PA18.1 Floodplain Connectivity September 2020

Tucannon Habitat Programmatic 2020 Annual Summary

(January 2020– December 2020)

BPA Project #2010-077-00

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Acknowledgments:

A special thanks goes to the Tucannon Programmatic partners, it's through our collective hard work and dedication to our mission that measurable habitat improvement is achieved. We need to thank Tucannon landowners for having faith in our science based process and for committing to the goals and objectives of restoring habitat and preserving salmon and steelhead for future generations.

Implementers:

Columbia Conservation District
Confederated Tribes of the Umatilla Indian Reservation
Nez Perce 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:

Contents

Introduction:

The Tucannon River Programmatic Habitat Project #2010-077-00 is a restoration "Umbrella" project focusing on improving Snake River spring Chinook habitat in the Tucannon River, located near Dayton, WA (Figure 1). This annual report summarizes the habitat restoration projects and associated restoration support funded, partially or entirely, through the Tucannon Programmatic Habitat and the Programs implementation partners (Program) for the calendar year of 2020. The primary funding sources for this report include; Bonneville Power Administration (BPA) and Washington State Salmon Recovery Funding Board (SRFB). Most projects include some level of cost share, both in-kind and cash, which are not included in this report. The Program is managed by the Snake River Salmon Recovery Board (SRSRB) and consists of the following partnership: the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Columbia Conservation District (CCD), Pomeroy Conservation District (PCD), Nez Perce Tribe (NPT), U.S. National Forest (USNF) and the Washington Department of Fish and Wildlife (WDFW). The Program has worked as a group since 2012, starting with the implementation of the Tucannon Conceptual Restoration Plan, Reaches 6 to 10 Phase II (Anchor QEA, 2011) (2011 Plan). In 2020, the Program initiated two restoration projects, completed implementation on one LWD project, and supported the development of three conceptual/preliminary designs for implementation during the 2021-2023 construction years. Collectively, the Program has funded 16 projects that were identified and prioritized in the 2011 Plan and coordinated restoration actions on 5 other project areas (Figure 2).

Because of the sheer magnitude of the work being completed in the Tucannon collectively, and the need to move lower in the Tucannon Basin to work on overwinter survival issues for Tucannon spring Chinook. The Program began the process of updating the existing 2011 Plan, this restoration plan update starting in 2018. The updated Conceptual Restoration Plan (2021 Plan) (Anchor QEA, 2021) has now been completed and will be used in the future to identify and select projects based on the updated goals and objectives needed to increase survival for Tucannon spring Chinook. The Program is currently using the results of the 2021 Plan to adapt and modify implementation projects to ensure future projects are being completed using the most up-to-date science.

The SRSRB serves as the southeastern Washington Regional Organization and Lead Entity for salmon recovery in the Washington State portions of the Snake River and Walla Walla River watersheds. The SRSRB supports the implementation of the Salmon Recovery Plan for SE Washington (SRSRB 2011), by guiding regional SRFB funding to high priority habitat restoration projects based on goals and objectives, as well as, providing scientific technical support as needed to program implementers. The SRSRB provides a regional perspective for salmon

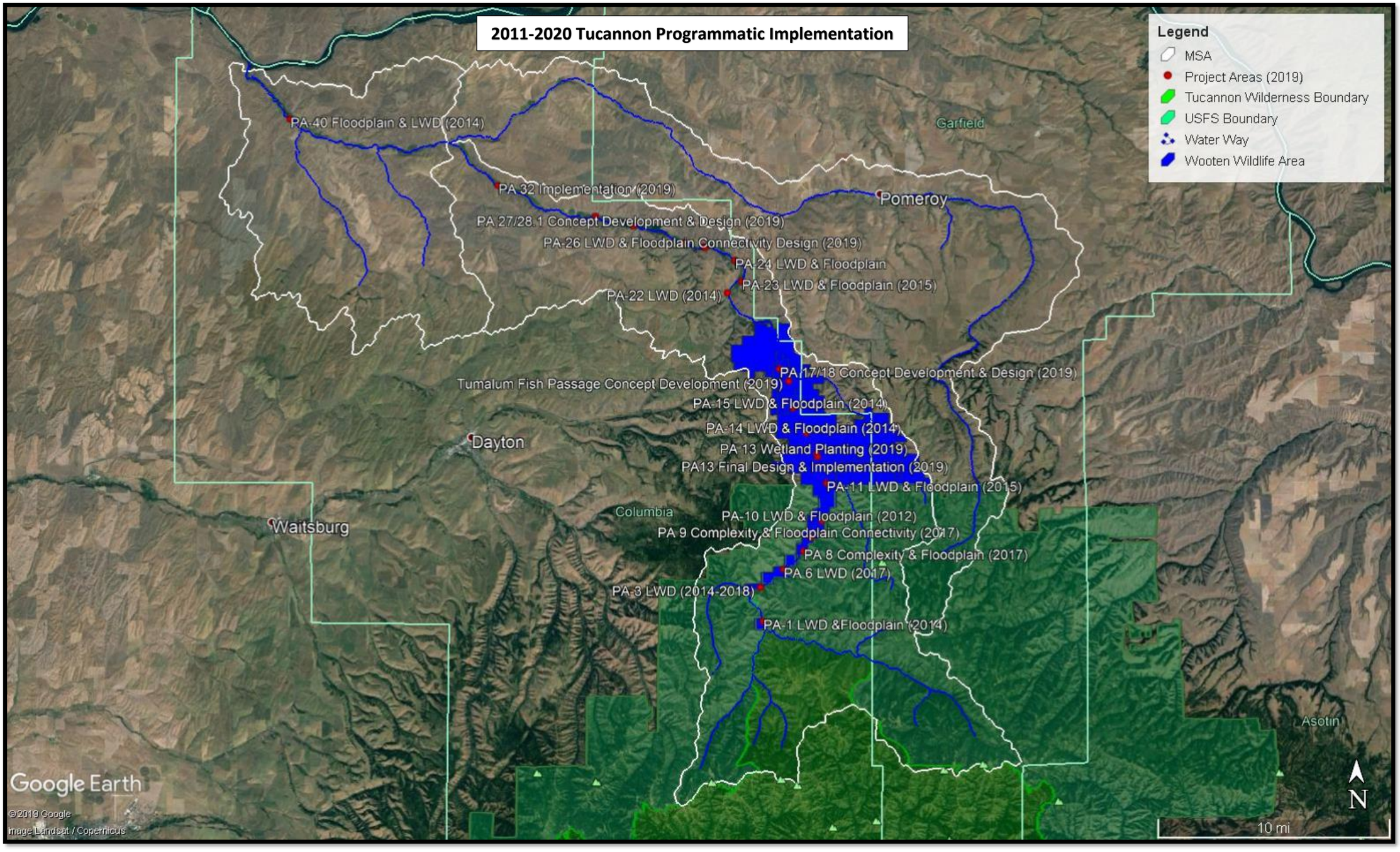

Figure 1: Distribution of habitat restoration project designed and implemented with support of the Tucannon Habitat Programmatic (2010-00-077) 2011-2020.

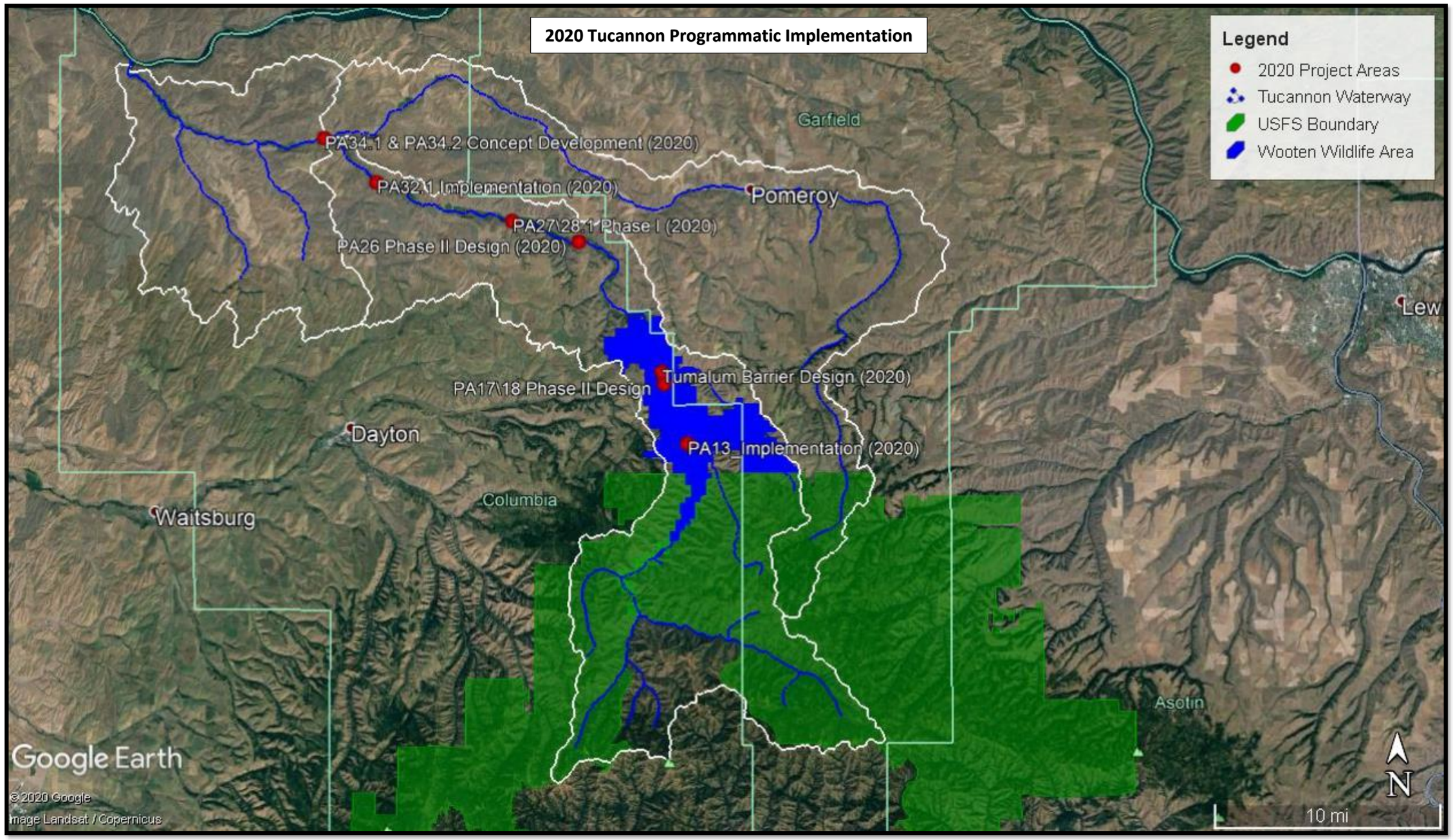

Figure 2: Google Map of the Tucannon basin, from the headwaters in the Blue Mts. (lower) downstream to the Snake River (upper) located in SE Washington east of the City of Dayton. The red dots indicate the approximate locations of the two Programmatic supported projects implemented, one initiated and two design projects and the two project concepts implemented in 2020.

recovery, by participating in salmon recovery efforts and issues throughout the State of Washington. The SRSRB not only works to develop and maintain partnerships in restoration, but also participates in monitoring and land management issues. Lastly, the SRSRB provides a sounding board (Table 1) for public input and involvement in salmon recovery in southeastern Washington, both with respect to floodplain restoration projects and building the baseline support need for large-scale restoration necessary to increase spring Chinook in the region.

Table 1. Active Members of the Snake River Salmon Recovery Board for the year of 2020.

Member	County	Affiliation
Michael Largent	Whitman	Commissioner
Jon Jones	Whitman	Citizen
Gary Ryan	Whitman	Citizen
Justin Dixon	Garfield	Commissioner
Bill Bowles, Chair	Garfield	Citizen
Todd Kimball	Walla Walla	Commissioner
Larry Hooker	Walla Walla	Citizen
Brian Shinn	Asotin	Commissioner
Brad Johnson	Asotin	Citizen
Jerry Hendrickson	Asotin	Citizen
Marty Hall	Columbia	Commissioner
Roland Schirman	Columbia	Citizen
Don Jackson	Columbia	Citizen
Gary James	Tribal	CTUIR
Kris Fischer	Tribal	CTUIR
John Foltz	Staff	SRSRB
Kris Buelow	Staff	SRSRB
Ali Fitzgerald	Staff	SRSRB

Tucannon River Habitat Characteristics and Limiting Factors:

Historically, the Tucannon River watershed was converted from an anabranching channel form (Figure 3) existing on a narrow forested valley bottom (Hecht, 1982) to a single channel form by the development of commercial timber harvest, followed by further straightening to assist livestock and agricultural operations. Originally, the anabranching river planform would have had multiple channels separated by stable, forested islands that divide flows up at bankfull discharge, with floodwaters accessing the floodplain more frequently than today. During the 1960's following a number of flooding events in the Tucannon Valley, that led to a significant loss of property and infrastructure (Johnson 1995) the US Army Corps of Engineers (USACE) straightened and leveed the channel, increasing the conveyance capacity, and confining the river to a single channel at the valley margins. From 1937 through 1978, the length of the main channel of the Tucannon River had been reduced between 7- 20% depending on the reach, and

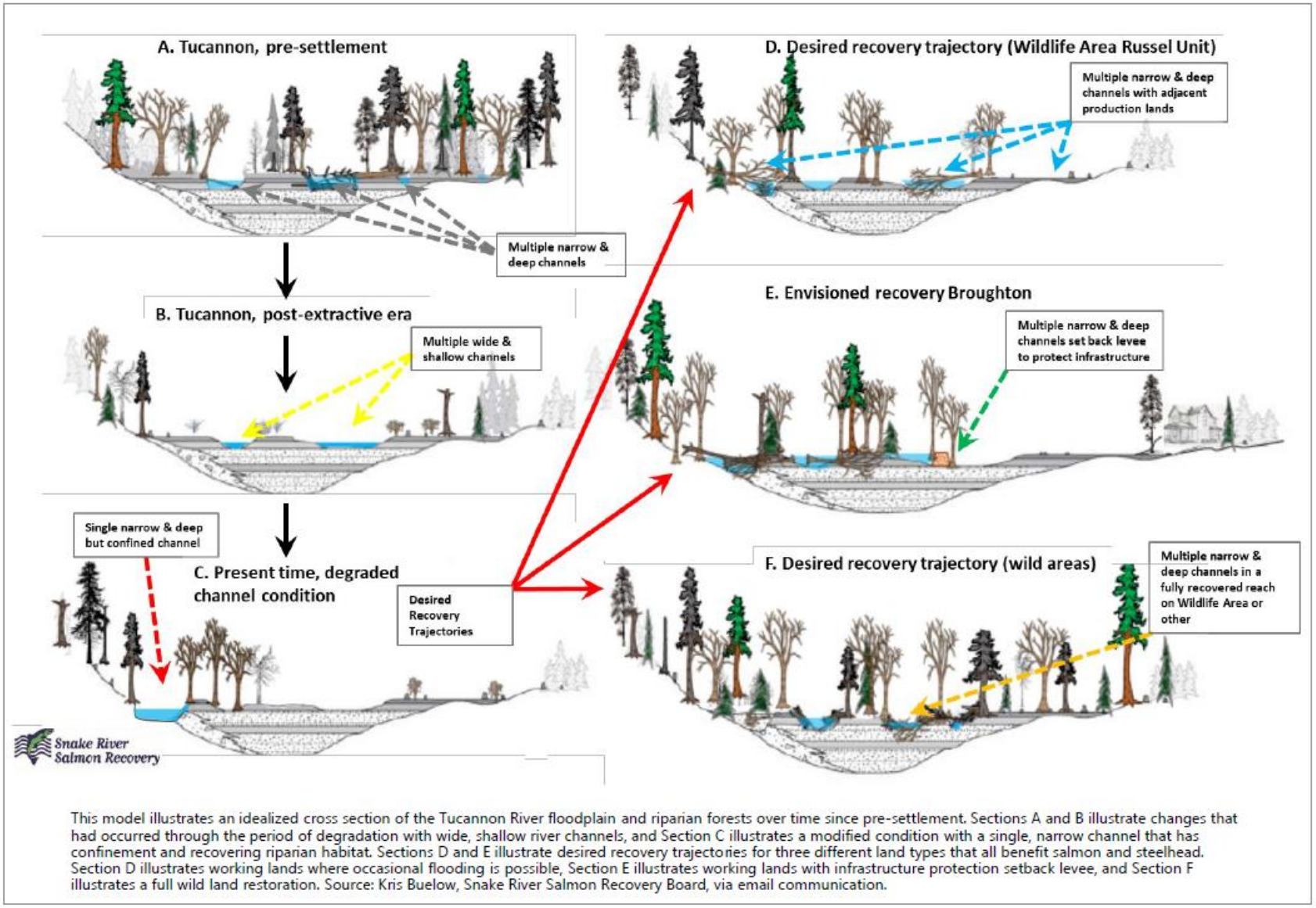

Figure 3. Tucannon Conceptual Stream Model

possibly as much as 50% of the Tucannon' s total river length was lost through channelization and further confinement (Hecht, 1982). Today much of the Tucannon River is stuck in a state of arrested degradation or what is referred to as Stage 3s in the Stream Evolution Model (Cluer and Thorne, 2013) (Figure 4). Ultimately, rivers in this stage of channel evolution are less productive biologically because of lack of floodplain connectivity and increased stream velocities that require higher energy to forage in these channel types.

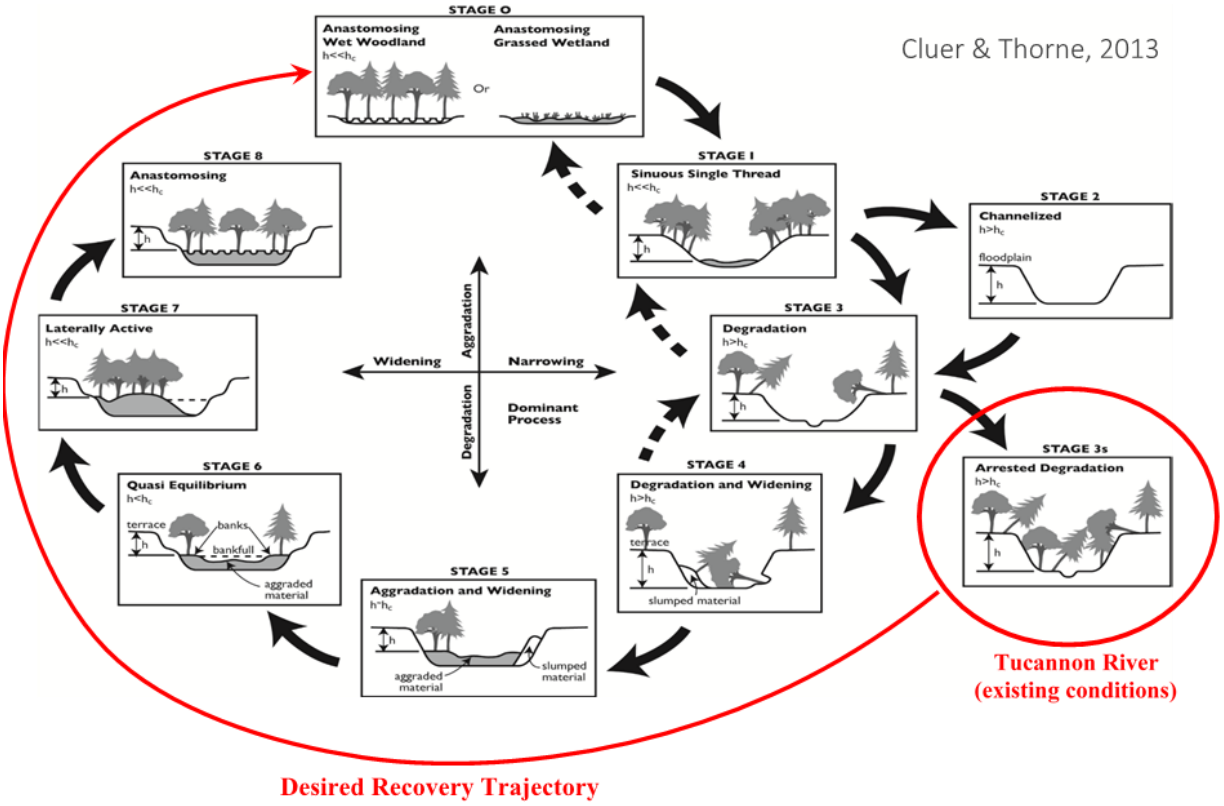

Figure 4. Stream Evolution Model (Clure & Thorn, 2013) illustrating the current channel shape for the most severely impacted reach of the Tucannon in red and the desired trajectory for recovery.

Once the Tucannon River was confined and straightened, velocities in the river channel increased, which led to further channel incision through the floodplain. These newly formed incised channels further increased confinement and resulted in fundamental problems, which greatly decreased channel complexity and its associated ecological benefits. Channel incision, confinement, and disconnection between the channel and floodplain contribute to a variety of secondary impairments in the physical and ecological functioning of the river including spatial and structural simplification of the channel and floodplain, lowering of the water table, increased stream velocities, impairment of riparian forest communities, and a reduction in overall aquatic habitat.

The degradation of physical and ecological processes in the Tucannon River caused three very common problems for salmonids typically associated with confined and incised channels: (1) diminished velocity refuge, (2) minimal food production and availability, and (3) redd scour (Cluer, 2019). Stage 3s rivers with a high conveyance capacity undergo a decrease in velocity refuge when discharge increases, limiting food production and requiring high energy expenditure for foraging salmonids (Facey and Grossman, 1990; Sommer et al., 2001a; Kemp et al., 2006; Jeffres et al., 2008; Katz et al, 2017).

In 2020, the Program completed an update to the Tucannon Conceptual Restoration Plan (2021 Plan) (Anchor QEA 2021) in which an evaluation of current habitat conditions, in the Tucannon basin identifies the lack of flood plain connectivity and channel complexity as the limiting ecological factors for salmon and steelhead. The plan refocuses restoration efforts on reconnecting floodplains through levee modification, and the reduction of incision as the primary actions in restoring habitat unit diversity and ecosystem resilience necessary for salmonid survival. These two limiting factors are identified in the Salmon Recovery Plan for SE WA (SRSRB 2011) and by the Program. A progression of how goals and objectives of past and previous plans and current goals and objectives of the Program and the 2021 Plan relate to salmon life histories and expected ecological out comes from restoration (Table 2).

Project Implementation Monitoring & Adaptive Management

Beginning in 2012, the Program collected rapid-habitat data on instream restoration projects implemented in the Tucannon, for the purpose of project implementation and effectiveness monitoring. This effort was initiated for the purpose of providing habitat metric data to inform our goals and objectives in our various contract and program reporting. Early during the development of the protocol a high degree of coordination with the Tucannon Columbia Habitat Monitoring Protocol (CHaMP) and Asotin Intensively Monitored Watershed (IMW) program lead to the adoption of modified methods and protocols used currently in the Tucannon basin. The goal of the continued monitoring effort is to significantly limit the number of metrics collected during an individual survey so that an entire project could be surveyed (~1-2km) over a relatively short period of time. The rapid-habitat approach was taken to limit the number of hours necessary to collect meaningful information on the primary metrics driving limiting factors in the basin. This approach allowed the SRSRB to continually survey a relatively large number of project areas over a longer duration of time from 2014 to the present.

Rapid-habitat metrics were derived from the 2011 Plan (Anchor QEA, 2011), identifying the primary limiting factors; degraded channel complexity and limited floodplain connectivity, which focused on attributes that are easily measurable and repeatable in the field (Table 3).

Table 2. Summary of Life History and Limiting Factors and how restoration goals and objectives relate across the Sub-basin Plan 2004, Salmon Recovery Plan SE WA (2011) the Programmatic (2011) and the 2021 Plan.

Salmon Life History Stage	EDT Limiting Factors [1]	Key Limiting Factor [2]	Cause of Problem	2011 Salmon Recovery Plan Obj. [3]	2011 Programmatic Objectives [4]	2020 Prioritization Goals [5]	2020 Prioritization Objectives [5]	Expected Ecological Response [5]	Assessment Method [8]
Spring Chinook Egg-Fry	Sediment Load [A, a] Temperature [b] Channel Stability [C] Habitat Diversity [D]	Large Wood Log Jams Confinement [F] Riparian Function Key Habitat (pools) Temperature	Channelization, loss of floodplain and riparian, loss of channel complexity and function	Riparian: > 40-70% max LWM: > 1 key piece/channel width Confinement: < 20-50% of Length Temperature < 4 day > 72°F Embeddedness: < 20% [G]	OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-6 [H]	Increase complexity at low-winter flows, during spring and winter peaks Reconnect abandoned floodplains Increase retention and storage of bed load gravel	Flow Complexity to levels of current 90th percentile of basin for low-winter and mean spring/winter peaks 75% of the available floodplain is connected at the 2-year event > 15% pool area	Improved habitat conditions for summer and fall juvenile rearing and winter refugia Improved extreme event refugia, riparian growth, wood material availability, bedload material availability juvenile rearing	Channel complexity at low-winter, mean-winter, and 1-year flow Channel aggradation floodplain potential, encroachment removal, and total floodplain potential Excess transport capacity, connectivity, and complexity analysis
Spring Chinook Fry-Smolt	Temperature [B] Channel Stability [C] Habitat Diversity [D] Key Habitat [E]	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature	Channelization, loss of floodplain and riparian, loss of channel complexity and function		OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-5				
Spring Chinook Adult	Temperature [B] Habitat Diversity [D] Key Habitat [E]	Large Wood Log Jams Riparian Function Key Habitat (pools) Temperature	Loss of channel process and complexity		OBJ-1, OBJ-3, OBJ-4, OBJ-5	Improve quantity and quality of pools	> 15% pool area	Improved adult holding and cover	Pool frequency analysis and excess transport capacity analysis
Steelhead Egg-Fry	Sediment Load [A, a] Temperature [b] Channel Stability [C] Habitat Diversity [D] Key Habitat [E]	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature Sediment [A]	Channelization, loss of floodplain and riparian, loss of channel complexity and function	Riparian: > 40-70% max LWM: > 1 key piece/channel width Confinement: < 20-50% of Length Temperature < 4 day > 72°F Embeddedness: < 20% [G]	OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-6 [H]	Increase complexity at low-winter flows, during spring and winter peaks Reconnect abandoned floodplains Increase retention and storage of bed load gravel	Flow Complexity to levels of current 90th percentile of basin for low-winter and mean spring/winter peaks 75% of the available floodplain is connected at the 2-year event > 15% pool area	Improved habitat conditions for summer and fall juvenile rearing and winter refugia Improved extreme event refugia, riparian growth, wood material availability, bedload material availability juvenile rearing	Channel complexity at low-winter, mean-winter, and 1-year flow Channel aggradation floodplain potential, encroachment removal, and total floodplain potential Excess transport capacity, connectivity, and complexity analysis
Steelhead Fry-Smolt	Temperature [B] Channel Stability [C] Habitat Diversity [D] Key Habitat [E]	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature	Channelization, loss of floodplain and riparian, loss of channel complexity and function		OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-5				
Steelhead Adult	Habitat Diversity [D] Key Habitat [E]	Large Wood Log Jams Riparian Function Key Habitat (pools) Temperature	Loss of channel process and complexity		OBJ-1, OBJ-3, OBJ-4, OBJ-5	Improve quantity and quality of pools	> 15% pool area	Improved adult holding and cover	Pool frequency analysis and excess transport capacity analysis
Fall Chinook Egg-Fry	Sediment Load [A] Temperature [B] Habitat Diversity [D] Key Habitat [E]	Large Wood Log Jams Confinement Riparian Function Key Habitat (pools) Temperature Sediment [A]	Channelization, loss of floodplain and riparian, loss of channel complexity and function	Riparian: > 40-70% max LWM: > 1 key piece/channel width Confinement: < 20-50% of Length Temperature < 4 day > 72°F Embeddedness: < 20% [G] Note: The Recovery Plan identifies these objectives as habitat recovery for the Tucannon downstream of Pataha Creek but not directly for fall Chinook.	OBJ-1 OBJ-2 OBJ-3 OBJ-4 OBJ-6	Increase complexity at low-winter flows, during spring and winter peaks Reconnect abandoned floodplains Increase retention and storage of bed load gravel	Flow Complexity to levels of current 90th percentile of basin for low-winter and mean spring/winter peaks 75% of the available floodplain is connected at the 2-year event > 15% pool area	Improved habitat conditions for summer and fall juvenile rearing and winter refugia Improved extreme event refugia, riparian growth, wood material availability, bedload material availability juvenile rearing	Channel complexity at low-winter, mean-winter, and 1-year flow Channel aggradation floodplain potential, encroachment removal, and total floodplain potential Excess transport capacity, connectivity, and complexity analysis
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Fall Chinook Adult	Temperature [B] Habitat Diversity [D] Key Habitat [E]	Large Wood Log Jams Riparian Function Key Habitat (pools, spawning riffles) Temperature	Loss of channel process and complexity		OBJ-1, OBJ-2, OBJ-3, OBJ-4, OBJ-5, OBJ-6	Improve quantity and quality of pools	> 15% pool area	Improved adult holding and cover	Pool frequency analysis and excess transport capacity analysis

Table 2. Continued

Notes:
[A] – Fine sediment on redds is no longer an impact to salmonid redds upstream from Patah Creek and is identified as being only an active limiting factor downstream of Patah Creek.
[a] – Diminished or disrupted bed load in some reaches has led to insufficient gravel to support riffle and pool development.
[B] – Water temperature that is too cold or too warm can reduce the survival of all salmonids in the Tucannon River and is the result of poor river channel shape and loss of connection to the floodplain, leading to reduced hyporheic flow in channel and return flow from floodplain storage.
[b] – Egg-to-Fry stage are primarily impacted by low water temperature in the Tucannon River; for example, ice impacts to redds and larvae.
[bb] – Warm temperatures increasing moving downstream below the Tucannon Fish Hatchery Weir and more so below Marengo, WA.
[C] – Channel stability in the Tucannon River is best described as the plane bed channel with bed armor and entrenchment, which has led to increased stream power and bed scour and loss of floodplain connectivity and confinement.
[D] – Habitat diversity in the Tucannon River is the extent of habitat complexity within a river segment, including side channels at base flow up to ~ 5-year return flow, pools, riffles, and off-channel habitats on the floodplain.
[E] – Key habitat is referring directly to the number of pools, spawning riffles, and off-channel rearing habitats including large wood log jams.
[F] – Floodplain and river meander confinement.
[G] – Embeddedness is a restoration objective for the lower Tucannon River below Pataha Creek and is not currently limiting above Pataha Creek.
[H] – The programmatic objective for embeddedness < 20% for all reaches above Pataha Creek is currently being met.
[1] – The limiting factors used in this table were taken from the Salmon Recovery Plan for SE WA (2011) Chapter 5 (Table 5-1).
[2] – The key limiting factors for the Tucannon River are listed in full detail in the Salmon Recovery Plan for SE WA (2011) Chapter 5 (Table 5-2).
[3] – A summary table of restoration objectives is provided in the Salmon Recovery Plan for SE WA (2011) Chapter 6 (Table 6-2).
[4] – For a full description of the Programmatic Restoration objectives, see Table 1-1 in this report.
[5] – A list and full description is provided in Table 1-2 in this report.

Table 3. Rapid habitat metrics collected for projects conducted under the Program 2014 through 2020.

Metric	Units	Expected Ecological Goal
Large Wood Debris	# of pieces >6m long >0.3m dia	Improved habitat condition for summer and fall juvenile rearing and winter refugia
Pools	Frequency, area & maximum depth	Improved adult holding and juvenile cover
Perennial Side Channels	Length, width & volume at base flow	Channel complexity at low winter and summer flows
Ephemeral Side Channels	Length, width & volume at base flow	Floodplain connectivity and channel connectivity a low winter flows

In 2021, the Program began to formalize habitat monitoring protocols in the absence of an outside large scale monitoring effort (i.e. CHaMP). This has led to the identification of a number of relatively quick field measurements which can be used to better track floodplain connectivity and channel complexity.

Rapid-habitat surveys are conducted at base flow (~100 cfs – 60 cfs) as measured at the highest real-time stream gage in the Tucannon River, which is at Marengo (WDOE stream gage https://fortress.wa.gov/ecy/eap/flows/station.asp?sta=35b150) during the day of the survey. Each project funded or implemented under the Program has a survey for the entire project reach conducted pre & post-implementation, with an as-built survey completed in the late summer after construction is completed. Pre-project surveys are used in the development of project concepts and designs, and are used to provide the majority of background information toward project development and permitting. The pre-project surveys in combination with hydraulic models (HEC-RAS) developed during previous topo-bathymetric LiDAR data collections are used in the development of project area specific goals and objectives. As-built surveys are used locally by the Program to complete contract reporting on deliverables to the BPA Pisces database at CBfish.org, SRFB Prism and CTUIR CDMS project reporting data bases. The rapid-habitat data support the project information used in reporting project implementation in the State of Washington Salmon Recovery Portal which populate habitat metric in the WA State of the Salmon Report and help inform the NOAA 5yr Status updates. Follow up surveys are planned on a two year recurring cycle, meaning a minimum of two winter flow periods after the as-built survey is completed. This informs project funders and helps project implementer's track project longevity while meeting contractual requirements and project effectiveness for the purpose of informing the Program's adaptive management approach. Follow up surveys are also conducted following major high flow events, (flow events exceeding the 5 yr return flow), or when visual observation warrant a follow up survey to capture unusual or interesting conditions that might require additional restoration/maintenance actions.

In addition to the rapid-habitat surveys, the program is using large scale GIS techniques such as geomorphic change detection (GCD) to inform adaptive management in the Tucannon River (Wheaton et al., 2010a; Wheaton et al. 2010b; Wheaton, 2008). GCD was first used in the Tucannon by CHaMP and AEM programs, to support adaptive management actions on the Tucannon River over the last decade. To replace the loss of CHaMP and AEM programs, the Program is collecting and using topo bathymetric LiDAR data (QSI, 2017 and QSI, 2020). These datasets use green lasers to penetrate the water surface at shallow depths to produce a high-resolution topographic map of the river channel and floodplain over the entire Tucannon River. A full description of how the Program is planning on using topo-bathymetric LiDAR to track channel complexity, floodplain connectivity and excess stream power can be viewed in the 2021 Plan (Anchor QEA, 2021) @ https://snakeriverboard.org/reports/tucannon-river-documents/.

Collecting topo-bathymetric LiDAR data following significant flow events (>5yr return interval), allows continued assessment of geomorphic change in the Tucannon River. Using LiDAR instead of CHaMP and AEM, allows the Program to cover the whole basin at a much larger spatial scale and a fraction of the cost (time and money). This information in combination with the rapid habitat metrics described above help to improve the Program's understanding about how the different reaches of the Tucannon respond to different treatment techniques over various time scales and flow events. Large scale Tucannon LiDAR collection assists the Program with monitoring progress toward the goals and objectives outlined in the Updated 2021 Plan.

Topographic datasets collected for the Tucannon River in 2017, combined with rapid habitat Survey data, inform the analyses that were conducted as part of the 2021 Plan. Results of the updated analyses show that large portions of the Tucannon River remain below the desired targets for floodplain connectivity and channel complexity. These combined data also show minimal geomorphic change and minimal increases in habitat complexity in areas where restoration treatments were not aggressive enough in approach. Data and analyses continue to support the need for more aggressive restoration treatments that increase floodplain connectivity and channel complexity over shorter timeframes. A more aggressive approach will hopefully create more durable restoration outcomes on the Tucannon River moving forward.

In the fall of 2020, the Program supported CTUIR in the collection of a second topo-bathymetric LiDAR dataset which is currently undergoing QA/QC analysis and is intended as a GCD comparison to the 2017 data set used in the 2021 Plan. As part of the 2021 Plan, methods to automate the development of habitat metrics for floodplain connectivity and channel complexity were developed for the spatial data sets completed in the 2021 Plan (Anchor QEA 2021). It is the intention of the Program to use this approach to track habitat change, combined with rapid habitat surveys to fill in the interim periods between LiDAR surveys to inform progress towards Tucannon Basin goals and objectives.

2020 Implementation:

The Program is focusing efforts and leveraging resources to complete the highest priority projects identified in the 2011 Plan and now transitioning into the 2021 Plan. To date the Program implemented restoration actions on all or part of 17 (Figure 1) of the initial 44 project areas identified in the 2011 Plan. The following section outlines in detail the work implemented by the Program in 2020 (Figure 2).

The project case summaries outlined in the following section of this report are supported by habitat data collected and synthesized by the Program collected during design, pre and post project surveys. Results of these surveys are used in combination with the topo-bathymetric LiDAR and modeling results in the 2011 Plan (Anchor QEA, 2011) and now the 2021 Plan (Anchor QEA, 2021) to develop project reach objectives (Reach Obj.), pre-project existing conditions and a post project condition where implementation actions were conducted in 2020.

Metrics for these time periods are provided in the tables (example Table 4) associated with each project.

Project reach objectives are developed for each project area based on recommendation identified in the 2011 Plan (Anchor QEA, 2011), observation made in the field during design surveys and existing infrastructure and or landowner constraints. Reach objectives are produced for perennial and ephemeral side channel length and will be reported as a change in length pre-project, post project as-built and in future follow up surveys. This metric relates to the channel complexity metric identified in the 2021 Plan and will be used as an interim data point between topo-bathymetric data surveys to inform adaptive management. The number of LWD key pieces is a restoration target set at >1 piece per bank full width in the Salmon Recovery Plan for SE WA 2011 and updated to >2 key pieces per bankfull with in the 2011 Conceptual Restoration Plan, and was defined and a piece being >6m long and 0.3m dia. in the 2021 Plan. LWD abundance in the Tucannon is a key driver in the development of channel complexity channel and floodplain connectivity, and is enumerated and classified into jams or other habitat forming features. Lastly, simple pool metrics are collected as they are a good indicator of floodplain connectivity and channel complexity; including frequency, estimated area, maximum depth, forcing mechanism and pool complexity (pool cover).

The tables provide data form the surveys which have been conducted at the time of this report in addition to schedule upcoming surveys which are scheduled through the first 2yr reoccurring survey.

Partner – WDFW Projects

Project Title: PA13 Levee Removal and Channel Reconfiguration Final Design & Site Preparation

Implementer: Washington Department of Fish & Wildlife

BPA Programmatic Funding (2010-077-00): In FY19, $1,115,000 (#74314 REL 85), In FY18, $93,666 (#74314), In FY17, $58,500 (#75493), In FY16, $69,669 (#72044).

Matching Funds: WDFW received Washington State Capitol Funding to remove levees surrounding Rainbow Lake increasing available floodplain to PA13, the WDFW contribution toward the project through levee removal is $275,000 cash. WDFW also received a SRFB grant in FY19 for $399,991 (19-1495) to be used for additional stream restoration implementation.

Project Timeline: Concept Development 2017, Design 60%-90% 2018, Final design funding site preparation and material sourcing 2019/20, instream work Phase I started in 2020-21 with wetland planting and site preparation, and Phase II instream and riparian planting 2022

Location: Tucannon River mile 39 to river mile 40; Start Lat/Long 46.319376 / -117.664189 End (Lat/Long) 46.309638 / -117.657055 (Figure 2).

Recovery Expectations: Due to the degraded nature of this project reach (Figure 5), and the aggressive active nature of the project design including levee removal and channel reconfiguration, it is anticipated that as-built conditions will be very close to the anticipated design objectives. Winter freshets and high flow are anticipated to redistribute and sort gravel and cobble to increase spawning habitat quality over a 2-5 yr time frame.

Priority Populations & Life Stages: All life stage for Snake River ESU Spring/Summer Chinook (Threatened), all life stages for Snake River DPS Summer Steelhead (Threatened) and adult through juvenile rearing for Columbia River bull trout.

Potential Future Actions: Following implementation at this project efforts will be made to monitor gravel deposition, side channel connectivity and floodplain connectivity/riparian health. In the event monitoring efforts indicate a deficiency in meeting objectives additional gravel and LWD loading may be implemented as part of the management strategy.

Project Goals & Objectives: The goal for this project is to increase floodplain connectivity and channel complexity in the 1 mile reach between the Tucannon Hatchery weir and the Hatchery Bridge.

Short Term Objectives: Increase channel roughness and LWD structure within the one mile reach, for the purpose of reducing stream power currently in excess (Anchor 2021).

- Construct 31 ELJs and supplement gravel and a cobble materials to raise bed elevation.
- Place LWD complexity to achieve a minimum of 2 pieces per bank full width over a 10 year average.

Short Term Objectives: Increase floodplain connectivity to the one mile reach. This objective will focus on habitat recovery.

- Improve floodplain connectivity and reduce excess stream power by removing approximate 499 m of river levee.
- Improve channel complexity and reduce excess stream power by reconnect > 1600 m of isolated side channels at base and mean winter flows
- Increase habitat resilience and riparian function by reconnecting >21 acres of new floodplain at or below the 2 yr return interval.
- Provide rearing habitats and increase habitat diversity and connectivity by connecting ~3 acres of off channel wetland habitat.

Long Term Objective:

- Reestablish floodplain associated habitats and benefits as identified in the 2021 Plan (Anchor QEA, 2021)
- Improve adult holding pools (>1m deep) for spring Chinook and steelhead
- Improve spring Chinook spawning habitat by reducing excess stream power and increasing residual pool depth and creating pool tail outs.

Project Background and Summary:

Background: Project Area 13 was identified as a high priority restoration project in the 2011 Plan (Anchor QEA, 2011) and was prioritized in the plan for early implementation and approved for funding by the Regional Technical Team and the Salmon Recovery Board, in 2019. The project reach is characterized as being highly confined by river levees protecting Rainbow Lake and the Tucannon Fish Hatchery infrastructure. The river through the reach had been straightened and became incised below the hatchery fish trap reducing channel complexity (Figure 5). The reach is located in the center of the Tucannon spring Chinook spawning reach and while a relatively high proportion of redds are observed within the reach annually, habitat conditions are poor, with few deep pools for adult holding and juvenile rearing habitats are limited as identified during pre-project design surveys. Due to poor floodplain connectivity and low channel complexity the planned project will focus on expanding floodplain through a combination of removing confining levees, reducing channel incision and connecting disconnected side channel. The reach objectives for this project area were identified in the 2011 Plan and were supported and refined through data collected during the pre-project rapid habitat design survey in 2020, which identified >1,200 m (Table 4) of disconnected perennial and ephemeral side channel that could be available for reconnection through removing confining features and reducing channel incision. Although mean pool depth is currently meeting the restoration objective that value is a result of a couple very deep pools that formed

in the 2020 flood and while pool area and frequency remain below the objective for pools (Table 4).

In 2016, WDFW initiated the removal and set back of the Rainbow Lake dam, which was confining river meander and floodplain connectivity, increasing available disconnected floodplain by >3.6 acres. These acres were previously lake bed (Impoundment) and remained behind ~925' of river levee until 2018 when the levee/dam was removed by WDFW (Figure 6). The removal of the Rainbow Lake dam allowed for the creation of wetland habitats in the footprint of the displaced reservoir. In 2019, the Program worked with WDFW in the establishment of this wetland through the shaping of the landform (WDFW match) and planting of wetland plant species (Figure 7).

Table 4. Project Area 13 project reach objectives and pre-project survey rapid habitat metric results collected June 30, 2020. The table provides the summery results of rapid habitat surveys conducted to capture pre-project post project conditions with future surveys identified as 2 year follow up on post project conditions. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m^2)	Mean Depth Range (m)
Reach Obj.	N/A	800	800	>180	31	none	>14	2,646	1.0-1.5
Pre-project (2020) Phase I & II	1.26	220	268	28	3	8	8	874	1.0-1.5
Pre-project (2021) Phase I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Post-project (as-built) 2021 Phase I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

In early February of 2020, the upper Tucannon basin was impacted by a significant flood event following a 5-9 inch rain on snow event which lead to significate landslides and road closures across the upper basin. As a result of the event and road closures the implementation of this

project was delayed one work window from 2020 to 2021, with site access and materials sourcing being delayed into the late summer of 2020. Site conditions have been assessed and some minor adaptations have been made in the design. Overall conditions in the project areas remained the same following the flooding however in areas where the river migrated and recruited LWD materials, habitat units like deep pools were formed (Figure 8). A pre-construction survey will be conducted prior to the construction window during base flow in 2021.

Prior Efforts: In 2019, the Program coordinated with WDFW in the planting of the Rainbow Lake wet land as part of the reconstruction of the off channel impoundment seasonally used to supply water to the Tucannon Fish Hatchery. The reservoir was built through the Lower Snake River Compensation Program to mitigate for lost fisheries opportunities and is managed by WDFW. Beginning in 2017, WDFW began implementing the W.T. Wooten Floodplain Management Plan (WDFW, 2012) with the first project targeting reconfiguration and levee set back of the impoundment, funded by the State of WA as a capital project. The goals of this project were to reduce the impoundments encroachment on the floodplain, improve public fishery value and enhance water supply to the Tucannon Fish Hatchery. The objective that most aligned with the Tucannon Habitat Program was the removal of ~290 m of the original reservoir dam (Figure 6) and the creation of ~3.5 acre wetland on the previously inundated reservoir bed (Figure 5). The reservoir was drained in 2017 and the new impoundment was dredged to a new configuration and depth leaving an area of ~5.5 surface acres. In the fall of 2018, a new dam was constructed excluding ~3.5 acres of reservoir bed, which was reshaped and planted with wetland species (Figure 5) in a joint effort between the Program and WDFW. The wetland was planted in March 2019 with ~3,000 willow, and ~500 cottonwood plugs and 250 river birch plugs. Within the wetted perimeter ~500 Juncus and Carex native spp plugs were planted. The wetland planting has become established and remains in good condition following inundation during 2020 flooding event, it is anticipated that this wetland complex will be connected to the main-stem Tucannon River as part of PA13 being implemented in 2021-22.

Project Summary: Project Area 13 was designed by WDFW in 2018-19 and updated in 2020, for the purpose of enhancing and restoring instream habitat in this project area through a variety of treatment actions in the main channel, along the banks, and within the floodplain. The treatments include; removal of river levees and rip rap, reconnecting side channels, construction of a channel meander, and construction of instream habitat features such as engineered log jams to raise the river bed, the placement of LWD materials to provide channel roughness and habitat complexity, and riparian planting. The principal benefits of project implementation will be restoration of historic spring Chinook spawning, juvenile summer and winter rearing and adult holding habitats. The associated recovery of riparian areas is expected to be enhanced increasing resiliency by naturally occurring flooding over the long term.

Implementation Actions (from restoration design): Reconnect >1.6 km isolated side channel (~50/50 perennial-ephemeral) habitat through the removal of ~200 m of river levee, and the

placement of associated log jams (Figure 10). The removal of levees and placement of logjams will reconnect ~14.6 acres of low floodplain, and an additional 3.6 acres previously part of Rainbow Lake impoundment footprint (Figure 6). Install ~31 ELJs and other LWD structures in the main channel to increase channel complexity over a 1.26 km reach. Additional, unsecured mobile LWD will be placed in main channel, side channels and on the floodplain for complexity. Re-plant adjacent floodplain and riparian areas where disturbed to re-vegetate and restore disturbed construction access sites and staging areas. During planting, efforts will be made to increase pines and cottonwoods throughout the reach for the purpose of future LWD key piece recruitment. The 2021-22 removal of the addition 200 m of river levee is anticipated to reconnect the 3.6 ac wetland created in 2019 (Figure 9).

Current Emphasis:

Site access and material sourcing began in August 2020 and focused on preparing the site for material delivery to begin construction in July of 2021. This project remains a multi phased endeavor with the construction phases spanning two in water work windows and the riparian revegetation and plantings potentially spanning into a third year.

In 2020, a rapid habitat survey was completed to measure pre-project existing condition measuring main cannel length, length of existing perennial and ephemeral side channels and flood paths, number of LWD key pieces (> 6 m long & > 0.3 m dia.), the number of existing log jams, the number of single mobile logs, pool frequency, and estimate of pool area and maximum pool depth (Table 4). The existing condition for the project reach metric are displayed in table 1 with the reach objective for comparison. It is anticipated that a pre-project survey will be conducted during base flow conditions in the early summer of 2021 prior to implementation flowed by a post project survey conducted following 2021 implementation. In 2022 an additional survey will be conducted prior and following implementation for the entire project reach both phases and results will be compared to the restoration objectives listed in table 4. The current monitoring strategy for project implementation will use the rapid habitat monitoring protocol conducting a follow up post project survey after 2 freshets or one significant flood >2yr return whichever occurs first.

Figure 5: Tucannon River Project Area 13 pre-project conditions in 2018. The upper left image is the Tucannon Fish Hatchery weir and fish trap located at the upper most end of the project area. The project reach is described as a combination of plain bed riffle and rapids (lower left and right images) caused and maintained by river levees and riprap. The upper right image shows one of the river levees being removed in 2021 as part of the restoration project design for this reach.

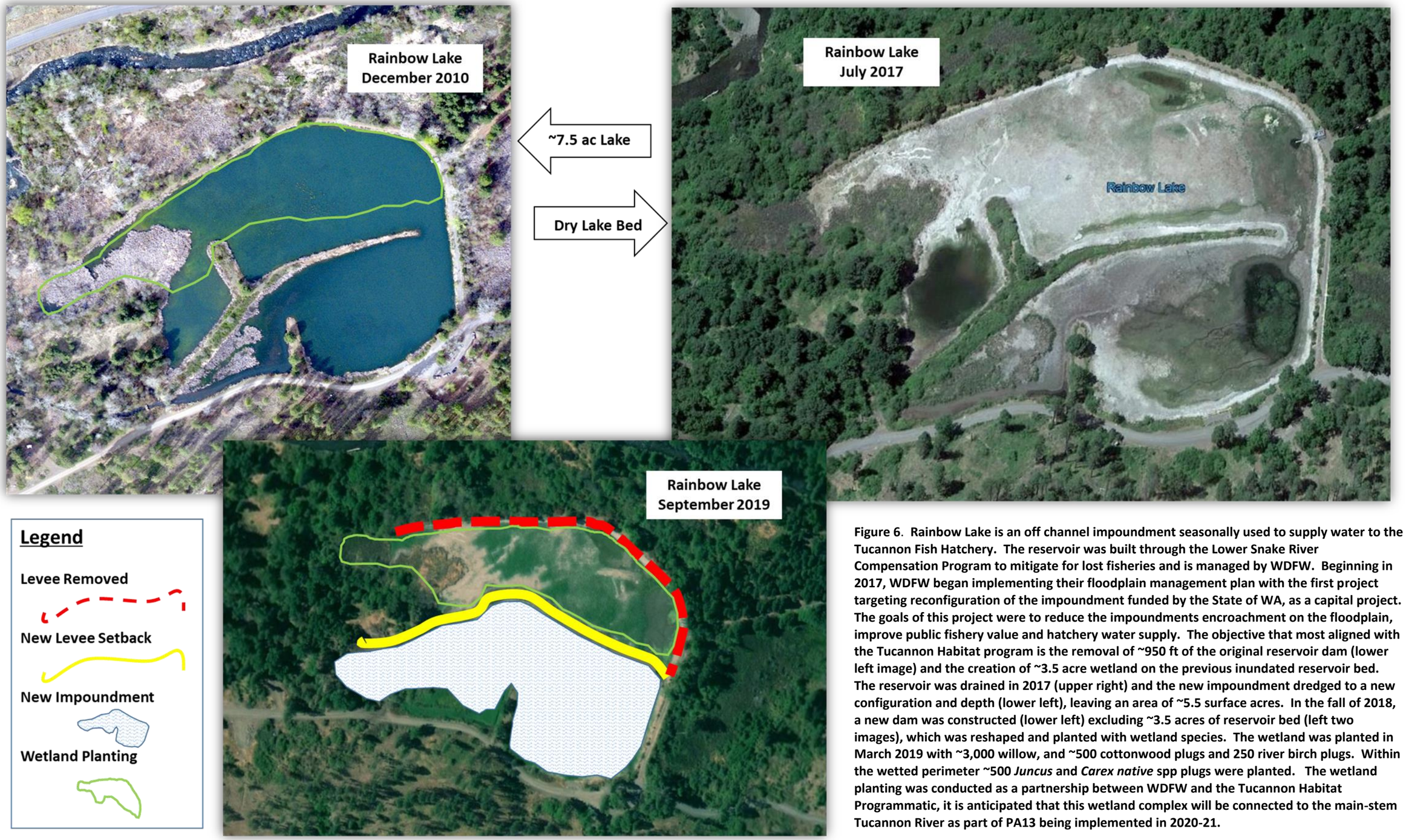


Figure 6. Rainbow Lake is an off channel impoundment seasonally used to supply water to the Tucannon Fish Hatchery. The reservoir was built through the Lower Snake River Compensation Program to mitigate for lost fisheries and is managed by WDFW. Beginning in 2017, WDFW began implementing their floodplain management plan with the first project targeting reconfiguration of the impoundment funded by the State of WA, as a capital project. The goals of this project were to reduce the impoundments encroachment on the floodplain, improve public fishery value and hatchery water supply. The objective that most aligned with the Tucannon Habitat program is the removal of ~950 ft of the original reservoir dam (lower left image) and the creation of ~3.5 acre wetland on the previous inundated reservoir bed. The reservoir was drained in 2017 (upper right) and the new impoundment dredged to a new configuration and depth (lower left), leaving an area of ~5.5 surface acres. In the fall of 2018, a new dam was constructed (lower left) excluding ~3.5 acres of reservoir bed (left two images), which was reshaped and planted with wetland species. The wetland was planted in March 2019 with ~3,000 willow, and ~500 cottonwood plugs and 250 river birch plugs. Within the wetted perimeter ~500 *Juncus* and *Carex native* spp plugs were planted. The wetland planting was conducted as a partnership between WDFW and the Tucannon Habitat Programmatic, it is anticipated that this wetland complex will be connected to the main-stem Tucannon River as part of PA13 being implemented in 2020-21.

Figure 7: Project Area 13 off channel wetland created in 2018-19 by the removal and setting back of the Rainbow Lake dam and was planted in 2019 in cooperation between WDFW and the Program. In the spring 2020 the wetlands were fully inundated during a 25 yr. flood event and performed as intended.

Figure 8: Deep pool habitats formed in 2020 flood event as a result of disturbance to armored banks and the recruitment of LWD.

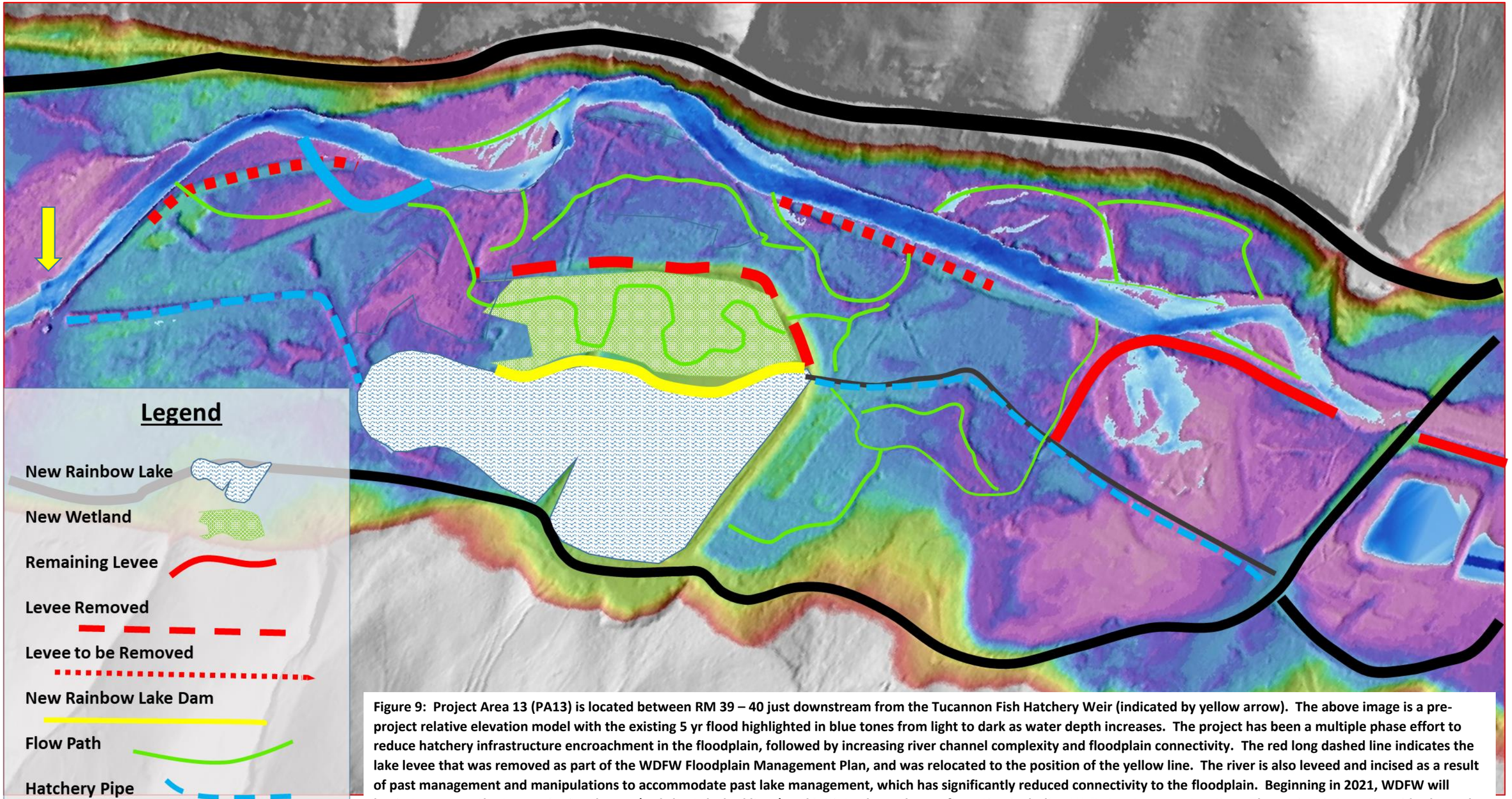


Figure 9: Project Area 13 (PA13) is located between RM 39 – 40 just downstream from the Tucannon Fish Hatchery Weir (indicated by yellow arrow). The above image is a pre-project relative elevation model with the existing 5 yr flood highlighted in blue tones from light to dark as water depth increases. The project has been a multiple phase effort to reduce hatchery infrastructure encroachment in the floodplain, followed by increasing river channel complexity and floodplain connectivity. The red long dashed line indicates the lake levee that was removed as part of the WDFW Floodplain Management Plan, and was relocated to the position of the yellow line. The river is also leveed and incised as a result of past management and manipulations to accommodate past lake management, which has significantly reduced connectivity to the floodplain. Beginning in 2021, WDFW will begin to remove the two main river levees (red short dashed lines) and initiate channel reconfiguration including LWD structure construction. The project is targeting side channel connection identified by the green lines. One river levee will remain disconnecting a spring well collector used by the Tucannon Fish Hatchery (red line).

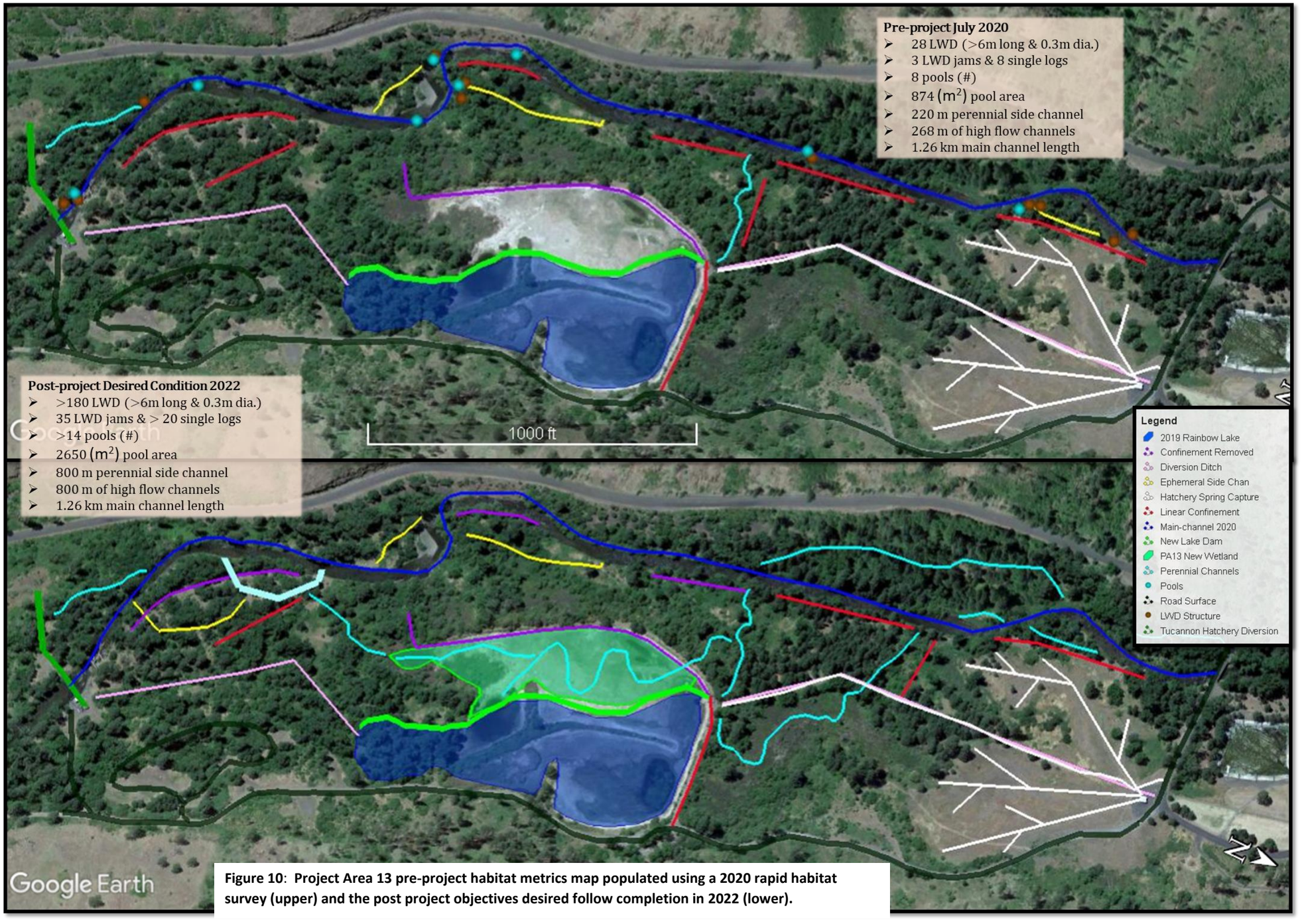


Figure 10: **Project Area 13 pre-project habitat metrics map populated using a 2020 rapid habitat survey (upper) and the post project objectives desired follow completion in 2022 (lower).**

Partner – CTUIR Projects

Project Title: PA17/18 Design Concept Development

Implementer: Confederated Tribes of the Umatilla Indian Reservation

BPA Programmatic Funding (2010-202-00): In 2020 $675,000 (CR-343949) construction support, in 2019 $5,000 (#84038) design support and in 2018 - $35,700 (#73982) design funds.

Other BPA Funds (2008-202-00): In 2020, $92,000 for design (73982 REL 100), in 2019 - $164,535 (#73982 REL 72)

Matching Funds: No other matching funds have been identified for this project area at the time, but it is anticipated that CTUIR would consider pursuing floodplains by design or SRFB grant as match in 2021-22.

Location: The project reach is located between RM 33.1 and 37.35. With a start Lat/Lon 46.343913 -117.681008 and end Lat/Lon 46.352667 -117.684059 (Figure 2)

Project Time Line: Coordinate and outreach 2017, concept development and build landowner support 2018-19, preliminary design 2020, final design and construct 2021-22.

Priority Populations & Life Stages: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened) and all life stages, Columbia River bull trout and other native species.

Project Goal & Objectives: The project goal will be to enhance the Primary Touchstones of CTUIR River Vision (Jones et. al. 2008) within PA17, to the maximum extent possible. The goals of the Southeast Washington Salmon Recovery Plan included instream wood replenishment, increasing channel complexity, and reconnecting the river to its floodplain. Increase hydration of an inset floodplain through the construction of log jams, and the connection/creation of side channels. Specific project objectives will be developed during the design process in 2020-21.

Objectives: Note: The following objectives will be refined as the design nears completion.

1) Replenish instream wood to > 2 key pieces of wood per channel width.

2) Design large wood structures to:

- Raise the bed elevation, reconnecting the river and floodplain
- Decrease stream velocities and increase sediment deposition throughout the reach
- Increase connectivity using old side-channels throughout the reach
- Increase the local water table through hyporheic exchange with the alluvial aquifer

3) Replenish the floodplain forest with native tree plantings.

Background: The project area at PA17/18 is a wide ranging ongoing effort to work with one of the most highly developed and impacted reaches within the priority spring Chinook domain of the Tucannon basin. There are multiple opportunities to working within the long reach to improve the impact of habitat degradation that have occurred over the past decades. In 2017, CTUIR worked to implement the lower most 1.6 km of the project area connecting habitats within PA18.1. In 2015, the CCD worked on the stream reach located on WDFW and private properties located upstream and contiguous with this effort, to increase channel roughness and channel connectivity. In working with landowners in the larger PA17/18 project area it was determined that the next step would be to work from the top down through the area where the most habitat gains could be realized quickest, building off habitat gains from recent project work completed by the CCD in 2015.

Summary: The Project Area 17/18 floodplain and channel complexity project development goals in 2020, were to make contacts with private landowners through a number of public meetings and events held within the basin. The results of these efforts has led to enough interest amongst the landowner group to move forward from concept development to preliminary design (Figure 9) and the development of landowner agreements in 2019. The primary goal of the project design concepts developed in 2020 focus on increasing floodplain connectivity and increasing channel complexity through side channel reconnection and strategic channel roughness elements (Figure 11). A combination of channel spanning and channel apex type structures will be placed to encourage increased flows onto the left bank floodplain where a number of long flow paths had developed (Figure 12) in past floods but were discouraged by prior (discontinued) land management approaches.

Current Emphasis: In 2020, CTUIR continued to work with private landowners within this high priority (Tier I) reach to identify and implement restoration objectives that have high fish benefit while working with the 22 property owners within this reach. As of the winter of 2019 the majority of the landowners within the ~3 mile reach have expressed interest in doing some level of restoration and have returned signed agreement forms to CTUIR based on their review of the concept drawing. CTUIR has continued working with a design engineer (using Tucannon Accord funding) to produce a preliminary designs for BPA technical EC review to complete a final design in early 2021.

A site assessment was completed in 2020 in support of concept design development with the metrics from that survey provided below (Table 5). Project implementation would target a potential 50% increase in perennial flow (Figure 12) channels and an overall increase frequency of inundation into ephemeral flow paths from the 5yr to the winter flow to 1 yr return interval or less. The project concepts focus heavily in two reaches where existing condition has transformed to the where previously large floodplain flow paths on the left bank may be relatively easy to reconnect (Figure 13) at a more beneficial flow (<1 yr return interval). The floodplain channels will be roughened using a number of embedded logs to aid in channel formation over time. A full revegetation plan will be developed to initiate riparian vegetation

over the length of the project. Prior to implementation a follow up pre and post -project survey would be completed to capture and document project implementation and support the as-built condition.

Table 5: Pre-project habitat metrics collected in floodplain expansion reach identified in PA17/18.1. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m^2)	Mean Depth Range (m)
Preliminary Reach Obj.	None	958	1,258	177	25	70	20	2,400	1.0-1.5
Pre-project (2020)	1.11	407	1,576	128	14	5	16	2,093	1.0-1.5

Example channel conditions being targeted for additional channel roughness undet the PA17-18 Phase II design.

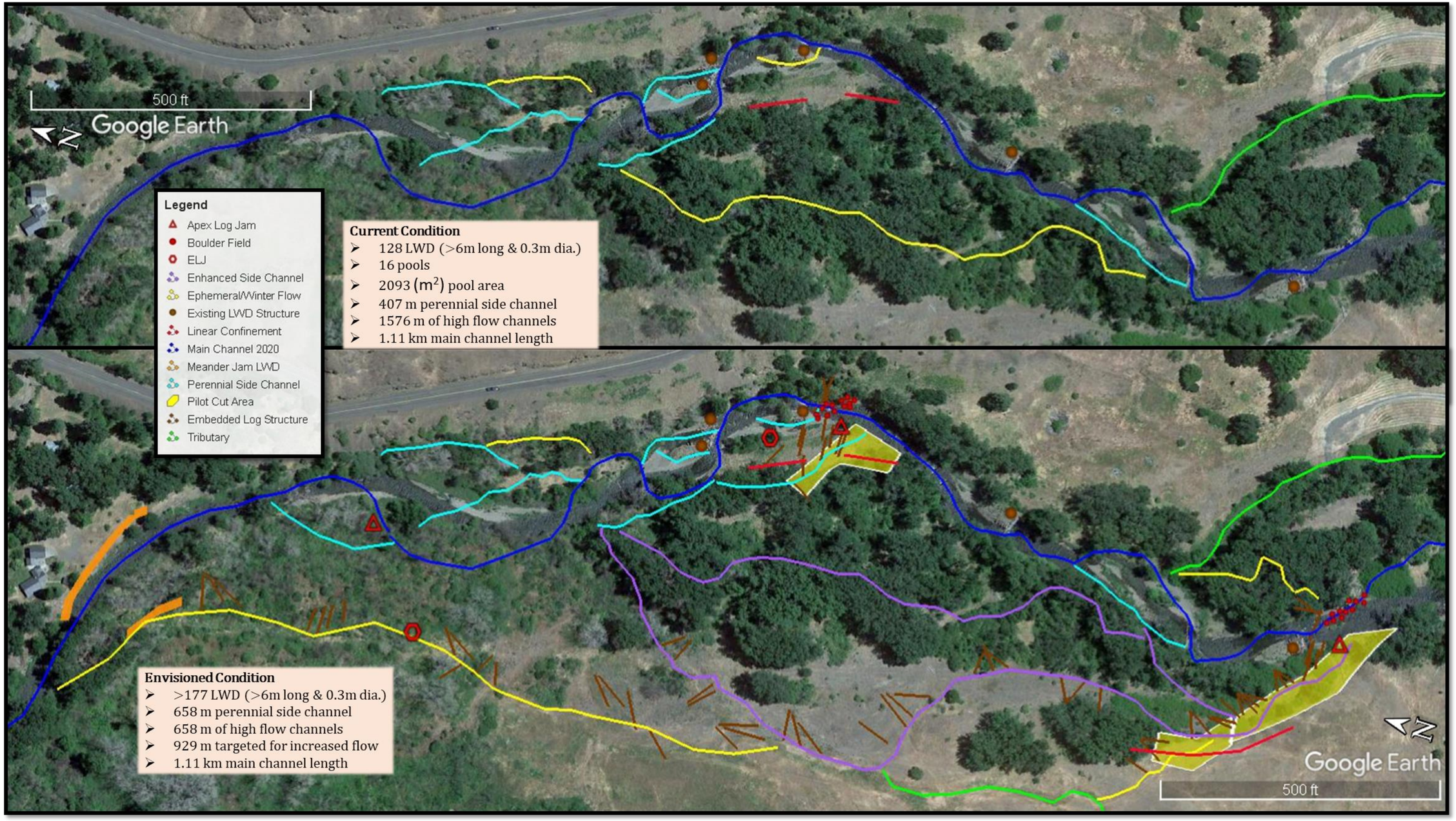


Figure 11: Project 17/18 Phase II project reach identified current design effort. In 2020, a rapid habitat survey was conducted of the entire project reach being designed (upper map) and is being compared to the desired condition developed for the design concept. The design concept will focus on removing remain confining features and increase connectivity to existing disconnected flow paths.

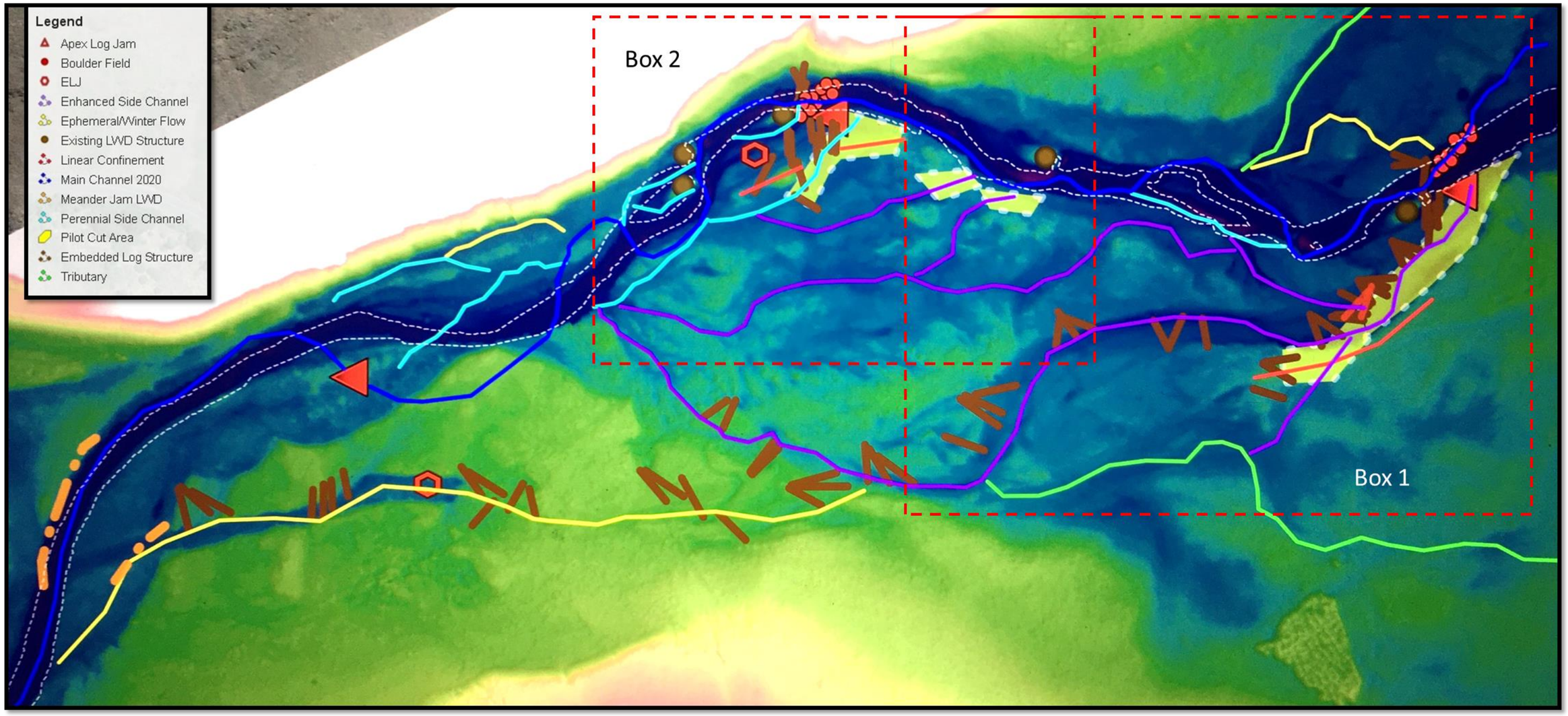
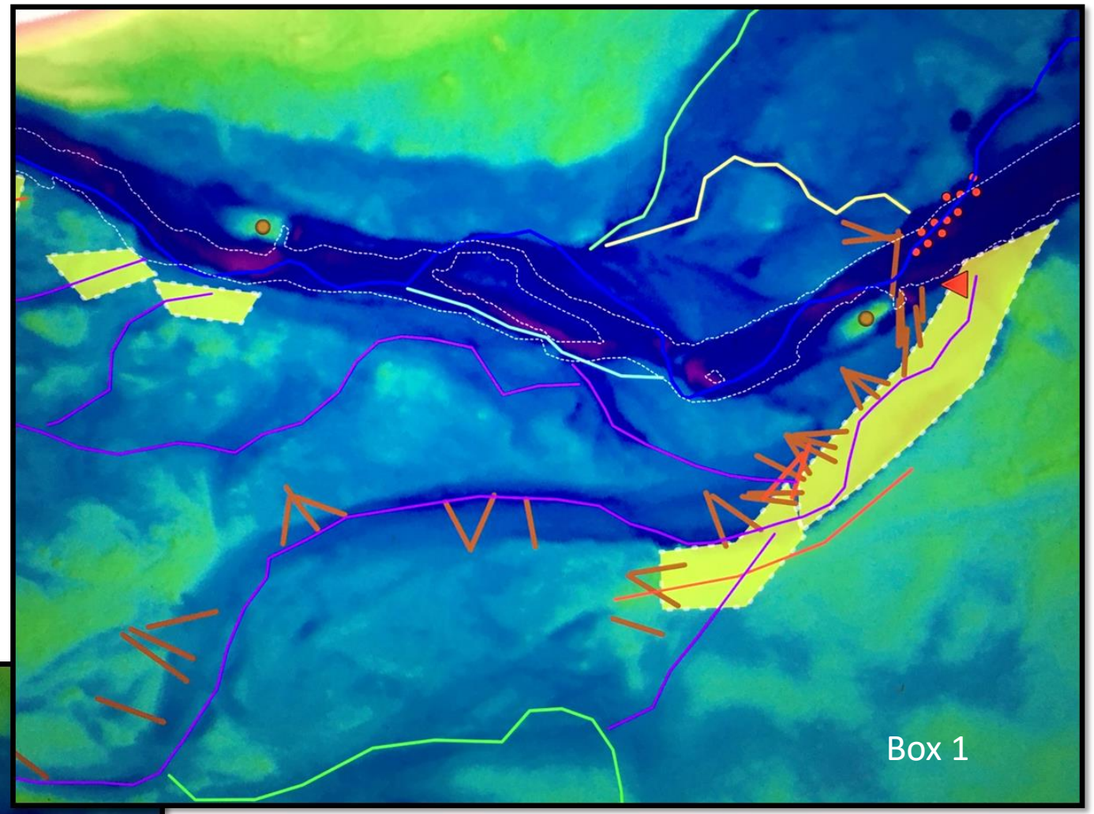


Figure 12: Relative elevation model developed using 2017 bathymetric LiDAR for the current design in Phase II of PA 17/18.1. The map illustrates the current position of the main channel following the 2020 flooding as well as existing LWD structures placed in 2015. The two dashed boxes indicate the location where significant LWD structures will be paired with side channel cuts to increase channel complexity and floodplain connectivity (Figure 13).



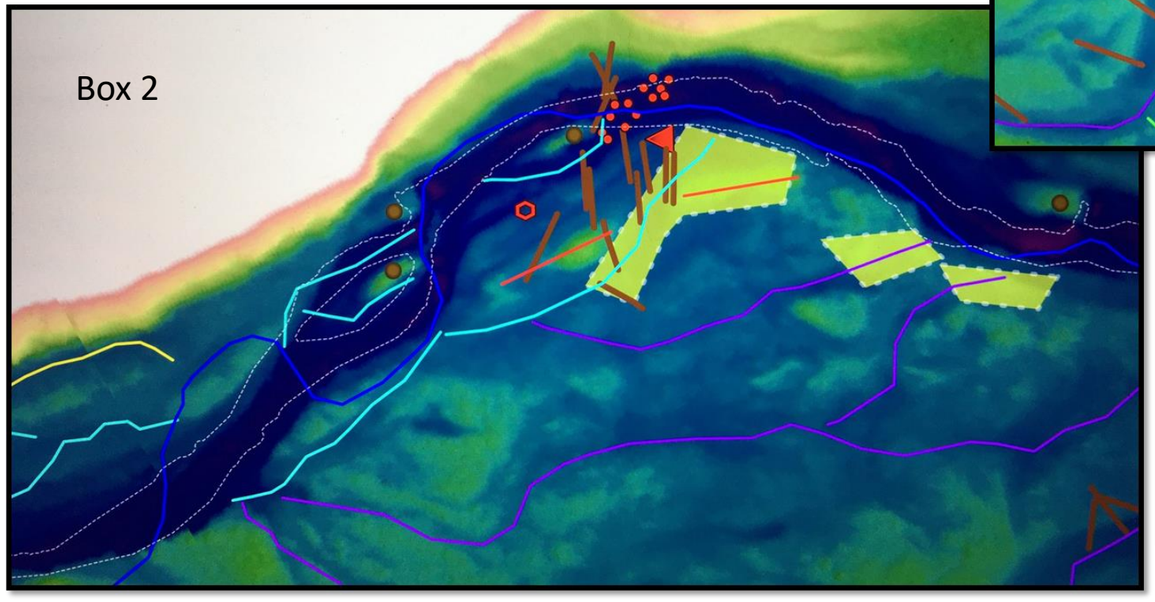


Figure 13: Design concept details for the two areas where significant instream structures will be constructed in association with side channel pilot cuts as illustrated in Figure 10. The callout labeled Box 1 is the upstream most pilot channel and Box 2 illustrates the lower pilot cut area.

Project Title: PA27/28.1 Add Function & Complexity: Phase I Design & Implementation

Implementer: Confederated Tribes of the Umatilla Indian Reservation

BPA Programmatic Funding (2010-077-00): In 2021, $332,350 (CR-343034), in 2020 $827,500 (#73982 REL 98) and in 2019, $73,112 (73982 REL 42).

Other BPA Funding (2008-202-00): In 2020, CTUIR committed ~$151,000 (CR-336509).

Matching Funds: Non-BPA matching funds have not been quantified for this project area, but could be in the donation of existing low lying agricultural lands for conversion to floodplain.

Location: Tucannon River mile 22.25 to 23.2.5. With a start Lat/Lon 46.453672 -117.816916 and end Lat/Lon 46.456387 -117.832140 (Figure 2).

Project Time Line: Project design was initiated late in 2019 (CCR-43470) with the first half phase (Phase 0.5) being completed early in 2020. This project was split into multiple phases to accommodate both available funding and permitting timelines in 2020-22, and further Phase 1 was divided into two phases (Phase 0.5 and Phase 1) in 2020 to fit within available funding and work window. Initial project Phase 0.5 was implemented in 2020 (#CR-73982 REL 98), with the final Phase I design planned for completion in early 2021 and planned implementation planned in 2021 (CR-343034 & CR-343732). PA27/28.1 will also have a second phase (Phase II) planned to be designed in 2021 for implantation in 2022-23 based on available funding.

Recovery Expectations: This project is located in a dynamic section of the Tucannon River Valley, and it is expected that change in channel form and habitat complexity will occur at a relatively fast rate compared to other locations within the basin. The flow rate required to activate bed load in this reach occurs in a 1-2 recurrence interval, so the project is expected to contribute significantly to habitat uplift within 2-5 yrs. Additionally, the aggressive design approach will significantly alter habitat conditions within the reach. Periodic site visits and rapid surveys (+2 yrs. or following high water events) will continue to follow development in side channel and floodplain connectivity (Table 6).

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Columbia River bull trout (threatened), Pacific Lamprey (SPP of Concern).

Priority Life Stages Targeted: All life stages

Potential Future Actions: Due to the restoration goal of reconnecting floodplain, it may be required in upcoming years to revisit pilot channel cuts and associated LWD structures to ensure side channel and floodplain objective are met. Additional floodplain structures may also be desired once the floodplain objective is being met. Revisit riparian planting and health over time as floodplain land scape evolves from shrub step or agriculture to a more functional riparian habitat.

Project Goals and Objectives

Goal: Return a roughly 1.4 km reach within project area 27/28 identified in the 2021 Plan (Anchor QEA, 2021) and located on a private farm, closer to its historic, naturally functioning state, increase fish habitat quality/quantity and floodplain connectivity.

The goal of the project is to address the Primary Limiting Factors identified for the Tucannon River in the 2008 Fish Accords (Three Treaty Tribes-Action Agencies 2008), incorporating the primary touchstones described in the Umatilla River Vision (Jones, et al, 2008), and be consistent with the Snake River Salmon Recovery Plan for Southeast Washington (SRSRB 2006), Draft Columbia River Bull Trout Recovery Plan (USFWS 2010) and the Tucannon Sub basin Plan (CCD 2004).

Objectives: final objectives for this restoration project will be identified in early 2021 as part of the final Phase I Basis of Design Report.

- Short Term Obj. (3 yrs):
    a. Increase floodplain connectivity and frequency of inundation to a condition closer to historical and natural (1-2 yr return) on approximately 24 acres of low-lying floodplain currently not frequently inundated (at < 5yr return). Re-engaging the floodplain will result in flows that are less confined, have decreased stream power, allow for increased and more variable gravel deposition, increase groundwater tables, and increased base flows and decreased water temperatures.
    b. Increase channel complexity with channel morphology (channel form, sinuosity, complexity, geomorphic and hydrograph stability) closer to historical and functional possible maximum >1,600 m of perennial side >channel, and >1,000 m of ephemeral side channel.
    c. Installing >134LWD structures within the bank full channel and on low-lying flood paths to create pool habitat, instream cover habitat, channel complexity, substrate sorting and floodplain connectivity and roughness.
- Long Term Obj. (3-5 yrs):
    a. Restore natural channel forming processes through the addition of large wood to increase channel complexity, and restoration of sediment routing processes through the removal of levees and other floodplain impediments.
    b. Reestablish native floodplain plant communities and riparian function with site-appropriate native vegetation and off-channel habitat. Realistic, cost-effective planting plans will maximize plant survival and minimize labor and maintenance; the planting plan will reflect CTUIR First Food values.
    c. Restore a floodplain and upland terrace forest.

Project Summary: Project Area (PA) 27/28.1 is located within the active river channel and floodplain of the Tucannon River, on private property from RM-22.25 to RM-23.1. The project

is identified as a priority for restoration in the 2021 Plan (Anchor QEA, 2021). The primary reach objectives are to increase floodplain connectivity through: removing channel confining features, the placement of LWD features and reconnecting perennial and ephemeral side channel features. It is predicted that through the reduction of channel confinement and the increase in channel and floodplain roughness (LWD) a reduction in excess stream power and the formation of longer perennial flow paths will result supporting a > pool frequency and depth range..

Status (FY20): Due to the size and potential cost of this project in relationship to programmatic annual budgets the project is being phased over a number of fiscal and construction periods. The project design was completed for phase 0.5 (see contract #73982 REL42) the first half of Phase I; and advanced by CTUIR project staff working within the CTUIR Tucannon project (2008-202-00) funds. The first half of Phase I (Phase 0.5) was implemented in 2020 and the remaining elements currently being included in a 2021 Phase I final design. The final Phase I design implementation target has been set for 2021.

Status (FY21): In the 2021 work window, Phase I (second half of Phase I) will be implemented, completing the majority of the in water work for PA 27/28.1 currently being proposed by CTUIR. Phase II project concepts will be initiated and may include modification existing irrigation access and efficiencies to aid in reducing the impacts of agricultural practices on the floodplain and waterway.

Implementation (FY20): In 2020, CTUIR completed implementation management and supervision for: pre-construction site preparation, permitting, design finalization and Phase 0.5 implementation at PA-27/28.1. The Phase 0.5 design involved final design and construction of the floodplain connectivity and LWD placement for about half of the overall project elements planned in Phase I (Table 6).

The design focused on creating multiple habitat structure, floodplain connection, and improving stream function deficiencies associated with this reach of the Tucannon River (Figure 14). Enhancing and restoring instream habitat in this project area is being accomplished through a variety of treatment actions in the main channel, along the banks, and within the floodplain. In total, the Phase 0.5 restoration efforts in 2020 increased perennial side channel length by >500 m through channel connectivity measures and increased LWD jam frequency (Table 6). Pools were not directly developed during construction and are expected to develop following changes in channel geomorphology during high flow events, and will be reported in future reports (2021-2023). These design features are intended to benefit spring Chinook by providing better refuge and spawning habitat for adults, reducing redd scour during winter flood events, and increasing rearing habitat and over-winter survivals for juvenile salmonids. Project restoration objectives have been developed for this project area and are based on conditions observed during pre-project field visits metric data and use the recommendations identified in the 2021 Plan (Anchor QEA 2021) for floodplain channel complexity, LWD key pieces, pool frequency and pool area.

Background: This project has been designed and is being implemented using "Stage-0" (Clure 2018) as defined in the River Evolution Model (Clure 2018) as the restoration target for river and floodplain in this projects. This treatment approach requires some additional explanation given their relative infancy as a restoration approach. The driving goal of restoring to "Stage-0"

Table 6: Project Area 27 and 28.1 project habitat metrics collected in pre and post project rapid habitat surveys conducted in 2020 for Phase 0.5 of Phase I. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area ($m^{2)}$	Mean Depth Range (m)
PA27 Reach Obj. 2023	None	~500	~200	>54	>15	>12	15	1,030	1.0-1.5
PA27_Pre-project Phase 0.5 (2020)	0.43	204	49	24	7	6	11	571	0.5-1.0
PA27_Post-project as-built Phase 0.5 (2020)	0.43	204	0	85	10	4	11	571	0.5-1.0
PA28.1 Reach Obj. 2023	None	1,600	1,000	>123	>160	30	45	2,360	1.0-1.5
PA28.1_Pre-project Phase 0.5 (2020)	0.98	270	620	83	19	16	32	1385	0.5-1.0
PA28.1_Post-project as-built Phase 0.5 (2020)	1.01	776	854	392	112	15	31	1373	1.0-1.5

is a type of approach to address channel-floodplain disconnection through lowering (grading) of artificially high (i.e. disconnected) floodplain areas and filling of incised channels. These actions effectively equalize floodplain and channel elevations to maximize floodplain engagement, minimize stream power per unit width, re-initiate sediment deposition, and raise groundwater tables to promote vegetation success. Specific elements of this approach include:

- Floodplain grading that targets removal of artificially high areas (such as berms and roads). Importantly, low areas such as those containing wetlands are avoided with floodplain excavations.

- Designs error on the side of more rather than less connectivity to allow the stream to find its natural multi-threaded dynamic equilibrium. Maximum connectivity is achieved through partial filling of the channel with material excavated from high floodplain areas. Excavation of narrow side channels are de-emphasized.
- Placement of loose logs and other roughness elements further decrease unit stream power (stream power per unit width) across the floodplain.

A focus on less engineered elements of a Stage-0 approach, including loose logs and broad (low-detail) excavations, can save significant construction costs.

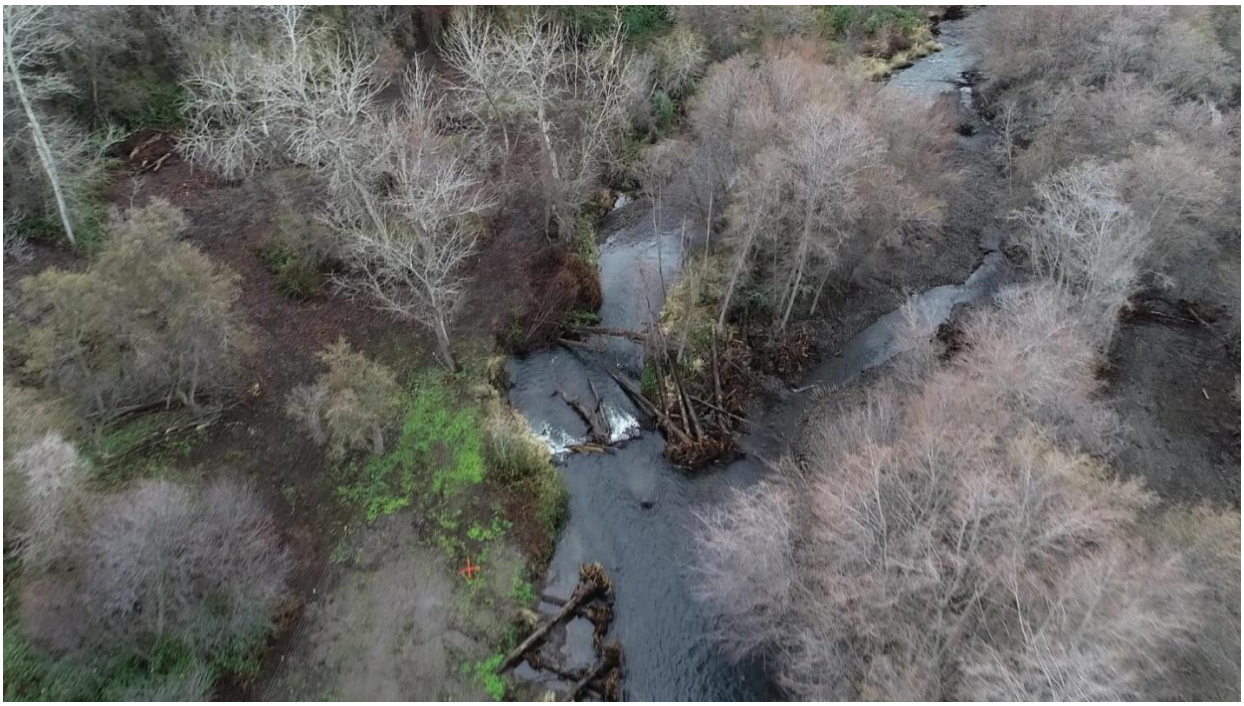


Image taken from a drone survey Feb 2021, in PA28.1.

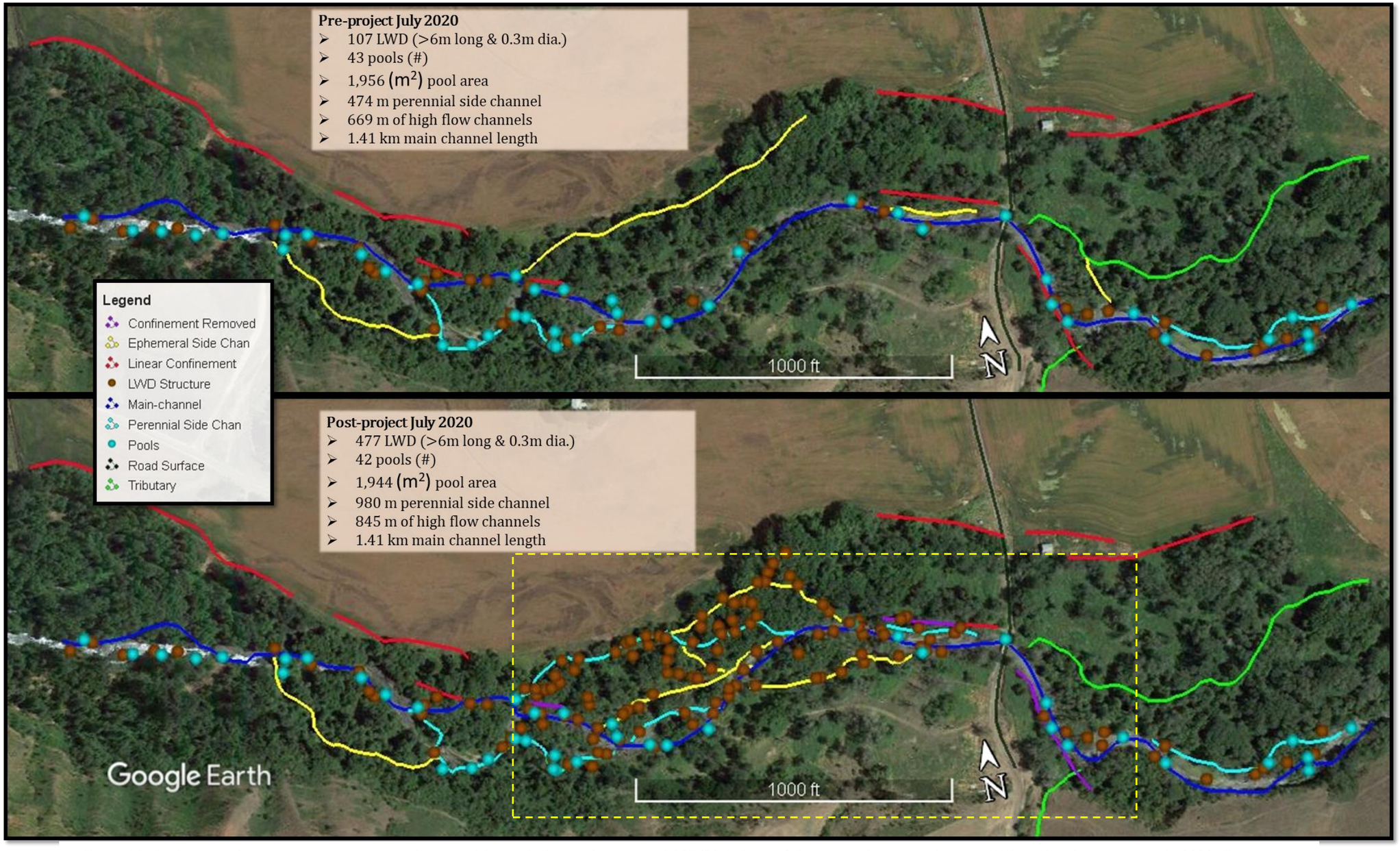


Figure 14: Project map illustrates pre and post project conditions within the first half of PA27/28.1 (Phase 0.5) floodplain connection and LWD project implemented in 2020. The yellow dashed box indicates the approximate area of work in 2020.

Project Title: 2020 Tucannon River LiDAR Data Collection and Analysis

Implementer: Confederated Tribes of the Umatilla Reservation

BPA Programmatic Funding (2010-077-00): The Program supported the CTUIR in the 2020 Tucannon River Basin Terrestrial NIR LiDAR, Topo-bathymetric LiDAR, 4-Band Orthophotography Acquisition, Post-processing and Data Analysis. In 2020, $182,785 (86158)

Matching Funds: Matching funding toward this project come from the FY20 SRFB program funds, at a sum of $73,000 (IAA 20-2013).

Location: Entire Tucannon Basin floodplain and major tributaries.

Project Time Line: LiDAR acquisition in November 2020 and 4-Band Orthophotography acquisition in May 2021. In 2021, the Program, QSI and Anchor QEA will work together to analyze the 2011, 2017, and 2021 LiDAR datasets. A final draft document is planned for completion in the spring of 2022.

Priority Populations: The 2020 LiDAR data acquisition and analysis will support natural habitats and native flora and fauna of the Tucannon basin through improving natural river process. Although these efforts are targeting Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Snake River Fall Chinook (Threatened), Columbia Basin Bull trout (Threatened) analysis of this data is intended to help restore natural process that will provide habitat for all species present including pacific lamprey and bivalves.

Priority Life Stages: All life stages.

Project Goal & Objectives: The overall goal of the 2020 LiDAR data acquisition and analysis is to provide a topographic layer to compare geomorphic changes (floodplain connectivity and channel complexity) since the 2017 LiDAR data collection. The fall of 2020, was chosen for the next LiDAR data collection, because of the 30 year flow event that occurred in early February of 2020, which is the highest flow event since Program restoration started and dating back to 1997.

Objectives: LIDAR DATA ACQUISITION

- Acquire Topobathymetric Lidar Point loud in November 2020 (Figure 15)
- Develop Surface Models March – April 2021
- Acquire Intensity Images, March April 2021
- Develop Vectors April-May 2021
- Develop Geodatabase to deliver surface models, vectors and raster's for 2010, 2017 and 2021 data sets. June-August 2021
- Reporting including methods, results accuracy assessment and metadata. August – November
- Presentation Ready Graphics June 2021

DATA ANALYSIS

- Geomorphic Change Analysis
  - Geomorphic Change GIS Data: channel traces, lidar differencing, change locations shapefile (Figure 16)
  - Geomorphic Change Summary Memorandum
- HEC-RAS Update
  - HEC-RAS file packages for both the 1D and 2D models
- Floodplain Connectivity Analysis
  - Model Result Layers in GIS Meeting CTUIR Data Standards:
  - Inundation shapefiles and depth rasters at low-winter, mean-winter, 1-year, 2-year, 5-year, 10-year, and 25-year flow events
  - Connected, disconnected, and unavailable areas as part of the connectivity analysis
  - Detailed Data and Calculations for Connectivity Analyses
  - Connectivity Analysis Report
- Habitat Complexity Analysis
  - Model Result Layers in GIS Meeting CTUIR Data Standards:
  - Island, river thalweg, and valley line shapefiles used for the complexity analysis
  - Detailed Data and Calculations for Complexity Analyses
  - Complexity Analysis Report
- Presentation Ready Graphics
  - To be determined in collaboration with CTUIR and Anchor QEA throughout the post-processing period.

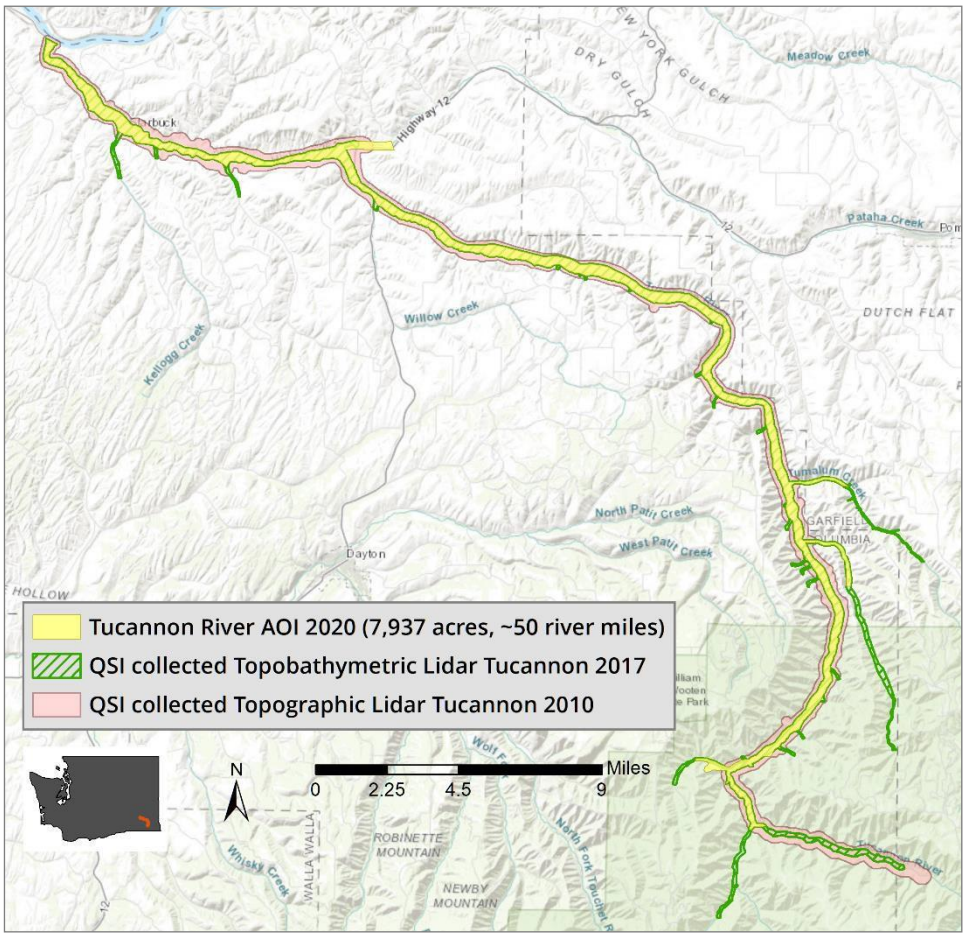


Figure 15: 2020 Tucannon River LiDAR coverage map.

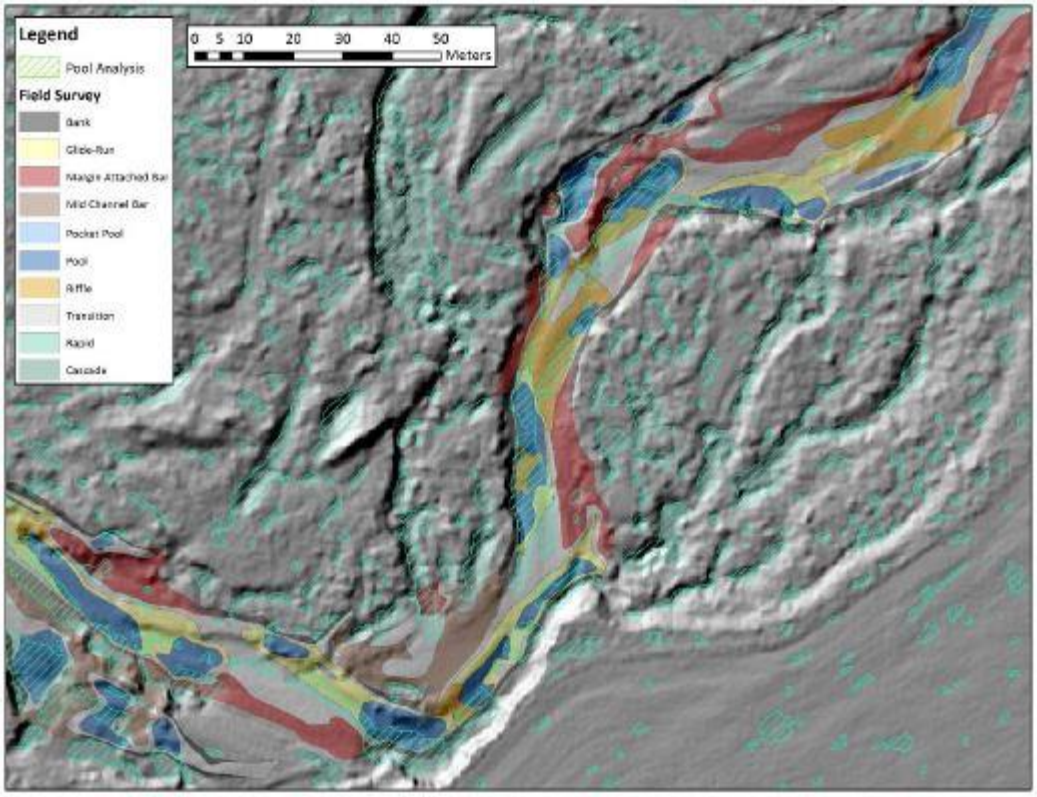


Figure 16: Example of the Tucannon LiDAR analysis classifying different habitats using the bathymetric green LiDAR. The blue areas in the map are pools.

Partner – NPT Projects

Project Title: Tumalum Fish Passage

Implementer: Nez Pierce Tribe

BPA Programmatic Funding (2010-077-00): In 2021, $275,000 (Planned)

Other BPA Funding (2007-393-00): In 2020, NPT ~$116,000 (#74017 REL 45)

Matching Funds: Matching funding toward this project come from the FY20 SRFB grant round, through the SRSRB LE process at sum of $316,110 (20-1053).

Location: Tucannon River mile ~32.7 and Lat/long 46.358986 -117.685199 (Figure 2).

Project Time Line: Initial preliminary design development began in 2019 (#74017 REL 45) to be completed by April, 2020. In 2020, NPT will work to finalize designs and (CR-338656) initiate implementation in 2021-22.

Recovery Expectations: This project is located in Tumalum Creek a small disconnected (33% passable culvert) tributary to the main stem Tucannon. It is anticipated this project will reconnect the tributary and increase fish access and use through channel improvement in the lower mile of the tributary.

Priority Populations: Snake River DPS Summer Steelhead (Threatened), for all life stages.

Potential Future Actions: It is not anticipated that future actions would be required in relation to the removal of the fish passage barrier. Additional floodplain structures may be desired once the floodplain and stream channel objective is met. Revisit riparian planting and health over time as floodplain land scape evolves from shrub step dominated to typical wetted Tucannon riparian forest type.

Project Goals and Objectives

Goal: Restore (100%) fish passage into the Tumalum watershed through the modification of the Tucannon Road crossing located ~762 m from the confluence with the Tucannon.

Conceptual Project Objectives: Detailed objectives will be developed during project development.

I. Develop a fish passage design for the Tucannon Road Crossing, to provide 100% passage
II. Long Term Obj. (3-5 yrs): Improve stream channel and Riparian function in this stream delta for both fish passage and geomorphic process.
III. Planting to restore a floodplain and upland terrace forest

Project Background & Summary

Background: Tumalum Creek is a tributary of the Tucannon River that has been disconnected by a road culvert under the Tucannon Rd. The culvert has formed a barrier based on slope and

drop, and currently blocks fish passage (33% passable based on slope and drop, 2019 WDFW survey) into the basin (Figure 17). The road crossing is located within the tributary delta which has been modified, channelized and leveed to flow directly downstream to the Tucannon. Fish access to the main stem will be improved by reducing confinement on the delta and increasing channel complexity. Channel habitat features are being coordinated with CTUIR and PA17/18 Design Concept Development.

Summary: Tumalum Creek is a tributary to the Tucannon River in Southeast Washington located within the Tucannon Major Spawning Area as identified in the Snake River Salmon Recovery Plan (2011). The overall project goal is to implement a project to resolve a partial fish passage barrier for the Tumalum Creek culvert that will pass all life stages of ESA-listed Snake River summer steelhead and allow access to spawning and rearing habitat to approximately 10.8 km upstream of the existing culvert. The barrier was identified in the 2008 Walla Walla Community College Road Crossing Barrier Assessment and included in the WDFW Inventory Assessment.

The existing barrier culvert is an approximate 20 m long corrugated metal pipe which was installed sometime prior to 1996. The culvert itself is in good condition, however, it is considered only 33% passable due to a slope of 1.91%, and in most seasons has a drop exceeding 30 cm.

The NPT worked to secure a habitat resource design sub-contractor to produce preliminary designs to a 60% level beginning in 2019 and is expected to be at 90% design in March 2021. The NPT has been awarded a grant requests to finalized design and initiate implementation in 2021-22 work window.

The project will work to replace one passage barrier culvert with a 60 ft. L x 15 ft. W x 11 ft. H open-bottom concrete box culvert and install a WDFW stream simulation immobile roughened channel throughout the extent of the culvert and approximately 3 m. above and below the culvert inlet and outlet to provide passage for all life stages of Snake River summer steelhead.

Maintain existing mature riparian forest on 1.25 acres to the largest extent possible to provide the maximum amount of shade and natural recruitment while contributing to water temperature regulation in the project reach and future natural wood recruitment to Tumalum Creek and the Tucannon River. Any riparian lost during construction will be replanted as appropriate.

The removal of passage barrier will open complete access to more than 10.8 km of salmonid spawning and rearing habitat. The added benefit to habitat work in the immediate vicinity up and downstream from the barrier on adjacent properties will provide additional benefit to fish passage and rearing.

Figure 17: **Tumalum Creek is a tributary of the Tucannon and currently is utilized by summer steelhead as spawning and rearing habitat. The culvert at the Tucannon Road crossing is currently only 33% passable based on slope and drop out of the culvert. The image above show the stream crossing with to images showing the entrance (upper right) and exit from the culvert (lower left).**

Partner – CCD Projects

Project Title: TUCANNON (PA-26) PHASE II: ADD FUNCTION & COMPLEX

Implementer: Columbia Conservation District

BPA Programmatic Funding (2010-077-00): In 2021 $227,685 (CR-343235) and in 2020, $108,720 (84836).

Other BPA Funding (1994-018-06): In 2019, CCD committed ~$26,000 (#81774), in 2013, $152,000 (#59663). In 2011, $64,000 (#50146)

Matching Funds: In 2019, the CCD was awarded a SRFB grant for $304,775 (19-2094), In 2016 a grant from the Conservation Commission $50,000 and in 2009 and 2010, the CCD was awarded two SRFB grants totaling $694,260 (10-1633 & 9-1742) to remove the river levee.

Location: Tucannon River mile 26.2 to 26.7 (Figure 2).

Project Time Line: The initial project including levee removal and setback was completed in 2012. Phase I of the LWD structure placement was implemented in 2013 (#59663 - #50146), Phase II preliminary designs were initiated in 2019, and are planned for completion in early 2021. Implementation of Phase II is planned for 2021-22. Phase III design are being considered for 2021-22, a determination will be made in early 2021.

Recovery Expectations: This project is located in a dynamic section of the Tucannon River Valley, and it is expected that changes in channel form and habitat complexity will occur at a relatively fast rate following LWD structure placement. The flow rate required to activate bed load in this reach occurs in a 1-2 return interval (~600-1,000 cfs), which is expected to result in a quick habitat response, of 5-10 yrs. Periodic site visits and rapid habitat surveys (following high water events) will continue to make observations in side channel connectivity, floodplain connectivity, LWD retention and pool frequency and mean depth.

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Columbia River bull trout (threatened), Pacific Lamprey (SPP of Concern).

Priority Life Stages Targeted: All life stages

Potential Future Actions: Field observation will be accompanied by rapid habitat surveys two winter flows or following a flood flow greater than the 2 yr return interval, post construction. These surveys will be used to inform adaptive management and guide decisions in implementing maintenance actions.

Due to the restoration goal of reconnecting floodplain it may be required in upcoming years to revisited pilot channel cuts and associated LWD structures to ensure side channel objective and floodplain objectives are being met. Additional floodplain structures may also be desired once the floodplain objective are met. Revisit riparian planting and health over time as floodplain

land scape evolves from shrub step dominated to typical wetted Tucannon riparian forest type. Consideration of placing LWD structures strategically in the future to aid in maintaining the setback levee built in 2012.

Project Goals and Objectives

Goal: Return a 1.29 km reach of the 5.95 km long project area 26, identified in the Tucannon Conceptual Restoration Plan (Anchor QEA, 2011) and located on three private farms, closer to its historic, naturally functioning state, increase fish habitat quality/quantity and floodplain connectivity.

Objectives:

- Phase II Short Term Obj. (3 yrs): Installing LWD structures within the bank full channel that create pool habitat, instream cover habitat, channel complexity, substrate sorting and floodplain connectivity.
    - Place 28 log jams within the main channel (1.29 km) for the purpose of creating channel complexity and increasing localized floodplain connectivity.
    - Place 15 log structure within floodplain flow paths to create complexity during winter and high flow periods
    - Increase pool frequency and volume > 50% within 3 years
    - Increase flood frequency and duration on 14 acres of available floodplain from the >5yr interval to <2 yr interval.
- Phase II Long Term Obj. (3-5 yrs): Increase floodplain connectivity and channel complexity.
    - Maintain > 2 key pieces beyond 10 years
    - Anticipated a 50% increase side channels within the first 10 yrs.
    - Connect disconnected low floodplain (<2 yr flow) ~ 14 acres
- Planting to restore a floodplain and upland terrace forest
    - 1,200 trees interstitially planted
    - 0.5 acres of new cover trees planted

Background & Project Summary

Background: In 2011, river levees and gravel berms were removed or breached throughout the entire reach (Figure 13) as part of the 5.95 km long PA 26 Phase I project. The goal of Phase I was to restore properly functioning geomorphic condition by reducing river channel and floodplain confinement (Figure 13). In 2011, levee removal was a relatively new and innovative restoration technique for SE Washington State, resulting in a conservative approach being implemented where the levee would be removed and set back in the first year, and channel modifications would be delayed to make observations on how the channel would recover naturally ("letting the river do the work"). Based on observations made in 2013 following two high water events, seventeen log jams were placed within the 5.95 km reach as a pilot effort in accordance with landowner's wishes at the time. Five log jams were placed within the upper 1.29 km reach now being designed in Phase II (CR-340020) to provide fish cover while

observations of river conditions were ongoing. Monitoring surveys conducted by CHaMP and the Program between 2012 and 2017 indicated limited change in channel shape or gravel storage within the reach and that the ~14 ac of floodplain liberated by the 2011 levee removal project had experienced very limited flood inundation in 2012 and none between 2013 & 2017. The CHaMP program recommended additional LWD structure placement to sort and retain gravel bars to encourage lateral channel migration and increased floodplain inundation frequency and duration (Hill 2017). The Phase II proposed work (CR-340020) is located on the upper 1.29 km of the project reach on which restoration actions were performed in 2011 & 2013 Phase I and is the first significant log jam project to be proposed for implementation following the CHaMP recommendations.

Problem Statement: Geomorphic processes, floodplain connectivity, and accompanying habitat for spring Chinook and summer steelhead within the reach have been influenced by historic land use practices within the 5-year floodplain. These activities have led to limited instream and floodplain habitat complexity, degraded floodplain connectivity and riparian condition and elevated summer water temperatures, all key habitat limiting factors for Chinook and steelhead (Anchor QEA 2011a).

Table 7: Project area 26 Phase II habitat metrics collected using the rapid habitat surveys in 2015 and in 2020. Restoration objectives for this project reach are based on priority restoration objectives identified in the Tucannon Conceptual Restoration Plan (Anchor 2021) and the envisioned site conditions. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area ($m^{2)}$	Mean Depth Range (m)
Phase II Reach Obj.2023	none	>800	>800	>175	36	5	18	~2,400	1.0-1.5
Pre-project Phase II (2015)	0.99	062.8	0.0	63	17	7	14	293	0.5-1.0
Pre-project Phase II Design (2020)	0.99	181	0	25	8	7	11	646	0.5-1.0

The reach currently is not meeting recovery potential described in the 2021 Plan (Anchor QEA 2021), and recovery objectives developed from 2020 rapid habitat survey indicate significant

potential gains of > ½ km of perennial side channel and significant gains in pool area (Table 7). This project aims to address these factors through the construction of log jams and floodplain enhancements to encourage natural functioning conditions.

Summary: The PA26 Phase II LWD Structure placement project being designed by the CCD will focus on developing better connection of the winter flood flow (>~140cfs or <1yr), with adjacent floodplain, where previously the levee and gravel berms were removed in 2012. The design approach will use LWD roughness features within the ordinary wetted channel to encourage gravel bar development and stream bed aggradation to initiate channel meander and more frequent floodplain inundation. It is anticipated that through regular floodplain inundation side channels and riparian function will be gained contributing habitat resilience in salmonid recovery. In total, within the upper 1.29 km long reach 33 individual log structures will be constructed in channel and 15 will be constructed on the floodplain in likely flow paths to aid in the shaping of future side channels as they develop. The stream work will provide increased inundation both in frequency and duration of ~ 14 acres of floodplain (Figure 18). A preliminary design (30%) was completed and used to leverage a SRSRB grant award in 2019. The near final design was completed in 2020 and include LWD structures focusing on aggrading gravel channel beds, splitting flows and shaping channel bed form (Figure 19).

Future work in project area 26 will be considered and negotiated with the downstream landowner (Phase III) in up-coming fiscal years. The effort in the next reach downstream may involve similar type of actions currently being implemented including removal of confining features and structure placement.

PA26 Plain bed river form within the project reach will be treated with LWD structure to increase channel complexity and floodplain connectivity.

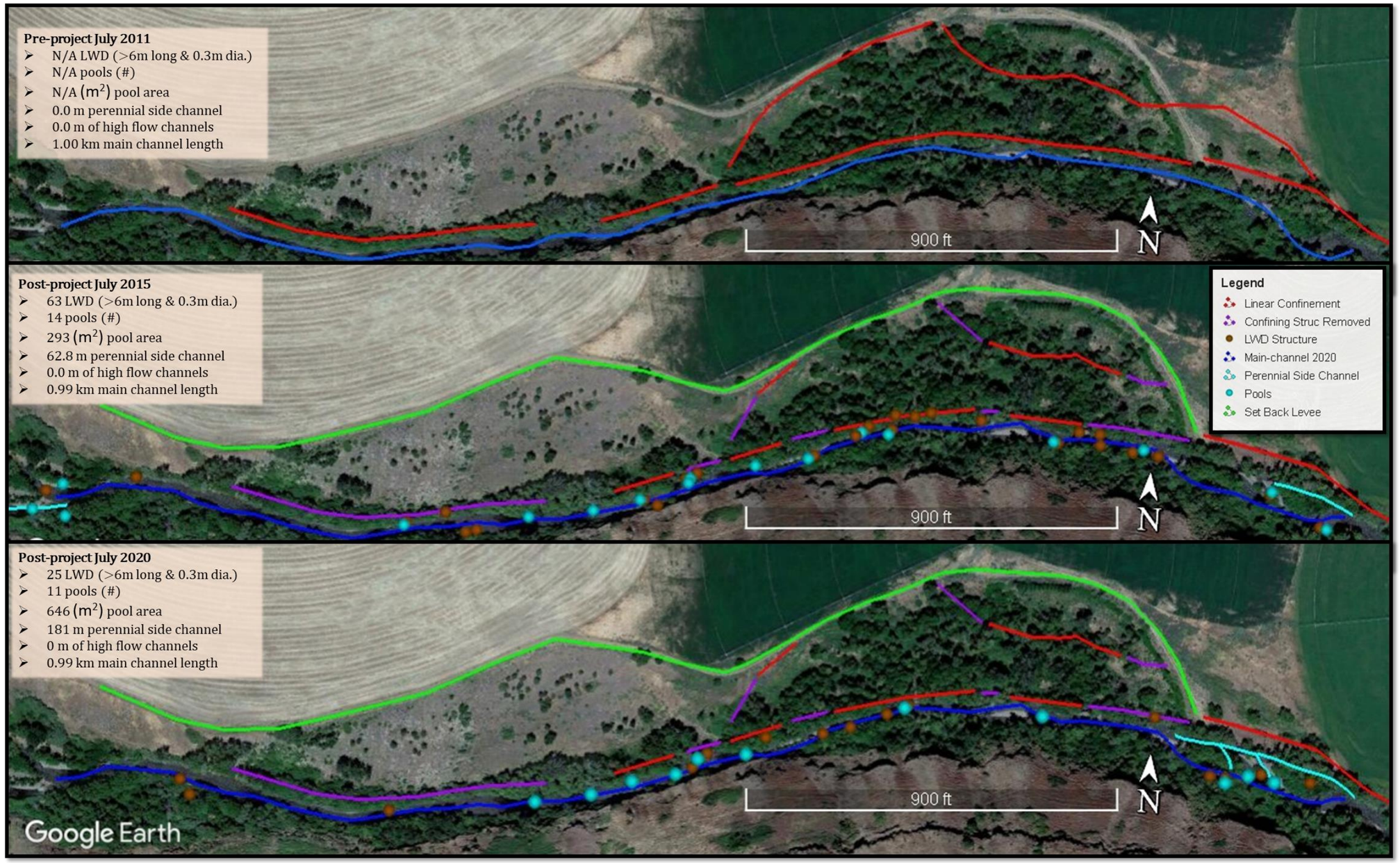


Figure 18: Project area 26 Phase II habitat metrics displayed for rapid habitat surveys conducted in 2011, 2015 and 2020. The 2011 survey was only completed on channels and does not include pools or LWD.

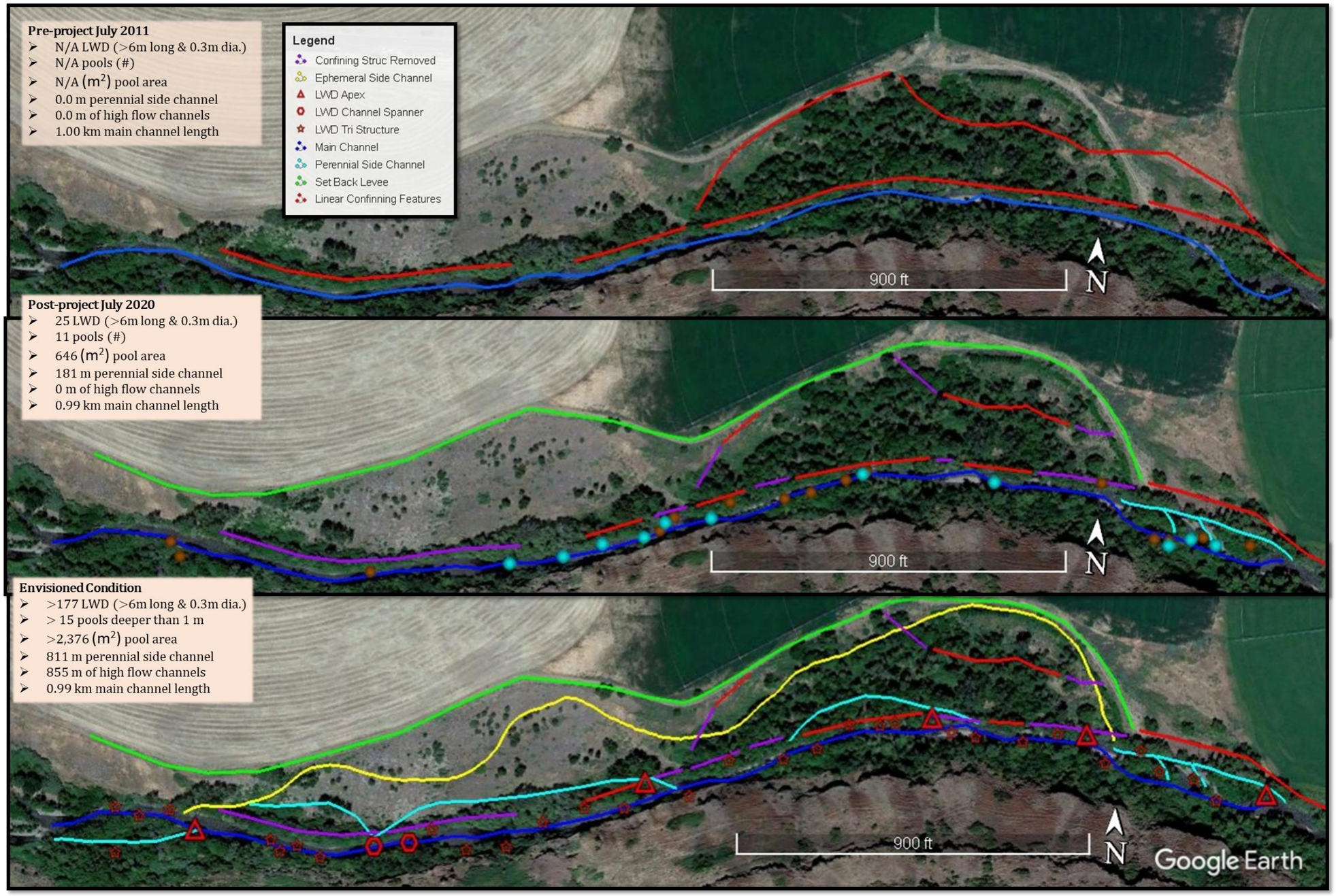


Figure 19: Project area 26 Phase II reach pre-project condition for 2011 and 2020 with the illustrated envisioned condition following construction of the 2020 design. Project reach objectives are provided for the pre project 2011 channels and confining features only (upper map), pre-project 2020 (middle map) and a post project envisioned condition (lower map).

Project Title: Tucannon River Habitat Restoration (PA32.1)

Implementer: Columbia Conservation District

BPA Programmatic Funding (210-202-00): FY20 $88,000 (#84836) FY19 $5,000 (#81783) FY18 $5,000 (#78668)

Other BPA Funds (1994-018-06): FY20 Construction oversight and engineering $29,250 (#84826) FY19 CCD finalize design & implement levee removal $367,105 (#81774), and in FY18 CCD $35,217 (#78668) was used to produce restoration designs.

Matching Funds: In FY19 the CCD received a SRFB grant for $224,757 (# 18-2091) to use towards construction.

Project Time Line: 2018 Design and permit, 2019 implement levee removal and construction of setback levee and in 2020 implement Phase I LWD construction and floodplain expansion.

Location: Start Lat/lon 46.482834/-117.953257, End Lat/lon 46.477932/-117.942397 (Figure 2)

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened)

Priority Life Stages: All life stages for all species are present at this project.

Project Goal: Improve floodplain connectivity, increase channel complexity and reduce excessive stream power to support natural river process and habitat abundance and resiliency.

Short term objectives**:** Connect floodplain habitats (at 1-2 yr flood interval) through levee removal and LWD structure placement in stream and on floodplain.

a. Remove ~670' of river levee and reconnect ~27acres of low floodplain at <2 yr flow interval through placement of key LWD structure and roughness features.
b. Place 54 LWD structures for the purpose of increasing channel complexity and roughness and increase floodplain connectivity.

Long term objectives: A list of longer term objective are identified have been developed from project field surveys (Table 5).

Project Back Ground & Summary:

Background: Project Area 32 was identified as a high priority restoration project in the Tucannon Conceptual Restoration Plan (Anchor QEA 2011 April) and was prioritized in the plan for early implementation and approved for funding by the Regional Technical Team and the Salmon Recovery Board, in 2019. The Program provided the CCD, design and technical support toward the development of PA 32.1, including a pre-design rapid habitat survey and design surveys in 2019 and 2020 prior to project implementation. The program supported the CCD in concept development, HIPP documentation and provided technical support. A restoration

design was finalized in 2019 and updated in 2020, with implementation beginning in September 2019 and completed in August 2020.

Summary: Restoration actions at PA32.1 spanned two years and involved the removal of channel confining features, the placement of LWD structures, in channel and on the flood plain and the construction of a set-back levee to maintain protection to adjacent agricultural fields.

In 2020, approximately 58 structures composed of 251 LWD key pieces (>6m long & 0.3 m dia) with root-balls attached, small to medium size "racking trees, and slash (tree limbs and other course woody debris) were placed in channel and on the floodplain. A total of 26 LWD structures were built within the wetted channel adding to the 11 existing natural LWD structures (Table 8). The goal of LWD structures are to encourage channel complexity through gravel bar formation, pool development, increase floodplain inundation frequency and side channel development. Two single logs were places for fish cover purposes, increasing the total number of single logs in the project area to 5. All structures were anchored and secured using ballast rock and secured together using pins and rope connections. Structures built on the floodplain were buried and buttressed with rock. Natural materials pre-existing in the project area remain unsecured as they were prior to implementation.

In 2019, the project increased floodplain connectivity through the removal of 367 m of river levee, cobble berms and rip rap located on the river bank and in conjunction with river channel roughness LWD structures placed in 2020, will increase flood frequency on 27 ac of low-lying floodplain (Figure 20). This project areas is located on an active farm and the low-lying adjacent alfalfa fields are used to produce hay for winter stock animals. The field is supported by two irrigation pivots which had conserved water trusted it to instream flows and cannot be flooded on an annual basis. To accommodate the existing agriculture production and the goal of increasing flood inundation at < 1 yr flood a 760 m setback levee was constructed to protect the fields up to the 5 yr flood (Figure 20).

It is the intention of this project to increase the overall floodplain and side connection at <1 yr flood intervals to improve habitat availability at the frequent flows (the high winter flow experienced 9 out 10 yrs. in the Tucannon basin) providing fish cover and increase productivity as described in Clure (2013). This approach has allowed the Program the ability to increase available winter rearing habitats significantly in many areas of the basin and most recently ~4 miles upstream in PA28.2 (Figure 1).

The key habitat features being monitored at this project site include geomorphic changes in channel form and habitat units, channel complexity (number and length of side channels) and excessive stream power as defined in the 2021 Plan. This dataset is being populated through the analysis of topo-bathymetric LiDAR collect pre- project in 2017 and post project in 2020, with anticipated follow up surveys planned after significant flood flows (>5yr) or 2028 whichever occurs first. Pre-project rapid habitat surveys were completed in 2019 and 2020 with a post project survey completed following construction in 2020 (Table 8). Rapid habitat

surveys are planned to be repeated ever two years following construction or following significant flood flow >2yr return interval.

Rapid habitat survey metrics for two pre-project surveys and one post project as-built survey were collected at or near base flow conditions in 2019, again in July of 2020 and in late August of 2020 following construction (Table 8). The pre-project surveys show a fairly large increase in active ephemeral side channel from 2019 to 2020. This is likely the result of the larger flood event that occurred in February 2020, which inundated nearly all of the floodplain topped the setback levee and inundated the adjacent fields. This was not entirely unexpected if not inconvenient between construction work windows, as the levee set-back was constructed to top at > 5 yr. flood elevation. The metrics for LWD frequency, pool frequency remain general the same across pretreatment years but show increases following construction as for perennial side channels. Currently a follow up survey is planned for the summer of 2022, when we would compare site metrics to anticipated project objectives (Table 8).

Table 8: Project area 32.1 rapid habitat survey results collected in 2019 and 2020 during pre-project surveys and in 2020 following implementation. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m^2)	Mean Depth Range (m)
Project Reach obj 2022	none	>1000	>1000	>100	>50	>10	>20	3,000	>1.0-1.5
Pre-project (2019)	0.98	105	119	23	11	6	19	740	0.5-1.0
Pre-project (2020)	1.08	106	1532	13	13	5	21	1023	0.5-1.0
Post-project (as-built) 2020	1.08	881	1086	268	68	5	34	1964	0.5-1.0
Post-project +2yrs 2022	N/A	N/A	N/A	N/A			N/A	N/A	N/A

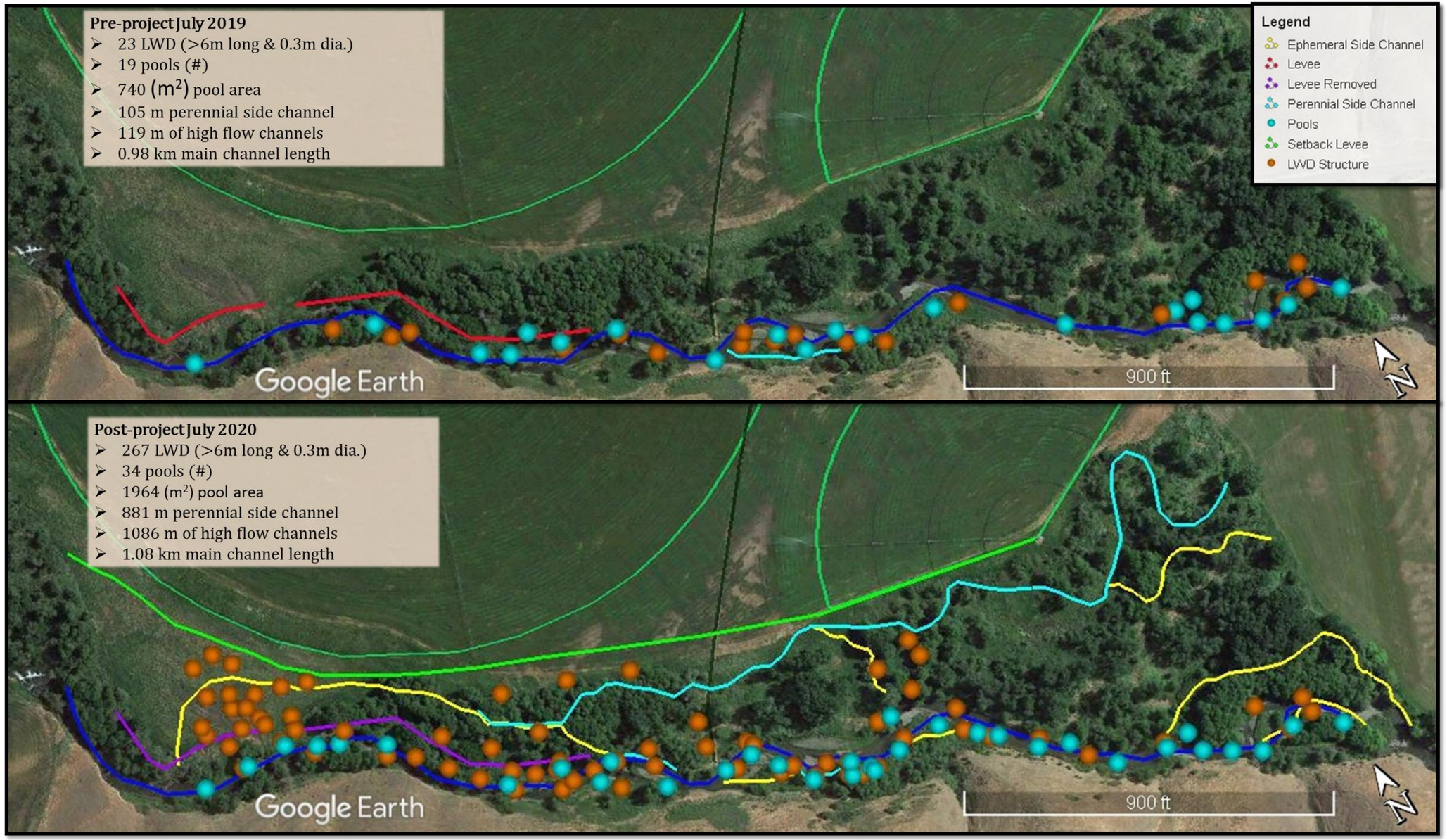


Figure 20: Project area 32.1 constructed in 2019 and 2020 to increase floodplain connectivity and channel complexity. The maps above are developed from the results of rapid habitat surveys conducted in 20119 and 2020 before and after project completion.

Project Title: Tucannon River Habitat Restoration (PA34.1 & 34.2)

Implementer: Columbia Conservation District

BPA Programmatic Funding (210-202-00): FY20 $2,000 (#84836)

Other BPA Funds (1994-018-06): FY201 engineering ~$20,500

Matching Funds: In FY20 the CCD received a SRFB grant for $81,066 (# 20-1052) to complete construction designs, engineering and modeling.

Project Time Line: In 2020, the CCD and the programmatic worked to complete a project reach assessment and concept development. Initiate concept prioritization, selection and design development including permits for future implementation in 2022-2023.

Location: PA34.1 Start Lat/lon 46.505962/-117.988847, End Lat/lon 46.508280/-117.996584 and PA34.2 4 Start Lat/lon 46.506280/ -117.996584, End Lat/lon 46.506293/ -118.010482 (Figure 2).

Priority Populations: Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened) and Snake River ESU Fall Chinook (Threatened)

Priority Life Stages: All life stages for, Snake River DPS Summer Steelhead and Snake River ESU Fall Chinook. This project would have benefits to winter rearing and migration of Snake River ESU Spring/Summer Chinook and Columbia River bull trout.

Project Goal: The anticipated goals of the design would be to improve floodplain connectivity, increase channel complexity and reduce excessive stream power to support natural river process and habitat abundance and resiliency.

Objectives: Detailed project objectives will be identified during project development and design phases in 2021-22 prior to implementation in 2022.

Project Back Ground & Summary:

Background: The Program provided the CCD, field assessment and technical support toward the development of design concepts for project area PA 34.1 and PA34.2 in 2020, including a pre-design rapid habitat survey (Table 9) and initial concepts and objectives to aid in securing funds for design development in 2021. These projects were prioritized in the 2021 Plan as priorities for restoration actions based on potential for connecting floodplain and potential to have significant habitat gains for winter rearing salmonid habitats.

The Columbia Conservation District has received a SRFB grant to initiate project design on one or both the project areas beginning in 2021 for construction in 2022-23.

Summary: The projects are both located on an active private farm (Figure 2) and the current active river and riparian habitats are adjacent to active irrigated farm fields that are protected

by channel confining features like levees, riprap, gravel berms and a bridge (Figure 21). The design concepts are currently investigating opportunities to remove some of the river confining features, adding LWD and reconnecting floodplain. It is anticipated enacting this goal will lead to significant increases in channel complexity, particularly in channel complexity more than doubling perennial side channel length (Table 9).

In 2021, the Program will work with the CCD to continue to develop design concepts and work with the land owner to determine the potential needs for the development of a setback levee to accommodate the conversion of disconnected floodplains to low-lying floodplain. The current existing condition and potential restoration objectives are provided in an illustration which show the existing condition as well as restoration potential (Figure 21).

Table 9: Project area 34.1 and 34.2 rapid habitat survey results from 2020 project reach assessments for design concept development. Project metrics in this table include main channel length in meters, side channel length for both perennial channels and ephemeral channels in meters, LWD key pieces (>6 m long and 0.3m dia.), the number and type of LWD jams or single logs and the frequency depth and areas of pools.

Project Area Survey Type	Main Channel Length (km)	Side Channel (m)		LWD Key Piece (#)	Structure #		Pools		
		Peren	Ephem		Jams	Single Log	Freq. (#)	Area (m^2)	Mean Depth Range (m)
PA34.1 Pre-project (2020)	1.11	329	982	22	12	5	14	447	0.5-1.0
PA34.1 Project Reach obj.	None	1,000	500	>111	>28	5	30	3,330	>1.0-1.5
PA34.2 pre-project (2020)	1.27	1,500	1,000	69	35	8	N/A	N/A	N/A
PA34.2 Project Reach obj.	None	N/A	N/A	121	50	12	31	4,000	>1.0-1.5

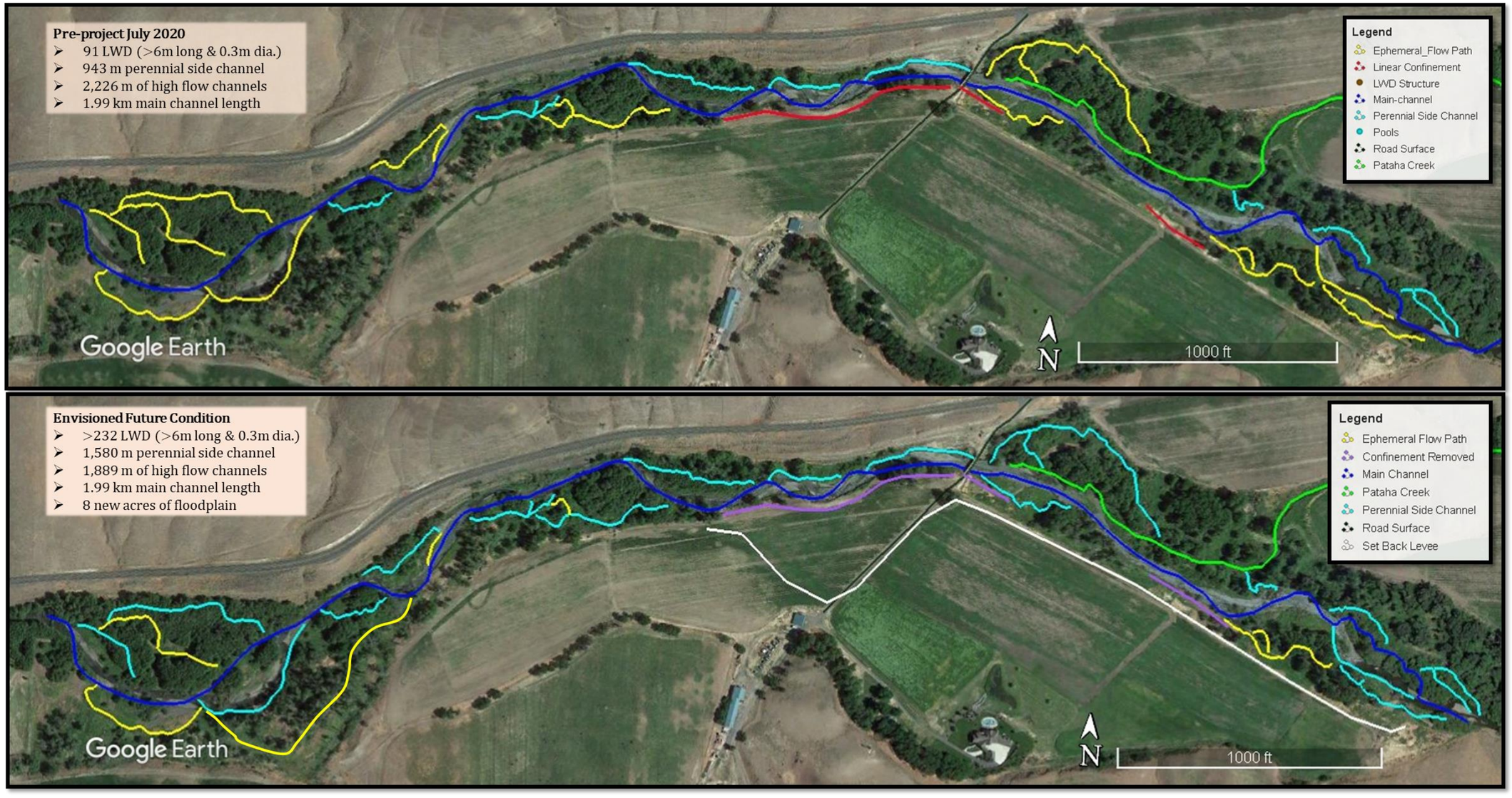


Figure 21: Project area 34.1 and 34.2 illustrated from left to right respectively. The upper map was developed from current field conditions observed in 2020 during the pre-project rapid habitat surveys. The lower map is developed based on 2020 field conditions and observations made in the field and existing relative elevation models provided in the 2020 Tucannon Conceptual Restoration Plan (Anchor 2021).

Project Title: Conceptual Habitat Restoration Strategy: Tucannon Plan Update

BPA Programmatic Funding (2010-077-00): The Program supported the CCD in acquiring data an providing document review during the plan update.

Other BPA Funds (1994 018-06): In FY 2020 the CCD provided $199,950 towards completion of the plan.

Location: Tucannon Basin, not including the Pataha Creek

Project Time Line: 2018 fill data gaps and conduct field evaluations. In 2019 finalize assessment and supporting material and update the Conceptual Restoration Plan to a draft documents. A final draft document is planned for completion in the winter of 2020-21.

Priority Populations: The Conceptual Restoration Plan update aimed to support natural habitats and native flora and fauna of the Tucannon basin through improving natural river process. Although these efforts are targeting Snake River ESU Spring/Summer Chinook (Threatened), Snake River DPS Summer Steelhead (Threatened), Snake River Fall Chinook (Threatened), Columbia Basin Bull trout (Threatened) restoring natural process will also provide habitat for all species present including pacific lamprey and bivalves.

Priority Life Stages: All life stages.

Project Goal & Objectives: The overall goal of the Tucannon Basin Habitat Restoration Geomorphic Assessment & Restoration Prioritization (Anchor QEA 2021) plan was to evaluate existing habitat conditions and prioritize habitat restoration efforts for the Tucannon Habitat Programmatic (2010-77-00) and its implementation partners within the basin for the time period 2021-2028.

Objectives:

a. Evaluate limiting factor priorities.
b. Articulate and solidify restoration goals and define both short term and long term restoration objectives for projects.
c. Update and evaluate fish distribution and habitat use date collected for the WDFW in basin Tucannon Life Cycle Model.
d. Consideration to all priority native fish species.
e. Consideration of tributaries and connectivity throughout the Tucannon basin.
f. Evaluate project implementation and change detection information.
g. Evaluate, prioritize and incorporate project reaches 2-5 in winter rearing habitats.
h. Produce a prioritized list of projects and designate implementers.
i. Formalize and prioritize adaptive management actions.

Project Background & Summary:

Background: In April 2011, the Columbia Conservation District (CCD) completed work with Anchor QEA to conduct the Tucannon River Geomorphic Assessment (Anchor QEA, 2011). Later that year, focusing on the high-priority areas for Tucannon spring Chinook, the CCD coordinated the development of a habitat restoration plan for the Tucannon River from RM-20 upstream to RM-50: the Conceptual Restoration Plan (Reaches 6-10), Tucannon River Phase II (Anchor QEA, 2011). In coordination with the CCD, the SRSRB worked to complete the Conceptual Restoration Plan for reaches 2-5, completing the entire 50 miles of river summarized in the Integrated Species Restoration Prioritization Tucannon River (Anchor QEA, 2012). These assessments and restorations plans have prioritized restoration efforts in the Tucannon since 2012 allowing the Program to work collaboratively in coordinated restoration efforts.

Overview: Since the 2011 assessment and prioritization, the Tucannon River has experienced significant implementation of instream and floodplain restoration, and some notable geomorphic change has been observed in areas of targeted restoration projects. The 2011 Plan identified significant data gaps making it difficult for project implementers during project analysis and implementation prioritization. Many of these data gaps have been narrowed, including sharpening the interest in fish use/distribution and how this information moves the needle towards salmon recovery. In addition to increasing our understanding of fish use in the basin, the use of bathymetric green Light Detection and Ranging (LiDAR) data has become more common and prices have decreased allowing for LiDAR and aerial photographic data collection, enabling the analysis of topographical data at a basin wide scale. Two bathymetric green LiDAR data sets have been collected, with the second collection event currently undergoing QA/QC analysis (discussed previously in this report). This greatly increase the topographic and riverine data analysis abilities in the Tucannon basin with the first green LiDAR dataset collected in 2017 and the second green LiDAR dataset following the 2020 flood event in November 2020.

The restoration opportunities presented in the report are focused on promoting natural geomorphic and ecological processes to restore ecosystem functions. Developing restoration strategies that take advantage of those opportunities and promote natural processes is vital to providing the greatest benefit to salmonid abundance and productivity in the near term, as well as long-term sustainability of project actions. In order to adequately understand how process-based restoration strategies can be used to promote the goals and objectives of this assessment, the plan examines the driving geomorphic processes and the expected geomorphic response of each prioritization goal. Through understanding the driving geomorphic processes of the prioritization goals, process-based restoration strategies have been developed that are expected to induce the desired geomorphic responses to achieve the prioritization goals and promote the desired ecological outcomes. The 2021 Plan identifies general restoration strategies that may be developed as an opportunity, along with the physical and biological benefits of each opportunity, and which analysis results were used to inform each restoration opportunity.

The 2021 Plan worked to consolidate and better define the habitat limiting factors by better defining the causes of the problem, the salmon life history stage being impacted as well as the expected ecological response to restoration actions (Table 2). The 2021 Plan goes one step further to identify standardized assessment methods and techniques for each prioritized limiting habitat factor. This approach will standardize habitat change across the basin utilizing datasets collected in the past as well as standardizing procedures for animating data analysis of both past and future datasets.

Channel braiding occurring on the Wooten Wildlife adjacent to the Tucannon Fish Hatchery in 2020 during elevated winter flow on PA 14.1 implemented in 2014.

Future Project Implementation (3-5 Year Plan)

In 2020, the Program worked to finalize project designs for implementation in out years and is planning future implementation on a number of projects identified as future work from the 2019 summary report. Following the completion of the 2021 Plan in early 2021 the Program will initiate action on priorities as they are outlined in the 2021 Plan. In 2020, the Program continued to address the priority work outlined in the 2011 Plan (Anchor QEA 2011) and now the 2021 Plan, as identified in the 5 year work plan (Table 10). The program coordinates with all the restoration partners in the Tucannon basin to provide up to date and current information of restoration priorities and future implementation.

Table 10: Tucannon Programmatic Habitat 5yr Work Plan 2021-2026.

Project Title	Priority Population	Limiting Habitat Condition(s)	Prioritized Habitat Action Types	Proponent Organization	Proposed Year of Implementation
Project Area 13	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	WDFW	Phase I -2021 Phase II - 2022
Project Area 17/18	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	CTUIR	Phase I -2022 Phase II - 2023
Project Area 27/28.1	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	CTUIR	Phase 1.5 - 2021 Phase 2 - 2022
Tucannon LiDAR	All	Floodplain connectivity, channel complexity, excessive stream power, and pools	Assessment	CTUIR	2021
Tumalum Fish Passage	Tucannon DPS Summer Steelhead	Passage Barrier	Fish Passage under Tumalum	NPT	2022
Project Area 26 Phase II	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Addition of large wood, channel modification, side channel reconnection and riparian enhancement	CCD	2021-22
Project Area 26 Phase III	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Addition of large wood, channel modification, side channel reconnection and riparian enhancement	CCD	Phase III 2022-23 Phase IV 2023-24
Project Area 34.1	Tucannon DPS Spring Chinook, Fall Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	CCD	2025
Project Area 34.2	Tucannon DPS Spring Chinook, Fall Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Removal of channel confining features, addition of large wood, channel modification, side channel reconnection and riparian enhancement	CCD	2024
Project Area 10.3	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, gravel augmentation and riparian enhancement	WDFW	2024-25
Project Area 14.1&2	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, gravel augmentation and riparian enhancement	WDFW	2023-2024
Project Area 1.1	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, gravel augmentation and riparian enhancement	CTUIR	2024-2025

Table 10 (continued): Tucannon Programmatic Habitat 5yr Work Plan 2021-2026.

Project Title	Priority Population	Limiting Habitat Condition(s)	Prioritized Habitat Action Types	Proponent Organization	Proposed Year of Implementation
Project Area 5	Tucannon DPS Spring Chinook & Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, gravel augmentation and riparian enhancement	Unknown	2026
Project Area 6 Hixion Creek & Floodplain	Tucannon DPS Spring Chinook, Summer Steelhead, and Bull Trout	Fish Passage and connectivity	Channel connectivity and fish passage	Unknown	2022-24
Cummins Creek Delta Channel Complexity	Tucannon DPS Summer Steelhead	Floodplain connectivity, channel complexity, excessive stream power, and pools	Addition of large wood, channel modification, side channel reconnection, beaver augmentation and riparian enhancement	Unknown	2020-2026
Tucannon PA 44 Floodplain	Tucannon DPS Summer Steelhead, Fall Chinook	Floodplain connectivity, channel complexity, excessive stream power, and pools	Channel reconfiguration, addition of large wood, channel modification, side channel reconnection, and riparian enhancement	CCD	2022
Little Tucannon Bridge	Tucannon Summer Steelhead, Bull Trout	Fish Passage and floodplain connectivity and habitat complexity	Bridge relocation, delta reconfiguration, addition of large wood, channel modification, side channel reconnection, and riparian enhancement	CTUIR	2022-23

Northwest Power & Conservation Council Staff Recommendations

The SRSRB, in coordination with BPA, began work in 2017 to address the Northwest Power Planning Council (NWPPC) staff recommendations made in the June Decision Memo to the NWPCC. We continued in 2019 to be committed to making positive changes in our umbrella project in response to ISRP's review and NWPCC staff recommendations. To initiate these changes the Program is nearing completion of an update to the 2011 Plan (Anchor QEA 2011) in the 2021 Plan (Anchor QEA 2021) which focused on addressing staff recommendation described in the following passages. The following summarize progress toward addressing the recommendations:

#2 Measurable Objectives-The SRSRB developed recovery and restoration goals and objectives in the Salmon Recovery Plan for SE Washington (2005), and further refined them in the 2021 Plan. In 2020, the updating effort in the 2021 Plan took a closer look at the Program goals and objective and described the progression over time from the Sub-Basin Plan (Table 2) and the Salmon Recovery Plan relating them from the EDT and Key Limiting factors identified in the earlier plans and how they relate to what we are seeing as the root cause of the problems in 2019 (Table 2). The 2011 Plan then identified and prioritized habitat goals and objectives that measurable and repeatable using a number of assessment methods. The 2021 Plan identified floodplain connectivity and channel complexity as the primary limiting factor inhibiting habitat recovery at a geomorphic scale in 2019. While the Program can generate short-term objectives (3-5 years) based on the current portfolio of projects identified and their expected outcomes (2011 Plan), long-term objectives (5-10 years) are based on changes in geomorphic process which will be assessed using the positive changes in floodplain connectivity, channel complexity and reduction in excessive stream power as described in the 2021 Plan (Anchor QEA 2021). The restoration plan long-term objectives beyond 2023 are based on the following considerations - FCRPS BiOp process, resulting BPA mitigation commitments, regional prioritization of projects (also conducted within the 2021 Plan), and funding coordination.

Short-term objectives: At the project scale, restoration sponsors identify the project-specific objectives based on what is identified in the 2021 Plan (Anchor QEA 2021), what is identified in rapid habitat surveys and what is achievable given landowner and or fiscal constraints. The highest priority goals identified in the 2021 Plan (Anchor 2021) are based on habitat outcomes for species and life stages (Table 2) and primarily focus on increasing floodplain connectivity, channel complexity and reducing stream power. The purpose of having these goals in prioritizing actions and projects is that making improvements toward these goals should make improvements in some of the restoration objectives of both the SRSRB and the Program. Objectives where we see improvement are floodplain connectivity, and channel complexity caused by LWD retention and LWD jam formation, which results in gravel deposition and increased pool frequency and quality. As LWD jams increase and gravel bar formation increases we have observed increased perennial side channels and floodplain connectivity over relatively short periods of time of 1-3 years. Standardized assessment methods have been identified to

measure these metrics both periodically at a basin scale and in real time at the project level. The restoration goals and associated assessment result indicators have been identified restoration strategies (Table 11).

Long-term objectives: The most useful type of objectives are those that help the Program and BPA make decisions about project prioritization, funding, and future design strategies. The 2021 Plan has provided a comprehensive, prioritized project portfolio with associated project outcomes related to fish, habitat, and population productivity and viability (Anchor QEA, 2021). Based on the needs identified in the 2021 Plan, BPA mitigation commitments, funding coordination, and expected BPA funding it may be possible to select the set of Program projects and layout meaningful objectives beyond 2028. This will allow the Program and BPA to forecast potential habitat related outcomes further into the future.

The Program is currently reviewing the information provided in the 2021 Plan and using the assessment methods to formalize a streamlined monitoring plan that can be used at the contract level and rolled up to the Program (watershed) level, to evaluate progress toward meeting both long and short term goals and objectives. In the absence of ongoing programmatic monitoring projects within the basin and uncertainty in future inclusion of the Tucannon in new basin wide approaches, the program and its partners have used the recent 2021 Plan update to crosswalk existing limiting factors with prioritize measurable habitat metrics, that can be measured periodically using existing information collected in support of the Program and in basin partners. The 2021 Plan (Anchor 2021) identify a number of prioritization weighting metrics collected through remote sensing (LiDAR) and rapid habitat surveys (implementation monitoring) to evaluate outcomes at sites where measurable objectives have been developed. One particularly interesting outcome will be modeling channel complexity before and after project implementation for low flow, winter flow and the 1 year flow interval, described in the 2021 Plan (Anchor QEA 2021). This type of modeling may allow us to develop and track changes in habitat fish capacity and suitability over time using one of the available models like the Habitat Suitability Model (HSI) to index changes in available key habitat spatially and temporally. The Program is investigating in the potential for animation of these models on line at TucannonRiver.org hosted by CTUIR and powered by the CTUIR CDMS database, to more effectively streamline data QA/QC and progress reporting. Collectively, the Program is developing a streamline monitoring plan in 2021, which will focus on the limiting factors identified in the 2021 Plan to be most effective for capturing Tucannon priorities and that are quantifiable and measurable. The goal would then be to use as much remote sensing information and approaches that are animated (reproducible) to reduce the effort and subjectivity of larger more complicated monitoring efforts.

The Program plans to track progress toward meeting objectives through the reforms to the M&E programs in the basin, but currently there are few monitoring effort aimed at measuring wild fish and habitat outcomes at project sites or project reaches. Fish monitoring is outside the control or ability of this project to fund monitoring. The SRSRB coordinates with the co-

managers fish programs to assist in securing equipment and has funded some effort like the Tucannon Life-Cycle Model developed by WDFW (Crawford 2019).

There are a number of data gaps particularly in adequate stream flow gauging and monitoring of juvenile fish within the basin

#3 Use of Data and Information-The Program continues to rely on existing literature and the 2021 Plan to inform our review of the biological benefits of proposed habitat actions. The current 2021 Plan has focused on integrating new date in the form of 2017 bathymetric green LiDAR and 2020 bathymetric green LiDAR to assess the associated metrics as part of a geomorphic change detection analysis developed to support of the 2021 Plan.

#4 RM&E-The SRSBB is involved in the NWPCC effort to develop an M&E Strategy and is open to any guidance that could improve data and information available for project selection, design, implementation, and evaluation if and when it is developed. The Program will provide the NWPCC with the finding of our local technical team in the development of a streamlined monitoring plan for the Tucannon basin currently underway.

The Program in currently developing a monitoring strategy to assist with the planning and prioritization processes going into the future. The Program is taking this approach in the absence of existing habitat RM&E efforts within the basin. The Program is using the 2010 LiDAR, the 2017 bathymetric green and the 2020 bathymetric green LiDAR data sets to conduct geomorphic change analysis and develop modeled floodplain inundation at various flow intervals. These inundation models are then being used to conduct floodplain connectivity analysis, channel complexity analysis and model stream power. Due to the cost of LiDAR acquisitions and no dedicated budget to conduct surveys the Program works with the partners to identify and cost share data acquisitions up to this point. The current goal is to acquire a new data set on an eight year cycle or following significant flood events. In the interim the metrics of channel complexity can be reevaluated using the existing rapid habitat survey data which is collected in support of Program reporting and is on a 2 yr. cycle. The Program data is now being stored in the CTUIR CDMS database for future analysis. The Program is currently work to add data attributes to the rapid habitat surveys that can be used to provide interim measures of floodplain connectivity and stream power.

Table 11. Prioritization goals and their driving geomorphic process.

Goal	Driving Geomorphic Processes	Assessment Result Indicators	Restoration Strategies
Increase complexity at low-winter flows (~130 cfs)	• Bedload sediment transport and availability • Floodplain connection and inundation • Wood material recruitment	• Standardized Complexity Evaluation at Low-Winter Flow	• Gravel augmentation for channel dynamics • Address encroaching features • Reconnect/develop side channels • Develop instream structure (wood) • Riparian zone enhancement for wood recruitment
Increase complexity during spring and winter peaks (~1,000 cfs ??)	• Bedload sediment transport • Floodplain connection and inundation • Wood material recruitment	• Standardized Complexity Evaluation at Mean-Winter Flow • Standardized Complexity Evaluation at 1-year Flows • Excess Transport Capacity	• Gravel augmentation for channel dynamics • Address encroaching features • Reconnect/develop side channels • Develop instream structure (wood) • Riparian zone enhancement for wood recruitment
Reconnect disconnected and abandoned floodplains	• Bedload sediment transport • Floodplain connection and inundation • Channel confinement and incision	• Channel Aggradation • Encroachment Removal • Excess Transport Capacity	• Channel aggradation to reverse incision • Address encroaching features • Reconnect/develop side channels
Improve quantity and quality of pools	• Bedload sediment transport • Wood material recruitment	• Pool Frequency Analysis • Excess Transport Capacity	• Gravel augmentation for channel dynamics • Address encroaching features • Develop instream structure (wood) • Riparian zone enhancement
Increase retention and storage of in-channel bedload sediments	• Bedload sediment transport • Channel confinement and incision • Wood material recruitment	• Excess Transport Capacity • Channel Aggradation	• Gravel augmentation • Address encroaching features • Develop instream structure (wood) • Riparian zone enhancement for wood recruitment • Modify or remove obstructions

#5 Screening Criteria-The Program and BPA, through coordination with the SRSRB Regional Technical Team, continue to consider and incorporate information on climate and are developing priorities based on future predicted changes. We currently have very little information on contaminants within the basin beyond the TMDL (WDOE 2010) for temperature. Human population growth within the Tucannon basin in relation to real estate development has been relatively stable over the last decade with few new home being constructed. There is some information regarding demands on natural resources identified in a WDFW studies conducted on public resource use on the Wooten Wildlife Area. One avenue to track changes in land use the Program is utilizing from the LiDAR data collected in 2010 and in 2020 developed a riparian habitat cover change detection model identified in the 2021 Plan. The

Program feels that increasing trends in riparian cover would be a surrogate for floodplain connectivity, with stable growth showing an increase in floodplain connectivity.

#6 Information Gathering-The Program continues to gather implementation and effectiveness monitoring data when it is available and summarize those data in annual reports and summaries to the ISRP and NWPCC. Projects in partnership with CTUIR generally have implementation monitoring conducted pre and post construction but very few have effectiveness monitoring. Without dedicated funding for either type of monitoring for Program Projects the information is limited and often inconsistent. The Program has coordinated the development of a Tucannon website and worked with CTUIR to enter existing data into the CTUIR CDMS data base, which will be available for release in 2021 at the web domain TucannonRiver.org.

#7 Monitoring Sites-The monitoring projects directly associated with the Program (CHAMP, AEM) input data into monitoringresrouces.org. To this point the restoration project data is stored at the State of Washington Salmon Recovery Portal https://srp.rco.wa.gov/site/320 and is updated periodically by the SRSRB. Project site data is collected in support of project development and setting as-built conditions is QA/QC by the SRSRB in coordination with the project implementers and is currently be developed for permanent storage on CTUIRs database in support of the Program with public portal through Tucannon.com web domain also supported by CTUIR on behalf of the program.

#8 Two-Year Contracts-The SRSRB encourages the NWPCC to coordinate directly with BPA on the potential for two-year contracts for the umbrella projects. The Tucannon Programmatic operates on 1.25 FTE and annual contracting and report competes for time and effort that would otherwise be utilized in the field supporting project implementers.

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