Wind River Habitat Restoration Strategy

SUBMITTED TO
Lower Columbia Fish Recovery Board

FEBRUARY 27, 2017

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Lower Columbia Fish Recovery Board
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PREPARED BY
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FEBRUARY 27, 2017

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1. Introduction and Background

1.1 OVERVIEW

This habitat restoration strategy is intended to guide aquatic habitat restoration activities for salmon and steelhead in the Wind River watershed. The strategy builds on previous work of the Lower Columbia Fish Recovery Board's (LCFRB) Salmon Recovery and Fish and Wildlife Subbasin Plan (Recovery Plan) (LCFRB 2010). The strategy identifies reach-specific habitat conditions and limiting factors, identifies site-specific restoration projects, and prioritizes those projects based on biological benefits, cost, and certainty of success.

The Wind River subbasin is the first major Columbia River tributary in Washington upstream of Bonneville Dam. The subbasin historically supported abundant fall Chinook, summer and winter steelhead, chum, and coho. These fish populations are components of Lower Columbia Evolutionarily Significant Units (ESUs) that have been listed as Threatened under the Endangered Species Act (ESA). In response to these ESA listings, the LCFRB developed the Recovery Plan, which encompasses the Wind River subbasin. The Recovery Plan describes fish population status, trends, and goals for recovery, and outlines limiting factors and key habitat priorities necessary for recovery. The nine Key Priorities identified in the Wind River subbasin are:

1. Reduce Passage Mortality at Bonneville Dam and Mitigate for Effects of Reservoir Inundation
2. Protect Intact Forests in Headwater Basins
3. Manage Forest Lands to Protect and Restore Watershed Processes
4. Manage Growth and Development to Protect Watershed Processes and Habitat Conditions
5. Restore Floodplain Function, Riparian Function and Stream Habitat Diversity
6. Evaluate and Address Passage Issues at Hemlock Dam and Lake and Other Barriers
7. Align Hatchery Priorities with Conservation Objectives
8. Manage Fishery Impacts so they do not Impede Progress Toward Recovery
9. Reduce Out-of-Subbasin Impacts so that the Benefits of In-Basin Actions can be Realized

This effort focusses primarily on #5 above. Other priorities are being addressed as part of other programs or regulations, or have already been conducted. Although the Recovery Plan outlines general limiting factors and priorities for habitat work, it does not define site-specific actions that will contribute to species recovery. This habitat restoration strategy defines those site-specific actions, and provides the technical basis for restoration projects to move forward in the Wind River subbasin. The strategy is based on a technical assessment that included synthesizing existing information, performing field surveys, and soliciting input from community stakeholders. The assessment identified a suite of potential projects and prioritized those using methods consistent with the LCFRB's regional Habitat Strategy. Two of the top-priority projects were further developed to the preliminary design stage; the documentation for these design projects has been compiled separately. Information provided in this report is intended to be used as a foundation for cooperative restoration implementation in the Wind River watershed for the benefit of fish and the local community. This habitat restoration strategy is incorporated into the LCFRB 6-year Habitat Work Schedule (LCFRB 2010).

1.2 WIND RIVER WORKGROUP

The Wind River subbasin has benefitted from many years of collaborative watershed research and restoration. In response to the ESA listing of fish species in the 1990s, several entities joined together to better understand the wild steelhead population of the Wind River and support its recovery. During this time a Bonneville Power Administration-funded steelhead restoration project was initiated to support the research, monitoring and restoration efforts of four partners: U.S. Geologic Survey Columbia River Research Laboratory (USGS), Washington Department of Fish and Wildlife (WDFW), U.S. Forest Service Gifford Pinchot National Forest (USFS), and Underwood Conservation District (UCD). As part of this effort, the Wind River Watershed Council was formed, which involved multiple community members and landowners as well as watershed professionals in the region. Other stakeholder planning efforts developed, including the Watershed Resource Inventory Area (WRIA 29 and WRIA 29A) planning processes and the South Gifford Pinchot Collaborative Group. Funding support for the watershed council ended, and over time the Wind River Watershed Council became inactive.

The initiation of this habitat restoration strategy provided an opportunity to form the Wind River Work Group (WRWG) in 2015. The partners involved in the WRWG include a variety of federal, state, tribal, and private interests. Thus far facilitated by the LCFRB, the WRWG provides a collaborative process that builds upon existing partnerships and encourages new relationships.

During the first few meetings, which are always open to the public, community interests and concerns were identified and defined in order to guide restoration priorities. The Vision and Goals of this group were formalized early in the process, and are described below, in Section 1.4.

Throughout the development of the habitat restoration strategy, WRWG members contributed significant input, especially with regard to existing publications and data in the watershed, the geographic scope, project and reach prioritization, and project design alternatives.

WRWG members include:

- Eli Asher, Cowlitz Indian Tribe
- Brian Bair, US Forest Service TEAMS Enterprise and Bair LLC
- Thomas Buehrens, Washington Department of Fish and Wildlife
- Jeanette Burkhardt, Yakama Nation Fisheries Program
- Stephanie Caballero, U.S. Forest Service Gifford Pinchot National Forest
- Lee Carlson, Yakama Nation Fisheries Program
- Bengt Coffin, U.S. Forest Service Gifford Pinchot National Forest
- Pat Connolly, U.S. Geological Survey Columbia River Research Laboratory

- Dan Gundersen, Wind River landowner
- Shiloh Halsey, Gifford Pinchot Task Force
- Bob Hamlin, Skamania County Commissioner
- Tom Hausmann, NOAA Fisheries
- Dave Howe, Washington Department of Fish and Wildlife
- Ian Jezorek, U.S. Geological Survey Columbia River Research Laboratory
- Amelia Johnson, Lower Columbia Fish Recovery Board (position previously held by Karen Adams)
- Sam Kolb, Washington Department of Fish and Wildlife
- Tom Linde, Wind River landowner and LCFRB Chair
- Steve Manlow, Lower Columbia Fish Recovery Board (position previously held by Jeff Breckel)
- Margaret Neuman, Mid-Columbia Fisheries Enhancement Group
- Jan Thomas, Underwood Conservation District
- Tova Tillinghast, Underwood Conservation District
- Nate Ulrich, Columbia Land Trust
- Del Wilson, Wind River landowner
- Larry Zeigenfuss, US Fish and Wildlife Service - Carson National Fish Hatchery

1.3 THE PUBLIC AS A PARTNER IN RESTORATION

This habitat restoration strategy is not a regulatory document and does not require compliance or implementation from any entity or individual. Instead, it relies solely on the willing cooperation and support of public jurisdictions, private landowners, local interest groups, and the community within the subbasin. In addition, public and stakeholder involvement strengthens the implementation and long-term stewardship of restoration efforts. While the WRWG provides one forum for engaging the public on the habitat restoration plan and specific projects, there have been several additional efforts to reach out to the community. Regular WRWG public meetings were held in Carson, Stevenson, and Hemlock, with two additional web-based meetings. The meeting dates are listed below:

September 16, 2015
October 20, 2015
November 17, 2015
December 16, 2015
January 19, 2016
February 16, 2016
March 15, 2016
April 19, 2016
May 17, 2016
June 21, 2016 - public workshop at USFS Training Center in Hemlock
August 16, 2016
September 20, 2016 - public workshop at USFS Training Center in Hemlock
October 18, 2016
December 19, 2016 - via web
January 17, 2017 - via web
February 21, 2017 – via web (pending)

At its December 16, 2015 meeting, the WRWG finalized an outreach plan for this effort, shown in Appendix A. The objectives of the outreach plan are:

1. Listen to better understand community interests and concerns;

2. Inform the public on how well things have worked so far, current activities, and how the habitat strategy development is voluntary and non-regulatory; and
3. Develop partnerships to obtain community and landowner support for doing projects.

Additional public outreach efforts included press releases to the Skamania Pioneer newspaper, meeting with the Stabler Community Council, posting up-to-date information on the LCFRB and UCD websites and other social media, and holding informational interviews with community leaders. Individual letters and requests for permission were sent to private landowners adjacent to waterways within the geographic scope to allow for the field data gathering. Numerous individual conversations followed the landowner outreach so as to further develop specific habitat projects. Projects that are located on private land have only been moved forward into the design phase with landowner consent, and it will be necessary for project sponsors to secure landowner permission prior to seeking implementation funding.

1.4 VISION AND GOALS

The following Vision and Goals for the Wind River Restoration Strategy Development were discussed, revised and agreed upon at two Wind River Work Group meetings on Nov. 17, 2015 and Dec. 16, 2015.

1.4.1 Vision

Create a restoration strategy that maintains and improves fish habitat and habitat-forming processes while maintaining support of community values

1.4.2 Goals

- Sustain and restore water quality, water quantity, and watershed function
- Restore and enhance fish habitat and habitat-forming processes with an emphasis on wild steelhead
- Recommend monitoring and evaluation efforts to assess achievements toward these goals. Communicate findings to stakeholders.
- Incorporate local input and knowledge to inform watershed enhancement activities
- Promote the vision and goals of the Wind River strategy through community involvement and outreach
- Respect the local culture, economic interests, property rights, and other community values.

1.5 GEOGRAPHIC SCOPE

The proposed study segments were determined through input from members of the Wind River Work Group and additional staff from the WA Dept of Fish & Wildlife. Various factors were considered in determining the study segments, including the importance of the reach for fish, the potential for meaningful restoration, and whether or not streams were part of recent US Forest Service restoration planning efforts. These considerations led to the first cut at a prioritization of the stream segments by the WRWG. The final selected stream segments were further filtered based on where landowner permissions were obtained, access considerations, and achieving a target of 20 total survey miles. Figure 1 shows the final geographic scope of the survey effort, with the Trout and Trapper Creek Basins highlighted as being part of recent USFS restoration planning efforts (public lands only). Table 1 lists the study segments and includes the evaluation results and rationale for selection.

The final geographic scope for this study incorporated 20.5 stream miles, and included portions of the Little Wind River, Lower Trout Creek, Paradise Creek, Middle Wind (Stabler to Hatchery), Upper Wind (Above the Hatchery), and Dry Creek.

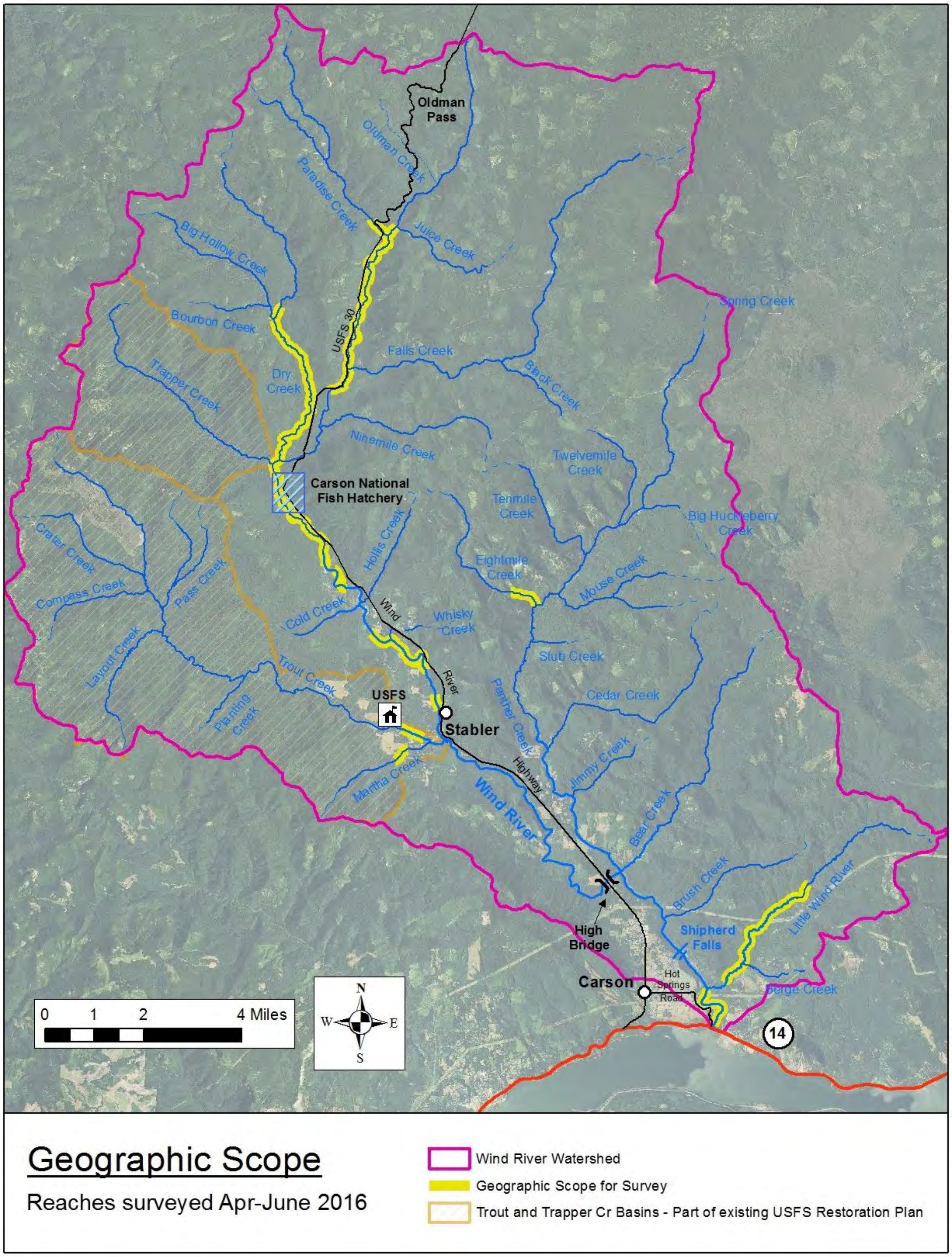

Figure 1. Map of geographic scope of reaches included in the assessment.

Table 1. Selection of stream segments for geographic scope of the survey and project identification effort.

Stream or Segment	WRWG Rank October 20th	WDFW Rank of top 22 miles	Total Anad. Miles	LCFRB Tier	USFS Land? (Y/N)	Covered in USFS Restoration Plan? (Y/N)	Inclusion in Survey Scope? (Y/N)	Final Survey Miles	Notes
Little Wind	H	3	3.1	1	Y&N	N	Y	3.1	Lower 0.5 mile already treated
Eightmile	H	6	1.5	not tiered	Y	N	Y	0.6	Includes first 0.6 miles affected by recent harvest. Upper portion in good shape and challenging access
Layout	H	4	3	4	Y	Y	N		Already covered in USFS Restoration Plan
Upper Trout	H	2	7	4	Y	Y	N		Already covered in USFS Restoration Plan
Lower Trout (PCT to the mouth)	H	M	4.3	1,4,2	Y&N	Y&N	Y	0.8	Martha to FS bdry. Lower Canyon not included. Remainder already covered in USFS Restoration Plan
Lower Trapper (Lower 2 Miles)	H	5	2	4	Y	Y	N		Already covered in USFS Restoration Plan
Paradise	H	L	2.4	4	Y	N	Y	0.5	Includes lower portion along road and campground. Upper portion in good shape.
Hollis	H	L	1.2	not tiered	Y	N	N		Barrier culvert at WR Hwy 0.2 mi up. 1.2 mi to a barrier falls. Surveyed by UCD 2015. Access challenges.
Cold	H	L	0.1	not tiered	N	N	N		No landowner permissions
Middle Wind (Stabler to Hatchery)	H	1	7.2	2,4	Y&N	N	Y	4.6	Included where landowner permissions allowed.
Martha Creek	H	M	2.1	2	Y&N	Y&N	Y	0.3	Includes lower private portion where permissions granted. Upstream covered in USFS Restoration Plan
Upper Wind (Above Hatchery)	H	M	10.6	1,2,4	Y	N	Y	5.4	Includes hatchery to Dry Cr; along WR Hwy dwnstrm of Falls Cr; Mining Reach; along Paradise CG
Cedar	M	M	2	4	Y&N	N	N		Not included. Not high priority from either ranking
Trout (Canyon)	M	L	2	2	Y	Y	N		Already covered in USFS Restoration Plan
Lower Planting	M	L	1.5	not tiered	Y	Y	N		Already covered in USFS Restoration Plan
Crater	M	7	1.6	4	Y	Y	N		Already covered in USFS Restoration Plan
Cannavina/Whiskey (lower 0.5 mi of each)	M	M	1	not tiered	N	N	N		Not included. Not high priority from either ranking
Lower Wind (Below Shipherd)	M	M	3	2	Y&N	N	Y	1.2	Includes lower 1.2 miles (Little Wind to Hwy 14) based on discussion at Dec 16 2015 WRWG meeting
Panther	L	L	11.4	1,2,4	Y&N	N	N		Not included. Not high priority from either ranking
Compass	L	M	2.1	4	Y	Y	N		Already covered in USFS Restoration Plan
Pass	L	L	1.7	not tiered	Y	Y	N		Not included. Not high priority from either ranking
EF Trout	L	L	1.1	4	Y	Y	N		Not included. Not high priority from either ranking
Dry	L	8	4.7	4	Y	N	Y	4.0	Mouth to road crossing/culvert (above Big Hollow)
Ninemile	L	L	2.3	4	Y	N	N		Not included. Not high priority from either ranking
Lower Oldman	L	L	0.5	not tiered	Y	N	N		Not included. Not high priority from either ranking
Lower Youngman	L	L	0.3	not tiered	Y	N	N		Not included. Not high priority from either ranking
Canyon Reach Wind	L	L	6.3	1	Y&N	N	N		Not included. Not high priority from either ranking for restoration. However, preservation value acknowledged.
Falls Creek	L	L	1.7	4	Y	N	N		Not included. Not high priority from either ranking
						Total survey mileage		**20.5**	

2. Watershed Conditions

This section provides an overview of the geomorphology, hydrology, and habitat condition of the Wind River, Skamania County, Washington. Ecologic processes are integrated with the geomorphologic and hydrologic assessment for a holistic understanding of the historic, current, and potential functioning condition of the study site. Conditions and trends are evaluated herein to identify, prioritize, and develop various restoration projects throughout the Wind River watershed. To complete this assessment, existing datasets and studies were analyzed and field work surveys were performed by Inter-Fluve, Inc., (IFI) and Underwood Conservation District (UCD) staff. An emphasis was placed on identifying site-specific aquatic habitat and geomorphic conditions in order to inform the identification and prioritization of potential habitat restoration actions.

The purpose of this assessment is to document and evaluate geomorphic processes, hydrologic processes, and aquatic and riparian habitat conditions in the Wind River watershed and to present a comprehensive restoration strategy.

2.1 GEOLOGY

The Wind River subbasin occupies about 224 mi^2 within the south-central portion of the South Cascades geologic province. The province is a complex mosaic of terranes, dominated by extrusive volcanics, resulting from approximately 40 million years of volcanism within the Cascade Volcanic Arc (WADNR 2015). Modern topography and hydrography is influenced by the location and orientation of faults and folds in the Wind River subbasin (Czajkowski et al. 2014). The surficial geology of the Wind River subbasin include intrusive and extrusive volcanics, marine and riverine sedimentary rocks, and unconsolidated alluvium and colluvium (Figure 2).

During the lower Eocene, subduction of basaltic Farallon lithosphere beneath the North American continent formed extensive accretionary terranes in modern-day western Washington and Oregon (Wells et al. 2014). Volcanism associated with the subduction of this material extruded primarily mafic lavas, such as basalt, during this early period of Cascade volcanism (WADNR 2015). Ongoing subduction continued to drive regional volcanic activity throughout the Oligocene, depositing alternating layers of lava, ash, and volcaniclastic rocks. The Ohanapecosh Formation, composed of andesite lava flows, tuff-breccias, and debris-flow tuffs, covers a large portion of the Wind River basin and was deposited approximately 35 to 29 million years ago (Berri and Korosec 1983).

During the middle Miocene, flood basalts sourced from the Columbia Plateau flowed across the southeast portion of the Wind River subbasin. The majority of extruded material during these episodes occurred between 17 and 14 million years ago (Tolan et al. 2009). Noteworthy flood basalt members traversing the lower Wind River subbasin include the Grande Ronde (15.6 million years ago), Frenchman Springs (15.3 myo), Priest Rapids (15 myo), Asotin (13 myo), and Pomona (12 myo; WADNR 2015). Two additional andesite flows erupted through the Ohanapecosh Formation during this period in the vicinity of Big Butte, Warren Ridge, and Stevenson Ridge. Numerous additional basaltic and andesitic dikes were emplaced throughout the lower Wind River subbasin during this period (Czajkowski et al. 2014). Regional tectonism during the period concurrent and immediately prior to the eruption of the Columbia Flood Basalt Group resulted in folding, faulting, and tilting of Eocene and Oligocene deposits of the South Cascades province, as well as older units of flood basalts (Berri and Korosec 1984).

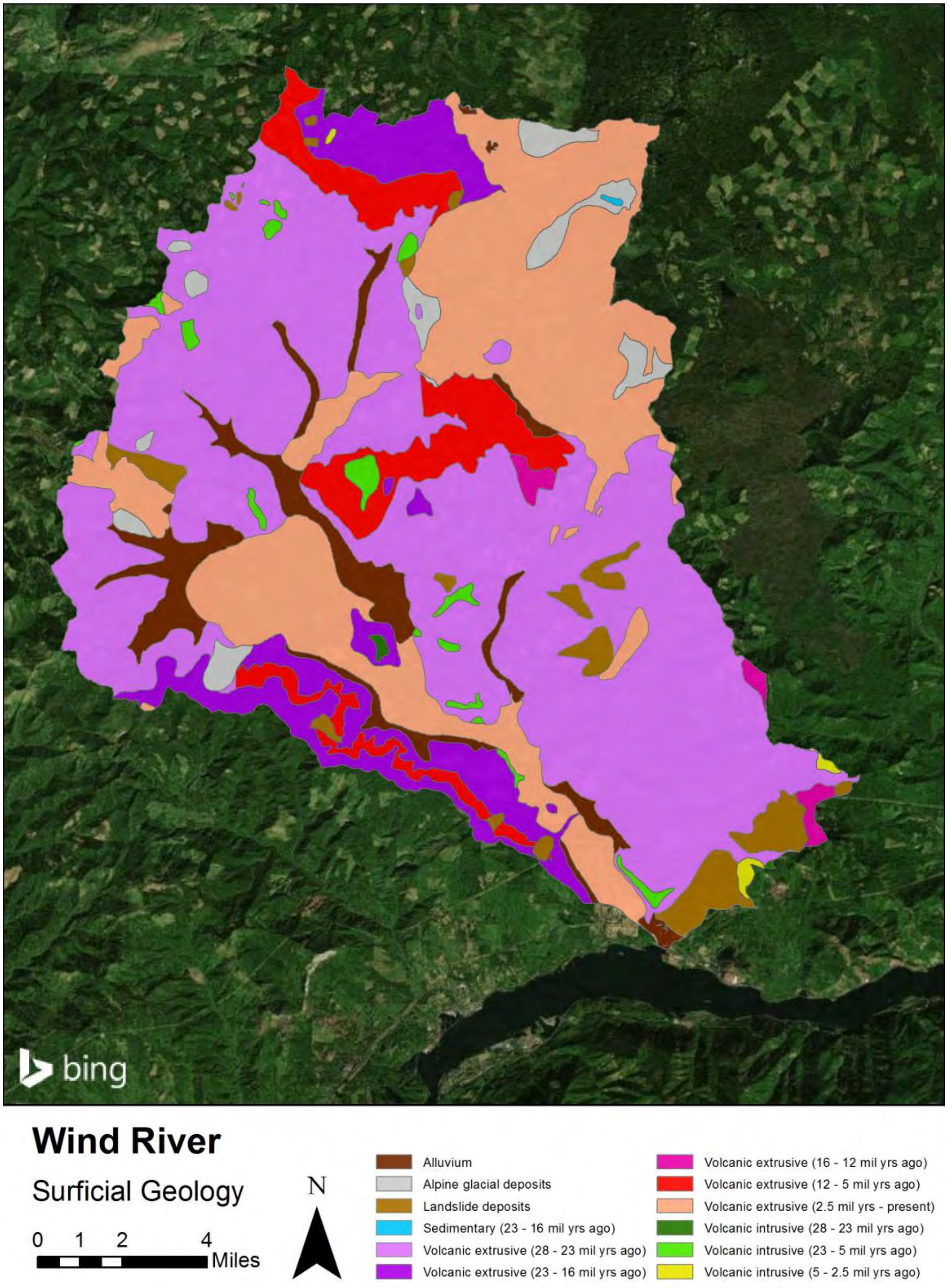

Figure 2: Surficial geology of the Wind RiverBasin study area with approximate age of origin.

Local volcanism accelerated during the Pliocene and Quaternary periods, dominated by mafic basalt eruptions from numerous centers (Berri and Korosec 1984). Eruptive centers within or near to the Wind River subasin include Trout Creek Hill, Cedar Creek, and the various cones of the Indian Heaven plateau. The eruption of the Trout Creek Hill volcano sent basalt down-valley to the Columbia River (Czajkowski et al. 2014). Ash and tuff deposits from regional andesitic stratovolcanoes, including Mount Hood, Mount St. Helens, and Mount Rainier, are present within the Wind River subbasin. Hypabyssal intrusives of late Oligocene to Pliocene age are present throughout the Wind River subbasin. Diorite and intrusive andesite in the Trapper Creek watershed are members of the Miocene Silver Star Pluton. Gabbro is evident in the vicinity of Bunker Hill and Warren Ridge. Tertiary and Pliocene quartz diorite plutons are present in the lower Wind River valley, with Wind Mountain being the most prominent example.

Analysis of geothermal resource potential in the lower Wind River Valley identified a series of northeast-trending faults of Pliocene to Quaternary age, including the Bear Creek, Brush Creek, and Little Wind River faults (Czajkowski et al. 2014). Evidence of tectonic shear was observed in the vicinity of the Brush Creek confluence with the Wind River. The St. Martins and Shipherd's hot springs occur between the Little Wind River and Brush Creek faults, and lie within the proposed Shipherd Fault Zone. This deformation episode represents a combination of crustal response to subsurface intrusion and regional tectonic forces. The combined effects of faulting and folding, bedrock stratigraphy, weathering patterns, and sporadic large earthquakes render the Wind River subbasin prone to extensive landsliding. A significant portion of the watershed is composed of alluvium/colluvium landslide deposits (Figure 2).

2.2 GEOMORPHOLOGY

2.2.1 Valley Geomorphology

The Wind River valley rests within the high-relief mountainous landscape of the western Cascade Range. Elevation within the basin ranges from 80 feet at the confluence with the Columbia River to 5,366 feet at Gifford Peak. The contemporary aspect of the valley is governed by regional fault zones that have imposed both hydrographic and topographic influences on the drainage basin for millennia. The main valley (downstream from the Trapper Creek confluence) trends northwest to southeast, reflecting the direction of the dominant regional tectonic forces and running parallel to Miocene-age faults and folds. Younger faults in the lower basin run southwest to northeast, including those occupied by Bear Creek, Brush Creek, and the Little Wind River. The Wind River – Bear Creek confluence occurs along one of these faults. The steep, timbered drainages of the Wind River basin are the result of fluvial incision, due to the watershed's relatively low elevation and occurrence within the rain-on-snow climatic zone. However, small alpine glaciers were present during the most recent ice ages, between 20,000 and 9.500 years ago (late Pleistocene to early Holocene). Multiple locations within the headwaters and tributaries of the Wind River valley were formed or influenced by glacial processes, creating small cirques and deposits of glacial drift. Glacial landscape features are most prevalent in the vicinity of Mowich Butte, West Crater, Soda Peaks, and the Indian Heaven plateau.

In the Cascade Range, retreating continental and alpine glaciers at the close of the last ice age resulted in increased discharge and sediment loads to mountainous river systems. This resulted in deposition of glacial outwash deposits along valley bottoms throughout the range. As glaciation in the Wind River subbasin was limited to small alpine ice bodies, and corresponding outwash deposits are only visible in the present day towards the headwaters of the Wind River and its tributaries (Figure 2). Glacial outwash likely traversed beyond the headwaters but became obscured by Quaternary alluvial fill in the vicinity of the Trout Creek Hill Volcano (TCHV). The TCHV erupted approximately 340,000 years ago, sourcing basalt flows that progressed through the lower Wind River Valley and into the Columbia River (Berri and Korosec 1984). The basalt infilling of the Wind River Valley resulted in locally changed base levels for the upper Wind River and its tributaries, causing gravel and sand deposition. These deposits are still visible in the upper reaches of Trout Creek (west of the TCHV) and in the Wind River valley near the Carson Fish Hatchery. As incision progressed through the newly-deposited basalt, further alluvial deposits were stranded as terraces along Panther, Bear, and other tributaries entering the Wind River from the east (Berri and Korosec 1984).

The geomorphology of the modern Wind River Valley is dictated by patterns of regional volcanism and superimposed on by modern discharge and sediment regimes. While glacial influences in the basin are limited to small cirques and outwash deposits at higher elevations, increased discharge and sediment supply corresponding to alpine glacier retreat resulted at the end of the last ice age (~10,000 years ago). Upstream of Stabler (~RM 11.5), the Wind River occupies an alluvial floodplain forced by the valley filling behind TCHV basalt. Much of the sediment transported during glacial retreat and more recent time contributed to the alluvial fill here and west of Trout Creek Hill, an area known as "Trout Creek Flats". Sediment delivered from adjacent hillslopes and tributaries is deposited on the valley floor, which varies from 0.3 to 1.5 miles wide. Quaternary basalt and andesite filled the valley between the Dry Creek (RM 19) and Falls Creek (RM 22) confluences and forced a wider valley bottom with incising bedrock channels. Downstream of Stabler, the valley narrows as the Wind River incises into TCHV basalt infilling. Various tributaries of the lower Wind River incise into THCV basalt along existing faults (e.g. Bear Creek, Brush Creek, and the Little Wind River). Landslide and debris flow deposits in the lower valley tend to strand along the valley toes at the margins of TCHV fill and isolated from the Wind River itself. This is different from the upper valley, where the river is able to move across a wider lateral area to incorporate recent deposits from hillslopes.

Landsliding is a common and significant disturbance event in the Wind River subbasin, due to the combined influences of climate, geology, and land-use history in the watershed. While undercutting of hillslope deposits is a significant driver of landslides in the watershed, locations underlain by Miocene-age and older volcaniclastics are especially at-risk, being tilted and prone to weathering into silts and clays (Rawding 2000). Glacial outburst flooding and corresponding alluvial deposits in the lower watershed are also prone to failure. Though relatively uncommon compared to drier areas of the Cascade Range, wildfire serves as a geomorphic agent in the basin and promotes mass-wasting via vegetative removal. The Wind River Valley was partially burned by the Siouxan and Yacolt Burns of 1902.

2.2.2 Channel Geomorphology

The Wind River is unregulated and influenced by the geologic history described previously. The modern channel occupies an alluvial valley floor and is inset beneath landslide deposits, alluvial fans, and gravel terraces corresponding to glacial retreat. As discharge and sediment flux reduced with warming climate during the Holocene, the glacial outwash deposits were incised into and stranded along the valley margins in the upper portion of the watershed. This is a classic example of Schumm et al.'s channel evolution process (1986), where incision follows alterations to discharge and sediment regimes and forms a new inset, active floodplain within the abandoned terraces. This evolutionary track is not visible in the bedrock-confined lower Wind River, though some terraces are visible there as well. These deposits are the result of adjusted base levels and forced deposition of tributary sediment following the eruption of the TCHV. As the river incised through the TCHV basalts these deposits were stranded along Panther Creek and other eastern tributaries of the lower Wind River (Berri and Korosec 1984).

Trends in basin hydrology and sediment supply in the last 150 years have been dominated by anthropogenic activity on the landscape. Vegetation clearing, road and bridge building, log rafting, and other logging-related activities have resulted in increased sediment supplied to the mainstem Wind River and its tributaries. This was the dominant historical economic activity in the basin, occurring throughout lands managed by federal (89% of basin area), state (2%), and private timber groups (6%; Rawding, 2000). Despite a reduction in timber extraction in recent decades, the legacy of large-scale logging persists – approximately 20% of the Wind River subbasin is categorized as containing early-seral vegetative cover (LCFRB 2010) and logging continues within the middle and upper portions of the basin. A gold mine is present downstream of the Paradise Creek confluence at approximately RM 24. These activities are correlated with accelerated soil erosion and reduced stability on hillslopes, as well as increased turbidity and reduced channel stability in the channel itself. In the lower Wind River Valley, bank armoring and water withdrawal associated with urban development at Carson (RM 2) and Stabler (RM 7) affect flow timing, discharge, and temperature as well as the ability of the Wind River to laterally migrate across its floodplain.

Sediment is presently contributed to the channel from tributaries, mass-wasting processes, near-channel banks, and hillslopes. Tributaries in the basin are highly connected to adjacent hillslopes and prone to flashy discharges following rain-on-snow events, spring snowmelt, and fall storms. Large-scale development of logging roads and systematic vegetation removal in the basin has increased the sediment load within these tributaries. The width of the Wind River valley precludes direct incorporation of alluvial deposits at valley toes, especially where the river is laterally confined by bedrock canyons. Where it exists, floodplain surfaces act as both source and sink for sediment progressing through the system. Activation typically occurs through overbank scour, lateral bank erosion, channel avulsion, and side-channel reactivation. During high flow events, additional sediment is sourced from the channel bed. There are significant point-sources of sediment within the watershed as well, including the Wind River Mine (RM 24), recent landslide deposits on the lower Wind River and Little Wind River, and a highly-erosive gully created by runoff from golf course in Carson (RM 1; LCFRB 2010).

Excessive sedimentation of the Wind River Subbasin due to forestry practices has caused concerns related to bank stability by federal and state land agencies. A majority of surveyed streams in the basin have above-average to excessive in-stream sediment levels, with Dry Creek, Youngman Creek, and the upper Wind River having the highest percentages of fines (LCFRB 2010). High width-to-depth ratios have been documented in the middle Wind (RM 12-19), Eightmile Creek, and Cedar Creek (LCFRB 2010). This section resides in alluvial fill behind TCHV basalts and experiences rapid channel migration and avulsions during high flow events. Bank stability concerns have also surfaced in the Trout Creek watershed, to the west of the middle and lower Wind River. Incision through valley-filling alluvium has resulted in weakened banks and overall unstable channels.

Little information exists regarding floodplain connectivity and riparian condition within the Wind River basin. Large trees in the riparian zone comprise about 33% of surveyed areas (LCFRB 2010), and past removal of mature riparian vegetation has contributed to the overall lack of large woody debris observed in the fluvial system. Floodplain connectivity is noticeably impinged by FS 30, the Carson Fish Hatchery, and various residential developments in the middle Wind River.

2.3 HYDROLOGY

The Wind River is a 5th order stream emptying into the Columbia River at RM 154.5 near Carson, WA. The river is approximately 31 mi. long, and the basin drains approximately 225 sq. mi. The maritime climate produces cool, wet winters and hot, dry summers. The basin has a mean annual precipitation of 110 inches, with the highest precipitation occurring between November and April, and summer months having very little precipitation (LCFRB 2010).

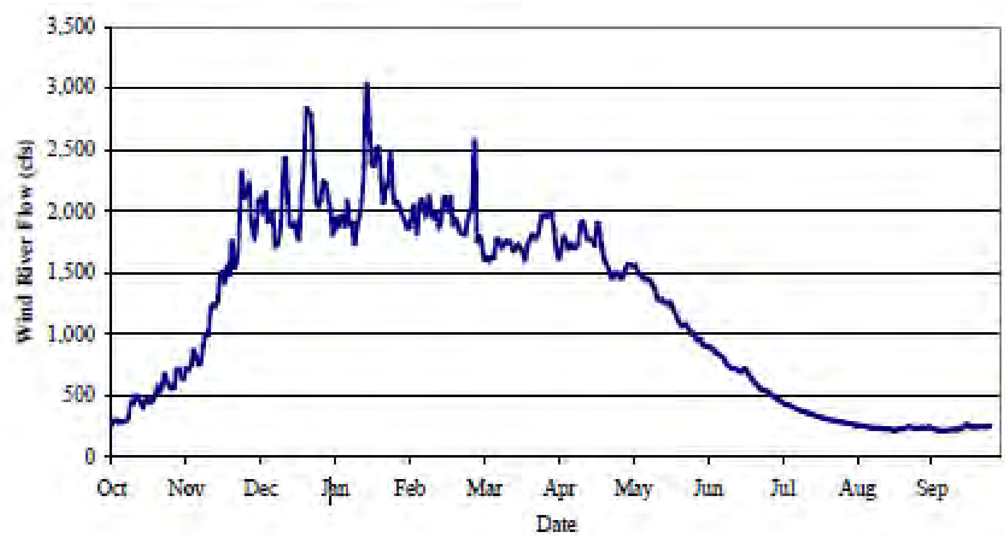

Figure 3. Wind River hydrograph (1934-1980), source LCFRB 2010. Peak flows occur in the winter and spring months, with the lowest flows occurring in August and September.

Mean flows range from 236 cfs in the late summer months to 2,168 cfs in the winter months (USFS 2001). The general pattern of the annual hydrograph is depicted in Figure 3. Summer flows are driven primarily by groundwater and snowmelt, and several tributaries (Martha Creek, Dry Creek, and portions of Trout Creek) regularly go subsurface in the summer months. Winter flows are primarily precipitation driven; with rain and rain-on-snow events creating peak flows. Areas of early-seral vegetation, combined with moderate-to-high road densities are also believed to affect peak flow timing and magnitude (LCFRB 2010). The peak flow of record occurred in February 1996, when flows reached an estimated 53,600 cfs. The 1996 event was estimated by the US Geological Survey (USGS) to be a 125-year event (USFS 2001).

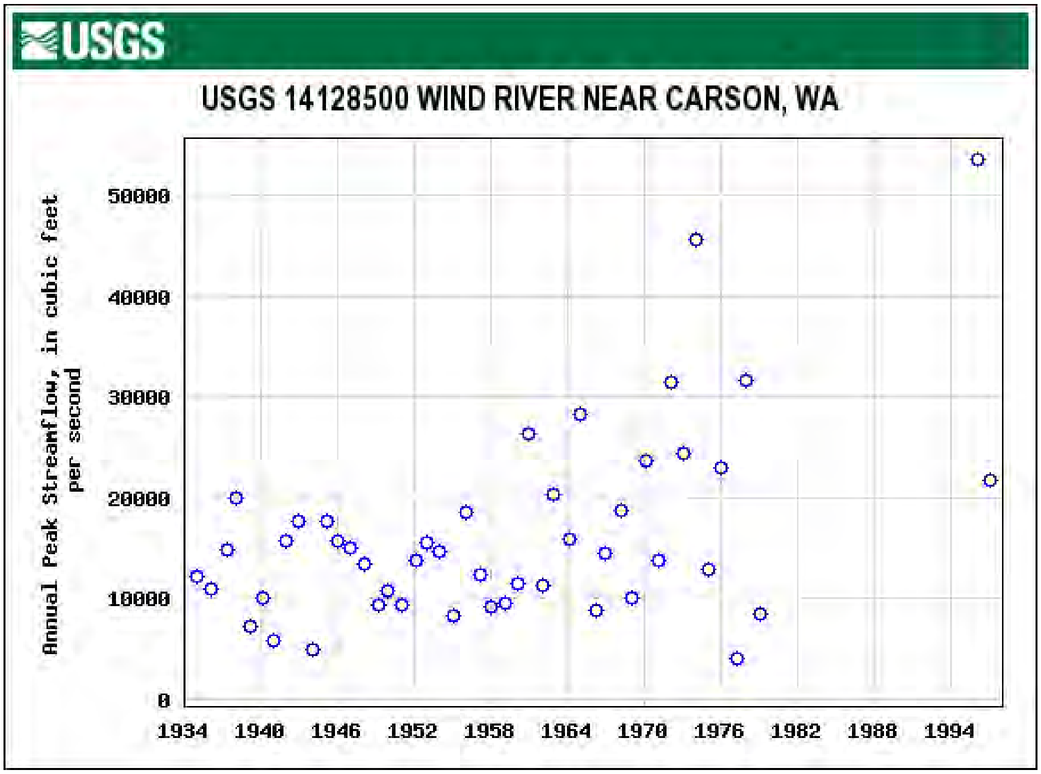

Figure 4. Annual peak flows from 1934 through 1997. The rain-on-snow event in February 1996 triggered peak flows of more than 50,000 cfs.

2.4 RIPARIAN CONDITIONS

Riparian conditions vary throughout the Wind River subbasin, but show a general trend of moderately impaired to impaired conditions (LCFRB 2010). Past timber harvest practices as well as residential, agricultural, and transportation corridors have all impacted riparian forests in the watershed (LCFRB 2010). These land-uses have led to reduced stream canopy cover, reduced bank stability, and reduced wood recruitment – all identified in the Wind River basin as habitat limiting factors (LCFRB 2015). Reaches with the highest level of impairment are the upper middle Wind and lower and middle Trout Creek (LCFRB 2010).

3. Fish Populations and Limiting Factors

3.1 FOCAL FISH POPULATIONS

Focal fish populations in the Wind River subbasin include summer and winter steelhead, and fall Chinook, chum, and coho salmon. Current population numbers for these focal species fall well below historical levels, and all are listed under the ESA as Threatened. It is estimated that between 30 - 90% of historical fish habitat has been lost (LCFRB 2015). Historical timber harvest practices, hydropower infrastructure, and rural development have all contributed to the loss of fish habitat in the subbasin.

Summer steelhead have the largest distribution of the focal species and are found throughout the subbasin, both in the mainstem and tributaries. Winter steelhead are distributed throughout the lower mainstem and in lower Trout Creek. Coho are primarily found in the Little Wind River, and in the mainstem below Shipherd Falls. Fall Chinook are distributed as far upstream as the Carson National Fish Hatchery (NFH), but are primarily found in the mainstem below Shipherd Falls and in the Little Wind River. Chum distribution is unknown; potential spawning habitat exists in the Wind River below Shipherd Falls and in the Little Wind River (LCFRB 2010), but numbers are believed to be very low. Table 2 shows current and historical abundance of focal salmon and steelhead populations.

Table 2. Status of focal salmonid and steelhead populations in the Wind River subbasin (reproduced from LCFRB 2010).

Species	Population	Recovery priority[1]	Viability		Improve-ment[4]	Abundance		
			Status[2]	Obj.[3]		Historic[5]	Current[6]	Target[7]
Fall Chinook (Tule)	Upper Gorge	Contributing	VL	M	>500%	n/a[8]	<50	1,200
Chum	Upper Gorge	Contributing	VL	M	>500%	11,000	<50	900
Winter Steelhead	Upper Gorge	Stabilizing	L	L	0%[9]	n/a[8]	200	200
Summer Steelhead	Wind	Primary	H	VH	0%[9]	n/a[8]	1,000	1,000
Coho	Upper Gorge	Primary	VL	H	400%	n/a[8]	<50	1,900

[1] Primary, Contributing, and Stabilizing designations reflect the relative contribution of a population to major population group recovery goals.
[2] Baseline viability is based on Technical Recovery Team viability rating approach.
[3] Viability objective is based on the scenario contribution.
[4] Improvement is the relative increase in population production required to reach the prescribed viability goal
[5] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NMFS back-of-envelope calculations.
[6] Approximate current annual range in number of naturally-produced fish returning to the watershed.
[7] Abundance target were estimated by population viability simulations based on viability goals.
[8] Historical abundance and recovery goal information is not available at this time due to a lack of information regarding population dynamics.
[9] Improvement increments are based on abundance and productivity, however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

3.2 FISH LIFE HISTORY AND USE

3.2.1 Steelhead

Winter steelhead are found in low numbers throughout the mainstem Wind River below RM11, in Trout Creek, and in the Little Wind River. Historically, winter steelhead were limited in distribution by Shipherd falls; however, the addition of a fish ladder there in 1956 allowed passage, and winter steelhead spawning is now observed as far upstream as the Carson NFH at RM 11. Winter steelhead return to the Wind River subbasin between December and April, and spawning occurs between March and early June. Fry emerge between March and May. Juveniles rear for 1-2 years, emigrating between April and May, with a peak in early May (LCFRB 2010).

Summer steelhead are distributed throughout the basin, in the mainstem and tributaries. Historically, they were the only salmonid species found above Shipherd Falls. Summer steelhead return to the Wind River from May through November, with spawning occurring early March through May. Fry emerge between April and May. Juveniles rear for 1-2 years, emigrating between April and May, with a peak in early May (LCFRB 2010). The majority of Wind River juveniles spend one year in their natal stream before moving down the mainstem to the canyon reaches, where they will rear for another year before emigrating. Alternatively, some juveniles spend several years in their natal streams, with no stop in the canyon reaches as they emigrate (personal communication with WRWG members 2016).

The Mining Reach (Falls Creek to Paradise Creek) has higher numbers of rearing juveniles as compared to the middle reaches (Carson NFH to Stabler Bend). This is presumed to be due to higher habitat complexity in the Mining Reach. Some parr also move in the fall, perhaps when the Mining Reach is beginning to reach capacity, potentially driving some movement to the middle Wind reach (personal communication with WRWG members 2016). The middle Wind is an important spawning reach, but rearing numbers are lower than expected. This is presumably due to the lack of habitat complexity and cover found in the middle Wind. Temperature is not thought to be a limiting factor to rearing, because although it is an alluvial reach, there are many cold water inputs (personal communication with WRWG members 2016). Rearing habitat is thought to be the primary limiting factor in the middle Wind, due to the following issues:

- Simplification of habitat
- Lack of large woody debris
- Floodplain disconnection
- Lack of sinuosity
- Little or no cover, pool habitat
- Little or no off-channel habitat, such as side-channels, oxbows, wetlands

Overall, spawning habitat is not thought to be a limiting factor, although some redd scour could be occurring, but in general the channel-forming flows do not occur when redds are present (personal communication with WRWG members 2016).

Both winter steelhead, as well as low numbers of summer steelhead, also use the Little Wind River for spawning and rearing (personal communication with WRWG members 2016).

3.2.2 Coho

Coho are present in low numbers in the Wind subbasin. Their distribution includes the mainstem below Shipherd Falls, although their primary use is in the Little Wind River. Coho return in late summer and fall, with spawning occurring in the fall and winter. Fry emerge in the spring, and smolts emigrate between March and May of their second year (LCFRB 2010).

3.2.3 Fall Chinook

Fall Chinook historically were not found above Shipherd Falls, although they are now found in small numbers as far upstream as the Carson NFH. The heaviest spawning of fall chinook is found in the mainstem Wind below Shipherd falls. There is some use of the Little Wind River for spawning as well (LCFRB 2010, personal communication with WRWG members 2016).

Tule fall Chinook return to the Wind in September, with spawning also occurring in September. Fry emerge January through March, with juveniles rearing near and downstream of spawning areas and emigrating in spring and early summer as sub-yearlings (LCFRB 2010). Mid-Columbia bright fall Chinook return to the Wind River in late September to October, spawning from late October through November. Fry emerge in the spring, with emigration in spring and early summer as sub-yearlings (LCFRB 2010).

3.2.4 Chum

Very low numbers of chum are assumed in the Wind River; very few fish are counted (less than 150) over Bonneville Dam each year. Inundation of spawning and rearing habitat at the mouth of the Wind River is thought to significantly impact chum numbers as well. Adult chum migrate from mid-October through November, with spawning occurring in late November. Fry emerge in early spring, with emigration occurring shortly thereafter (LCFRB 2010).

3.3 HABITAT LIMITING FACTORS

3.3.1 Overview of Limiting Factors

Habitat limiting factors at the basin-scale are provided below. These were obtained from existing sources including the Recovery Plan (LCFRB), the Limiting Factors Analysis (WACC 1999), and surveys performed as part of this strategy. These are defined in greater detail at the reach-scale in Section 4.3.

Temperature – High summer temperatures in Bear, Eightmile, Trout Creek, Lower Wind, Middle Wind, and others. High temperatures are caused by high width-to-depth, lack of riparian shade, and water withdrawals.

Sediment – High turbidity in Panther, Trout, Wind. Likely from road density, historical timber harvest, golf course, landslides, and bank erosion.

Pools – Quantity and quality are low, including percent pool, pools/mi, pool depth, pool cover

Large Wood – Low numbers and small sizes due harvest, lack of recruitment, and lack of retention.

Channel Stability – Low large wood numbers, high width-to-depth ratios, excessive sediment inputs, mass wasting in lower basin, riparian clearing, and human infrastructure

Riparian Function – Riparian clearing due to harvest, roads, residential development. Many riparian zones are in early seral stage or cleared. Impaired conditions affect bank stability, hydraulic roughness, shade, large wood recruitment, and nutrients.

Floodplain and Channel Migration Zone Function – Impaired floodplain and CMZ connectivity due to civil infrastructure (e.g roads and bridges), floodplain clearing/development, bank armoring, levees, and stream channel incision.

Side- and Off-Channel Habitat – Lack of habitat availability and quality due to floodplain/CMZ impairment, lack of large wood, and riparian impairment.

3.3.2 Species Life Stage Limiting Factors

The species- and life stage-specific limiting factors presented here (Table 3) are from the Recovery Plan (2010) and are based primarily on the EDT model.

Table 3. Species life-stage factors table.

Species and Lifestage		***Primary factors***	***Secondary factors***	***Tertiary factors***
Wind Fall Chinook				
most critical	Egg incubation	sediment	channel stability, key habitat	harassment, pathogens, temperature
second	Fry colonization	habitat diversity, predation	channel stability, food	flow, competition (other spp), pathogens
third	Spawning	habitat diversity, harassment	key habitat, pathogens	flow, sediment, predation
Wind Chum				
most critical	Prespawning holding	habitat diversity, harassment	pathogens	flow, temperature
second	Egg incubation	sediment	channel stability, key habitat, harassment	pathogens
third	Spawning	habitat diversity, harassment	flow, pathogens, temperature	
Wind Coho				
most critical	Egg incubation	key habitat	sediment	channel stability
second	0-age summer rearing	key habitat	habitat diversity, temperature	competition (hatchery), food, predation
third	Fry colonization	key habitat	flow, food, habitat diversity	channel stability, predation
Wind Summer Steelhead				
most critical	Egg incubation	sediment	temperature	key habitat

Species and Lifestage		Primary factors	Secondary factors	Tertiary factors
second	0-age active rearing	habitat diversity, pathogens	flow, temperature, competition (hatchery), predation	
third	1-age active rearing	competition (hatchery)	flow, habitat diversity	pathogens, predation, temperature
Wind Winter Steelhead				
most critical	0-age summer rearing	competition (hatchery), habitat diversity, pathogens, temperature	predation	flow, food
second	Egg incubation	sediment, temperature	key habitat	channel stability, harassment, pathogens
third	0,1-age active rearing	flow	channel stability, food, habitat diversity	

4. Restoration Strategy

4.1 OVERVIEW

The restoration strategy is intended to guide effective and efficient restoration for the Wind River study area. The restoration strategy is the final product of two efforts: (1) identification of potential projects, and (2) subsequent prioritization of the importance of those projects. The project types and prioritization have been guided by the existing body of knowledge (see Annotated Bibliography – Appendix B), habitat objectives, technical evaluation by the project partners (Wind River Work Group), and by field and analytical work conducted as part of this effort. This section describes the methods for identifying and prioritizing projects and presents the project list and results of the prioritization.

4.2 HABITAT RESTORATION GOALS AND STRATEGIES

Habitat restoration goals and strategies at the subbasin-scale are listed here (Table 4). These were obtained from existing sources and modified by the WRWG at the Nov 17, 2015 WRWG meeting.

Table 4. Basin-scale habitat restoration goals and strategies.

Goal and Strategies	Applicability to this Effort
Protect/restore hillslope processes	
Management of forest practices (being addressed as part of other efforts, e.g. USFS management plans)	Low
Address road/residential/golf course runoff issues	Moderate
Protect stream corridor structure and function	
Identify well-functioning areas that may be at risk	High
Restore floodplain function and channel migration processes	
Set-back, breach, or remove artificial confinement structures (e.g. levees)	High
Remove/modify bank armoring to restore channel migration and margin habitat	High
Enhance availability, connectivity, and habitat within floodplain wetlands	High
Restore floodplain vegetation conditions	High
Restore riparian conditions	
Restore the natural riparian plant community	High
Control invasive plant species	High
Restore degraded water quality with emphasis on temperature and sediment	
Increase riparian shading	High
Decrease channel width-to-depth ratios	High
Address leaking septic systems	Low
Ensure adequate instream flow	Low
Address fish passage issues	
Restore access to isolated habitats blocked by culverts, dams, or other barriers	High
Restore channel structure and stability	
Place large woody debris (LWD) to enhance cover, pool formation, bank stability, and sediment sorting	High
Use LWD jams to enhance lateral channel dynamics, channel aggradation, split-flow, etc to restore geomorphic processes and long-term habitat formation	High
Structurally modify channel morphology to create suitable habitat	High
Restore natural rates of erosion and mass wasting within river corridors	High
Create/restore off-channel and side-channel habitat	
Restore historical off-channel and side-channel habitats where they have been eliminated or impaired	High
Create new off-channel habitats for juvenile rearing	High
Create new off-channel spawning habitats (e.g. for chum in lower basin)	Moderate
Provide for adequate instream flows during critical periods	
Protection and restoration of instream flows (being addressed as part of other efforts, e.g. WRIA planning)	Low

4.3 HABITAT ASSESSMENT METHODS AND RESULTS

Existing and target habitat conditions were identified for each reach within the geographic scope (the reach definitions used for this assessment are the same as used in the Recovery Plan). This task helped to inform the specific habitat attributes that should be targeted for restoration and also helped with populating the metrics used for project scoring and prioritization. Use of consistent habitat attributes among the study reaches also allows for useful comparisons between reaches.

The list of attributes and their definitions are included in Appendix C. Each reach is given a "good", "fair", or "poor" rating for each attribute. The attributes and their definitions are a derivation of other similar lists used by resource agencies and restoration practitioners in the Pacific Northwest, such as the NMFS Matrix of Pathways and Indicators (NMFS 1996) and the Reach-Based Ecosystem Indicators (REI, e.g. US Bureau of Reclamation 2009). The target condition is represented by the definition for the "good" rating, except where unique reach conditions justify an alternate target.

For the reaches in this assessment, the ratings were developed by consulting existing information and through collection of new data during the field surveys. Existing information used for these ratings primarily came from existing recent US Forest Service Level II stream habitat inventories. Recent data, within the last 5 years, were available for various reaches, including much of the middle mainstem Wind River and Dry Creek. For reaches where habitat surveys have not been performed, or where the data were very old (e.g. greater than 10 years old), new data were collected during the field surveys using a Rapid Habitat Assessment method, described below. For some attributes, including the riparian attribute and floodplain connectivity attribute, aerial photographs and LiDAR data were used to help determine the ratings. The final ratings for each reach in this study are included in Appendix D.

As described above, a rapid habitat assessment was performed during the field surveys to fill in data gaps in habitat information needed to develop the habitat attribute ratings. The rapid assessment protocol included recording both qualitative and quantitative data on stream attributes. Rapid assessment attributes included riparian condition (buffer width, canopy closure, riparian disturbance, stand age), floodplain connectivity (connectivity, disturbance and road density within the floodplain), bank condition (hydromodifications and anthropogenic erosion), vertical channel stability (anthropogenic aggradation or incision), pools (total number, depth, and cover), large wood (>24 in diameter, 50 ft long) and log jam counts, habitat complexity (total number of habitat units), off-channel habitat (presence and abundance), man-made fish passage barriers (total count), and percentage of fine sediment (visual estimates). Site conditions for each attribute were recorded approximately every 1,000 feet throughout the reach, with the exception of pools, habitat units, and LWD/log jams which were counted continuously throughout the entire reach; and canopy closure and road density, which were defined in the office using LiDAR and aerial photos. See Appendix E for a blank field data sheet.

4.4 PROJECT IDENTIFICATION

Potential projects were identified based on multiple considerations, including: 1) previous studies, 2) professional experience and knowledge of design team and WRWG members, 3) new analyses and field surveys conducted as part of this effort, 4) evaluation of previous projects in the area, 5) a comparison of existing and target fish use and habitat conditions, and 6) current site conditions and human uses. Processes operating both at the watershed- and reach-scales were considered when identifying potential projects. At the watershed-scale, the influence and condition of the hydrologic, sediment, wood, and temperature regimes were taken into account when developing project recommendations. The conditions of these processes were obtained from the existing literature, the investigators' knowledge of the subbasin, and from input from the WRWG.

Field data collection occurred from late April through June 2016, in conjunction with the rapid habitat surveys described previously. Teams from UCD and IFI surveyed the 20 stream miles within the geographic scope. Potential habitat enhancement project sites were documented with GPS coordinates, photos showing general site conditions, extent of the proposed project, and notes outlining the scope, presumed site access, any additional opportunities or challenges, and the overall potential gain or effect of the project.

4.5 PROJECTS

The suite of identified project types includes floodplain reconnection, off-channel habitat enhancement, riparian restoration, instream large wood placement, and protection. The scope and scale of project types varies depending on the particular habitat conditions, land uses, and geomorphic context of the site. The individual project descriptions and site maps are provided in Appendix F. Figure 5 below shows the general distribution of projects at the subbasin-scale. The projects are listed in priority order in Section 4.6.2.

It is important to note that other planning efforts in the basin have also identified projects. These include the USFS Restoration Action Plans for the Trout and Trapper Creek Basins and the UCD's on-going project opportunity list. The geographic scope for this current effort purposefully did not include high priority reaches in the Trout Basin specifically because of the USFS effort that had recently been performed there. The project lists from the USFS Trout and Trapper Creek plans are included in Appendix G and the UCD project list is included in Appendix H.

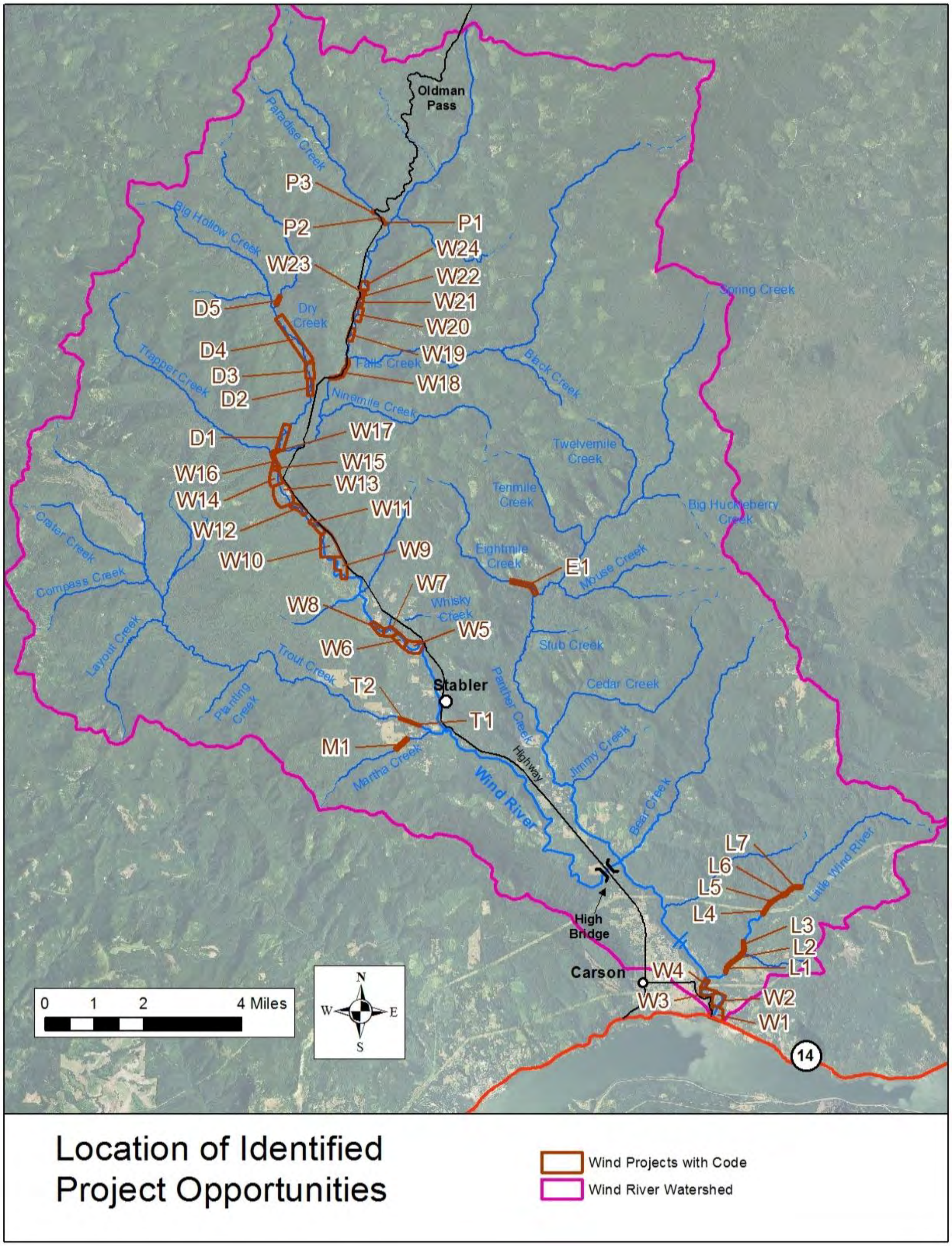

Figure 5. Location of projects identified as part of the restoration strategy. Project codes are included in the project list in Table 6. Detailed project descriptions and concept maps are included in Appendix F.

4.6 PROJECT PRIORITIZATION

4.6.1 Project Prioritization Methods

Projects identified as part of this effort were prioritized using a methodology consistent with the LCFRB methods used to score project proposals for funding in the LCFRB Lead Entity region. The LCFRB method has 3 primary components to the scoring: 1) Benefits to Fish (BTF), 2) Certainty of Success (COS), and 3) Cost. For the purposes of this Wind River Restoration Strategy, we have incorporated only the first two components – benefits to fish and certainty of success – for scoring and ranking of projects. Although we have identified the approximate cost range for each project, we have not used cost for scoring since 1) costs are very preliminary at this point, and 2) the cost of a project ends up very much depending on how a particular sponsor proposes to accomplish it. These considerations also apply somewhat to the COS ratings, albeit less so, and so the COS score should be considered preliminary at this stage of project development. The methods for assigning the BTF and COS scores are included in the sections below, as well as a description of how we addressed project costs.

The BTF score utilizes quantitative reach-scale fish and habitat information from the Recovery Plan. For the purposes of project scoring in this assessment, we have made some modifications to how the BTF scoring is performed in the Wind River. These modifications, and the rationale behind them, are described below.

It should be recognized that a project that is brought forward for a SRFB application submitted to the LCFRB could differ substantially from the scale and scope of the projects identified here, especially given that project details frequently change once landowners and stakeholders become engaged in the early stages of project planning. Projects submitted for SRFB funding therefore could receive different scores than in this assessment. For these reasons, the scoring applied here should be viewed as a means to provide a relative ranking of projects in the Wind River, and is not meant to imply that a project would necessarily receive the same scoring during the official grant round. It should also be recognized that other projects in the Wind River not identified in this assessment, such as ones outside of the geographic scope of this effort, could potentially score highly during the grant round if they satisfy the key LCFRB scoring criteria.

Benefits to Fish

The Wind River project prioritization framework follows the 'Benefits to Fish' score methodology used by the LCFRB Technical Advisory Committee (TAC) (LCFRB 2016). The BTF score incorporates the following:

1. Population/Reach Rating (H, M, L) and Score (100 pt max)
2. Protection/Access/Restoration (PAR) Rating (H, M, L) and Score (100 pt max)
3. Overall Rating (H, M, L) and Score (200 pt max)

The Population/Reach Rating and Score are based on the Reach Tier and the species- and reach-specific Species Reach Potential (SRP) developed as part of the Recovery Plan. For the

Protection/Access/Restoration Rating and Score, we have only applied the restoration component, since all of the projects included in the strategy are primarily restoration focused. The Restoration Score indicates the extent to which a project is anticipated to address the targeted restoration need for the reach, and incorporates considerations of project scope and scale. For additional detail of how these scores are derived, we refer the reader to the LCFRB document "Lower Columbia Fish Recovery Board Project Evaluation Criteria" (LCFRB 2016).

Certainty of Success

The COS rating and score evaluate how likely a project is to achieve proposed outcomes or benefits. The COS receives equal weight as the BTF score, with a total possible score of 200 points. Additional details on the factors considered in scoring these categories can be found in the LCFRB Habitat Project Application Evaluation Questions (LCFRB 2017). For purposes of scoring within this strategy, COS ratings were qualitatively assigned based on staff, consultant and WRWG feedback. Considerations included, but were not limited to, field survey information and data, landowner willingness, and infrastructure and logistical constraints.

Cost

Although cost was not used as a scoring component for this assessment, we made an effort to provide approximate cost ranges for each project. This is based on the investigators experience with similar project types in the region. This is for informational purposes and for general guidance to project sponsors to assist in project planning.

Modifications to SRP and Tiering for Project Scoring Purposes

The unique character of the Wind River warrants reconsideration of some of the measures that underlie the LCFRB scoring methodology. The first proposed modification is re-evaluation of a reach's SRP, which affects the reach tier ratings and scores. The SRP is a reflection of how important a particular reach is to the fish population of interest. The SRP is based both on the reach's restoration ***and*** preservation values produced from the EDT model. For each reach, the EDT model predicts how population-scale abundance, productivity, and spatial diversity would be expected to change under two scenarios: 1) restoration of habitat in the reach, and 2) hypothetical degradation of habitat within the reach (the inverse of which is preservation). These analyses result in six model output values – change in abundance, productivity, and diversity for both the restoration and preservation scenarios. For the purposes of determining SRP, these six values are summed for each reach and then all reaches are ranked and are binned into the 3 SRP categories (High, Medium, or Low). These SRPs, which also affect the Reach Tier designations, are used in the LCFRB ranking as described previously.

Compared to other basins throughout the lower Columbia recovery planning region, the Wind River watershed is unique in that a few reaches (high functioning canyon reaches in the mainstem Wind River, lower Trout Creek, and Panther Creek) have such high preservation values that the reaches with high restoration value end up receiving lower SRP ratings.

Due to this unique condition, in order to evaluate the potential restoration importance, and to accurately prioritize restoration projects, we have modified the way that the SRP is calculated, using only the restoration value and not the preservation value. This is done for every summer steelhead reach in the basin, not just the reaches that are part of the geographic scope of the restoration strategy. These modified reach tier ratings and supporting rationales will be presented to the LCFRB TAC for consideration in future project scoring in the Wind River basin, but will not re-define existing reach tiers in the Recovery Plan. Performing this analysis for the basin results in the following reaches moving from a 'Medium' to a 'High' SRP (and thus Tier 1 for prioritization purposes): Martha, Wind 5b, and Wind 5c. Reach Wind 5a moves from a 'Low' to 'High'. Only one reach, Panther 1c, moves from an SRP of 'Low' to 'Medium', and is thus prioritized as if it were Tier 2. We assume that reaches that would move down in value (e.g. from 'High' to 'Medium' SRP) are left as is for prioritization purposes. Results are summarized in Table 5.

A second modification was to the SRP rating for reach Wind 5d. This reach lies just above the hatchery on the middle Wind River. It extends from the tributary Tyee Springs upstream to Trapper Creek. In the process of this assessment, this reach was found to have an error in the most recent EDT run that resulted in an erroneous 'Low' SRP value. The SRP calculation was therefore performed using an older run result, which moved this reach into the 'High' SRP category. The same error was found with reach Trapper Creek, but the corrected calculation did not result in a shift in SRP value (i.e. it remained 'Low').

The WRWG also considered the potential modification of SRPs for reaches in the Trout Creek basin that lie above the former Hemlock Dam site. This could have affected scoring for projects in the Trout Creek basin identified as part of US Forest Service restoration planning efforts. The rationale was based on the idea that removal of Hemlock Dam in 2009 may have increased the potential fish benefit of restoration in these reaches – a condition that would not have been represented in the 2005-2006 running of the EDT model. However, after careful consideration and input from multiple agency fish biologists that have worked in the basin for years, it was decided that it is too early to tell if the SRPs for these reaches should be altered or not.

Table 5. Revised SRP and Tiering for Wind River subbasin reaches. Changes that resulted in a lower SRP or tier are not included. Note that these changes are performed only for the purposes of scoring of projects as part of this restoration strategy and do not affect the SRPs or Reach Tiers in the Recovery Plan.

Reach	Former Steelhead SRP rating	Former Tier	Revised Steelhead SRP rating	Revised Tier
Wind 1	Low	2	Med	No revision (already med SRP for chum)
Martha	Med	2	High	1
Wind 5a	Low	4	High	1
Wind 5b	Med	2	High	1
Wind 5c	Med	2	High	1
Wind 5d	Low	4	High	1
Panther 1c	Low	4	Med	2

4.6.2 Prioritized Project List

A total of 43 potential projects were identified during the course of this assessment. Eight projects ranked 'high' (H/H) for both Benefits to Fish (BTF) and Certainty of Success (COS) during initial scoring. Eighteen projects ranked 'high/medium' (H/M) with a 'high' score in either BTF or COS, and a 'medium' score in the other. Three projects ranked 'medium' (M/M) for both BTF and COS. The remaining 14 projects scored a 'low' in either BTF, COS, or both. The projects and rankings are shown in the table below.

The Hatchery Reach Project (W13) and the Beaver Campground Project (W10) were rated very high for BTF. However, the WRWG recognized that these are large and complex projects with many stakeholder considerations that need to be addressed prior to moving forward with restoration design work. For these reasons, these projects were ranked lower for COS at this time. The WRWG believes these are nevertheless highly beneficial projects, and it is recommended that additional feasibility and planning work be pursued at these sites in order to advance the projects further towards design and implementation.

Table 6. Prioritized project list with rankings.

Project Name -- Code	Stream Reach	BTF #	BTF rank	BTF rank group	COS rank	COS #	BTF/ COS group	BTF+ COS #	Updated Ranking within groups
Stabler Bend -- W5	Wind 5a	95	7	H	High	190	H/H	285	**1**
Little Wind River Phase IV -- L1	Little Wind 1	59	15	H	High	190	H/H	249	**2**
Big Butte -- W12	Wind 5c	77	10	H	High	170	H/H	247	**3**
Lower Headwater Flats -- L5	Little Wind 1	61	13	H	High	170	H/H	231	**4**
Berge Confluence -- L2	Little Wind 1	58	17	H	High	170	H/H	228	**5**
Powerline -- L4	Little Wind 1	55	19	H	High	170	H/H	225	**6**
Martha -- M1	Martha	49	23	H	High	170	H/H	219	**7**
Wind River bel Trapper Cr Confluence -- W16	Wind 5d	44	25	H	High	170	H/H	214	**8**
Hatchery Reach -- W13	Wind 5c & 5d	129	1	H	Med	105	H/M	234	**1**
Beaver Campground -- W10	Wind 5c	122	3	H	Med	105	H/M	227	**2**
Mining Middle Road Contact -- W20	Wind 6d	51	22	M	High	170	H/M	221	**3**
Mining Downstream Road Contact -- W19	Wind 6d	49	24	M	High	170	H/M	219	**4**
Middle Butte Fan -- W21	Wind 6d	41	26	M	High	170	H/M	211	**5**
Wind River bel Dry Cr confluence -- W17	Wind 6a	30	34	M	High	170	H/M	200	**6**
Mining Upstream Road Contact -- W22	Wind 6d	29	35	M	High	170	H/M	199	**7**
Mineral Springs Bridge Reach -- W14	Wind 5d	82	8	H	Med	105	H/M	187	**8**
Beaver North -- W11	Wind 5c	80	9	H	Med	105	H/M	185	**9**
Stump House -- W9	Wind 5c	77	11	H	Med	105	H/M	182	**10**
Upper Headwater Flats -- L7	Little Wind 1	66	12	H	Med	105	H/M	171	**11**
Middle Headwater Flats -- L6	Little Wind 1	61	14	H	Med	105	H/M	166	**12**
Whisky --W7	Wind 5a	59	16	H	Med	105	H/M	164	**13**
Dillon -- L3	Little Wind 1	57	18	H	Med	105	H/M	162	**14**
Stabler North --W6	Wind 5a	55	20	H	Med	105	H/M	160	**15**

Project Name -- Code	Stream Reach	BTF #	BTF rank	BTF rank group	COS rank	COS #	BTF/ COS group	BTF+ COS #	Updated Ranking within groups
Middle Mining Large Wood -- W24	Wind 6d	38	27	M	High	105	H/M	143	**16**
650 Road Fill -- W23	Wind 6d	38	28	M	High	105	H/M	143	**16**
Mineral Springs Road Bridge -- W15	Wind 5d	37	29	H	Med	70	H/M	107	**18**
Indian Cabin Road Reach -- W4	Wind 2	119	4	M	Med	105	M/M	224	**1**
In-Lieu Bend -- W3	Wind 2	117	6	M	Med	105	M/M	222	**2**
Falls Confluence Highway Slope -- W18	Wind 6c	31	31	M	Med	70	M/M	101	**3**
Lower Dry Creek -- D1	Dry Creek 1	32	30	L	High	170	H/L	202	**1**
Spoil Bank -- D3	Dry Creek 1	31	32	L	High	170	H/L	201	**2**
Forest Road 64 Crossing-- D5	Dry Creek 2	26	38	L	High	170	H/L	196	**3**
Dry Creek Upper Bedrock Channel -- D2	Dry Creek 1	24	39	L	High	170	H/L	194	**4**
Paradise Creek Large wood -- P3	Paradise 1	21	42	L	High	170	H/L	191	**5**
Upper Dry Cr Key Piece Supplementation -- D4	Dry Creek 1	30	33	L	Med	137.5	M/L	167	**6**
Log Dump Bend -- W2	Wind 2	126	2	M	Low	35	M/L	161	**7**
Paradise Cmpgrnd Off-Channel Enhance -- P1	Paradise 1	20	43	L	Med	137.5	M/L	157	**8**
Wind River Confluence -- W1	Wind 1 & Wind 2	119	5	M	Low	35	M/L	154	**9**
Meadow Crest -- T1	Trout 1b	28	36	L	Med	105	M/L	133	**10**
Summer's End -- T2	Trout 1b	27	37	L	Med	105	M/L	132.5	**11**
Eightmile -- E1	Eightmile	24	40	L	Med	105	M/L	129	**12**
Paradise Bridge -- P2	Paradise 1	22	41	L	Med	70	M/L	92	**13**
Cannavina -- W8	Wind 5a	53	21	H	Low	35	H/L	88	**14**

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Appendix A – Public Outreach Plan

1. Outreach Plan

The Wind River Work Group discussed the best ways of conducting outreach around the restoration strategy development effort on Dec. 16, 2015. The outline below includes the objectives and primary methods of outreach that will be used during this project. The work group agreed that sharing key messages about what has already been achieved in the watershed is important, and that information should be presented in a larger context of why it's important. Additionally, the work group wanted to emphasize that the strategy development effort isn't really new, but builds on a long history of prior restoration efforts and aims to improve current processes.

1.1 MAIN OBJECTIVES OF THE OUTREACH PLAN

Listen – to better understand community interests and concerns;

Inform – let people know how well things have worked so far, let them know what the current strategy development effort is about, and how this is voluntary and non-regulatory; and

Develop Partnerships – obtain, where feasible, community and landowner support for doing projects.

1.2 OVERVIEW OF OUTREACH METHODS

1.2.1 Press Releases in Skamania Pioneer:

- Introduce project, including status of fish populations and restoration activities: Submitted to Pioneer January 2016
- Announce public workshop near June date: May or June
- Provide updates quarterly: April, July, and October

1.2.2 Website:

- LCFRB has set up a project page with updates and posts as the project develops: http://www.lcfrb.gen.wa.us/#!wind-river-habitat-strategy/cv7s

1.2.3 UCD Website, Facebook Page, and E-Newsletter:

- UCD will post a link to the LCFRB site about this project and provide updates and meeting notices as needed.

1.2.4 Stabler Community Council:

- LCFRB staff and consultants are attending a meeting January 12, 2016 to introduce the project, share current information on fish status and restoration efforts, and gain input on Vision, Goals, Concerns, Interests, etc.
- LCFRB plans to have frequent contact with Community Council to pass along updates

1.2.5 Wind River Work Group:

It is a goal to have regular community participation in the Wind River Work Group. Agendas will include a public comment period, and all discussion and decisions will be stronger with community and landowner input.

Appendix B – Annotated Bibliography

Bair, LLC. 2009. Little Wind River Watershed Restoration Assessment, Project and Prioritization Recommendations. Prepared for Underwood Conservation District.

This watershed scale assessment of the Little Wind River identified priority projects through existing data, aerial photos, and field assessments. Restoration priorities were 1) reducing fine sediment delivery via unimproved road network in the upper watershed, and 2) riparian vegetation restoration, and in-channel restoration work to increase habitat complexity. The identified projects were (in priority order): 1) Larson Lake and Buck Mountain Road System Storm Proofing and Drainage Network Rehabilitation, 2) Little Wind River and Berge Creek Riparian Restoration, 3) Lower Reach and Confluence Stream Channel Rehabilitation Projects, 4) Little Wind River and Berge Creek Large Woody Debris (LWD) Replacement and Restoration Project. Conceptual cost estimates are included for each project.

Beecher H., D.H. Bighouse, B. Vadas, T. Hegy, S. Boessow, J. Pacheco, J. Kohr, R. Murphy, P. LaRiviere, A.Wald, and B. Caldwell. 2008. Wind River Instream Flow Study 2007, Final Report, Prepared as a joint Washington Dept. of Ecology and Dept. of Fish & Wildlife study.

This study was undertaken to analyze actual Wind River mainstem stream flows and model available fish habitat results for coho, Chinook, steelhead and cutthroat trout, in order to recommend minimum instream flows. The authors' intent was to look at an area of the Wind most sensitive to withdrawals and low flows, and evaluate the physical habitat for fish species at different life stages and various flows. The study size was centered at the Pacific Crest Trail bridge, RM 12.4.

The study involved 10 transects over half a mile of stream, with depth and velocity measurements at various flows. Data were used to calibrate an RHABSIM (riverine habitat simulation) model, to output "weighted usable areas" (WUA) for each fish life stage, per species, per flow stage. Units of WUA were square area of habitat per 1,000.ft of stream length, found through formulas that determine habitat suitability according to depth, velocity, substrate and cover. WUAs were calculated at flows of 29.2, 73, 142, 250, 600 and 1,500 cfs.

The authors found that spawning WUA reached its peak at about 150 cfs for cutthroat, 200 for coho, 300 for Chinook and 400 for steelhead. Incubation ideal flows were estimated at 2/3 those of spawning flows. Ideal rearing flows for steelhead were found at about 550 cfs, though that species shows a large plateau of ideal WUA modeled at between 200 and 800 cfs. Migration flows were not modeled, though upriver migration is associated with spawning flows.

River wetted width increases, obviously, with stream flow. Wetted widths were found to average 96' at 200 cfs, 100' at 300, 104' at 400, and 111' at 500.

The study provided recommendations for ideal mainstem minimum flows: i.e., how much water should be left in the Wind River to maximize fish production and minimize stress. The authors conclude that at the PCT bridge area (the Middle Wind River reach above Stabler), ideal instream flows are 200 cfs between August and February; 400 cfs March to May; and 550 June to July. The study also reports flow recommendations for the lower watershed (at the Shipherd Falls gage), and includes all study data including WUA habitat curves. Ideal WUA may not be the only point worth considering: 200 cfs, for example, while not the ideal for steelhead rearing, provides 97% of available WUA, and below that flow, habitat rapidly declines.

Buehrens, T., D. Rawding, P.C. Cochran, P. Connolly, I. Jezorek, S. Claeson and B. Coffin. 2015. Ecosystem Responses to Dam Removal and Habitat Restoration in the Wind River, WA. Presentation to the American Fisheries Society, Portland, OR, August 8, 2015.

This presentation gives a graphical overview of WDFW and partners' fish sampling in the Wind River subbasin, with special emphasis on pre- and post-dam removal conditions (substrate, macroinvertebrates, fish) proximal to Hemlock Dam on Trout Creek, which was decommissioned in 2009. Erosion and deposition patterns are mapped. Fish response is statistically preliminary but subsequent returns in the Trout Creek tributary system have been consistently high, suggesting that adult and smolt steelhead abundance appears to be increasing.

Caballero, Stephanie. 2015. Watershed Condition Framework: FY2016 Watershed Restoration Action Plan. Pacific Northwest Region, Gifford Pinchot National Forest, Mt. Adams Ranger District.

This document serves as a restoration action plan for the USFS lands within the Wind River Basin. This document currently contains background and contextual information on the entire basin, with focus on restoration projects in the Trapper Creek-Wind River and Trout Creek subwatersheds. The action plan pulls from existing surveys, data, and past projects dating from 1989 to the present. Currently the top two priority watersheds, Trout Creek (Priority 1) and Trapper Creek-Wind River (Priority 2), have been assessed. Additional subwatersheds will be added to the Plan as they are analyzed. With partnerships, and dependent on funding (of which potentially 50% would come from partners), the USFS predicts that it is possible to complete the essential projects in these two watersheds by 2020. These essential projects are laid out in an extensive list for the Trout Creek and Trapper Creek-Wind River subwatersheds. Project details include specific location by river mile, projected cost and timeline, watershed condition indicator addressed and LCFRB (2010) Habitat Plan measures addressed. Total project costs are estimated at $2,507,000, between the two watersheds.

Current habitat conditions throughout the Wind River basin are discussed, including topography, land use, climate, hydrology, fish distribution, riparian condition, and in-channel habitat condition limiting factors. Primary issues of concern basin-wide are identified as: elevated stream temperatures, elevated sediment and turbidity, and habitat simplification and access. Proposed restoration projects identified to address these limiting factors include road work, stream channel, streambank, and floodplain rehabilitation, conservation, education, and grants and agreements (partnerships). The plan includes lists of past restoration projects in the basin from 1991-2015, by project type, subwatershed, and year.

Claeson, S. M., J. L. Li, J. E. Compton, and P. A. Bisson. 2006. Response of nutrients, biofilm, and benthic insects to salmon carcass addition. Canadian Journal of Fisheries and Aquatic Sciences. 63: 1230–1241.

Researchers obtained frozen hatchery Chinook salmon carcasses from a local hatchery and added them to three stream sites in the upper Wind River in summer-fall 2003 (104 kg of carcasses in the upper Wind River, 88 kg of carcasses in Paradise Creek, and 58 kg of carcasses in Ninemile Creek). After a period of decomposition, researchers then sampled water chemistry, leaf decomposition, benthic macroinvertebrates and stable isotopes from surrounding habitat.

Researchers found that carcass addition in Wind River streams did not strongly alter water chemistry or cause substantial algal blooms, despite sampling during summer low-flow conditions, which would have been expected to create conditions for maximum effect on water chemistry. "In these montane, low-order streams, effects from carcass addition on stream chemistry appear minimal."

Reviewing their own results and similar results from other Northwest carcass-addition experiments, researchers suggest that adding salmon carcasses to headwater streams may have "transient effects" on trophic levels in riparian areas, and/or be limited by unquantified physical controls such as stream gradient or canopy closure. Also, unlike natural spawning areas, carcass addition does not accompany substrate disturbance found with redd excavation. The authors conclude that results seen in their experiment are mostly within background variation levels.

Connolly, P. S. James, K. Wieman, B. Bair, I. Jezorek, D. Rawding, P. Cochran, and S. Stampfli. 2001. Wind River Watershed Restoration Project, Segments I-IV. Project No. 1998-01900, 235 electronic pages, (BPA Report DOE/BP-00004973-1)

This report briefly covers the BPA partners' (USGS, USFS, WDFW, UCD) activities during the BPA reporting period of 1999, in four segments. Segment I of the report covers watershed coordination and education efforts led by UCD.

Segment II of the report covers USFS's restoration efforts in the watershed. Accomplishments reported include a total of 4.4 road miles decommissioned (which were partially reported in 1998); physical habitat surveys conducted on Dry Creek and Paradise Creek; and 60 riparian acres planned for thinning. Additionally, the Stabler Reach Bank Stabilization project was reported by UCD, involving the installation of 4 log/boulder complexes, 47 logs, bank sloping, and planting along 500 feet of the Wind River. Additional restoration work conducted by USFS was described as Trout Creek Flats Channel Rehabilitation, Phase IV, Mining Reach of the Wind River Riparian and Channel Rehabilitation, and Upper Wind River and Trout Creek Riparian Rehabilitation.

Segment III of the report covers fish population monitoring conducted by WDFW and USGS, including work completed on two tasks: 1) conduct sampling and analyses to derive population estimates for steelhead parr and other salmonids (USGS's primary focus) and 2) conduct sampling and analyses to derive annual estimates of production of steelhead smolts in the subbasin (WDFW's primary focus). These tasks were undertaken to meet the objective of determining productivity and characterizing early life history of steelhead in the Wind River watershed.

Segment IV of the report covers physical habitat monitoring: sediment monitoring by USFS, flow, temperature and habitat monitoring by USFS, and water quality monitoring by UCD.

Connolly, P., G. Johnston, B. Bair, and K. Wieman. 1999. Wind River Watershed Restoration Project, Vol. II of III. Project No. 1990-05400, 31 electronic pages, (BPA Report DOE/BP-09728-2).

Volume II of III (see Connolly et al 1999). Describes on-the-ground restoration activities of UCD on private land (the Stabler Cut-Bank Project), USFS road decommissioning, riparian thinning and planting, and UCD-led education efforts, including programs in local schools in the greater Wind River watershed, community outreach, and technical assistance site visits with streamside landowners.

Connolly, P., G. Johnston, D. Rawding, K. Wieman, B. Bair, P. Cochran, and T. King. 1999. Wind River Watershed Restoration Project, Vol. I of III. Project No. 1990-05400, 91 electronic pages, (BPA Report DOE/BP-09728-1).

Volume I of III (See also Connolly et al. 1999, Connolly et al. 2001, and Wieman 1999). This is the first report of the Wind River Watershed Project (WRWP), a multiagency effort, during its first year of funding through BPA. The agencies involved (and still operating the WRWP) included USDA Forest Service (USFS), the US Geological Survey's Columbia River Research Lab (USGS), Washington Department of Fish & Wildlife (WDFW), and Underwood Conservation District (UCD). The document describes the overarching vision of the WRWP partners to restore Wind River basin water quality and fishery resources. Also described is the five-fold approach: Coordination, watershed assessment, restoration, monitoring (of fish population dynamics) and education.

Volume I includes descriptions of activities in each of these five areas, as separate reports, labeled A-E.

Report A outlines the history and activities of the Wind River Watershed Council and a technical advisory committee facilitated by UCD.

Report B of this document focuses on watershed assessment goals, objectives and procedures for developing and prioritizing restoration projects.

Report C includes a summary of USFS physical habitat monitoring which focuses on a spawning gravel study in Trout, Trapper, Martha, Paradise, Panther, Dry, and Layout Creeks, and Middle and Upper Wind River. Conclusions included that the Wind River subwatersheds sampled are not at risk of excessive fine sediment.

Report D includes steelhead smolt and parr production monitoring information from WDFW. Four rotary screw traps were installed in the Wind River watershed, in the upper Wind River, lower Trout Creek, lower Panther Creek and Lower Wind River, to estimate natural steelhead (*Oncorhynchus mykiss*) smolt and parr production from key reaches. Differences between observed and predicted smolt production were stated as likely due to habitat degradation, lack of adult wild steelhead escapement, and model imprecision, with habitat degradation a large component of that discrepancy. Therefore, habitat protection in the lower Wind River along with habitat protection and restoration in Panther Creek, Trout Creek, and the upper Wind River were stated as needed to rebuild depressed populations of wild steelhead, listed as threatened under the Endangered Species Act.

Report E includes a discussion by USGS of juvenile steelhead and rearing conditions. The objective of this work was to determine productivity and life history of juvenile steelhead in the Wind River watershed. Field sampling was conducted to derive population estimates for steelhead parr and other salmonids in several tributary streams of the Wind River subbasin. Surveys focused on formerly established index reaches, as well as new index reaches, within Panther Creek and Trout Creek. The report focuses on comparing the annual data on juvenile steelhead populations, stream temperatures, and stream flows collected in 1998 with those data available from previous years. Trout Creek was the primary focus with the analysis to date, where runs of adult steelhead had dropped from a few hundred a year in the 1980s to under 30 per year in the 1990s (USFS 1996, see also Section D of this document).

This document provides a good opportunity to review and assess restoration activities from the 1990s and their long-term effectiveness.

Howard, D. 2004. Wind River Watershed Temperature Total Maximum Daily Load Detailed Implementation Plan. Washington State Department of Ecology, Water Quality Program, Publication Number 04-10-037

This Detailed Implementation Plan gives action items to the Wind River Watershed Temperature TMDL (2002). The Wind River Watershed Temperature TMDL (2002) was created to satisfy Clean Water Act requirements to address the 303(d) listed waters in the Wind River Basin, including Bear

Creek, Trout Creek, and Eightmile Creek. No point sources were identified in the TMDL document for temperature in the Wind River, and so the entire allocation (TMDL) is given to non-point sources. Non-point sources identified include riparian vegetation disturbance, channel widening resulting in higher width-to-depth ratios, and reduced summertime base flows.

Four specific temperature restoration goals are outlined: 1) Restore shade to limit solar radiation to streams, 2) Restore channel integrity so that low flow channel form avoids increases to stream solar radiation, 3) Limit road related runoff so that channel form can be maintained, and 4) Maintain low flow so that temperature is not affected.

The plan recommends both general restoration targets related to these goals (tree planting, road decommissioning, restoring stream channels), allowing for a timeline of 50 or more years to establish mature riparian vegetation, and specific projects (e.g., removal of Hemlock Dam). The plan allows for updating of load allocations and encourages an adaptive management approach. The plan also lists cooperating agencies and their roles in implementation, both regulatory and non-regulatory.

Jenkinson, R., E. Plummer, and T. Cochrane. 2009. Cannavina and Whisky Creek Fish Passage Survey Report. Underwood Conservation District.

This report summarizes field assessments completed by UCD in the summer of 2009 to identify fish passage barriers and quantify potential fish habitat using the Washington Department of Fish and Wildlife (WDFW) Fish Passage and Surface Water Diversion Screening Assessment and Prioritization protocol. A total of 5 stream crossings were identified as fish passage barriers of some degree. These included 2 crossings on Cannavina Creek, 1 crossing on Whisky Creek, and 2 crossings on a tributary to Whisky Creek. Over 2 miles of potential fish habitat were identified above the barrier culverts. The report includes specific data on each culvert as well as the upstream habitat data. [Work during the summer of 2015 addressed the barrier culverts on Cannavina Creek.]

Jezorek, I., and P. Connolly. 2010. Wild Steelhead and Introduced Spring Chinook Salmon in the Wind River, Washington: Overlapping Populations and Interactions, 2000-2007 USGS Technical Report, 46 electronic pages, (BPA Document ID #P116331)

This report investigated factors influencing distribution and abundance, and potential interactions between, populations of hatchery-origin spring Chinook salmon and wild summer steelhead in a portion of the Wind River watershed. The U.S. Fish and Wildlife Service raises and releases spring Chinook salmon at the Carson National Fish Hatchery at river kilometer 28.0 on the Wind River, some of which escape or are naturalized to the river. Historically, Shipherd Falls, at river kilometer 4.0, was a barrier to Chinook salmon, but a fish ladder was installed in 1956 to allow adult Chinook salmon to access the fish hatchery. USGS personnel snorkeled to assess distribution and abundance in one to six stream reaches per year during 2001-2007. Juvenile steelhead were found in each sampled reach per year, but juvenile Chinook were not. Juvenile Chinook salmon distribution varied from river kilometer 29.7 to 42.5 at the upstream extent. Low flow appeared to limit access of escaped adult Chinook salmon to upper stream reaches. Abundance of juvenile Chinook salmon was influenced by base flow during the previous year. Juvenile abundance of age-0 steelhead was primarily influenced by number of steelhead spawners the previous year, and abundance of age-1 steelhead was influenced primarily by abundance of age-0 steelhead the previous year. Juvenile steelhead abundance did not show a relationship with base or peak flows, nor with number of escaped Chinook salmon adults during the previous year. There was no detectable negative influence of the relatively low abundance of escaped Chinook salmon progeny on juvenile steelhead abundance.

Jezorek, I. and P. Connolly 2015. Biotic and abiotic influences on abundance and distribution of nonnative chinook salmon and native ESA-listed steelhead in the Wind River, Washington. Northwest Science, 89(1):58-74.

This study investigates managers' concerns that non-native spring Chinook salmon produced at the Carson National Fish Hatchery on the Wind River might be adversely affecting wild steelhead populations, and/or might develop a self-sustaining population. WDFW snorkel data was analyzed for six reaches along the mainstem Wind River and researchers looked at the distribution of juvenile spring Chinook and juvenile steelhead, the influence of streamflow, and the influence of fish populations on each other. Their results suggest current Chinook populations are having no adverse effects on wild steelhead populations. There is also no evidence to suggest that non-native spring Chinook populations are abundant enough to be self-sustaining at current levels.

Kennedy/Jenks Consultants. 2004. Stabler Area Water Quantity and Quality Study Report. 89 electronic pages. Prepared for Skamania County, Stevenson, Washington.

This report, written for Skamania County, looks at whether projected future increases in population and potential development of the former USFS Nursery site, in the vicinity of the community of Stabler located in the Wind River basin, may cause impacts to availability and quality of groundwater and stream water resources. The report analyzes historic information and data, as well as some collected field data, which may help the County make future decisions regarding land use and natural resource management. Specific objectives of the study report include: Quantify the amount of groundwater and stream flow in the study area; evaluate the present quality of these waters; evaluate potential changes in stream water and groundwater availability from projected groundwater usage; evaluate the changes in quality of both stream water and groundwater from septic discharges and other pollution sources; Design a monitoring network to obtain data to evaluate changes in water quality and quantity over time, and; Train County staff to collect surface water and groundwater samples for long term monitoring of the water resource. Sections of the report present a water budget assessment for the area, a discussion of pollutant loading to the area's water resources, findings regarding the potential impacts of land use changes, and recommendations. The impacts of future residential development at projected rates is concluded to not adversely reduce flow rates in nearby surface waters, however reducing aquifer recharge and infiltration is not recommended. Similarly water quality is not expected to be adversely affected by future projected growth or development. The report's recommendations focus on refining the monitoring plan and protection of aquifer recharge areas.

Kohler A. E., T. N. Pearsons, J. S. Zendt, M. G. Mesa, C. L. Johnson, and P. J. Connolly. 2012. nutrient enrichment with salmon carcass analogs in the Columbia River basin, USA: A stream food web analysis. Transactions of the American Fisheries Society, 141(3):802-824

Using pasteurized salmon carcass analogs (SCAs: a compact, low-moisture pellet), researchers can mimic the addition of salmon carcasses to streams, while avoiding associated problems (e.g., disease). The authors of this paper included 15 streams from the upper Salmon River, Middle Fork Salmon River, Yakima River, Klickitat River, and Wind River subbasins (Cedar and Martha Creeks) to conduct an upstream-downstream, before-after experimental nutrient addition over three years. They measured water chemistry, periphyton accrual and macroinvertebrate density, salmonid growth rates and stomach fullness, and stream food-web nitrogen and carbon stable isotopes. Results varied, and "were not altogether expected". Nutrient concentrations were not observed, for example, whereas short-term increases in periphyton and macroinvertebrates were observed. The authors concluded that nutrient-addition to streams creates widely varying responses based on spatial scale and physical conditions, and that SCA-enhancement has the potential to boost marine-derived nutrients in ecosystems where they are otherwise limited. These treatments also have the potential to increase the productivity of nutrient-limited freshwater systems.

Lower Columbia Fish Recovery Board. 2010. Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan, Vol. II P, Wind Subbasin. Prepared for Northwest Power and Conservation Council.

As part of its mission to guide fish and wildlife recovery and mitigation for hydropower facilities' impacts, the Northwest Power and Conservation Council (NPCC) created the Columbia Basin Fish and Wildlife Program to strategically assess and guide efforts in support of "healthy and harvestable" populations of fish and wildlife in Oregon and Washington. An original Plan was adopted in 2005, and included both the recovery plan and 62 subbasin plans, including 12 in the Lower Columbia Region, of which the Wind River is one.

The Wind River subbasin plan was updated in 2010 in collaboration with LCFRB, NPCC, federal and state agencies, tribes, local governments and other stakeholders. The subbasin plan describes current local populations of endemic wildlife and fish. Historically, the Wind hosted abundant runs of Chinook, coho and chum salmon, and steelhead trout. Now all four are listed as Threatened under the federal Endangered Species Act. Although recovery of these species will take regional coordination, the subbasin plan outlines local limiting factors and ongoing recovery and mitigation activities. There are a number of threats and conditions to be remedied in support of these populations' recovery.

The subbasin plan lays out nine "Key Priorities" to meet for the Wind subbasin to make the necessary contributions to recovery:

1 Reduce Passage Mortality at Bonneville Dam and Mitigate for Effects of Reservoir Inundation

2 Protect Intact Forests in Headwater Basins

3 Manage Forest Lands to Protect and Restore Watershed Processes

4 Manage Growth and Development to Protect Watershed Processes and Habitat Conditions

5 Restore Floodplain Function, Riparian Function and Stream Habitat Diversity

6 Evaluate and Address Passage Issues at Hemlock Dam and Lake and Other Barriers

7 Align Hatchery Priorities with Conservation Objectives

8 Manage Fishery Impacts so they do not Impede Progress Toward Recovery

9 Reduce Out-of-Subbasin Impacts so that the Benefits of In-Basin Actions can be Realized

Lower Columbia Fish Recovery Board. 2015. WRIA 29A Watershed Planning Detailed Implementation Plan. 185 electronic pages.

As a result of WRIA 29-wide planning (1999-2005), Western WRIA 29 (29A) planning efforts to complete the watershed management plan (2005-2006), and development of instream flow measures and recommendations (2006-2009), the WRIA 29A initiating governments re-established the planning unit in 2013 to develop the Detailed Implementation Plan (DIP). The WRIA 29A area includes the Little White Salmon River, the Wind River and Rock Creek. The DIP outlines the background and process of plan development, and then discusses water supply, stream flows, and water management measures in Chapter II. There are a number of conclusions listed for each basin, and primary actions are to implement surface and groundwater monitoring, address unauthorized water withdrawals, and adopt water management measures for state rule. In Chapter III, water quality is discussed with specific sources addressed and recommended actions: septic systems, roads, vegetation, and stormwater. Chapter IV briefly touches on aquatic habitat limiting factors and recommended actions to improve habitat. Chapter V discusses public outreach actions with key messages about water conservation, water quality, water metering, land stewardship, septic system management, voluntary actions to reduce fecal coliform, and wildfire prevention and preparedness. The final chapter discusses plan implementation actions and funding into the future.

Underwood Conservation District (UCD) BPA Annual Reports, 2002-2014

UCD. 2002-2003. White, J.and R. Plumb. Wind River Watershed Restoration Project; Underwood Conservation District, 2002-2003 Annual Report, Project No. 199801900, 37 electronic pages, (BPA Report DOE/BP-00005480-1)

Overview of projects completed by Underwood Conservation District in the Wind River Watershed during 2002-2003 for the BPA funded Wind River Watershed Restoration Project. Projects during this reporting period included the following work elements; coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), water quality monitoring throughout the Wind River, with a focus on Trout Creek, an updating of the Watershed Enhancement Projects (WEP) list, several riparian revegetation projects with private landowners, and outreach efforts with school groups and the general public. Appendix A includes water quality data and analysis in Trout Creek, in the first of a 2 year effort to monitor water quality conditions that may facilitate the parasite *Heteropolaria lwoffi,* previously found in the Trout Creek basin. This parasite is associated with low pH levels (acidic conditions) and so the focus was on pH levels.

UCD. 2003-2004. White, J. and R. Plumb. Wind River Watershed Restoration Project; Underwood Conservation District, 2003-2004 Annual Report, Project No. 199801900, 37 electronic pages, (BPA Report DOE/BP-00005480-2)

Work during this report period focused on coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), water quality monitoring throughout the Wind River, education projects with local school groups and general outreach, riparian revegetation projects with landowners along the mainstem Wind River, and continued updates of the WEP list. Appendix A includes results from the pH data collection project; the results indicate pH was not abnormally low.

UCD. 2004-2005. Cochrane, T. and J. White. Wind River Watershed Restoration Project; Underwood Conservation District, 2004-2005 Annual Report, Project No. 199801900, 17 electronic pages, (BPA Report DOE/BP-00005480-3)

Work during this report period focused on coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), continued water quality monitoring throughout the Wind River basin and focused on temperature, education projects with local school groups and general outreach, riparian revegetation projects with landowners along the mainstem Wind River. Appendix includes summary of continuous temperature monitoring.

UCD. 2005-2006. Cochrane, T., J. White, and M. Haight. Wind River Watershed Restoration Project; Underwood Conservation District, 2005-2006 Annual Report, Project No. 199801900, 42 electronic pages, (BPA Report DOE/BP-00023799-1)

Work during this report period focused on coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), continued water quality monitoring throughout the Wind River basin focused on temperature, water chemistry monitoring in Little Wind River, Paradise Creek, Crater Creek, Panther Creek, and the Upper Wind River, in coordination with USGS to establish baseline information about nutrient levels, continued riparian vegetation monitoring for private landowner projects, refining and prioritizing the WEP list, and preliminary designs for the Middle Wind River Riparian Enhancement Project. Appendix A includes summary of continuous temperature monitoring.

UCD. 2006-2007. Cochrane, T., J. White, and M. Haight. Wind River Watershed Restoration Project; Underwood Conservation District, 2006-2007 Annual Report, Project No. 199801900, 31 electronic pages, (BPA Report DOE/BP-00028164-1)

Work during this report period focused on coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), continued water quality monitoring throughout the Wind River basin focused on temperature, continued riparian vegetation monitoring for private landowner projects, refining and prioritizing a priority project list, and final designs for the Middle Wind River Riparian Enhancement Project. Appendix A includes summary of continuous temperature monitoring. Appendix B includes photo-documentation of Stabler Bend. Appendix C includes tree and weed densities at several restoration sites. Appendix D includes three high priority fish habitat enhancement projects on the middle and lower Wind River. Appendix E includes engineering plans for the Middle Wind River Stream Channel and Riparian Restoration Project.

UCD. 2007-2008. Cochrane, T. and J. Gomez. Wind River Watershed Restoration Project; Underwood Conservation District, 2007-2008 Annual Report, Project No. 199801900, 22 electronic pages, (BPA Report DOE/BP-00033559-1)

Work during this report period focused on coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), continued water quality monitoring throughout the Wind River basin focused on temperature, continued riparian vegetation monitoring, replanting and removal of noxious weeds for private landowner projects. Appendix A includes a map of treated area for scotch broom removal. Appendix B includes tree and weed densities at several restoration sites. Appendix C includes photo-documentation of Stabler

Bend. Appendix D includes the Jursik/Betton/Grilley Cutbank project preliminary drawings and cost estimate. Appendix E includes summary of continuous temperature monitoring.

UCD. 2008-2009. Plummer, E., J. Gomez, and T. Cochrane. Wind River Watershed Restoration Project; Underwood Conservation District, 2008-2009 Annual Report, Project No. 199801900, 14 electronic pages, (BPA Report DOE/BP-00039493-1)

Work during this report period focused on coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), continued water quality monitoring throughout the Wind River basin focused on temperature, continued riparian vegetation monitoring, replanting and removal of noxious weeds for private landowner projects. Appendix A includes a project site map showing the Middle Wind, Jursik/Betton/Grilley and Stabler Bend sites. Appendix B includes a Stabler Bend weed control map and a plant and weed density discussion. Appendix C includes the Middle Wind Site Planting Map. Appendix D includes the Middle Wind Auger Planting photo-documentation.

UCD. 2009-2010. Plummer, E. and T. Cochrane. Wind River Watershed Restoration Project; Underwood Conservation District, 2009-2010 Annual Report, Project No. 199801900, 23 electronic pages, (BPA Report DOE/BP-00049229-1)

Work during this report period focused on coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), continued water quality monitoring throughout the Wind River basin focused on temperature, continued riparian vegetation monitoring, replanting and removal of noxious weeds for private landowner projects, completing engineering and design work for the Little Wind project, and implementing the Jursik/Betton/Grilley cutbank stabilization project, identifying and developing future projects, maintaining large wood structures at the Middle Wind site. Appendix A includes a project site map showing the Middle Wind, Stabler Bend, and Little Wind sites. Appendix B includes a discussion of monitoring plant survival and weeding effectiveness. Appendix C includes the Stabler Bend Planting Site Map. Appendix D includes Stabler Bend photo-monitoring. Appendix E includes Middle Wind Stinger Planting photo-monitoring. Appendix F includes Middle Wind Large Wood Structure Reconstruction photo-monitoring. Appendix G includes Wind River temperature monitoring graphs.

UCD. 2010-2011. Tillinghast, T. Wind River Watershed Restoration Project; Underwood Conservation District, 2010-2011 Annual Report, Project No. 199801900, 29 electronic pages, (BPA Report DOE/BP-00053638-1)

Work during this report period focused on coordination of the Wind River Watershed Council (WRWC) and the Technical Advisory Committee (TAC), continued water quality monitoring throughout the Wind River basin focused on temperature, engineering and design work for the Little Wind River Community Habitat Enhancement Project, identification and development of future projects.

Appendix A includes a project site map showing the Middle Wind, Stabler Bend, and Little Wind sites. Appendix B includes a discussion of monitoring plant survival and weeding effectiveness. Appendix C includes the Stabler Bend Planting Site Map. Appendix D includes Stabler Bend photo-monitoring. Appendix E includes Middle Wind Stinger Planting photo-monitoring. Appendix F includes Middle Wind Large Wood Structure Reconstruction photo-monitoring. Appendix G includes Wind River temperature monitoring graphs.

UCD. 2011-2012. Tillinghast, T., D. Richardson and C. McNeil. Wind River Watershed Restoration Project; Underwood Conservation District, 2011-2012 Annual Report, Project No. 199801900, 30 electronic pages, (BPA Report DOE/BP-00062453-1)

Work during this report period focused on continued water quality monitoring throughout the Wind River basin focused on temperature, engineering, design and implementation of Phase I of the Little Wind Community Habitat Enhancement Project, continued riparian vegetation monitoring, replanting and removal of noxious weeds for private landowner projects, identification and development of future projects, and watershed coordination among project partners. Appendix A includes a Wind River restoration project site map showing the Middle Wind, Stabler Bend, Whisky Creek, and Little Wind sites. Appendix B includes photos and a site map for vegetation projects at six different Wind River sites. Appendix C includes the Little Wind River Community Habitat Restoration Project Phase 1 Completion Memo. Appendix D includes the Watershed Enhancement Project (WEP) list, Updated FY2012. Appendix E includes Wind River temperature monitoring graphs.

UCD. 2013. Tillinghast, T., D. Richardson and C. McNeil. Wind River Watershed Restoration Project; Underwood Conservation District", 1/1/2013 - 12/31/2013 Annual Report, Project No. 1998-019-00, 23 electronic pages, (BPA Report DOE/BP-00062453-2)

Included in this report is a detailed summary of the preparation and execution of Phase 2 of the "Little Wind River Community Habitat Restoration" project and discussion of ongoing continuous stream temperature monitoring.

UCD. 2014. Tillinghast, T., D. Richardson and C. McNeil. Wind River Watershed Restoration Project; Underwood Conservation District, 1/1/2014 - 12/31/2014 Annual Report, Project No. 1998-019-00, 31 electronic pages, (BPA Report DOE/BP-00065828-1)

Work during this report period focused on completing the Little Wind River Community Habitat Restoration Project and ongoing continuous water quality monitoring throughout the Wind River basin focused on temperature. Appendix A includes a summary of the Little Wind River Habitat Restoration Project, including the Phase 3 Completion Memo. Appendix B includes Wind River temperature monitoring data.

US Forest Service (USFS) BPA Annual Reports, 1998-2014

USFS. 2000-2002. Bair, B., A. Olegario, P. Powers, D. Doede, E. Plimmer, and J. Deshong. Wind River Watershed Restoration Project, Segment II, Project No. 1998- 01900, 66 electronic pages, (BPA Report DOE/BP-00000407-1)

Included in this annual report are monitoring and restoration work by the USFS under the Wind River Watershed Restoration Project to BPA from 1999-2001. This document, Segment II, reports only on USFS projects. This report summarizes four main restoration projects (primarily riparian area restoration work in conjunction with LWD placement) completed between 1999-2001, in Trout Creek, Panther Creek, Dry Creek, and the mainstem Wind River. They include: Trout Creek Phase IV, Panther Creek Bank Stabilization (at the Panther Creek Campground), Dry Creek Restoration, and the Mining Reach restoration. Also included are project summaries on road decommissioning efforts, the methodology and results from stream surveys to establish reference reach data as well as presenting data for potential restoration reaches covered here, the riparian revegetation strategies used, and the re-establishment of the USGS discharge gage at Shipherd Falls.

USFS. 2003-2004. Coffin, B., B. Bair, and G. Robertson. Wind River Watershed Project, Annual Report: October 2003 – November 2004. Report to Bonneville Power Administration, Project No. 1998-019-00.

Work during this report period focused on four objectives: coordination, tasks include participating with the Wind River Watershed Council Action Committee and the Technical Advisory Committee (TAC); monitoring, tasks include assisting WDFW to determine adult escapement through redd surveys and snorkeling in Layout creek, Trout Creek and Crater Creek, and adult fish traps at Hemlock Dam and Shipherd Falls; and restoration, with the Upper Trout Creek Restoration Project and the feasibility study and Draft Environmental Impact Statement (DEIS) for the removal of Hemlock Dam, and the Hemlock Dam Fish Ladder Video Camera Recordings, an underwater field study focused on the movement of steelhead through the existing fish ladder. Appendix A is a summary of the DEIS.

USFS. 2004-2005. Coffin, B. and G. Robertson. Wind River Watershed Project, Annual Report: October 2004 – September 2005. Report to Bonneville Power Administration, Project No. 1998-019-00.

Work during this report period focused on operating the Hemlock Dam Adult Steelhead Trap, conducting redd surveys in Trout Creek, East Fork Trout Creek, Compass Creek, Crater Creek, and Upper Trout Creek, conducting additional video recordings monitoring fish movement past Hemlock Dam, operation and maintenance of the Wind River Gage (below Shipherd Falls), extensive riparian restoration including the thinning and consequent instream placement of over 1300 trees in upper Trout Creek and Layout Creek, the rehabilitation of 26 dispersed recreation sites (undeveloped but heavily used camping areas) along the mainstem Wind River, Panther Creek, Falls Creek, Trout Creek, Dry Creek, and Trapper Creek, and the completion of the Hemlock Dam final EIS. Appendix A is a summary of the Hemlock Dam FEIS.

USFS. 2005-2006. Coffin, B. and T. Lawson. Wind River Watershed Project, Annual Report: October 2005 – September 2006. Report to Bonneville Power Administration, Project No. 1998-019-00.

Work during this report period focused on the continued operation of the Hemlock Dam Adult Steelhead Trap, redd surveys in Trout Creek and its tributaries, continued riparian work in the Trout Creek basin, and continued operation and maintenance of the Wind River Gage. Also included are the replacement of a barrier culvert on Mouse Creek and the decommissioning and culvert removal of Road 6801 in the Panther Creek basin.

USFS. 2006-2007. Coffin, B. and T. Lawson. Wind River Watershed Project, Annual Report: December 2006 – November 2007. Report to Bonneville Power Administration, Project No. 1998-019-00.

Work during this report period focused on the continued operation of the Hemlock Dam Adult Steelhead Trap, red surveys in Trout Creek and its tributaries, and the Upper Trout Creek Restoration Project, which included extensive instream and riparian restoration in upper Trout Creek and Layout Creek.

USFS. 2007-2010. Coffin, B. Wind River Watershed Project, Annual Report: December 2007 – November 2010. Report to Bonneville Power Administration, Project No. 1998-019-00.

Work during this report period focused on the continued operation and maintenance of the Wind River Gage, riparian plantings in Trout Creek, Mouse Creek (at the site of the previous road decommissioning) and Trapper Creek, continued monitoring of the Upper Trout Creek

Restoration project, and the removal of a small dam on Maidenhair Creek, a tributary to Trapper Creek. Also included are the NEPA phase of the Upper Wind River Road Decommission project, decommissioning almost 3 miles of road and remove fish passage-barrier-culverts on Oldman and Youngman Creeks, tributaries to the Upper Wind River and the Trapper Creek Side Channel project to remove a previously permitted cabin in order restore access to the side channel.

USFS. 2010-2012. Coffin, B. Forest Service Activities under the Wind River Watershed Project, Annual Report: December 2010 – December 2012. Report to Bonneville Power Administration, Project No. 1998-019-00.

Work during this report period focused on the continued operation and maintenance of the Wind River Gage, the implementation phase of the Upper Wind River Road Decommission Project, the removal of the Martha Creek Dam on Martha Creek, the planning and design phase of the Layout Creek Fish Passage Improvement project. Also included in this report are the preliminary projects identified in the Watershed Restoration Action Plan (WRAP) (See Caballero 2015).

USFS. 1990. GPNF Land and Resource Management Plan. United States Forest Service – Gifford Pinchot National Forest, Vancouver, WA.

This is the Forest Plan for the Gifford Pinchot National Forest. The Plan directs natural resource management activities and establishes management standards in the GPNF. The Plan provides an overview of the forest and its defining characteristics, and chapters discussing: Analysis of the Management Situation (AMS); Issues, Concerns, and Opportunities (ICOs); Forest Management Direction; and Implementation of the Forest Plan. A management area prescription for the Wind River Experimental Forest is included (see Chapter 4, Forest Management Direction, pg 129).

The Plan was updated in 1994, to incorporate changes with regard to the northern spotted owl and its habitat. These amendments and the full plan can be found online: http://www.fs.usda.gov/main/giffordpinchot/landmanagement/planning

USFS. 2001a. Wind River Watershed Analysis (Second Iteration). United States Forest Service--Mt. Adams Ranger District/Gifford Pinchot National Forest.

This analysis updates the original document (USFS 1996), providing updates on HUC delineations (new 6th field HUCs), hydrologic conditions, fisheries information, restoration and monitoring efforts, vegetation conditions, and habitat conditions and connectivity.

Updates include: HUC boundaries went from 26 6th field designations to 8 6th fields to follow federal guidelines on delineation; a roads analysis summary (a separate document, see USFS 2001b) to identify the reason for and impact from each FS road. Also includes a summary of the water quality restoration plan (a separate document), and looks again at upland restoration efforts (road decommissioning) and instream and riparian restoration, updates vegetation information and provides timber harvest recommendations for ten different subwatersheds.

Risk factor analysis and restoration prioritization was repeated on 6th and 7th field watersheds in this iteration, using a higher level of resolution and returning updated results. The highest priority 6th field watersheds identified were: Trout Creek, and the Upper and Middle Wind River. Highest priority 7th field watersheds identified were: Lower Trout Creek (due to Hemlock Dam), Layout Creek, Upper Trout Creek, Middle Wind, Upper Wind, and the Compass/Crater Creek.

Appendix A shows NMFS ratings (Properly Functioning, Functioning At Risk, Not Functioning) for 6th and 7th field watersheds and contains data related to sediment, turbidity, contaminants and nutrients, migration barriers, large woody debris, off-channel habitat and more.

USFS. 2001b. Wind River Watershed Roads Analysis. United States Forest Service--Mt. Adams Ranger District/Gifford Pinchot National Forest.

Created to complement the second iteration of the Wind River Watershed Analysis. Roads were identified as a key element associated with several of the limiting factors discussed in the original 1996 Watershed Analysis document, as well as the WCC's 1999 Limiting Factors Analysis. This report identifies agency and public needs for each FS road in the Wind River basin; assesses the potential impact created from each road, recommend roads as essential, or considered for decommissioning or other treatment, and provides ranking of the roads for future project work. The analysis covers the reported 343 miles (70% of all roads in the watershed) that are managed by the Mt. Adams Ranger District, and was conducted using solely GIS data and existing information.

USFS. DRAFT. The 2011-2013 Wind River Stream Survey Report, Gifford Pinchot National Forest, Mt. Adams Ranger District.

This draft document reports stream survey data collected over three years on the mainstem Wind River, through 12 reaches, spanning River Mile (RM) 8.0 to RM 31.7 (Reach 2, RM 9.3- RM 11.5, was not surveyed due to safety concerns).

Survey information for each reach includes channel characteristics (e.g., gradient, width:depth ratio, bank stability), aquatic habitat (e.g., pool:riffle ratio, LWD, percent fines, pool depths), and fish species observations, with natural migration barriers noted in Reaches 8 and 9. Fish were observed in all reaches, and most tributaries were considered accessible to fish. Specifically, whitefish (*Prosopium williamsoni*), rainbow trout/steelhead trout (*Oncorhynchus mykiss*), and adult Chinook salmon (*Oncorhynchus tshawytscha*) were found in Reaches 1-6, and rainbow trout/steelhead trout (*Oncorhynchus mykiss*) was found in Reaches 7-12. Side channels comprise nearly 27% of available habitat, with the most side channel habitat found in Reach 7 (Falls Creek at RM 22 to RM 25.9 just above Paradise Creek Campground).

LWD was low throughout all reaches, with the majority of wood categorized as small. The lower reaches (RM 8.0-RM 22) were characterized by large, deep pools with good habitat.

Management activities are discussed and recommendations given.

US Geological Survey (USGS) BPA Annual Reports 2000-2014

USGS. 2000-2001. Connolly, P., I. Jezorek, K. Martens. Wind River Watershed Restoration Project, Segment I, Annual Report for 2000-2001, Project No. 1998-01901, 156 electronic pages, (BPA Report DOE/BP-00004973-2)

Report A, the authors provide information on flow, temperature, and habitat conditions in the Wind River subbasin. Personnel from CRRL monitored flows at 12 sites in 2000 and 17 sites in 2001. USGS staff maintained a large array of water-temperature sites in the Wind River subbasin, including data from 25 thermographs in 2000 and 27 thermographs in 2001. Habitat surveys were conducted on 14.0 km in 2000 and 6.1 km in 2001, focused primarily on upper Tout Creek and upper Wind River watersheds, and some reach surveys in the Panther Creek watershed. Data on flow, temperature, and stream reaches have been collected by USGS-CRRL personnel since 1996. Some of the data collected in 2000-2001 were compared to those data available from earlier work. Report B discusses data resulting from extensive fish sampling efforts in the Wind River Watershed, which are an extension of past surveys conducted annually since 1996. Activities include electrofishing, PIT tagging, snorkel surveys, and disease screening for wild fish collected. The report includes the first ever attempt to generate population estimates for the salmonids in this watershed.

USGS. 2002-2003. Connolly, P., I. Jezorek. Wind River Watershed Restoration Project; US Geological Survey Reports, Annual Report for 2002-2003, Project No. 199801900, 80 ELECTRONIC pages, (BPA Report DOE/BP-00004973-3), Submitted January 2006.

During this reporting period, USGS conducted flow monitoring, temperature profiling and habitat surveying throughout the Wind River watershed. Reach-scale habitat data was primarily gathered in the Panther Creek watershed. These data add to the database of habitat and fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2003-2004. Connolly, P., I. Jezorek. Wind River Watershed Restoration Project; US Geological Survey Reports, 2003-2004 Annual Report, Project No. 199801900, 164 electronic pages, (BPA Report DOE/BP-00004973-4), Submitted June 2005.

During this reporting period, USGS conducted flow monitoring, temperature profiling and habitat surveying throughout the Wind River watershed. USGS personnel also conducted juvenile salmonid surveys. Report A focuses on flow, temperature, and habitat conditions, while Report B addresses juvenile steelhead population and other fish sampling. These data add to the database of habitat and fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2004-2005. Connolly, P., I. Jezorek. Wind River Watershed Restoration Project; US Geological Survey Reports, 2004-2005 BPA Annual Report, Project No. 199801900, 128 electronic pages, (Document ID #P108963), Submitted October 2007.

During this reporting period, USGS conducted flow and temperature monitoring as well as habitat data collection throughout the Wind River watershed. USGS personnel also conducted juvenile salmonid population surveys. These surveys expanded to include the mainstem Wind River to assess effects of non-indigenous Chinook on native steelhead. These data add to the database of habitat and fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2005-2006. Connolly, P., I. Jezorek. Wind River Watershed Restoration Project; US Geological Survey Reports, 2005-2006 BPA Annual Report, Project No. 199801900, 35 electronic pages, (Document ID #P108962), Submitted November 2007.

During this reporting period, USGS conducted flow and temperature monitoring throughout the Wind River watershed. USGS personnel also conducted juvenile salmonid surveys. These data add to the database of habitat and fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2006-2007. Connolly, P., I. Jezorek. Wind River Watershed Restoration Project; US Geological Survey Reports, 2006-2007 BPA Annual Report, Project No. 199801900, 28 electronic pages, (Document ID #P108888), Submitted December 2007.

During this reporting period, USGS conducted flow and temperature monitoring throughout the Wind River watershed. USGS personnel also conducted juvenile salmonid surveys. These data add to the database of habitat and fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2007-2008. Jezorek, I., C. Munz, P. Connolly. Wind River Watershed Restoration Project; US Geological Survey Reports, 2007-2008 BPA Annual Report, Project No. 199801900, 11 electronic pages, (Document ID #P114143), Submitted November 2009.

During this reporting period, USGS conducted temperature monitoring throughout the Wind River watershed and assisted with smolt trapping and tagging of smolt and parr steelhead with PIT tags. A PIT tag interrogation system was installed in Marth Creek, and two other system setups were maintained and monitored in the fish ladder at Hemlock Dam. These data add to the database of habitat and fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2008-2009. Connolly, P., I. Jezorek, C. Munz. Wind River Watershed Restoration Project; US Geological Survey Reports, 2008-2009 BPA Annual Report, Project No. 199801900, 10 electronic pages, (Document ID #P119520), Submitted November 2010.

During this reporting period, USGS conducted temperature monitoring, focused on the Trout Creek watershed, and assisted with smolt trapping and tagging of smolt and parr steelhead with PIT tags. USGS personnel also maintained PIT tag interrogation system setups in Trout Creek and in the fish ladder at Hemlock Dam. These data add to the database of habitat and fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2009-2010. Connolly, P., I. Jezorek, C. Munz. Wind River Watershed Restoration Project; US Geological Survey Reports, 2009-2010 BPA Annual Report, Project No. 199801900, 8 electronic pages, (Document ID #P120931), Submitted April 2011.

During this reporting period, USGS conducted temperature monitoring, focused on the Trout Creek watershed, and assisted with smolt trapping and tagging of smolt and parr steelhead with PIT tags. USGS personnel also maintained a PIT tag interrogation system setup in Trout Creek. These data add to the database of habitat and fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2010-2011. Connolly, P., I. Jezorek, C. Munz. Wind River Watershed Restoration Project; US Geological Survey Reports, 2010-2011 BPA Annual Report, Project No. 199801900, 21 electronic pages, Submitted March 2012.

During this reporting period, USGS work focused on PIT-tagging parr steelhead and establishing a network of instream PIT tag interrogation systems. PIT tagging primarily occurred in headwater sections of the subbasin. The PIT tag system was maintained in Trout Creek. Temperature loggers were also maintained near the PIT tagging sites. The PIT-tagged parr steelhead will provide movement and life history data through recapture events and detections at instream PIT tag systems. These data add to the database of fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2011-2012. Jezorek, I., P. Connolly. Wind River Watershed Restoration Project; US Geological Survey Reports, 2011-2012 BPA Annual Report, Project No. 199801900, 41 electronic pages, (Document ID #P133526), Submitted August 2013.

During this reporting period, USGS work focused on PIT-tagging parr steelhead and establishing a network of instream PIT tag interrogation systems. PIT tagging primarily occurred in headwater sections of the subbasin. The PIT tag system was maintained in Trout Creek, and new systems were installed in the Wind River, Trapper Creek, Paradise Creek, and the upper Wind River. Temperature loggers were also maintained near the PIT tagging sites. The PIT-tagged parr steelhead will provide movement and life history data through recapture events and detections at instream PIT tag systems. These data add to the database of fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2012-2013. Jezorek, I., P. Connolly. Wind River Watershed Restoration Project; US Geological Survey Reports, 2012-2013 BPA Annual Report, Project No. 199801900, 45 electronic pages, (Document ID #P138064), Submitted May 2014.

During this reporting period, USGS work focused on PIT-tagging parr steelhead. A network of instream PIT tag interrogation systems was maintained to monitor movement of these fish. Long-term monitoring of PIT-tagged fish over multiple years will provide information on various life-histories and their effect to smolt production and adult returns. Adult steelhead movement is helping to assess the efficacy of the removal of Hemlock Dam from Trout Creek (removed in summer 2009).

PIT tagging primarily occurred in Trout Creek and upper Wind River. The PIT tag systems were maintained in Trout Creek, the upper Wind River, Paradise Creek, and the upper Mine Reach of the Wind River, and a new system was installed in Martha Creek. Temperature loggers were also maintained near the PIT tagging sites. These data add to the database of fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

USGS. 2014. Jezorek, I., P. Connolly. Wind River Watershed Restoration Project; US Geological Survey Reports, 2014 BPA Annual Report, Project No. 199801900, 58 electronic pages, (Document ID #P144015), Submitted May 2015.

During this reporting period, USGS work focused on PIT-tagging parr steelhead. A network of instream PIT tag interrogation systems was maintained to monitor movement of these fish. Long-term monitoring of PIT-tagged fish over multiple years will provide information on various life-histories and their effect to smolt production and adult returns. Adult steelhead movement is helping to assess the efficacy of the removal of Hemlock Dam from Trout Creek (removed in summer 2009).

PIT tagging primarily occurred in Trout Creek and upper Wind River. The PIT tag systems were maintained in Trout Creek, the upper Wind River, Paradise Creek, and the upper Mine Reach of the Wind River, Martha Creek, and a new system was installed in Trout Creek at the 43 bridge. Temperature loggers were also maintained near the PIT tagging sites. These data add to the database of fish data collected in the Wind River since 1996 as part of the Wind River Restoration Project.

Washington Conservation Commission. 1999. WRIA 29 Salmonid Habitat Limiting Factors Analysis Report. Olympia, WA.

Much discussion within this report is given to the concept of limiting factors, or in other words, those habitat impacts or conditions which act as bottlenecks on a given species by reducing its numbers below a natural carrying capacity. The report describes Columbia Basin anadromous fish species and the Wind River subbasin's physical characteristics. The report outlines three major defining features for fish in the Wind River subbasin – fire, flows and Shipherd Falls – and all three have been altered in the past century. E.g., on USFS land, the shift away from late successional trees (those >21" dbh) as a percentage of cover went from 58% in 1850 to 44% in 1950 to 22 in the late 1990s.

Four categories of limiting factors in the Wind are discussed: Channel conditions, passage, water quality, and water quantity. These factors are generally caused by "site problems" creating a causal domino effect, such as the loss of riparian cover leading to a paucity of LWD and excessive sedimentation. The authors suggest that correcting site problems on the landscape will correct the major limiting factors. They outline a formula to rank site problems that include factors such as stream miles affected by a given problem, the severity of clean water impacts, the number of limiting factors influenced, and others. Finally, they rank 37 top problem sites limiting salmonid habitat in the Wind subbasin.

Washington Department of Fisheries, 1951. Lower Columbia River Fisheries Development Program, Grays River Area, Wash., August 1951. Preliminary Draft.

This report from the Washington Department of Fisheries has extended discussions of abundance and commercial value of salmon species and steelhead by watershed. The Wind River watershed discussion starts at page 220, and includes observations on anadromy along the mainstem and main tributaries, including then-current spawning areas. The report features a small set of historic data, including water year flows (1935-47) and fall Chinook egg-take records (pounds of eggs removed from the system to support the hatchery: 1899-1938). Annual steelhead runs at the time were estimated at 2,500 fish. The report notes the presence of a mill dam at RM 14 blocking upstream passage until its removal in 1947. Additional aspects of the report may be useful for their historic, and ultimately humbling, insights into perceived ecosystem function at the time, including the log jams on Cedar Creek and other tributaries "obstructing fish".

Washington Department of Fish and Wildlife (WDFW) BPA Reports

WDFW. 2000-2004. Rawding D. and P.C. Cochran. Wind River Winter and Summer Steelhead Adult and Smolt Population Estimates from Trapping Data, 2000-2004 Technical Report, Project No. 199801900, 35 pages, BPA report DOE/BP-00004276-1. Submitted November 2005.

From 2000 to 2004, wild steelhead smolt production was estimated for the Wind River, and key subwatersheds in Trout Creek, Panther Creek, and the upper Wind River. The number of smolts emigrating past these sites averaged 22,369, 1,665, 932, and 1,670, respectively. Smolts emigrating from Panther Creek, Trout Creek, and Upper Wind River accounted for an average 4%, 7%, and 7% of the total smolt production, respectively.

Wild steelhead in this basin appear to have developed a life history strategy where spawning and early rearing occurs in the headwaters and tributaries, followed by an age-1 parr emigration to canyon reaches of the mainstem Wind River during the spring to finish freshwater rearing. Total smolt abundance at each location was approximately 50% of the average during 2002, due to a low adult spawning escapement in 2000. Adult summer steelhead escapement was estimated using four different mark-recapture methodologies. Adult wild summer steelhead abundance increased from 193 adults in brood year 2000 to 1,067 adults in brood year 2003. Escapement estimates for wild winter steelhead in the Wind River ranged from 20 to 51 fish. The Wind River wild steelhead population was comprised of 3% to 11% winter steelhead from 2000 to 2004.

WDFW. 2004-2005. Rawding, D. and P. Cochran. Wind River Winter and Summer Steelhead Adult and Smolt Population Estimates from Trapping Data, 2004-2005 Annual Report, Project No. 199801900, 30 electronic pages, (BPA Report DOE/BP-0019617-1). Submitted May 2005.

This memorandum reports on trapping and fish-estimating efforts in 2004 and 2005 in major subwatersheds of the Wind River system: Wind River mainstem, Trout Creek, Panther Creek, and the Upper Wind. The number of smolts estimated to be emigrating past these sites in 2005 was 42,846, 3,786, 1,410, and 3,634, respectively. Smolts emigrating from Trout Creek, Panther Creek, and Upper Wind River accounted for 9%, 3%, and 8% of the total smolt production, respectively, with the majority of the remaining production (80%) coming from the mainstem Wind River below these traps. Adult wild summer steelhead abundance for 2005 spawners was estimated to be 542 fish. The escapement estimate for wild winter steelhead in the Wind River was 22 adults.

WDFW. 2005-2006. Rawding D. and P.C. Cochran. Wind River Winter and Summer Steelhead Adult and Smolt Population Estimates from Trapping Data, 2005-2006 Annual Report, Project No. 199801900, 43 pages, (BPA report DOE/BP-00019617-2). Submitted January 2007.

In 2006, wild steelhead smolt production was estimated for the Wind River and key subwatersheds. A total of 19,125 smolts were estimated to emigrate from the Wind River subbasin, including 1,428 from the Trout Creek subwatershed, 961 from the Panther Creek subwatershed, and 2,044 from the Upper Wind River. Smolts emigrating from Trout Creek, Panther Creek, and the Upper Wind River accounted for 7%, 5%, and 11% of the total smolt production from the Wind River, respectively. The remaining 77% of the smolts originated from the middle and lower mainstem of the Wind River. Adult summer steelhead escapement was estimated using four different mark-recapture methods. The wild summer steelhead abundance was estimated to be 648 fish; the wild winter steelhead escapement was estimated at 38 adults.

WDFW. 2007a. Cochran P.C. and D. Rawding. Preliminary 2007 steelhead smolt monitoring results. Memorandum to BPA on project no. 199801900, 3 pages, BPA report P103590. Submitted August 2007.

Preliminary estimates of steelhead smolt outmigration have been completed for 2007 from the Wind River basin, as well as four production areas within the basin, using data from the four screw trap monitoring sites. An estimated 19,291 wild smolts outmigrated from the Wind basin in 2007. Estimates from Trout Creek, Panther Creek, upper Wind, and the middle/lower Wind areas were 1,529, 1,115, 1,520 and 15,127 smolts, respectively. Biological and life history data were collected from steelhead smolts in addition to abundance estimates. WDFW tagged 2,724 wild steelhead smolts with PIT tags.

WDFW. 2007b. Cochran P.C. Preliminary 2007 summer steelhead estimate in the Wind River. Memorandum to BPA on project no. 199801900, 3 pages, BPA report P105276. Submitted September 2007.

The Wind River was snorkeled from Dry Creek to Shipherd Falls on September 12-13, 2007. Preliminary data analysis from August and September snorkel surveys and from the Trout Creek adult trap is 430 wild, summer steelhead. Additional estimates, 1999-2007, are presented in this graph:

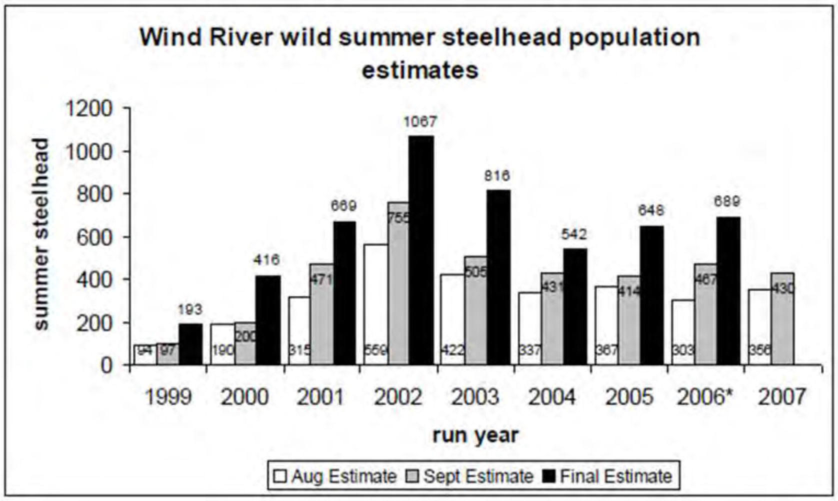

Figure 1. Summer steelhead population estimates in the Wind River from snorkel surveys (August and September) and the Jumper method (final) for run years 1999-2007 (spawn year 2000-2008).

WDFW. 2006-2007. Rawding D. and P.C. Cochran. Steelhead and Spring Chinook Salmon Smolt and Adult Population Estimates from Trapping Data in the Wind River, 2007. Memorandum to BPA on project no. 199801900, 33 pages, BPA report P106695. Submitted January 2008.

Wild steelhead smolt production was estimated for the Wind River and key subwatersheds in 2007. A total of 19,291 smolts were estimated to emigrate from the Wind River subbasin, including 1,514 from the Trout Creek subwatershed, 1,104 from the Panther Creek subwatershed, and 1,520 from the Upper Wind River.. Smolts emigrating from Trout Creek, Panther Creek, and the Upper Wind River accounted for 8%, 6%, and 8% of the total smolt production from the Wind River, respectively. The remaining smolt production of 15,153 (78%) emigrated from the middle and lower mainstem of the Wind River. The wild summer steelhead abundance was estimated to be 689 fish; the wild winter steelhead escapement was estimated to be 22 adults. The spawning escapement of spring Chinook salmon was estimated to be 359 fish.

WDFW. 2008a. Cochran P.C., D. Rawding, and B. Glaser. Wind River Snorkel Survey Results. Memorandum to BPA on project no. 199801900, 3 pages, BPA report P108417. Submitted August 2008.

This was the 20th consecutive season that WDFW has conducted an August snorkel survey on the Wind River. The objectives of the snorkel survey are to obtain a count of steelhead for trend comparison with the previous 19 years, and to provide mark/resight data for estimating the number of steelhead in the river at the time of the survey. The adjusted total is 103 wild steelhead in the snorkel survey index area. Raw and adjusted steelhead and spring Chinook index counts, by section, are reported in this document, as is a summary of snorkel counts since 1988 and the wild steelhead index since 1988.

WDFW. 2008b. Cochran P.C. and D. Rawding. Preliminary 2008 summer steelhead estimate in the Wind River. Memorandum to BPA on project no. 199801900, 2 pages, BPA report P109675. Submitted September 2008.

The Wind River was snorkeled from Dry Creek to Shipherd Falls on September 11-12, 2008. The September population estimate, using pooled counts and data from the Trout Creek adult trap, is 368 wild summer steelhead. August and September snorkel survey and final summer steelhead population estimates for the 1999-2007 run years are reported in this memorandum.

WDFW. 2008. Rawding D. and P.C. Cochran. Steelhead and Spring Chinook Salmon Smolt and Adult Population Estimates from Trapping Data in the Wind River, 2008. Project no. 199801900, 34 pages, BPA report P115305. Submitted August 2009.

Wild steelhead smolt production was estimated for the Wind River and key subwatersheds in 2008. A total of 28,582 smolts were estimated to emigrate from the Wind River subbasin, 1,486 from the Trout Creek subwatershed, 636 from the Panther Creek subwatershed, and 806 from the Upper Wind River. Smolts emigrating from Trout Creek, Panther Creek, and the Upper Wind River accounted for 5%, 2%, and 3% of the total smolt production from the Wind River, respectively. The remaining smolt production of 25,654 (90%) emigrated from the middle and lower mainstem of the Wind River. The wild summer steelhead abundance was estimated to be 637 fish; the wild winter steelhead escapement was estimated to be 22 adults. The spawning escapement of spring Chinook salmon was estimated to be 69 fish.

WDFW. 2009. Rawding D. and P.C. Cochran. Steelhead Smolt and Adult Population Estimates from Trapping Data in the Wind River, 2009. Project no. 199801900, 34 pages, BPA report P117760. Submitted May 2010.

Wild steelhead smolt production was estimated for the Wind River and key subwatersheds in 2009, yielding an estimated total of 25,177 smolts emigrating from the Wind River subbasin, including 2,675 from the Trout Creek subwatershed, 1,096 from the Panther Creek subwatershed, and 1,458 from the Upper Wind River. Smolts emigrating from Trout Creek, Panther Creek, and the Upper Wind River accounted for 11%, 4%, and 6% of the total smolt production from the Wind River. The remaining smolt production of 19,947 (79%) emigrated from the middle and lower mainstem of the Wind River. Adult summer steelhead escapement was estimated using four different mark-recapture methods. The wild summer steelhead abundance was estimated to be 542 fish.

WDFW. 2010. Cochran P.C., D. Rawding and B. Glaser. Wind River Snorkel Survey Results. Memorandum to BPA on project no. 199801900, 2 pages, BPA report P118518. Submitted August 2010.

This was the 22nd consecutive season that WDFW has conducted an August snorkel survey on the Wind River. The objectives of the snorkel survey are to obtain a count of steelhead for trend comparison with the previous 21 years, and to provide mark-resight data for estimating the number of steelhead in the river at the time of the survey. Adult spring Chinook salmon and Chinook redds were counted where present. Juvenile steelhead and salmon, mountain whitefish and resident rainbow trout (trout greater than 12") were observed but not enumerated. A total of 349 steelhead were counted in the Dry Creek to Shipherd Falls index area (331 wild, 3 hatchery and 15 unknown). The adjusted count is 346 wild steelhead in the snorkel survey index area. Raw and adjusted steelhead and spring Chinook index counts, by section, are reported in this memorandum, along with a summary of snorkel counts since 1988. Snorkelers counted 66 tagged and 265 untagged steelhead on August 5. The population estimate is 967 with a range of 833-1,190 and a coefficient of variation (CV) of 9%.

WDFW. 2010. Rawding D. and P.C. Cochran. Steelhead Smolt and Adult Population Estimates from Trapping Data in the Wind River, 2010. Project no. 199801900, BPA report P122313. Submitted July 2011.

Wild steelhead smolt production was estimated for the Wind River and key subwatersheds in 2010, yielding a total of 19,683 smolts estimated having emigrated from the Wind River subbasin, including 2,645 from the Trout Creek subwatershed, 976 from the Panther Creek subwatershed, and 2,074 from the Upper Wind River. Smolts emigrating from Trout Creek, Panther Creek, and the Upper Wind River accounted for 13%, 5%, and 11% of the total smolt production from the Wind River, respectively. The remaining smolt production of 13,988 (71%) emigrated from the middle and lower mainstem of the Wind River. The wild summer steelhead abundance was estimated to be 729 fish; the wild winter steelhead escapement was estimated to be 40 adults.

WDFW. 2011. Rawding D. and P.C. Cochran. Steelhead Smolt and Adult Population Estimates from Trapping Data in the Wind River, 2011. Project no. 199801900, 32 pages, BPA report P128223. Submitted January 2012.

Wild steelhead smolt production estimated: A total of 18,513 smolts were estimated to emigrate from the Wind River subbasin, including 2,651 from the Trout Creek subwatershed, 1,200 from the Panther Creek subwatershed, and 1,430 from the Upper Wind River. Smolts emigrating from Trout Creek, Panther Creek, and the Upper Wind River accounted for 14%, 6%, and 8% of the total smolt production from the Wind River, respectively. The remaining smolt production of 13,232 (72%) emigrated from the middle and lower mainstem of the Wind River. The wild winter steelhead escapement was estimated to be 19 adults based on expanded trap counts, and redd surveys below Shipherd Falls.

WDFW. 2012a. Cochran P.C. Preliminary 2013 summer steelhead estimate in the Wind River. Memorandum to BPA, on project no. 1998-019-00, 3 pages, BPA report P129748. Submitted September 2012.

This memorandum reports on snorkel surveying from Dry Creek to Shipherd Falls in Sept. 13-14, 2012, and preliminary data analysis. WDFW and personnel from USGS and community volunteers typically snorkel the Wind River in mid-August and again in mid-September to estimate wild summer steelhead adult abundance using a mark-resight method. (The August survey was not completed in 2012, for the first time since 1998, due to staff time demands.) The pooled estimate from the September 2012 effort was 551 wild summer steelhead. (Data from snorkel surveys and other methods are gathered and reported in WDFW's escapement summary documents.)

WDFW. 2012b. Cochran P. C., T.W. Buehrens, and D. Rawding. Steelhead Smolt and Adult Population Estimates from Trapping Data in the Wind River, 2012. Project no. 199801900, 35 pages, BPA report P133046. Submitted July 2013.

Wild steelhead production was estimated for the Wind River and key subwatersheds in 2012 for a total of 14,051 smolts estimated to have emigrated, including 1,791 from the Trout Creek subwatershed, 706 from the Panther Creek subwatershed, and 776 from the Upper Wind River. Smolts emigrating from Trout Creek, Panther Creek, and the Upper Wind River accounted for 13%, 5% and 5% of the total smolt production from the Wind River. The remaining smolt production of 10,925 (77 %) emigrated from the middle and lower mainstem of the Wind River. Adult summer steelhead escapement was estimated for spawn year 2012 at 796; the wild winter steelhead escapement was estimated to be 21 adults.

WDFW. 2014. Buehrens, T.W., P.C. Cochran and D. Rawding. Abundance and Productivity of Wind River Steelhead and Preliminary Assessment of their Response to Hemlock Dam Removal, 2013. Project no. 199801900, 45 pages, BPA report P137072. Submitted 2014.

This report details early stages of post-Hemlock Dam fish response and ongoing steelhead life history monitoring in the Wind River subbasin, including key tributaries of Trout Creek, Panther Creek and the Upper Wind River. A total of 32,459 smolts were estimated to have emigrated from the Wind River basin, including 2,731 from Trout Creek, 1,286 from Panther Creek, and 1,461 from the Upper Wind River. Smolts emigrating from Trout Creek, Panther Creek, and the

Upper Wind River accounted for 8%, 4%, and 5% of the total smolt production from the Wind River. The remaining smolt production of 26,981 (83%) emigrated from the middle and lower mainstem of the Wind River. A high percentage of the smolts produced from the middle and lower Wind River reaches immigrated into this area the previous spring as parr. Wind Basin smolt abundance in 2013 was the second highest since monitoring began. Adult summer steelhead escapement was estimated for spawn year 2013 at 740.The wild winter steelhead escapement was estimated to be 23 adults based on expanded trap counts, and redd surveys below Shipherd Falls.

WDFW. 2015a. Buehrens, T.W., P.C. Cochran, and D. Rawding. Abundance and Productivity of Wind River Steelhead and Preliminary Assessment of their Response to Hemlock Dam Removal, 2014. Project No. 199801900, 48 pages, BPA Report P143484. Submitted January 2015.

This report serves to summarize an intensive monitoring effort by WDFW over calendar year 2014, with the two main purposes of (1) measuring the population status and trends of threatened Wind River wild summer steelhead and (2), its response to habitat-improvement activities in the watershed, principally the 2009 removal of the USFS Hemlock Dam in the Trout Creek tributary subbasin. WDFW's efforts at life-cycle monitoring of wild steelhead has included estimating smolt abundance in the three headwater subbasins (Upper Wind, Trout Creek and Panther Creek) and at the confluence with the Columbia River, and adult total population abundance, using trapping and snorkeling mark-resight methods, as well as the "jumper" method of estimation. In the 2000-2014 period, smolt abundance has ranged from 8,021 to 42,846, and the population of adult steelhead above Shipherd Falls (at RM 2.1) ranged from 227 to 1,483 per year. In 2014, the smolt estimate was 27,094 from the Wind River system, including 3,984 from the Trout Creek subbasin, 835 from Panther Creek, and 1,372 from the Upper Wind; or, in other words, 15%, 3% and 5% of the total smolt production in the Wind River system, respectively. The remaining 20,904 (77%) emigrated from the middle and lower mainstem of the Wind River. Researchers believe many of these immigrated into the middle and lower reaches from the tributary subbasins the previous spring. The report also details spawner to adult return rates.

The second point of study elucidated by this report is the response of steelhead to the 2009 removal of Hemlock Dam on Trout Creek. Long-term monitoring allows for testing a dozen dam-removal hypotheses by WDFW and USGS researchers. However, statistical analysis to detect significant changes in Trout Creek smolt and adult abundance in response to the newly opened habitat will require, the authors write, at least 10 years of post-dam monitoring, due to variability in fish survival and other responses. Preliminary results, they write, suggest that smolt and adult abundance may be increasing in Trout Creek relative to other areas of the Wind

River system. This report outlines in some detail fish-related data collection and analysis methods.

WDFW. 2015b. Cochran P. C. and T. Buehrens. Estimates of wild Wind River steelhead escapement, Brood Year 2015. Memorandum to BPA on project no. 199801900, 6 pages, BPA report P144855 and 2 other reports (132839, P108494).

This report summarizes trapping, tagging and snorkeling data for spawn year 2015 in the Wind River, and the resulting population estimates of adult steelhead using those three data-sets plus the "jumper method. In the current year, wild adult summer steelhead are estimated at 577 from the "jumper method," and 606 from a snorkel count. The wild summer estimate above Shipherd Falls was 10 fish. This report includes earlier years' data. These earlier data were reported in memoranda of the same title ("Estimates of wild Wind River steelhead escapement, Brood year X"), as BPA reports P132839 and P108494.

Wieman, K. 1999. Wind River Watershed Restoration Project, Vol. III of III. Project No. 1990-01900, 35 electronic pages, BPA Report DOE/BP-09728-3.

Volume III of III (see Connolly et al 1999). Assessment of Hemlock Dam impact on fishery, and restoration options.

WRIA 29 Instream Flow Committee. 2005. Watershed Management Plan for Western Water Resource Inventory Area 29 (Western WRIA 29). Skamania County Department of Planning and Community Development: Stevenson, Washington.

Following state law and with a grant from Department of Ecology, Skamania County hosted a number of meetings with a wide range of stakeholders in WRIA 29 between 1999 and the end of 2005. Western WRIA areas ("WRIA 29a"), including the subbasins of Rock Creek, the Little White Salmon River and Wind River, were studied separately from areas of Klickitat County. This Management Plan resulted in several key findings and some 54 recommendations. Key findings stated that a lack of water quantity and water quality data made in-depth analysis difficult, including whether low stream flows were adequate for fish and human needs ("Concern exists regarding the supply of sufficient, clean water in the Carson area, as well as in several small undocumented, grandfathered, community water systems serving many of Western WRIA 29's residents.") and that several streams suffered from high temperatures and excessive sediment deposition. The thrust of the Plan's recommendations was to encourage the collection of additional water quantity and quality data.

Chapter 4 of the Plan specifically discussed the Wind River subbasin. Here, precipitation averages 103", with ~60" annually at the mouth and ~125" in the upper basin, peaking in winter months as snow and rain-on-snow events and dipping as low summer flows. (See table below.) Several flow

studies are cited: see Plan references. Consultants study stream flows in the early 2000s concluded that the aquifers, especially in the Trout Creek area, responds quickly both to withdrawals and to precipitation recharge; and that consumptive uses in the watershed depleted only about 2.4% (3.9 cfs) during low summer flows, but that total allocations were set at ~200 cfs – compared to 164 cfs during the mainstem river's low flow period. In other words, "there could be low flow problems in the summer months."

Additionally, the Plan stated that there were 181 miles of fish-bearing streams in the subbasin, and the Wind River was approximately 31 miles long. Water temperatures in "many areas" were high enough to stress fish. High temperatures were said to be caused in large part by loss of riparian forest cover, channel-widening and low summer flows, exacerbated by excessive fine sediments, lack of instream LWD and bank instability.

Table 6: Peak and Low Mean Monthly Flows in the Wind River

Gauge:	#14-128000 Panther Creek	#14-127000 Above Trout Crk	#14-128500 Carson
Drainage Area	30.1 mi^2	108 mi^2	225 mi^2
Peak Mean Flow	321 cfs (Feb.)	955 cfs (Dec.)	2,138 cfs (Feb.)
Low Mean Flow	64 cfs (Sep.)	101 cfs (Sep.)	235 cfs (Sep.)

Yinger, M. 2012. Skamania County PUD #1 / Carson Water System Phase One Report: Cost Reimbursement Option for Processing Water Right Application. 44 electronic pages.

This report, written for Skamania County Public Utility District No. 1 (PUD), is aimed at delineating the boundaries of the source aquifer, investigating the source aquifer's continuity with surface waters and identifying senior applications requesting water from the same source aquifer. This process is part of a cost reimbursement agreement with the state in order to expedite decision-making on its water right applications for two existing wells located in the northern portion of the PUD's service area: the Industrial Park Well and the Linde Well. The PUD's new water right applications to the state request an additional 50 gallons per minute from the Industrial Well and a total of 4.39 cubic feet per second from both wells. The report describes and maps the hydrogeologic setting of the Wind River Valley, and describes that the source aquifer for each well is in hydraulic connection with the Wind River, Panther Creek and Trout Creek. The majority of consumptive water use from these wells would not likely be returned to the source aquifer, as it would be used south of the source aquifer boundary. [Ecology has stated they are not planning to issue water rights until the process has begun for setting instream flows.]

Other Data with relevance to the Wind River Basin

Description	Source	Date
GIS files		
LiDAR coverage of portions of the WR basin	Oregon DOGAMI	October 2016
Tax Parcels	Skamania County / Contact Assessor's Office; view parcels online: http://www.skamaniacounty.org/assessor/assessor/mapsifter/	Ongoing
Fish Passage Barrier Inventory Database	WA Dept. of Fish & Wildlife (WDFW)	2015
Washington 303d List	WA Dept. of Ecology (ECY)	2012
National Hydrography Dataset	US Geological Survey (USGS)	2015
DNR WCHYDRO stream layer	WA Dept. of Natural Resources (WA DNR)	
Roads layers from Skamania County, USFS, WA DNR	Various	Various
EDT reach tier layer	Lower Columbia Fish Recovery Board (LCFRB)	
Riparian Buffers (minimum vegetation buffers based on stream type)	ECY	2013
Aerial Photos		
ESRI aerial imagery and topography	Environmental Systems Research Institute (ESRI), online basemaps, ArcMap 10.3.1	2015

Description	Source	Date
Other data, reports, and information		
Wind River flow gage near Carson, WA (USFS gage)	National Oceanic & Atmospheric Administration (NOAA) http://www.water.weather.gov/ahps2/hydrograph.php?wfo=pqr&gage=wcnw1	Ongoing
Wind River Instream Flow Data. Discharge (cfs) and stage (height) readings from six stations historically, one currently (at the Stabler bridge).	ECY https://fortress.wa.gov/ecy/eap/flows/regions/state.asp?stationfilter=1&region=	Ongoing; data primarily from 2008-2012, with some ongoing data collection
Watershed Enhancement Project ideas / internal spreadsheets (WEP List)	Underwood Conservation District (UCD)	Periodically updated, approx. 2000-2013
Water Quality Data, focus on continuous temperature data	UCD	Ongoing; datasets begin 1999.
• WDFW Salmonid Stock Inventory (SaSI): Final Adult escapement estimates: https://fortress.wa.gov/dfw/score/score/species/population_details.jsp?stockId=6805 & https://fortress.wa.gov/dfw/score/score/species/population_details.jsp?stockId=6810 • WDFW statewide Juvenile Migrant Exchange (JMX): all juvenile data; final juvenile estimates • Wind Project Access Database: all data • PTAGIS: all project juvenile and adult PIT tag data	WDFW	Various

Description	Source	Date
Unpublished fisheries and habitat data (summaries included in BPA reports)	USGS	Various
Investigative reports on wells and potential well development	Skamania County Public Utilities District #1	Ongoing; including 2006, 2007, 2008 and on
Wind River Fish Passage Inventory (scheduled for completion Fall 2016)	UCD	2014-2016
Columbia River Instream Atlas (CRIA) habitat ranking process, data, and tools for WRIA 29A	WDFW, Ecosystem Restoration Division, Habitat Program in Vancouver, WA	Ongoing: anticipated to be complete by Sept. 2016
NorWest Temperature database	US Forest Service (USFS); http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html	Ongoing
Stream Survey Reports for tributaries to the Wind River including: Dry Creek (1992 & 2015), Panther Creek (2001), Little Wind River (2007), Martha Creek (2010), Eightmile Creek (1994), Paradise Creek (1993), Upper Wind River (1996), Trout Creek (2008) and Wind River (1991, 1993, 2001), plus others	USFS; Wind River Ranger District, Mt. Adams Ranger District	1988-2015
Land Status and Cadastral Survey Records	US Bureau of Land Management (BLM); http://www.blm.gov/or/landrecords/survey/ySrvy1.php	Various

Appendix C – Habitat Attribute Definitions

Habitat attribute definitions used to rate reach-level conditions. The source for attribute definitions is provided in brackets.

Reach Attribute	Good	Fair	Poor
Riparian condition	At least a 100 ft. riparian buffer with: > 80% mature trees, or consistent with potential native community < 20% riparian disturbance (human) > 80% canopy closure in the riparian zone. Three seral stages represented [Reach Based Ecosystem Indicators, e.g. USBR 2012]	25 to 100 ft. riparian buffer with: 50 to 80% mature trees < 20% riparian disturbance (human) > 80% canopy closure in the riparian zone. Two seral stages represented [Reach Based Ecosystem Indicators, e.g. USBR 2012]	Less than 25' buffer width <50% mature trees One seral stage represented [Reach Based Ecosystem Indicators, e.g. USBR 2012]
Floodplain connectivity	Floodplain areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession. Minimal human disturbance of the floodplain. <2mi/mi² road density in the floodplain [adapted from NFMS 1996]	Reduced linkage of wetland, floodplains and riparian areas to main channel, overbank flows are reduced relative to historical frequency as evidenced by moderate degradation of wetland function, riparian vegetation/succession 2-3 mi/mi² road density in the floodplain [adapted from NFMS1996]	Reduced linkage of wetland, floodplains and riparian areas to main channel, overbank flows are reduced relative to historical frequency as evidenced by moderate degradation of wetland function, riparian vegetation/succession >3 mi/mi² road density in the floodplain [adapted from NFMS 1996]
Bank condition / Channel migration	Channel is migrating at or near natural rates. Minimal bank armoring or human-induced erosion. [Reach Based Ecosystem Indicators, e.g. USBR 2012]	Limited amount of channel migration is occurring at a faster/slower rate relative to natural rates, but significant change in channel width or planform is not detectable; large woody material is still being recruited. [Reach Based Ecosystem Indicators, e.g. USBR 2012]	Little or no channel migration is occurring because of human actions preventing reworking of the floodplain and large woody material recruitment; or channel migration is occurring at an accelerated rate such that channel width has at least doubled, possibly resulting in a channel planform change, and sediment supply has noticeably increased from bank erosion. [Reach Based Ecosystem Indicators, e.g. USBR 2012]
Vertical channel stability	No measurable trend of human-induced aggradation or incision. [adapted from Reach Based Ecosystem Indicators, e.g. USBR 2012]	Measureable trend of aggradation or incision that has the potential to but not yet caused disconnection of the floodplain or a visible change in channel planform (e.g., single thread to braided).	Enough incision that the floodplain and off-channel habitat areas have been disconnected; or, enough aggradation that a visible change in channel planform has occurred (e.g., single thread to braided).

Reach Attribute	Good	Fair	Poor
Pools (quantity/quality)	Pools have good cover and cool water and only minor reduction of pool volume by fine sediment. Many large pools >3 ft. deep with good fish cover. Pool frequency dependent upon channel width* (5' width = 184 pools/mi, 10' = 96 pools/mi, 15' = 70 pools/mi, 20′ = 56 pools/mi, 25′ = 47 pools/mi, 50′ = 26 pools/mi, 75′ = 23 pools/mi, 100′ = 18 pools/mi) [Reach Based Ecosystem Indicators, e.g. USBR 2012, and NMFS 1996]	Meets pool frequency standards but LWD recruitment inadequate to maintain pools over time. Moderate reduction of pool volume by fine sediment. Fewer large pools >3 ft. deep with good fish cover. [adapted from NFMS 1996]	Does not meet pool frequency standards and no deep pools. [adapted from NFMS 1996]
Large wood and log jams	> 80 pieces/mi (>24 in diameter; > 50 ft. long) [from NMFS 1996] ≥30 log jams/mi (jam = >10pieces/jam, >6in diam and 20 ft long) [based on reference conditions in Upper Wind (Wind 7a)]	Currently meets standards for 'Good', but lacks potential sources from riparian areas of woody material recruitment to maintain that standard. [adapted from NFMS 1996] 10 – 30 log jams/mi	Does not meet standards for 'Good' and lacks potential large woody material. [adapted from NFMS 1996] <10 log jams/mi
Mainstem habitat complexity	Greater than 20 habitat units per mile [adapted from The Nature Conservancy's Key Ecological Attributes]	Between 5-20 habitat units per Mile [adapted from The Nature Conservancy's Key Ecological Attributes]	Less than 5 habitat units per mile [adapted from The Nature Conservancy's Key Ecological Attributes]
Off-channel habitat	Reach has ponds, oxbows, backwaters, side-channels, and other off-channel areas with cover that are consistent with natural conditions. No manmade barriers are present that prevent access to off-channel areas. [adapted from NFMS 1996]	Reach has some ponds, oxbows, backwaters, side-channels, and other off-channel areas or these areas have no cover. [adapted from NFMS 1996]	Few or no ponds, oxbows, backwaters, side-channels, and other off-channel areas. [adapted from NFMS 1996]
Fish passage	Passage open year-round [NMFS 1996]	Passage not possible at base/low flows [NMFS 1996]	Passage not possible at a range of flows. [NMFS 1996]
Temperature	Always meets applicable Water Quality Standards for Surface Waters of the State of Washington or more stringent spawning and incubation protection guidelines. [WDOE 2012]	Typically meets applicable Water Quality Standards for Surface Waters of the State of Washington or more stringent spawning and incubation protection guidelines. [WDOE 2012]	Does not meet applicable Water Quality Standards for Surface Waters of the State of Washington or more stringent spawning and incubation protection guidelines. [WDOE 2012]

Reach Attribute	Good	Fair	Poor
Flow	Watershed hydrograph indicates flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography. [WDOE 2012]	Some evidence of altered flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography. [WDOE 2012]	Pronounced changes in flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography. [WDOE 2012]
Fine Sediment	<12% fines (<0.85mm) in gravel; turbidity low [NMFS 1996]	12-17% fines; turbidity moderate [NMFS 1996]	>17% fines; fines at surface or depth in spawning habitat; turbidity high [NMFS 1996]

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Appendix D – Habitat Attribute Ratings

Reach Attribute Summaries

The tables below constitute a master list of each stream reach, the habitat attribute rankings, and a brief narrative justification for those rankings. Reach rankings are based on a compilation of current field survey data, data collected from previous survey efforts by USFS, and remote calculations using LiDAR and aerial photo analysis. Ranking criteria for each attribute can be found in Appendix C.

Note: Upper Hollis Creek was not surveyed during this effort due to a recent habitat survey completed by UCD (July 2015) and challenging stream access. Information included here for Hollis Creek is from the 2015 survey, which used a different habitat data protocol and is therefore missing some of the ranked attribute information.

Table 1. Reach Attribute Summaries.

Reach	Riparian condition	Floodplain connectivity	Bank condition / Channel migration	Vertical channel stability	Pools (quantity/ quality)	Large wood and log jams	Mainstem habitat complexity	Off-channel habitat	Fish passage	Fine Sediment
Wind 7a	**Good** Greater than 100' buffer width, mature trees, minimal riparian disturbance. [Field observations and Office data, 2016]	**Good** High connectivity, minimal disturbance (trail), no road density in floodplain. [Field observations and Office data, 2016]	**Good** No hydromodifications or anthropogenic erosion. [Field observations and Office data, 2016]	**Good** No trend of human-caused aggradation or incision. [Field observations and Office data, 2016]	**Good** 8 pools (30/mi), 4 deep, 2 good cover, 6 some cover. [Field observations and Office data, 2016]	**Good** 43 pieces (165 pcs/mi), 10 jams (38.4 jams/mi). [Field observations and Office data, 2016]	**Good** 18 units, (69 units/mi). [Field observations and Office data, 2016]	**Good** Good connection to off-channel habitat. [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Good** 2/3 observations <12%, 1/3 >17%, previous survey noted 7% fines. [Field observations and Office data, 2016]
Paradise Creek	**Fair-Good** 3/5 observations >100' buffer; 3/5 observations no riparian disturbance, while 2/5 had roads and campground. Mixed riparian forest stand age classes. [Field observations and Office data, 2016]	**Poor** Only 1/5 observation had good connectivity and only 2/5 lacked anthropogenic disturbances; CMZ is bisected by highway; campground roads in floodplain. [Field observations and Office data, 2016]	**Fair-Poor** Poor hydro-modifications (2/5 observations had roads), but good bank erosion (none). [Field observations and Office data, 2016]	**Fair** 3/5 observations show good stability; 1/5 affected by roadway; channel is migrating at/near natural rates with minimal bank armoring, except along campground. [Field observations and Office data, 2016]	**Fair** 11 pools (22/mi), 5 shallow and 6 deep. 10 had some or good cover. [USFS 1993 survey, Field observations and Office data, 2016]	**Poor** 54 pieces/mi and 14 jams/mi. 1993 USFS survey stated "high recruitment potential." [Field observations and Office data, 2016]	**Good** 35 units/mi. [Field observations and Office data, 2016]	**Fair** No off-channel habitat at 4/5 observations; abundant at 1. [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Good** 4/5 observations showed <17%, and mostly <12%. [Field observations and Office data, 2016]
Wind 6d (Mining Reach)	**Fair** Buffer width mostly greater than 100', canopy closure is approx. 60% over the channel, riparian disturbance is minimal, riparian stand age is mostly small trees [Field observations and Office data, 2016]	**Fair** High connectivity and low disturbance in riparian areas, road density is greater than 3 mi/mi² of floodplain [Field observations and Office data, 2016]	**Fair** 66% of the channel had no hydromodifications and no human-caused bank erosion found [Field observations and Office data, 2016]	**Fair** 66% of channel was vertically stable [Field observations and Office data, 2016]	**Fair** 27.7 pools/mi, nearly half of all pools were deep [USFS 2012 survey]	**Fair** 18 med+large pieces/mi, 9.3 log jams/mi found [USFS 2012 survey]. IFI survey observed much more wood and more jams (27 jams/mi), possibly due to a different interpretation of bankfull channel. Most wood is small.	**Good** 57 habitat units/mi) [USFS 2012 survey]	**Good** 55% of channel had good off-channel habitat available [Field observations and Office data, 2016]	**Good** no fish passage barriers [Field observations and Office data, 2016]	**Fair** all ocular measurements recorded >17% fine sediment in channel but no turbidity and less fines in spawning gravels [Field observations and Office data, 2016]

Reach	Riparian condition	Floodplain connectivity	Bank condition / Channel migration	Vertical channel stability	Pools (quantity/ quality)	Large wood and log jams	Mainstem habitat complexity	Off-channel habitat	Fish passage	Fine Sediment
Wind 6c DS of Falls Creek	**Poor** Buffer width is often less than 100' due to road, canopy closure is approx. 50% over the channel, riparian disturbance is frequent due to road, riparian stand age is mixed small and large trees [Field observations and Office data, 2016]	**Fair** Naturally confined but narrow floodplains likely encroached upon by road fill [Field observations and Office data, 2016]	**Poor** Majority of reach affected by road on right bank- hydromodification present throughout, intermittent human-caused bank erosion found [Field observations and Office data, 2016]	**Poor** High energy for bed scour due to road fill encroachment	**Fair** 33 pools/mi and all pools were deep [USFS 2012 survey, data based on entire Reach 6]	**Poor** 4.3 med+large pieces/mi, no log jams found [USFS 2012 survey, data based on entire Reach 6, and 2016 field observations]	**Good** 60 habitat units/mi) [USFS 2012 survey, data based on entire Reach 6]	**Good** Channel is in canyon – minimal off-channel habitat is natural and not expected [Field observations and Office data, 2016]	**Good** no fish passage barriers [Field observations and Office data, 2016]	**Poor** all ocular measurements recorded >17% fine sediment in channel, including spawning areas, which were limited [Field observations and Office data, 2016]
Wind 6a	**Fair** Canopy closure is <20% over the channel, riparian disturbance is minimal but there is a dirt road on river-left, riparian stand age includes med-large trees [Field observations and Office data, 2016]	**Good** Minimal disconnection, minimal floodplain disturbance [Field observations and Office data, 2016]	**Fair** Some bank erosion from human access points, but no significant effects on channel migration [Field observations and Office data, 2016]	**Good** No observable impacts [Field observations, 2016]	**Fair** 17.2 pools/mi, 86% are greater than 3 ft deep [USFS 2012 survey, data based on Reach 5]	**Poor** Virtually no wood in this reach [Field observations and Office data, 2016]	**Good** 30 units/mi [USFS 2012 survey, data based on Reach 5]	**Good** Short reach with not a lot of natural off-channel habitat	**Good** No fish passage barriers	**Fair** 12-17% fines
Dry 2 Big Hollow Upstream	**Fair** Impacted by 64 Road and crossing and young stand age [Field observations and Office data, 2016]	**Poor** 64 Road crossing and fill block upstream and downstream connectivity for significant portion of reach. Incision likely related to crossing [Field observations and Office data, 2016]	**Poor** 64 Road crossing limits channel migration and causes incision-related bank erosion downstream [Field observations and Office data, 2016]	**Poor** Incision related to 64 Road crossing [Field observations and Office data, 2016]	**Fair** 25 pools/mi and 65% of pools were deep [USFS 2015 survey, data based on Reach 2]	**Poor** 13 med+large pieces/mi [USFS 2015 survey, data based on Reach 2], and 7 log jams/mi found [2016 field observations]	**Good** >20 units/mi [2016 field observations]	**Fair** Downstream of 64 Road is fair due to incision-related disconnection [Field observations and Office data, 2016]	**Fair** 64 road crossing and culvert appears to be partial barrier [Field observations, 2016]	**Fair** 12-17% [Field observations, 2016]

Reach	Riparian condition	Floodplain connectivity	Bank condition / Channel migration	Vertical channel stability	Pools (quantity/ quality)	Large wood and log jams	Mainstem habitat complexity	Off-channel habitat	Fish passage	Fine Sediment
Dry 1 Mouth to Big Hollow	**Fair** Canopy closure is approx. 50% over the channel, riparian disturbance is moderate due to road/bridge and spoil bank, riparian stand age includes many large trees [Field observations and Office data, 2016]	**Fair** Minimal disconnection, floodplain disturbance from road/bridge and spoils bank, road density is greater than 3 mi/mi² of floodplain [Field observations and Office data, 2016]	**Fair** Spoil bank is causing hydromodification. Minimal human-caused bank erosion found [Field observations and Office data, 2016]	**Fair** 20% of channel was not vertically stable, 30% of channel was relatively stable, 50% of good [Field observations and Office data, 2016]	**Fair** 25 pools/mi and 65% of pools were deep [USFS 2015 survey, data based on Reach 2]	**Fair** 13 med+large pieces/mi [USFS 2015 survey, data based on Reach 2 only] and 15 log jams/mi [2016 field observations]	**Good** >20 units/mi [2016 field observations]	**Fair** Mostly good or naturally confined, except for limitations at spoil bank [Field observations and Office data, 2016]	**Good** only potential natural bedrock cascade and falls barriers present [Field observations and Office data, 2016]	**Fair** 12-17% fine sediment in channel, though spawning areas appeared to have less fines and a majority of measurements were <12% [Field observations, 2016]
Eightmile Creek	**Good-Fair** Some young stands in riparian area; buffer >100' in all observations, canopy cover 70-90% [Field observations and Office data, 2016]	**Fair** 3/7 observations good connectivity, 3/7 fair, 1/7 none. No floodplain disturbance and no roads in floodplain. [Field observations and Office data, 2016]	**Good** No anthropogenic erosion, no hydromodifications . [Field observations and Office data, 2016]	**Good** No human-induced trend of aggradation or incision. [Field observations and Office data, 2016]	**Fair** 36 pools (55 pools/mi) Few deep pools, most some cover or good cover. Width to depth 9.7. [Field observations and Office data, 2016]	**Fair** 48 pieces (74 pcs/mi), 7 jams (11 jams/mi) [Field observations and Office data, 2016]	**Good** 79 units (122 units/mi) [Field observations and Office data, 2016]	**Fair** 3/7 observations good, 2/7 fair, 2/7 low. [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Good-Fair** 1 observation > 17%, 3/7 12-17%, 3/7 <12%. [Field observations and Office data, 2016]
Wind 5d	**Fair** Canopy closure is <20% over the channel, there are a few areas with riparian disturbance (rd, hatchery, levees), wide buffers >100 ft, riparian stand age is mixed age [Field observations and Office data, 2016]	**Poor** Mineral Spgs Rd crossing + approach fills, hatchery facilities, and levees all disconnect floodplain processes	**Poor** Mineral Spgs Rd crossing + approach fills, hatchery facilities, occasional armoring, and levees all disconnect channel migration processes	**Poor** Mineral Spgs Rd crossing + approach fills, armoring, and levees have created a downcut channel that is still responding to impacts	**Poor** 8.6 pools/mi, 66% are greater than 3 ft deep [USFS 2012 survey, data based on Reach 4]	**Poor** 2.9 med+large pieces/mi, [USFS 2012 survey, data from Reach 4]. More wood observed in field surveys in 2016 compared to USFS data, possibly due to a different interpretation of bankfull channel. >10 jams/mi counted [Field observations, 2016]	**Good** 24 units/mi [USFS 2012 survey, data based on Reach 4]	**Poor** Floodplain disconnections, armoring, and associated downcutting has reduced off-channel connectivity compared to what would be expected naturally	**Good** No fish passage barriers	**Poor** 75% of ocular measurements recorded >17% fine sediment in channel, including spawning areas

Reach	Riparian condition	Floodplain connectivity	Bank condition / Channel migration	Vertical channel stability	Pools (quantity/ quality)	Large wood and log jams	Mainstem habitat complexity	Off-channel habitat	Fish passage	Fine Sediment
Wind 5c	**Fair** Road, campground, and hatchery facilities affect buffer width, canopy closure is less than 20%, stand age is mixed but medium age overall [Field observations and Office data, 2016]	**Poor** Road, campground levees, and hatchery fill affect connectivity [Field observations and Office data, 2016]	**Poor** Road, campground armoring, and hatchery armoring restrict CMZ [Field observations and Office data, 2016]	**Fair** Armoring and levees have caused downcutting but channel has stabilized since initial impacts [Field observations and Office data, 2016]	**Poor** 2.25 pools/mi, 100% are greater than 3 ft deep [USFS 2011 survey, data based on Reach 3]	**Poor** 14.3 med+large pieces/mi, [USFS 2011 survey, data from Reach 3].More wood observed in field surveys in 2016 compared to USFS data, possibly due to a different interpretation of bankfull channel. >10 jams/mi counted [Field observations, 2016]	**Fair** 11 units/mi [USFS 2011 survey, data from Reach 3]	**Poor** Road, campground levees, and hatchery fill disconnect off-channel habitat compared to what would be expected under natural conditions	**Good** No fish passage barriers	**Poor** Ocular measurements recorded >17% fine sediment in channel, including spawning areas
Wind 5a	**Fair-Poor** 3/5 observations >100' buffer; low canopy closure (20-40%); greater than 20% riparian area disturbed at 3/5 points. 4/5 observations noted large trees. [Field observations and Office data, 2016]	**Fair** 2/5 = good, 2/5 = low. Some disturbance at 3/5 sites. [Field observations and Office data, 2016]	**Fair** Bridge abutments at 2/5 sites, and old restoration project log jams at 2/5; 2/5 observations had no hydromodifications. [Field observations and Office data, 2016]	**Good** No trend of human-caused aggradation or incision. [Field observations and Office data, 2016]	**Fair** 9 pools (5/mi), 8 deep and 8 some or good cover. [Field observations and Office data, 2016]	**Poor** 63 medium or large pieces (38 LWD/mi). 7 jams (4/mi). [Field observations and Office data, 2016]	**Fair** 19 units (11.3/mi) [Field observations and Office data, 2016]	**Poor** 2/5 observations had none (1 was canyon), 3/5 were low habitat. [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Fair** 4/5 were <17%. Good. [Field observations and Office data, 2016]
Hollis Creek*	**Good** Minimal riparian disturbance observed, canopy cover 90% [UCD, 2015]	unknown	**Good-Fair** One location of relic dam has debris and heavily incised channel downstream. No other anthropogenic erosion or hydromodifications. [UCD, 2015]	unknown	**Good** 95 pools/mi. [UCD, 2015]	unknown	**Good** Average = greater than 100 units/mi [Field observations and Office data, 2016]	unknown	**Good** No man-made barriers. Natural barrier exists at 45.8532, -121.931324. [UCD, 2015]	unknown

Reach	Riparian condition	Floodplain connectivity	Bank condition / Channel migration	Vertical channel stability	Pools (quantity/ quality)	Large wood and log jams	Mainstem habitat complexity	Off-channel habitat	Fish passage	Fine Sediment
Trout Creek	**Fair** Some disturbance noted (logging, road crossing), canopy cover 20-40% [Field observations and Office data, 2016]	**Fair** 3/5 observations noted low connectivity, 2/5 noted high or not applicable (canyon). [Field observations and Office data, 2016]	**Good-Fair** No anthropogenic erosion, 1 hydromodification (road bridge) in boulder/canyon area. [Field observations and Office data, 2016]	**Good** Primarily bedrock through this reach. [Field observations and Office data, 2016]	**Fair-Poor** 7 pools (14.9/mile), 4 deep and 3 shallow; all had some cover. [Field observations and Office data, 2016]	**Poor** 9 pieces (19.1 LWD/mile) and no jams. [Field observations and Office data, 2016]	**Good** 22 units (46.8/mile) [Field observations and Office data, 2016]	**Fair** 3/5 observations had some modest off-channel habitat, 2/5 had none (canyon reach). [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Good** 5/5 observations <12%. [Field observations and Office data, 2016]
Martha Creek	**Fair** ¾ of observations noted some riparian disturbance and buffer width of less than 100'. Canopy closure 70-90%. [Field observations and Office data, 2016]	**Good** Good connectivity and low disturbance in riparian areas, road density is less than 1 mi/mi2 of floodplain [Field observations and Office data, 2016]	**Good-Fair** No hydromodifications present; no anthropogenic bank erosion. Some areas of incision. Previous USFS survey recorded 94.9% bank stability. [Field observations and Office data, 2016]	**Fair** Some areas of heavy incision, high cut banks, and bedrock stretches [Field observations and Office data, 2016]	**Fair** Meets pool frequency but lacks deep pools, and pools with good cover [Field observations and Office data, 2016]	**Poor** 18 pcs/mi, 6 jams/mi. Modest potential future recruitment likely. [Field observations and Office data, 2016]	**Good** 35 units (103/mi). [Field observations and Office data, 2016]	**Fair** 2/4 observations noted some available off-channel, 2/4 noted no available off-channel.	**Good.** No barriers. [Field observations and Office data, 2016]	**Good** No observations of >17% fines. [Field observations and Office data, 2016]

Reach	Riparian condition	Floodplain connectivity	Bank condition / Channel migration	Vertical channel stability	Pools (quantity/ quality)	Large wood and log jams	Mainstem habitat complexity	Off-channel habitat	Fish passage	Fine Sediment
Little Wind River 3 (upper)	**Good** Greater than 100' buffer width, no disturbance, >90% canopy cover. [Field observations and Office data, 2016]	**Good-Fair** No roads impinge floodplain; modest to limited incision; 3/6 observations showed limited connectivity, 2/6 good connectivity. [Field observations and Office data, 2016]	**Good** No hydromodifications present; no anthropogenic bank erosion. [Field observations and Office data, 2016]	**Good** No obvious trend of aggradation or incision. [Field observations and Office data, 2016]	**Fair** 42 (33.5/mi), 26 had some cover and 13 good cover. [Field observations and Office data, 2016]	**Poor** 31pcs (24/mi), and 4 jams (3/mi). [Field observations and Office data, 2016]	**Good** 100 units (77.5/mi). [Field observations and Office data, 2016]	**Fair** 3/6 observations = good; 3/6 observations = none. [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Fair** 3/6 observations <12%, 1/6 = 12-17%, 2/6 = >17%. [Field observations and Office data, 2016]
Little Wind River 2 (middle)	**Good** Greater than 100' buffer width, no disturbance, 70-90% canopy cover. [Field observations and Office data, 2016]	**Good** Connected, if limited, floodplain ¾ observations, no disturbance, no roads. [Field observations and Office data, 2016]	**Good** No hydromodifications present; no anthropogenic bank erosion. [Field observations and Office data, 2016]	**Good** No obvious trend of aggradation or incision. [Field observations and Office data, 2016]	**Fair-Good** 34 pools (41/mi); 22 are shallow; 0 no cover, 26 some cover, 8 good cover. [Field observations and Office data, 2016]	**Poor** 31 pcs (37.3/mi), and 8 jams (9.6/mi). [Field observations and Office data, 2016]	**Good** 76 units (91.5/mi). [Field observations and Office data, 2016]	**Fair** 2/4 observations had no off-channel habitat (canyon), 1 had low, 1 had good habitat. [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Good** 3/4 observations <12%, 1 = >17%. [Field observations and Office data, 2016]

Reach	Riparian condition	Floodplain connectivity	Bank condition / Channel migration	Vertical channel stability	Pools (quantity/ quality)	Large wood and log jams	Mainstem habitat complexity	Off-channel habitat	Fish passage	Fine Sediment
Little Wind River 1 (lower)	**Good** Greater than 100' buffer width. Little to no ongoing disturbance. Some large conifers. 70-90% canopy. [Field observations and Office data, 2016]	**Good-Fair** No roads impinge floodplain; modest to limited incision. [Field observations and Office data, 2016]	**Good** No hydromodifications present [except for remnant dike below sampled area; and that was recently breached]; no anthropogenic bank erosion. [Field observations and Office data, 2016]	**Good** No obvious trend of aggradation or incision. [Field observations and Office data, 2016]	**Fair** 36 pools/mi, but 75% of them are shallow. 31 have some cover, but limited cover, and 5 have no cover. [Field observations and Office data, 2016]	**Poor** 15 pcs (15/mi), and 2 jams. [Field observations and Office data, 2016]	**Good** 74 units (74/mi). [Field observations and Office data, 2016]	**Fair** 4 of 6 observations had some, mostly limited connected habitat. 1/6 low, 1/6 none. [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Fair** 3/6 observations = >17%, and 2/6 = 12-17%. [Field observations and Office data, 2016]
Wind 2	**Fair** Minimal riparian disturbance, 0-20% canopy cover, 25-100' buffer. [Field observations and Office data, 2016]	**Poor** Floodplain disturbance (riprap, fill, sheet pile), 1.8 mi/mi² road density. [Field observations and Office data, 2016]	**Poor** Several hydromodifications (riprap, levee structure) and anthropogenic erosion. [Field observations and Office data, 2016]	**Poor** Several hydromodifications (riprap, levee structure) and anthropogenic erosion. [Field observations and Office data, 2016]	**Poor** Reach is essentially one large pool due to backwater from Bonneville. Pool is deep, and has some areas of cover. [Field observations and Office data, 2016]	**Poor** Only 1 piece of large wood noted within the channel, and no jams within the channel. [Field observations and Office data, 2016]	**Poor** 5 units (3.9 units/mi). Reach comprised primarily of one pool, with several riffles and glides. [Field observations and Office data, 2016]	**Poor** Very minimal off-channel habitat available. [Field observations and Office data, 2016]	**Good** No barriers. [Field observations and Office data, 2016]	**Poor** All observations >17% fines. [Field observations and Office data, 2016]

Appendix E – Rapid Assessment Field Form

Rapid Assessment Form

Reach:

Description of location:

Date:

Surveyors:

Attribute	Sub-category														Notes/Observations	Overall Rating (Good, Fair, Poor)
	Sub-category attribute	F/O	Results Data Point 1	Data Point 2	Data Point 3	Data Point 4	Data Point 5	Data Point 6	Data Point 7	Data Point 8	Data Point 9	Data Point 10	Data Point 11	Data Point 12		
Riparian condition	Buffer width	O														
	Canopy closure	O														
	Riparian disturbance	F & O														
	Stand age	F													sapling/pole, small tree, large tree, mature tree	
Floodplain connectivity	Connectivity	F														
	Disturbance	F														
	Road density	O														
Bank condition / Channel migration	Hydromods	F														
	Human-caused erosion	F														
Vertical channel stability		F														
Pools (quantity/quality)	# pools	F													0,1,2 level of cover; Shallow or Deep	
	Pool depths	F														
	Pool cover	F														
Large wood and log jams	# med+large pieces	F													Count wood >24" diam, >50' long (or greater than 2X BFW)	
	# jams	F													Count log jams (>10 pieces/jam, >6in diam, 20 ft long)	
Mainstem habitat complexity	Total # units	F													Count total number of units at least enough to categorize; >20/mi, 5-20/mi, <5/mi	
Off-channel habitat		F														
Fish passage	Man-made barriers present?	F														
Temperature		O														
Flow		O														
Fine Sediment	4 ocular estimates/rch	F													<12%, 12-17%, >17%	

take data points every 1000ft, with at least 4 pts per reach

Appendix F – Project Descriptions and Concept Maps

The table below contains project descriptions. The table is followed by project concept maps.

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 1 and 2	Wind River Confluence	W1	Confluence area contains open water, boat ramp, parking area, riprap shorelines, old bridge abutments, and sand bars. Future plans include moving boat ramp and parking area to southeast corner of mouth area. Once this occurs, convert former parking area\boat ramp and existing sand bars to multi-thread side-channel complex with vegetated islands. This would re-create delta features, increase margin habitat, and increase habitat complexity. Also look for opportunities to improve shoreline complexity at riprap banks throughout mouth area. Utilize old log raft logs that will be moved for new boat ramp work for habitat logs. Remove old concrete bridge abutments.	Mouth area is used by multiple user groups. Need to coordinate work with County/Port.	
Wind 2	Log Dump Bend	W2	Fill, levees, bank armoring, and docks affect river processes and habitat at the old log dump. At the outside of the bend on river-left, there is erosion of the high bank. Enhance the log dump area to re-create, to the extent possible, river delta dynamics and habitat conditions. This could include removal of the levee at the top end of the log dump, creating a multi-thread side-channel complex through the log dump pond (with vegetated islands), re-grading the right-bank floodplain to increase inundation, and removing or setting back bank armoring, including a section of sheetpile. Actions would also include re-establishment of native riparian and floodplain vegetation. These actions would take pressure off of the eroding left-bank; look for other opportunities to address left-bank erosion, but access is challenging.	Private lands. Work here would likely require land acquisition. Work on the left bank would be challenging given access conditions.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 2	In-Lieu Bend	W3	The inside of the bend contains side-channel scars and a backwater area at the downstream end. There is a large jam at the upstream end of the side-channel scar complex. Could reposition the wood in the jam, and use select excavation, to increase activation of the side-channel. Could also redistribute wood into mainstem jams or into the existing backwater area downstream. Could add wood to mainstem channel margins and to the apex of the mid-channel island downstream. Work with tribes to enhance riparian conditions and margin habitat at the In-lieu fishing area.	Important to avoid any main channel work that would increase erosion of the high and erodible right bank. In-lieu fishing uses will need to be considered.	
Wind 2	Indian Cabin Road Reach	W4	Uniform reach with riprap along left bank (along access road). Add large jams to right-bank bar to increase planform diversity and multi-thread conditions, and to potentially increase activation of right-bank floodplain/off-channel habitat. Add wood to left-bank riprap to enhance margin habitat. Remove old metal bridge supports.	High energy reach for mainstem jams. Effects on road would need to be assessed. Private Properties.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 5a	Stabler Bend	W5	Activate the complex of channel scars (none are active at low flows). Could put ~20% of flow through here to take pressure off of Stabler Bend. Put in far left bank channel against the hillslope toe. Keep channel against hillslope at downstream end (in the trees). Revegetate open area at downstream end and control for invasives (mainly scotchbroom). Old Stabler log jams at upstream end beginning to deteriorate. At downstream end, some signs of additional erosion and undermining of jams. Possibly place more jams here and/or design a controlled neck cut-off to relieve pressure on this bend.	Depending on gradient and elevation, might be able to activate complex with large wood and select excavation only at the upstream end. Wetlands could be an issue if there is a need for excavation throughout length of side-channel complex. Any work in this area needs to keep in mind imminent avulsion risk across neck at downstream end. Site is private property. There is some interest in controlling Scotch broom but difficult access for owners.	
Wind 5a	Stabler North	W6	This is a long and straight uniform reach with glide habitat and very little cover. There is also high width-to-depth especially given recent bank erosion. Good opportunity for bank and bar apex jams to enhance split flows and channel complexity. Possible off-channel habitat enhancement by increasing activation of right bank floodplain. Good alcove potential at downstream end on right bank above private residence.	Possibly tough access across private property.	

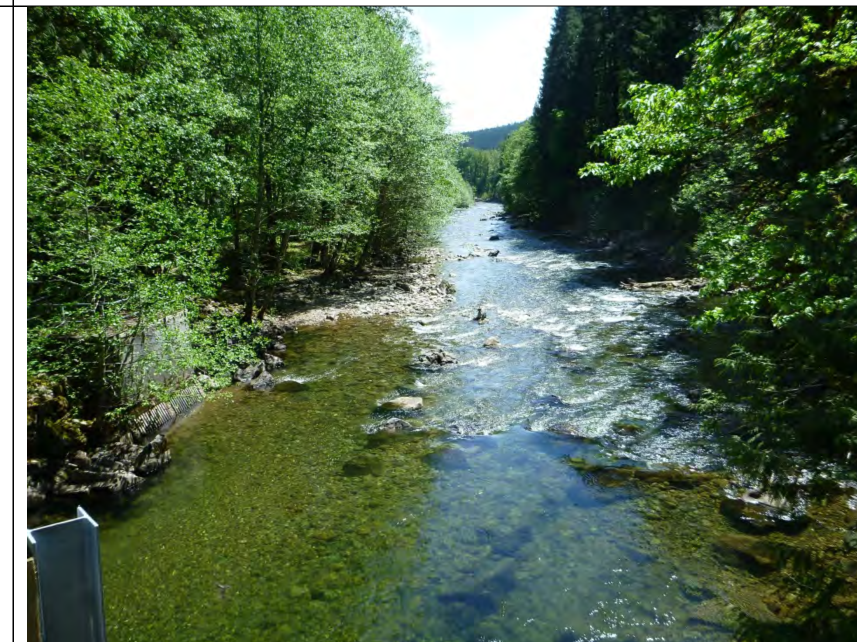
Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 5a	Whisky	W7	Uniform reach with Jurzik cut bank at downstream end left-bank and semi-active right bank side-channel. Cut-bank is conglomerate plus mudstone with boulders on the lower bank and alluvium on the upper bank. There is some large wood at the downstream end already. Could mimic this further upstream along bank. Add large wood for complexity and anchor to boulders. Activate the right bank side channel more (currently not flowing). Add right bank margin jams and apex jams. Investigate activating the far right-bank floodplain/side-channel for possibly improving off-channel habitat and taking pressure off of Jurzik cut bank. Replant cleared riparian area on the left bank upstream of the Jurzik cut bank.	Possibly tough access across private property. Anchoring large wood along the cut-bank may be challenging. Activating far right-bank side-channel may be challenging given landowner permissions.	
Wind 5a	Cannavina	W8	Multiple private parcels with cleared riparian areas and uniform channel. Look for opportunities to replant riparian zones and add instream complexity using large wood.	Work will take cooperation from landowners.	
Wind 5c	Stump House	W9	This is a newly avulsed section of stream that is currently too dynamic to allow vegetation to establish. Large wood structure using large apex jams would help create and maintain islands and allow vegetation to establish. Could also add large key piece analogs or up-angled rootwads to capture wood. Most of the off-channel areas are fairly well connected but there are some opportunities to enhance connectivity at low flows.	Adjacent landowners that have not given permissions for surveys limits how much of the floodplain was investigated and will likely limit the larger scale opportunities here. UCD has previously placed some wood in a left bank side-channel in this reach.	

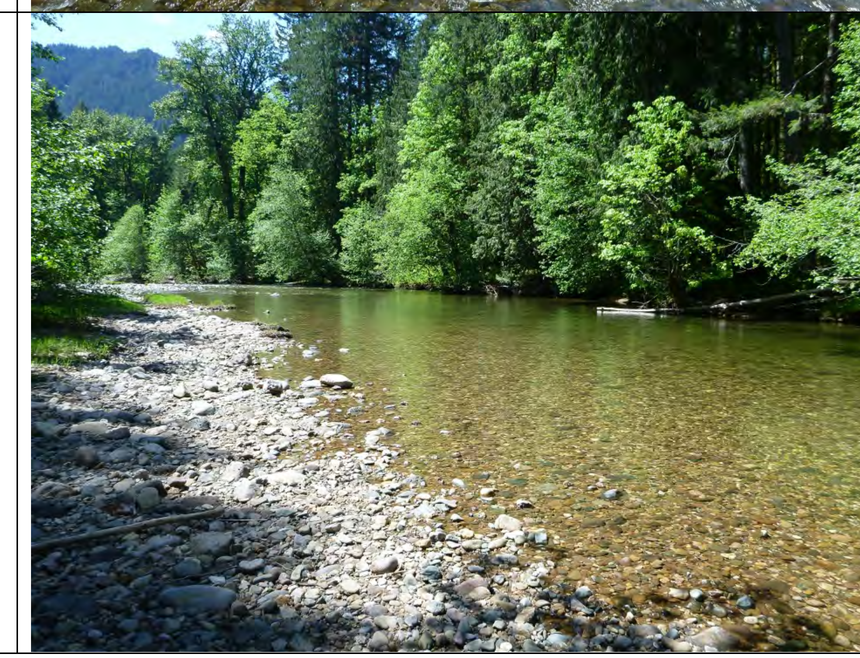
Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 5c	Beaver Campground	W10	Levees, fill, and armoring associated with Beaver Campground have significantly impacted floodplain connectivity, off-channel habitat, and instream habitat. There are multiple opportunities for restoration, including: 1) Removal of concrete bulkhead armoring and removal/set-back of associated levee on river-left upstream of CG - creation of low floodplain surface and riparian buffer; 2) Removal/set-back of left bank levee extending downstream along CG, or activation of adjacent side channel; 3) Activate right bank side-channel; 4) Activate left bank floodplain and off-channel complex at downstream end; 5) Add complexity to the main channel throughout, including apex and bank jams,	Campground is the primary constraint. Could it be reconfigured to allow for levee set-back? Past UCD work is located on left bank at lower end, including buried jams, near and at inlet to left bank side channel complex. Goal was to keep the main channel from occupying the side channel but to keep the side channel active. Would be good to increase the level of activation of this left bank side channel complex. There is groundwater flow at lower end of right bank side-channel scar. Could be good to preserve or enhance GW conditions rather than fully activate side channel.	 Concrete bulkhead at upstream end of Beaver CG, river-left.

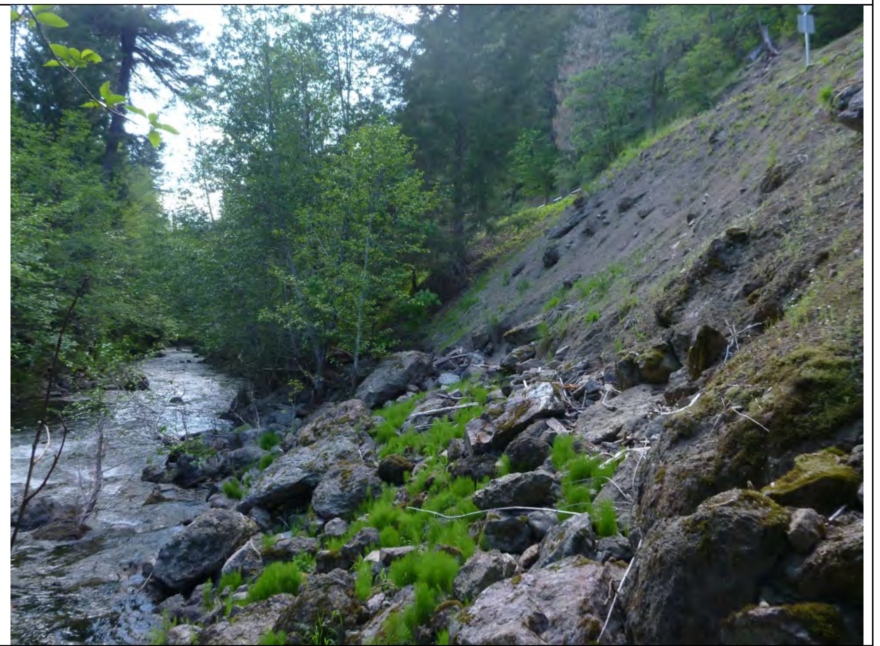
Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 5c	Beaver North	W11	Uniform reach with disconnected side channel and riprap bank armoring. Opportunities include: 1) Construct alcove at existing left-bank side-channel outlet at upstream end (groundwater inputs); 2) remove riprap on river left (from Wind River Road) at upstream end of armoring and set back, closer to the road. Create a lower floodplain and revegetate; 3) Activate large side channel scar on the right bank using a large apex jam on bar near the inlet and a left bank margin jam. Load the side channel with large wood. There is a good bar apex/riffle crest from which side channel can be activated. Currently there are large old-growth pieces at jam at head of side channel which can be repositioned and used. Consider shifting main channel into this alignment to remove channel from riprap and bulkhead at Campground. Another option is to enhance the lower end as a groundwater channel; 4) Add wood/complexity in the form of bank and bar apex jams throughout.	Modifying road riprap where road is close would be challenging. May have to enhance in place. There is bedrock located in this reach and needs to be considered when planning earthwork.	 Left-bank riprap  Side-channel scar right-bank

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 5c	Big Butte	W12	Very little mainstem or off-channel complexity. Opportunities include: 1) Increase mainstem complexity throughout reach by adding bank and bar apex jams. At upstream end, add wood to right bank at large pool. At downstream end, there are some buried bank jams - add more and larger bank as well as apex jams; 2) Might be opportunities to activate side-channels including on the left bank at upstream end and on right bank at downstream end. Or create alcoves at side-channel scar outlets.	Access might be difficult at upstream end.	

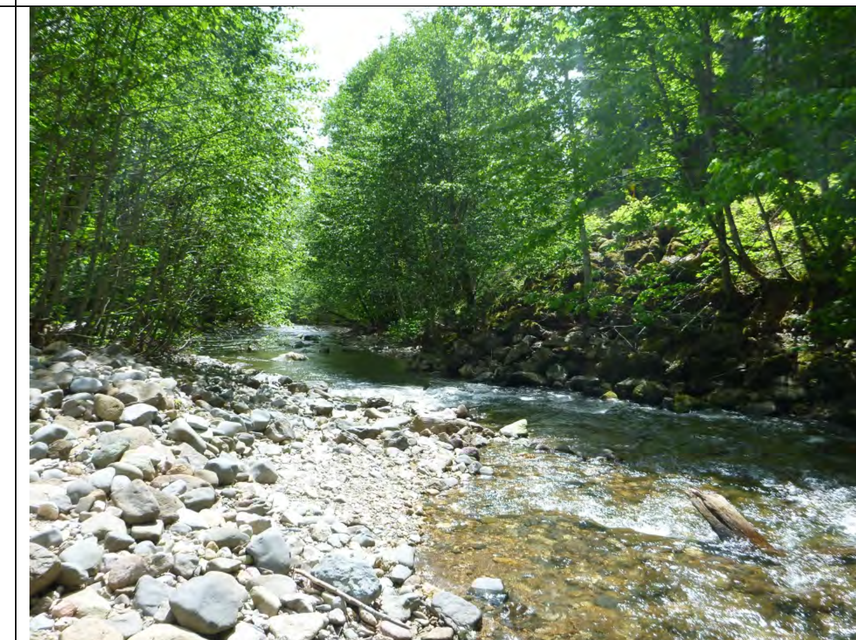
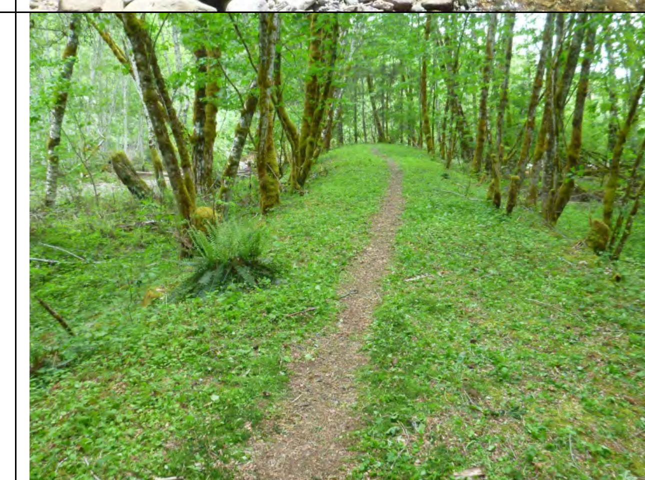
Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 5d and 5c	Hatchery Reach	W13	There is abundant potential for restoration of channel and floodplain processes here. Several sub-projects are possible: 1) Remove or set back the levee on left bank near the hatchery to reconnect the left-bank floodplain; 2) Add large wood (apex and big bank jams) to main channel and active side-channels throughout; 3) Remove fill at head of disconected right-bank side-channel at upstream end of project reach; 4) Reconnect off-channels, side channels, and floodplain wetlands in the right-bank floodplain across from hatchery (possibly connecting up with side-channel described in #3) where large wood appears to have been placed to prevent channel movement to the west and away from the hatchery entrance; 5) Remove, modify, or enhance left-bank riprap downstream from hatchery entrance; 6) Enhance connectivity of right-bank side-channel complex across from hatchery entrance (re-enters downstream at project terminus) using select excavation and a bar apex jam at inlet; 7) Add complexity (apex and bank jams) at pool downstream of riprap; 8) Create cold water alcove on left bank where Tyee Springs reenters channel.	The hatchery and associated infrastructure presents significant constraints. The contemporary need and function of levees, riprap, and other hydromods needs evaluation to understand realistic opportunities. Past work appears to have been conducted to maintain the main channel in its current alignment, presumably to maintain fish access into hatchery entrance channel. Investigate options for restoring floodplain and channel migration zone processes while maintaining fish access.	 Left-bank levee upstream of hatchery  Floodplain wetland complex west bank across from hatchery

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 5d	Mineral Springs Bridge Reach	W14	This reach is incised and disconnected from floodplain due to upstream bridge/fill and levee/canal on river-left. Reach is straight, cobbles and boulders, steep riffles and glides, high energy flow, and very little complexity. No off-channel habitat. Boulders probably provide some decent steelhead cover. There are some existing logs placed along margins (cabled and/or buried). At a minimum, add more large wood (as has been done) but bigger and more aggressive to create deposition areas and habitat. Also look for opportunities for off-channel enhancement and floodplain reconnection, potentially using jams to activate floodplain and modifying left bank levee/canal system or activating the left-bank side channel scar as a low flow side-channel.	High energy reach. Log jams will need significant ballast to maintain integrity. Work to the east of the channel could affect diversion canal and berm. Need to evaluate current use and need for canal.	
Wind 5d	Mineral Springs Road Bridge	W15	The bridge and associated approach fill on the west side severely disconnected the floodplain and has locked the channel into its current alignment, causing incision, simplification, and lack of off-channel habitat here and downstream. Look for opportunities to increase connectivity through modifying the road fill/crossing or mitigating for these impacts by creating new off-channel habitat features.	Modifications to road fill or bridge would be expensive.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 5d	Wind River below Trapper Creek Confluence	W16	There is past log jam work through here but more could be completed. Add large apex jams - piling or backfill burial ballasted. Add jams to left bank (be strategic and leave gaps where good recruitment would still occur). Place apex jam on bar towards downstream end.	There are cabled logs just downstream of Trapper Creek on the right bank and an existing apex log jam. There is a newly activated side channel on right bank, with some old restoration logs washed down near here. There is other evidence of placed logs moving - the ones in place are cabled or well-buried. There is a dispersed recreation area on the left-bank throughout.	
Wind 6a	Wind River below Dry Creek Confluence	W17	This is a very uniform glide with very little in-channel or margin habitat complexity. Add large wood to right bank to create pool scour and cover. Add apex jam just above Trapper Creek confluence.	There is an existing dirt access road along the river-left bank.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 6c	Falls Confluence Highway Slope	W18	Over approximately a half-mile, the high road prism abuts the channel, with intermittent (sometimes heavy) riprap and impacted riparian vegetation. Look for opportunities to establish woody vegetation on the highway slope and to increase margin complexity in the channel using large wood. There are a few pieces of placed large wood at the base of the riprap from old projects.	Riparian work on highway slope could be challenging and large wood margin complexity along the riprap may not be worth it.	
Wind 6d	Mining Downstream Road Contact	W19	A 50' riprap section appears to have been an emergency placement after big firs were recruited. Riprap is intermittent, with areas of failure. This is a multi-thread channel with some flow farther east - very complex. Shift the channel away from highway toward valley-left using log jams. Use jams along highway to prevent re-occupation of channel adjacent to highway. Establish a riparian buffer between river and road. Add large wood key pieces throughout the channel to capture numerous smaller deciduous large wood in the channel. There is a second riprap section along road at downstream end where margin complexity could be increased, but road bank is high and canyon is starting here so there is less impact or opportunity for improvement.	There are road integrity and safety issues at these sites, which could boost importance and help with funding.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 6d	Mining Middle Road Contact	W20	Two locations of highway riprap along right bank. At the downstream location, the riprap has failed or might soon fail. Near RM 22.9 the riprap is failing and a jam is putting the highway at risk. There is an old dry channel in the left bank floodplain that would be an easy place to shift the channel. Shift the channel away from highway toward valley-left using log jams. Use jams along highway to prevent re-occupation of channel adjacent to highway. Add large wood key pieces throughout the channel to capture numerous smaller deciduous large wood in the channel.	There are road intergrity and safety issues at these sites, which could boost importance and help with funding.	
Wind 6d	Middle Butte Fan Large Wood	W21	Channel is currently very uniform and single thread. It has a higher gradient and is more confined from left bank fan. It's likely a constriction/valley grade control for depositional reach upstream. Young alder and maple are present on the right bank floodplain (less than 10" diameter). The left bank is a higher disconnected surface (fan). Add large wood "key" pieces (~0.2 miles) for complexity and to create pocket pools and to retain gravels. Large wood placements would recruit small/young large wood.	Access from Wind River Highway or helicopter drop key pieces.	

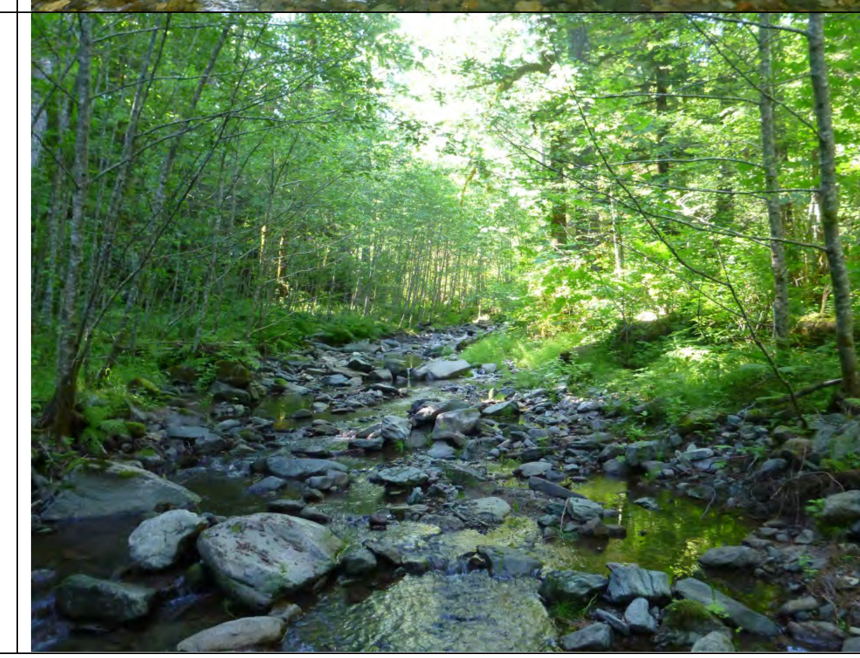
Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 6d	Mining Upstream Road Contact	W22	Add large wood jam to right bank at the upstream end of the riprap. Possibly force river channel to shift into left bank floodplain (depending on elevation).	Potential to shift channel into left bank at the upstream end might be more feasible than at other locations.	
Wind 6d	650 Road Fill	W23	There is an old bridge approach fill/levee causing severe floodplain disconnection on right bank. A concrete abutment is located at the end of the fill approximately 10' from the active channel. Riprap is also located along the edge and at the end. A concrete abutment and road fill is also located on the left bank, with a couple of pilings still present. The left bank has a higher surface (above the floodplain elevation) so the encroachment on the floodplain is not as severe. Also present nearby at the end of the 650 spur road is a dispersed camp site with a 40' long berm and riprap. Remove right bank bridge approach fill/levee. Also remove left bank approach (at least the fill closest to river). Add instream habitat complexity - key pieces to capture alders and maples that have been recruited and will be coming down.	This is the old highway alignment. There is good access from spur road off of Wind River Highway.	 

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Wind 6d	Middle Mining LW	W24	Add large wood key pieces to help capture the numerous alders and maples that have been recruited and will be coming down over time.	Access via old hwy alignment (now abandoned - 650 spur road) or via helicopter placement.	
Paradise Creek	Paradise Campground Off-Channel Enhancement	P1	Right bank off-channel habitat potential. Excavate a low-flow side channel. Remove old push-up levee extending approximately 200 feet along right bank. Add apex jam (use existing LW) to encourage erosion on the left bank and recruitment of large trees and floodplain activation upstream at the top of the existing right bank bar.	Potential effects to eroding left bank along campground will need to be evaluated.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Paradise Creek	Paradise Bridge	P2	Increase the bridge span length to reduce floodplain constriction and increase the channel migration zone. Removing associated armoring would enhance margin complexity.	Costs may be prohibitive.	
Paradise Creek	Paradise Creek Large Wood	P3	Use LW jam(s) to aggrade channel and activate floodplain. Use existing large key pieces currently spanning the channel (not much wood but a few large (3'-4' diameter) pieces). There is an opportunity to maneuver these logs together, add additional wood (including, potentially, newly dead snag trees on site), to create a log jam behind existing key pieces. The goal would be to aggrade a slightly incised channel and activate the adjacent floodplain.	Relatively large buffer (100'?) between stream and Wind River Highway, but floodplain would need to be evaluated for hazards to infrastructure. There is a bridge downstream. Past incision indicated by inset floodplain with lower current bankfull width. Alders on lower surfaces potentially from 1996 flood. New signs of aggradation on lower surface might signify channel is on an aggrading trend.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Dry 1	Lower Dry Creek	D1	This project site is between the mouth and the beginning of the bedrock canyon. It is low gradient and alluvial with large active gravel bars and active scrolling. Needs large wood structure. There has been past work through here, including margin log placements at the upstream end and an engineered jam near the downstream end. Opportunities include: 1) Add wood, either construct margin and apex jams or add large key pieces that can collect smaller wood over time. Place jams to strategically erode banks where good tree recruitment would occur; 2) Use jams and select excavation to activate floodplains, side-channels, and alcove habitat. Lots of opportunity through here.	The effects of seasonal subsurface flow on fish needs to be evaluated before performing work here.	
Dry 1	Dry Creek Upper Bedrock Channel	D2	Low complexity and low large wood numbers. More confined and less natural floodplain, but low gradient and has potential to have good rearing and spawning habitat. Add key pieces of large wood to collect smaller debris and form jams. Jams would provide rearing cover as well as retain spawning gravels.	Bedrock contacts through here and likely high energy in floods due to natural confinement. Redd scour is a potential issue. The effects of seasonal subsurface flow, and passage at falls downstream, needs to be evaluated before performing work here.	

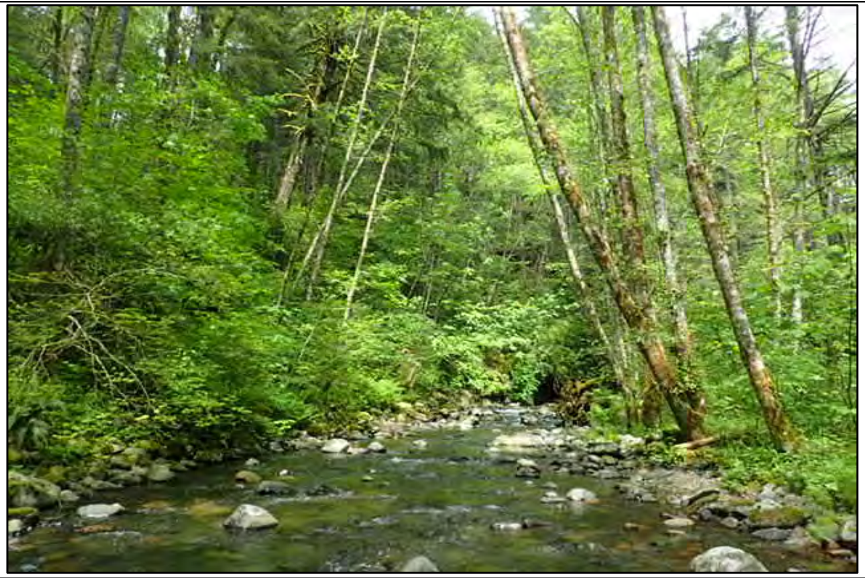
Reach	Project Name	Project Code	Project Description	Considerations	Photo
Dry 1	Spoil Bank	D3	"Spoil Bank" forms cross-floodplain levee on river-left, which disconnects floodplain connectivity and limits off-channel habitat. There is past project work upstream in left-bank floodplain to enhance side-channel habitat. Remove spoil bank to reconnect floodplain. Create new side-channels and enhance connectivity to existing floodplain habitat in both the left- and right-bank floodplains. Enhance mainstem complexity (there is very little large wood throughout here). Plant riparian conifers (cedars) throughout.	Spoil bank material could be moved closer to road to avoid impacts to floodplain connectivity. Past project in left-bank floodplain could be enhanced by increasing level of activation of side-channel.	
Dry 1	Upper Dry Creek Key Piece Supplementation	D4	Reach has woody debris but most is small and riparian areas have young trees, mostly deciduous. Add large key pieces, possibly by helicopter to limit impacts. This would create stable key pieces to form and maintain jams. Good locations for placements are intermittent and do not encompass the entire project reach. Some areas through here have high complexity, with numerous smaller debris jams. Could also fall select large cottonwoods and maples (there are large ones >2' dbh).	Access from Dry Creek Road, may be challenging in places and will impact riparian zones.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Dry 2	Forest Road 64 Crossing	D5	The FR64 fill bisects and disconnects the Dry Creek floodplain significantly (original floodplain is wide, ~300 ft here). Culvert at FR64 is an 11' diameter CMP with side baffles but no streambed material. The downstream 15' of culvert is fast shallow flow then 1.5 ft drop to a deep pool, which probably limits passage at some flows (high and low). There are also two log sills downstream of the outlet pool, presumably to address passage issues. Upstream of FR64 crossing there is nothing to do: old growth, well-connected floodplain, good riparian cover and structure, and lots of wood, off-channel habitat, and deep complex pools. Downstream of the 64 road is more downcut and the floodplain is not well connected. There is a more open canopy and less old growth, less off-channel habitat, less active gravel bars, and sediment starved from the road crossing. Replace culvert with long bridge or multiple large culverts to enhance passage and floodplain connectivity. Add channel-spanning jams to downstream channel to aggrade stream, activate floodplain, and provide habitat complexity.	Floodplain and habitat enhancements downstream from the road crossing will have limited value if the road fill remains in place and continues to create a sediment deficit. The effects of seasonal subsurface flow in lower Dry Creek on fish needs to be evaluated before performing work in upper portions of Dry Creek.	
Eightmile	Eightmile	E1	Channel is lacking large wood. Riparian zone at lower and middle is dominated by ≤ 6" alders. The vegetation and channel show evidence of past debris flow (2009?), with some related scouring/incision. The few large pieces of large wood are creating nice pools. There is a large debris flow jam just upstream of the reach. Adding key pieces will help to capture and retain this material as it makes its way downstream, and will help to activate floodplain surfaces. Fell large trees into channel (there are some on hillslope that would reach channel) and/or use helicopter to bring in large wood.	Challenging access for machinery	

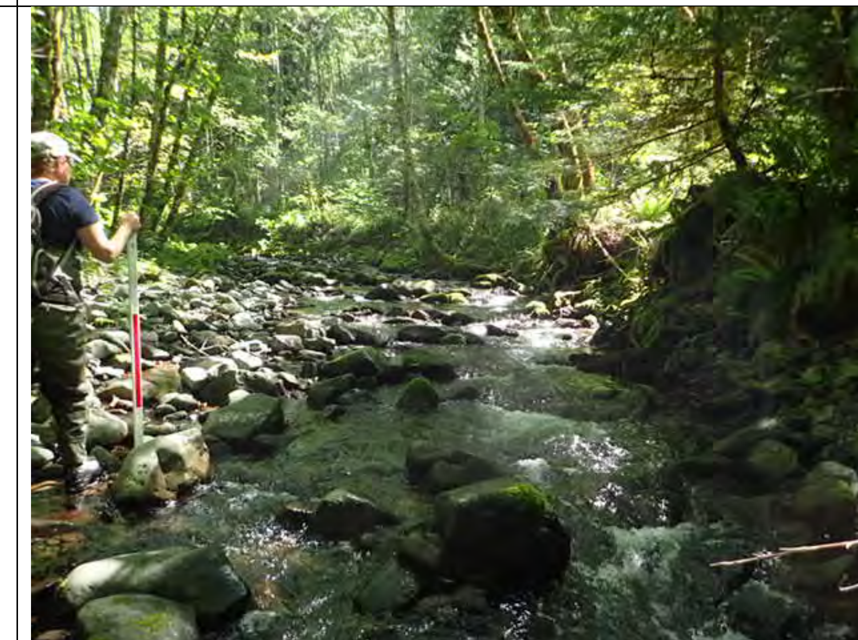
Reach	Project Name	Project Code	Project Description	Considerations	Photo
Trout Creek	Meadow Crest	T1	At top end, both sides of river, especially on the north bank, there is a wide (~100') forested riparian area and stream is continuous riffle. There are no log jams in this reach. Add one or more log jams to capture gravels and provide cover habitat. Existing trees may be able to be used for anchoring. In middle and downstream, also potential sites for log jams, possibly incorporating recent blow down (3-4 logs).	Private lands and potentially challenging access.	

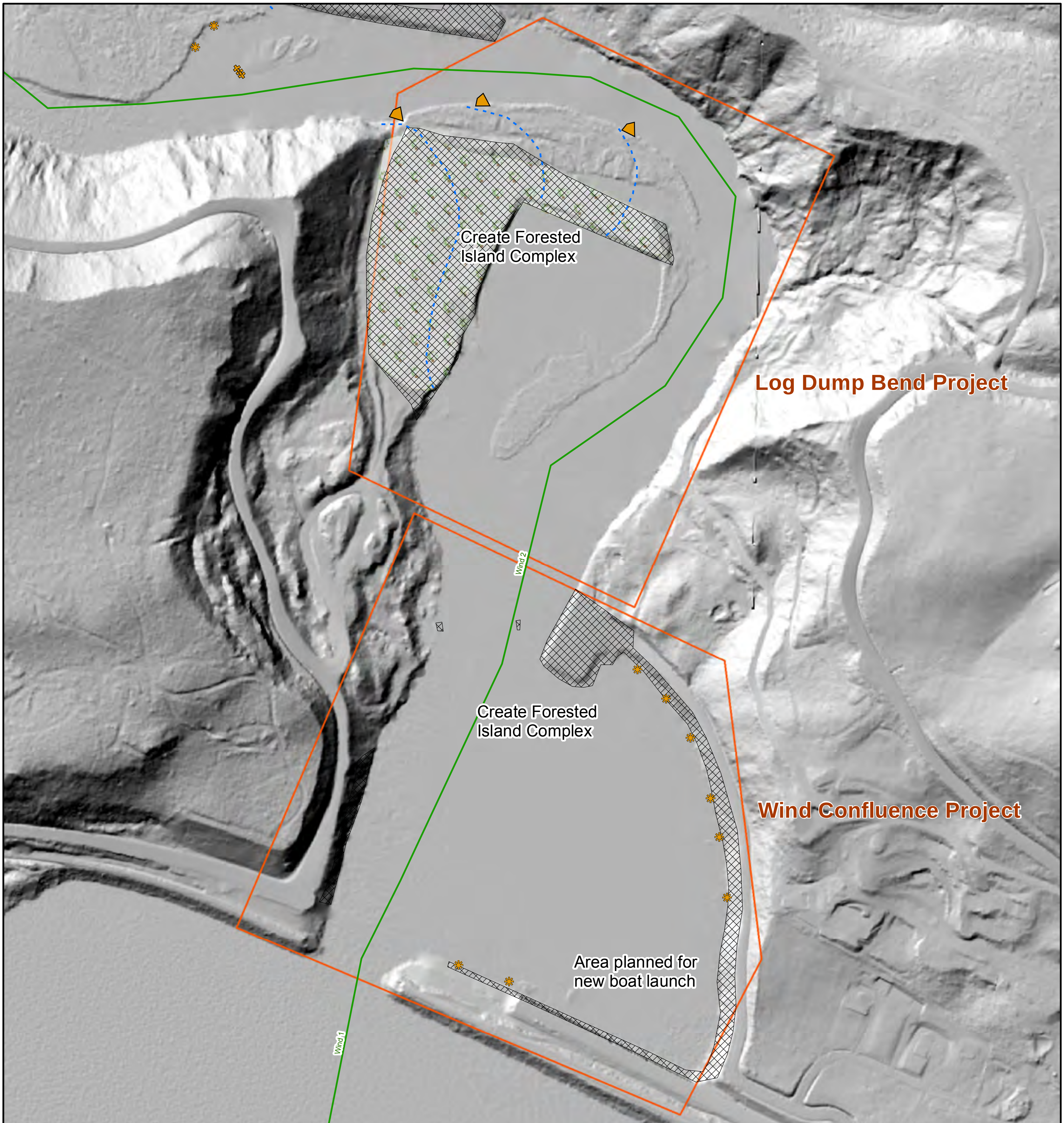
Reach	Project Name	Project Code	Project Description	Considerations	Photo
Trout Creek	Summer's End	T2	This is the most complex area in this reach downstream of Hemlock Bridge. Conditions include a 150ft+ side-channel (left bank), a vegetating cobble bar, a steep south bank with existing mature conifers, and a couple of large logs currently on the south stream bank, plus a small row of alders near these logs. Add one or more engineered log jams in/across the north bank side channel or keyed into the alder screen and existing LWD on south bank. Maybe additional opportunities for log jams downstream.	Private lands and potentially challenging access. Potential access via Summer Road. Top photo shows north bank and existing log and main channel. Bottom photo shows portion of side channel, looking upstream.	 

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Martha Creek	Martha	M1	Upstream portion is young riparian forest and downstream portion is older forest. Add wood and jams to scour pools, capture gravels, activate floodplain, and create side-channel habitat. In middle and downstream areas, consider felling trees into channel from the occasional high banks. Place jams strategically to cause erosion to recruit large riparian conifers.	Federal and county property. Good access via nursery property. Seasonal subsurface flow conditions, and impact on fish, should be considered.	
Little Wind 1	Pipeline	L1	Confined valley with narrow alternating floodplain surfaces. Much of it is boulder/cobble plane-bed channel. Low large wood and young alder dominated riparian zone. Add large wood and small log jams, including excavation of scour pools. Similar to past work performed in downstream reach by UCD. This is essentially a continuation of that effort. Wood placements will add direct habitat, maintain scour pools, and help to activate floodplain surfaces and side-channels. Good opportunity for channel spanning jams to activate floodplains and create forced pool-riffle morphology. Could fell fir trees from nearby hillslopes and maneuver into channel.	USFS (Scenic Area) property. The river-right road is too high for access, but can move machinery up-valley by crossing back and forth and tracking up alternating floodplain surfaces. Felling and maneuvering into stream nearby firs using grip hoist may also be an option.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Little Wind 1	Berge Confluence	L2	Similar conditions as L1. A few long riffles with no habitat complexity. There is more wood through here than in L1, but several stretches are plane-bed with no wood. Selectively fell large firs from nearby hillslopes and maneuver into stream to help build jams to create scour pools, increase complexity, collect gravels, and activate the small floodplain surfaces and short side-channels. There also may be some downed wood (including spanners) that could be maneuvered into the channel.	Machinery access challenging. Likely accomplished using hand crews with grip hoists pulling down firs on hillslopes. Helicopter placement may also be an option.	
Little Wind 1	Dillon	L3	Similar conditions as L1 and L2. Reach contains some eroding banks with recruited wood spanning the channel. There is a bedrock channel at upstream end. Use grip hoist to maneuver existing downed wood into channel and to fell hillslope firs and place in channel. Good location for helicopter placement as well. At downstream end river-left, there appears to be a small push-up levee, but origin is unclear. Remove if possible or use jams to direct flow into levee to erode levee and activate the left bank low surface.	Machinery access likely not possible. Good location for helicopter placement of wood and/or using hand crews with grip hoists pulling down firs on hillslopes.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Little Wind 1	Powerline	L4	This is above a downstream more confined reach with landslides, more abundant large wood, and boulder-bedrock channel. Beginning here, and continuing upstream, is a lower gradient channel with occasional broad floodplains. But the channel has incised into this floodplain in many areas and there are many plane-bed sections and low large wood numbers. The riparian and floodplain is primarily young alders. Place large wood and log jams to activate and reconnect the floodplain, reconnect side-channels, create complexity, trap gravels, force pool-riffle channels, and maintain scour pools.	USFS (Scenic Area) lands. Can obtain machinery access via an old logging road.	
Little Wind 1	Lower Headwater Flats	L5	Similar conditions and opportunities as L4. Long relic side-channels that are relatively disconnected due to channel incision. Channel contains long plane-bed riffles. There are large stumps and logging debris (cables) on site. Place large wood and log jams to activate and reconnect the floodplain, reconnect side-channels, create complexity, trap gravels, force pool-riffle channels, and maintain scour pools. Plant cedar to jumpstart succession under alder canopy; focus on planting along wide benches along stream.	USFS (Scenic Area) lands. Can obtain machinery access via an old logging road.	

Reach	Project Name	Project Code	Project Description	Considerations	Photo
Little Wind 1	Middle Headwater Flats	L6	Similar conditions to L4 and L5. Wide floodplain benches but stream appears incised and somewhat disconnected. Add jams to activate floodplains and side-channels and to enhance channel complexity. Consider shifting main channel into more complex and sinuous alignment in floodplain. Depending on access conditions, either use helicopter, local felling of trees, or machinery.	USFS (Scenic Area) lands. Potential machinery access via old logging road, or from downstream access point. Otherwise, use hand crews with grip hoists or helicopter placements.	
Little Wind 1	Upper Headwater Flats	L7	Similar conditions to L4, L5, and L6. Wide floodplain benches but stream appears incised and somewhat disconnected. Add jams to activate floodplains and side-channels and to enhance channel complexity. There are some areas already exhibiting complexity that would be improved by additional wood. Depending on access conditions, either use helicopter, local felling of trees, or machinery.	USFS (Scenic Area) lands. Potential machinery access via old logging road, or from downstream access point. Otherwise, use hand crews with grip hoists or helicopter placements. Upstream of this site is more confined with more abundant large wood contributed from steep hillslopes.	



Wind River Restoration Strategy

Lower Wind River - Downstream Projects

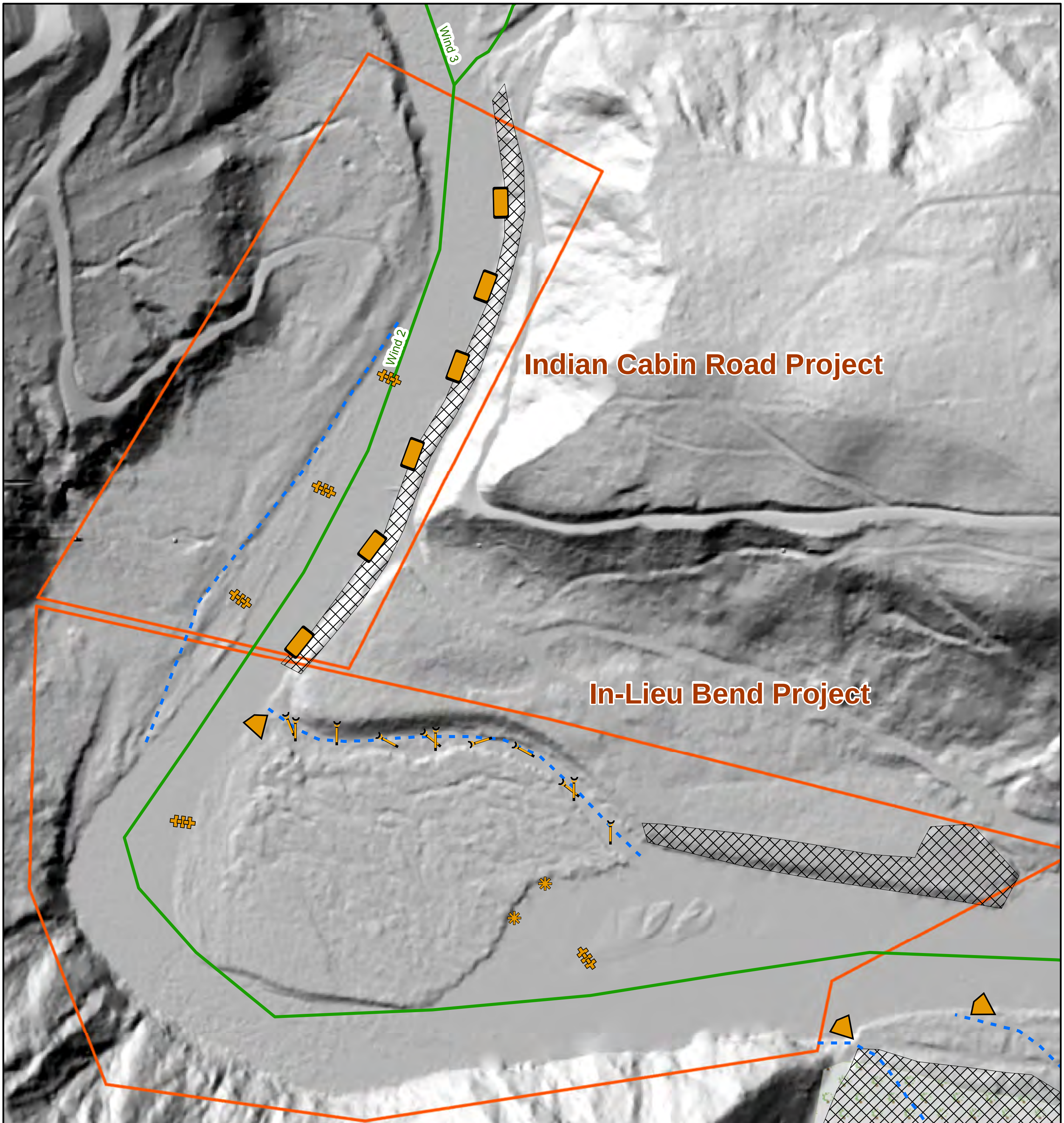
0 150 300 600 Feet

N

- EDT Reach
- Project Area

Project Elements

- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



Wind River Restoration Strategy

Lower Wind River - Upstream Projects

0 150 300 Feet

N

EDT Reach

Project Area

Project Elements

Bar apex log jam

Large wood capture structure

Individual log placement

Large wood margin complexity

Channel margin log jam

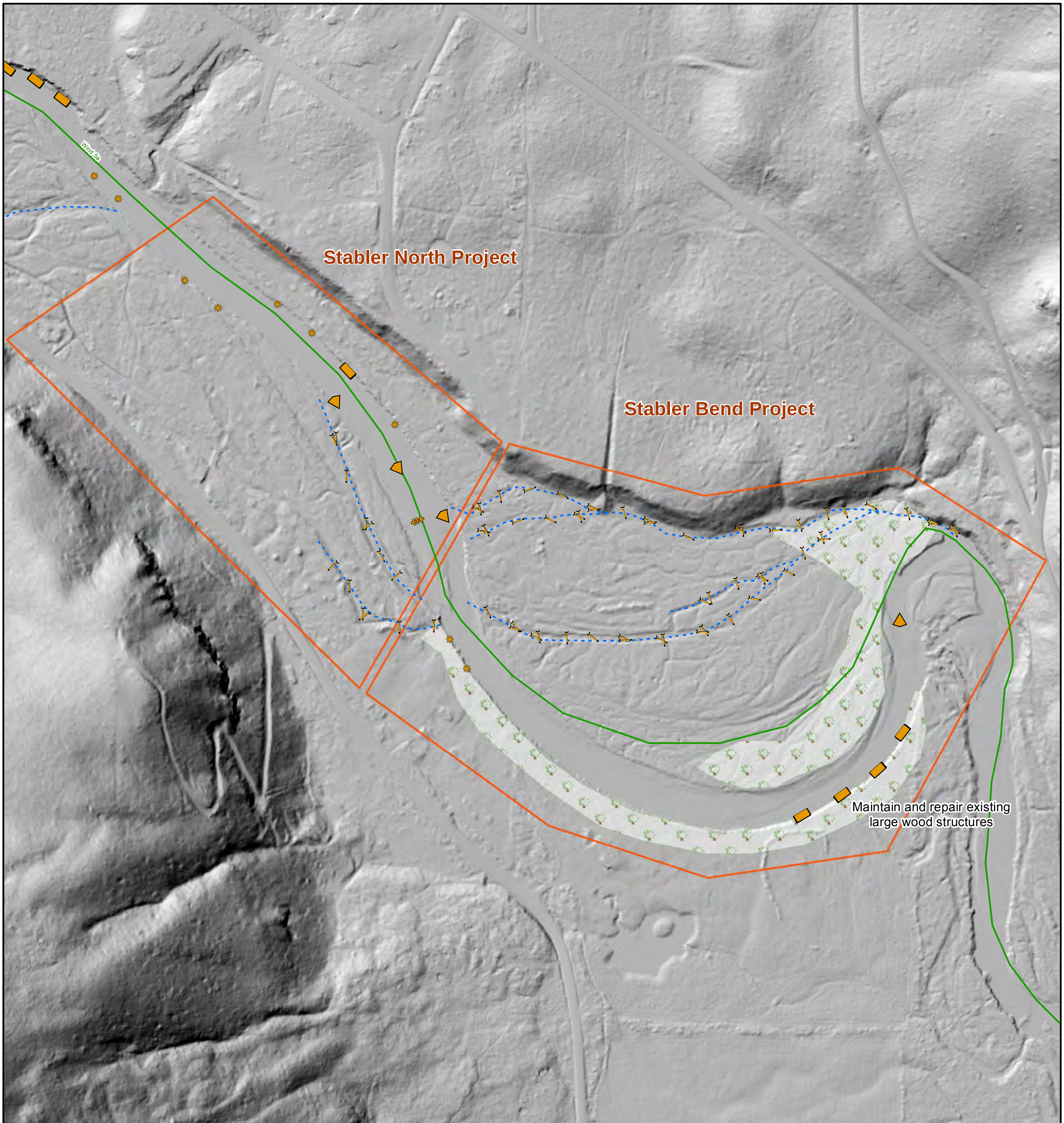
Channel Spanning Structure

Whole tree placement

Enhance side channel connectivity

Removal/modification of fill or armoring

Riparian revegetation



Wind River Restoration Strategy

Wind River - Stabler Area Projects

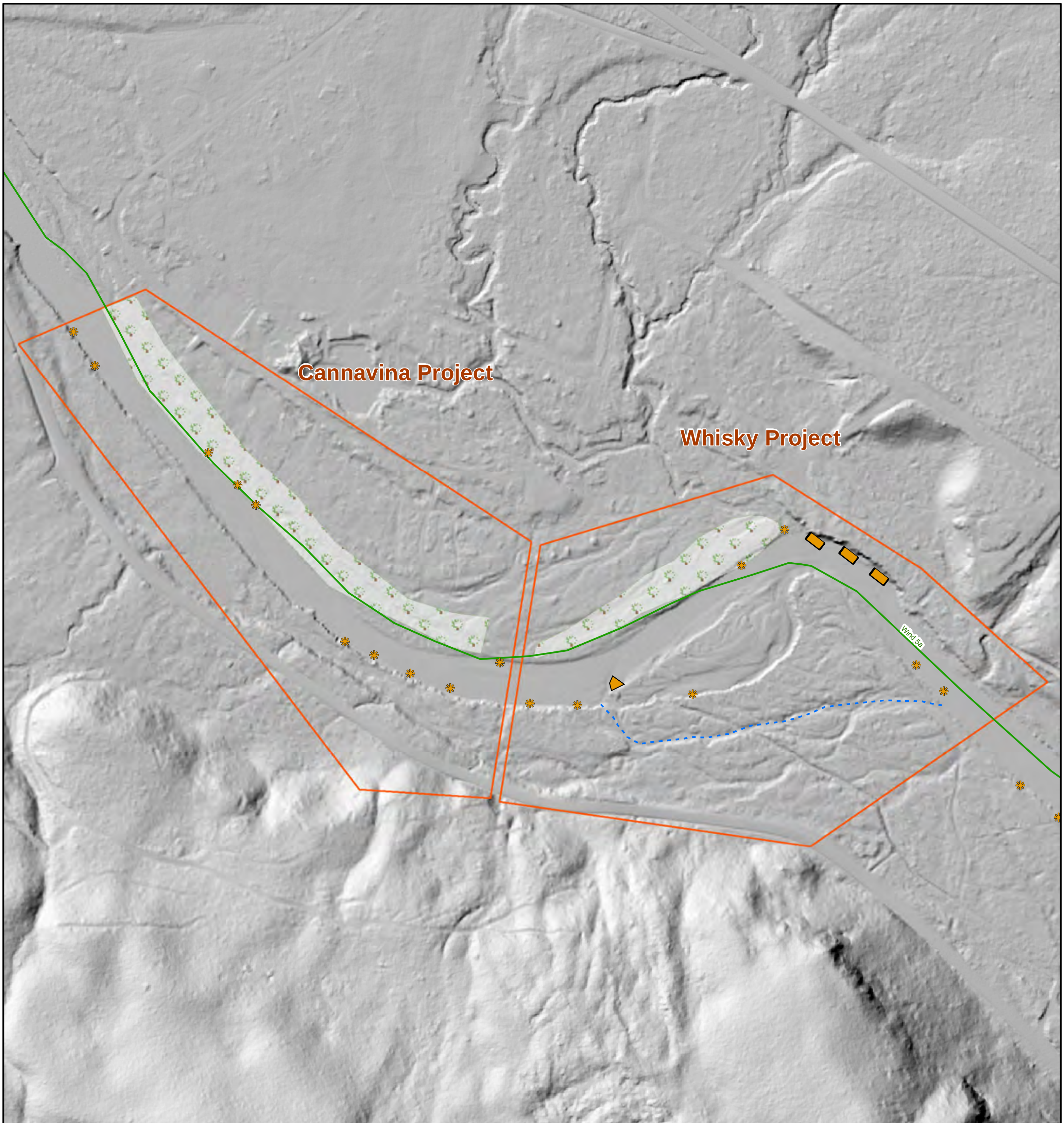
0 150 300 600 Feet

N

EDT Reach
Project Area

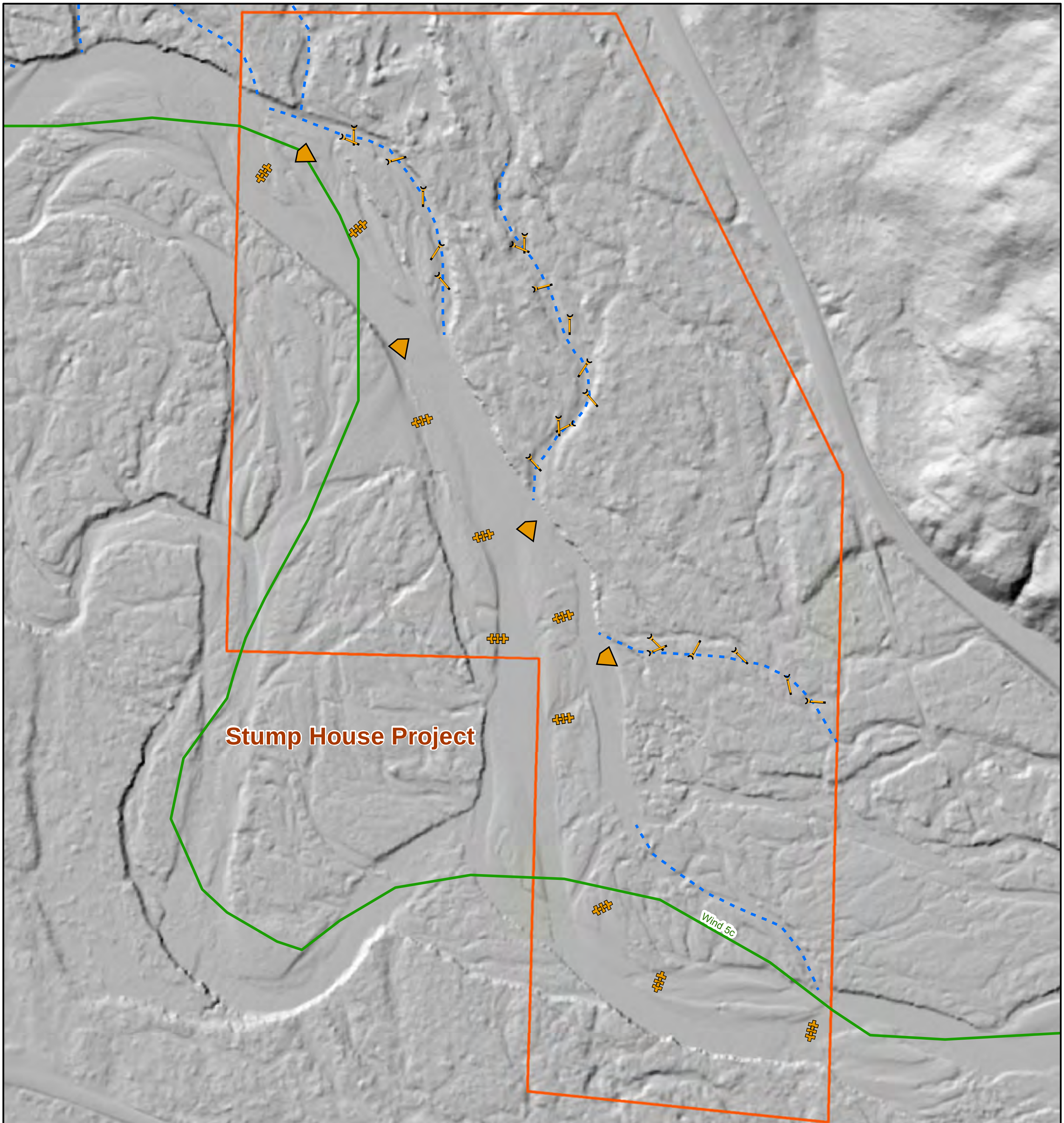
Project Elements

- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



Wind River Restoration Strategy

Wind River - Cannavina & Whisky Projects



Wind River Restoration Strategy

Wind River - Stump House Project

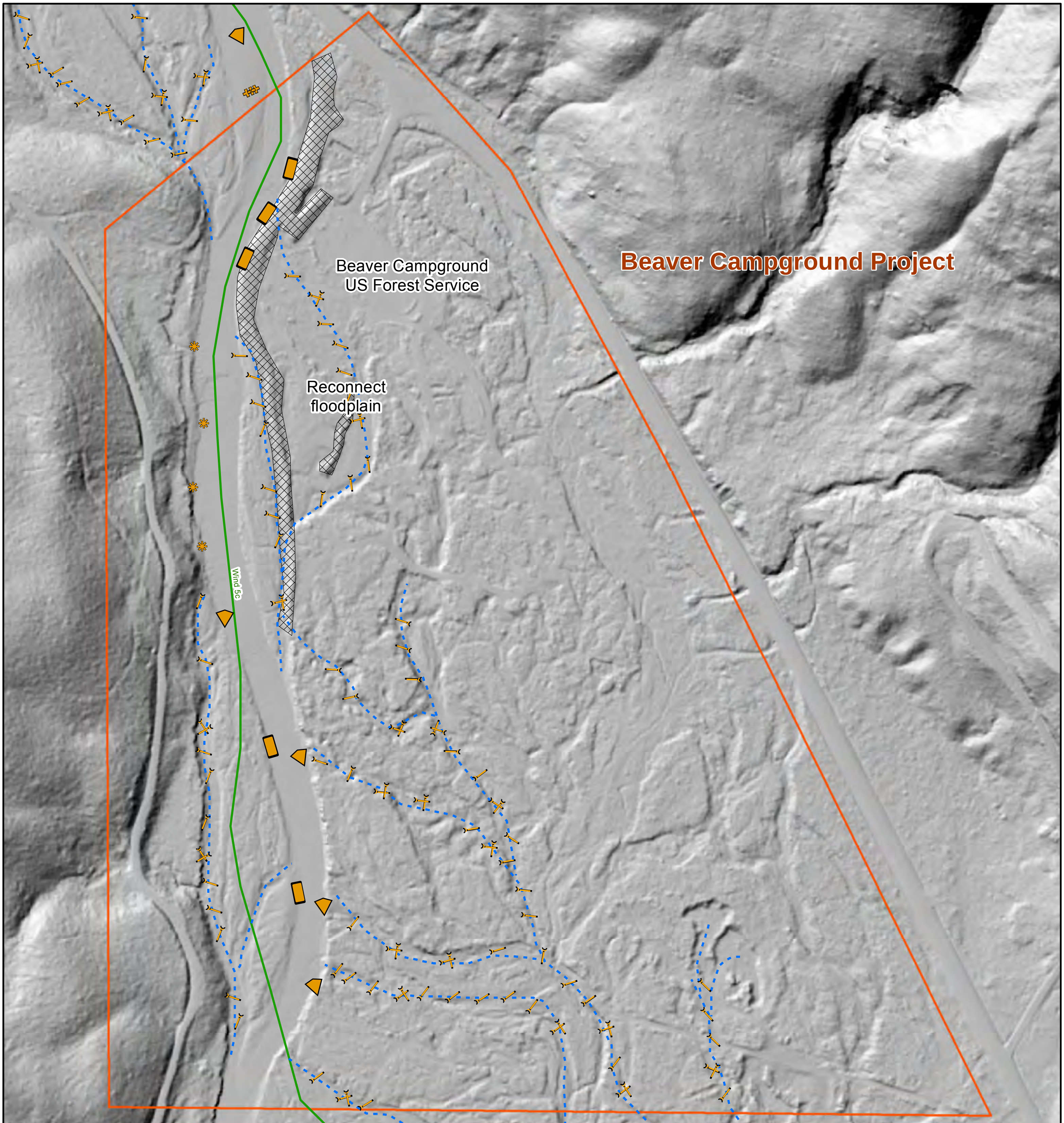
0 150 300 Feet

N

- EDT Reach
- Project Area

Project Elements

- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



Wind River Restoration Strategy

Wind River - Beaver Campground Project

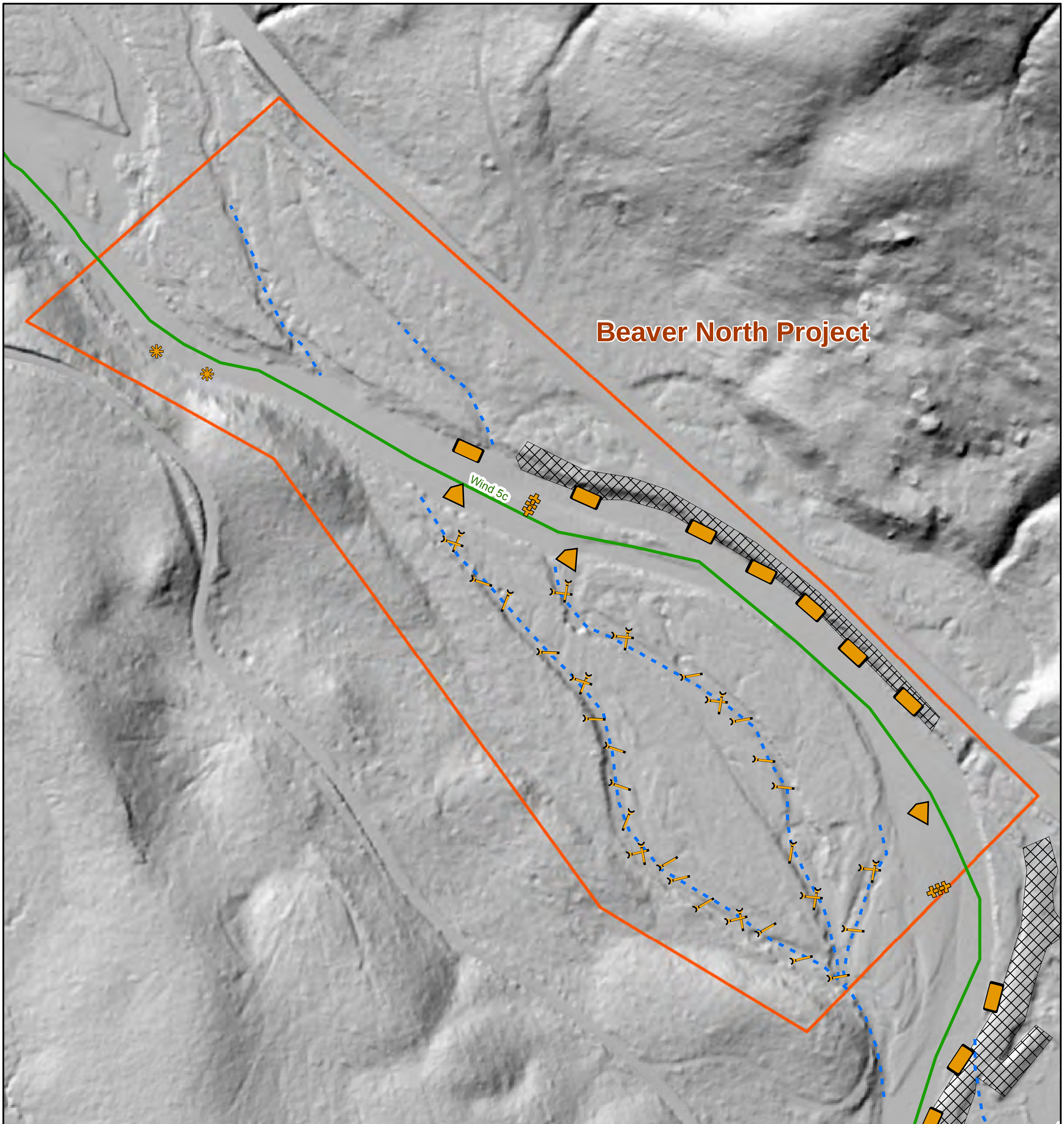
0 150 300 Feet

N

- EDT Reach
- Project Area

Project Elements

- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



Wind River Restoration Strategy

Wind River - Beaver North Project

0 150 300 Feet

N

EDT Reach

Project Area

Project Elements

Bar apex log jam

Large wood capture structure

Individual log placement

Large wood margin complexity

Channel margin log jam

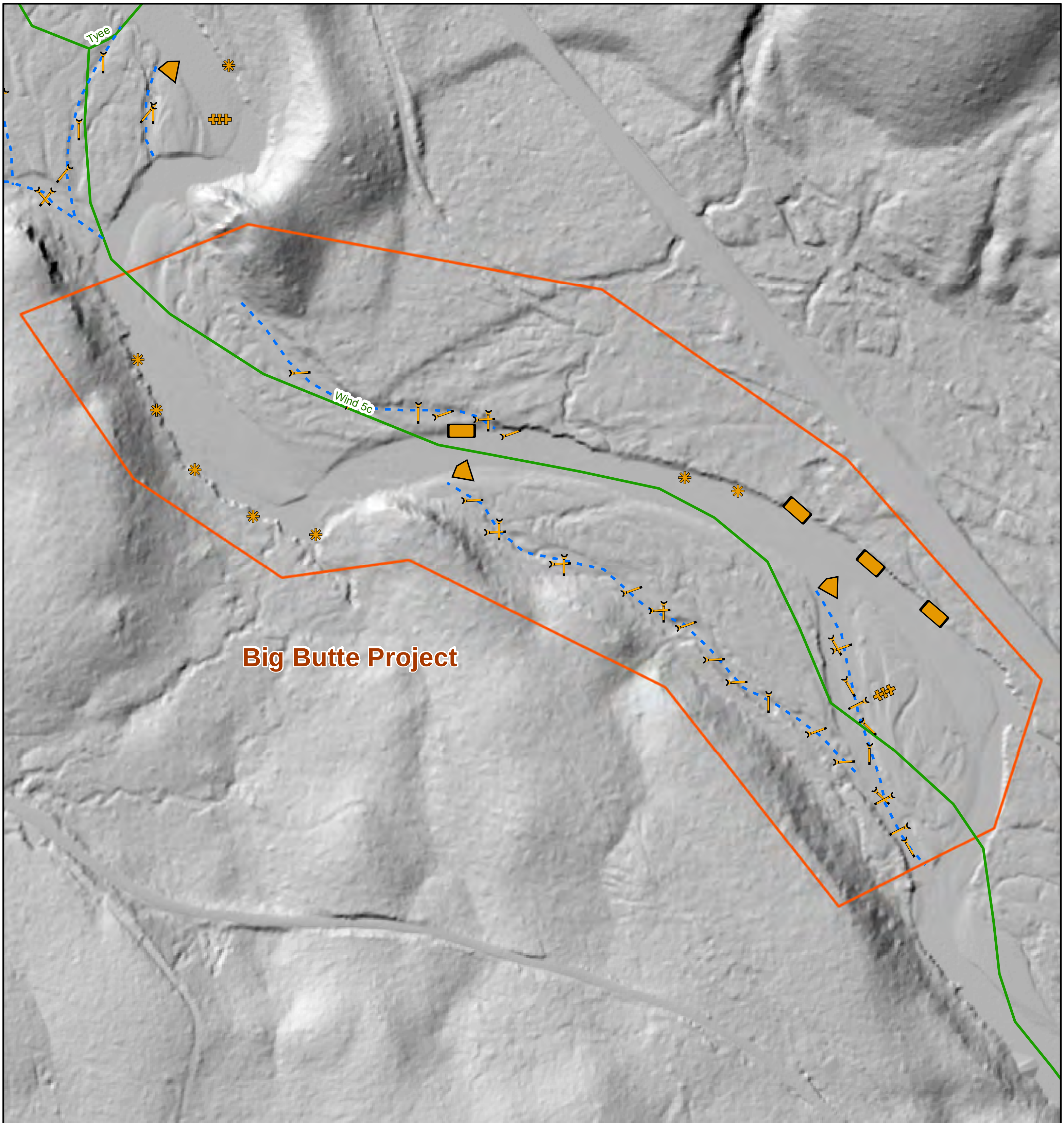
Channel Spanning Structure

Whole tree placement

Enhance side channel connectivity

Removal/modification of fill or armoring

Riparian revegetation



Wind River Restoration Strategy

Wind River - Big Butte Project

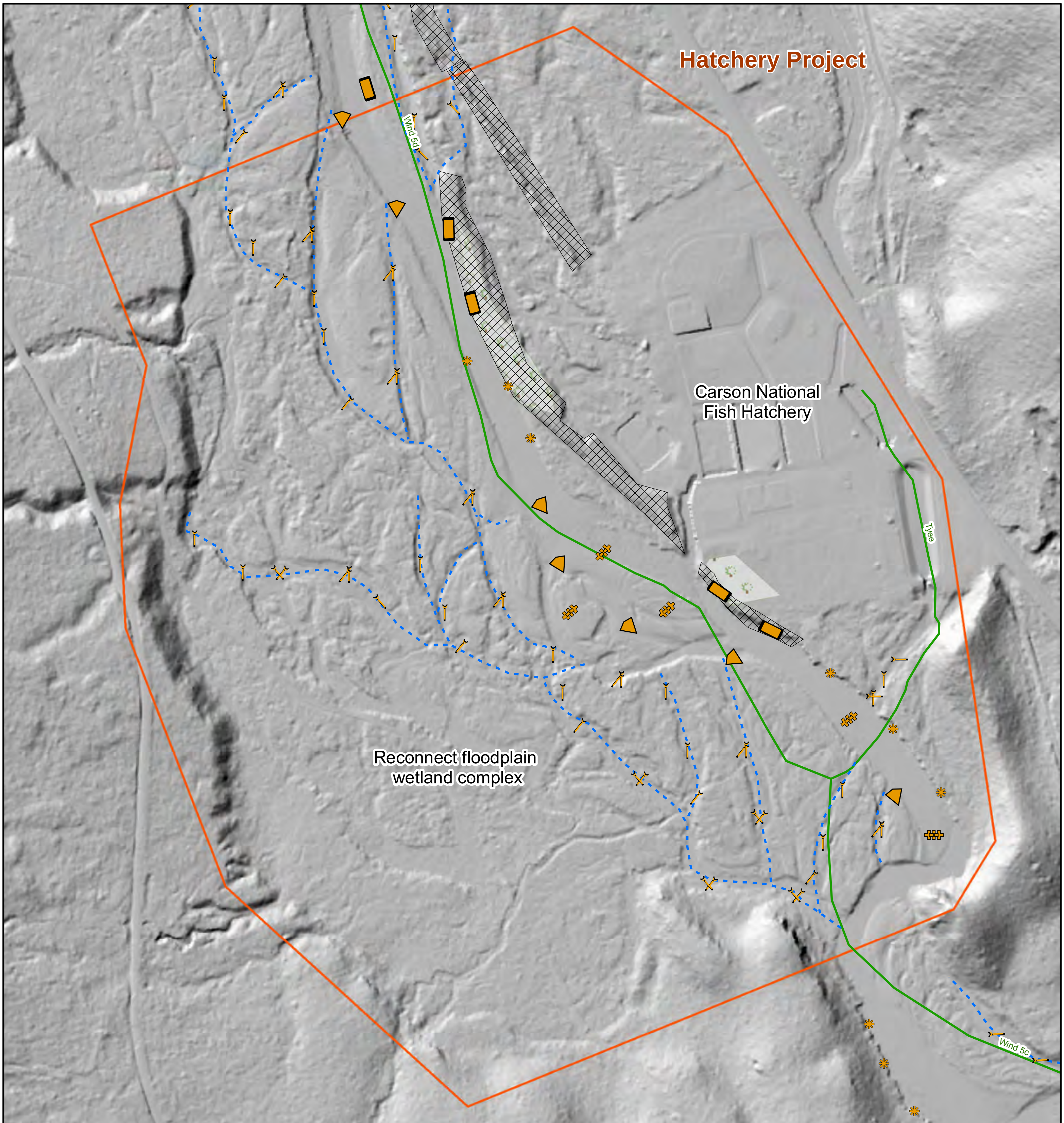
0 150 300 Feet

N

EDT Reach
Project Area

Project Elements

Bar apex log jam
Large wood capture structure
Individual log placement
Large wood margin complexity
Channel margin log jam
Channel Spanning Structure
Whole tree placement
Enhance side channel connectivity
Removal/modification of fill or armoring
Riparian revegetation



Wind River Restoration Strategy

Wind River - Hatchery Project

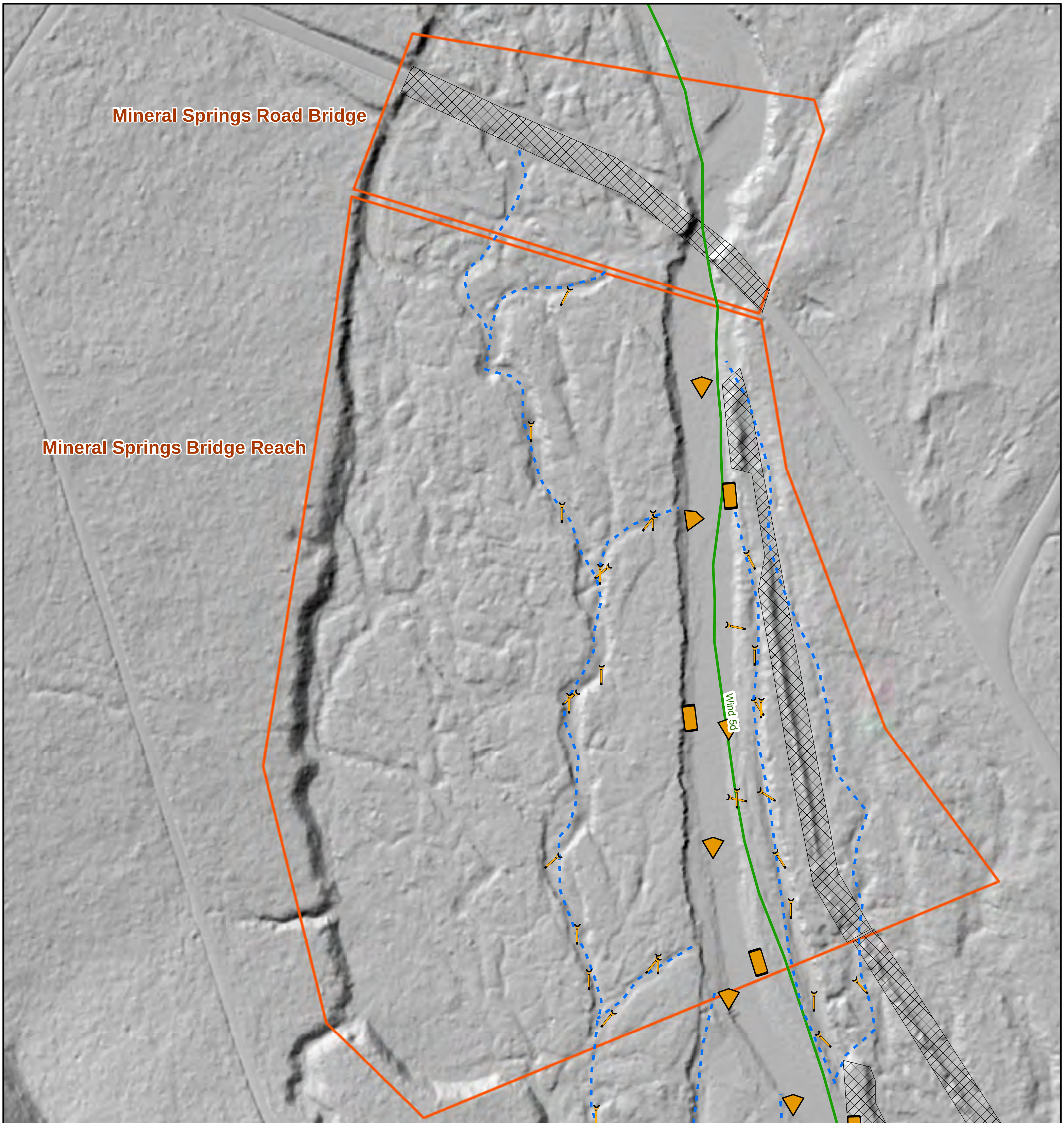
0 150 300 Feet

N

- EDT Reach
- Project Area

Project Elements

- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



Wind River Restoration Strategy

Wind River - Mineral Springs Road Area Projects

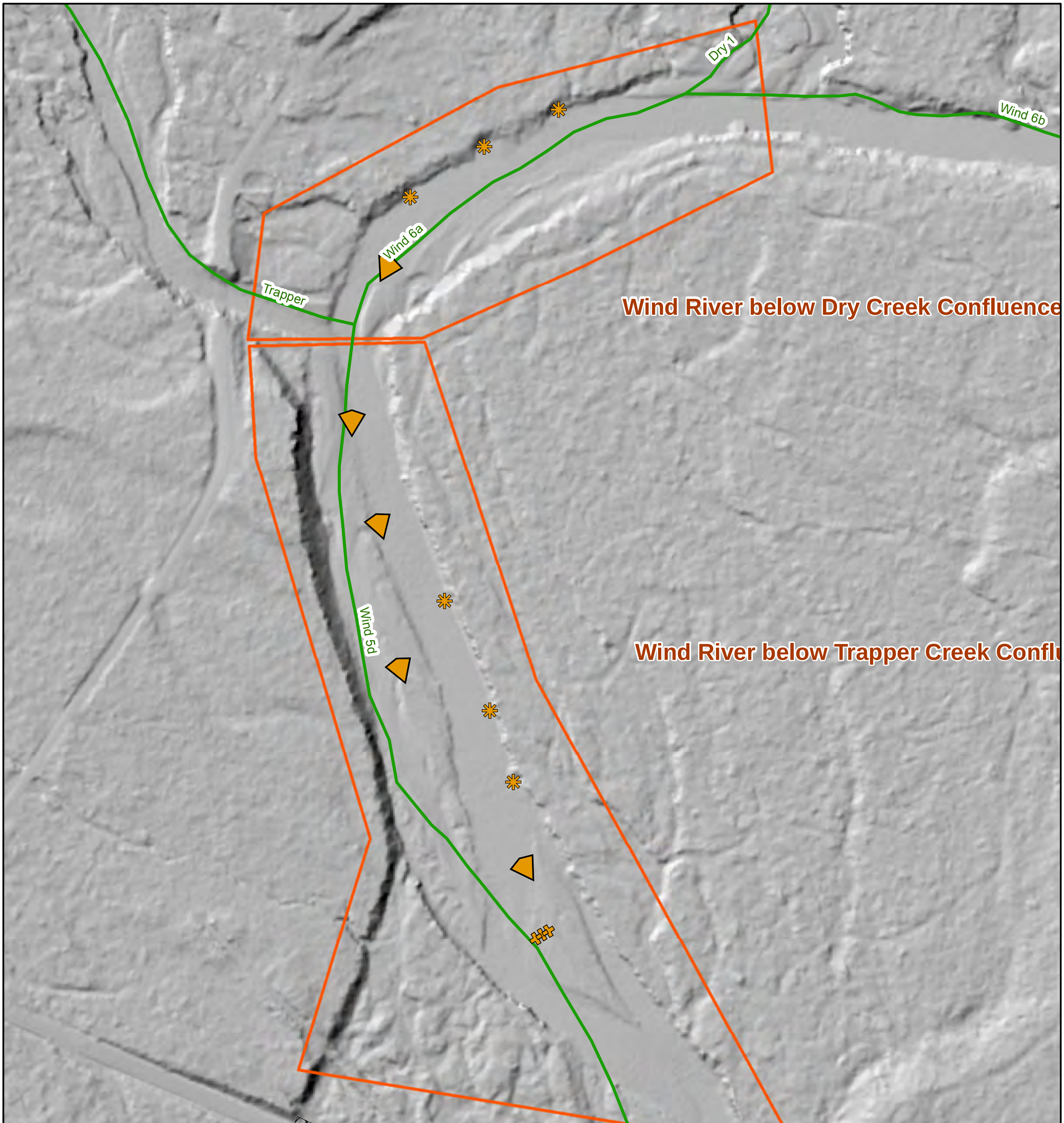
0 150 300 Feet

N

EDT Reach
Project Area

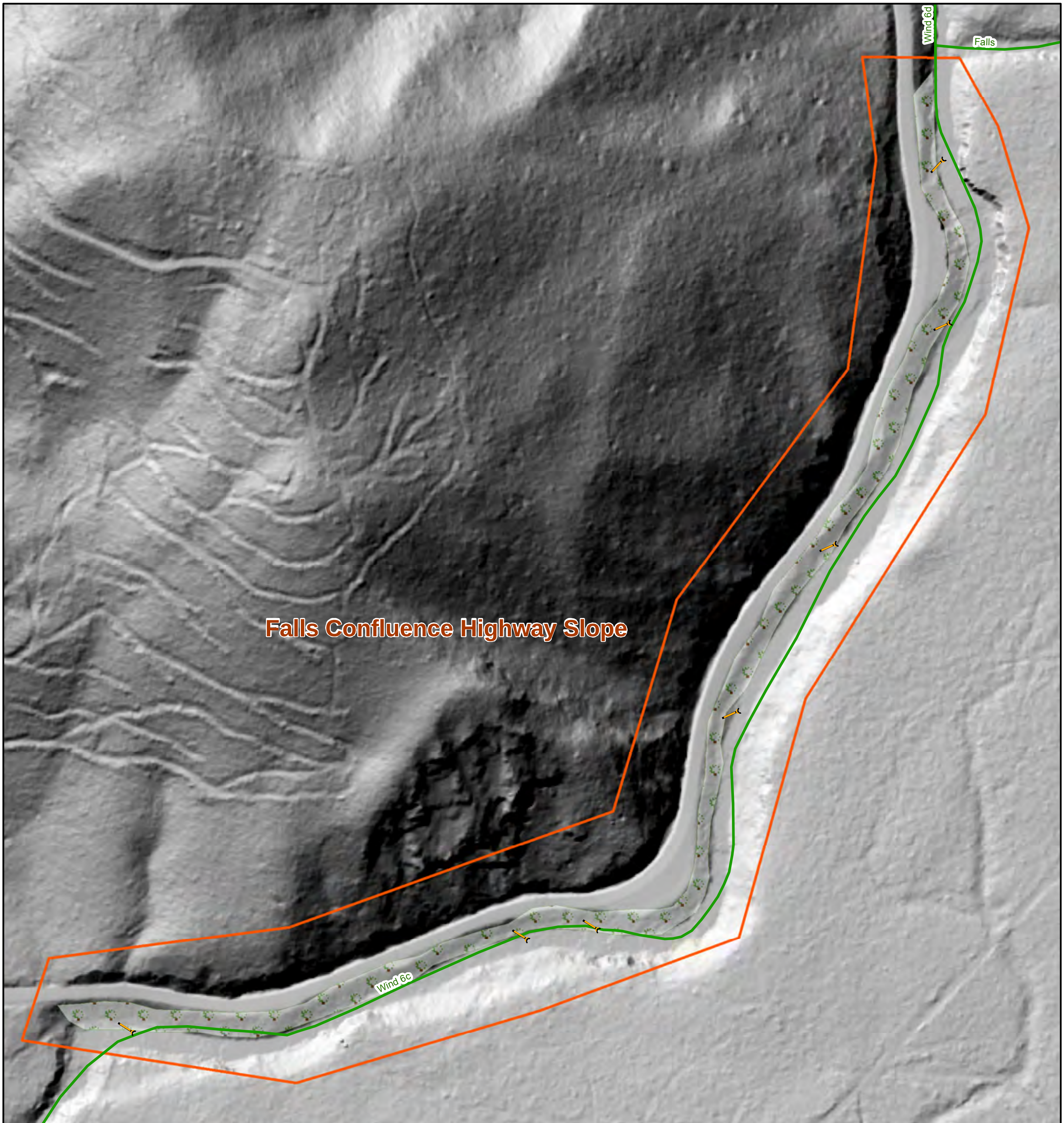
Project Elements

Bar apex log jam
Large wood capture structure
Individual log placement
Large wood margin complexity
Channel margin log jam
Channel Spanning Structure
Whole tree placement
Enhance side channel connectivity
Removal/modification of fill or armoring
Riparian revegetation



Wind River Restoration Strategy

Wind River - Trapper-Dry Confluence Projects



Wind River Restoration Strategy

Wind River - Falls Confluence Highway Slope

EDT Reach

Project Area

Project Elements

Bar apex log jam

Large wood capture structure

Individual log placement

Large wood margin complexity

Channel margin log jam

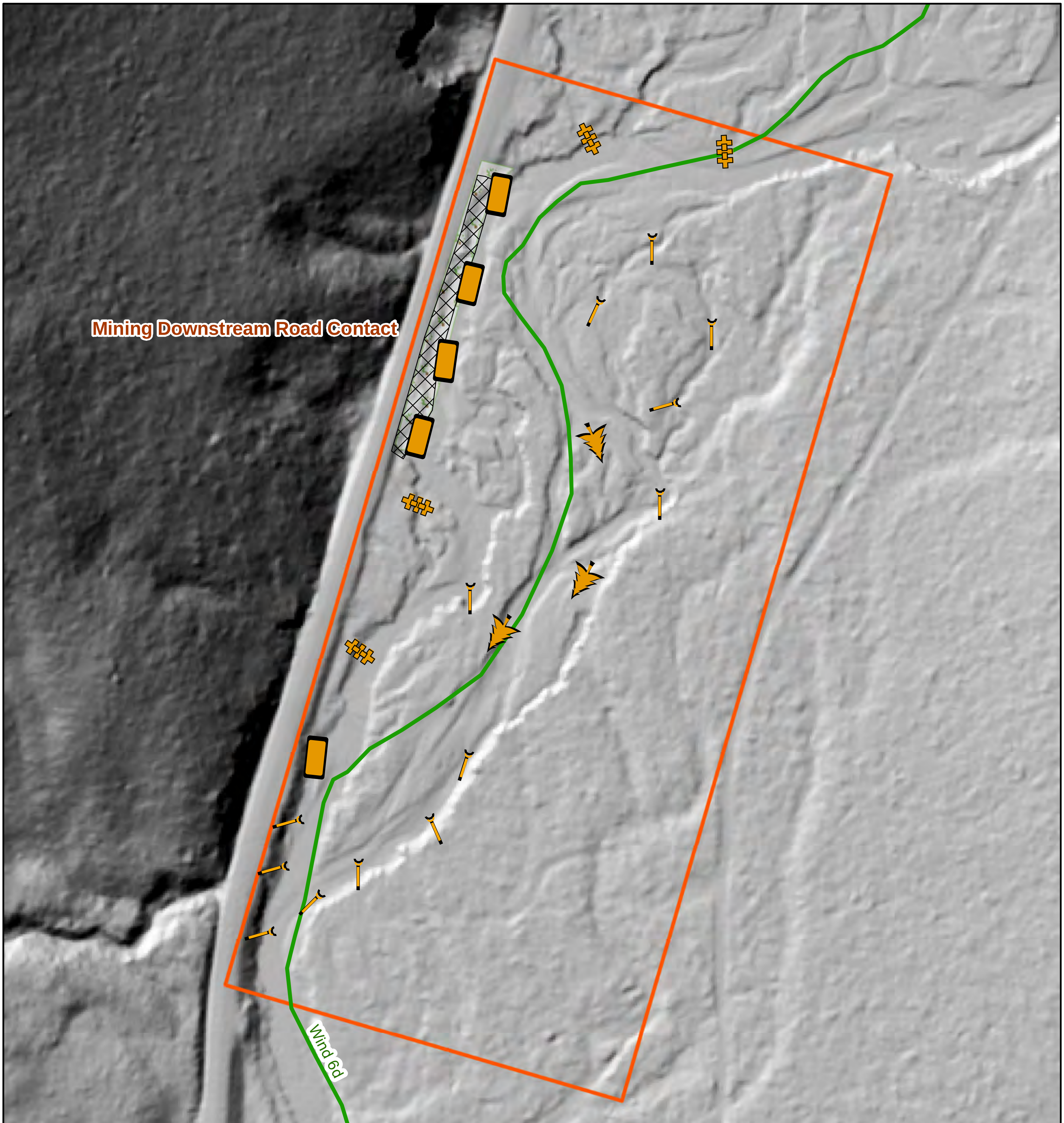
Channel Spanning Structure

Whole tree placement

Enhance side channel connectivity

Removal/modification of fill or armoring

Riparian revegetation



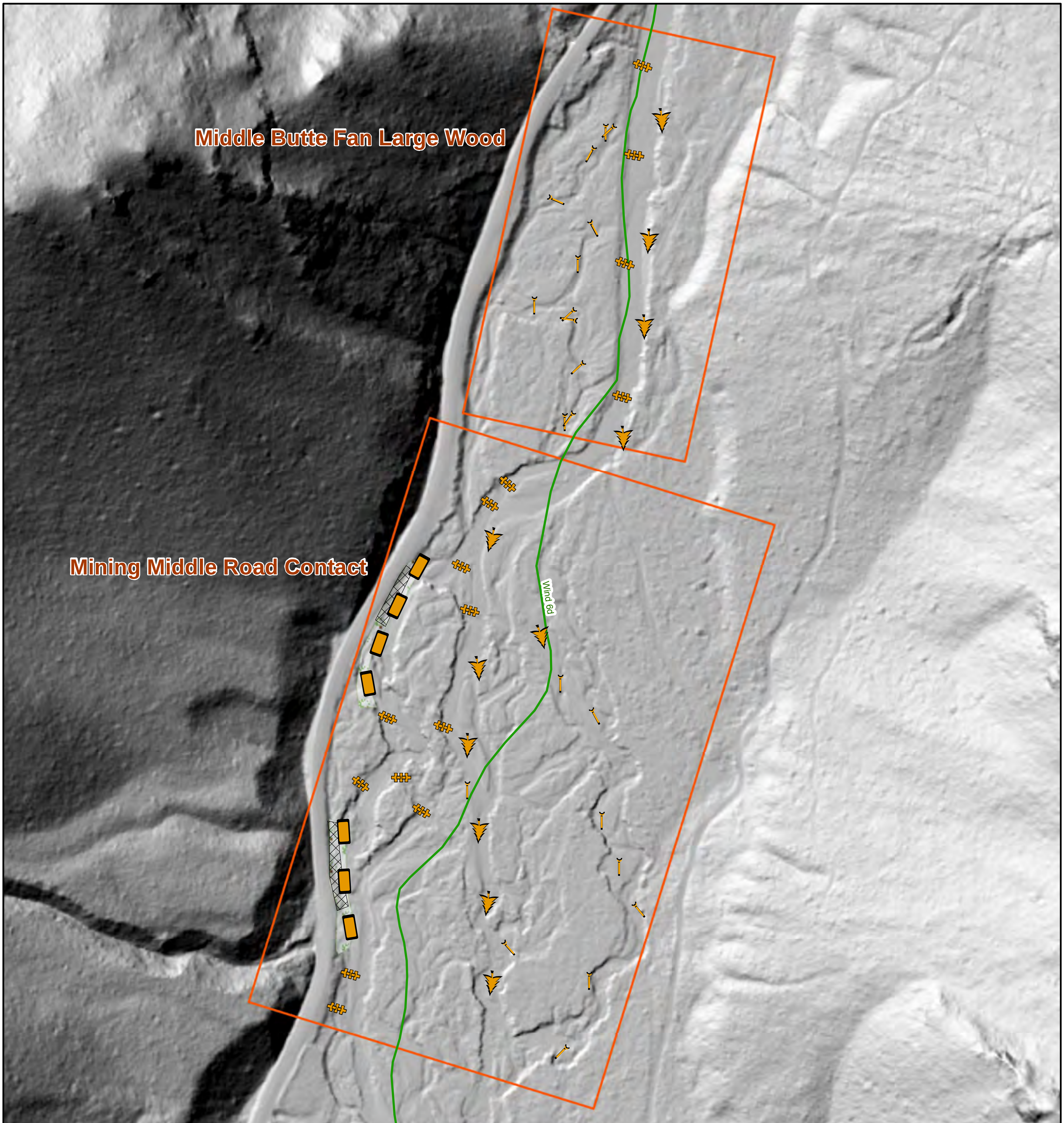
Wind River Restoration Strategy

Wind River - Mining Reach Downstream Road Contact

EDT Reach
Project Area

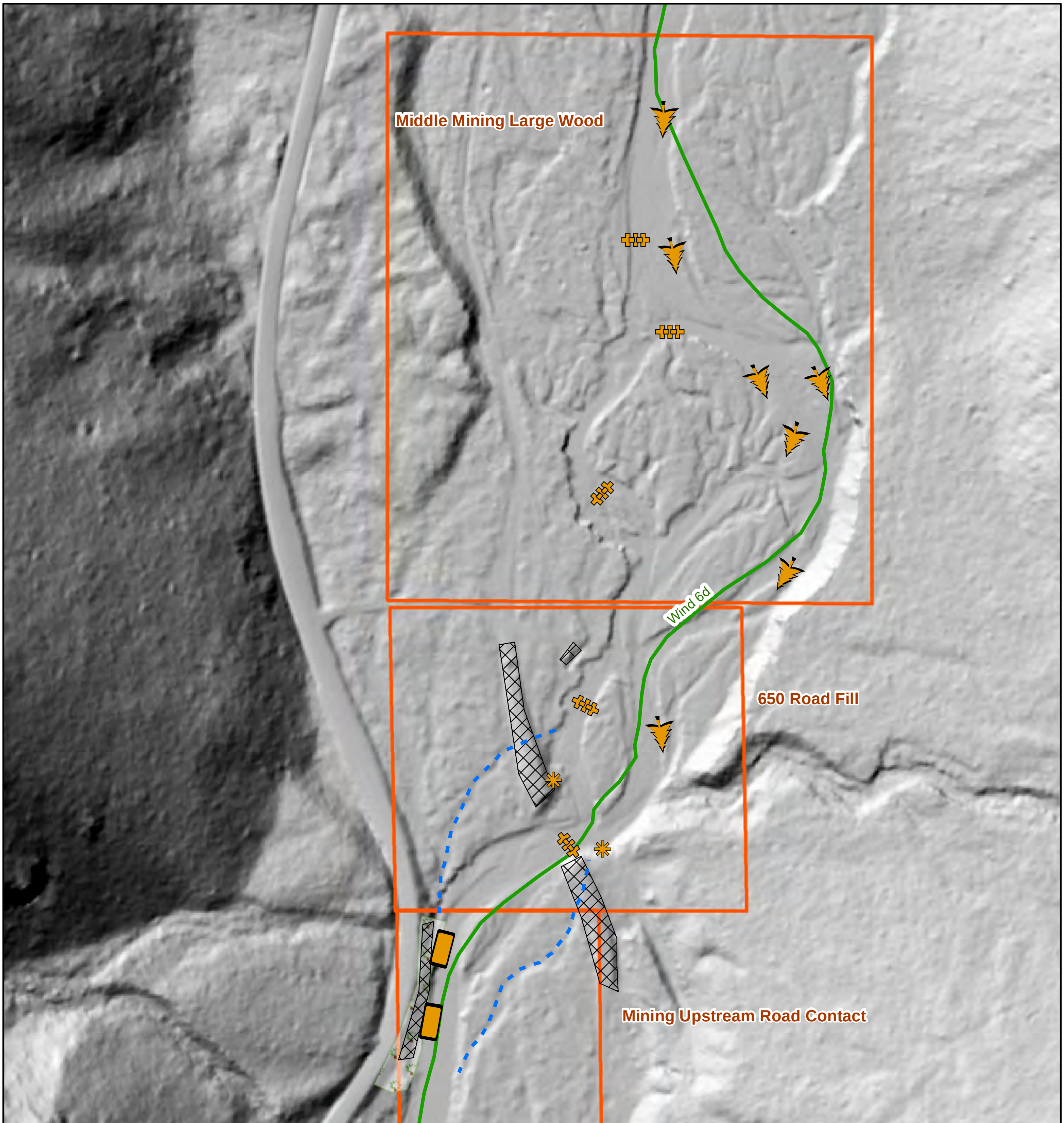
Project Elements

- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



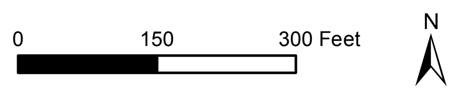
Wind River Restoration Strategy

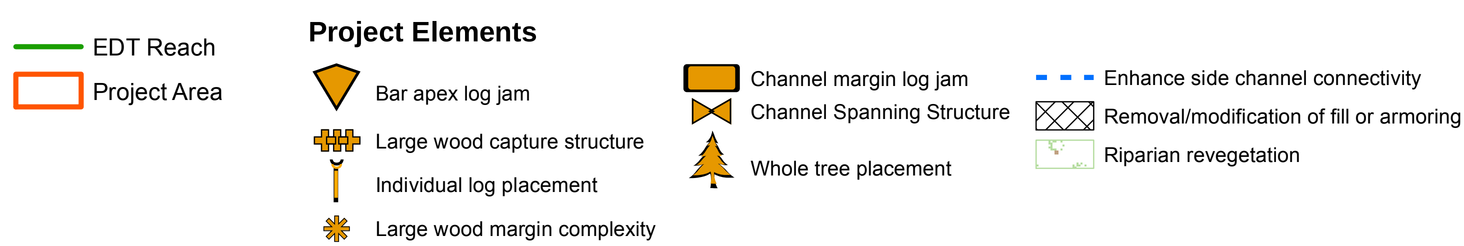
Wind River - Middle Mining Reach Projects

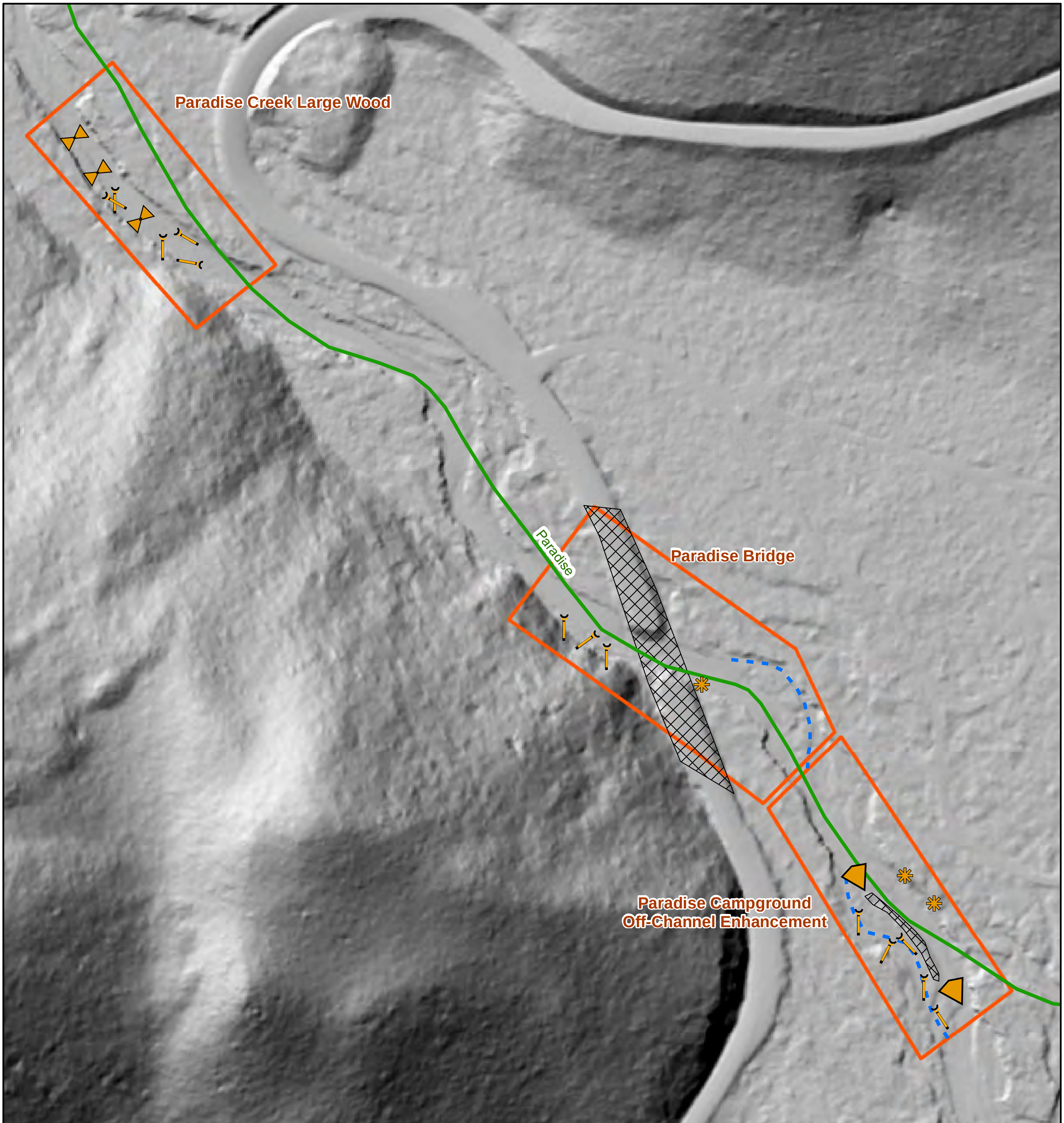


Wind River Restoration Strategy

Wind River - Upper Mining Reach Projects







Wind River Restoration Strategy

Paradise Projects

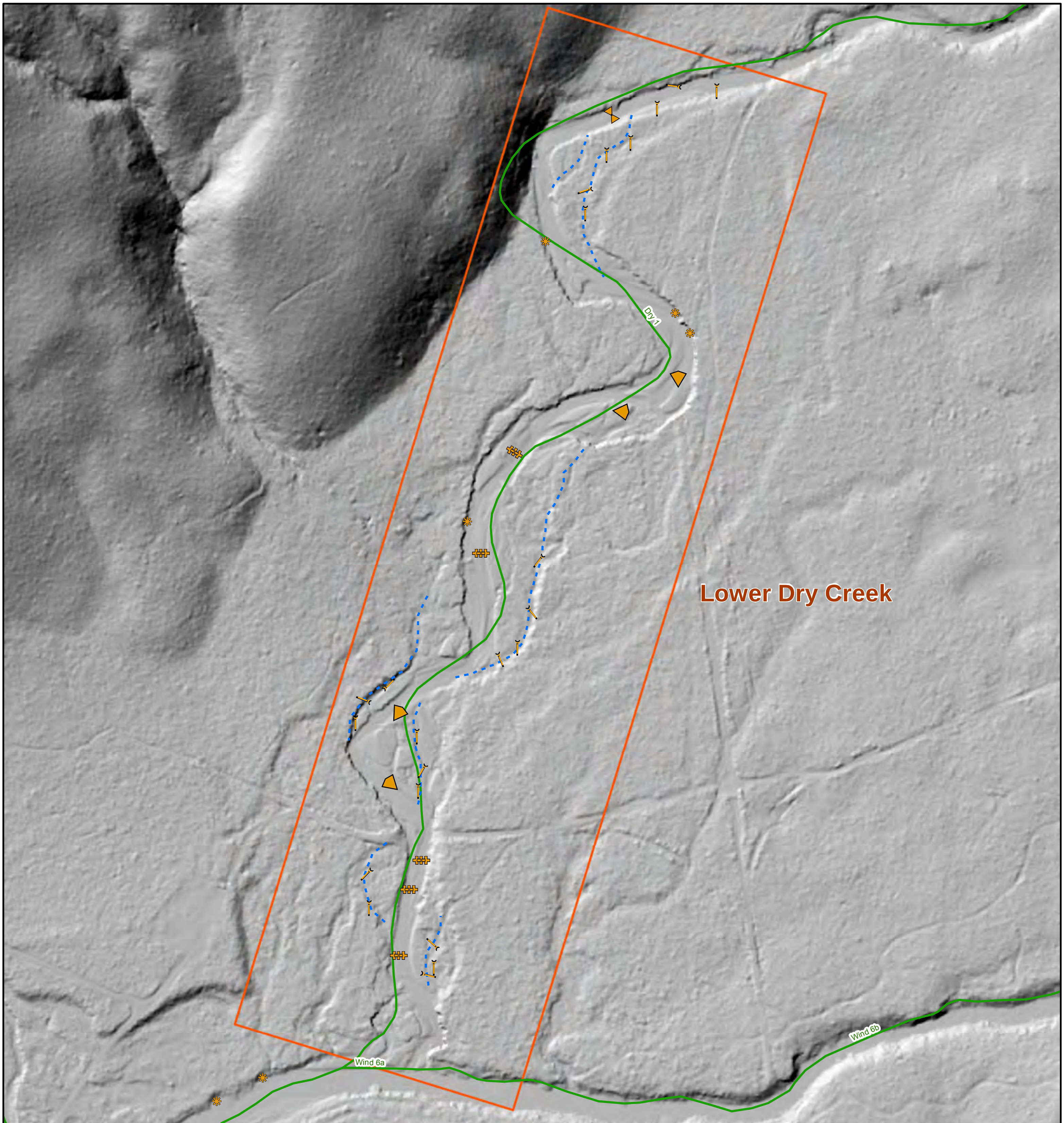
0 150 300 Feet

N

- EDT Reach
- Project Area

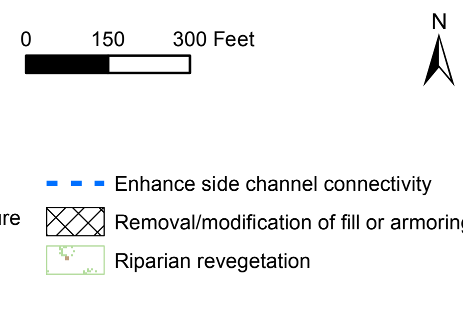
Project Elements

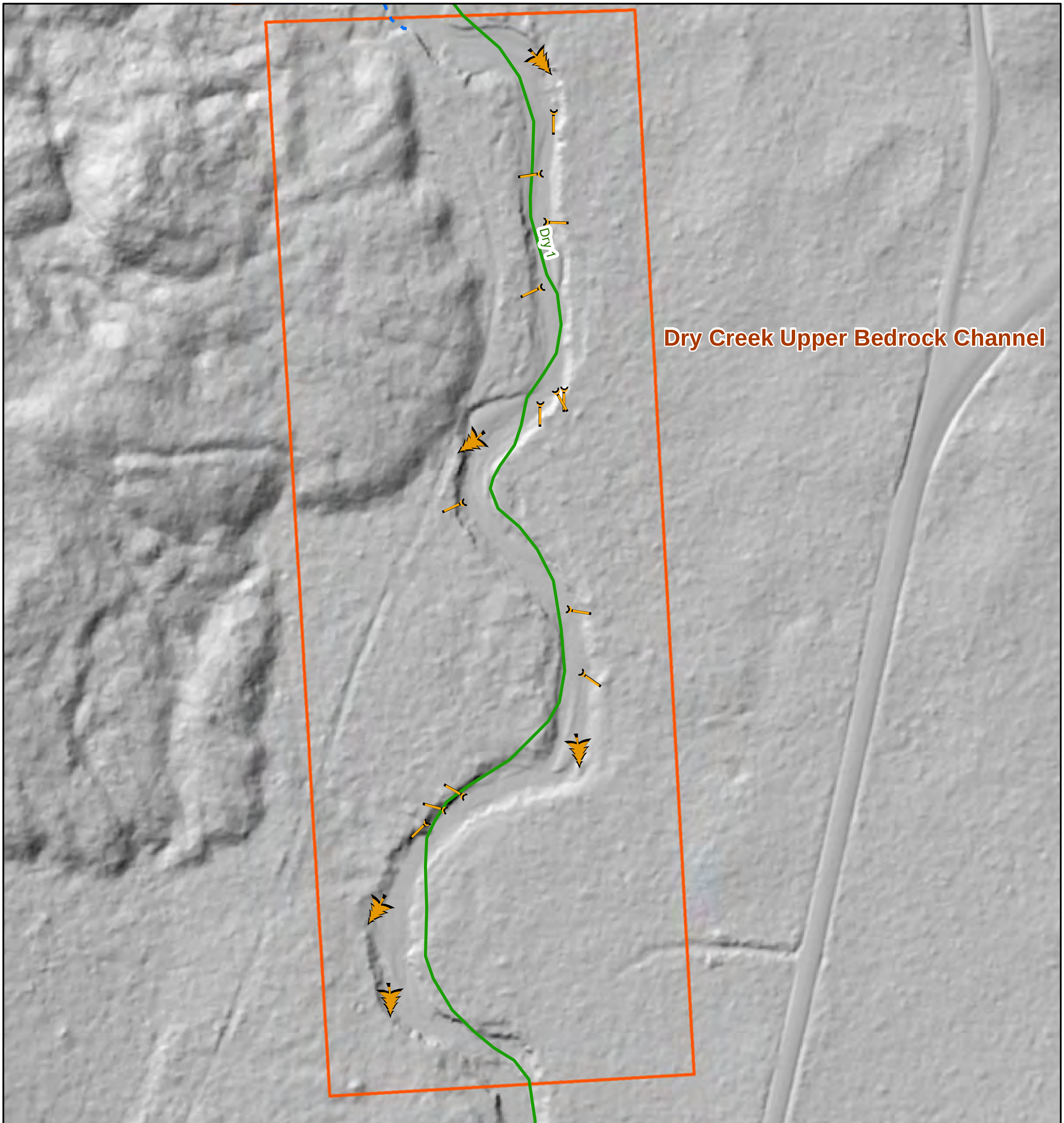
- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



Wind River Restoration Strategy

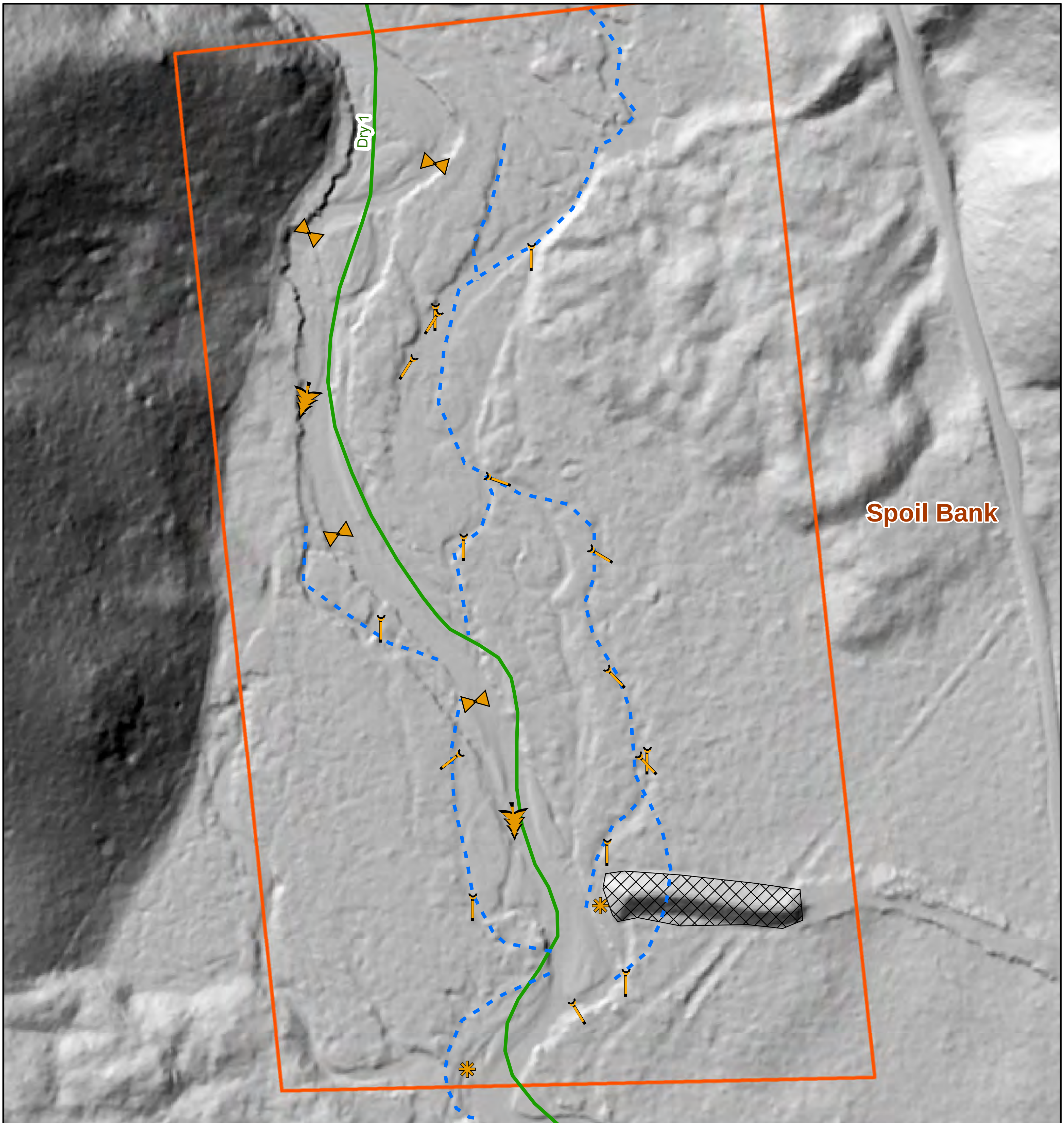
Lower Dry Creek





Wind River Restoration Strategy

Dry Creek - Upper Bedrock Channel



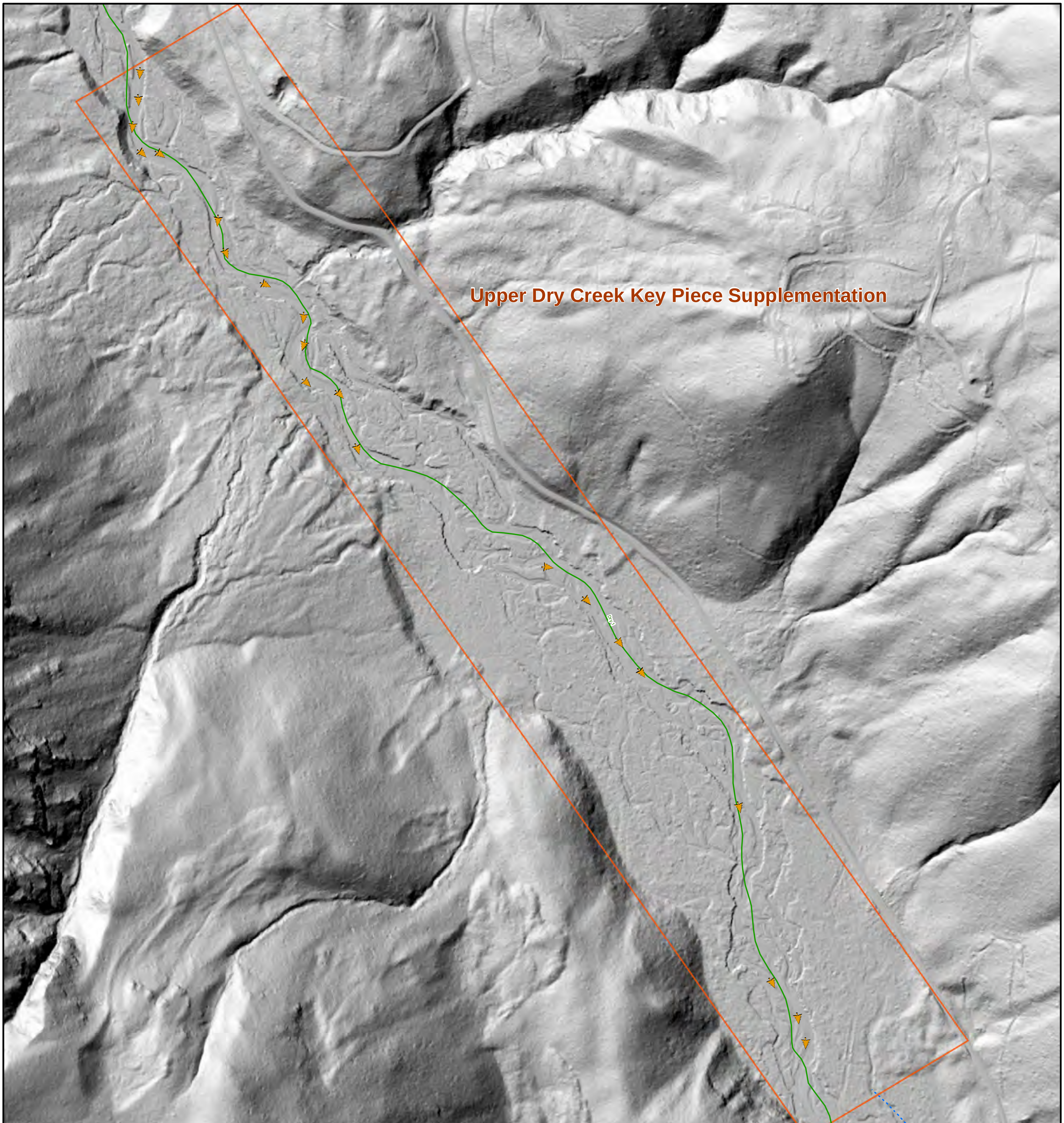
Wind River Restoration Strategy

Dry Creek - Spoil Bank

EDT Reach
Project Area

Project Elements

- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



Wind River Restoration Strategy

Dry Creek - Key Piece Supplementation Project

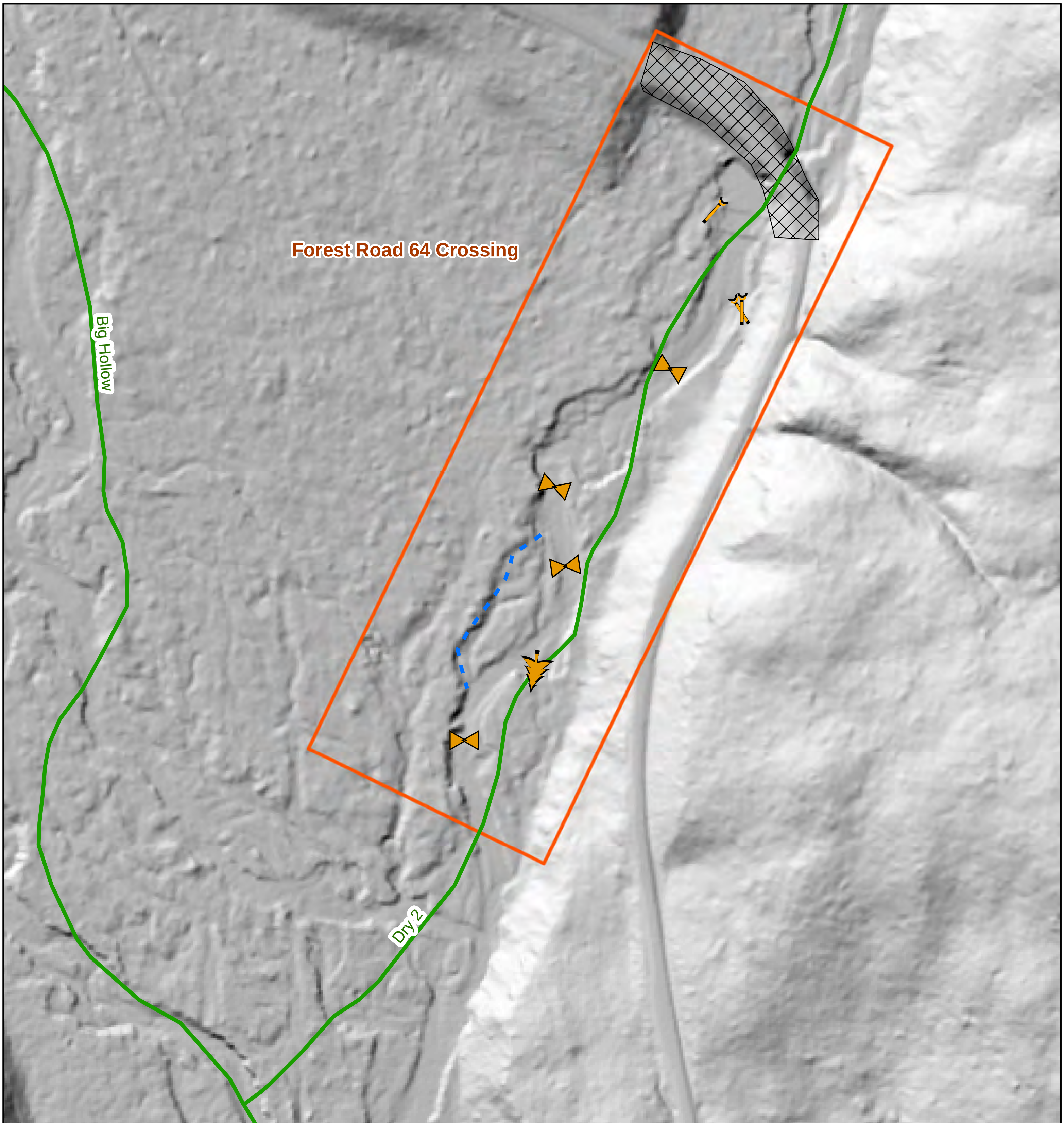
0 150 300 600 900 Feet

N

EDT Reach
Project Area

Project Elements

Bar apex log jam
Large wood capture structure
Individual log placement
Large wood margin complexity
Channel margin log jam
Channel Spanning Structure
Whole tree placement
Enhance side channel connectivity
Removal/modification of fill or armoring
Riparian revegetation



Wind River Restoration Strategy

Dry Creek - Forest Road 64 Crossing

0 150 300 Feet

N

EDT Reach

Project Area

Project Elements

Bar apex log jam

Large wood capture structure

Individual log placement

Large wood margin complexity

Channel margin log jam

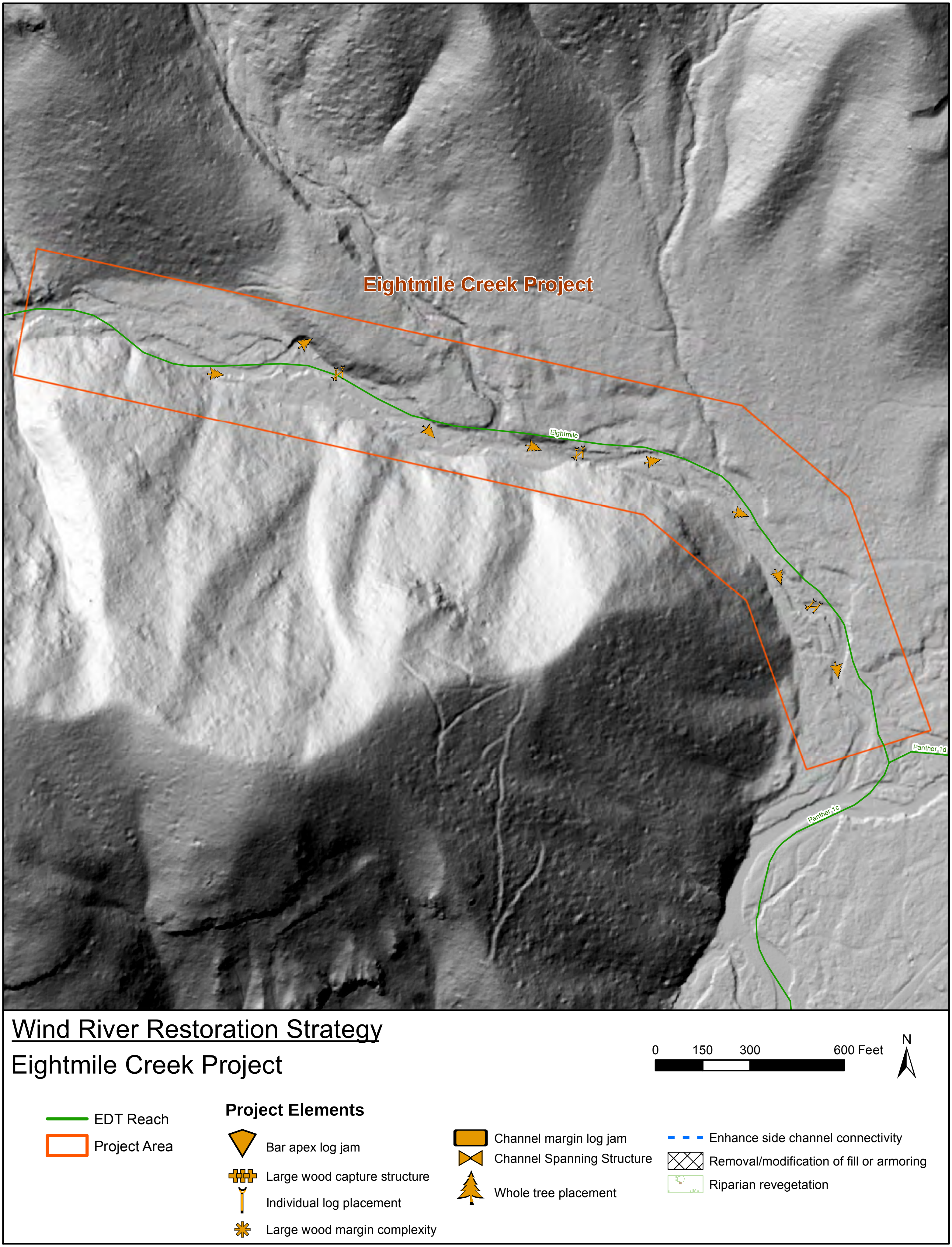
Channel Spanning Structure

Whole tree placement

Enhance side channel connectivity

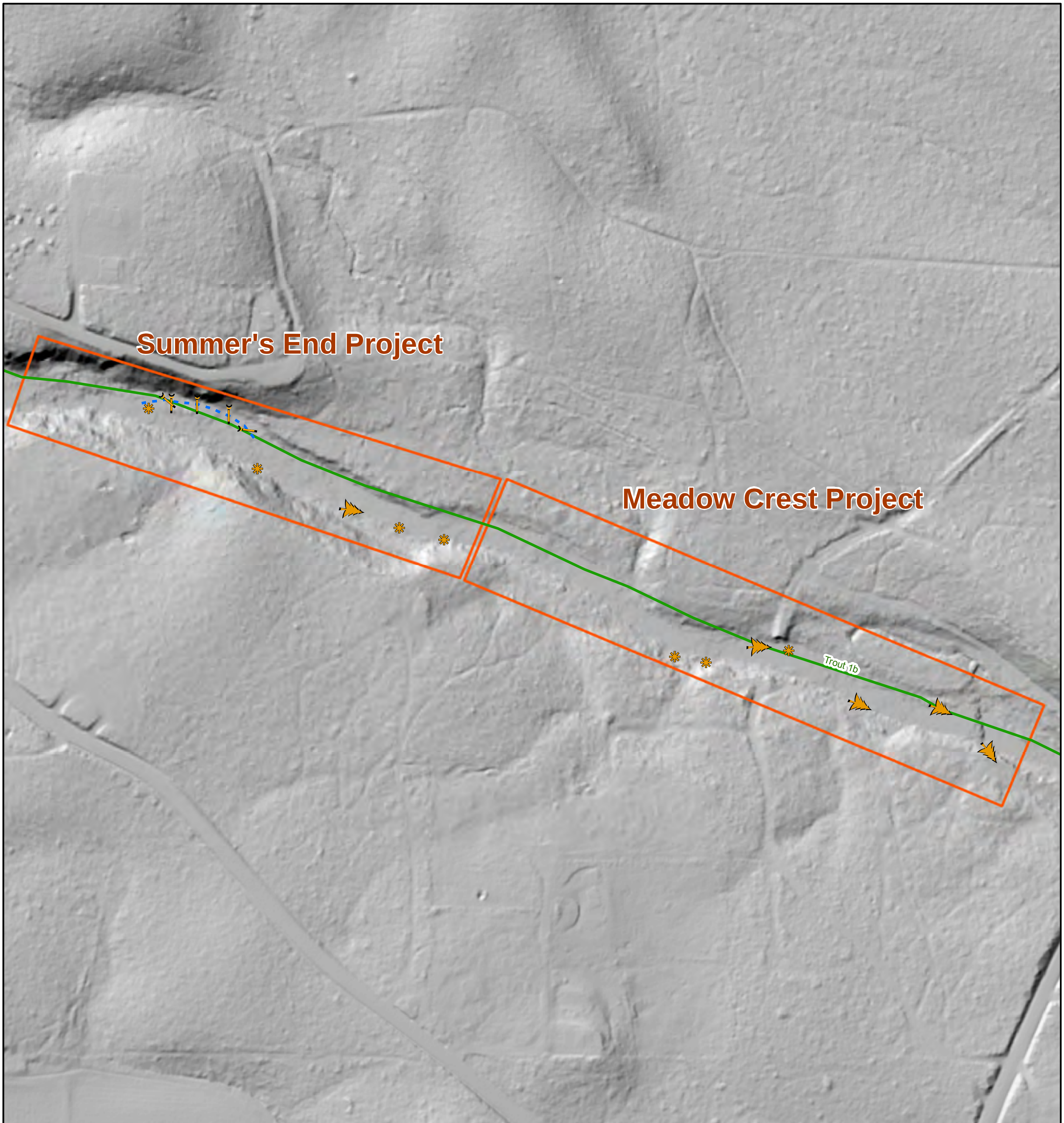
Removal/modification of fill or armoring

Riparian revegetation



Wind River Restoration Strategy

Eightmile Creek Project



Wind River Restoration Strategy

Lower Trout Creek Projects

0 150 300 Feet

N

EDT Reach

Project Area

Project Elements

Bar apex log jam

Large wood capture structure

Individual log placement

Large wood margin complexity

Channel margin log jam

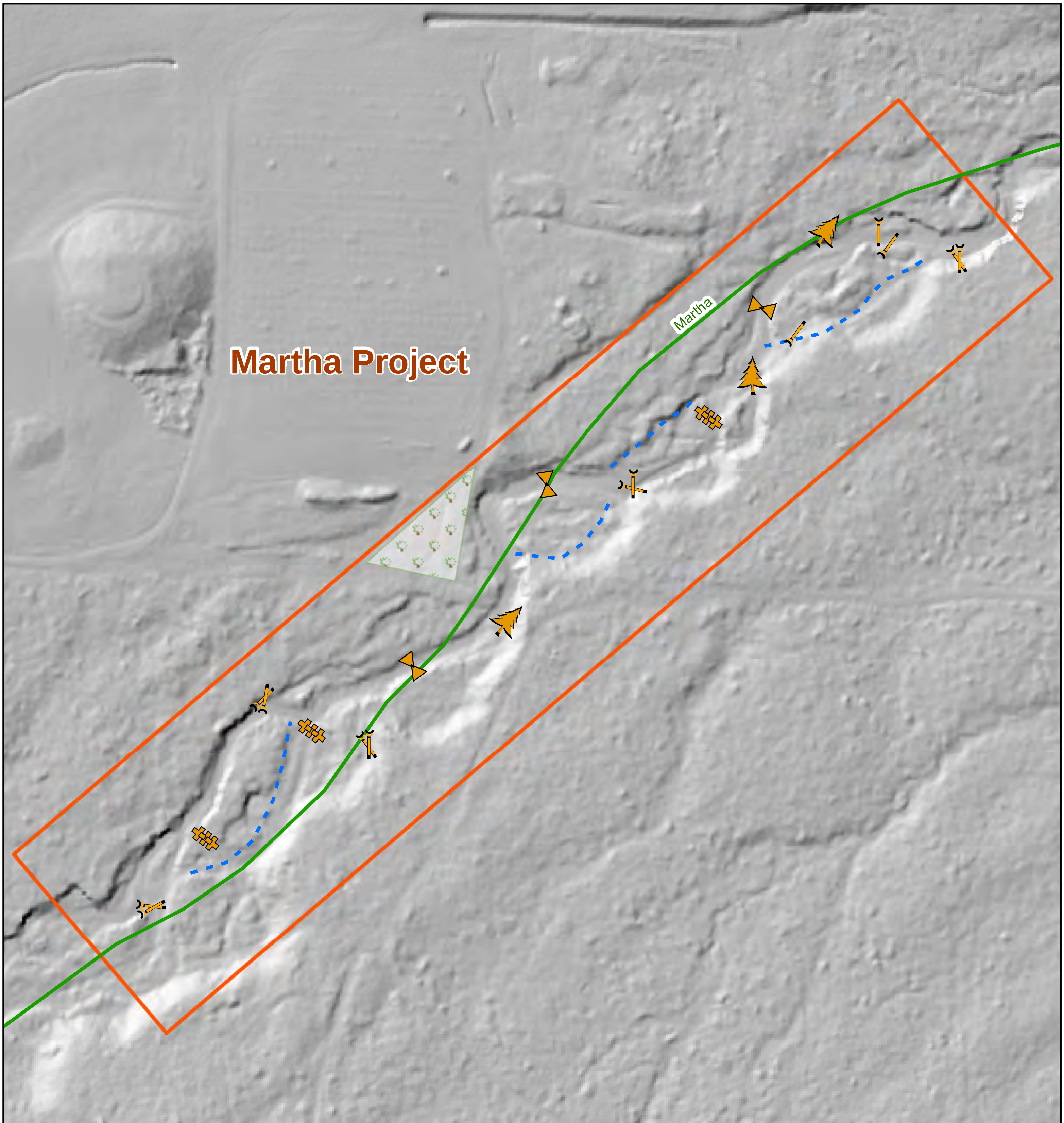
Channel Spanning Structure

Whole tree placement

Enhance side channel connectivity

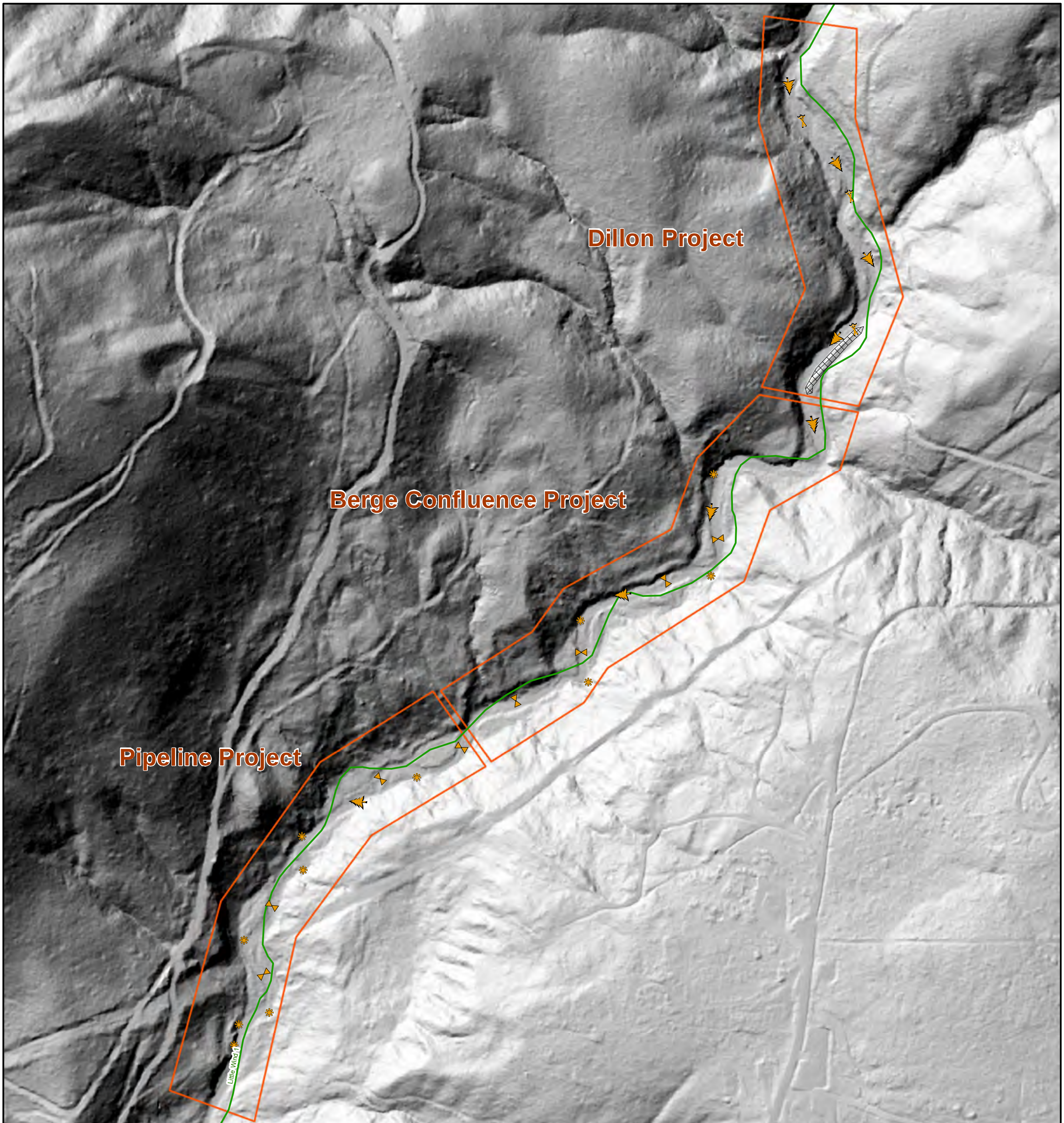
Removal/modification of fill or armoring

Riparian revegetation



Wind River Restoration Strategy

Martha Creek Project



Wind River Restoration Strategy

Little Wind River - Downstream Projects

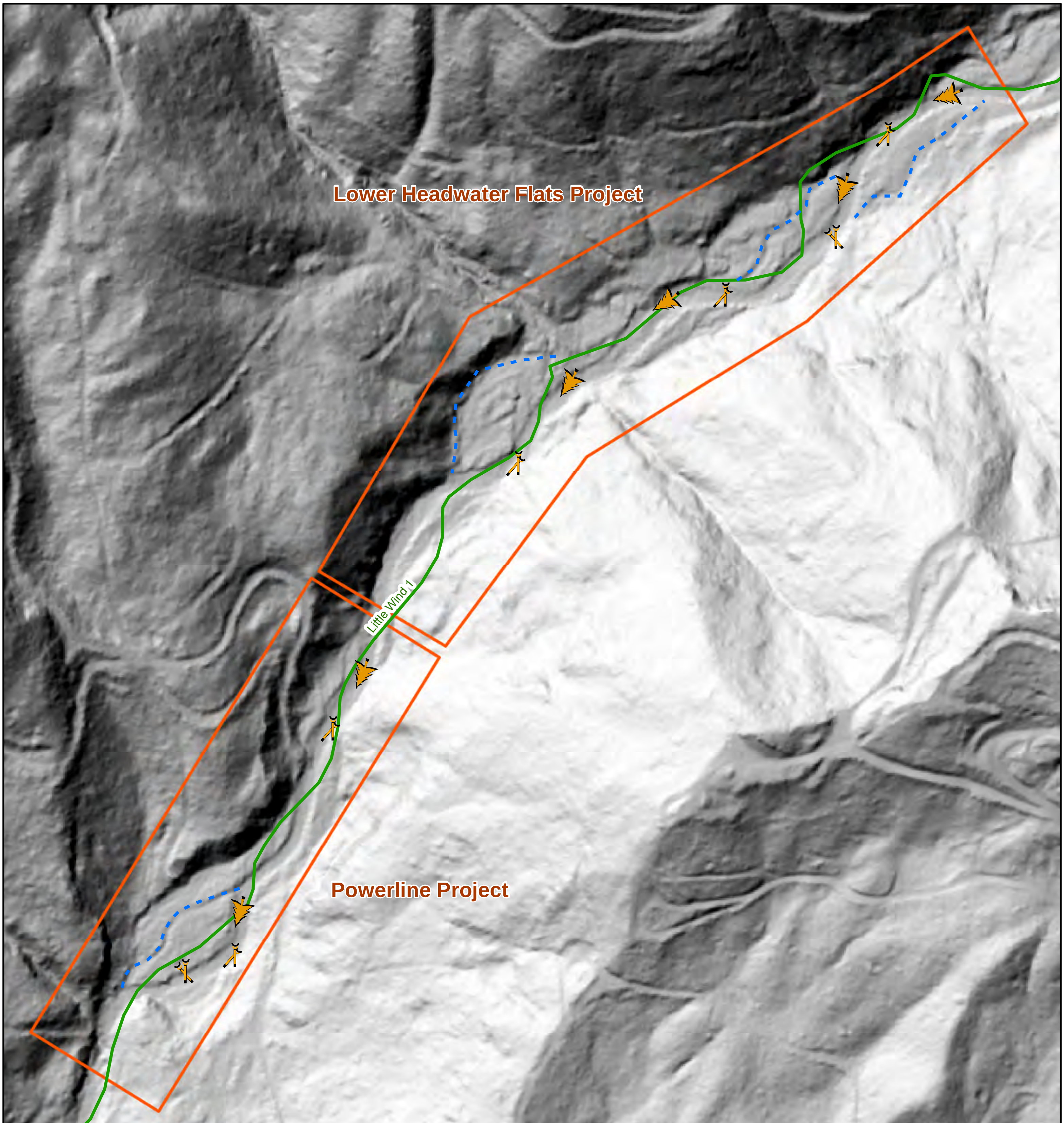
0 150 300 600 Feet

N

EDT Reach
Project Area

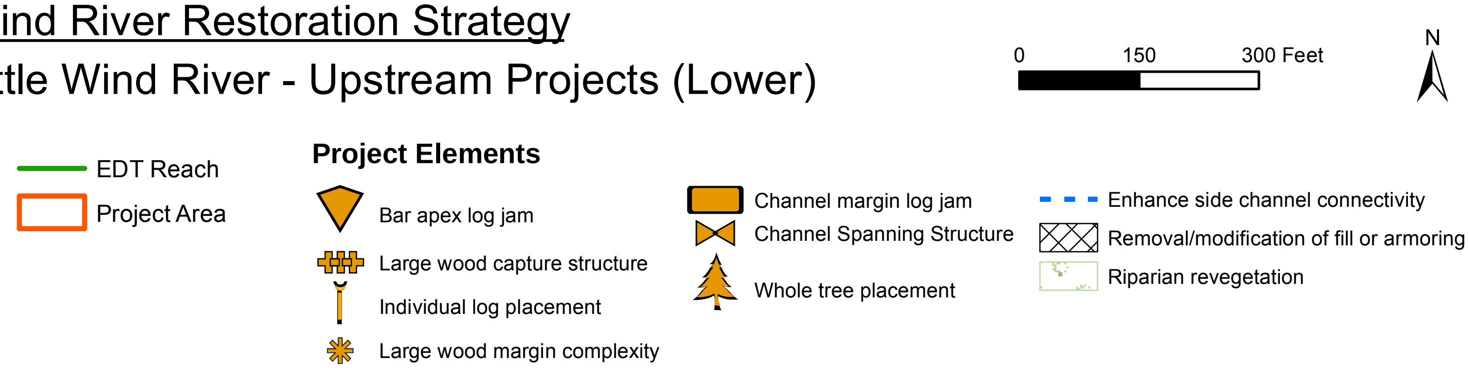
Project Elements

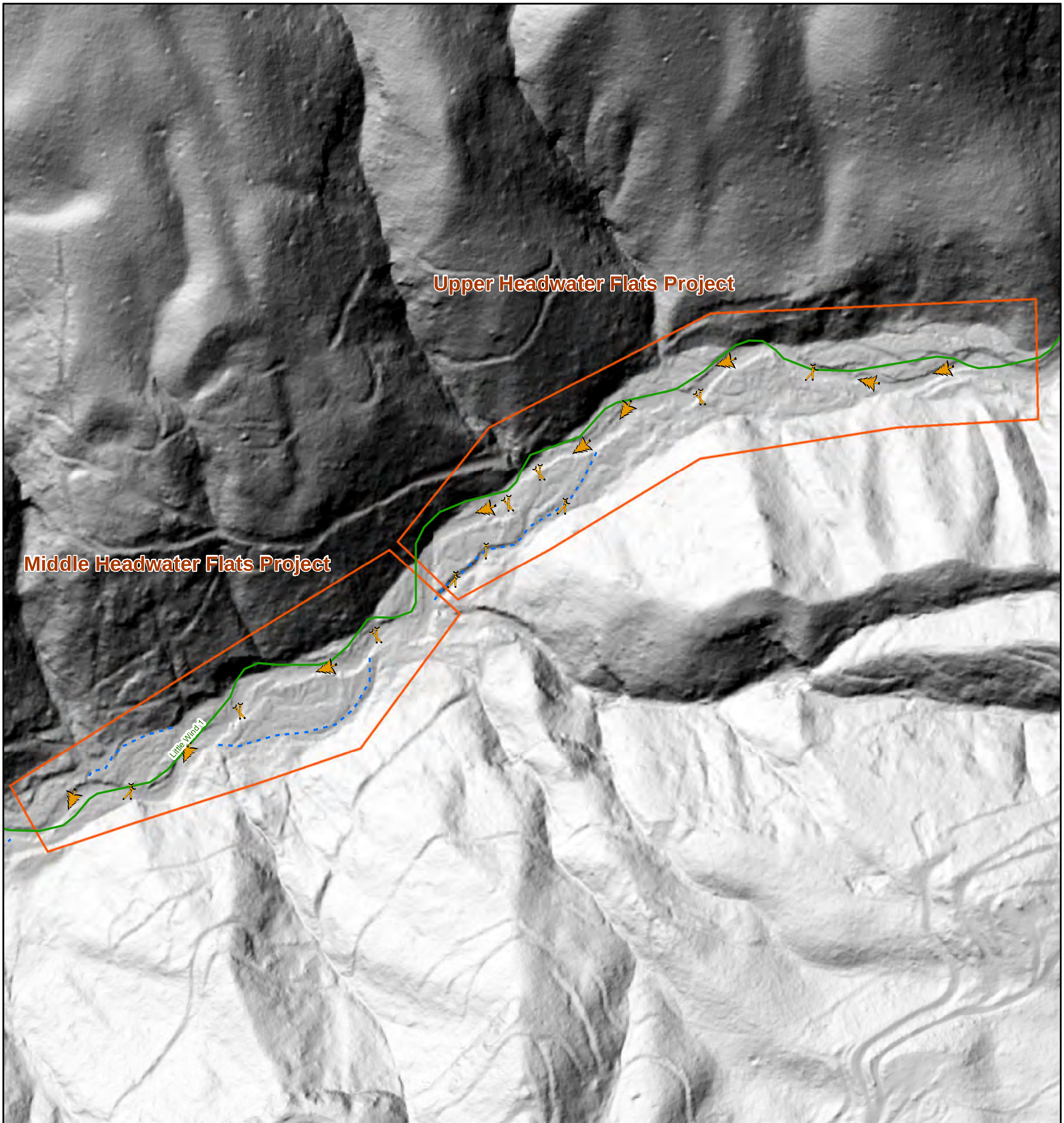
- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation



Wind River Restoration Strategy

Little Wind River - Upstream Projects (Lower)





Wind River Restoration Strategy

Little Wind River - Upstream Projects (Upper)

0 150 300 Feet

N

EDT Reach
Project Area

Project Elements

- Bar apex log jam
- Large wood capture structure
- Individual log placement
- Large wood margin complexity
- Channel margin log jam
- Channel Spanning Structure
- Whole tree placement
- Enhance side channel connectivity
- Removal/modification of fill or armoring
- Riparian revegetation

Appendix G – USFS Project Lists for Trout and Trapper Creeks

This list is based on projects identified through restoration planning efforts by the US Forest Service for the Trout and Trapper Creek basins within the Wind River Watershed (USFS 2015). These project lists will be updated as new restoration needs are identified and projects are completed, and the project sequencing and timing of implementation will be determined as funding and partnership opportunities arise.

References

Unites States Forest Service (USFS). 2015. Watershed Condition Framework. FY 2016 Watershed Restoration Action Plan. Subwatersheds Trout Creek and Trapper Creek. USFS Pacific Northwest Region – Gifford Pinchot National Forest, Mt. Adams Ranger District.

Table 1. List of essential projects for Trout Creek subwatershed.

Project Name	Project Description	Watershed Condition Indicator Addressed	Recovery Plan Habitat Measure Addressed (LCFRB 2010)	Location, River Mile (RM)	Proposed Timeline* and Projected Target	Total Cost (estimated) and funding source**	Species Addressed
Hemlock Tree Planting Project	Interplant trees in riparian areas on Lower Trout Creek	Native species, invasives, stream shade	Restore riparian conditions	Hemlock Restoration Site, Trout Creek (RM 2.0)	2016-17	$6,000 NFVW	Lower Columbia River (LCR) steelhead trout, rainbow trout, sculpin species
Lower Trout Creek Habitat Improvement Project	Construct large wood complexes along stream and floodplain, manipulate large instream boulders, reopen and reconstruct relict side-channels, remove concrete and steel structures remaining in Trout Creek associated with past water systems	Large woody debris, streambank stability, channel geometry	Restore floodplain function and channel migration processes. Restore channel structure and stability	Trout Creek (RM 2.0 - 4.0)	2016-2018 Target: 2 miles instream restoration	$176,000 NFWF	LCR steelhead trout, rainbow trout, sculpin species, endemic amphibian species, wood duck, Coldwater Corydalis plant
Lower Trout Creek Wetland Enhancement Project	Enhance wetland habitat by controlling invasive weeds, planting natives, and restoring drainage patterns	Riparian vegetation condition, floodplain connectivity, native species, invasives	Restore riparian conditions	Trout Creek (RM 2.0 and 3.1)	2017-2019 Target: 4.0 acres wetland improved	$54,000 NFVW	LCR steelhead trout, rainbow trout, sculpin species, American beaver, elk, deer
Trout Creek and Tributaries Riparian Enhancement and Invasives Control Project	Underplant riparian forest, control weeds along streams and riparian areas	Riparian vegetation condition, native species, invasives	Restore riparian conditions	Trout Creek (RM 2.0) and (RM 8.0 – 9.0) Layout Creek (RM 0.0 -2.6) Compass Creek (RM 0.0 – 1.0) Crater Creek (RM 0.0 – 1.5)	2017-2020 (requires sustained work on an annual basis) Target: 150 acres riparian forest improved / invasives treated	$45,000 NFVW	LCR steelhead trout, American beaver, elk, deer
Martha Creek Wetland Enhancement Project	Enhance wetland habitat by controlling invasive weeds, planting natives, and restoring drainage patterns	Riparian vegetation condition, floodplain connectivity, native species, invasives	Restore riparian conditions	Martha Creek (RM 1.0)	2017-2019 Target: 2.0 acres wetland improved	$18,000 NFVW	LCR steelhead trout, American beaver, elk, deer

Project Name	Project Description	Watershed Condition Indicator Addressed	Recovery Plan Habitat Measure Addressed (LCFRB 2010)	Location, River Mile (RM)	Proposed Timeline* and Projected Target	Total Cost (estimated) and funding source**	Species Addressed
Layout Creek Wetland Enhancement Project	Enhance wetland habitat by controlling invasive weeds, planting natives, and restoring drainage patterns	Riparian vegetation condition, floodplain connectivity, native species, invasives	Restore riparian conditions	Layout Creek (RM 2.2)	2017-2019 Target: 1.5 acres wetland improved	$17,000 NFVW	LCR steelhead trout, American beaver, elk, deer
Upper Trout Creek & Layout Creek Habitat Improvement Project	Supplement existing structures, construct new large wood structures, increase density of large wood	Large woody debris, streambank stability, channel geometry	Restore floodplain function and channel migration processes. Restore channel structure and stability	Trout Creek (RM 7.0 – 9.4) Layout Creek (RM 0 - 2.6)	2017-2020 Target: 5.0 miles stream restored	$306,000 NFWF	LCR steelhead trout, rainbow trout, sculpin species
Combined with preceding project	Restore channel banks at abandoned ford	Stream-bank stability, channel geometry	Restore channel structure and stability	Layout Creek (RM 2.2)	2017-2020 Target: 0.1 mile instream restoration	(combined with previous project) NFWF	***Same as preceding project***
Compass, Crater, and Pass Creeks Habitat Improvement Project	Construct log complexes in gullied channel segments to improve aquatic habitat and habitat for Corydalis, a rare plant	Large woody debris, streambank stability, channel geometry	Restore floodplain function and channel migration processes. Restore channel structure and stability.	Compass Creek (RM 0.0 - 1.0); Crater Creek (RM 0.0 - 1.5); Pass Creek (RM 0.0-1.5)	2017-2020 Target: 4.0 miles instream restoration	(combined with previous project) NFWF/VW	LCR steelhead trout, rainbow trout, sculpin species, endemic amphibian species, Coldwater Corydalis plant

Project Name	Project Description	Watershed Condition Indicator Addressed	Recovery Plan Habitat Measure Addressed (LCFRB 2010)	Location, River Mile (RM)	Proposed Timeline* and Projected Target	Total Cost (estimated) and funding source**	Species Addressed
Trout Creek Subwatershed Road Decommissioning Project	Decommission roads and restore appropriate drainage	Habitat fragmentation, road density, drainage density, proximity to streams, soil erosion	Restore degraded hillslopes. Restore channel structure and stability.	FR 42-420 (MP 0.0 – 0.3) FR4309-600 (MP 0.0 - 0.1) FR 33-407 (MP 0.0 - 0.6) FR 33-409 (MP 0.0 -0.9) FR 33-410 (MP 0.0 - 0.1) FR 33-620 (MP 0.0 - 0.2) FR 33-602 (MP 0.0 - 0.2)	2018-2020 Target: 3 miles road de-commissioned	$100,000 CMLG	LCR steelhead trout, rainbow trout, sculpin species
Forest Road 4309-415 Fish Passage Project	Upgrade existing culvert	Habitat Fragmentation, Aquatic Organism Passage (AOP)	Address passage issues	Trout Creek tributary at Forest Road 4309-415 (Mile post (MP) MP-0.8)	2019-2020 Target: 1.0 miles habitat opened	$81,000 CMLG	LCR steelhead trout, rainbow trout, sculpin species
Forest Road 42 Fish Passage Project	Upgrade existing culvert	Habitat Fragmentation, AOP	Address passage issues	Trout Creek tributary at Forest Road 4200 (MP 4.3)	2019-2020 Target: 1.0 miles habitat opened	$81,000 CMLG	LCR steelhead trout, rainbow trout, sculpin species

Project Name	Project Description	Watershed Condition Indicator Addressed	Recovery Plan Habitat Measure Addressed (LCFRB 2010)	Location, River Mile (RM)	Proposed Timeline* and Projected Target	Total Cost (estimated) and funding source**	Species Addressed
Brook Trout Removal Project	Non-native fish removal, particularly at small side-channels where brook trout spawn and rear	Ecological interactions, invasives, competition, predation	Address competition and predation issues	Trout, Planting, Martha, Layout, Compass, Crater, Pass, East Fork Creeks	2019-2020 (& annually) Target: 10 miles of instream habitat improved for LCR steelhead by reducing competition with and predation by brook trout	$32,000 NFWF	LCR steelhead trout, rainbow trout, sculpin species
Nutrient Enhancement Project	Nutrient Enhancement	Survival & Productivity (summer steelhead)	Altered nutrient exchange processes	Trout, Unnamed tributary to Trout, Martha, Planting, Pass, Layout, Compass, Crater Creeks	2019-2020 (& annually) Target: 10 miles of instream habitat improved for LCR steelhead by enhancing instream and riparian nutrient levels	$42,000 NFWF	LCR steelhead trout, rainbow trout, sculpin species

*Proposed timeline is subject to change based on funding and capacity. **NFVW, NFWF, and CLMG are internal Forest Service funding sources.

Table 2. List of essential projects for Trapper Creek.

Project Name	Project Description	Watershed Condition Indicator Addressed	Recovery Plan Habitat Measure Addressed (LCFRB 2010)	Location, River Mile (RM)	Proposed Timeline* and Projected Target	Total Cost (estimated) and funding source**	Species Addressed
Government Mineral Springs (GMS) Dam Project	Trapper Creek Tributary Dam—Fish Passage Improvement	Habitat Fragmentation Aquatic Organism Passage (AOP)	Address passage issues	No name stream (GMS Dam is located at RM 0.33 of tributary that enters Trapper Creek at RM 1.3)	2016-2017 Target: 0.5 miles habitat opened	$10,000 NFWF	LCR steelhead trout, rainbow trout, sculpin species
Trapper/Wind Riparian Rehabilitation Project	Obstruct direct vehicular access to Wind River and Trapper Creek at user-built access points, decompact soils, plant, and establish drainage	Riparian vegetation condition, proximity to streams, soil erosion	Restore riparian conditions	Wind River (RM 17.0 – 22.4) Trapper Creek (RM 0.0 - 0.6)	2017-2018 Target: 12 acres riparian forest improved	$30,000 NFVW	LCR steelhead trout, rainbow trout, mountain whitefish, sculpin species
Trapper Creek Side Channel Activation Project	Activate abandoned side channel—Trapper Creek	Streambank stability, floodplain connectivity	Restore side channel habitat	Trapper Creek side channel at GMS (RM 1.0)	2018-2020 Target: 0.2 miles side channel opened	$50,000 NFWF	LCR steelhead trout, rainbow trout, sculpin species
Trapper Creek Channel Improvement Project	Remove failing gabion walls, construct fish friendly bank protection	Large woody debris, streambank stability, channel geometry	Restore channel structure and stability.	Trapper Creek in GMS reach (RM 0.5-1.0)	2018-2020 Target: 0.5 miles stream restored	$60,000 NFWF	LCR steelhead trout, rainbow trout, sculpin species
Wind River Large Wood Supplementation Project	Construct large wood complexes along stream and floodplain	Large woody debris, streambank stability, channel geometry	Restore floodplain function and channel migration processes. Restore channel structure and stability	Wind River (RM 17.0 – 19.5)	2018-2020 Target: 2.5 miles stream restored	$320,000 NFWF	LCR steelhead trout, rainbow trout, mountain whitefish, sculpin species

Project Name	Project Description	Watershed Condition Indicator Addressed	Recovery Plan Habitat Measure Addressed (LCFRB 2010)	Location, River Mile (RM)	Proposed Timeline* and Projected Target	Total Cost (estimated) and funding source**	Species Addressed
Ninemile Creek Channel and Riparian Improvement Project	Thin and underplant riparian forest, rehab damaged riparian landings, construct wood complexes, control weeds along Ninemile Creek	Riparian vegetation condition, native species, invasives	Restore riparian conditions	Ninemile Creek (RM 0.0 – 1.5)	2019-2020 Target: 36 acres riparian forest restored	$100,000 NFVW	LCR steelhead trout, rainbow trout, sculpin species, American beaver, elk, deer
Forest Road (FR) 5401 Fish Passage Project	Upgrade existing culvert	Habitat Fragmentation AOP	Address passage issues	Trapper Creek trib at FR 5401	2019-2020 Target: 1.0 miles habitat opened	$80,000 CMLG	LCR steelhead trout, rainbow trout, sculpin species
Middle Wind River Road Decommissioning Project	Decommission roads and restore appropriate drainage	Habitat fragmentation, road density, drainage density, proximity to streams, soil erosion	Restore degraded hillslopes. Restore channel structure and stability	FR6063-039 (MP 0.95 – 1.36) FR60-078 (MP 0.0 – 0.61) FR60-088 (MP 0.0 – 0.75) FR60-089 (MP 0.0 – 0.54)	2019-2020 Target: 2.3 miles road decomm.	$130,000 CMLG	LCR steelhead trout, rainbow trout, mountain whitefish, sculpin species
Wind River Bank Repair Project	Remove steel plate berm along Wind River and replace with fish-friendly bank protection	Large woody debris, streambank stability, channel geometry	Restore channel structure and stability	Wind River (RM 17.3)	2019-2020 Target: 0.1 miles stream restored	$160,000 NFWF	LCR steelhead trout, rainbow trout, mountain whitefish, sculpin species
Forest Road 64 Fish Passage Project	Replace culvert with bridge	Habitat Fragmentation AOP	Address passage issues	Dry Creek at FR64	2019-2020 Target: 0.75 miles habitat access improved	$430,000 CMLG	LCR steelhead trout, rainbow trout, mountain whitefish, sculpin species

*Proposed timeline is subject to change based on funding and capacity. **NFVW, NFWF, and CLMG are internal Forest Service funding sources.

Appendix H – UCD Wind River Watershed Identified Projects List

The table below includes projects on the Underwood Conservation District's project list. These projects are concepts and possibilities, not necessarily proposed or planned, and are therefore subject to change. Some projects overlap with those identified as part of the current restoration strategy effort.

Appendix H – UCD Wind River Watershed Identified Projects List

Table 1. UCD Wind River Watershed Identified Projects List.
NOTE: These projects are concepts and possibilities, not necessarily proposed or planned. They are listed in geographic order starting at the mouth of the Wind River, going upstream.

Project Name	Watershed	Lat/Long	River Mile (RM) (approx.)	Reach	Ownership	Parcel #	Project Type	Project Description	Source Document	Limiting Factors	Habitat Benefits	Notes
Invasive Species Boat-Cleaning Station	Lower Wind River	45.7175, -121.7890	RM 0	Wind 1	Skamania County	3082700080100	Invasive species prevention	An invasive species cleaning station should be installed in conjunction with new Wind River Boat Launch.	UCD Watershed Enhancement Projects (WEP) List (Dec. 2012)	Aquatic invasive species	Prevention of habitat loss	
Little Wind River Habitat Enhancement (Phase IV) -- or -- Middle Little Wind River	Little Wind River	45.7315, -121.7834	RM 0.5 - 2.0	Little Wind 1	Eubank, Gundersen, and USFS	3082230020000, 03082240010000	Instream habitat	Logs, ELJs or other habitat features and planting	Little Wind River Watershed Restoration Assessment, Project and Prioritization Recommendations (Bair/UCD, 2009); and UCD landowner conversations, ongoing	Lack of large woody debris (LWD), pools and spawning gravel	Gravel capture to create and sustain spawning habitat; in-stream habitat complexity	This is a component of the Little Wind River Habitat Enhancement Project, Phase 4 (L1) project identified in the Wind River Habitat Strategy.
McNee Riparian Reforestation	Martha Creek	45.7951, -121.9240	RM 0.5-0.9	Martha Creek	McNee, Skamania County	4072700200000, 04073500040000, 04073500040100	Bank stability, Riparian forestry	Assess previous planting, instream bank erosion, areas of scour	UCD Fish Passage Inventory 2014-16	unstable bank, scour	stabilize bank, recruit LWD/gravels, provide large wood recruitment and shading	This is a component of the Martha (M1) project identified in the Wind River Habitat Strategy.

Project Name	Watershed	Lat/Long	River Mile (RM) (approx.)	Reach	Ownership	Parcel #	Project Type	Project Description	Source Document	Limiting Factors	Habitat Benefits	Notes
Middle Wind Reforestation	Middle Wind River	45.8225, -121.9187	RM 13	Wind 5a	Multiple, including potentially Little Church of the Valley, Dix, Miller, Sandberg and O'Leary	4072300010100, 04072300010000, 04072211010300, 04072211010100, 04071400100000	Riparian planting, possibly LWD/bank protection	Remove Scotch broom, long-term weed management plan, riparian and floodplain plantings	UCD WEP List (Dec. 2012)	Loss of riparian forest	Future wood recruitment, bank stability	This is a component of the Stabler Bend (W5) project identified in the Wind River Habitat Strategy.
Stabler Bend Side Channel	Middle Wind River	45.8245, -121.9202	RM 13	Wind 5a	Little Church of the Valley	4071400100000	Side channel reactivation	Open relic channel into active side channel	observation	Lack of habitat complexity, Lack of off-channel refugia	Increased habitat complexity, floodplain connectivity, and storm over-flow capacity	This is a component of the Stabler Bend (W5) project identified in the Wind River Habitat Strategy.
Jurzik Cutbank	Middle Wind River	45.8283, -121.9284	RM 13.5	Wind 5a	Jurzik, Betton-Grilley	4071500050300	Bank stability	Bank stabilization/engineering, revegetation and other habitat features	UCD WEP List (Dec. 2012)	Unstable bank	Reduce sedimentation, provide bank stability for mature vegetation, and instream channel complexity	This is a component of the Whisky (W7) project identified in the Wind River Habitat Strategy.
Whisky Creek	Whisky Creek / Middle Wind	45.8282, -121.9299	RM 0.2	Whisky Creek	Punton, Betton-Grilley, Shumsky	04071500050600, 04071500050500, 04071500050400	Multiple habitat projects (fish passage, enhancement at confluence)	Couple potential, related projects in a complex on Whisky Creek: the Betton-Grilley cutbank, habitat improvement needs at mouth of Whisky Creek, two culverts on Whisky Creek	UCD WEP List (Dec. 2012)	Fish passage barrier, unstable banks	Fish passage, Potential LWD	One landowner previously opposed culvert replacement.

Project Name	Watershed	Lat/Long	River Mile (RM) (approx.)	Reach	Ownership	Parcel #	Project Type	Project Description	Source Document	Limiting Factors	Habitat Benefits	Notes
Hollis Creek Barrier Removal	Hollis Creek	45.841, -121.93941	RM 0.20	Hollis Creek	Skamania County		Barrier removal	Replace barrier culvert on Hollis Creek under the Wind River Hwy.	UCD Fish Passage Inventory 2014-16	culvert is a 100% passage barrier due to slope and outfall drop	reconnection of approx. 1.2 miles of quality rearing habitat	Although the road and culvert are county-owned, the Birkenfelds own the parcels immediately upstream and downstream of the culvert.
Hollis Creek Debris Removal and Bank Stabilization	Hollis Creek	45.847712, -121.93527	RM 0.8	Hollis Creek	USFS	4070000010000	Debris removal, bank stabilization	remove concrete and metal debris from streambed, address high cut bank	UCD Fish Passage Inventory 2014-16	unstable bank, debris instream	stabilize bank, remove debris instream	Potential access road beginning at Wind River Hwy, crossing Birkenfeld parcel and ending on USFS property, approximately 130 ft from the stream.
Price-Misner Reforestation	Middle Wind River	45.8482, -121.9572	RM 15.6	Wind 5c	Hollis, USFS (formerly Misner and Price)	4070900050000, 04070900040000	Riparian planting, possibly LWD/bank protection	Assess previous work for effectivness and follow-up: Evaluate instream structures' streambank effects (measure bank geometry vs control sites up- or down-stream), and evaluation/planting of native conifers	UCD WEP List (Dec. 2012)	Loss of riparian forest; lack of instream channel stability and complexity; wide and shallow channel increases stream temps.	Future wood recruitment, bank stability, instream channel stability and complexity	This is a component of the Stump House (W9) project identified in the Wind River Habitat Strategy.
Beaver Campground Berm	Middle Wind River	45.8550, -121.9585	RM 16.7	Wind 5c	USFS	4070000010000	Bank restoration and channel complexity	Remove concrete berms, stabilize bank with bioengineering, and provide vegetation and other habitat features	observation	Bank armoring	Riparian planting; instream habitat complexity	This is a component of the Beaver Campground (W10) project identified in the Wind River Habitat Strategy.