Irish Cove Brook Restoration Project

Irish Cove, NS

2011 Work Plan

Nova Scotia Salmon Association Adopt A Stream Program

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Irish Cove Brook – Site Description

Irish Cove Brook is located on the southeastern side of the Bras d'Or Lake, Cape Breton NS. The lower reaches of the stream are downstream of the #4 Trunk Highway, flowing through an old limestone pit that was reclaimed several years ago; the stream was not restored. The total instream length of the stream between the #4 Highway crossing (454849.7N 604022.1W) and Bras d'Or Lake outlet (454917.8N 604034.8W) is 1040m with a design width of 6.5m, for a total riverine habitat area of approximately 6760sqm.

Fig. 1 Location of Irish Cove Brook, NS

The upper 620 m of this section includes a culvert plunge pool 18m long that has been formed by scouring during high flows. This has deposited gravel and cobble in the stream channel, completely blocking a 117m section of the channel except during very high freshets. The normal flows now leave the plunge pool through a scoured out channel on the right bank, along the toe of the highway fill, lowering the water level in the pool creating fish passage problems in the culvert. Sixty meters downstream this channel rejoins the original channel in a phase shifted meander pattern. There is a small amount of seepage under the infilled channel. Both channels flowed during high flow events in the fall of 2010.

Downstream, the brook in over-widened with sections in excess of 21m wide three times the natural width,in the out of phase pattern. This means where the original channel had a right pool and meander the flows are building a left pool and meander. The net result is poor quality pools and over widened riffles with shallow flows that are a fish passage problem and raise the water temperature.

There are two high eroding banks on the right side (a 40m long bank at 454857.4N 604019.4W, and a 51m long bank at 454902.0N 604021.1W). These banks are eroding as a result of the over widened channel and realigned meander pattern caused by the cutting of the back channel. If the original pattern is re-established then the brook would meander away from these eroding banks toward the left back which is stabilized with rock.

The remaining approx. 400m is in good condition structurally but the substrate was embedded in silt and sand from the eroding banks. This section was cleaned with the SandWand in 2010 after the observation that the toe of the eroding banks was on bed rock and erosion now was minor and due only to rain run off on the slopes and high flows that would normally deposit sand bed load out of the main channel.

The brook upstream of the highway is disturbed by the changes in hydrology created by the culvert, but there is no other development in the watershed; preliminary surveys indicate degraded habitat extends above the culvert for approximately 120m the culvert, excellent habitat more than one kilometer above the highway, and fair habitat beyond due to the steep stream gradient. Access to the stream is a problem above the culvert and will limit restoration work in this area, but the upstream section is not considered a limiting factor on the overall salmonid population at this time.

2010 Monitoring and considerations related to SandWand test plots

In 2010 351m of brook was cleaned of sand and silt using the SandWand with an average width of 6.5m there was approximately 2281 sqm restored.

This lower section of Irish Cove Brook had physical habitats degraded by sedimentation, the brook has excellent water quality and appeared to have optimum water temperature during sampling in July 2009 the temperature below this area was 17.8^0C and above was 15.9^0C air temperature was 21^0C, and the pH was 6.99. Thermographs in the Brook in 2010 (fig 2) showed more detailed results. Water temperature at the culvert pool was good throughout the late summer Water temperatures below the over widened section fluctuated more widely and were often above Trout tolerance levels. Trout in the SandWand section of the river remained in pools with ground water springs. It appears as though the temperature variation and increase disappeared as the SandWand work progressed but there are other possible explanations that might give this result including dropping air temperatures.

In June 2011 an air temperature logger, and water temperature loggers at three locations, just below the culvert, below the over widened section and below the SandWand section, were installed and will be left in place over the summer to better define this this observation.

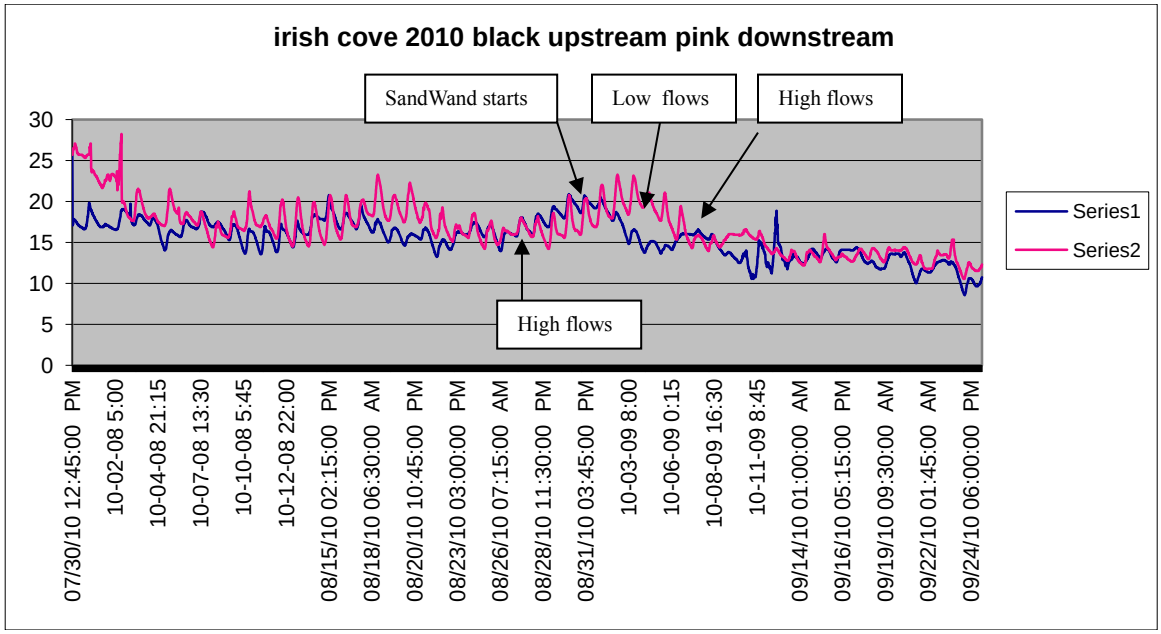

Fig 2 2010 Temperature Monitoring Results
Black (Series 1) is the upstream thermograph just below the culvert pool.
Pink (Series 2) is the downstream thermograph just upstream of the ford and just above the end of the SandWand work for 2010.

The wide shallow sections at the upper half of the site was not fixed with rock sills as planned or treated with the SandWand in 2010. Flows through this over widened section seem to be critical to the extent of the warming. In low flows the temperatures reached well above the optimum trout habitat levels in August and early September. This is due entirely to the shape of the channel being wide and shallow and the sand content of the substrate limiting the inter-gravel flow which is normally a heat sink that moderates stream temperature.

The temperature daily fluctuation is greater at the lower site commonly in the 3 to 5 degree range before the SandWand work but as we did the SandWand cleaning the water temperature fluctuation drops to be in the same range as upstream and the temperature pattern is more closely matched. This higher fluctuation occurred despite a large contribution of ground water entering the lower section that later in the season resulted in the downstream being cooler than the upstream on a few occasions.

Unfortunately, the insect samples decayed before they were analyzed. However, site observations during the collection of the insects are that some but not all are removed by the SandWand work and that the numbers and diversity appeared to increases after a 10 day period likely due to insect drift and increased habitat capacity. The insect work will be repeated this year before and after cleaning of the substrate.

The substrate samples were taken before the Sand Wand treatment and immediately after by working a 15cm diameter steel cylinder into the gravel 25 to 30 cm and digging out the substrate placing it in plastic zip lock bags. The samples were air dried a sieved through an Endicott 2.35mm sieve. The sand and gravel /cobble samples were then weighed. The total weight of the dried samples was between 2725 gm and 2667 gm and averaged 28.7% sand before the cleaning and 2.1% after the cleaning.

Observation of the pump output at both the Irish Cove site and the Little Sackville River site showed that no fish were caught in the SandWand. Electrofishing at Irish Cove before the Sand Wand work 3 sweep zippen estimates of 58.4/ 100 sqm trout and after the work 36.9 /100 sqm trout showed a 37% reduction in trout density and they were the only fish present. This reduction in density immediately after the work was attributed to the disturbance of working through the site and the fish moving to other locations. Electrofishing 10 days later showed a density estimate of 60.2 /100 sqm trout the same density as before the work. Electrofishing this year will be indicative of the habitat improvement due to the removal of the sand.

Trout observed during the work just moved short distances to new cover and minnow species in the Little Sackville continued to school past the Wand and hoses.

2011 Project Description

The Nova Scotia Department of Transportation and Infrastructure Renewal (NSTIR) is contracting the NSLC - Adopt A Stream Program to restore fish habitat in Irish Cove Brook according to the plans outlined in the *Fish Habitat Compensation Plan – NSTIR Trunk 4 Widening in Irish Vale Cape Breton approved by DFO as compensation for work on the reconstruction of trunk 4 and other sites.* Restoration activities are to focus on the section of stream downstream of the Trunk 4 Highway as outlined in the compensation agreements.

This year we placed three thermographs in the stream, at the culvert, and above and below the SandWand section and a fourth for air temperature.

The use of rock sills as originally proposed in this area would bring the channel back to a normal width, partially clean the sand out and deepen the pools. This will cool the water and moderate the daily fluctuation range.

However, it was observed, following the Little Sackville SandWand work, and also in Irish Cove in June 2011 that the removal of sand acted to un-grout the gravel and cobble making it more mobile and easier for the flows to shape the thalweg. If this would work in the over widened sections it would be a much softer restoration technique than taking in machines and rock for rock sills. It is proposed that the SandWand be used on this over widened section along with some thalweg work by hand in the riffle sections. The wide bars could be planted with willow stakes to further stabilize them. The results of this technique will be monitored using the thermographs, photos and physical habitat survey forms. If this does not work the rock sills could be placed later.

In accordance with the compensation agreements and with modifications based on 2010 surveys Adopt a Stream is proposing the following restorative measures to improve habitat in the lower reaches of Irish Cove Brook:

1. Provision of better fish passage at the highway culvert by restoring the plunge pool's right bank so that the water level in the culvert is again in compliance with culvert installation guidelines at 454850.9N 604023.1W. This culvert is 12 ft wide by 10 ft high with a cement bottom that slants slightly to the left. The culvert slope is 1.5%. On September 27th 2010 the water depth at the inlet was 0.1 ft and the outlet was slightly backed up from the plunge pool with a water depth of 0.95 ft. The thalweg of the out flow from the plunge pool was 0.3ft deep.

For a 6 inch trout to pass through this culvert it would need a water depth of at least 0.2ft which would require a flow of 16 cubic ft /sec which would give a mean velocity of 6.9 ft/sec. far too fast for the trout to swim against for 220 ft.

The proposal is to block off the existing channel with a weir at the bank full elevation of the new flow channel. This will allow this channel to function as a high flow channel. The outlet of the plunge pool would be 2.25 ft higher than the current outlet and back flood the culvert providing passage under normal flows. This will mean cutting down the outlet from the plunge pool in the new channel by 1.86 ft and stabilizing it with onsite boulders. Each reach will be 128ft long and 21.3 ft wide bank to bank, bank height 2 ft, riffles will be 83 ft long and pools 43 ft. The pattern will fit the existing pattern at the junction of the two channels and establish the meander pattern for the reaches below. There will be three reaches built with rock sills as gradient controls.

Table 1. Location of rock sills

Rock Sill #	**Coordinates**
1	454851.9N 604023.4W
2	454852.5N 604022.0W
3	454853.3N 604020.7W

These rock sills can all be constructed in the dry as they are in the reconstructed channel. We plan to use a small rubber tracked excavator and a small rubber tracked bobcat type loader. These machines have a very low impact on the ground and can be brought in overland to the site or over the existing bridge. The rock for the sills will be found on site. The channel along the toe of the slope will be blocked off with a 1 meter high gabion wall set into the gravel banks this will be filled with onsite material. A second gabion wall will be used as a mat to stabilize the channel below the main wall so that the plunging flow of high water does not erode the base. This barrier will be covered with gravel, cobble and small boulder from the rebuilt channel for a more natural look and added stability.

The channel along the toe of the slope will be electrofished to rescue Trout in the area.

The rock sills will be constructed alternating from left to right and according to specifications outlined in the *Ecological Restoration of Degraded Habitats: A Watershed Approach* manual, DFO 2006. The design of the rock sill will be as shown in drawing below from this manual Work will begin at the upstream end at sill number one and proceed downstream.

The two eroding banks will be stabilized using willow plantings. Willow cuttings from local willows will be used along the lower part of the slope. The upper parts will be grassed with highway mix and covered with mesh erosion protection materials. Some excess woody debris has gathered in sections of the stream near and downstream of the two eroding banks. Some of this material will be removed by hand to improve fish passage and water flow, and will placed outside of the flood plain.

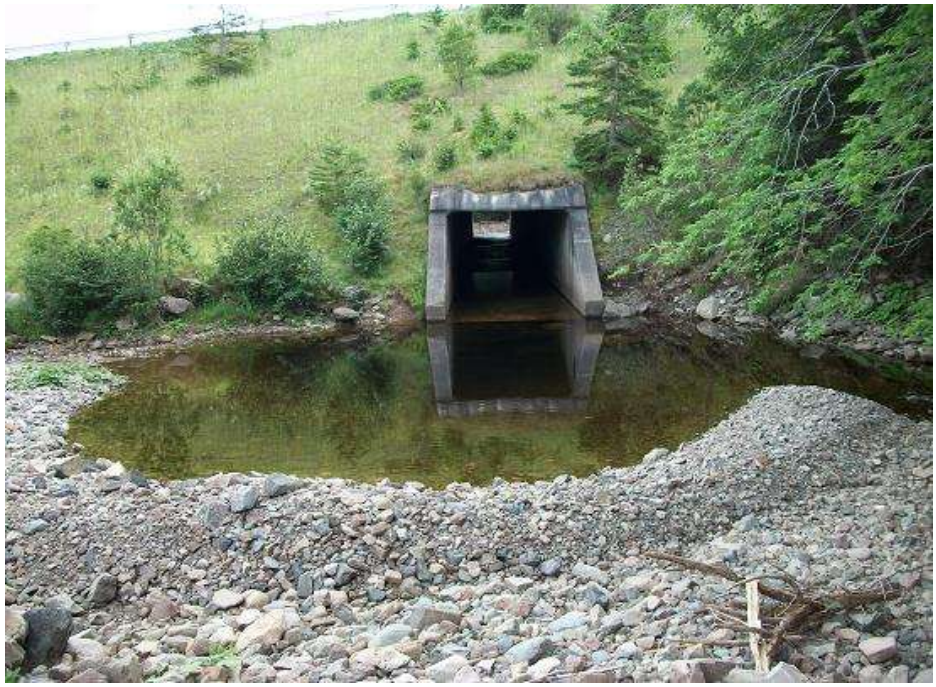

Fig 3 A large 19m diameter pool has been scoured at the outlet of the Highway #4 culvert

Fig 4 With the original channel blocked the flows are directed right down a 60m back channel

Fig 5 Material scoured out of the plunge pool has been deposited in the channel, blocking water flow

2. The use of the SandWand and hand work to correct thalweg problems on the riffle areas to solve the over-widened sections of the brook that are currently affecting water temperature and fish passage under low flows. The planting of the bars to help stabilize them and to build up the banks.

Fig 6 Pool and thalweg form and depth has been lost for much of the section downstream of the highway crossing

3. Stabilization of two eroding banks (91m total) including riparian planting. These banks will be on the inside of the meander and are the result of an over-widened channel and ice scour from the ice created in the very wide sections above. These ice problems will be eliminated by the restoration work, the main flow will not be along the banks, but along previously rocked left banks, so they should respond well to planting and check dams to stop minor gullying and not need any rock work.

Fig 7 Lower eroding bank

4. Substrate cleaning using the SandWand technology in 490m cleaned last year above Lakeshore Drive bridge (454914.6N 604031.9W) will be checked to see if it filled with sand and will be re-cleaned if necessary

The SandWand work will be done under the blanket permit for the use of this equipment and as part of the assessment of the effectiveness of this technique.

The project will be managed by Bob Rutherford NSSA Adopt-A-Stream Habitat Biologist and Stephen Caines, Project Technician with NSSA Adopt A Stream

Bob Rutherford Watercourse Alteration Certification #R0603091

Project Timeline

Project planning is underway and if permits can be obtained from DFO and NSE and a letter of authorization from DNR the instream work will proceed in August, ending before September 30th 2011. NSE and DFO will be contacted prior to and upon completion of the 2010 instream work.

Monitoring

Sections of the brook (one in the lower half and the other in the upper half) will be electrofished in 2011 to assess the work done in 2010 and establish a baseline trout population in the upper area. The same sites will be electrofished in years 2012, 2013, and 2015 to assess increases in the trout population.

Pre work and post work stream habitat assessments will be carried out to assess pool quality, substrate embededness, bank stability, bank vegetation, water temperature regimes and insect density and

diversity (CABIN). Post habitat assessments will be conducted in the fall of 2011, 2013, and 2015.

Stream structures will be assessed for their structural integrity, effectiveness and planting will be checked to ensure it has established. The pit has been restored and there is vegetation establishing but this focus will be on the additional planting along the stream. Plantings will be monitored for 3 years and replacement planting will be done if more than 10% are lost. Watering or other care is not anticipated since the planting will be adjacent to the stream.

Monitoring reports will be prepared for submission to NSTIR for submission to DFO in the fall of 2011, 2013, and 2015.

Project Benefit

A stable channel with non-eroding banks and clean substrate will greatly increase the productive capacity of the channel for salmonids. Narrowing the wide shallow areas to a natural width will lower the water temperature and keep the stream temperatures with in the optimum range for trout - below 16^0C. The rock sills will maintain pool depths and thalweg development and will keep the water cool and provide suitable rearing habitat for trout. The most common limiting factor in these streams is migration habitat. In this case both in river habitat is degraded to the point of preventing migration and the culvert is impassable due either to shallow flows or high velocities over a long distance. This work will greatly improve this habitat providing fish passage from the Bras d'Or Lake to the upper Irish Cove Brook watershed and lakes.

The work will increase the food supply by capturing organic materials from the improved riparian vegetation to support shredder insects and providing insect habitat deep into the substrate. This is critical in these watersheds with few wetlands and limited available phosphorus to feed instream primary productivity. The cleaned gravel will provide cover for a range of age classes of salmonids now limited by available cover.

Sand and silt free gravels will provide increased spawning areas and clean out several springs and seeps along the stream.

This work will also benefit the wildlife and in particular the birds nesting adjacent to the stream. This work will not adversely affect any species and there are no SARA or other listed species in the old pit area.

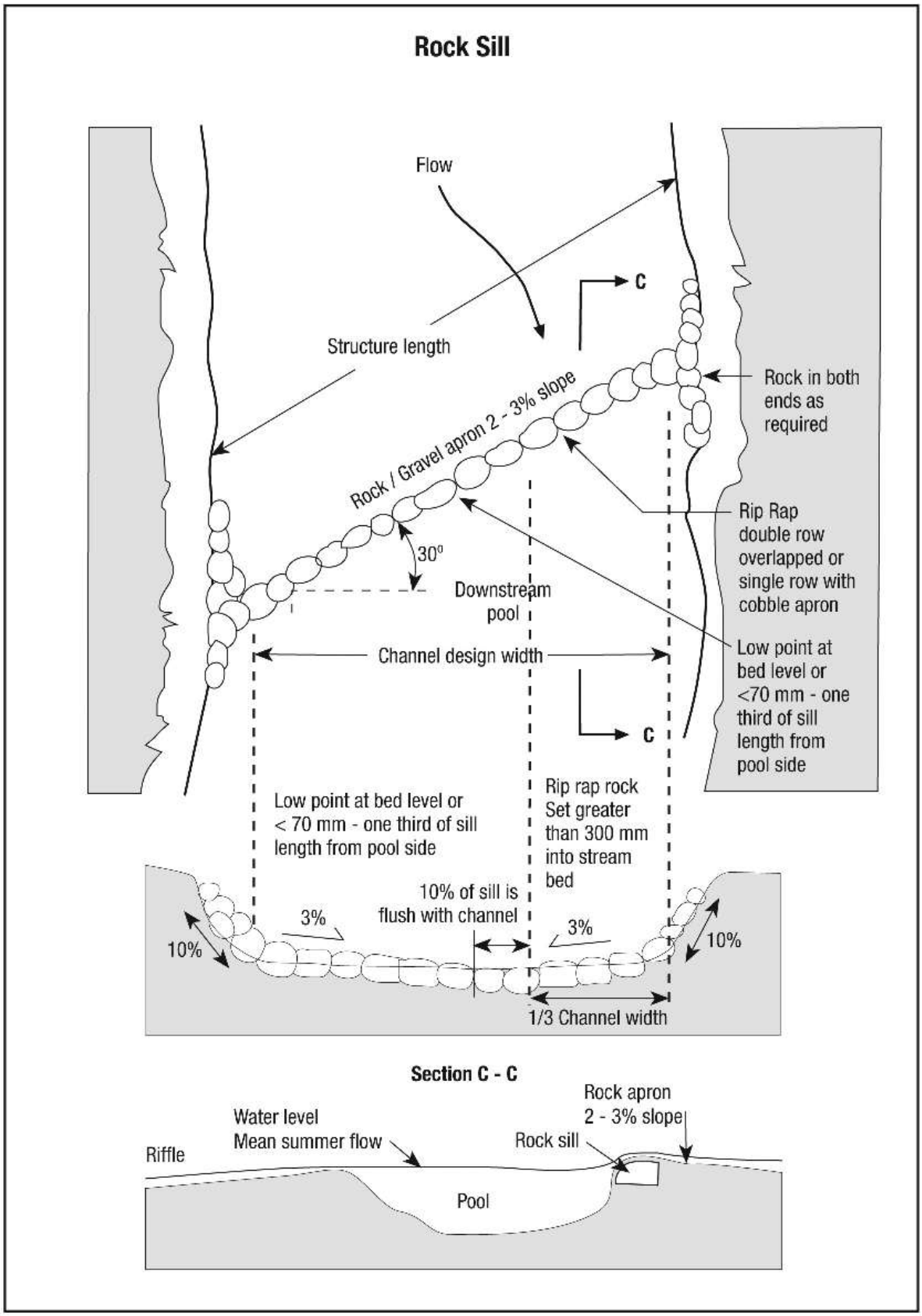

Fig 8. Rock sill diagram