Fish Habitat Restoration Methods Concept Specification
Deflectors

Purpose:

- To provide rearing habitat for juvenile and adult trout by developing a narrower, deeper channel and/or a pool area.
- To flush silt from a stream reach.
- To create a point bar and allow silts to redeposit alongside the bank.

Conditions Where Applicable:

- Instream location and sizing must be approved by an Adopt-A-Stream Biologist.
- Deflectors are typically used in low gradient (up to 2 %), sections of streams. Deflectors should not be used where there is an unstable flood plain or other unstable reaches of the stream without additional stabilization works.
- Deflectors can be installed as single structures or in pairs. As single structures they are installed in a staggered fashion on alternate banks. Twin deflectors can be installed as a single unit or several may be required especially along long, straight stretches.

Single Deflectors:

- Used to concentrate flow, narrow and deepen the channel.
- The use of several of these structures in an alternating fashion encourages meandering of the stream by deflecting the main current (thalweg) toward the center of the stream.
- Single deflectors are placed 6 stream widths apart based on the fish habitat channel design which is the 1:2 year mean daily flow channel width.

Twin Deflectors:

- Narrow the watercourse toward the center of the channel.
- Often used in watercourses that are very over widened to locate the thalweg (deepest part of the channel) in the proper meander location.
- In very over widened watercourses two deflectors uses less materials than a large single deflector and is usually preferred if they fit with the meander pattern.

Habitats Created:

- Used primarily to develop the thalweg and pools.
- Will develop pools on the opposite side of the stream and just downstream of the deflector.
- Normally create the upstream end of a point bar.

- Twinned deflectors narrow and center the fish habitat channel in over-widened sections.
- Enhance fish habitat for juvenile and adult fish rearing and migration.

Advantages:

- Aid in stabilizing stream banks and consequently controlling erosion.
- Accentuate the stream flow, keeping downstream reaches of the stream clean of sediment deposits.
- Tree deflectors are easy to build by hand.

Disadvantages:

- Those constructed with boulders or log cribs may require equipment to install and consequently require additional considerations to prevent any adverse effects caused by the construction equipment.
- If materials have to be brought in or machinery is required, costs may be high.
- Deflectors must be located properly in the meander pattern or they can cause watercourse instability.
- Deflectors may require some bank stabilization work downstream on the opposite bank.
- If trees are used, they need to be freshly-cut to provide adequate bed load retention.

Design Criteria:

- Since deflectors are used to concentrate and redirect the stream flow, the developing pattern of stream flow needs to be determined before attempting any work.
- Deflectors should be placed upstream and on the opposite side of a natural pool location.
- Use materials that will withstand flood conditions (e.g. trees or log riprap in low flood-prone areas, rock in moderate flood prone areas, and riprap mixtures with large median size and cribbing in severe flood prone areas).
- Normally used in long runs.
- A series of single deflectors alternating from bank to bank will assist in developing a natural meander pattern.
- Deflectors should only extend to leave the design width of the watercourse open.
- The tips of the deflector(s) must not narrow the stream to a width less than the design 1:2 year flood channel width.
- Deflectors are intended to guide the water.
- They should have no protrusions on which drifting debris can accumulate.
- Rock and log crib deflectors should be triangular in shape (i.e. 30^{o} on the bank at the upstream tip, 90^{o} at the tip out in the stream and 60^{o} at the downstream bank. The 30^{o} angle guides the current toward the center of the stream rather than the opposite bank and therefore is less apt to cause erosion downstream. If downstream erosion does result from your work then some bank protection work may be necessary.

- The downstream edge of the deflector should be at an angle of 90° to the upstream edge. This will allow floodwaters that overtop the deflector to leave at an angle away from the bank.
- The deflector should be at bank height where it meets the bank and slope down to approximately ½ the bank heath at the outer tip.
- If using a single deflector and the opposite bank is eroding, it should be stabilized by rocking or another suitable method.
- Re-vegetate any exposed soil as soon as possible after work is completed.

Implementation Steps:

Deflectors can be constructed using four different materials: trees, rock riprap, log riprap, and log crib and rock.

Tree Deflector:

- Tree deflectors should be built in areas subject to low to moderate levels of flooding.
- Use thick, freshly cut coniferous trees like balsam fir or various spruce species.
- Determine suitable locations so that the downstream end of the tree (i.e. the tip of the tree) is just above the upstream end of the design location of a pool.
- Anchor the tree butt to the top of the stream bank with rebar, or secure to a tree stump with rope or galvanized wire. Also, anchor the tip of the tree onto the stream bed with re-bar. Do not anchor to a living tree.

Rock Deflector:

- Rock deflectors should be built in areas subject to low to moderate levels of flooding.
- Rock deflectors should be built at sites where rock is plentiful or can be delivered to the site.
- Determine suitable locations so that the downstream end is just above the upstream end of the design location of a pool.
- Sake out the location and size (area to be covered) by the deflector. The help of an experienced person will be an asset.
- At base of the structure, use large rocks 36 - 38 cm (14 - 15 in) to construct outside edge or rocks 1.5 times the size of the largest rock in the river whichever is larger. The largest rocks should be placed on the upstream side and near the bottom. Fit the largest rock at the apex of the deflector. Use double rows of rocks in the upstream side of deflector. First row of rocks should be fitted into streambed. When fitting, lay rocks masonry style (i.e. with joints staggered).
- Slope deflector up to the bank from the tip to the top of the bank forming a shape like the corner of a pyramid using the large rock. Fill in center of deflector with smaller stone. If the bank is high, the deflector should be sloped up to a height that exceeds the 1:2 year storm flow or the height of the flood plain on the opposite bank if it is lower.

- To prevent rock from rolling or moving, use angular rock and chink in smaller rock in open spaces along upstream face.
- Upstream and downstream ends of the deflector should be protected with rock to prevent the river from washing around ends.
- Anchoring the structure by vegetating top of structure with grasses or shrubs may be desirable. Flooding characteristics will determine which plant type is most suitable.
- The bank opposite the deflector should be stable or may have to be protected to prevent erosion.

Log Riprap Deflector:

- Log riprap deflector should only be built in areas subject to low levels of ice damage.
- Build on sites where quality wood is available or can be delivered.
- Obtain necessary materials: No.9 gauge galvanized wire, 20-30 cm (8-12 in) angular rock, 3.0-6.1 m (10-20 ft) logs and prepared brush bundles. Materials and methods for construction are similar to those used in the Log Riprap bank stabilization technique.
- Stake outer edge of structure.
- Cut and place first log along upstream side then along downstream side. Continue placing logs on top. Top log should be at water level or slightly higher.
- Fill in center of deflector with brush bundles, rock, etc. When top of deflector is reached logs can be paced over top and wire down to prevent smaller rock and brush mats from washing out.
- Key in upstream and downstream of structure. Place in angular rock at the base of the deflector.
- When silt bar develops downstream, stabilize by planting.

Log Crib Deflector:

- Log crib deflector can be built on sites that are subject to moderate to high levels of flooding.
- Build at sites where rock and logs are plentiful or can be delivered.
- Estimate and obtain the required materials. Materials and methods used in this technique are similar to those in the Log Crib Structure technique.
- The proportion of the total log to be anchored into the bank is dependent on the following: the amount of log protruding into the main stream, amount of ice movement, volume of water and the type and amount of debris, including logs and limbs which may impact the structure as they are transported downstream. Logs may be set tight to a stable bank or may be embedded up to 1 m (3 ft) into the bank.
- The downstream log of the crib frame must but to and behind the upstream log at the apex of the deflector.
- Secure logs to streambed by drilling through logs and driving in reinforcing rods through logs into streambed. Further anchoring may be obtained by driving T-bars (possibly cut in half) into the streambed adjacent to and on the inside of the deflector. Secure T-bars

to log with galvanized wire. T-bars should extend only to top of log.

- NOTE: A frame is generally only required when the materials used (rocks, gravel, rubble) are not of sufficient size to withstand stream flows or depth of water. If all wood components can be submerged the life expectancy will be increased. If logs are exposed to air they should be peeled.
- If the structure must be greater than one log high, secure logs together with dock spikes or rebar. Before using dock spikes or rebar, pre-drill holes slightly smaller than the spike or rebar diameter.
  - Cross brace logs can be added to increase strength of the structure.
  - Rocks and rock rubble are placed within the frame.
  - Where frequent flows are not expected to overtop the deflector, soil may be used to cover the rocks and then seeded with grass. Both grass and shrubs will add shade, cover and improve aesthetics.

References:

Melanson T., S. LeBlanc, M. Goguen, and N. LeBlanc. 1999. Enhancement of Regional Sport Fisheries Through River Restoration: Case Studies for Shediac, Cocagne, Bouctouche, and Kouchibouguacis Watersheds. Southeastern Anglers Association 1996- 1998 Progress Report. 78 p.

Ministry of Natural Resources of Ontario "Community Fisheries Involvement Program: Field Manual". 1982.

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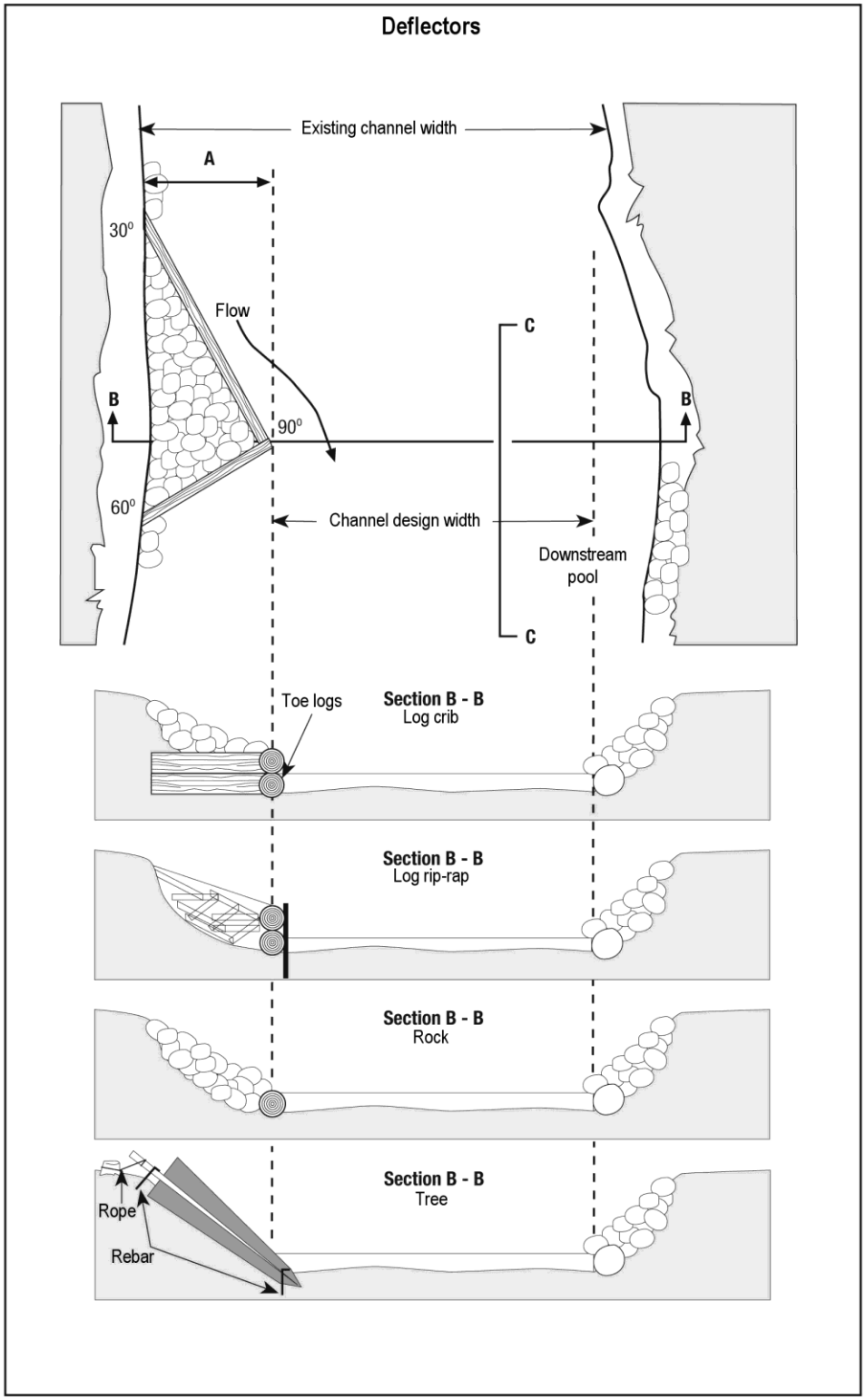

Figure 1. Conceptual drawings of a deflector and several types of deflectors (Thaumas Environmental Consultants Ltd. and DFO).

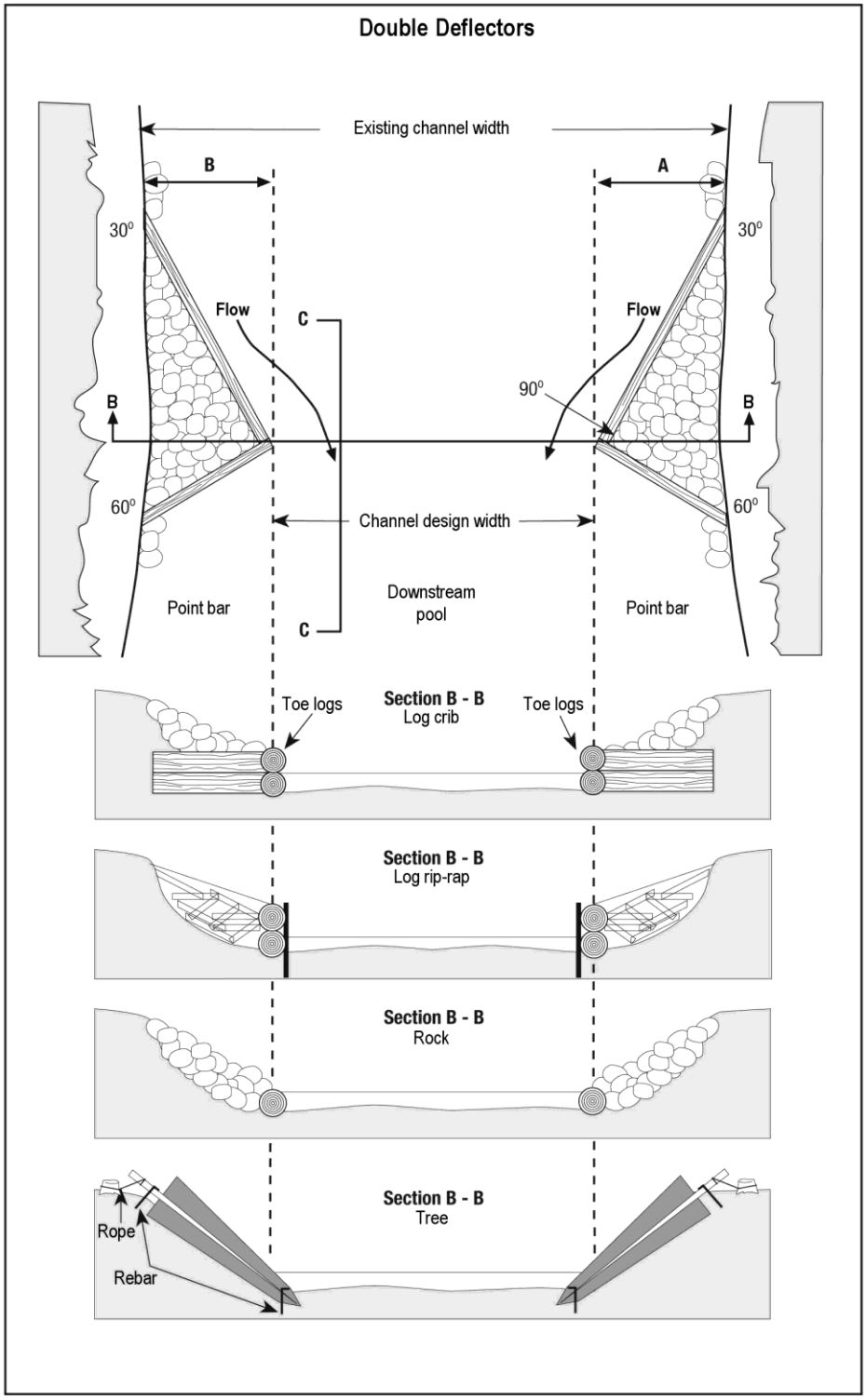

Figure 2. Conceptual drawings of double deflectors and several types of double deflectors (Thaumas Environmental Consultants Ltd. and DFO).