

Technical Tip

Channel Rehabilitation: Debris Groins as a Bank Stabilization Option

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Changes in natural stream channels and banks are only perceptible over a period of years if riparian areas are undisturbed. Past practices of logging or land clearing to streambanks can shift the “dynamic” equilibrium of streams. The resulting effects on some sites, include widening of channels, expansion of bars, and eroding of streambanks. Where widespread, these conditions in a watershed have serious aquatic resource implications, including degraded water quality, reduced fish survivals (or stock productivity), and depressed fish habitat capacity. Such conditions will persist for several decades, at least until mature riparian trees have re-established, or the supply and transport of sediments have stabilized, or both.

In considering restorative measures to accelerate natural recovery, there have been two common approaches. One of these has been to walk away; this should be the first option to consider, based on an appraisal of the following questions:

- are the hillslopes relatively stable, particularly road crossings of gullies?
- does revegetation (e.g. willow growth on bars) indicate that the natural recovery process is in progress?
- what is the steepness of the channel gradient relative to debris-flow risks from upstream?

If there is evidence of an improving trend, or if channel disturbances are localized, there is a second option to consider. B.C.'s Watershed Restoration Program has recently utilized debris groins as a mechanism for stabilizing and even narrowing channels.

Conventional prescriptions for eroding banks have typically been the rip-rap armouring treatments commonly observed along highways and dikes. These treatments are largely unnatural and expensive — as much as \$1000 per lineal meter of streambank. In addition, they frequently feature smooth streamline alignments that efficiently pass water hydraulically but are depleted of fish habitat. Large boulders installed along the toe of armoured banks can dissipate energy and greatly improve habitat capacity. This is often all that can be done to mitigate the aquatic habitat losses that rip-rap treatments may produce. However, debris groins are viable alternatives to rip-rap. Not only do they more closely resemble natural fluvial templates, but they are also more effective in shifting the thalweg sufficiently

to allow sediment deposition and re-vegetation.

Natural Debris Groin Templates

In mature forested streams, log jams of varying sizes and locations are common stabilizing features. Lateral jams in natural river systems may be up to a kilometer in length. Occasionally, a large jam may span the entire channel. Until recently, this typically has led people to urge their removal. Some of these large jams became the focus of stream restoration endeavors or log salvage revenue: the prevailing view seems to have been, “the only good jam is a removed jam.” While we are all familiar with the large apex jams at the upstream end of bars on split channels, lateral jams at bends often go unnoticed unless they are large. A closer look indicates that there are many types of jams. A common type is one that originates directly from trees that fall into a stream, with their large rootmasses acting as anchors. Some such jams are swept laterally to the stream and provide a natural type of armouring. Others fall upstream or lodge next to other logs or large boulders; these act as “key logs,” producing log matrices that accumulate small and large woody debris. These form lateral jams that deflect the flow away from banks, causing sediment deposition and re-invasion of riparian vegetation. These provide the natural template for “debris groins.” It is important to note that such jams are often associated with lateral scour pools, providing prime fish-holding and rearing sites in all sizes of streams, but especially in medium or larger streams.



Figure 1. Debris groin at the West Kettle River, ballasted to hold ramp-logs against the channel bed.

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Applications to Channel Restoration

Over recent years, with the expansion of aquatic restoration efforts, certain limitations were evident. Although we have improved our capability of restoring and rehabilitating fish habitat with reasonable success in stable channels, we have been limited in our effectiveness in accelerating the recovery of logging-distabilized channels. We have frequently walked away from eroding banks, although they were known to be large sources of fine sediments.

Logistically we had been constrained by limited access to very large mature whole trees. Alternatively, we have relied on large boulders for ballast, either those already present in the channel or transported to the site. For debris groins, we prefer to ballast logs to overcome buoyancy by sloping them downward into the bed of the channel. In this way we can transfer the current's frontal drag forces downward towards the bed, as in natural templates for this treatment (Figure 1). Ballasting must be sufficient to counteract buoyancy of logs (see Chapter 9 in

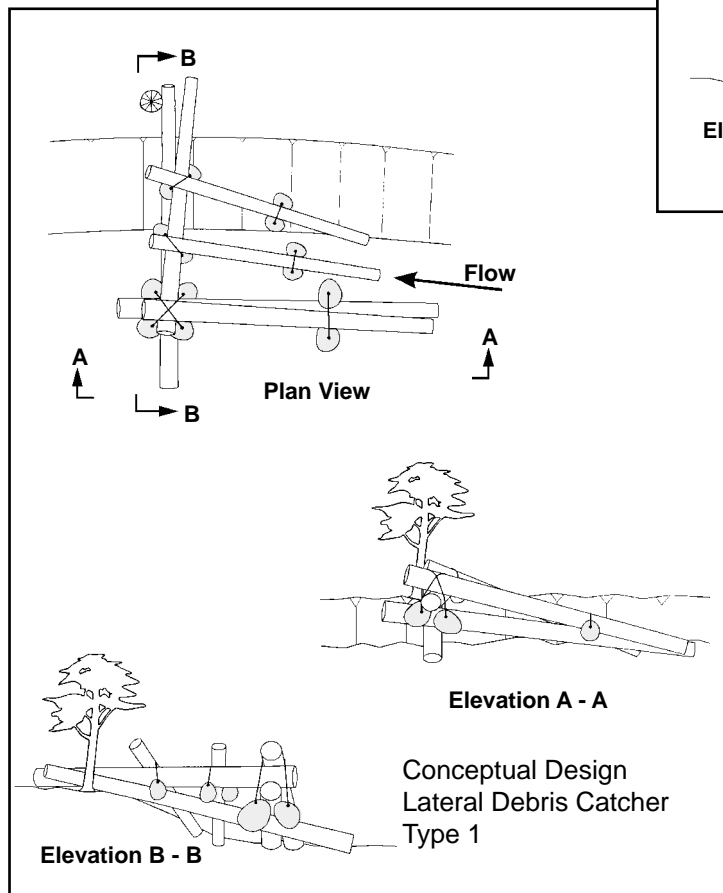


Figure 2. Debris groin type 1 for sites where there are no boulders in the channel to attach logs (Boulders are slung over logs using expoxied solid core 1/2" galvanized cable).

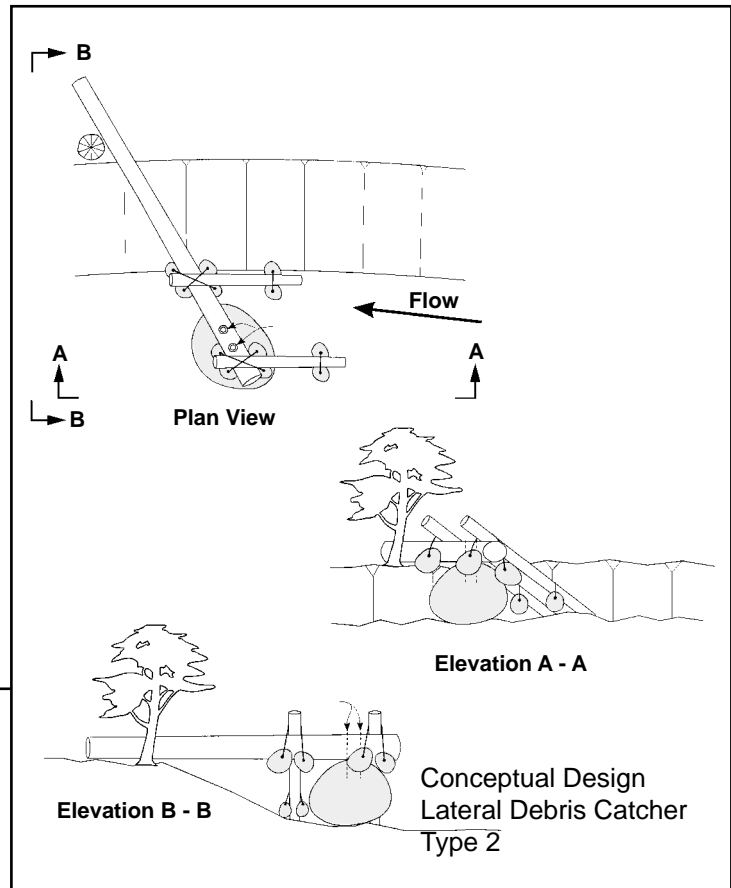


Figure 3. Debris groin type 2 for sites where a large boulder is available in the channel for epoxy cable attachments (Boulders are slung over logs using expoxied solid core).

WRP T.C. No.9). In templates, large rootwads of such trees act as natural anchors so that the smaller ends of the trees are weighted into the substrate. This creates wedges or rakes to capture drifting woody debris. Also, we can strategically place such debris groins in series to stabilize entire eroding bends.

Now, what can we do about fish habitat? The key would be to create some roughness and lateral pool habitat. Following the pattern of certain lateral jams, we could attach whole trees that would then trail downstream. However, this may cause excessive sediment deposition behind the tree, promoting in-filling of habitat. It is therefore not a desirable design feature, unless bank erosion has been excessive and extends for a significant distance. A beneficial alternative is to scrape away the armour layer beside the groin to accelerate the creation of a lateral scour pool that might otherwise take several years to scour naturally. There is no need to excavate below the coarse cobble layer because the substrate

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is often sandy gravel under the amour. Immediately adjacent and downstream of debris groins, we have observed that scour creates prime habitat.

Design Features

Figures 2, 3 and 4 show the design features of debris groins. Specifications for materials will vary with stream power, as indicated by channel width and gradient. The width of the debris groin should be adjusted according to the amount the channel has been widened. At Narrowlake Creek, where the stream was widened by 2-3 times, the debris groins were 6 m wide. Structures installed for demonstration in the more constricted channel at Keogh River were only 3 m wide. Height is another important design feature. Debris groins should extend just above bankfull flood levels to prevent trapped woody debris from being washed away at a peak event, as occurred at the Coquitlam River (Figure 5). Some variations in design will also be needed to take advantage of large instream boulders for attachment, or to provide an elevated support for the structural members of the debris groins if the site is along a steep bank. Use of opposing rootwads to provide in-channel height is an option that also creates prime rearing habitat

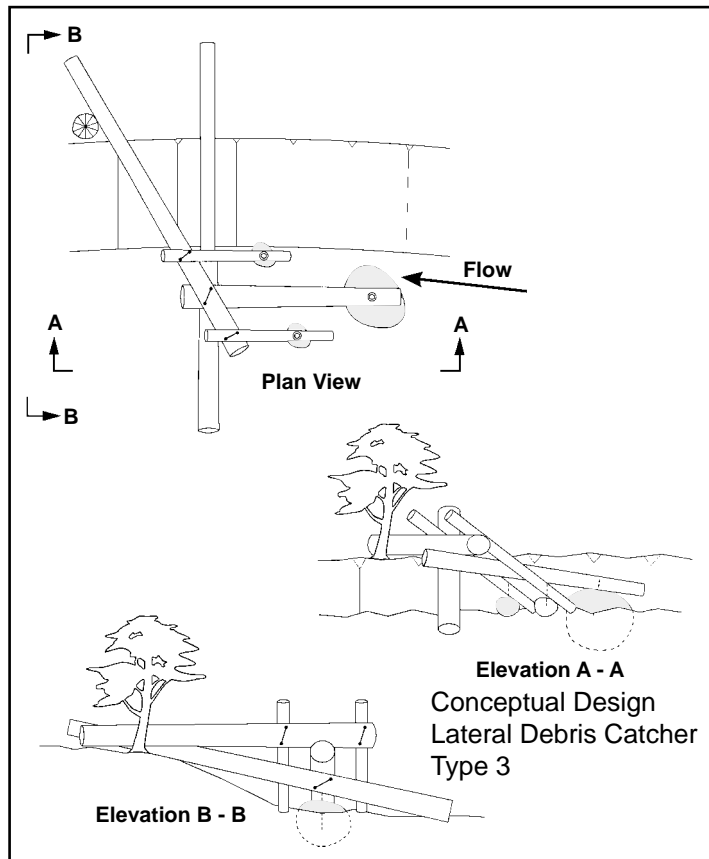


Figure 4. Debris groin type 3 for use at a site where a large boulder is unavailable for the main support log, but are available for ramp logs.



Figure 5. Debris groin at Coquitlam River in winter, 1999. The height of the groin should be just above floodplain height to prevent debris washout.



Figure 6. Debris groin located at a large steep eroding bank. Rootwads are used to gain elevation for the wide ramp of logs constructed at Narrowlake Creek.

(Figure 6). Machine-planted willow clumps to a depth that roots are wetted will also accelerate bank recovery.

Expanded Applications and Limitations

We are still uncertain about the maximum gradients at which debris groins remain functional, although it is clear that these will vary according to the stability of the watershed and its channels. As we gain more experience, we may find that steep channels (5%), with unraveling banks due to past streambank logging, may be suitable sites, but only if the watershed is relatively stable. However, debris groins are unlikely to remain stable during a debris torrent.

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