Large Woody Material
There is a lot at "Stake"

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Presentation Outline

1. Introduction
2. Large Woody Material
3. General Rules for Application
4. Design Concepts for LWM
5. Construction and Mitigation
6. Case Studies (SICD and Otter Creek)
7. As-Built Monitoring
8. Q & A Session

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- Burnside Aquatic Group Team Lead – Project Manager
- 30yrs Aquatic related experience in Canada and Internationally
- Fish Habitat Protection and Enhancement, Permitting and Approvals, In-water Works, Natural Channel Design and Construction, Transportation, Development, Water Resources
- Recipient of the “Outstanding Technical Achievement” Award by OACETT – 2021 for the Barefoot Box Culvert™ and Design

Why Use Wood?

"Woody material is used for bank protection because it provides a living, natural defense against erosion. It absorbs wave and current energy, slows water velocities to trap sediment, and stabilizes the soil with deep root networks. Unlike concrete or steel, it also naturally restores local aquatic ecosystems." (Google AI)

Key Advantages

- **Natural Energy Dissipation:** Fallen trees, branches, and rootwads create "roughness" in the waterway. Instead of deflecting water downstream (like hard riprap or seawalls do), wood slows the current, safely shedding energy.
- **Soil Retention:** The root systems of woody plants act as natural rebar, locking soil in place and protecting banks from slumping and erosion.
- **Sediment Catchment:** Woody structures capture and retain organic and mineral sediment, promoting the natural buildup and repair of the bank.
- **Flood Mitigation:** Adding wood and trees helps connect the stream channel to its floodplain, which reduces flood stress and damage downstream.

Ecological & Economic Value

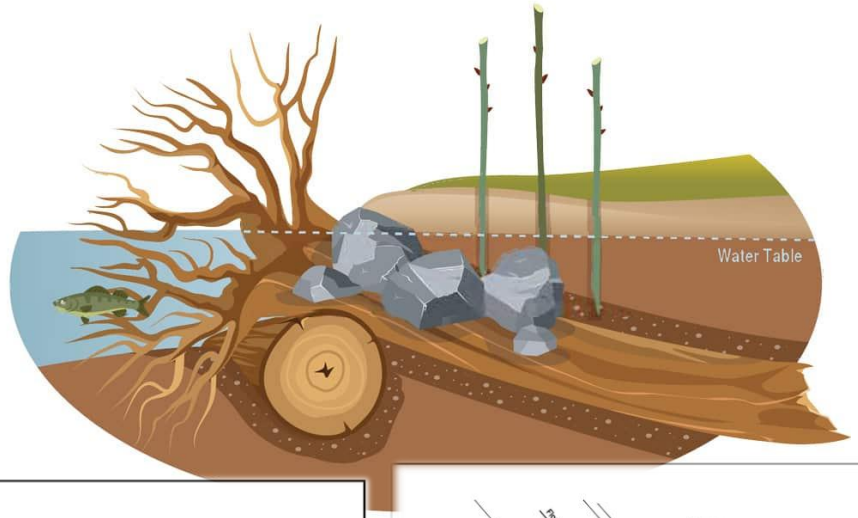
- **Habitat Creation:** Wood embedded along the banks creates shaded, slow-water refuges for fish and a foundation for aquatic food webs.
- **Cost-Effective & Sustainable:** When implemented with bankside vegetation management, utilizing native woody material is a sustainable, cost-effective alternative to rigid, artificial structures.

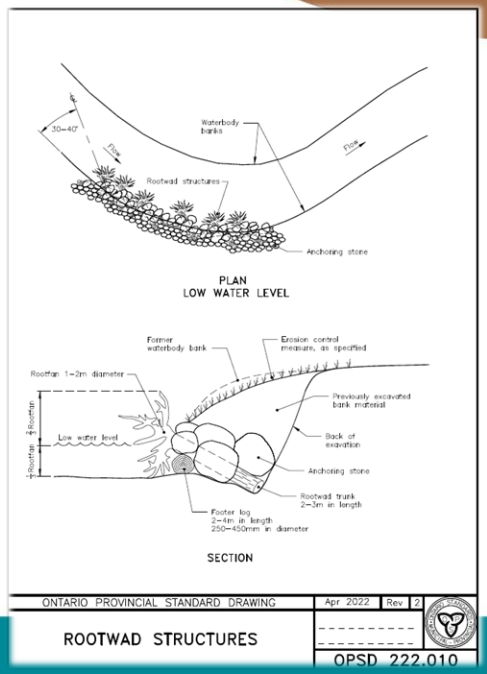
Large Woody Material

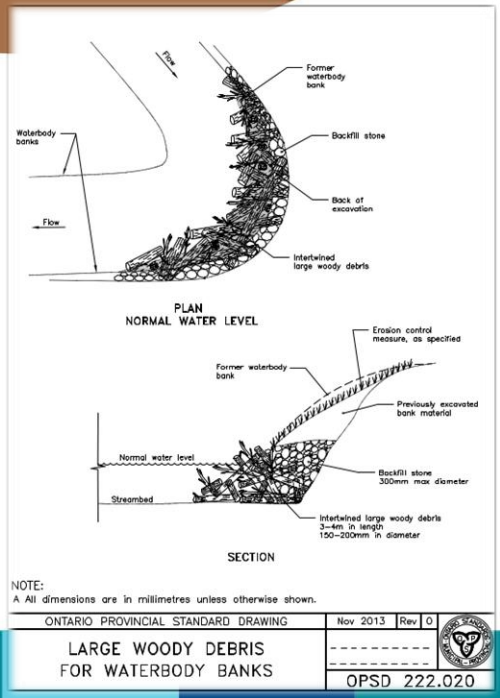
- “Material” not “Debris” although generally known as LWD
- Larger diameter material (>10cm/4”) that is used for certain prescriptions depending on application
- Durable native hardwoods and low resinous conifers (Maple, Oak and Cedars)
- Preferred to have root mass although depending on application may not be easily installed
- Use of local sources (not imported due to invasive pests) sometimes available within the project limits

Typical Woody Material Prescriptions

- Rootwad Structures (OPSD)
- Woody Debris on Banks (OPSD)
- Stone and Woody Material Matrix
- Crib Walls
- “Leaky Berm”







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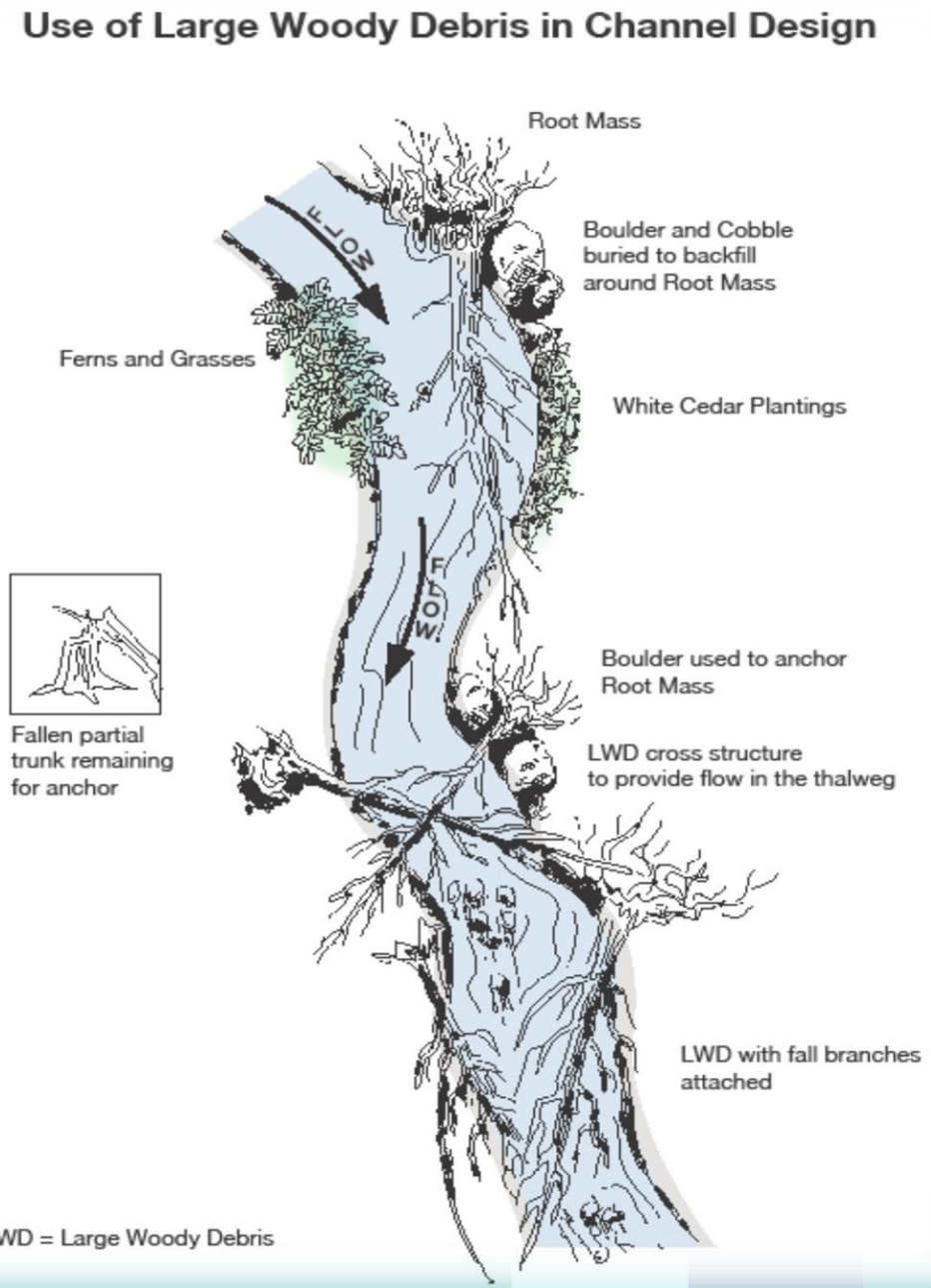
Use of Wood – What's at "Stake"

- Wood floats and will move if not anchored (stakes, pins, rock or soil anchors)
- Needs to be layered to create a matrix that is integral (think of shingles on a roof)
- Downstream to upstream from the base up (keyed into toe and banks), tips down
- "Jacks Rule" 45 deg to the bank
- Deflect erosive flows to opposite banks or Thalweg

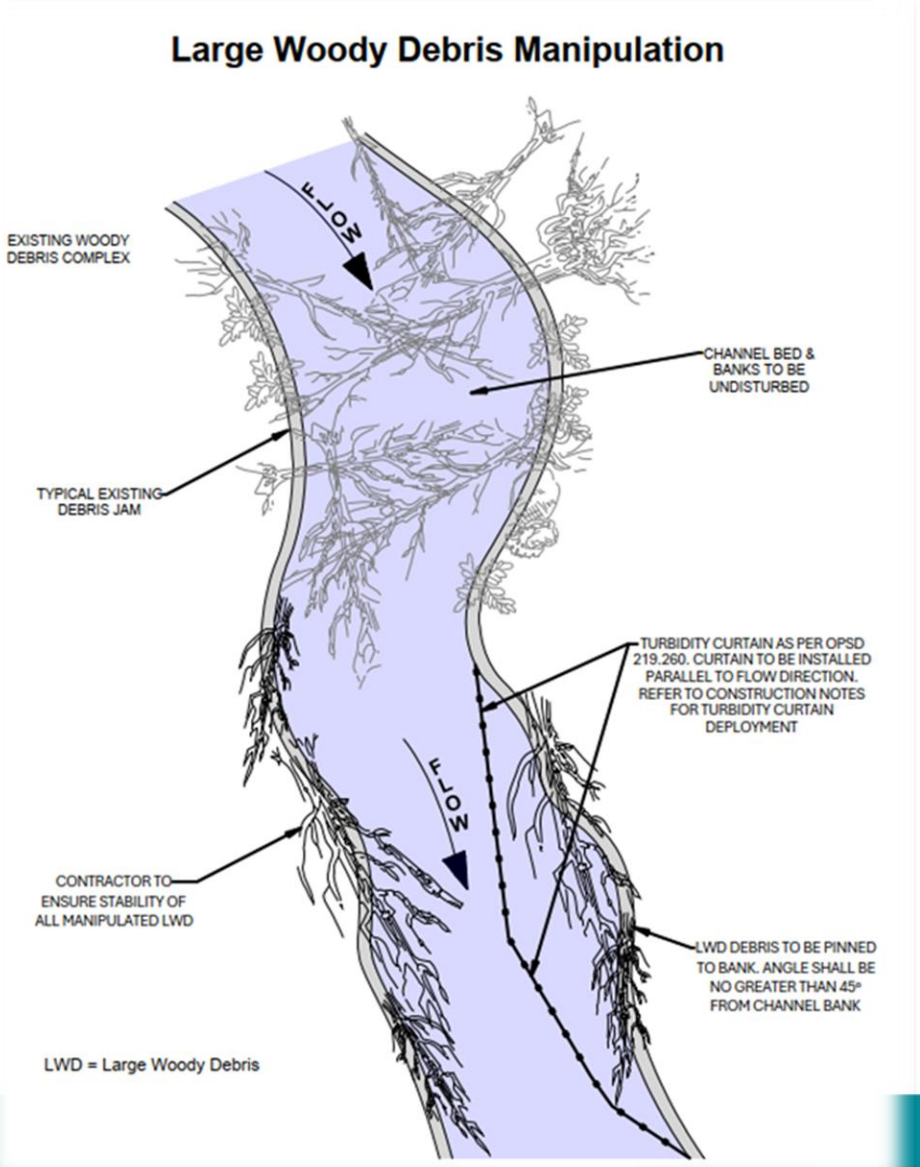
Conceptual Innovation

- Conceptual use of woody material angled to maintain thalweg and stream flows
- Anchored root wads using stone and soil
- Provides suitable habitat for aquatic life
- Approved by DFO and CAs for various projects



Woody Material Manipulation

- Manipulation of woody material angled to maintain thalweg and stream flows
- Pulled back and staked or pinned
- “Jack’s Rule” 45 deg to the bank angled downstream
- Restoring flows, sediment transport and deposition



In-Water Works Construction and Mitigation

- Complete “Issued for Construction” drawings supported by “Experienced Restoration Practioner”
- Qualified Contractor with experience and suitable equipment
- Proposed Mitigation depending on site and sensitivity
- Phasing of the in-water works
- Cofferdams and pump around
- In-water works mitigation (isolation and exclusion of aquatic life)

Exceptions to the Rule for Mitigation

- Municipal Drains permitted to work in the “wet”
- Exclusion and isolation for aquatic life using seine nets and fish barriers
- Take breaks but “get er done”
- Sediment traps and monitoring of downstream conditions

Case Study – South Innisfil Creek Drain

- DFO Authorization for 10km of Channel Improvements
- Multi Level Mitigation
- Natural Channel Design Features
- Baseline eDNA
- Drains Done Differently

(NVCA/OMAFRA)

“Sod Matting”

Concept and Use for bank protection developed by R&M Construction

Monumental in the success of the project due to highly mobile bank soils

South Innisfil Creek Drain – Innisfil, Ontario

Stone Protection and Brush Material

Stone Protection and Woody Material

Newly Constructed

1yr Post Construction

Woody Material Matrix and Stakes

Woody Material Crib and Brush Layering

Woody Material Matrix with Vertical Stakes

Before

After

Review of Post Flood Conditions September 2021

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Woody Material Matrix with Horizontal and Vertical Stakes

Facing Upstream

Facing Downstream

Woody Material Matrix with Horizontal and Vertical Stakes

“Leaky Berm”1st Year Construction

Before

After

“Leaky Berm” 5 Year Post Construction

Facing Upstream

Facing Downstream

SICD - Phase 1 of 10KM- July 2021

“Drains Done Differently”

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Drains
Done Differently.

South Innisfil Creek Drain (SICD) Improvement
Ecological Enhancements
Green Infrastructure: Bank Stabilization

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Trees that have large, circular, and fibrous root masses are preferred, such a non-native Manitoba Maple or an Ash; the many native Ash trees in Ontario killed by the emerald ash borer provide a readily available supply.

A single root wad c/w wood pins and stone for anchorage or ballast

The root wad stabilization technique involves burying the footer log into the eroded or slumping drain bank until the root is flush with the bank's soil. In soft native soils, the end of the trunk can be cut on a 45-degree angle (or flatter) with a chainsaw and inserted or pushed on a downward angle into the bank using an excavator. If bank soils are hard, a keyway or trench is excavated to install the footer log, which is typically oriented perpendicular to the flow, particularly if multiple root wads are installed abutting each other. Root wads also work effectively when placed facing upstream at a 30-degree angle to the drain bank, with the footer log extending downstream and into the bank.

Once installed, the root wad is anchored or pinned into it place, preferably with wooden pins; duck-billed soil anchors and aircraft cable with crimps can also be used. Where a keyway or trench is excavated, fill should be placed over the footer logs to anchor them with sod mats on top. Root wads can be installed in combination with other woody material, live stakes, river stone or riprap; stone acts as ballast and also serves as a pinning material. Dogwoods and willows provide suitable material for live stakes which can sprout and grow to increase long-term bank stability.

Woody Material Structures

This procedure involves the removal and/or manipulation of existing log jams consisting of woody material (WM). Material which has accumulated in the middle of the drain is typically moved over to one or both sides to improve bank stability and re-establish the main flow path. In order to supplement existing materials, the process can also include the manipulation and placement of additional WM, which is either imported or acquired from a nearby clearing operation. WM structures are stabilized using wooden pins and/or duck-billed soil anchors.

WM is pulled back from the middle of the drain to the bank(s), which allows the main flow path to properly form and provide suitable velocity to convey sediment. All WM (existing and new) is manipulated, moved, and placed using appropriate equipment such as a backhoe or excavator; where access is limited, hand work may be required by the Contractor and crew.

Log jam pre-construction

Woody material structure post-construction

Once placed, WM is pinned horizontally and vertically with an excavator by inserting or pushing smaller sharpened wood pieces of appropriate diameter (150 to 200mm) and length (2.0 to 3.0m) into the soil to ensure that all of the material is held against the bank being protected, while also preventing it from floating or lifting during higher flows and more significant runoff events. WM is often used in combination with riprap/river stone and/or sod mats, both acting as ballast with the latter also providing instantaneous vegetation coverage and future stability once deeper and denser roots are established.

BENEFITS

Sod Mats

Sod mats provide immediate and long-term stabilization of a drain bank and create an instantaneous vegetated cover on an overflow shelf or floodplain bench without the need for fine grading and seeding. The roots and vegetation in and on the mat are local to the area, have a higher probability of survival, are in full growth, and mat roots often become denser and grow deeper.

This form of vegetative cover can provide pollinator and wildlife habitat, provide shade for aquatic habitat, reduce flow velocity on the floodplain bench, and promote sediment deposition on the graded bench instead of in the drain. They are a valuable natural resource that can be harvested from areas proposed for demolition that are otherwise buried or discarded. With the proper equipment, they are easily salvaged from within or adjacent to the drain corridor and within the reach of the excavation equipment. They can also be used in combination with other forms of bank protection such as root wads, woody material, and riprap.

Root Wads

Root wads are a natural resource and surplus material that is often discarded in or beside the spoil bank where clearing is required for a drain improvement or widening project. Although they require heavy equipment for installation, root wads can effectively provide toe and bank stability, enhance aquatic habitat, and collect sediment and floating debris. They are particularly valuable to fish by providing refuge habitat.

Woody Material Structures

Woody Material is another surplus natural resource that is also often discarded when improving a drain, especially if clearing is required. If there are access restrictions that will not allow the use of an excavator, an all-terrain vehicle (ATV) may need to be substituted and used to haul the WM. These natural structures can restore bank stability, create habitat, and enhance flow conditions in a way that will naturally create a main flow path within the drain. These structures also collect sediment and floating debris, and can become more stable over time as new vegetation colonizes the sediment deposits.

WM manipulation and placement can establish a long lasting and natural looking open drainage system. If properly placed, WM structures can stabilize drain banks, establish suitable areas for sediment deposition, and provide habitat for aquatic and terrestrial species.

Otter Creek Sediment Removal and Rehabilitation

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Rehabilitation and Habitat Creation

- 360m of new channel created
- Critical habitat for coldwater species

- More than 20 sites assessed, for sediment removal
- All work completed with 1 yr.

Questions and Answers Session