Fish Habitat Restoration Methods Concept Specification
Rock Sills

Purpose:

- To support a section of riffle upstream and create a pool downstream to enhance trout and salmon habitats and develop habitat diversity.
- Used to create stable deep water habitat in a stream.

Conditions Where Applicable:

- Instream location and sizing must be approved by an Adopt-A-Stream Biologist.
- In a stream with low to moderate grade (up to 3 %), with gravel or small cobble substrate, and where natural flows and currents can be allowed to shape the streambed.
- The rock sill as a gradient control holding the riffle/run substrate from falling into the pool. They are not intended to create a significant head difference or plunge pool.
- The sills serve the same function as the digger logs and can be found in natural streams. They can be scaled up for larger streams and rivers where you can't find suitable sized logs.

Habitats Created:

- Pool habitats > 45 cm deep in low flow.
- Sorted substrate, with sands and silt redistributed to point bars and the flood plain.
- Sorted substrate and pools capture leaf litter and organics, supports larger insect populations, provides better spawning and juvenile escape cover, and overwintering habitats.
- Encourages the development of the thalweg between pools.
- Creates deep water habitat, which is as essential for many fish species as cover to maintain temperature stability etc.

Advantages:

- Uses natural processes to develop deep pools; the continuing scour will prevent pools from filling in.
- If positioned correctly, a rock sill will create a pool that will not fill in.
- Helps develop a proper riffle/pool ratio and sorted gravels in disturbed streams.
- Can be built with on-site materials where there is an availability of rock larger than needed for stability in a stream of the size being restored.

Disadvantages:

- If not positioned, sized and anchored correctly, rock sills will breach or wash away, do nothing, or further disturb habitat.
- Requires machinery on larger steams and on rivers to move rocks into position.
- Can be done by hand on smaller streams but requires extensive manual labour.

- Disruption of substrate will cause turbidity and possible sedimentation of fine materials downstream.
- Does not provide the undercut cover that digger logs do. This means additional work would need to be done to provide cover for rearing and for spawning habitat cover.
- Structure must be checked regularly to make sure it is still functioning correctly.
- Access for materials and equipment can be difficult.

Design Criteria:

- The sill must be placed at the head of a pool location. These are every six channel widths based on the design width of a 1:2 year daily mean flow channel (bankfull width) and on alternating sides of the stream.
- Can be sized for all watercourse widths. Select rock sized at least double the diameter of the largest armouring rock in the watercourse. Rocks this size may be on site where the geology provides small boulders.
- The sills are rotated to a 30^{o} angle from straight across the stream and when looking downstream, turned toward the side the pool is on.
- Generally the sill should be at streambed level at the thalweg and rise on a 3 % (34:1) slope to the width of the design channel then 10 % (10:1) to the banks of the existing channel.
- The thalweg and channel design width section of the rock sill can be moved from side to side in an over-widened channel to increase meander length, lower gradient and help dig deeper pools. Alternately, they can be aligned to maintain the existing gradient depending on needs.
- The thalweg location may be left flush with the channel bottom for 10% of the channel width before it starts to rise and should be located one-third of the design channel width from the poolside.
- The channel at the site of construction should be a single, main channel with cobble/gravel substrates and stable vegetated banks. Additional bank stabilization may be needed.
- A rock ramp should be built on the upstream side, sloping the stream bed up to the sill on a 20:1 ratio.
- Cobble and large rocks armouring the surface should be removed from the pool area to assist the scour by the flows.
- When the pool has formed, the cobble and large rocks, removed initially, may be replaced to provide juvenile instream cover as needed.
- Sills work with the stream flows to sort gravel and shape pools and riffle thalweg. This typically takes two to three years to fully form.
- Sills and ramps need periodic maintenance until the stream has achieved its new form and vegetation has stabilized the new banks.
- The sills work with the flowing water to create fish habitat. You are not digging a pool. The material that is scoured from the pool area is needed to build the point bar and shape the channel.

Implementation Steps:

- There are two approaches to selecting rock.
  - The preferred approach is to use a standard riprap rock mix with the median rock diameter at least 10 % larger than the cobble armour on the stream bottom. A R500 riprap mix is commonly used on gravel cobble bed streams.

  or
  - Use large boulders. If doing the work by hand on small streams, use rock up to 60 cm (24 in) so they can be moved. On larger rivers, use boulders up to two tons and placed by machine.
  - Set the rock so that it is embedded in the stream bottom to achieve the desired surface grade
  - For small boulders, dig the trench two rocks wide and set the boulders in an alternating pattern like brickwork.
  - Set in as per the design criteria.

Modifications:

- Rock sills can be used in combination with deflectors to narrow the watercourse and aid in developing a longer deeper pool.
  - The deflector is built according to the details in other fact sheets and placed on the downstream end on the side opposite the pool.
  - The sloping up of the rock sill outside the channel design width has the effect of narrowing the watercourse and building point bars so there is not a great a need for deflectors.

Rock Sills (to create riffles):

Rock sills are really gradient controls. To dig and develop pools they are used in the same way as digger logs. However, they can be used in other locations in the watercourse to achieve different results.

- When a watercourse has been badly disrupted and plans are to restore the alignment of the watercourse and to build meanders, pools, and riffles; rock sills can be used to stabilize the crest of the riffle. The design of the sill is the same as if it was at the head of a pool with the thalweg on the same side as the pool adjacent to and above it. The rock ramp above it is built on an approximately 2 % slope and the riffle on an approximately 1 % slope in such a way that the sill is flush with the crest of the riffle. Any drop over the sill will scour on the downstream side and if the riffle needs to be on a slope greater than 1 % it will have to be armoured with rock larger than the armour cobble generally found in gravel cobble streams.
- When a river gradient is changed by realignment, channelization, or over-widening of a reach, the stream bottom cuts back or degrades to find a new stable slope and to provide material to rebuild the reach below. In this case, the altered section of stream needs to be rebuilt but sills can also be used at the crests of riffles to stop them from degrading faster or to restore their original height.

- In steep streams with a step-pool pattern, rock sills can be used to step the watercourse down over steep sections.

All of these techniques require detailed design.

References:

British Columbia Watershed Restoration Program. (1997).

MacInnis, Charles and Danielle Goff, DFO Antigonish Area Office. 2005. Personal communication.

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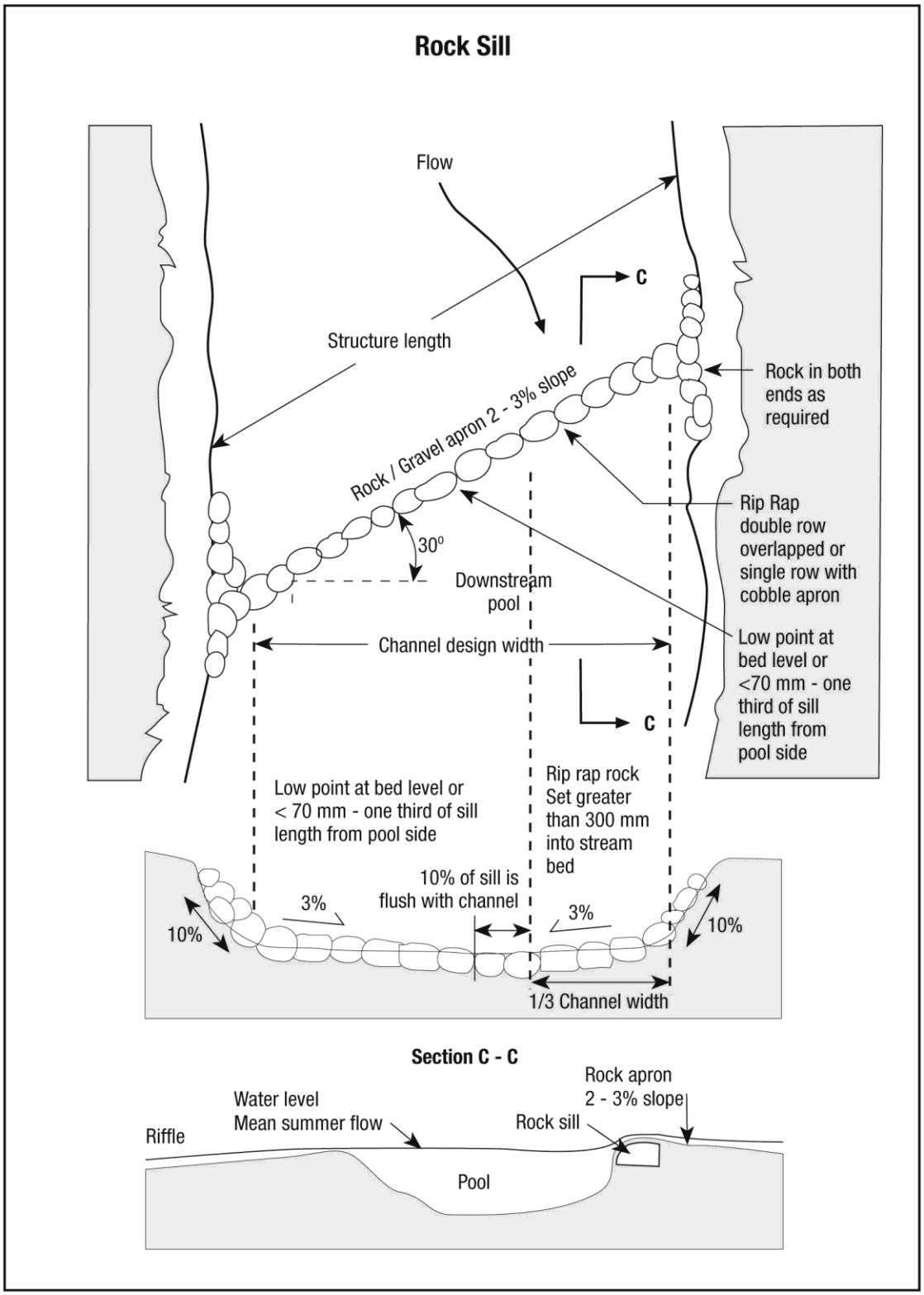

Figure 1. Conceptual drawing of a rock sill (Thaumas Environmental Consultants Ltd.).

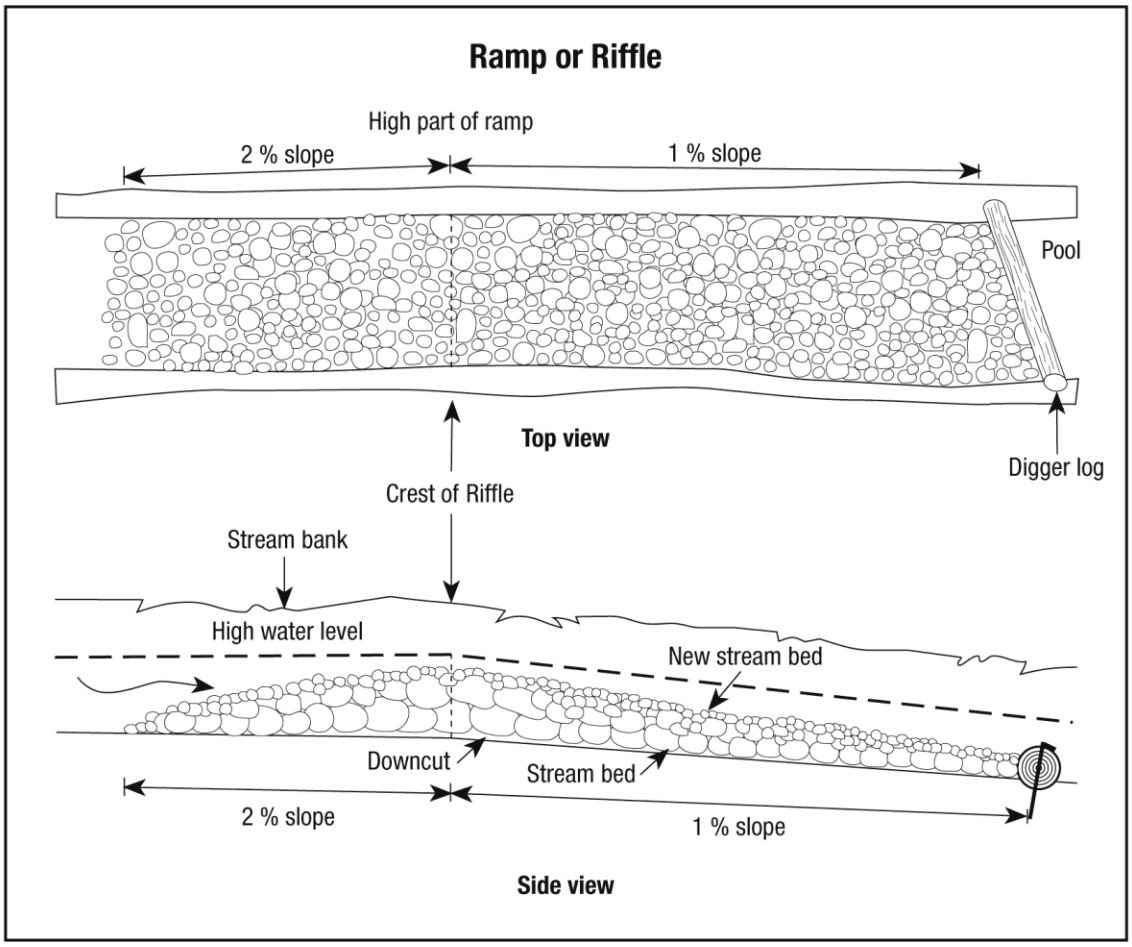

Figure 2. Conceptual drawings of a rock sill used as a gradient control in a riffle.