Existing problem

Fish passage limited to climbing species only. Upstream and downstream passage prevented by permeable rock bed below dam.

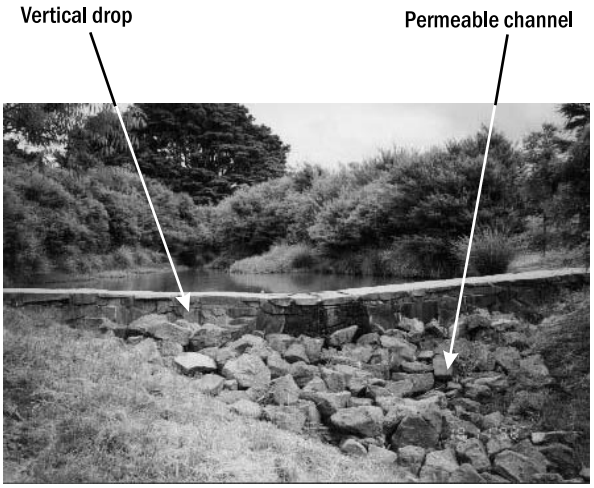

Plate 6: Low dam on Puhinui Stream.

Solution at construction

- Construct a sloping dam face that incorporates a low flow channel or;
- construct a bypass channel along one of the banks or;
- construct a fishway.

Retrofitting options

- Create an artificial channel on dam face by filling the dam face with smaller rocks grouted into place to prevent water seepage or;
- construct a bypass channel along one of the banks or;
- construct a fishway.

Existing problem

Fish passage limited to climbing species only.

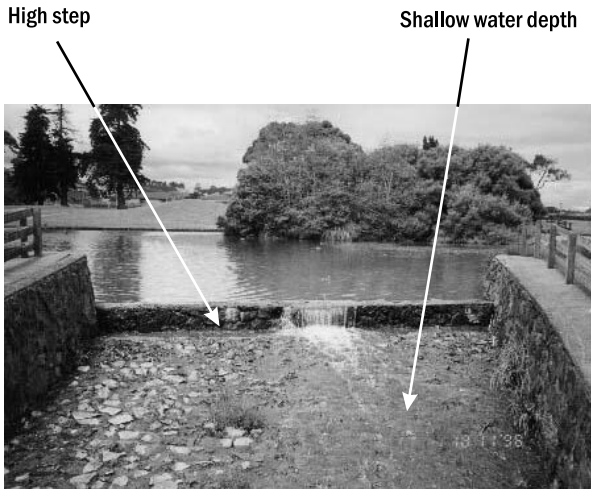

Plate 7: Dam spillway on Puhinui Stream.

Solutions at construction

- Construct the weir crest on a slope (or with a notch). Create a pool and weir channel on the spillway. Ensure there are no steps or velocity barriers anywhere between the toe of the spillway and the head pond.
- Alternatively, construct a bypass channel along one bank.

Retrofitting options

Option 1:

- Build a fish pass on the spillway.

Option 2:

- Notch the weir and form a pool and weir channel in a zigzag pattern down the spillway face.

Option 3:

- Construct a natural channel on one side of the spillway. (Ensure that the channel entry is at the base of spillway.)

Existing problem

Fish passage limited to climbing species only.

Plate 8: Flow measuring weir on Meola Creek.

Solutions at construction

- Build a natural rock weir and calibrate.

Retrofitting options

Option 1:

- Remove concrete structure and construct a stable calibrated reach with rocks and mortar.

Option 2:

- Fill downstream end of wall with rock and mortar to create a climbing surface - recalibrate weir.
- If swimming species require passage, construct notched rock weirs downstream to flood the existing weir at low and medium flows - recalibrate weir.

Existing problem

Fish passage problems include high water velocities at medium and high flows, no in-stream features where fish can rest, feed, or take refuge. Lack of shading leads to increased water temperature.

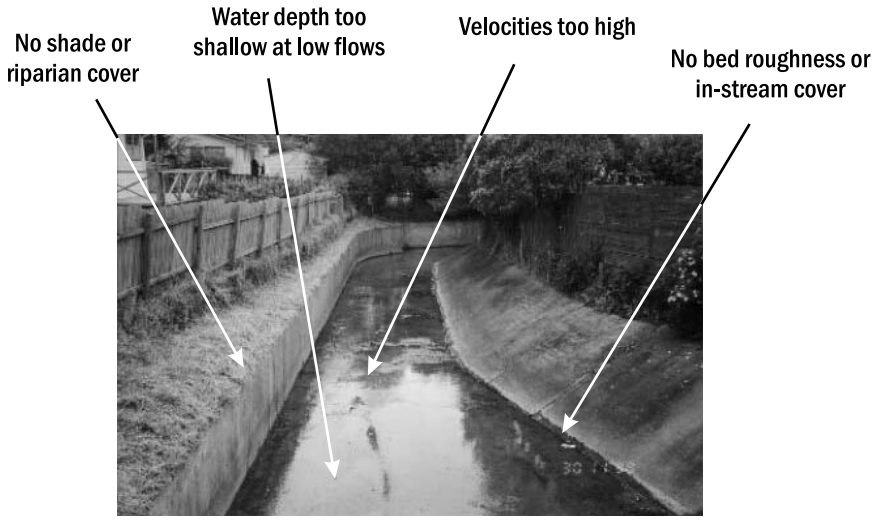

Plate 9: Channelised section on Awaruku Stream.

Solutions at construction

- Use rock and mortar (at least on one bank) to create a "natural" stream bed.
- Use large rocks in channel to create resting areas and reduce water velocities at medium to high flows.
- Plant vegetation along bank to provide shade and cover.

Retrofitting options

- Plant shade species along channel banks.
- Insert large rocks in the channel to create diversity.
- Cement rocks along one side of the channel to help reduce velocities and provide resting areas for fish.
- Remove sections of the smooth concrete channel and rebuilt using rocks and grout so as to create pools and backwaters.

Existing problem

The upstream and downstream passage of fish is not possible except during high flows when the weir is overtopped.

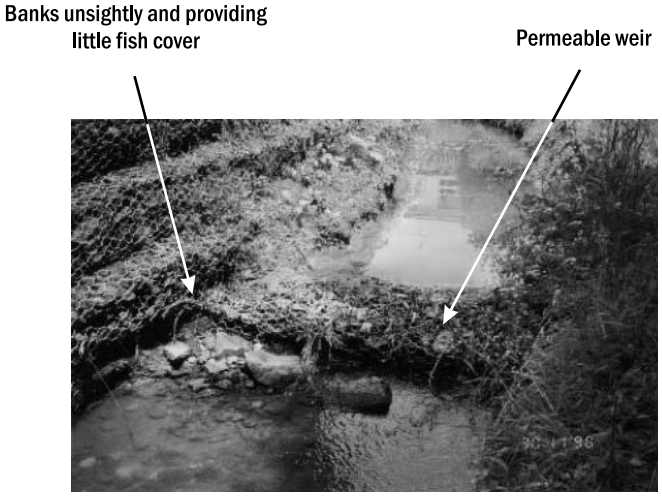

Plate 10: Water permeable erosion control weir on Awaruku Stream.

Solutions at construction

- Use rocks to create a notched weir.
- Plant shade species.
- Use large rocks to stabilise the stream banks.

Retrofitting options

Option 1:

- Remove gabion basket and replace with one or more notched large rock weirs.

Option 2:

- Create notch in existing gabion basket and grout gabion basket.

Option 3:

- Add one or more notched rock weirs downstream to flood existing weir.

Existing problem

Passage possible for climbing species only (Note also the permeable erosion control mattress and steep drop at top of ramp).

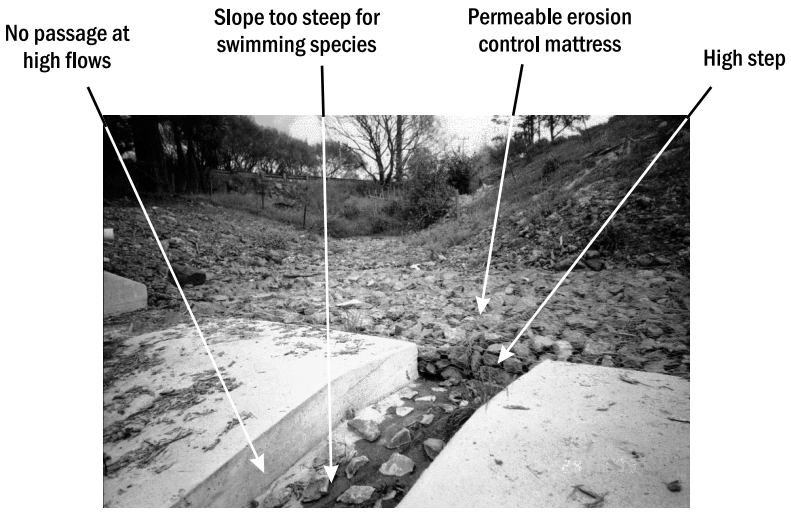

Plate 11: Steep bedslope modification at entry of culvert on an unnamed tributary of Weiti Stream.

Solutions at construction

- Regrade upstream channel to even out slope. Insert notched rock weirs if required.
- Dish inlet apron and use rocks to produce a low velocity zone along the margins at all flows.
- Use embedded rocks on channel floor and banks to prevent erosion. Do not create steps or velocity barriers in the channel.

Retrofitting options

Option 1:

- Remove ramp if passage for swimming species is required and regrade upstream reach.

Option 2:

- If only climbing species are present reshape apron (dish and roughen surface) to allow passage at medium flows.
- Grout channel floor.

Existing problem

Passage restricted for weak swimmers. No substrate available for anguilliform locomotion.

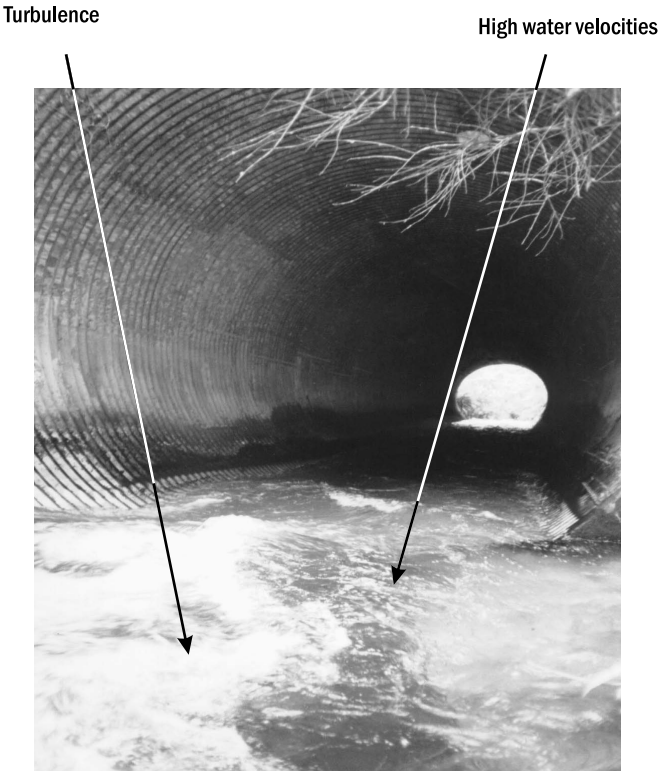

Plate 12: Fast turbulent flows through culvert.

Solutions at construction

- Install the culvert with the invert positioned below the streambed.
- If required, insert rocks or baffles on the floor of the culvert.
- Build notched weir(s) at outlet to flood the toe of the culvert.
- Create bevelled headwall at inlet and outlet.

Retrofitting options

- Build notched weir(s) at outlet to increase water depth in culvert.
- Insert baffles or spoilers on floor of culvert to reduce water velocities.
- Build rounded rock headwall to help reduce turbulence at inlet and outlet.

Existing problem

Passage limited to climbing species only.

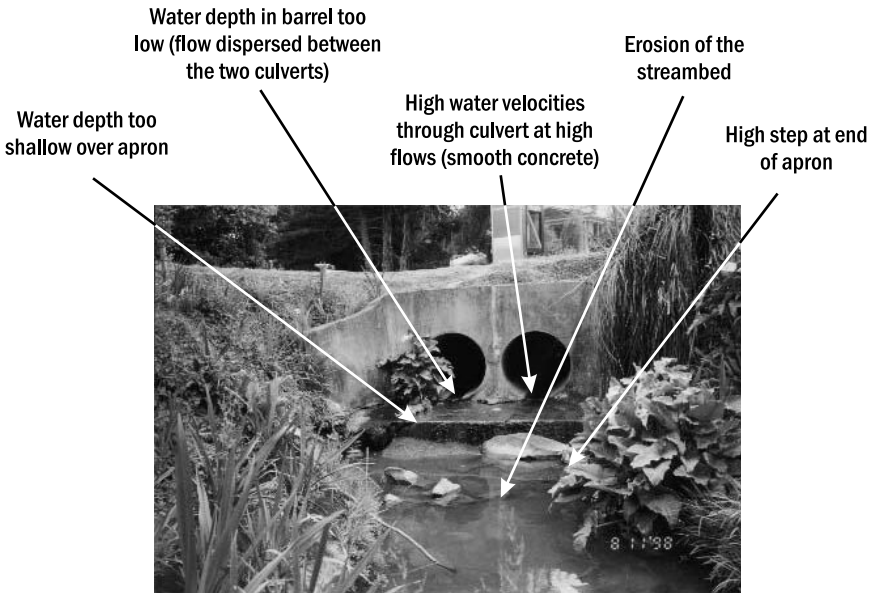

Plate 13: Water level too low in culvert and over downstream apron.

Solutions at construction

- Armour stream banks
- Armour streambed

Option 1:

- Build a single large culvert with the invert positioned below the streambed.

Option 2:

- Place one barrel lower than the other to cater for passage during low flow conditions.
- Include rocks on barrel floor or insert baffles to reduce water velocities through the culvert.

Retrofitting options

- Insert spoilers or baffles to reduce water velocities through the culvert barrel.
- Partially block off one of the culverts at the inlet to concentrate water through one culvert during low flows.
- Build notched weir(s) downstream of apron to flood the toe of the culvert.
- Dish apron (or flood).