8 Stream works

Background considerations

Works in or around streams can have direct impacts on watercourse habitat, such as physical disturbance or destruction, and on watercourse ecology, such as through sediment and temperature-related effects. The loss of watercourses through works such as piping and extensive culverting can have permanent adverse ecological effects. A resource consent will be needed for works in or around watercourses and fish spawning or migration times may affect the timing of works.

Large quantities of sediment can potentially be generated by works in watercourses; not only by the works themselves but also by storm scour through erodable construction areas. Sediment generated and transported by these flows will have an instant and direct effect because the material is already in the receiving environment. It can cause the suite of adverse effects outlined in section 1.3. Great care is therefore needed when working in or around watercourses.

The preferred approach is to avoid works in and around watercourses wherever possible, unless the work involves naturalisation of boxed drains or other habitat and amenity improvements.

The usual order of preference for watercourse crossings is (from first to last):
- bridges;
- bottomless arch culverts;
- arch culverts;
- box culverts; then
- round culverts.

Any permanent structure such as a culvert should be dug in at least 150 millimetres into the channel to avoid creating fish passage barriers as well as to allow for future bed re-grading. Lengthy culverts need to include measures such as those outlined in:

- Chapter 13.2 of the CCC Waterways, Wetlands and Drainage Guide (2003); and/or
- ARC TP 131 (Fish Passage Guidelines for the Auckland Region).

Where works in or near a watercourse are desirable or unavoidable, then specific control practices and methodology are required to minimise potential adverse impacts. This guideline does not address culvert installation per se, but focuses on methods to avoid, remedy and mitigate erosion and the generation of sediment during that process.

Erosion and sediment control considerations

Erosion and sediment control measures are not usually constructed in channels with permanent flow because significant storm flows can be generated from the upper catchment that can greatly reduce the effectiveness of the control measures. The measures themselves can impede fish passage and cause their own adverse effects because of the degree of construction disturbance. For these reasons, the actual construction work such as construction of culverts or naturalisation of the channel should be carried out off-line, that is - in a work zone away from stream flows. It may be possible to do this off-line from the watercourse in question, or a watercourse diversion may be necessary. Sediment curtains may be appropriate. In some situations, the issue can be resolved through careful construction methodology – for example, by bridging instead of culverting a stream, or by realigning the roading network to avoid the need for any kind of stream crossing.

Temporary watercourse diversions

Diversion of watercourse flow above the site is usually the first consideration. This flow can be pumped around a site (when works are for short durations only), conveyed through temporary drainage coil or plastic flumes or similar or diverted into a specifically designed, constructed and stabilised diversion channel (section 6.3.1). Some of the disadvantages to pumping and/or small pipes is their lack of capacity should flows increase; running out of fuel if the pump is unattended – for example, at night; and fish passage constraints.

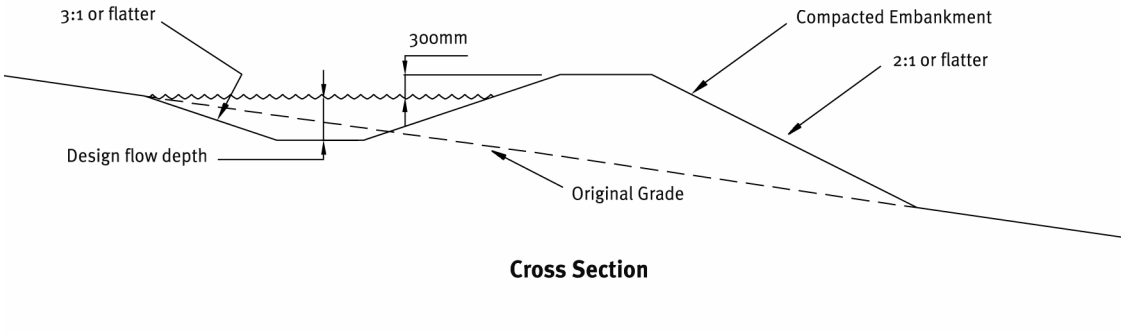
Where works in a watercourse will take place over a period of time, it is usual to construct a separate diversion channel, stabilise it and then divert flow into it and, therefore, away from the work area. This makes construction easier and gives better environmental outcomes.

Design considerations

The diversion system needs to be capable of conveying the flow from the five percent AEP storm event. General design details are in section 6.3.1 and as shown below in Figure 8.1. Recently excavated channel banks and beds will need stabilising against scour before watercourse flow is directed into them (see section 6.3.5 for soft armour channel protection and section 6.3.6 for hard armour channel protection).

Figure 8.1 Diversion channel

Source Auckland Regional Council, 1999



Construction

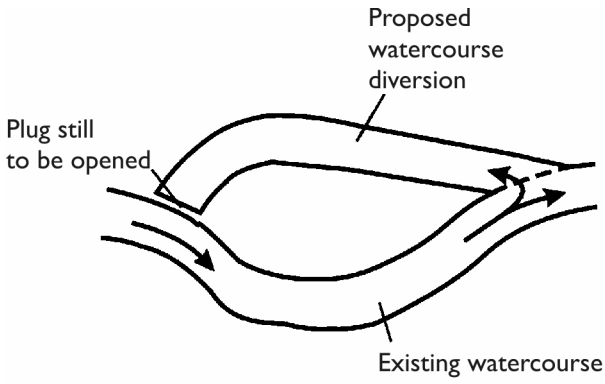
The typical construction sequencing of a temporary diversion channel is outlined in the four steps overleaf.

Step 1

- Size the diversion channel to allow for a five percent AEP storm event and mark it out on the ground.
- Excavate the diversion channel, leaving each end untouched so that the watercourse does not breach the diversion.
- Stabilise the diversion channel appropriately (often with needle-punched geotextile fabric for short-term diversions) so that the new temporary channel does not become a source of sediment.
- Pin the fabric to the manufacturer's specifications and trench the fabric into the top of both sides of the diversion channel and entry point.
- Open the downstream end and allow water to flow up the channel, keeping some water within the existing channel to reduce problems when the upstream plug is excavated.
- Open the upstream plug and allow water to flow into the new channel.

Figure 8.2 Watercourse diversion step 1

Source Auckland Regional Council, 1999

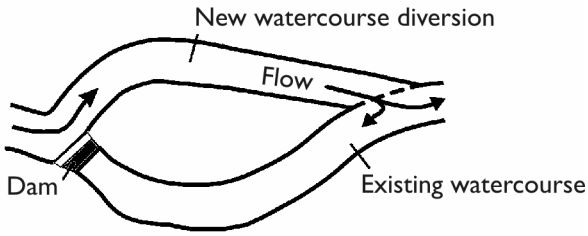


Step 2

- Place a non-erodible dam (see Figure 8.6) in the upstream end of the existing channel. This can be a compacted earth bund with shotcrete/concrete or appropriate geotextile pinned over it. Other options include steel sheet plates pushed into the channel by machine, stacked sandbags or other non-erodible material.

Figure 8.3 Watercourse diversion step 2

Source Auckland Regional Council, 1999

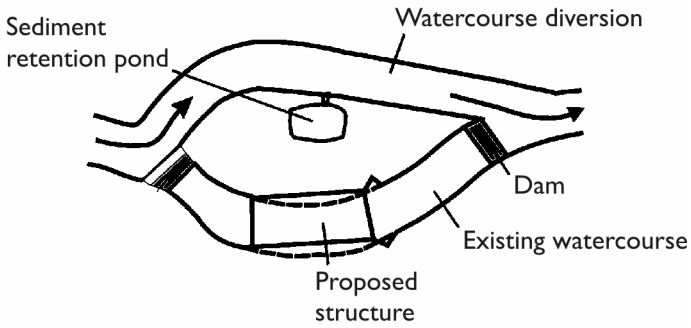


Step 3

- Install a non-erodable downstream dam to prevent backflow into the construction area.
- Drain the existing watercourse by pumping to a sediment retention measure such as a sediment retention pond (section 7.2.1) for treatment of sediment-laden water.
- Outflow from this pond may need to be temporarily halted (e.g. by raising the decants above the water level or by inserting a mechanical bung into the outlet pipe) to maximise sedimentation.
- Construct the structure and complete all channel work.

Figure 8.4 Watercourse diversion step 3

Source Auckland Regional Council, 1999



Step 4

- Remove the downstream dam first, allowing water to flood back into the original channel.
- Remove the upstream dam. 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.

Figure 8.5 Watercourse diversion step 4

Source Auckland Regional Council, 1999

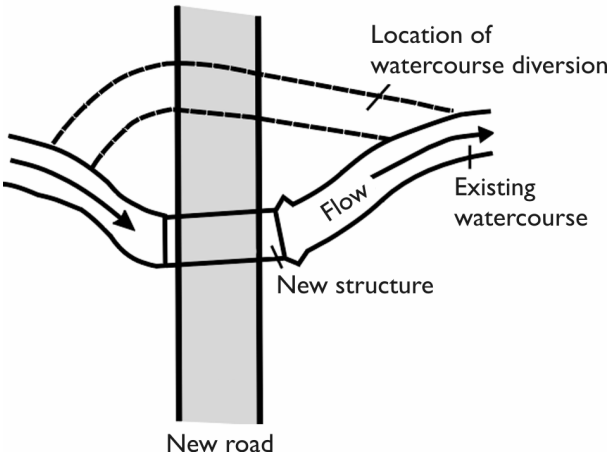
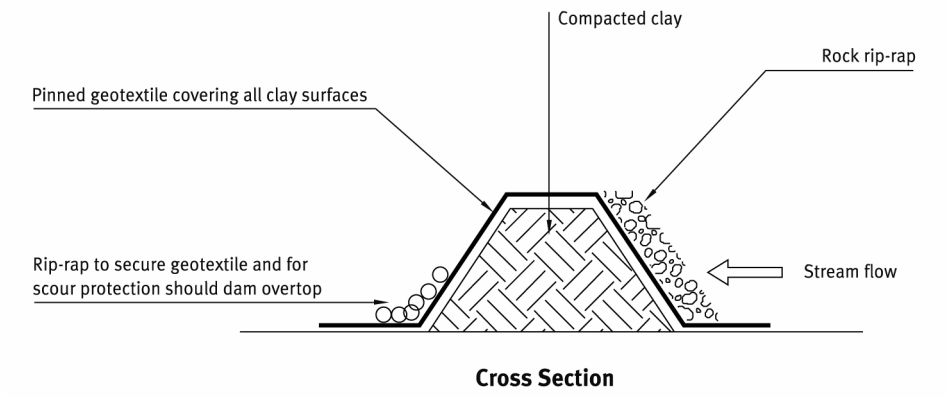


Figure 8.6 Watercourse barrier

Source Auckland Regional Council, 1999



Performance inspection and maintenance

- There is often some pressure on temporary stream works, particularly during storms but also by errant machinery.
- The pinning of protective fabric is often poorly done – make sure that it is carried out in accordance with the manufacturer's specifications. If the material is ripped, repair it.
- Watch also for scour where the diverison channel re-enters the main channel.

Some examples of diversion systems

	An operational stream diversion with: ✓ temporary fabric protection for the channel; ✓ mulch stabilisation above the immediate channel sides; and ✓ sediment fencing and site grading beyond channel to direct run-on flows away from the channel to a sediment retention pond *(not in photo)*.
	Construction of a clean water diversion system on steep country: ✘ fabric needs to be extended upslope and buried.
	✓ Operational clean water system in an active construction site.

	✓ A fabric diversion flume conveying clean run-on water through a small construction area.