TOITŪ TE WHENUA

LAND INFORMATION NEW ZEALAND

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146 TE MAWHAI ROAD, TE AWAMUTU

FORMER TOKANUI HOSPITAL DEMOLITION AND REMEDIATION EROSION AND SEDIMENT CONTROL PLAN – DEMOLITION WORKS - DRAFT

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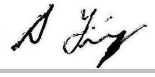
Status	Final	Signature	
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TOITŪ TE WHENUA – LAND INFORMATION NEW ZEALAND

FORMER TOKANUI HOSPITAL DEMOLITION AND REMEDIATION

EROSION AND SEDIMENT CONTROL PLAN – DEMOLITION WORKS (DRAFT)

TABLE OF CONTENTS

DRAWINGS (provided separately)

33205/3000	BUILDING DEMOLITION - EROSION AND SEDIMENT CONTROL OVERALL PLAN
33205/3001	BUILDING DEMOLTION - EROSION AND SEDIMENT CONTROL – SHEET 1 OF 3
33205/3002	BUILDING DEMOLTION - EROSION AND SEDIMENT CONTROL – SHEET 2 OF 3
33205/3003	EROSION AND SEDIMENT CONTROL – BUILDING DEMOLITION – SHEET 3 OF 3
33205/3100	SEDIMENT RETENTION POND PLAN AND SECTIONS
33205/3101	SEDIMENT RETENTION POND DETAILS
33205/3102	EROSION AND SEDIMENT CONTROL TYPICAL DETAILS
33205/3200	NON-BUILDING CONTAMINATED AREAS – EROSION AND SEDIMENT CONTROL PLAN
33205/3201	NON-BUILDING CONTAMINATED SOIL REMEDIATION AREAS – EROSION AND SEDIMENT CONTROL PLAN – AREA I (FILL)
33205/3202	NON-BUILDING CONTAMINATED SOIL REMEDIATION AREAS – EROSION AND SEDIMENT CONTROL PLAN – DEMOLISHED STRUCTURE
33205/3203	NON-BUILDING CONTAMINATED SOIL REMEDIATION AREAS – EROSION AND SEDIMENT CONTROL PLAN – AGRICULTURAL AREA
33205/EMB004	CULVERT 2 REMOVAL – EROSION AND SEDIMENT CONTROL PLAN
33205/PL004	STORMWATER SYSTEM PIPE LINING WORKS – INDICATIVE WORKS PACKAGES PLAN
33205/PL100	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 1 (WP1)
33205/PL101	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 2 (WP2)
33205/PL102	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 3 (WP3)
33205/PL103	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 4 (WP4)
33205/PL104	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 5 (WP5)
33205/PL105	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 6 (WP6)
33205/PL106	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 7 (WP7)
33205/PL107	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 8 (WP8)
33205/PL108	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 9 (WP9)
33205/PL109	STORMWATER SYSTEM PIPE LINING WORKS – STAGE 10 (WP10)

APPENDICES

A Erosion and Sediment Control Calculations

B WRC ESCG Fact Sheets

TOITŪ TE WHENUA – LAND INFORMATION NEW ZEALAND
FORMER TOKANUI HOSPITAL DEMOLITION AND REMEDIATION

EROSION AND SEDIMENT CONTROL PLAN – DEMOLITION WORKS (DRAFT)

1.0 INTRODUCTION

This Erosion and Sediment Control Plan (ESCP) has been prepared in support of a resource consent application for planned demolition and remediation works on the former Tokanui hospital site, which are planned to take place over the next 2-4 years. It has been prepared in accordance with the Waikato Regional Council "Erosion and Sediment Control: Guidelines for Soil Disturbing Activities" (WRC ESCG), the associated Demolition Management Plan for the site, and best practice. It does not cover repair and upgrade works on the closed disposal site (landfill), which are the subject of a separate resource consent application and ESCP.

2.0 SITE LOCATION AND DESCRIPTION

The former Tokanui Hospital (the Site) was a psychiatric hospital approximately 80ha in area, with 76 buildings, a wastewater pump station, swimming pool, eight substations, closed landfill, substantial roading and inground infrastructure and services. The site location and extent are shown in Figure 1.

Figure 1: Site Location and extent

3.0 BACKGROUND INFORMATION

3.1 SITE MANAGEMENT AND DEED OF SETTLEMENT REQUIREMENTS

The Site is currently managed by Toitū Te Whenua Land Information New Zealand (LINZ) on behalf of the Crown but has been held in the Treaty Settlements Landbank since 1999 following the hospital's closure in 1998. Land held in the Landbank is Crown land which has been declared surplus can be used as cultural or commercial redress in Tiriti o Waitangi Settlement claims.

The Ngāti Maniapoto (herein referred to as Maniapoto) Deed of Settlement (the Deed), that was initialed in December 2020, acknowledged the cultural significance of the Site and the need for demolition and remediation of the Site before it can be offered to Maniapoto.

Under the Deed, Maniapoto and the Crown have agreed that LINZ complete the demolition and remediation of the Site. The proposed demolition, deconstruction and remediation works cover the following:

- **"Vertical building structures":** all above-ground built structures within Areas 2, 3 and 4 of the Tokanui Hospital site, including associated footings/foundations.
- "**Horizontal infrastructure**": Partial removal of the roading, accessways, and services as defined in Table 1.
- **"Contaminated land"**: Contaminated land is defined by the Ministry for the Environment as sites at which hazardous substances occur at concentrations above background levels and where assessment indicates it poses, or is likely to pose, an immediate or long-term risk to human health or the environment.

These works are for simplicity referred to in this plan as the "**demolition works**". They are described in detail in the separate Demolition Management Plan (DMP).

3.2 SUMMARY OF SITE DEMOLITION AND REMEDIATION WORKS

The scope of the demolition works is summarised in Table 1.

Table 1: Scope of Demolition Works

Item	Required Works
BUILDINGS	
Buildings, including footings/ foundations	Demolition and/or deconstruction of all buildings within Areas 2, 3 and 4 of the site, including all footings/foundations. This includes historic demolition debris buried around specified buildings that is inferred to come from historic building renovation, demolition and/or extension works.
HORIZONTAL INFRASTRUCTURE	
Roading/ paving (6.3ha, 8.8km)	Removal of 3.49ha roading/paving and paving materials containing coal tar paving and reinstatement with soil backfill; 3.48km (2.79ha) residual roading retained and converted to farm access track standard (i.e. remove paving and retain hardfill basecourse)
Old road	Removal of redundant road embankment crossing over Wharekōrino Stream

embankment & Culvert 2 (~1350dia)	(approximately 6m wide by 50-60m long); earthworks over 3000m^2 area of approximately 6800m^3 volume, stream bank grading and riparian planting
Concrete Ducts	Remove entire system (2937m); 880m^3 minimum backfilling
Other Services	Partial removal: 633 surface features (MHs, fire hydrants, valve boxes, etc.), all asbestos water pipes, other pipes/ducts down to 800mm depth (including non-asbestos water supply, wastewater and stormwater pipes except for the trunk stormwater system) and associated structures down to 1m depth
Wastewater Treatment Plant (WWTP)	Removal of remaining WWTP infrastructure, grit chamber, inlet pipe and footbridge, trickling filter and stone media, UV treatment system, flow meter and outlet pipe.
CONTAMINATED SOIL	
Contaminated Soil	Low and moderate level contaminated soil from around the perimeters (halos) of many buildings on-site, comprising almost entirely allophanic topsoil, and containing primarily lead or asbestos contaminants plus other non-building areas with localised pockets of fill containing construction and demolition debris and some heavy metal, hydrocarbon and/or asbestos contamination. These soils are estimated to comprise approximately 3,255m^3 of confirmed contaminated soils with provisional allowances for additional contaminated soils of 4527m^3, giving a combined total of 7,782m^3, rounded up to 7,800m^3.

The 633 surface features referred to under "other services" are listed in Table 2.

Table 2: Infrastructure Features Inventory and Condition

Asset/underground service	Comments	No	Condition
Power	Light poles (99), power poles (18), other (7)	124	Moderate to poor
Concrete ducting	Concrete duct access chambers (37)	37	Generally moderate
Water	Fire hydrants (41), valves (25)	66	Very poor
Stormwater	Manholes (145), catchpits (56)	201	Moderate
Wastewater	Manholes (152)	152	Poor to very poor
Telecom	Telecom post	7	Moderate
Unknown lids	4x4 lids	46	Moderate
Total		**633**	

Note: WWTP remaining infrastructure is covered in Table 1.

4.0 ESCP OBJECTIVES

The main rationale and objectives for this ESCP are:

(a) To provide for appropriate erosion and sediment control measures during site demolition and remediation works, that comply with best practice, regulatory requirements and technical reports for the hospital site.

(b) To minimise disturbance to areas where erosion may occur, including steep slopes and exposed land.

(c) To minimise the extent and duration of works on the site, including temporary stockpiles, and to ensure revegetation can occur in a staged manner, so as to reduce the risk of silt/sediment running off the site and entering the downstream receiving environment.

(d) To install perimeter controls such as diversion drains and silt fences to prevent sediment leaving the site.

(e) To provide sediment removal devices such as decanting earth bunds and sediment retention ponds to minimise the amount of sediment laden runoff leaving the site.

(f) To provide for temporary diversions during any stream works.

(g) To provide appropriate erosion and sediment controls for any works in or within 10m of identified wetland areas.

(h) To ensure exposed areas are stabilised as soon as practicable by lining, grassing or mulching to prevent erosion.

(i) To provide guidance in case of unforeseen events including poor weather.

(j) To ensure all control measures are inspected and repaired after storm events.

(k) To ensure that the site is stabilised prior to the removal of sediment control measures.

(l) To mitigate dust emissions from the site during earthworks so as not to adversely affect any nearby properties.

(m) To minimise potential environmental effects.

5.0 PROPOSED EARTHWORKS AND LAND DISTURBANCE ACTIVITIES

5.1 EARTHWORKS DEFINITIONS

Waikato Regional Council refer to their Planning Standards definition of earthworks:

"the alteration or disturbance of land, including by moving, removing, placing, blading, cutting, contouring, filling or excavation of earth (or any matter constituting the land including soil, clay, sand and rock); but excludes gardening, cultivation, and disturbance of land for the installation of fence posts."

Waipa District Council defines earthworks as:

"the disturbance of the land surface by moving, removing, placing or replacing soil, spoil or earth, by excavation, cutting or filling operations (but does not include mineral extraction activities or tillage of land associated with the growing of crops where there is no significant change to landform)."

The **National Environmental Standard - Freshwater** (NES-FW) applies to all works within or within 10m of wetlands and defines land disturbance as:

"the alteration or disturbance of land (or any matter constituting the land including soil, clay, sand and rock) that does not permanently alter the profile, contour or height of the land."

5.2 OVERVIEW AND SEQUENCING

Based on the above definitions, earthworks and land disturbance works for the site have been divided into the following categories:

(a) Backfilling of cavities created by the removal of building footings/foundations and reinstatement to pasture with subsoils, topsoil and grassing.
(b) Removal of low-moderate level soil contamination from around site buildings and in other localised non-building areas and reinstatement with clean soil.
(c) Backfilling of cavities created by the removal of 3.49ha (5.3km) of roading/paving (subbase, basecourse and surface paving) and associated coal tar contamination and reinstatement to pasture with subsoils, topsoil and grassing.
(d) Removing the surface paving from the remaining 2.71ha (3.3km) roading/paving areas and some areas of coal tar contaminated basecourse and subbase and reinstatement to gravel farm track standard.
(e) Trenching for services and inground structures removal, with excavated soil being replaced in the trenches and topped up with clean soil (subsoils and topsoil as appropriate plus grassing) or hardfill under remaining roading areas.
(f) Minor soil disturbance works in the WWTP compound associated with the removal of remaining WWTP infrastructure.
(g) Removal of a redundant road crossing over the Wharekōrino Stream and associated culvert, including a temporary stream diversion.
(h) Lining of the trunk stormwater pipe system to extend its life, including temporary stream diversions.

Overall demolition works sequencing and indicative timing is set out below. Items involving earthworks and land disturbance activities are highlighted in red.

Table 3: Proposed Work Sequencing

Phase	Works	Indicative Timeframe
1	1. Site establishment; 2. Environmental Clean of Structures; 3. ACM Removals (including void spaces except for sub-floor); 4. Lead based paint (LBP) Removals; 5. Visual clearance inspections; 6. Soft strip and salvage; 7. Structural demolition and salvage; 8. Removal of demolished materials; 9. Sub-floor investigation	8.5 months to 2.2 yrs
2	1. Sub Floor ACM remediation;	4.5 – 6

	2. Slab and foundation removal; 3. Contaminated HALO scrape and validation; 4. Backfilling and topsoiling.	months
3	1. ACM Services removal; 2. SW WW services removal; 3. Concrete duct and other service removal; 4. Hardstand (roading/paving) removal (including coal tar), including embankment over Wharekōrino Stream; 5. Backfilling and finishing/topsoiling/grassing. 6. WWTP demolition and remediation works.	11-13 months
4	7. Lining of trunk stormwater line	3-6 months

5.3 EARTHWORKS AND LAND DISTURBANCE AREA AND VOLUME SUMMARY

Earthworks and land disturbance areas and volumes are set out in Table 4.

Table 4: Estimated Earthworks and Land Disturbance Quantities

Item	Description	Area (ha)	Excavation Volume (m^3)	Cut to Fill Volume (m^3)	Extra Fill Volume Required (m^3)
A	Building footprints[1] – backfilling	3.69	7,750	0	7,750
B1	Contaminated soil removal - buildings	1.28	2,403	0	2,403
B2	Contaminated soil removal – non-building areas	0.20	852	0	852
B3	Contaminated soil removal - provisional	Counted under A, B1, E	4,527	0	4,527
C	Roading complete removal & backfilling	3.49	10,424	0	10,424
D	Residual roading conversion to farm track	2.71	3,301	0	3,301
E	Services and in-ground structures removal, including WWTP[3]	1.24	2,385	825	1,560
G	Removal of Culvert 2 embankment road crossing over Wharekōrino Stream[2]	0.30	6,800	50	450
H	Stormwater trunk lining	N/A	N/A	N/A	N/A
	Total		38,442	875	31,267

Notes: All quantities are solid measure; red quantities are soil

1. Building footings/foundations volumes are based on limited building plan data and from FTL Halo spreadsheet analysis - low confidence estimate (6,200m^3) used with 25% contingency added
2. Culvert 2 embankment: 400m^3 topsoil, 60m^3 roading and 6300m^3 cut earthworks; 50m^3 fill earthworks and 450m^3 topsoil.
3. Services and inground structures – stated area is estimated soil disturbance area; additional width alongside trench may be disturbed due to trafficking – excavator and small truck –

allowing for this would increase works area to approximately 8.8ha. This is conservative and does not allow for overlapping areas from different services.

6.0 EROSION AND SEDIMENT CONTROL MEASURES

Erosion and sediment control requirements are set out in this section. All sediment control works are to be operational prior to any other works commencing on site and shall remain in place until development works are complete and measures are in place to minimise erosion.

All erosion and sediment controls shall comply with the WRC document 'Erosion & Sediment Control Guidelines for Soil Disturbing Activities' dated January 2009, technical report number No.2009/02, updated in 2014, with current information on specific items found online (https://waikatoregion.govt.nz/services/publications/tr200902/).

6.1 SUMMARY

Principal erosion and sediment control measures to be used on the site are summarised below.

Table 5: Primary Erosion and Sediment Control Measures Summary

Item	Provided	Comments
Construction Entrance	Possibly	Majority of internal vehicle movements will be via existing roading/paving. For vehicles trafficking unpaved areas, construction entrance will be provided or alternatively wheel wash or water blaster.
Filter Socks	Possibly	Possibly around stockpile areas and existing stormwater catchpits, where present in works areas.
Silt Fences	Yes	Primary means of sediment control. Site is relatively flat and silt fences will be installed on downgradient side of works areas. Provisional locations are shown in 3000 series drawings.
Super Silt Fences	No	Not required, as proposed silt fencing complies with WRC ESCG criteria.
Clean diversion drains/bunds	Yes	At relevant locations around the site to divert clean runoff around works areas. Provisional locations are shown in 3000 series drawings.
Dirty diversion drains/bunds	Yes	Likely required in contractor's yard to direct dirty runoff to DEB/SRP.
Decanting earth bunds	Possibly	Possibly as alternative to SRP
Sediment retention ponds (SRPs)	Yes	Proposed for use in contractor's yard area.
Stream diversions	Yes	Required for Culvert 2 embankment removal works and stormwater trunk main lining works.

The final design, location and sequencing of these measures may vary from that shown here, and will be determined on-site by the contractor and supervising engineer prior to commencement of works within each phase or sub-phase. Approval for any significant changes will be sought from WRC, as required.

6.2 OVERVIEW

All sediment laden runoff from the site will be routed through sediment retention structures. These structures are to be designed, constructed and maintained in accordance with best practice and generally as set out in this report. The proposed erosion and sediment controls include the following:

(a) Temporary and long term control works for the separation at source of dirty and clean stormwater.

(b) Silt fences as the primary means of erosion/sediment control.

(c) Clean and dirty water diversion drains.

(d) Ponds (SRPs) for retention, sediment control and treatment of stormwater in order to remove coarse silt close to source and to settle out finer particles (where required).

(e) Temporary stream diversions.

6.3 PROPOSED SEQUENCING

The works will be broken up into a number of different works areas. The expected sequence of earthworks and associated activities in each work area is summarised below:

- Install all silt/sediment control structures required for earthworks/land disturbance, including silt fences, sediment retention ponds, diversion drains/bunds and construction entrance for machinery access to site, as appropriate. Obtain approval from Engineer prior to commencing works.
- Undertake demolition works, which will create cavities requiring backfilling. For unpaved, non-contaminated areas, strip topsoil and stockpile (separately) for reuse.
- Undertake backfilling, placing and compacting subsoils, followed by retopsoiling. Where services cross over areas to be reinstated as gravel farm tracks, backfill with hardfill.
- Mulch, hydroseed or grass all batters and exposed soil surfaces, as appropriate. This will be done progressively as different areas are completed.
- Decommission silt control devices once exposed surfaces are fully stabilised.

Specific requirements for the Culvert 2 embankment works, stormwater trunk main lining are set out later in this document.

Further details on specific items from the above list are given in the following sections as required

6.4 VEGETATION REMOVAL

Vegetation tends to improve erosion and sediment control by binding of the soil by the root systems of trees and other vegetation, which provides mechanical reinforcement and resists

erosion by surface water, and by the reduction of surface water by the evapotranspiration process. Vegetation strips may also enhance the natural sediment filtering process.

Vegetation removal for the demolition works primarily involves grass (pasture) removal from unpaved areas where services are to be removed. Vegetation removal within the disturbance areas will be delayed as much as practicable prior to commencement of land disturbance works in each works area to minimise the time unstabilised ground is exposed. These areas will be stabilised as soon as practicable once demolition works are complete in each area.

6.5 EXISTING UNDERGROUND SERVICES

Existing stormwater, wastewater, water supply, power and telecom services and associated inground structures will be removed in accordance with Demolition Management Plan requirements – all Asbestos pipes, 800mm depth for other pipes and 1000mm for structures. These works will be undertaken in short duration work packages, undertaking excavation, removing pipes/structures and final inspections prior to starting the next package. This methodology will significantly reduce the time disturbed ground is exposed and allow permanent stabilisation measures to be taken as soon as practicable.

Trench spoil will typically be placed on the upgradient side of the trench and provision made for covering this spoil with pinned geotextile in the case of predicted wet or windy weather. Provision will also be made for placing filter socks or similar below the disturbed ground when trenching is located outside of areas serviced by silt fences. The trench will then collect any direct rainfall on to it, while the mounded trench soil will divert clean runoff around the works. Topsoil will then be spread and permanently stabilised or compacted hardfill backfill placed in areas designated for gravel farm tracks.

Any direct rainfall into trenches will be allowed to soak into the underlying ground, or if this may impede or delay the works, a portable pump will be used to pump out water collected in the trench with this being pumped into a “turkey’s nest” or similar device and then allowed to disperse across adjacent grassed areas. In any locations where this is not possible, the water would be collected by sucker truck and taken to the on-site SRP for treatment or pumped out into an intermediate bulk container (IBC) for transfer to the on-site SRP or disposal off-site.

Figure 2: Top - Turkey's nest made from filter socks; Bottom left: dewatering bag and pipe sock; Bottom right: mobile "turkey's nest.

Any water trapped in buried services that are to be removed, particularly stormwater or wastewater reticulation, will be removed by sucker truck and disposed of to the nearby sewer system or as trade waste. Alternatively, it may be disposed of as stormwater, if water quality testing determines this is appropriate.

6.6 PERIMETER CONTROLS

Prior to earthworks activities commencing, appropriate perimeter and diversion drain controls (clean and dirty) will be installed for sediment control. Principal perimeter controls include silt fences and diversion drains/bunds, while filter socks may also be used.

The locations of these various devices, as described in the following, are shown on the Fraser Thomas drawings. These locations are provisional and exact requirements and locations may be changed on-site by the Engineer or Contractor during construction, subject to discussion and agreement with the WRC Monitoring Officer.

6.7 FILTER SOCKS

Filter socks are tubular stormwater and sediment control devices, consisting of a mesh tube filled with filter material (e.g. compost, sawdust, straw). Where works are detached from the main works areas and diversion drains are not required, filter socks can be used to bund the works area and treat the associated dirty runoff. The main advantage of these devices is their portability and flexibility allowing constant adjustment as works progress.

Filter socks may be installed:

- Where small gradients exist and the works area is small.
- As a containment structure where it is not possible to drain to the sediment removal devices (e.g. works in a gully).
- As check dams to slow flow in the diversion drains.
- Around existing stormwater catchpits.

They can also be substituted for silt fences in some locations on-site.

6.8 SILT FENCES

Silt fences are a temporary barrier of woven geotextile fabric used to intercept runoff, reduce velocity, and impound sediment runoff from small areas (<0.3ha) of disturbed soil. On gradients steeper than 2%, returns will be placed in accordance with the WRC ESCG. Silt fences (or diversion bunds) will be used as the primary means of silt control across the site.

6.9 SUPER SILT FENCES

Super Silt fences are a temporary barrier of woven geotextile fabric used to intercept runoff, reduce velocity, and impound sediment runoff. Super silt fences are an upgraded version of silt fences. The use of a chain link fence and two layers of geotextile enable them to be used on catchments greater than 0.5ha, subject to contributing catchment slope and length constraints. On gradients steeper than 2%, returns need to be placed in accordance with the WRC ESCG.

It is not anticipated that super silt fences will be required for these works.

6.10 DIVERSION DRAINS / BUNDS

Temporary and long term diversion drains/bunds have been divided into clean and dirty water drains.

Clean water diversion drains will be installed at relevant locations around the site to direct clean runoff to avoid it entering active works areas and/or mixing with dirty runoff.

Dirty water collection drains/bunds will be used to collect dirty runoff from works areas (primarily contractor's yard) where appropriate and convey it to downstream sediment retention ponds or decanting earth bunds.

The drains will be designed with capacity to accommodate a 20 year storm event plus sufficient freeboard to accommodate a 100 year event. All drains over 2% gradient will be lined or otherwise stabilised to prevent localised scour and erosion.

Due to the relatively flat nature of the site, most clean/dirty water drains have small catchments. Required drain dimensions are shown below.

Table 6: Clean and Dirty Water Drain Dimensions

Drain Type	Width (m)		Depth (m)
	Base	Top	
1	0.1	1.45	0.225
2	0.2	1.85	0.275

Notes:

1. Drain ID: D = dirty; C = clean
2. Side slopes based on 1V:3H. Steeper side slopes of up to 1V:2H may be used on approval of Council and Engineer.
3. All drains with gradients >2% or velocities >1.5m/s need lining with geotextile.

6.11 DECANTING EARTH BUNDS

Decanting earth bunds (DEBs) are designed to settle out sediment entrained in runoff during construction activities before it can leave the site, or enter the stormwater system. DEBs are appropriate for exposed catchments of up to 0.3ha. They are sized using WRC ESCG for a minimum volume of 3% of the contributing catchment. This gives a DEB size of 90m^3 for the maximum allowable catchment area. No DEBs are proposed for use at this stage. However, they may be used to substitute for SRPs (using several DEBS for each SRP replaced) or in localised situations where the generation of concentrated dirty runoff can not be avoided, meaning silt fences are not suitable for use.

6.12 SEDIMENT RETENTION PONDS

Sediment retention ponds (SRPs) are designed to settle out sediment entrained in runoff during construction activities before it can leave the site, or enter the stormwater system.

The contractor's yard is considered the main area where SRPs should be utilised. This area may be used for temporary storage of different materials (e.g. hardfill, subsoil and topsoil backfill material) and also for processing some demolition materials (e.g. crushing concrete). These activities have potential to generate dirty runoff.

The contractor's yard is proposed to be located in the former industrial part of the site. Most of this area is paved or covered with buildings. Specific buildings may be able to be used for the storage of some materials while others will be demolished in the early stages of demolition works to make this space function better. The appropriate location for an SRP in this area is at the location of Building B74 (laundry) or near it. This building has a footprint of 322m^2 with reinforced concrete perimeter footings and concrete slab foundation, while the required SRP footprint for the 0.95ha construction yard catchment is 409m^2. Hence, it is proposed to demolish this building prior to use of this area as a construction yard and to construct a SRP at the location of Building B74. Alternatively, if this potentially may delay other works, the SRP would be constructed in the grassed area immediately north of B74. The SRP has been oversized by approximately 100m^3 so that it can accommodate some extra volume that may be generated from dewatering in other works areas (refer section 6.5).

The SRP discharge pipe would be connected to the site's stormwater system.

Table 7: Sediment Retention Pond Details

Item	Contractor's Yard
Pond ID	SRP-1
Pond catchment (ha)	0.95
Required volume (m^3)	190
Pond surface area (m^2) - top of pond	409
Provided dead storage (m^3)	91
Total storage (m^3)	297
Freeboard (mm)	300
Decant rate (details)	2.9L/s (1 x decant with 127 holes)
Primary spillway	100dia pipe, 1% gradient
Discharge pipe	100mm dia at minimum 1% gradient
Emergency spillway	6m base width, 1V:3H side slopes, 0.3m depth

6.13 FLOCCULATION

The contractor's yard catchment will contain materials from a variety of sources, including possible crushed concrete which can generate alkaline runoff. Once the materials to be stored in this area are better defined and appropriate samples can be collected for bench testing, a Chemical Treatment Management Plan (CTMP) will be prepared, with the CTMP provided to WRC for approval. The CTMP will include procedures to deal with elevated pHs associated with concrete runoff if this is found to be necessary. The requirements within this plan must be met prior to commencing activities in this area.

Batch or rainfall activated flocculation dosing will be provided for the SRP to enhance silt/sediment removal during site earthworks in accordance with the CTMP provided, if bench testing finds this to be necessary.

The pH and clarity of the pond discharge will be monitored for compliance with the WRC ESCG and remedial works undertaken in accordance with the CTMP, as required.

6.14 TOPSOIL AND BACKFILL STOCKPILE AREAS

Topsoil and backfill materials will be stockpiled at suitable locations. These stockpiles will either be grassed, hydroseeded, mulched or covered with geotextiles to prevent erosion and transport of loose soil, and be provided with appropriate perimeter controls (silt fence, small bunds (minimum 300mm high) or filter socks).

6.15 STABILISATION OF COMPLETED WORKS AREAS

As each work area is completed, they will be backfilled appropriately (subsoils/topsoil or hardfill) and re-vegetated through either grassing, mulching or hydroseeding. Any excess backfill materials and topsoil will remain stockpiled and maintained in a stabilised condition for future use.

6.16 DUST CONTROL MEASURES

Standard dust control measures will be used to control dust at the site and soil disturbance measures will be suspended if dry and windy conditions prevail, or alternatively the disturbance area shall be watered and maintained in a slightly moist state to minimise dust generation.

Dust management during excavation/land disturbance works and stockpiling will generally comply with the procedures set out in *Good Practice Guide for Assessing and Managing Dust* (Ministry for the Environment, 2016).

Further dust control measures are included in the DMP.

6.17 VEHICLE SILT/SEDIMENT TRACKING MITIGATION

If vehicles transporting materials on/off site can be restricted to paved areas, then their wheels are less likely to require cleaning prior to leaving the site.

For any vehicles trafficking unsealed areas, they are likely to pick up silt/sediment on their wheels, which could subsequently be deposited on internal roading within the site and/or the

public road network. For such vehicles, they will be required to pass through a stabilised construction entrance, prior to leaving the site. This comprises a stabilised accessway, complying with updated TR2009/02 requirements; i.e. it will maintain a minimum of 50-75mm washed gravel depth of 150mm over a minimum 10m length and minimum 4m width on a geotextile layer. This will minimise the deposition of sediment onto adjacent properties.

Alternatively, the contractor may provide a wheel wash or water blaster, subject to runoff being directed to an appropriate silt/sediment trap or other device, prior to discharge off-site.

6.18 MULCHING, TEMPORARY AND PERMANENT SEEDING

The primary objective of erosion and sediment control is to minimise the time ground is exposed prior to permanent stabilisation. If delays occur during the works or an intermediate form of stabilisation is required (e.g. on stockpiles), mulching or hydroseeding may be utilised. Permanent stabilisation can be achieved via the application of topsoil (100mm minimum thickness), followed by seeding or planting. Disturbed areas will be considered stabilised once a minimum 80% vegetative cover has been established. Grass seed will be sown at an appropriate rate as set out in the WRC ESCGs (90kg/ha for perennial rye grass; 30kg/ha for brown top; 30kg/ha for red/white clover mix). Mulch will be applied at a minimum rate of 6000kg/ha.

Combined mulching and seeding will not only stabilise the works area instantly (from the mulch) but will also typically decrease the time required to achieve 80% vegetative cover.

6.19 WEATHER MONITORING

Monitoring and predicting rainfall is essential to the performance of erosion and sediment control and civil works in general. Forecast rainfall will be monitored and high risk wrk will be undertaken during extended periods of fine weather, as much as practicable. When rainfall is predicted, all efforts will be made to ensure that the necessary measures are in place prior to rainfall and further inspections are made during rainfall and after to ensure that erosion and sediment control measures are functioning as intended.

7.0 WORKS IN A WATERCOURSE

7.1 CULVERT 2 REMOVAL (C2)

7.1.1 Works Overview

There is a redundant road embankment crossing the Wharekōrino Stream that provided an historical side road entrance to the Site, located in the north-eastern area of the site. The location of this road crossing is shown on drawing 33205/EMB004. The culvert through this embankment has not been able to be located yet, due to it being completely submerged. This culvert is estimated to have a diameter of 1350mm to be consistent with the upstream culvert 3. The road embankment is approximately 6m wide (at the top) by 50-60m long. It is relatively high, with an estimated height of 5.5m from the stream bed to the embankment crest. This culvert has a significant influence on flood levels affecting the existing disposal site

while the road embankment acts as a dam, affecting stream flow patterns and ecology. The embankment itself was heavily overgrown and had been subject to flytipping, but this has recently been cleared, with all debris, waste and vegetation removed.

The stream bed is very flat through this area, with significant water ponding both upstream and downstream of the culvert. This means it will be challenging to remove the bottom section of embankment within the stream bed itself.

Geotechnical investigation of this embankment found that the majority of the fill material appears to be controlled fill, likely borrowed from a nearby source. The exception was fill material, containing minor (ETP05), trace (ETP06) and abundant (ETP07) construction debris including concrete, bricks, metal and wire in 0.6-1.0m layers.

Embankment fill testing for contamination found that all samples complied with site specific remedial standards. Most samples were within or slightly above background levels, although Benzo-a-pyrene equivalent (BAP) was detected in one sample at 5.4mg/kg and asbestos was detected at one location at <0.001wt %, adjacent to where an asbestos pipe was found.

Based on the above, it is considered that the majority of the fill embankment can be reused for backfilling within the hospital site.

7.1.2 Embankment Removal Methodology

Removal of this culvert and the associated stream embankment would involve the following works over an approximately 3,000m^2 area, involving total excavation volume (soil and roading materials) of 6,800m^3:

C2.1: Vegetation and tree removal, with trees being mulched on-site, where practical;

C2.2: Establishment of erosion and sediment controls; including temporary damming of stream (likely both upstream and downstream) and diversion of stream runoff by pumping around the works area. During these works, the existing culvert will remain live for as long as possible, as examined further below.

C2.3: Removal of redundant road paving, basecourse and subbase material to stockpile. Reuse suitable materials on-site as backfill material and dispose of other materials off-site to appropriate processing or disposal facility.

C2.4: Remove road embankment to stockpile. Reuse suitable materials on-site for backfill material for the hospital demolition works and dispose of excess spoil and any unsuitable materials off-site to appropriate facility. The embankment should be removed in horizontal layers down to near the top of the culvert. A portable pump capable of handling summer low stream flows will be used to convey water over the remaining embankment during the final removal works, while part of the embankment will also be lowered and temporarily lined with geotextile to create a spillway in the event of a storm. The culvert (estimated 1350mm dia x 20-30m long) and associated inlet/outlet structures will all be removed.

C2.6: Trim stream banks to tie in with existing stream profile (3000m^2).

C2.7: Place clean topsoil along stream batters – estimated 100-150mm thick and cover with biodegradable coir matting or similar.

C2.8: Grass and/or plant upper stream banks (estimated 1500m^2) and plant lower stream banks (estimated 1500m^2).

C2.9: Remove temporary dams and erosion/sediment controls.

These works are shown on the 33205/EMB series plans, with the erosion and sediment control plan being 33205/EMB004. Any stream works must comply with the Fish Management Plan (separate document).

7.2 WWTP DECOMMISSIONING WORKS

The WWTP decommissioning works involve several items either within or adjacent to the Wharekōrino Stream, including:

- Item 4: Remove WWTP outfall pipe.
- Item 8: Remove grit chamber on wastewater inlet line.
- Item 9: Remove inlet wastewater pipe strapped to footbridge.
- Item 10: Remove footbridge.
- Item 11: Remove any associated ancillary cabling/ducts (e.g. electrical controls, former monitoring cables, etc. from footbridge).

Item numbering is with reference to drawing 33205/2010.

Item 4 can be undertaken with a filter sock or similar below the pipe outlet, which is located above the normal stream water level.

Items 8-11 all involve works within the watercourse. The contractor for these works will be required to provide a specific ESCP describing associated erosion and sediment control measures to minimise potential adverse effects on the stream during the works.

7.3 TRUNK STORMWATER PIPE LINING

7.3.1 Works Overview

Stormwater runoff from rural farm land to the west of the site (166ha area catchment) flows into and through the site via a combination of open channels and pipe reticulation, discharging into a tributary of the Wharekōrino Stream and then flowing to the north under Te Mawhai Road, into the Pūniu River a short distance downstream. This system is referred to as the trunk stormwater system. It comprises a total length of 1770m of 675-900dia pipe in moderate to poor condition. The two natural wetlands onsite are located in different areas on top of the trunk stormwater system.

Archived plans show that the stormwater system was designed to have some flood detention areas located in the central and north-eastern corner of the site, before discharging into the Wharekōrino Stream tributary. A stormwater pipe is shown on these plans as running under the flood detention basin, which has separate culverts feeding into it, with a re-entry structure conveying water from the flood detention basin into the underlying stormwater system.

It is proposed to reline all damaged trunk stormwater pipes on site, which is expected to increase the lifetime of the system by at least 50 years. As this falls outside of the main

demolition works scope, this will be undertaken after completion of the demolition works, when heavy plant and machinery has been removed from site.

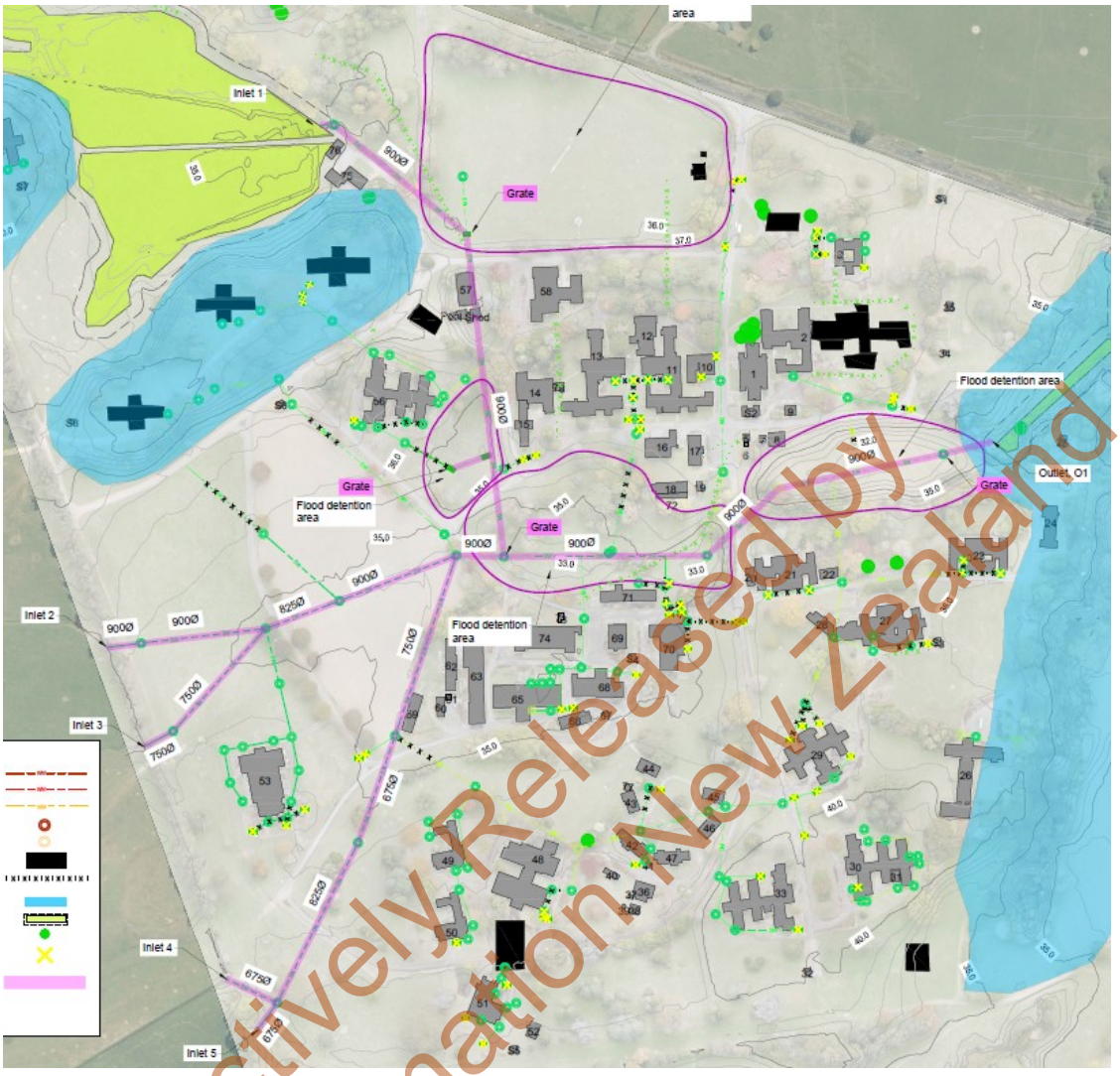


Figure 3: Trunk Stormwater System and associated flood detention basins (purple shading)

7.3.2 Trunk Main Lining Works Methodology

The trunk stormwater pipe network is shown in Figure 2. The pink highlighted pipes are to remain and be lined. This system has 5 inlets, I1-I5, receiving runoff from off-site, upgradient rural areas. It also drains some flood detention basins within the site (the blue shaded areas) via open grates which will be retained. It discharges to a tributary of the Wharekōrino Stm at Location O1.

Drawing 33205/PL001 (refer Demolition Management Plan) shows the contributing off-site catchments to the inlets. The downstream end of the trunk main is flooded either due to partial blockage or to backwater effects from the main stream.

The pipe system comprises the following:

- 1170m x 900dia pipe
- 143m x 825dia pipe

- 292m x 750dia pipe
- 163m x 675dia pipe

Review of the CCTV shows limited sections within these pipe lengths require lining.

Stormwater non-trunk pipe removal and capping works will be undertaken separately as part of site demolition works and in advance of stormwater trunk pipe lining works, so that all piped inlets into the trunk main system will be removed or capped, except for those pipes draining flood detention areas.

The pipe lining works are likely to take around 3-6 weeks and would be conducted during summer – likely January-March to take advantage of the typically driest time of year. Given the size of the contributing catchments and photos/videos of flow in pipes from the CCTV survey, it is considered unlikely these works can be done at a time of no flow (i.e. there is always likely to be some flow through pipes). A preliminary methodology for these works is set out in the following:

(a) Sand bagging or similar at the downstream end near Location O1 to cut off backwater from the Wharekōrino Stream. This dam would remain in place for duration of works. Install "outlet pump" above dam to pump out backwater in pipes (one-off event) and continue pumping out flows down pipe.

(b) Divide the pipe into work sections, based on 3-5 day work packages. Each work package would depend on the distance between adjacent manholes and the magnitude of repairs required in each section from which would an estimated time to complete each section can be determined.

(c) Works would proceed from Location O1 upstream.

(d) Install an upstream dam in the manhole at the upper end of Works Package 1, with a pump to divert flows around the works extent, past the outlet pump directly to the stream itself (preferable).

(e) Undertake lining works in Works Package 1 area.

(f) On completion and allowing for relevant curing time, relocate upstream dam and upstream pump to upper end of Works Package 2. The upstream pump will be used to pump any water in the pipe above the works area past Works area 2 to Works Area 1 upper MH, with water flowing down the lined pipe and being pumped to the stream via the outlet pump. The outlet pump may be removed once the works have reached a point where they are no longer affected by backwater effects.

(g) Continue steps (e) and (f) until all damaged pipe is lined.

(h) Remove all internal dams and allow natural flows through the pipe system from I1-I5 to O1.

These works and the associated erosion and sediment controls for temporary stream diversion are shown on drawing 33205/PL004-PL109.

The final methodology would be confirmed on appointment of a lining contractor. This would be submitted to WRC for review and approval, as part of the final ESCP for WRC certification.

8.0 MAINTENANCE

8.1 GENERAL

The sediment control measures will be regularly monitored during earthworks/land disturbance operations and after any significant rain event.

A visual inspection of the earthworks erosion/sediment control system will be carried out as soon as practicable and no later than 15 hours after a heavy rainfall event, in which 20mm of rain or greater is recorded on the site rainfall gauge within the preceding 24 hour period or 15mm or greater within one hour. The status of the system, including any problems or unusual occurrences, will be recorded. Remedial works will be carried out as soon as conditions are safe for workers and machinery.

Maintenance of all structures including silt fences, sediment retention ponds, diversion drains and/or bunds will be carried out on a regular basis. Exposed surfaces will be stabilised with grass by hydroseeding or by geotextile fabric or mulching, and reinstated as soon as practicable after works.

Maintenance will be the responsibility of the Contractor and will be carried out daily-weekly and subsequent to any storm event that produces runoff. The maintenance inspection will include, but not be limited to, the following:

- Inspection of silt fences, including:
  - Check waratahs, returns and back stays are secure in ground.
  - Check geotextiles extend into ground and there are no gaps under the fence.
  - Check geotextiles for tears and replace immediately.
  - Check joins in geotextile and replace where necessary.
  - Remove silt when sediment accumulation reaches 50% of the fabric height.
  - Make any necessary repairs when bulges occur.

- Inspection of any filter socks including:
  - Removing sediment once sediment reaches approximately 50% of the fabric height and repairing/replacing the filter sock if damaged (e.g. bulging).
  - Inspection after each rainfall event.
  - Checking the integrity of the filter sock and media.
  - Check for excessive ponding, indicating that the filter media has become clogged.

- Inspection of earthworks area including:
  - Checking for exposed areas and either isolate with a diversion drain, silt fence and re-seed, mulch the exposed area.
  - Checking for erosion on batter slopes and stabilising, as necessary.

- An inspection of the topsoil stockpiling areas, including:
  - Inspecting the silt fences/bunds, cleaning, repairing and checking that geotextiles are covering stockpiles and properly secured.

- Inspection of any decanting earth bunds and the sediment retention ponds, including:
  - Checking embankments, spillways, level spreader and any exposed areas. Any areas with seepage/leaks will be sealed.
  - Checking the sediment depth (at 6 monthly intervals) and removing sediment once it reaches 20% of the total sediment retention pond volume. To assist in gauging sediment loads, the 20% volume height will be clearly marked on the decant riser. During pond cleaning, the outlet valve will be shut and water containing sediments will be pumped to the landfill or an area where it can be treated before being discharged from the site. Any such area will be in a location where the sediment cannot be eroded and re-enter the stormwater system.
  - Checking the operation of the decant arrangement.
  - Checking any debris arrestors/screens and clearing them.

- Inspection of temporary diversion bunds and channels, including:
  - Checking for exposed areas and re-hydroseeding;
  - Checking for obstructions, damage and erosion and reinstating drains/bunds where necessary. Parts of the channel experiencing regular erosion will be treated with either turf slabs, tensar mat, reno mattress or rock riprap.

- Inspection and maintenance of any temporary roading/tracking.

- Inspection of the downstream receiving environment, to check for sediment buildup/deposition.

8.2 MITIGATION AND CONTINGENCY MEASURES

Multiple measures have been included in the design of sediment control measures for the demolition works to prevent excess sediment loads entering the receiving environment. These measures include:

- Undertaking enabling works (topsoil stripping, minor earthworks/soil disturbance, etc.) over as short a period as possible, ideally during an extended period of fine weather.
- Undertaking services removal works in short work packages to minimise the trench area open at any one time.
- Installation of appropriately sized SRPs to settle out and decant sediments prior to discharge of flows to the stormwater system.
- Installing clean runoff diversion bunds/drains to minimise the loading on the sediment retention ponds.
- Installation of filter socks or silt fences downslope of all earthwork/land disturbance areas and around temporary stockpiles to contain silt/sediments on-site. Perimeter measures will remain in place until restoration of the associated works area is complete.
- Stabilising exposed surfaces as soon as practicable upon completion of earthworks with mulch, hydroseed or topsoil and grass to reduce erosion.

Provided these mitigation measures are in place and correctly maintained the risk of sediment runoff from the proposed works is considered to be less than minor.

8.3 PROPOSED MONITORING

The SRPs associated with site development earthworks will be monitored as set out in this ESCP and in accordance with any additional requirements in the CTMP.

8.4 DECOMMISSIONING

Sediment control works in specific works areas may only be decommissioned once it has been determined that all surface soils have been suitably stabilised through consultation and inspection by the contractor and LINZ. Decommissioning will be undertaken by light weight equipment or manually where possible and include the following:

- Respread any excess stockpiled topsoil and decommission the topsoil stockpiling area.
- Backfill any temporary collection drains and/or remove any diversion bunds and turf or mulch/grass seed as appropriate.
- Removing relevant silt fences, accumulated silt/sediment and reinstating the ground surface in those areas by turfing, mulching and/or grassing as appropriate.
- Remove bunds and decant structure and remove the SRP, as appropriate. Sediments from the pond will be spread out on a pre-selected area to be dried, topsoiled and grassed, or disposed of to an appropriate disposal facility. The pond area will be reinstated by grassing.
- Remove any temporary sediment control devices on stormwater inlets.

8.5 ASBUILTS

As-built certification for the proposed sediment retention devices and associated dirty water and clean water diversion drains will be provided to WRC on completion.

J:\33 series\33205 Tokanui infrastructure\ESCP\33205 ESCP 240924.doc

Drawings

(refer separate volumes)

Appendix A

Erosion and Sediment Control Calculations

Fraser Thomas Overland Stormwater Runoff - Rational Method			
Job no:	33205	Date:	9/10/2024
Client:	TOITŪ TE WHENUA - LINZ	Revision:	1
Job Name:	Tokanui Hospital Horizontal Infrastructure	Designer:	FV
		Reviewer:	TB
Purpose:	20 year ARI Temp Drains		

As per New Zealand Building Code E1/VM1, 2.0

Catchment runoff

Q = (C · i · A) / 360

Catchment coefficient based on NZBC clause E1

Stormwater intensity is taken from the HIRDS database output

RCP	Historical	Climate scenario - IPCC Representative Concentration Pathway (RCP)
ARI	20	yearly
Time of concentration method	Calculated	As per New Zealand Building Code E1/VM1, 2.3.2 b) or user input
User Time of concentration	N/A	minutes
Period	N/A	years

Catchment area	Surface type	Area, A_i ha	Run-off Coeff, Table 1 Ci	Slope correction Table 2 %	Run-off Coeff, Ci	T_c (min)	Intensity (mm/hr)	Flow Q (m^3/s)
D1	Grass	0.495	0.67	0-5%	0.72	10	108.00	0.106
		0.495						**0.106**
D2	Grass	0.443	0.67	0-5%	0.72	10	108.00	0.089
		0.443						**0.089**
D3	Grass	0.680	0.67	0-5%	0.72	10	108.00	0.136
		0.680						**0.136**
D4	Grass	0.108	0.67	0-5%	0.72	10	108.00	0.022
		0.108						**0.022**
D5	Grass	1.500	0.67	0-5%	0.72	10	108.00	0.300
		1.500						**0.300**
D6	Grass	0.094	0.67	0-5%	0.72	10	108.00	0.019
		0.094						**0.019**

Fraser Thomas Overland Stormwater Runoff - Rational Method			
Job no:	33205	Date:	9/10/2024
Client:	TOITŪ TE WHENUA - LINZ	Revision:	1
Job Name:	Tokanui Hospital Horizontal Infrastructure	Designer:	FV
		Reviewer:	TB
Purpose:	100 year ARI Temp Drains		

As per New Zealand Building Code E1/VM1, 2.0

Catchment runoff

Q = (C · i · A) / 360

Catchment coefficient based on NZBC clause E1

Stormwater intensity is taken from the HIRDS database output

RCP	Historical	Climate scenario - IPCC Representative Concentration Pathway (RCP)
ARI	100	yearly
Time of concentration method	Calculated	As per New Zealand Building Code E1/VM1, 2.3.2 b) or user input
User Time of concentration	N/A	minutes
Period	N/A	years

Catchment area	Surface type	Area, A_i ha	Run-off Coeff, Table 1 Ci	Slope correction Table 2 %	Run-off Coeff, Ci	T_c (min)	Intensity (mm/hr)	Flow Q (m^3/s)
D1	Grass	0.495	0.67	0-5%	0.72	10	149.00	0.147
		0.495						**0.147**
D2	Grass	0.443	0.67	0-5%	0.72	10	149.00	0.122
		0.443						**0.122**
D3	Grass	0.680	0.67	0-5%	0.72	10	149.00	0.188
		0.680						**0.188**
D4	Grass	0.108	0.67	0-5%	0.72	10	149.00	0.030
		0.108						**0.030**
D5	Grass	1.500	0.67	0-5%	0.72	10	149.00	0.414
		1.500						**0.414**
D6	Grass	0.094	0.67	0-5%	0.72	10	149.00	0.026
		0.094						**0.026**

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 5 2024

Drain Type 1 (20 year)

Trapezoidal

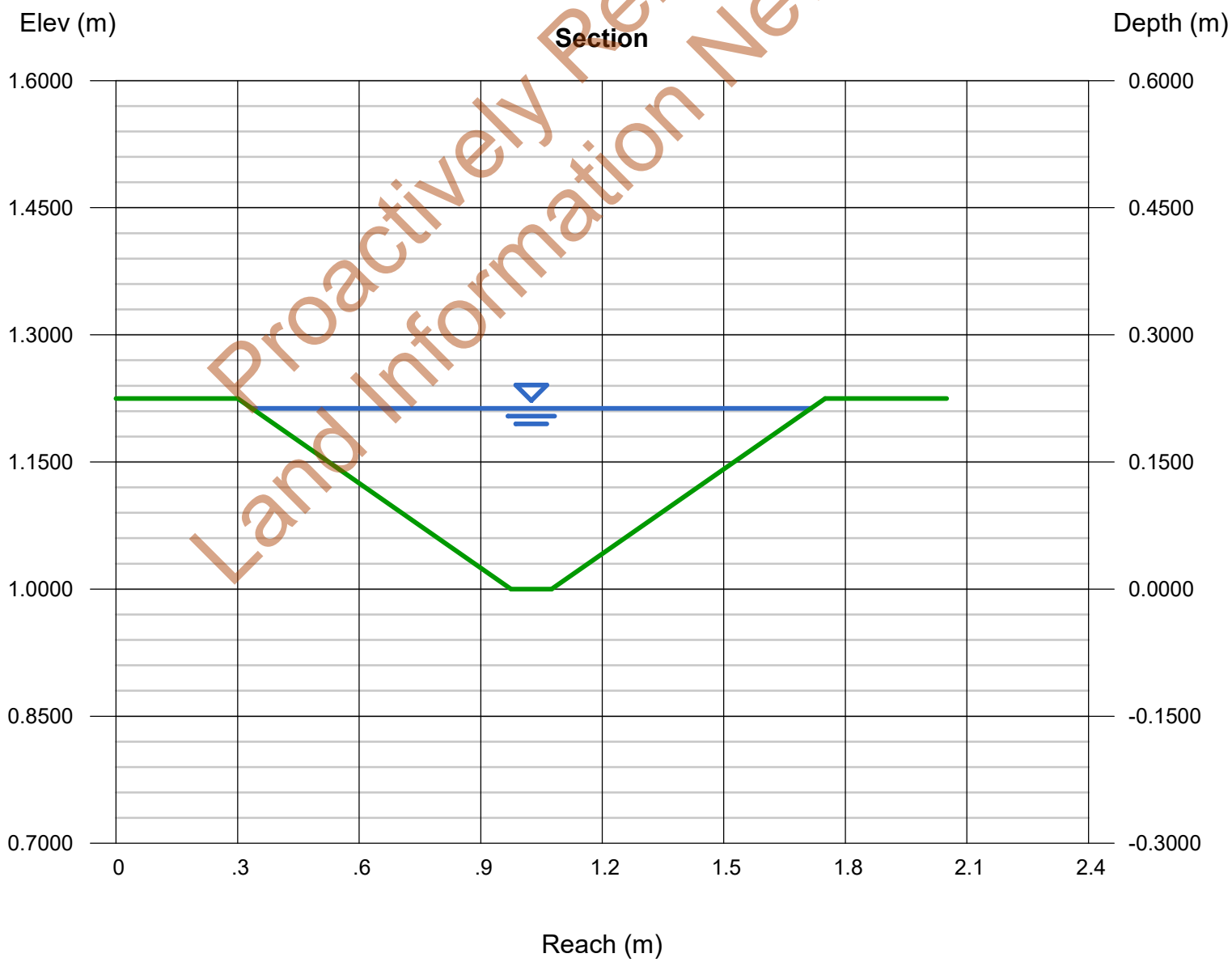
Bottom Width (m)	= 0.1000
Side Slopes (z:1)	= 3.0000, 3.0000
Total Depth (m)	= 0.2250
Invert Elev (m)	= 1.0000
Slope (%)	= 1.0000
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cms)	= 0.1400

Highlighted

Depth (m)	= 0.2134
Q (cms)	= 0.140
Area (sqm)	= 0.1579
Velocity (m/s)	= 0.8866
Wetted Perim (m)	= 1.4494
Crit Depth, Yc (m)	= 0.1981
Top Width (m)	= 1.3802
EGL (m)	= 0.2535



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 5 2024

Drain Type 1 (100 year)

Trapezoidal

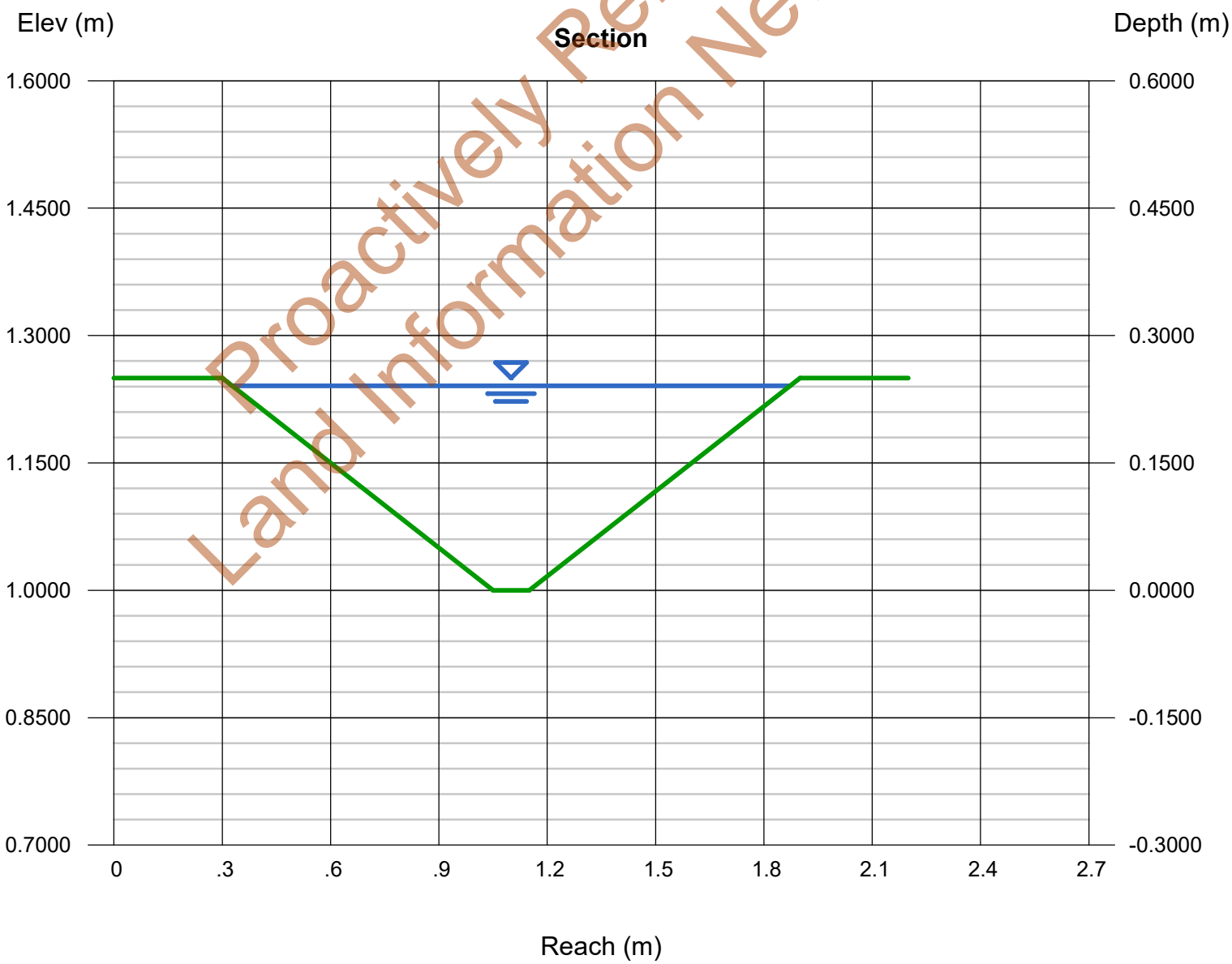
Bottom Width (m)	= 0.1000
Side Slopes (z:1)	= 3.0000, 3.0000
Total Depth (m)	= 0.2500
Invert Elev (m)	= 1.0000
Slope (%)	= 1.0000
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cms)	= 0.1900

Highlighted

Depth (m)	= 0.2408
Q (cms)	= 0.190
Area (sqm)	= 0.1980
Velocity (m/s)	= 0.9595
Wetted Perim (m)	= 1.6229
Crit Depth, Yc (m)	= 0.2256
Top Width (m)	= 1.5448
EGL (m)	= 0.2878



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 5 2024

Drain Type 2 (20 year)

Trapezoidal

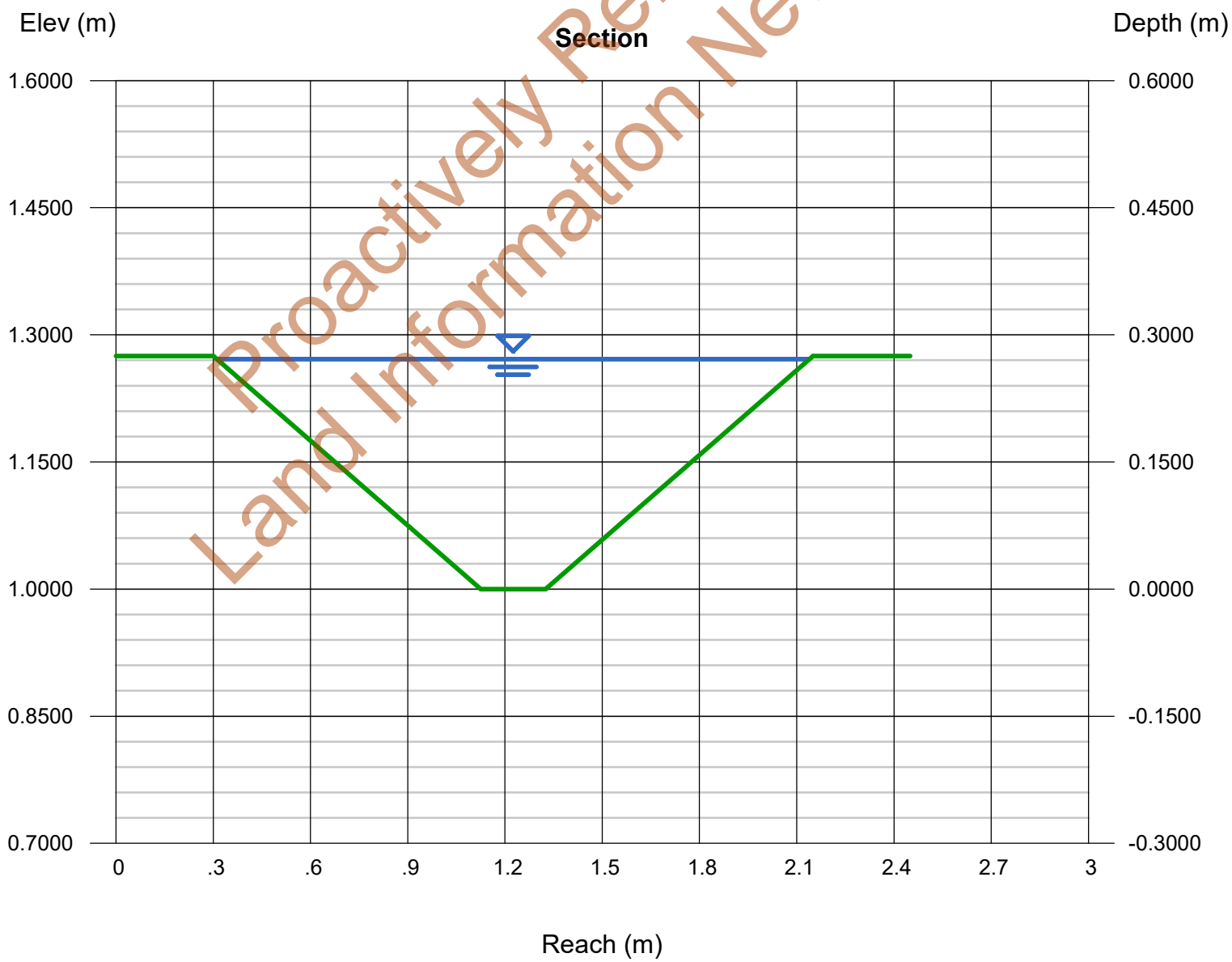
Bottom Width (m)	= 0.2000
Side Slopes (z:1)	= 3.0000, 3.0000
Total Depth (m)	= 0.2750
Invert Elev (m)	= 1.0000
Slope (%)	= 1.0000
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cms)	= 0.3000

Highlighted

Depth (m)	= 0.2713
Q (cms)	= 0.3000
Area (sqm)	= 0.2750
Velocity (m/s)	= 1.0908
Wetted Perim (m)	= 1.9157
Crit Depth, Yc (m)	= 0.2591
Top Width (m)	= 1.8276
EGL (m)	= 0.3320



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 5 2024

Drain Type 2 (100 year)

Trapezoidal

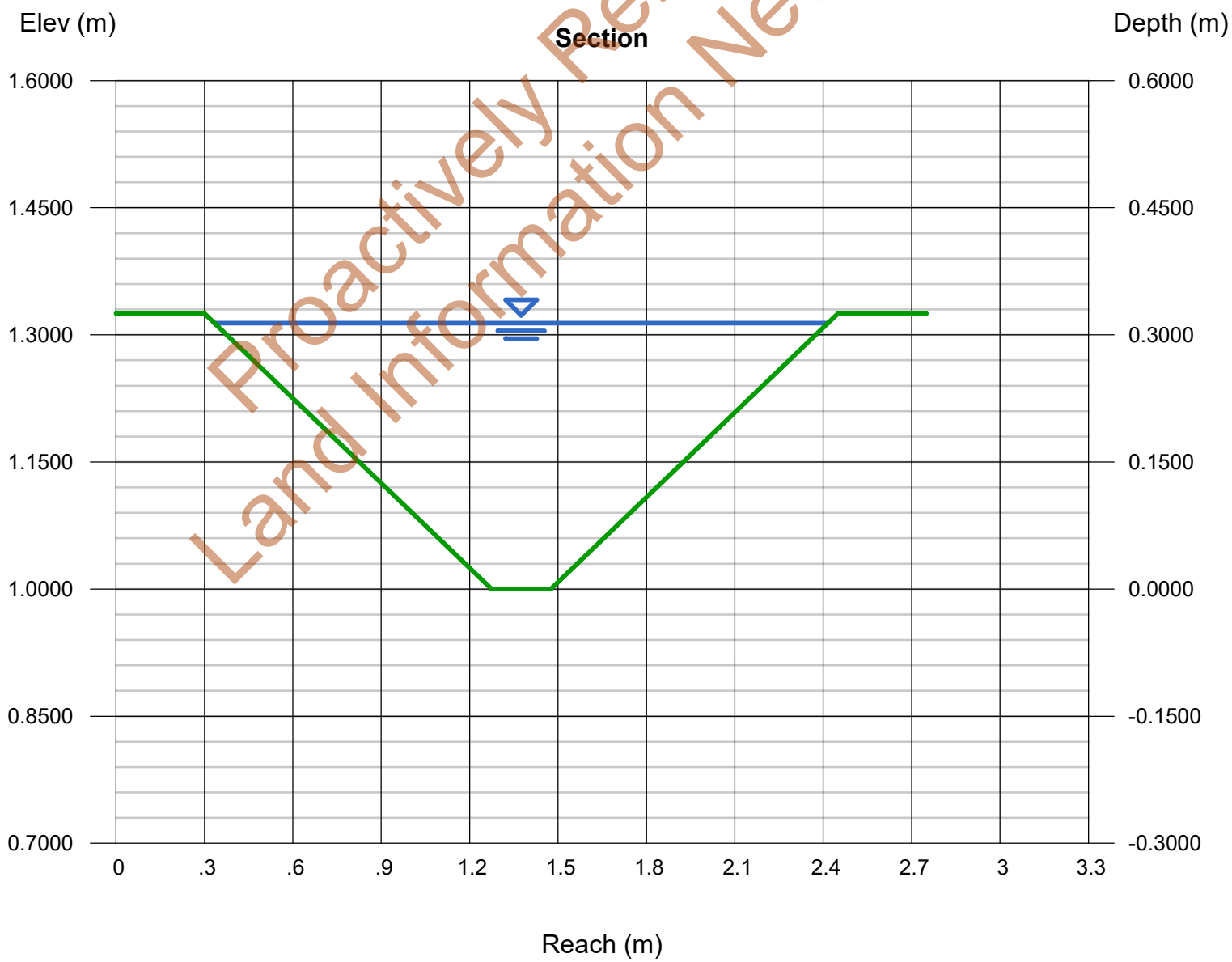
Bottom Width (m)	= 0.2000
Side Slopes (z:1)	= 3.0000, 3.0000
Total Depth (m)	= 0.3250
Invert Elev (m)	= 1.0000
Slope (%)	= 1.0000
N-Value	= 0.025

Calculations

Compute by:	Known Q
Known Q (cms)	= 0.4200

Highlighted

Depth (m)	= 0.3139
Q (cms)	= 0.4200
Area (sqm)	= 0.3585
Velocity (m/s)	= 1.1716
Wetted Perim (m)	= 2.1856
Crit Depth, Yc (m)	= 0.3018
Top Width (m)	= 2.0837
EGL (m)	= 0.3840



Client	LINZ	**Contractors Yard**	By	TB	Date	20/09/2024
Job	33205	**SRP-1**	Checked	SF	Date	25/09/2024

Job location: Waikato

Catchment area: 0.95 ha
Catchment slope: 1 %
Catchment length: 100 m

Maximum catchment area = 5 ha

Storage Volume Requirement

If catchment slope > 10 % then 3% catchment
Or if slope length > 200 then 3% catchment, else 2%
Volume requirement: 2% of catchment area
Storage volume: 190 m^3

Pond Parameters

Depth 1.7 m from invert to primary spillway
Length to width ratio 3
Internal batter slopes 1: 2
Entry batter slope 1: 3
Pond invert level 33.1 m RL
Baffles required: No

Location	Depth	Level	Width	Length	Area	Volume	Required
Base	0	33.1	3.2	21.5	69	0	
Dead storage	0.8	33.9	6.4	25.5	163	91	57
Primary spillway	1.7	34.8	10.0	30.0	300	297	190
Emergency spillway	2	35.1	11.2	31.5	353	395	
Top of pond	2.3	35.4	12.4	33.0	409	509	

Check:

Max decant operating range no more than 1.5m: OK
Live storage = 70% of storage volume OK
Dead storage = 30% of storage volume OK
Dead storage depth must be between 0.54 m and 0.8 OK

Decants

Number of decants: 1
Decant rate: 3 L/s per ha
Required decant flow: 2.85 L/s
Design decant flow: 2.85 L/s

Decants	RL	Holes
Decant 1	33.9	126.66667
Decant 2	NA	NA
Decant 3	NA	NA
Decant 4	NA	NA

Total holes
126.66667

Discharge Pipe

Spillway diameter 100 mm
Pipe gradient 1% (Pipe to be at 1-2% grade)
Pipe capacity 5 L/s
Pipe sufficient: Yes

Emergency spillway

Catchment C value 0.9
Rainfall rate 166 mm/hr 1% AEP storm event
Q_p 0.39 m^3/s

Emergency (1% AEP) spillway dimensions

Bottom width: 6 m
Side slope = 1V: 3 H
Spillway depth 0.3 m
Top width 7.8 m
Spillway capacity 1.86 m^3/s
Spillway sufficient: Yes

Forebay design

Level spreader level 35.2 m RL (100-200mm above emergency spillway level)
Forebay top width: 11.60 m
Forebay base width: 7.60 m
Forebay top length: 8 m
Forebay base length 4 m
Forebay depth 1 m
Forebay volume 59 m^3

Appendix B

WRC ESCG Fact Sheets

Earthworks series – erosion and sediment control factsheet

Stabilised construction entrance

DEFINITION

A stabilised pad of aggregate on a filter cloth base located at any point where traffic will be entering or leaving a construction site.

PURPOSE

To prevent site access points from becoming sediment sources and to help minimise dust generation and disturbance of areas adjacent to the road frontage by giving a defined entry/exit point.

APPLICATION

Use a stabilised construction entrance at all points of construction site ingress and egress, with a construction plan limiting traffic to these entrances only. They are particularly useful on small construction sites but can be used for all projects.

DESIGN

- Clear the entrance and exit area of all vegetation, roots and other unsuitable material and properly grade it.
- Provide drainage to carry run off from the stabilised construction entrance to a sediment control measure.
- Place aggregate to the specifications below and smooth it.

Stabilised construction entrance

AGGREGATE SPECIFICATIONS	
Aggregate size	50-75mm washed
Thickness	150mm minimum
Length	10m minimum
Width	4m minimum

Maintenance

Maintain the stabilised construction entrance in a condition to prevent sediment from leaving the construction site.
After each rainfall inspect any structure used to trap sediment from the stabilised construction entrance and clean out as necessary.
When wheel washing is also required, ensure this is done on an area stabilised with aggregate which drains to an approved sediment retention facility.

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Earthworks series – erosion and sediment control factsheet

Catch pit protection

Always implement appropriate best management site practices and primary environmental controls to prevent problems from first occurring, and minimise the amount of contaminants you have to manage and the potential risks of discharges from your site.

To prevent run off of muddy/silty water into gutters and drains, use one or more of the following measures:

1. Bunding: The drain is surrounded by a sediment sock/tube or sand bags, which traps sediment but still allows water to flow through to prevent flooding.
2. Catch pit (sump protection): Install a specially designed bag inside the drain sump to catch any dirty/silty run off but allow water to flow through. The methodology for ensuring no gap between the fabric and the road surface is always an issue. The best approach is to put light gravel on top to weigh down the fabric.
3. Covering: This must be well secured to prevent any water seeping through. If the drain grate can be lifted, place a barrier sheet/plastic under it and hold in place by the grate. Only use this method when there is no risk of causing flooding elsewhere.

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Earthworks series – erosion and sediment control factsheet

Silt fence

DEFINITION

A temporary barrier of woven geotextile fabric used to intercept run off, reduce its velocity and impound sediment laden run off from small areas of disturbed soil.

PURPOSE

To detain flows from run off so that deposition of transported sediment can occur through settlement.

Silt fences can only be used to intercept sheet flow. Do not use silt fences as velocity checks in channels or place them where they will intercept concentrated flow.

APPLICATION

- On low gradient sites or for confined areas where the contributing catchment is small, such as short steep batter fills and around watercourses.
- To delineate the limit of disturbance on an earthworks site such as riparian areas or bush reserves.
- To store run off behind the silt fence without damaging the fence or the submerged area behind the fence.
- Do not install silt fences across watercourses or in areas of concentrated flows.

DESIGN

- Ensure silt fence height is a minimum of 400mm above ground level.
- Place supporting posts/waratahs for silt fences no more than 2m apart unless additional support is provided by tensioned wire (2.5mm HT) along the top of the silt fence. Where a strong woven fabric is used in conjunction with a wire support, the distance between posts can be extended up to 4m. Double the silt fence fabric over and fasten to the wire and posts with wire ties or cloth fastening clips at 150mm spacing. Ensure supporting posts/waratahs are embedded a minimum of 400mm into the ground.
- Always install silt fences along the contour. Where this is not possible or where there are long sections of silt fence, install short silt fence returns, projecting upslope from the silt fence to minimise concentrations of flows. Silt fence returns are a minimum of 2m in length, can incorporate a tie back and are generally constructed by continuing the silt fence around the return and doubling back to eliminate joins.
- Join lengths of silt fence by doubling over fabric ends around a wooden post or batten or by stapling the fabric ends to a batten and butting the two battens together as shown in figure 1 (overleaf).
- Maximum slope lengths, spacing of returns and angles for silt fences are shown in table 1 (overleaf).
- Install silt fence wings at either end of the silt fence projecting upslope to a sufficient height to prevent outflanking.

- Where impounded flow may overtop the silt fence, crossing natural depressions or low points, make provision for a riprap splash pad or other outlet protection device.
- Do not use silt fences in catchments of more than 0.25ha.
- Where water may pond behind the silt fence, provide extra support with tie backs from the silt fence to a central stable point on the upward side. Extra support can also be provided by stringing wire between support stakes and connecting the filter fabric to this wire.

CONSTRUCTION SPECIFICATIONS

- Use silt fence material appropriate to the site conditions and in accordance with the manufacturer's specifications.
- Excavate a trench a minimum of 100mm wide and 200mm deep along the proposed line of the silt fence. Install the support posts on the downslope edge of the trench and silt fence fabric on the upslope side of the support posts to the full depth of the trench. Backfill the trench with compacted soil.
- Use supporting posts of tanalised timber a minimum of 50mm square, or steel waratahs at least 1.5m in length.
- Reinforce the top of the silt fence fabric with a wire support made of galvanised wire of a minimum diameter of 2.5mm. Tension the wire using permanent wire strainers attached to angled waratahs at the end of the silt fence.
- Where ends of silt fence fabric come together, ensure they are overlapped, folded and stapled to prevent sediment bypass.

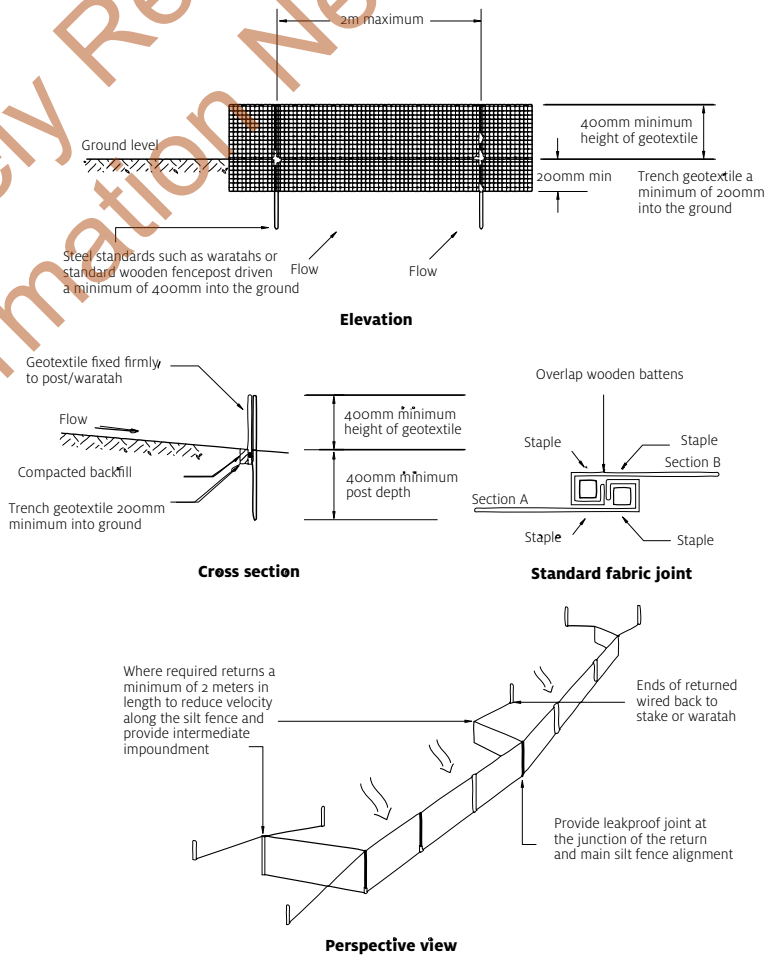
MAINTENANCE

- Inspect silt fences at least once a week and after each rainfall. Make any necessary repairs when bulges occur or when sediment accumulation reaches 50 per cent of the fabric height.
- Any areas of collapse, decomposition or ineffectiveness need to be immediately replaced.
- Remove sediment deposits as necessary to continue to allow for adequate sediment storage and reduce pressure on the silt fence. Ensure that the sediment is removed to a secure area.
- Do not remove silt fence materials and sediment deposition until the catchment area has been appropriately stabilised. Stabilise the area of the removed silt fence.

Table 1

Silt fence design criteria			
Slope steepness (%)	Slope length (m) (Maximum)	Spacing of returns (m)	Silt fence length (m) (Maximum)
Flatter than 2%	Unlimited	N/A	Unlimited
2-10%	40	60	300
10-20%	30	50	230
20-33%	20	40	150
33-50%	15	30	75
> 50%	6	20	40

Figure 1



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Earthworks series – erosion and sediment control factsheet

Silt sock/filter log

DEFINITION

A temporary barrier of woven geotextile fabric with mulch/bark filling used to intercept run off, reduce its velocity and impound sediment laden run off from small areas of disturbed soil.

PURPOSE

To detain flows from run off so that deposition of transported sediment can occur through settlement. Are a suitable alternative to silt fences in small/limited spaces.

Can be used to contain and filter discharges from pumped water or concrete wash water (turkeys nest).

Can be used for clean water diversions in small areas and to assist with catch pit protection.

Do not place silt socks in channels or use them where they will intercept concentrated flows.

APPLICATION

- On low gradient sites or for confined areas where the contributing catchment is small, such as short steep batter fills, around watercourses and small building sites.
- Around stockpiles, berms and silt edges where run off is imminent.
- In kerbs and channels, and around catch pits to divert water and retain sediment.
- Can be effective check dams.
- As a turkeys nest to treat pumped dirty water and concrete wash water.
- Can be doubled and secured down to increase capacity.

DESIGN

- Place directly onto the ground.
- Can be secured in place with twine and stakes to keep firmly in place to prevent water undercutting the sock and causing erosion at the edge of the site.
- Always install silt socks along the contour.
- Join lengths of silt sock by overlapping and securing the ends and securing with pegs and twine.

CONSTRUCTION SPECIFICATIONS

- Use product appropriate to the site conditions and in accordance with the manufacturer's specifications.
- Can be secured with pegs and twine to reduce movement and possible erosion.

MAINTENANCE

- Inspect silt socks at least once a week and after each rainfall. Make any necessary repairs or when sediment accumulation reaches 50 per cent of the sock height.
- Any areas of underscoring, decomposition or ineffectiveness need to be immediately replaced.
- Remove sediment deposits as necessary to continue to allow for adequate sediment storage and reduce pressure on the silt sock. Ensure that the sediment is removed to a secure area.
- Do not remove silt socks until the catchment area has been appropriately stabilised.

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Earthworks series – erosion and sediment control factsheet

Decanting earth bund

DEFINITION

A temporary berm or ridge of compacted earth constructed to create impoundment areas where ponding of run off can occur, and suspended material can settle before run off is discharged.

PURPOSE

Used to intercept sediment-laden run off and reduce the amount of sediment leaving the site by detaining sediment-laden run off.

APPLICATION

Decanting earth bunds can be constructed across disturbed areas and around construction sites and subdivisions. Keep them in place until the disturbed areas are permanently stabilised or adequately replaced by other means.

Decanting earth bunds can assist the settling of sediment laden run off, and are particularly useful for controlling run off after topsoiling and grassing before vegetation becomes established. Where works are occurring within the berm area, compact the topsoil over the berm area as bunds adjacent and parallel to the berm. This will act as an impoundment area and controlled outfall while also keeping overland flow away from the construction area.

DESIGN

- Decanting earth bunds need a constructed outlet structure and spillway, (see follow sections of this guide). The depth should be measured from the base of the decanting earth bund to the top of the primary spillway.
- Construct the decanting earth bunds such that the maximum contributing catchment does not exceed 0.3ha
- Lay the discharge pipe at a 1-2 per cent gradient, compact fill appropriately and incorporate an anti-seep collar.
  - Ensure all anti-seep collars and their connections are watertight.
- Use a flexible thick rubber coupling to provide a connection between the decant arm and the primary spillway or discharge pipe. Fasten the flexible coupling using strap clamps and glue and /or screws to prevent it coming off.
- Ensure the section of pipe leading through the decanting earth bunds and continuing downslope below the decanting earth bunds is non-perforated.
- On earthwork sites with slopes less than 10 per cent and less than 200m in length, construct the decanting earth bund with a minimum volume of 2 per cent of the contributing catchment ($20m^3$ for each 1000 square metres of contributing catchment).
- On sites with slopes greater than 10 per cent and/or 200m in length, construct decanting earth bunds with a minimum volume of 3 per cent of the contributing catchment ($30m^3$ capacity for each 1000 square metres of contributing catchment).

- Where possible, install the discharge pipes through the embankment as the embankment is being constructed.
- Fully stabilise the external batter face by vegetative or other means immediately after construction.
- Ensure all external bare areas associated with the decanting earth bund are stabilised in a manner consistant with the guidelines, such as mulch, cloth or vegetation.

DESIGN – EMERGENCY SPILLWAY

Stabilise the emergency spillway by lining it with a strong woven low permeability geotextile overlaid with a soft non-woven needle punched geotextile. Ensure the geotextile is pinned at 0.5m centres over the full area of the emergency spillway.

If there is sand, pumice or other erodible material under the spillways geotextile lining, install a waterproof layer underneath the geotextile, and an alternative method to pinning the geotextile is as follows:

- Bury the edges of the geotextile as per Figure 1.
- Connect a No 8 gauge wire between two waratah standards on either side of the spillway invert, tighten to hold the geotextile down as shown in Figure 1.
- If there is sand, pumice or other erodible material in the decanting earth bund embankment then an antiseep collar must be installed during the construction of the embankment.
- Ensure that all decanting earth bund embankments are compacted appropriately, particularly around the outlet pipe.
- Where possible, construct emergency spillways in well vegetated, undisturbed ground (not fill) and discharge over long grass. The emergency spillway must be located behind the decant system as far away as possible from the inlet.
- If the emergency spillway is constructed on exposed soil, provide complete erosion protection by means such as grouted riprap, asphalt, erosion matting/ geotextile or concrete.
- Construct the emergency spillway with a minimum of 100-150mm freeboard height above the primary spillway invert.
- The minimum emergency spillway dimensions are 2 metres wide with 250mm freeboard

Figure 1:

Connect to waratah on both sides, tighten wire

Waratahs	
No 8 gauge wire	

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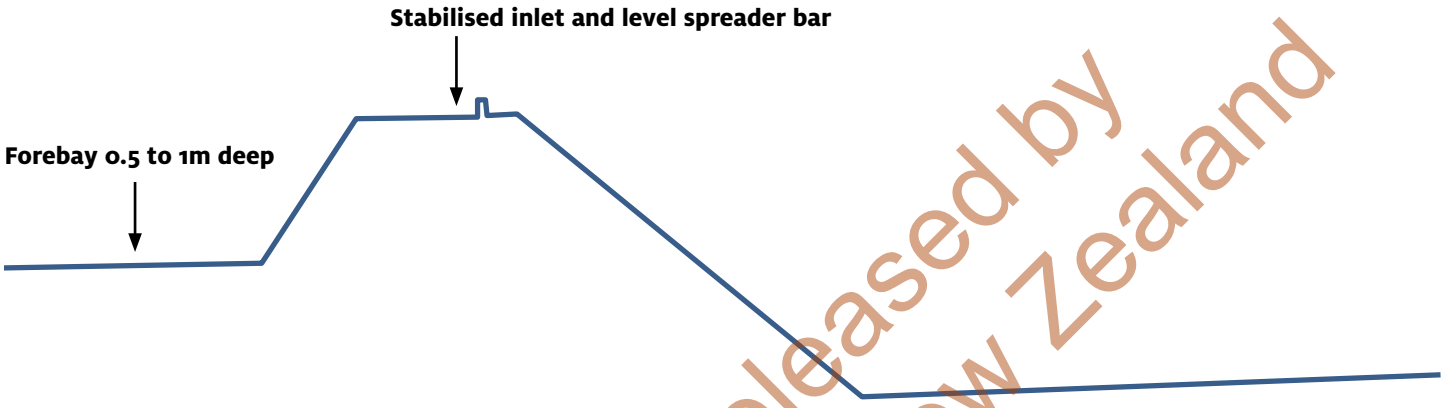
DESIGN – OPTIONAL FOREBAY

Benefits include the ability to clean deposition from the front of the control structure without damaging the 'clean' discharge side of the control.

- Construct a forebay with a volume equal to 10 percent of the pond design volume.
- The forebay is to extend the full width of the main pond and is to be 0.5 to 1 m deep.
- Inlets into the forebay are to be stabilised.
- Access to the forebay is to be maintained at all times to allow easy and frequent removal of accumulated sediments by an excavator.
- Sediment should also be removed after every large storm event and or when 20% of the pond volume is accumulated sediment.

Figure 2:



DESIGN – T-BAR DECANT

T-bar decants must be able to operate through the full live storage depth of the sediment retention pond.

- Position the decant inlet to provide 50 per cent live storage volume with a minimum distance of 5m of flat ground from the inlet. Otherwise raise the inlet so the dead storage level extends out at least this far.
- The decant rate is to be equal to 3 litres per second per hectare. Set the decant rate by drilling the correct amount of 10mm holes in the decant. For a 1,000 square metre contributing catchment 13 X 10mm holes will provide 0.3 litres per second. For a 1,500 square metre contributing catchment 20 x 10mm holes will provide 0.45 litres per second.
- The DEB must be set up so that all inflows enter as far as possible away from the decant.
- Ensure that a primary spillway (upstand riser) is constructed as part of the T-Bar decant, as detailed in figure 3.
- Ensure that the T-bar decant float is securely fastened with steel strapping directly on top of the decant arm and weight it to keep the decant arm submerged just below the surface through all stages of the decant cycle. This will also minimise the potential for blockage of the decant slots by floating debris.
- Position the T-bar decant at the correct height by supporting the decant arm between waratahs as detailed in figure 3.

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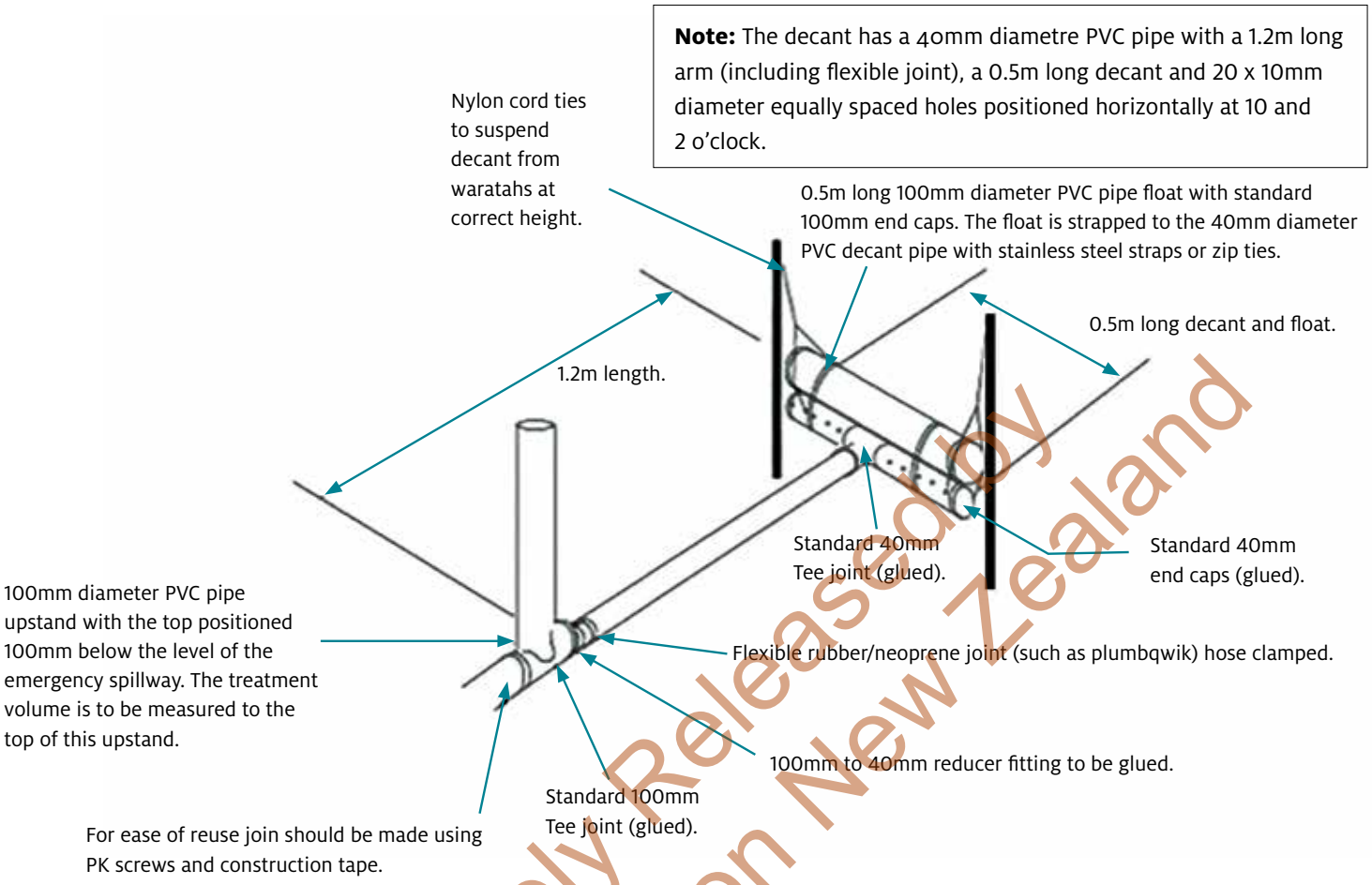
Figure 3: 40mm decant with upstand for decanting earth bund.



MAINTENANCE

Inspect and maintain decanting earth bunds regularly and after each rainfall event to check for accumulated sediment which may cause overtopping. Check any discharge points for signs of scouring and install further armouring or other stabilisation if scouring is evident.

Earthworks series – erosion and sediment control factsheet

Decanting earth bund

DEFINITION

A temporary berm or ridge of compacted earth constructed to create impoundment areas where ponding of run off can occur, and suspended material can settle before run off is discharged.

PURPOSE

Used to intercept sediment-laden run off and reduce the amount of sediment leaving the site by detaining sediment-laden run off.

APPLICATION

Decanting earth bunds can be constructed across disturbed areas and around construction sites and subdivisions. Keep them in place until the disturbed areas are permanently stabilised or adequately replaced by other means.

Decanting earth bunds can assist the settling of sediment laden run off, and are particularly useful for controlling run off after topsoiling and grassing before vegetation becomes established. Where works are occurring within the berm area, compact the topsoil over the berm area as bunds adjacent and parallel to the berm. This will act as an impoundment area and controlled outfall while also keeping overland flow away from the construction area.

DESIGN

- Decanting earth bunds need a constructed outlet structure and spillway, (see follow sections of this guide). The depth should be measured from the base of the decanting earth bund to the top of the primary spillway.
- Construct the decanting earth bunds such that the maximum contributing catchment does not exceed 0.3ha
- Lay the discharge pipe at a 1-2 per cent gradient, compact fill appropriately and incorporate an anti-seep collar.
  - Ensure all anti-seep collars and their connections are watertight.
- Use a flexible thick rubber coupling to provide a connection between the decant arm and the primary spillway or discharge pipe. Fasten the flexible coupling using strap clamps and glue and /or screws to prevent it coming off.
- Ensure the section of pipe leading through the decanting earth bunds and continuing downslope below the decanting earth bunds is non-perforated.
- On earthwork sites with slopes less than 10 per cent and less than 200m in length, construct the decanting earth bund with a minimum volume of 2 per cent of the contributing catchment ($20m^3$ for each 1000 square metres of contributing catchment).
- On sites with slopes greater than 10 per cent and/or 200m in length, construct decanting earth bunds with a minimum volume of 3 per cent of the contributing catchment ($30m^3$ capacity for each 1000 square metres of contributing catchment).

- Where possible, install the discharge pipes through the embankment as the embankment is being constructed.
- Fully stabilise the external batter face by vegetative or other means immediately after construction.
- Ensure all external bare areas associated with the decanting earth bund are stabilised in a manner consistant with the guidelines, such as mulch, cloth or vegetation.

DESIGN – EMERGENCY SPILLWAY

Stabilise the emergency spillway by lining it with a strong woven low permeability geotextile overlaid with a soft non-woven needle punched geotextile. Ensure the geotextile is pinned at 0.5m centres over the full area of the emergency spillway.

If there is sand, pumice or other erodible material under the spillways geotextile lining, install a waterproof layer underneath the geotextile, and an alternative method to pinning the geotextile is as follows:

- Bury the edges of the geotextile as per Figure 1.
- Connect a No 8 gauge wire between two waratah standards on either side of the spillway invert, tighten to hold the geotextile down as shown in Figure 1.
- If there is sand, pumice or other erodible material in the decanting earth bund embankment then an antiseep collar must be installed during the construction of the embankment.
- Ensure that all decanting earth bund embankments are compacted appropriately, particularly around the outlet pipe.
- Where possible, construct emergency spillways in well vegetated, undisturbed ground (not fill) and discharge over long grass. The emergency spillway must be located behind the decant system as far away as possible from the inlet.
- If the emergency spillway is constructed on exposed soil, provide complete erosion protection by means such as grouted riprap, asphalt, erosion matting/ geotextile or concrete.
- Construct the emergency spillway with a minimum of 100-150mm freeboard height above the primary spillway invert.
- The minimum emergency spillway dimensions are 2 metres wide with 250mm freeboard

Figure 1:

Connect to waratah on both sides, tighten wire

Waratahs	
No 8 gauge wire	

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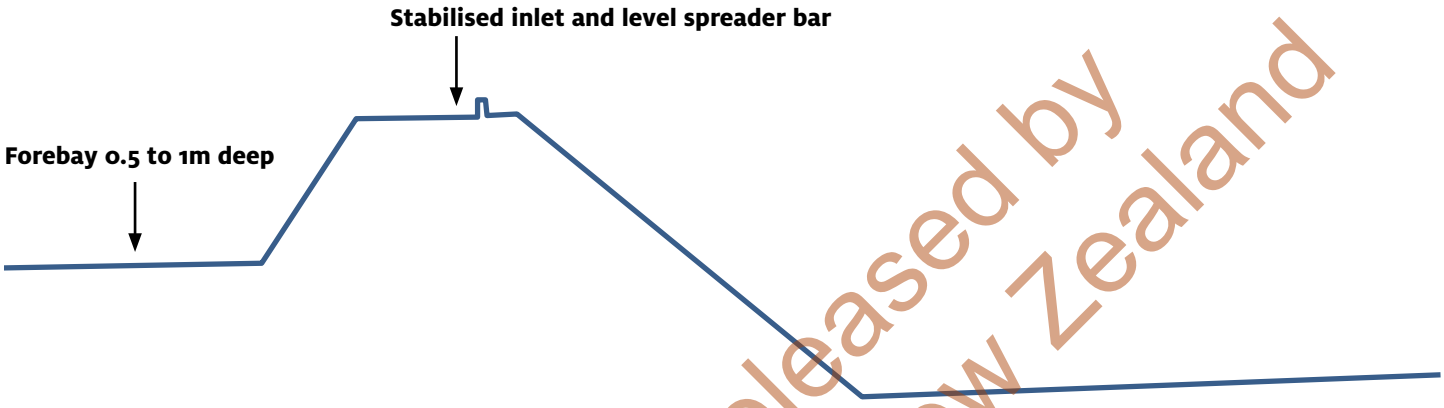
DESIGN – OPTIONAL FOREBAY

Benefits include the ability to clean deposition from the front of the control structure without damaging the 'clean' discharge side of the control.

- Construct a forebay with a volume equal to 10 percent of the pond design volume.
- The forebay is to extend the full width of the main pond and is to be 0.5 to 1 m deep.
- Inlets into the forebay are to be stabilised.
- Access to the forebay is to be maintained at all times to allow easy and frequent removal of accumulated sediments by an excavator.
- Sediment should also be removed after every large storm event and or when 20% of the pond volume is accumulated sediment.

Figure 2:



DESIGN – T-BAR DECANT

T-bar decants must be able to operate through the full live storage depth of the sediment retention pond.

- Position the decant inlet to provide 50 per cent live storage volume with a minimum distance of 5m of flat ground from the inlet. Otherwise raise the inlet so the dead storage level extends out at least this far.
- The decant rate is to be equal to 3 litres per second per hectare. Set the decant rate by drilling the correct amount of 10mm holes in the decant. For a 1,000 square metre contributing catchment 13 X 10mm holes will provide 0.3 litres per second. For a 1,500 square metre contributing catchment 20 x 10mm holes will provide 0.45 litres per second.
- The DEB must be set up so that all inflows enter as far as possible away from the decant.
- Ensure that a primary spillway (upstand riser) is constructed as part of the T-Bar decant, as detailed in figure 3.
- Ensure that the T-bar decant float is securely fastened with steel strapping directly on top of the decant arm and weight it to keep the decant arm submerged just below the surface through all stages of the decant cycle. This will also minimise the potential for blockage of the decant slots by floating debris.
- Position the T-bar decant at the correct height by supporting the decant arm between waratahs as detailed in figure 3.

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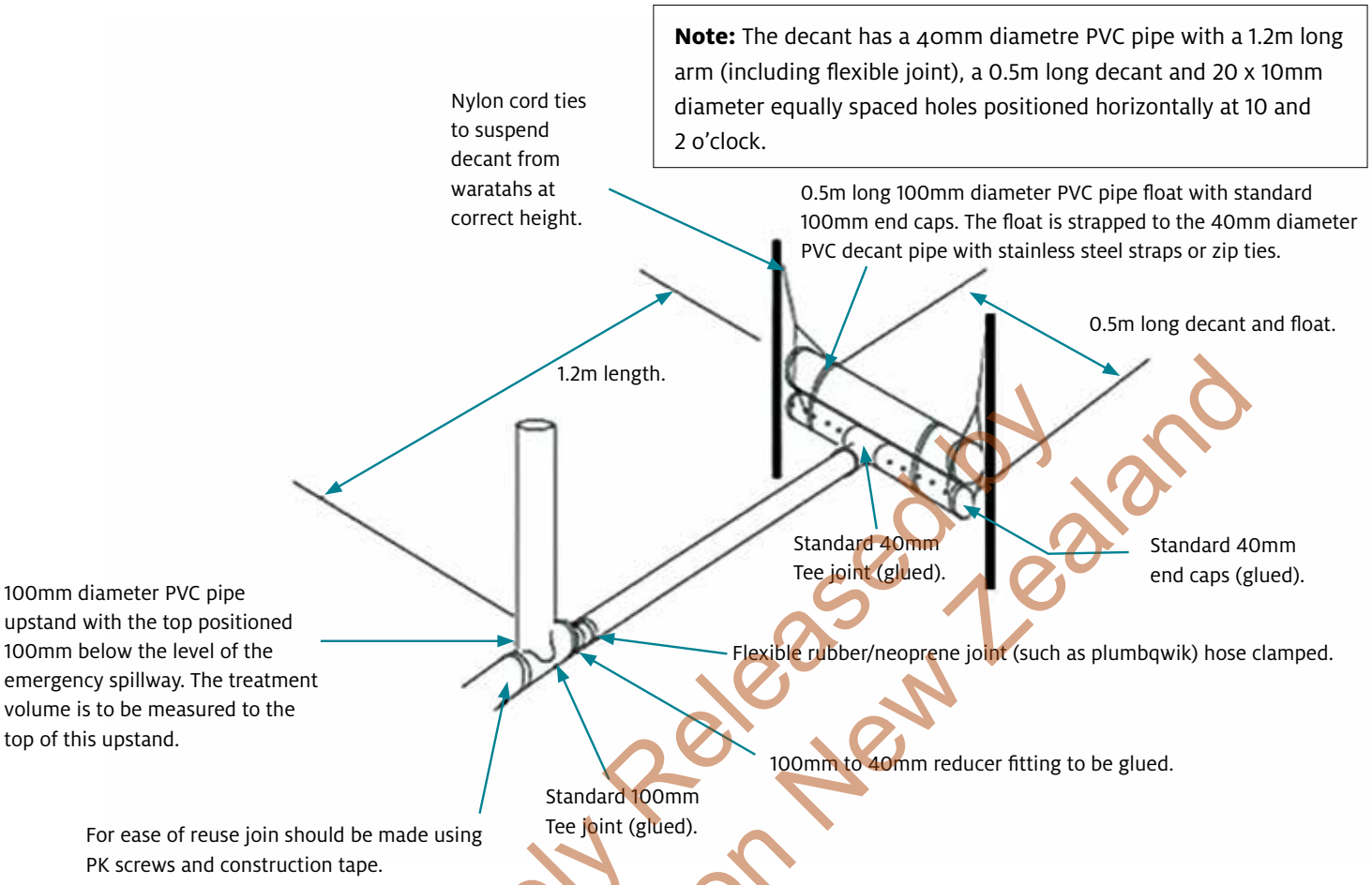
Figure 3: 40mm decant with upstand for decanting earth bund.



MAINTENANCE

Inspect and maintain decanting earth bunds regularly and after each rainfall event to check for accumulated sediment which may cause overtopping. Check any discharge points for signs of scouring and install further armouring or other stabilisation if scouring is evident.