Tucannon River Programmatic Habitat Annual Report

Project #: 2010-077-00

Annual Progress Report

(Reporting Period January 2017 to December 2017)

Contractor:

Snake River Salmon Recovery Board

Contract: #75494

John Foltz, Director
Kris Buelow, Program Coordinator

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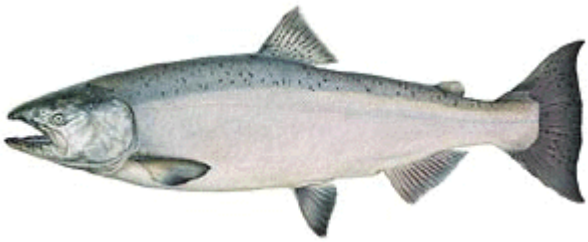
Contact Information:
SRSRB Office,
410B E Main St.
Dayton, WA 99328
509-382-4115
steve@snakeriverboard.org
kris@snakeriverboard.org



Snake River Salmon Recovery

Acknowledgments:

A special thanks goes to the partners of the Tucannon Programmatic, it is through your hard work and continued support that measurable habitat improvement is achieved. Also, the landowners for having faith in a sciences based process and committing to restoring habitat and preserving valuable species for future generations.

Implementers:

Columbia Conservation District
Confederated Tribes of the Umatilla Indian Reservation
Nez Peirce Tribe
Snake River Salmon Recovery Board
US National Forest
Washington Department of Fish and Wildlife

Funders:

Bonneville Power Administration:
Salmon Recovery Funding Board:
Washington Conservation Commission:

Partners:

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Introduction:

The Tucannon River Program Habitat Project 2010-007-00 (herein referred to as the Program) is a restoration "Umbrella" project focusing on improving Snake River spring Chinook habitat in the Tucannon River, near Dayton, WA (Figure 1). The Program is managed by the Snake River Salmon Recovery Board (SRSRB) in conjunction with the partners: the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Columbia Conservation District (CCD), Nez Perce Tribe (NPT), U.S. National Forest (USNF) and the Washington Department of Fish and Wildlife (WDFW). The Program partners have been working as a group for 7 years in the implementation of the Conceptual Restoration Plan, Reaches 6 to 10 Tucannon River Phase II (Anchor November 2011). Collectively, the Program has funded 12 of the 28 projects identified in the plan and coordinated treatments on 3 others.

The SRSRB serves as the Regional Organization and the Lead Entity for salmon recovery in the Washington State portion of the Snake River basin and the Washington State portion of the Walla Walla River basin, supporting the implementation of the Salmon Recovery Plan for SE Washington (SRSRB 2011) and guiding funding for the Salmon Recovery Funding Board (SRFB). The SRSRSB provides a broader perspective for salmon recovery than a typical one-watershed process, by participating in salmon recovery efforts and issues throughout the State of Washington working to develop and maintain partnerships in restoration but also in monitoring, and land management issues. The SRSRB also provides a sounding board for public input and involvement in salmon recovery both in projects and in approaches, building the baseline support need for large-scale restoration.

The Program restoration goals were reviewed and refined in the Tucannon Geomorphic Assessment (Anchor QEA 2011, herein referred to as the Assessment) and are geared towards shifting the river back to a more natural and properly functioning condition (PFC). The Assessment identified the following primary habitat factors currently limiting spring Chinook; riparian condition (4.1), instream structural complexity (5.2), floodplain connectivity (6.1) and summer temperature (8.1) (SRSRB 2011). The Assessment identifies the importance of large woody debris and floodplain connectivity in the development and maintenance of healthy naturally functioning riparian habitats.

The Program restoration objectives (Table 1) closely align with those identified in the Sub-basin Plan and the Salmon Recovery Plan for SE WA and were directly applied to the implementation actions identified in the Conceptual Restoration Plan, reaches 6 to 10 Tucannon River Phase II, (Anchor November 2011, here in referred to as the Conceptual Restoration Plan). Based on the goals and objectives outlined in the Assessment, 28 discreet conceptual restoration projects (RM 20-50) are developed and prioritized in the Conceptual Restoration Plan. The concepts focus on PFC as the restoration goal, the Program priorities focus on increasing floodplain connectivity, reducing channel confinement and increasing in channel complexity at the intensity needed to reset natural process and have an impact at the watershed scale.

The restoration approach enacted by the Program and its partners has focused on restoring stream channel complexity and floodplain connectivity to the extent possible give landownership and public support. Where possible restoration actions target full reconnection of floodplain at flows >1.5 year flood. In 2017, the Program adapted some of the more widely used channel evolution models (Cluer 2013, Brierly 2005) for forested wondering gravel bed, to best fit the Tucannon River (Figure 2, Figure 3). The floodplain model illustrate the ecological process targeted for habitat restoration in the Tucannon and communicates the benefits to practitioners and the public. The model illustrates that as floodplain roughness is lost, the river channel devolves to a wider shallow channel traveling unabated over the floodplain. In the Tucannon, this lead to land management activity, which trained the river to be straighter and steeper, and in some place trapped the river behind levees. Once this had occurred, channel evolution stalled; remain incised until actions to push it back toward functioning (Figure 3). The Program approaches floodplain connectivity from three angles, the removal of river levees or gravel berms/fill that blocks overbank flow or disconnected channels from being floodplain (Figure 4). In many project reaches simple removal of blockages is not, the single action required to reconnect floodplain in the Tucannon. These reaches also require the placement of LWD in some structural form, but for the purpose of reducing channel capacity and increasing flood stage (Figure 5). Wood structures are placed in the Tucannon for the purpose of reconnecting incised channels, which exhibit plane bed condition and stuck in this evolutionary step (Figure 2). The third approach is to cut or reconnect side channels an approach to spreading flows and proving winter refuge for juvenile Chinook (Figure 6).

Floodplain connectivity created in a previously incised reach of the Tucannon River in PA-14, during an estimated 450cfs flow.

Purpose:

The purpose of the Program is to guide restoration funding in support of the implementation of the Sub-basin Plan, the Salmon Recovery Plan for SE WA, and the 2008 FCRPS Biological Opinion in support of improving spring Chinook habitat in the Tucannon River. In the development of the Assessment habitat limiting factors were identified and updated from the existing plans into the habitat objectives

that currently have the greatest biological benefits, which prioritized the Program objectives (Table 1). The Conceptual Restoration Plan went one-step further, identifying and prioritizing over-winter survival of juvenile Tucannon River Spring Chinook as a critical life stage limiting the recovery of this ESA threatened species. The Conceptual Restoration Plan also identified channel complexity and floodplain connectivity as the two highest priority factors suppressing ecological function, and developed restoration action/objectives targeting those factors. Within the Conceptual Restoration Plan 28 discrete restoration projects located within the highest priority spring Chinook spawning and rearing habitat (RM20 to RM50), were prioritized for implementation. Each conceptual project identifies restoration actions, potential improvements that could be made toward restoration objectives and a description of geomorphic and biologic benefits from meeting the objectives. The Program has prioritized the 28 conceptual restoration projects outlined in Conceptual Restoration Plan, Reaches 6 to 10 Tucannon River Phase II (Anchor November 2011) and has been working with the project implementers since 2011 toward completion.

The Program has been in place through the development of the restoration plans and is the center for coordination and prioritizing restoration within the basin. The Program works in setting an annual work plan and in coordination with the implementation partners and the Program partners allocates budgets and assists in the pursuit of matching funds. The Program provides technical support to the implementation partners and coordinates outside technical design review. The Program will invest its self in the update of the conceptual Restoration Plan in 2018 by providing technical and administrative support during the process.

The Program also provides a forum for the implementers to coordinate their restoration project amongst regional BPA funded projects including the CCD Columbia County Tucannon Stream & Riparian Restoration Project (1994-018-06), the CTUIR Tucannon Watershed: Protect and Restore Habitat (2008-202-00), and the WDFW Floodplain Management Plan.

Area of Primary Focus:

The Tucannon River is a Snake River tributary originating in the Blue Mountains of southeast Washington (Figure 1) and is located in Columbia and Garfield Counties. The main channel is approximately 58 miles long and drains about 503 square miles before entering the Snake River approximately 3 miles upstream of Lower Monumental Dam. Several major tributaries drain into the main stem including, Pataha Creek, Tumalum Creek, Cummins Creek, Little Tucannon, and Panjab Creek. A full description of the basin has been provided in the Assessment.

In 2011, the weight of evidence reviewed in the Geomorphic Assessment (Anchor 20111 April) and the Conceptual Restoration Plan (Anchor 2011 Nov) identified river mile 20 to 50 to have the greatest impact on salmonids, based on spawning density. Beginning in 2013, WDFW developed a model for the Tucannon life cycle of spring Chinook and steelhead parr and smolts, within the Tucannon Basin.

Fish tagged in 2014, 2015, and 2017 with passive integrated transponder tags in their summer rearing areas, for the purpose of monitoring survival through the four PITT arrays located downstream in the basin (Figure 28). The results of this study have indicated that yearling and age zero Chinook Parr emigrate in large proportions from the upper watershed as water temperatures decline into late fall and winter. This is likely a response to reduced winter carrying capacity, however it has been determined that these fish are exhibiting lower than expected survival (<20% over winter) in the lower river before leaving in the spring and entering the Snake River. In 2017, the Program initiated an update to the Conceptual Restoration Plan and as part of that update will investigate the limiting habitat factors identified for the middle and lower river and incorporate actions (projects) that can increase over winter survival in these reaches.

As part of the Conceptual Restoration Plan Reach 3-5 (Anchor 2012), nineteen additional conceptual projects have been identified to benefit Chinook and steelhead, these project reaches were not part of the initial project prioritization and implementation, because the recommendation from the WDFW fish program identified the reaches as passage only. It is the intention of the Program to update the Conceptual Restoration Plan, integrate and prioritize project reaches 2-5 river mile 2 to 20 (Figure 27). Prioritizing the conceptual projects in these reaches considering higher fish benefit to winter survival will increase the probability for project implementation in these reaches. During the process, the Tucannon Coordination Committee will work with the program and partners to solicit entities who will conduct implementation within these reaches of the following 3-5 years.

Focal Species:

The Tucannon supports four populations of threatened species including the Snake River ESU spring Chinook, Snake River fall Chinook, Snake River ESU summer steelhead, and the Columbia River bull trout. All reaches of the Tucannon River are utilized during one or more life stage annually except fall, which only use the lower river. The lower Snake River spring Chinook is currently only found in the Tucannon River, having been extirpated from Asotin Creek (Figure 1).

The Tucannon River spring Chinook is a sub-population of the Snake River spring Chinook ESU, which has been listed as threatened under the Endangered Species Act since 1996, and is the primary focus of the Program restoration project. The Tucannon River is the lowest downstream tributary spring Chinook population in the Snake River.

The population was in decline throughout the 1980s, but reached a critical low in the mid-1990s when the number of wild adults dipped to as few as three naturally produced individuals. More recently, adult returns to the Tucannon have been steadily increasing as overall habitat conditions improve (Gallinat 2015). The current know distribution for spawning and rearing spring Chinook in the Tucannon is from RM 20 upstream to RM 58 based on available information (Figure 1). It is anticipated that as conditions improve this boundary would be expanded downstream. At the drafting of the Snake River Salmon

Recovery Plan in 2005, spring Chinook and steelhead were not observed spawning or rearing downstream of RM 30. In more recent years improving stream temperatures has supported spawning and rearing downstream to at least RM 20 and potentially further downstream to Pataha Creek (SRSRB 2011).

In 2017, two colonies of bivalves (Margaritifera spp) were discovered in PA-28 and one in PA-18. The colonies are mapped and the CTUIR bivalve research project and USFWS regional office either are or will be notified for record and future study. As rare native spp observations are made the Program makes record of native species maps them into our data base, notification of interested parties and help to develop more information of their presence and increases as habitat improves. As we improve natural function in the Tucannon, habitats that are more diverse will support greater distribution and number of native vertebrate and invertebrate species.

To data, the Program has focused on restoration priorities targeting spring Chinook and primarily actions improving winter rearing and survival. It is widely believed that actions taken to improve spring Chinook habitat (floodplain and channel connectivity and complexity), will also improve conditions for other native species such as steelhead, bull trout, native rainbow trout, white fish, mountain sucker and pacific lamprey. In our efforts to restore natural process, we anticipate positive changes in species diversity as well as abundance. In 2018, as part of the Conceptual Restoration Plan update the Program plans to be more inclusive of non-game native species for the purpose of food web development.

Climate Change

Climate change forecasts for the Blue Mountains predict increasing ambient air temperatures by 2.4-3.1 °C by 2050, with a slight increase in winter precipitation (Halofsky 2016). It is not clear if an increase in precipitation would be snow or rain, but decreasing snowpack is predicted. Decreasing snow pack will alter hydrology by increase peek runoff and reducing summer base flows. Hydrology in the Tucannon Basin particularly peek flows driven by rain on snow events, producing the large peek flow floods in mid-winter. Reducing snowmelt into summer will have negative impacts on summer flows and negatively influence water temperatures. August mean water temperature in the Tucannon River priority reaches, may increase on the order of 1.4°C and 2.4°C by the years 2040 and 2080 (http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html).

Changes in hydrology and water temperature under impaired river conditions will have a large negative impact on spring Chinook and other salmonids in the Tucannon. Increases in winter peek flow will increase bed scour and deposition affecting redds and over winter survival. Earlier peek flows and lower summer flows will affect migrating adults as well as impact out migrating smolts reducing survival. Lower summer base flows will also exacerbate summer high temperature affecting summer survival and could reduce carrying capacity.

The projects and restoration actions outlined in the Conceptual Restoration Plan (Anchor 2011 April) were focused on channel complexity and floodplain connectivity actions that should buffer against the impacts of climate change. The Tucannon may have a head start in in buffer against climate change, brought about by increased wood loading in the headwaters following forest fires in 2005 & 2006, increasing natural storage. In fact, it would appear that the watershed is responding to changes brought on by natural process, leading the program and partners to mimic natural wood loading in project design. Stream flow measured at the WDOE stream gage at Marengo indicates summer base flows are treading up through time (Figure 8) while precipitation over the basin measured by NRCS is remaining relatively flat (Figure 9). A comparison of base flow in adjacent watersheds flowing out of the North West slops of the Blue Mountains revel the Tucannon to be unique in its upward trend (Figure 10). Particularly in comparing the North Fork Touchet and the Tucannon which are watershed sharing a boundary with the North Fork Touchet being in a significantly higher rainfall zone than the Tucannon (Figure 9). An analysis conducted by the WDOE in 2015 illustrated the effects of a shift in stream hydrology in the Dungeness River WA, caused by an early snowmelt (Figure 12). Early snow pack melt lead to higher than normal winter flows and much lower than normal summer base flows. The results of the same analysis conducted by WDOE (Figure 13) for the Tucannon showed similar higher than average flows in December through February, reflecting warmer temperatures in the mountains. Followed by lower than normal runoff in April and May, indicating very little snowmelt derived runoff, but in the Tucannon contrasted to what occurred in the Dungeness July-September flows were closer to normal. We feel this is a result of increasing water retention time caused by channel complexity and floodplain connectivity, however we will look replicate this analysis in an update to the Tucannon Conceptual restoration Plan.

The Program partners share restoration objectives and implement restoration actions that lead to increasing channel complexity and floodplain connectivity, including removing confining features, increasing channel complexity and floodplain connectivity. Future project implemented in the watershed will continue to increase connectivity of channel and floodplains, increase side channels and floodplain storage by reducing incision and increasing riparian vegetation.

Summer mean high water temperature in the Tucannon also have been declining over the period of record going back 1985 at the Marengo gage (Figure 14). Many of the projects completed in the basin by the CCD focused on restoration actions which target reducing water temperatures including the planting of >14 river miles of riparian habitat, and treating heat sink reaches by reducing the width to depth ratio.

More recently, projects including channel complexity and floodplain connectivity are influencing stream temperatures by improving hyporheic flow and buffering base flow by raising the shallow water table. Riparian planting is an important component of our long-term strategy however, as a Program; we have not planted that many acres of riparian trees to this point. Our riparian restoration approach has adapted due to the poor survival observed in previous projects within the region and Tucannon. Many areas

where we would like to see trees but they are not established, soil conditions are so divergent from normal that baring importing soil and summer watering, trees die. We have shifted our approach to encouraging the river to deposit fines on the floodplain and recruiting cottonwoods and alders naturally. In areas where natural recruitment does not occur, we have initiated non-native suppression and planting of woody native species. Additionally we have begun to plant Ponderosa pines and Douglas Firs within the existing colonizing riparian forest to provide successional forest types into the Future.

Projects leading to increasing channel length and complexity also increases floodplain connectivity and side channels development and increase water retention time in the basin. Additional roughness will continue buffer maximum peek flows minimizing flood scour releasing flows longer into summer. Increases floodplain connectivity will recharge the shallow aquifer, increasing positive feedback to summer base flows as well as improvements in riparian health, buffering summer high and winter low temperatures. Improvements in riparian habitat will reduce ambient air temperature and increase shading as well as increase future wood inputs, which is the driver of the system. If we can see significant and lasting habitat improvements on a significant proportion of the watershed, we should be able to buffer against the most severe impacts of hydrology and temperature changes predicted in the models.

2017 Actions:

In 2017, the Program and the partners implemented 3 large reach scale restoration projects, advanced designs on 2 more reach scale projects for implementation in 2018-20 and initiated concept development of 2 additional project areas for implementation in 2019-22. The Program conducted rapid habitat surveys on all 3 implementation projects pre/post implementation and collected pre-project information for concept development for 2 of the design projects. Rapid habitat surveys were conducted on 6 of the project areas completed in previous years to capture change following the first big flood flow since 2009-10, prior to the Program. An update to the Conceptual Plan (Anchor 2011 Nov) and associated Assessment Chapters (Anchor 2011 April) was scoped and initiated for completion in 2018-19. The Program worked with CTUIR to acquire a bathymetric LiDAR data set for the entire watershed, with the purpose of providing updated data to the Conceptual Plan update but also the dual purpose of habitat change detection (since 2010). These data sets are also very valuable in the development of project designs and outreach materials.

The Program has coordinated with the CCD to initiate an update to the Tucannon Conceptual Restoration Plan (Anchor 2011 Nov), for the purpose of incorporating new information on Chinook life history, distribution and survival. Implementation monitoring results will be used to update the plan as to work remaining in the initial 28 projects. The update will review information on project effectiveness and make recommendation on additional actions that may be required to meet restoration goals in the original 28 project areas. In 2012, Tucannon River reaches 2-5 were developed into conceptual restoration plans of their own (Anchor 2012), but at the time were outside the known priority area for

spring Chinook and were not ranked as priorities. With the new developments in Chinook migration behavior and survival, we plan to integrate the conceptual restoration plans re prioritizing projects based on updated information. We also anticipate a broader look at the Tucannon tributaries and their influence on buffering against climate change. Climate change impacts on the basin and the actions implemented to buffer those impacts will be explicitly outlined as part of the update. Within the plan we will capture our approach to adaptive management explaining what we have done to date and setting a path forward, for measuring progress and conducting management actions.

In 2017, the program completed restoration actions on 3 projects areas located throughout the basin (Figure 7). Project area 28 (PA28) was located at RM 20 on private property while the other two (PA18 & PA-6-9) were on the WDFW Wildlife Area. In 2018, the Program is supporting the completion of designs on PA-13 and the final field season on PA28 Phase III (Figure 7), while concept development continues on PA17.

2017 Budget - <u>Administrative & Projects:</u>

The Program formed in January 2011 (FY11) with the initial FTE support at 0.15 for the SRSRB Director, 0.15 FTE for a Coordinator and 0.12 FTE for a student intern to provide office and technical support. A goal of the early Program was to maintain a high ratio of implementation to administration while allowing staff to become familiar with the inner workings of BPA contracting and reporting. A detailed account of administrative history and past expenditures are outlined in the 2016 Program Summary Report (Buelow 2017).

In 2017, the Program operated with 11% of the overall budget going toward administration, 3% supporting project effectiveness monitoring and 86% going to the project sponsors conducting project implementation (Figure 15). With the 11% or $155,042 the Program supports 1.25 FTE to coordinated and administer the Program, provide partner technical support, perform program outreach and conduct program reporting bother within the program and outside the program as requested by BPA and the NW Power Council.

One of the primary goals of the Program is to support the project partners/implementers in the pursuit of matching funds for construction and in 2017, the Program construction budget was match at 34% (Figure 16), primarily comprised of three successful SRFB application which totaled >$700k for implementation in 2017. Considering the SRFB grants in the Tucannon are used for implementation out administrative burden was ~7% of the total construction budget in 2017.

In 2017, 4 entities utilized the Program annual budget, (including match), the CCD, CTUIR, WDFW and WWCC. The CCD, CTUIR and WDFW received Program funding to conduct restoration implementation and the support activities related to implementation including project design, permitting,

materials, construction management, field engineering and construction sub-contractors. The WWCC is the Program fiscal agent, and has been the recipient of the administrative and management funds to support SRSRB staff in the operations of the program.

In 2017, the CCD continued to work on Project Area 28, which had been sub-divided into three phases with implementation beginning in 2016, continuing in 2017 and planned for completion in 2018. In 2016, the CCD received a Program budget (#72405) for $210,000 and matched 100% from their project (1994-018-06) to design and implement PA28 phase I. In 2017, the CCD worked with the Program to acquire implementation-matching funds for Phase II, and was awarded $304,775 (16-2094) from the SRFB, which they matched to their project budget (1994-018-06). As a result, the CCD did not require a Program budget for work under Phase II. All though a construction budget was not provided in 2017, the Program participated in the development and review of design, developing environmental documents, documented pre/post habitat conditions, supported construction management, and final reporting. The Program worked closely with the CCD on Phase III design site review in September 2017, and the finalization of design for permitting in 2017-18. In 2018, the Program is providing a construction budget to complete Phase III identified in contract 76992.

In 2017, CTUIR initiated work on Project Area 18 completing the instream work elements associated with that project. The CTUIR, utilized their FY16/17 Accords Tucannon Program (2008-202-00) contract (72049) to fund project design, project management and construction management. The Program contributed a construction and materials budget of $797,054 in a 2017 contract (73400). The Program provided CTUIR with technical support to pursue a SRFB grant to fill the reminder of the project construction and riparian planting budget, receiving a $406,864 (16-2091) to match implementation.

The WDFW worked with the Program and the partners in 2017 to complete implementation on PA-6, 8 & 9. Program funding ($90,125) was utilized by WDFW to prepare preliminary designs on PA-13, complete designs on PA6-9, conduct project preparations and preform construction management in 2017 (75493). WDFW received a $362,913 contract from the program (73343) to finalize designs following the 2017 high flow, completed site preparations and secure materials leading up to implementation. The Program provided WDFW technical support to acquire implementation-matching funds from the SRFB in 2016, receiving $402,012 (15-1323) from the SRFB for use in 2017.

The 2017, construction season presented a unique opportunity for cost saving through a partnership between WDFW and CTUIR leading to a saving >$350,000 primarily through efficiencies. The two sponsors were able to coordinate the use of helicopters between their projects and consolidate contracting for both implementation budgets in the CTUIR program budget (73400). Additionally, once the contract was consolidated in CTUIR's contract as a pass through sub-contract we were able to make some minor adjustments to designs and utilize a Vertol helicopter for a little over half the project turns

saving about 25% in addition to administrative savings. More information on these saving can be reviewed in appendix 1. The program will continue to try to identify opportunities to maximize efficiency, applying those savings to implementation.

The program is currently working with the partners in the designs and permitting of projects for implementation in 2018-20. Funds were provided to WDFW in the sum of $58,500 (75493) on the PA-13 design. The CCD is currently working with the program to develop concepts on PA-32 for design in 2018 and implementation in 2019. CTUIR and the program are coordinating private landowners to develop project concepts in PA-17 with the intention of design in 2018. Both sponsors (CCD & CTUIR) are currently using their own program funds to develop design in 2018. The Program anticipates providing construction budgets for these projects in 2019-20. As project concepts firm up and preliminary designs produce construction budgets the Program will work with the sponsors to pursue matching funds.

In 2017, the WWCC received a contract (75494) which it use to support staff in the management of the program. The program administration and operation costs in 2017 were $155,042 to the program. The WWCC also provided some project effectiveness monitoring under the CHaMP program conducted in 2017 at $33,152. Administrative costs will remain stable in 2018.

Project Prioritization:

The Conceptual Restoration Plan identifies 28 reach-scale restoration actions that will significantly improve river processes and habitat function. The approach to project selection was to conduct a geomorphic assessment of the entire watershed in 2010 utilizing LiDAR, high-resolution aerial imagery and field surveys. The basin was delineated into 10 discrete reaches throughout 50 miles of the river. The geographic reaches were prioritized based on the most limiting life history of spring chinook, which is egg to parr. Based on spawning and rearing, the priority reach is from river mile 20 to river mile 50 (Figure 1), which includes geomorphic reaches 6 through 10. Within this 30-mile long geographic area, 28 reach-scale restoration projects were identified and then prioritized based on expected biological response, consistency with natural geomorphic processes, and benefit-cost ratio, largely following the watershed restoration framework recommended by Ronnie et. al. (2002) and as described in the Tucannon River Geomorphic Assessment (Anchor QEA April 2011). The purpose of the assessment was to strengthen the technical understanding of existing physical conditions and geomorphic processes in the basin in order to identify and prioritize habitat restoration actions. Anchor QEA characterized channel and floodplain conditions, channel confinement, and the historic channel occupations area. The source, magnitude, and distribution of hydrologic and sediment inputs through the basin were evaluated and characterized. That information delineated discrete reaches throughout the river. Further, this strategic approach was based on the recommendation from the ISRP and has led to conceptual project plans that are refined into final designs prior to implementation.

With guidance and input from the Regional Technical Team, 28 individual reach-scale projects were identified through a geomorphic assessment and conceptual restoration plan for inclusion in the Program program. On an annual basis, individual projects are considered for funding approval, by the SRSRB. Future habitat work under this project will be based on the projects identified in the Conceptual Restoration Plan, Reaches 6-10 Tucannon River Phase II (Anchor QEA, November 2011) with review and support from the RTT and approval by SRSRB. In addition to habitat restoration projects identified in the geomorphic assessment, any emerging and confirmed fish passage impediments will be reviewed by RTT and may be added to the work plan for consideration by the SRSRB.

The selection criteria that prioritizes the projects is further described in Chapter 9 of the Conceptual Restoration Plan, Reaches 6-10 Tucannon River Phase II (Anchor QEA, November 2011) that address the limiting factors outlined for the Tucannon River in the 2008 Federal Columbia River Power System Biological Opinion.

The project evaluation criteria are (1) expected biologic response, (2) consistency with natural geomorphic process, and (3) benefit-to-cost ratio. Biologic and geomorphic criteria were assigned qualitative values of high, moderate, or low value and benefit-to-cost was given a qualitative ratio using high, moderate, or low values. The expected biological benefit was scored based on the expected magnitude of benefits and the likelihood that project objectives would be met. Those projects that most directly address limiting factors and critical life stages, while creating the greatest volume and diversity of quantifiable habitat, received the highest scoring. The juvenile spring Chinook life history stage (egg to parr) was identified as critical to improving the spring Chinook population in the Tucannon River. In particular, the persistent lack of adequate juvenile rearing habitat, especially during winter and spring runoff (post-emergence to parr), bed scour during stochastic winter/spring flows, and summer water temperature have been identified as limiting to juvenile populations. The expected biologic response of each project was evaluated within the following categories (1) provides immediate habitat benefits for critical life history stages, (2) reconnects isolated habitats or improves existing habitats and promotes floodplain connectivity, and (3) provides diversity throughout the active channel and low-lying floodplain for all life history stages.

The consistency with natural geomorphic process criteria was also used. Natural geomorphic processes are the primary factor in creating and maintaining high quality habitat in properly functioning rivers and streams. Designing for geomorphic process or removing inhibitors to geomorphic processes are very important considerations in project prioritization. The sustainability and functionality of the project is highly dependent on consistency with geomorphic processes, and it is the restoration of these processes that will create, and maintain habitat features in the long term. The projects that will effectively address the rehabilitation of natural processes received the highest qualitative rating. Consistency with natural geomorphic processes were evaluated within the following categories (1) removes stressors that promote habitat degradation or inhibit natural channel and floodplain processes, (2) promotes reach-scale

geomorphic response consistent with natural processes, (3) promotes the retention of LWD and sediment and forces pool-riffle morphology and complex channel plan form.

After 8 years of implementing priority projects from the Conceptual Restoration Plan, in 2018 the Program and its partners are initiating a plan update. The Program has coordinated with the CCD to initiate an update to the Tucannon Conceptual Restoration Plan (Anchor 2011 Nov), for the purpose of incorporating new information on Chinook life history, distribution and survival. Implementation monitoring results will be used to update the plan as to work remaining in the initial 28 projects. The update will review information on project effectiveness and make recommendation on additional actions that may be required to meet restoration goals in the original 28 project areas. In 2012, Tucannon River reaches 2-5 were developed into conceptual restoration plans of their own (Anchor 2012), but at the time were outside the known priority area for spring Chinook and were not ranked as priorities. With the new developments in Chinook migration behavior and survival, we plan to integrate the conceptual restoration plans re prioritizing projects based on updated information. We also anticipate a broader look at the Tucannon tributaries and their influence on buffering against climate change. Climate change impacts on the basin and the actions implemented to buffer those impacts will be explicitly outlined as part of the update. Within the plan, we will capture our approach to adaptive management explaining what we have done to date and setting a path forward, for measuring progress and conducting management actions.

In 2017, the Program implementers continued working on project from previous years and no new project solicitation was conducted. During the Conceptual Restoration Plan update in 2018 the Program will reconvene the Tucannon Coordinating Committee (TCC) to both work on the update but also to prioritize and solicit project implementers as part of the update. The Tucannon basin is typically implementer poor and has not had a funding base large enough to attract a large number of implementers into the basin. Outside of the Program implementation partners, no agencies have implemented projects in the basin. Which has lead us to use a focus solicitation approach for implementation sponsors. Prioritizing the projects and soliciting who would do them in committee has helped our process to be collaborative and effective over the past 7 years. A complete description of project solicitation is outlined in the 2016 annual program report (Buelow 2017).

Tucannon River Programmatic Parent Contract #79454

The following sections of this report will provide a detailed description of activities conducted in support of the Program, under the work elements outlined in the scope of work (contract number 79454). When applicable, methods, results and progress on deliverables are described for January 1, 2017 through December 31, 2017.

Programmatic Implementation:

Program Implementation

Work Element 119, 185, 132: Manage and Administer Project, Produce Status Reports & Annual Report:

Deliverables: 2017 SOW development, property inventory, submitted in Pisces. Coordinate the Tucannon River Programmatic and identify project matching funds. Complete periodic status reports and annual report.

During the time period January 1, 2017 through December 31, 2017 the SRSRB managed the implementation of the Program through the "Parent" contract: (79454) and was the point of contact from SRSRB office at 410 B East Main Street, Dayton, Washington 99328. The SRSRB coordinated monthly RTT meetings on the 3rd Wednesday of each month for the purpose of prioritizing restoration actions, set restoration goals and objectives and reviewing restoration designs. In 2017, the Tucannon Implementers Committee (TIC), a group of project sponsors, resource experts and land managers locally involved in Tucannon River habitat restoration continued to meet on quarterly basis. The TIC is a subcommittee of the RTT with the purpose of identifying restoration activities which best meet the restoration objectives (Table 1) and coordinating those activities over the duration of the Program. The TIC works to streamline restoration, review design, sharing information, coordinating with monitoring efforts determine the pursuit of matching grants and discussing project progression. The participants of the TIC included representation from the, USFS, CTUIR, NPT, WDFW, CCD, PCD, TSS and SRSRB.

In 2017, the Program coordinated with the implementers to conduct pre/post rapid surveys of the project areas for the purpose of measuring the project as-built condition at a reach scale following restoration. The data collected on the projects includes pre-existing wood, side channel and pools, post construction wood, and side channels as well as an extensive photo record. Metrics collected are directly comparable to CHaMP metrics so the as-built data is applicable to CHaMP monitoring within and across basins and useable in effectiveness monitoring. The Program coordinates with the implementers to conduct status, annual and completion reporting and relies on the data collected in the rapid habitat surveys to provide date for these efforts. All 2017 data (as-built) was provided to the Tucannon CHaMP program staff, and in 2017 we coordinated surveys to capture implementation and effectiveness monitoring. During the 2017 field season, surveys were completed on PA-1, PA-3, PA- 6, 8 & 9, PA-15, PA-18 & 28. The Program also collected floodplain surveys of side channels only on PA-10 and PA-24. The additional floodplain effort was initiated due to the high flows that occurred in March 2017.

The Program staff work closely with those conducting monitoring in the basin and has helped coordinate and set up treatment control sites for both CHaMP and AEM that would correspond with restoration actions. In 2017, we worked with monitoring groups to identify and produce products which would best reflect outcomes of restoration work in the Tucannon and plans to continue this in 2018. In working

with WDFW we help scope and implement two studies including a Life Cycle Model and chinook and steelhead movement study. The information from these two studies will provide insight into winter migrations and survival of spring Chinook and inform future restoration priorities.

The Program also pursues and tracks project and program matching funds (Figure 16) provided or received by the partners and sponsors. Match comes to the Program in the form of in-kind support, material donations and restoration grants. Materials donations have been coordinated with the USFS and project sponsors to identify, secure and track the distribution/placement of materials. The Program coordinates and provides technical supported in the pursuit of restoration grants by assisting and supporting the application process. In FY17, the Program implementers were successful in securing Salmon Recovery Funding Board Grants totaling $712,775 for the implementation of PA-18 and PA-28 both funded under Program for implementation in 2017. The Program is already beginning the process of acquiring matching grants for the 2018/19 work windows.

Adaptive Management;

The Program and the partners have been working to formalize a practical approach to conducting an evaluation of completed projects so that lessons learned can be used to make the work we do better in the future. Most of the projects implemented to date have objectives we can measure such as LWD volumes, pool densities and floodplain connectivity. We have been utilizing rapid habitat surveys to observe and document increasing channel complexity, floodplain connectivity, pool frequency and LWD densities as a way to evaluate changes within those projects. This approach allows us to observe change and evaluate if the changes are occurring at a rate appropriate to the action or if immediate additional actions could improve or speed up recovery. Using this approach, we have identified a need for project maintenance opportunities that would greatly improve processes set into motion by the initial project. Maintenance has been required at low incidence following last year's high flow. One project on private project and in several location on the WDFW where bed aggradation had occurred filling previously incised channels requiring addition floodplain structures to engage at high flow. As a Program we do not have emergency or maintenance funds, but work within existing budgets to contract the modification required.

We plan to incorporate into our Conceptual Restoration Plan update a chapter to formalize and set guidelines for evaluation and prioritizing corrective or additive actions going forward. We don't anticipate strictly adhering to the formal adaptive management model, as funds continue to decline for monitoring, but will utilize a more rapid approach that can using existing or more periodic effectiveness monitoring approach.

Community Involvement and Education'

Work Element 99: Outreach and Education

Deliverable: Conduct one project tour, present program accomplishments to regional agency personnel and LE Board. Develop outreach materials.

The SRSRB and the Program conducted outreach activities in 2017 by attending public habitat restoration meetings, coordinating and hosting public tours, and posting its completed and planned projects on the Washington State Habitat Work Schedule (http://hws.ekosystem.us/). Additionally, SRSRB staff attends local public meetings where they lead discussions on the restoration and protection of salmon habitat in the Tucannon. The SRSRB operates highly visible office in downtown Dayton that is highly accessible to the public, providing opportunity for individuals to meet with the SRSRB Director and staff.

The Program participates in a number of public forms and boards during the scoping and design of projects in the Tucannon including SRSRB, the Tucannon River Citizens Work Group and the Lead Entity SRFB review. It is through these processes restoration projects proposed under the Program are vetted by the watershed landowners and stakeholders. All projects funded through the Program in 2017, were supported through the SRSRB Lead Entity beginning in the design –process through implementation. Using this approach ensures a wide cross-section of support from landowners, agencies, tribes, Columbia County residents, and County officials providing at least a peripheral knowledge of the projects.

In 2017, the Program collected extensive photo and video records of implementation throughout the entire implementation season. The result has been a number of outreach materials prepared by the SRSRB for CTUIR, WDFW and the CCD. We anticipate continuing this effort in 2017. The Program hosted the BPA film crew during our helicopter wood loading project in July and anticipate a sort film highlighting that effort.

The Program participated in and conducted a number of field tours during 2017, including a landowner tour in November, which was attended by 16 individuals not including supporting faculty. The SRSRB (Debbie Seney) continued the youth education program working with 4th graders in the three counties, with the priority of teaching restoration of natural systems and salmon natural history. In total, > than 500 students participated in the 2017 program. This program is not continued in 2018 do to changes in funding and personnel, though efforts will be made to provide some type of outreach to students in the future. The Program and the implementing partners have always worked closely with private landowners in the basin as is reflected by the volume of restoration work completed on their properties. During the March high water and immediately following the high water Program staff and partners made a point of being present in the basin meeting with landowner to discuss observations and talk through concerns they might have had.

In 2017, the Program provided outreach tours to a number of agencies including the Idaho Department of Fish and Game Habitat Restoration program for the purpose of information sharing and helping IDFG develop larger and more effective restoration projects. In 2018, the Tucannon Program is planning on visiting Idaho to our projects being conducted in an effort to further cross pollinate ideas and efforts.

The Program initiate an effort to update the Program website where we will provide a public portal for outreach materials and provide access to project data and information on a broader platform. This is being completed through a partnership with the CTUIR technology group currently developing and maintain the CTUIR domain. This work is planned to be completed sometime early in 2018 and the new web link will be provided in the 2018 final report.

Conduct Environmental Compliance

Work Element 165: Produce Environmental Compliance Documentation

In 2017, the Program worked to initiate and assist project sponsors in the development of project permits for PA-6, 8 &9, PA-18 and 28. Permitting support included assisting in the development and finalization of the JARPA, SEPA, Forest Practices, 401&404, HIPP III and Cultural Resource documents. The Program also coordinated with the BPA EC Lead in the development of variance requests for PA-6, 8 & 9 and PA-28 in the HIPP III process. The Program also provides assistance in the development of project completion documentation for project implementers as per HIPP III requirements.

The Program implementers have utilized a structure anchoring technique, which has locally been called a rock bolo (Figure 31). The rock bolo is constructed by the connecting of two rocks using a section of chain 3 to 5 feet between the rocks. The bolo is placed over top of otherwise unanchored logs to hold them down in elevated flows. The bolo was a preferred method in our region for two reasons; one being the ease of placement and visual certainty provided private landowners and other stakeholders. The second being the ability to place materials in the main channel while offering stability and minimizing the need for excavation of the riverbed. Over the years we have observed that log structures work best when they infringe greatly on the main channel, however to do so either anchoring in the bed or using rock is necessary for structures to persists. As a program, we have tried to minimize the amount of riverbed we excavated due to the impacts caused by de-watering exclusions needed and the difficulty of containing water that is pumped from the exclusions. In 2018, the Program will investigate the transition to increased channel excavation and water exclusion in the design of PA-13. We are exploring options for anchoring and ballasting materials in future projects on the private properties in the middle and lower river. We will need to provide both actual 100yr flood protection as well as perceived protection for landowners if we plan to improve over winter habitats in this reach. We will also explore options for placing structures using methods to anchor and ballast log jams in mid-channel using a minimum excavation and minimum number of water exclusions. It is likely not feasible to

conduct 40-70 enclosures and dewaters to dig in jams within a 5 week work window. One technique we may investigate will be the use of driven pile to use as anchoring, which has not been attempted in the region due to proximity to bedrock but also because equipment is not readily available in eastern WA.

Program Project Reporting:

The Program has funded the implementation of restoration projects in 12 project areas (of the 28 identified in Conceptual Restoration Plan), including project areas 10, 3, 1, 14, 11, 15, 24, 28, 6, 8, 9, and 18 (Figure 7; Table 2). In 2017, the Program worked with sponsors to implement project areas 6, 8 & 9 as one combined project, project area 18 and phase II of project area 28. The parent contract supports the general functions of the Program through a full time habitat biologist to coordinate program activities in the field, with the support of the SRSRB Regional Director.

The Program provides annual program updates to the SRSRB in the development of the implementation work plan and completion and accomplishment reporting. All activities and progress toward goals are reported in the annual summary report provided to BPA and attached to the annual parent contract, which is submitted in March for the previous calendar year. All reports are installed on the SRSRB website for download at http://snakeriverboard.org/wpi/library/reports/ and project implementation and metrics data can be found for each project on the Habitat Work Schedule website at http://hws.ekosystem.us/.

The Program is working with CTUIR to develop a Tucannon basin geo-database containing the 2010 LiDAR data set and incorporating the 2017 data set for visualizing change in channel shape and riparian response. Rapid habitat and as built data from completed projects will be included as a layer to help detect change but also visualize change in channel and floodplain.

The Tucannon habitat restoration and monitoring partners provide invaluable support in the form of technical background and expertise in the prioritization of projects and field observations. The Program works closely with those conducting both habitat and biological monitoring in the basin, meeting nearly on a monthly basis through the RTT.

Completed Projects 2017:

The Program and its partners have been focusing their efforts on leveraging their resources to complete the highest priority projects identified in the Conceptual Restoration Plan. To date, 11 of the 28 project identified have been implemented by the Program and its partners (PA-1, 3, 6, 8, 9, 10, 11, 14, 15, 18, 24), and an additional three by the CCD using their own project (funding in combination with SRFB and other grant funding (PA-22, 23, 26) (Figure 7).

In 2017, the Program supported the CCD in implementing the second year at PA-28 completing the second Phase II of work and with the final Phase III implementation in 2018. WDFW (PA-6, 8 & 9) and CTUIR (PA- 18), completed instream implementation in 2017 (Figure 7). Our implementation process takes about 3 years from start to finish, with year 1 project development assessment, conceptual and preliminary design, year 2 design review and vetting internally (RTT, SRSRB and HIPPIII) permitting and year 3 staging, site prep and construction and year 4+ riparian restoration, stewardship and future adaptive management. CTUIR is in year 1 of a concept development in PA-17 (Appendix 2 – slide 5 & 6). WDFW is in year two of on PA-13 focusing on preliminary designs review this winter (Appendix 4), with permitting beginning this summer followed by site preparation and material acquisition this fall winter 2018.

Project stories are develop by the Program in coordination with the implementers and the partners for the purpose of better describing site conditions and history of each project area. The stories summaries describe previous work completed at project areas, development of the project concepts and designs, project goals and objectives and a desired time line for meeting those goals. The project stories for the three project implemented in 2017 are provided in the appendix section of this report (Appendices 1-3). The Program also collects project implementation metric for the purpose of tracking contract deliverables and change in on site conditions over time, Results for implementation on all 14 completed projects is summarized and used in this report (Table 2;). The Program collects pre/post project reach data (for the entire project length) in the form of an adapted rapid habitat survey (using CHaMP compatible metrics) focusing on setting photo points, delineating existing channels, pools and LWD key pieces (>6m long and 0.3m die). The purpose of this effort is to help in developing clear and concise restoration goals and objectives, support restoration designs, document as-built conditions, support future effectiveness monitoring and to aid in the development of the data and maps in this report (Table 2 and Appendix 1-3).

The projects completed between 2011 and 2016 were describe in detail in the 2016 Annual Report (Buelow 2017). New data on project effectiveness and watershed change detection is being collected, summarized and analyzed with the report due to back to the SRSRB in Mid-Mach 2018. This report will summarize the finding of CHaMP monitoring following the 2017 high flow compared to the data set so far. It is anticipated the summary will be rolled into the project stories. The BPA and GSRO - AEM programs also participating in the generation of this report and finds will be reported in the 2018 Program annual report. Date used in the following summary was collected as part of the rapid habitat surveys conducted by the Program which has prioritized pre-post surveys in years of construction. In 2017, a greater effort was conducted to capture change brought about by the high flows of 2017 (Figure 18).

2017 ***Completed Projects Detail (Table 2)***
PA-6-9 Construction Build 2017 (WDFW)

PA-18 Construction Build 2017 (CTUIR)
PA-28 Phase II Construction Build 2017 (CCD)
PA-13 Design 2017, -Build 2018-19 (WDFW)
PA-17 Design 2017-18 (CTUIR)
PA-32 Concept Development (CCD)

PA-6, 8, & 9: Update Design & 2017 Construction: (#68874 & #73343)

Summary: In 2015 and 2016, WDFW completed a field assessment and design for the project areas -6, 8 & 9 as described in the Conceptual Restoration Plan (Anchor 2011 April) RM 43.9 to RM 44.9 and RM 45.3 to RM 45.9 (Figure 7). The effort initially looked at four project areas between RM 43.9 and 45.9 including PA 7 (Figure 7), with a goal of wood loading using trees identified on the floodplain that were being killed by a western pine beetle (*Dendroctonus brevicomis*) outbreak on the W.T.Wooten Wild Life Area. During the reach assessment, PA-7 was determined to have restoration elements (USFS infrastructure) that and would require further review and NEPA consultation, with the USFS as the federal lead. Due to the length of time that would be involved, PA-7 was combined with the USFS feasibility assessment for PA-4 & 5, now named PA-4, 5 &7, planned for initiation in 2019-20. Further review of the project areas 6, 8 & 9 went ahead with plans for wood loading and design in 2015-16, but during the design development it was determined that in light of the recent school fire (2005) the trees identified for culling on the Wildlife Area would better serve as snags for avian nesting.

The projects are identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) as a strategic implementation project with a biological response that may take time to fully mature and achieving full benefits may be dependent on other actions. In 2014, WDFW developed the W.T. Wooten Floodplain Management Plan (2014) covering the WDFW ownership within the Tucannon Floodplain. As part of this document concepts were developed, which would make changes and alterations to the impoundments and their diversion points, located within the floodplain and confining the river. The plan identified two confining features within the PA- 6, 8 & 9 reach not considered feasible during the 2011 prioritization process including the elimination of the Big-4 impoundment and the removal of its protective levees, water diversion point and dam. Additionally, in 2015 a rapid habitat survey showed the mean LWD key pieces/bankfull volume to average 0.66 (Table 2) for the three project areas. With this shift in management, the wood loading and side channel connectivity actions increased in priority. With the changes in WDFWs management approach and the low LWD key piece volume the project was provided design funding in 2014-15 and implementation funding in 2016&17 (Table 4).

Goal and Objectives: The overall project goals are to improve LWD channel complexity and improve floodplain connectivity. Objective #1 will be to place LWD in volumes >2pieces/bankfull width configurations to increase complexity/cover, and off channel habitats (~96 jams). Objective #2 will be

to reconnect side channel habitat (0.22 mi) and increase floodplain connectivity reducing channel incision through channel bed roughness and deposition (Appendix 1 – Slide 2).

The riparian habitat within this project reach is well developed mature fir, spruce and pine forest, a feature that has been greatly reduced through past land management and more recently be catastrophic forest fires in 2005 and again in 2006. Collectively we determined construction using helicopter would be the best approach for minimizing impact to riparian forests. Beginning in 2015, the project design moved forward with the intention of using a helicopter.

The project place 116 LWD structures using > 660 logs and trees (>6m long & 0.3m dia.), placed using a helicopter to minimize impacts to existing high quality riparian areas during construction (Appendix 1 – Slide 4). In total, the project place wood structure in 1.96 miles of the Tucannon, increasing LWD key piece (>6m long & 0.3m dia.) densities from the pre-project 0.87 key pieces/bankfull width to a minimum of >4.5 pieces. The breaching of a small spoil berm running adjacent to the river in the upper most end of the project (Appendix 1 – Slide 4, 7) is expected to reconnect 0.22 mi of side channel habitat and help revitalize a section of lower Hixion Cr. that exists in an old paleo channel of the Tucannon. The remainder of channel connectivity actions design in this project work to reduce channel incision through increasing bank erosion and capturing that material. During the project, large volumes of racking and slash were incorporated with the intended purpose of decreasing the time for structure interaction with the typical flows, an observation learned during previous projects constructed by helicopter.

Stage:
The projects were implemented in July of 2017 and were exposed to a moderated bank full flow ~1000 cfs in December 2017. It is not likely that a greater flow than the early winter rain on snow event will occur in the spring of 2018 due to lower significant below normal snow pack in 2017/18 (Figure 17). Many of the structural features placed in 2017 are targeting the lengthening of channel laterally and the reduction of incision through deposition. Both of these responses require flows adequate to move bed load, in some localized areas this will occur rapidly but in other, it will require flows closer to a 5-year event ~2,000 cfs. The frequency an event of this magnitude has been one every 10 years but they have occurred more often lately as a result of rain on winter snow. In 2018, the Program will conduct a rapid habitat survey to determine change since the as built survey in 2017 and make determination on immediate change in habitat and notes on places or things to watch. A follow up survey will be conducted 2 -3 years later or following a significant flow whichever occurs first.

Results:
Results reported for this project are based on the post project "as built" rapid habitat survey completed prior to winter high flows, in October 2017. Comparisons pre to post-project conditions are presented as a percent increase from pre-project condition (Table 3). A small proportion of pre/post project photo

points are provided in Appendix 1 (slide 11-19) illustrating the types of channel conditions being targeted for treatment and the types of actions or structures being placed to modify them. A pre-project and post project map illustrating side channels, LWD structures, and pool frequency are provided for each project reach (Appendix 1 - slide 8, 9 & 10), showing improvement that took place directly as a result of project implementation working to meeting short tem goals.

- Increase of in LWD densities of > 390%
- The construction of 116 LWD structures increased pool frequency by .93% and pool area surface area by 287%
- Side channels (perennial and ephemera) within the reach increased by 240%
- Perennial channel length increased by36%
- It was estimated that flood frequency on an additional 7 acres of floodplain would be improved, but it is anticipated this will take longer to capture additional acres.

PA-18: Design & Construction (#73400)

Summary: In 2015 and 2016, CTUIR initiated the design and development of PA-17 & 18 between RM 32.1 & RM 35.15 (Figure 7) located on the WDFW Wildlife Area and private properties (Appendix 2 - Slide 5) using CTUIR Tucannon Habitat Program funding and Program technical support. The design efforts propose a two-phased approach where initial work will begin in 2016/17 on WDFW properties (PA-18) followed by phase II with interested private landowners in PA-17 (Appendix 2 – Slide 5). This approach will allow CTUIR to develop contacts and build landowner support before conceptualizing designs with private landowners.

The projects are identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) as projects targeted for early implementation that would have elements that would provide immediate biological response and taking some time to fully mature to achieving full benefits, removes important stressors from the system and had a high benefit to cost ratio.

The implementation funds were provided through the Program, SRFB and CTUIR Tucannon Project (Table 4) for implementation in 2017. PA-18 preliminary design, were developed in 2015 and finalized in 2016 for the WDFW ownership from the downstream bridge upstream to the private ownership (Appendix 2 – Slide 5 & 7).

Goal and Objective: The primary project goal is to return the project reach closer to its historic naturally functioning state, increasing quantity and quality of fish habitat. Three primary objectives have been established to accomplish the state goal including; (i) placing LWD structure within the bankfull channel to create pools, cover, encourage channel migration, substrate sorting and floodplain

connectivity, (ii) modify floodplain topography to increase connectivity and provide fish increased access to a spring channel that runs nearly the length of the project reach, (iii) enact the riparian planting plan.

i. The project design identifies ~45 log structure configurations (Table 2) ranging in size and shape, for the purposes ranging from fish cover and complexity to more structural channel shaping objectives (Table 1) of increase channel complexity (lateral movement and bar development) and floodplain connectivity (side channel development and incision reduction).
ii. The design identifies four locations where short pilot channels were cut, to connect existing disconnected flow paths on the floodplain with some of them identified as perennial and some as high flow (Table 2; Appendix 2 – Slide 8). Logjams have been designed to work with these side channel cuts to provide increased flow volumes during annual freshets and peek flow. It is not the long-term goal of the Program to ensure side channel paths are maintained perennial but is a short-term goal to provide relief from flood flows while the main channel works with placed wood and reshapes moves the reach closer to PFC. The project enhanced 0.82 miles of side channel, and reconnect and create another 1 miles during construction.
iii. The project plans to plant ~27 acre of inter-plantings amongst existing riparian forests, ~32 acres of Ponderosa pine on adjacent uplands and ~18 acres of existing grass and un-vegetated fields with Douglas fire and Ponderosa pine. Planting would take place during the plant dormant period over a number of years beginning as early as 2017-18 and as far out as 2022 as the reach floodplains develop.

Stage:

The project site has undergone a number of restoration actions over the past 20 years with each one being built on top as land management improves and habitat conditions improve. In 1995, WDFW acquired the property from private ownership with the intention of managing it as part of the wildlife area. The flood of 1996-97 lead to extensive bed and bank erosion at the site leading to summer temperature concerns as well as fine sediment (Appendix 2-slide 12). In 1998, WDFW constructed 5 log jams for the purpose of stabilizing lateral channel migration and reducing the width to depth ratio. Over the first 10 years, the channel did narrow and riparian habitat developed and matured behind the structures (Appendix 2 – slide 12). In the high flows of 2009-10, conditions developed which lead to the development of a channel-spanning log and debris jam anchored in the lower end of the project and the formation of a center channel bar. By 2013, the channel had completely filled and the reach expressed its self as a multiple channel depositional reach that is highly connected and becoming inhabited by beavers. The reach is an excellent example of resetting to "Stage Zero" (Cluer 2018) in the channel evolution model developed for the Tucannon (Figure 2, Figure 3).

The project built in 2017 by CTUIR, works to maintain the process occurring in the upper 1/3 of the reach (Appendix 2 – slide 9, 12), expanding it onto the adjacent floodplain and replicating it down

stream where possible. In this reach as in other on the Tucannon we are enlarging the flooded area to combat changing hydrology brought on by climate change. The approach will be multiple treatment in many places and will require decades, but we feel it is the only viable approach to buffering climate change effects.

In July and August 2017 the project was implemented, and exposed to a moderated bank full flow ~1000 cfs by December 2017. It is not likely a flow > the early winter rain on snow event will occur in the spring of 2018, due to lower normal (57% at the time of this report) snow pack in 2017/18 (Figure 17). Many of the structural features placed in 2017 are targeting increasing floodplain connectivity and channel complexity. Both of these responses require flows adequate to move bed load, in some localized areas this will occur rapidly but in other, it will require flows >1,550 cfs. The frequency of event of this magnitude has been one every ~5 years but they have occurred more often lately as a result of rain on winter snow. In 2018, the Program will conduct a rapid habitat survey to determine change since the as built survey in 2017 and make determination on immediate change in habitat and notes on places or things to watch. A follow up survey will need to be conducted 2-3 years later or following a significant flow whichever occurs first.

Results:
The project reach has a CHaMP site located near the center of the project that was sampled in 2017 pre-project and was treated in July 2017 (Appendix 2 – Slide 10). A total 10 LWD structures were built within the site perimeter, including a side channel pilot cut, gravel berm removal and gravel bar augmentation (Appendix 2 – slide 14 & 15). Pre-project habitat units indicate a low pool surface area within the reach and a high proportion of plain bed riffle (Appendix 2 – slide 10). It is anticipated the survey would be sampled in 2018 to capture change in site conditions.

The following results reported for this project are based on the post project "as built" rapid habitat survey completed prior to winter high flows, in October 2017. Comparisons to post-project conditions are presented as a percent increase from pre-project condition (Table 3). A small proportion of pre/post project photo points are provided in Appendix 2 (slide 13-20) illustrating the types of channel conditions being targeted for treatment and the types of actions or structures being placed to modify them. A pre-project and post project map illustrating side channels, LWD structures, and pool frequency are provided for each project reach are shown in Appendix 2 (slide 8) showing improvements directly resulting from project implementation targeting short term goals. A comparison of pre and post project side channels are made from channel delineation during the rapid habitat surveys and form historic aerial photographs to illustrate changes that have been occurring on this project area since the flood of 1996. (Appendix 2 – slide 9). The map time series shows a transition and development of depositional reach on the upper end of the project reach with a big increase by 2017. The floodplain response resulted following a project that occurred in 1998 by WDFW previously described (Appendix 2 – slide 12)

- Increase of in LWD densities of > 900%
- The construction of 49 LWD structures increased pool frequency by 89% and pool area surface area by 162%
- Placed 29 structures on the floodplain where flows will likely occur in the future.
- Increased side channels (perennial and ephemera) within the reach increased by 44%
- Increased perennial channel length by 6%
- New floodplain will be delineated in 2018 following high flows.

PA-28 Phase I-III Design and Construction (#72405)

Summary: The project area 28 design was supported by the CCD in coordination with the Program beginning in 2015, was updated for Phase II in 2017 following high flows in march of 2017 (Figure 18). In the Conceptual Restoration Plan PA-28 is identified as long-term strategic implementation priority with a more uncertain biological response and potentially dependent on other actions to achieve full benefits. Changing conditions at the project site and the increased understanding in the importance of middle river floodplain connectivity and off channel/side channel habitat for juvenile spring Chinook reduced the uncertainty around a potential biological response at this project, increasing the priority of this reach in 2015 leading to implementation in 2016-18. During the Assessment in 2010, geomorphic process within the reach appeared to be stable if not recovering, and due to existing infrastructure, improving on the condition would be cost prohibitive. By 2015, changing conditions at the site including the loss of LWD key pieces (red alder) through quick deterioration, and subsequent mobilization from the site has led to rapid channel migration and a degradation of channel forming processes observed in 2010. A 2015, rapid habitat survey identified LWD pieces to be 0.56 pieces/bankfull < 2 pieces/bankfull width (Table 2). Additionally, landowner sentiment toward the Program change in regards to the disconnected floodplain on the lower half of the project (Appendix 3 – Slide 5), allowing for much larger gains in floodplain than considered in 2011 Conceptual Restoration Plan.

Goal and Objectives: The project goals are to increase river channel complexity and improve floodplain connectivity.

Objectives:

- LWD key pieces to meet or exceed the 2 pieces/bankfull width
- removing confining feature at the top of the project and breach the berm in the middle of the project area (Appendix 3 – slide 9)
- Create and reconnect 0.93 miles of perennial side channel (Appendix 3 – slide 8)
- Augment 0.2 miles of high flow channels. An illustrated map of the project area is provided in Appendix 3 (Slide 8).
- The project will reconnect ~24 ac of floodplain currently disconnected.

Stage: The CCD completed preliminary designs in 2015, using funds through their Columbia County BPA project (#68607). The project is located on private property from ~ RM 21.5 – 19.4 (Figure 7) and implementation began in 2016, was continued in 2017 and will be finalized in 2018. Phase I completed in 2016 focused on increase side channel LWD key pieces and floodplain connectivity (Appendix 3 – Slide 10 & 11). The project involved the construction of a set back levee to protect existing agriculture while the LWD structure increased floodplain connectivity (Appendix 3 – slide 11 &12). Project design was completed for Phase III in the winter of 2017-18 and is going through final review with implementation planned in 2018. The design effort is funded through the CCD project 1994-018-06 and will be supplemented for final design and field fitting in 2018 by the Program.

Prior to this salmon recovery project, the landowner had participated in three previous projects to improve habitat conditions on his property for salmonids. The projects were on farm actions including conversion of irrigation to five pivots, which lead to the conservation and trusting of >0.5 cfs. The landowner put the low-lying areas where we are now working in the CREP and fenced both banks of the river keeping the cows out of the riparian.

Results: In 2017, Phase II (PA-28a) was implemented (Appendix 3 – Slide 5) building on what was completed in Phase I, which placed LWD key pieces in 0.52 miles of converted ephemeral channel creating pools and increasing floodplain connectivity (Appendix 3 – slide 10). Pre/post project LWD locations are illustrated in Appendix 3 (Slide 5) along with pool distribution. The project also targeted side channels, enhancing and reconnecting both ephemeral and perennial side channels (Appendix 3 – slide 7). Reconnected floodplain by removing gravel berms and developing pilot channels.

Two CHaMP site are located within the project reach with pretreatment data collected and habitat units' layers developed (Appendix 3 – Slide 20). The CHaMP sites were treated in 2017 but at the time of this summer post project data had not been collected, it is anticipated this will occur in 2018.

The following results were derived from the pre and post project rapid habitat surveys conducted by the SRSRB for the purpose of implementation monitoring and the development of an as built condition. A full map for the project area is illustrated in Appendix 3 (slide 5) showing the distribution of structures placed, changes in pool frequency, distribution and the changes in channel following the projects. A channel evolution time series for the project area was developed for the reach from historical aerial images and antidotal comments from the landowner to illustrate change though time going back to 2006 (Appendix 3 – slide 6 & 7). The time series is carried through into our envisioned channel condition following project completion in 2019 (Appendix 3 – slide 8). Our objective for a project site like this is similar to the one illustrated in the forested wandering gravel bed (Figure 2), where accommodations are made within the floodplain for landowner infrastructure, by setback levees.

In 2017, the post project rapid habitat survey found the following changes in habitat from pre project to post- project (Table 2, Table 3):

- LWD increased from 162 -564 pieces a 248% increase
- The construction of 60 structures increased pools 88%
- Pool area increase 48% prior to flows
- Side channel length increased by 49% (1.22 mi)
- Increased perennial channel length 48% (1.77 mi)

2016 Ongoing Project Concept Development Preliminary Design & Reach Assessments

PA-13 Project Concept Development and Preliminary Design (#73343)

Project Area 13 was identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) as a project targeted for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to cost ratio. The project is located between RM 39.2 and RM 40 (Figure 7) on the WDFW Wooten Wildlife Area just below the Tucannon Hatchery diversion weir and fish trap. The project site is confined by river levees and the Rainbow Lake impoundment on the east bank, and by the upstream Tucannon Hatchery Weir and the Tucannon Hatchery Rd on the downstream end (Appendix 4 - slide 1&2). River complexity and floodplain connectivity throughout the entire reach are impacted providing an excellent opportunity to increase salmon spawning and rearing habitat (Appendix 4 - slide 6).

The Tucannon Floodplain Management Plan Workgroup received capital funding ($2 million) in the 2016 biennium to redesign and minimize impacts on the Tucannon floodplain. Rainbow Lake (Appendix 4 – slide 5) was selected for early implementation, and initial concepts call for making the lake footprint smaller in the floodplain (Appendix 4 - slide 1 & 4) removing most of the protective levees increasing available space for increase channel complexity and increased floodplain connectivity. In 2017, WDFW initiated the changes to the impoundment by excavating a deeper and plans to remove the levees and construct the new levee to keep the river from entering the impoundment. This work is occurring separate from the PA-13 restoration design..

The Program has supported WDFW in concept development (2015) and preliminary design in 2016-17. Current conditions within the reach are characterized as a single thread, plain-bed channel with forced pool-riffle and local rapid sections (Anchor QEA Nov 2011). The channel is typically straight, wide, and contains little complexity (Anchor QEA 2011 Nov). A rapid habitat survey conducted by ELR identified the number of LWD key pieces within the reach to be one of the lowest surveyed, at 0.16 pieces/bankfull width. No side channels exist within the reach and leveed sections have rip rap with

large rock. The primary goal would be to increase channel complexity, providing spawning and rearing habitat and to produce some floodplain connectivity closer to naturally functioning condition. Due to infrastructure associated with the hatchery (diversion dam, lake, water pipeline, levees and road bridge) and access to the put and take mitigation fishery, complete (100%) restoration of the historic floodplain will not be feasible. However due to the number of spring Chinook that regularly spawn in this reach (Appendix 4 – slide 2), and the general poor spawning habitat available in the reach, we feel that restoration here remains a high priority.

The restoration goals and objectives for the project reach are conceptually described as follows:

Goal: 1). Increase channel complexity to provide adult holding, spawning and juvenile rearing habitat. 2). Increase floodplain connectivity and side channel length.
Objectives will be to place

- Build >24 ELJs for the purpose of developing channel complexity, developing pools and sorting bed load.
- Add bed load to augment the materials tha have been removed at the hatchery weir
- Build sufficient river bed roughness to hold and sort these materials
- Increase perennial length of the project reach ~5%
- Remove and use as gravel augmentation river berms 1,100’ of levee and berm.

Two CHaMP control sites are located within the project area targeted for restoration design in 2017. The preliminary design being prepared would add significant volumes of LWD, remove levees and produce bed lifts in each of the sites. The work conducted by ELR produces habitat unit map layers which indicate a low pool habitat ration compared to riffle and glide habitat within both reaches.

In 2018, a rapid habitat survey will be conducted to capture pre-project conditions on a larger scale for presentation in the 2018 report.

Conceptual Restoration Plan Update 2018

The CCD and Program are currently engaged in scope of work development for the purpose of updating Conceptual Restoration Plan (anchor 2011 Nov) to incorporate new data and habitat and populations within the basin since the development of the plan. As part of this effort the Geomorphic Assessment (Anchor 2011 April) will also be updated with new information on Chinook distribution and survival, current habitat conditions and positive changes in stream temperature and flow. It will be a priority of the process to summarize and evaluate completed actions and integrate the project work completed to so far into an updated Conceptual Restoration Plan. The updated plan will aim to be more holistic considering restoration actions that will benefit a wider range of native Tucannon species observed or known once to be abundant.

In 2011, the Conceptual Restoration Plan was extended to reaches 3-5 (RM 20 - RM 2) for the purpose of steelhead habitat restoration using the same habitat priorities and objective as the was used in reach 6-10 for Chinook priorities. Several of those projects had been tier 1 projects including PA-40 which was funded for implementation in 2013 by the SRFB and completed in 2013-14 by the CCD. To date the Program has not funded project in this portion of the river based on the Chinook spawning and rearing priorities developed in the 2011 Assessment. As part of the Conceptual Restoration Plan (Anchor 2011 Nov) update the Program will add new information regarding spring Chinook survival in these parts of the river and reprioritize projects and consider restoration actions for these areas in the middle and lower Tucannon.

The update will include a number of new chapters not previously included in the 2011 document including; adaptive management, maintenance, consideration of forest management practices, tributary influences and contributions and a lessons learned project performance review section. It is anticipated the update will be completed sometime in 2019 but will be well on its way to completed in 2018.

2017 Monitoring Efforts in the Tucannon Basin:

Columbia Habitat Monitoring Protocol (CHaMP)

We are using the Columbia Habitat Monitoring Program (CHaMP) protocol to collect habitat data (CHaMP 2014) for project effectiveness evaluation and change detection monitoring. CHaMP began in the Tucannon watershed in 2011 and a survey design was established using control and treatment areas as strata for distributing site locations. The Tucannon CHaMP study design uses the generalized random tessellation stratified survey (GRTS; Stevens and Olsen 2004) to distribute sampling effort across the Chinook domain in the treatment and control strata identified at the beginning of the project. After five years, all annual sites and panel sites plus an additional two years of panel sites have been sampled. Each year the sites surveyed are assigned a GRTS weight based on the stratum extent (km) / number of sites within stratum. The Program has been working with ELR the CHaMP contractor in charge of managing the project in the Tucannon in a summary and analysis report for work completed up to this point which is due to the SRSRB in March of 2018. We have been working closely with the contractor to distil products that can be useful in conveying progress and failure to implementers and landowners in the basin. The completed projects that currently have treatment monitoring sites within them include PA-3, PA-10, PA-11, PA-14, PA-15, PA-18, PA- 22, PA-23, PA-24, PA 26 and PA-28. At the time of the last monitoring report in 2016, the data used only captured work completed through 2014 that had received a flow post construction. In 2014, the program had only completed <40% of the implementation (Figure 19) that has been completed at the time of this rpeort. Preliminary results from CHaMP show that LWD, and pools have increased as well as deposition including mid channel bars. A full update on the CHaMP findings will be summarized in the 2018 Annual Report.

Action Effectiveness Monitoring (AEM),

Natural System Designs has been collecting action effectiveness monitoring data to detect change in both habitat and fish abundance at seven matched treatment control sites. In 2017, four of those sites had been treated including PA-3, 14, 24 & 26. The AEM project in the Tucannon has been able to coordinate with the CHaMP project where a restoration project fits within the AEM sample design they have been able to use the habitat measurements provided by CHaMP and collect fish data for those sites and intern they have collected habitat data in sites not covered under CHaMP. The AEM project is developing Habitat Suitability Index modeling for pre and post projects treatment expected fish abundance to make comparisons to observed abundance. Initial finding of the AEM project show higher use of restored habitat by Chinook than control areas.

WDFW Fish Monitoring & Life Cycle Modeling:

The WDFW Research Lab and fish program conduct fish in fish out, and basin wide spring Chinook redd surveys annually. In 2013, 14 and 17, WDFW built and tested an in basin model for juvenile spring Chinook survival. Tagging juvenile fish in the upper basin during the late summer early fall on and near the spawning areas prior to emigration from the system. Following tagging recaptures were observed at the 4 pittag stations located throughout the basin (Figure 29) and operated by the WDFW fish program. Preliminary observations from this study indicate over winter habitats extends lower into the basin than was previously known (Figure 28) below RM 20 down to the mouth of Pataha Cr (Cram 2017 January RTT). Additionally, survival in the reaches during winter is low (as low as 19%) much lower than fish rearing in other reaches upstream. This has prompted the Program to reevaluate the priorities in the Conceptual Restoration Plan in its current update. Preliminary information from the study indicates survival last winter during the flood flows was better than what occurred in the past supported by a relatively high parr density compared to previous years and those fish were far more abundant in areas where restoration had occurred relative to areas where it had not. This program has been coordinating with the CHaMP program in the identification of habitat units and reach delineation. We will continue to work with WDFW to interrupt what they are finding and adapt the program where necessary.

We feel that one of the best measures of effective habitat restoration will be improving returns of spring Chinook, however this is a longer term goal than often expected, by funders, the public and frankly ourselves. We all must use patients when predicting and measuring fish return as a measure in successful habitat restoration. Time will be required following restoration action before the habitat can improve (from 1-5 years) depending of flow and then fish need to respond to the habitat which will take generations to see population response. A model has been developed to display the timeline of when projects in the Tucannon have been implemented against brood years for Chinook (Table 5) charting their life history and when we should expect them to return. What the table illustrates is adult run returning last summer was spawned following the first project completed by the program in 2012. It is not likely at the time habitat had adjust greatly by then and we know that by 2014 we had implemented

about 40% of the work to date (Figure 19). The table also indicates the incremental impacts of watershed restoration, the time it takes to see change and the time fish response will take place. While fish are trying to rebound other impacts occur both natural and management, including the droughts in 2014 and 2015 (Table 5) and the peek flow in 2013-14. The 2013-14 flow was a winter peek, which was followed by apparent low survival of Chinook fry in 2014 (WDFW 2016). It is speculated that red scour lead to low survival as very little restoration had been completed. Other actions influencing the number of Tucannon spring Chinook redds adults or parr abundance on any given year include fish management, as an example in 2017 all the adults captured at the hatchery trap were retained for broodstock maintenance, impacting seeding of natural fish above the weir (Appendix 4 – slide 2) where > half of restoration actions have occurred to date. The impacts on fish distribution, fecundity, and proportion of jacks in the population are changing in the basin but the extent and long-term impacts are not understood. To understand the reaction of fish in the system we will first need to understand the management actions outside of habitat that are also driving populations.

2017 Project Performance Update "Rapid Habitat Survey Data":

In March 2017, the Tucannon River experience the highest sustained flow since the flood flows of 1996-97 (Figure 18). The flows were the result of early snowmelt caused by rain on snow followed by a quick warm up taking all the snow by the end of March. This is the first bed mobilizing flow our projects had experienced since the majority were built (Figure 19).

The Program has implemented a significant reach of the river with LWD structure (>15 mi) and the level of intensity varies from project to project (Figure 20), as well as the level of stability expected from structures. Stability expectations range from fully mobile materials (expected to move 1st flow) to extremely stable (last thing remain in the valley). In 2017, the Tucannon experienced the larges flood since 1996-97 flood (Figure 18), although not as large as the 1996-97 flood, the 2017 flood mobilized bed load at a significant level to engage and make significant change in the Tucannon Channel.

The time laps camera located on project area 10 captured a series of images through the winter of 2016-17 showing the extent of the flood and icing that occurs on and around structure (Figure 21). Overall we found structures built in the Tucannon to be quite stable when they were designed to be, and a survey of projects identified only 9 constructed structures out of >500 experience significant damage of loss. Three of these structures were ruined due to a high degree of wood racking on them during flood flow in excess of the design load, resulting in a very large log structure forming downstream (Figure 23). The project area was purposefully loaded with a lot of mobile wood to allow it to move within this low risk area in the top end of the project. We did anticipate materials would move and large structures would form, however we did not anticipate so little material would be left behind leaving a nearly 1000' reach without a jam (Figure 23). This lead to the modification of 2017 active project design including

additional stability features more frequently than previous every 400-500' to hedge against large loss. In the 2017 work window several whole tree log jams were placed within the reach to replenish wood densities.

We also had two project areas shed some logs off structures passing them downstream as well as two structures that came apart due to broken eyebolts. All 9 logs were collected downstream on a stable structure and did not cause damage, but did require corrective action in the 2017 work window. This was the only project area where materials left a project area, and not by coincidence were they the only two project we did not employ a catchers mitt group of structures. We have used the catchers mitt concept with success picking favorable areas with good floodplain to place very stable structures to capture materials while meeting a habitat objective. An example of one is the structure placed in 2015 on project area 15 (Figure 24) placed in the main channel adjacent to a levee removal and just upstream from private property. In 2017, the structure performed well capturing >40 trees and logs (natural and project LWD) engaging the floodplain and creating a meander jam with several deep pools.

Single log placement experience some damage (Figure 22) in 2017, with most of the damage occurring where the trees they were impinged in broke, were ripped out of the ground or undercut and recruited into the river. None of these outcomes was problematic with an exception of when placed log stem stems broke resulting in loss of the structure benefit. It appeared that the majority of broken stems occurred in grand or white fir, which will be taken into account in future designs.

We have been anticipating flood flows in the Tucannon Basin since the completion of our first project in 2012, and overall we had a very welcome and productive flow in 2017. All though the peek came on quickly on Mach 10 and took nearly all the snow pack by the end of March, nearly 6 week earlier than average, habitat benefited, and as a result fish did too. In the following section, we will cover changes detected by direct observation collected in rapid habitat surveys. Floods accelerated and expanded floodplain connectivity through channel bed aggradation, and by interaction with ELJs and creating channel length (Figure 25). Some areas had very high levels of deposition (Figure 26 & 27) increase bed elevation and creating broad side channel and wetland networks (Figure 27) in the adjacent forest areas (Appendix 5). The 2017 high flow worked with structure that had not been in place in the Tucannon for likely more than 100 years, and the results has been the expansion of flood extant, increase in side channels and increased perennial channel length (Table 3, Appendix 5).

The 2017, rapid surveys were completed on about half of the projects implemented between 2011 and 2016 by the Program not including 2017 project implementation previously covered in the report. Extra assessment effort was committed in 2017 following high flows in an effort to capture increased floodplain connectivity and channel complexity. Four of the project surveyed for channels, pools and LWD are illustrated and summarized in Appendix 5. In general, all project showed increase in pool frequency, pool area and not included in this summary it would seem pool depth and complexity (Table

2, Appendix 5). LWD key pieces tended to remain relatively stable within projects although key pieces had some redistribution, loss and recruitment. We have a very large number of LWD key pieces tagged within the basin and have done several follow up surveys to relocate pieces finding mobility from tens of feet to 1000s of feet; further analysis is needed and would be interesting.

Monitoring Summary:
In summary, the Program works closely with the individuals conducting monitoring in the Tucannon Basin allowing for continuous coordination amongst habitat entities making implementation and effectiveness monitoring observation available at a local level. This interaction may not be apparent from the outside looking in but from the inside looking out, it has enabled our program to adapt within season to make more informed restoration decisions. The first observation from project effectiveness has been the level of intensity in LWD treatment, beginning in 2011 LWD design did not call for the number of LWD pieces we now feel are necessary to drive geomorphic change, and through effectiveness monitoring we began those changes in 2014. It was observed early on that given the size and increasing intensity of the projects we needed more mobile racking material added to structures to make them less porous and more effective in driving change. In 2017, following high flows structure stability has been qualified with minimal structure loss and very little movement of material out of project areas, which has important for us to communicate to local landowners. This has validate our catcher's mitt approach to managing mobile LWD and increasing natural wood loading in privately owned river corridor and floodplain.

Observations from effectiveness monitoring has indicated changes in side channels abundance and increases in perennial channel length. We have learned that some projects are multi-layer endeavors that will take several treatments to achieve restoration objectives. A concept where examples are just starting to appear as reach scale changes observed following the 2017 flood. Project reaches initially treated for complexity only now exhibiting a geomorphic change (reduced incision and meander length), may be evaluated for more floodplain goals and objectives.

Monitoring has helped us focus on limiting factors, which will have the greatest benefits to salmonids and allows us to commit fewer efforts on those that are recovered and stable like fine sediments (Figure 30).

Observations in fish migration timing and habitat use has indicated varied survival rates within the basin and is leading us to better understand fish migration within the basin and will help us to re-focus restoration efforts. Fish monitoring coordinated with CHaMP and rapid habitat data is showing that Chinook densities are significantly higher in treatment sites compared to control sites and that pool habitats within those treatment site are highly selected. Not only is effectiveness monitoring aiding us in understanding the changes occurring in the environment, but also validating hat we expect to see.

Lessons Learned:

Over the past few years the Program has been trying to collectively get on paper some of the lessons learned in conducting large scale implementation Programs. I will try to capture some of that in the following section.

1. In setting up a large scale restoration program the Geomorphic Assessment and Conceptual Restoration plan used in the Tucannon has been very effective.
2. From the time the Assessment starts, you will need 2-3 years minimum before the first project implementation.
3. A project that requires engineered design will 3 years to complete. One year to conceptualize, and develop preliminary design, one year to permit and finalize design, stage and build and one year to close out and plant.
4. Free wood is not free! Make sure the materials you are receiving meet the specification of your needs and are of quality that will last in the environment.
5. A number of strategically placed stabile structures may help maintain and even distribution following flood events.
6. The placement of over stabile structures that are intended to rack materials before leaving a project area can be very effective.
7. During flood events visit your projects and meet with landowners to show them you're interested and there to help if things come unraveled.
8. Need to set expectation at a level that is achievable and plan on multiple treatments in some tough areas. It took 150 years to pull a lot of these areas apart its going to take a while to fix them.
9. Fish can respond slowly. Chinook have a long life history and it will take a couple of their generations to see effect at the population level.
10. Restoring river channel function and proving adequate floodplain is an effective way to restore Chinook habitat, improving riparian habitat, flow and temperature.

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