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North East Levin Stormwater

Erosion and Sediment Control Plan
Tributary Crossings & Attenuation Areas 3 and 4; Koputaroa Stream Tributary
September 2021

Horowhenua District Council

V4 Draft for Consenting

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1 INTRODUCTION

This Erosion and Sediment Control Plan (ESCP) outlines the proposed controls to minimise erosion and control sediment from stormwater runoff during the undertaking of proposed earthworks in and around the upper reaches of the Koputaroa Stream tributary, from the site of 181 Roslyn Road, Levin through to 259 State Highway 57, Levin. These earthworks shall provide attenuation volume to mitigate potential adverse effects of Levin stormwater discharge on downstream properties, before discharging to the northeast into the Koputaroa Stream tributary.

The proposed attenuation areas will provide sufficient storage in order to achieve hydraulic neutrality with respect to peak flows.

Scope and Version Control

This ESCP relates to the stream crossings, culvert upgrades, embankments for creating attenuation areas, and earthworks to be undertaken to increase attenuation volume capacity. Earlier versions (v1, v2) of this ESCP detailed the necessary controls for an earlier proposal of the attenuation system. In 2021, it was identified that larger attenuation volumes were required to achieve hydraulic neutrality (as documented in consent s92 information responses) and, as a result, the required earthworks volume has increased. The ESCP was therefore updated (v3, July 2021) to ensure that the proposed erosion and sediment control measures are appropriate for preventing adverse effects in terms of sedimentation during the construction phase. It has further been updated (this version, v4, September 2021) following discussions with the contractor, Higgins, in order to incorporate their proposed methodology and to address queries from Regional Council. The primary change in this version of the ESCP is incorporation of the contractor's proposed methodology to undertake stream diversions to enable the works to be completed in the dry and to utilise the proposed embankments as sediment retention devices.

A separate ESCP has been prepared with respect to the first attenuation area, known colloquially as Coley Pond. The earthworks requirements for Coley Pond have not changed significantly and therefore updating of the ESCP for Coley Pond is not required at this time.

Both the Coley Pond ESCP and this ESCP are prepared as draft for consenting purposes. This is standard practice for consenting matters, with the ESCP to be finalised and submitted for technical certification as a condition of consent.

2 DESCRIPTION OF WORKS TO BE UNDERTAKEN UNDER THIS ESCP

The subject site is situated along the watercourse of the Koputaroa Stream tributary, across several properties to the northeast of the intersection between Fairfield Road and Roslyn Road.

The earthworks shall be undertaken at five (5) distinct sites, along a tributary which has been highly modified, with areas of wet weeds in the natural low points of the site. There are very few trees on site, and no ecologically significant areas in the surrounding vicinity, including downstream.

The existing topography is generally flat over most of the site apart from the existing watercourse. The immediately adjacent ground is graded/contoured down towards the watercourse base.

The sites, and the proposed earthworks are as follows:

1. **Crossing No 1:** This is a stream crossing / culvert upgrade and does not involve any significant earthworks. These works are not required to give effect to the current proposal but may be undertaken if agreed and requested by the landowner. Works at this site are unchanged from that detailed in the earlier version of this ESCP.

2. **2nd Embankment:** This was an embankment and culvert upgrade which was proposed to create the formerly proposed 2nd Attenuation Area. The 2nd Attenuation Area is no longer proposed and any works in this area would only be undertaken to provide improved access across the stream for the landowner if so requested. The works are the embankment only and do not involve any significant earthworks. These works are not required to give effect to the current proposal. If works are undertaken at this site, the scope and erosion and sediment control measures are unchanged from that detailed in the earlier version of this ESCP.

3. **3rd Attenuation Area and Embankment.** An embankment is proposed which will create an attenuation area during times of high rainfall and stormwater runoff. This area and embankment is to be constructed in two stages as shown in the drawings in Appendix A, with erosion and sediment control measures as follows:
    - Stage 1 Methodology
        - Create a stream diversion around the earthworks extent to enable works to be undertaken in the dry (note that cultural monitor and fish recovery methods to be undertaken as per any conditions of consent)
        - Create a clean water diversion to divert upstream catchment away from the work area
        - Create a temporary intermediary embankment at the downstream extent (but upstream of where the diversion re-enters the stream). This will act as sediment control detention basis for the works area, with decant provided.
        - Undertake the earthworks to create the attenuation area.
        - Stabilise completed earthworks area
        - Decommission the temporary embankment and diversion.
    - Stage 2 Methodology, to be undertaken in two halves as follows:
        - An embankment is to be constructed on the true right side of the stream (above the stream water line) to act as sediment detention, with decant provided. Silt fencing between the embankment and water course may be installed (to be confirmed in the final pre-construction ESCP) to protect the water course during the embankment construction.
        - Complete earthworks on true right above embankment. The earthworks area is the majority of the catchment area for this work site and therefore clean water diversion is not required.
        - Once the earthworks on the true right are stabilised, divert the watercourse through this area.
        - Construct remainder of attenuation area embankment which will act as sediment retention area for remainder of attenuation area 3 earthworks
        - Create clean water diversion above earthworks areas.
        - Undertake remainder of earthworks to create attenuation area 3, using downstream embankment as sediment retention with decant.
        - Stabilise earthworks area.
        - Liven stage 2 attenuation area by removing temporary embankment.

4. **4th Attenuation Area and Embankment.** An embankment is proposed which will create an attenuation area during times of high rainfall and stormwater runoff. The embankment construction is generally as per the earlier proposal and the way in which these works across the stream will be undertaken is as per the earlier version of this ESCP. Due to the need to maintain vegetation on either side of the works as well as the site topography of the site, it is not possible to divert the watercourse around this site. It is proposed to undertake the works within dry areas but diverting the watercourse “over” or “through” the site by use of novaflow pipework from attenuation area 3 embankment outlet to downstream of the works area and / or overpump the water from attenuation area 3 to downstream of the works area. Topography of the area means

that clean water diversion is not required above the earthworks area (ie there is no significant run-on catchment to the site).

5. **Crossing No 2:** This is a stream crossing / culvert upgrade and does not involve any significant earthworks. These works have been agreed with the landowner. Works at this site are unchanged from that detailed in the earlier version of this ESCP.

Figure 2.1: Location of Works

The works to be undertaken at the site will generally be as follows:

- Install ESC devices as described above and in this ESCP, including stabilised construction entrances.
- Topsoil stripping and stockpiling.
- Bulk earthworks, excavation to create proposed attenuation areas and culvert embankments as per the relevant stage.
- Stabilisation and establishment of grass cover.
- Removal of ESC devices.
- Planting of excavated attenuation areas.

Refer also to the ESCP plans included in Appendix A. For attenuation areas 3 and 4, these plans are overlaid on Figure 4.1 from GHD Ltd's stormwater assessment report. The cross-sections included in that base plan show the water level at the design 100 year water level downstream of Coley Pond. The invert shown in these cross-sections is not the invert of the stream, but is the level obtained via LIDAR and reflective of existing vegetation. The design invert for the attenuation areas is controlled via the outlet level for Attenuation Area 4 to match to the existing watercourse. Within the attenuation areas, the final design will include some shaping to reinstate the low level meandering watercourse that maintains hydraulic connectivity for the watercourse along this stretch of the tributary.

The sites receive water from a culvert through the downstream embankment of the first attenuation area (Coley Pond) (which is received as stormwater from the residential area) plus any runoff from the adjacent paddocks.

The works of this stage of stormwater attenuation areas are intended to be undertaken in a period(s) of sustained dry weather. The 'Stage 1' stormwater treatment and attenuation area (Coley Pond) shall enable significant catchment of stormwater volume in the occurrence of any rain events during the earthworks[1], allowing the watercourse through the site to be effectively managed to be at or near low water flows, thereby controlling the amount of water which needs to be diverted around the active works area. Note that water flow will not be held up entirely within Coley Pond, but the attenuation volume within Coley Pond may be used to manage high flows during the earthworks. When there is water in Coley Pond, some flow will be maintained in order to maintain hydraulic connectivity downstream of the active earthworks areas.

No winter works are proposed and no works will be undertaken between 1 May and 30 September in any year.

3 PRINCIPLES FOR EROSION & SEDIMENT CONTROL

This ESCP identifies and outlines systems to minimise surface erosion during the execution of the earthworks and to deal with any sediment that is transported by rainfall-generated runoff. This will reduce the impact of the earthworks both across the site and within the watercourse. The principles to be adopted are as follows.

3.1 Minimising Disturbance

The areas of earthworks will be limited to within the confines of the attenuation areas and dam embankments as much as possible. Diversion of the flowing water away from the earthworks areas will enable the earthworks to be undertaken in the dry while maintaining stream flow past the earthworks area to maintain continuity of flows downstream. The proposed works will also be undertaken in stages with each stage being stabilised before the next stage is opened up.

The principal areas of earthwork excavation will be to increase the storage volumes of the third attenuation area, shown in Figures 3.1 and 3.2, and the fourth attenuation area, shown in Figure 3.3.

Figure 3.1
Third Attenuation Area to be Excavated, View to North

[1] *Coley Pond will be capable of retaining volumes, equivalent to the entirety of the modelled 2-year rainfall event (estimated volume of 2-year event is 13,655 m^3 as per Table 3.6 of GHD stormwater modelling report) and approximately 42% of the 10-year event.*

Figure 3.2
Third Attenuation Area to be Excavated, View to North-East
(True left side of current watercourse area. Watercourse in growth of Raupo)

Figure 3.3
Fourth Attenuation Area to be Excavated, View to North
(From True right side of current watercourse, Excavation area opposite side)

Assessment by ecologists consulted by both Horowhenua District Council and Horizons Regional Council have determined that there is less than minor ecological value in existing vegetation at sites of the third and fourth attenuation areas. The fourth attenuation area, as expanded in the current proposal, has been specifically designed to avoid established plantings. Disturbance of existing vegetation will be minimised as far as practicable, and any vegetation lost during excavation and construction of embankments can be addressed by replanting.

The limits of earthwork disturbance shall be generally as shown in site plans provided in Appendix A. On site these limits of disturbance will be marked by pegs and/ or temporary fences as needed.

3.2 Earthworks Staging

Earthworks of each geographically separate attenuation area will be completed and replanted in turn, to minimise open areas as much as possible.

Proposed staging of works has been summarised above.

Table 3.1: Summary of Earthworks Areas and Volumes (Approx.)

Attenuation Area		Area (m^2)	Volume (m^3)
Area 3	Stage 1	3,000	2,500
	Stage 2 – True Right	6,000	5,000
	Stage 2 – True Left	8,000	7,500
Area 4		3,000	2,700

Note that areas specified above are greater than the footprint area shown on GHD Ltd's drawing Figure 4.1 which is the base plan for the ESCP drawings included in Appendix A. This is because the footprint area notated by GHD is the footprint area of the normal water level within the attenuation area, rather than the extent of earthworks area stated in Table 3.1 above.

Haul Roads will be via the existing farm access routes with stabilised entrances.

3.3 Protect Steep Slopes

The site topography is generally very flat. In this regard, there are no steep slopes currently on the site.

3.4 Protect Water Bodies

As stated above, the works of this stage of stormwater attenuation areas are intended to be undertaken in a period(s) of sustained dry weather, thereby minimising impact of erosion sediment upon the watercourse.

The existing watercourse will be diverted around the active work areas in order to enable the works to be undertaken in the dry, and to maintain continuity of flow past the active site to the downstream watercourse. Furthermore, construction of the Stage 1 Attenuation area will allow Levin stormwater to be attenuated, thereby managing water flows that will need to be diverted.

Clean water diversion drains are also proposed upgradient of the area to be disturbed where there is a run-on catchment.

3.5 Stabilisation of Exposed Areas

The planned re-vegetation or stabilisation of the site will be undertaken as soon as practical following the completion of the earthworks. This would generally be done by mulching in conjunction with seed and fertiliser for regrassing and / or hydroseeding. Excavated attenuation areas and side slopes are to be planted with grass species suitable for the region, to be confirmed through consultation with local Iwi and Horizons.

Immediate topsoiling and grassing can achieve a successful grass strike within three weeks. To encourage rapid strike, a watering program may be implemented if necessary. Once 80% cover has been established, it will be deemed sufficient for erosion control. Cut-off drains and silt fencing (where used) for retention of sediment will remain in place at the edges of exposed earthworks areas until such time.

3.6 Installing Perimeter Controls

A stabilised construction entrance shall be established prior to commencement of earthworks. This will provide a defined entry/ exit point for the site, prevent said access point from becoming a sediment source, and assist in minimising dust generation and disturbance of areas adjacent to the road frontage.

Where utilised, silt fencing shall be installed, and cut-off drains established before commencement of earthworks. Cut-off drains are to be established around the up-gradient perimeter of the extent of earthworks in the third attenuation area true left works in order to capture clean run-on and divert it around the earthworks extent.

3.7 Dust Control

Due to the distance from residential properties nuisance value of any dust generation by earthworks is likely to be less than minor. However, careful monitoring and management of dust will be undertaken at the same time as erosion and sediment control monitoring. Measures to be undertaken include visual observation of dust, monitoring of wind conditions, and the use of a watercart if and as required.

Haul Roads will be via existing farm races with stabilised entrances as shown in Appendix A.

3.8 Detention Devices

Active earthwork areas have been split into stages as set out above. Due to the nature of the works (being to create attenuation areas), rainwater within the active earthworks areas will naturally flow to the embankments which are being constructed to form the attenuation areas. Therefore, the proposal is to use these embankments to act as sediment retention devices during the active earthworks phase, in addition to the temporary embankment to be used in “Stage 2 – true right” phase of attenuation area 3.

Decant devices will be installed as set out below at the outlet (embankment) points.

3.9 Inspection

Prior to commencement of earthworks, site inspection shall confirm the installation of a stabilised construction entrance, sediment decants, and perimeter cut-off drains.

Periodic assessment and supervision of necessary adjustments to the erosion and sediment controls will be conducted by the Engineer to the Contract (or their representative). Prior to grass strike over disturbed areas on the site, this is proposed to be done on a weekly basis if no significant storm events have occurred that require earlier assessment. If an intense storm does occur, the controls will be checked as soon as practicable. Once grass strike has occurred, assessments will be done only after intense storms for the duration of the contract defects liability period.

3.10 Evolution of the Plan

This ESCP is considered a live document for the duration of the project. Should monitoring indicate that the measures outlined in this ESCP have proven to be insufficient, and require amendment or alteration at any stage, this ESCP will be updated, with the necessary changes implemented on site.

This ESCP has drawn on the principles contained in the Greater Wellington Region Council, Erosion and Sediment Control Guidelines for the Wellington Region, 2006, and Greater Wellington Erosion & Sediment Control Guide for Land Disturbing Activities, February 2021.

4 EROSION AND SEDIMENT CONTROL METHODS

Erosion and Sediment Control Methods referenced above are based on standard details and procedures set out in Greater Wellington Erosion & Sediment Control Guide for Land Disturbing Activities, February 2021.

4.1 Top Soiling

The topsoil from areas of cut will be stockpiled for later re-use, generally at the location shown on the earthworks site plans, in Appendix A.

Additional material excavated from the third and fourth attenuation areas shall be used for the construction of the adjacent culvert embankments.

As excavation is completed in sequence with the earthworks plan, topsoil will be reinstated and grassed. It is not expected that any additional topsoil will need to be imported to the site to complete the earthworks.

Excess material excavated shall be removed off site for reuse or disposal at an approved site. Any temporary stockpiling will be undertaken within the active earthworks work area.

4.2 Re-Vegetation

As discussed above, site stabilisation will be by mulching in conjunction with seed and fertiliser for regrassing and / or hydroseeding. It is anticipated that grass strike should take approximately 2-3 weeks after topsoil is replaced. Once 80% cover has been established, it will be deemed sufficient for erosion control. Sediment control devices shall remain in place until such time.

As discussed above in section 3, grass species previously identified by local Iwi and Horizons as being suitable for the region will be chosen.

4.3 Silt Fence

Due to the proposed methodology to divert the watercourse around the active earthworks areas, provide cut-off drains and sediment retention and decants, silt fencing is not considered necessary for the proposed works, but may be used (to be confirmed with final ESCP following pre-works site inspection) on the downstream side of the temporary embankment in Area 3.

Where utilised, silt fencing at each work site shall remain in place until such time as re-vegetation cover has taken hold sufficiently to manage erosion control.

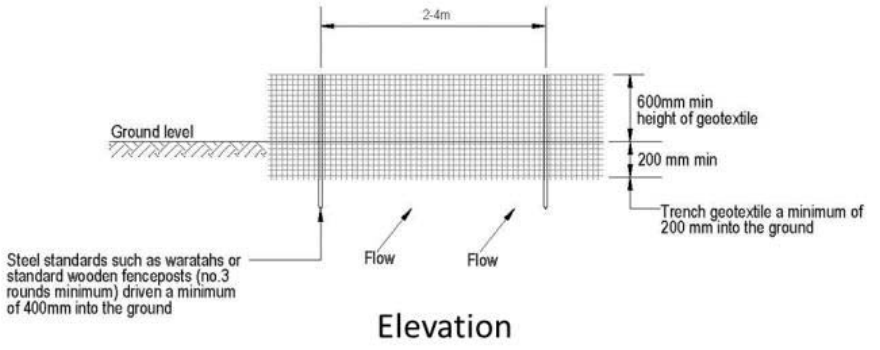
If required, silt fences shall be constructed and maintained as per the construction specifications and maintenance requirements detailed in Waikato Regional Council's Silt Fence Factsheet as referenced on Horizons Regional Council's website and attached as Appendix B, specifically:

- Construction
  - Excavate a trench a minimum of 100 mm wide and 200 mm deep along the line of the silt fence (along the watercourse boundary above the water line)
  - 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 spots of tanalised timber a minimum of 50 square or steel waratahs at least 1.5 m in length.

- Reinforce the top of the silt fence fabric with a wire support made of galvanised wire of a minimum diameter of 2.5 mm. 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 once per week and after each rainfall event.
  - Make any necessary repairs when bulges occur or when sediment accumulation reaches 50 percent of the fabric height.
  - Any areas of collapse, decomposition or ineffectiveness are to be replaced immediately.
  - Sediment deposits are to be removed as necessary to continue to allow for adequate sediment storage and reduce pressure on the silt fence. Sediment is to be removed to a secure area.
  - Sediment fences are not to be removed until the earthworks area has been adequately stabilised (80% grass cover).

A typical detail is as shown below in Figure 4.1 – Silt Fence Installation Detail.



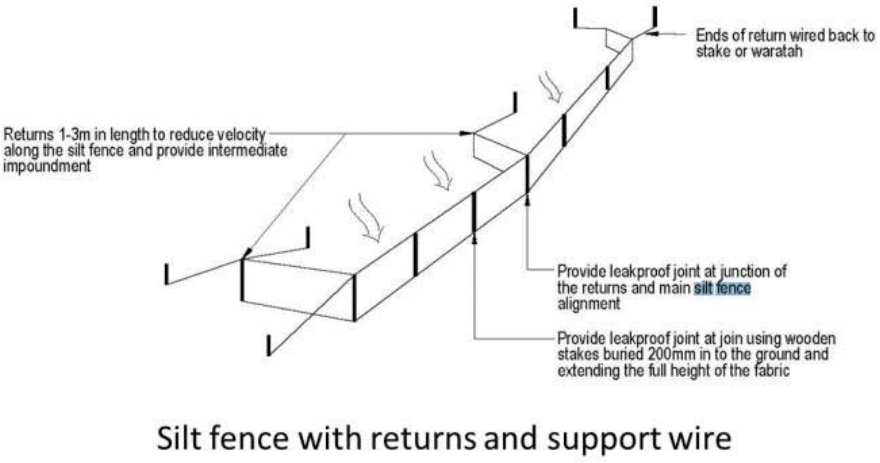


Figure 4.1
Silt Fence Installation Detail

4.4 Scour Protection

As detailed in the project description, the site topography is generally very flat. In this regard, there are no steep slopes or gradients within the watercourse that would require scour protection in the form of Rip Rap, or similar.

4.5 Stabilised Construction Entrance

Site entrance will likely be via 128 Fairfield Rd for the majority of earthworks, for embankment #2 through to embankment #4, including attenuation areas between these embankments. Site of crossing #1 may be accessed from property at 183 Roslyn Rd, while crossing #2 may be accessed from property at 259 State Highway 57, Levin.

A stabilised construction entrance shall be located at any point where traffic will be entering or leaving the site, to prevent site access point(s) from becoming sediment sources, and to assist in minimising dust generation and disturbance of areas adjacent to the road frontage.

The entrance shall be a stabilised pad of aggregate on a filter cloth base and is to be utilised with a construction plan limiting traffic to this entrance(s) only. The entrance and/ or exit area shall be cleared of all vegetation, roots and other undesirable material, and then constructed as per Figure 4.2 and Figure 4.3 below. Drainage shall be provided to carry runoff from the stabilised construction entrance into an existing roadside drain where such is present.

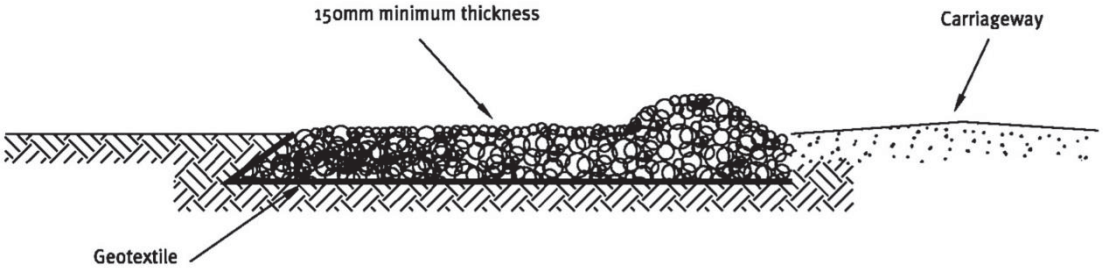


Figure 4.2
Stabilised Construction Entrance Cross-Section

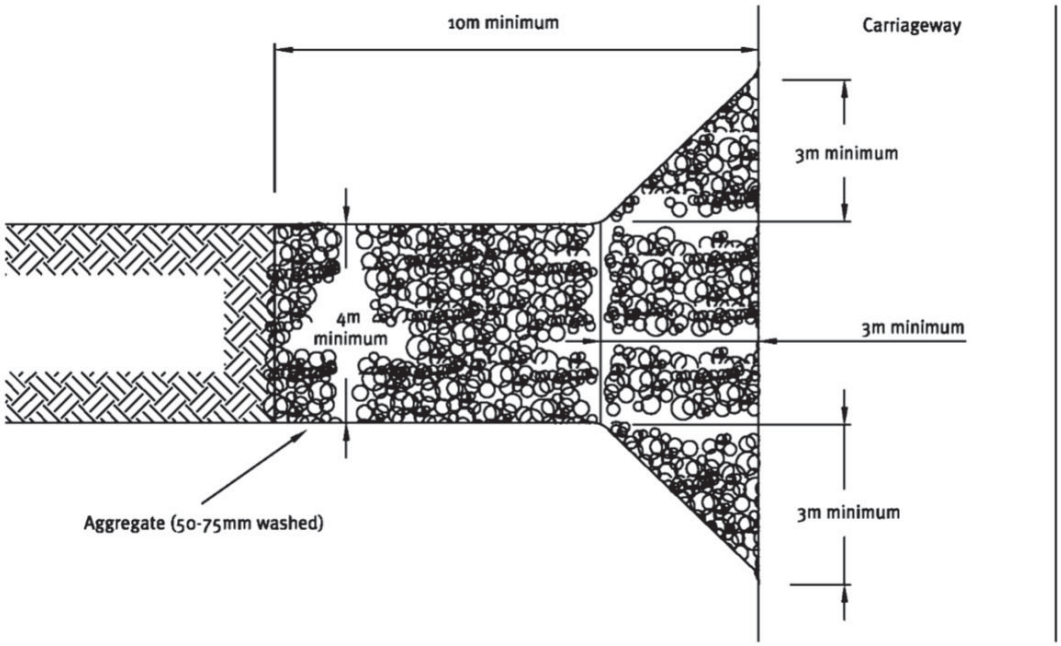


Figure 4.3
Stabilised Construction Entrance Plan View

4.6 Clean Water Cut-Offs

Site Areas for Crossing No. 1, No. 2 and 2nd Embankment are very small and do not require clean water runoff diversions. Clean water cut-offs are proposed for the 3rd and 4th attenuation areas including the associated excavation areas.

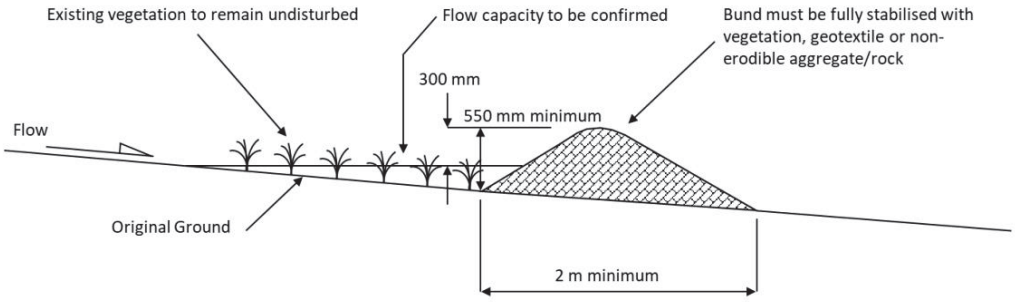


Figure 4.4
Clean Water Cut-Off Drain
Figure 17 of GWRC, Erosion & Sediment Control Guide for Land Disturbing Activities, Feb 2021 (GWRC 2021)

As per the Greater Wellington Erosion & Sediment Control Guide for Land Disturbing Activities in the Wellington Region, specific design of the cut-off drains is not required as the contributing area to each of the drain sections is less than 5 ha. Therefore, construction of the cut-off drains to the above specifications is adequate.

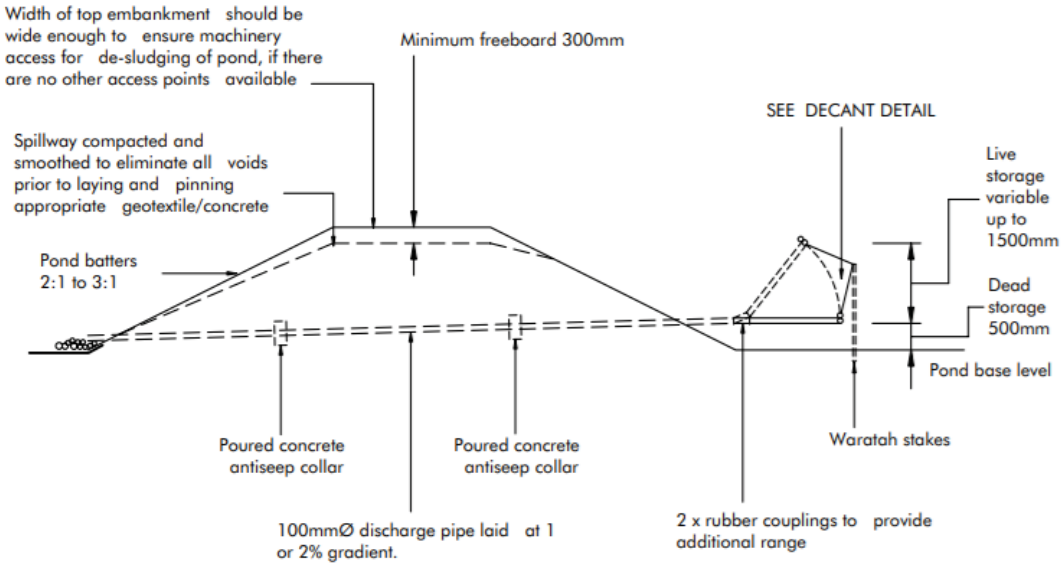
4.7 Sediment Retention

A sediment retention area is to be created at the downstream most point of the earthworks area using the embankments as retention devices.

The maximum earthworks area which will be served by the sediment retention area is approximately 8,000 m^2. Therefore, as per the GWRC 2021:

- Retention area sizes are required as follows (3% of the catchment area)
  - Area 3, stage 1: 90 m^2
  - Area 3, Stage 2 true right: 180 m^2
  - Area 3, Stage 2 true left: 240 m^2
  - Area 4: 90 m^2
  - The area in the location is to be temporarily shaped as far as possible to create a shape ratio of between 3:1 to 5:1 for the retention area.
- A forebay of 10-20 m^2 shall be provided in addition to above pond size (10% of the pond size). The forebay is required to be across the full width of the retention area and between 0.5 and 1.0 m deep.
- A single T-bar decant is to be installed. This is sufficient to meet the design discharge rate (3 L/s/ha of contributing catchment, therefore a discharge rate of 3 L/s is required for the up to a 1 ha catchment). Refer Figures 4.5 and 4.6.

Single decant
for catchments up to 1.5 hectares



CROSS SECTION

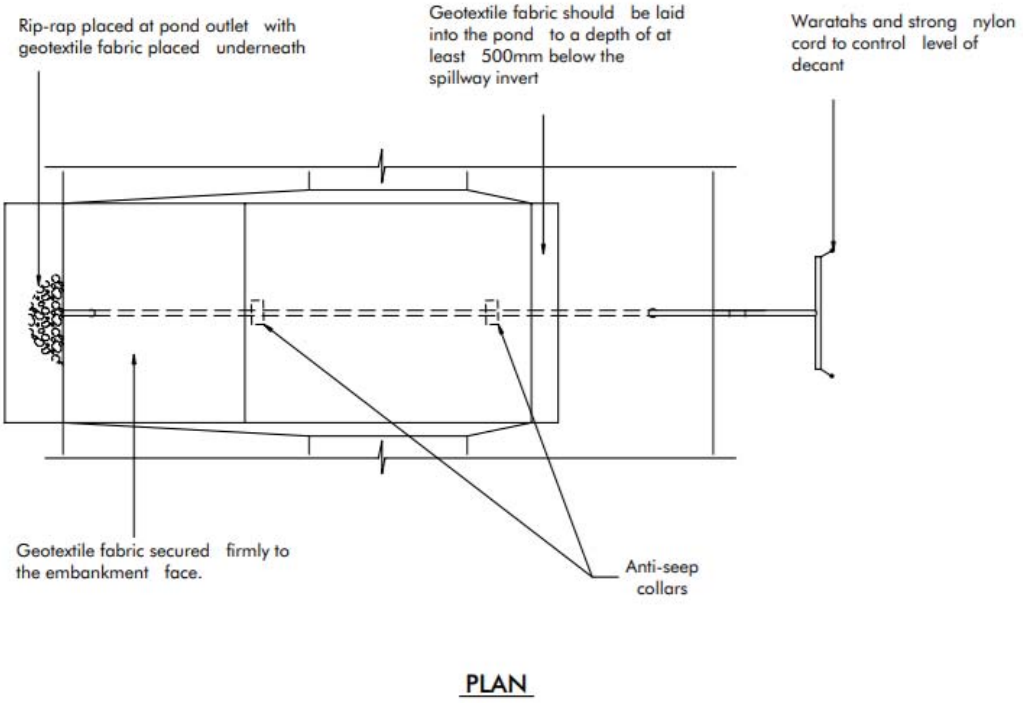


Figure 4.5: Decant Structure

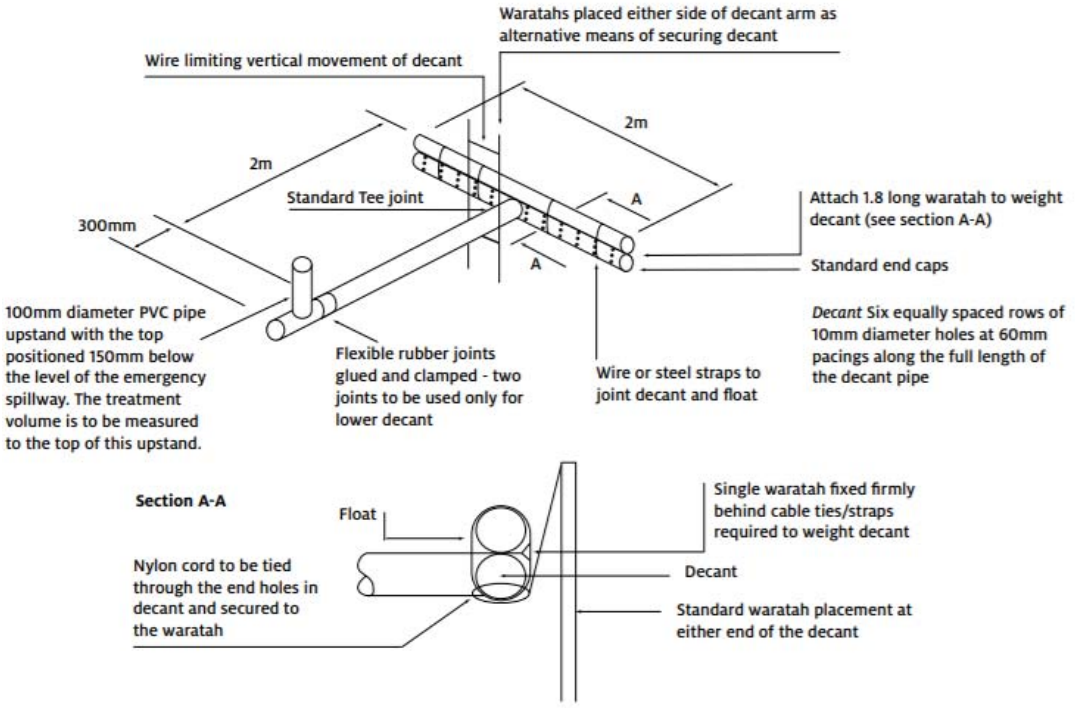


Figure 4.6: T-Bar Decant Detail

Sediment capture levels in the sediment retention pond shall be checked weekly and sediment shall be cleared out if it reaches 30% of the pond volume.

5 MAINTENANCE, MONITORING AND REPORTING

The erosion and sediment control systems will be inspected on a weekly basis prior to grass strike successfully occurring and within 24 hours of rainfall events where a heavy rain warning is issued by the New Zealand MetService. Damage to any ESC devices will be remedied after the rainfall event has ceased and the ground has drained sufficiently for vehicles access.

If damage to any of the ESC devices occurs during the normal course of earthworks or other works on the site, the responsible party must report the damage to the Engineer to the Contract (or their representative) as soon as is practical. The damage will be inspected by the Engineer to the Contract (or their representative), whom will arrange for remedial work to be undertaken. If possible, all remedial work will be prioritised to be completed prior to the next rainfall event.

This ESCP is considered a live document for the duration of the project. Should monitoring indicate that the measures outlined in this ESCP have proven to be insufficient, and require amendment or alteration at any stage, this ESCP will be updated, with the necessary changes implemented on site.

6 HEAVY RAINFALL RESPONSE AND CONTINGENCY MEASURES

While earthworks are being undertaken it is the responsibility of the contractor to monitor weather forecasts. An inspection of all site ESCP devices shall be undertaken prior to the forecast event. If any ESCP device does not meet design standards, remedial work will be undertaken prior to the rainfall event, if at all possible.

7 SITE RESPONSIBILITIES

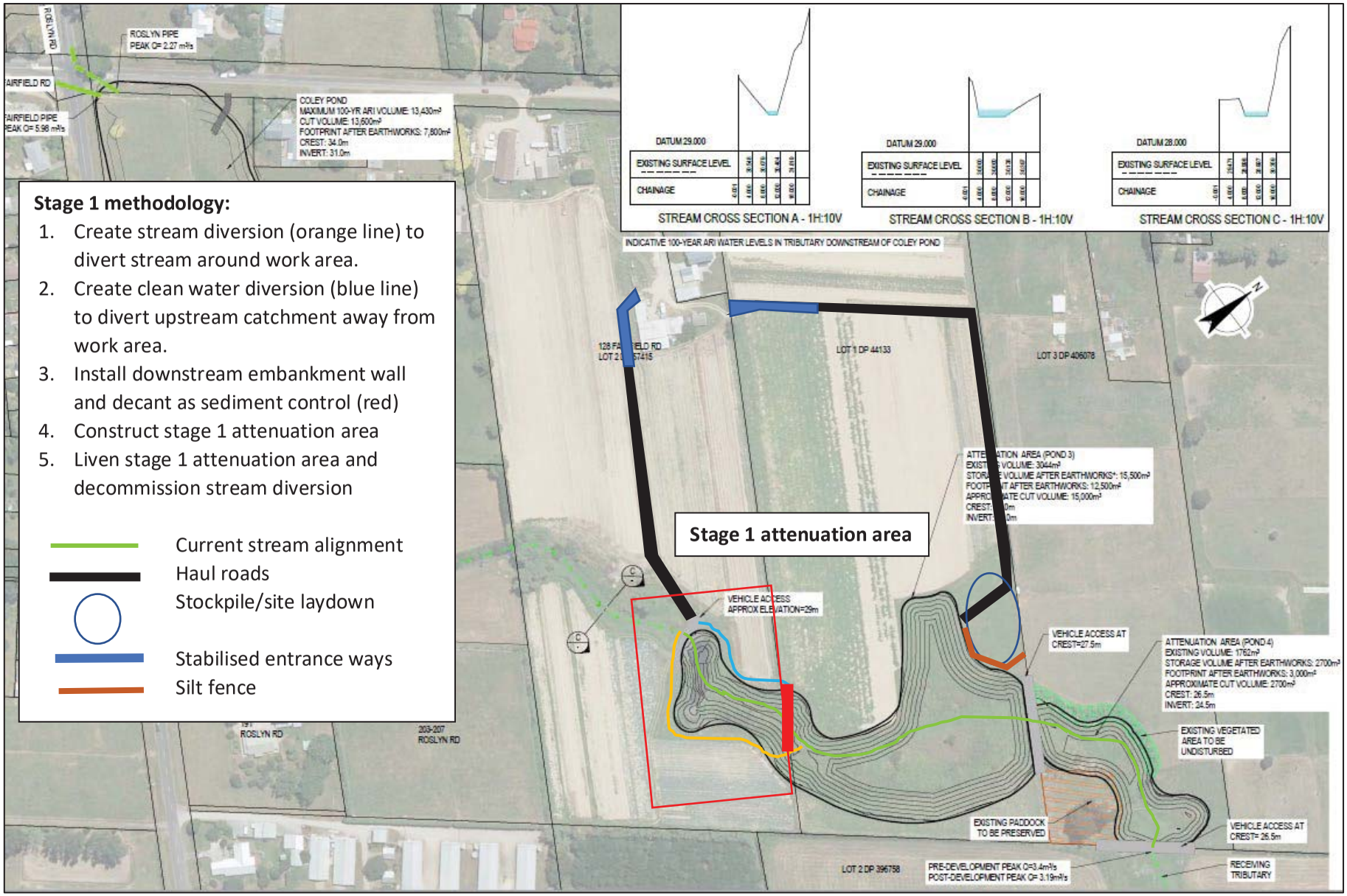
Individuals with responsibility for routine monitoring and maintenance, provision of design details for ESC devices, and ensuring that ESC devices have been constructed correctly are detailed in the below table.

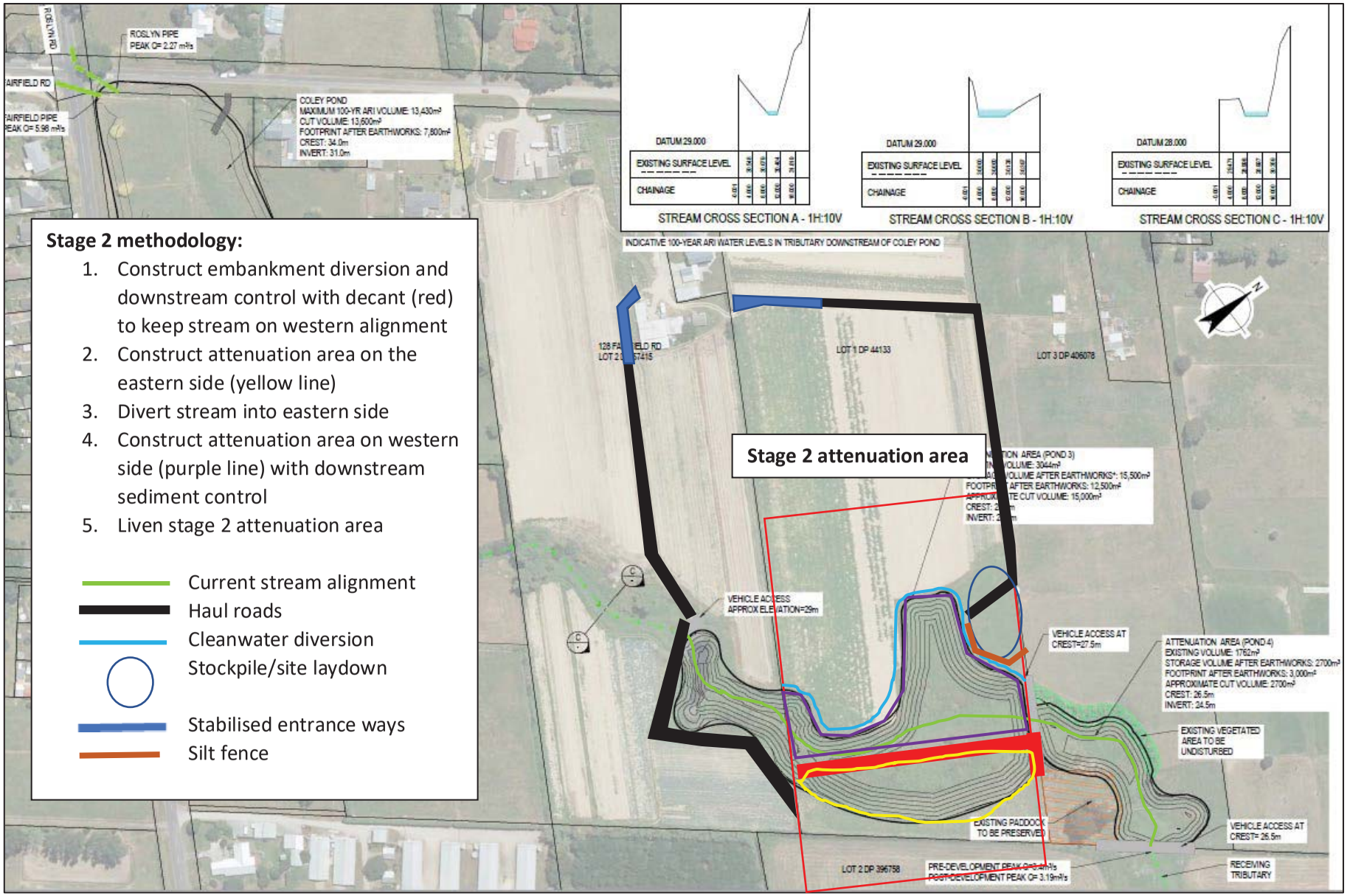
Table 7.1
Site Responsibilities for Routine Monitoring and Maintenance

Role	Responsibility	Contact Number
Engineer to the Contract	Monitoring of ESC Devices, weather forecasts, provision of design detail, ensure ESC devices constructed in line with design criteria, maintenance and documentation of ESCP.	GHD Ltd Name and contact details to be confirmed
Earthworks Contractor	Monitoring of weather forecasts, construction of ESC devices, report any damage to ESC devices, remediation of ESC devices if required.	Higgins Project Manager name and contact details to be confirmed.

Appendix A

EROSION & SEDIMENT CONTROL PLANS

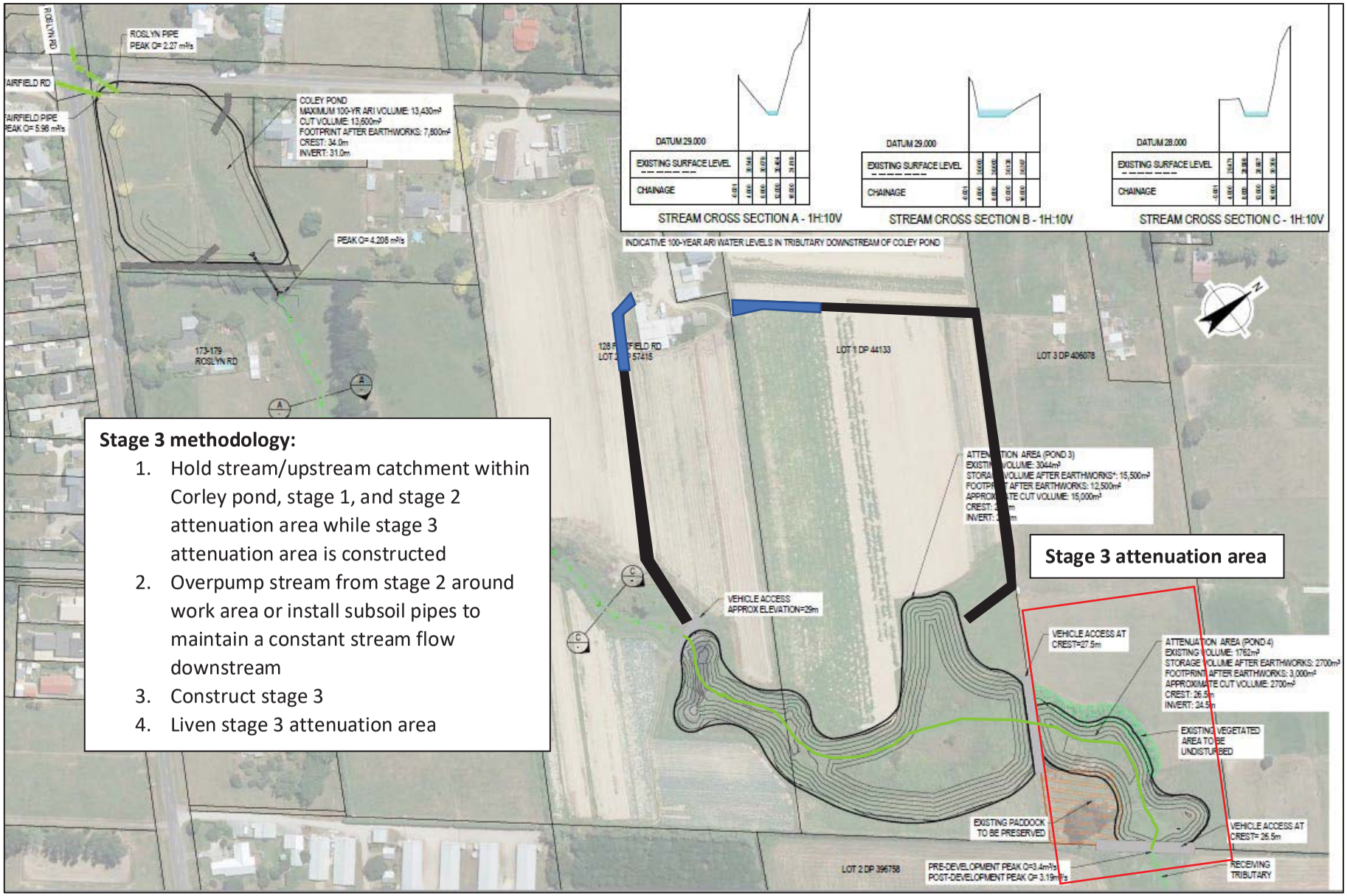

Stage 1 methodology:
1. Create stream diversion (orange line) to divert stream around work area.
2. Create clean water diversion (blue line) to divert upstream catchment away from work area.
3. Install downstream embankment wall and decant as sediment control (red)
4. Construct stage 1 attenuation area
5. Liven stage 1 attenuation area and decommission stream diversion
Current stream alignment
Haul roads
Stockpile/site laydown
Stabilised entrance ways
Silt fence
ROSLYN PIPE
PEAK Q= 2.27 m³/s
AIRFIELD RD
FAIRFIELD PIPE
PEAK Q= 5.96 m³/s
COLEY POND
MAXIMUM 100-YR ARI VOLUME: 13,430m³
CUT VOLUME: 13,600m³
FOOTPRINT AFTER EARTHWORKS: 7,800m²
CREST: 34.0m
INVERT: 31.0m
DATUM 29.000
EXISTING SURFACE LEVEL
CHAINAGE
STREAM CROSS SECTION A - 1H:10V
DATUM 29.000
EXISTING SURFACE LEVEL
CHAINAGE
STREAM CROSS SECTION B - 1H:10V
DATUM 28.000
EXISTING SURFACE LEVEL
CHAINAGE
STREAM CROSS SECTION C - 1H:10V
INDICATIVE 100-YEAR ARI WATER LEVELS IN TRIBUTARY DOWNSTREAM OF COLEY POND
LOT 1 DP 44133
LOT 3 DP 406078
Stage 1 attenuation area
VEHICLE ACCESS
APPROX ELEVATION=29m
VEHICLE ACCESS AT
CREST=27.5m
ATTENUATION AREA (POND 4)
EXISTING VOLUME: 1762m³
STORAGE VOLUME AFTER EARTHWORKS: 2700m³
FOOTPRINT AFTER EARTHWORKS: 3,000m²
APPROXIMATE CUT VOLUME: 2700m³
CREST: 26.5m
INVERT: 24.5m
EXISTING VEGETATED
AREA TO BE
UNDISTURBED
EXISTING PADDOCK
TO BE PRESERVED
VEHICLE ACCESS AT
CREST= 26.5m
LOT 2 DP 396758
PRE-DEVELOPMENT PEAK Q=3.4m³/s
POST-DEVELOPMENT PEAK Q= 3.19m³/s
RECEIVING
TRIBUTARY
203-207
ROSLYN RD



Stage 2 methodology:

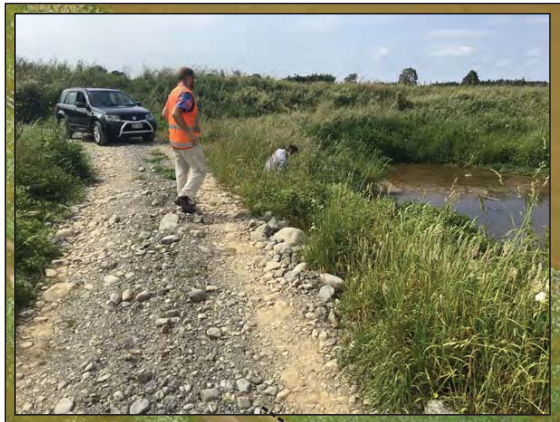
1. Construct embankment diversion and downstream control with decant (red) to keep stream on western alignment
2. Construct attenuation area on the eastern side (yellow line)
3. Divert stream into eastern side
4. Construct attenuation area on western side (purple line) with downstream sediment control
5. Liven stage 2 attenuation area

Current stream alignment
Haul roads
Cleanwater diversion
Stockpile/site laydown
Stabilised entrance ways
Silt fence



Stage 3 methodology:

1. Hold stream/upstream catchment within Corley pond, stage 1, and stage 2 attenuation area while stage 3 attenuation area is constructed
2. Overpump stream from stage 2 around work area or install subsoil pipes to maintain a constant stream flow downstream
3. Construct stage 3
4. Liven stage 3 attenuation area



2nd Embankment

Upstream; To Crossing No. 1

2nd ATTENUATION AREA

No Attenuation to be created in this area

Typical Embankment Details

N

0 10 20 30 40 50 m

- Embankment
- Culvert
- Current Channel
- Earthworks Extent
- Embankment Slope
- Silt Fencing

REV.	AMENDMENTS	BY.	APPD.	DATE.

DRAWN			
DESIGNED			
CHECKED			
APPROVED			
	NAME	DATE	

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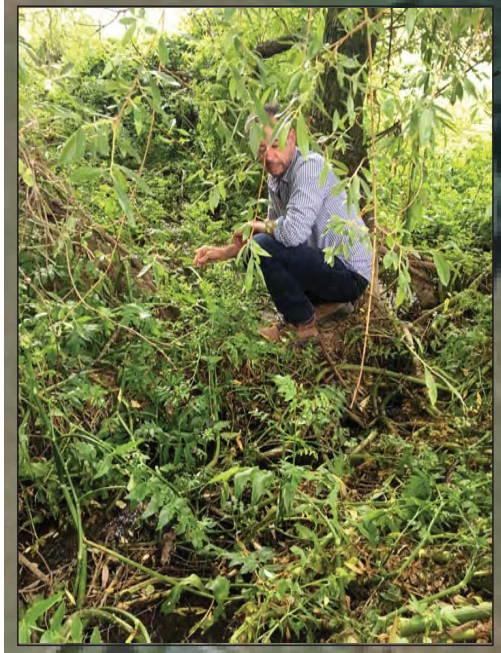
CLIENT	Horowhenua District Council
PROJECT	Koputaroa Stormwater Consenting
TITLE	Earthworks Stage 2 Second Embankment

SCALE	A1		ORIGINAL
	A3	1:350	
PROJECT		27019	DATE ISSUED
SHEET No			
REVISION No			

Upstream; To 1st ATTENUATION AREA

Crossing No. 1



0 10 20 30 40 50 m

N

Legend

- Embankment
- Culvert
- Current Channel
- Earthworks Extent
- Embankment Slope
- Silt Fencing

REV.	AMENDMENTS	BY.	APPD.	DATE.

		NAME	DATE
DRAWN			
DESIGNED			
CHECKED			
APPROVED			

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CLIENT	Horowhenua District Council
PROJECT	Koputaroa Stormwater Consenting
TITLE	Earthworks Stage 2 Crossing No. 1

SCALE	A1	ORIGINAL
	A3 1:350	
PROJECT	27019	DATE ISSUED
SHEET No		
REVISION No		

REV.	AMENDMENTS	BY.	APPD.	DATE.

DRAWN			
DESIGNED			
CHECKED			
APPROVED			
	NAME	DATE	

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CLIENT	Horowhenua District Council	SCALE	A1	ORIGINAL
PROJECT	Koputaroa Stormwater Consenting		A3 1:50k	
TITLE	Earthwor2s Stage 5 Crossing No. 5	PROJECT	57k19	DATE ISSUED
		SHEET No		
		REVISION No		

Appendix B

FACTSHEETS REFERENCED BY HORIZONS REGIONAL COUNCIL

Earthworks series – erosion and sediment control factsheet

Sediment Retention Pond (SRP)

DEFINITION

A temporary pond formed by excavation into natural ground or by the construction of an embankment, and incorporating a device to dewater the pond at a rate that will allow suspended sediment to settle out.

PURPOSE

To treat sediment-laden run off and reduce the volume of sediment leaving a site, thus protecting downstream environments from excessive sedimentation and water quality degradation.

APPLICATION

Sediment retention ponds are appropriate where treatment of sediment-laden run off is necessary, and are the appropriate control measure for exposed catchments of more than 0.3ha. It is vital that the sediment retention pond is maintained until the disturbed area is fully protected against erosion by permanent stabilisation.

The location of the sediment retention pond needs to be carefully considered in terms of the overall project, available room for construction and maintenance and the final location of any permanent stormwater retention facilities that may be constructed at a later stage.

Another major consideration is whether drainage works can be routed to the sediment retention pond until such time as the site is fully stabilised.

The general design approach is to create an impoundment of sufficient volume to capture a significant proportion of the design run off event, and to provide quiescent (stilling) conditions, which promote the settling of suspended sediment.

The sediment retention pond design is such that very large run off events will receive at least partial treatment and smaller run off events will receive a high level of treatment. To achieve this, the energy of the inlet water needs to be low to minimise re-suspension of sediment and the decant rate of the outlet also needs to be low to minimise water currents and to allow sufficient detention time for the suspended sediment to settle out.

Specific design criteria are discussed below, but can be summarised as the following:

- Use sediment retention ponds for bare areas of bulk earthworks of 0.3ha or greater.
- Restrict catchment areas to less than 5.0ha per sediment retention pond. This limits the length of overland flow paths and reduces maintenance problems.

- Locate sediment retention ponds so as to provide a convenient collection point for sediment laden flows from the catchment area. This will require strategic use of cut-offs, run off diversion channels and contour drains.
- Locate sediment retention ponds to allow access for removing sediment from the pond.
- Locate sediment retention ponds to allow the spillway to discharge over undisturbed, well vegetated ground.
- Do not locate sediment retention ponds within watercourses.
- Embankment and spillway stability are generally the weak point in sediment retention pond construction. Correct compaction, particularly around emergency spillways, discharge pipes and anti-seep collars, will keep the system robust.

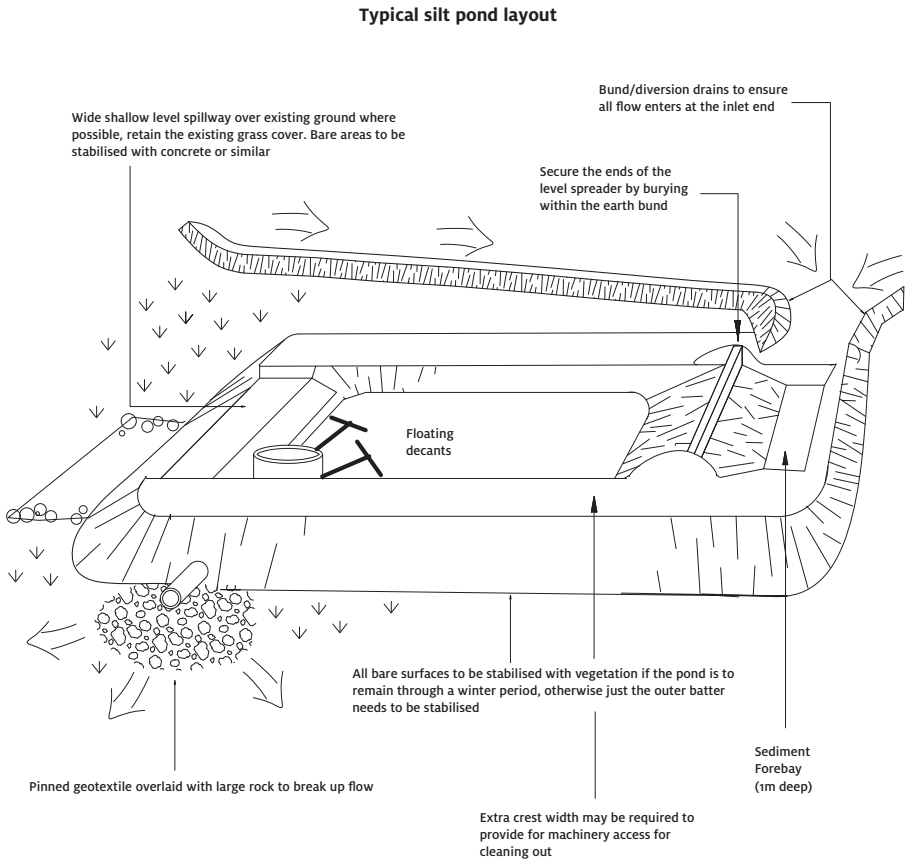


Figure 1: Typical silt pond layout

DESIGN - SIZE OF THE POND

Calculate the volume of the sediment retention pond using the depth measured from the base of the sediment retention pond to the top of the primary spillway. The following design criteria apply:

- On earthwork sites with slopes less than 10 per cent and less than 200m in length, construct a sediment retention pond with a minimum volume of 2 per cent of the contributing catchment (200m^3 for each ha of contributing catchment).
- On sites with slopes greater than 10 per cent and/or more than 200m in length, construct sediment retention ponds with a minimum volume of 3 per cent of the contributing catchment (300 m^3 capacity for each ha of contributing catchment).
- An additional 10 per cent of this volume is to be used as a sediment forebay.
- The slope angle is determined by the steepest slope within a 50m radius of the sediment retention pond inlet or by the average slope angle over the contributing catchment, whichever is the greater.
- On sites that are particularly steep, have a high clay content or have sensitive downstream environments, a greater sediment retention pond volume and/or the use of chemical treatment may be required.
- Clean out sediment retention ponds when the volume of sediment accumulated within them reaches 20 per cent of the design volume.
- Clearly show the sediment retention pond dimensions necessary to obtain the required volume, as detailed above, on the site's erosion and sediment control plan(s).

DESIGN - DEAD STORAGE (PERMANENT STORAGE)

Dead storage is the component of impoundment volume that does not decant and remains in the sediment retention pond. It is important for dissipating the energy of inflows.

- Ensure dead storage is a minimum of 30 per cent of the total sediment retention pond storage by positioning the lowest decant 0.54 - 0.8m above the invert of the sediment retention pond.

DESIGN - LIVE STORAGE (DECANT STORAGE)

- Live storage is the volume between the lowest decant outlet level and the top of the sediment retention pond primary spillway.
- Ensure that the live storage volume capacity is 70 per cent of the total sediment retention pond storage.
- The approved decant design detailed in these guidelines allows the decant system to be raised as sediment deposition increases, thereby maintaining the percentage volume of live storage.

Sediment retention pond showing decant system.

DESIGN - DECANTING/OUTLET DE-WATERING DEVICE

- De-water the sediment retention pond to remove the relatively clean water without removing any of the settled sediment, and without removing any appreciable quantities of floating debris.
- The use of a floating T-bar de-watering device, which allows for the decanting of the cleaner surface water from the top of the water column, is required.
- The required decant rate from a sediment retention pond is 3 litres/second/ha of contributing catchment. This rate ensures that appropriate detention times are achieved.
- A standard T-bar design is detailed in figure 2 for various sized catchments. Single decant without manhole riser needs to have a primary spillway (upstand riser) installed.
- To achieve a decant rate of 4.5 litres/second per decant, for a 1.5 ha catchment, drill 200 10mm diameter holes positioned evenly over the decant.Holes can be blocked as required for smaller catchments. Block out 65 holes if a decant rate of 3 l/sec is required.
- T-bar decants must be able to operate through the full live storage depth of the sediment retention pond.
- If two decant systems are required, ensure the lower T-bar decant operates through the full live storage depth of the sediment retention pond. The upper T-bar decant is to operate through the upper 50 per cent of the live storage depth of the sediment retention pond only.
- If three decant systems are to be used, then the lower T-bar decant operates through the full live storage depth and the second T-bar decant through the upper two thirds of live storage depth of the sediment retention pond. The upper T-bar decant operates through the upper one third of live storage depth of the sediment retention pond.
- 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. The most successful method found to date is to weight the decant arm by strapping a 1.8m long waratah between the float and the decant (approximately 4kg of weight).
- Position the T-bar decant at the correct height by supporting the decant arm between warratahs as detailed in figure 2.
- Lay the discharge pipe at a 1 - 2 per cent gradient, compact the fill material around it using a machine compactor and incorporate anti-seep collars with the following criteria:
    - Install collars around the pipe to increase the seepage length along the pipe with a spacing of approximately 10m.
    - The vertical projection of each collar is 1m.
    - 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. To provide sufficient flexibility (such as is required for the lower decant arm) install two couplings. Fasten the flexible coupling using strap clamps and glue.

- Where a concrete riser decant system is utilised, ensure the lower decant connection is positioned on an angle upwards from the horizontal so as to split the operational angle that the decant works through. This will reduce the deformation force on the coupling used.

T-Bar decant

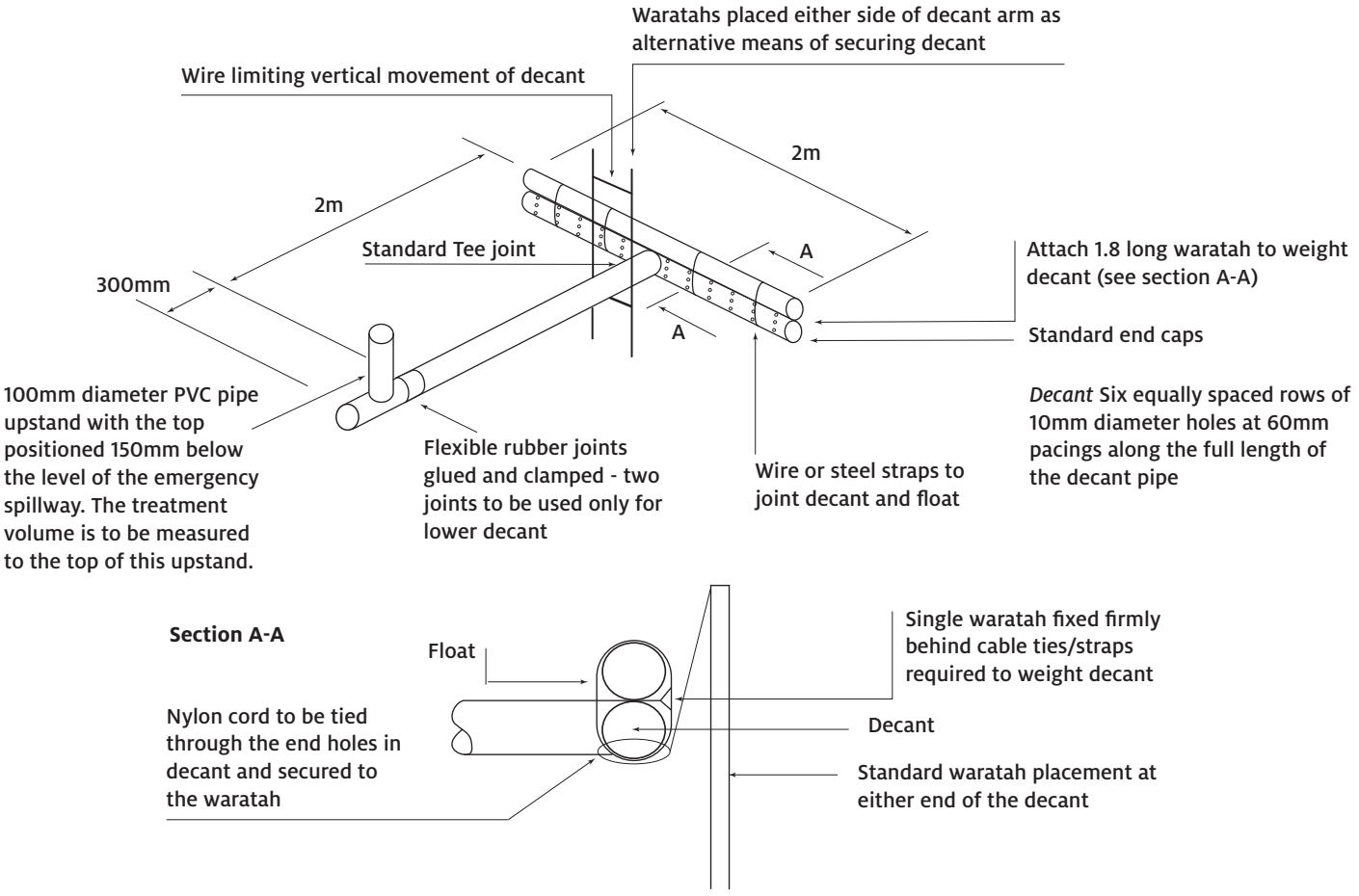


Figure 2: T-Bar decant

DESIGN - FOREBAY

- Construct a forebay with a volume equal to 10 per cent of the pond design volume. On sites with slopes less than 10 per cent and lengths less than 200m this equates to a forebay volume of 0.2 per cent of the contributing catchment area - 0.2 m^3 per 100 m^2 of contributing catchment. On sites with slopes greater than 10 per cent and lengths greater than 200m, forebay volume is equivalent to 0.3 per cent of the contributing catchment area ie: 0.3 m^3 per 100 m^2 of contributing catchment.
- The forebay is to extend the full width of the main pond and is to be 0.5 to 1m deep.
- All 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.

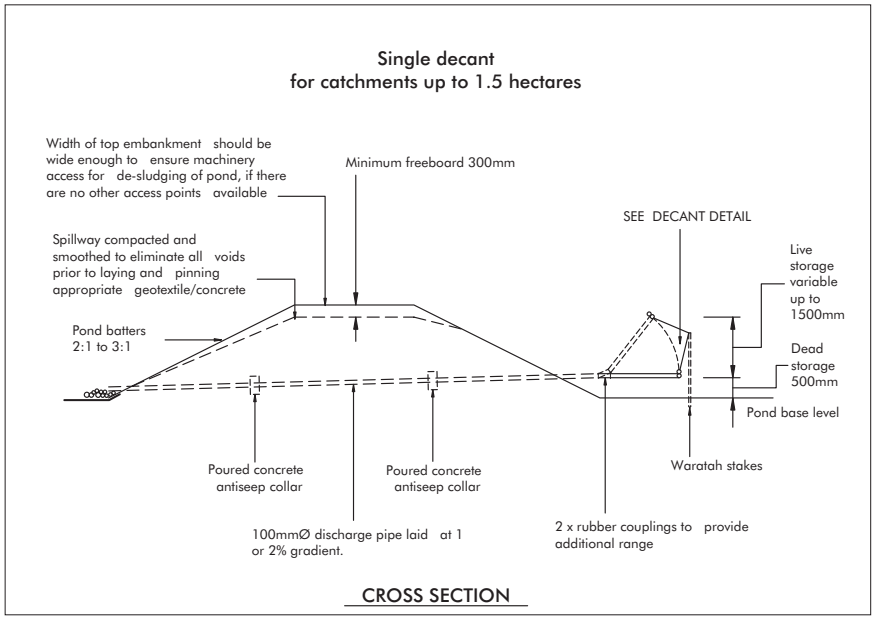


Figure 3: Cross section of single decant

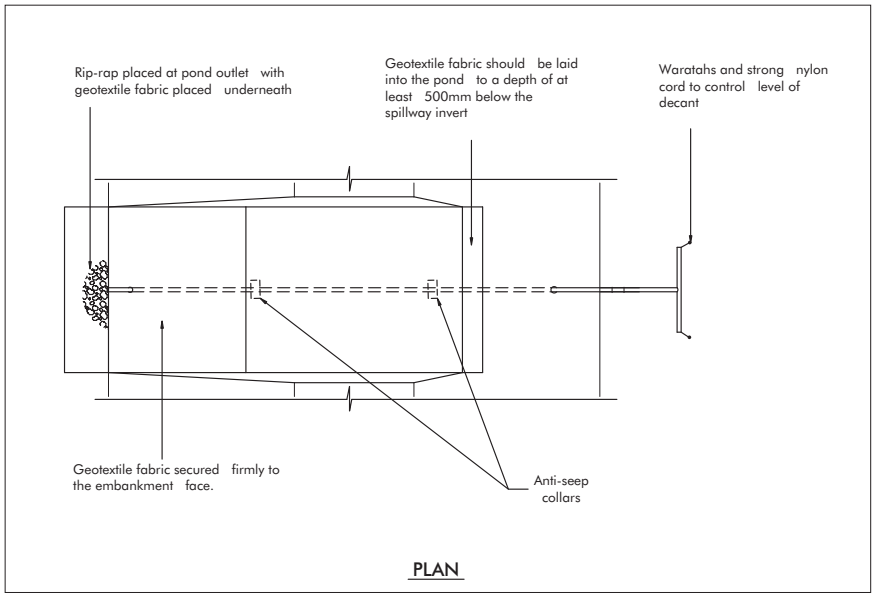


Figure 4: Plan view of decant

DESIGN - SHAPE OF THE POND

- Ensure the length to width ratio of the sediment retention pond is no less than 3:1 and no greater than 5:1. The length of the sediment retention pond is measured as the distance between the inlet and the outlet (decant system). A 2:1 ratio may be used if the pond depth is no greater than 1m.
- Maximise the distance between the inlet and the outlet (including the emergency spillway) to reduce the risk of short circuiting and to promote quiescent conditions. If this cannot be achieved by correctly positioning the inlet and outlets, install baffles to achieve the appropriate length to width ratio design.
- Ensure that the sediment retention pond has a level spreader as described in figure 5 to promote the even and gradual dissipation of the heavier inflow water across the full area of the sediment retention pond.

DESIGN - EMBANKMENT

- Thoroughly compact the sediment retention pond embankment, with material laid in 150mm layers and compacted to engineering standards.
- Before building a sediment retention pond, install sediment controls such as silt fences below the construction area and maintain them to a functional standard until the sediment retention pond batters are fully stabilised.
- 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 bare areas associated with the sediment retention pond (including internal batters) are stabilised with vegetation if the sediment retention pond is to remain in use over winter.

DESIGN - POND LEVEL SPREADER

- Incorporate a pond level spreader between the forebay and the main pond to spread inflow velocities, thereby allowing rapid dissipation of inflow energies. Combine the pond level spreader with a well compacted and smoothed inlet batter (no steeper than a 3:1 gradient), stabilised over its entire area. The essential design feature is to ensure the pond level spreader is completely level, non-erodible and spans the full width of the sediment retention pond.
- Stabilise the level spreader and inlet embankment to the base of the pond with a layer of strong woven low permeability geotextile overlaid with a layer of soft non-woven needle punched geotextile. Pin at 500mm centres.
- To ensure even inflows, install a trenched and pegged 150mm x 50mm timber weir or similar across the full width of the inlet. Bund the edges with compacted earth to prevent outflanking and line to prevent erosion. This timber weir is haunched using site concrete which also serves to toe in the geotextile protection that will be required.
- Position the top of the pond level spreader weir 100 – 200mm above the invert of the emergency spillway.

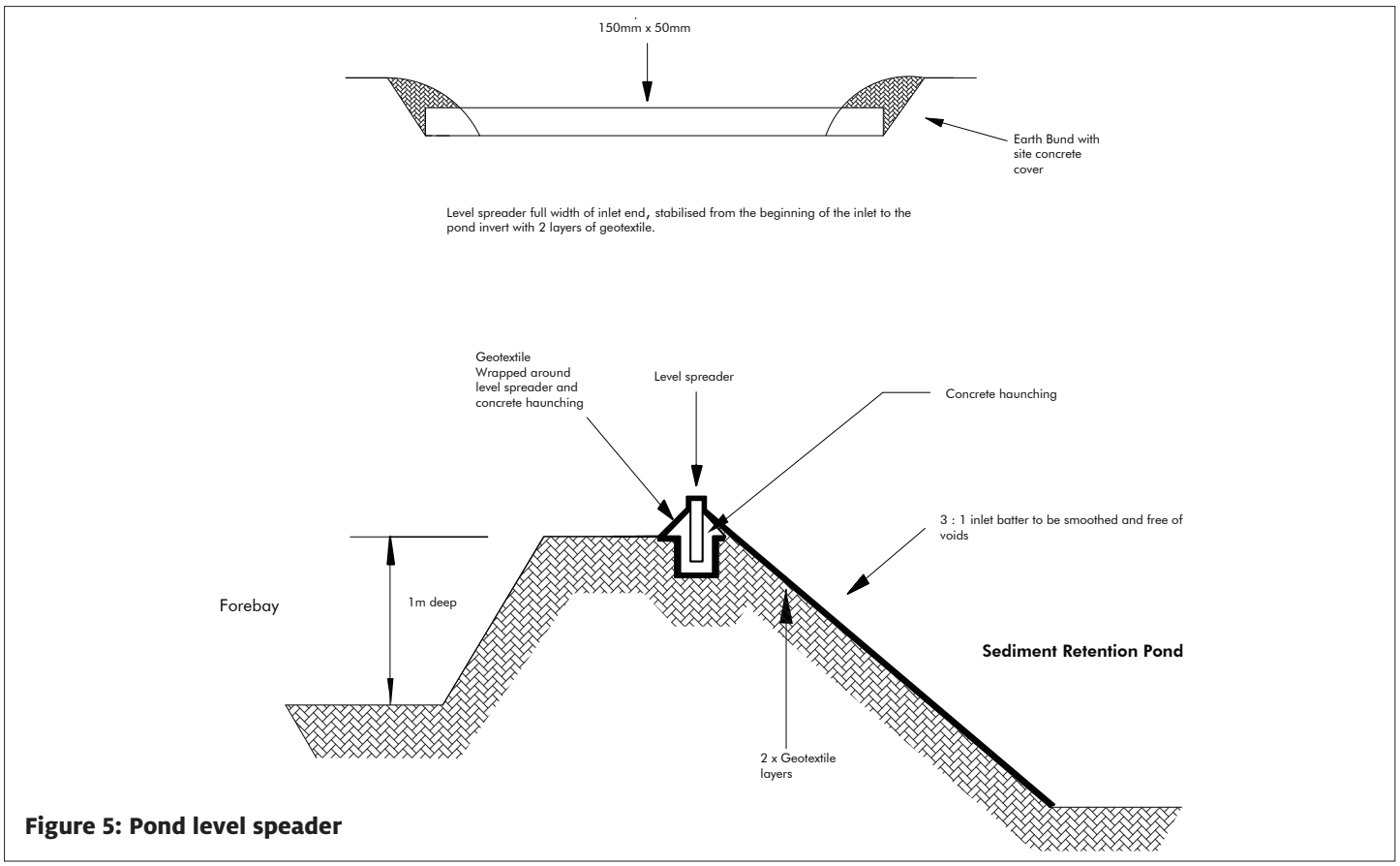


Figure 5: Pond level speader

OPTIONAL ENHANCEMENTS

- Install one or more silt fences accross the width of the sediment retention pond.
- Slope the base of the pond towards the inlet end. This will reduce sediment travelling to the decant end of the pond.

DESIGN - DEPTH OF POND

- Sediment retention pond depths may be 1 - 2m deep, but no deeper than 2m. Deeper ponds are more likely to cause short circuiting problems during larger storm events and require specifically designed floating decant systems.
- The decant design in these guidelines operates through a maximum live storage range of 1.5m.

DESIGN - PRIMARY SPILLWAY

- For catchments up to 1.5ha use a discharge and primary spillway pipe diameter of 100mm.
- For contributing catchments between 1.5 and 3ha in area, use a discharge and primary spillway pipe diameter of 150mm.
- Where contributing catchments are 3ha or greater a concrete manhole riser and a minimum 300mm diameter outlet pipe must be used as a primary spillway. The concrete manhole riser must have a sealed bottom and be weighted to prevent floating.
- If the sediment retention pond is to operate over the winter and the contributing catchment is fully stabilised, disconnect the T-bar decant to reduce the frequency of emergency spillway activation and consequent erosion.
- Where a primary spillway upstand riser is used, place the top of the riser a minimum 600mm lower than the top of the sediment retention pond embankment and a minimum 300mm lower than the emergency spillway crest. Ensure the riser and the discharge pipe connections are all completely watertight.

SPILLWAY

- An emergency spillway is essential for all sediment retention ponds.
- Emergency spillways must be capable of accommodating the critical 1 per cent AEP event without eroding.
- Emergency spillways must discharge onto stabilised ground. The emergency spillway must be located at the outlet end of the pond behind or beside the decant system.
- The emergency spillway crest and outer batter requires a very high standard of stabilisation with the fill material well compacted.
- Construct the emergency spillway as a stabilised trapezoidal cross section. The trapezoidal cross sections need to be continued down the outside batter to avoid flows outflanking the geotextile.
- When utilising geotextile for emergency spillway stabilisation purposes, the batter face must be smooth and all voids filled.
- If geotextile is used, a strong woven low permeability geotextile is laid first and then covered 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.
- Where possible, construct emergency spillways in well vegetated, undisturbed ground (not fill) and discharge over long grass.
- Construct the emergency spillway with a minimum of 300 mm freeboard height above the primary spillway invert.

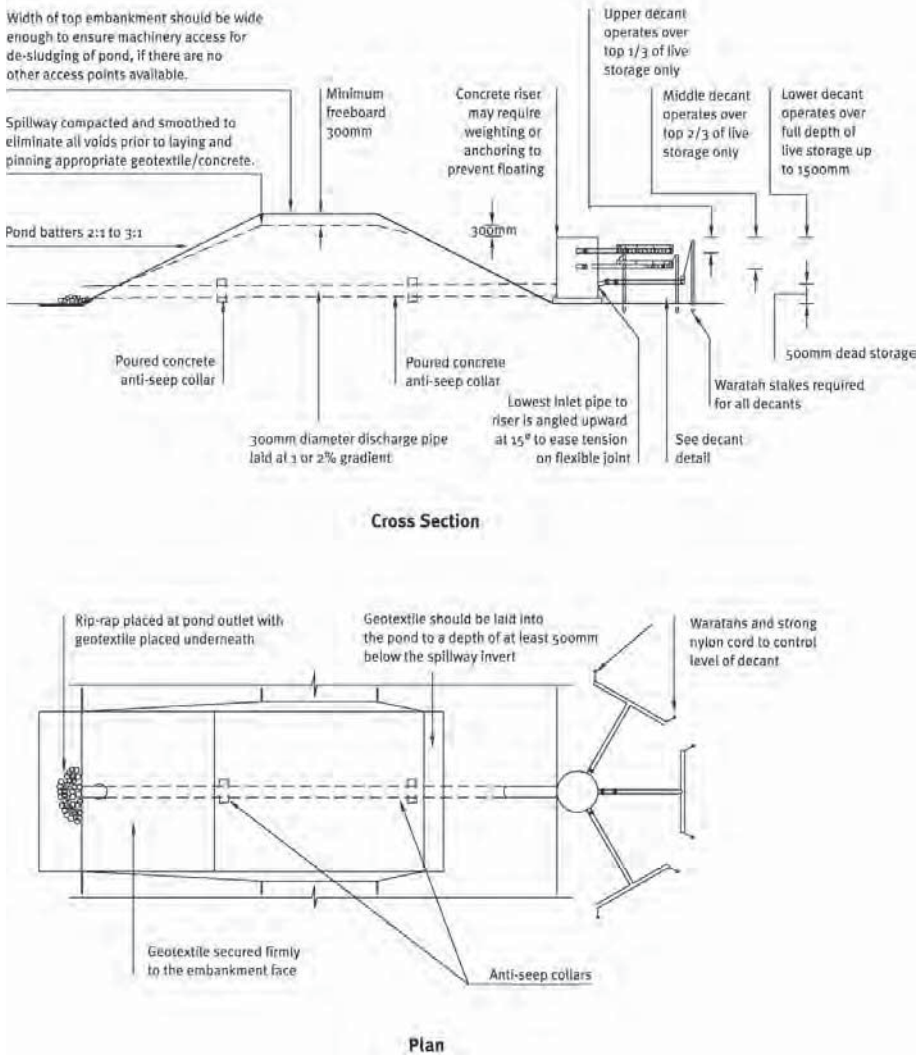


Figure 6: Cross sections of plan SRP emergency spillway

CONSTRUCTION SPECIFICATIONS

- Construct a fabric silt fence across the downslope end of the proposed works.
- Clear areas under proposed fills of topsoil or other unsuitable material down to competent material. Large fill embankments may need to be keyed in.
- Use only approved fill.
- Place and compact fill in layers as per the engineer's specifications.
- Do not place pervious materials such as sand or gravel within the fill material.
- Construct fill embankments approximately 10 per cent higher than the design height to allow for settlement of the material. Install appropriate pipe work and anti-seep collars during the construction of the embankment and compact around these appropriately.
- Install and stabilise the emergency spillway.
- Install and stabilise the level spreader.
- Securely attach the decant system to the horizontal pipework. Make all connections watertight. Place any manhole riser on a firm foundation of impervious soil.
- Do not place pervious material such as sand or scoria around the discharge pipe or the anti-seep collars.
- Check sediment retention pond freeboard for differential settlement and rectify as necessary.
- Stabilise both internal and external batters with vegetation.

POND MAINTENANCE AND DISPOSAL OF SEDIMENT

- Clean out sediment retention ponds before the volume of accumulated sediment reaches 20 per cent of the total sediment retention pond volume. To assist in gauging sediment loads, clearly mark the 20 per cent volume height on the decant riser.
- Clean out sediment retention ponds with high capacity sludge pumps, or with excavators (long reach excavators if needed) loading onto sealed tip trucks or to a secure area immediately adjacent to the pond.
- The erosion and sediment control plan (ESCP) should identify disposal locations for the sediment removed from the sediment retention pond. Deposit the sediment in such a location so that it does not lead to a direct discharge to receiving environments. Stabilise all disposal sites as required and approved in the site's ESCP.
- Inspect sediment retention ponds a minimum of once per week and before every forecasted rainfall event. Inspect for correct operation after every run off event. Immediately repair any damage to sediment retention ponds caused by erosion or construction equipment.

SAFETY

Sediment retention ponds are attractive to children and can become safety hazards if not appropriately fenced and if safety rules are not followed. Low gradient pond batters provide an additional safety measure. Check the safety requirements of the city or district council authority and the Occupational Safety and Health branch of the Department of Labour.

CHEMICAL TREATMENT

Some chemicals can be used successfully to promote flocculation (clumping together) of suspended solids in the sediment retention pond to increase the particle mass and speed the rate of settling:

- Poly Aluminium Chloride (PAC)
- poly-DADMAC
- Haloklear
- Crystalfloc

Chemical dosing systems are likely to be required where the design sediment retention pond volume cannot be achieved because of site constraints and/or where a high level of treatment is required because of the sensitivity of the receiving environment. Chemical treatment is also more likely to be required where the clay component is high or when specifically requested by council.

All chemical treatments require flocculation mangement plans to be submitted and approved by Waikato Regional Council before commencing any flocculation method.

Waikato Regional Council
Private Bag 3038
Waikato Mail Centre
Hamilton 3240

For more information call Waikato Regional Council's freephone on 0800 800 401 or visit www.waikatoregion.govt.nz.

Waikato Regional Council earthworks factsheet series no. 2. December 2014 (4035)

Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

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.

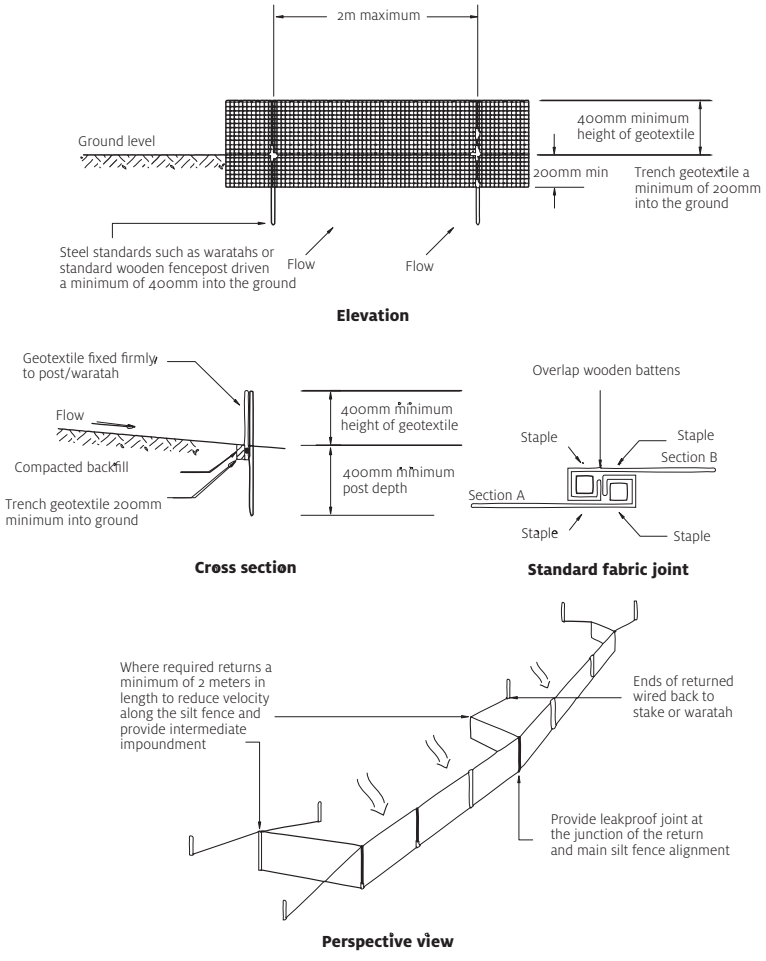
MAINTENANCE

- 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



Waikato Regional Council
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Te Kaunihera ā Rohe o Waikato

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