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:

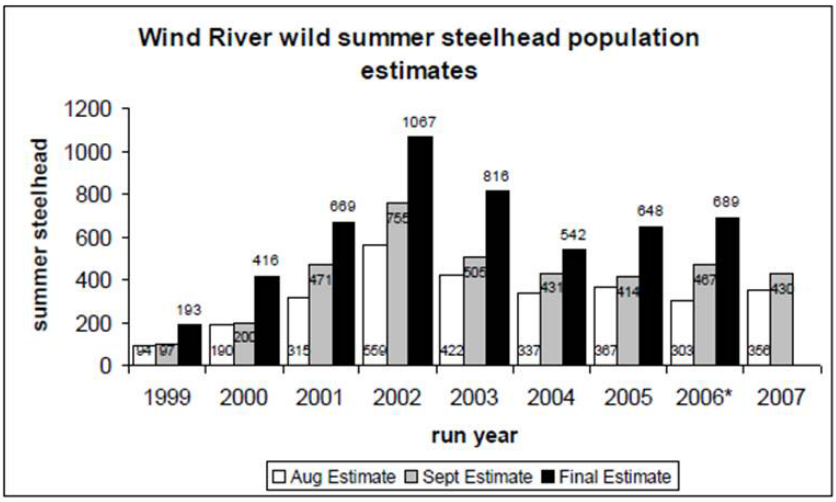

Figure 1. Summer steelhead population estimates in the Wind River from snorkel surveys (August and September) and the Jumper method (final) for run years 1999-2007 (spawn year 2000-2008).

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