HAWKE'S BAY WATERWAY GUIDELINES

WORKS IN WATERWAYS

HAWKE'S BAY REGIONAL COUNCIL

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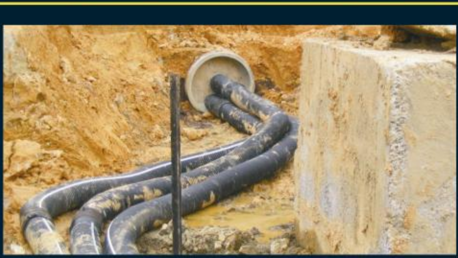

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SAFEGUARDING YOUR ENVIRONMENT + KAITIAKI TUKU IHO

Hawke's Bay Waterway Guidelines

Works in Waterways

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Acknowledgement
This document for the Hawke's Bay Region is based primarily on the Auckland Regional Council's Technical Publication No. 90 "Erosion and Sediment Control Guidelines for Land Disturbing Activities". The Works in Watercourses approach is provided in the ARC's TP 90. The ARC gave permission to use their document and that permission is greatly appreciated.

Modifications to the ARC document have been made so there will be some differences to the ARC approach to account for advances in practice design and to reflect local conditions.

Note
This document is a living document and may be reviewed from time to time as industry standards change and best practice evolves. Please contact Hawke's Bay Regional Council to ensure the latest version is used.

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Contents

1 Introduction

Works in or around streams have the potential to have a direct impact on watercourse habitat (e.g. by habitat disturbance or destruction) and on watercourse ecology (such as through sediment and temperature related effects). Note that erosion and sediment control measures are not usually constructed in channels having permanent flow. This is because the catchments are too large, the permanent flows limit the effectiveness of any controls, they can impede fish passage and they cause their own effects because of the degree of construction disturbance.

Culvert Construction with a Temporary Diversion Channel

Great care is therefore required for works in and around watercourses to avoid potential effects as much as possible. Where this is unavoidable, specific control measures and methodology are required to minimise potential adverse impacts.

The following sections set out some general information and highlight a number of ideas that can help minimise the effect of works near or in watercourses.

Works within watercourses have very high potential for erosion and discharge of sediment. This is because such work is undertaken in or near flowing water - the major cause of erosion. Flowing water causes ongoing scour and provides the transport mechanism to allow sediment to be dispersed downstream of the works and ultimately, into the marine environment.

The following erosion and sediment control methods and techniques are specific to temporary watercourse works only. Such works may also require a range of control measures additional to those discussed. These other measures are described in the Erosion and Sediment Control Guidelines for the Hawke's Bay Region and include both erosion control and sediment control techniques.

Design and planning consideration for a permanent watercourse crossing need to take into account the permanent nature of the crossing in question. Be sure that they are constructed in accordance with all relevant requirements.

When considering temporary works in waterways, there are a number of different activities that need to be considered.

- Temporary waterway crossings,
- Dam and pumping or dam and diverting,
- Temporary waterway diversions, and
- Rock outlet protection.

All of these activities impact on streams directly and indirectly through generation of sediment that can adversely impact downstream aquatic resources. Whereas sedimentation during a storm can have significant adverse impacts to aquatic organisms, sedimentation generated during low flow conditions can have devastating impacts to aquatic resources.

This guideline provides guidance for reduction in sedimentation effects for those activities discussed above.

2 Temporary Watercourse Crossings

2.1 Definition

A bridge, ford or temporary structure installed across a watercourse for short term use by construction vehicles.

Bridge on a Forestry Project Constructed of Available Wood

2.2 Purpose

To provide a means for construction vehicles to cross watercourses without moving sediment into the watercourse, damaging the bed or channel, or causing flooding during the construction, maintenance or removal of the structure.

2.3 Application

Where heavy equipment is required to be moved from one side of a watercourse to the other, or where traffic must cross the watercourse frequently for a short period of time.

2.4 Design

Careful planning can minimise the need for watercourse crossings. Wherever possible, avoid crossing watercourses by completing the development separately on each side of the channel, thus leaving the watercourse in its natural state.

If no other option exists and a watercourse crossing is required, select a location where the potential effects of the crossing (including construction) are minimised. Plan watercourse crossings well before you need them and if possible, construct them during periods of dry weather. Complete construction as rapidly as possible and stabilise all disturbed areas immediately during and following construction.

Do not build a watercourse crossing during the fish migration period for the watercourse. The Hawke’s Bay Regional Council can help identify these periods for particular watercourses.

There are three main types of crossing:

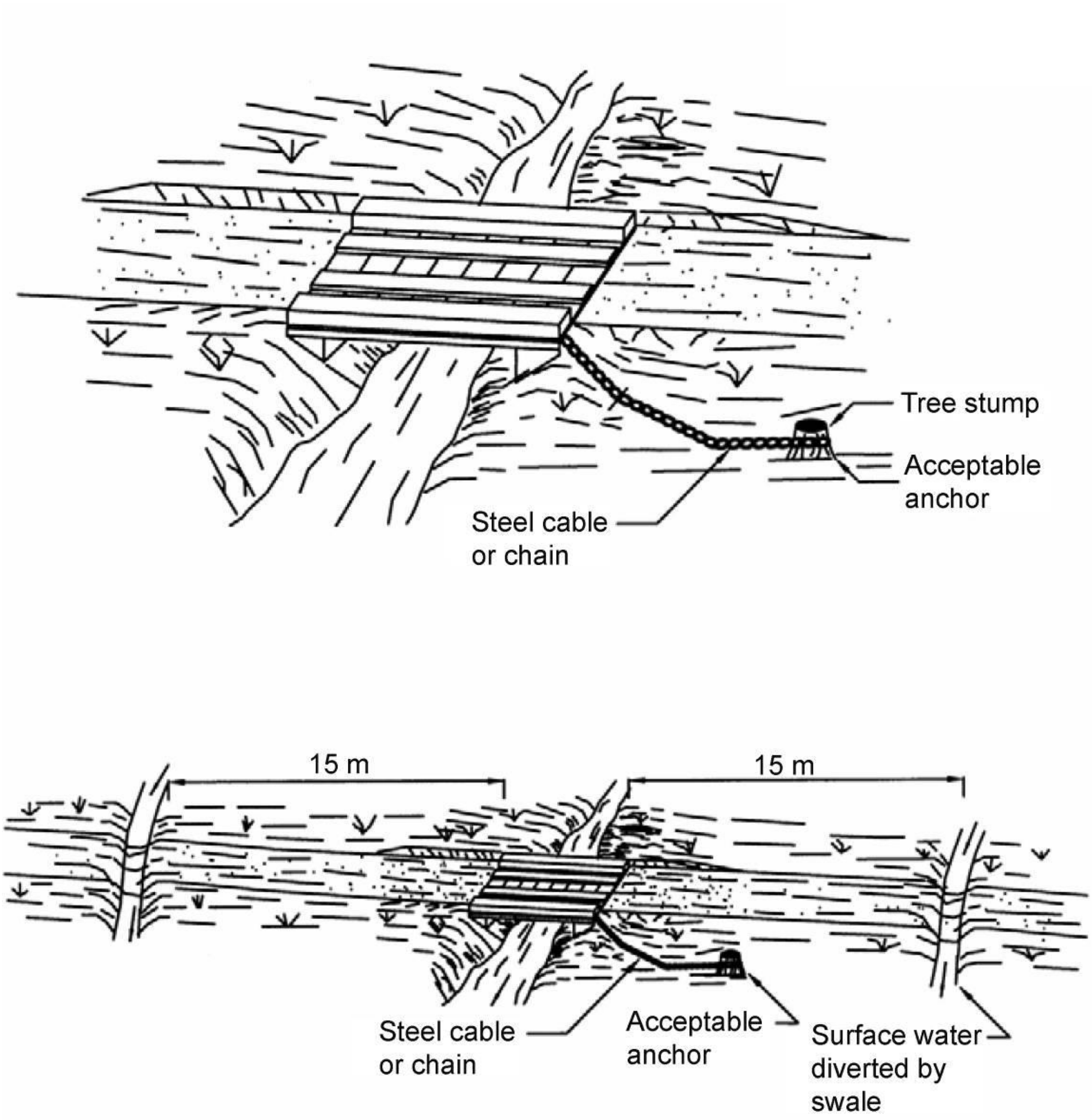
- Bridges,
- Culverts and
- Fords.

2.4.1 Bridges

Where available materials and designs are adequate to bear the expected loadings, bridges are the preferred temporary watercourse crossing method. They provide the least obstruction to flow and fish migration, cause little or no modification of the bed or banks and generally require little maintenance.

It should be noted, however, that bridges can be a safety hazard if not designed, installed and maintained appropriately. A schematic of a temporary bridge is shown in Figure 2-1.

Figure 2-1
Standard Configuration for a Temporary Bridge



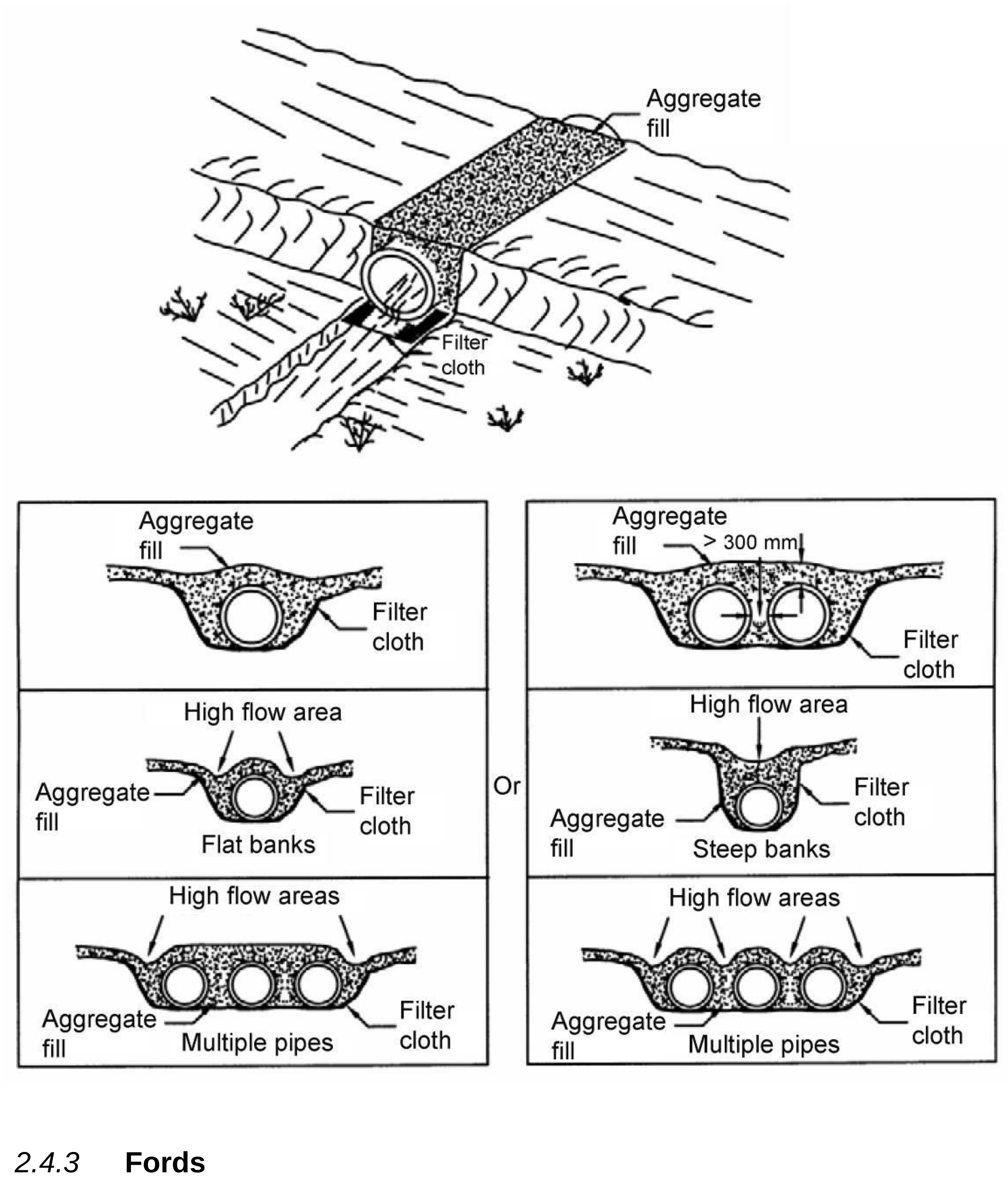
2.4.2 Culvert Crossings

Culverts are the most commonly used type of temporary watercourse crossing, and can be easily adapted to most site conditions. The installation and removal of culverts, however, causes considerable damage to watercourses and can also create the greatest obstruction to flood flows.

When installing a temporary culvert, sizing is important as storm flows could cause erosion or overtop the culvert causing failure of the temporary access. Rather than attempt to size temporary culverts through hydrological analyses, it is recommended that the cross-section of the culvert be sized for approximately 85% of the channel cross-section if the duration of the crossing is less than one year. Longer than one year would necessitate a hydrologic design and scour protection to ensure the integrity of the crossing in the event of overtopping to ensure minimal adverse impacts.

A schematic of a temporary culvert is shown in Figure 2-2.

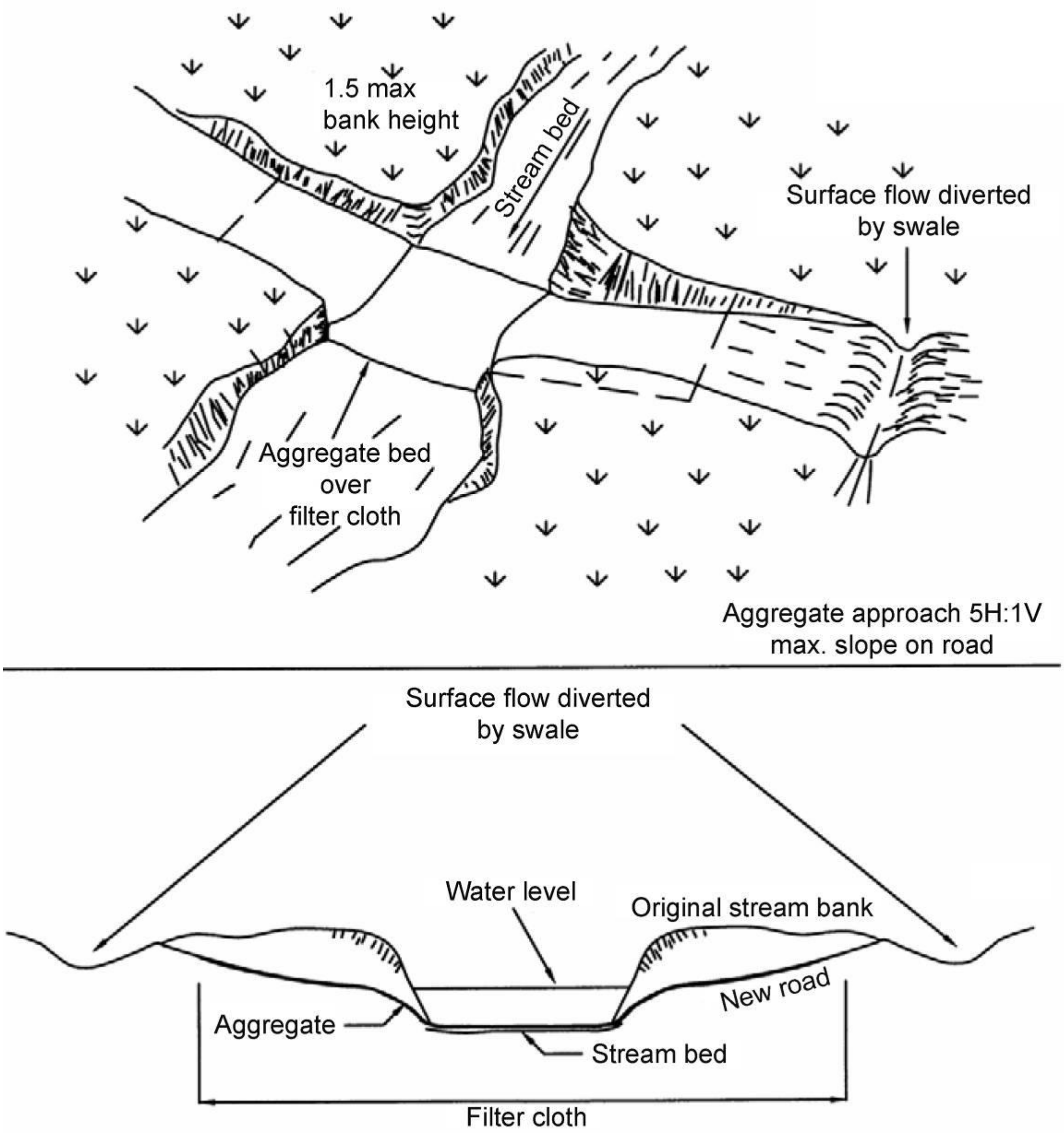
Figure 2-2
Standard Configuration for a Temporary Culvert



2.4.3 **Fords**

Made of stabilising material such as rock, fords are often used in steep catchments subject to flooding, but where normal flows are shallow. Only use fords where crossing requirements are infrequent. They can offer little or no obstruction to flows, are relatively easy to install and maintain, and in most cases can be left in place at the end of the construction activity. A schematic of a temporary ford is shown in Figure 2-3.

Figure 2-3
Standard Configuration for a Temporary Ford



As well as erosion and sediment control measures, structural stability, utility and safety must also be taken into account when designing temporary watercourse crossings. These details must be supplied to the Hawke's Bay Regional Council for approval prior to construction. In addition, a resource consent may be required for the construction of the proposed crossing. This can be determined by consultating with the Hawke's Bay Regional Council.

Any temporary crossing shall comply with the technical requirements of the various agencies involved and any specific requirements imposed by the Hawke's Bay Regional Council.

When the structure is no longer needed, remove the structure and all material from the site. Immediately stabilise all areas disturbed during the removal process by revegetation or artificial protection as a short term control measure. Keep machinery clear of the watercourse while removing the structure.

2.5 Maintenance

Inspect temporary watercourse crossings after rain to check for blockage in the channel, erosion of the banks, channel scour or signs of instability. Make all repairs immediately to prevent further damage to the installation. Permanent crossings need to be inspected following major storm events, again with all repairs being made immediately.

3 Dam and Pumping or Dam and Diverting

3.1 Definition

A dam and pumping or a dam and diverting is a temporary practice used to covey surface water from above a construction activity downstream of that activity.

Water Being Diverted Past a Construction Site

3.2 Purpose

There are several diversion methodologies that will assist in providing dry working conditions for culvert installation. Damming a stream and pumping the flows around the work site back to the stream minimises disturbance considerably compared with constructing a new diversion channel. With high flow streams, diversions are sometimes the only option, however with most small streams, damming and pumping are less harmful to the environment and relatively simple to carry out. The dam is also essential to temporary waterway diversions that are discussed in the next section.

3.3 Design

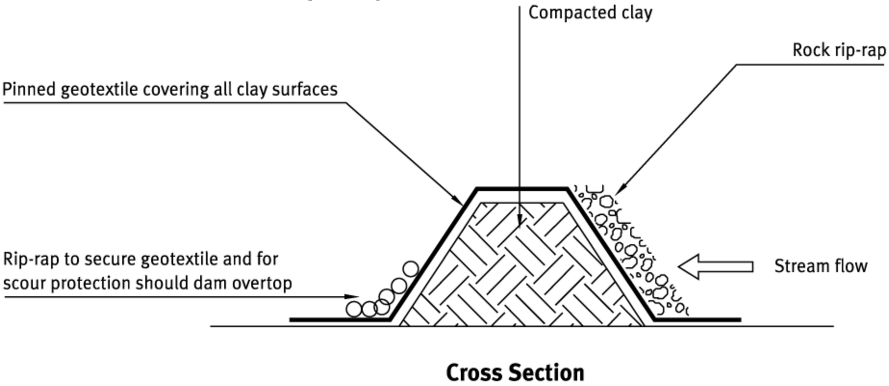
Construct a dam across the stream with stabilised materials such as sand bags, large rock with geo-textile support or other suitable construction materials. Install a pump in the dam and ensure that sufficient hose length is available to reach below the new culvert outlet. Place the pump inlet in a drum with holes to minimise the possibility of sucking sediment from the bottom of the dam. Make sure that the outlet is to a stabilised area with an energy dissipater such as riprap boulders or similar. Figure 3-1 provides a schematic of a temporary waterway diversion dam.

Construction Notes:

(a) Make sure that the dam is capable of holding back the incoming flows.

(b) Ensure the pump is capable of conveying the flows, as overtopping the dam will cause problems when laying compacted base material for the new culvert.

Figure 3-1
Temporary Watercourse Diversion Dam Detail



4 Temporary Waterway Diversions

4.1 Definition

A short term watercourse diversion to allow works to occur within the main watercourse channel under dry conditions.

Waterway Diversion on a Highway Project

4.2 Purpose

To enable watercourse works to be undertaken without working in wet conditions and without moving sediment into the watercourse.

4.3 Application

Temporary watercourse diversions are used as temporary measures to allow any works to be undertaken within permanent and ephemeral watercourses.

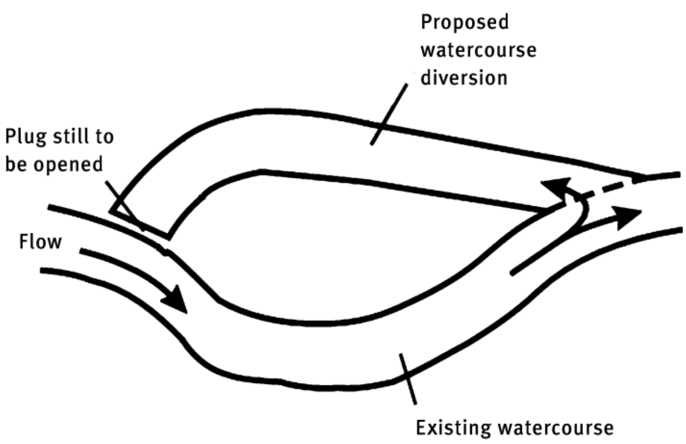
4.4 Design

Divert all flow via a stabilised system around the area of works and discharge it back into the channel below the works to avoid scour of the channel bed and banks. Figures 4-1 to 4-4 show the suggested steps to minimise sediment generation and discharge from works within a watercourse.

4.4.1 Step 1

Excavate the diversion channel leaving a plug at each end so that the watercourse does not breach the diversion. Size the diversion channel to allow for a 5% AEP rain event. Stabilise the diversion channel appropriately to ensure it does not become a source of sediment. Anchor suitable geotextile cloth in place to the manufacturer's specifications, which will include trenching into the

Figure 4-1
Diversion Channel Prior to Plug Removal

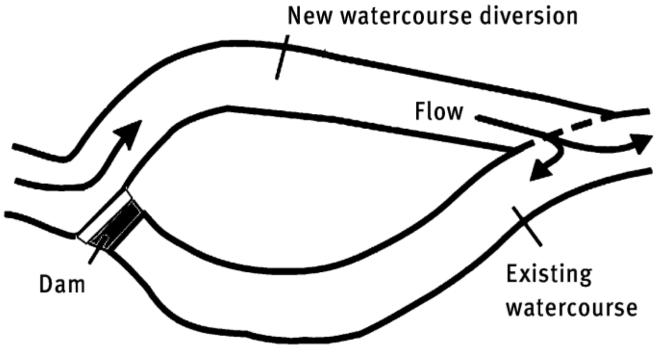


top of both sides of the diversion channel to ensure that the fabric does not rip out. Open the downstream plug and allow water to flow up the channel, keeping some water within the channel to reduce problems when the upstream plug is excavated. Open the upstream plug and allow water to flow into the channel.

4.4.2 Step 2

Immediately place a non-erodible dam in the upstream end of the existing channel. Construct the dam as specified in Figure 3-1, where a compacted earth bund has shotcrete/ concrete placed, or appropriate geotextile pinned over it, with rock rip-rap extending over the upper face and adjacent to the lower face for scour protection.

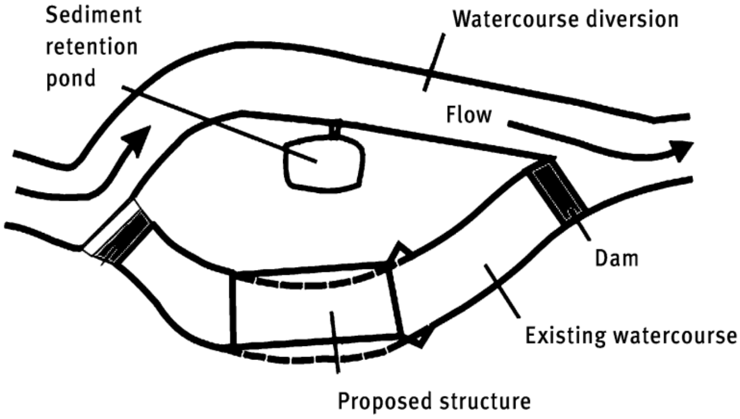
Figure 4-2
Opening Up Bypass Channel and Closing off Existing One



4.4.3 Step 3

Immediately install a non-erodible downstream dam to prevent backflow into the construction area. Drain the existing watercourse by pumping to a Sediment Retention Pond where treatment of the ponded water can occur prior to re-entering the live section of the watercourse. Construct the structure and complete all channel work.

Figure 4-3
Dewatering Construction Area into a Sediment Pond

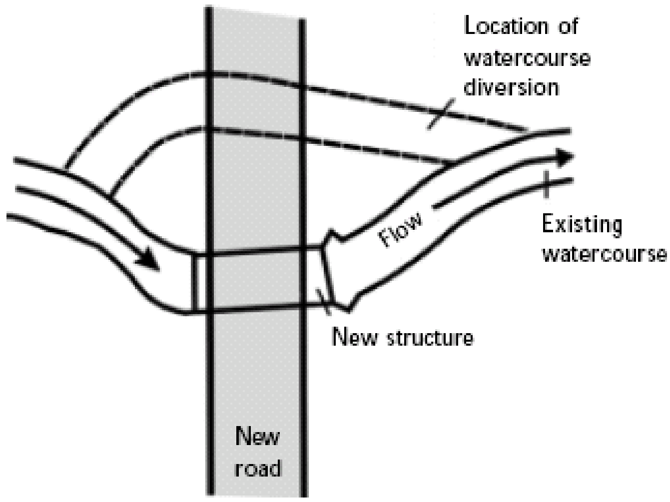


4.4.4 Step 4

Remove the downstream dam first, allowing water to flood back into the original channel. Remove the upstream dam and fill in both ends of the diversion channel with non-erodible material. Pump any sediment-laden water to a Sediment Retention Pond. Fill in the remainder of the diversion and stabilise.

4.5 Maintenance

Figure 4-4
Re-establishment of Flow in Original Channel



Any works within a watercourse will require ongoing and vigilant maintenance to minimise sediment generation. To achieve this, identify and correct any signs that may indicate a potential problem. Take particular notice of the following signs.

- The geotextile lining ripping, or
- Scour occurring where the flow re-enters the channel, or
- Undercutting of the diversion lining, and
- Make repairs immediately.

5 Rock Outlet Protection

5.1 Definition

Rock placed at the outfall of channels or culverts.

Rock Outlet Protection for a Temporary Drain

5.2 Purpose

To break up concentrated flows, to reduce the velocity of flows to non erosive rates and to stabilise the outfall point.

5.3 Application

This practice applies where discharge velocities and energies at the outlets of pipes, culverts or flumes are sufficient to cause erosion. This will apply to most concentrated flow outfalls and outlets of all types such as sediment retention ponds, stormwater management ponds and road culverts.

5.4 Design

The following design does not apply to rock lining of watercourse channels. Detailed design of Rock Outlet Protection depends on the location.

- Do not use Rock Outlet Protection to protect pipe outlets at the top of cuts or on slopes steeper than 10 % because they reconcentrate flows and generate high velocities after the flow leaves the apron.
- Ensure the channel containing the Rock Outlet Protection is straight throughout its entire length and is constructed using rock riprap or gabion baskets/reno mattresses.
- Remove soft material down to a firm bed and smooth and level the outfall area to eliminate voids
- Ensure riprap is composed of a well graded mixture of washed rock and has an appropriate geotextile placed underneath it at all times to prevent soil movement into and through the riprap. There are two scenarios where riprap is used: at the oufall of pipes and at the end of diversion channels. Riprap at pipe outfalls should be designed according to the following approach:
    - Determine the discharge velocity for the 2-year rainfall event.
    - Enter that value into the following equation to determine the equivalent diameter of stone:
      $D_s = 0.25 \times D_o \times F_o$

      Where
      d_s = rip rap diameter (m)
      D_o = pipe diameter (m)
      F_o = Froude number = $V/(g \times d_p)^{0.5}$

d_p = depth of flow in pipe (m)
V = velocity of flow in pipe (m/s)
g = 9.8 m/s^2

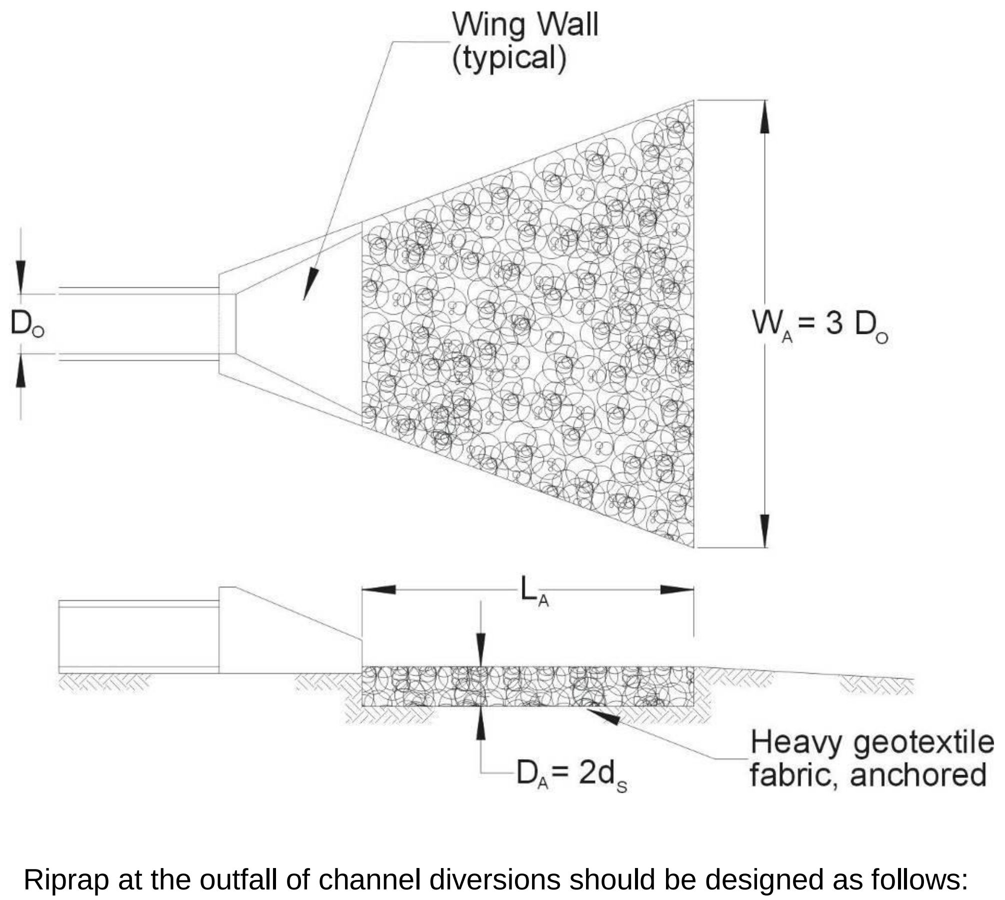
- The thickness of the stone layer is 2 times the stone dimension, $D_A = 2d_s$
- The width of the area protected is 3 times the diameter of the pipe. $W_A = 3D_o$
- The height of the stone is the crown of the pipe + 300 mm
- The length of the outfall protection is determined by the following equation:

  $L_a = D_o(8 + 17 \times LogF_o)$

  Where:
  L_a = Apron length (m)

  Figure 5-1 schematically shows a rip rap outfall structure.

Figure 5-1
Plan View and Cross-Section of Rock Outlet Protection



- Riprap at the outfall of channel diversions should be designed as follows:
  - Riprap sizes shall be according to the following Table 5-1.

Table 5-1 **Riprap Sizing Table**	
Velocity (m/s)	Rock D_{50} (mm)
1.5	150 (smallest stone size recommended)
2.1	200
3.0	400
4.5	750
Above 4.5 m/s	Specific design for riprap size is needed

  - Velocities shall be determined based on the expected duration of the diversion. For time frames in excess of 6 months, the velocity shall be determined from the 2-year, one-hour rainfall. For durations less than 6 months, the velocity shall be determined using the 2-year one-hour storm. For durations less than one week, the design shall be based on the the 2-year 10-minute storm.
  - Largest stone recommended = 1.5 D_{50}
  - Thickness of riprap layer = 2 D_{50}
  - Filter fabric shall be placed under the riprap
  - The smallest stone size shall be 150 mm in diameter.
- If gabion baskets are used, construct gabion baskets of hexagonal twist mesh with heavy galvanised steel wire. Ensure foundation conditions for the gabion baskets/reno mattresses are the same as for rock rip rap and place filter cloth beneath all gabion baskets. In some circumstances a key may be needed to prevent undermining of the main gabion structure.
- Design the structure in accordance with Hawke's Bay Regional Council approval and use materials within the relevant manufacturer's and engineering specifications.
- Remember that works within a watercourse such as the placement of rock rip rap or gabion baskets may require a resource consent from the Hawke's Bay Regional Council. Contact the Council well ahead of time so that any consents needed may be obtained before works are due to start.

5.5 Maintenance

Once installed, the maintenance requirements of the such structures is very low. Inspect after high flows to check scour and dislodgement and make repairs immediately.