12 Removing or Passing Barriers

12.5 Replacing a weir with a rock ramp

River Neb

Location - Glenfaba, Isle of Man SC24648287
Date of construction - September 2006
Length - 75m rock ramp
Cost - £112,800

Type	Medium energy, gravel
Designation	Protection under fisheries legislation for sea trout, salmon, European eel, brook lamprey and river lamprey
Monitoring	Electrofishing

Gabion and concrete stepped structure – 1995

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Collapsing weir with deep scour hole used for swimming – January 2004

Description

The River Neb is a short river on the Isle of Man known for its Sea Trout. The river has a large number of weirs originally installed for the mining and milling industries, interrupting flow, sediment and fish passage.

At Raggatt, 2 km from the coast, a large weir had been constructed in 1850 to feed water to Glenfaba Mill. In the mid 1980s the weir was in a poor state and was replaced with stepped concrete capped gabions. Total removal was not an option, so the aim was to maintain the existing head of water (to feed the mill leat) and to replace the existing dilapidated structure before it fell apart and released the accumulated sediment from above.

Strict fisheries legislation (Isle of Man Fisheries Act 2012 and Inland Fisheries Regulations 2017) required the new structure to be passable by all life stages of Sea Trout. The large deep scour pool was being used as a swimming pool but contained boulders and loose gabion wire that presented a safety issue.

Various plans were drawn up and reviewed over a number of years, initially focussed on a concrete weir and fish pass design, budgeted at £273,000. This was finally revised for a more environmentally friendly and 60% cheaper rock ramp design.

The aim was to create a sufficiently shallow ramp that allowed easy fish passage, mimicked a steep section of river and gave greater stability to the built structure at high flows. This would also remove the current maintenance and liability burden of the deteriorating weir.

Design

The existing river, weir and scour pool were surveyed to calculate levels and volume of fill material. The design was to mass fill the 3m+ deep scour hole, add a geotextile membrane to prevent the heavy top stone from sinking in to the fill, and then place large 1-3 tonne rocks on this new base layer for the full 20m width and 40m length of the ramp. This was done in two stages, right bank first (leaving a narrowed channel with capacity for the 1 in 2 year event) then from the more accessible left bank to infill the flowing channel quickly to bring the bed up to the surface. The design required very low flows to enable completion of the left side, working in the wet (over-pumping or piping the low flow could also be used depending on flow volumes).

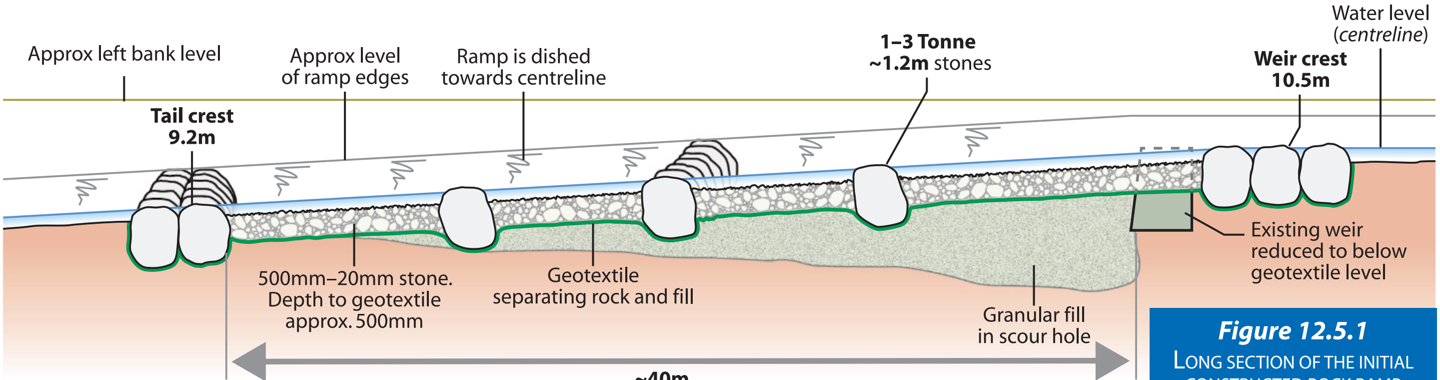

Figure 12.5.1
Long section of the initial constructed rock ramp

These techniques were developed to suit site specific criteria and may not apply to other locations

The proposed sequence and method of working was:

1. Raise the left bank level (construct a new flood embankment) to protect the extensive left bank floodplain (and old historic course of the Neb) from inundation.

2. Infill the scour hole with graded fill material (in this case crushed 250mm to 5mm concrete) working from the bank outwards.

3. Fill to half channel width, unroll the geotextile and begin to place the 1-3 tonne keystone rocks, gently sloping from the bank to the middle of the ramp (a 1 in 50 fall along the line of stones (groyne). The groynes act to direct flow from side to side and towards the dished centre of the ramp.

4. Define the crest level with three rows of the 1-3 tonne rocks.

5. Infill the areas between crest, groynes and tail with 500mm to 20mm stone. The keystone rocks prevent excessive movement within the ramp, and prevent the mass movement of stone infill from the ramp.

Nearly completed rock ramp, embankment and vertical blockstone edge prior to storm - 2007

Once the first half channel is complete, move to the other bank and work quickly to raise the flowing channel.

6. Two layers of 1-3 tonne rock to be used to create hard bank protection to the ramp, the right bank mill leat and to the new embankment on the left bank.

At this point, when the works were 80% complete, a large storm event occurred breaching the new left bank embankment and bypassing the rock ramp, flooding the left bank floodplain and scouring and redistributing the rock ramp material.

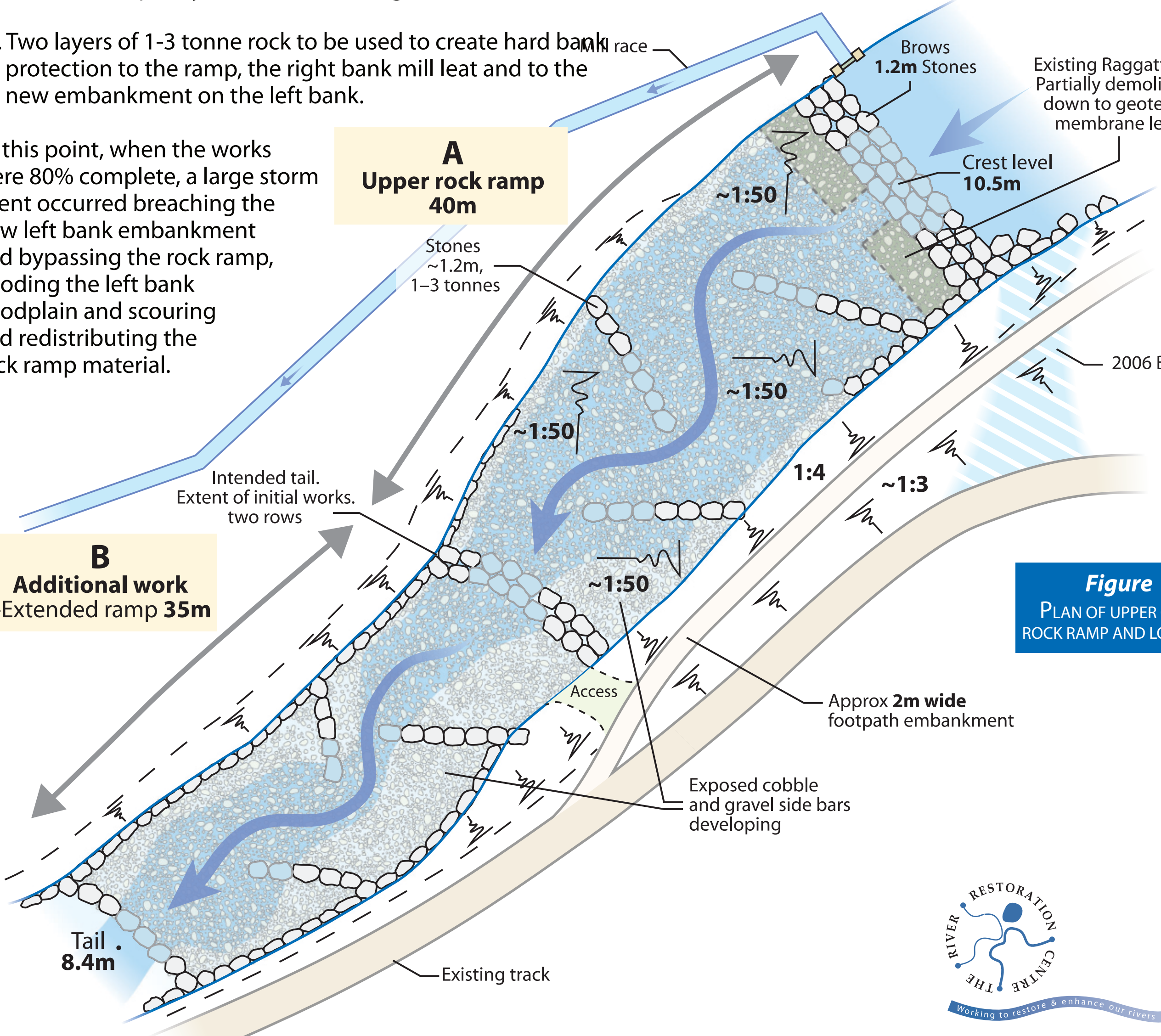

Figure 12.5.2
PLAN OF UPPER CONSTRUCTED ROCK RAMP AND LOWER EXTENSION

These techniques were developed to suit site specific criteria and may not apply to other locations

Post-storm revisions

Following this the left bank and embankment design was revised and the ramp lengthened.

7. The vertical rock face was removed and the embankment was regraded to a slope of 1 in 4 from the 2m footpath top width down to the water's edge, creating a gentle vegetated slope with additional high flow capacity.

8. Turf and coir geotextile provided vegetation cover and initial protection. There was also addition of a Lintobent impermeable clay core liner to solve continued leakage within the narrow upstream end of the embankment.

9. The bankside rock armour was removed to enable the embankment protection matting to be dug in beneath the edge of the rock ramp surface. This spare rock was reused to add four further keystone groynes to lengthen the ramp by a further 35m, incorporating the material redistributed by the storm event, and add further rock groynes to add stability to the ramp. No further smaller rock infill was added. This was left to be filled by ramp redistribution and cobbles from upstream sediment supply.

Whilst this additional work added to the cost, the works still came in under budget at £112,000. In addition, the redesign removed an otherwise vertical hard engineered left bank wall and replaced it with shallow vegetated slopes, able to dissipate and spread high flows across the widened embankment area, reducing shear stress and erosion potential across the ramp.

Removal of the vertical edge stones and modified to a turfed shallow slope following the breach event.
Stones used to form the ramp extension – Nov 2007

Coir matting laid over the turf to provide initial protection - Nov 2007

Subsequent performance – 2007 to 2019

Initial movement of stone at the bank edge, but the turf and coir remained intact. Preferential route then filled. – March 2008

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There was movement of the smaller rock (500mm down) as it settled and moved with subsequent flow events. Some adaptive management was required early on to fill in preferential flow routes that developed close to the embankment edge, due to settlement and scour.

The vegetated banks have colonised well and the re-profiled embankment and channel slopes fit better into the landscape than the initial rock armour walls. Gravel deposition has occurred on the left forming a marginal exposed gravel bar (further protecting the embankment toe).

An unexpected benefit of the work, resulting from the doubling of the ramps length, is the very high density of juvenile salmonids occupying the boulder strewn habitat of the ramp. 1000 juvenile salmon and trout were recorded in a 2010 electrofishing survey of the ramp itself.

Similar results of bypass channel and rock ramps being designed as compensatory habitat for salmonids have been implemented in Nordic countries. Where derelict/failing structures cannot be removed (water supply, heritage, etc.). Shallow gradient rock ramps have the potential to allow water, sediment and fish movement.

Settlement of the ramp and embankment. – 2009

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Wide, shallow rock ramp crest also provides fish habitat – 2009

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Rock ramp looking upstream towards its crest and showing the extent of habitat available to juvenile fish – 2009

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The ramp is working well under higher flow conditions – 2010

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Still working well and providing habitat after 13 years – 2019

Contacts

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