to assist with a reduction in sediment generation; and
- To address any potential effects from sediment discharges in response to the monitoring programme.

5.5 Chemical treatment

5.5.1 Overview

Flocculation (the chemical treatment of a SRP or DEB) will be used to improve the efficiency of sediment retention devices unless bench testing proves otherwise. .

In each SCWMP that specifies chemical treatment (flocculation) of SRPs and DEBs, the SCWMP shall include:

- Specific design details of the chemical treatment system;
- Monitoring maintenance (including post-storm) and contingency programme;
- Details of optimum dosage (including catchment specific soil analysis and assumptions, and consideration of any environmental effects);
- Procedures for undertaking bench testing; and
- Details of the person or bodies that will hold responsibility for the maintenance of the chemical treatment system and the organisational structure which will support the system.

Preliminary testing has been undertaken on soils from the Project area and has demonstrated that chemical flocculation is likely to be required (refer to section 7.3.6 of the CWAR for further discussion in this regard). Based on these results, there are chemical flocculants and methodologies that will be suitable for the Project. An overview of these flocculation methods are outlined below, and specific details shall be provided in the relevant SCWMPs.

5.5.2 Flocculation methods

Flocculants typically come in three forms, liquid, solid and powder:

- Liquid flocculant can be added to construction runoff flowing into a SRP or DEB via rainfall activated systems or via manual batch dosing to contained water in the treatment device. Suitable for variable flows.
- Flocculant supplied as a solid brick or block, secured in a wire cage, can be placed at a point of turbulence that will have the greatest contact with concentrated construction runoff. Suitable for concentrated low to moderate flows.
- Powder flocculant is placed into geotextile socks. These socks can be pinned to the ground and dispersed construction runoff can be directed through the sock or they can be placed within diversion channels.

Liquid flocculant shall be applied at all SRPs and DEBs (pending further bench testing). All SRPs and DEBs (with greater than 500m^2 of contributing catchment area) will be treated with rainfall activated systems (e.g. sheds or similar approved).

Preliminary testing of liquid flocculant has been carried out on three soil samples collected at the Project site. Testing results are attached in the CWAR. Results indicate that the following products are likely suitable for Project soils:

- Poly aluminium chloride (PAC). Optimal dosage range of 5-15ppm. Results note a minor reduction of water pH, and close monitoring of water pH is recommended for this product.
- PolyDADMAC 40% solution. Optimal dosage range of 2-4ppm. Results noted no change in water pH.
- Blend of PolyDADMAC and 33% PAC solution. Optimal dosage range of 2-6ppm. Results note some reduction of water pH, and close monitoring of water pH is recommended for this product.

The above products are considered suitable for use in a rain activated treatment system or a placed as powder form into a geotextile sock. PAC may also be used for manual application to contained water (batch dosing).

Bulk storage of flocculant will be appropriately stored at the construction yard, to ensure it is available when required.

5.5.3 Flocculation management (for PAC)

5.5.3.1 Monitoring and maintenance requirements

Instructions for routine management and maintenance of the chemical treatment system include as follow. This is based on the use of PAC in a rainfall activated shed system, however similar principles will apply if other flocculants are utilised within the Project:

REDUCING THE HEADER TANK WATER VOLUME.

The header tank is used to avoid dosing during the initial stages of rainfall when site conditions are dry and no runoff is expected.

The volume in the header tank is lowered using the lowest of the three outlet tubes.

After 3 days without rain - reduce volume to 50%.

After 6 days without rain - reduce volume to empty (level at lowest outlet).

REFILLING THE PAC RESERVOIR.

The PAC reservoir tank should be refilled when the displacement tank is half full, or sooner if heavy rain is predicted. This is done by first emptying the displacement tank (baling with a bucket is efficient), and then refilling the reservoir tank until the PAC level is at the lower edge of the outlet.

OBSERVATION OF WATER QUALITY IN POND.

The SRP or DEB water quality and clarity will be observed on a daily basis and recorded on a monitoring sheet. On a weekly basis, pH shall be measured from water detained by the SRP or DEB.

PERIODIC SYSTEM CHECKS.

- Check that the rainfall catchment tray is not leaking – especially along the lower edge of the tray. This should be done after rainfall has ceased.

- Check the lower hose with the small tube outlet, from the header tank to the displacement tank, is not blocked.
- Check the chemical discharge hose is not blocked and flows easily when displacement tank lowered.

PRIOR TO FORECAST RAIN AND DURING RAIN

- Check the full operating system to ensure appropriate operational effectiveness.
- Check the colour/clarity of water within the treatment pond. Visual indicators of poor performance of the treatment system, or effects of other influences on stormwater quality include:
    - If the treated water in the SRP or DEB is consistently very clear it could indicate overdosing, with the possibility of lowered pH. Low pH (i.e. less than 5.5) presents a potential risk to receiving waters as a result of elevated free aluminium concentration in the discharge. If the treated water is consistently clear the pH of the water in the pond will be tested, and the dosage rate adjusted if required.
    - If the treated water in the SRP or DEB is consistently discoloured, it could indicate underdosing. If the treated water is consistently discoloured, the catchment area and soil characteristics will be reviewed, and the design amended if required.

5.5.3.2 Record keeping and reporting

All monitoring records and maintenance checks and actions should be recorded on site checklists and this shall include the clarity of the water in the SRP or DEB.A copy of the maintenance record for the chemical treatment system will be kept in the treatment system shed.

The integrity of the treatment system should be checked weekly during both dry and wet weather. This check should include a quick check of the plumbing, a check that the header tank hoses are clear, and a check of the dosing point to ensure that the chemical would drop into the stormwater flow from the site.

After rain, draining of the header tank is required at least on the 3rd day and 6th day following rain, and possibly more frequently if the treated water in the pond is consistently clear.

After moderate or heavy rain the dosing point should be checked to ensure that the chemical is being delivered into the storm flows during low flow conditions.

The integrity of the catchment tray, particularly the seal between the tray and the upstand should be checked monthly.

5.5.3.3 Storage of flocculant on site

Any flocculant should be kept in secure storage, either in a locked shed or container, or in the chemical treatment system shed. This will be secured on the site.

Empty flocculant drums will be washed out with water, and the washwater poured onto dry soil well away from any watercourse. Drums can be disposed of to a drum recycling company.

5.5.3.4 Chemical spill contingency plan

If there is a spill of flocculant onto the ground it should be immediately contained using earth bunds to prevent it entering water. The spilt flocculant should be recovered if possible and placed in polyethylene containers. If the spilt flocculant cannot be recovered, it should be mixed with a volume of soil equal to at least ten times the volume of spilt flocculant, and buried in dry soil.

If there is a spill of PAC into ponded water, discharge from the pond to natural water should be prevented.

If there is a spill of PAC into flowing water:

1. The TRC should be advised immediately.
2. The volume of the spill should be recorded.
3. If possible the water and spilt PAC should be pumped into a bund or pond until all the spilt PAC has been removed from the watercourse.
4. If the PAC cannot be removed from the watercourse any downstream users should be identified and advised. In association with TRC an action plan will be developed.

5.5.3.5 Chain of Responsibility for Monitoring and Maintaining the Chemical Treatment Systems

The Environmental Manager will have primary responsibility for maintenance and monitoring the effectiveness of the chemical treatment system. Specialist resource will be utilised as necessary throughout the Project implementation.

5.5.3.6 Training of Person Responsible for Monitoring and Maintenance of Chemical Treatment System

Training of the site environmental staff will occur as necessary to ensure that routine monitoring and maintenance of the system is undertaken and appropriate records kept.

5.6 Decommissioning of structural controls

The removal of any erosion or sediment control measure shall only occur after the area serviced by the measures has been stabilised as determined by the Environmental Manager, or certification to remove has been granted by the Manager, TRC Environmental Regulation. The process for decommissioning structural erosion and sediment control measures shall be set out in the relevant SCWMPs.

'Stabilised' is defined as inherently resistant to erosion or rendered resistant, such as by using indurated rock or by the application of aggregate, geotextile, vegetation, mulch or other approved measures set out in the CWMP. Where vegetation (e.g. hydro seeding or

establishing grass strike) is used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once 80% vegetative cover has been established.

5.7 Non-sediment contaminants

Non-sediment contaminants generally consist of site and materials management measures that may directly or indirectly discharge into the receiving environment from site activity.

Potential non-sediment contaminants used in construction activity on the Project are listed in the CWAR and are repeated in Table 5.2 below. Table 5.3 provides a management approach for these contaminants.

Table 5.2 - Potential non-sediment contaminants

Product / work activity	Potential contaminants	Indicator	Non-visible potential contaminants
Adhesives	• Adhesives • Glues • Resins • Epoxy • PVC Cement	Oily sheen or discoloration from some products	• Phenols • Formaldehydes • Asbestos • Benzene and • Naphthalene
Asphalt Paving	Hot and Cold Mix Asphalt	Oil Sheen	Oil, petroleum distillates, Poly aromatic hydrocarbons
Cleaning Products	Cleaners, ammonia, lye, caustic sodas, bleaching agents, chromate salts	Discolouration	Acidity / alkalinity
Concrete	Cement	Discolouration	Alkalinity (High pH)
Flocculants	Specific to Flocculant used but can include pH and aluminium	Clarity	• Aluminium toxicity • pH
Sanitary Waste	Portable Toilets, disturbance of sewer lines	Discolouration, sanitary waste	Bacteria, Biological Oxygen Demand, Pathogens
Vehicle and Equipment Use	Equipment operation, maintenance, washing, refuelling	Oil sheen, sediment	Total Petroleum, hydrocarbons, coolants, benzene and derivatives

Table 5.3 - Potential non-sediment contaminants - management approach

Product / work activity	Potential contaminant management
Adhesives	• Store materials in an area that is not subject to rainfall contact • Use adhesives carefully and clean up any spilled material • Properly dispose of containers in designated disposal areas once empty
Asphalt paving	• Water runoff should discharge to a treatment system designed to capture hydrocarbons
Cleaning products	• Store materials in an area that is not subject to rainfall contact • Use adhesives carefully and clean up any spilled material • Properly dispose of containers in designated disposal areas once empty
Concrete	• Concrete truck chutes, pumps and internals should only be washed out into the areas built for this task. • Hand tools should only be washed out into the formed areas awaiting installation of concrete
Flocculants	Refer to Section 7.3.6 of the CWAR • Ensure the use of flocculants follows an approved flocculant management plan and industry best practice • Regularly measure pH of the discharge from sediment retention devices
Sanitary waste	• Avoid knocking over portable toilets • Place portable toilets away from site vehicle movement areas • Service portable toilets regularly • Empty portable toilets before they are moved • Avoid breaking sanitary sewer lines that may exist onsite by pre-construction determination of location of such infrastructure.
Vehicle and equipment use	• Fuel storage tanks shall be bunded to store a minimum of 100% of the tank's capacity. No bulk fuel storage is expected for the Project and mobile refuelling will occur. • Procedures and practices shall be put in place to minimise or eliminate the discharge of lubricants, coolants or hydraulic fluids to the receiving environment • Have spill prevention and control measures and procedures in place

6 Specific Project Activities

This section summarises construction water management measures and practices to manage construction-related runoff from specific Project activities.

The practises discussed below are those accepted by the industry as best practice. However construction methods and practises for these activities below will be further developed and detailed within the relevant SCWMPs. Indicative locations of the activities are shown in Drawing MMA-DES-ESC-C0-DRG-1001-1010 in Appendix A of this CWMP.

6.1 Vegetation removal

Vegetation removal will form part of the land disturbance activity required to facilitate construction, and it is typically the initial activity to occur. While the vegetation removal itself does not include earthworks activity, it is often associated with a number of earthworks activities, such as access road construction.

Vegetation removal that creates an erodible surface is not anticipated to be required as a standalone activity, and instead will be undertaken as part of wider earthworking activities. If vegetation removal is required as a standalone activity, a separate SCWMP shall be prepared to set out any supplementary controls that are required.

Prior to undertaking any vegetation removal that creates an erodible surface, erosion and sediment control measures that apply to wider earthworks shall be installed. Where removal of vegetation creates an erodible surface, progressive stabilisation is required within 14 days (or a period otherwise agreed in relevant SCWMPs). Stabilisation will occur (as per Section 5.3 above) prior to diversion channels and treatment devices being established.

To reduce effects on terrestrial habitat, vegetation clearance will be undertaken in accordance with the CEMP and the ELMP, including the Bat, Avifauna and Vegetation Clearance Management Plan chapters of the ELMP. As part of the vegetation removal activity, care will be taken to ensure any stockpiles of mulched vegetation are not placed in locations where leachate from the mulch will discharge directly into watercourses.

6.2 Access track and haul road establishment

Access tracks and haul roads will be required along the length of the alignment to transport, plant, machinery, personnel, and materials through the Project area and between construction zones.

Temporary access tracks will typically be established by placing a layer of geotextile fabric on the existing ground and overlaying structural fill. Access tracks which cross waterways will have appropriately sized temporary culverts (with fish passage provisions included where fish migration is required) installed beneath the track. A stabilised overflow path will be maintained for all crossings located within the flood plain on the northern side.

In areas of very weak ground, a bridging layer (e.g. logs) may be used with underlying geotextile fabric. This construction method will generally be applied in locations where the

unsuitable soil material is of a depth or extent that removal of this unsuitable material is not practical (e.g. depth greater than 500mm).

Where all-weather access is required, the road surface will be constructed using clean hardfill. During construction, in addition to sediment control measures such as DEBs and silt fences, sufficient hardfill material shall be on hand to allow progressive covering as the road is formed. This allows a construct and cover operation with a stabilised road surface completed on a daily basis and prior to forecasted rain.

Where roads are subject to high or heavy traffic use (e.g. hauling roads), the construct and cover methodology may not be suitable and the track itself likely will become a source of sediment. In this circumstance, dirty water diversions (DWDs) will be constructed on the downslope side of road to receive and direct runoff to the closest treatment device (DEB or SRP).

Where access roads and/or haul roads form a component of the larger earthworks footprint, these road surfaces will be treated by erosion and sediment control measures for the wider area and shall be set out in location based SCWMPs.

6.3 Stockpile establishment and management (temporary sites)

Materials to be stockpiled onsite will include topsoil, subsoil, unsuitable material gained from the bulk earthworks operations, and imported hardfill material, such as crushed rock and/or road aggregate. Stockpiles of organic material for re-use during establishment of the permanent landscaping for the Project are also likely to be required.

Temporary soil stockpiles will be established over the course of the Project. As these areas have the potential to generate sediment laden discharges, establishment of stockpiles and disposal sites are subject to the SCWMP process (likely to be incorporated into location based SCWMPs). Where required, the SCWMP shall confirm:

- Locations of proposed stockpiles sites. For temporary stockpile sites located within the low lying valley in the northern extent of the Project, the potential flood risk will be assessed and additional measures implemented as required (e.g. perimeter bunding);
- Set back distance from permanent watercourses or proposed details for diversion of the watercourse if required;
- Location of clean water drains (CWD) to direct upslope runoff away from the stockpile area where required. CWDs will prevent erosion of the base of the stockpile, which could affect the stability of the stockpile and induce a slip within the stockpiled material;
- Proposed treatment device(s) (e.g. SRP) and associated DWDs to direct sediment-laden runoff from the surface of the stockpile for treatment. Where temporary stockpile sites are within a larger earthworks footprint, the control measures will likely be incorporated into the erosion and sediment control measures for the wider area.

- Expected stockpile period. Stockpiles which are expected to remain untouched for longer than one month (or otherwise agreed in the SCWMP) shall be progressively stabilised e.g. covered with geotextile (or similar approved) or hydroseeded or topsoiled and grassed; and
- Measures to control dust in accordance with the DMP to minimise the discharge of dust from stockpile operations in proximity to sensitive receivers and the transport of material to/from stockpiles.

Stockpiles comprising of sawdust, chip and/or mulch can produce leachate, which can have an adverse effect on aquatic life. Procedures for locating wood residue piles away from any waterways, collection and treatment of any leachate from wood residue piles shall be carried out in accordance with the Vegetation Management Plan chapter of the ELMP.

6.4 Spoil disposal site establishment and management (permanent disposal sites)

Construction of the Project will generate surplus clean fill material, estimated at approximately 145,000m^3. Multiple surplus disposal sites have been provisionally identified and are shown in Drawings MMA-DES-ESC-C0-DRG-1001 to 1010 in Appendix A of this CWMP.

The nature and footprint of these sites vary across the Project extent, as summarised below:

- Raising of the lower valley in the North region over an area of up to 1.5 ha;
- Filling of existing gullies in the North region over an area of up to 0.8ha; and
- Filling of existing gullies in the South region over an area of up to 1.5ha.

Project wide activity specific SCWMPs shall be prepared for all disposal sites to be established for the Project. Key considerations for the SCWMP shall include:

- DEB or SRP sized to include spoil disposal catchment area;
- Bunding to contain all saturated soils or other wet materials (where required). Silt fences may be installed if required downslope of bunds to allow drainage while minimising sediment discharge from the material;
- Permanent diversion of streams located within gully spoil disposal sites; and
- Temporary clean water cut-offs to separate run-off from the undisturbed catchment from the area of fill. These temporary cut-offs may be installed prior to commencement of works or progressively extended as the fill progresses.

An indicative cross section of a disposal site demonstrating these concepts is provided in Figure 6.1. The establishment and management of spoil disposal sites shall be confirmed by activity specific SCWMPs.

Some sites identified for permanent spoil disposal may be used for the temporary storage of topsoil, or surplus until on-alignment fill sites become available. If this is the case, erosion and sediment control measures shall be installed prior to such temporary stockpiling.

Following completion of construction, the disposal sites will be recontoured so water drains to the edge of the fill area to a permanent drain or stream diversion. The finished surface will be topsoiled, grassed and planted in accordance with the Project Landscape and Environment Design Framework and the Vegetation Management Plan chapter of the ELMP.

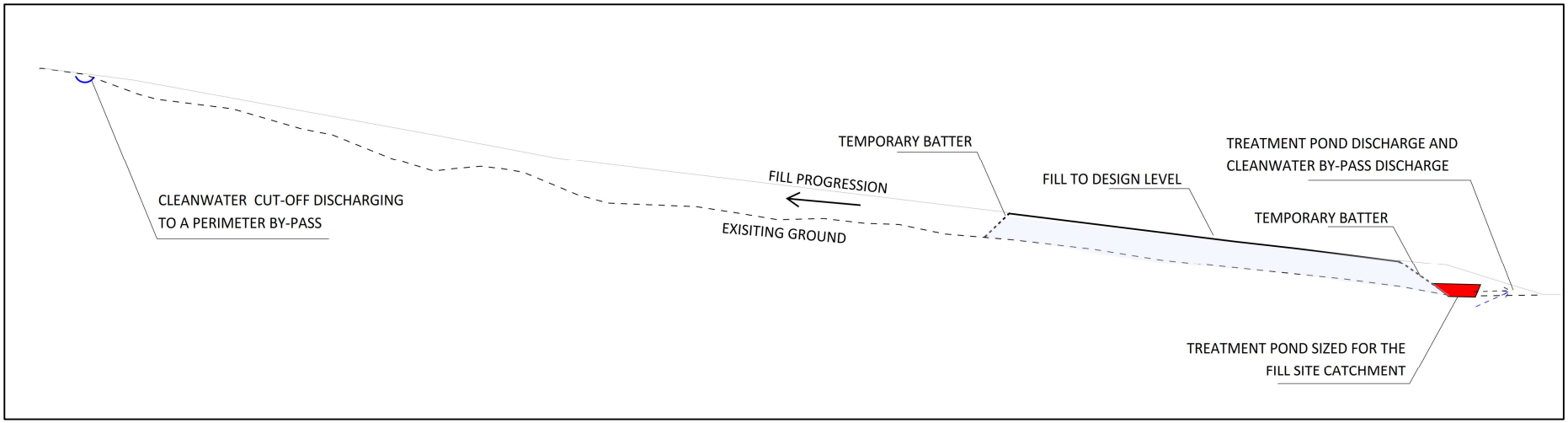


Figure 6.1 – Erosion and sediment control for an indicative disposal site

6.5 Construction yards

Construction yards and laydown areas will be required for repairs, maintenance, re-fuelling of earthmoving equipment, lay down and storage areas for materials delivery, workshops, project offices, messing, and ablution facilities during the construction phase. The yards will operate throughout the construction period.

The establishment of all construction yards will be highlighted within the relevant SCWMPs.

The main construction yard is proposed at the northern end of the alignment and will provide:

- Main site offices and carpark;
- Main plant/equipment storage and workshop and servicing;
- Fuel storage and refuelling facilities
- Main access to northern end of alignment;
- Main delivery point and laydown area for materials (including stockpiles); and
- Transfer and segregation point for site and Project office waste (for off-site disposal)

Smaller construction yards will be established at the bridge and tunnel construction work areas as well as remote locations where crews are based. These yards will primarily comprise a small office and also provide for:

- Local plant/equipment storage;
- Local access to alignment;
- Delivery point for construction materials;
- Ablution facilities; and
- Collection of site waste.

Construction yard establishment is recognised as a quick process, and the yard surface generally will be progressively stabilised with 100 to 150 mm thick layer of clean hardfill material on reaching the required level. This shall stabilise the surface and ensure traffic movement to and from the site do not generate sediment.

Erosion and sediment control required for establishment and operation of construction yards shall include:

- Silt fences around the perimeter of the yard during the yard establishment phase of works as necessary.
- Stabilised construction tracks established at entry and exit points to reduce the transfer of sediment onto the external SH3 network;
- SRPs, DEBs or CIS installation as necessary to treat any exposed earthworks areas during construction;
- Stabilisation with hardfill, dependent upon final yard usage, to minimise sediment generation; and
- If necessary, CWDs will be established at the perimeter of the yard to intercept and divert clean overland flow from catchments uphill of the construction yards.

Construction water management practices to be implemented during operation of the main construction yard include:

- Vehicle movements and parking within designated areas of hardstand;
- Non-sediment contaminants (chemicals, petroleum and solvent based) products to be stored within appropriately designed bunded areas;
- Measures at site access points to minimise vehicles tracking soil from the Project onto public roads (e.g. wheel brush); and
- If sediment laden runoff are observed from yard surfaces, the runoff will be collected and/or directed to the closed sediment treatment device (e.g. SRP or DEB or CIS).

6.6 Stream works

Stream works for the Project comprise the construction of stream diversions and the installation and/or extension of culverts.

SCWMPs will be prepared for all stream works to confirm:

- Design specifications;
- The method of construction; and
- Timing and duration of stream works.

Further description on proposed stream works are set out in Section 6.6.1 and 6.6.2 below. In additional, SCWMPs shall consider the following:

Design specification

The Transport Agency Guideline set out the following design events for sizing of temporary diversions:

- The 2 year peak catchment discharge for a diversion duration of less than 30 days;
- The 10 year peak catchment discharge for the diversion duration between 30 and 60 days; and
- The 20 year peak catchment discharge for a diversion duration of greater than 60 days.

If site constraints (e.g. space) limit the size of temporary diversions to less than recommended guidelines, the specific design of the diversion shall be confirmed in the SCWMP and shall be supported by a contingency plan for conveying overtopping flows in wet weather. Such overtopping of flows will be based on provision of an overland flow path that has the capacity to allow the passage of the 100 year ARI rain event.

Timing

The timing of stream diversion works shall consider peak fish migration and spawning seasons as practicable, as described in the Assessment of Ecological Effects – Freshwater Ecology (Technical Report 7b) including all fish recovery protocols. All stream works shall be timed for a suitable fine weather window forecast.

The works will be staged such that if heavy rain or flood conditions are forecasted, the area may be stabilised prior to the event. Placement of geotextile fabric and/or rock are considered feasible techniques to promptly stabilise any exposed areas. This material shall be on hand in sufficient quantity prior to all heavy rain forecasts.

Fish management

The Freshwater Management Plan chapter of the ELMP and the Fish Recovery and Rescue Protocols for the Project provide for fish management measures during stream works.

Measures to enable fish passage will be required at temporary access track culverts where fish migration and recruitment is identified. The specific design to enable temporary fish passage (where required) will be confirmed in the SCWMP, and shall be in accordance with the ELMP and the Fish Recovery and Rescue Protocols.

At all locations, any fish observed in any of the pools within the work area will be removed by hand netting and released downstream of the work area. Any fish or eels discovered during excavation will also be captured and released downstream in accordance with the ELMP.

6.6.1 Temporary or permanent stream diversions

Permanent stream diversions are proposed to realign a natural stream channel (or section of stream channel) for the Project (refer to the CEMP and the AEE). Stream diversions will also be required during construction to temporarily divert flows around working areas in order to allow works to progress or provide access to construction areas.

For both permanent and temporary stream diversions, works shall endeavour to establish an 'off-line' environment to allow majority of works to be completed outside of the active stream channel. However, there are locations where this approach is not practical (i.e. steep gullies where large fill embankments are proposed) so an online approach has also been developed.

The following sequences are indicative only, and alternative methods may be proposed (e.g. sheet piling, installing coffer dam). Stream diversion sequences shall be confirmed in the relevant SCWMPs. Refer also the Freshwater Management Plan chapter of the ELMP.

Indicative off-line diversion

The off-line approach is the preferred approach where practical and recognises that works within the water body are limited in extent to the "tie-in" locations between the diversion and the existing stream. A work sequence to achieve this could comprise:

- Establish set back distance from existing stream (if any). Where a setback of at least 10 m between the working area and the stream cannot be maintained, a silt fence (or similar approved) shall be installed on the stream side of the working area prior to excavating the channel.
- Excavate the base for a channel or pipe diversion, working from the lowest to the highest point without excavating the tie-in to the existing stream. Permanent

channels/pipes shall be sized in accordance with permanent stormwater design details and the conditions of consent.

- Stabilise all erodible surfaces created by the diversion:
    - For channels, stabilise the channel to ensure it does not become a source of sediment. Permanent channels shall be stabilised in accordance with permanent stormwater design details. Temporary channels may be stabilised using pinned geotextile fabrics, rock armour, logs (where available). If scouring velocities are observed rock or log checks may be installed within the channel.
    - For pipes, install the pipe, and backfill the trench. Where headwater depth is anticipate at the pipe inlet point, any erodible material at inlet will be protected against scour (e.g. pinned geotextile or concrete or a headwall structure or similar approved).
- Just prior to completing the tie-in to the existing stream, construct a non-permeable bund at each end of the tie-in extent to minimise flows through the tie-in area. Pump stream flow around the works area if required.
- Remove the downstream bund and allow stream flows to enter the diversion. Once flows have entered the diversion, the upstream bund can then be removed. Removing the downstream bund first will allow some water to enter the diversion channel, and reduce the scouring velocities when the upstream bund is removed;
- Where required, retain the non-erodible bund within the original stream channel immediately downstream of the entrance to the newly constructed diversion in order to divert flows into it.
- If required, place a non-erodible bund immediately downstream end of the original stream channel but upstream of the new diversion channel outlet to prevent backflow into newly drained area of works. Once the flows have been diverted and the bunds placed, fish removal from the original channel can be completed in accordance with the ELMP.

<u>Indicative online stream diversion</u>

Where an off-line approach is not practical, an online approach may be proposed for locations where permanent stream diversions are required e.g. beneath fill embankments in existing gullies. The online approach recognises that diversion of stream flows must occur first, with all subsequent works (e.g. plant access or earthworks) occurring in a "dewatered" stream environment. A work sequence to achieve this could comprise:

- Construct a non-permeable bund across the stream channel ahead of the work front. The purpose of the bund is to create sufficient water depth to impound water to enter the inlet of a pump or gravity pipe. Where natural barriers or pools are present a bund may not be required.
- Pump or pipe the stream flow around the works area, discharging back into an existing watercourse downstream of the works area. The inlet of the pump will be supported above the base of the stream and will contain a fish grill, to prevent fish from entering the pump intake structure. The pump flow rate will be selected to

equal the stream flow at the time of works, so that the existing channel is dewatered. The point of discharge to the existing watercourse shall be stabilised (e.g. rock or geotextile) to prevent scour.

- Once the flows have been diverted and the stream dewatered, fish removal from the original stream channel will be completed in accordance with the ELMP and associated Fish Recovery and Rescue Protocols.
- Install and extend appropriately sized clean water diversion pipes to the non-permeable bund.
- Extend access and earthworks to the non-permeable bund.
- Construct a second non-permeable bund approximately100-200m ahead of the work front and over pump or pipe the stream flow around and extending past the works area. Once flows are diverted past the works area, the initial bund can then be removed.
- Repeat the above process as often as required.

Key considerations for SCWMPs with stream diversion works shall include:

- Non-erodible bunds shall comprise a sand bag barrier with an impermeable lining to minimise seepage through the sand-bags. Low permeable soil (e.g. clay) shall be placed immediately behind the sand-bags to prevent water flowing through the sand-bag barrier and into the construction area.
- Any water remaining within the original stream channel and works area may be pumped to the closest treatment pond or through a series of turkey nest structures (or similar approved) if sediment laden. Where pumping to a treatment pond is required, decant systems within the treatment ponds shall be raised during the pumping process to allow for settlement of sediment and chemical flocculant applied as necessary.
- Material excavated from the diversion channel will be placed in stockpiles away from the stream diversion, where it cannot slump back in.
- Construction works, including the removal of weak and unsuitable material, filling, culvert construction, can commence within the original channel as required.
- While it is considered unlikely to be required, if necessary, CWDs (or similar approved) may be installed above the area of work to exclude clean stormwater runoff from upslope undisturbed catchments outside of the works from the works area.

6.6.2 Culvert construction

Temporary and permanent culvert construction will be required in a number of locations throughout the Project area. A summary of the permanent culverts is provided in Section 4 of the AEE. Where possible, permanent culverts will be installed early on in the work to convey stream flows during construction.

In some locations (e.g. lower valley floors where soft compressible soils are present), the construction method may not allow a one-off installation of the permanent culvert. In such cases, a temporary culvert will be required prior to earthworks commencing if stream flows

are present. The drawings included in Appendix A provisionally indicate where temporary culverts are required. The need for temporary culverts will be confirmed in the relevant SCWMPs.

Additional temporary culverts will be required for the duration of the Project at the proposed access road along the western side of Pascoes' valley and at all crossing of the main stem of the Mangapepeke Stream.

A stabilised overflow path shall be established at all main crossings for flood events to flow over the road in a controlled manner and return to the stream channel/flood plain.

All temporary access road culverts outside of the permanent alignment shall be removed when not required, or on completion of works. The stream channel and riparian margin disturbed outside the permanent alignment shall be restored to existing conditions on the removal of temporary culverts.

The culvert construction method will generally replicate the offline stream diversion method, where construction mostly isolated from the existing stream flows with the exception of the tie-in locations. If culvert construction works are required within a stream channel, either:

- A temporary stream diversion will be established to divert flows; or
- If it is not possible to divert the stream, the culvert will be installed by pumping the flows around the culvert works areas. This will only be carried out in situations where a temporary stream diversion is not considered practical. The decision to pump as opposed to installing a diversion channel will be made by the Project team, and will be set out in the relevant SCWMP.

All other construction activity following the culvert construction, such as the placement of fill, will only be carried out once erosion and sediment control measures are in place.

When the works have been completed, any disturbed and erodible areas will be stabilised through mulching or vegetation establishment.

Key considerations for SCWMPs with culvert works shall include:

- Timing of stream works to avoid peak fish migration and spawning seasons where practicable;
- Incorporating fish passage within culverts where migration and recruitment are identified;
- Prior to any works commencing on the construction of a particular culvert, a period of forecast dry weather, sufficient to construct the portions of the culvert within a waterbody, shall be confirmed through appropriate weather monitoring system;
- Any sediment laden water present within the work area and/or dewatered stream channels shall be pumped to the closest treatment pond or through a series of turkey nest structures (or similar approved).
- Culverts are expected to be installed in sections such that the immediate area may be stabilised at the end of each working day, and prior to forecasted rain.

- On completion of the culvert, all plant, materials and labour will be demobilised from the stream channel and any disturbed banks shall be stabilised in accordance with the Freshwater Management Plan chapter of the ELMP and relevant SCWMPs;
- In the event of high rainfall during the course of construction of the culvert, or prior to leaving the site for more than a 24 hour period where culvert works are incomplete, the following will occur:
    - All loose material that could enter a watercourse is to be removed from the flood plain of the stream;
    - Erosion and sediment control measures are checked;
    - Any downstream sand bag barriers are checked and, if required, removed; and
    - The streambed in the location of the culvert is stabilised to ensure flows overtopping upstream bunds (if any) will not create scour issues. It is expected that this may be achieved through geotextile fabric being appropriately pinned and trenched in at the head and toe of the work area
- As soon as the culvert is commissioned and stream flows are directed through the culvert, operational considerations shall apply which includes verifying that short term or long term fish passage remains and that the hydrological design aspects of the Project are fully addressed.

6.7 Bridge construction

The Project will require the construction of a bridge over a tributary of the Mimi River between CH 4150 – 4270, upstream of the kahikatea swamp. Bridge construction works will include:

- Establishing a dedicated bridge construction yard adjacent to either the northern or southern bridge abutment or both (to be confirmed). Cut earthworks are likely required to form this yard.
- Stage 1: Bridge Abutment and Pier Foundations. Access to both bridge abutments will be established for plant and equipment and construction access across the tributary will not be not required. Plant and equipment (drill rig and excavator) will be craned into place from the abutments to minimise the need for access tracks to the valley floor. Concrete and grout is likely to be required for constructing the bridge foundations.
- Stages 2-3: Bridge Piers and Deck. Erect braced piers at both ends and place steel superstructure to both ends. Erect central steel superstructure span.

The Project also requires the construction of a second bridge over a tributary of the Mangapepeke Stream.

Erosion and sediment control for bridge works shall primarily comprise the placement of controls around and below the bridge abutment and pier locations but above the stream bank profile. This shall include:

- Installing one or more rows of super silt fences downslope of the working area; and

- Pumping all sediment laden or cement laden water within the abutment and pier excavations to the nearest treatment device for pH and sediment treatment (e.g. CIS).

An activity specific SCWMP shall be prepared for bridge construction works. Sediment laden water generated from localised earthworks for the yard construction shall be collected and treated by one or more CIS (or similar approved). Specific management protocols for concrete and grout use shall be included in the SCWMP, and shall set out procedures for immediately containing all cement and other contaminant spills.

6.8 Tunnel construction

The proposed Mount Messenger tunnel is located between Chainage 3400 – 3635 through the ridge line east of Mount Messenger. Works in this tunnel zone will include earthworks at the northern and southern tunnel portals, and excavation through the ridge line to connect the northern and southern construction zones.

Works also include:

- Establishing a dedicated tunnel construction yard adjacent to either the northern or southern portal. Cut and fill earthworks are likely required to form this yard.
- Establishing a concrete and materials delivery area.
- Excavating the tunnel in stages. Excavated spoil will be taken directly into the closest fill site, and temporary stockpiling is not envisaged to be necessary. The anchor bolts and shotcrete lining will be installed as the excavation proceeds. This will provide temporary protection as well and serve as the final tunnel lining.
- Pavement, drainage, utilities and concrete barriers construction will be done after completion of the two-stage excavation process.
- The tunnel portals may be completed to final profile after all excavation and pavement works are completed if not required before for structure support.

An activity specific SCWMP shall be prepared for tunnel construction works. Sediment laden water generated from localised earthworks for the yard construction and portal entrance (if any) shall treated by the nearest SRP or a dedicated CIS. If grout/cement laden water is generated, a dedicated CIS (or similar approved) shall provide treatment for pH prior to its discharge or reuse. Removal of this water offsite also remains an option if required.

Low volumes of groundwater may be encountered during these works. If groundwater becomes sediment and/or cement laden during works, it shall be collected and treated by a CIS to an acceptable standard for sediment and/or pH, prior to discharge or reuse for construction purposes. A target pH of between 6.5 and 8.0 shall be achieved prior to discharge or reuse of any water being treated for pH.

6.9 Soil nails and rock anchors

Soil exposed by the cut embankments and within the slopes between the bridge abutments and piers are likely to require soil geotechnical stabilisation with soil nails (or similar). Rock anchors may be required where weak and unfavourable rock is exposed in the cuttings (e.g. cut embankments, tunnel portals).

Soil nails and rocks anchors are proposed to be installed by drilling a hole, placing a steel bar and filling the hole with high strength grout. A steel plate is then bolted on to the face of the cutting.

Localised grout overspills will occur during installation of the soil nails and rock anchors in the immediate vicinity of works, and may result in grout laden water. A Project wide activity specific SCWMP shall be prepared to manage this. Key considerations for this SCWMP shall include:

- Containing all grout overspills at the location of the overspill to minimise grout laden water being generated;
- Measures to minimise grout entering any drain or pipe downstream of the works (e.g. bunding the area of works);
- Keeping grout laden water separate from sediment laden water to minimise the volume of water requiring pH treatment.; and
- Collecting all grout laden water for pH treatment (via CIS or similar approved) prior to discharge or reuse. A target pH of between 6.5 and 8.0 shall be achieved prior to discharge or reuse of any water being treated for pH. Untreated grout laden water shall not be discharged to clean or dirty water drains, or streams.

7 Winter works

Winter works refer to all earthworks occurring in the winter period (1 May to 30 September inclusive). The CWMP recognises that works in this period are more likely to present a higher risk of sediment discharges to the receiving environment due to the wetter soil conditions, colder climate and potential for higher rainfall. The Project shall manage this risk through the risk assessment process outlined within the relevant SCWMP as per Section 1.7 of the SCWMP template (Appendix B).

For the winter period this risk assessment, which shall be undertaken within the SCWMP process, shall specifically consider:

- The scope/nature of the proposed works;
- Structural controls proposed, or existing, that will be/are installed;
- Additional non-structural controls to be implemented (e.g. increased on site monitoring and staging); and
- Maintenance consideration of structural controls to ensure effective access can be achieved to undertake the maintenance and controls continue to work efficiency.

The CWDMP shall continue to apply to any winter works being carried out as a way to identify improvements or the need to reduce scope where required.

A summary of the winter works assessment and documentation procedure is shown in Figure 7.1 below.

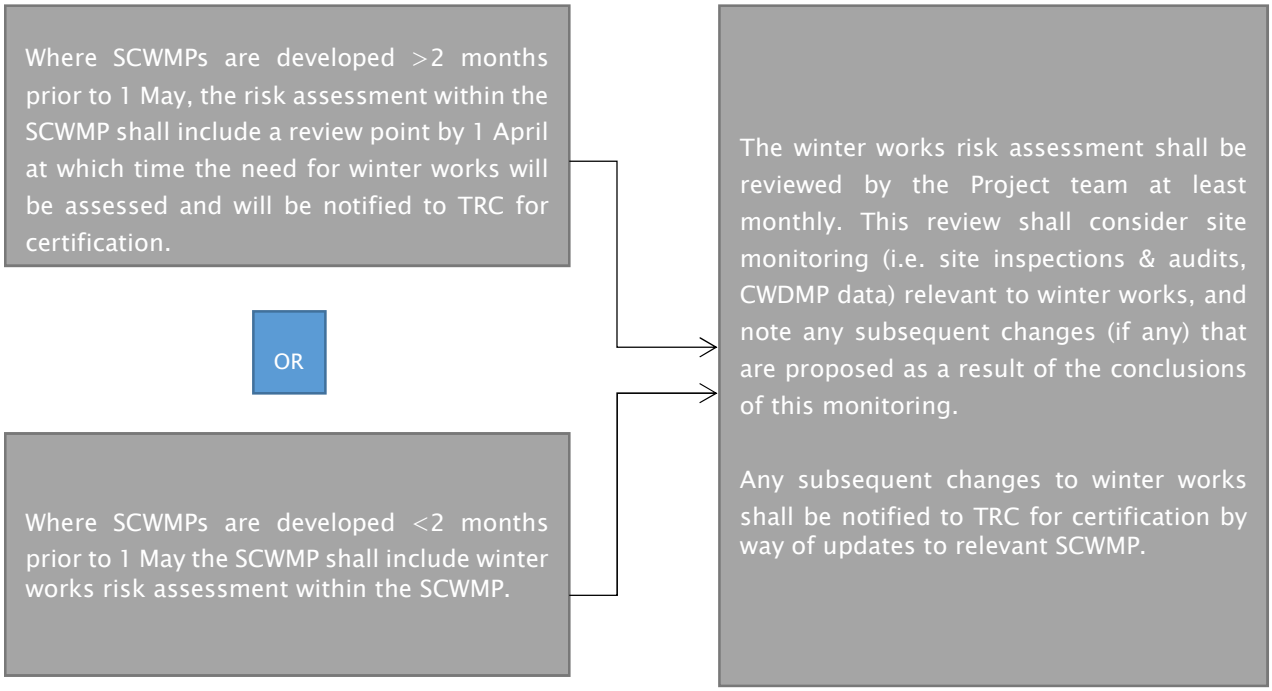


Figure 7.1 - Winter works assessment and documentation

The risk assessment process that forms part of the SCWMP process is based on Table 7.1 as outlined below:

Table 7.1 - Risk assessment Process – Winter Works

Date prepared	
Is Winter Works required	Yes or No
Risk assessment	Scope/nature of the proposed works and associated risk (eg area of works, vicinity of receiving environment, slope of works area, duration of works):
	Structural controls required to minimise risk:
	Non-structural controls required to minimise risk:
	Maintenance considerations to ensure risk continues to be minimised:
Next review date	

This above process allows for winter works to be assessed on a SCWMP basis, within a risk assessment framework and ensures TRC are kept informed throughout. All winter works will be subject to TRC certification and works over that period will only occur with this certification in place.

8 Maintenance

8.1 Overview

Table 8.1 identifies the maintenance actions for specific erosion and sediment control (E&SC) devices.

Table 8.2 identifies requirements on an activity basis to ensure appropriate maintenance can be carried out. Maintenance is based on routine inspections, or will occur in response to predicted rainfall events, or as a result of inspection following rainfall events.

A trigger rainfall event (refer Section 10.1.1) will require an inspection to check the condition and continued effectiveness of sediment control measures.

Table 8.1 - Maintenance actions for specific erosion and sediment control devices

E&SC devices	Maintenance trigger	Action
Diversion drain	Debris in channel forcing water out of channel	Remove debris
	Scour along edges of cut off or break out	Widen cut off channel and extend armour
	Scour in channel	Place armour rock in cut off channel
	Scour at outlet	Place armour rock at outlet
	Sumps within DWDs are full after rain event	Clean sumps to original capacity
Pipes	Any build-up of debris in flume or pipe inlet	Remove debris
	Scour at inlet	Protect inlet with geotextile overlain with armour
	Scour around outlet	Place armour to dissipate energy
SRP	Forebay more than 20% full with sediment	Empty forebay and remove sediment
	Main pond more than 20% full with sediment	Empty pond and remove sediment
	Floating decant blocked or sunk	Empty pond and repair decant
	Scouring at discharge point from pond	Place material (e.g. geotextile) to dissipate energy from discharge
	Erosion of bund	Armour bund by either placement of geotextile or rock
Silt fence/Super silt fence	Fence flapping in wind	Reattach fabric to guide wire and increase number of fabric locks. If required install additional waratahs

E&SC devices	Maintenance trigger	Action
	Build-up of sediment greater than 150mm in depth resulting in straining structure	Remove sediment
	Large rocks distorting fence alignment	Remove rocks
	Bottom of silt fence not properly anchored	Dig fence into ground and backfill.
	Undermining of fence by concentrated flow	Identify options to minimise concentrated flow
	Silt fence broken off top wire	Install additional clips on top wire. In very windy locations a netting fence may be required to keep the silt fence in place
DEBs	More than 20% full with sediment	Remove sediment. Consider baffle installation.
	Scour at exit point	Install concreted pipe exit or sand bag over flow point to provide erosion resistant surface
	Insufficient capacity filling quickly	Enlarge trap or provide additional DEBs
CISs	More than 20% full with sediment	Remove sediment
	Outlet blocked	Empty CIS and clear blockage
	Scouring at discharge point from CIS	Place material (e.g. geotextile) to dissipate energy from discharge
Road DEBs /sumps/sediment pits	More than 50% full with sediment	Remove sediment
	Scouring at discharge point from DEB	Place material (e.g. geotextile) to dissipate energy from discharge
	Flocculant rainfall activated shed not operating as required. Plumbing blocked, flocculant levels low, header tank blocked or roof of shed has debris on it. Water quality in SRP or DEB not achieving outcomes. Refer section 5.5.3.	General maintenance of full flocculant shed. Following every rain event checking full operation of flocculant shed and undertaking maintenance as required.

Table 8.2 - Summary of maintenance requirements on an activity basis

Activity	Maintenance requirements
Roads (access and haul)	• Shape surface to minimise riling and scour and regrade road surfaces following heavy rainfall • Identification of sites to dewater (if required) and dispose sediment removed from dedicated DEBs • Inspection and sediment removal at any dedicated E&SC measures (e.g. CWDs, DEBs)
Spoil disposal sites	• Identification of sites to dewater (if required) and dispose sediment removed from dedicated SRPs • Access to dedicated E&SC measures (e.g. silt fences, CWDs, SRPs) and discharge points to allow inspections and sediment removal.
Stream works	• Access to entrance and exit points of all temporary diversions (pipe or channel) to check for and repair scour. Access to allow inspection and repair of channel scour. • If pumps are required, refuelling of pump generators away from water course.
Bridge construction	• Access to dedicated E&SC measures (e.g. CIS) and discharge points to allow inspections and sediment removal. Identification of sites to dewater (if required) and dispose sediment removed from dedicated CIS, • If pumps are required, refuelling of pump generators away from water course.
Tunnel construction	• Identification of sites to dewater (if required) and dispose sediment removed from dedicated treatment measures. • Access to dedicated E&SC measures (e.g. CIS) and discharge points to allow inspections and sediment removal. • If pumps are required, refuelling of pump generators away from water course
Bulk earthworks	• Identification of sites to dewater (if required) and dispose sediment removed from erosion and sediment control devices
	• Temporary stockpiling sites: Access to dedicated E&SC control measures (e.g. silt fences, CWDs and DWDs) to allow inspection, sediment removal and repair

Activity	Maintenance requirements
	• Treatment ponds: Access around full perimeter to all SRPs and DEBs to allow: • Safe inspection and monitoring of inlet and outlet water quality; • Sediment removal at both fore bay and main pond; and • Repair of side bunds, outlet structure, scouring at discharge point and/or spillways as required. • Longitudinal controls (e.g. silt fences, diversion drains): Access to allow inspection and repair of undermining and scour.
	• Chemical treatment devices: Vehicle access to flocculant reservoirs for topping up of chemicals. Rainfall activated devices will be inspected following every rainfall event and during heavy rainfall to record level of flocculant in the reservoir. Additionally: • Water within header tanks may need to be adjusted to prevent over or under-dosing of the device; and • Devices will need to be regularly checked for blockages (e.g. leaves) at the catchment tray, and also low and high rate hoses to ensure that rainwater enters the header tank and flocculant exits the device at the correct dosage rate.

8.2 Improvements

Section 8.1 identifies inspections of the sediment control devices that will be undertaken to ensure they are operating correctly and achieving the erosion and sediment control objectives. However, if the devices are found not to be operating correctly, the appropriate response identified in Table 8.3 will be assessed and implemented as necessary.

Table 8.3 – E&SC Device Potential Improvements

E&SC Device	Improvement trigger	Improvement
Diversion drains	Source of sediment laden water	Line base of channel with geotextile or rock
		Regrade the channel to have a flatter slope
Pipes	Water undermining the pipe.	Reinforce pipe inlet and/or outlet
		Construct a formal inlet/outlet structure (if appropriate)
		Increase number of pipes
Sediment Retention Pond	Poor operating performance	Assess if the chemical remains appropriate for the soil type, assess if dosing rate can be increased and/or dosing system can be adjusted.

E&SC Device	Improvement trigger	Improvement
		Reduce catchment area
		Improve catchment condition e.g. progressive stabilisation
		Clean out fore-bay
		Reconsider baffle design in the SRP
DEB	Poor operating performance	Increase capacity of the DEB
		Reduce catchment area by installing another DEB
		Assess if the chemical remains appropriate for the soil type, assess if dosing rate can be increased and/or dosing system can be adjusted.
		Improve catchment condition e.g. progressive stabilisation
Silt fence/super silt fence	Poor performance	Repair/replace fence fabric
		Replace with super silt fence
		Avoid concentrated flow paths into silt fence or super silt fence

9 Roles and Responsibilities and Training

9.1 Roles and responsibilities

This section outlines the responsibilities expected for all aspects of construction water management. Within the Mt Messenger Alliance an Erosion and Sediment Control Team will be established and will form a key part of the overall organisational structure. The Erosion and Sediment Control Team have a direct link to both the Environmental and Construction Managers and will be a key role in developing construction methodologies for the Project that align with the intent of the approved CWMP.

It is noted that any local sub-contractors utilised within the Project will operate within this same structure and will comply (under supervision) with the Mt Messenger Alliance management systems and expectations.

Table 9.1 - Construction Water Management Responsibilities

Organisation	Responsibilities
Transport Agency	• Overall responsibility for compliance with the Resource Management Act 1991 (RMA) and any conditions of the designations and resource consents • Ensuring SCWMPs are included in contract documentation as necessary to ensure sub-contractor buy in • Reviews of CWMP and SCWMPs as required during construction • Audits of E&SC devices and methodologies • Record keeping as necessary
Mt Messenger Alliance	• Overall responsibility for environmental management during construction • Preparation of the CWMP and SCWMPs • Implementation and review of the CWMP and SCWMPs • Installation of construction water measures and erosion and sediment devices • Inspection and maintenance of erosion and sediment control devices • Stabilisation activities • Training in relation to the CWMP and SCWMPs • Monitoring and reporting in accordance with the CWMP and SCWMPs
Taranaki Regional Council (Consent Authority)	• Review and comment on the CWMP and any SCWMPs provided with the application • Certification of the SCWMPs not provided with the application • Auditing to ensure compliance with the CWMP and SCWMPs

9.2 Project inductions and training

9.2.1 Inductions

All people working on-site, or with site responsibilities, will be required to undertake a formal site induction process as outlined in the CEMP. No person will be permitted to work on the site until they have completed the induction process.

Part of this induction process will be based on environmental management, including erosion and sediment control and the requirements under this CWMP.

The induction will include information on the ecological and, cultural values of the area, sensitive areas and, key environmental risks, including areas defined within the SCWMPs as having a higher risk. Information will also be provided on environmental controls such as erosion and sediment control devices.

9.2.2 Training

The Alliance Management Team, Construction Manager, Site Managers, superintendents environmental and ecology team members (responsible for implementation of this CWMP) will undergo a general environmental awareness training to make all aware of their responsibilities relating to this CWMP. Training requirements are described in full detail within the CEMP with specific training requirements relating to this Plan outlined in Table 9.2.

Table 9.2 - Construction Water Management Training

Environmental Aspect	Specific Training
Erosion and Sediment Control / Construction Water Management	• Relevant TRC regional plans and earthwork guidelines • Transport Agency erosion and sediment control guidelines for state highway infrastructure • Design details for the erosion and sediment control and construction water management measures and associated methodologies during construction • The performance standard as defined in this CWMP to be achieved by all erosion and sediment controls on site • The sensitivity of the receiving environment to sediment discharges • Understanding risk for specific activities and/or locations • SCWMP requirements
Stream works	• Briefing on the values of waterbodies within and downstream of the Project area and the sensitivity of the receiving environment to sediment discharges. • The objectives of the stream design including fish passage requirements. • Briefing on the Project Fish Recovery and Rescue Protocol, which contains the methodology to minimise direct effects of

Environmental Aspect	Specific Training
	construction on fish, kōura and kākahi (freshwater mussels) prior to draining, diverting or excavating streams. • Construction method requirements for stream works (stream diversions, culverting or other in-stream work).
Vegetation Clearance	• A briefing on the values of any significant areas of vegetation that are to be retained. • Briefing of the Project Vegetation Clearance Protocol and related terrestrial ecology protocols included in the ELMP – Bat Management, Lizard Management, Avifauna Management. • The methods that shall be used to identify and protect retained vegetation during construction.

A record shall be kept of all training, including the information presented and a list of attendees (refer to the CEMP for further detail).

9.2.3 Toolbox talks

Environmental issues, including construction water management and erosion and sediment control, will form a regular part of toolbox meetings to ensure all workers are aware of the key issues.

10 Site Monitoring

Site monitoring and management will be implemented through regular site visits by a suitably qualified and experienced person in construction water management, to identify changing site conditions and continuous improvement opportunities in response to monitoring outcomes. Internal construction team planning meetings shall be held while earthworks are occurring (frequency yet to be determined), where changes that may potentially affect the construction water management will be discussed.

10.1 Monitoring programme

The CWDMP provided at Appendix C to this CWMP will be implemented during the Project in accordance with the CWAR. The focus of this monitoring programme is to quantify potential sediment discharges from the Project and enable appropriate site management responses to be identified. Monitoring will include:

- Weather forecast monitoring for daily and weekly planning;
- Visual assessments of the receiving environment;
- Flocculation monitoring;
- Devices monitoring, which includes monitoring of outflow turbidity and/or total suspended solids associated with a selection of SRPs;
- Monitoring of the receiving environment through manual water quality sampling both upstream and downstream of discharges where required;
- Continuous downstream (immediately downstream from the project earthworks) turbidity sampling in the Mimi and Mangapekeke Streams pre and during earthworks activities; and
- Water quality and habitat surveys (fish and invertebrates) pre and during earthworks in accordance with the Freshwater Management Plan chapter of the ELMP.

10.1.1 Rainfall triggered monitoring

Rainfall has a direct effect on the performance of erosion and sediment control measures. Experience suggests that high intensity rainfall of short duration can have the same, if not worse effect as continuous rainfall over a 24 hour period. To maximise the success of erosion and sediment control measures, site management and construction planning must take into account measured rainfall.

Rainfall events shall instigate monitoring and inspection to check the condition and continued effectiveness of the sediment control measures (referred as Trigger Event in the CWDMP).

As an initial trigger, a Trigger Event of greater than 25mm in a 24 hour period or 15mm in a 1 hour period will instigate this process, however this may be revised once rainfall on site is better understood.

Other triggers to instigate monitoring will include:

- Spillage/accident reports that cause a discharge of sediment or contaminants to the aquatic environment; and/or
- Obvious degradation of the receiving environment immediately downstream of the SRPs such as accumulation of sediment, conspicuous oil/grease, scums/foams, floatable matter, fish kills, discolouration of water or significantly increased growth of nuisance algae.

Monitoring to identify potential effects from construction related discharges will be carried out in accordance with the CWDMP, Freshwater Management Plan chapter of the ELMP and conditions of consent. The response and reporting of incidences relating to construction water management shall be carried out in accordance with Section 7 & 8 of the CWDMP.

10.1.2 Monitoring response to indicators of effects

The CWDMP identifies thresholds to instigate a further site investigation of potential effects on the receiving environments (after reasonable mixing) as a result of construction water discharge.

The CWDMP also identifies "management" thresholds, which allow early detection of potential on site issues. Management threshold levels do not indicate potential effects.

If monitoring results indicate potential effects thresholds are exceeded, procedures set out in the Freshwater Management Plan chapter of the ELMP shall be carried out. As a minimum, the following steps shall be undertaken:

- In the first instance, investigate a possible (cause-effect) association with the Project;
- Should this investigation establish linkages between the adverse effect and on-site practices, then investigate alterations to the operational methods (including modifications to environmental control measures and methodologies) as a first order response;
- Assess the effectiveness of the alterations in operational methods by conducting further monitoring to alleviate/avoid adverse effects on the environment; and
- Assess the need for, and nature of, any remedial action.

The most likely causes for effects are:

- Incorrect installation of devices;
- Sub-optimal performance of the measures and methodologies implemented; and/or
- Damage from heavy rainfall/storm events.

The monitoring programme shall provide a process for a 'check and balance' approach, which enables the opportunity for improvement as necessary throughout the construction period.

10.1.3 Chemical treatment monitoring

While the careful use of flocculants at SRP's and DEBs at the correct dose rate has the positive effect of improving treatment efficiencies, overdosing can have negative impacts if residual compounds leave with the pond discharge and enter receiving waters. Overdosing

shall, as far as practicable, be avoided or addressed by identifying appropriate indicators (e.g. pH) and management thresholds in the CWDMP.

Chemical use shall be reassessed if data shows that the current chemical flocculation methods are exceeding the above triggers. It is noted that some of the flocculants available have no effect on pH levels and if such chemicals are used on this Project then there will be no requirement to monitor discharge pH levels. Where other chemical flocculants are used, specific monitoring parameters (if any) shall be set out in the relevant SCWMPs.

10.2 Wet weather response and contingences

A plan and check list of measures to be undertaken in advance of forecasted wet weather will be prepared and updated by project team. These measures may include:

- Sealing off of fill surface;
- Stabilisation of higher risk locations;
- Construction of cut off channels to divert water to treatment devices;
- Construction of cut off channels to reduce overland flow path lengths;
- Construction of bunds to reduce discharges to the front faces of fills; and
- Checking of all erosion and sediment controls to ensure they are operational, including all temporary diversion channels and spillways.

A rainfall actions list (or similar approved), detailing site specific measures shall be prepared, and shall be discussed and documented at regular project meetings.

The weather forecast shall be monitored and in advance of predicted rainfall, ensure that all erosion and sediment controls measures are in place and the rainfall actions are completed.

11 Incident Response

Incident response shall be undertaken in accordance with the process outlined in Section 5.15 of the Project CEMP.

In relation to construction water management, an incident is defined as:

- Discharges from non-stabilised areas that are not treated by erosion and sediment control measures as required by the CWMP / SCWMPs;
- Failure of any erosion and sediment control measures;
- Discharge of a hazardous substances, including cement, to a water body;
- Failure of any temporary stream diversion; and
- Any other incident, which either directly or indirectly causes, or is likely to cause, adverse ecological effects in any waterbodies, that is not authorised by a resource consent.

Incidents will primarily be identified by site observations by Project staff and as a result of specific environmental and erosion and sediment control inspections undertaken by the Environmental team. An incident may also be identified as a result of the monitoring undertaken for the Project (as detailed in Section 10) or through complaints or stakeholder feedback.

11.1 Corrective Actions

As soon as practicable after an incident, the Environmental Manager and the Construction Manager shall:

- Determine the immediate actions to be taken to re-establish control measures where these have failed or have not been implemented in accordance with the relevant management plan as soon as possible.
- The corrective actions shall be implemented as soon as practicable, taking into account health and safety issues.
- Liaise with TRC to establish what remediation or rehabilitation is required and whether this is practicable to implement.

In addition to the above requirements the incident report will include the following details:

- Description and location of incident;
- Description of the weather conditions before the incident;
- Description of work being carried out at the time of the incident and how the incident occurred;
- Corrective actions taken to rectify the situation and mitigation measures to be taken to minimise the adverse effects on the environment;
- Causes of the incident; and
- Environmental controls in place at the time of the incident.

Additional monitoring may be required as a result of the incident and changes may be required to the CWMP or approved and future SCWMPs. Any such changes will be made in accordance with the revision provisions of this CWMP and the conditions of consent.

12 Review

12.1 Review process

A review of the CWMP will be undertaken at least annually by the Alliance. The management review will be organised by the Environmental Manager and the Project team will be informed of any changes to this CWMP through the regular Project communications processes. The review will take into consideration:

- Compliance with the Project consent / designation conditions, the CEMP and management plans.
- Any significant changes to construction activities or methods that require the description of construction activities to be updates and/or any unanticipated more than minor adverse effects resulting from the Project.
- Key changes to roles and responsibilities within the Project team.
- Results of inspections, monitoring and reporting procedures associated with the management of adverse effects during construction.
- Relevant comments or recommendations from TRC or NPDC regarding the CEMP or management plans.
- Unresolved complaints and any response to complaints and remedial action taken to address the complaint.

The outcomes of any review will be provided to TRC and NPDC.

Where the CWMP is updated as part of a review, the on-site version shall be updated promptly and prior to any works associated with the amendment being implemented.

12.2 Minor amendment

In accordance with the consent conditions, minor amendments may be made to this final CWMP at any time. Minor amendment is any amendment where the adverse environmental effect arising from the amendment is the same or less than the effect that would result in the absence of the amendment.

Any minor amendment to the CWMP shall remain consistent with the overall original version of the final CWMP.

The Alliance shall provide TRC with a copy of any amendment as soon as practicable and before any construction works associated with that amendment are implemented.

12.3 Material amendment

Material amendments to this CWMP may be made at any time subject to certification by TRC.

Material amendments are any amendments that are consistent with the overall intent of the original version of the final CWMP, but that are not minor amendments in accordance with Section 12.2.

In the event of material amendment, the amendment shall be submitted to TRC for certification 20 working days before the commencement of works to which the amendment applies. Works unaffected by the material amendment may continue during the certification process.

Appendices

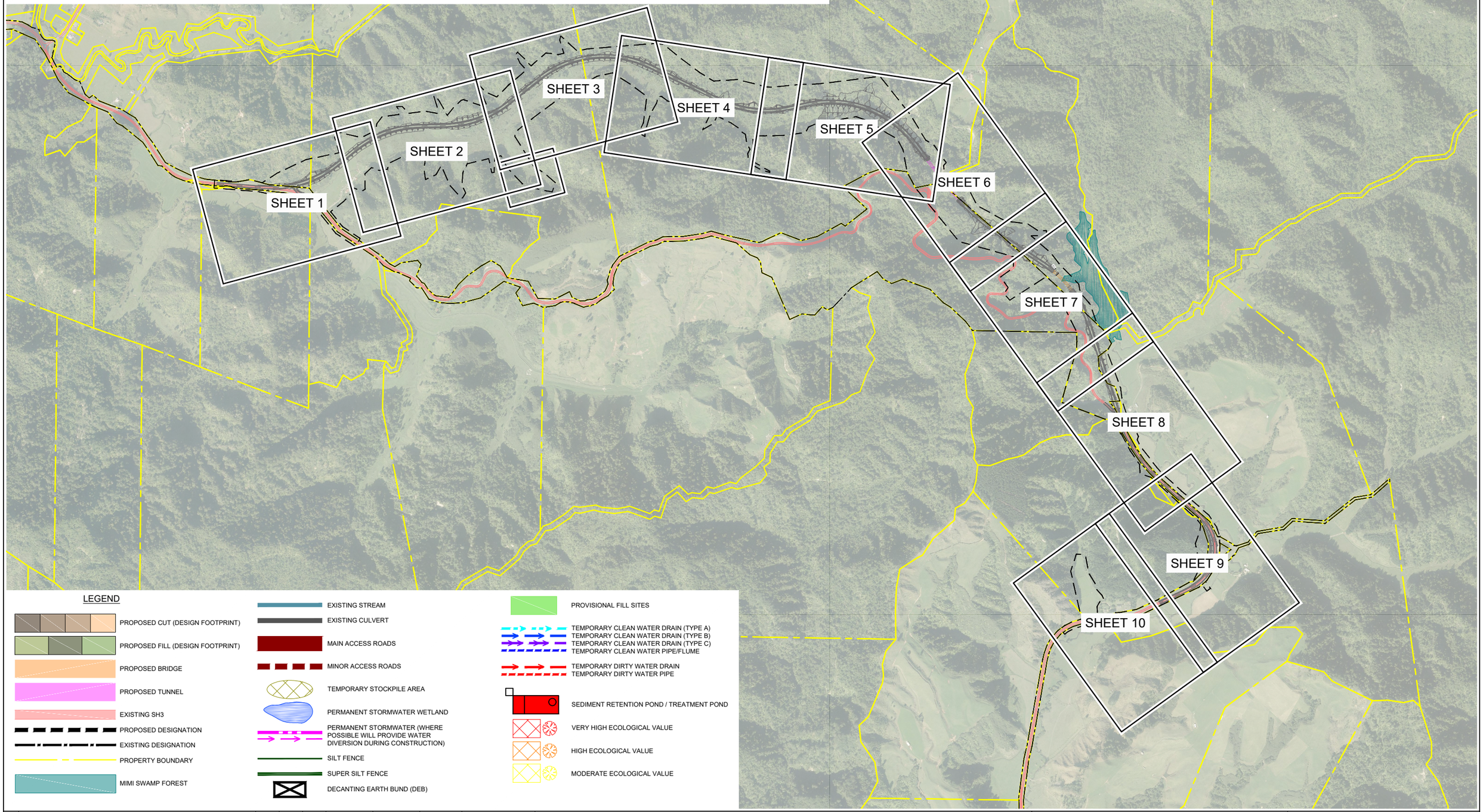
Appendix A: Conceptual Erosion and Sediment Control Plans and Typical Details

- Conceptual Erosion and Sediment Control Plans – MMA-DES-ESC-C0-DRG-1000-1010
- Erosion and Sediment Control Typical Details – MMA-DES-ESC-C0-DRG-4001-4008
- Fill 12 Establishment works indicative sequence – MMA-DES-CON-C0-DRG-1201 and MMA-DES-CON-C0-DRG-120
- Fill 13 Establishment works indicative sequence – MMA-DES-CON-C0-DRG-1301

CONCEPTUAL PLANS DESCRIBE EROSION AND SEDIMENT CONTROL FOR MAIN CONSTRUCTION WORKS ONLY.
PLANS TO BE READ IN CONJUNCTION WITH THE CONSTRUCTION WATER MANAGEMENT PLAN (CWMP)

NOTES

1. SILT FENCE AND SUPERSILT FENCE ARE THE PRIMARY TREATMENT FOR LINEAR SHAPING EARTHWORKS.
2. SEDIMENT RETENTION PONDS ARE THE PRIMARY TREATMENT FOR CUT AND FILL EARTHWORKS. SEDIMENT POND VOLUMES SHOWN ARE SIZED IN ACCORDANCE WITH NZTA GUIDELINES TO APPROXIMATELY 2.6% OF THE CATCHMENT (FINAL VOLUME TO BE CONFIRMED)
3. ALL SEDIMENT RETENTION PONDS DISCHARGE TO LAND A MINIMUM DISTANCE OF 5m FROM AN ACTIVE STREAM CHANNEL WHERE PRACTICABLE.
4. WHERE NOTED SEDIMENT RETENTION PONDS MAY BE REPLACED WITH CONTAINER IMPOUNDMENT SYSTEMS (CIS), BUT THIS WILL REQUIRE A SPECIFIC ASSESSMENT OF SUITABILITY PRIOR TO IMPLEMENTATION.
5. SILT FENCE WILL BE INSTALLED AROUND ALL TEMPORARY STOCKPILE SITES.
6. ACCESS ROADS CONSTRUCTED USING CUT AND COVER METHODOLOGIES. DECANTING EARTH BUNDS (DEB) TREATING ACCESS ROAD SURFACE.
7. REFER TO DRAWING MMA-DES-ESC-C0-DRG-4006 FOR TYPE A, B AND C CLEAN WATER DRAIN DETAILS.
8. DESIGN GUIDELINES FOR ALL EROSION AND SEDIMENT CONTROLS (ESC) TO FOLLOW NZTA GUIDELINES WHERE PRACTICABLE. SEDIMENT RETENTION PONDS LOCATED WITHIN THE FLOOD PLAIN TO BE SPECIFICALLY DESIGNED.
9. PROGRESSIVE STABILISATION IN ACCORDANCE WITH THE CONSTRUCTION WATER MANAGEMENT PLAN TO APPLY.
10. ADAPTIVE MONITORING IN ACCORDANCE WITH THE CONSTRUCTION WATER MANAGEMENT PLAN TO APPLY.
11. PROVISIONAL FILL SITES MAY BE USED FOR TEMPORARY STOCKPILING AS REQUIRED. REFER CONSTRUCTION WATER MANAGEMENT PLAN FOR EROSION AND SEDIMENT CONTROL OF PROVISIONAL FILL SITES.
12. SELECTION OF STORAGE AND STOCKPILE LOCATIONS FOR LOGS AND WOODY MATERIAL SHALL BE IN ACCORDANCE WITH THE ECOLOGY AND LANDSCAPE MANAGEMENT PLAN.
13. REFER ECOLOGY AND LANDSCAPE MANAGEMENT PLAN FOR REQUIREMENTS AT AREAS OF IDENTIFIED ECOLOGICAL VALUE.



LEGEND

- PROPOSED CUT (DESIGN FOOTPRINT)
- PROPOSED FILL (DESIGN FOOTPRINT)
- PROPOSED BRIDGE
- PROPOSED TUNNEL
- EXISTING SH3
- PROPOSED DESIGNATION
- EXISTING DESIGNATION
- PROPERTY BOUNDARY
- MIMI SWAMP FOREST
- EXISTING STREAM
- EXISTING CULVERT
- MAIN ACCESS ROADS
- MINOR ACCESS ROADS
- TEMPORARY STOCKPILE AREA
- PERMANENT STORMWATER WETLAND
- PERMANENT STORMWATER (WHERE POSSIBLE WILL PROVIDE WATER DIVERSION DURING CONSTRUCTION)
- SILT FENCE
- SUPER SILT FENCE
- DECANTING EARTH BUND (DEB)
- PROVISIONAL FILL SITES
- TEMPORARY CLEAN WATER DRAIN (TYPE A)
- TEMPORARY CLEAN WATER DRAIN (TYPE B)
- TEMPORARY CLEAN WATER DRAIN (TYPE C)
- TEMPORARY CLEAN WATER PIPE/FLUME
- TEMPORARY DIRTY WATER DRAIN
- TEMPORARY DIRTY WATER PIPE
- SEDIMENT RETENTION POND / TREATMENT POND
- VERY HIGH ECOLOGICAL VALUE
- HIGH ECOLOGICAL VALUE
- MODERATE ECOLOGICAL VALUE

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab MMA-DES-ESC-C0-DRG-1000
Scales NOT TO SCALE
Original Size A1

Te Ara o Te Ata

This drawing is not to be used for construction purposes unless signed approved and issued For Construction

NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET LAYOUT

Approved D. KENDERDINE
Status FOR CONSENT
Drawing Number MMA-DES-ESC-C0-DRG-1000
Revision C

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MMA-DES-ESC-C0-DRG-1001
MMA-DES-ESC-C0-DRG-1002

SRP1 (0.7ha)
CHAINAGE 350-550
VOLUME: 180m³

DEB1

DEB2

SRP2 (2.14ha)
CHAINAGE 550-825
VOLUME: 560m³

MANGAPEPEKE STREAM

PREFERRED YARD SITE

YARD SRP/FILL 1A (1.46ha)
VOLUME: 380m³
CATCHMENT INCLUDES
ALLOWANCE FOR FILL
SITE 1A

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

KEY PLAN
SHEET 1
SHEET 2
SHEET 3
SHEET 4
SHEET 5
SHEET 6
SHEET 7
SHEET 8
SHEET 9
SHEET 10

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab
MMA-DES-ESC-C0-DRG-1001

Scales
1:2000 (A3)
1:1000 (A1)

Original Size
A1

Te Ara o Te Ata

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NZ TRANSPORT AGENCY
WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL
CONCEPTUAL PLANS FOR MAIN
CONSTRUCTION WORKS - SHEET 1

Approved
D. KENDERDINE

Status
FOR CONSENT

Drawing Number
MMA-DES-ESC-C0-DRG-1001

Revision
C

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MMA-DES-ESC-C0-DRG-1001
MMA-DES-ESC-C0-DRG-1002
MMA-DES-ESC-C0-DRG-1002
MMA-DES-ESC-C0-DRG-1003

SRP3 (1.8ha)
CHAINAGE 825-1350
VOLUME: 390m³

BUNDED AREA FOR TEMPORARY STOCKPILING. BUNDS SPECIFICALLY DESIGNED TO MINIMISE FLOOD RISK

DEB2

SRP2 (2.14ha)
CHAINAGE 550-825
VOLUME: 560m³

MANGAPEPEKE STREAM

SRP-FILL 2A/2B (1.3ha)
VOLUME: 340m³

DEB3

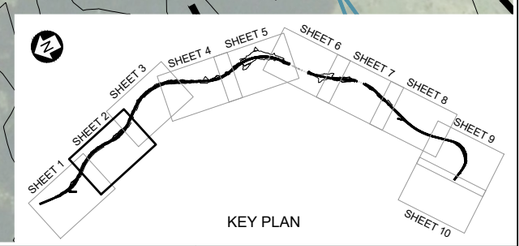
DEB4

SRP4 (3.58ha)
CHAINAGE 1350-1850
VOLUME: 920m³
CATCHMENT INCLUDES ALLOWANCE FOR STOCKPILE AREA

REFER CWMP FOR MANAGEMENT OF PROVISIONAL FILL SITES

REFER CWMP FOR MANAGEMENT OF PROVISIONAL FILL SITES

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m



KEY PLAN

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-1002
Scales: 1:2000 (A3) 1:1000 (A1)
Original Size: A1

Te Ara o Te Ata

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Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 2

Approved: D. KENDERDINE
Status: FOR CONSENT
Drawing Number: MMA-DES-ESC-C0-DRG-1002
Revision: C

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MMA-DES-ESC-C0-DRG-1002

MMA-DES-ESC-C0-DRG-1003

MMA-DES-ESC-C0-DRG-1003

MMA-DES-ESC-C0-DRG-1004

MANGAPEPEKE STREAM

DEB5

BUNDED AREA FOR TEMPORARY STOCKPILING. BUNDS SPECIFICALLY DESIGNED TO MINIMISE FLOOD RISK

SRP5 (1.79ha)
CHAINAGE 1850-2300
VOLUME: 470m³

DEB4

SRP4 (3.58ha)
CHAINAGE 1350-1850
VOLUME: 920m³
CATCHMENT INCLUDES ALLOWANCE FOR STOCKPILE AREA

SEE INSET A

INSET A

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-1003

Scales: 1:2000 (A3) 1:1000 (A1)

Original Size: A1

Te Ara o Te Ata

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EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 3

Approved: D. KENDERDINE

Status: FOR CONSENT

Drawing Number: MMA-DES-ESC-C0-DRG-1003

Revision: C

MANGAPEPEKE STREAM

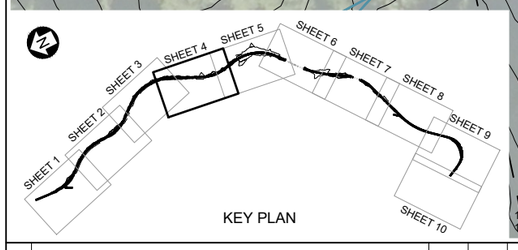
SRP6 (1.32ha)
CHAINAGE 2300-2700
VOLUME: 340m³

MMA-DES-ESC-C0-DRG-1003

MMA-DES-ESC-C0-DRG-1004

MMA-DES-ESC-C0-DRG-1004

MMA-DES-ESC-C0-DRG-1005



KEY PLAN

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-1004

Scales: 1:2000 (A3) 1:1000 (A1)

Original Size: A1

Te Ara o Te Ata

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EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 4

Approved: D. KENDERDINE

Status: FOR CONSENT

Drawing Number: MMA-DES-ESC-C0-DRG-1004

Revision: C

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MMA-DES-ESC-C0-DRG-1004

MMA-DES-ESC-C0-DRG-1005

MMA-DES-ESC-C0-DRG-1005

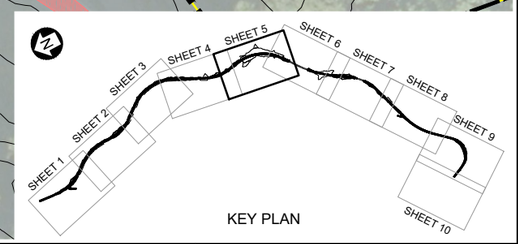
MMA-DES-ESC-C0-DRG-1006

REFER CWMP FOR INDICATIVE SEQUENCE OF TEMPORARY STREAM DIVERSION WORKS

DEB5

SRP7 (5ha)
CHAINAGE 2700-3400
VOLUME: 1300m³

1:1000 @ A1
1:2000 @ A3 0 10 20 30 40 50 60 70 80 90 100 m



KEY PLAN

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab MMA-DES-ESC-C0-DRG-1005

Scales 1:2000 (A3) 1:1000 (A1)

Original Size A1

Te Ara o Te Ata

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EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 5

Approved D. KENDERDINE

Status FOR CONSENT

Drawing Number MMA-DES-ESC-C0-DRG-1005

Revision C

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MMA-DES-ESC-C0-DRG-1006
MMA-DES-ESC-C0-DRG-1005

SRP8 (2.28ha)
CHAINAGE 3650-4025
VOLUME: 590m³

REFER TO CWMP FOR TUNNEL CONSTRUCTION OVERVIEW

MMA-DES-ESC-C0-DRG-1006
MMA-DES-ESC-C0-DRG-1007

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

KEY PLAN
SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7 SHEET 8 SHEET 9 SHEET 10

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-1006
Scales: 1:2000 (A3) 1:1000 (A1)
Original Size: A1

Te Ara o Te Ata

NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 6

Approved: D. KENDERDINE
Status: FOR CONSENT
Drawing Number: MMA-DES-ESC-C0-DRG-1006
Revision: C

MMA-DES-ESC-C0-DRG-1006

MMA-DES-ESC-C0-DRG-1007

MMA-DES-ESC-C0-DRG-1007

MMA-DES-ESC-C0-DRG-1008

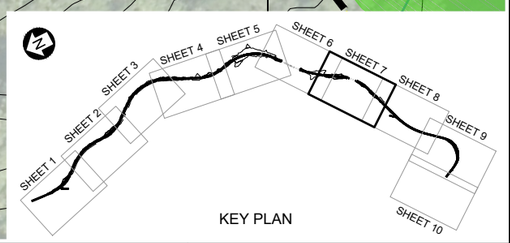
SRP8 (2.28ha)
CHAINAGE 3650-4025
VOLUME: 590m³

DEB OR SIMILAR

REFER TO CWMP FOR BRIDGE CONSTRUCTION OVERVIEW

CLEANWATER CATCHMENT BELOW EXISTING SH3 AND UP-SLOPE OF THE ACCESS ROAD IS PROPOSED TO BE ALLOWED FOR WHEN SIZING ESC MEASURES FOR EARTHWORKS

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m



KEY PLAN

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-1007

Scales: 1:2000 (A3) 1:1000 (A1)

Original Size: A1

Te Ara o Te Ata

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EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 7

Approved: D. KENDERDINE

Status: FOR CONSENT

Drawing Number: MMA-DES-ESC-C0-DRG-1007

Revision: C

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MMA-DES-ESC-C0-DRG-1007
MMA-DES-ESC-C0-DRG-1008
MMA-DES-ESC-C0-DRG-1008
MMA-DES-ESC-C0-DRG-1009

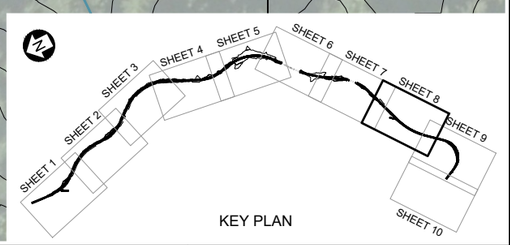
SRP9 (1.47ha)
CHAINAGE 4025-4500
VOLUME: 380m³

MIMI RIVER

FILL 3: PONDING OF RUN-OFF DISCHARGE VIA FLOATING T-BAR OR PUMP

REFER CWMP FOR MANAGEMENT OF PROVISIONAL FILL SITES

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m



KEY PLAN

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-1008
Scales: 1:2000 (A3) 1:1000 (A1)
Original Size: A1

Te Ara o Te Ata

NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 8

Approved: D. KENDERDINE
Status: FOR CONSENT
Drawing Number: MMA-DES-ESC-C0-DRG-1008
Revision: C

MMA-DES-ESC-C0-DRG-1008

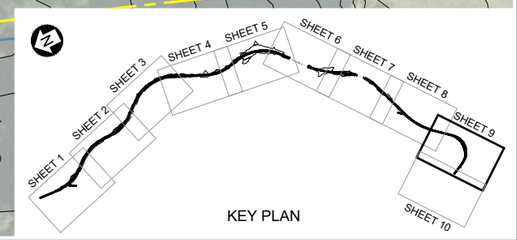
MMA-DES-ESC-C0-DRG-1009

DEB OR CIS (0.3ha)
CHAINAGE 5450-5750
VOLUME: 96m³

MMA-DES-ESC-C0-DRG-1009

MMA-DES-ESC-C0-DRG-1010

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m



KEY PLAN

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab
MMA-DES-ESC-C0-DRG-1009

Scales
1:2000 (A3)
1:1000 (A1)

Original Size
A1

Te Ara o Te Ata

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NZ TRANSPORT AGENCY
WAKA KOTAHI

Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 9

Approved
D. KENDERDINE

Status
FOR CONSENT

Drawing Number
MMA-DES-ESC-C0-DRG-1009

Revision
C

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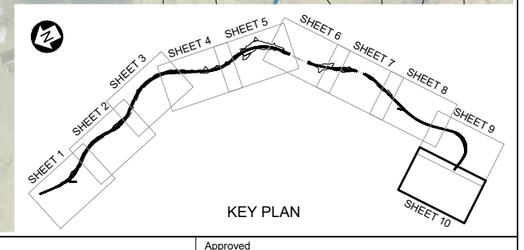
MMA-DES-ESC-C0-DRG-1009

MMA-DES-ESC-C0-DRG-1010

REFER CWMP FOR MANAGEMENT OF PROVISIONAL FILL SITES

SRP-FILL 4 (1.6ha)
VOLUME: 420m³

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m



KEY PLAN

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
C	SEDIMENT RETENTION POND VOLUMES AMENDED	QDO'S	WHE	SPP	GR	BS	04/05/2018
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-1010

Scales: 1:2000 (A3) 1:1000 (A1)

Original Size: A1

Te Ara o Te Ata

NZ TRANSPORT AGENCY WAKA KOTAHI

Mt Messenger Bypass

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MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL CONCEPTUAL PLANS FOR MAIN CONSTRUCTION WORKS - SHEET 10

Approved: D. KENDERDINE

Status: FOR CONSENT

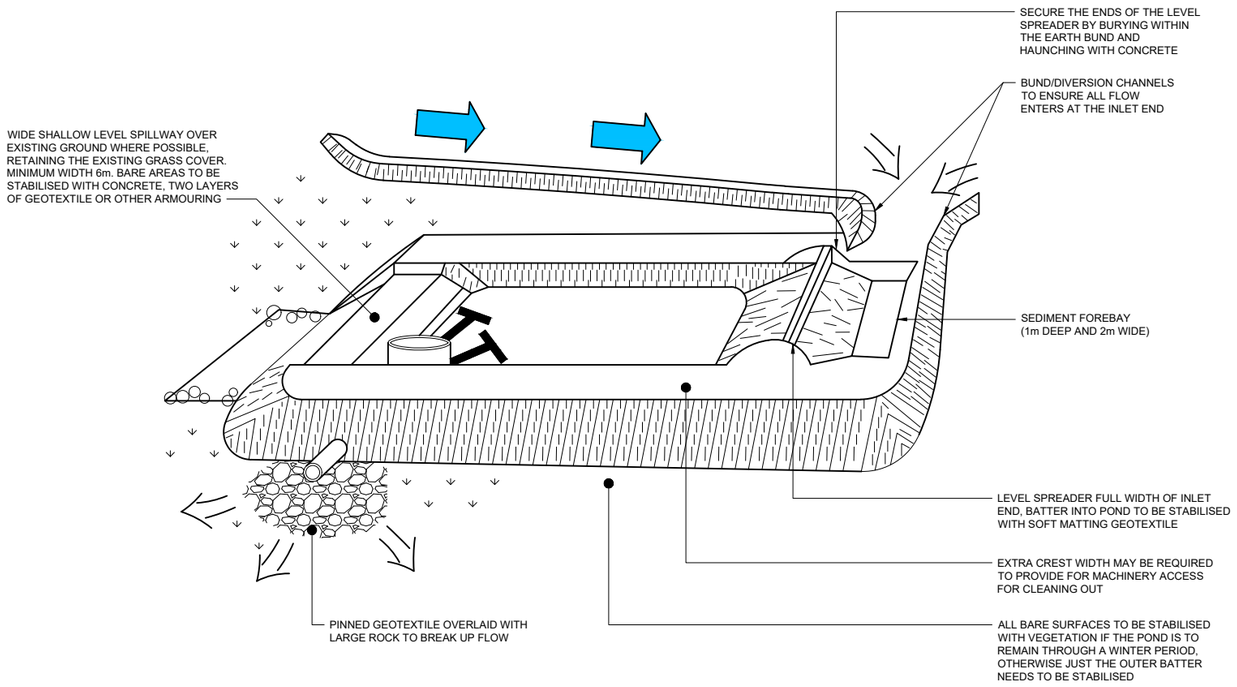
Drawing Number: MMA-DES-ESC-C0-DRG-1010

Revision: C

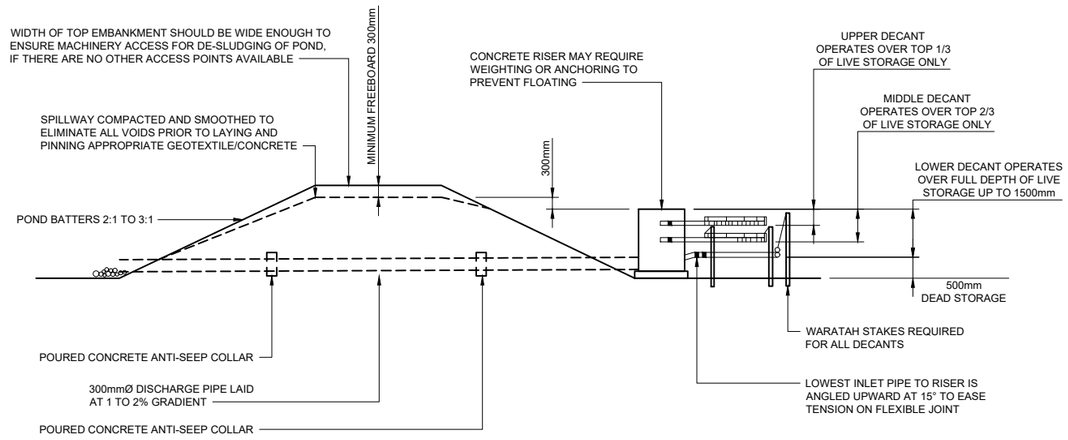
NOTES

1. REFER TO NZTA EROSION AND SEDIMENT CONTROL GUIDELINES FOR STATE HIGHWAY INFRASTRUCTURE (NZTA GUIDELINES)

2. PRIOR TO SEDIMENT RETENTION POND CONSTRUCTION:
- CHECK GROUND CONDITIONS TO ENSURE STABLE AND GEOTECHNICAL ASSESSMENT OCCURS.
- CONFIRM DESIGN IS NOT IN THE FLOOD PLAIN.
- INSTALL SILT FENCE OR SUPER SILT FENCE BELOW WORKS AREA.
- REMOVE UNSUITABLE MATERIAL AND CONFIRM APPROPRIATE LOCATION.



SCHEMATIC - SEDIMENT RETENTION POND
N.T.S.



SECTION - SEDIMENT RETENTION POND FOR THREE DECANTS
N.T.S.

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab MMA-DES-ESC-C0-DRG-4001
Scales NOT TO SCALE
Original Size A1

Te Ara o Te Ata

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NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL TYPICAL DETAILS SEDIMENT RETENTION POND

Approved **D. KENDERDINE**
Status **FOR CONSENT**
Drawing Number **MMA-DES-ESC-C0-DRG-4001**
Revision **B**

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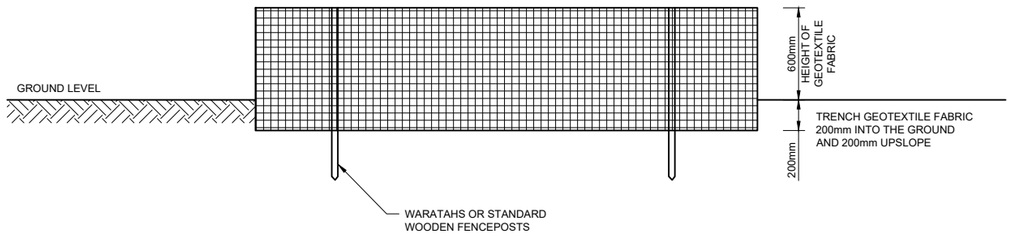
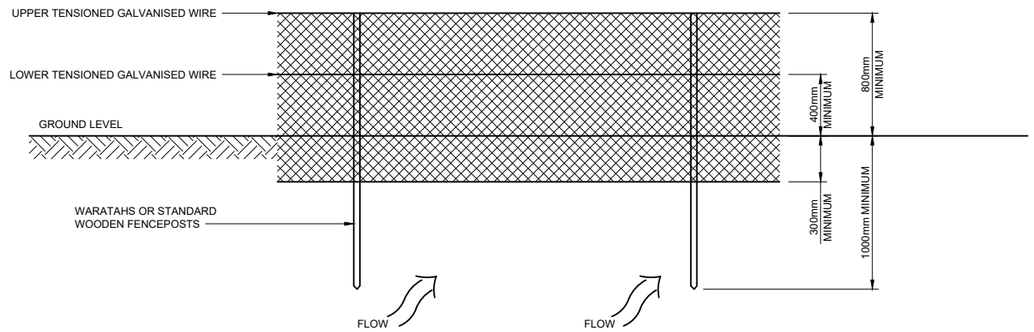
NOTES

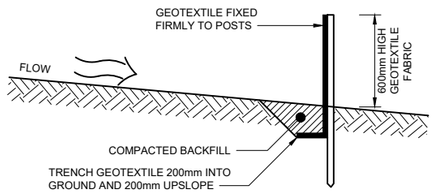
1. REFER TO NZTA EROSION AND SEDIMENT CONTROL GUIDELINES FOR STATE HIGHWAY INFRASTRUCTURE (NZTA GUIDELINES)



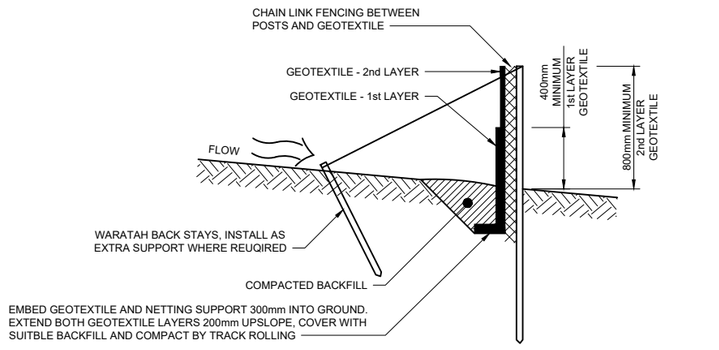
ELEVATION - SILT FENCE
SCALE 1:20 (A1)



ELEVATION - SUPER SILT FENCE
SCALE 1:20 (A1)



TYPICAL SECTION - SILT FENCE
SCALE 1:20 (A1)



TYPICAL SECTION - SUPER SILT FENCE
SCALE 1:20 (A1)

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-4002
Scales: 1:40 (A3) 1:20 (A1)
Original Size: A1

Te Ara o Te Ata

NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

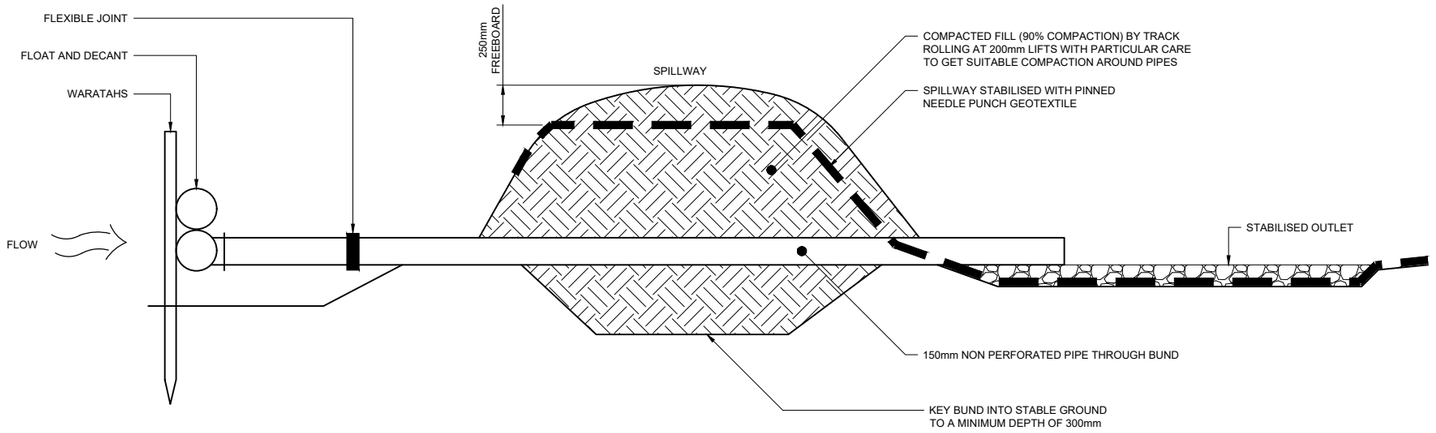
EROSION AND SEDIMENT CONTROL TYPICAL DETAILS SILT FENCE

Approved: **D. KENDERDINE**
Status: **FOR CONSENT**
Drawing Number: **MMA-DES-ESC-C0-DRG-4002**
Revision: **B**

NOTES

1. REFER TO NZTA EROSION AND SEDIMENT CONTROL GUIDELINES FOR STATE HIGHWAY INFRASTRUCTURE (NZTA GUIDELINES)

2. DECANTING EARTH BUNS TO HAVE:
- 3:1 TO 5:1 LENGTH TO WIDTH RATIO
- FLOATING DECANTS
- ABILITY TO SAFELY PASS 1% AEP RAIN EVENT.



DECANTING EARTH BUND
N.T.S.

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-4003
Scales: NOT TO SCALE
Original Size: A1

Te Ara o Te Ata

NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

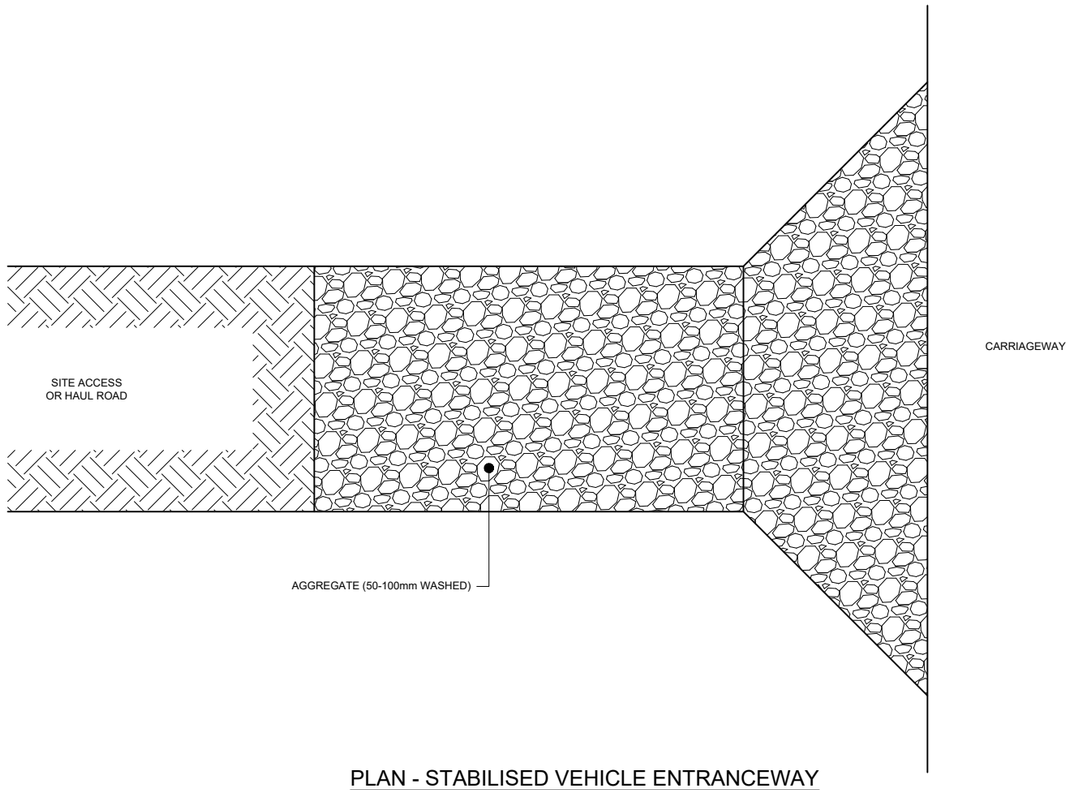
MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL
TYPICAL DETAILS
DECANTING EARTH BUND

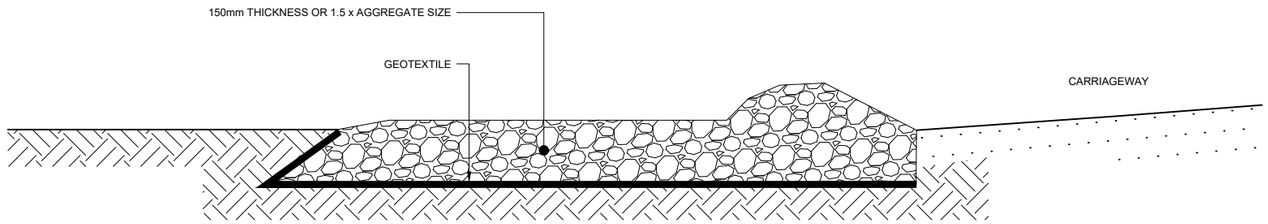
Approved: D. KENDERDINE
Status: FOR CONSENT
Drawing Number: MMA-DES-ESC-C0-DRG-4003
Revision: B

NOTES

1. REFER TO NZTA EROSION AND SEDIMENT CONTROL GUIDELINES FOR STATE HIGHWAY INFRASTRUCTURE (NZTA GUIDELINES)



PLAN - STABILISED VEHICLE ENTRANCEWAY
NOT TO SCALE



SECTION - STABILISED VEHICLE ENTRANCEWAY
NOT TO SCALE

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab MMA-DES-ESC-C0-DRG-4004
Scales NOT TO SCALE
Original Size A1

Te Ara o Te Ata

NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL
TYPICAL DETAILS
STABILISED VEHICLE ENTRANCEWAY

Approved D. KENDERDINE
Status FOR CONSENT
Drawing Number MMA-DES-ESC-C0-DRG-4004
Revision B

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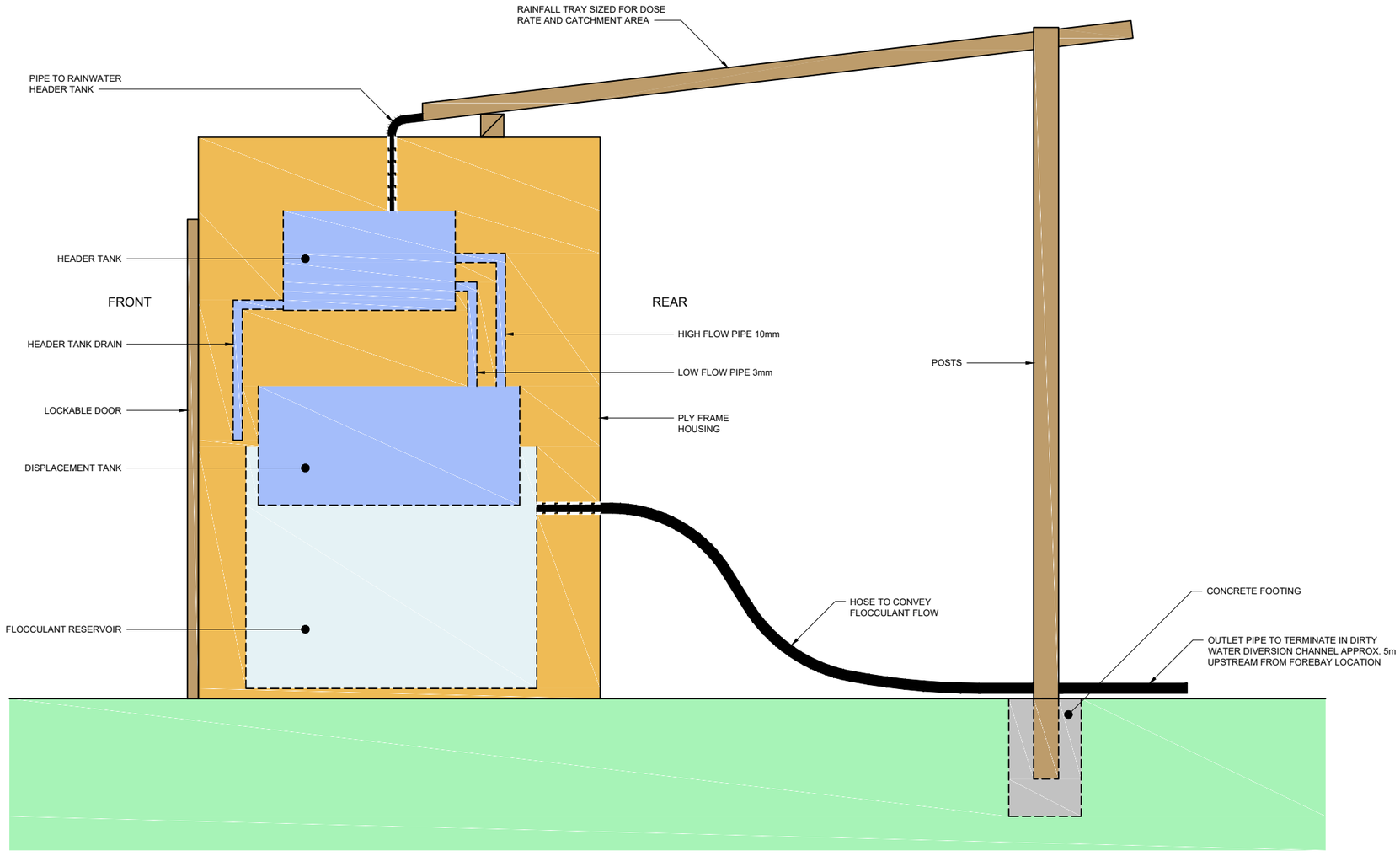
1. REFER TO NZTA EROSION AND SEDIMENT CONTROL GUIDELINES FOR STATE HIGHWAY INFRASTRUCTURE (NZTA GUIDELINES)



Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab MMA-DES-ESC-C0-DRG-4005

Scales NOT TO SCALE

Original Size A1

Te Ara o Te Ata

NZ TRANSPORT AGENCY WAKA KOTAHI

Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL TYPICAL DETAILS FLOCCULATION SYSTEM

Approved **D. KENDERDINE**

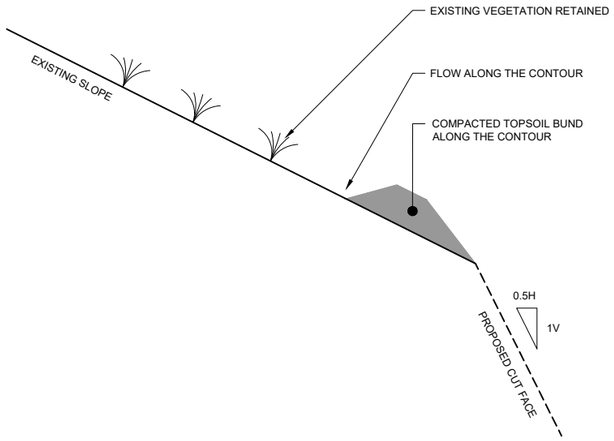
Status **FOR CONSENT**

Drawing Number **MMA-DES-ESC-C0-DRG-4005**

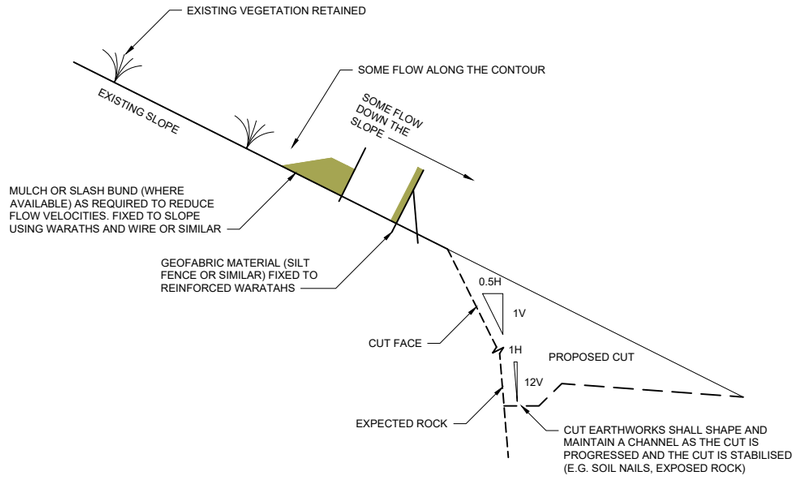
Revision **B**

NOTES

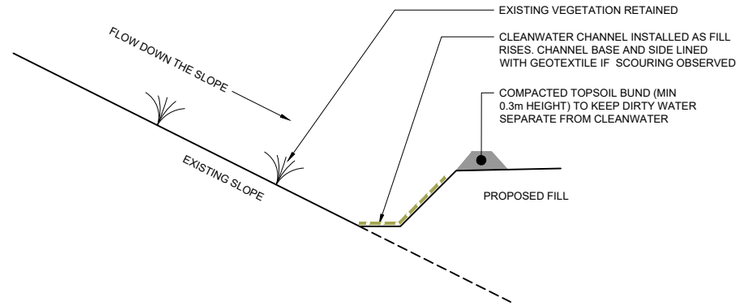
1. REFER TO NZTA EROSION AND SEDIMENT CONTROL GUIDELINES FOR STATE HIGHWAY INFRASTRUCTURE (NZTA GUIDELINES)
2. DESIGN DIMENSIONS SUBJECT TO SPECIFIC DESIGN WITHIN CWMP AND SITE SPECIFIC MANAGEMENT PLAN DETAILS.



SECTION - CLEAN WATER DIVERSION TYPE A
N.T.S.



SECTION - CLEAN WATER DIVERSION TYPE B
N.T.S.



SECTION - CLEAN WATER DIVERSION TYPE C
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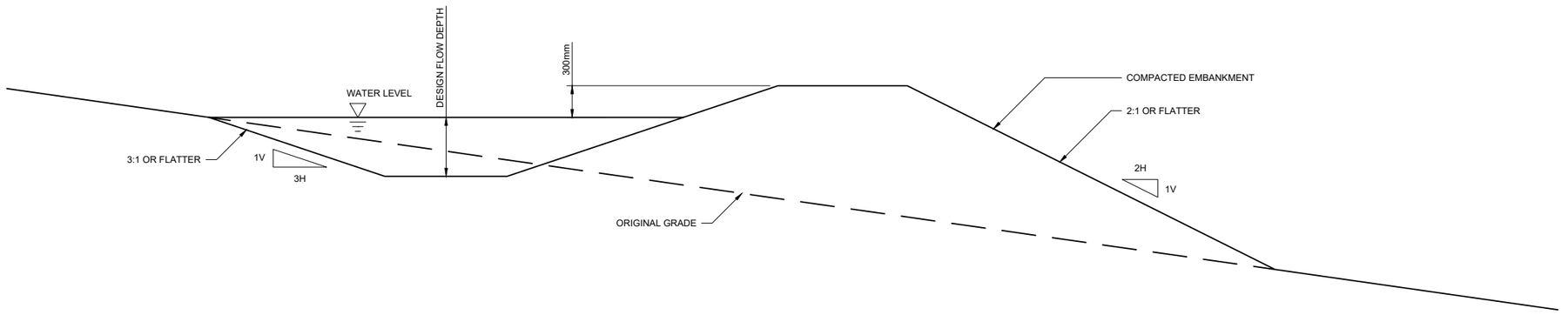

SECTION - DIRTY WATER DIVERSION
N.T.S.

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-C0-DRG-4006
Scales: NOT TO SCALE
Original Size: A1

Te Ara o Te Ata

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NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL TYPICAL DETAILS WATER DIVERSION

Approved: **D. KENDERDINE**
Status: **FOR CONSENT**
Drawing Number: **MMA-DES-ESC-C0-DRG-4006**
Revision: **B**

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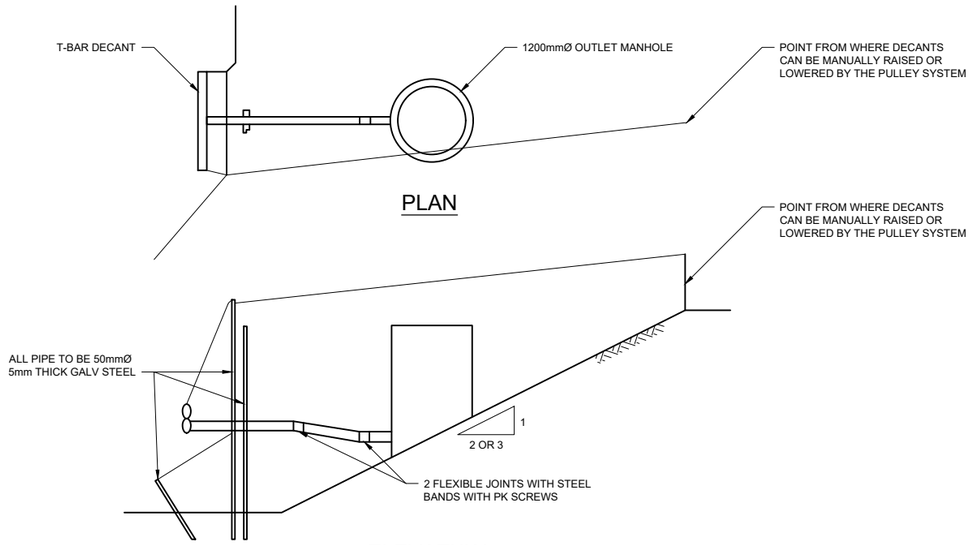
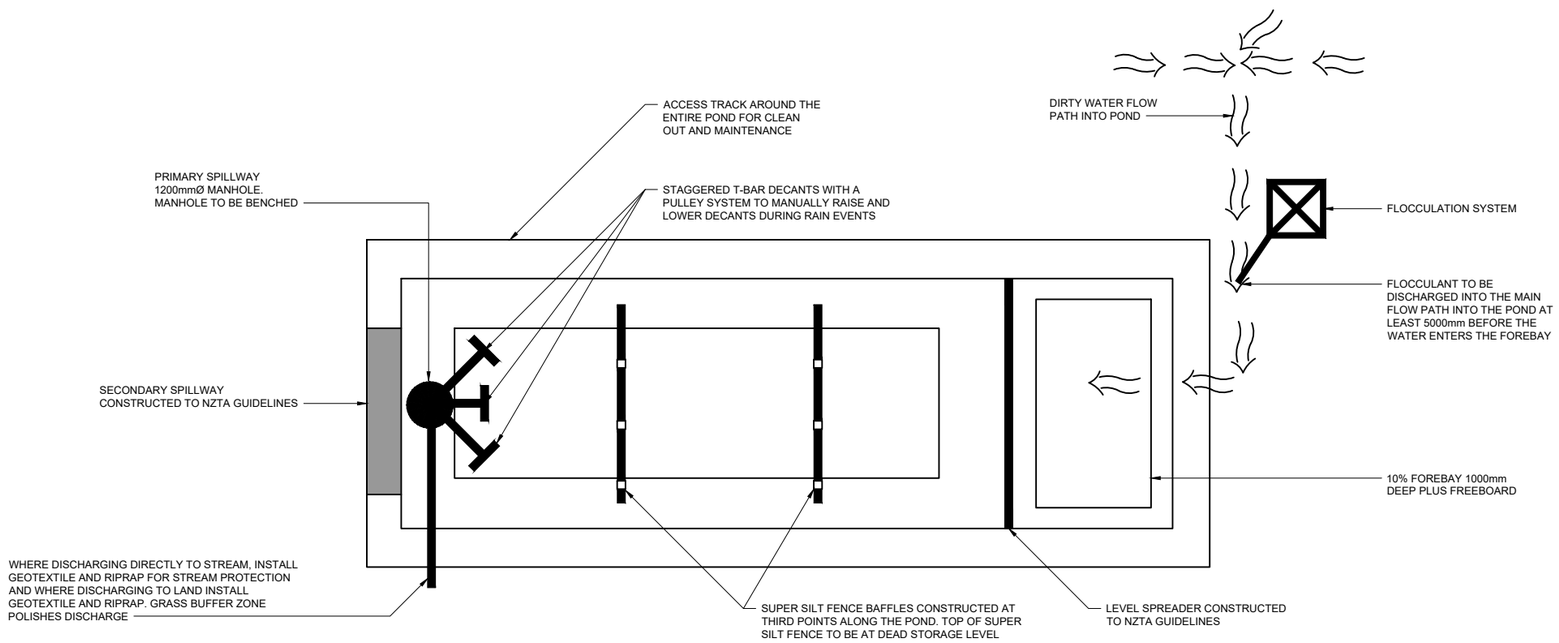
NOTES

1. REFER TO NZTA EROSION AND SEDIMENT CONTROL GUIDELINES FOR STATE HIGHWAY INFRASTRUCTURE (NZTA GUIDELINES)
2. ALL ROPE FOR PULLEY SYSTEM TO BE NYLON ROPE.
3. ROPE TO BE SECURED TO THE BANK WITH A STAKE SO THAT IT CAN BE EASILY ACCESSED DURING A RAIN EVENT AND INDIVIDUAL DECANTS CAN BE MANUALLY RAISED OR LOWERED.
4. IF A PULLEY SYSTEM NOT INSTALLED THEN A "PLUG" WILL BE UTILISED IN THE OUTLET PIPE TO CEASE FLOWS AS NECESSARY.



DECANT PULLEY SYSTEM

N.T.S.



SEDIMENT RETENTION POND TYPICAL DETAILS

N.T.S.

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab: MMA-DES-ESC-CO-DRG-4007
Scales: NOT TO SCALE
Original Size: A1

Te Ara o Te Ata

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NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

EROSION AND SEDIMENT CONTROL TYPICAL DETAILS SEDIMENT RETENTION POND

Approved: D. KENDERDINE
Status: FOR CONSENT
Drawing Number: MMA-DES-ESC-CO-DRG-4007
Revision: B

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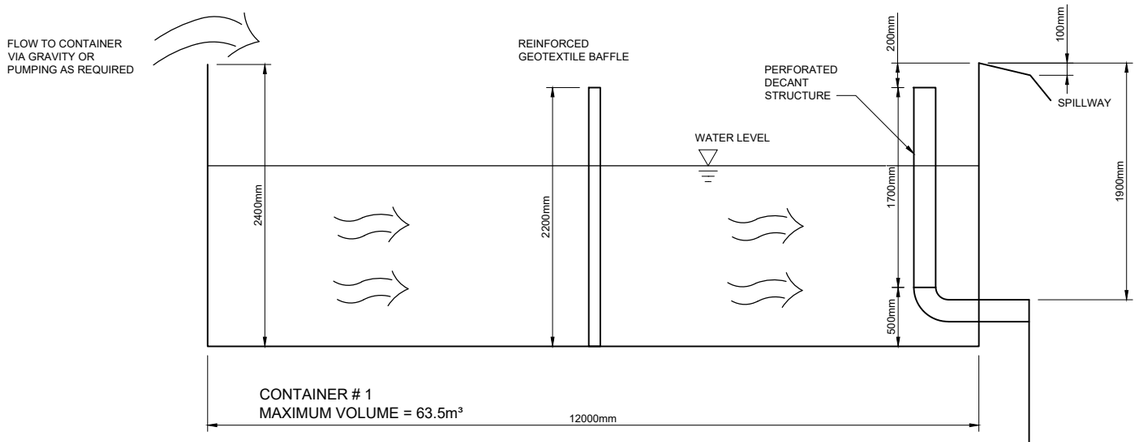
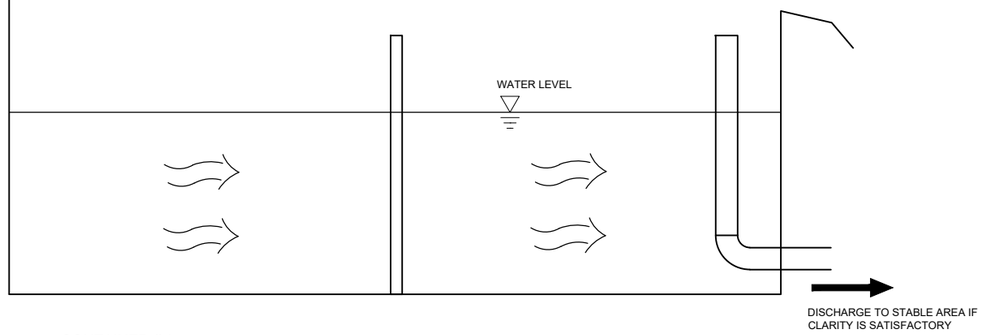
NOTES

1. REFER TO NZTA EROSION AND SEDIMENT CONTROL GUIDELINES FOR STATE HIGHWAY INFRASTRUCTURE (NZTA GUIDELINES)
2. SHIPPING CONTAINERS CAN BE USED TO CREATE CONTAINERS. BAFFLE DESIGNED FROM REINFORCED GEOTEXTILE TO ALLOW FLOWS TO PASS. STRUCTURAL INTEGRITY OF CONTAINERS TO REMAIN.
3. CONTAINER # 1 WILL BE POSITIONED 1900mm HIGHER THAN CONTAINER # 2 IF CONTOURS DO NOT ALLOW THIS THEN CONTAINER # 1 WILL BE RAISED BY 1900mm.
4. WATER CLARITY CAN BE CHECKED IN CONTAINER # 2 AND FLOCCULANT ADDED MANUALLY IF NECESSARY TO ACHIEVE WATER CLARITY.





CONTAINER # 2
MAXIMUM VOLUME = 63.5m³
SAME DETAIL AS CONTAINER # 1

CONTAINER IMPOUNDMENT SYSTEM

N.T.S.

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	FOR CONSENT	QDO'S	WHE	SPP	GR	LG	14/11/2017
A	PRELIMINARY DRAFT - FOR EXTERNAL REVIEW	QDO'S	WHE	SPP	GR	KJB	06/10/2017

Tab MMA-DES-ESC-C0-DRG-4008
Scales NOT TO SCALE
Original Size A1

Te Ara o Te Ata

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NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

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EROSION AND SEDIMENT CONTROL
TYPICAL DETAILS
CHEMICAL TREATMENT DEVICES

Approved D. KENDERDINE
Status FOR CONSENT
Drawing Number MMA-DES-ESC-C0-DRG-4008
Revision B

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STAGE 1: INITIAL ACCESS AND ESC

- ECOLOGICAL SURVEYS AND ASSESSMENTS PROGRESSIVELY COMPLETED PRIOR TO WORKS TREE REMOVAL COMPLETED.
- INSTALL EROSION AND SEDIMENT CONTROLS.

BY THE END OF THIS STAGE:

- ESC MEASURES ARE IN PLACE (INCLUDING DIRTY WATER DIVERSION CHANNEL) AND ACCESS IS ESTABLISHED TO THE TOE OF FILL 12.

LEGEND

- TEMPORARY PIPE (COMPLETED)
- TEMPORARY PIPE (UNDER CONSTRUCTION)
- SILT FENCE
- SEDIMENT RETENTION POND (SRP) / DECANTING EARTH BUND (DEB)
- ACCESS TRACK
- DIRTY WATER DIVERSION
- EXISTING STREAM
- EARTHWORKS AREA FILL
- EARTHWORKS AREA CUT
- PERMANENT PIPE
- PERMANENT STREAM DIVERSION

STAGE 2- FILLING BEGINS

- PROGRESSIVE VEGETATION CLEARING.
- PIPE INSTALLATION AND FILL WORKS AS PER METHOD A ALONG THE MAIN STREAM.
- UPPER ACCESS TRACK FORMED.

BY THE END OF THIS STAGE:

- A STABILISED OVERTOPPING PATHWAY WILL BE FORMED.
- CLEAN WATER DIVERSION PIPE IS OPERATIONAL UNDER THIS STAGE OF FILL.

TEMPORARY DIVERSION PIPE OUTLET TO A STABILISED DISCHARGE POINT (e.g PINNED GEOMEMBRANE)

DOWNSTREAM ESC CONTROLS:
1. INSTALL SILT FENCE BETWEEN WORKING AREA AND STREAM.
2. CONSTRUCT SRP SIZED FOR THE ESTABLISHMENT WORKS FILL.
3. FORM RAISED CHANNEL FOR DIRTY WATER DIVERSION TO DEB ALONG ACCESS TRACK.

DEB IS REQUIRED TO COMMENCE STAGE 2 OF ESTABLISHMENT WORKS (0.3ha; 77m³)

UPPER ACCESS TRACK ESC CONTROLS
1. SILT FENCE ALONG DOWN SLOPE SIDE
2. DIRTY WATER CUT OFFS DIRECTING TO CHANNEL
3. CHANNEL FOR DIRTY WATER DIVERSION TO SRP

TEMP PIPE 15

DEB (0.3ha; 77m³)

METHOD A FOR TEMPORARY PIPE INSTALLATION

DAILY PLANNING OF WORKS TO SUIT AVAILABILITY AND DURATION OF FAIR WEATHER WINDOWS.
WITHIN THESE FAIR WEATHER WINDOWS, WORKS SHALL BE STAGED AS FOLLOWS:

1. CONSTRUCT COFFER DAM UPSTREAM. INSTALL PUMP. OVER PUMP TO THE EXISTING STREAM OR TEMPORARY PIPE INTAKE.
2. CARRY OUT FISH RELOCATION WITHIN DRAINED CREEK.
3. MUCK OUT STREAM BED, PLACE DRAINAGE MATERIAL, LAY THE TEMPORARY DRAINAGE PIPE AND BACK FILL. LENGTH OF PIPE SHALL BE GOVERNED BY THE AVAILABLE FAIR WEATHER WINDOW.
4. INSTALL THE MINOR GULLY DIVERSION PIPES AND CONTINUE FILLING UP TO THE UPSTREAM COFFER DAM.

EACH WATERFALL FEATURE PROVIDES A NATURAL DAM AND OVER PUMP POINT. THE MINOR GULLY DIVERSION PIPES WILL BE EXTENDED AS THE FILL COMES UP (REFER MMA-DES-CON-C0-FIG-0002)

STAGE 3- FILLING CONTINUES UP THE VALLEY

- ENLARGE SRP, EXTEND PIPE AND FILL AS PER METHOD A.

BY THE END OF THIS STAGE:

- ACCESS IS BY THE UPPER ACCESS TRACK.
- TEMPORARY CLEANWATER DIVERSIONS UP TO CULVERT 15 INTAKE IS COMPLETE.

TEMP PIPE 14

TEMP PIPE 15

DEB ENLARGED AND DEEPENED TO SRP AS EARTHWORKS FOOTPRINT GROWS (0.7ha; 197m³)

STAGE 4 - ESTABLISHMENT FILL

- INSTALL PERMANENT CULVERTS AND ASSOCIATED STRUCTURES.
- CONTINUE STAGED FILL AS PER METHOD A TOWARDS TUNNEL PORTAL.

BY THE END OF THIS STAGE

- PERMANENT CULVERTS AND ASSOCIATED STRUCTURES ARE COMPLETED.

CULVERT 15

CULVERT 14

SIDE GULLY PIPE

CONTINUE FILLING UP TO TUNNEL PORTAL

SRP TO COMPLETE ESTABLISHMENT EARTHWORKS (0.7ha; 197m³)

1:2000 @ A1
1:4000 @ A3
0 20 40 60 80 100 120 140 160 180 200 m

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	MINOR AMENDMENTS TO DEB/SRP SIZES	QDO'S	GGC*	SPP	H.MILLIKEN*	B.SYMMANS	22.05.2018
A	FOR INFORMATION ONLY	QDO'S	GGC*	SPP	H.MILLIKEN*	B.SYMMANS*	27.04.2018

Tab: MMA-DES-CON-C0-DRG-1201
Scales: 1:4000 (A3) 1:2000 (A1)
Original Size: A1

Te Ara o Te Ata

This drawing is not to be used for construction purposes unless signed approved and issued For Construction

NZ TRANSPORT AGENCY WAKA KOTAHI
Mt Messenger Bypass

MT MESSENGER BYPASS

CONSTRUCTION
FILL 12 MULTISTAGED CLEANWATER DIVERSION METHOD A

Approved: **NOT FOR CONSTRUCTION**
Status: **FOR INFORMATION**
Drawing Number: **MMA-DES-CON-C0-DRG-1201**
Revision: **B**

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STAGE 1.1 PREPARATORY WORKS

- ECOLOGICAL SURVEYS AND ASSESSMENTS PROGRESSIVELY COMPLETED PRIOR TO WORKS. TREE REMOVAL COMPLETE.
- INSTALL EROSION AND SEDIMENT CONTROLS DOWNSTREAM
- LIFT PUMPS INTO PLACE (LIKELY WITH A HELICOPTER) AND SUSPEND PUMP DISCHARGE PIPE DOWN THE VALLEY.
- PREWELD PIPE SEGMENTS.

BY THE END OF THESE WORKS:

- PIPES PREWELDED TO REQUIRED LENGTHS.
- ACCESS IS ESTABLISHED TO THE TOE OF FILL 12.
- STREAM BED DRAINED AND FISH RELOCATION COMPLETED.

COFFER DAM POSITION TO BE DETERMINED BASED ON LAYING AND BACKFILLING THE REQUIRED LENGTH OF PIPE IN THE AVAILABLE WEATHER WINDOW

TEMPORARY DIVERSION PIPE OUTLET TO A STABILISED DISCHARGE POINT (e.g PINNED GEOMEMBRANE)

DOWNSTREAM ESC CONTROLS
1. INSTALL SILT FENCE BETWEEN DEB AND STREAM
2. CONSTRUCT DEB SIZED FOR THE ESTABLISHMENT WORKS FILL
3. DIRTY WATER DIVERSION TO DEB ESTABLISHED ON FILL FACE

DEB TO COMMENCE ESTABLISHMENT WORKS (0.3ha; 77m³)

LEGEND

- TEMPORARY PIPE (COMPLETED)
- TEMPORARY PIPE (UNDER CONSTRUCTION)
- SILT FENCE
- SEDIMENT RETENTION POND (SRP) / DECANTING EARTH BUND (DEB)
- ACCESS TRACK
- DIRTY WATER DIVERSION
- EXISTING STREAM
- EARTHWORKS AREA FILL
- EARTHWORKS AREA CUT
- PERMANENT PIPE
- PERMANENT STREAM DIVERSION
- COFFER DAM
- PUMP LINE

STAGE 1.2 INSTALL AND COMMISSION PRIMARY CLEANWATER DIVERSION PIPE

- REFER METHOD B.

NOTE: WORKS TO BE PERFORMED IN PERIOD OF LOW STREAM FLOWS AND SUITABLE WEATHER FORECAST (APPROX. 7 DAYS)

MAJOR TRIB
PRIMARY TRIB
MAJOR TRIB
DEB (0.3ha: 77m³)

METHOD B FOR TEMPORARY PIPE INSTALLATION

THE OBJECTIVE: TO INSTALL AN ENTIRE SECTION OF PIPE UP TO THE HEADWALL IN A SINGLE INSTALLATION OPERATION.
THIS WILL BE ACHIEVED AS FOLLOWS:

1. DO ALL PREPARATORY WORKS, INCLUDING EROSION AND SEDIMENT CONTROL OFF-LINE PIPE JOINTING, AND HAVING MATERIAL AVAILABLE ON HAND.
2. SELECT A SUITABLE WEATHER WINDOW (E.G. 7 DAYS) AND INSTALL THE ENTIRE LENGTH OF THE PRIMARY TEMPORARY DIVERSION PIPE, INCLUDING INTAKE AND SIDE GULLY STRUCTURES.
3. FILL ABOVE THE PIPE TO THE REQUIRED HEADWALL HEIGHT.
4. COMMENCE BULK FILLING TO INSTALL PERMANENT CULVERTS AND ASSOCIATED STRUCTURES.
5. AS THE FILL HEIGHT RISES, THE MAJOR TRIBUTARY TEMPORARY DIVERSION PIPES CAN BE INSTALLED IN A SIMILAR FASHION.

STAGE 1.3: FILL BEGINS

- PIPES ARE INSTALLED.

NOTE: THESE WORKS ALSO TO BE PERFORMED IN PERIOD OF LOW STREAM FLOWS AND SUITABLE WEATHER FORECAST (APPROX. 7 DAYS) .

DEB ENLARGED AND DEEPENED TO SRP AS EARTHWORKS FOOTPRINT GROWS (0.7ha; 197m³)

1:2000 @ A1
1:4000 @ A3
0 20 40 60 80 100 120 140 160 180 200 m

STAGE 2 - FILL WORKS TO INSTALL PERMANENT CULVERTS

- INSTALL PERMANENT CULVERTS AND ASSOCIATED STRUCTURES.
- CONTINUE STAGED FILL AS PER METHOD A TOWARDS TUNNEL PORTAL.

BY THE END OF THIS STAGE

- PERMANENT CULVERTS AND ASSOCIATED STRUCTURES ARE COMPLETED.

CULVERT 15
CULVERT 14
SIDE GULLY PIPE
CONTINUE FILLING UP TO TUNNEL PORTAL
SRP TO COMPLETE ESTABLISHMENT EARTHWORKS (0.7ha; 197m³)

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
B	MINOR AMENDMENTS TO DEB/SRP SIZES	QDO'S	GGC*	SPP	H.MILLIKEN*	B.SYMMANS	22.05.2018
A	FOR INFORMATION ONLY	QDO'S	GGC*	SPP	H.MILLIKEN*	B.SYMMANS*	27.04.2018

Tab: MMA-DES-CON-C0-DRG-1205
Scales: 1:4000 (A3) 1:2000 (A1)
Original Size: A1

Te Ara o Te Ata

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MT MESSENGER BYPASS

CONSTRUCTION
FILL 12 SINGLE STAGED CLEANWATER DIVERSION - METHOD B

Approved: **NOT FOR CONSTRUCTION**
Status: **FOR INFORMATION**
Drawing Number: **MMA-DES-CON-C0-DRG-1205**
Revision: **B**

FILL 13

- EARTHWORKS TO ESTABLISH ACCESS TO FILL 13.
- LAY TEMPORARY DIVERSION PIPE AS SHOWN ON MMA-DES-CON-C0-SKT-0003. (METHOD A OR B)
- COMMENCE STAGE 1 FILL TO FORM ACCESS TO THE TUNNEL PORTAL.

LEGEND

- TEMPORARY PIPE
- SEDIMENT RETENTION POND
- ACCESS TRACK
- EXISTING STREAM
- EARTHWORKS AREA FILL (STAGE 1)
- EARTHWORKS AREA CUT
- CLEANWATER ROAD BUNDS

N

FORM CLEANWATER DIVERSION BUNDS ALONG EXISTING ROAD

MAJOR TRIB

PRIMARY STREAM

METHOD A: FOR TEMPORARY PIPE INSTALLATION

DAILY PLANNING OF WORKS TO SUIT AVAILABILITY AND DURATION OF FAIR WEATHER WINDOWS.
WITHIN THESE FAIR WEATHER WINDOWS, WORKS SHALL BE STAGED AS FOLLOWS:

1. CONSTRUCT COFFER DAM UPSTREAM. INSTALL PUMP. OVER PUMP TO THE EXISTING STREAM OR TEMPORARY PIPE INTAKE.
2. CARRY OUT FISH RELOCATION WITHIN DRAINED CREEK.
3. MUCK OUT STREAM BED, PLACE DRAINAGE MATERIAL, LAY THE TEMPORARY DRAINAGE PIPE AND BACK FILL. LENGTH OF PIPE SHALL BE GOVERNED BY THE AVAILABLE FAIR WEATHER WINDOW.
4. INSTALL THE MINOR GULLY DIVERSION PIPES AND CONTINUE FILLING UP TO THE UPSTREAM COFFER DAM.

EACH WATERFALL FEATURE PROVIDES A NATURAL DAM AND OVER PUMP POINT. THE MINOR GULLY DIVERSION PIPES WILL BE EXTENDED AS THE FILL COMES UP (REFER MMA-DES-CON-C0-FIG-0002)

METHOD B: FOR TEMPORARY PIPE INSTALLATION

THE OBJECTIVE: TO INSTALL AN ENTIRE SECTION OF PIPE UP TO THE HEADWALL IN A SINGLE INSTALLATION OPERATION.
THIS WILL BE ACHIEVED AS FOLLOWS:

1. DO ALL PREPARATORY WORKS, INCLUDING EROSION AND SEDIMENT CONTROL OFF-LINE PIPE JOINTING, AND HAVING MATERIAL AVAILABLE ON HAND.
2. SELECT A SUITABLE WEATHER WINDOW (E.G. 7 DAYS) AND INSTALL THE ENTIRE LENGTH OF THE PRIMARY TEMPORARY DIVERSION PIPE, INCLUDING INTAKE AND SIDE GULLY STRUCTURES.
3. FILL ABOVE THE PIPE TO THE REQUIRED HEADWALL HEIGHT.
4. COMMENCE BULK FILLING TO INSTALL PERMANENT CULVERTS AND ASSOCIATED STRUCTURES.
5. AS THE FILL HEIGHT RISES, THE MAJOR TRIBUTARY TEMPORARY DIVERSION PIPES CAN BE INSTALLED IN A SIMILAR FASHION.

1:1000 @ A1
1:2000 @ A3
0 10 20 30 40 50 60 70 80 90 100 m

Rev	Revision Description	Drawn	Drawing Checked	Designed	Design Checked	Approved	Date
A	FOR INFORMATION ONLY	QDO'S	GGC*	SPP	H.MILLIKEN*	B.SYMMANS*	27.04.2018

Tab: MMA-DES-CON-C0-DRG-1301
Scales: 1:2000 (A3) 1:1000 (A1)
Original Size: A1

Te Ara o Te Ata

This drawing is not to be used for construction purposes unless signed approved and issued For Construction

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CONSTRUCTION
FILL 13 CLEANWATER DIVERSIONS AND STAGE 1 FILL

Approved: **NOT FOR CONSTRUCTION**
Status: **FOR INFORMATION**
Drawing Number: **MMA-DES-CON-C0-DRG-1301**
Revision: **A**

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Appendix B: Specific Construction Water Management Plan Template

Specific Construction Water Management Plan Template

July 2018

MMA-DES-ESC-E1-TPL-2090

NZ TRANSPORT AGENCY WAKA KOTAHI

Mt Messenger Bypass

New Zealand Government

Contents

1 SCWMP Overview

1.1 Purpose

This Specific Construction Water Management Plan (SCWMP) template has been prepared in accordance with the guidance in the Construction Water Management Plan (CWMP) to meet resource consent conditions.

This SCWMP is considered a **field document**, and is developed in consultation with suitably qualified staff (e.g. construction supervisors and engineers) to guide construction works (refer Section 2).

This SCWMP may be updated over time based on feedback from Taranaki Regional Council (TRC) compliance staff and/or in response to lessons learned as works proceed and/or as part of the CWMP review process.

1.2 Scope

Guidance Note:

Select one of the two statements below:

- *Location based, as defined by Chainage extent; OR*
- *Project wide activity based*

Reference to the following drawings should be made which illustrates the area addressed by the SCWMP. This shall include (but not be limited to):

- *Location plan showing area addressed by this SCWMP*
- *Illustrative construction method and erosion and sediment control drawings*
- *Typical and/or specific design of erosion and sediment control devices*
- *Staging / sequence drawings (where relevant)*

State which activities are addressed in the SCWMP for this location:

- *Establishment works;*
- *Stream works; and/or*
- *Main construction works.*

This SCWMP covers construction works between Chainage X – X as shown on Figure/Drawing XX attached in Appendix A. OR

This SCWMP covers the activity of XXX along the full alignment with the general design of this activity illustrated within Figure/Drawing XX attached in Appendix A.

This SCWMP addresses the following activities within this location:

- Establishment works;
- Stream works; and
- Main earthworks.

1.3 Description

The works are located within the Tongaporutu and/or Mimi Catchment(s).

The footprint and duration of works are summarised in Table 1 below.

The potential maximum open earthwork area associated with this SCWMP is XX ha.

Guidance Note:
Additional description text may include: All laydown areas, top soil/unsuitable stockpiles will be progressively stabilised and it is unlikely that this whole area will be open at once.

Table 1.1 – Activity and duration

Works type	√	Description	Duration	Area (ha)	Earthworks volume (m^3)
Establishment works					
Stream works					
Main earthworks					

1.4 Site Conditions

Guidance Note:
State likely site conditions relevant to the SCWMP.
Example text could include:
The site conditions for the project alignment typically comprises:

- *In cut area: shallow colluvial soils (predominately silt, typically 1 to 2m deep) overlying soft rocks of the Mount Messenger Formation (siltstones and fine sandstones).*
- *Beneath fill embankments: materials eroded from the surrounding hillsides which have been re-deposited as weak and highly compressible alluvium (clayey to sandy silt) up to 30m deep in places.*

SRPs and DEBs used for treatment of cut areas, or fills constructed from soil material sourced from on site, are expected to require chemical flocculation. Flocculation application rates will be monitored as earthwork operations progress over time to ensure dosing continues to be effective with the changing geology.

It is not expected earthworks will encounter soil conditions, such as acid based soils, that would compromise the effectiveness of the erosion and sediment control measures or methodology proposed.

If any unexpected geological conditions are encountered, discussions will be held with the TRC monitoring officer to determine appropriate contingency measures.

1.5 Monitoring

This SCWMP will be monitored in accordance with the Monitoring Programme as per resource consent conditions and the CWMP.

An important focus of site monitoring will be to ensure that when large or high intensity rainfall events are forecasted, appropriate monitoring and or maintenance is implemented in response. This monitoring will include a 'feedback loop' to ensure that all personnel are aware of any changing requirements and or any improvements to management practices.

This feed-back loop will include procedures for adapting erosion and sediment controls in response to the monitoring outcomes.

The following sections are to be completed and reviewed by suitably qualified staff (e.g. construction supervisors and engineers).

---

2 Construction Method and Erosion and Sediment Control Measures

2.1 Overview

This SCWMP has been prepared and reviewed by the following suitably qualified persons:

SCWMP prepared by:	
Construction method(s) reviewed by:	**Construction / Earthworks Manager**
SCWMP reviewed by:	**Environmental Manager**
Approved for Release:	**Alliance Manager**

All erosion and sediment control measures have been designed by a suitability qualified staff who meet the following requirements:

Plan Preparation Requirements	√
Is familiar with the requirements of the Transport Agency Guidelines, conditions of consent, the CWMP and any supporting plans (e.g. Chemical Treatment Plans).	
Is familiar with expected site conditions and proposed construction methodologies relevant to this SCWMP.	
Is familiar with topographical lay of the surrounding land relevant to this SCWMP.	
Has completed a site visit relevant to this SCWMP.	

2.2 Specific control measures

Table 2.1 summarises the sequence of works and the specific application of erosion and sediment control measures from the CWMP. **Refer Figure/Drawing XX for locations.**

Table 2.1 – Work sequence and erosion and sediment control (ESC) measures

Work Sequence	ESC measure	Comments (e.g. type of chemical treatment)

Guidance Note:

Typically, DEBs and SRPs shall be treated with rainfall activated flocculation (e.g. floc shed).The need for additional chemical treatment is to be assessed on a case by case basis

All chemical treatment will be undertaken and managed in accordance the CWMP. Bench testing of the soils associated with this SCWMP has been undertaken, and results are provided in Appendix B of the CWMP with associated design details.

It is possible that further bench testing will be required as earthworks progress with this informing the ongoing flocculation management on site.

2.3 Stabilisation

Guidance Note:

Note: if the 14 days is not considered appropriate or practicable for the SCWMP then an alternative date will be detailed within this section with the justification and rationale for this alternative period outlined.

References to stabilisation trial outcomes may be made as trialled outcomes become available. Stabilisation may include temporary and/or permanent measures as required.

The CWMP sets out the definition of **Stabilised Area** and **Actively Worked.** Areas not subject to works for more than a 14-day period will be identified and stabilised as works proceed (referred as "Stabilisation Trigger").

Stabilisation Trigger:	14 days not Actively Worked	**Guidance note:** or otherwise justified above
Is the Stabilisation Trigger likely to occur	Yes or No	**Guidance note:** circle one
Stabilisation techniques **Guidance note:** Required if Yes is circled		
Frequency of check on Activity Worked area **Guidance note:** Required		

2.4 Works within 20 Year ARI Flood Plain

Guidance Note:

Only if required, and to be specifically assessed.

Example Text:

This SCWMP involves works which are located within the 20-year flood level of the Mangapepeke Stream. The location of the works and the erosion and sediment control measures are considered the only viable option for this SCWMP. Based on the predicted flood depth, a standard freeboard level of 0.6 m above the primary spillway is likely sufficient to prevent flood waters from overtopping the pond. The lower 0.5 m of the outer bund face may be stabilised (e.g. lined with geotextile) where flood flow velocities of greater than 1 m/s are predicted. This typically will apply to all bunds within 5 m of the stream channel.

In addition, the following will apply (but is not limited to):

Structural:

- *Locating stockpiles of erodible material (e.g. topsoil) within bunded areas.*
- *High level of compaction when constructing flood protection bunds*

Non-structural:

- *Monitoring rain forecast, particularly for events predicted to exceed the 5 year or greater ARI rainfall event.*
- *Ensuring the sediment retention pond forebays are fully cleaned prior to forecasted heavy rain events.*
- *Ensuring sediment build up behind silt fences are fully removed prior to forecasted heavy rain events.*

2.5 Risk Analysis and Contingency Measures

Guidance Note:

Identify the risk of the location associated with the SCWMP. This shall be based on:

- Existing environment including: Existing slope; Proximity to stream; Vicinity of wetland environments;
- The need to establish access in steep slopes;
- Seasonal timing of works; and
- Any works between 1 May – 30 September (Winter Works)

The potential risk of increased sediment discharges from activities of this SCWMP is assessed in Table 2.2 along with specific measures (both structural and/or non -structural) to address this risk.

Guidance Note:
If no risk activities are identified, Table 2.2 may be replaced with the statement: *The works have been assessed and no risk activities are identified.*

Table 2.2 - Risk assessment

Risk activity	Specific measures	Residual risk after controls

In accordance with the CWMP, this SCWMP includes a risk assessment process to assess works in the winter period (1 May to 30 September inclusive).

Table 2.3 - Risk assessment for works 1 May to 30 September inclusive

Date prepared	
Is Winter Works required	Yes or No **Guidance note:** circle one
Risk assessment **Guidance note:** Required if Yes is circled	Scope/nature of the proposed works and associated risk (eg area of works, vicinity of receiving environment, slope of works area, duration of works):
	Structural controls required to minimise risk:
	Non-structural controls required to minimise risk:
	Maintenance considerations to ensure risk continues to be minimised:
Next review date	**Guidance note:** if prepared > 2 months to 1 May, this shall be reviewed by 1 April

2.6 Works in a Watercourse

Guidance Note:

Only include this section if works in, or within 10 m, of a watercourse are proposed. If such works are not required in this SCWMP, then the SCWMP concludes at Section 2.7 above.

Reference back to construction methods and/or sequences set out in Section 2.5 above.

As a minimum, all works within 10 m of a watercourse shall have silt fences or super silt fences on the downslope side of the works area.

2.6.1 Stream diversion capacity (channel or pipe)

The permanent stream diversions are formally sized to convey the 100-year storm event.

All temporary stream diversions are designed to allow flows through the diversion for events up to the 20 year ARI event.

For rain events that exceed the capacity of the formal temporary diversion, flow will be directed over stabilised surface ("overflow path"), which will be established on a rain forecast reactive basis. This stabilised surface will comprise XXX.

Design details are summarised below.

Design Details

Guidance Note:

Include a summary column for each stream diversion proposed.

Item	**Diversion ID: XXX**	
Construction method	On-line OR Off-line construction as set out in the CWMP	
Contributing catchment area above work site	X ha	
Stream type and name	Permanent Stream / Intermittent Stream – Name	
Design rainfall event	Frequency: XX % AEP	Qp = Xx m^3/s
Duration of works within watercourse	Time of Year: XXX Duration: X Weeks	
Fish Passage requirements	If required	
Estimated baseflow at time of works	X m^3/s	
Dewatering details		
Minimum coffer dam height	If required	
Pump size capacity	If required	

Item	Diversion ID: XXX
Diversion design (including contingency measures if required)	
Construction Figure/Drawing reference	Figure/Drawing XX
Diversion pipe diameter	X mm, as required.
Diversion pipe length	X m, as required.
Diversion channel dimensions	As required.

Appendices

Appendix A: Figures/Drawings/Calculations

Appendix B: Chemical Treatment Bench Tests and Design

Appendix C: Construction Water Discharges Monitoring Programme (CWDMP)

1 Purpose

The purpose of this CWDMP is to outline the construction related monitoring detail that will occur throughout the Project. The CWDMP includes details of processes and procedures that will be followed and confirms how this monitoring data will be used in the context of the Project to ensure effects are managed appropriately.

This CWDMP identifies:

- Monitoring locations;
- Monitoring methods;
- Baseline monitoring results;
- Development of management thresholds;
- Incident response; and
- Reporting.

2 Objectives

The primary objectives for this CWDMP are outlined as follows:

1. To provide information for making effective on-site decisions on necessary continuous improvement of erosion and sediment control measures (both structural and non structural).
2. To assist in understanding the outcome of on-site decisions to water quality and stream ecology, and support any determination of potential ecological effects from sediment discharged by the Project earthworks.

3 Water Quality Monitoring

3.1 Receiving Environments

Monitoring of Project discharges to receiving environments will be carried out as follows:

- Immediate Mangapepeke and Mimi catchments:
  - Event based inspections and grab sample monitoring at treatment pond outlets;
  - Baseline vs in Project comparative analysis of continuous stream monitoring at "downstream of project" sites; and
  - Comparative analysis of seasonal aquatic and macroinvertebrate monitoring.
- Wider Tongaporutu and Mimi catchments:
  - Comparative analysis of "control" sites with "downstream of project" sites.

3.2 Monitoring Process and Locations

The process for water quality monitoring locations during construction is illustrated in Annexure 1 of this CWDMP. The monitoring locations listed below and shown on Figure 3.1 will be used to sample discharges and sediment deposition from any resultant site run-off during construction and to assist with identifying any potential effects on the receiving environments. These are as follows:

- Control sites (i.e. not affected by construction discharges, but discharging to the wider catchment):
    - Mangapepeke Stream catchment: Site WQ1; and
    - Mimi Stream catchment: Site WQ4.
- Sites downstream of construction discharges:
    - Mangapepeke Stream catchment: Site WQ2; Mimi Stream catchment: Sites WQ3 and WQ5; and
    - Continuous turbidity sampling sites downstream of construction activities in the Mimi and Mangapepeke Streams (location in close vicinity of WQ2 and WQ5 as above).
- Sediment deposition at ecologically sensitive sites:
    - Site EM5 within the Mimi Wetland.
- Ecological monitoring of fish and macroinvertebrate communities downstream of the Project earthworks and immediately below locations of Fill 12 and 13 (during construction), refer Freshwater Ecology Management Plan chapter of the Project Ecology and Landscape Management Plan (ELMP):
  <u>Managapepeke catchment:</u>
    - EM1 at site Ea10a (control);
    - EM3 at site u/s E4 (downstream of fill 12); and
    - EM 2 at site E2 (downstream).

  <u>Mimi catchment:</u>
    - EM4 at site u/s Ea25 (control);
    - EM5, EM6 and EM7 at sites Es25 and d/s E6 (downstream fill 13); and

- EM8 at site Ea26 (downstream).

To allow comparison with baseline (and pre construction) water quality, monitoring of WQ2, WQ3 and WQ5 sites commenced in November 2017. In addition, continuous turbidity sampling sites near WQ2 and WQ5 will be installed to further support the comparative analysis.

Control sites WQ1 and WQ4 provide water quality data to assist with comparative analysis of Project and non-Project related discharges to the wider receiving environment.

Figure 3.1 also shows the location of the weather monitoring station installed on site and illustrates the monitoring locations in the context of the overall Project alignment.

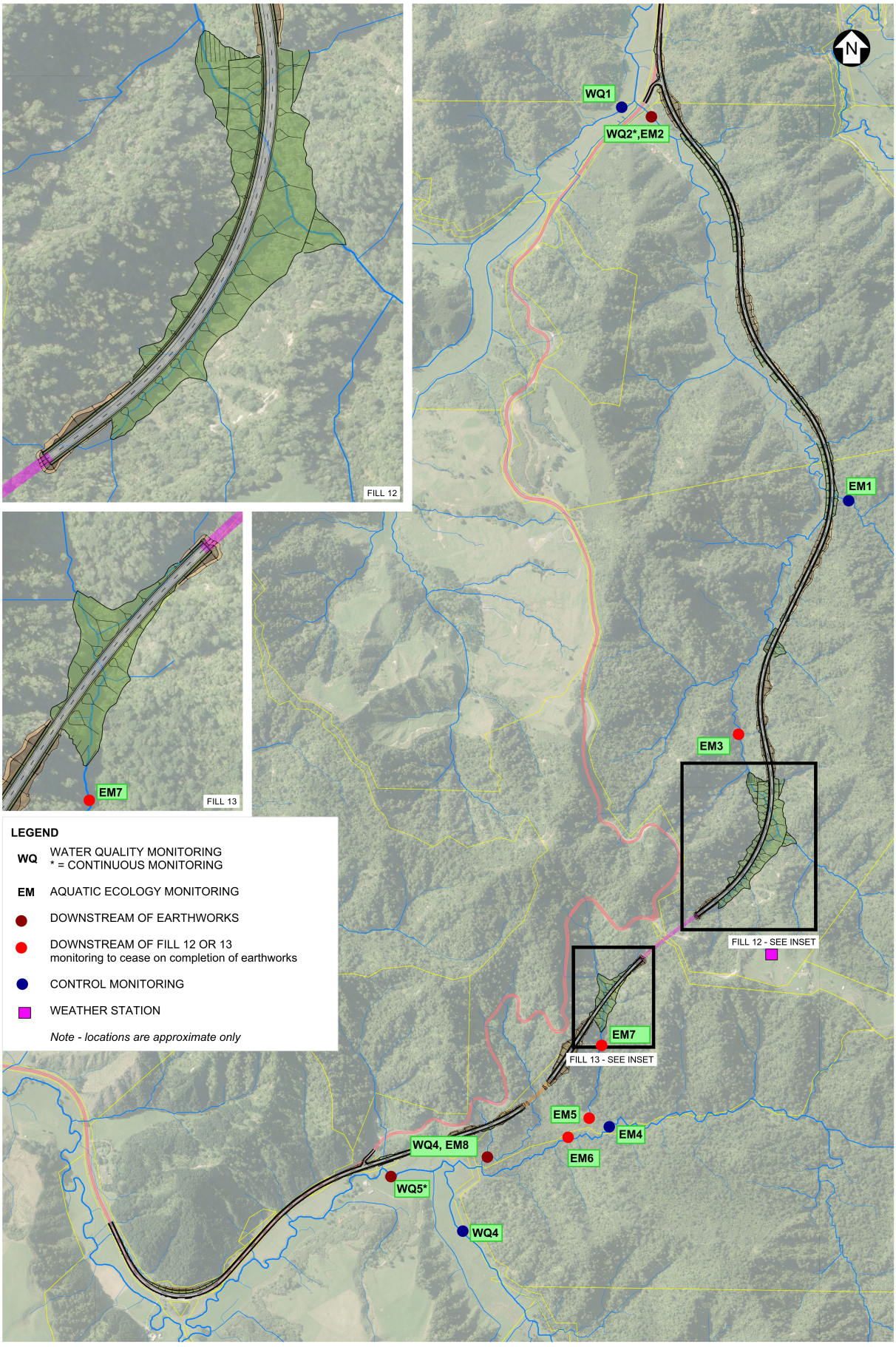

Figure 3.1 – Sampling Locations

4 Erosion and Sediment Control Measure Monitoring

In addition to the catchment sampling, water quality from both inflow and outflow locations from a selection of sediment retention ponds (SRPs) will be monitored during construction.

Monitoring of construction related discharges shall commence at the start of the bulk earthworks phase and shall finish when relevant Project areas are stabilised and the erosion and sediment control devices have been decommissioned.

Table 4-1 outlines the sampling methods and frequency at each monitoring location as identified in Section 3 above.

As an initial trigger, rainfall greater than 25 mm in a 24 hour period and 15 mm in a 1 hour period will instigate a sampling round. This is referred to as a Trigger Event.

Sampling shall be undertaken in accordance with the techniques outlined below and in Sections 4.1- 4.6 of this CWDMP.

- To monitor construction related effects, both pH and turbidity shall be monitored using calibrated field probes.
- At least one sample (field measurement) shall be taken at each monitoring location (as per Table 4-1) during a trigger event. More than one sample may be required to ensure a representative measurement is obtained if high variability occurs. In this circumstance, the sample number will represent what is required for the monitoring person to be satisfied a representative sample has been obtained.
- Calibration of field probes shall be carried out by collecting grab samples on a 3 monthly basis for lab testing of pH and turbidity. Water samples shall be collected in laboratory supplied containers, and transferred to an accredited laboratory under chain of custody.
- Total suspended solids (TSS) shall be tested at the same time as the calibration samples to establish TSS and turbidity relationships. Turbidity records can then be more accurately converted to TSS using these relationships for assisting with assessment of any potential effects.

Table 4.1 - Sampling details

Monitoring Location	Purpose	Sampling Parameters	Sampling method	Frequency (may be revised as additional monitoring information becomes available)
Control Sites WQ 1 and WQ4	Monitor changes to water quality downstream of construction discharges. Provides for a project wide and catchment wide understanding of rest of catchment water quality	• Turbidity and pH. • TSS at 3 monthly intervals	Stream level triggered sampling at each site with stream level sampling point related to trigger event.	• Stream level calibrated to trigger event of 15mm/hr and 25 mm in a 24 hour period. • Frequency will be rain dependent throughout construction period.
Stream Sampling Stream sites WQ2, WQ3 and WQ5	Monitor changes to water quality downstream of construction discharges.	• Turbidity and pH. • TSS at 3 monthly intervals	Stream level triggered sampling at each site with stream level sampling point related to trigger event.	• Stream level calibrated to trigger event of 15mm/hr and 25 mm in a 24 hour period. • Frequency will be rain dependent throughout construction period.
Continuous Stream monitoring Near WQ2 and WQ5 sites	Continuous turbidity sampling to determine water quality downstream of the project earthworks prior to and during the earthworks activity.	• Turbidity	Continuous turbidity meter installed on site. Ability to manually download data on a regular basis.	• Continuous both pre and during earthworks activities
Manual Sampling Sediment retention ponds (SRPs) – a minimum of 50% of SRPs on site at any one time will be subject to this sampling. All SRPs discharging into the Mimi Wetland will be subject to this monitoring programme.	Assess the effectiveness of SRPs to inform SRP management, overall erosion control in the catchment, general performance and maintenance requirements. Will also determine effectiveness of flocculation programme.	• Turbidity for each trigger event. • pH weekly and for each trigger event. • TSS at 3 monthly intervals	Manual sampling at pond inflow and outflow on a selection of SRPs (50% on site as a minimum.).	• Frequency will be rain dependent throughout construction period. • pH on a weekly basis.

Sediment Deposition Sampling EM5 Mimi Wetland with location as shown in Figure 4.1.	Monitoring of sediment deposition as an ecological trigger.	• Sediment Deposition	In field sampling and measurements.	• Frequency will be rain dependent throughout construction period. • In response to exceedance of management thresholds at the upstream SRPs.
Ecological Monitoring Fish and Macroinvertebrate monitoring at sites shown on Figure 3.1.	Up to twice yearly (spring and summer) ecological monitoring during construction. Monitoring immediately downstream of Fill 12 and 13 during earthworks. Collection of baseline fish and macroinvertebrate data to allow comparison once earthworks starts.	• Fish surveys • Aquatic Macroinvertebrate surveys	In field sampling	• Twice yearly baseline collection of data pre earthworks. • Up to twice yearly during earthworks (frequency may be reduced). • Monitoring downstream of Fills 12 & 13 are only required during filling activity

4.1 Meteorological Monitoring

Rainfall will be monitored at a site climate station located as shown in Figure 3.1. Wind, air temperate and humidity are also recorded at the site climate station.

Rainfall is recorded at no less than 15 minute intervals and accessed "real-time" through a web portal: https://live.harvest.com/?cmd=home&sid=8047&group=Main

Rainfall trigger alerts are send via SMS and email when the "rolling" hourly or 24 hourly totals reach the initial rainfall trigger values.

4.2 Manual Sampling

Manual water quality samples will be collected at the inflow and outflow of:

- the selected SRPs based on 50% of those utilised on site at any one time; and
- all SRPs that discharge directly into the Mimi Wetland.

Other sediment retention devices, such as decanting earth bunds, will be monitored in this same manner. The specific location of the sediment retention devices to be monitored shall be confirmed in the relevant SCWMPs.

At each monitoring location, a 1 L grab sample (approximately) shall be collected for testing (field and/or lab testing).

4.3 Stream Sampling

Static samplers are installed at WQ 1 to 5 monitoring locations. Static samples are a stationary device that collect a 1 L sample once the stream level reaches a pre-determined level that is representative of the stream channel depth (refer Figure 3.2). A submersible level logger continuously records stream level (relative to the stream bed) and allows the sampling level to be calibrated to rainfall records and for this project is calibrated to a rainfall of 25 mm in 24 hours.

Static samplers shall be emptied as soon as practical following a Trigger Event. The samples collected shall be emptied into a clean container for testing of field parameters or into laboratory supplied containers and shipped to a laboratory under chain of custody documentation.

Figure 4.1 – Static sampler and level logger configuration at WQ4

4.4 Continuous Stream Monitoring

Continuous turbidity loggers will be installed within the Mimi and Mangapepeke Streams near the Project site boundary. Continuous stream levels loggers are already installed at WQ1-5 locations (refer section 4.3 above).

The continuous turbidity and stream level monitoring will enable:

- Understanding of changes in the stream under both antecedent (preceding dry) and rainfall conditions;
- Understanding of changes in stream quality from any construction related discharges which are likely to continue post-rainfall; and
- Changes in the stream to be recorded in a manner that is independent of grab sampling response time.

Continuous stream monitoring will commence prior to construction and inform the baseline data analysis (refer section 5).

When continuous monitoring is combined with information from routine environmental inspections and an understanding of the construction works areas, it will assist in identifying if changes to the stream are Project or Non-Project related, and trigger a process for ecological assessment if necessary.

4.5 Sediment Deposition Sampling

Sediment deposition at the Mimi Wetland shall be monitored in accordance with the monitoring procedure outlined within the Freshwater Ecology Management Plan in the ELMP. The location of this monitoring is as per Figure 4.1 below and will occur in response to an exceedance of relevant SRP Management Thresholds as per Section 5 of this CWDMP.

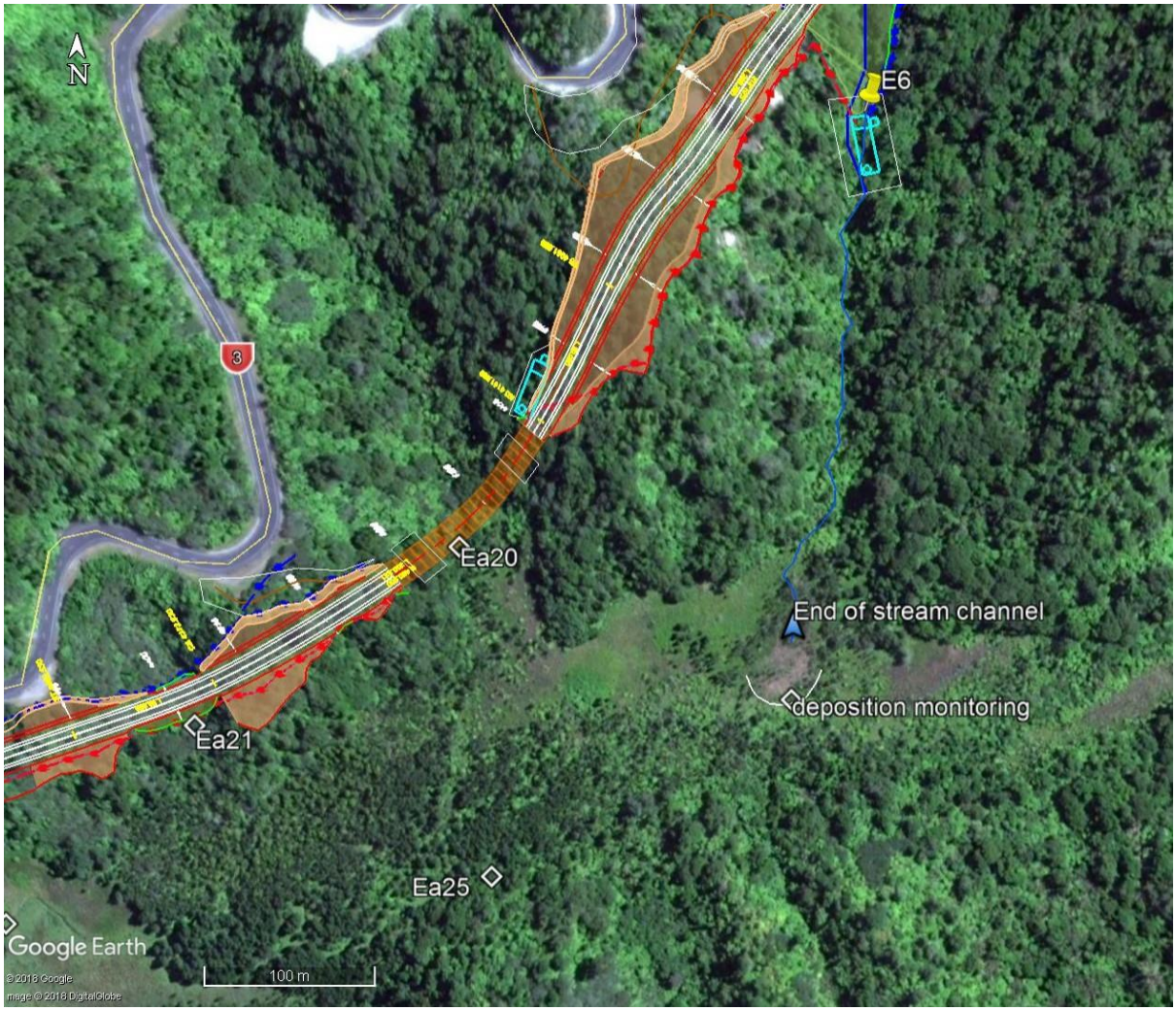

Figure 4.1 – Location of stream channel entering Mimi Wetland and location of sediment deposition monitoring in the event of SRP Management Threshold exceedance

4.6 Ecological Monitoring

Ecological monitoring of the immediate receiving environments (Mangapepeke and Mimi Streams) shall be monitored in accordance with the monitoring procedure outlined within the Freshwater Management Plan chapter of the ELMP. In summary:

- Fish and macroinvertebrate monitoring in summer and spring will be carried out prior to earthworks commencing in the catchment (baseline);
- Biannual fish and macroinvertebrate monitoring will be carried out once earthworks commence (construction period). Biannual monitoring includes sampling directly downstream of Fill 12 & 13, while filling activities are occurring. Following at least one year of baseline monitoring and one year of construction monitoring, monitoring

frequency may reduce if the first year of monitoring finds only small changes in the fish or aquatic macroinvertebrate community.

- Annual reporting during construction, which includes an assessment of the overall magnitude of any effects associated with the Project on the streams.

5 Baseline Water Quality Monitoring

Project baseline stream water quality sampling at sites WQ1 to 5 commenced in November 2017. The primary purpose of this baseline monitoring is to understand non-Project related water quality (with a focus on pH and sediment) in the immediate and wider freshwater environment. This baseline has been undertaken with reference to the trigger event of 25mm in 24 hours and has a relationship to high stream flow conditions in the Mangapepeke and Mimi Stream catchments.

Samples, using a stream level calibrated sampler, have been collected from nine rainfall events to date. The total rainfall for these events range from 25 – 170 mm within a 24 hour period, Samples were analysed for turbidity, pH and Total Suspended Solids (TSS) with the results outlined in Annexure 2.

In summary, where more than 25 mm total rainfall is recorded:

- The average pH at all sites (WQ1-WQ5) ranges from 6.8- 7.1.
- At the control sites:
    - WQ1: TSS concentrations typically range between 100 – 1000 mg/L, generally increasing with total rainfall and higher peak intensity;
    - WQ4: TSS concentrations typically stays above 1000 mg/L for most rainfall conditions; and
    - Turbidity levels are above 100 NTU at both locations.
- At monitoring site WQ3 downstream of the Mimi Wetland, TSS concentrations typically range between 100 – 1000 mg/L, with concentrations typically being higher for higher rainfall. Turbidity levels typically are above 150 NTU, increasing with higher rainfall.
- At the downstream sites:
    - WQ5: TSS concentrations range from 138 – 8100 mg/L and turbidity levels are above 100 NTU;
    - WQ2: TSS concentrations range from 17 – 3200 mg/L. Similarly, a wide range of 30 -2800 NTU is observed for turbidity; and

- The maximum concentrations at both these sites were measured following 81 mm total rainfall. TSS concentrations are notably higher at WQ5 compared to WQ2.

Further baseline sampling will continue prior to the commencement of the Project, which will provide the ability for comparative analysis over time.

In addition, continuous stream monitoring (refer section 4.4) will be undertaken prior to earthworks commencing. This will provide a continuous record of baseline stream water quality at/near the boundary of the Project site and will allow for a direct comparative analysis to continuous sampling results collected during earthworks.

6 Management Thresholds and Process

Management thresholds allow early detection of potential on site issues but do not in themselves, indicate potential effects.

Management thresholds are determined for sediment and other construction water discharges including: concrete, oil/fuel and chemical flocculants, as outlined below. Exceedance of these thresholds shall instigate a second level of investigation as described below. These thresholds shall be referenced when Trigger Event monitoring occurs and any follow up monitoring that may be required.

First level of **Post Event** investigation (Trigger Event exceeded):

When a Trigger Event is exceeded, a site audit inspection of the various construction water management measures shall be undertaken by site monitoring staff as soon as practicable (under safe conditions) following the trigger. The audit shall evaluate the performance of the project construction water management controls and identify any issues or opportunities that may exist, in conjunction with obtaining Stream Sampling and Manual Sampling water quality data.

Second level of **Post Event** investigation (Management Threshold exceeded):

Following an exceedance of a Management Threshold (as specified in 5.1 below) a second level of investigation shall be undertaken, which includes:

- The site monitoring staff re-notifying the E&SC supervisor and the Project Environmental Manager.
- The E&SC supervisor inspecting the specific site area where the threshold has exceeded, identifying specific continuous improvement opportunities (if any) and

documenting it as per the reporting process set out below (refer section 6). This step will include:

- Inspect the earthworks site, all water management including erosion and sediment controls and associated management procedures to identify any problems or activities likely to have contributed to the threshold exceedance;
- Collect further water quality samples from device discharges as necessary; and
- Remedy any identified problems and implement any further controls on activities that are likely to contribute to ongoing management threshold exceedances.

- In the event of an exceedance of the Management Threshold for sediment (as a result of the Sediment Deposition Sampling) within the Mimi swamp forest, the ecological response and monitoring actions set out in the Freshwater Management Plan (Chapter 8) of the ELMP shall be undertaken.

6.1 Management Thresholds

6.1.1 Sediment Management

The following Management Thresholds shall be applied:

- For Manual Sampling, less than 80% reduction in turbidity between the pond inflow and outflow.
- For Continuous stream monitoring, an increase in turbidity 20% greater than that pre earthworks for a similar magnitude rainfall event (immediate receiving environment trigger):
    - WQ2* (earthworks) x 1.2 > WQ2* (pre earthworks)
    - WQ5* (earthworks) x 1.2 > WQ5* (pre earthworks)

  (where WQ2* and WQ5* are a function of continuous turbidity and rainfall)
- For Stream Sampling, a difference of more than 20% in turbidity or pH from the control sites at the following locations (wider receiving environment trigger):
    - WQ2 (north discharge) x 1.2 > WQ1 (north control)
    - WQ5 (south discharge) x 1.2 > WQ4 (south control).

- For Sediment Deposition monitoring at the Mimi swamp forest, greater than 6 mm at any point within the area demarcated by the line shown in Figure 4.1.

6.2 Concrete management

Concrete or grout particles in water can result in sediment and high pH. Concrete and grout wash or waste water shall be contained for treatment and testing on-site prior to discharge into the freshwater environment. The following management thresholds shall apply:

- Water visually appears to be tinted grey; and/or
- pH of more than 8 at the treatment device outflow.

6.3 Oil/Fuel management

All practicable measures shall be carried out to avoid oil/fuel spills into the freshwater environment, (i.e. appropriate containment, bunding of storage areas, limiting storage volumes). The following management thresholds shall apply:

- Notable leaks/spills outside of the containment/bunded area; and/or
- Oil sheens in the downstream freshwater environment.

6.4 Flocculant management

Where flocculant containing PAC is used, it is proposed to adopt visual observation and pH parameters to monitor all SRP's and DEBs where this chemical treatment is used. The following management thresholds shall apply:

- Water visually appears to be tinted blue-green; and/or
- pH of less than 5.5 at the SRP outflow.

Chemical use and dose rates shall be reassessed if data shows that the current chemical flocculation/coagulation is breeching management thresholds.

It is noted that some of the flocculants available have no effect on pH levels and if such chemicals are used on this Project then there will be no requirement to monitor discharge pH levels. Where other chemical flocculants are used, specific monitoring parameters (if any) shall be set out in the relevant SCWMPs.

6.5 Review of management thresholds

Management thresholds may be revised by the Environmental Manager where appropriate as further information (such as baseline water quality, rainfall and on site experience) becomes available.

7 Incident Response

Incident response shall be undertaken in accordance with the process outlined in Section 5.16 of the Project CEMP. In relation to construction water management, an incident is defined as:

- Discharges from non-stabilised areas that are not treated by erosion and sediment control measures as required by the CWMP / SCWMPs;
- Failure of any erosion and sediment control measures;
- Discharge of a hazardous substances, including cement, to a water body;
- Failure of any temporary stream diversion and
- Any other incident, which either directly or indirectly causes, or is likely to cause, adverse ecological effects in any waterbodies, that is not authorised by a resource consent.

Incidents will primarily be identified by site observations by Project staff and as a result of specific environmental and erosion and sediment control inspections undertaken by the Environmental team. An incident may also be identified as a result of the monitoring undertaken for the Project or through complaints or stakeholder feedback.

7.1 Corrective Actions

As soon as practicable after an incident, the Environmental Manager and the Construction Manager shall:

- Determine the immediate actions to be taken to re-establish control measures where these have failed or have not been implemented in accordance with the relevant management plan as soon as possible.
- The corrective actions shall be implemented as soon as practicable, taking into account health and safety issues.
- As appropriate, liaise with TRC to establish what remediation or rehabilitation is required and whether this is practicable to implement.
- Carry out any remedial action to the satisfaction of TRC (as appropriate).

In addition to the above requirements an incident report will include the following details:

- Description and location of incident;
- Description of the weather conditions before the incident;
- Description of work being carried out at the time of the incident and how the incident occurred;
- Corrective actions taken to rectify the situation and mitigation measures to be taken to minimise the adverse effects on the environment;
- Causes of the incident; and
- Environmental controls in place at the time of the incident.

Additional monitoring may be required as a result of the incident and changes may be required to the CWMP or approved and future SCWMPs.

8 Monitoring reporting

All investigations to construction water management controls and methodologies shall comprise:

- A full audit of all erosion and sediment controls relevant to the location; and
- For Management Threshold exceedances, an audit report provided to the Environmental Manager within 5 days, which shall include:
    - Monitoring and sampling results from both Stream Sampling, continuous sampling and Manual Sampling;
    - Cause and duration of any exceedance (based on visual observations and/or further monitoring and sampling) with reference to the Management Thresholds;
    - Actions to minimise further construction related discharges, carried out to the satisfaction of the Environmental Manager, and in accordance with the ELMP where required; and
    - An assessment by the Project Freshwater Ecologist to assess the extent of any effect on the Mimi Wetland (for exceedance of Management Thresholds at SD1 only) or any ecological effects determined through the ecological (fish and invertebrates) monitoring.

All Trigger Events will be reported to TRC, as soon as practicable with any associated Management Threshold exceedances, actions and response to that Trigger Event documented.

Implementation of further construction water management controls and continuous improvement may need to occur in order to minimise sediment yields and construction water discharges from the works and minimise any potential effects on the downstream environment. This will be confirmed by the Project Erosion and Sediment Control specialist and may include further temporary stabilisation of disturbed surfaces, installation of additional sampling or measurement devices and changing methodologies.

A review of the CWDMP will occur to assess the effectiveness of the monitoring programme to advice site management and detect changes in ecological trends. The timing of the review will be 3 monthly from works commencement for the first 12 month period followed by annual reviews for each subsequent 12 month period, carried out to the satisfaction of the Environmental Manager.

The review will consider:

- If additional sampling / measuring points are appropriate;

- If the use of continuous or automatic samplers to monitor water quality at further sites is necessary to achieve the monitoring outcomes and objectives; and
- If further, or an amended, ecological monitoring programme is required.

Additional data from the above methods will be determined necessary if the existing monitoring programme cannot:

- Satisfactorily detect changes in ecological trends as a result of the Project, as determined by the Project Freshwater Ecologist; and/or
- Satisfactorily identify and isolate Project areas when Second Level Investigations are required, as determined by the Project Erosion and Sediment Control specialist with resultant identification of continuous improvement opportunities.

ANNEXURE 1 – MONITORING PROCESS DIAGRAM

FEEDBACK LOOP FOR CONTINIOUS IMPROVEMENT…. FEEDBACK LOOP FOR CONTINIOUS IMPROVEMENT… FEEDBACK LOOP FOR CONTINIOUS IMPROVEMENT… FEEDBACK LOOP FOR CONTINIOUS IMPROVEMENT

FEEDBACK LOOP

Trigger Event – Greater than 15mm/hr or 25mm total rain in 24 hours

Stream Sampling (WQ1 to WQ5)

To provide catchment wide water quality knowledge:
1) pH and turbidity event samples (baseline & during construction)

2) Visual inspection during and/or post event (during construction)

Manual Monitoring (grab samples, deposition measurements)

pH and turbidity grab samples At 50% SRPs, which shall include all SRPS upstream of Mimi Wetland

Sediment deposition monitoring at Mimi swamp forest

First level investigation

Site audit inspection to evaluate performance of the project construction water management controls and identify any issues or opportunities

Check Management Thresholds as per Section 6.1 of CWDMP

If Management Thresholds not exceeded

No further site action

Report Trigger Event results to TRC

Event Reporting to TRC

Report Trigger Event results to TRC

If Management Thresholds are Exceeded

Notify E&SC supervisor and the Environmental Manager

Inspection and further monitoring as directed by the E&SC supervisor

Event Reporting to TRC

Report exceedance of Management Threshold exceedances, along with proposed actions, further monitoring and/or remedial actions

If sediment deposition trigger is exceeded

Project ecologists to assess the extent of any effect on the Mimi swamp forest

Undertake an assessment of the overall magnitude of any effects associated with the Project on the Mimi swamp forest and recommendations for further monitoring or remedial actions.

Review of Monitoring Programme

3 monthly from works commencement for the first 12 month period followed by annual reviews for each subsequent 12 months

Routine monitoring

Quantitative: Continuous Turbidity monitoring near WQ2 & WQ5

Continuous turbidity (baseline & during construction)

Note: Continuous turbidity records will be manually downloaded for analysis following a trigger event.

Qualitative: Weekly site monitoring during construction

Visual inspections of erosion and sediment control measures

System checks on flocculation units

Weekly pH sampling at ponds where PAC is used

Quarterly monitoring during construction

Sampling carried out during a Trigger Event:

TSS grab samples at 50% of SRPs (during event

TSS grab samples at WQ1-WQ5

Maintenance actions register/list

Register maintained by the E&SC supervisor noting maintenance actions, priority order and completion date.

Develop TSS –turbidity relationships

Baseline relationship

During construction

Ecological monitoring

Baseline monitoring in Mimi and Mangapepeke Catchments

Fish survey and Macroinvertebrate monitoring in summer and spring (6 locations)

Sediment deposition event monitoring (1 location)

At base of fills 12 & 13 during filling activity (note 1)

Fish survey and Macroinvertebrate monitoring 2 locations)

Sediment deposition event monitoring (1 location)

Mimi and Mangapepeke Catchments (note 1)

Fish survey and Macroinvertebrate monitoring in summer and spring (4 locations)

Annual report

Summary of water quality and ecological monitoring results

Assessment of the overall magnitude of any effects associated with the Project on the streams

Recommended actions for site management amendments (if any)

Note 1: *Frequency may be reduced to once a year after 1 year of construction monitoring, based on results.*

CWDMP ELMP

Accidental Spills or Incidents and Management Response in Section 7 of the CWDMP

ANNEXURE 2 – BASELINE STREAM SAMPLING RESULTS (as at May 2018)

Table A2-8.1: WQ1 Summary

ID	Sampling details				North Control - low sampler				North Control - high sampler			
	Event date	Total rainfall (mm)	Peak intensity (mm/hr)	Comments	pH_l	TSS (g/m3)_l	Turbidity (NTU)_l	Settleable solids (mL/L)_l	pH_h	TSS (g/m3)_h	Turbidity (NTU)_h	Settleable solids (mL/L)_h
				Max	**7.00**	**25000.00**	**21000.00**	**56.00**	**7.30**	**16300.00**	**9200.00**	**70.00**
				Mean	**6.94**	**6637.60**	**5133.00**	**26.33**	**6.80**	**3622.83**	**2013.67**	**28.20**
1	8/11/2017	25	11	sampler not installed								
2	5/01/2018	81	25	Possible slow leak noted during collection (low only)	7.00	7300.00	4100.00	20.00	6.40	16300.00	9200.00	56.00
3	18/01/2018	50	8		7.00	162.00	101.00	<1	6.70	177.00	97.00	<1
4	12/02/2018	23	6	only low collected	7.00	66.00	34.00	<2				
5	8/03/2018	170	38		6.90	25000.00	21000.00	56.00	6.90	1260.00	640.00	70.00
6	9/04/2018	25	3	only high collected					6.80	990.00	208.00	3.60
7	12/04/2018	47	15	only high tested					6.70	2400.00	1800.00	9.00
8	16/04/2018	53	23	only high tested					7.30	610.00	137.00	2.40
9	6/05/2018	26	11	only low collected	6.80	660.00	430.00	3.00				

Table A2-8.2: WQ2 Summary

ID	Sampling details				North discharge - low sampler				North discharge - high sampler			
	Event date	Total rainfall (mm)	Peak intensity (mm/hr)	Comments	pH_l	TSS (g/m3)_l	Turbidity (NTU)_l	Settleable solids (mL/L)_l	pH_h	TSS (g/m3)_h	Turbidity (NTU)_h	Settleable solids (mL/L)_h
				Max	**7.40**	**1180.00**	**1500.00**	**9.80**	**7.20**	**3200.00**	**2800.00**	**9.00**
				Mean	**7.12**	**308.33**	**315.85**	**8.00**	**6.85**	**720.13**	**629.88**	**5.03**
1	8/11/2017	25	11	Test round - rainfall measured at TRC station	6.90	1180.00	1500.00	6.20	6.90	980.00	1050.00	5.00
2	5/01/2018	81	25	Possible low sampler represents a previous event. Possible slow leak on high sampler noted during collection	7.10	94.00	53.00	<3	7.10	3200.00	2800.00	9.00
3	18/01/2018	50	8	Both samplers not full	7.00	17.00	18.10	<5	6.80	43.00	34.00	<1.7
4	12/02/2018	23	6	Only high tested					7.20	63.00	46.00	<3
5	8/03/2018	170	38		7.10	360.00	230.00	9.80	6.90	119.00	93.00	<1.2
6	9/04/2018	25	3		7.40	125.00	51.00	<1.5	6.60	76.00	46.00	<1.3
7	12/04/2018	47	15	only high tested					6.80	970.00	740.00	<1.3
8	16/04/2018	53	23	only low collected	7.20	74.00	43.00	<1				
9	6/05/2018	26	11	only high tested					6.50	310.00	230.00	1.10

Table A2-8.3: WQ3 Summary

ID	Sampling details				South wetland - low sampler				South wetland - high sampler			
	Event date	Total rainfall (mm)	Peak intensity (mm/hr)	Comments	pH_l	TSS (g/m3)_l	Turbidity (NTU)_l	Settleable solids (mL/L)_l	pH_h	TSS (g/m3)_h	Turbidity (NTU)_h	Settleable solids (mL/L)_h
				Max	**7.10**	**10100.00**	**4200.00**	**26.00**	**7.20**	**10900.00**	**4900.00**	**28.00**
				Mean	**6.88**	**2305.20**	**959.20**	**14.10**	**6.83**	**2386.43**	**1334.43**	**8.94**
1	8/11/2017	25	11	sampler not installed								
2	5/01/2018	81	25		6.90	750.00	370.00	2.20	6.70	10900.00	4900.00	28.0
3	18/01/2018	50	8	Intakes blocked by vegetation	6.90	330.00	155.00	<2	6.70	610.00	330.00	2.0
4	12/02/2018	23	6	only low collected	7.10	66.00	32.00	<3				
5	8/03/2018	170	38		6.70	10100.00	4200.00	26.00	6.70	2800.00	2300.00	8.7
6	9/04/2018	25	3		6.80	280.00	39.00	<1.5	6.80	280.00	165.00	<5
7	12/04/2018	47	15	only high tested					6.90	1660.00	1440.00	4.0
8	16/04/2018	53	23	only high tested					7.20	145.00	54.00	<1.7
9	6/05/2018	26	11	only high tested					6.80	310.00	152.00	2.0

Table A2-8.4: WQ4 Summary

ID	Sampling details				South Control- low sampler				South Control- high sampler			
	Event date	Total rainfall (mm)	Peak intensity (mm/hr)	Comments	pH_l	TSS (g/m3)_l	Turbidity (NTU)_l	Settleable solids (mL/L)_l	pH_h	TSS (g/m3)_h	Turbidity (NTU)_h	Settleable solids (mL/L)_h
				Max	**7.30**	**10400.00**	**4800.00**	**31.00**	**7.60**	**39000.00**	**18500.00**	**100.00**
				Mean	**6.88**	**3455.00**	**2321.67**	**16.92**	**6.96**	**7497.00**	**4139.29**	**26.43**
1	8/11/2017	25	11	Test round - 25mm rainfall measured at TRC station	6.60	2100	3300	24	6.70	3400	5000	25.0
2	5/01/2018	81	25	Both intakes blocked on both samplers while filling	7.30	2000	1070	<5	7.60	119	75	<7
3	18/01/2018	50	8		6.70	2300	1100	6	6.80	3300	2300	12.0
4	12/02/2018	23	6	Only low collected	7.10	1830	3100	16				
5	8/03/2018	170	38		6.70	10400	4800	31	6.80	39000	18500	100.0
6	9/04/2018	25	3		6.90	2100	560	8	7.00	1600	360	6.0
7	12/04/2018	47	15	no sample - leaked								
8	16/04/2018	53	23	only high tested					7.10	4500	2500	14.0
9	6/05/2018	26	11	only high tested					6.70	560	240	1.6

Table A2-8.5: WQ5 Summary

ID	Sampling details				WQ5 South discharge - low sampler				WQ5 South discharge - high sampler			
	Event date	Total rainfall (mm)	Peak intensity (mm/hr)	Comments	pH_l	TSS (g/m3)_l	Turbidity (NTU)_l	Settleable solids (mL/L)_l	pH_h	TSS (g/m3)_h	Turbidity (NTU)_h	Settleable solids (mL/L)_h
				Max	**7.20**	**1160.00**	**500.00**	**3.00**	**7.20**	**8100.00**	**7600.00**	**42.00**
				Mean	**6.98**	**524.00**	**209.25**	**2.50**	**6.93**	**4242.50**	**3188.25**	**21.60**
1	8/11/2017	25	11	sampler not installed								
2	5/01/2018	81	25		7.00	1160	500	3	6.60	8100	4200	20.0
3	18/01/2018	50	8		7.00	220	94	<1	6.70	4800	3400	15.0
4	12/02/2018	23	6		7.20	86	51	<3	7.20	102	53	<1
5	8/03/2018	170	38	low not collected					7.10	7100	6900	32.0
6	9/04/2018	25	3		6.70	630	192	2	6.80	138	53	<1
7	12/04/2018	47	15	only high tested					6.90	7500	7600	42.0
8	16/04/2018	53	23	only high tested					7.10	3200	1540	12.0
9	6/05/2018	26	11	only high tested					7.00	3000	1760	8.6