Section 26
Guidelines for Large Woody Debris Placement Strategies

PART 1. INTRODUCTION **1**
FOREST PRACTICES HYDRAULIC PROJECTS (FPHP) 2
OFF-CHANNEL HABITAT ENHANCEMENT AND OTHER TYPES OF ENHANCEMENT 2
PART 2. STANDARD LWD PLACEMENT GUIDELINES **2**
PLANNING 2
PREFERRED LOCATIONS 2
CHANNEL CONFIGURATION A 3
CHANNEL CONFIGURATION B 3
CHANNEL CONFIGURATION C 3
CHANNEL CONFIGURATION D 3
THE CRITERIA FOR WOOD PLACEMENT 3
PREFERRED PLACEMENT OF WOOD SPECIFICATIONS AND STRATEGIES 4
LOGJAMS AND MAXIMUM LOADING 4
PART 3. EASTERN WASHINGTON **5**
PART 4. CREDIT SYSTEM **6**
CLAIMING CREDIT 6
SURPLUS CREDIT 6
DONATIONS 6
CLAIMING CREDIT - CALCULATION OF PLACED LWD 6
COLLECTING CREDIT – CALCULATION OF OUTER ZONE TREES 6
CREDIT RATIO 6
REFERENCES **7**
APPENDIX A LWD PLACEMENT AND CREDIT CALCULATION WORKSHEET **8**

PART 1. INTRODUCTION

This manual provides the technical guidance for in-channel wood placement. Large woody debris (LWD) placement can be accomplished using this manual or with an approved alternate plan (**WAC 222-12-040**). The intent is to facilitate long-term fish habitat development in streams located in managed forestlands by creating incentives for landowners to place wood. Credit for LWD placement is given in the form of harvest of additional Riparian Management Zone (RMZ) outer zone trees (**WAC 222-30-021(1)(c)(iii)** and **WAC 222-30-022(1)(c)(ii)**). Most managed forestland streams in Western Washington, and many managed forestland streams in Eastern Washington are currently deficient in LWD as a result of historic riparian harvest practices, splash damming, and stream clean-out activities. Although LWD placement provides relatively short-term habitat benefits, timber harvest in the RMZ outer zone exchanged for LWD placement in fish habitat streams may provide incentives for landowners to improve fish habitat until mature trees can contribute naturally.

Forest Practices Hydraulic Projects (FPHP)
An approved FPA for a forest practices hydraulic project (FPHP) is required for all in-channel LWD placements. ~~HPAs are issued by the Washington Department of Fish and Wildlife (WDFW) under Chapter **220-110** WAC to~~FPHPs regulate construction or other activities that "use, divert, obstruct, or change the natural flow or bed of any Type S, F, or N ~~w~~Waters ~~of the state...~~" (**WAC 222-16-010**). Landowner are encouraged to consult with the department and the department of fish and wildlife prior to submitting an application involving a FPHP to help ensure that project plans and specifications meet fish protection standards. See Board Manual Section 5, Guidelines for Forest Practices Hydraulic Projects for more information regarding LWD placement.

LWD placement will usually be done in conjunction with a harvest site and associated Forest Practices Application (FPA). FPAs may also be required for fish enhancement groups that fell trees and place LWD as part of a cooperative effort with the landowner. Enhancement groups should contact the DNR region office to determine if one is appropriate. **See paragraph on Donations below.**

Off-channel habitat enhancement and other types of enhancement
It is anticipated that most enhancement activities will be in the form of un-anchored wood placement, which is addressed in detail below. However, where the appropriate opportunities exist, off-channel habitat restoration opportunities are encouraged by WDFW. These opportunities are site-specific in nature. Consultation with DNR and WDFW is required to ~~receive an HPA~~FPA/N for a forest practices hydraulic project (FPHP) ~~and~~ determine the amount of basal area credit.

PART 2. STANDARD LWD PLACEMENT GUIDELINES

Refer to Appendix A, LWD Placement and Credit Calculation Worksheet.

Planning
Watershed scale planning is highly encouraged to identify preferred locations for LWD placement. Landowners should consult with tribal and WDFW habitat biologists to identify preferred locations as well as undesirable locations. The use of watershed analyses, Habitat Conservation Plans (HCPs) and other habitat assessment and habitat restoration planning documents may be helpful in this regard. At minimum, the following locations should be avoided:

1. Channels that have a history of, and a near-future likelihood of debris torrents and other mass wasting activity.
2. Locations immediately above permanent culverts
3. Confined channels where the valley floor width is less than twice the bankfull width. See Section 2 for identifying Channel Migration Zones and bankfull channel features.

Preferred Locations
LWD placement is limited to Type S or F Waters. Among those sites that are appropriate, different restrictions or levels of consultation may be necessary. The chart below (modified from ODF and ODFW 1995) identifies four "Channel Configurations", which represent ranges of

channel gradient and bankfull width. Different placement criteria and procedures apply to different channel configurations.

Channel Configuration A

This is the preferred channel configuration for LWD placement. LWD can be placed provided that the LWD placement protocol described herein is followed. If an insufficient number of credit trees **(see paragraph on "credit" below)** are available from the outer zone of the harvest unit, the landowner may choose to place more LWD in the channel and harvest outer zone credit trees from concurrent and/or future harvest units in the same Watershed Analysis Unit (WAU) (see paragraph on "surplus credit" below). The LWD placement and credit calculation worksheet, below, may be used to calculate credit and track the collection of surplus credit ~~at~~ for subsequent harvest sites. LWD may be placed up to the maximum allowed in the paragraph on "logjams and maximum wood loading" below.

Channel Configuration B

Configuration B is used for a set of channel conditions that are intermediate in their desirability as sites for wood placement. Stand composition is used as the decision criteria for determining the desirability of wood placement for these conditions, and therefore the procedures to follow for placing wood. If the combined basal areas of core and inner zones are dominated by deciduous trees (i.e. ≥ 70%) then follow the procedures used for Channel Configuration A. Otherwise, follow the wood loading limits and other procedures for Channel Configuration C.

Channel Configuration C

This is not a preferred channel configuration for wood placement. Credit trees for LWD placement may only be taken from the adjacent outer zone of the riparian buffer, which places a tight limit as to how much wood can be placed. In other words, there will be no surplus credit granted so that outer zone trees can be taken from other harvest units. Additional wood can be placed only if the operator receives ~~consent~~ approval from ~~the~~ DNR, in consultation with the WDFW area habitat biologist.

Channel Configuration D

If a landowner wants to create an in-channel fish habitat enhancement project, this must be done with an alternate plan **(WAC 222-12-040)**. The plan will include engineering designs ~~HPA terms and conditions,~~ and rationale on why placement is superior to retaining trees in the outer buffer. LWD without sufficient diameter or attached root wads are not likely to qualify for credit. Stream channels wider than 40 feet bankfull width fall within the Channel Configuration D.

The criteria for wood placement

Minimum wood length: Logs to be placed must be a minimum of twice BFW and meet a minimum diameter as specified below. Placement logs with root wads attached must be a minimum 1.5 times diameter BFW and meet a minimum diameter as specified below. (ODF and ODFW 1995 and watershed analysis).

Minimum wood diameter: Placement piece diameters must meet or exceed diameters listed in the table below. Diameters of placed pieces are measured at the widest diameter of the bole

within the banks. If root wads are placed within the channel, diameters are measured at an approximate equivalent location to breast height as if it were standing.

BFW in feet	**Minimum Diameter**
< 5	12 inch diameter
> 5 and < 16	16 inch diameter
>16 and < 32	22 inch diameter
> 32	26 inch diameter

Type of wood and quality: All wood placed for credit must be conifer. Larch, cedar and Douglas fir are preferred because they will provide stability over a longer period of time. Credits will only be provided for LWD that is freshly cut or from downed wood that has a solid rot-free core. Measure the solid rot-free core for credit diameter if the wood in the piece is not from a live tree. If downed logs or root wads are taken from an upland source, it must not compromise downed log requirements for wildlife **(WAC 222-30-020(11).**

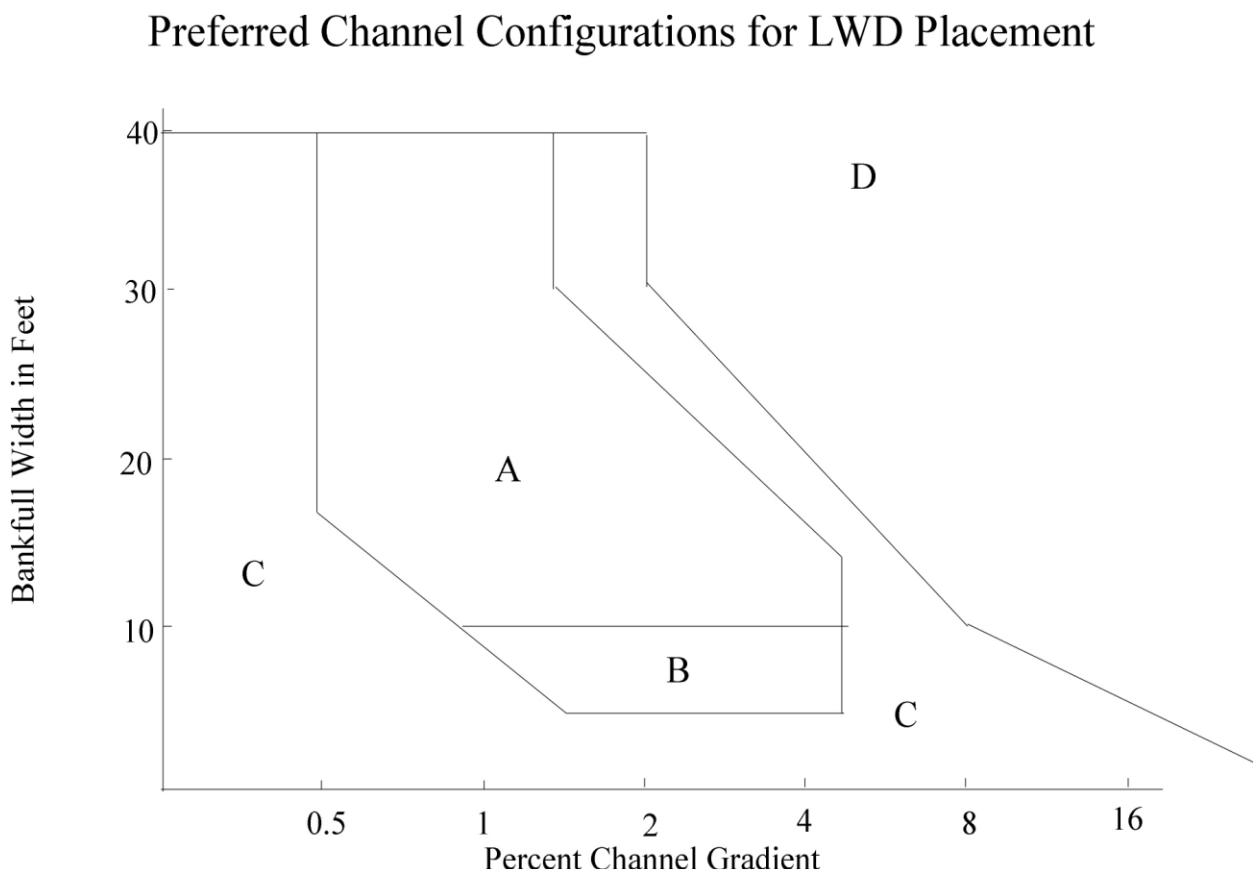
Preferred Placement of Wood Specifications and Strategies

It is recommended that an experienced biologist be consulted on wood placement. There are a number of strategies that can or should, be applied depending on the width and gradient of the stream. At the very least, it is recommended that boles (trunk of the tree) should be partially in the water and partially on the bank. Root wads should be placed entirely within the bankfull width.

Logjams and Maximum Loading

Operators are encouraged to place multiple pieces of LWD into logjam formations on wider streams, even if this causes a concentration of placed LWD in a few locations within a stream segment or harvest unit. However, there are some limits as to how much LWD can be packed into short segments of streams. Placed logjams must be spaced, at a minimum of 1 – 3 bankfull widths apart, and should not exceed the number of LWD (this includes both natural recruitment and placed LWD) indicated in the table below**.**

BFW in feet	**Maximum number of LWD per logjam**
< 5	2 pieces
> 5 and < 16	5 pieces
>16 and < 32	12 pieces
> 32	15 pieces



Restrictions to Riparian Zone Disturbances. Ground disturbance should be minimized and limited to areas necessary for placement access. Ground disturbance should be limited to 5% of the length of the stream reach in the harvest unit or area of the proposed activity when placing LWD. Use of helicopter, cable, and tracked-excavator systems for wood-placement is strongly encouraged. Use of crawler tractor or rubber-tired skidder is strongly discouraged as a method to place logs in streams, due to expected ground disturbance and limited ability for desired placement. Disturbed soils with the potential to erode into the stream should be treated with erosion control measures available and appropriate for the site. ~~Permitees~~ Applicants are not responsible for bank erosion and scour that occurs in response to LWD placement.

PART 3. EASTERN WASHINGTON

One half of the outer zone leave trees may be harvested as credit for LWD placement, as long as the remaining half are left in the outer zone. Thus, up to 10 trees, 8 trees and 5 trees per acre may be harvested in the High Elevation habitat type, the mixed conifer timber habitat type, and the Ponderosa pine timber habitat type, respectively. Minimum diameters and placement frequency for LWD has not been determined for eastside streams. Until additional data ~~is~~ are available, the minimum LWD size and placement frequency will be the same as Western Washington criteria.

PART 4. CREDIT SYSTEM

Credit accrued from placement of LWD can only be used to harvest trees from the outer zone. Refer to the LWD Placement and Credit Calculation Worksheet below.

Claiming Credit

Credit can be claimed whenever LWD placement activity takes place under channel configurations A-C. Channel Configuration D projects and off channel enhancement will require an alternate plan.

Surplus Credit

Where wood is placed to the maximum allowable number of pieces in a given channel segment, surplus credit may apply to other harvest units within the same WAU.

Donations

Landowners may also claim credit for donating wood to volunteer and funded enhancement efforts that occur in managed forestlands, provided that the provisions of this manual are followed.

Claiming Credit - Calculation of placed LWD

Credit for placed logs will be cross-section area of the piece calculated from diameter measured at the widest point that lies within the bankfull width. When root wads are placed in the channel, diameter will be measured at "dbh", as if the root wad were a standing tree (i.e. 4.5 feet above the estimated ground level). If the root wad portion of the placed log is outside the channel, credit diameter will be the same as for a log.

Collecting Credit – Calculation of outer zone trees

For purposes of calculating basal area credit, it is assumed that outer buffer leave trees will average 15" dbh or 1.23 square feet of basal area each. This holds true for both eastern and western Washington.

Credit ratio

When enhancement logs are placed in Type S or F Waters (per **WAC 222-30-021(1)(c)(iii)**), landowners will be credited two units of harvest basal area for every one unit of cross-section area placed in the stream, i.e., a **2:1 credit ratio**. When enhancement logs are placed in response to compensation for roads within the riparian zone, as per **(WAC 222-30-021(1)(b)(iii)** and **WAC 222-30-022(1)(b)(iv)**, landowners will be credited one unit of harvest basal area for every one unit of cross-section area placed in the stream i.e. a **1:1 credit ratio**.

References

Cederholm, CJ, LG Dominguez and TW Bumstead. 1997. In PA Slaney and D. Zaldokas, eds. Fish Habitat Rehabilitation Procedures. Watershed Restoration circular No. 9. Ministry of Environment, Lands and Parks. Vancouver, BC.

[ODF and ODFW 1995] Oregon Dept of Forestry and Oregon Dept of Fish and Wildlife. 1995. A Guide to Placing Large Wood in Streams. ODF, Salem, OR. 31 pp.

Schuett-Hames, D., A. Pleus, L. Bullchild and S. Hall. 1994. Ambient Monitoring Program Manual. Northwest Indian Fish Commission, Olympia. TFW-AM994-001.

Slaney PA and D. Zaldokas, eds. 1997. Fish Habitat Rehabilitation Procedures. Watershed Restoration circular No. 9. Ministry of Environment, Lands and Parks. Vancouver, BC.

[WFPB, 1995] Washington Forest Practices Board. 1995. Board Manual: Standard Methodology for Conducting Watershed Analysis.

Appendix A LWD Placement and Credit Calculation Worksheet

To receive LWD credit, a copy of this work sheet must be submitted as part of your Forest Practices application/notification.

STEP 1.
Determine Average Bankfull Width in the channel reach within the harvest unit for the fish-bearing stream. See board manual, Section 2. If there is more than one fish-bearing stream within a harvest unit, determine average bankfull width for each stream independently. Where multiple stream segments exist within one harvest unit, average BFW may need to be computed for each segment. **Average BFW ____**

STEP 2.
Determine minimum large woody debris (LWD) size. The minimum diameter for wood by finding the appropriate BFW on the following chart:

BFW (in feet)	Minimum Diameter
< 5	12 inch diameter
> 5 and < 16	16 inch diameter
>16 and < 32	22 inch diameter
> 32	26 inch diameter

Minimum Diameter: _____
Determine minimum length of placed bole 2 X BFW = _____
Determine minimum length of placed rootwad 1.5 X BFW = _____

STEP 3.
Select logs/trees for placement:
__ Are they conifer?
__ Do they have a solid core?
__ Do they meet minimum diameter?
__ Do they meet minimum length?
__ Can they be transported to the site without excessive disturbance? (See "Restrictions to Riparian Zone Disturbances")
__ Does site placement exceed in stream loading criteria ? (see "Logjams and Maximum Loading")

IF wood is being placed in Channel Configurations C or non-deciduous B, or placing wood to compensate for a basal area deficit due to a stream-adjacent parallel road, *skip to STEP 7.*
IF* wood is being placed in Channel Configurations A or Deciduous B, *go to STEP 4.

STEP 4.
Determine placement of logs and measure their widest diameter within bankfull width. In-channel rootwads are measured at a location equivalent dbh if it were standing (i.e., 4.5 feet from the ground). Tally diameters in table below to the nearest two-inch size category.

dbh	Tally	Number (add up tally)	Basal Area	Credit (Number X Basal Area)
12			.8	
14			1.1	
16			1.4	
18			1.8	
20			2.2	
22			2.6	
24			3.1	
26			3.7	
28			4.3	
30			4.9	
32			5.6	
34			6.3	
36			7.1	
38			7.9	
40			8.7	

SUM _____

STEP 5.
Compute Basal Area.
Multiply the "number" column with the "Basal Area" column, and record the number in the "credit" column. Sum the last column.
Multiply the (SUM) from Step 4 by the credit ratio to get basal area credit. The credit ratio is 2.0 for standard LWD placement and 1.0 for placement associated with a stream adjacent parallel road. (See Credit Ration above).

TOTAL BASAL AREA CREDIT _____

STEP 6.
Credit taken.

Where outer zone trees are to be harvested under 2:1 credit ratio, assume that all outer zone trees are 15 inches in diameter or a basal area of 1.23 sq feet.

Total number of trees available for harvest:
Total Basal Area Credit/1.23 = _____
(Round to the nearest whole number)

If the site is a Channel Configuration C, D, or non-deciduous B, credit trees may only be harvested from the adjacent harvest site. The total number of trees computed above may be harvested from the RMZ outer zone within the harvest unit, provided that a minimum of 10 TPA is retained in the outer zone.

If the site is a Channel Configuration A or Deciduous-dominated B, credit trees may be harvested from other sites. Keep track of the Basal Area Credit on the following worksheet. On each harvest site from which credit trees are harvested, record the FPA number, the number of outer zone trees taken, and complete the remaining balance of credit trees. Once again, a minimum of 10 TPA must be retained in the outer zone.

Copies of this credit sheet should be submitted with each FPA

FPA number	# trees harvested	Balance remaining

STEP 7.
The following steps reverse the sequence used in steps 4-6 because the landowner needs to determine how much LWD cross-sectional area is needed first. The landowner can then place the appropriate LWD cross-sectional area in the streams.

STEP 7A.
If you are placing wood in Channel Configurations C or non-deciduous B, then:

1. Determine **Length** of outer zone from field measurements.
2. Determine **Width** of outer zone. Use table in **WAC 222-30-021 (b)(I)** entitled Option 1: Thinning from below for western Washington. Use either tables in **WAC 222-30-022** for eastern Washington RMZs depending on the width of the stream.
3. Determine minimum **LWD cross sectional area** to achieve full LWD placement credit for the harvest site.
   Cross Sectional Area (sq ft) = Length * Width * 0.000141

For WESTERN WASHINGTON and High elevation habitats in EASTERN WASHINGTON it is (enter length and width):

Cross Sectional Area = _____ * _____ *** 0.000141**

For mixed conifer timber habitat types in EASTERN WASHINGTON:

Cross Sectional Area = _____ * _____ *** 0.000106**

For ponderosa pine timber habitat types in EASTERN WASHINGTON:

Cross Sectional Area = _____ * _____ *** 0.000076**

Cross Sectional Area = _____

[Computational Basis: Cross Sectional Area = *L * W * X * T * BA * CR*

Where L = length (feet)
W = width (feet)
X = Inverse sq ft per acre. Constant at 1/43560
T = allow harvest of outer zone trees per acre
(This is constant at 10, except in eastern Washington.)
BA = Basal Area. Outer zone trees are assumed to have 1.23 sq ft of basal area. Constant at 1.23
CR = Inverse Credit ratio. Constant at

*X*T*BA*CR = (1/43560)*10*1.23*( ) = 0.000141]*

STEP 7B.
If you are placing LWD to compensate for a basal area deficit as a result of a stream adjacent parallel road, determine the basal area deficient (Cross Sectional Area):

Cross Sectional Area Deficient = (required basal area) - (actual basal area)

Cross Sectional Area Deficient = _____ -_____ = _____

See **(WAC 222-30-021(1)(b)(iii))** for details in Western Washington and **(WAC 222-30-022(1)(b)(iv))** for details in Eastern Washington.

STEP 8.
Place wood meeting minimum size requirements as computed in STEP 2. Remember that the diameter is based on the widest section of the bole (trunk) within the banks. Once the Cross Sectional Area computed in STEP 7A or 7B above is reached, additional placement cannot receive additional credit.