NORTH FORK CALAWAH MASS WASTING MODULE
CAUSAL MECHANISM REPORT AND PRESCRIPTION

WAU: North Fork Calawah (200315)

Resource Sensitivity: Mass Wasting Hazard #1, MWMU #1 – Inner Gorges (Map K-2)

Landform Description:
Inner gorges in the North Fork Calawah WAU are formed by two distinctly different erosional processes. Along low gradient, fish-bearing channels, such as Devil's Creek, the inner gorge edges are formed by fluvial undercutting and downcutting. The inner gorge surface is >70% and can exceed 100% in places. Where the bedrock is particularly competent, such as it is in the tributaries north of the lower mainstem North Fork Calawah River, these inner gorges may have lower sidewalls of exposed and nearly vertical bedrock. The larger of these inner gorges, such as Devil's Creek, were delineated as GMU 90 in the original watershed analysis; smaller ones such as the unnamed tributaries north of the lower mainstem and west of Devil's Creek were included in the planar hillslope GMU (Map A-2).

The second type of inner gorge is incised into the steep hillslopes in the watershed and carries high gradient streams, >20%, to the valley floor. These are formed by repeated debris flows and were called "debris flow tracks" in the original watershed analysis; the larger ones were delineated as GMU 78 and the rest were included in the planar hillslope GMU. Where channels within the debris flow tracks are larger, near the valley floor, or flow across debris fans and glacial terraces on the valley floor, fluvial processes play more of a role and there is a transitional zone between the two types of inner gorge. With rare exception, hillslope inner gorges have one to many bedrock hollows within their headwater drainage.

Side slopes of the inner gorge landform are experiencing active erosion. The side slopes of the inner gorges formed by fluvial undercutting experience debris slides and slumps. The side slopes of the inner gorges formed by debris flows traveling down the channel are scoured, and then the oversteepened colluvium above the scoured edge may experience debris slides and slumps (which can evolve into debris flows). Both situations lead to the side slopes of the inner gorge landform being oversteepened and displaying historic failure scars. The top edge of the inner gorge is demarked by a break-in-slope created by the erosional activity on the side slopes of the inner gorge.

Delineation of hillslope inner gorges that are incised a few to approximately 20 feet into the extended hillslope is often as simple as delineating between the fall line of trees into the inner gorge and the fall line of trees on the extended hillslope. But if there has not been a historic debris flow within a hillslope inner gorge, delineation can be difficult because of the smooth and stable appearance of the side slopes and because of the convex nature of the upper break-in-slope; where this occurs, delineation can follow the subtle, convex break-in-slope which may be more distinct where historic failure scars occur. Where a historic debris flow has occurred, there may be two breaks-in-slope, one on the edge of the scoured portion of the side slope and a second one higher on the hillslope; where this occurs, the higher break-in-slope should be used for delineation. The larger inner gorges with low gradient channels may have a broad expanse of >70% hillslope above them, all within the fall line of the feature. Where this occurs, look for a break-in-slope, which can be either convex or concave in nature, between the upper planar or convex hillslope which does not have evidence of historic landslide processes and the side slopes of the inner gorge that do display evidence of historic landslide processes; where this occurs, the break-in-slope may be used to delineate the inner gorge.

Situation Summary:
Clearcut harvest, fires and roads have all been observed to increase the extent and frequency of mass wasting. Roads and harvest in MWMU #1 increase frequency and volume of landslides with direct

delivery to the habitat of salmonids and other aquatic species. Likely channel effects are filling of pools and bed aggradation as a result of coarse sediment inputs, and the infiltration of spawning gravels by fine sediments.

Triggering Mechanisms:
Loss of rooting strength by clearcut harvest or wildfire elevates landslide rates above levels observed in mature forests. Road-related triggers include focused water, undersized stream-crossing culverts and sidecast construction. These triggers cause twice as many landslides as loss of rooting strength.

Rule Call for Management Response:
Hazard: High

Vulnerability: Moderate and High

Rule Call: Prevent and Avoid

Prescriptions:
Harvest Prescriptions:
Except where an allowable exception is applied, there is no timber harvest within MWMU #1 if delivery to public resources is possible or a threat to public safety exists.

Allowable Exceptions:

1) Yarding Corridors (where full suspension over the timber rooted within MWMU #1 is not possible and some impacts to the timber may occur)
    a. Yarding corridors are not to exceed 30-feet in width and shall not be spaced closer than 150 feet where they cross the MWMU (see Figure 1).
    b. Yarding corridors must be placed so that they do not cross sensitive sites as defined in WAC 222-16-010 where these sensitive sites lie within MWMU #1.
    c. Full suspension is required over the MWMU. Best management practices such as 40-feet log lengths, mid-span supports and elevated tail holds will be used as necessary to achieve full suspension.
    d. Approximate yarding corridor locations where full suspension above the canopy of the MWMU is not possible will be provided to WADNR on a map. Yarding corridor profiles for those locations will also be provided.
    e. As mitigation, trees cut within the MWMU must be left on the ground. To the extent possible, these shall be felled side hill within the MWMU so that they may stop small debris slides and limit delivery of surface erosion.

2) Road Right-of-Ways
    a. Harvest and removal of trees within the MWMU are allowed for new road construction, including construction spatially coincident with orphaned roads. Harvest may extend to the estimated top of the cutslope as delineated by slope staking (see below), and may extend one more tree width where individual trees are deemed to be danger trees by the road builder. Harvest may extend 30-feet horizontal from the center line to either side in a ridgetop location or downhill in a midslope location to allow the road builder room to safely maneuver and to remove existing fill where it exists.

b. Right-of-way trees may not be decked within the MWMU between October 15th and March 15th. Each deck must be limited to 15 trees and must be removed from the MWMU at the end of the construction project or before October 15th, whichever comes first. If road construction spatially coincident with an existing road prism is occurring between October 15th and March 15th, the logs must be placed outside of the MWMU as road construction occurs.

Road Prescriptions, to be followed if delivery to public resources is possible or a threat to public safety exists:

1) The upper extent of the cutslope is to be slope staked within MWMU #1.

2) No waste areas or landings are to be placed within MWMU #1.

3) Sidecast:
   a. No sidecast may be permanently placed within MWMU #1. When blasting has the potential to sidecast irretrievable material into MWMU #1, then smaller and more controlled blasting efforts, with the use of blast mats, is required. The no sidecast requirement does not preclude the presence of temporary sidecast during the construction process nor the construction of stream-crossing fills, described below.
   b. New construction across MWMU #1shall be limited to the period of time from March 15th to October 15th except where road construction is spatially coincident with existing road prisms including orphaned roads. The use of a temporary sidecast prism shall be limited to the period of time from March 15th to October 15th. Any extension requires an FPA amendment.
   c. Outside of the approved seasonal window, the road segment must be fully constructed or stabilized. Fully constructed means that the culverts and cross-drain culverts specified in the FPA are in place, the ditches are functioning, and that the topping rock has been hauled in, smoothed and compacted. Stabilized means that the temporary sidecast must be completely removed either by endhaul or overhaul to a designated waste area or by placing it on the full-benched portion of the road prism in a manner that creates outsloped drainage, and waterbars must be installed on each side of MWMU #1 or every 50 feet within MWMU #1 if the road segment crossing the MWMU is longer than 100 feet.
   d. An FPA to construct new road that crosses one or more MWMU must specify construction segments such that each segment can be fully constructed (see above) before the next one is started, and the total length of construction crossing MWMU #1 and #2 is <700 feet in each segment.
   e. An FPA to construct road that crosses one or more MWMU must include a table that catalogs the road into discrete segments by road station. Each segment must have a landform designation such as planar or convex. If the segment is the crossing of a MWMU, the MWMU is the landform designation. The table must also include, for each segment, a gradient or gradient range, and a specific designation about sidecast. If the sidecast designation is "No sidecast" then whether or not a temporary sidecast prism is allowed during construction will also be specified in the table.

f. An FPA to construct either new road or road that is spatial coincident with an existing road prism must include a map of the road location that displays MWMU #1 within 200 feet of the road right-of-way.
g. As mitigation, during construction spatially coincident with existing road prisms including orphaned roads, sidecast pullback must be done within MWMU #1 wherever there is remaining sidecast. In some locations, there may be no remaining sidecast because of previous failures.

4) Cross-drain culverts:
   a. Wherever possible, cross-drain culverts should be placed on convex or planar surfaces outside of MWMU #1. No cross-drain outlets may be placed within MWMU #1 except in the following two situations and where these situations exist, the ditch length to these cross-drains must be minimized by another cross-drain:
      i. The road lies within MWMU #1 or a combination of MWMU #1 and another MWMU for a total, unbroken distance exceeding 200 feet; or
      ii. Construction spatially coincident with an orphaned road has a low point within the MWMU.
      iii. Where a cross-drain culvert must be placed within MWMU #1, this shall be noted on the table and map as described about in 3) d and e.
   b. Cross-drain culverts shall be spaced so that the length of ditch draining to each is less than 300 feet.
   c. Wherever a cross-drain culvert outlet is placed on a hillslope exceeding 40%, either a downspout (see below for definition) or a keyed energy dissipater (see below for definition) is required.

5) Stream-crossing culverts:
   a. Shall be sized as required by standard forest practices (WAC 222-24-040).
   b. Fish-passable culverts on Type F and Type S streams shall be designed and reviewed as required by standard forest practices (WAC 222-24).
   c. Non-fish-passable culverts shall be installed on the gradient of the stream without a flume or downspout up to 45%. Where the stream gradient is greater than 45%, the culvert shall be installed at no less than 45%, and then a flume, downspout or keyed energy dissipater will be required.
   d. The exception to b. is where the channel gradient at or below the road is less than the gradient above the road – where this occurs, the culvert is to be installed at the lower gradient or a gradient intermediate between the two gradients.
   e. Where the stream gradient is >25% and the inlet fill depth is <6 feet, the inlet and outlet walls are to be a minimum of 2 feet thick and built of interlocking, angular rock. The core of the fill may be built of shot or ripped rock (preferred but not required) or may be mineral soil that is compacted with a vibratory compactor in lifts of 1 foot. Key the outlet toe into native material.
   f. Where the stream gradient is >25% and the inlet fill depth is ≥6 feet, the entire fill is to be built of interlocking, angular rock. This material can be shot or ripped rock of assorted

sizes, and it is acceptable to bed the pipe with smaller materials to protect it. Key the outlet toe into native material.

g. Where debris flows may reach the stream crossing (see below in Justifications and Intents) and where the road grade permits, stream-crossing fills are to be elevational low points with respect to the adjacent road segments, such that a debris flow will transport across the road and not down the road surface. Where a steep road grade of or close to 12% adverse haul or 18% favorable haul is necessary to reach a control point and creating a low point is untenable, a relief pipe of at least 24 inches diameter is to be installed downhill of the site, either within 100 feet or on the next convex or planar hillslope. If another stream crossing culvert is within 100 feet, this can be considered the relief pipe.

Justification for and Intent of Prescriptions:
Justification for the prescriptions is provided in the section titled Testing the Prescriptions in Module K – 2015 Mass Wasting Prescription Reanalysis Level 2 of the North Fork Calawah Watershed Analysis (Dieu, 2015). Additional justification is provided below.

Inherent in the avoidance of harvest within this MWMU, except for the allowable exceptions, is the intent that other activities such as broadcast burning and aerial spraying are not conducted within the MWMU. Basic road maintenance including road-side herbicide application, where normally permitted by current forest practices rules and other applicable laws, and mechanical brushing are allowed.

It is the intent of the yarding corridor requirements for full suspension and 150-feet-spacing that: 1) A careful analysis of yarding is conducted by the landowner so these restrictions can be met; 2) The careful analysis can be provided to the WADNR if they ask for additional information; and 3) The FPA be submitted as a Class IV-S with a SEPA checklist and a geotechnical report where these restrictions cannot be met. It is also the intent of the yarding corridor requirements that, to the extent practicable, the corridors be perpendicular to the MWMU #1 feature.

It is the intent of this prescription that danger trees, as defined by Labor & Industries WAC, within MWMU #1 be felled within the MWMU and left on the ground.

It is the intent of this prescription that construction of an entirely new road prism within MWMU #1 is only permissible where no reasonable alternative exists. For example, the road location may have to cross MWMU #1 one or more times to get from the valley floor to the ridgetop, but then should thereafter remain on or near ridgetop without crossing MWMU #1 to access adjacent timber stands. Where MWMU #1 exists, the use of existing road prisms, including new construction of orphaned road prisms, is encouraged and is preferable to construction of entirely new road prisms.

Where MWMU #1 has an existing road prism and temporary sidecast is not necessary to the construction process, the seasonal prescription is not required. Construction of existing road prisms including orphaned road prisms has occurred during the winter months and landslides have not occurred for the simple reason that temporary sidecast has not been present.

The seasonal restriction dates have precedence in hydraulic code, and the occurrence of significant storms and/or shallow-rapid landslide initiation is very rare during this time frame. Significant rain is not expected after March 15th. During most years, fall freshets start on or very close to October 15th. On rare drought years, fall freshets wait until the first week of November and then are quite extreme events (e.g.,

2006 with all the damage at Mt. Rainier National Park). It may be possible to continue road construction for another 1-2 weeks after October 15th, but only with an amendment to the forest practices application.

It is the intent of the use of the word "downspout" that a full-round pipe be used to carry ditch water away from the outlet of a cross-drain culvert. As most cross-drain culverts are double-walled plastic pipes, the downspouts will most often be single-walled "flex" pipes. This specifically means that half-round drainage structures, formally called "flumes," are not to be used.

It is the intent of the use of the phrase "keyed energy dissipator" that the object (large rock or stump) or collection of objects (pile of smaller rocks) be keyed into the hillslope by excavating a small platform onto which the energy dissipator can be placed and remain secure.

WAC 222-24-042 (2) (a), *Culvert installation in Type Np and Ns Waters*, states that "All permanent culverts must be designed to pass the 100-year flood event with consideration for the passage of debris likely to be encountered." This portion of WAC 222-24-040 referenced above in the prescriptions is emphasized here as an important component of the standard forest practices rules about culvert sizing.

Where a stream-crossing is experiencing heavy sediment or debris loads or debris flows may reach the site, inlet designs that include one or more of miters, trash racks and launch slopes of 3:1 are recommended. Evidence of a heavy sediment or debris load is the presence of abundant, loose and clean rocks and wood in transport in the channel above the crossing. Debris flows may be expected to reach the stream crossing if bedrock hollows are present in the headwaters of the channel and if the channel gradient exceeds 20% for most or all of the distance down the hill to the stream crossing. These measures are not required prescriptions because failure of stream-crossing fills under the original North Fork Calawah Prescriptions and Standard Forest Practices has not been observed and because these best management practices appear to be less important with the over-sized culverts in use today.
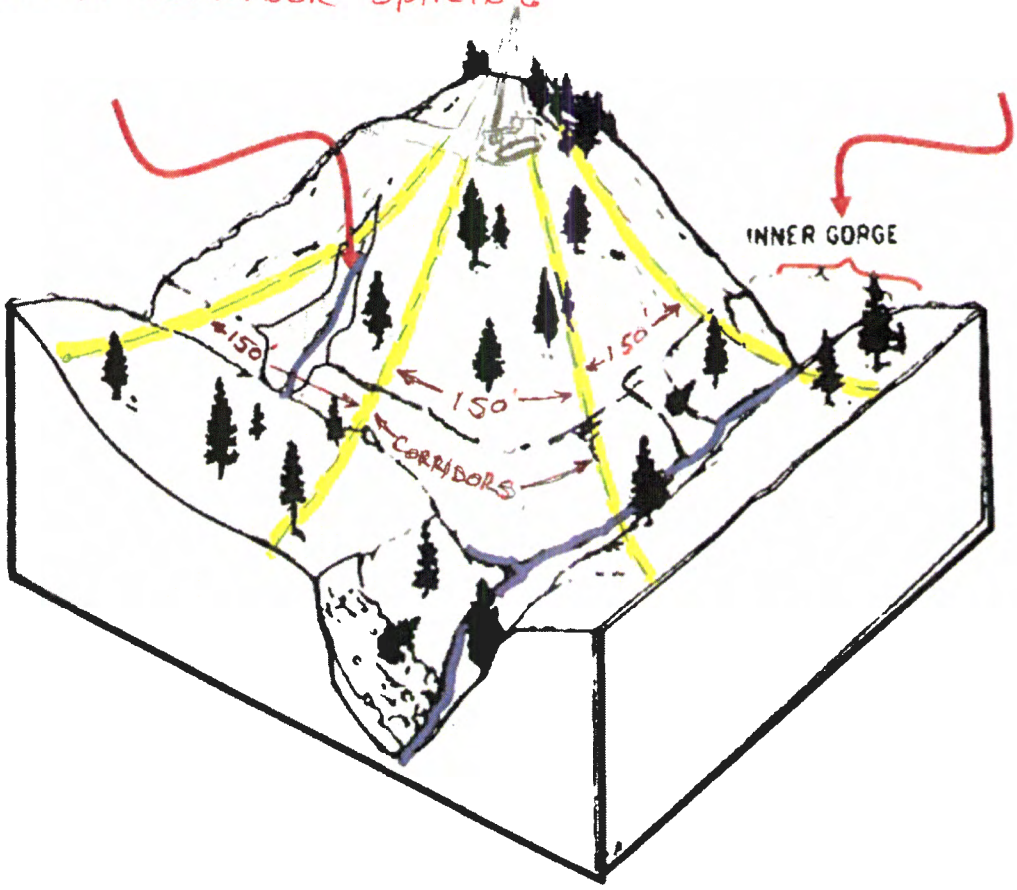
FIGURE 1: CORRIDOR SPACING