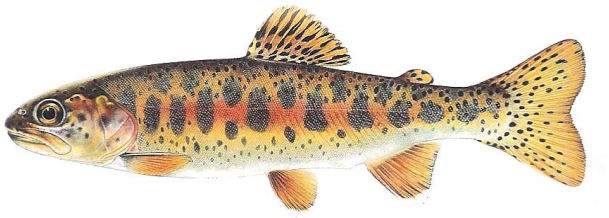
Progress Report 2017-2019: Hangman Creek Fisheries Enhancement Restoration Summary

BPA Project # 2001-032-00

Report covers work performed under BPA contract #(s) 82051, 78986, & 75767

Report was completed under BPA contract # 82051

5/1/2017 - 12/31/2019



Redband trout (Oncorhynchus mykiss gairdneri)

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1 Summary

Restoration for this reporting period covers three contracts, 75767, 78986, and 82051 for May 2017 through December 2019. Channel and riparian work continued on k'wne' 'ulchiyark'wmtsut, as well as several smaller projects on fish-bearing tributaries. In 2017 repairs were necessary for the second relict channel activated to maintain the fill area (Rkm 22.1 – 22.9) where the man-made channel was located prior to construction. In 2018 beaver dam analog structures were built in two locations (Rkm24.7 and Rkm 26.2) to improve overbank flooding to support riparian vegetation. In 2019, an artificial riffle was constructed at Rkm 24.9 for the same reason. Riparian enhancement occurred in each year and involved each of the four reaches of the k'wne' 'ulchiyark'wmtsut, project area. Improving fish passage within the watershed continued with a project HA_30.6 to replace two culverts that were not passable by salmonids. Stream channel work on Sheep Creek (SH_0.8) continued with LWD placements in the engineered channel in 2017, and its activation in 2018. Indian Creek (IN_4.6) was treated with LWD to improve pool habitat in 2018.

2 Site Description and Background

Hangman Creek drains 430,000 acres of northern Idaho and eastern Washington. The study area consists of the portion of the Hangman Creek watershed that lies within the Coeur d'Alene Reservation and east into the headwaters outside of the reservation. The Washington-Idaho State border, which corresponds to the border of the Coeur d'Alene Indian Reservation, marks the western boundary of the project area. The total acreage is 157,586, with 147,993 of that within the reservation. Elevations range from 754 meters in the northwest corner of the Project Area where Hangman Creek flows west into Washington to 1,505 meters at the top of Moses Mountain on the southeastern end of the Hangman/Coeur d'Alene Basin watershed divide. The named tributaries within the basin include Mission, Sheep, Smith, Nehchen, Indian, the SF Hangman and its tributaries Conrad and Martin, and the upper part of Hangman Creek east of the Reservation along with its named tributaries Parrot and Bunnel (Figure 1).

Assessment of the fisheries populations included a broad spatial sampling of fish and habitat in order to determine distribution and limiting factors over the entire Hangman watershed within Idaho boundaries (Peters et al 2003). Fisheries assessments from 2002 - 2013 in Hangman Creek indicate distinct linkages between land management practices and the presence of salmonids. In land managed for timber production and small home sites, habitat includes medium to dense forest canopy, gravel and cobble dominated substrate, and temperatures conducive to salmonid spawning and rearing (Peters et al. 2003; Kinkead and Firehammer 2011, 2012). In valleys dominated by various agriculture practices, discharge, temperature, dissolved oxygen, excess fine sediments, and lack of canopy and instream complexity coincide with an absence of salmonids during summer rearing (Kinkead and Firehammer 2011 & 2012). The spatial focus of the project was further delineated to prioritize tributaries and main-stem reaches at, or above Mission Creek where salmonid distribution is at its lowest extent (Green et. al 2008) in order to connect isolated salmonid populations.

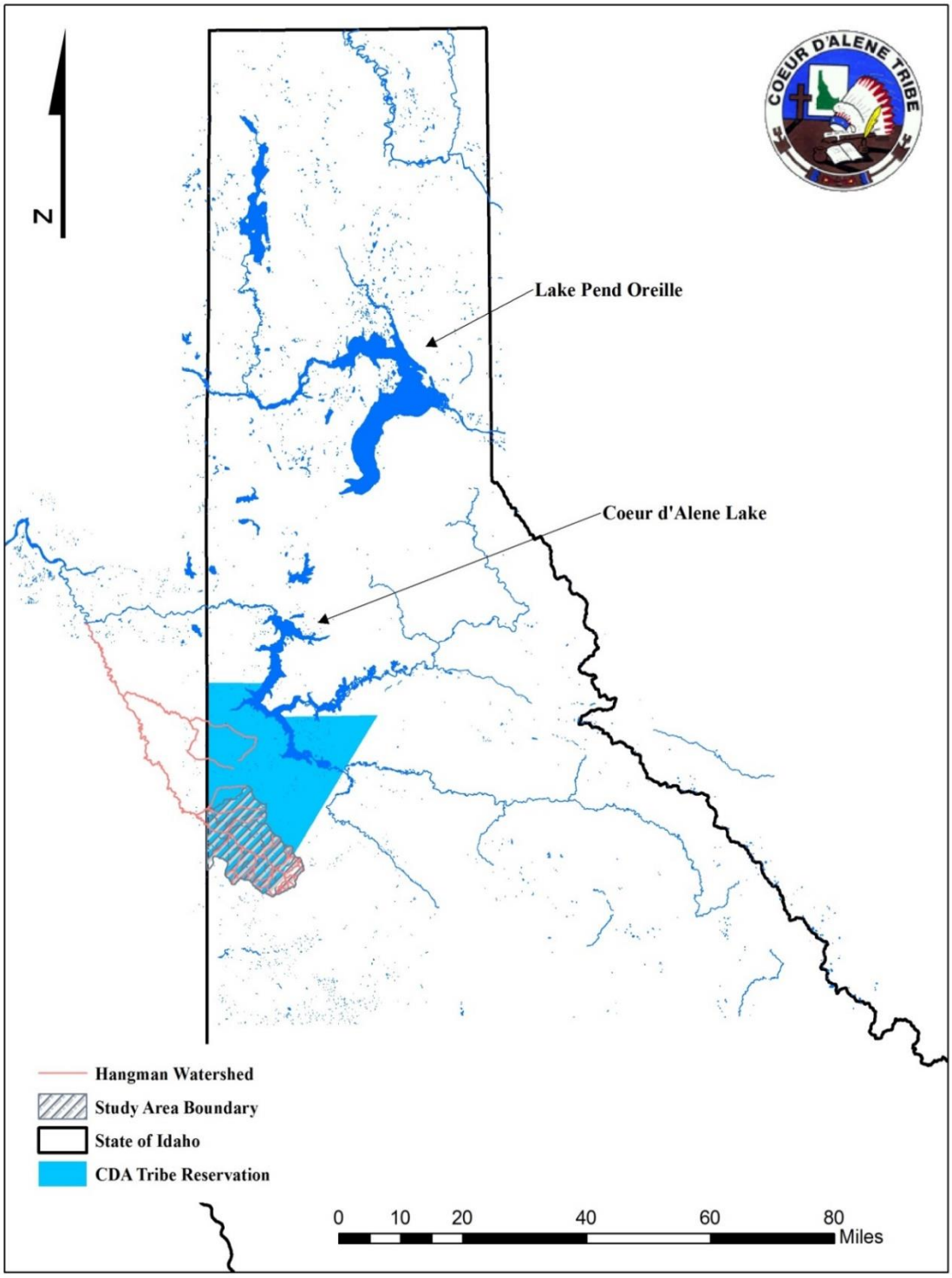


Figure 1. The Hangman Creek watershed study area, located in Idaho almost entirely within the Coeur d'Alene Reservation.

The Coeur d'Alene Tribe began transitioning from simple to more dynamic restoration approaches which rely more on hydrogeomorphic processes and away from the more traditional channel form or physical structure approach as described by Palmer et. al, (2014). Early in the assessment phase of the project the Coeur d'Alene Tribe contracted Hardin-Davis Inc. to use Instream Flow Incremental Methodologies to model the response of physical habitat and stream temperatures to simulated changes in flow and canopy cover. The results indicated improving canopy on the main stem of Hangman Creek was the key to increasing useable habitat for salmonids. It was determined that by increasing the canopy to 50%, temperatures would drop an estimated 2°C. while adding complexity within the stream channel using large wood to increase pool quantity and quality was necessary in the forested tributaries of Indian and Nehchen Creek (Hardin-Davis 2005). This conclusion resulted in efforts to add LWD to Indian Creek during 2008-2010 (Kinkead and Firehammer 2011, Kinkead and Biladeau 2013). Small restoration projects were also initiated on the main stem of Hangman with riparian enhancement in 2005 (Kinkead and Firehammer 2011 & 2012). These initial efforts on the main stem and tributaries of Hangman Creek show that while moderately impacted habitat can be restored with simple methods, severely impacted stream reaches required better channel/floodplain connectivity to ensure proper riparian function and plant persistence. Cost constraints prompted the Coeur d'Alene Tribe to consider using beaver to restore natural channel and riparian conditions.

The Coeur d'Alene Tribe then contracted with Herrera Environmental Consultants, Inc. to evaluate the feasibility of using beaver as a restoration tool across the entire upper watershed as a cost-effective means of restoring the hyporheic connection between incised stream channels and floodplains, and to replenish shallow ground water. All of the restoration work completed from 2017 – 2019 described in this report were identified and prioritized by Herrera and summarized in Figure 2. Herrera concluded the following (Kinkead and Biladeau 2013); delay any restoration work on reaches downstream of Mission Creek identified as reach HAMF04 until significant work had occurred on upstream reaches; Sheep Creek SHMF02 is a priority for restoration using beaver because of access and suitable habitat; Hangman Creek (HAMF13) should be the initial reach restored on the main stem of Hangman; Indian Creek (INMF02) was given a low priority for restoration using beaver due to a lack of riparian habitat containing hardwoods. Additional projects designed to improve fish passage in the priority areas were identified by Kinkead and Firehammer (2012) and completed in 2014. The lowest reach on Sheep Creek, below SHMF02, was identified as another location to gain improved stream channel to floodplain connection in conjunction with an on-going restoration project initiated by BPA project 2001-033-00.

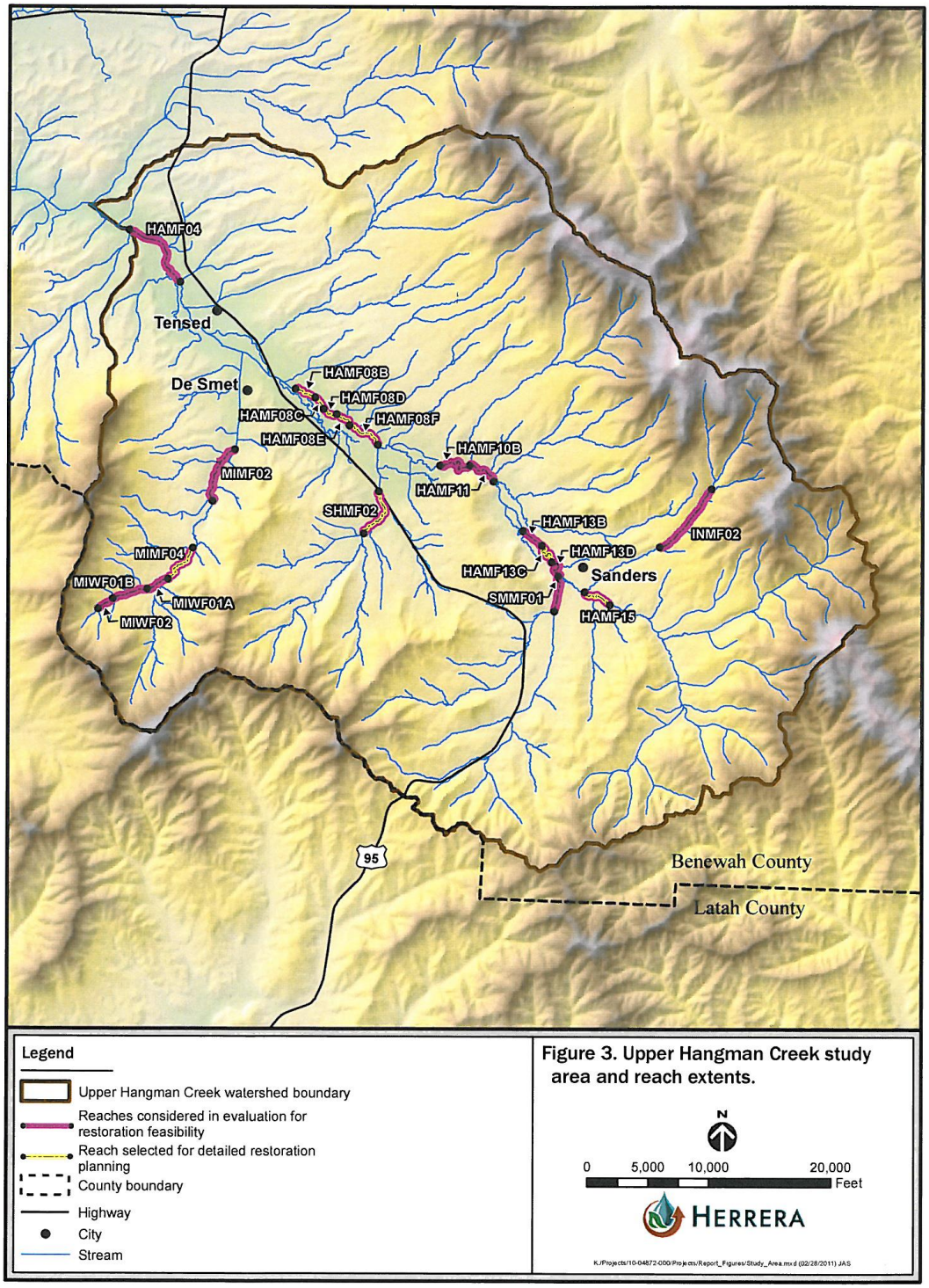


Figure 2. Map of reaches assessed and prioritized for restoration utilizing beaver (from Herrera 2011).

3 Introduction to Restoration Activities

Implementation of restoration and enhancement activities that occurred in the Hangman Creek watershed during three contract periods, January 1st 2017 – December 31st 2019, is summarized in Table 1 and Table 2. This is followed by a more detailed site characterization and summary of activities for individual treatments. In two locations, multiple treatments have been implemented to meet the objectives for the given resources. These treatments are grouped under the same project ID heading so that the interrelationship of activities is more apparent.

A brief explanation of the project ID that is used in the summary Table 1 & Table 2 and in the detailed descriptions is warranted here. The project ID is an alphanumeric code that corresponds to the location of individual treatments in relation to the river kilometer of the drainage network for the watersheds of interest. The first digit of the code signifies the watershed that the treatment is located in, using the first letters in the watershed name (e.g., HA=Hangman Creek, SH=Sheep Creek, etc.). The series of numbers that follow correspond to the river-kilometer location (in kilometers and 10ths) at the downstream end of treatment sites(s). River kilometer is tabulated in an upstream direction from mouth to headwaters. In the case of Hangman Creek, the 0.0 Rkm marker is at the Idaho/Washington boundary and continue upstream from that point. This is not to be confused with earlier reach numbers identified by Herrera using RM (Figure 2). Site descriptions include drainage area derived from GIS methods and bankfull discharges which were obtained from USGS StreamStats (2017). Locations of restoration treatments are shown in Figure 3.

Table 1. Summary of restoration/enhancement activities and associated metrics completed for BPA Project 2001-032, 2017-2019.

Project Description			Project Chronology			
Project ID	Activity	Treatments (Metrics)	Pre-2017	2017	2018	2019
HA_20.5	Increase Instream Habitat Complexicty and Stabilization	Offer Aspen Clippings to Beaver 26 m³ supports one ave size dam	156 m³ aspen	57 m³ aspen	26 m³ aspen	----------
HA_22.9 Phase 1	Increase Instream Habitat Complexicty and Stabilization	Fill Man-made channel (m) & activate relict channel (m)	Fill 425m of man-made channel, activate 1.6km relict channel	----------	----------	Activated 425m relict channel
HA_22.9 Phase 1	Plant Vegetation	Riparian Enhancement (area treated (ha); streambank length treated (km); number of plants; Height and length of fence installed (ft)	3,900 Live cuttings, 6,240 herbceous plugs, 18 lbs wetland seed, 60 lbs upland seed, 205 (5) gal deciduous trees, 750 (2) gal deciduous trees. 2km streambank vegetated, 17.5 ha. Protected with 20 cattle panel	230 (5) gal upland shrubs, 203 (2) gal deciduous trees, 72 (5) gal deciduous trees, Protected with 20 cattle panels	230 (5) gal mixed deciduous trees, and 70 (2) gal mixed deciduous trees, Built 470 meters 8' fence and 200' of 4' fence, and 24 cattle panels	150 (5) gal mixed deciduous trees, 100 live cuttings, 150 large plugs red cedar, 300 ponderosa pine plugs
HA_22.9 Phase 1-4	Increase Instream Habitat Complexicty and Stabilization	Offer Aspen Clippings to Beaver 26 m³ supports one ave size dam	208 m³ aspen (8 beaver dam)	57 m³ aspen	147 m³ aspen	283 m³ aspen
HA_24.3 Phase 2	Increase Instream Habitat Complexicty and Stabilization	Install LWD structure of riffle w/ Heavy Equipment; Install Analog beaver dam	Installed 2 Choke Flow Structures using root wads		Installed 3 Analog beaver dams	Installed 1 artificial riffle with heavy equipment
HA_24.3 Phase 2	Plant Vegetation	Riparian Enhancement (area treated (ha); streambank length treated (km); number of plants; Height and length of fence installed (ft)	Planted 5,150 willow poles, 400 Cottonwood poles, 125 (5) gal hardwood trees, 1,730 (2) gal deciduous trees, 600 (2) gal upland shrubs, 20 lbs wetland grass, seed, and 50 (2) gal upland shrubs, and 1,782 herbaceous plugs. Installed 1,700 feet of wildlife exclusion fencing. 23 ha and 1.8km treated	----------	20 lbs upland seed, 20 lbs wetland seed (Maintenance of Vegetation)	50 (8) gal Cottonwood,295 (5) gal mixed deciduous trees, and 600 live cuttings, 500' of 4' fencing, and 7.7 ha treated
HA_21.0 Phase 3	Increase Instream Habitat Complexicty and Stabilization	Fill Man-made channel (m) & activate relict channel (km). Constructed of new channel (m)	Fill Man-made channel (450 m) & activate relict channel (2.3 km). Constructed 225 m of overflow relief channel	Repair 450m of fill, build 2 new berms	----------	----------
HA_21.0 Phase 3	Plant Vegetation	Riparian Enhancement (area treated (ha); streambank length treated (km); number of plants; Height and length of fence installed (ft)	Planted 600 (2) gal alders, 100 (2) gal upland shrubs, 300 conifers, and 20 lbs upland seed, and 20 lbs of wetland seed, 76 ha treated, 1.2km streambank treated	563 (5) mixed deciduous trees, 557 (2) gal mixed deciduous trees, built 700 m 8' wildlife exclusion fence, (Maintenance of Vegetation)	840 (5) gal mixed deciduous trees, 320 (2) gal mixed deciduous trees, 1,985 live cuttings, 20 lbs upland seed, 20 lbs wetland seed, 1,000' of 4' fence, and 2.0 ha treated	305 (5) gal mixed deciduous trees, 75 (2) gal mixed deciduous trees, and 4,100 live cuttings, and installed 200' of 4' fence and 34 cattle panels, and 2.1 ha treated

Table 2. Summary of restoration/enhancement activities and associated metrics completed for BPA Project 2001-032, 2017-2019.

Project Description			Project Chronology			
Project ID	Activity	Treatments (Metrics)	Pre-2017	2017	2018	2019
HA_25.7 Phase 4	Increase Instream Habitat Complexicty and Stabilization	Install Analog beaver dams	----------	----------	Installed 3 Analog beaver dams	----------
HA_25.7 Phase 4	Plant Vegetation	Riparian Enhancement 2.0 ha and 515 m of stream bank; Height and length of fence installed (ft)	Planted 483 willow poles, 100 potted (5) gal deciduous trees, 100 (2) gal upland shrubs, and 200 (2) gal aspen trees, treated 2.0 ha and 515km streambank, and installed 303m of 8 ft tall wildlife exclusion fencing	30 (5) gal mixed deciduous trees, and 605 live cuttings	10 (5) gal mixed deciduous trees, 10 (2) gal mixed deciduous trees, Built 470m wildlife exclusion fence (Maintenance of Vegetation)	100 (5) gal mixed deciduous trees, 25 (2) gal mixed deciduous trees, 250 live cuttings, 150 large plugs of red cedar, 400 ponderosa pine plugs, and built 150' of 4' fence, and 1.6ha treated
SH_1.3	Increase Instream Habitat Complexicty and Stabilization	Offer Aspen Clippings to Beaver (Materials for 4 Beaver Dams/year)	468 m^3 aspen	57 m^3 aspen	----------	----------
SH_0.8	Increase Instream Habitat Complexicty and Stabilization	Construct Choke Flow Structure on Sheep Creek	Installed 2 Choke Flow Structures using root wads	----------	----------	----------
HA_26.2	Increase Instream Habitat Complexicty and Stabilization	Analog Beaver Dams	----------	----------	----------	----------
IN_4.6	Increase Instream Habitat Complexicty and Stabilization	LWD Placement	----------	----------	Placed LWD at 10 locations	----------
HA_30.6	Remove Fish Passage Barrier	Number of Fish Barriers removed; length of streams given access to fish (km)	----------	----------	----------	2 culverts replace; 2.4km of stream for fish access

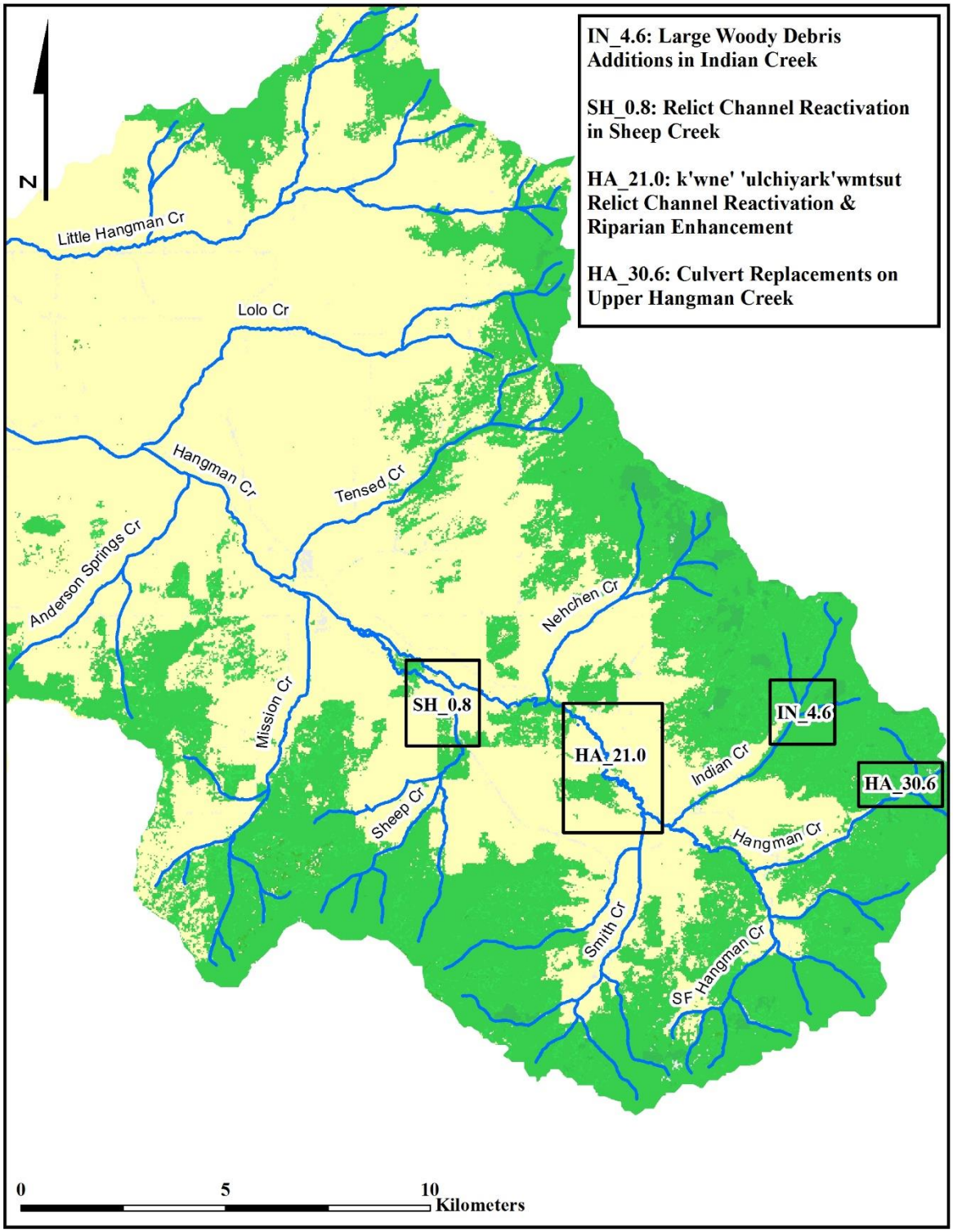


Figure 3. Locations of individual restoration projects completed 2017 – 2019 in the Hangman watershed.

4 Individual Restoration Projects

4.1 IN_4.6: Large Woody Debris Additions in Indian Creek

Project Location:

Sub-Watershed: MF Indian Creek	Legal: T44, R 3W, Sect 30
River Kilometer: 4.6	Begin: Lat: 47.113073°N Long: -116.725478 °W

Site Characteristics:

Slope/Valley gradient: 6.0%	Aspect: SW	Elevation: 3,222 ft.
Valley/Channel type: B4	Proximity to Water: In channel and riparian	
Bkf Discharge (cfs): 40	Drainage Area: (0.5mi²)	

Problem Description:

Indian Creek is home to a robust population of redband trout in the Hangman Creek watershed and is currently the only perennial tributary of Hangman Creek within reservation boundaries. Indian Creek is considered a priority to protect and enhance for purposes of maintaining a source population of native trout with a potential for dispersal into other areas of the watershed. Following World War 2 Indian Creek was dominated by a Western Red Cedar/ fern complex with a mosaic of open stands of aspen and alder following natural disturbances, with white pine, ponderosa pine, and Douglas fir in the uplands (Aripa 2003). However, most of the cedar in this short 0.4km section of Indian Creek was harvested approximately 25 years ago resulting in the current conditions. The watershed has mostly third order growth at this time, where red alder, fern, and various forbs dominate the riparian habitat, and grand fir dominates the upland. In areas where the riparian area was logged in the last 30 years, there is large number of expiring mature alder that contribute to LWD loading. This has resulted in numerous side channels formed by the unstable debris jams, which are not contributing to pool forming processes. Pools are on average 0.7 ft. in depth, and fine sediments are limiting spawning in this reach. Typically, the only pools found are formed by remnant downed cedar (Kinkead and Firehammer 2011).

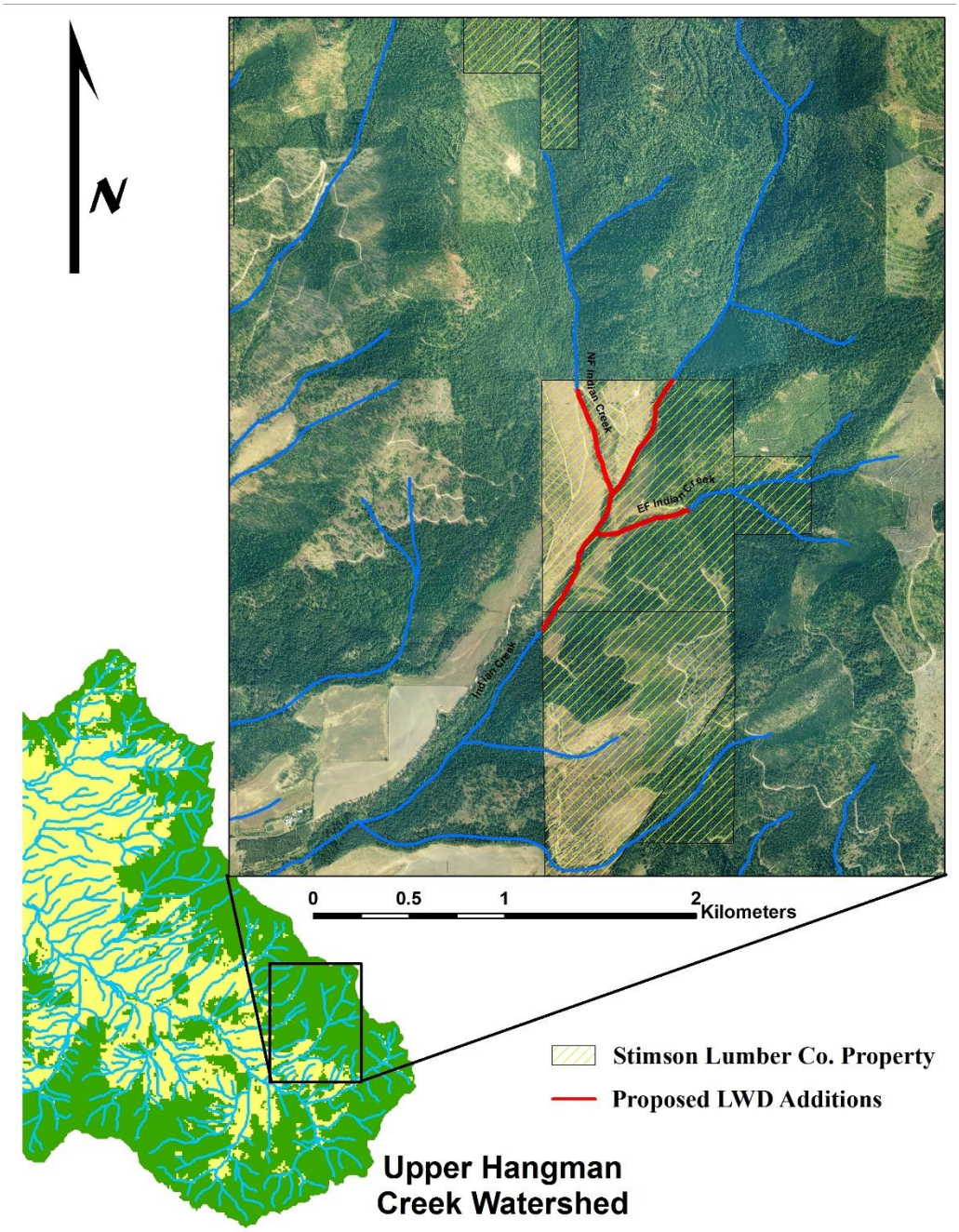


Figure 4. Location of MF Indian LWD Additions.

Description of Treatment

The large woody debris project was initiated in 2018. The primary strategy for this restoration project was to treat reaches lacking in pools, by adding stable wood for pool forming processes, along with secondary goals of decreasing erosion and creating a mosaic of stored fine sediments and sorted gravels for spawning. The riparian zone is already well established with alder and forbs, and the goal of construction was to limit disturbance while placing large woody debris. Accordingly, all wood was placed without heavy equipment, and logs were moved in using a portable log hauler on rubber wheels. The channel was not dredged and banks were seldom excavated with hand tools to place the logs at proper angles. Six log cross-vanes and four j-hooks were constructed throughout upper Indian Creek. These LWD structures are only intended to function until the recruitment of conifers improves.

Picture 1. MF Indian Creek Rkm 4.6, typical log cross-vein installed to improve pool habitat and sort substrate sizes.

Relationship to Scope of Work

The project fulfills the Program commitments for Work Elements E in the 2017 Scope of Work and Budget Request (Contract# 75767) for the contracting period dating May 1, 2017 through April 30, 2018.

4.2 SH_0.8: Relict Channel Activation in Sheep Creek.

Project Location:

Sub-Watershed: Sheep Creek	Legal: T44N, R4W, Sec 30
River Kilometer: 0.2	Begin: Lat 47.1287°N Long -116.8747°W

Site Characteristics:

Slope/Valley gradient: 0.08%	Aspect: X	Elevation: 2,533 ft.
Valley/Channel type: F5	Proximity to Water: In channel and riparian	
Bkf Discharge (cfs): 84	Drainage Area: (10.5mi²)	

Problem Description:

Much like many areas throughout the Palouse, portions of Sheep Creek, a major tributary in upper Hangman Creek, were channelized in order to move water off the landscape for the benefit of dryland agricultural practices. In turn, the natural stream channels were abandoned and replaced by excavated and straightened stream channels. In this particular case, the majority of the abandoned natural channel was still relatively intact.

In 2007, the Coeur d'Alene Tribe Natural Resources Program initiated a project near the mouth of Sheep Creek to reroute the stream through a 3.8 km reach of relict channel. This has resulted in a new location of the mouth of Sheep Creek; entering Hangman Creek approximately 3.5 kilometers downstream of the current location. However, an engineered channel 550 meters in length was necessary to complete the reactivation project. In order to help maintain this channel, stream flows above and beyond bankfull capacity are diverted using an engineered log jam constructed 310 meters upstream of the engineered channel (Kinkead and Biladeau 2017) (Picture 2). However, this engineered channel lacked any structure to form pools necessary for fish to utilize for migration upstream.

Picture 2. Lower Sheep Creek during winter 2016/7 through the choke flow structure built in 2016.

Description of Treatment

The Fisheries Program continued its channel work on Sheep Creek into the present reporting period with all work from 2016 through 2018 shown in Figure 5. In 2017 the engineered channel built by BPA Project 2001-033-00 was treated with LWD consisting of 4-J-hooks and 4 cross-vanes in preparation of channel activation planned for 2018 (Picture 3 & Picture 4). The structures were installed to direct flow away from corners in order to decrease bank erosion and create pools that will aid in upstream migration of salmonids. In 2018, 1,000 feet of the straightened channel of Sheep Creek was filled and the face was armored with rock and logs, diverting flows into the engineered channel (Picture 5). The beginning and ending of the engineered channel was rocked to maintain the grade of the stream. A drone photo shows the new channel activated during the winter of 2018/19 (Picture 6). BPA project 2001-033 is now actively working on reestablishing riparian vegetation along this channel.

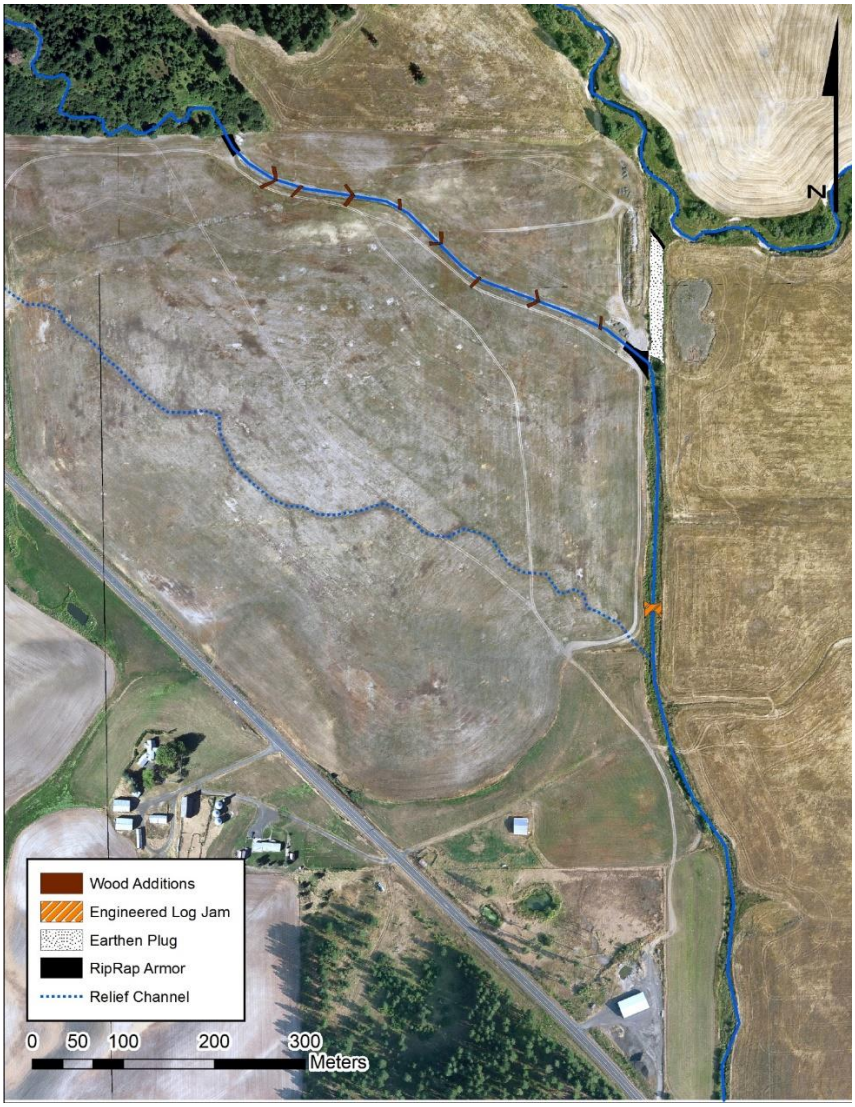


Figure 5. Map of Lower Sheep Creek SH_0.8 showing restoration treatments from 2016 – 2018.

Picture 3. Construction of cross-vanes on engineered channel of Sheep Creek prior to re-activation.

Picture 4. Completed Construction of cross-vane on engineered channel of Sheep Creek prior to re-activation, with cultural monitoring on site.

Picture 5. Channel plug constructed in 2018 to divert flow out of straightened man-made channel into relict channels.

Picture 6. Activated channel on Sheep Creek, 2019.

Relationship to Scope of Work

The project fulfills the Program commitments for Work Elements F in the 2017 Scope of Work and Budget Request (Contract# 75767) for the contracting period dating May 1, 2017 through April 30, 2018, as well as Work Element C in the 2018 Scope of Work and Budget Request (Contract# 78986) for the contracting period dating May 1, 2018 through April 30, 2019.

4.3 Hardwood Clippings Provided to Beaver (Multiple Locations)

Project Location:

Sub-Watershed: Hangman Creek	Legal: T44, R 4W, Sec 34
River Kilometer: 21.0 – 25.7	Lat: 47.11226°N Long: -116.81862°W

Site Characteristics:

Slope/Valley gradient: 0.05%	Aspect: NW	Elevation: 2,600 ft.
Valley/Channel type: F5	Proximity to Water: In channel and riparian	
Bkf Discharge (cfs): 450	Drainage Area: (37.6²)	

This set of reaches entails the entire k'wne' 'ulchiyark'wmtsut project area where beaver foraging threatened riparian enhancement efforts.

Project Location:

Sub-Watershed: Sheep Creek	Legal: T44N, R4W, Sec 36
River Kilometer: 1.3	Begin: Lat 47.11345°N Long -116.77966°W

Site Characteristics:

Slope/Valley gradient: 0.8%	Aspect: S	Elevation: 2,706 ft.
Valley/Channel type: F5	Proximity to Water: In channel and riparian	
Bkf Discharge (cfs): 80.6	Drainage Area: (7.2mi²)	

This 2nd reach of Sheep (SH2) begins above the bridge at HWY 95 and continues until the culvert on the Benewah County road. Reach passes thru CDA Tribal Allotment A336/340.

Project Location:

Watershed: Hangman Creek R13	Legal: T44N, R4W, Sec 28 NW ¼
River Kilometer: 20.5	Lat: 47.130289°N Long: -116.834803 °W

Site Characteristics:

Slope/Valley gradient: 0.5%	Aspect: NW	Elevation: 2,605 ft.
Valley/Channel type: C5	Proximity to Water: Riparian	
Bkf Discharge (cfs): 423	Drainage Area: (39.9mi²)	

Hangman Reach 11 (HA11). Reach lies within CDA Tribal Trust land 1030 and commonly referred to the "Sweatlodge Area". Riparian enhancement was initiated in 2005 and has been ongoing with different treatments and plant protection methods.

Problem Description:

All three of the locations described above have active beaver populations which do not have access to adequate hardwoods in order to build stable dams. Data gathered in previous beaver assessments indicate that mud, grass, and hawthorn are often used for building materials without incorporating any large materials as a foundation. Reed canary grass typically dominates the riparian area, along with a minimal amount of alder. Aspen and cottonwood were nonexistent prior to riparian enhancement associated with the restoration project. Hangman Creek Reach HA11 (Rkm 20.5) has a deeply incised channel with little connection between the stream and riparian area. Sheep Creek Reach SH02 (Rkm1.3) has moderately incised channels where peak flows occasionally spill out into the floodplain. Hangman Creek HA13 and HA14 (k'wne' 'ulchiyark'wmtsut, (Rkm 21.0 – 26.2) have on-going stream channel restoration and riparian enhancement occurring, and supplying beaver brush in these locations has proven to be successful in deterring foraging on newly planted willows and potted trees.

Description of Treatment

An estimated 173m³ of hardwood clippings, consisting of mostly aspen along with cottonwood and alder, were cut and placed at existing beaver dams to supplement food and building supplies at three general locations; Sheep SH02, Hangman HA11, and Hangman HA13 in 2017. In 2018 Sheep Creek was eliminated in order to focus efforts in Hangman Creek within the k'wne' 'ulchiyark' 'wmtsut project area. Within these 3 stream reaches, an equivalent of 1,151 pieces of two-inch diameter by 10 feet long hardwood pieces were provided, roughly enough materials to build twenty dams four feet high, ten feet long, and fifteen feet wide. By 2019 the total estimated volume of 173 m^3 of dam building materials was increased to 283 m^3 aspen cuttings throughout all phases of the *k'wne' 'ulchiyark'wmtsut* area due to the increased presence of beaver and their impacts on newly planted riparian vegetation (Picture 7 & Picture 8)

Picture 7. Aspen cuttings left at beaver lodge.

Picture 8. Typical size range of aspen cuttings provided to beaver.

Relationship to Scope of Work

The project fulfills the Program commitments for Work Elements J in the 2017 Scope of Work and Budget Request (Contract# 75767) for the contracting period dating May 1, 2017 through April 30, 2018, Work Element H in the 2018 Scope of Work and Budget Request (Contract# 78986) for the contracting period dating May 1, 2018 through April 30, 2019,as well as Work Element I in the 2019 Scope of Work and Budget Request (Contract# 82051) for the contracting period dating May 1, 2019 through April 30, 2020.

4.4 HA-21.0: k'wne' 'ulchiyark'wmtsut "Make it crooked again" Relict Channel Reactivation and Floodplain Connection Phases 1 – 4

Project Location:

Sub-Watershed: Hangman Creek	Legal: T44N, R4W, Sec 34
River Kilometer: 21.0 – 25.7	Begin: Lat 47.11226°N Long -116.81862°W

Site Characteristics:

Slope/Valley gradient: 0.05%	Aspect: NW	Elevation: 2,600 ft.
Valley/Channel type: F5	Proximity to Water: In channel and riparian	
Bkf Discharge (cfs): 400	Drainage Area: (37.6mi²)	

Problem Description:

During the late 1940's and early 1950's, approximately 4.3 kilometers of Hangman Creek, a perennial stream, was abandoned and replaced by 1.9 kilometers of excavated channel to promote agricultural practices and the use of a railway for transporting timber products. The newly excavated channel resulted in a higher gradient stream with little to no sinuosity. This in turn increased stream velocity and promoted head-cutting and stream bank erosion within the new channel and upstream. The adjacent floodplain became disconnected from the stream, changing the valley bottom from predominantly mixed forest wetland habitat to a combination of

forested wetland/scrub-shrub/upland forest habitat. Furthermore, large amounts overstory canopy were removed from the floodplain, adjacent riparian habitats, and along the stream channel to promote dryland agriculture and ranching practices in this area.

Restoration efforts were initiated in 2014 in this reach of Hangman Creek, and although much of the major construction activities were completed prior to this reporting period (Kinkead and Biladeau, 2017), repairs and additional channel work were necessary to maintain and improve floodplain connectivity throughout the project area. In 2016, approximately 300 meters of straightened channel was filled with native material in order to reactive an adjacent relict channel and restore connection to the surrounding floodplain (Kinkead and Biladeau, 2017). Subsequent flood events resulted in damage to the fill material which threatened to negate restoration efforts (Picture 9 and Picture 10).

Picture 9: Flood waters flowing down fill area in spring 2017.

Picture 10. Breached berm at bottom of Phase 3 prior to repair in 2017.

Description of Treatment

The dynamic approach to restoration relies more on hydrogeomorphic processes and away from the more traditional channel form or physical structure approach (Palmer et al, 2014). The restoration concept in Hangman Creek, although does incorporate the addition of physical structures, is intended to facilitate natural channel and riparian forest developmental processes in the project reach, leading to a more dynamic and resilient riverine and wetland ecosystem. Beechie et al (2010) describes process-based restoration actions as a way to reestablish normative rates and magnitudes of processes that create and/or sustain stream and floodplain ecosystems. This restoration design is intended to do just that, which in turn will lead to improvements in salmonid and wildlife habitat quality through the reconnection of the channel and floodplain over a large portion of the valley bottom. This will in turn maintain connectivity to the groundwater and provide additional habitat structure and depth. The design will further facilitate restoration of a riparian corridor composed of a mosaic of floodplain emergent, scrub-shrub and forested wetlands, and adjacent riparian forest. This is especially important as an increasingly dynamic and diverse riparian/floodplain ecosystem is essential for its ability to respond to future perturbations both physically and biologically, enabling it to evolve and continue to function in response to shifting system drivers such as climate change (Beechie et. al 2010).

Along with the development of a diverse and dynamic ecosystem, the Coeur d'Alene Tribal Fisheries Program also hopes to achieve a number of short-term objectives (<10 years) through this restoration project incorporating four phases (Figure 6).

- Increase floodplain connectivity
- Reduce in-stream temperatures to levels acceptable for redband trout *Oncorhynchus mykiss gairdneri* spawning and rearing
- Increase the rate of redband trout dispersal between subpopulations
- Increase rearing habitat for redband trout
- Reduce erosion rates within the stream channel
- Provide higher rates of mean base flow while blunting the peak(s) in the hydrograph
- Increase streambed elevation to natural conditions
- Promote colonization and persistence of beaver *Castor Canadensis*

Four stream channel restoration actions were completed within the *k'wne' 'ulchiyark'wmtsut* project area during 2017 thru the summer of 2019 which include;

1) Repair and reinforce fill area for the Phase 3 relict channel activation at Rkm 22.1 – 22.9
2) Installation of analog beaver dams below existing riparian enhancement efforts, three at Rkm 26.2, and three at Rkm 24.7
3) Activation of a 420 m relict meander at Rkm 24.0.
4) Construction of an artificial riffle at Rkm 24.9.

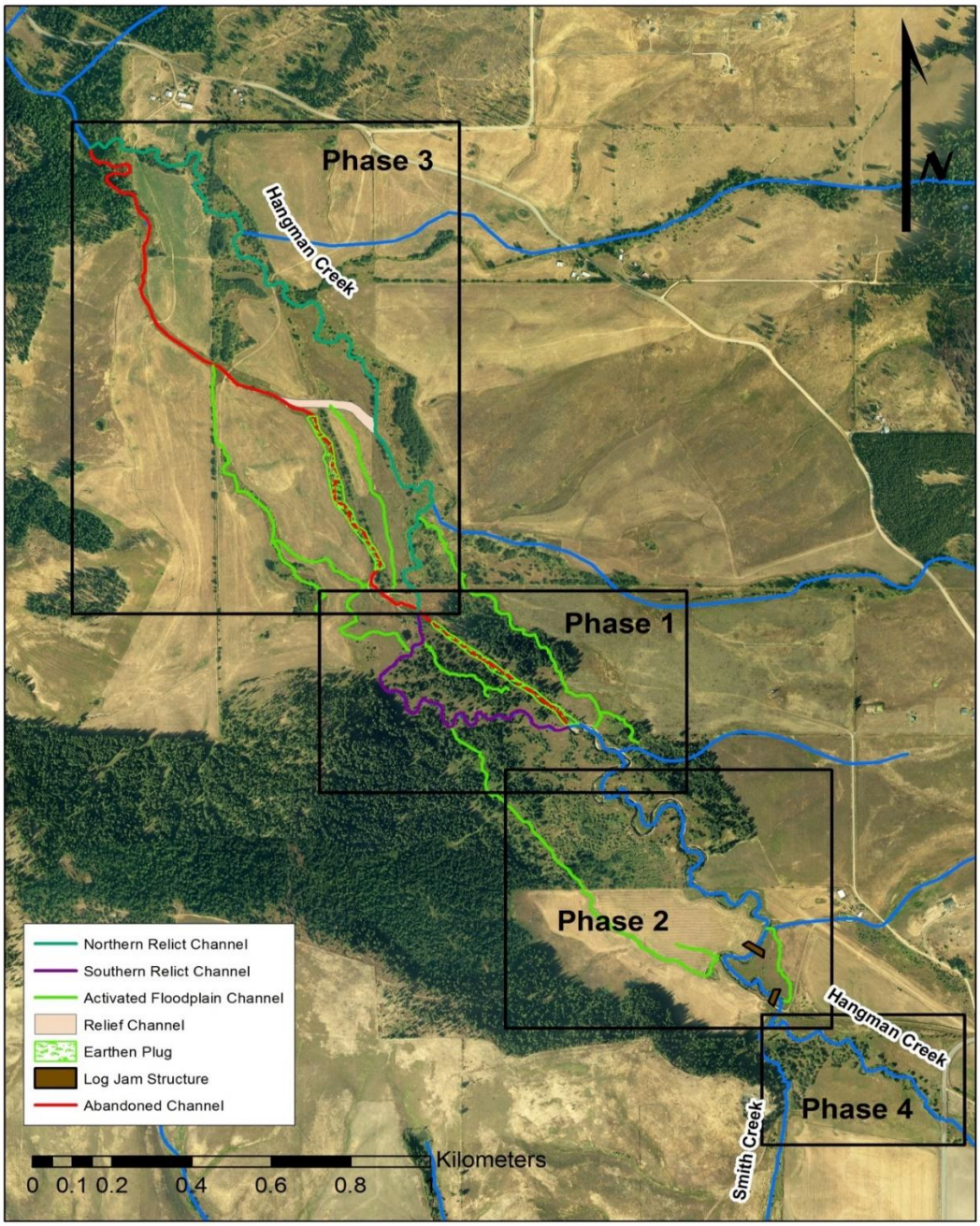


Figure 6. Project area highlighting the 4 phases of construction and the restoration design elements.

4.4.1 Repairs to Phase 3 Relict Channel Reactivation

During the summer of 2017 heavy equipment was used to repair the partially washed out earthen plug and to construct two additional berms intended to deflect over-land flows away from the fill material. Additionally, the rock berm at the downstream extent of the earthen plug was repaired and reinforced (Picture 10). Upon completion of the repairs, additional emergent wetlands (shallow ponds) were created upstream the berms (Picture 11**)** and **(**Picture 12**).**

*Picture 11**.** Aerial view of repairs showing 3 berms and the resulting shallow ponds, spring 2018.*

Picture 12. Repairs in the fill area of Phase 3 consisted of two additional berms creating 3 ponds.

Emergent wetlands created behind the berms have been extensively used by painted turtles (Picture 13) & resident and migrating waterfowl (Picture 14). Native plants such as camas, a culturally important species to the Coeur d'Alene Tribe (Picture 15), have now established in the area naturally.

Picture 13. Painted turtles Rkm 21.5

Picture 14. Tundra swans Rkm 22.5.

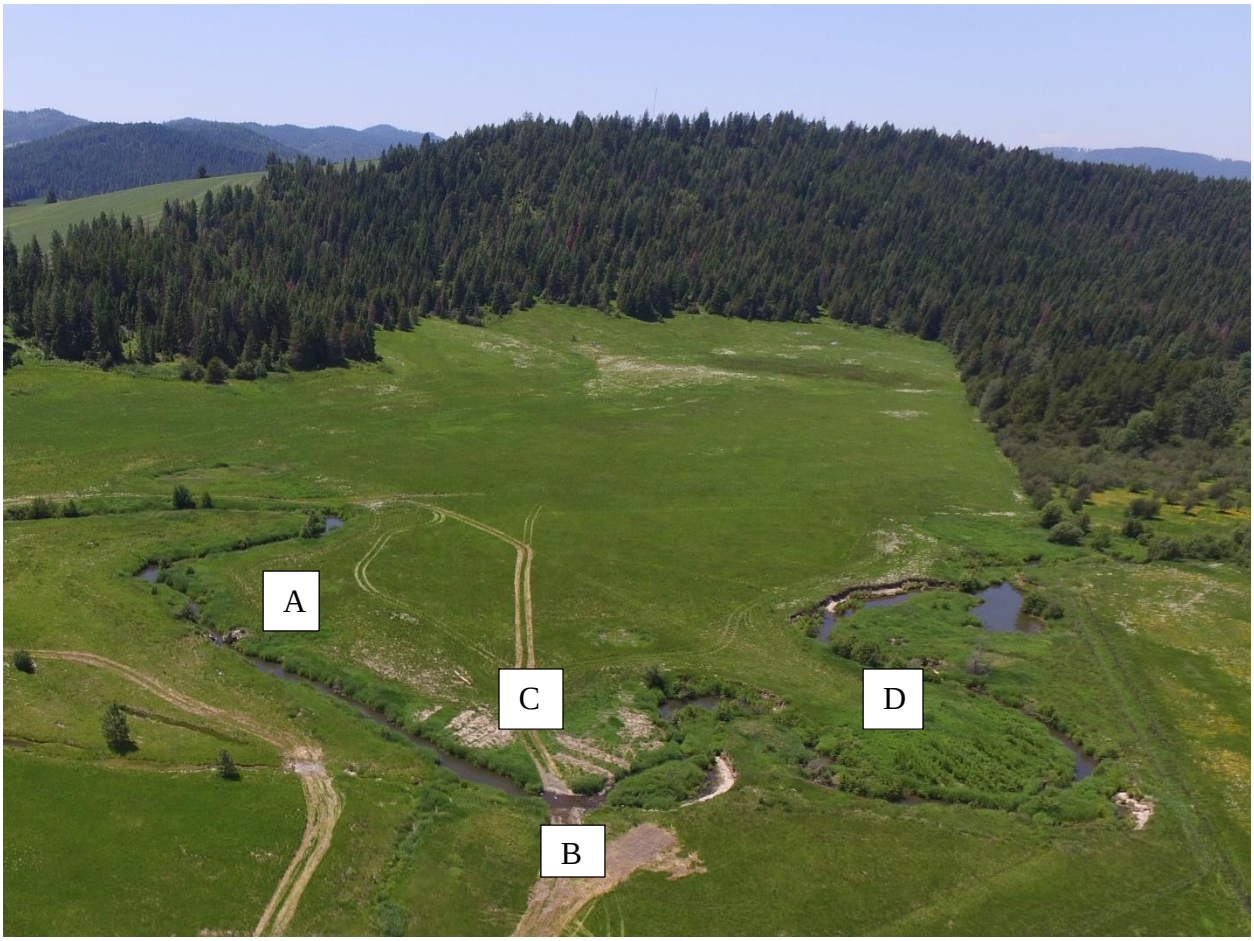
Picture 15. Camas (Camassia quamash) is established throughout the project area due to of improved ground water conditions, and the absence of agriculture practices.

4.4.2 Phase 2 Artificial Riffle & Grade Adjustment Rkm 24.9

In 2015, two engineered logjams were constructed within Hangman Creek (Picture 16) designed to force water out onto the floodplain during winter and spring runoff. However, the water level during the summer is still well below the top of banks and riparian plantings have largely failed due to a lack of shallow groundwater. Additionally, access to the southern side of the stream in this reach was still needed. Immediately downstream of the engineered logjams, an artificial riffle was therefore constructed which increased the elevation of the channel by 30 inches and provided for access across the stream (Picture 17). The aerial photo shows the area that has raised water levels that will support future riparian enhancement efforts (Picture 18).

Picture 16. Choke structure on Phase 2 at Rkm 24.7 in June 2018.

Picture 17. Artificial riffle constructed at Rkm 24.6.



Picture 18. Phase 2, Upstream to downstream. (A) Choke structure built in 2016 at Rkm 24.7, (B) Artificial riffle built in 2019 at Rkm24.6, (C) Willows trenched in 2019, and (D) Willow patch planted in 2016.

4.4.3 Installation of Analog Beaver Dams

During the summer of 2018 a less intrusive method to the landscape was initiated to aggrade the stream channel and facilitate overbank flow while supporting existing riparian plants. This was accomplished the same way we supported natural beaver dams, by driving in 4-inch diameter posts into a picket fence formation and weaving in willows or timber slash. Three structures were installed upstream above the confluence with Smith Creek in Phase 4 (Picture 19) at Rkm 26.2. As of December, 2019 all three structures are intact and have required no maintenance (Picture 20). Three additional structures were installed in Phase 2 adjacent to the three willow patches as shown in Picture 18 at Rkm 24.7. High flows thru this reach are severe but did not disturb the posts. However, much of the brush woven into the posts was washed downstream. Successful analog beaver dams have raised the base flow elevation 1-2 feet at Rkm 26.2 which helps to support freshly planted willow patches and potted trees. The difference in the stream power between the two sites is duly noted for future application of this method on a larger scale.

Picture 19. Construction of an Analog beaver dam year later.

Picture 20. Functioning analog beaver dam one

4.4.4 Relict Channel Activation Rkm 23.9

In 2014, 450 meters of straightened, man-made channel was filled with excavated material in order to reactivate approximately 1400 meters of relict stream channel. In addition, a 90 meter engineered channel was constructed to connect Hangman Creek to the relict stream channel and to bypass adjacent private property which contained 420 meters of the relict channel. In 2018, the Coeur d'Alene Tribe acquired this property, and with it the opportunity to reactivate the remaining portion of the relict channel within. In 2019 a flow-choke structure was installed within the previously constructed bypass channel. This structure was designed to raise the stream bed elevation and force the majority of flows through the meander (Figure 7).

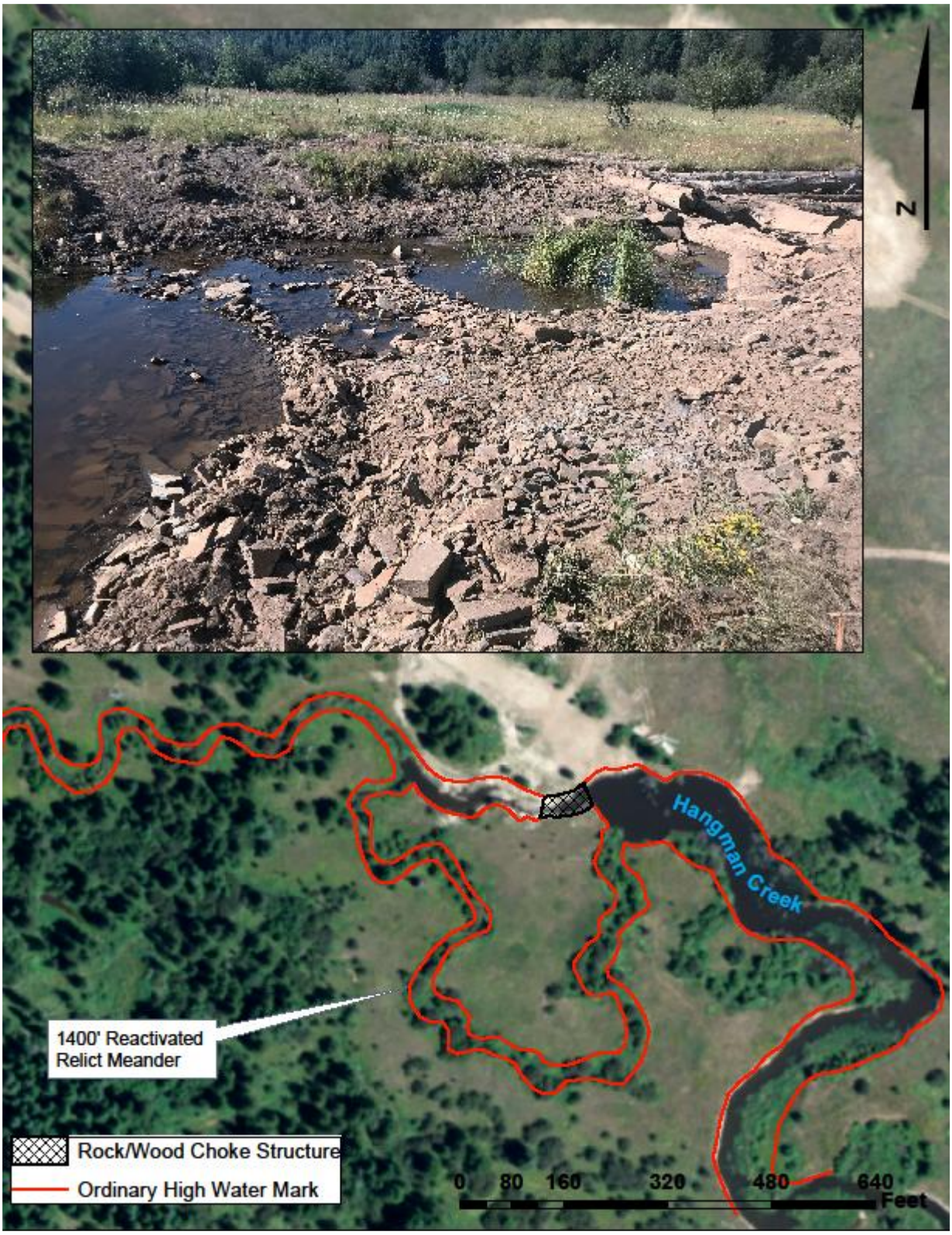


Figure 7. Reactivated relict meander and location of the flow choke structure within the constructed bypass channel.

Relationship to Scope of Work

The project fulfills the Program commitments for Work Elements K in the 2017 Scope of Work and Budget Request (Contract# 75767) for the contracting period dating May 1, 2017 through April 30, 2018, Work Element I in the 2018 Scope of Work and Budget Request (Contract# 78986) for the contracting period dating May 1, 2018 through April 30, 2019., The original WE was substituted (REF CCR-42732), as well as Work Element D in the 2019 Scope of Work and Budget Request (Contract# 82051) for the contracting period dating May 1, 2019 through April 30, 2020.

4.5 HA_23.0: Riparian Enhancement k'wne' 'ulchiyark'wmtsut (4 Phases)

Project Location:

Sub-Watershed: Hangman Creek	Legal: T44N, R4W, Sec 34
River Kilometer: 21.0 – 25.7	Begin: Lat 47.11226°N Long -116.81862°W
	End: Lat 47.102884°N Long -116°802739W

Site Characteristics:

Slope/Valley gradient: 0.05%	Aspect: NW	Elevation: 2,600 ft.
Valley/Channel type: F5	Proximity to Water: In channel and riparian	
Bkf Discharge (cfs): 400-450	Drainage Area: (37.6mi²)	

Problem Description:

From the World War II era to the present, streams were straightened and channelized to provide more arable lands, with the greatest modifications occurring during the 1950s and 1960s. By 1996, the predominant land use within the Hangman Watershed on the Coeur d'Alene Reservation was agriculture (65.1%), followed by forest (37.9%), development (0.3%), grassland (0.2%) and wetland (0.006%) (Redmond and Prather 1996). More specifically to the project area, a straightened channel was dug to accommodate the railroad delivering timber from the upper Hangman watershed. The straightened channel resulted in higher velocities and further degradation of the channel, and isolation of the channel from its floodplain. Water flowing through the perched water table was lost by evaporation once reaching the raw banks (Picture 21). Loss of historical baseflow, and the increased distance from the top of raw banks and the stream thalweg had a detrimental impact on the riparian communities which were once dominated by aspen, cottonwood and willows.

Picture 21. Phase 1 prior to channel fill and directing water into relict channel in 2014.

Description of Treatment

The riparian enhancement design has several components that seek to re-create the historic mosaic of wetland/floodplain flora that once was found in Hangman Creek, with a different emphasis in each of the four phases of k'wne' 'ulchiyark'wmtsut. Initial riparian designs from 2012-2016 led to the following 4 principles: 1) Supply beaver with the necessary food in both winter and summer, and building materials to create a self-sustaining ecosystem with natural connections of stream and floodplain. 2) Establish additional species that currently are successful in the watershed such as thinleaf alder *Alnus incana* and pacific ninebark *Physocarpus capitatus* to provide shade and streambank cohesion. 3) Plant a wide variety of wetland and upland seed, live willow poles, potted riparian shrubs and trees, and upland shrubs/trees in locations where heavy equipment disturbed native vegetation. 4) Use adaptive management to make changes in plant protection methods and species composition to address impacts from ungulates and other terrestrial grazers, as well as a firmly established beaver population.

As riparian survival results from the project became available, and expertise in riparian ecology increased within the Coeur d'Alene Tribe Fisheries Program, methods were further refined to include a full set of riparian communities to Hangman Creek which includes forbs, mid-story shrubs and willows, and overstory species such as pacific willow, black cottonwood, and aspen. Working with our plant suppliers, our riparian prescriptions include all types of vegetation that are successful in the watershed, and distinct species for three elevation zones; lower streambank, mid bank and upper bank. (Wildlife Habitat Nursery 2015). Low bank species include drummond willow *Salix drummondiana,* big leaf sedge *Carex amplifolia,* and beaked sedge *Carex utriculata*. Mid-level bank species include alder, mackenzie willow *Salix rigida v mackenzieana*, common rush Juncus effusus, and inflated sedge *Carex vesicaria*. High bank species included bebbs willow *Salix bebbiana*, pacific willow *Salix lasiandra,* Quaking aspen *Populus tremuloides*, and Baltic rush *Juncus balticus*. Additional habitat requirements were identified to guide planting locations and provide for species that require porous soils such as

sandbar willow *Salix exigua ssp melanopsis* and daggerleaf rush *Juncus ensilfolius*, or are not high flow-tolerant such as Creeping spikerush *Eleocharis palustris*, daggerleaf rush, and pacific willow.

4.5.1 Riparian Restoration throughout Project Reach

Summary of riparian enhancement over the entire project area during 2017 -2019, including plant type, planting methods, and locations are shown in Figure 8 and Table 3. Riparian enhancement includes the following plant types; conifers which includes western cedar *Thuja plicata*, and ponderosa pine *Pinus ponderosa*; potted hardwoods which included quaking aspen, black cottonwood, mountain alder, coyote willow *Salix exigua*, pacific willow, water birch B*etula occidentalis*, serviceberry *Amelanchier alnifolia*, and pacific ninebark *Physocarpus capitatus*. Willow poles included a total of 5 species, pacific, Drummond, bebbs, sandbar, and mackenzie.

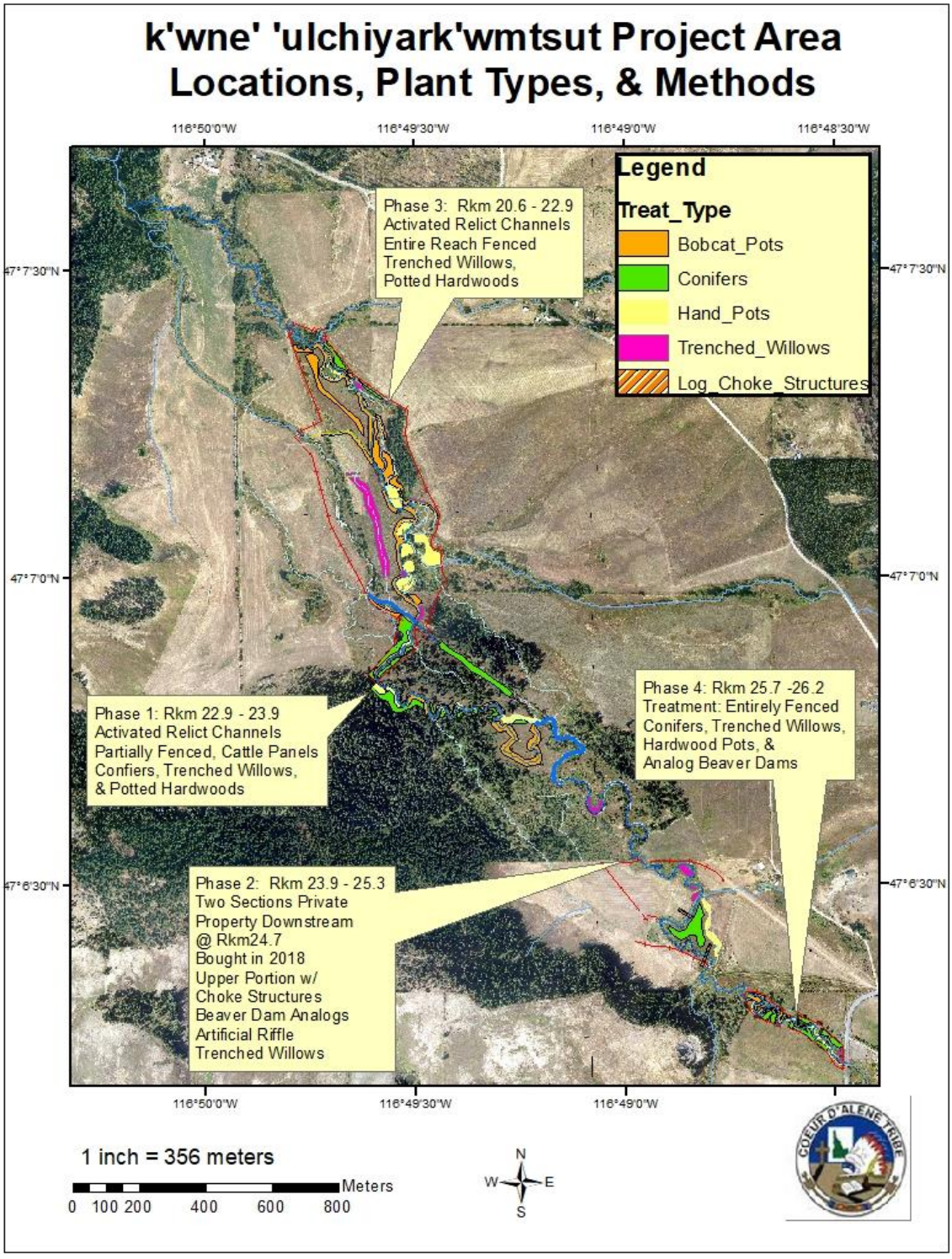


Figure 8 Map of the k'wne' 'ulchiyark'wmtsut project area and summary of riparian enhancement during 2017 -2019. Map details locations and types of plants/methods, along with wildlife exclusion fencing.

Table 3. Summary of riparian planting on Hangman Creek from 2017 – 2019.

Riparian Restoration Treatment						
	Phase 1	Phase 2	Phase 3	Phase 4	Other	Total
Total Hardwood Poles 2017-9	100	600	6085	855	0	7690
Total Hardwood Trees 2017-9	725	345	2660	175	50	3975
Total Conifers 2017-9	450	0	550	0		1000
Total Upland Shrubs 2017-9	230	0	0	0		230
Riparian Protection Metrics						
Length of 8ft Fencing	848	2902	7580	2556		10165
Area (acres) Enclosed by 8 ft. Fence	1.2	7.7	21.3	1.6		31.8
Cattle Panel Enclosures	64		34			162
Willow Patch Enclosures Ave 30 ft. X 50ft	2	4	7	4		17
6 ft. Fence Enclosures Single Tree	4		8			12

Plant survival assessments (Table 4) over the last four years show marked differences in plant survival and growth spatially and across species. Assessments of survival have also confirmed levels of palatability by ungulates and beaver, as well as the ability to survive and thrive in fine sediments and the flashy hydrograph of Hangman Creek. Ponderosa pine has done generally well throughout the 4 zones, but especially when planted within a moister area. Western red cedar was planted in April 2019 in two separate areas with distinct differences in survival. Above average temperatures followed the planting, and is suspected of having an impact on survival especially in areas with little to no canopy and solar protection. Planting 5 gallon potted hardwoods continues to show better results than 1 gallon pots. This is especially evident for thinleaf alder where one gallon pots had a survival rate of 5%, while the corresponding survival rate for 5 gallon pots was 75%. One plant species that had surprisingly low survival and growth was Douglas hawthorn, which is prolific naturally in the project area.

A wide variety of willows have been planted, both individually, and in enclosed patches using the trenching method. Pacific willow has far exceeded other species, both in its survival rates and resilience after impacts by beaver. The other four species have not done as well for various reasons. Sandbar and bebbs willow are better suited for porous soils (Wildlife Habitat Nursery 2015) and our survival assessments have confirmed this. Mackenzie willow grows well in the Hangman watershed, although planting elevation and the corresponding moisture content of the soil can heavily influence survival. Drummond willow grows very well, but because it needs to be planted in the lower bank zone, it is rarely protected by fencing used in the willow patch enclosures. Outside of protection, beaver eat them as fast as they are planted. Pacific willow is normally found on the upper banks of a stream, therefore needing less water than other species, and will grow up to 45ft tall. For all these reasons we have emphasized pacific willow in our trenching method and began to plant potted Pacific willow in 2017.

Table 4. Summary of plant survival on Hangman Creek during 2017 – 2019.

Summary of Plant Survival 2017 - 2019		
	% Survival	**Planting Year**
Conifers		
Ponderosa Pine (PP)- Phase 1	50%	2016 and 2019
Cedar Phase 1	50%	Spring 2019
PP -Phase 2 downstream of crossing	1%	2015
PP-Phase 2 upstream of crossing	70%	2016 between channel and swale
PP-Phase 3	60%	2016
PP -Phase 4	80%	2015 and 2019
Cedar Phase 4	15%	Spring 2019
Potted Trees		
Alder 1 gal	5%	Planted in all Phases, 2014 - 2016
Alder 5 gal	75%	Planted in all Phases, 2014 - 2019
Pacific Willow 5 gal	70%	Planted in all Phases, 2017 - 2019
Cottonwood 5 gal	40%	Planted in all Phases, 2014 - 2019
Aspen 5 gal (Phase 3)	60%	Planted in all Phases, 2014 - 2018
Hawthorn Phase 2	1%	2015
Hawthorn Phase 3	5%	2016
Hand Drilled Willow & Cottonwood Poles		
Phase 1, Engineered Channel	2.0%	Planted in 2014, 2015, 2016, & 2017
Phase 1, Relict Channel	0.5%	Planted in 2015 & 2016
Phase 2,	0.0%	Planted in 2016
Phase 3, Relict Channel	1.0%	Planted in 2016 & 2017
Trenched Willows		
Pacific Willow	90%	2015 -2019, and in increasing numbers
Bebbs	10%	Phase 2 - 2016, Phase 4-2017
Drummond	10%	Used in decreasing numbers 2014 - 2019
Sandbar	30%	Phase 4 2017
Mackenzie	30%	Plant in all phases, 2015-2019

4.5.2 Phase 1-Riparian Enhancement: 2017-2019

Thinleaf alder and Douglas hawthorn were found throughout the length of the relict channel within this reach of Hangman Creek upon reactivation in 2014. Since that time however, beaver colonization and the resulting dam construction have increased water elevations and killed the majority of these plants along the stream bank (Picture 22). Replacing this lost canopy with alder and additional species of hardwood has been a primary objective throughout the three years of this reporting period.

Picture 22. After relict channel was reactivated and beaver built several dams in Phase 1, existing alders began to die off.

4.5.3 Phase 2-Riparian Enhancement: 2019

A small amount of riparian work was done in Phase 2 due the low survival rates of previous riparian efforts. However, 300 willow poles were trenched and protected by 36" tall fencing in spring of 2019. With channel work raising the baseflow water level (Picture 17 and Picture 18), initial survival has been excellent for pacific and mackenzie willow. A relict channel reactivated in summer of 2019 (Section 4.4.4 and Figure 7) was planted with (345) 5 and 8 gallon pots of various hardwoods, planted by Trout Unlimited volunteers. It is anticipated that the existing Douglas hawthorn and alder found in the channel will die off due to beaver activity, and the resulting lost canopy will be replaced by these hardwoods planted on the banks of this channel.

4.5.4 Phase 3-Riparian Enhancement: 2017-2019

The lowest reach on the k'wne' 'ulchiyark'wmtsut project encompasses an area completely devoid of native riparian vegetation, where reed canary grass dominates the riparian habitat along with the occasional Douglas hawthorn (Picture 23 and Picture 24). Riparian enhancement occurred in 2017-2019 and included a large proportion of the willow patches we had planted over the entire project. By 2018 the plantings were protected from browsing after an 8-foot wildlife exclusion fence was installed around the entire treatment area (Picture 25 and Figure 6). The highest rate of willow survival and growth is observed in this reach, although no supplemental watering has been done. In 2018, we began planting pacific willow in pots in this reach (Picture 26) in response to the positive survival and growth of the species.

Picture 23. Reed canary grass and Douglas hawthorn in Phase 3 Rkm 22.0.


Picture 24. Drone Photo in June 2018 showing Phase 3 (Rkm 21.0 – 23.5).

Picture 25. Wildlife exclusion fence around Phase 3 at Rkm 23.6

Picture 26. Pacific willow planted from pots at Rkm 22.0

4.5.5 Phase 4 Riparian Enhancement: Trout Unlimited

Since 2008, the Spokane Falls Chapter of Trout Unlimited (SFTU) has taken a major role in the project through it support of riparian enhancement on the reach of Hangman Creek between Rkm 25.0-26.0. Donations have totaled $15,000 and incorporated countless man-hours over the last 3 years to plant trees and provide a conduit for outreach in the region. Planting events have included traditional dances (Picture 27) and presentations focusing on the goals of the project,

followed by the actual riparian work (Picture 28). These events have been met with positive feedback and SFTU would like to expand their involvement to 2-3 times a year. Annual presentations are done at public meetings in Spokane to present accomplishments and future plans. One Coeur d'Alene Tribal biologist was voted onto the Board of Directors for 2020, so a close relationship is well established.

Picture 27. Traditional dance performed prior to fall planting with Spokane Falls Trout Unlimited in 2018.

Picture 28. Spokane Falls Chapter Trout Unlimited members in fall 2019 planting potted hardwoods at Rkm 24.0.

4.5.6 Adaptive Management of Riparian Enhancement

Learning how to plant riparian plants into soil with the appropriate substrate size and moisture content, along with assessing many types of deterrents for ungulate and beaver browsing has been key in improving plant survival over the course of the reporting period. Trenching willows has become the preferred method for establishing willows throughout the project area in locations where access by a small excavator is feasible. This method ensures year-round access to ground water and also enables the program to protect large amounts of willows from potential browsing with minimal resources. Once planting is complete, a 36' tall fence is built to deter beaver (Picture 29, Picture 30, Picture 31, Picture 32, Picture 33 and Picture 34). Drummond willow is an exception due to its need to be at the lower banks where fences tend to be torn out by high flows, and sometimes outside any protection. Drummond willow will continue to be a challenge to get established in the project area.

Picture 29. Trenching willow.

Each Trench is dug 4 feet deep with an 8" bucket. If trenching in late May, water should be at the bottom of trench

Picture 30. Placing willows:

5'-7' willow poles are placed every 6" -12" apart and excavator back fills trench

Picture 31. Finished willow trenches

Picture 32. Protecting willows

Section of trenches is then protected with 42" fencing and lined with chicken wire at bottom to discourage burrowing by beaver

Picture 33. *First-Year growth of pacific and Mackenzie willow, Rkm 22.0 in 2019*

Picture 34. Second Year growth of pacific willow in 2019

Planting willows one by one with augers will need to be incorporated to get a more continuous extent of willows along the streambanks, particularly Drummond willow which is among the species that will grow in the fine sediments of Hangman Creek. Once willow is well established in fenced enclosures, beaver will be able to browse all willows in a self-sustaining cycle. Maturing potted hardwoods should also help with the establishment of willow by shading out the competing reed canary grass.

In addition to the incorporation of using heavy equipment to trench willows, other minor, but nonetheless important methods have been adopted. Accommodating a flashy hydrograph and extensive wildlife browsing pressure has been key to improving survival and growth. Shifting to multi-layer protection methods such as large scale wildlife exclusion fencing, cattle panels, purchasing taller plants, trenching willows, and incorporating species less palatable to browsers were the main components of adaptation.

Rain on snow events and ice flows occur during the months of January – March (Picture 35), with some major flooding occurring as late at the 4th week of May (Picture 36). These high-flow events have had detrimental impacts on small potted trees and those not protected with cattle panels installed to deflect ice and debris while flooding. Bigger trees and the use of cattle panels have done well to improve survival during major flood events.

Seasonally high densities of wildlife within the project area places a great deal of impacts due to browsing on the riparian enhancement efforts. Although they are found in small numbers, moose (Picture 37) have entered trenched willow patches and eaten up to a 1,000 willow poles in one weekend. A large herd of elk (Picture 38) gather on the property every spring for calving and browsing and some remain throughout the year. Whitetail deer are found on the property year round. The 8' tall wildlife exclusion fencing has done well to deter browsing, although frequent maintenance is needed, especially where the fences go across streams and swales. Cattle panels (Picture 39) have also done well to deter ungulates when combined with planting taller potted trees to get the apical branch above their reach. Black cottonwood in particular has been targeted for extra protection due to its fast growth and superior shade factor. When outside the wildlife exclusion fencing, a variety of products have been used which are designed to deter ungulate browsing including Deer Away, blood-urine mixes, and garlic sticks (Picture 40).

The use of less palatable species such as coyote willow, and to a lesser degree alder has increased since we first began riparian enhancement in 2008 (Kinkead and Firehammer 2012). Our survival assessment (Table 4) confirms that there is less wildlife browsing on alder and coyote willow, despite the fact that chemical deterrents or cattle panels are not used as protective measures.

Picture 35. January ice flow on Hangman Creek.

Picture 36. Rain-On-Snow May 2003.

Picture 37. Moose looking for a way thru the fence.

Picture 38. Elk at near Rkm 22.0.

Picture 39. Cattle panels used for black cottonwood.

Picture 40. Garlic stick tree protection

Beaver previously occupied the area in low numbers. However, after major restoration actions occurred, they appear to have expanded their distribution into this reach, acting as both a nuisance and partner. Live trapping beaver for relocation was tried in 2010, and is no longer an option (Picture 41 and Picture **42**) proving to be too time consuming as it is preferred to capture and relocate an entire family. Secondly, tribal elders prefer to not trap beaver, regardless of the reason for trapping. The delivery of aspen brush (Section 4.3) has really helped to deter beaver from harvesting newly planted vegetation. Installing cones has also helped to deter beaver. However, beaver have been known to go after well-established trees only protected by cones (Picture 43), as well as potted trees staged in areas immediately before we plant them! (Picture 44). Maintenance and protection of riparian enhancement will continue to be necessary until a self-sustaining riparian ecosystem is established.

Picture 41. Live trapping beaver in 2010.

Picture 42. Beaver frequently seen Rkm 21-25.

Picture 43. Beaver damage at Rkm 20.0

Picture 44 . Beaver break into plant storage.

Establishment of forbs including various rushes and sedges has had mixed results. Early attempts using plugs in 2015-6 showed poor results. Changing water levels due to drought or flooding by beaver dams has made it less than cost effective to plant plugs of forb species. Wetland seed was also used prior to 2017. However, many species are getting established where good hydrologic conditions exist. Common rush (Picture 45), daggerleaf rush, beaked sedge, saw-beak sedge *Carex stipata* (Picture 46), short beaked sedge *Carex brevior* (Picture 47), and water sedge *Carex aquitilis* are found from Rkm 21.0 to 24.0 where water levels have stabilized. Creeping spikerush is commonly found in swales (Picture 48), and big leaf sedge is commonly found in pools behind beaver dams.

Picture 45. Common rush Rkm 22

Picture 46. Saw-beak sedge Carex stipata

Picture 47 Short-beaked sedge Rkm 23.5

Picture 48. Creeping spikerush in swale

Relationship to Scope of Work

The project fulfills the Program commitments for Work Elements G, H, and I in the 2017 Scope of Work and Budget Request (Contract# 75767) for the contracting period dating May 1, 2017 through April 30, 2018, Work Elements D,E, F, G, and J in the 2018 Scope of Work and Budget Request (Contract# 78986) for the contracting period dating May 1, 2018 through April 30, 2019,as well as Work Elements E, F, H, and J in the 2019 Scope of Work and Budget Request (Contract# 82051) for the contracting period dating May 1, 2019 through April 30, 2020.

4.6 HA_30.6: Culvert Replacements on Upper Hangman Creek

Project Location:

Sub-Watershed: Hangman Creek	Legal: T44, R 3W, Sect 33
River Kilometer: 30.6	Begin: Lat: 47.111°N Long: -116.7282 °W

Site Characteristics:

Slope/Valley gradient: 6.0%	Aspect: SW	Elevation: 3,222 ft.
Valley/Channel type: B4	Proximity to Water: In channel and riparian	
Bkf Discharge (cfs): 40	Drainage Area: (0.5mi²)	

Problem Description:

Two damaged culverts along the Sanders-Imida road at Rkm 30.6 were classified as barriers to fish migration. The 36" Hangman Creek culvert had a 16" drop from the outlet and a rusting hole on the top (Picture 49 and Picture 50). Hill Creek, a tributary of Hangman at Rkm 30.6 had a failing culvert that was comprised of two 24" pipes that were frequently plugged with debris.

Picture 49. Migration barrier at Rkm 30.6.

Picture 50. Hole in culvert at Rkm 30.6.

Description of Treatment

The Coeur d'Alene Tribe partnered with Benewah County to replace the Hangman Creek pipe with a new 75' long by 66" X 51" squash pipe set below grade (Picture 51), and with boulders placed downstream to back up water into the culvert to ensure fish passage. The Hill Creek culvert was also replaced the same week with a new 60" pipe and set below grade. Disturbed ground was treated with alder and willows. Fish now have unhindered access to 2.4 km of stream.

Picture 51. Completed culvert on Hangman Creek at Rkm 30.6

Relationship to Scope of Work

The project fulfills the Program commitments for Work Elements D in the 2017 Scope of Work and Budget Request (Contract# 75767) for the contracting period dating May 1, 2017 through April 30, 2018.

4.7 SJ_18.5 Native Willow Nursery for Support of Restoration Actions

Project Location:

Watershed: St. Joe River/CDA Lake	Legal: T46N R2W S17
Sub Basin: Hepton Lake	Lat: 47.331487 N. Long: -116.626013 W

Site Characteristics:

Slope/gradient: 0%	Aspect: NA	Elevation: 650 m
Valley type: NA	Proximity to water: Adjacent to lacustrine habitat	
Other: Project treats approximately 6.8 ha (17 acres) of previously farmed wetlands adjacent to open water lacustrine and backwater riverine habitat.		

Problem Description: Aquatic ecosystem restoration is an evolving discipline, encompassing a wide array of approaches, many of which are defined by current and desired conditions and the degree of departure from undisturbed reference sites. Where restoration in the past may have been focused on treating symptoms of disturbance, such as reducing erosion through hardening of streambanks, a desirable alternative is to remove the source of disturbance and facilitate the recovery of natural processes. One benefit of this changing approach is the greatly reduced need for material inputs and continued manipulation over time as natural processes are allowed to come into equilibrium. The role and use of native plant materials is an integral component of most restoration prescriptions that adhere to this approach.

Much of the wetland, stream and lake habitats prioritized for treatment throughout the Coeur d'Alene Reservation and surrounding land has been degraded or significantly altered by anthropogenic activities. Major restoration actions prescribed for many of these areas emphasize a reliance on the functions and values imparted by native plant communities to some degree. The need for native wetland plant species, especially woody species like willows, greatly exceeds their availability in the natural environment. Reliance on commercial nurseries alone to meet these needs will be an exceedingly costly proposition that places an excessive burden on the limited financial resources available to the Tribe and other agencies for implementing projects. Therefore, The Coeur d'Alene Tribe, with support from the Coeur d'Alene Basin Restoration Partnership, has established a nursery for native willow species that can be made available for restoration projects in an effort to reduce costs over time while providing a steady and identifiable supply (Figure 9).

Description of Treatment: In the fall of 2018, approximately 6 hectares (15 acres) of the nursery was prepared for planting. The existing vegetation consisting of mostly reed canary grass was mowed, wildlife exclusion fence was installed and rows for planting were scalped to remove the majority of the reed canary grass biomass (Picture 52). Shade/weed fabric was installed in all prepared rows. In March and April of 2018, a total of 16,000 willow poles (4,000 each of Drummond, pacific, mackenzie and sitka *Salix sitchensis* were planted in the nursery (Picture 53 willow. Picture **54**). Willow species were isolated from each other in accessible rows for

future harvest. Overall survival is estimated to be 85% – 90%, with the lowest survival rates observed in sitka willow and the highest in pacific and mackenzie willow.

Figure 9. Location of nursery near St. Maries, ID.

Picture 52. Site preparation included removal of canary grass using a small dozer.

Picture 53. Rows of planted mackenzie willow.

Picture 54. Rows of drummond willow.

Project Timeline: Initial site preparation occurred in October, 2018. Final plantings are scheduled to be completed by spring, 2021. These additional plantings will include 3 more endemic species of willow which include bebb, geyer *Salix geyeriana* and sandbar, along with other native deciduous plants such as black cottonwood and native birch species *Betula spp.* to be planted in a separate 2-acre enclosure within the same project location.

Project Goals & Objectives: The project goal is to establish a stooling bed for native willows covering no less than 17 acres that can provide a steady supply of cuttings for riparian and floodplain restoration projects.

Willow cuttings are used in a large proportion of stream and lake restoration projects throughout the Coeur d'Alene and St. Joe sub-basins. Willows cuttings can be difficult and expensive to collect from natural systems, especially while they are dormant. Purchasing willow poles from local vendors is costly and as demand increases for restoration projects, their availability will diminish. Furthermore, a supply of willows from a location and elevation which closely resembles the restoration location will likely increase survival of planted cuttings.

Objectives:

1. Maintain up to 7 species of endemic riparian willows within a local plantation.
2. Maintain up to 40,000 individual hardwood plants
3. Provide consistent and easy access to cuttings during periods of dormancy.

Relationship to Scope of Work

The project fulfills the Program commitments for Work Element G in the 2019 Scope of Work and Budget Request (Contract# 82051) for the contracting period dating May 1, 2019 through April 30, 2020.

5. Future Restoration Outlook

The Hangman Creek Fisheries Program will continue to focus on restoring natural processes associated with a diverse and resilient stream/floodplain ecosystem. Potential for large-scale restoration projects such as the k'wne' 'ulchiyark'wmtsut project exist throughout the upper Hangman watershed; in both lower tributary and main stem stream reaches. These areas typically contain low gradient streams within large valley bottoms, capable of supporting diverse ecosystems and promoting the hydrogeomorphic processes that once dominated the landscape. These types of restoration actions are thought to have the most impact toward recovering the fragmented fish and wildlife populations that currently reside in the upper Hangman watershed. There will be a continuation of restoration prioritization that seeks to connect isolated fish populations in tributaries that include, and are upstream, of Mission Creek. Undoubtedly, beaver support and proliferation will continue to be the centerpiece of our restoration efforts, as they are instrumental in promoting and maintaining a healthy ecosystem.

Riparian restoration will continue using all the lessons learned such as;

- Trench willow to get plant roots deeper
- Balance plant species choices between survival and benefit to wildlife browsing
- Use tall potted trees and a multi-layer approach to plant protection to realize plant survival goals.
- Adapt a plant survival and growth assessment to monitor progress toward restoration goals.

Channel restoration will mimic work done in 2014 – 2019;

- Fill straightened man-made channels
- Activate adjacent relict channels
- Build Beaver Dam Analogs (BDA) and artificial riffles to aggrade the channel and improve stream-floodplain connection with greater efforts to protect the structures from high flow events using rock and fabric.

We will also continue to pursue small-scale restoration projects such as removing migration barriers and increasing stream habitat complexity in tributaries. These types of projects are shown to have immediate beneficial results for redband trout populations, and the opportunity to implement projects such as these are present throughout the project area.

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