I.S.RIVERS
LYON 2018

ENGINEERING DESIGN AND INSTALLATION OF LARGE WOODY DEBRIS

Conception technique et installation de grands débris ligneux

Engineering Design[1, 2]

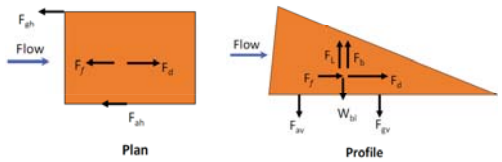
General Considerations

Category	Decisions
Hydrology	What is the design event? How will the structures affect/interact with smaller and larger flows? Should ice be considered in the design?
Reach layout	How many structures will be placed and where?
Materials	What types and sizes of logs and other materials will be used? Sources?
Dimensions and shape	What type/shape of structures will be employed? What will their dimensions be?
Hydraulics	How will the project affect habitat quality and high flow stages?
Sediment	What effect will the project have on local scour and deposition, bank erosion, reach scale morphology, channel response, habitat value, and terrestrial plant colonization?
Vegetation	How much effort should be devoted to planting vegetation? Should effects of vegetation on structural stability (surcharge, sediment cohesion), erosion, and bank stability be included in analysis, and, if so, how?
Anchoring	What is the magnitude of forces that the structures must be designed to resist? Will anchoring involve passive or active restraints? What factors of safety will be used?
Construction	What construction methods will be utilized? Will channel be de-watered or large wood placed in the "wet"? What adverse impacts will be created by construction, and how can they be controlled? What time windows (seasons) will be used for construction?
Economics	Can the project be delivered within budget? How can value be increased?

Structure Type Considerations

- The configuration should address the dominant fluvial (erosion, deposition, etc.) processes operating onsite.
- Key habitat deficiencies (e.g., lack of pools, lack of cover, lack of woody substrate) should be addressed. The project should be in harmony with the anticipated future geomorphic and riparian response of the reach.
- Economic, political, institutional, social, and construction access issues should be considered.
- Suitable materials must be available at a reasonable cost. If logs of adequate size for natural stability without anchoring are not be available, designs must adjust accordingly.
- Safety issues for recreational use and nearby infrastructure should be addressed.
- The most desirable structures emulate naturally occurring large wood formations.
- Permanently fixed structures placed at regular intervals for erosion control are often necessary but do not replicate features typical of natural settings. When possible (i.e., when dynamic, mobile boundaries and wood are acceptable), structures should look and behave like stable wood jams.

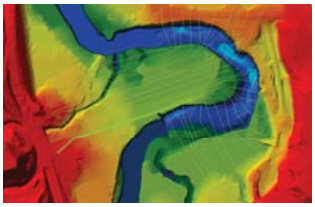
Stability Analysis



F_{av} = vertical restraining force due to anchors or other restraints
W_{bl} = weight of ballast
F_{gv} = vertical geotechnical forces

F_f = friction between LWD and stream boundary
F_{gh} = horizontal geotechnical force
F_{ah} = horizontal force due to anchors or restraints
F_d = drag force, F_L = lift force, F_b = buoyant force

Design Data Needs



- One bed material sample from the center of each cross section.
- Streamflow data or regional regression relations for flow frequency.
- Wood dry density and approximate sizes of available wood.
- Desired wood loading.
- Cross-section surveys including representative sections spaced at no more than one channel width, ideally at each structure location, with a minimum of 10 per reach to try to capture more than one complete riffle-pool sequence (if they exist).
- Thalweg profile survey (at least three riffle-pool sequences or 15 to 20 channel widths long) to determine the reach bed slope

Low Impact Installation

Water and Sediment Management

Work should occur during the lowest expected annual flows and when critical species are known to be absent. As much water as possible should be diverted away from the work zone using either pumped or gravity flow in conjunction with diversion/containment structures (i.e. push-up dams, cofferdams, etc.). Turbid water should be contained or lifted away into upland zones so that suspended fines can settle or filter out before this water returns to natural flow.

Flow Diversion

Strategic Materials Delivery

Work Zone Dewatering

Sediment Transport Control

Equipment Selection

Machines should be tooled for minimal impact to sensitive environments. Size and dimension should be large enough to meet required lifting and reach capacities while being small enough to maneuver within site constraints. Where access is highly limited aerial deliver of wood and ballast materials may be preferred.

Michael Patrick Moore

1. Bureau of Reclamation and U.S. Army Corps of Engineers. 2015. *National Large Wood Manual: Assessment, Planning, Design, and Maintenance of Large Wood in Fluvial Ecosystems: Restoring Process, Function, and Structure.* Available: www.usbr.gov/pn/.
2. Brooks, A. P. 2006. *Design Guidelines for the Reintroduction of Wood into Australian Streams.* Land & Water Australia, Canberra.

Biohabitats