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Removing or Passing Barriers

12.2 Step pool cascade fish pass and culvert bed improvement

LODGE BURN

LOCATION - COLERAINE TOWN CENTRE, N. IRELAND NW02689199

DATE OF CONSTRUCTION - APRIL/MAY 2012

LENGTH – 40m

COST – £88,500

Lodge Burn	Low energy, clay
WFD Mitigation measure	Click Here to view details
Waterbody ID	GBNI1NB030301223
Designation	None
Project specific monitoring	Fish, River Corridor Survey (pre-project only) hydromorphology

Description

The aim of this project was to improve fish passage through a reach of the Lodge Burn in Coleraine. Part of a 1 in 100 year design standard Flood Alleviation Scheme, a cascade fish pass was constructed and a gravel bed installed within the culvert.

The Lodge Burn has a history of channel modifications including mill ponds, drainage works and culverting. Despite its relatively small catchment size (16.4km^2), it has historically been an important spawning and rearing tributary for migratory fish, given its proximity to the River Bann estuary and Atlantic Ocean (8.5km). The natural dominant substrate is gravels and cobbles, although this has been altered in some areas by dredging or siltation.

Initial scoping identified significant hydromorphological pressures within the town. The site was classified as "bad ecological status" for Water Framework Directive (WFD) in 2009. A major cause of this was identified as a perched culvert with a concrete bed and steep apron, located in the centre of Coleraine. This was obstructing sediment transport and fish passage. The location of this structure meant that re-design of the reach had to work within a very confined space between two high flood walls and within the culvert. The works consisted of a cascade fish pass and lowering of the culvert bed. Thorough site investigation was needed to ensure that the baffles within the culvert did not affect the integrity of the culvert, floodwalls or any adjoining buildings.

The scheme involved liaison with the local council, WFD Catchment Stakeholder Group, local residents, statutory agencies and local fisheries interest groups. A 'salmon in the classroom' scheme was also undertaken with a local primary school, and the fish release was reported on BBC television and in the local press.

Existing culvert beneath buildings was impassable to fish due to depth, velocity and slope of the concrete bed and apron – August 2010

Design

The works were carried out in four key stages;

1. Flow management; works to install the step-pool cascade and improve the culvert bed had to be conducted in the dry. A fully isolated dry working area was achieved by sandbagging and over-pumping.

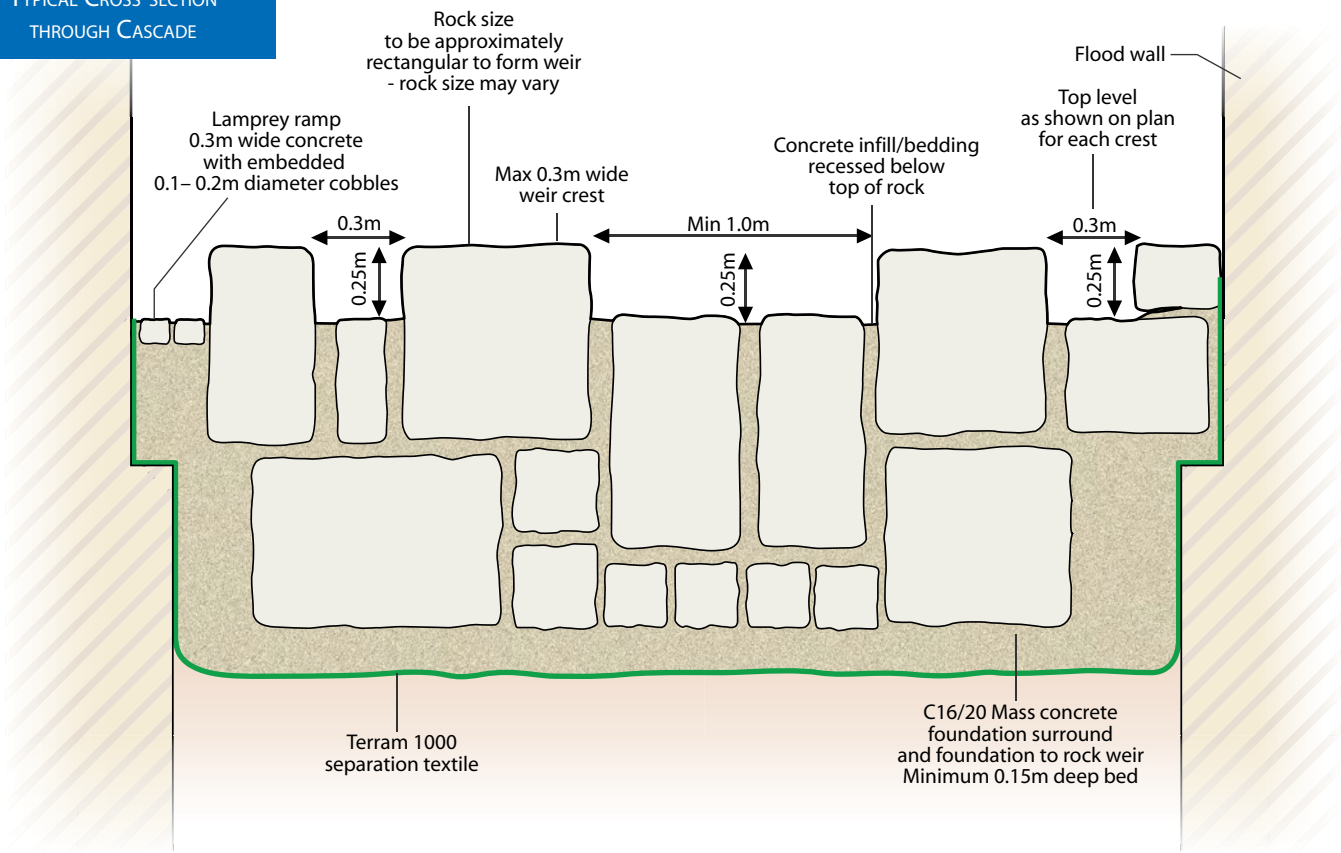
2. Modify culvert bed; the culvert had to be enlarged to incorporate the loss of capacity and increased roughness of the new cobble bed. The culvert bed was carefully excavated 0.3m below the existing level.

Stainless steel baffles (0.15m high) were secured across the culvert at 2.5m intervals to prevent scouring of the placed bed material.

3. Install natural bed in culvert; a mix of cobble and boulders (0.15m-0.3m) were placed across the bed and ramped up at the sides to concentrate low flows to the centre of the channel, in order to provide adequate water depth for fish entering the culvert.

At the culvert exit, larger boulders and a reinforced concrete lip were installed to maintain sufficient depth of flow within the culvert.

Figure 12.2.1
TYPICAL CROSS-SECTION THROUGH CASCADE



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Cascade during construction – May 2012

4. Remove concrete apron and install cascade; the concrete apron was broken out creating a 1.5m drop to the channel bed. This was overcome by creating a series of six steps and pools, each with a crest 250mm lower than the previous one. The core of the first cascade was constructed with reinforced concrete as it would take the initial force of flows leaving the culvert. The remaining five were constructed of large rocks (0.5 to 1.5 tonnes) concreted in place to prevent washout (*Figure 12.2.1*).

A notch was designed in each structure to concentrate flows during periods of low water. Each pool had a minimum 1m depth, which generated areas of lower flow velocity in which fish can rest before continuing their ascent.

Spacing between cascades was 6m, therefore in total the pass extended for 36m downstream of the culvert.

A concrete brook lamprey (*Lampetra planeri*) ramp was designed into one side of the channel.

Due to the constrained working space, construction had to proceed in an upstream to downstream direction. Once ach cascade was put in place it was not possible for machinery to travel back upstream of it again.

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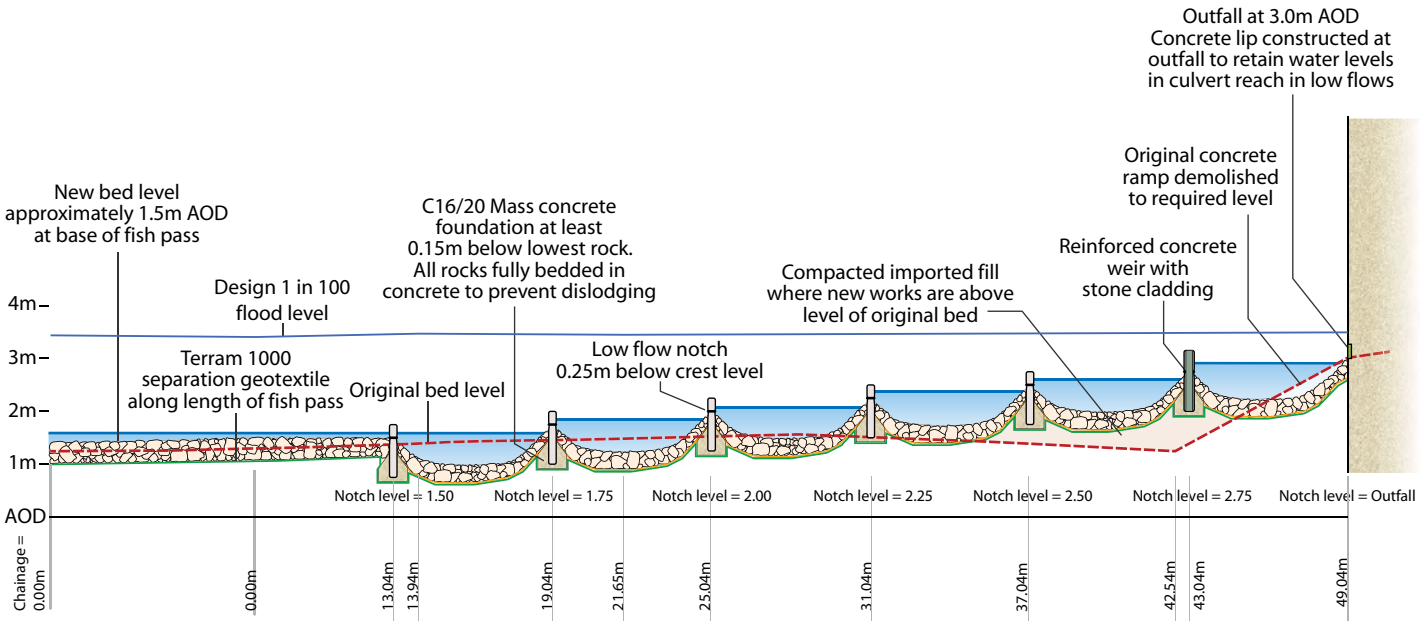

Figure 12.2.2
LONGITUDINAL SECTION THROUGH CASCADE FISH PASS

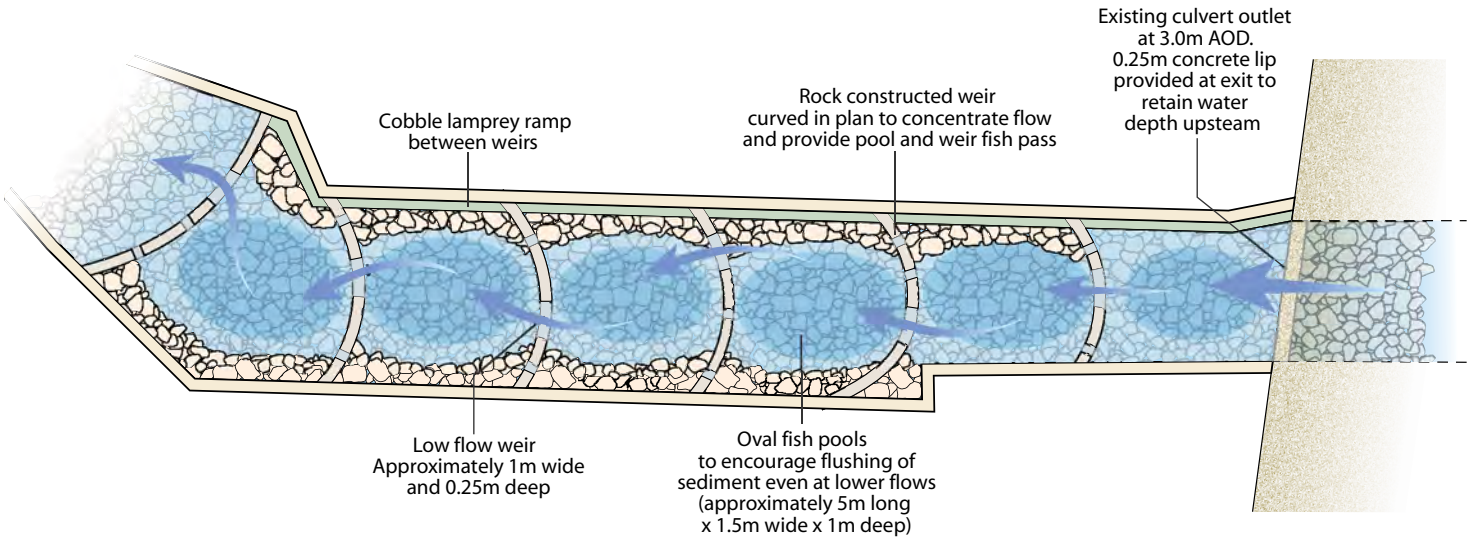

Figure 12.2.3
OVERAL PLAN OF CASCADE FISH PASSAGE

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Culvert shortly after construction completed – May 2012

Subsequent performance

This project is a good example of what can be achieved to improve fish passage in a very confined space. The new pass has had a positive response in terms of aesthetics.

Flooding shortly after construction caused some damage to the face of the first cascade. Gravel and cobble washout from the culvert resulted in the infilling of pools, however this material was removed subsequently by the Rivers Agency. This initial movement highlighted the importance of incorporating sufficient self-maintaining processes in pool design (i.e. sufficient flow to maintain the pool depth), as well as the need to anticipate early wash-out of excess material. The remaining cobble bed material within the culvert is now deemed to be stable.

Enhancement features within Flood Alleviation Schemes are often designed to perform in low flow conditions. It is also important that they are sufficiently robust to withstand flood events, as failure can often result in an increased flood risk and difficulty in carrying out maintenance works.

It was envisaged that some maintenance of the pass would be needed, so a demountable barrier was included in the floodwall design to allow channel access if required. A maintenance and management plan was developed to aid the decision making process for when intervention may be required.

Adult brown trout (*Salmo trutta*) were observed upstream of the culvert, suggesting effective passage was occurring. There was also evidence of an otter (*Lutra lutra*) using the channel edge close to the culvert. In addition a River Hydromorphology Assessment Technique (RHAT) survey was carried out to help quantify the effects of the scheme in the future.

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The channel post-construction during low flows – May 2012

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High flow event in channel demonstrating good fish passage opportunity – June 2012

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