

Step 5 – Taking Action

Toe Protection/Erosion Control Options



Direct (~on-site) solutions



- Combatting toe erosion *directly* by **increasing riverbank's resistance to erosion** through an **increase in size/stability of material** in contact with flowing water
 1. Riprap
 - Vegetated riprap
 2. Gabions
 3. Geotextile bags
 4. Sheet piles
 5. Crib walls

1. Riprap (and Vegetated Riprap)



- Key considerations
 - Rock size and shape
 - Height and steepness
 - Extent and tie-ins
 - Embedment
 - Filter base
- Pros
 - “Flexible” protection (self-adjusts)
 - Effective over long-term, with maintenance
- Cons
 - Considered not fish-friendly (DFO permit?)
 - Transfers energy downstream
 - Availability of riprap-sized rock?
- Cost
 - \$\$\$\$



2. Gabions

- Key considerations
 - Stacked or sloping
 - Height (tiers)
 - Embedment
- Pros
 - Achieves stability without large rock
- Cons
 - Considered not fish-friendly (DFO permit?)
 - Prone to undermining
 - Transfers energy downstream
 - Wire cages release stone once rusted!
- Cost
 - \$\$\$



Credit: TRCA



Credit: B. Turcotte

3. Geotextile Bags

- Key considerations
 - Timeframe for usage
 - Height (stackable?)
 - Embedment
 - Generally for temporary/emergency use
- Pros
 - Achieves stability without large rock
- Cons
 - Considered not fish-friendly (DFO permit?)
 - Transfers energy downstream
- Cost
 - \$\$



Credit: B. Turcotte

4. Sheet Piles



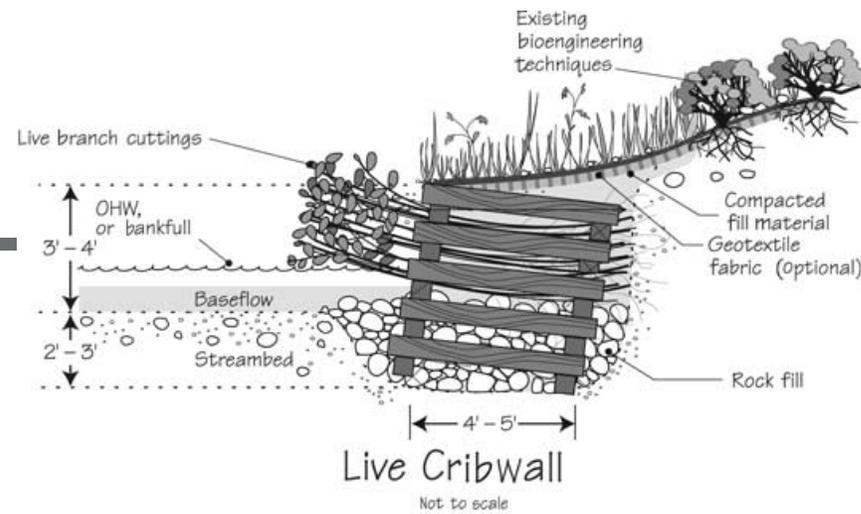
- Key considerations
 - Embedment
 - Vulnerable bank downstream?
 - Height
- Pros
 - Robust material and erosion protection
- Cons
 - Considered not fish-friendly (DFO permit?)
 - Transfers energy downstream
 - Difficult to extract if needed in future
- Cost
 - \$\$\$\$



Credit: Tongxiang Jude Technology

5. Crib Walls

- Key considerations
 - Availability of logs
 - Lifespan due to rot
 - Embedment
 - Growth potential for plants
- Pros
 - Hold steep angle
 - Fish-friendly
- Cons
 - Requires many logs
 - Labour-intensive construction
- Cost
 - \$\$\$



Indirect (~off-site) solutions



- Addressing toe erosion *indirectly* by **slowing water flow** along the riverbank
 1. Log spurs
 2. Rock spurs (Bendway weirs)
 3. Gravel bar reshaping
 - NRC example from Calgary!
 4. Opposite bank reshaping
 5. Channel realignment

1. Log Spurs

- Key considerations
 - Availability of logs
 - Vertical brace logs pounded into bed
 - Spacing
- Pros
 - Natural appearance
 - Fish-friendly – no DFO permit?
 - Shifts energy away from bank
- Cons
 - Requires many logs
 - Lifespan due to rot
 - Prone to damage by ice jams
- Cost
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Credit: ELR



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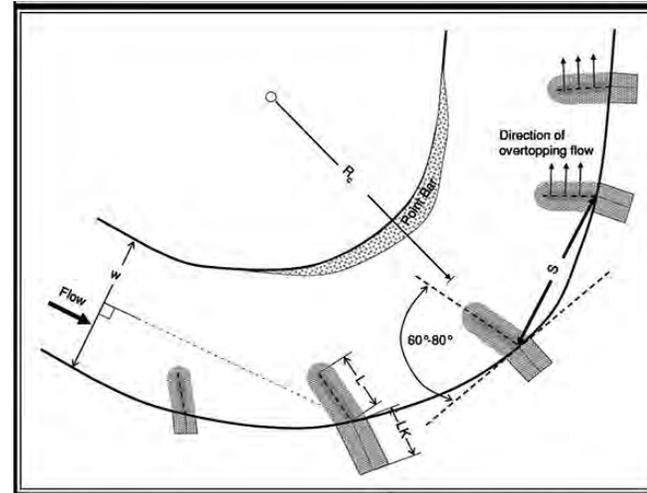


Credit: B. Turcotte

2. Rock Spurs (Bendway weirs)



- Key considerations
 - Availability of riprap-sized rock
 - Spacing
 - Angle from bank
 - Avoid/reduce riprap along bank?
- Pros
 - Shifts energy away from bank
- Cons
 - Considered not fish-friendly (DFO permit?)
 - Potential for damage by ice jams
- Cost
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Credit: California Highway Design Manual

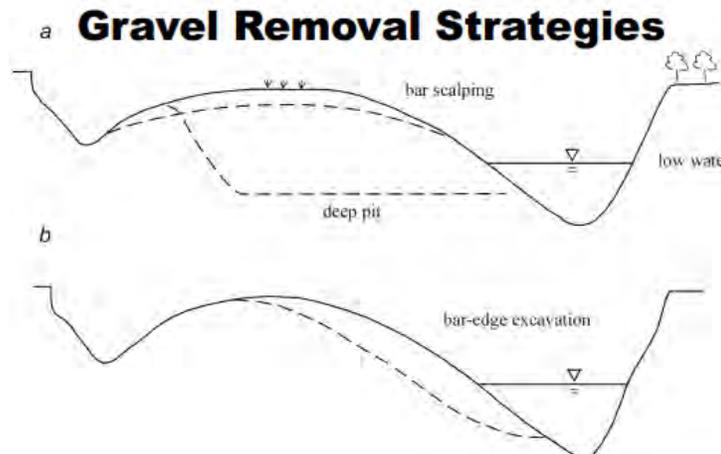


3. Gravel Bar Reshaping



NRC example from Calgary!

- Key considerations
 - Sediment load of river
 - Effects of changes on flow pattern at different flood levels (modelling!)
- Pros
 - Addresses cause of erosion
- Cons
 - Not fish-friendly?
 - May require repeated dredging if bar re-forms
- Cost
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Engineering Study for Lillooet River Corridor

Gravel Bar Locations Along Lower Reaches of Lillooet River

4. Opposite Bank Reshaping



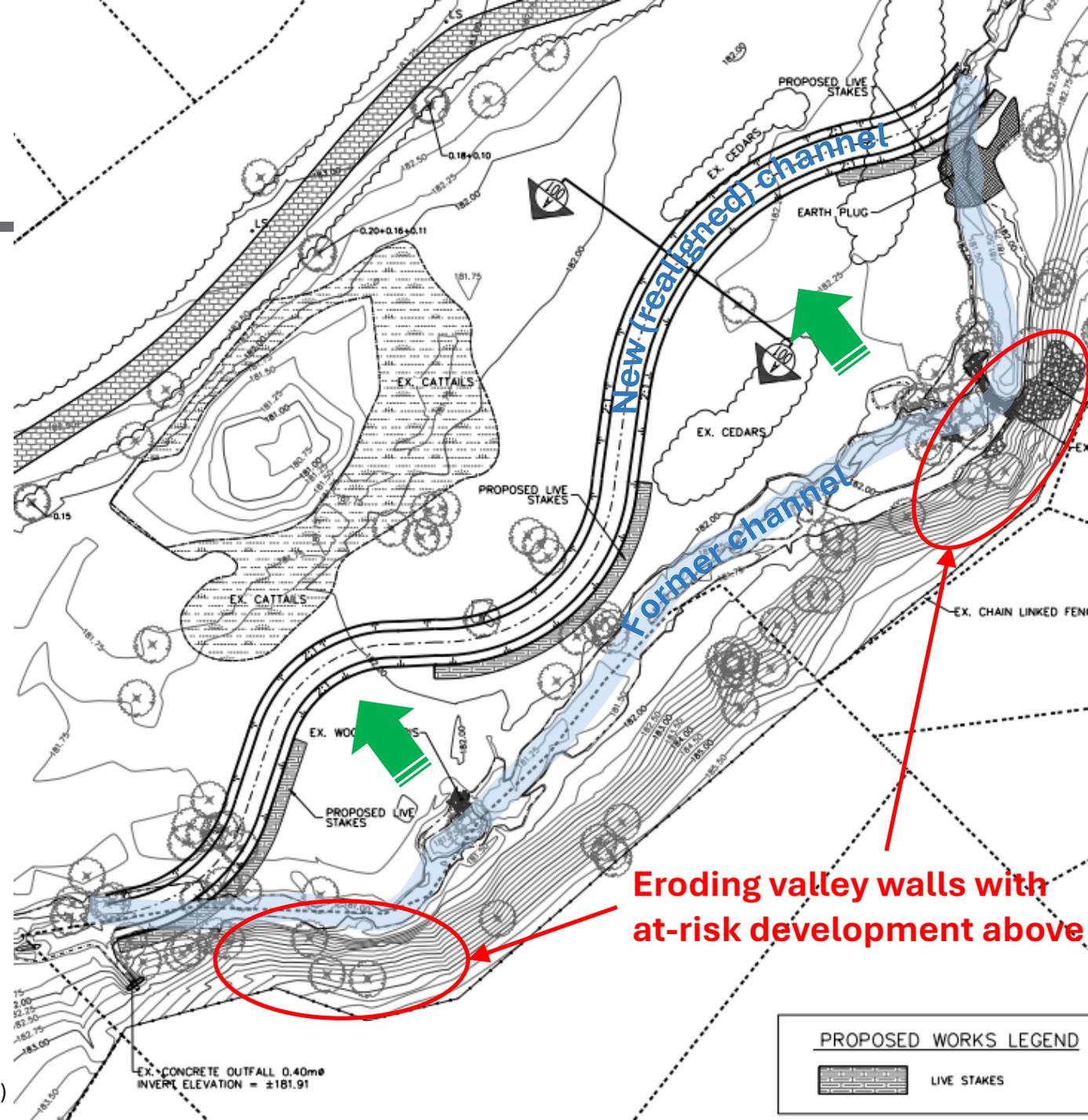
- Key considerations
 - Effects of changes on flow pattern at different flood levels (modelling!)
- Pros
 - Addresses *cause* of erosion
 - Avoids need for rock or logs
 - Likely considered fish-friendly
- Cons
 - Lower certainty in success
 - Wider channel → bar formation?
- Cost
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Pretend how erosion patterns may change IF this rock hill were smaller or gone?...



5. Channel Realignment

- Key considerations
 - Only practical for creeks or side channels
 - Interaction with ice jams?
- Pros
 - Natural approach to addressing *cause* of erosion
 - Long-term solution requiring little to no maintenance
 - Opportunity to restore/enhance habitat
 - Avoids need for much rock
- Cons
 - Typically considered temporary impact to fish habitat (DFO permit?)
- Cost
 - \$\$\$\$



Credit: SLR (formerly Palmer)