Fish Habitat Restoration Methods

Aquatic Habitat Restoration Introduction

For stream habitat restoration to be effective it must be designed properly. Structures placed or sized wrong will not work. Stream restoration projects throughout the world have been criticized for the high failure rate due mainly to the placement and sizing of structures without proper consideration of the natural processes that form and maintain stream structure. A very common mistake is not identifying the location of the thalweg and meander pattern the flows are trying to create and working with it. If you don't work with the flow pattern then it will destroy the structures and you will not have restored the habitats.

The aquatic habitat restoration plan has to be done or approved by trained specialists to be effective. All projects with NSLC Adopt-a-Stream Program funding must have the layout and sizing of instream structures approved by Program staff.

There are some basic physical processes within a watershed that are responsible for giving a watercourse its shape. The force of gravity pulls the water downhill and the flowing water shapes the, sediments, cobble, and gravel forming a *channel*. Gravity is and accelerating force and would make the water flow faster and faster as it moves downhill but it is slowed by drag on the rocks on the bottom, instream woody debris, and the banks of the channel. As the flow increases the significance of the drag decreases as you really just have water flowing over water. When the water reaches this stage its internal strength (it is hard to pull water apart) causes the water to slosh from side to side. This can be demonstrated by watching increasing water flow down a chute. Low flows go down the center of the chute but as the flow increases the water sloshes higher and higher up the sides of the chute. In a stream as water sloshes to the left side, it's level is higher on the left bank than on the right bank. The water on the high side falls under the flow and digs a pool on the left side of the stream, sorting the cobble, gravel, sands, and silts, forming a point bar on the right, and building the crest of a riffle downstream of the pool. The water then flows down the riffle/run, sloshes up on the opposite side, and digs a pool on the right side. The water's digging action places a pool at approximately 5 to 7 channel widths on alternate sides and forms what is known as the meander pattern (Figure 1). The flow that forms the channel is the mean daily peak flow that occurs 66% of the time. This is known as the 1:2 year flood. There is a direct relationship between the flows, the channel width, and the meander length.

In designing habitat restoration the 1:2 year mean daily flow has to be calculated for the reach being restored. This is done by taking into consideration the land use, watershed slope and rainfall in the watershed upstream. This calculation of stream width and bank height is then ground-truthed on site and the location of the meander pattern the flow is trying to establish is found and used to site and size the instream structures.

The pattern is established by the physics of flowing water and can be calculated, from that the stream width can be calculated and in turn the meander length. However, the instream flow will encounter resistance from geological formations (bedrock or constrained valleys, boulders too big for the flow to move etc.), as well as man-made structures like culverts, bridges, and dams forcing it to readjust or restart the meander pattern. This has to be taken into consideration.

Vegetation also plays a role in channel development. Grasses, shrubs and trees grow along the edges of the channel in areas that are dry during most of the summer months. The roots of the plants help bind the soils and the tops of grasses and some shrubs lie down during high flows to prevent erosion. Fall and spring high flows are slowed as they pass through the vegetation and drop silt, sand and gravels they are carrying. This helps build and maintain the banks. These higher stable banks contain the 1:2 year daily mean flows and allow the water to create deeper pools, clean the bottom of sands and silts, and provide more diversity of stream habitats.

Branches, roots and trees (Large Woody Debris, LWD) that grow or fall into the river in random locations, also play an important part in building the structure of the stream and its habitats. In gravel and cobble bed rivers, the LWD is moved by flows. The logs moved by the flows are embedded where the bottom currents are slow at the head of the pools. Logs embedded at the head of the pools establish the toe of the riffle/run areas, allowing them to build stable slopes without the gravel being washed into the pools. The small branches lying in the pools provide habitat diversity and cover for all aquatic species. Roots hold soils on the banks and permit undercuts, important for cover in medium to large rivers.

Streams develop many forms and they can exhibit different flow patterns. Rosgen (1994) developed a stream classification system which is widely used today and which helps explain the varying characteristics of watercourses (Figure 2). Various stream types can be observed in a single watershed (i.e. A-type in the headwaters, to C-type in the mid reaches, and to E-type in bogs or meadows). Generally, as a river flows downstream, it progresses from streams with coarse substrate (>2 % slope) to gently sloping streams and rivers (< 2%) with finer cobble-gravel substrate and low gradient rivers (< 0.2%) with fine gravels sands and silt substrates. In Nova Scotia, many streams are B & C types, they are sinuous, moderately entrenched, and gently sloping However, other stream types are also found.

All stream restoration projects under the NSLC Adopt-a-Stream Program have to be designed by our trained and experienced staff to ensure we meet the restoration objectives of the Program. We have several project types including instream restoration of gravel and cobble bed streams with instream structures, SandWand removal of sand and slit from streams, thalweg and pool development in in cobble boulder streams, and culvert fish passage remediation. All require a high degree of design but are easily implemented by community groups once the plan is in place and they have received training on the proper installation techniques.

The **Fish Habitat Restoration Methods Concept Specification** fact sheets are to be used by groups doing general project planning and proposal applications. The instream locations and sizing must be determined by trained and experienced individuals and approved by AAS staff if the work is funded under the NSLC Adopt-a-Stream Program or done under the Program permit.

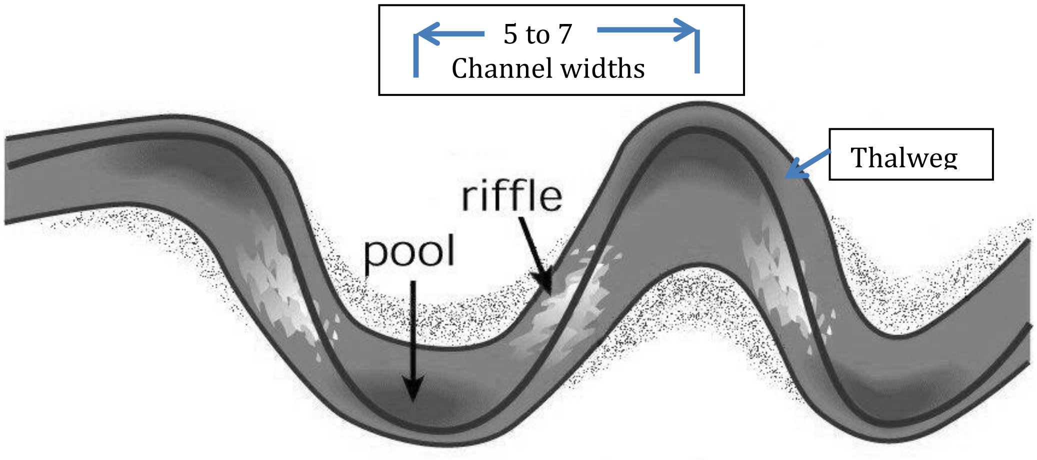

Figure 1 Pool-riffle sequence and erosional and depositional features in meandering streams (modified from FISRWG, 1999).

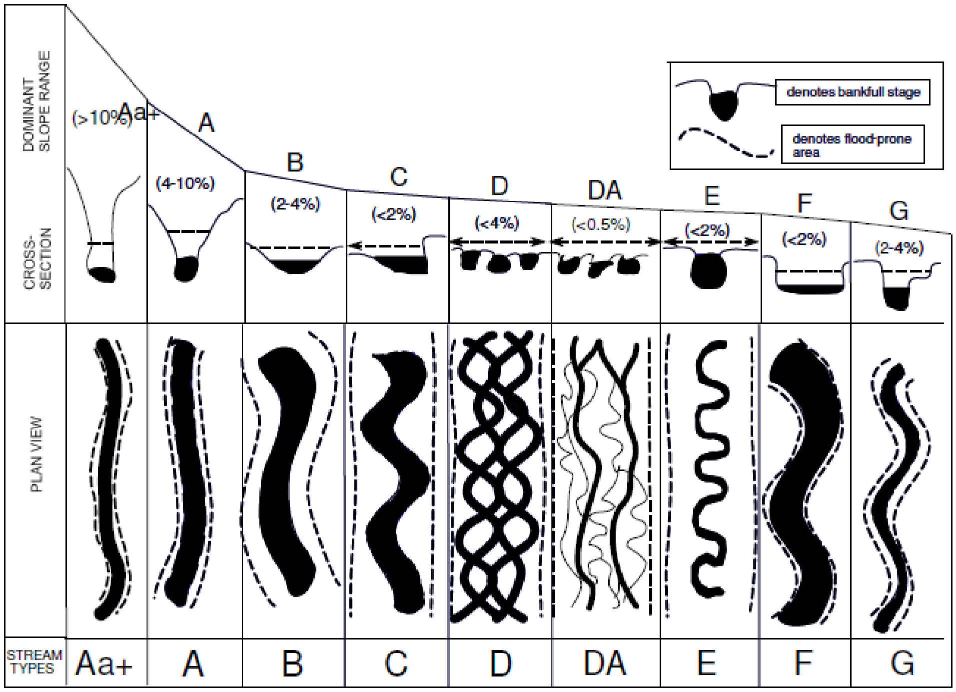

Figure 2 A stream classification system based on morphological features (Rosgen, 1994).

References

Rosgen, David L. 1994 A classification of natural rivers, Catena 22 (1994) 169-199 Wildland Hydrology, 157649 U. S. Highway 160, Pagosa Springs, CO 81147

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