FY 2008-2018 F&W Program Project Solicitation

Section 10. Narrative

Project ID:	2008-301-00
Lead Agency:	The Confederated Tribes of the Warm Springs Reservation of Oregon
Title:	Deschutes River Restoration Program
Province:	Columbia Plateau
Subbasin:	Deschutes
Lead Contact:	Scott Turo 541-553-2025 or sturo@wstribes.org

A. Abstract

The Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) Branch of Natural Resources through the Habitat Program will manage and execute the Deschutes River Restoration Program (DRRP). The goal of the DRRP is to improve aquatic habitat through comprehensive habitat restoration directed at factors limiting salmonid production. Projects implemented through the DRRP will be tiered to the actions listed in the Deschutes River Subbasin Plan (NWPPC 2003) for the west side of the Deschutes River, and the Mid-Columbia Steelhead Recovery Plan adopted by National Oceanic and Atmospheric Administration (NOAA) on September 30, 2008 (Federal Register Notice, Vol. 74 No. 188). The DRRP will also be executed through agreements established under the Columbia Basin Fish Accords (2008) to implement projects that improve spawning and rearing habitat to increase productivity of specific population groups of listed salmon and steelhead.

Projects developed under the DRRP will target four limiting factors identified through recovery planning and supported by aquatic habitat inventories and watershed analyses developed by the CTWSRO through their Integrated Resource Management Plan (IRMP) (1992). The factors limiting salmonid production targeted by the DRRP will include habitat complexity, fine sediment, water temperature, and altered hydrological processes. A three-tiered approach will be used to prioritize actions for implementation to address these factors. This approach considers and prioritizes projects based on the objective to:

- **Protect** existing high quality habitat and areas where ecological processes are functioning appropriately.

- **Manage** future land use through and integrated planning process that ensures ecological integrity and sustainability.

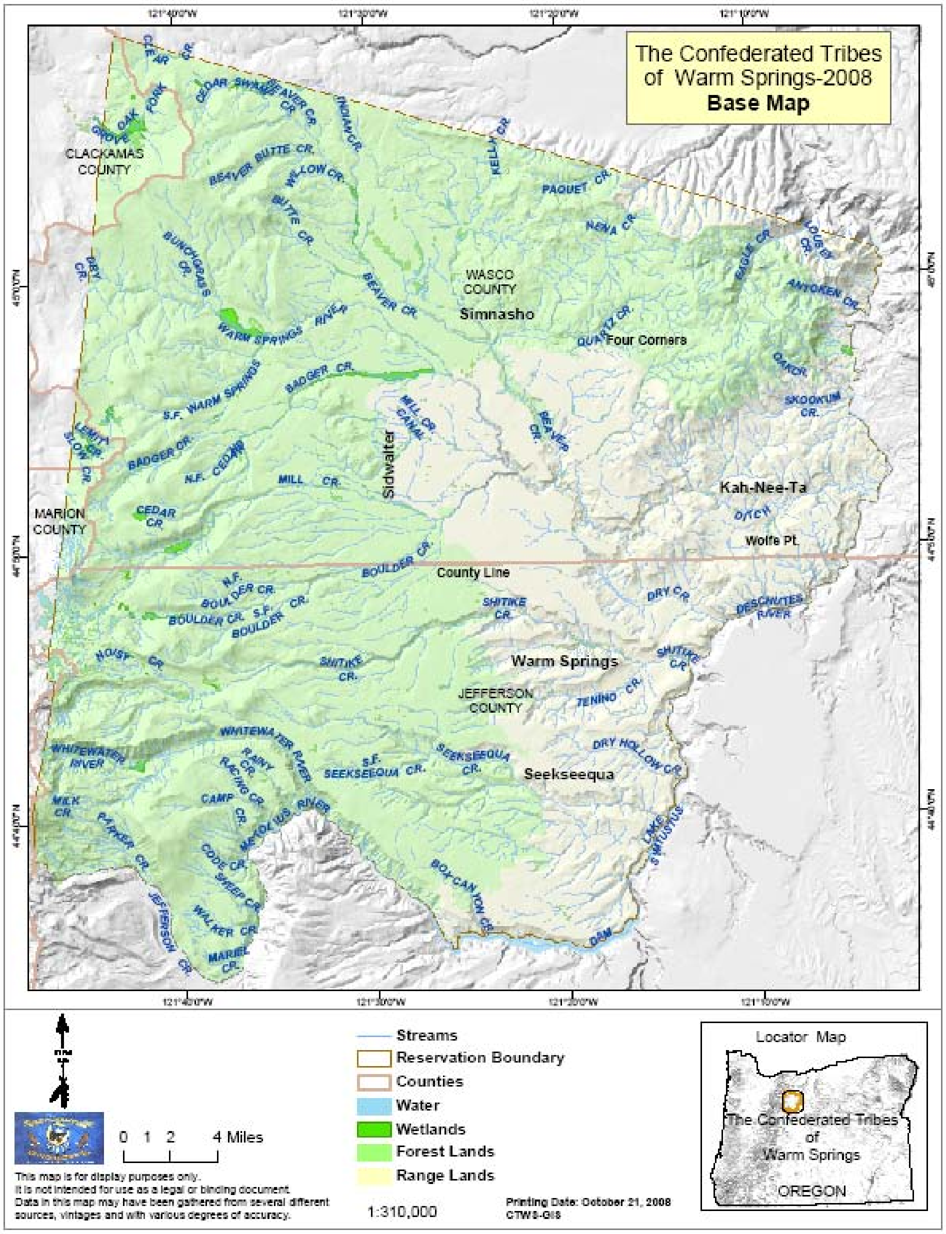
- **Restore** watersheds and habitats using a prioritized approach based on limiting factors analysis.

The DRRP will adopt a programmatic approach to cost share with other sources to achieve the goals stated above. Funding through this contract will support program administration including staff, equipment, and vehicles. Funding will also support restoration design, planning, and permitting required to implement the annual scope of work. The remaining Bonneville Power Administration (BPA) funds will be matched with Tribal and non-tribal funding to implement projects. A monitoring plan linked to regional restoration monitoring efforts and supporting the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) will be initiated to track the effectiveness of projects at achieving predetermined objectives and fuel adaptive management.

B. Technical and/or scientific background

Location

The Warm Springs Indian Reservation (Reservation) (Map 1) is located on the east slope of the Cascade Mountains in Oregon, north of Mt. Jefferson. The Reservation is approximately 660,000 acres and contains a large portion of the Deschutes basin downstream of the Pelton-Round Butte hydro-electric project. Due to their high Cascade origin many of



Map 1. The Warm Springs Indian Reservation.

the Reservation watersheds have excellent water quality and thus, serve as a stronghold for Deschutes Basin fish stocks. The Reservation provides habitat used for migration, spawning, and rearing by Mid-Columbia summer steelhead (*Oncorhynchus mykiss)*, spring Chinook salmon

(*Oncorhynchus tshawytscha*) bull trout (*Salvelinus confluentus)*, redband trout (*Oncorhynchus mykiss gairdneri)*, and a mainstem Deschutes population of fall Chinook (Map 2). Mid-Columbia summer steelhead and bull trout are listed as threatened under the Endangered Species Act (ESA). Pacific lamprey (*Lampetra tridentate)* are also native to most Reservation streams and support cultural and subsistence fisheries.

Sockeye salmon (*Oncorhynchus nerka)* used Suttle Lake in the upper Metolius watershed until construction of the Pelton Round Butte hydro-electric facility on the mainstem Deschutes River in the 1960s. Relicensing of the Pelton Round Butte Hydroelectric Complex in 2004 established the direction to re-engineer the juvenile migrant trap and reintroduce salmonids upstream of the facility. Improved juvenile passage is intended to create self sustaining populations of steelhead upstream of the dam. This will allow for increased basin wide production of steelhead and Chinook and improve potential to restore the sockeye run from a kokanee population in Lake Billy Chinook. Successful reintroduction of anadromous fish stocks upstream of the hydroelectric complex will require donor stock from downstream to rebuild the upstream populations. Thus, it will become increasingly important to maintain or restore downstream watersheds to a condition suitable to provide donor fish. Properly functioning watersheds with the appropriate type and quantity of aquatic habitat are fundamental to the success of recovery and reintroduction up and downstream of the Pelton Round Butte facility.

The Problem

Land use and development have combined to reduce and simplify aquatic habitat in many Reservation watersheds. These changes have resulted in altered hydrological processes that can be directly linked to the health of many watersheds. The effect of altered hydrology on biological communities, centers on impacts to habitat complexity and quantity, water temperature, and fine sediment delivery. Changes in the magnitude and timing of surface water runoff change the pattern and dimension of stream channels, therefore reducing habitat complexity. Erosion and sediment input increase, lowering aquatic productivity. Stream channels become over widened to accommodate increased runoff and sediment loads. Increased sediment delivery to the channel creates expanded riffle and high velocity habitats as the channel dimension flattens out to accommodate increased sediment inputs. The overall increase in stream power scours out large wood elements that drive habitat forming processes. Incision of the stream bed from this increase in stream power and sediment result in loss of the alluvial ground water storage capacity. Low summer base stream flow result from changes in the way the watershed processes annual precipitation creating limited habitat and elevated water temperatures. All of which contribute to reduced salmonid survival and production.

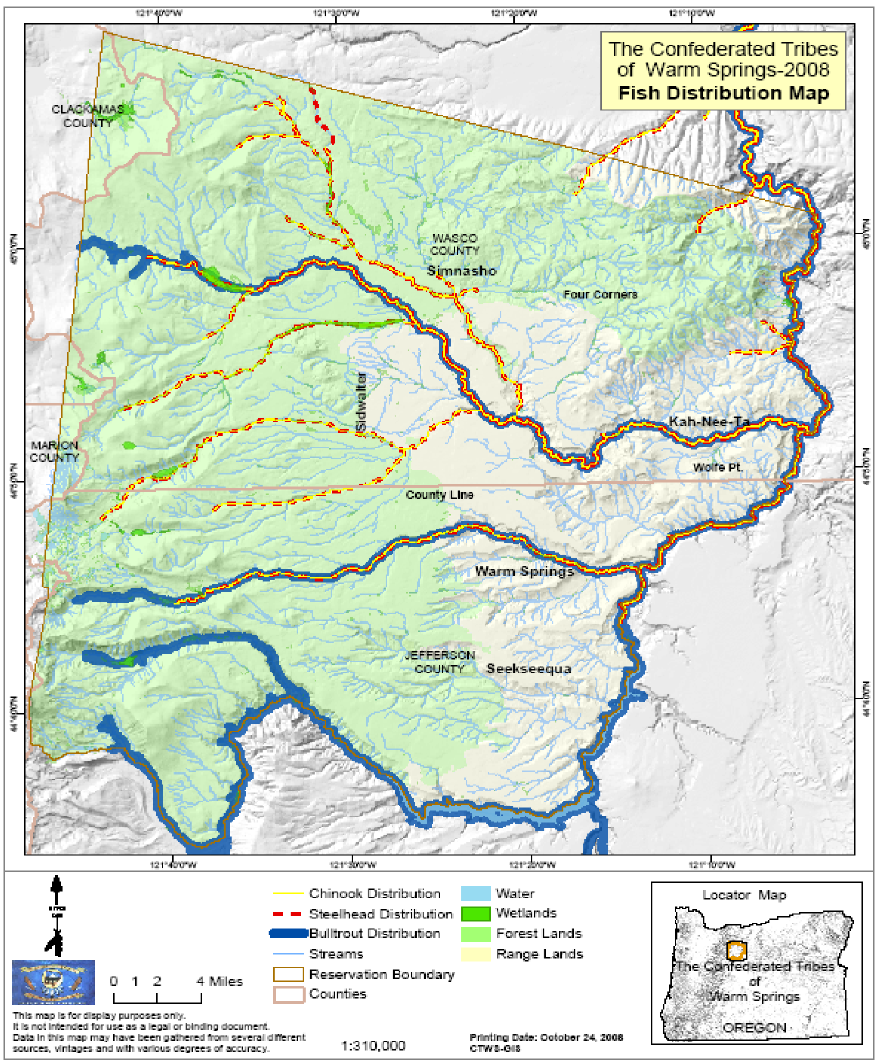
A limiting factors analysis conducted through the development of the Deschutes Subbasin Plan using the Ecosystem Diagnosis and Treatment (EDT) and Qualitative Habitat Assessment (QHA) compared focal fish species requirements during different life stages with the conditions existing in various stream reaches (NWPCC 2003). Data from existing habitat and population surveys along with local expertise were used to populate these models and evaluate habitat conditions. The focal aquatic species used for these analyses were spring Chinook salmon, steelhead/redband, bull trout and Pacific lamprey.

This subbasin level planning effort produced action items and strategies to guide recovery and project prioritization (Tables 3, 4 and 5). The Mid-Columbia Steelhead Recovery Plan identified factors limiting steelhead production (Appendix I), and produced tables for the Deschutes Westside steelhead recovery area (Table 5**)** listing specific projects by name, watershed, location, and limiting factor for implementation. These plans will guide the strategic decision making necessary to implement restoration actions on the Warm Springs Reservation.

Projects developed under the DRRP will address four limiting factors including: **habitat complexity and quantity, fine sediment, water temperature, and altered hydrology**. The following section will discuss each of these in more detail. Monitoring to evaluate restoration actions using regionally approved metrics and protocols from the www.monitoringmethods.org/ website, and reporting systems coordinated through PNAMP (www.pnamp.org/) is presented in the monitoring section of this document and detailed in Table 8 and 9.

Habitat Complexity and Quantity

Salmonids in small streams are specialists and require habitats for spawning and incubation, summer rearing, adult holding, migration, and winter rearing. Thermal and velocity refugia are two important habitats that influence juvenile rearing and foraging potential which both effect survival. Protecting and enhancing habitats that provide thermal refugia during warm water periods and velocity refugia during high flows are critical for restoration success. Land use has altered thermal and velocity refugia that no longer provide habitat for these essential life history requirements.



Map 2. Distribution of anadromous salmonids on the Warm Springs Indian Reservation

Timber harvest and livestock grazing are primary land uses that continue to occur throughout the Reservation. These activities are guided by the Tribes IRMP (1992) which includes provisions for the protection and restoration necessary to mitigate the effects of these activities. Legacy impacts are similarly addressed through active and passive restoration guided by the IRMP and other plans.

Historic harvest of large trees and road building to access timber within stream corridors have significantly reduced the amount of large instream wood in Reservation streams. Large wood is necessary for the creation and maintenance of complex habitat. The lack of large wood is most pronounced in the Warm Springs River and its tributaries (Beaver, Mill, and Badger Creeks), and Shitike Creek. Table 1 shows data from aquatic habitat surveys conducted in 1996 and 1997 detailing large woody debris counts and other habitat parameters in select Warm Springs Reservation stream reaches. The desired condition for density of large wood in drier eastside Cascade forested systems should be greater than twenty pieces per mile (PAC FISH 1994 and IRMP 1992). We used the Interior Columbia Basin Ecosystem Management Project Supplemental Draft Environmental Impact Statement, Appendix 9: Additional Aquatics Guidance and U.S. Fish and Wildlife Services (USFWS) and National Oceanic and Atmospheric Administration (NOAA) Matrices (ICEBMP 2000) to determine the quality of aquatic habitat complexity. This matrix helps determine whether specific habitat parameters and processes are functioning appropriately at the reach scale. Table 1 illustrates that based on these criteria in most the reaches surveyed the key habitat components are functioning at unacceptable risk. For example, width to depth ratios and pool frequency are functioning below acceptable levels. Adding large wood to the system will help restore habitat complexity as well as the processes that reduce stream power. Large wood provides a roughness element in channels, trapping gravels for spawning and debris to form large wood accumulations (log jams) that provide hiding cover throughout the year. Reduced stream power supports channel narrow in processes and ultimately benefits aquatic habitat complexity.

The role of large woody as a component of properly functioning systems has been well documented. Large wood significantly affects channel morphology and hydraulics necessary to form pools and increase pool volumes (Abbe and Montgomery 1996). Large wood can also influence the contribution and retention of organic matter and sediment (Fausch and Northcote 1992; Angermeier and Karr 1984; Smock et al. 1989; Beechie and Sibely 1997). Bisson et al. (1998) found that pools associated with large wood produced higher densities of juvenile salmonids. Woody material has been found to enhance fish and invertebrate biomass and production (Dudley and Anderson 1982; Bilby and Ward 1989; Fausch and Northcote 1992) and provide important cover for juvenile salmonids (Houslet 2004). Large woody debris promotes a more complex environment that produces increased fish biomass (Fausch and Northcote 1992) and greatly increases the resilience and resistance of fish species to floods and droughts (Pearsons 1992).

The upper Warm Springs River flows through mixed conifer forest that likely contributed a significant input of large wood which functioned as a key element in the system. Photo 1 shows typical channel segments of the upper Warm Springs River lacking instream woody debris and devoid of any large key pieces required to develop natural accumulations or debris jams necessary to increase habitat complexity. Photo 2 illustrates how woody debris provides habitat as escape cover for spawning adults and hiding cover for newly hatched juveniles.

Road building associated with timber harvest and municipal development (on lower Shitike Creek and along Highway 26 at Beaver Creek) in stream corridors and floodplains have also reduced stream channel sinuosity and associated complexity on selected streams. Pools are infrequent and shallow riffle habitats predominate. Floodplain connectivity and off channel habitat are limited, over head cover and large woody debris are infrequent in many stream reaches. McIntosh and others (2000) evaluated the historical changes in pool habitats across the Columbia Basin and found that in streams located in watersheds influenced by timber harvest, livestock grazing, and other anthropogenic activities, frequencies of the largest and deepest pools have decreased by just over 50% since 1945. Pool frequency and size, percentage of undercut bank, pieces of large wood per kilometer, percentage of overhead cover, percentage of off channel habitat, substrate, channel length vs. valley length (sinuosity), channel width to depth ratios and varied velocity distributions should all be considered when evaluating habitat complexity. Table 1 illustrates pool frequency, and large wood counts which have been reduced below properly functioning or desired levels in many stream reaches.

Photo 1. Typical stream reach in the upper Warm Springs River deviod of large wood.

The purpose of restoring the large wood component in the Warm Springs River and tributaries is to improve habitat complexity and quantity for all life stages and to restore geomorphic processes (wood recruitment and mobile wood elements) that create and sustain habitats over the long term.

Desired Condition: Restore complex aquatic habitats that provide conditions necessary to support self-sustaining populations of salmonid and non-salmonid fish species; invertebrate; and vertebrate riparian-dependent species. Ensure habitat elements, including spawning and rearing, substrate, pools, winter habitat, migration corridors, cover, food, complexity, water quality, thermal and velocity refugia, and connectivity are in functional condition and sufficiently distributed to support self sustaining populations of anadromous and resident salmonids.

Through the life of this contract the DRRP will restore large wood elements to over five miles of stream channel in priority watersheds on the Reservation and enhance and additional five miles of stream channel using other passive and active restoration techniques.

Table 1. Summary of habitat parameters by watershed and reach (*-*** indicate function criteria). Functioning criteria are outlined in the Matrix of Pathways and Indicators, Appendix 9: Additional Aquatics Guidance and USFWS and NMFS Matrices: *Functioning Appropriately, **Functioning at Risk, ***Functioning at Unacceptable Risk.

Beaver Creek

Reach	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9	Reach 10	Reach 11
Reach Length (miles)	0.7	1.0	3.1	2.1	5.8	5.8	0.6	1.4	0.9	1.0	3.0
Width:Depth Ratio	20.5***	21.6***	20.6***	32.9***	35.4***	23.8***	41.3***	26.2***	29.0***	26.6***	20.***
Large Wood/ Reach	0	0	0	0	0	2	1	0	0	3	1
Large Wood/mile	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***
Pools/Reach	19	21	68	27	62	245	66	35	52	73	120
Pools >3' Deep/mile	1.9***	2.6***	2.3***	2.0***	0.1***	4.0***	0.8***	0.7***	0.0***	0.3***	0.2***

Shitike Creek

Reach	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8
Reach Length (miles)	0.8	4.3	1.3	4.5	9.1	5.8	2	0.5
Width:Depth Ratio	17.9***	25.9***	35.8***	32.4***	18.5***	23.1***	18.6***	10.3**
Large Wood/ Reach	8	10	2	35	125	494	38	0
Large Wood/mile	0.0***	0.0***	0.0***	0.0***	0.1***	0.3***	0.1***	0.0***
Pools/Reach	5	52	8	39	58	76	10	3
Pools >3' Deep/mile	0.8***	3.5***	2.2***	2.7***	2.4***	4.0***	1.9***	1.9***

Warm Springs River

Reach	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7
Reach Length (miles)		1.3	3.8	5.2	3.7	1.8	3.9
Width:Depth Ratio	-	54.1***	37.3***	55.7***	28.1***	26.8***	15.8***
Large Wood/ Reach		1	4	6	21	17	142
Large Wood/mile	-	0.0***	0.0***	0.0***	0.0***	0.0***	0.1***
Pools/Reach	-	0	15	19	114	18	92
Pools >3' Deep/mile	-	0.0***	1.1***	0.6***	0.9***	1.4***	0.4***

Photo 2. Spring Chinook redd in the upper Warm Springs River with small debris jam downstream.

Fine Sediment

The composition of fine sediments within the streambed is elevated above acceptable levels (particles size < 6.4mm) in many Reservation watersheds (Turo 2009). The delivery of fine sediment to stream channels from stream bank erosion and upland run-off are the primary sources of fine sediments in Restoration streams. To better understand erosion at a watershed scale, GeoWEPP software was used in combination with GIS data to determine changes in soil loss and erosion in the Quartz and Coyote Creek watersheds on the Reservation. Although coarse in scale, results of the analysis illustrate increased soil loss associated with surface erosion of nearly 400% from historic conditions. Quartz and Coyote Creek watersheds specifically contribute large volumes of fine sediment to Beaver Creek, negatively affecting wild salmonid production.

Two main techniques have been used to collect sediment data, to evaluate the quality of salmonid habitat in Reservation streams (Turo 2009). **Vibert-Whitlock Boxes** were installed in streams across the Reservation between 1997 and 2002 to assess trends in the amount of fine sediment entering spring Chinook salmon redds. Vibert- Whitlock boxes are small plastic boxes that were designed for in stream incubation of salmonid embryos. In recent years their design has been modified and used to measure the intrusion of fine sediment into spawning gravels. The boxes measure 142 x 88 x 60 mm with square and rectangular openings 7-13 mm long and 3.3 mm wide. The boxes allow particles 3.3 mm or smaller to enter.

Thirty Vibert- Whitlock boxes were installed in Beaver Creek (S-400 crossing), Warm Springs River (Hehe) and Shitike Creek (Shaker Church) on the Reservation. The boxes were filled with clean spawning gravel and a dry weight was recorded. Each box was placed in the stream so the top of the box was even with the surrounding streambed and covered with clean spawning size gravels. Ten boxes were installed along a transect perpendicular to the stream flow. Each site was located within suitable spawning habitat for spring Chinook, and where a recent redd was constructed within ten meters. The boxes were placed in the stream immediately following spawning in mid-September and removed in mid-February, when spring Chinook alevins had likely emerged from the gravel.

Gravels were oven dried at 70º C for 24 hours and the mean percentage increase in weight from boxes that remained buried in the substrate was calculated for each sampling location. The percent increase indicates the amount of intrusion or percent composition of fine material (< 3.3mm in diameter) in the stream bed at a particular spawning location. The percentage can be used to evaluate the quality of spawning habitat in a given stream reach. Wolman pebble counts were also recorded at each site when the boxes were installed and removed. Figure 1 presents a summary of the Whitlock-Vibert sampling data collected on the Reservation from 1997 to 2002.

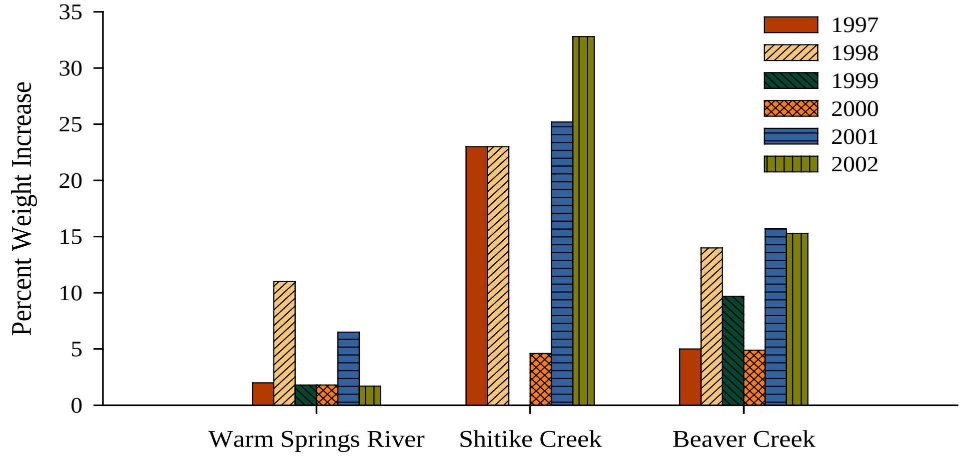


Figure 1. Mean percentage weight increase in Whitlock-Vibert boxes (1997-2002). 1999 data in Shitike Cr. is missing due to high stream flows.

Bulk Core Sampling of stream bed substrate was conducted in 2003 at 13 sites (Table 2) across the Reservation. Bulk core sampling was conducted to establish a baseline data set, detailing the composition of fine sediments of selected streams in spawning and rearing habitats.

Table 2. Summary of the cumulative particle size distribution for select Reservation streams collected using bulk core sampling techniques in 2003. The yellow line indicates the NOAA threshold.

	Beaver Creek						Shitike Creek			Warm Springs River			
Sieve size	Reach 2	Reach 4	Reach 5	Reach 6	Reach 7	Reach 9	Reach 1	Reach 6	Reach 7	McKinley	HeHe	HeHe-Schoolie	Meadows
0.21	6	8	6	3	5	3	5	1	1	7	3	4	4
0.42	10	12	8	5	7	6	8	2	3	10	5	6	7
0.85	14	20	12	11	12	11	14	10	8	14	9	9	12
1.7	19	28	19	18	17	16	21	20	15	19	15	13	16
3.35	26	37	27	28	25	25	26	27	23	27	24	21	23
6.3	36	47	36	37	34	36	30	37	31	37	35	31	33
9.5	45	55	49	45	42	44	34	44	40	46	46	44	43
12.5	52	60	52	52	49	52	38	50	47	52	53	53	51
25	75	76	79	73	74	77	60	71	77	75	75	77	73
50	98	93	98	95	93	96	97	92	99	95	98	98	94
68	100	100	100	99	100	99	100	98	100	100	100	100	100

The results illustrate that fine sediment in selected Reservation streams is potentially limiting aquatic production. Fine sediment from upland sources was identified as the primary limiting factor highlighted in both regional recovery plans.

Elevated levels of fine sediment can limit aquatic productivity. Reduced survival of embryos and emerging fry caused by increases in fine sediment is well documented (Chapman 1988). Incubating eggs of salmonids require spawning gravel that is relatively free of fine sediment (Bjornn and Reiser 1991). Studies of fine sediment have shown reduced salmonid survival, production and/or carrying capacity, with salmonid productivity negatively correlated with the amount of fine sediment in stream substrate (Shepard et al. 1984; Hicks et al. 1991; Bjornn and

Reiser 1991; Scully and Petrosky 1991; Rich et al. 1992; Weaver and Fraley 1993; Rich and Petrosky 1994; Meyer et al. 2005). A negative correlation in production has been attributed to reduced survival-to-emergence of salmonid fry from the redd (Scrivener and Brownlee 1989), primarily due to reduced dissolved oxygen concentrations to the incubating eggs (Maret et al. 1993) or entombment of the emerging alevins (newly hatched fish with yolk sac attached) within the redd. Suttle and others (2004) examined the role of fine sediment in population recovery of Columbia Basin stocks due to the impacts of fine sediment occurring at such a large geographic scale. Survival can be reduced due to a reduction in juvenile salmonid prey species caused by fine sediment accumulations in the stream bed. Decreases in juvenile steelhead growth and survival were observed with increasing levels of fine sediment and likely resulted from higher activity, aggression, and risk of injury (Suttle et al. 2004).

Desired Condition: The composition of fine sediments (<6.4mm) will be incompliance with standards set forth in the IRMP which at present is less than 20% of Reservation streams. Soil loss from upland erosion, surface runoff from roads and stream bank stability will be reduced.

Water Temperature

Extended exposure to elevated water temperatures can cause thermal stress and reduce survival of juvenile salmonids (McCullough et al. 2001 and Ebersole et al. 2003). Due to their high Cascade origin many of the Reservation watersheds have excellent water quality in their upper reaches. However, simplification of the stream channel, loss of floodplain connectivity and off channel wetlands, and reduction in riparian vegetation have resulted in elevated water temperatures that may cause thermal stress and displace individuals from quality habitat. Loss of floodplain connectivity and complexity has resulted in an overall reduction of surface and groundwater interaction which influences thermal refugia.

Interaction between surface and ground water also plays an important role in regulating water temperatures. Studies have shown that during warm periods water temperatures can be directly influenced by surface and groundwater exchange (Loheide and Gorelick 2006, Meisner et. al., Poole and Berman 2001, Ebersole et al 2003, Stanford and Ward 1993). Loheide and Gorelick 2006 (Figure 4) illustrates that surface and ground water interactions influence stream temperature at base flows through reduced, or buffered, diurnal temperature shifts. Groundwater inputs and hyporheic exchange also create thermal refugia at the habitat and reach scales allowing both juvenile and adult salmonids opportunities to thermoregulate and survive in streams where water temperatures reach chronically high levels (>25°C).

Thermal imagery (2001) of the Reservation streams shows the influence of springs and wetland features on local and reach scale temperatures (Figures 2 and 3). Intact and functioning wetlands are critical to maintaining water quality and protecting high quality cold water sources necessary for mediating the affect of elevated water temperature on natural salmonid production and survival. Key riparian corridors have been protected through fencing and off-site water developments. Efforts to increase protection of wetlands, meadows, and springs is on-going.

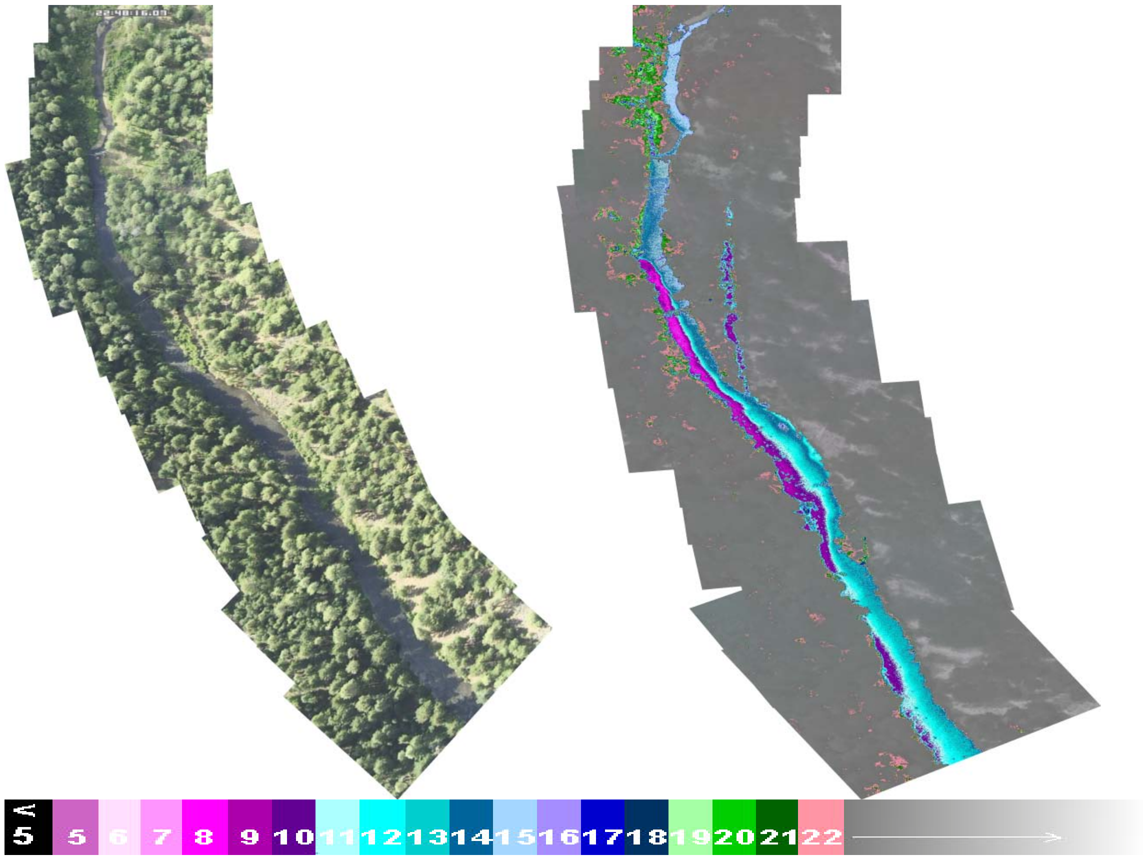


Figure 2. This mosaic shows a series of four springs at river mile 12.9 that cause Beaver Creek's temperature to drop from 15.6^{o}C to 12.2^{o}C. The spring on the left bank is 10.6^{o}C and the three right bank springs are 10.1^{o}C, 10.8^{o}C and 9.0^{o}C respectively.

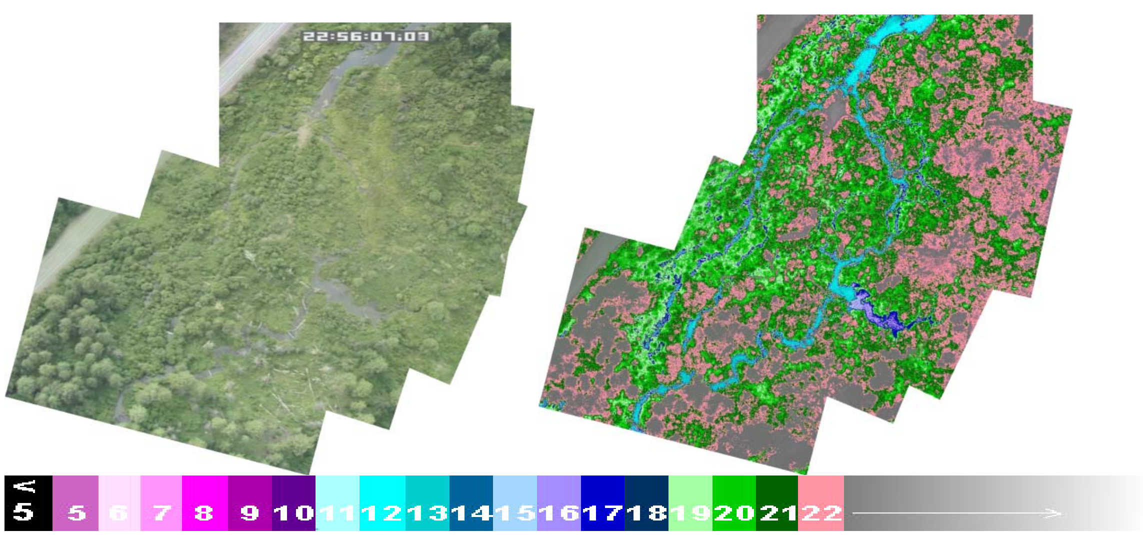


Figure 3. These mosaics show a marshy area of Beaver Creek (13.2^{o}C) at river mile 18.5 and the temperature signature of a distributed channel network through a connected wetland.

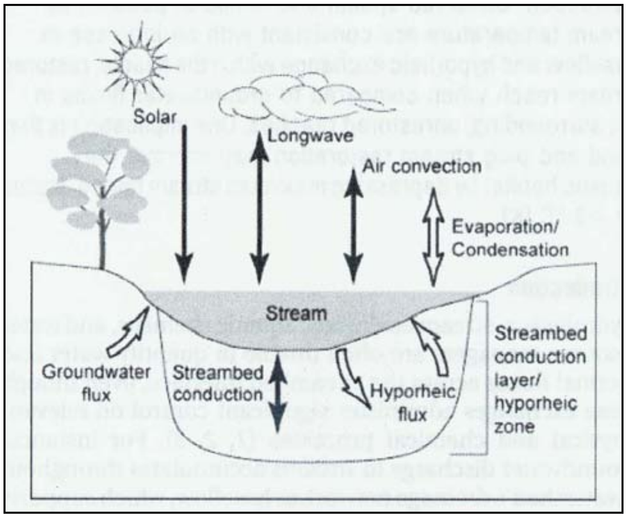


Figure 4. Mechanisms that influence stream temperatures from Loheide and Gorelick (2006).

Torgersen et al. 1999 concluded that spatial patterns of water temperature in the Middle Fork John Day River (MFJD) were more complex than in the North Fork John Day River (NFJD) and that the coldest reaches available to salmon in the MFJD were located in the low gradient, unconstrained reaches where surface and subsurface flows interact. This research highlights the importance of restoring processes that support floodplain connectivity and create variability in water temperatures.

In 2009 the Tribal Habitat Program implemented a restoration project on lower Shitike Creek that serves as an excellent case study for the floodplain restoration philosophy and planning process that will guide the DRRP. Post project temperature monitoring documented the creation and use of thermal refugia by salmonids during the warm summer season. Refugia temperatures were recorded as lows as 10˚C while the mainstem creek temperature peaked near 20˚C over the same time period (Turo and Struhs unpublished data 2010). Lower Shitike Creek has experienced historic channel straightening (Photo 3) that resulted in simplified channel geometry where surface and groundwater exchange was reduced.

Restoration activities that aim to restore fluvial processes that affect stream temperature can occur with an understanding of the watershed (Beechie et al. 2010). This concept was used in 2009 on lower Shitike Creek where several acres of floodplain were reconnected to the main stream channel using side channels, ponds, and floodplain grading (Photo 4). A focused effort was initiated in 2009 to document water temperature and potential cooling related to a more complex system of floodplain features. The predicted response from this work centers on the understanding that the overall stream temperature from where it enters the project area downstream to where it leaves the project may not change, but the thermal characteristics in between may change at a microhabitat scale providing additional thermal refugia. An array of themperature loggers has been deployed along with minnow traps to document thermal characteristics and fish use.

Desired Condition: Stream water temperatures will be within the standards set forth in the Tribes Water Quality Plan to maintain the beneficial uses for salmonid spawning, rearing, and migration. Fluvial process will be restored where possible to maintain the dynamics necessary to maintain thermal refugia.

Photo 3. Lower Shitike Creek channel straightening post 1964 flood, Warm Springs, Oregon.

Photo 4. Completed floodplain and aquatic restoration on lower Shitike Creek in Warm Springs, OR**.**

Altered Hydrology

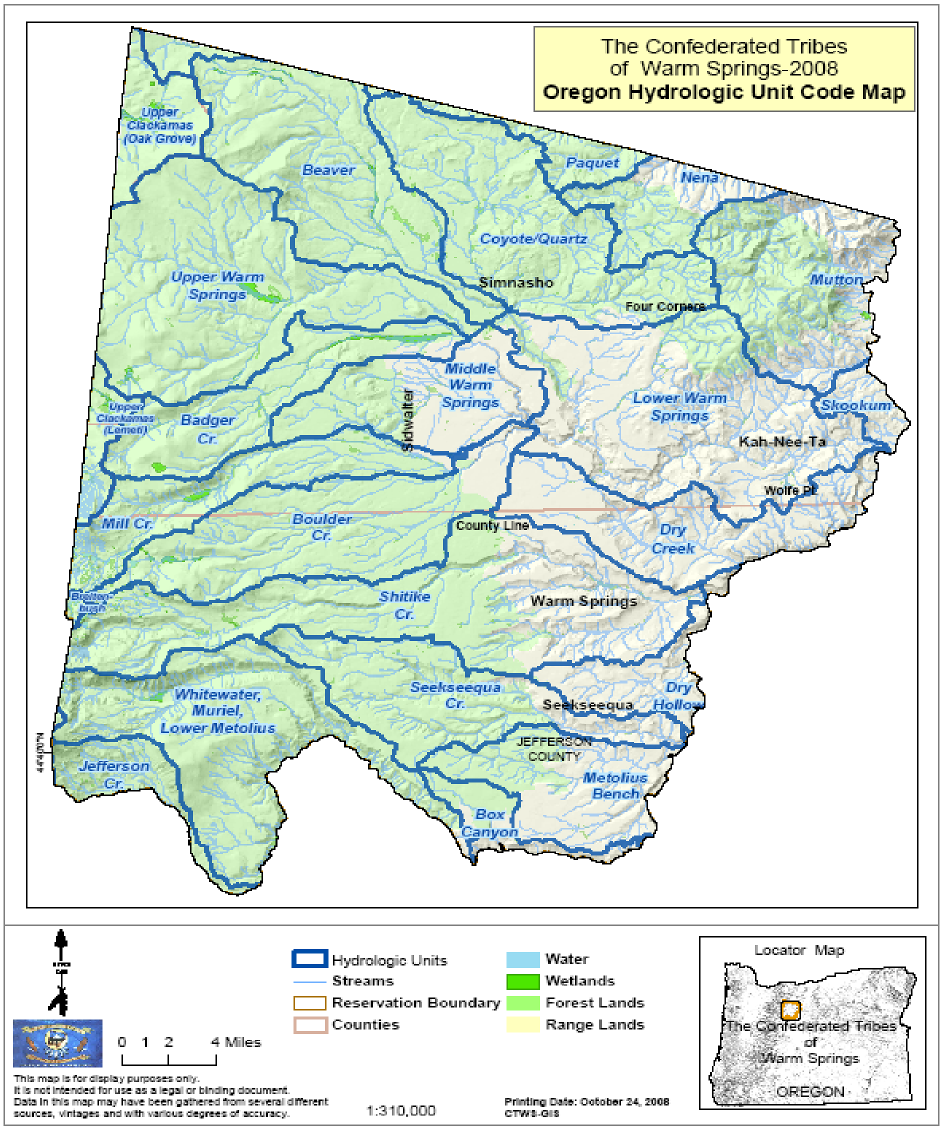
The Mid Columbia Steelhead Recovery Plan (Carmichael 2008) defines the limiting factor altered hydrology as: *Changes in the hydrograph that alter the natural pattern of flows over the seasons, causing inadequate flow, scouring flow, or other flow conditions that inhibit the development and survival of salmonids*. The Recovery Plan identified altered hydrologic process and altered sediment routing as factors limiting steelhead production and recovery on the Warm Springs Reservation.

Watersheds on the Reservation (Map 3) have been impacted by timber harvest, road building, and development, livestock grazing, agricultural production, along with natural landscape scale disturbances such as fire, floods, drought, and insect outbreaks in forested areas. Cumulative effects from these impacts can result in changes in the magnitude and timing of runoff events, and increases in erosion due to soil disturbance and increased overland flow. The greatest influence of the altered hydrologic cycle likely is road development, including associated ditches, skid trails and their orientation with respect to land slope and distance from stream channels which effectively increase the hydrologic network in a watershed (Brooks et al., 1997).

Coarse scale analysis using GeoWEPP software conducted within the Coyote Creek watershed showed that runoff has increased 33% form historic conditions (McKay 2007). Road densities in the Coyote Creek Watershed range from 1 to 12 miles of roads and skid trails per section and exceed the Tribes IRMP standard of 4.5 miles per section in commercial forested lands, 2.5 miles per section in wildlife management zones, and 1.0 miles per section in riparian areas in many sections throughout the watershed (IRMP 1992). In 2008 the Habitat Program secured funding to begin to address these issues in the Coyote Creek Watershed by completing a project that decommissioned roads and skid trails, resurfaced portions of main roads (Photos 5 and 6), and replaced several poorly sized and placed culverts. The DRRP will prioritize similar projects to address altered hydrological processes that are limiting aquatic and salmonid productivity.

Photos 5 and 6. Before and after photos of a resurfaced road in the Coyote Creek Watershed. The road captured a small stream due to an improperly sized culvert. Both the culvert and the road were fixed through this project.

Desired Condition: The rates of watershed runoff, including water yield, timing, frequency, magnitude, and duration of runoff, are sufficient to create and maintain healthy and diverse population of aquatic, wetland and riparian-dependent species and to maintain patterns of sediment, nutrient and wood routing. In short properly functioning watersheds should capture, store and safely release annual water yield.



Map 3. Distribution of 5th field hydrologic units on the Reservation.

The Restoration Strategy

The DRRP is guided by objectives to protect, manage, and restore aquatic species and habitats in Reservation watersheds to ensure projects with measurable benefits are selected for implementation. These principles support the stronghold concept which targets restoration in watersheds that maintain the strongest populations of focal species and intact ecological processes. Shitike Creek and the Warm Springs River sustain the last populations of naturally spawning spring Chinook, summer steelhead, and bull trout in the Deschutes Basin and provide a stronghold from which the DRRP can build. This strategy is tiered to and supported by assessment work already completed in the Deschutes Subbasin Plan, the Mid-Columbia Steelhead Recovery Plan, and the Tribal IRMP.

Deschutes Subbasin Plan

Subbasin planning efforts compiled and analyzed available habitat and watershed data to develop targeted actions within the Deschutes Westside Assessment Unit. The Warm Springs Indian Reservation lies in the Lower Westside Deschutes Assessment Unit in the Deschutes Subbasin Plan (Deschutes Subbasin Plan, Management Plan Page MP– 9-18).

This unit includes the lower 100 miles of the Deschutes River, the Warm Springs River system, Shitike Creek, and the smaller tributaries that enter the lower Deschutes River on its west bank. The Deschutes Subbasin Plan identified several overall habitat objectives presented in Table 3 (Deschutes Subbasin Plan, Management Plan Page MP– 11).

Table 3. Habitat objectives taken from the Deschutes Subbasin Plan, Management Plan Page MP– 11 for the lower Westside Deschutes Assessment Unit section 3.2.

Habitat Objectives
• Protect or restore 1,471 acres of riparian habitat along 163 miles of stream in the Lower Westside Deschutes Assessment Unit. • Protect and restore important wildlife habitats, including backwaters, oxbow sloughs, seeps and springs, and cottonwood groves, willows, and aspen groves. • Provide efficient fish passage to all historic fish habitat in the assessment unit • Increase minimum stream flows in lower Deschutes River tributaries and mainstem Deschutes. • Restore and maintain upland vegetative conditions to improve overall watershed health. • Restore and maintain grasslands and ponderosa pine forests (including white oak component) to benefit wildlife populations.

The lower Deschutes unit was further divided into the Warm Springs and Shitike Habitat Complexes. The specific objectives developed for these focal areas are presented in Tables 4 and 5.

Table 4. Management strategies for the Warm Springs River Habitat Complex taken from the Deschutes Subbasin Plan, Management Plan Page MP– 15.

Warm Springs River Habitat Complex

Management Strategies Specific to Habitat Complex

In Channel Strategies

- Increase minimum stream flow.
- Reduce stream temperature to meet water quality criteria for salmonid rearing.
- Reduce channel width by 50%.
- Restore and maintain instream habitat complexity with a minimum of 20 pieces per 100 meters of stream channel.
- Reduce substrate fine sediment percentage to less than 10%.
- Increase primary pool habitat.

Sub-Watershed Strategies

- Improve upland watershed health through effective management to increase water infiltration, retention and permeability rates and soil stability.
- Restore diverse riparian vegetative function by 50%.
- Proper construction and maintenance of range and forest roads can reduce sediment delivery to streams.
- Implement upland and riparian grazing systems to increase ground cover and slow runoff and erosion.
- Develop upland livestock water sources to help alleviate livestock concentrations in streams and riparian corridors.
- Restore and maintain healthy riparian and floodplain areas with good habitat complexity and species diversity.
- Restore water tables under former wet meadows and stream floodplains to provide natural sub-irrigation and stream flow and stream temperature moderation and reduce stream sedimentation.
- Manage riparian ecosystems to encourage restoration of beaver populations through restoration of woody vegetation.

Shitike Creek Habitat Complex

Management Strategies Specific to Habitat Complex

In Channel Strategies

- Maintain pristine condition of the stream above Peter's Pasture.
- Maintain or increase stream flow.
- Reduce stream temperature to comply with current water quality standards.
- Increase primary pool habitat by 20% in appropriate stream channel types.
- Restore diverse riparian vegetative corridors to provide 80% stream shading and increase stream bank stability to 80%.
- Reduce channel width-to-depth ratio to less than 10.
- Restore and maintain instream habitat complexity with a minimum of 20 pieces of large wood per 100 meters of stream channel or other comparable structure.
- Reduce substrate fine sediment percentage to less than 10%.

Table 5. Management strategies for the Shitike Creek Habitat Complex taken from the Deschutes Subbasin Plan, Management Plan Page MP– 17 Management Plan.

Sub-Watershed Strategies

- Improve upland watershed health through effective management to increase water infiltration, retention and permeability rates and soil stability.
- Proper construction and maintenance of roads can reduce sediment delivery to streams.
- Implement upland and riparian grazing systems to increase ground cover and reduce erosion.
- Develop upland livestock water sources to help alleviate livestock concentrations in the stream and riparian corridor.
- Restore and maintain healthy riparian and floodplain areas with good habitat complexity and species diversity.
- Restore water tables under former wet meadows and stream floodplains to provide natural sub-irrigation and stream flow and stream temperature moderation.
- Manage riparian ecosystems to encourage restoration of beaver populations through restoration of woody vegetation.

Mid-Columbia Steelhead Recovery Plan

Unlike the Deschutes Subbasin Plan the Mid Columbia Steelhead Recovery Plan includes habitat factors limiting the Deschutes River Westside steelhead population. The plan identifies actions necessary to achieve recovery goals, focusing on changes that build upon and adapt from existing social and regulatory programs (Carmichael et al 2008). The Mid-Columbia Steelhead Recovery Plan describes limiting factors and threats to the viability of Mid-Columbia steelhead in Oregon (Carmichael et al 2008).

Table 6 presents the limiting factors, threats, and sites affected for major and minor spawning areas in Deschutes River Westside steelhead population from the Mid-Columbia Steelhead Recovery Plan (Carmichael et al 2008). Appendix I includes a description of these tributary habitat limiting factors. Steelhead have been adversely affected by modified and reduced stream flows, impaired water quality due to elevated water temperatures and chemical inputs, impaired up and downstream fish passage, degraded channel structure and complexity (including riffles, pools and large woody debris), loss of riparian vegetation, reduced floodplain connectivity, and excessive levels of fine sediment caused by altered sediment routing. Threats contributing to these factors include agriculture, forestry and grazing practices that negatively impact steelhead growth and survival, dams and other barriers, water withdrawals, roads and channel manipulations. The Mid-Columbia Expert Panel identified land management as the greatest threat to Mid Columbia steelhead because, for most populations, the greatest impairment to viability has resulted from changes to the tributary spawning, rearing, and migration habitats (Carmichael et al 2008).

Table 6. Major limiting factors, sites affected and potential threats and causes for the Mid-Columbia Deschutes River Westside steelhead population.

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Potential Causes/Threats	Life Stages Affected
DESCHUTES WESTSIDE POPULATION					
Deschutes River Westside Population	Degraded riparian communities; degraded floodplain and channel structure (complexity, side-channel habitat, diversity); water quality (temp); altered hydrology (low flow); altered sediment routing; blocked and impaired fish passage	MaSAs and MiSAs	Abundance, productivity, spatial structure, diversity	Primarily livestock grazing, roads, residential development and agricultural practices that simplify habitat, irrigation withdrawals, forest practices, dams and other barriers	All life stages
Lower Warm Springs MaSA	Degraded floodplain and channel structure (complexity, loss of LWD); degraded riparian communities; degraded water quality (temp); altered hydrology; altered sediment routing	Beaver Creek [R, F, CS, T, S (mouth to Wilson Cr.)]; Warm Springs R. [(F, CS and R in Ka-Nee-Ta resort area), S, R (mouth to Schoolie Cr.)]; Quartz and Coyote creeks [F, CS, S]	Productivity, abundance, spatial structure and diversity	Confinement and runoff from Hwy. 26, livestock grazing, bank armoring and confinement in Ka-Nee-Ta area	All life stages are affected.
Middle Warms Springs MaSA			Degraded riparian communities; degraded floodplain and channel structure; altered sediment routing		
Upper Warm Springs MaSA		Degraded channel structure; water quality (temp)		Loss of LWD	
Mill Creek MaSA	Degraded floodplain and channel structure (channelization, complexity)		Mill Cr. [mouth to Old Mill Camp]	Channelization	
Shitike Creek MaSA	Degraded floodplain and channel structure; degraded riparian communities; altered hydrology; degraded water quality (temp, pollutants); altered sediment routing	Shitike Cr. [F, CS, R (mouth to upper road crossing, City of Warm Springs, near Hwy. 26); WQ (Warm Springs mill site and sewage lagoons)]	Productivity, abundance, spatial structure and diversity	Livestock grazing, riparian degradation and confinement through Warm Springs, Hwy. 26, Warm Springs mill site and sewage lagoons, channelization	All life stages are affected.

Tributary habitat strategies and actions, located in Section 9.3 of the Mid Columbia Steelhead Recovery Plan call for the protection of the highest quality habitats, maintenance of existing unimpaired habitats and ecosystem functions that support population viability, and habitat restoration through passive and active measures. Restoration strategies are linked directly to the limiting factors and aim to improve tributary spawning, rearing and migration conditions by restoring instream, riparian and upland habitat conditions, providing passage and floodplain connectivity, and addressing water quality and flow concerns.

Scope of proposed work

Funding will be used to support the infrastructure (vehicles, equipment, and supplies) and administrative needs (personnel, designs, and permits) necessary to manage a restoration program on the Reservation. The remaining BPA funding will be used for implementation of projects and be matched with Tribal restoration funding, and outside grants and agreements. Implementation funding will also come from a settlement fund established to complete the restoration plan developed from the 1999 gasoline spill into Beaver Creek (NOAA et. al 2008). Additional implementation funding will be secured through the Natural Resources Conservation Service for work focused on sediment reduction and watershed restoration in the Warm Springs River sub watersheds of Beaver, Coyote and Quartz Creeks. Table 7 provides a summary of the restoration work planned for development and implementation over the next 5 to 7 years through the DRRP. Due to funding opportunities, permitting timelines, coordination with other programs, and involvement of the Tribal public the specific timeline and projects associated with this work will need to be flexible.

Protect, Manage, and Restore

The first principle of protection will target sites threatened by further impacts. Currently the DRRP maintains an extensive network (70 miles) of existing riparian and wetland fences (Map 4) along with a dozen off-site water developments that protect critical aquatic habitats and improve the distribution of livestock on the landscape. As more projects are developed additional fences and upland water developments will be proposed to increase protection of critical habitats. Improvements to the grazing systems will be included with these projects to ensure livestock management is compatible with the proposed protection fences.

As an example a riparian fence along Beaver Creek was installed and has been maintained by the Program since the early 1980s to protect high quality spawning and rearing habitat used by steelhead, Chinook, and Pacific lamprey. Additionally this fence protects an extensive wetland complex (Figures 2 and 3) that provides significant cooling and water quality benefits to Beaver Creek. One section of this fence will be proposed for relocation to include more of the wetland complex in 2011. In addition a habitat enhancement project is proposed that will remove a road located in the floodplain and enhance instream habitat by adding large wood to a reach where habitat surveys indicate that wood counts are below standards. In this reach recruitment was interrupted by timber harvest and road building.

Active restoration is the focus of the proposal and will occur at the watershed scale aimed at one or all of the limiting factors presented in the prior sections. Projects will be prioritized based on limiting factors and priorities assigned in the Mid Columbia Steelhead Recovery and Deschutes Subbasin plans using a selection process described in the section below. A schedule of the proposed restoration work planned for the next 5-7 years is presented in Table 7.

One such project, in the Coyote Creek watershed provides an example of how problems will be arrested and priorities assigned. The delivery of fine sediment from upland sources along with deteriorated wetland conditions are negatively affecting fine sediment and altered hydrological process, ultimately reducing the value of critical aquatic habitat in Beaver Creek and in the Coyote Creek watershed. Roads in the Beaver Creek drainage will be removed or resurfaced to eliminate sediment inputs and reduce hydrologic connectivity of roads to the stream. Wetlands, springs, and riparian corridors will be protected using fencing, and water developments will be installed to improve grazing systems. Active restoration will focus on techniques to stabilize eroding banks and to store sediment and water.

Table 7. Five year project planning outline.

Aquatic Habitat Surveys[1]	
2010	Planning and Logistics
2011	Hire crew and begin survey
2012-2015	Continue survey

Priorities: 1) Warm Springs River, **2)** Warm Springs River tributaries **3)** Shitike Creek, **4)** Lower Deschutes River, **5)** all other

[1] For the first two years the Habitat Survey Crew, vehicle, and supplies will be funded with Tribal dollars. Years 2-5 maybe partially funded by BPA Supervisory over sight will be funded by BPA throughout the project.

Habitat Restoration	
Mill Creek Potter's Pond	
2010	Planning and Logistics
2011	Topographic Survey, Design Contract, Complete Design
2012	Permitting, Fundraising, Materials Acquisition
2013-2014	Implementation
2015-	Maintenance and Monitoring
Warm Springs River LWD Placements	
2010	Planning and Logistics
2011	Planning and Logistics, Desgin, LWD Acquisition
2013	Permitting, Fundraising, LWD Acquisition
2014-2015	Implementation
2016	Monitoring
Beaver Creek S501 Road Removal and Habitat	
2010	Planning and Desgin, LWD Acquisition
2011	Implementation
2012-	Maintenance and Monitoring
Quartz Creek Fencing and Bioengineering	
2010	Public meetings, Topographic Survey, Fence Implemenation
2011	Fence Implementation, Bioengineering Desgin
2012	Public meetings, Fence Implemenation, Bioengineering implemenation, Monitoring
2013	Public meetings, Fence Implemenation, Bioengineering implemenation, Monitoring
2014-2015	Public meetings, Fence Implemenation, Bioengineering implemenation, Monitoring, Hydrology and Water Management Investigations on Happy Valley Reservoir.
Coyote Creek Watershed Restoration	
2010	Map exsisting fencelines
2011	Public meetings, Topographic Survey, Water Development and Spring recon
2012	Public meetings, Water Development and Spring recon, Road Removal Mapping
2013	Road Removal Mapping, Fence Implementation, Water Development and New Fence Implementation, Public Meetings
2014	Road Removal Mapping, Fence Implementation, Water Development and New Fence Implementation, Public Meetings
2015	Road Removal Mapping, Fence Implementation, Water Development and New Fence Implementation, Public Meetings, Monitoring

Fencing and Water Developments	
2010	Fence Lower Dry Creek, Water Developments for Warm Springs River Riparian Protection Fence at Mckinley Arthur, Heath Coral, and Rattlesnake Springs. Badger Creek Riparian Protection Fence Water Development
2011	Four Corners Quartz Creek Water Development, Red Lake Water Development and N Fk Quartz Creek Protection Fence
2012	Lower Beaver Creek Water Development Upgrades, Maintenanace
2013-2015	Maintenance

Project Prioritization and Selection

Project prioritization criteria, developed and modified from Beechie et al. (2008) will be used to identify and prioritize protection and restoration projects. The goal of the prioritization process is to guide project selection and ensure funders and the tribal constituency that strategic investments are made at the watershed scale.

The following criteria will be used to prioritize restoration actions.

Planning

1. Does the project lie within the focal watersheds of the Warm Springs River or Shitike Creek?
2. Does the project or restoration action tier to the Deschutes Subbasin Plan or Mid Columbia Steelhead Recovery Plan?
3. Does the project address focal species?
4. Does the project address a limiting factor(s)? If so which ones.

Social

5. Does the project have local landowner and Tribal public support?
6. Does the project have educational value?

Technical

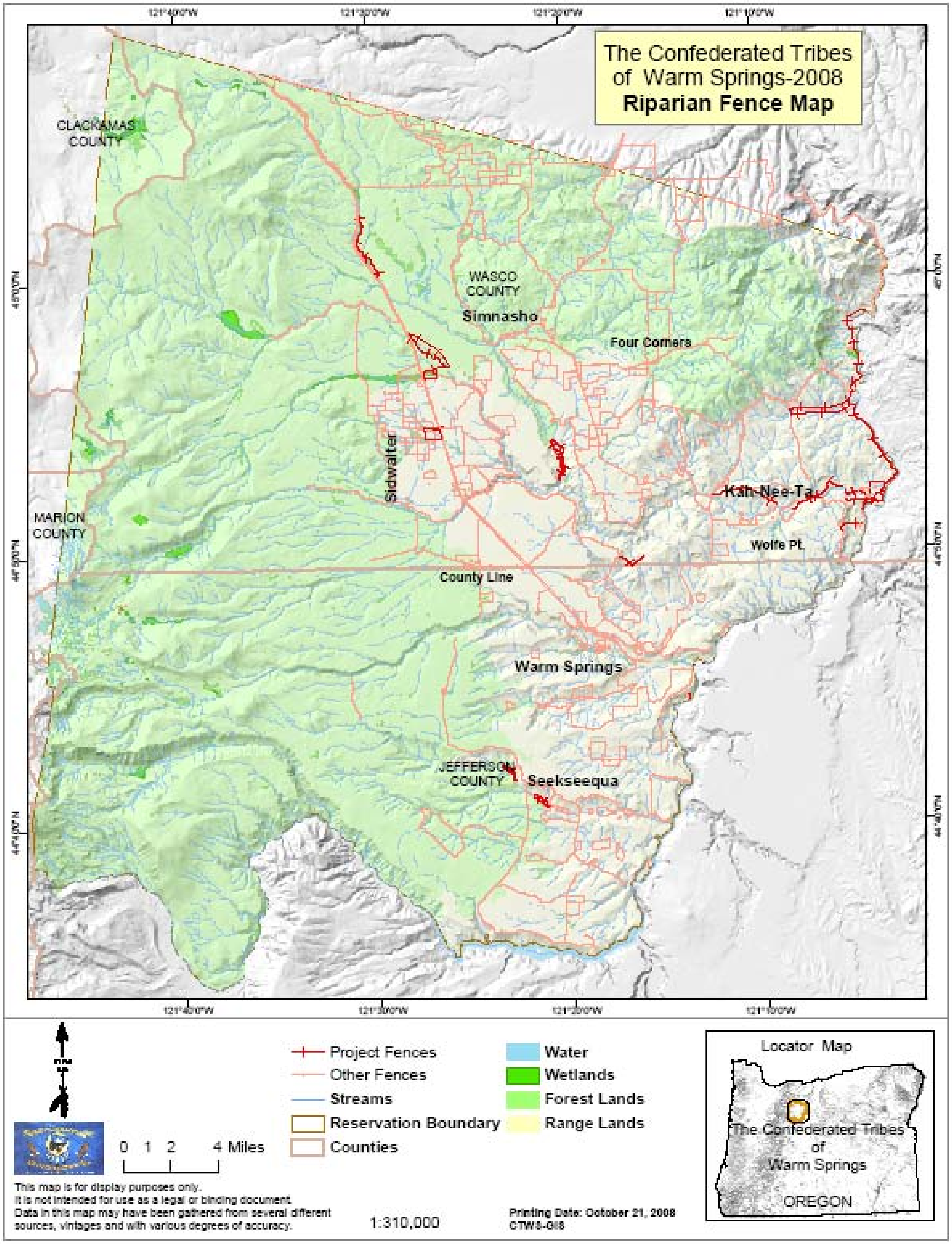
7. Is the proposed project using approved/tested restoration techniques?
8. Will the project have measureable benefits?

Financial

9. Is the project cost effective?
10. Will tribal jobs be created?

This selection and prioritization process is important because it not only ensures that strategic investments are being made; but it also accounts for social factors that influence success of comprehensive watershed restoration from a community perspective. For example, projects that have support from the public are important because they help build relationships while serving as opportunities for education. If a project creates local, living wage jobs through the procurement and bid process; social values surrounding a project increases. The Habitat Program is located within the Tribal Branch of Natural Resources which serves the Warm Springs Nation through the execution of a balanced direction for the protection, use, and enhancement of all Tribal natural resources. The DRRP project prioritization and selection process supports this goal.

Projects will be proposed by Habitat Program staff and further developed through the IRMP interdisciplinary project planning process where input is taken from all natural resources disciplines. Once complete the proposed project will be presented to the Tribal public through a series of public meetings. After public comments are included into the proposed project final review and approval will be given through Natural Resource Managers Interdisciplinary Team. When approved the project can be implemented under the guidelines and standards set forth in the IRMP and will adhere to any mitigation or additional requirements generated through the planning process mentioned above.



Map 4. Location of current riparian fences (marked in dark red) maintained through this contract.

Reporting and Monitoring

Post-project evaluation and monitoring along with dissemination of results is necessary for an adaptive management approach to ecological restoration. To effectively evaluate projects implemented through the DRRP three principle elements (adapted from Kondolf 1995) will be required for each project that will include:

- **Clear objectives** to identity potential failures and provide a framework for project evaluation.
- **Baseline data** to evaluate changes resulting from the project (e.g. effectiveness).
- **Long term commitment** to monitoring over the life of the project or at minimum 10 years to understand the effects/results and inform an adaptive management feedback loop.

In the truest sense restoration projects should be viewed as experiments and implemented using guidelines established under the scientific method. However in this situation the DRRP was funded through the Fish Accords MOA between the Tribes and BPA to implement restoration actions outlined in the Deschutes Subbasin Plan, Mid Columbia Steelhead Recovery Plan using the guidance and direction set forth in the Tribes IRMP. Many (if not all) of the techniques proposed for use through this funding agreement are standard restoration practices and are widely used across the Pacific Northwest. The Tribes will perform monitoring to a level that will ensure project objectives are met and deliver on the Federal investment. Specific monitoring will address physical components of the project while a second suite of monitoring will address biological indicators. The level of detailed monitoring that will be based on site specific treatment and will be guided by the regional direction for implementation and effectiveness monitoring of restoration actions (e.g. PNAMP protocols and methods).

Projects selected for implementation through the DRRP will employ a reporting system developed by NOAA Fisheries to support PNAMP. This effort has developed a comprehensive series of reporting metrics and protocols to track restoration actions at the project scale. The projects that may be implemented through the DRRP along with the specific reporting metric for each project type is presented in Table 8. In addition Table 9 presents a suite of monitoring actions that will be implemented to evaluate the effectiveness for each project, and were taken directly from the list approved protocols available through PNAMP and can be reviewed at www.monitoringmethods.org/Protocol.

Fish population responses to the restoration projects implemented through the DRRP will be monitored at the watershed scale through the BPA funded project 2008-311-00, Natural Production Monitoring and Management also managed by the CTWSRO. This project will also use monitoring protocols listed and approved through PNAMP. This project will annually monitor and report juvenile production using out-migrant trapping techniques, while juvenile rearing estimates will be generated using snorkel techniques within summer rearing habitats. Adult escapement will be calculated annually using index and census redd counts.

Water quality and water temperature will be monitored by the Tribal Branch of Natural Resources by the Environmental Program through a strategy approved by the Region 10 office of the Environmental Protection Agency (EPA). This monitoring strategy involves three components:

- Baseline monitoring at 48 sites on the Reservation on a monthly basis.
- Non-point source monitoring using grab samples and continuous monitoring at eight sites on the Reservation.
- Monthly monitoring to evaluate compliance with Tribal water quality standards at 48 sites on the Reservation.

As appropriate, based on treatment and site-specific conditions water quality monitoring may be expanded to include specific restoration sites. All of this data is on file within the Tribes water quality database and reported to EPA as per requirements of their annual funding agreement.

To monitor trends in the fine sediment composition of streambed substrate of Reservation streams the Habitat Program has developed a monitoring strategy that incorporates existing data (Table 1) as a baseline and uses regional approved protocols and techniques from BPA's Integrated Status and Effectiveness Monitoring Program (ISEMP) (Tussing 2009). This long term monitoring component will serve as the tool from which compliance to the IRMP and effectiveness of sediment reduction projects are evaluated. Aquatic habitat surveys will be conducted on Reservation streams using region wide methodologies proposed through the Columbia Habitat Monitoring Program (CHaMP) coordinated by NOAA's Integrated Status and Effectiveness Monitoring Program. Standardized habitat data collection protocols will be used to ensure data is suitable for use in Columbia Basin wide trend and condition analysis, and regional survival rates to support recovery analysis. Data management support will be provided through the Columbia River Intertribal Fisheries Commission and Tribal funding will be used to support the first three years of survey work. Aquatic habitat data will also be used in on Reservation land management decision making processes, Endangered Species Act Biological Assessment determinations, watershed and restoration planning, and project designs. The protocols and metrics that will be used to sample for treatment effectiveness are referenced in Tables 8 and 9.

Table 8. Proposed project types, reporting and monitoring metrics.

Deschutes River Restoration Program Proposed Project Types, Reporting and Monitoring Metrics

Project Type	Subtype	Definition	Objective	Long-term Monitoring
Instream Habitat			1. Improve stream/channel morphology in the treated stream reach. 2. Increase juvenile salmon abundance in the treated stream reach.	Photopoints, channel cross section and longitudinal profiles, redd surveys, presence absence and juvenile salmonid surveys, basin wide outmigrant trapping, habitat surveys and water temperature monitoring
	Engineered Large Wood	Placement of large wood in a stream channel using pinning and ballast		
	Large Wood Placement	Placement of large wood in a stream channel without pinning and ballast		
	New Channel Creation	Construction of new channel increasing length, pools, riffles, glides		
	Bank Stabilization	Use of wood, rock, vegetation, and/or bioengineering to stabilize stream banks		
	Spawning Gravel Placement	Addition of spawning sized gravel to stream channels		
	Boulder Placement	Addition of rounded boulders to stream channels		
	Off Channel Habitat-side channel	Construction or reconnection of side channels		
	Off Channel Habitat-slough creation	Construction or reconnection of slough features		
	Off Channel Habitat-pond creation	Construction or reconnection of ponds		
	Engineered Beaver Pond	Construction of simulated beaver ponds to provide habitat		
Sediment Reduction			1. Reduce to composition of fine sediment (particles less than 6.4mm) in the stream bed substrate.	Photopoints, redd surveys, fish presence absence surveys, long term bulk core sediment sampling, plant survival and composition surveys, channel cross section and longitudinal surveys
	Road Removal	Complete removal of road surfaces from the land		
	Road Resurfacing	Resurfacing a road with rock or another material to reduce surface erosion		
	Road Relocation	Abandoning a road from a sensitive area and moving to a less sensitive location		
	Road Crossing Improvement-rock	Addition of rock to reinforce a existing crossing while maintaining passage and channel geometry		
	Road Crossing Improvement-culvert improvement	Instillation of a properly sized culvert		
	Road Drainage System Improvements	Instillation of structures to control run off from roads		
	Bank Stabilization-bioengineering	Use of wood, rock, vegetation, and/or bioengineering to stabilize stream banks		
	Bank Stabilization- engineered large wood placement	Placement of large wood in a stream channel using pinning and ballast		
	Engineered Beaver Pond	Construction of simulated beaver ponds to provide habitat to retain sediment		
	Planting-riparian	Planting native species within riparian areas to stabilize banks and filter sediment		
	Planting-upland	Planting native species within upland areas to retain and filter sediment		
Fish Passage			1. Restore yearlong upstream and downstream passage on all anadromous and resident fish bearing streams	Fish presence absence and redd surveys, basin wide outmigrant trapping, and photopoints
	Culvert Removal	Complete removal of culverts		
	Culvert Replacement	Replacement of culverts that are undersized, improperly placed, or unmaintained		
	Instream Structure Removal	Removal of relic instream structures		
Riparian Improvement			1. Restore streamside vegetation, increase bank stability, and reduce sedimentation. 2. Reduce to composition of fine sediment (particles less than 6.4mm) in the stream bed substrate.	Photopoints, redd surveys, fish presence absence surveys, long term bulk core sediment sampling, plant survival and composition surveys, channel cross section and longitudinal surveys, and annual weed surveys
	Native Species Planting	Planting native species within riparian areas to stabilize banks and filter sediment		
	Weed Control	Removal and/or control of non-native and noxious weeds		
	Silvicultural Treatment-stand management	Prescribed burnings, stand thinnings, silivicultural practices, vegetation management		
	Fencing	Fence construction to improve and reduce livestock use in sensitive sites		
Upland Improvement			1. Reduce to composition of fine sediment (particles less than 6.4mm) in the stream bed substrate. 2. Improve the abilty of the watershed to capture, store, and safely release annual preciptation.	Photopoints, annual weed surveys, plant survival and composition surveys, long term bulk core sediment sampling, water development maintenance log
	Silvicultural Treatment-stand management	Prescribed burnings, stand thinnings, silivicultural practices, vegetation management		
	Juniper Removal	Thinning and removal of juniper to improve hydrology and upland vegetation composition		
	Native Species Planting	Planting native species within riparian areas to stabilize banks and filter sediment		
	Water Development- maintenance	Maintenance and improvement of existing water developments		
	Water Development-new	Construction of new water developments to improve livestock distribution		
	Weed Control	Removal and/or control of non-native and noxious weeds		
	Fencing	Fence construction to improve livestock distribution in upland areas		
Wetland Improvement			1. Reduce to composition of fine sediment (particles less than 6.4mm) in the stream bed substrate 2. Improve the abilty of the watershed to capture, store, and safely release annual preciptation.	Photopoints, plant survival and composition surveys, channel cross section and longitudinal surveys, and annual weed surveys
	Weed Control	Removal and/or control of non-native and noxious weeds		
	Fencing	Fence construction to improve and reduce livestock use in sensitive sites		
	Wetland Creation	Construction of wetland features to store and process water		
	Engineered Beaver Pond	Construction of simulated beaver ponds to provide habitat, retain sediment, and improve water storage		
	Native Species Planting	Planting native species within wetland areas to stabilize banks and filter sediment		
	Bank Stabilization-bioengineering	Use of wood, rock, vegetation, and/or bioengineering to stabilize stream banks		
Grazing Management			1. Restore streamside vegetation, increase bank stability, and reduce sedimentation. 2. Reduce to composition of fine sediment (particles less than 6.4mm) in the stream bed substrate. 3. Improve the abilty of the watershed to capture, store, and safely release annual preciptation.	Photopoints, annual weed surveys, plant survival and composition surveys, long term bulk core sediment sampling, water development maintenance log
	Fencing-riparian	Fence construction to improve and reduce livestock use in sensitive sites		
	Fencing-pasture	Fence construction to improve livestock distribution		
	Water Development- maintenance	Maintenance and improvement of existing water developments		
	Water Development-new	Construction of new water developments to improve livestock distribution		
	Weed Control	Removal and/or control of non-native and noxious weeds		

Table 9. Effectiveness monitoring protocols.

Deschutes River Restoration Program Effectiveness Monitoring Protocols

Long term Monitoring	Definition	Protocol	Metric	Frequency
Photopoints	Photographic documentation of pre and post projects to visually track changes over time	OWEB Guide to Photo point monitoring	N/A	Every 2 years
Channel Morphology-cross section and longitunal profiles	Survey documantation of the physical character of stream channels	PIBO Protocol for sampling stream channel attributes	Thalweg Depth, Wetted Width, Channel Form	years 1,3,5 and 10
Fine Sediment Sampling	Measurement of fine sediment levels in salmonid spawning gravels	PNAMP-ISEMP Field Manual of Scientific Protocols for Fine Sediment Sampling within the Upper Columbia Monitoring Strategy	Percet composition	Every 2 years
Aquatic Habitat Surveys	Measurement of aquatic habitat quantity and quality	USFS Region 6 Level 2 Aqautic Habitat Surveys		Every 10 years
Riparian Planting	Determine whether riparian plantings are effective in restoring riparian vegetation, stream bank stability, and reducing sedimentation.	SFRB MC-3 Protocol for monitoring the effectiveness of riparian planting projects	Number of Plants, Percent survival	years 1,3,5 and 10
Riparian Fencing	Determine whether livestock exclusion projects are effective in excluding livestock, restoring riparian vegetation and restoring stream bank stability.	SFRB MC-4 Protocol for monitoring the effectiveness of riparian livestock exclusion projects	stream miles	years 1,3,5 and 10
Redd Surveys*	Census surveys of available spawning habitat to determine adult fish abundance	ISEMP Field Manual of Scientific Protocols for Steelhead and Salmon Redd Surveys within the Upper Columbia Monitoring Strategy	# of fish per km	Annually
Juvenile Fish Abundance (rearing)*	Fish abundance monitoring within summer rearing habitat to characterize status and trends at the watershed level.	ISEMP Field Manual of Scientific Protocols for Underwater Observations within the Upper Columbia Monitoring Strategy	# of fish per m^2	Annually
Basinwide Juvenile Salmonid Production (out-migrant trapping)*	Juvenile outmigrat trapping is used to estimate abundance (production), size and condition for populations or subgroups of anadromous salmonid stocks.	ISEMP Field Manual of Scientific Protocols for Downstream Migrant Trapping within the Upper Columbia Monitoring Strategy	Total number of fish by species and age class	Annually
Water Temperature**	Water Temperture recored as seven day rolling maximum, minimum, and average	EPA Region 10		
Water Quality**	Selected water water chemistry and quality parameters	EPA Region 10		Annually

*Basin wide fish population and abundance monitoring will be conducted through BPA project #2008-311-00 titled Natural Production Status and Trend Monitoring in the Deschutes Basin

**Monitoring conducted through Tribal Environmental Program

C. Rationale and significance to regional programs

Section B (above) describes in detail how this proposed Program will implement the strategies and projects named in both the Deschutes Subbasin Plan and the Mid Columbia Steelhead Recovery Plan.

This project is also directly in line with the 2009 Amendments made to the Northwest Power and Conservation Council's Columbia Basin Fish and Wildlife Program (NWPCC) because it aims to rebuild, healthy, naturally producing fish (and indirectly wildlife) populations by protecting, mitigating, and restoring habitats and the biological systems within them (NWPCC 2009). This will occur within an adaptive management framework where monitoring and an understanding of the latest science associated with ecological restoration will be applied.

Most important is the process based restoration approach (Beechie et al. 2010) proposed by this Program which is directly in line with NWPCC's Scientific Foundation and Principles, specifically Principle 4 which states *"**Habitats develop, and are maintained, by physical and biological processes".*** Additionally the principle states that *"Habitats are created, altered, and maintained by processes that operate over a range of scales. Locally observed conditions often reflect more expansive or non-local processes and influences, including human actions. The presence of essential habitat features created by these processes determines the abundance, productivity, and diversity of species and communities. Habitat restoration actions are most effective when undertaken with an understanding and appreciation of the underlying habitat-forming processes."*(NWPCC 2009).

The DRRP is tiered to, and will also implement the Biological Opinion for the Federal Columbia River Power System (FCRPS) Habitat Strategy 1 "Protect and improve tributary habitat based on biological needs and prioritized actions."

As a federally recognized sovereign the CTWSRO have developed and are implementing an IRMP (1992) that provides guidelines for the stewardship of all natural resources and serves as a basis for making management decisions on the Warm Springs Reservation. The IRMP goals establish an interdisciplinary approach to resource management planning that will:

1. Preserve, protect and enhance environmental and cultural values.
2. Sustain traditional, subsistence and other cultural needs of current and future tribal members.
3. Provide for sustainable economic and employment opportunities.
4. Provide for public health and safety.
5. Manage for diversity, long term productivity and sustainability of all natural resources.

D. Relationships to other projects

The DRRP has a direct link and relationship with several other BPA funded projects in the Deschutes Basin (Table 10) along with relationships and linkage to several other non-BPA funded efforts. Population monitoring projects supported through MOA projects on the Reservation and the Deschutes Basin will provide the baseline status and trend monitoring required to evaluate the success of restoration and recovery efforts basin wide.

The recent relicensing of the Pelton-Round Butte Hydroelectric complex resulted in the first co-license (Tribes and PGE) issued through the Federal Energy Regulatory Commission. The other landmark decision that resulted from this process was the mandate that salmon and steelhead be reintroduced above the hydroelectric complex for the first time in fifty plus years. This reintroduction effort will use donor stock from populations downstream of the hydroelectric complex to develop the populations upstream. To accomplish this the populations below the dam must be both abundant and viable enough to serve as donor stock. One key element of viability and abundance is excellent habitat and healthy watersheds. Thus, robust populations and properly functioning habitat downstream of the dam is critical to the success of reintroduction of salmon and steelhead upstream of the hydro-complex.

Table 10. List of projects that either have a direct or indirect link to the Deschutes River Restoration Program #2008-301-00.

Funding Source	Project #	Project Title	Relationship
BPA	2007-157-00	Bull Trout Status and Abundance	Monitors bull trout trends within habitat program area.
BPA	2008-307-00	Deschutes River Sockeye Development	Develops recovery plan and monitors sockeye population trends within habitat program area.
BPA	2002-016-00	Lamprey Abundance	Determine status and limiting factors for lamprey in the Deschutes basin
BPA	2008-306-00	Escapement Goals-Deschutes River Fall Chinook	Monitor trends in Fall Chinook abundance on the Deschutes River.
BPA	2008-305-00	Steelhead Production Monitoring	Monitor trends in steelhead abundance on the Warm Springs Reservation.
BPA	2008-304-00	Spring Chinook Production Monitoring	Monitor trends in spring Chinook abundance on the Warm Springs Reservation.
BPA and others	1998-028-00	Implement Trout Creek Watershed Restoration	Enhancement of fish habitat in Trout Creek watershed. Deschutes basin recovery.
BPA	1994-042-00	Trout Creek O and M	Continue monitoring and maintenance of habitat projects in Trout Creek. Deschutes basin recovery.
Various		Upper Deschutes Watershed Council Crooked River Watershed Council	Habitat and passage projects in the upper basin. Increases in production will support viable populations.
Various		Natural Resources Conservation Service Soil and Water Conservation Districts	On the farm water efficiency and quality improvement projects within the basin.
Various		Pelton Round Butte Reintroduction Projects	Habitat enhancement and production monitoring projects involved with the upper Deschutes basin reintroduction effort.

E. Project history

No History available. This is a new project.

F. Proposed biological objectives, work elements, and methods.

Biological objectives will focus on the limiting factors at the watershed scale. Table 7 presents a list of projects that will be developed over the next five to seven years to improve habitat and watershed health. This list is not comprehensive and does not preclude the DRRP from developing projects outside this scope of work that will benefit the goals and objectives described in detail throughout this narrative. All of the projects developed through the DRRP will address one or all of the limiting factors and follow the guidance and recommendations of regional and Columbia Basin level planning decisions.

Ten objectives were developed to discuss the vision and direction of the Program. Ecological recovery and function may require decades at the minimum, especially concerning biological objectives one though four. The DRRP will establish a repeatable, robust monitoring element intended to track trends in fine sediment, habitat, water temperature, and hydrology within the emphasis area. Objectives to manage the program and conduct outreach with the Tribal public are included. Work elements will center on the planning and design of constructed habitat or watershed restoration features, as well as the planning and monitoring to track effectiveness.

A summary of the biological objectives includes:

1. Restoration of habitat complexity
2. Reduction in fine sediment—delivery and stream bed composition
3. Restoration of hydrologic function
4. Protect water temperature, increase thermal refugia
5 Increased floodplain and wetland areas
6. Protection of critical habitat areas
7. Improve upland and riparian vegetation composition
8. Fill data gaps and evaluate status and trends
9. Conduct Outreach to Tribal public
10. Manage the Deschutes River Restoration Program

Objective 1: Restore habitat complexity.

Methods:

Implement instream habitat enhancements that increase pool size and frequency, overhead cover, off channel habitat, and increase spawning habitat.

- Add large wood features
- Construct new main and side channel segments
- Construct new channel patterns, profiles and bed forms
- Restore/Enhance riparian and wetland vegetation

Applicable Work Elements:

WE #	WE Name
29	Increase In-stream Habitat Complexity
30	Realign, Connect, and/or Create Channel
31	Relocate Road
180	Enhance Floodplain
181	Create, Restore, and/or Enhance Wetland
184	Install Fish Passage Structure
186	Operate and Maintain Habitat / Passage
40	Install Fence
22	Maintain Vegetation
47	Plant Vegetation
53	Remove Vegetation
99	Outreach and Education
22	Maintain Vegetation
34	Develop Alternate Water Source
175	Produce Design and/or Specifications
122	Provide Technical Review
165	Produce Environmental Compliance Documentation

Objective 2: Reduce the delivery of fine sediment to stream channels from the uplands and reduce the composition of fine sediment in stream beds.

Methods:

1. Develop and implement projects that address limiting factors at the watershed scale.
   - reduce road densities
   - rehab compacted surfaces
   - improve livestock management
   - restore appropriate upland vegetation types
   - restore wetland storage and energy release features

2. Restore fluvial processes that transport and sort sediment loads.

Applicable Work Elements:

WE #	WE Name
33	Decommission Road
38	Improve / Relocate Road
55	Upland Erosion and Sedimentation Control
175	Produce Design and/or Specifications
122	Provide Technical Review
165	Produce Environmental Compliance Documentation
188	Provide access and Public Information
22	Maintain Vegetation
47	Plant vegetation

Objective 3: Restore hydrologic function within priority watersheds.

Methods:
1. Reduce road densities and other hydrologically connected features.

2. Restore compacted surfaces, and manage both upland and riparian vegetation.

3. Restore floodplain and wetland features where appropriate.

Applicable Work Elements:

WE #	WE Name
33	Decommission Road
38	Improve / Relocate Road
55	Upland Erosion and Sedimentation Control
175	Produce Design and/or Specifications
122	Provide Technical Review
165	Produce Environmental Compliance Documentation
22	Maintain Vegetation
47	Plant vegetation

Objective 4: Maintain or improve stream temperatures.

Methods:
1. Protect functioning floodplains, wetlands and springs.

Applicable Work Elements:

WE #	WE Name
30	Realign, Connect, and/or Create Channel
40	Install Fence
180	Enhance Floodplain
181	Create, Restore, and/or Enhance Wetland
22	Maintain Vegetation
26	Investigate Trespass
47	Plant Vegetation

Objective 5: Increase and enhance wetland areas

Methods:

1. Conducting planning and analysis prioritize wetland restoration sites.
   - Restore incised channel and wetland features
   - Incorporate appropriate surface water pond features where appropriate (mimic beavers)
   - Restore vegetation
   - Improve livestock management

Applicable Work Elements:

WE #	**WE Name**
29	Increase In-stream Habitat Complexity
30	Realign, Connect, and/or Create Channel
180	Enhance Floodplain
181	Create, Restore, and/or Enhance Wetland
184	Install Fish Passage Structure
186	Operate and Maintain Habitat / Passage
40	Install Fence
47	Plant Vegetation
53	Remove Vegetation
99	Outreach and Education
22	Maintain Vegetation
34	Develop Alternate Water Source
175	Produce Design and/or Specifications
122	Provide Technical Review
165	Produce Environmental Compliance Documentation

Objective 6: Protect critical habitat areas

Methods:

1. Maintain the existing riparian fence network. Work with range users in the development of new projects to include an improved livestock management. Include the long term maintenance into every project.

Applicable Work Elements:

40	Install Fence
47	Plant Vegetation
53	Remove Vegetation
99	Outreach and Education
22	Maintain Vegetation
34	Develop Alternate Water Source

Objective 7: Improve riparian and upland vegetation composition.

Methods:

1. Plant and manage vegetation to restore riparian and upland processes important fish habitat and watershed health.

Applicable Work Elements:

40	Install Fence
47	Plant Vegetation
53	Remove Vegetation
99	Outreach and Education
22	Maintain Vegetation
34	Develop Alternate Water Source

Objective 8: Fill data gaps and conduct status and trend monitoring of limiting factors

Methods:

1. Collect stream flow, temperature, sediment, and habitat data. Develop methods and analysis to track trends over time.

Applicable Work Elements:

WE #	**WE Name**
148	Install Flow Measuring Device
157	Collect / Generate / Validate Field and Lab Data
162	Analyze / Interpret Data
115	Produce Inventory or Assessment
160	Create / Manage / Maintain Database
99	Outreach and Education
183	Produce / Submit Scientific Findings Report

Objective 9: Conduct outreach with the Tribal public.

Methods:

1. Create open line of communication with the Tribal public to improve relationship and build better understanding of proposed projects and objectives. Promote Tribal participation in project development.

Applicable Work Elements:

WE #	**WE Name**
99	Outreach and Education
119	Manage and Administer Projects
191	Watershed Coordination

Objective 10: Manage and administer the Deschutes River Restoration Program.

Methods:
1. Manage and administer DRRP and non-BPA funding sources. Develop priorities, projects, and funding proposals. Produce annual and quarterly reports to satisfy contractual obligations.

Applicable Work Elements:

WE #	WE Name
114	Identify and Select Projects
118	Coordination
119	Manage and Administer Projects
132	Produce Annual Report
185	Produce Pisces Status Report
115	Produce Inventory or Assessment
122	Provide Technical Review
174	Produce Plan
191	Watershed Coordination

G. Facilities and equipment

This project will be managed from the Natural Resources building in Warm Springs, Oregon located on the Warm Springs Indian Reservation. The Habitat Program on the Reservation is small with three full time staff, two vehicles, one ATV, three computers, some fence supplies, tools and a small storage shed. As the program grows funding through this contract will support the growing needs of a full service restoration and land management operation.

It is anticipated that through the life of this contract equipment will be purchased to develop and monitor projects. Capital items to be purchased will likely include a GPS and survey equipment to design and layout restoration projects, an additional ATV to assist with weed and vegetation management, computers and software to manage and administer the program. A shop building for storage and work space will be required to support the needs of the program and will be incorporated into the contract. Hand tools, monitoring equipment, office supplies, and vehicle accessories will be purchased through this contract as well.

A list of this equipment and its condition will be maintained and supplied to the contracting officer annually.

H. References

Abbe, T.B. and D. R. Montgomery. 1996. **Large woody debris jam, channel hydraulics and habitat formation in large rivers.** Regulated Rivers Research and Management 12:201-221.

Angermerier, P.L., and J. R. Karr. 1984. **Relationships between woody debris and fish habitat in small warm water streams.** Transactions of the American Fisheries Society 113:716-726.

Beechie, T.J. and T.H. Sibley. 1997. **Relationships between channel characteristics woody debris, and fish habitat in northwestern Washington streams.** Transactions of the American Fisheries Society 126:217-229.

Beechie, T.J., Sear, D. A., Olden, J. D., Pess, G.R., Buffington, J. M., Moir, H., Roni, P., Pollock, M. M. 2010**. Process-based Principle for Restoring River Ecosystems. Bio Science** 60:209-222.

Beechie, T.J., Pess. G., Roni. P., Giannico. G. 2008. **Setting Restoration Priorities: a Review of Approaches and a General Protocol for Identifying and Prioritizing Actions** 28:891-905.

Bilby, R.E. and J.W. Ward. 1989**. Changes in characteristics and function of woody debris with increasing size of streams in western Washington.** Transactions of the American Fisheries Society 118:368-378.

Bisson, P.A, K. Sullivan, and J.L. Nielsen. 1988. **Channel hydraulics, habitat use and body form of juvenile coho salmon, steelhead and cutthroat trout in streams.** Transactions of the American Fisheries Society 117:262-273.

Bjornn, T. C., and D. W. Reiser. 1991. **Habitat requirements of anadromous salmonids. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitat.** American Fisheries Society Special Publication 19: 83-138.

Booneville Power Administration, 2008. **Columbia Basin Fish Accord Record of Decision**.

Carmichael, R., and Taylor, B. 2008. **Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment.**

Chapman, D, W. 1988. **Critical review of variables used to define the effects of fines in redds of large salmonids.** Transactions of the American Fisheries Society. 117: 1-21.

The Confederated Tribes of the Warm Springs Reservation of Oregon. 1992. **Integrated Resources Management Plan for the Forested Area IRMP I.**

Dudley, T. and N.H. Anderson. 1982. **A survey of invertebrates associated with wood debris in aquatic habitats.** Melanderia 39:1-12.

Ebersole, J., Liss, W., and Frissell, C. 2003. **Thermal heterogeneity, stream channel morphology, and salmonid abundance in northeastern Oregon streams.** Canadian. Journal of Fish and Aquatic Sciences. 60(10): 1266-1280).

Fausch, K. D. and T. G. Northcote. 1992. **Large woody debris and salmonid habitat in a small coastal British Columbia stream.** Canadian Journal of Fish and Aquatic Science 49:982-693.

Kondolf**, G.M. 1995. Five elements for effective evaluation of stream restoration**. **Restoration Ecology 3(2):133-136**

Stephen Katz, Katie Barnas, Stewart Toshach 2005.. **Data Management Needs for Regional Project Tracking to Support Implementation and Effectiveness Monitoring.** NOAA Fisheries Northwest Fisheries Science Center

Loheide, S. P. II and S. M. Gorelick. 2006. **Quantifying Stream-Aquifer Interactions through the Analysis of Remotely Sensed Thermographic Profiles and In-Situ Temperature Histories .** Environment, Science and Technology. 40:3336-3341.

Hicks, B. J., J. D. Hall, P. A. Bisson, and J. R. Sedell. 1991. **Response of salmonids to habitat changes.** Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19: 483-518.

Houslet, B. S. 2004. **Use of woody material by juvenile salmonids in the Metolius River, Oregon.** Deschutes National Forest. Bend, Oregon.

McCullough, D., Spalding, S., and Sturdevant, D. 2001. **Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonids**. United Stated Environmental Protection Agency. EPA 910-D-01-005

McIntosh, B. A., J. R. Sedell, R. F. Thurow, S. E. Clarke, and G. L. Chandler. 2000. **Historical changes in pool habitats in the Columbia River.** Ecological Applications 10:1478-1496.

Mckay, M. 2007. **Coyote Creek Watershed Analysis**. Warm Springs Reservation, Oregon.

McHenry, M. L., D. C. Morrill, and E. Currence. 1994. **Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in five north Olympic Peninsula watersheds.** Port Angeles, WA.

Northwest Power and Conservation Council (NWPCC). 2009. **Columbia Basin Fish and Wildlife Program 2009 Amendments.**

Northwest Power and Conservation Council (NWPCC). 2003. Deschutes Subbasin Plan.

NOAA, CTWSRO, USFWS, and U.S DOI. 2008. **Environmental Assessment and Restoration Plan for the March 4th 1999American Transport , Inc Gasoline spill in Beaver Butte Creek Warm Springs Reservation, Oregon.**

Pearsons, T. N., W. Li., and G. A. Lamberti. 1992**. Influence of habitat complexity on resistance to flooding and resilience of stream fish assemblages.** Transactions of the American Fisheries Society 121:427-436.

Pollock, M., Beechie, T., and Jordan, C. 2007. **Geomorphic changes upstream of beaver dams in Bridge Creek, an incised stream channel in the interior Columbia basin, eastern Oregon.** Earth Surface Processes and Landforms. (In Press)

Scully, R. J., and C. E. Petrosky. 1991. **Idaho habitat and natural production monitoring part I. General monitoring subproject annual report 1989.** BPA project No. 83-7, Bonneville Power Administration Division of Fish and Wildlife, Portland OR.

Shepard, B. B., S. A. Leathe, T. M. Weaver, and M. D. Enk. 1984. **Monitoring levels of fine sediment within tributaries to Flathead Lake, and impacts of fine sediment on**

bull trout recruitment. Wild Trout III Symposium. Yellowstone National Park, Wyoming, September 24-25.

Smock, L. A., G.M. Metzler, and J. E. Gladden. 1989. **Role of debris dams in the structure and functioning of low gradient headwater streams.** Ecology 70:764-775.

Turo, S. 2009 **Fine Sediment Monitoring Plan for the watersheds on the Warm Springs Reservation (Draft).**

Turo, S. 2008. **Coyote Creek Watershed Restoration Project-Road Treatments.** Warm Springs Reservation, Oregon.

Tussing. S. 2009. **A Field Manual of Scientific Protocols for Fine Sediment Sampling within the Upper Columbia Monitoring Strategy**.

United States Department of Agriculture Forest Service. 1994. **Environmental Assessment for the Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California.** 68p.

Weaver, T. M., and J. J. Fraley. 1993. **A method to measure emergence success of westslope cutthroat trout fry from varying substrate compositions in a natural stream channel.** North American Journal of Fisheries Management 13: 817-822.

I. Key Personnel

Scott Turo

B.S. Fisheries and Aquatic Ecology from the University of Montana ‘97

- November 2004-present
  Fish Habitat Program Manager and Off Reservation Habitat Biologist
  The Confederated Tribes of the Warm Springs Reservation of Oregon
  Warm Springs, OR

  Duties include Habitat Program development, and restoration project development and management. Endangered Species Act consultation for Reservation projects. Represent Tribal interests within the ceded lands across eastern Oregon.

- November 2001- November 2004
  Fish Biologist—Water Rights and Protection Division
  Yurok Tribal Fisheries Program
  Weitchpec, CA

  Managed a division of the Tribal Fisheries Program focused on monitoring the impacts of regulated flow on the Klamath and Trinity Rivers. Conducted life history investigations of green sturgeon using radio and sonic telemetry techniques, and studied adult and juvenile use of thermal refugia on the Klamath and Trinity Rivers.

- 1996-2001
  Held various technician and crew leader positions working on projects from Alaska to Wyoming. Through this I gained experience and exposure with all five species of Pacific salmon, and many resident interior salmonid species and their habitats.

Scott Struhs

B.S. Fishery Resource Management from the University of Idaho **‘98**
M.S. Hydrology from University of Idaho **2006**

- August 2005-July 2007
  Water Quality Planner
  Nez Perce Tribe
  Lapwai, ID

Managed the Clean Water Act (CWA) 106 Program. Represented the Nez Perce Tribe Water Resources Division in natural resource management within the Tribe's reservation and ceded lands.

- July 2001-August 2005
  Fish Biologist
  Nez Perce Tribe
  Orofino, ID

  Worked on the Nez Perce Tribe Spring Chinook Monitoring and Evaluation Project monitoring juvenile and adult spring Chinook in three northern Idaho streams. Tasks included juvenile survival estimates, fish density estimates, juvenile fish marking, adult marking and spawning surveys.

Johnny Holiday Sr.

- May 2008-present
  Fish and Wildlife Technician II
  Fish Habitat Program
  The Confederated Tribes of the Warm Springs Reservation of Oregon
  Warm Springs, OR

  Conducted fence and water develop maintenance. Managed projects and contractors for road decommissioning projects. Participated in fisheries monitoring data collection.

  13+ years of experience as a wildland fire suppression crew boss prior to becoming a Fish and Wildlife Technician II.

Appendix I
Tributary habitat limiting factors used for analysis in the Mid Columbia Steelhead Recovery Plan

Degraded floodplain connectivity and function: The loss, impairment or degradation of floodplain connectivity; access to previously available habitats (seasonal wetlands, off-channel habitat, side channels); and a connected and functional hyporheic zone. This factor includes reduced overwinter habitat and channel habitat. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Degraded channel structure and complexity: The loss, impairment or degradation of channels; a suitable distribution of riffles and functional pools; functional amounts and sizes of large woody debris or other channel structure. Includes reduced summer rearing habitat, degraded spawning habitat, reduced diversity and structure (wood, boulders, etc.), inadequate quantity or depth of pools, loss of side and braided channels. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Degraded riparian areas and LWD recruitment: The loss, degradation or impairment of riparian conditions important for production of food organisms and organic material, shading, bank stabilizing by roots, nutrient and chemical mediation, control of surface erosion, and production of large-sized woody material. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Altered hydrologic processes: Changes in the hydrograph that alter the natural pattern of flows over the seasons, causing inadequate flow, scouring flow, or other flow conditions that inhibit the development and survival of salmonids. Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Degraded water quality: Degraded or impaired water quality due to abnormal temperature, or levels of suspended fine sediment, dissolved oxygen, nutrients from agricultural runoff, heavy metals, pesticides, herbicides and other contaminants (toxics). Life stages affected: egg-to-smolt survival, smolt migration, adult migration, pre-spawning.

Altered sediment routing: Altered sediment routing leading to an overabundance of fine-grained sediments, excess of course-grained sediments, inadequate course-grained sediments and/or contaminated sediment. Includes excessive fine sediment that reduces spawning gravel or increases embeddedness. Life stages affected: egg-to-parr survival.

Impaired fish passage: The total or partial human-caused blockage to previously accessible habitat that eliminates or decreases migration ability or alters the range of conditions under which migration is possible. This may include seasonal or periodic total migration blockage. Includes dams, culverts, seasonal push up dams, unscreened diversions, and entrainment in irrigation diversions. Life stages affected: smolt migration, adult migration, juvenile upstream migration due to thermal blockage or water availability.